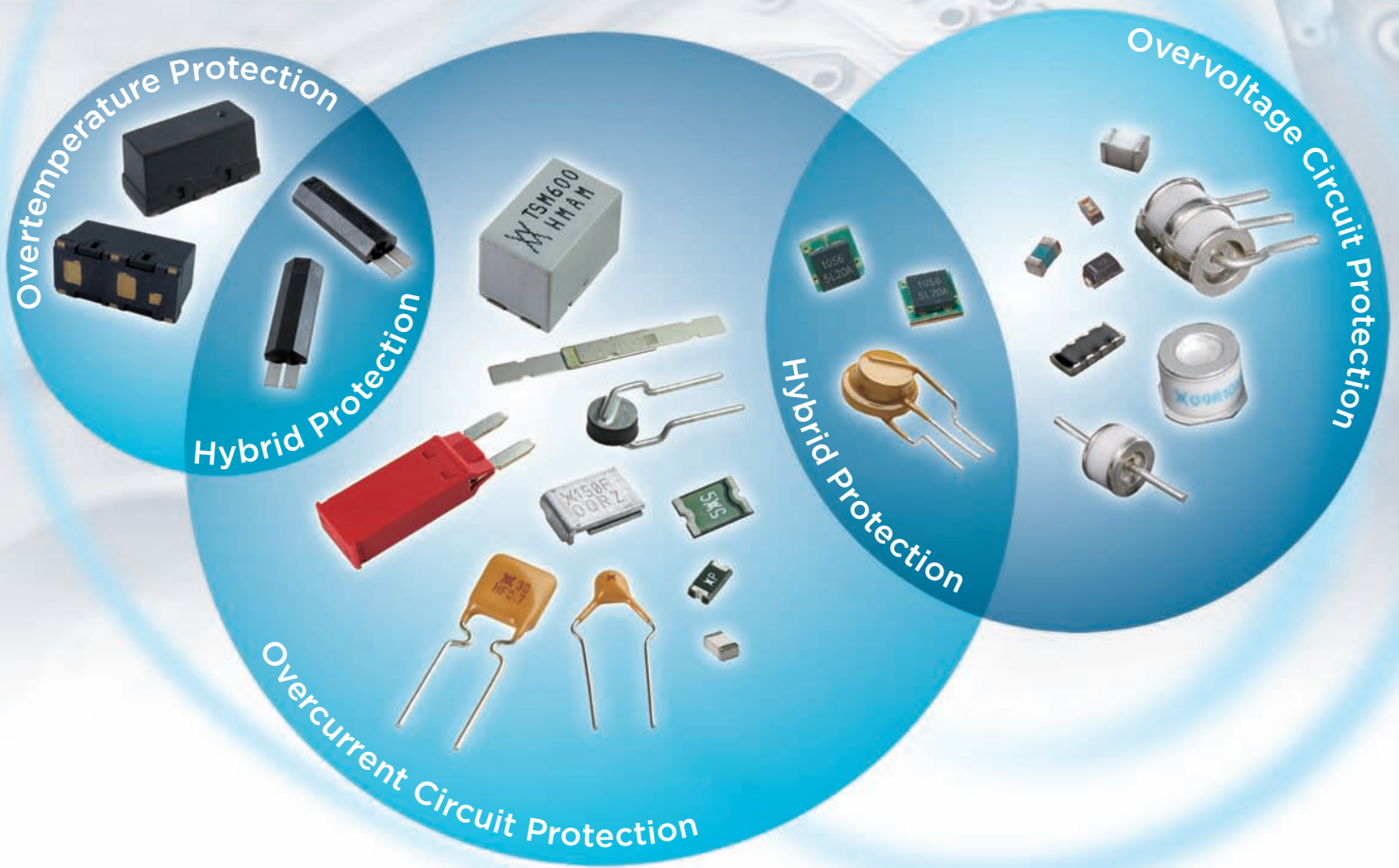




# Circuit Protection Products Catalog 2011

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This catalog is intended to present application, product, and technical data to assist the user in selecting circuit protection products, including PolySwitch resettable devices, RTP devices, MHP devices, PolyZen devices, 2Pro devices, Silicon ESD protection devices, ESD protection devices, chip fuses and gas discharge tubes. All information, including illustrations, is believed to be accurate and reliable. However, users should independently evaluate the suitability of, and test each product for their application. Tyco Electronics Corporation and/or its Affiliates in the TE Connectivity Ltd. family of companies (“TE”) makes no warranties as to the accuracy or completeness of the information in this catalog and disclaims any liability resulting from its use. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. TE’s only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products.

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**Coming Soon**

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**NEW  
NEW**

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# TE Connectivity

## Welcome to TE Connectivity

With a 50-plus year history of leadership, TE Connectivity is a global, \$12.1 billion company that designs and manufactures over 500,000 products that connect and protect the flow of power and data inside the products that touch every aspect of peoples' lives. Our nearly 100,000 employees partner with customers in virtually every industry – from consumer electronics, energy and healthcare, to automotive, aerospace and communication networks – enabling smarter, faster, better technologies to connect products to possibilities. TE Connectivity is an independent, publicly traded company whose common stock is listed on the New York Stock Exchange (NYSE) under the ticker symbol “TEL.”

## Our Product Advantage

We design, manufacture, and market over 500,000 products for more than 200,000 customer locations in a broad array of industries including automotive; data communications; consumer devices; telecom and enterprise networks; aerospace, defense and marine; medical; energy; and lighting. We bring advanced performance to every technology, product and service we provide, including connector systems, relays, fiber optics, circuit protection devices, distributed antenna systems, wire and cable, touch screens, heat shrink tubing, racks and panels, network cabling systems, and subsea communication systems. Our spirit of innovation drives us to continually hone our technological edge with the goal of delivering the best solutions – with the highest quality – every time.

## Our Technology Advantage

We invest approximately five percent of the company's sales revenue on research, development and engineering annually – in 2010 alone, our investment was US\$585 million. These efforts are supported by approximately 8,000 engineers at 13 global design centers who work closely with our customers to develop applications specific, highly engineered products and systems to satisfy customers' needs. We apply for more than 1,500 patents annually and hold more than 20,000 patents and patent applications in total. Our innovation, early design involvement and materials expertise give customers a competitive advantage by delivering new functionality, and by helping them to bring better performance to existing products, deliver new products to market faster, and realize greater efficiencies in their manufacturing processes.

## Our Global Advantage

We have an established manufacturing presence in approximately 20 countries, we operate in over 50 countries and serve customers in more than 150 countries. Our global coverage positions us near our customers and allows us to assist them in consolidating their supply base and lowering their production costs. In addition, our Global Account Management programs allow us to maintain close working relationships with the key customers in the markets we serve. With sales of US\$12.1 billion in fiscal 2010, we are significantly larger than many of our competitors – giving us scale and reach that generate direct dividends for our customers everywhere.

## Our Employee Advantage

We have nearly 100,000 dedicated employees who are based throughout the world, with approximately 38,000 employees in China alone. By maximizing the commitment of our approximately 8,000 engineers, and the reach of our approximately 6,000-member sales force serving customers in more than 150 countries, we can collaborate with customers to provide highly engineered products and innovative solutions to meet their needs. Our diverse and capable management team is equally dedicated to creating and sustaining those powerful customer alliances – and to earning their business every day.

# TE Circuit Protection

Our circuit protection products are a part of your everyday life. From your cell phone battery to your car's steering wheel, we are helping to make your world safer and your electronics more reliable.

For over 30 years we have pioneered the field of polymeric positive temperature coefficient (PPTC) resettable technology with our PolySwitch product line. We developed the first patents for the use of a PPTC device as a variable resistor in circuit protection applications in the 70's and 80's. Since then, we have continued to expand our family of PolySwitch PPTC devices to include wider voltage, current, and temperature ranges in a variety of form factors.

Established as a leader in resettable circuit protection solutions, we continue to expand our product portfolio to include overcurrent, overvoltage, overtemperature and hybrid circuit protection product lines.

Our overvoltage circuit protection products include gas discharge tubes (GDT), electrostatic discharge protectors (ESD) and Silicon ESD (SESD) protection devices. When used along with PolySwitch devices, these overvoltage devices can help provide a coordinated and resettable solution to assist OEMs in meeting stringent regulatory requirements and in improving equipment reliability.

Single-use fuses - such as pulse tolerant chip fuses, very fast-acting chip fuses, slow-blow chip fuses, fast-acting chip fuses, high-current-rated chip fuses, very fast-acting fuses and telecom fuses - are suitable for use in applications that need to disable the circuit rather than isolate it.

Hybrid protection product lines - PolyZen devices and 2Pro devices - integrate overcurrent and overvoltage protection functions in a single device. This effectively reduces component count and, when appropriately applied, can expand performance attributes and help improve system reliability.

In 2010, TE circuit protection introduced two new technologies, a Metal Hybrid PPTC (MHP) device and a Reflowable Thermal Protection (RTP) device. The MHP device offers a space saving, reliable solution for use in cordless power tools, e-bikes and back-up power supplies. RTP device is the first reflowable thermal protection device in a surface-mount package which helps manufacturers dramatically speed assembly time while saving board space.

To date, billions of TE circuit protection devices are being used to help protect a wide range of electronic products in the computer, battery and portable electronics, consumer, automotive, industrial, home appliance and HVAC, and telecommunication markets.

We are recognized as a leader in operational excellence and customer service. And, our products are in compliance with globally recognized ISO9000/TS16949 standards.

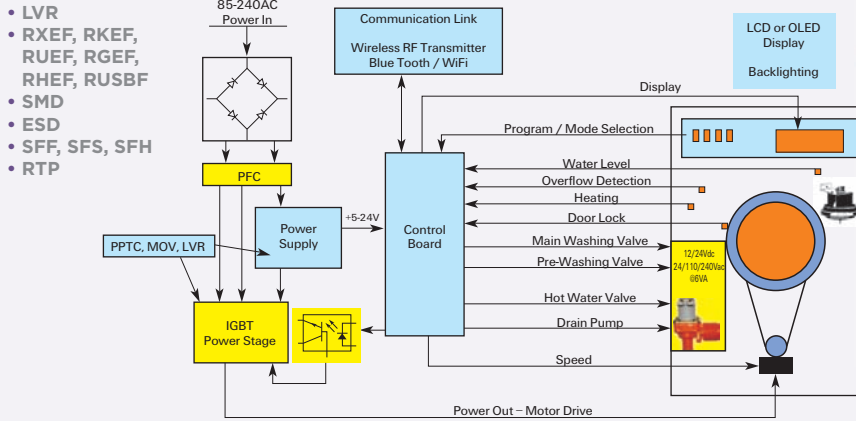
We offer a dedicated engineering sales force, world-wide manufacturing and design centers, and local engineering support devoted to our circuit protection business. This helps us to think, manage, and share globally, yet act locally to meet our customer needs.



## Application Summaries

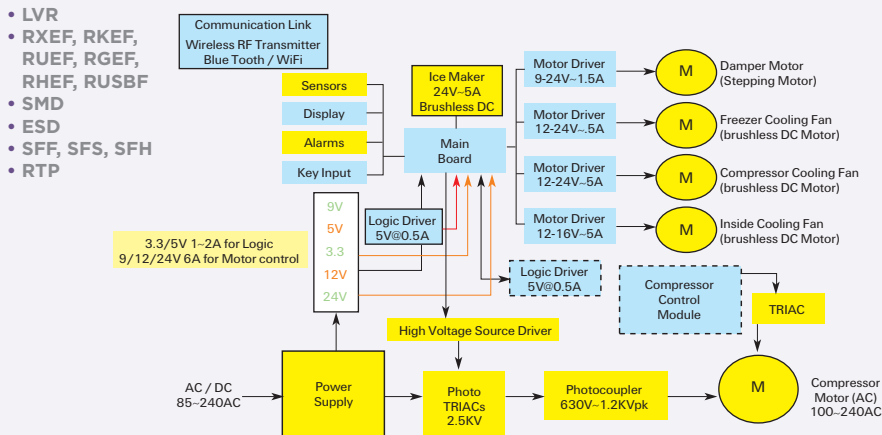
### Washing Machines

A number of circuit protection devices can be used to help provide overtemperature, overcurrent and overvoltage protection for the electric motors, LED displays and control electronics found in home appliances.



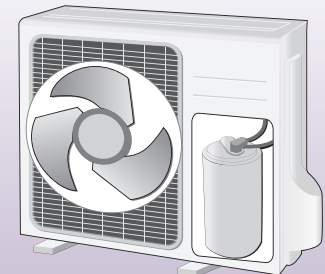
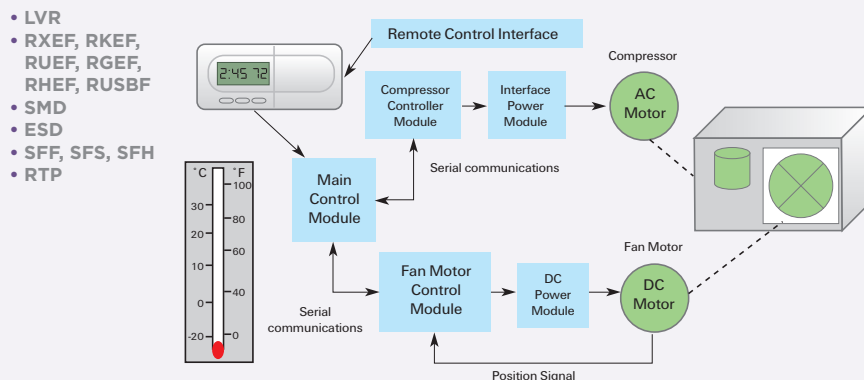
### Refrigerators / Freezers

Our circuit protection devices help protect the motors and fans, controllers, touchpads, displays and interface circuitry required by sophisticated appliances.



### Air Conditioning Units

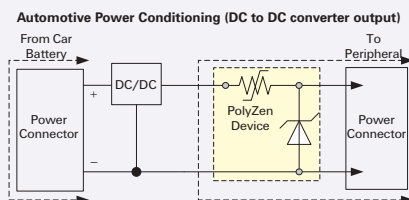
Resettable PolySwitch devices, ESD devices, and chip fuses help provide coordinated overcurrent and overvoltage protection for the motors, fans, displays and interface circuits used in modern HVAC equipment.



## Automotive Electronics

PolyZen devices help protect automotive peripherals and portable electronics that can be charged in the vehicle from damage caused by inductive voltage spikes, voltage transients, and reverse bias. The PolyZen device provides coordinated protection with a component that protects like a Zener diode, but is capable of withstanding the high-power fault conditions that can occur in automotive applications.

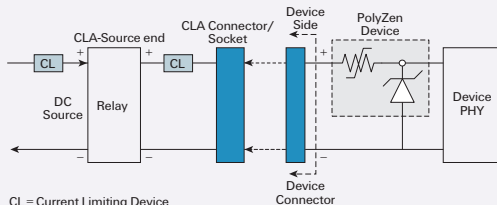
### • ZEN



## DC Cigarette Lighters and Power Plug Adapters

Charger circuits for mobile phones, iPods, after-market hands-free devices, or other battery operated equipment use connectors to plug into automobile cigarette lighter or power outlets. These assemblies must operate over a wide range of temperatures, charging conditions and in a harsh automotive environment.

Typically, overcurrent protection, such as a PolySwitch PPTC device, and overvoltage protection are coordinated at the input to the charger to help meet the stringent electrical requirement. A single PolyZen device can be used to help protect against damage caused by overcurrent and overvoltage faults.



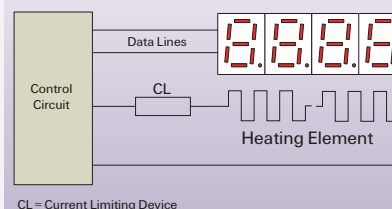
- AHRF, AGRF, AHEF
- AHS, ASMD
- SFF, SFS, SFH
- ZEN • RTP



## Liquid Crystal Display Backlight Heaters

There are an increased number of displays being designed into automobiles such as navigation systems, instrumentation displays, video and TV screens. A current limiting device should be employed to help prevent thermal runaway due to a failure in the control circuitry. In most cases the circuit will be powered off on a regular basis (ie: when the ignition is turned off). In this case a resettable PPTC protection device may be desired. In other cases a single-use fuse may be preferred.

- AHRF, AGRF, AHEF
- miniASMD, microASMD, nanoASMD
- SFF, SFS
- RTP

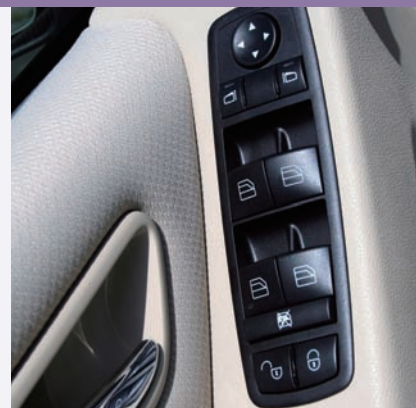


CL = Current Limiting Device

## Driver-Side Console

The switch console on the driver-side door allows the driver to control multiple functions, including power windows, side mirrors and power door lock. Small surface-mount PolySwitch devices help protect PCB traces against damage caused by overheating and smoking in the event of a short circuit. A variety of designs include PolySwitch devices to help protect PCB traces leading to power window motors, delicate carbon membrane in microswitches, transistors in LED backlighting circuits and small traces of the side mirror control circuit.

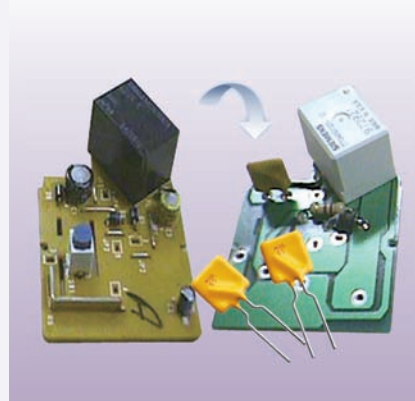
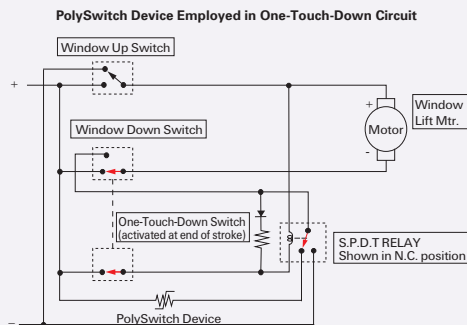
- miniASMD, microASMD, nanoASMD
- SFF, SFS



## One-Touch-Down Circuit for Power Windows and Power Sunroofs

This lower cost one-touch-down circuit employs a PolySwitch PPTC device to function as both a sense component and a switch component. This functionality allows a PolySwitch device to replace a number of other devices, such as the sense resistor, comparator, driver and control circuitry used in traditional power window and sunroof circuits. As a result, designers can achieve net cost savings through reduced component count and reduction in wire size.

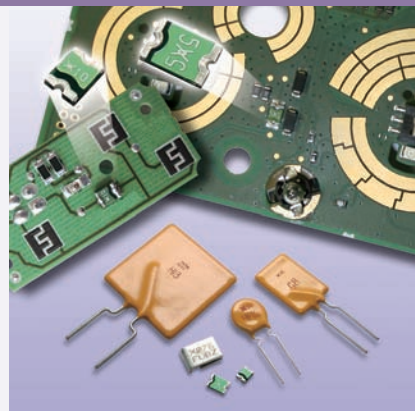
- AHRF, AGRF, AHEF
- AHS, ASMD



## Printed Circuit Board Trace

The width of the copper traces must be reduced to provide more space for the tighter-packed and smaller printed circuit boards. These "Black Box" control modules handle a large number of high-powered accessories such as power windows, power seat adjusters, remotely controlled door locks, and radio & GPS antennae. PolySwitch resettable devices can be used to help protect these delicate printed circuit board traces against damage caused by overcurrent conditions.

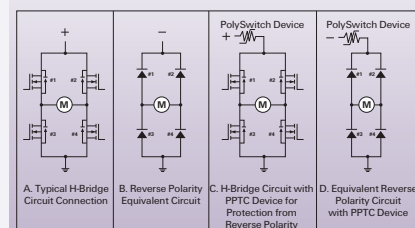
- AHRF, AGRF, AHEF
- AHS, ASMD, miniASMD, microASMD, nanoASMD
- SFF, SFS
- RTP



## H-Bridges

Automotive FET switched H-bridges must be protected from reverse polarity power sources. This may occur when jumper cables are connected to the wrong polarity of a dead or excessively discharged battery or when a new battery is installed backwards. Without protection, excessive heating can lead to failures in electronic modules or inadvertent activation of vehicle loads such as solenoids and motors, which can lead to unsafe conditions.

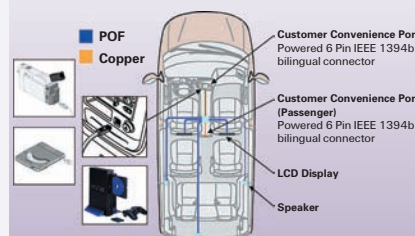
- AHRF, AGRF, AHEF
- AHS, ASMD



## Automotive Control Application and Multimedia Busses

Connecting lifestyles from the home to the vehicle has become a reality in the automotive industry. MOST, Flexray, IEEE1394 and other networks now co-exist with CAN and LIN. Their main goal is to facilitate equipment interfacing and information sharing for embedded equipment but also for after-market electronic equipment such as Portable Navigation Devices (PNDs), iPods, DVD players, etc. In a hot-pluggable automotive environment, where the consumer is connecting and disconnecting peripherals on a powered port, the potential for short-circuit damage is clearly present. PolySwitch devices and ESD protection devices can be used to help protect the connected equipment.

- AHS, ASMD, miniASMD, nanoASMD
- SFF, SFS
- ESD, SESD (Data Busses only)





## Navigation and Infotainment System

Infotainment and navigation systems are packed with electronics and connectivity elements. Circuit protection devices help protect a wide variety of functions such as powered antennae, CAN-bus, touch screen, USB ports, RF tuners, I/O lines, HDD, etc.

Overcurrent and overvoltage protection devices help prevent system breakdown and enhance design safety.

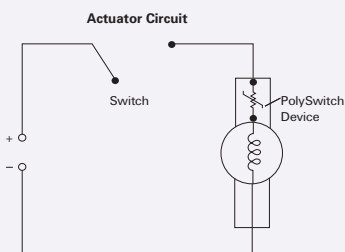
- AHRF, AGRF, AHEF
- AHS, ASMD, miniASMD, microASMD, nanoASMD
- ESD
- SESD
- SFF, SFS
- ZEN



## Automotive Actuators and Medium-Size DC Motors

Automotive electric motors can overheat and cause damage to temperature sensitive components. To help protect these components, custom made PolySwitch devices can be designed for specific customer applications. Installing a PolySwitch device in close proximity to the motor or solenoid offers the added benefit of limiting current due to excessive heat.

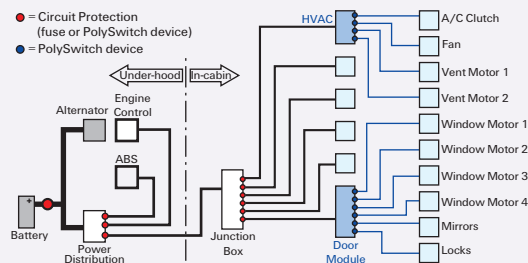
- AGRF, AHRF, AHEF
- SFF, SFS, SFH



## Automobile Harness

The wiring harness architectures of light and heavy vehicles have undergone considerable change due to increased electrical and electronic content. Resettable circuit protection that does not need to be driver accessible, such as PolySwitch PPTC devices, offers a number of solutions that may be used separately or in combination. Overvoltage protection devices (MOVs) are also recommended.

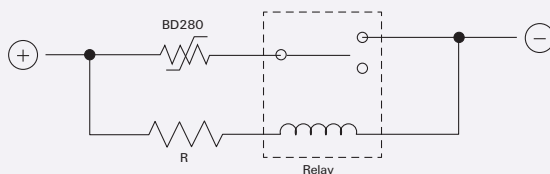
- AHRF, AGRF, AHEF
- ASMD
- BD280
- SFF, SFS



## Automobile Relay Protection

Relays contacts can pit during high current interrupt events. A PTC reduces current prior to contact switching events. The design becomes a tuned system that works in coordination with relay inertia.

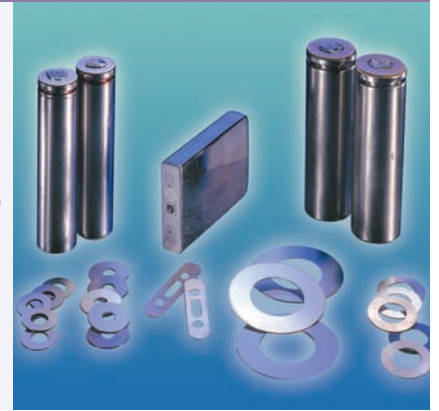
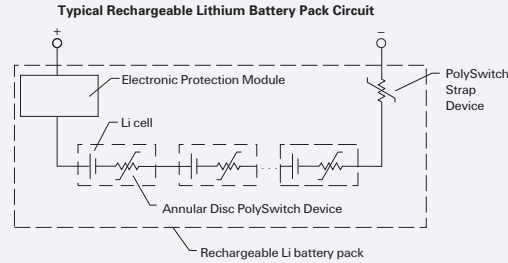
- BD280
- AHRF, AGRF, AHEF



## Lithium Cells and Battery Packs

External shorts, runaway charging conditions, or abusive charging can cause considerable damage to primary and secondary lithium cells. Rechargeable lithium batteries are used in notebook computers and cellular phones, as well as other portable electronic applications.

- LR4, SRP, VLR, VLP, VTP, MXP
- Custom Annular Disc Devices

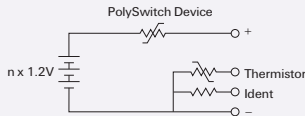


## Rechargeable Battery Packs

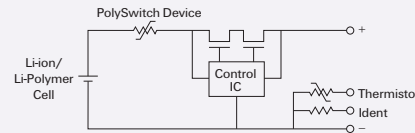
Due to external shorts, runaway charging conditions, or abusive charging, considerable damage can be sustained in both battery cells and pack surroundings. The most common applications are for lithium-ion (Li-ion) battery packs used in cellular phones, digital cameras and laptop/notebook computers or nickel-cadmium (NiCd) and nickel-metal-hydride (NiMH) battery packs used in other portable electronic applications.

- LR4, SRP, VLR, VLP, VTP, MXP, MHP
- SFF, SFS

**NiMH/NiCd Battery Pack Circuit Diagram**



**Single Cell Li-ion/Li-Polymer Battery Pack Circuit Diagram**

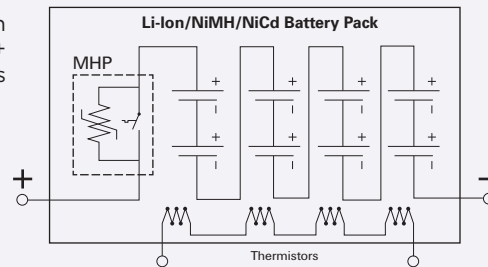


## Rechargeable High-Power Battery Packs

Due to their increased power and lower weight, Li-ion batteries are proliferating into new segments. Power tools, e-Bikes and e-Vehicles are applications moving towards using lithium-ion batteries.

There is a clear need for cost-effective, battery circuit protection devices that are capable of 30A+ hold currents and voltage ratings over 30V<sub>DC</sub>.

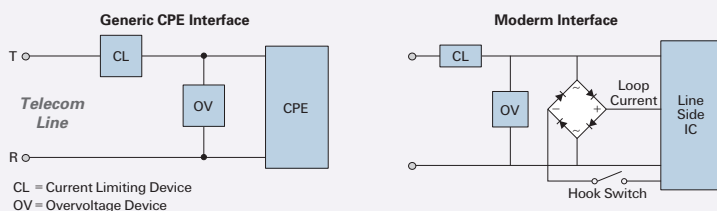
- MHP



## Customer Premise Equipment

To protect subscribers against damage caused by faults entering from outside wiring, customer premise equipment (CPE) is designed with power cross and lightning protection components. The following are recommended protection solutions based on regional requirements.

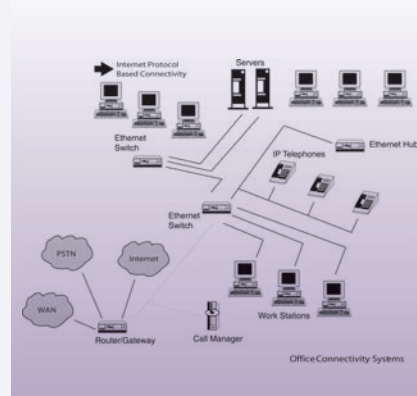
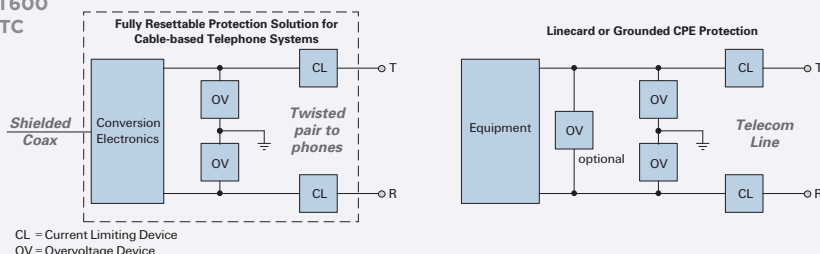
- RXEF • SMD
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC



## Short-haul/Intrabuilding Protection Requirements

Communications equipment that is not directly connected to the PSTN is subjected to lower level hazards. Here are a few circuit protection recommendations for LAN, WLL, VoIP and other intrabuilding applications.

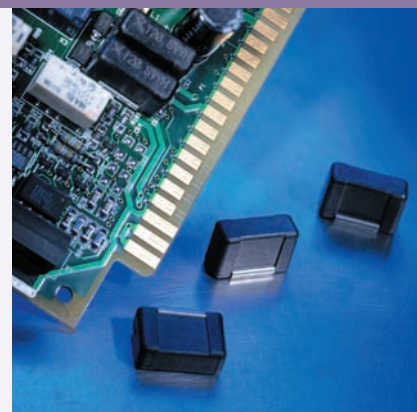
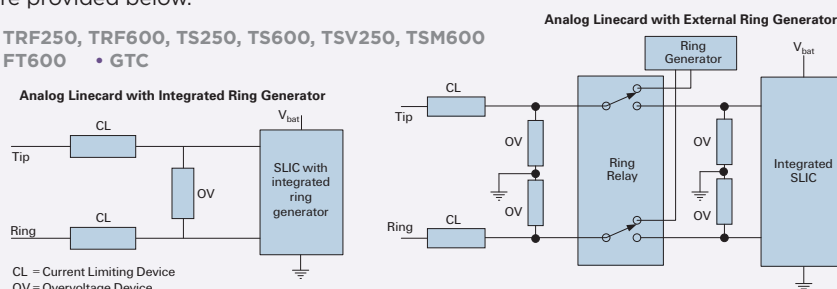
- TRF250, TS250, TSL250, TSV250
- FT600
- GTC



## Analog Linecards

Central office linecards are subject to transient overcurrent and overvoltage faults, which may be generated from nearby power cross, power induction, and lightning events. Circuit protection recommendations based on regional agency specifications are provided below.

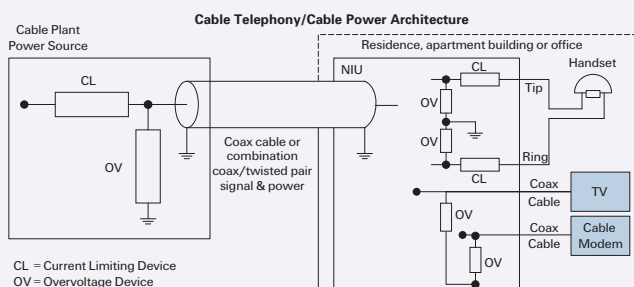
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600 • GTC



## Cable Telephony/Cable Power Passing Tap

Cable telephony electronics that are powered via twisted pair or coaxial cable are susceptible to power faults passed through the cable plant. Protection in the power passing taps decreases the risk of these faults.

- BBRF, TRF250, TRF600, TS250, TS600, TSL250, TSV250, TSM600
- FT600
- GTC

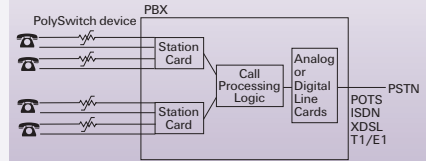




## PBX and Key Telephone Systems

Below are circuit protection device recommendations to help protect PBX and key telephone systems against damage caused by power faults and short circuits.

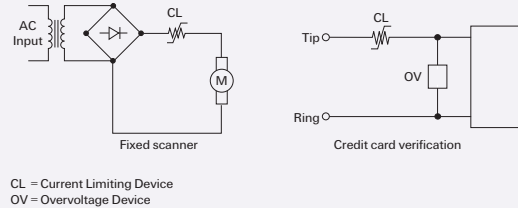
- TRF250, TRF600, TS250, TS600, TSM600
- FT600
- GTC



## POS Equipment

Equipment connected to telephone lines can be subject to power cross, induction, and lightning surge hazards. Scanner motors and ditherers need protection against damage caused by jams and stalls.

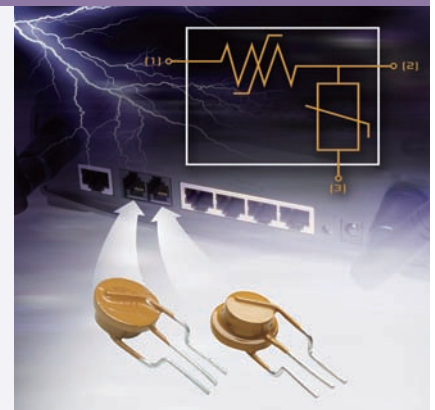
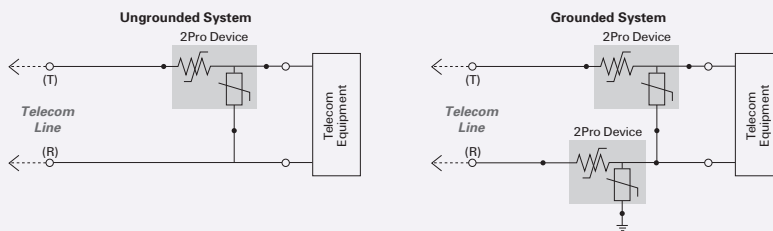
- RUEF, RXEF
- SMD, miniSMD
- TRF, TS
- FT600
- SFF, SFS



## Customer Premise Equipment using 2Pro Devices

2Pro devices help protect cost-sensitive PSTN and voice over internet protocol (VoIP) telephony equipment from damage caused by lightning and ESD surges, power contact and induction with AC lines. If left unprotected from these hazards, CPE may fail or may pose a safety risk for subscribers and maintenance personnel.

- TM2P

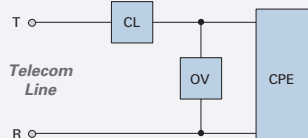


## UL60950 and TIA-968-A, (formerly FCC part 68) Requirements

UL60950 and TIA-968-A describe electrical hazards from which customer premise equipment (CPE) in North America must be protected. Below are resettable circuit protection recommendations.

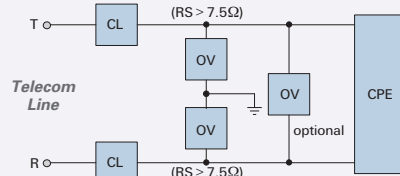
- TRF600, TS600, TSM600
- TM2P
- FT600
- GTC

Suggested Arrangement to Meet TIA-968-A for a Ungrounded CPE Design



CL = Current Limiting Device  
OV = Overvoltage Device

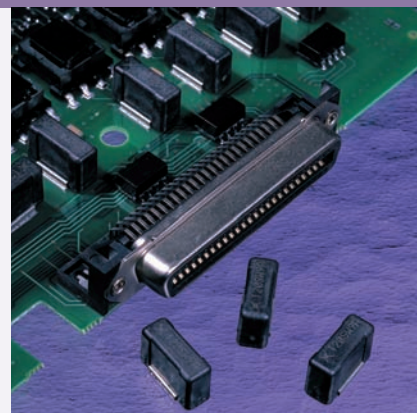
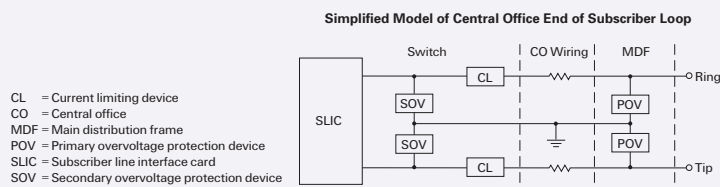
Suggested Arrangement to Meet TIA-968-A for a Grounded CPE Design



## GR-1089 : Public Switched Telephone Network Equipment

GR-1089 describes the electrical hazards which public switched telephone network (PSTN) equipment in North America should be protected against. The figure below shows several recommended resettable circuit protection solutions for a simplified model of a central office end of subscriber loop system.

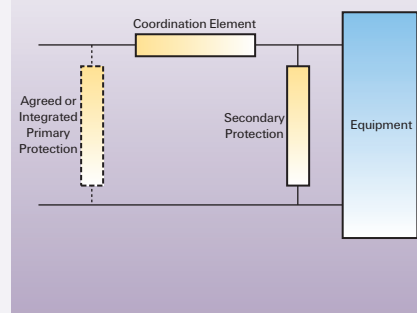
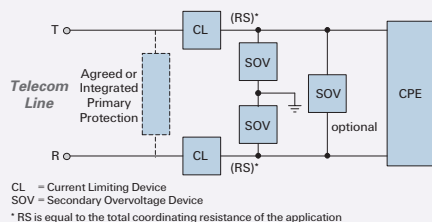
- TRF600, TS600, TSM600
- FT600
- GTC



## GR-1089-CORE, Issue 4

To help prevent damage to telecom equipment, circuits connected to outside lines generally need protection from lightning and power fault events. Protection may be primary. However, the equipment must be able to withstand the surges that the primary protector lets through. For this reason, secondary and even tertiary protection is included to help limit the potential damage of the surge let through. To be effective, the secondary protection must coordinate with the primary protection. TE Circuit Protection offers a broad line of overcurrent and overvoltage devices that can help Public Switched Telephone Network conserve valuable board space and meet emerging safety and performance standards.

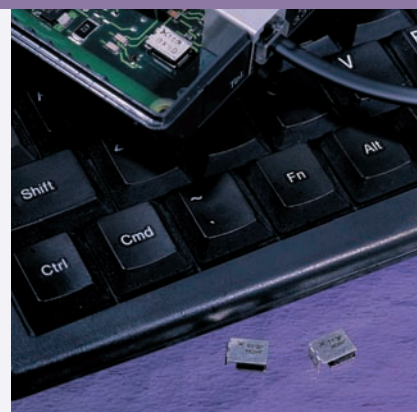
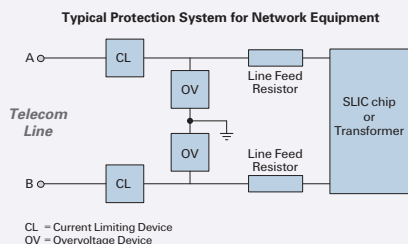
- TRF600, TS600, TSM600
- FT600
- GTC



## ITU-T Recommendations

ITU-T provides the figure below shows several recommendations for central office (K.20), customer premise (K.21) and access network (K.45) equipment. Below is an overview of our recommendations and resettable circuit protection solutions.

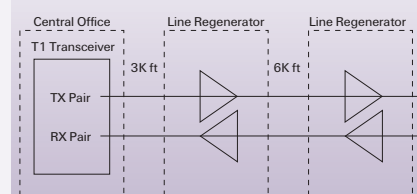
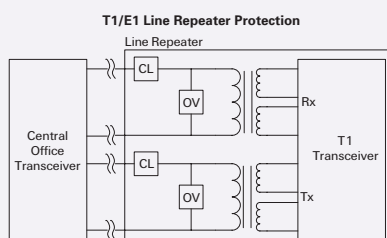
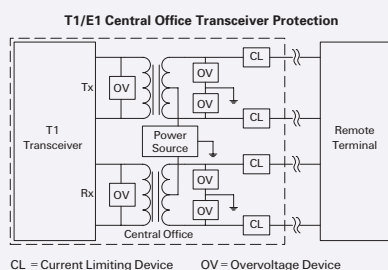
- TCF250, TRF250, TS250, TSV250
- FT600
- GTC



## T1/E1 Equipment

T1/E1 transmission equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. Here are our circuit protection recommendations based on regional agency specifications.

- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC

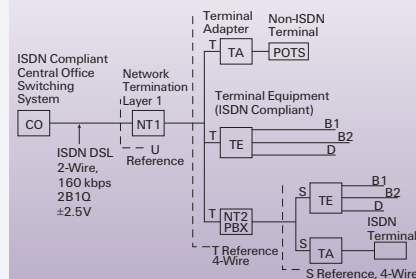
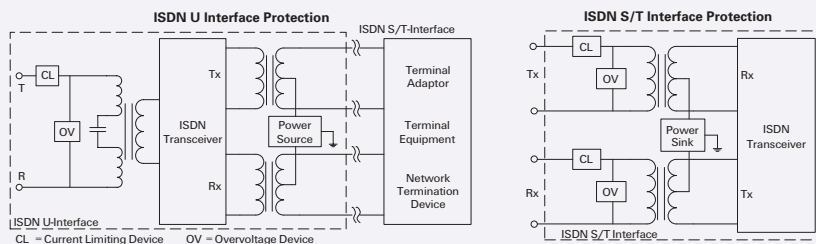




## ISDN Equipment

ISDN central office (CO) and CPE equipment must be protected against damage caused by transient power cross and lightning faults which may also enter via outside plant wiring. Circuit protection recommendations based on regional agency specifications are provided here.

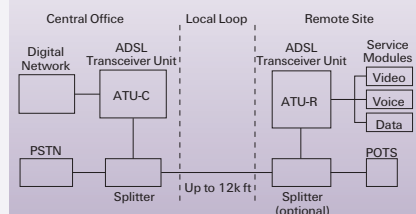
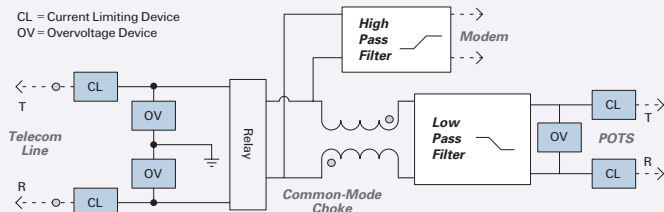
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC



## ADSL Equipment

ADSL equipment, like splitters, must be protected against damage caused by both external and intrabuilding faults. Resettable protection solutions are provided here, based on regional requirements.

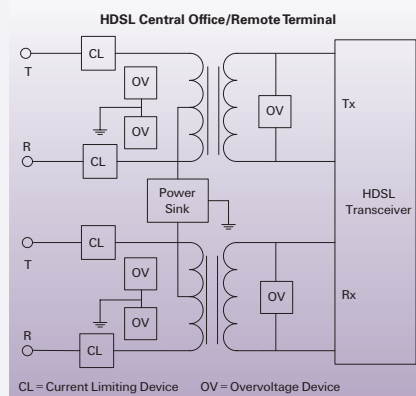
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC



## HD SL Equipment

HD SL equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. The following is our circuit protection recommendation, based on regional agency specifications.

- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC

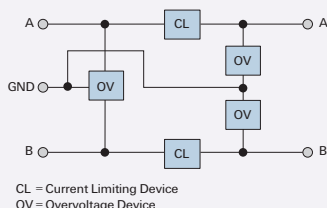


## Main Distribution Frame (MDF) Modules

Telecom system, such as MDF modules, typically have multi-stage circuit protection. Primary protection is used closest to the "outside world" where the highest surge withstand capability is typically needed. Secondary protection is needed to help protect against damage caused by hazardous power cross and lightning faults until the primary protection component activates.

- Primary:**
- TCF250, TRF250, TS250, TSV250
  - FT600

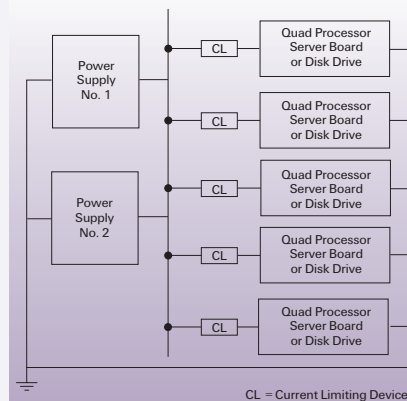
- Secondary:**
- GTC



## Backplane and Redundant Array of Inexpensive Disks (RAID)

Power backplane applications allow for field-serviceable and field-replaceable cards and drives to maximize the “up-time” of products. During card or drive replacements, the power on the backplane is live. Circuit protection is employed to help minimize safety risks, comply with IEC60950 Safety Requirement Clause 1.2.8.7 – Hazardous Energy Levels, and help protect against damage caused by short circuits caused by incorrect insertion of cards.

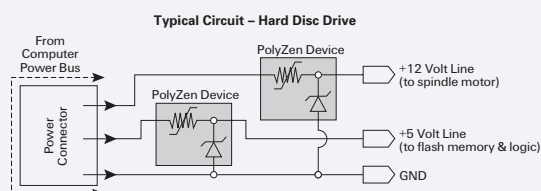
- RGEF, RXEF
- SMD, miniSMD, microSMD, picoSMD, femtoSMD
- SFF, SFS, SFH



## Hard Disk Drives

PolyZen micro-assemblies help protect devices on the 5V and 12V computer bus from overvoltage events and inductive voltage spikes resulting from rapid change in current. The PolyZen device incorporates a stable Zener diode for precise voltage clamping and a resistively non-linear, polymer positive temperature coefficient layer that responds to either diode heating or overcurrent events by transitioning from a low to a high resistance state. This unique device helps manufacturers meet safety requirements and reduce warranty costs.

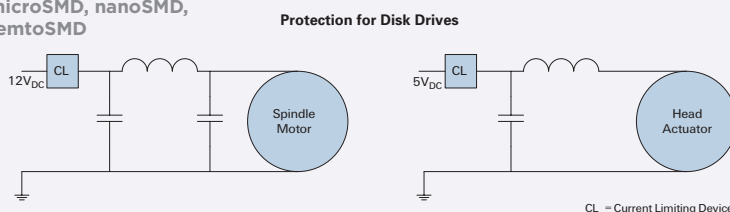
- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- ZEN
- SFF
- ESD (on data lines)



## 5V/12V Power Lines

The connection of a 12V line from the power supply instead of a 5V line can cause a high current inrush that can damage the other components in the circuit. Reverse polarity can cause damage to the tantalum capacitors, causing the capacitor to fail in a short-circuit mode. Applications that need this type of protection include hard disk drives, CD-ROM, CD-RW, DVD, and other storage devices.

- RUEF, RUSBF
- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFF, SFS
- ZEN

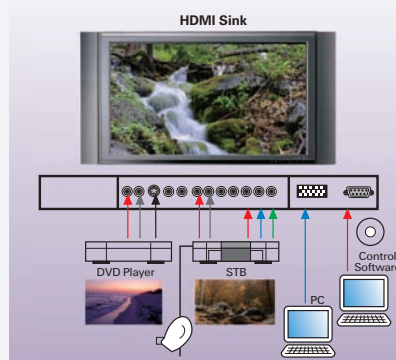
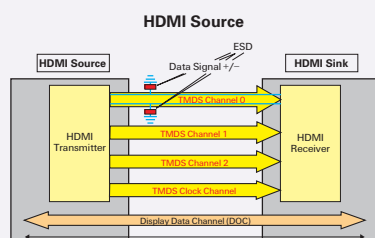


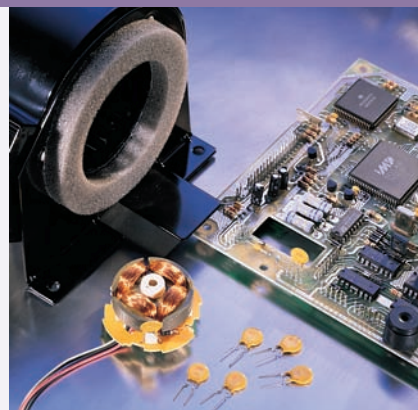
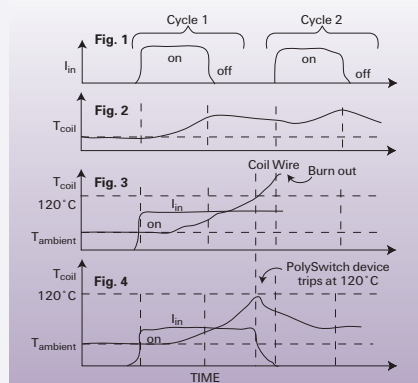
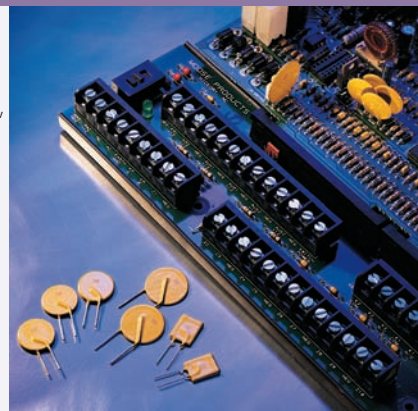
## HDMI: LCD, plasma, HDTV, set-top box, DVD player

High definition multimedia interface (HDMI) applications such as LCD displays, plasma displays, high definition television set-top boxes, and DVD players are susceptible to electrostatic discharge (ESD). To help protect the high speed TMDS lines against damage caused by ESD hits, ESD or SESD devices are used 2 per line.

- miniSMD, microSMD, nanoSMD
- ESD
- SESD
- SFF
- ZEN

**Note :** HDMI 1.3 reference layout, whitepaper, and testing results available upon request



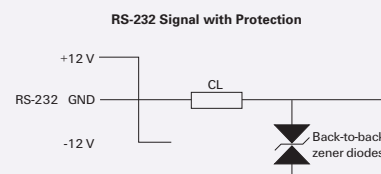
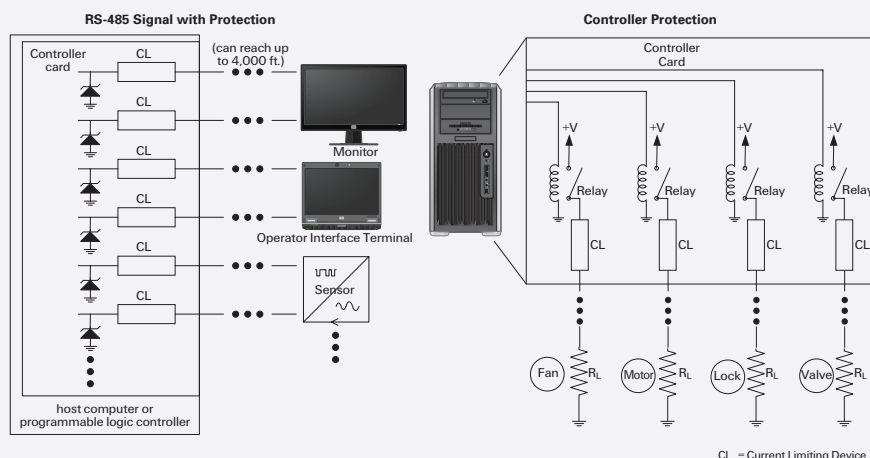




## Process and Industrial Controls

Pinched cables and incorrectly installed/connected cables lead to shorts, overheating, component failures, and burned circuit board traces.

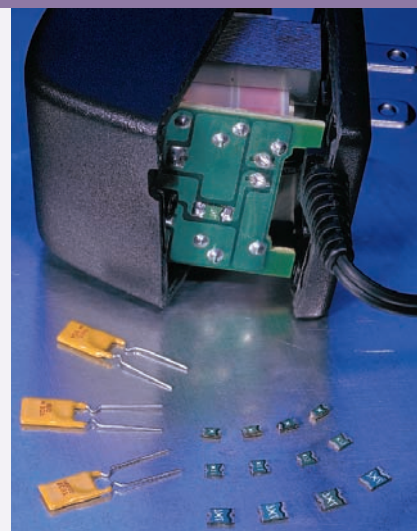
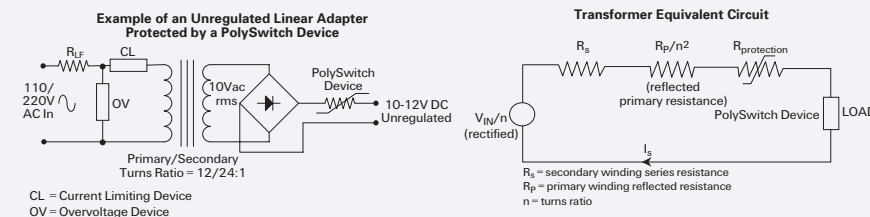
- RHEF, RUEF, RXEF
- SMD, miniSMD
- SFF, SFS, SFH



## Linear AC/DC Adapters

Linear AC/DC adapters, or “wall warts”, can be used in both battery charging applications and in low-cost DC power supplies for a variety of consumer equipment. Short circuits or excessive current draw can result in transformer winding overtemperature. PolySwitch devices can help end products meet UL requirements.

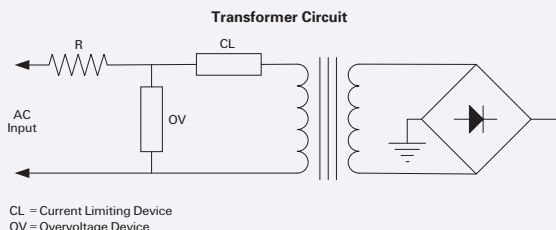
- RUEF, RXEF
- SMD, miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFS, SFH
- RTP



## Transformers

A short circuit can cause high currents, which produce high temperatures and can damage the power supply.

- RGEF, RHEF, RUEF, RXEF
- LVR
- SMD
- SFS, SFF



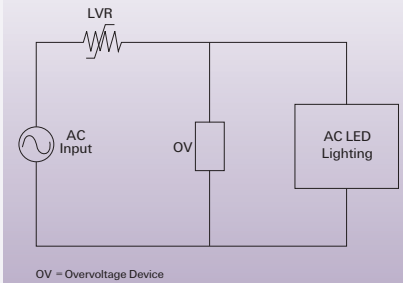


## Power Input Protection for AC LED

Lighting fixtures powered by AC power can be put at risk from high voltage or power transients on the AC inputs due to lighting strikes, power station load switching transients, or from the resulting surge currents.

Overvoltage and overcurrent protection are often viewed as unrelated conditions. TE Circuit Protection offers designers a complete solution that will help enhance product reliability and safety.

- LVR
- SMD, miniSMD

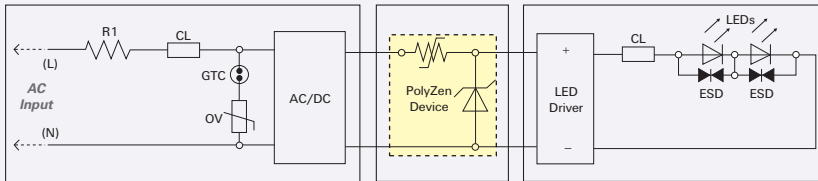


## Circuit Protection Opportunities in Solid State Lighting (SSL)/LED Lighting

LED driver integrated circuits (ICs) used in many LED applications require a protected DC input to provide a regulated-current output to the LED.

A PolySwitch device, in series with the LED driver IC, combined with a parallel voltage limiting device such as a Zener or transient suppression diode helps provide effective protection against damage caused by faulty DC input voltages. PolyZen devices provide both protection capabilities in one package.

- LVR
- ZEN
- RGEF, RHEF, RUEF, RXEF
- GTC
- ESD
- SFF, SFS, SFH



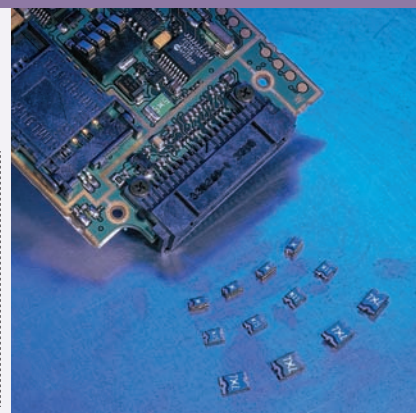
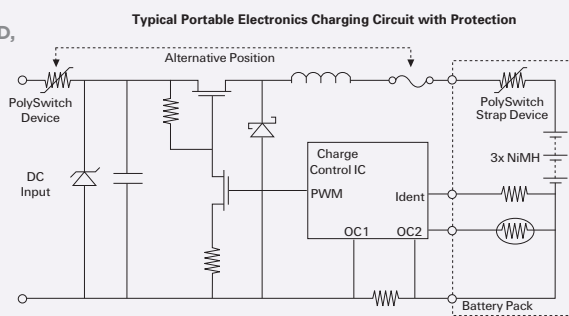
CL = Current Limiting Device  
OV = Overvoltage Device



## Portable Electronics Input Ports

The use of an incorrect or faulty adapter/charger can irreparably damage unprotected portable electronics equipment. Typical applications include cellular phones, PDAs, and digital cameras.

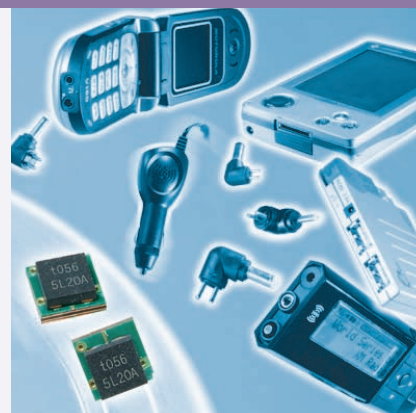
- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFS, SFH
- ZEN



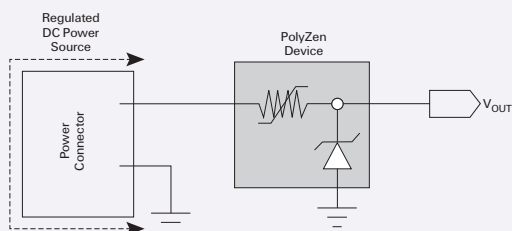
## Portable Electronics using PolyZen Devices

The PolyZen device's unique ability to withstand high inrush currents make it suitable to protect portable electronics and other low-power DC devices such as cell phones, PDAs, MP3 players, digital cameras and USB hubs. Transient protection is particularly important for peripherals that can be powered off computer and automotive power busses. PolyZen devices are designed to help lock out inappropriate power supplies and are especially effective at clamping and smoothing inductive voltage spikes.

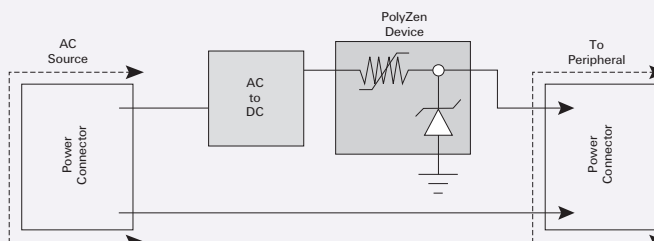
- ZEN



Typical Circuit - "On Board" Protection



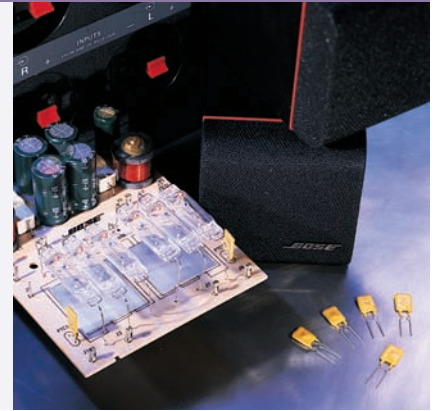
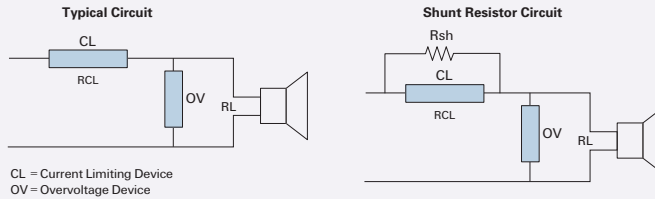
Power Conditioning (AC to DC converter output)



## Loudspeakers

High-powered amplifiers used with low-powered speakers may overdrive the speaker coils with excessive power during sustained high volumes. Low-powered amplifiers may be overdriven so that clipping occurs. This causes an upward frequency shift of power that can overload the tweeters. Digital recordings, with their ability to reproduce high-frequency material, place extra strain on tweeters. PolySwitch devices can help the design engineer solve these problems.

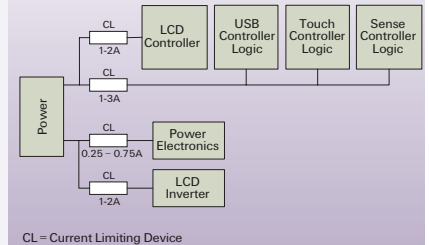
- RXEF, RKEF
- SFF, SFS



## LCD Monitors

Power for LCD monitors is supplied from the 5V and 12V busses. The LCD controller itself and the surrounding controller logic are powered from the 5V bus. The LCD inverter and the electronics on the board are powered from the 12V bus. Misconnections and mishandling during assembly or while in use can cause large overloads and short circuits in the system, damaging expensive components.

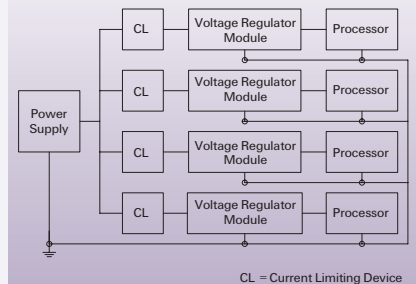
- RUEF, RXEF
- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFF, SFS, SFH
- ESD, SESD (Data lines and user interface buttons)



## Central Processing Units (CPUs)

Voltage regulation modules (VRMs) are used to supply power to central processing units. Due to load-change transients, processors can draw up to 13A. Also, during normal operation, the current demand can still change by as much as 7A as processor activity levels change. These high-current immediate demands can cause components to fail. Circuit protection helps prevent the VRM from damaging the processor in the event of a VRM failure.

- RGEF, RUEF
- SMD
- SFF, SFS, SFH

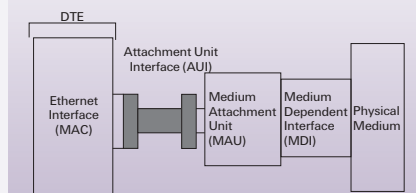
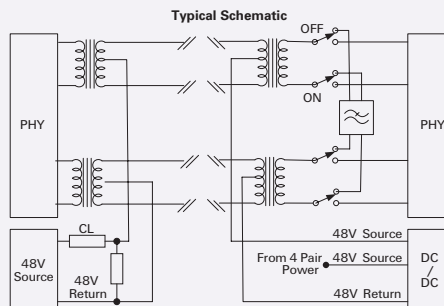


## IEEE 802.3 Ethernet LAN (Powered Ethernet)

The auxiliary unit interface (AUI) consists of signal circuits, power, and ground. Per the IEEE 802.3 standard, the Voltage Plus circuit is capable of operating at 12-15V<sub>DC</sub> for currents up to 500mA. In addition, per section 7.5.2.5, the source shall provide protection for this circuit against damage caused by an overload condition. Powering IP devices such as IP phones over the Ethernet cable introduces the potential for a short circuit and/or FET failure, causing service interruption.

- RUEF, RXEF
- miniSMD110F/16, miniSMD075F, SMD030F-2018
- SFF

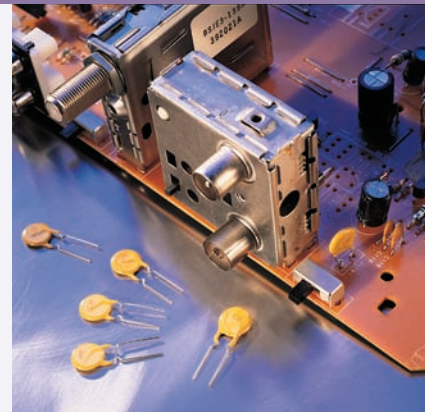
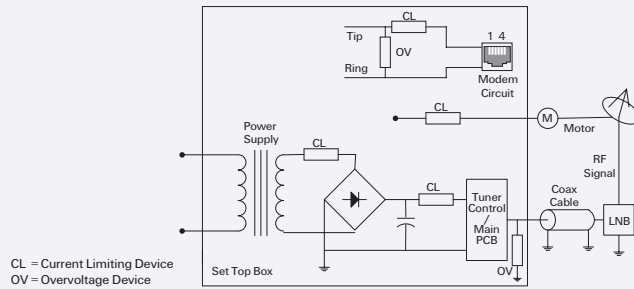
CL = Current Limiting Device



## LNB Satellite Set-Top Boxes

A short-circuit overload to the power supply can occur if the central pin in the coaxial cable connection to the receiver is bent or crushed against the connector during installation. It can also occur any time the user disconnects the antenna from the receiver.

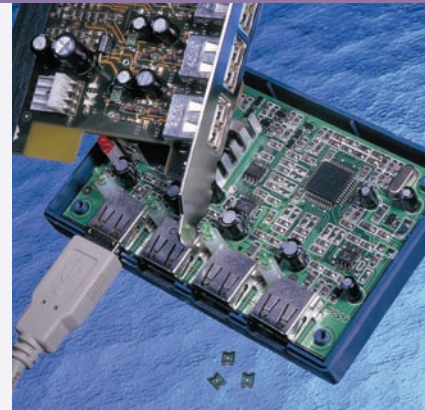
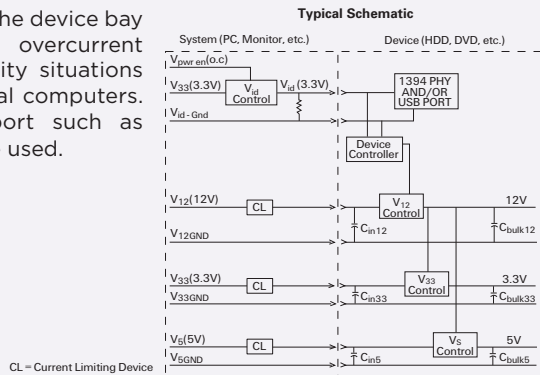
- SMD, miniSMD
- RXEF
- GTC
- SFF



## Device Bay

Due to hot-swappable bays, the device bay specification recommends overcurrent protection for high availability situations such as servers and industrial computers. An externally accessible port such as IEEE1394 or USB may also be used.

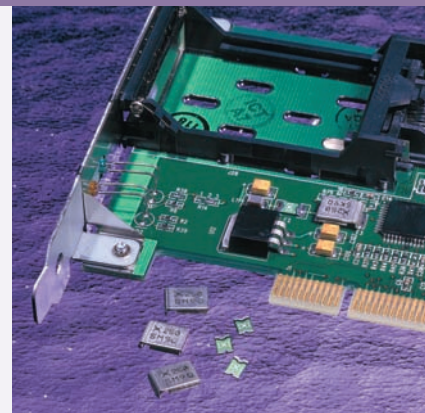
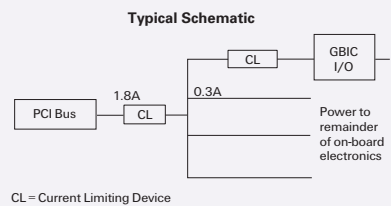
- RGEF, RUEF
- SMD, miniSMD, microSMD
- SFS, SFH



## Fibre Channel

A fault, such as a short circuit, during testing or hot-swapping a peripheral component interconnect (PCI) card can cause significant damage. Incorrect insertion of the gigabit interface converter (GBIC) or a foreign object placed into the connector can also cause permanent damage to the system. Protection on the PCI bus input is typically used as well as a secondary protector for the GBIC I/O.

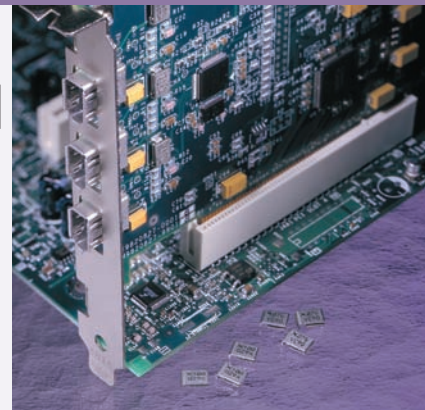
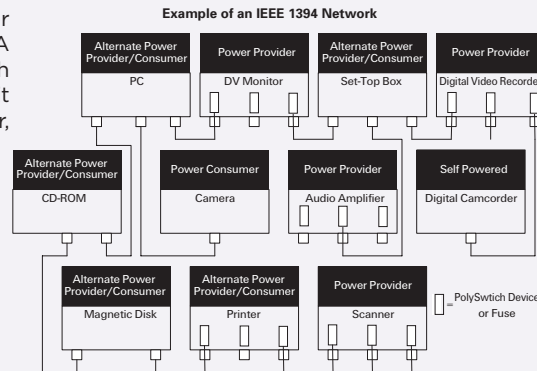
- RUEF
- miniSMDC110F, miniSMDC260F
- SFS



## IEEE 1394 FireWire, i.Link

IEEE 1394's complex power architecture provides up to 1.5A at voltages of 8-33V. PolySwitch devices help provide short-circuit protection in this high-power, hot-plugging environment.

- RKEF, RXEF
- SMD
- SFS

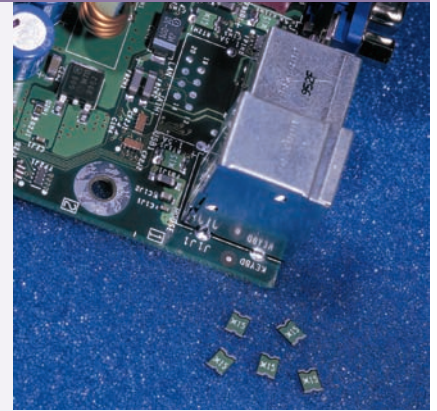
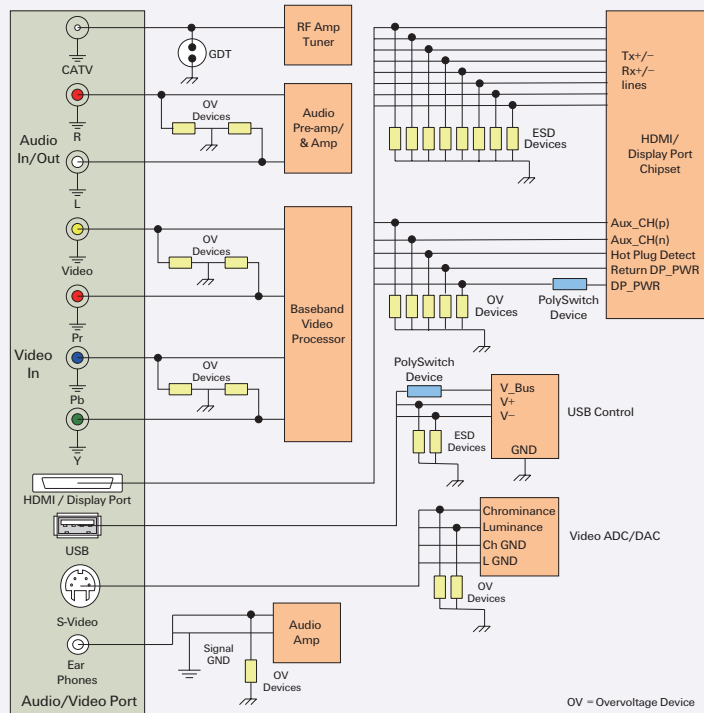




## I/O Ports

To meet regulatory agency requirements (UL60950), these ports must have a way of interrupting or limiting the current in the event of an overload or short circuit.

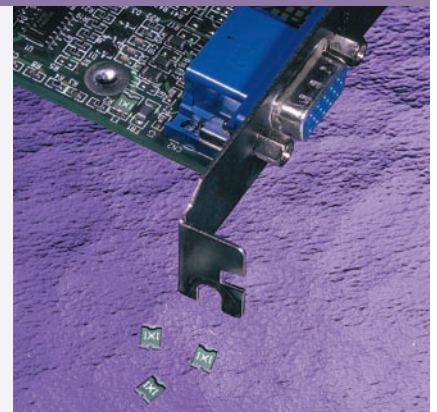
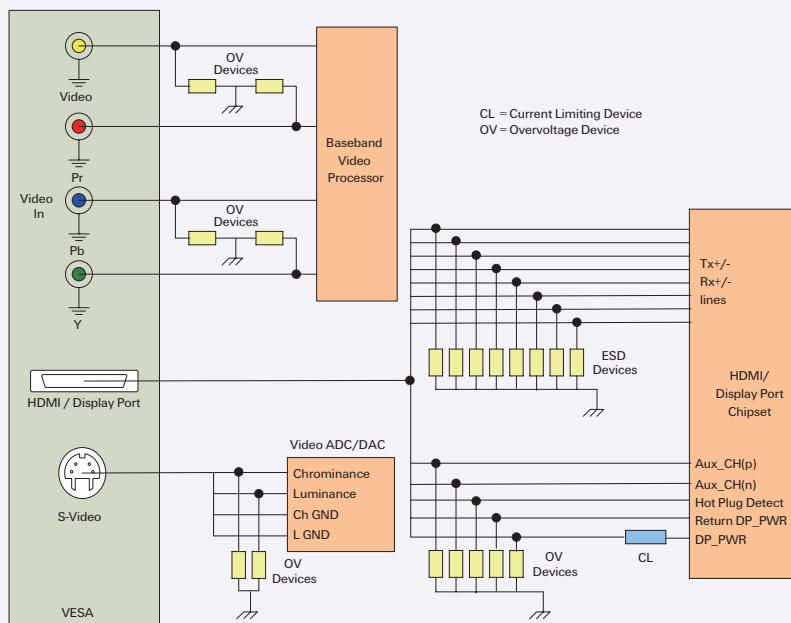
- RUEF, RUSBF
- SMD, miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFF, SFS
- ZEN
- ESD, SESD
- GTC



## Video Ports (VESA, DDC, DVI, HDMI, DisplayPort)

PolySwitch devices help protect video ports on PCI video cards and motherboard video ports from faults on the 5V interface line in Display Data Channel (DDC) circuits. These ports are designed for Energy Star compliance.

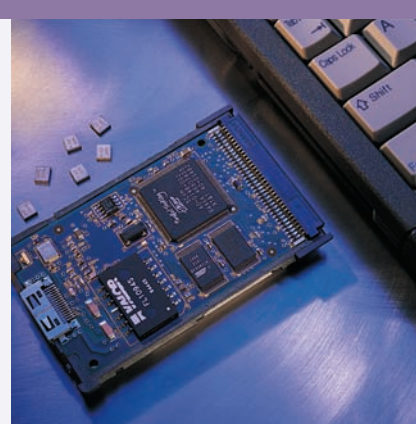
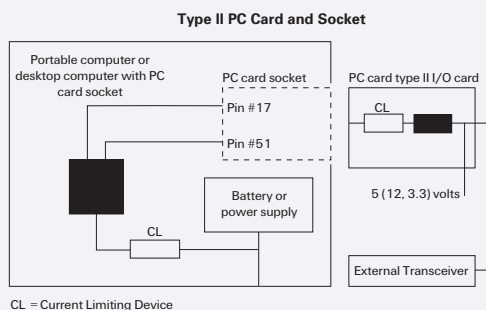
- RUEF, RUSBF
- SMD, miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFF, SFS
- ZEN
- ESD, SESD (Data lines)



## PC Cards and Sockets

Short circuits from external sources are the primary hazards for PC cards. The cards need protection from large current inrushes that can damage the PC card or the PC card bus.

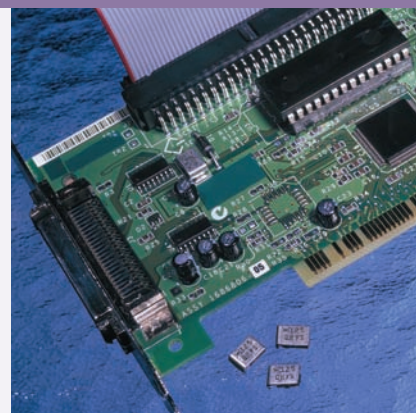
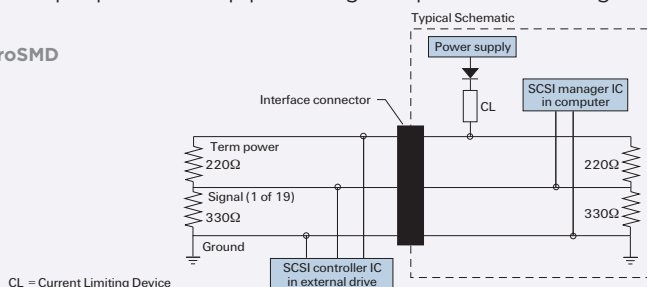
- RUEF, RUSBF
- SMD, miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- SFF, SFS
- ESD, SESD (Data lines)
- ZEN



## SCSI

The SCSI bus TERMPWR line can draw significant amounts of current in a short circuit condition. A short circuit anywhere on the bus can cause the entire bus and host to crash. PolySwitch PPTC devices can be used on the SCSI controller circuit and on each connected peripheral to help protect against permanent damage.

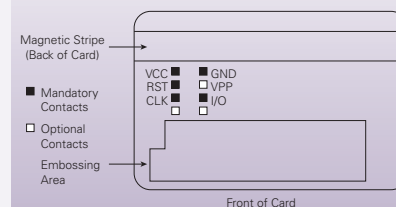
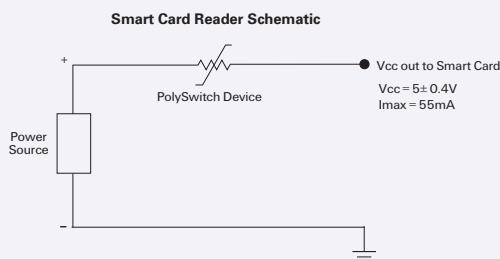
- RUEF, RXEF
- SMD, miniSMD, microSMD
- SFF, SFS



## Smart Card Readers

Smart cards are powered from the readers' Vcc output. Defective cards or foreign objects placed into the reader can cause a short circuit and permanently damage the reader.

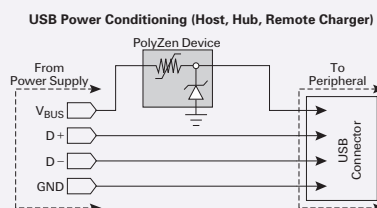
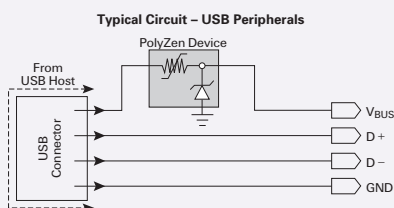
- microSMD010F



## USB Peripherals

PolyZen devices help protect against damage caused by overvoltage on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow-on electronics – such as flash memory and other 6V capable silicon – from inductive voltage spikes, incorrect power supplies, dirty power and other transients. The RoHS-compliant device offers massive power handling in a 4mm package.

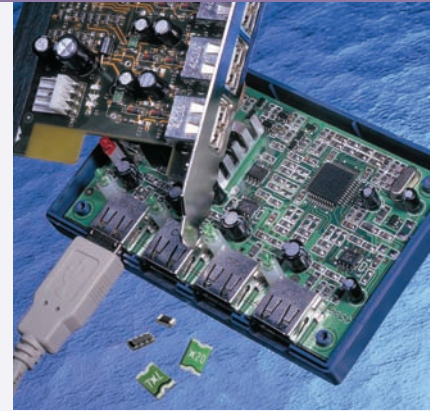
- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- ZEN
- ESD, SESD (on data lines)



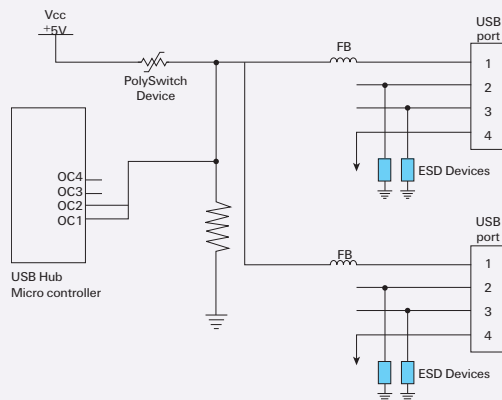
## Universal Serial Bus (USB)

PolySwitch devices help provide short-circuit protection in this hot-plugging environment for USB hosts, self-powered and bus-powered hubs.

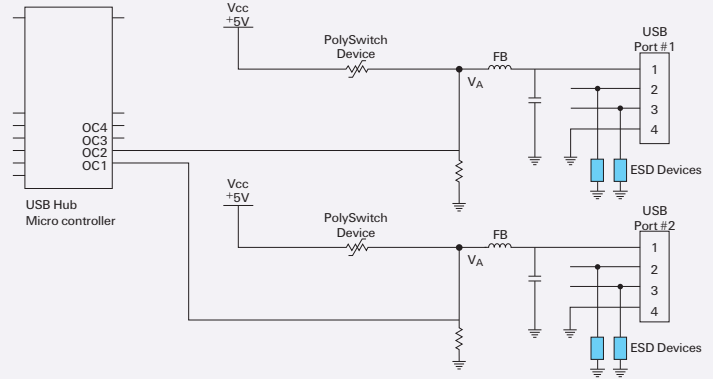
- ZEN
- RUEF, RUSBF
- miniSMD, microSMD, nanoSMD, picoSMD
- ESD
- SESD
- SFF, SFS



Ganged Port Protection  
(two-port example)



Low-active Overcurrent Pin Fault Reporting for  
Individual Port Protection

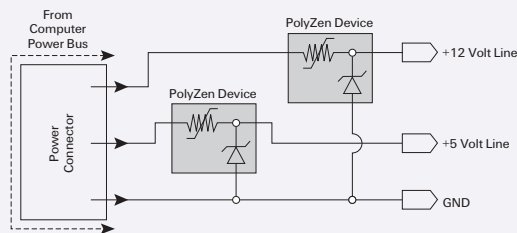


## Computer Subsystems and Peripherals

Computer electronics can be exposed to voltages well in excess of the bus voltage, and require protection for power sensitive electronics like flash memory. Voltage spikes can result from a hot disconnect of a peripheral, an internal system shutdown, or other internal power fluctuations. The PolyZen device provides coordinated protection with a component that protects like a Zener diode, but is capable of withstanding the high power fault conditions that can occur in computer electronics.

- miniSMD, microSMD, nanoSMD, picoSMD, femtoSMD
- ZEN
- SFF
- ESD (on data lines)

Typical Circuit – Computer Peripherals



# Application Solution Guide

## Appliances

| Appliances     | Overcurrent<br>Circuit Protection |                   |                          |                |                          |              |                                   |                  | Overvoltage<br>Circuit Protection |     |      | Over-<br>temperature<br>Protection | Hybrid<br>Protection |                 |                    |
|----------------|-----------------------------------|-------------------|--------------------------|----------------|--------------------------|--------------|-----------------------------------|------------------|-----------------------------------|-----|------|------------------------------------|----------------------|-----------------|--------------------|
|                | PolySwitch<br>Devices             | Chip Fuses        |                          |                |                          |              | 2410 Very<br>Fast Acting<br>Fuses | Telecom<br>Fuses | GDT                               | ESD | SESD | RTP<br>Devices                     | MHP<br>Devices       | 2Pro<br>Devices | PolyZen<br>Devices |
|                |                                   | Pulse<br>Tolerant | 0603 Very<br>Fast Acting | Fast<br>Acting | High<br>Current<br>Rated | Slow<br>Blow |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Buttons        |                                   |                   |                          |                |                          |              |                                   |                  |                                   | X   | X    |                                    |                      |                 |                    |
| Compressors    | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Displays       | X                                 | X                 | X                        | X              |                          | X            | X                                 |                  |                                   | X   | X    |                                    |                      |                 |                    |
| Motors         | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Power supplies | X                                 | X                 | X                        | X              |                          |              | X                                 |                  | X                                 |     |      |                                    |                      | X               | X                  |
| Transformers   | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      | X               |                    |
| TRIACs         | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |

## Automotive

|                                     |   |   |   |   |  |   |   |  |  |   |   |   |   |  |   |
|-------------------------------------|---|---|---|---|--|---|---|--|--|---|---|---|---|--|---|
| ABS systems                         | X | X |   | X |  | X | X |  |  |   |   | X | X |  |   |
| Antennae                            | X |   |   |   |  |   |   |  |  | X | X |   |   |  |   |
| Cigarette lighter accessories       | X | X | X | X |  | X |   |  |  |   |   |   |   |  | X |
| Connectors                          | X |   |   |   |  |   |   |  |  |   |   |   |   |  |   |
| Displays                            | X | X | X | X |  | X | X |  |  | X | X |   |   |  |   |
| Electronic control units            | X | X | X | X |  | X | X |  |  | X | X | X | X |  |   |
| HVAC and climate control            | X |   |   |   |  |   |   |  |  |   |   | X | X |  | X |
| Infotainment and navigation systems | X | X | X | X |  | X | X |  |  | X | X |   |   |  | X |
| Motors                              | X |   |   |   |  |   |   |  |  |   |   |   | X |  |   |
| Wire harness                        | X |   |   |   |  |   |   |  |  |   |   |   |   |  |   |

## Batteries

|        |   |   |  |   |   |   |  |  |  |   |   |  |   |  |  |
|--------|---|---|--|---|---|---|--|--|--|---|---|--|---|--|--|
| Li-ion | X | X |  | X | X | X |  |  |  | X | X |  | X |  |  |
| Ni-Cd  | X | X |  | X |   | X |  |  |  | X | X |  | X |  |  |
| Ni-MH  | X | X |  | X |   | X |  |  |  | X | X |  | X |  |  |

## Business and Retail Equipment

|                        |   |   |   |   |  |   |   |  |  |   |   |  |  |  |   |
|------------------------|---|---|---|---|--|---|---|--|--|---|---|--|--|--|---|
| Antennae               |   |   |   |   |  |   |   |  |  | X |   |  |  |  |   |
| Audio Input/Output     | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Batteries              | X | X |   |   |  | X |   |  |  |   |   |  |  |  |   |
| Buttons                | X |   |   |   |  |   |   |  |  |   |   |  |  |  |   |
| Displays               | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Motherboard components | X | X | X | X |  | X | X |  |  |   |   |  |  |  |   |
| Ports                  | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| HDDs                   | X | X | X | X |  | X | X |  |  | X | X |  |  |  | X |
| Power Input            | X | X | X | X |  | X | X |  |  |   |   |  |  |  | X |



## Communications

|                           | Overcurrent Circuit Protection |                |                       |             |                    |           |                             |               | Overvoltage Circuit Protection |     |      | Over-temperature Protection | Hybrid Protection |              |                 |
|---------------------------|--------------------------------|----------------|-----------------------|-------------|--------------------|-----------|-----------------------------|---------------|--------------------------------|-----|------|-----------------------------|-------------------|--------------|-----------------|
|                           | PolySwitch Devices             | Chip Fuses     |                       |             |                    |           | 2410 Very Fast Acting Fuses | Telecom Fuses | GDT                            | ESD | SESD | RTP Devices                 | MHP Devices       | 2Pro Devices | PolyZen Devices |
|                           |                                | Pulse Tolerant | 0603 Very Fast Acting | Fast Acting | High Current Rated | Slow Blow |                             |               |                                |     |      |                             |                   |              |                 |
| Antennae                  |                                |                |                       |             |                    |           |                             |               | X                              | X   |      |                             |                   |              |                 |
| Audio Input/Output        | X                              |                |                       |             |                    |           |                             |               | X                              | X   | X    |                             |                   |              |                 |
| Batteries                 | X                              | X              |                       |             |                    | X         |                             |               |                                |     |      |                             |                   |              |                 |
| Buttons                   | X                              | X              | X                     | X           |                    | X         |                             |               |                                | X   | X    |                             |                   |              |                 |
| Displays                  | X                              | X              | X                     | X           |                    | X         |                             |               |                                | X   | X    |                             |                   |              |                 |
| Fans                      | X                              | X              | X                     | X           |                    | X         |                             |               |                                |     |      |                             |                   |              |                 |
| HDDs                      | X                              | X              | X                     | X           |                    | X         |                             |               |                                | X   | X    |                             |                   |              | X               |
| Homeplug                  | X                              | X              | X                     | X           |                    | X         |                             |               | X                              |     |      |                             |                   |              |                 |
| HPNA                      | X                              | X              | X                     | X           |                    | X         |                             |               | X                              | X   | X    |                             |                   |              |                 |
| Low-speed test ports      | X                              | X              | X                     | X           |                    | X         |                             |               | X                              | X   | X    |                             |                   | X            |                 |
| MoCA                      | X                              | X              | X                     | X           |                    | X         |                             |               | X                              | X   | X    |                             |                   |              |                 |
| Motherboard components    | X                              | X              | X                     | X           |                    | X         | X                           |               |                                |     |      | X                           |                   |              |                 |
| Networking over powerline | X                              | X              | X                     | X           |                    | X         | X                           | X             | X                              | X   | X    |                             |                   |              |                 |
| Ports                     | X                              | X              | X                     | X           |                    | X         | X                           |               | X                              | X   | X    |                             |                   | X            |                 |
| Power input               | X                              | X              | X                     | X           |                    | X         | X                           |               | X                              |     |      |                             |                   | X            | X               |
| Power over ethernet       | X                              | X              |                       | X           |                    | X         |                             |               | X                              | X   | X    |                             |                   | X            |                 |

## Energy and Solar

|                    |   |   |   |   |   |   |   |  |   |   |   |   |   |   |  |
|--------------------|---|---|---|---|---|---|---|--|---|---|---|---|---|---|--|
| Batteries          | X | X |   | X | X | X | X |  |   | X | X |   | X |   |  |
| Charge controllers | X | X | X | X | X | X | X |  | X | X | X |   |   | X |  |
| Combiner boxes     | X | X |   |   | X | X | X |  | X |   |   |   |   |   |  |
| Inverters          | X | X |   |   | X | X | X |  | X | X | X | X | X |   |  |
| Junction boxes     |   |   |   |   | X |   | X |  |   | X | X |   |   |   |  |
| Disconnect Boxes   | X | X |   |   | X | X | X |  | X | X | X |   |   |   |  |

## Home Entertainment

|                    |   |   |   |   |   |   |   |  |   |   |   |  |   |   |   |
|--------------------|---|---|---|---|---|---|---|--|---|---|---|--|---|---|---|
| Audio Input/Output | X |   |   |   |   |   |   |  | X |   |   |  |   |   | X |
| Batteries          | X | X |   | X |   | X | X |  |   | X | X |  | X |   |   |
| Buttons            |   |   |   |   |   |   |   |  |   | X | X |  |   |   |   |
| Displays           | X | X | X | X | X | X | X |  |   | X | X |  |   |   |   |
| HDDs               | X | X | X | X | X | X |   |  |   | X | X |  |   |   | X |
| Motors             | X |   |   |   |   |   |   |  |   |   |   |  |   |   |   |
| PCB components     | X |   |   |   |   |   |   |  |   |   |   |  |   |   |   |
| Ports              | X |   |   |   |   |   |   |  | X | X | X |  |   |   |   |
| Power Input        | X | X | X | X | X | X | X |  | X |   |   |  |   | X | X |

## Industrial

|                       | Overcurrent<br>Circuit Protection |                   |                          |                |                          |              |                                   |                  | Overvoltage<br>Circuit Protection |     |      | Over-<br>temperature<br>Protection | Hybrid<br>Protection |                 |                    |
|-----------------------|-----------------------------------|-------------------|--------------------------|----------------|--------------------------|--------------|-----------------------------------|------------------|-----------------------------------|-----|------|------------------------------------|----------------------|-----------------|--------------------|
|                       | PolySwitch<br>Devices             | Chip Fuses        |                          |                |                          |              | 2410 Very<br>Fast Acting<br>Fuses | Telecom<br>Fuses | GDT                               | ESD | SESD | RTP<br>Devices                     | MHP<br>Devices       | 2Pro<br>Devices | PolyZen<br>Devices |
|                       |                                   | Pulse<br>Tolerant | 0603 Very<br>Fast Acting | Fast<br>Acting | High<br>Current<br>Rated | Slow<br>Blow |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Buttons               | X                                 |                   |                          |                |                          |              |                                   |                  |                                   | X   | X    |                                    |                      |                 |                    |
| Compressors           | X                                 |                   |                          |                | X                        |              |                                   |                  |                                   |     |      |                                    | X                    |                 |                    |
| Displays              | X                                 | X                 | X                        | X              |                          | X            | X                                 |                  |                                   |     |      |                                    |                      |                 |                    |
| Electromagnetic loads | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Motors                | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| Power input           | X                                 | X                 | X                        | X              |                          | X            | X                                 |                  |                                   |     |      | X                                  |                      | X               |                    |
| Transformers          | X                                 |                   |                          |                |                          |              |                                   |                  |                                   |     |      |                                    |                      |                 |                    |
| UPS Backup            | X                                 |                   |                          |                | X                        |              |                                   |                  |                                   |     |      | X                                  | X                    |                 |                    |

## Lighting

|                         |   |   |   |   |   |   |   |  |  |  |  |   |  |   |   |
|-------------------------|---|---|---|---|---|---|---|--|--|--|--|---|--|---|---|
| CFL electronic ballasts | X |   |   |   |   |   | X |  |  |  |  |   |  | X |   |
| LED ballasts            | X | X | X | X |   |   | X |  |  |  |  |   |  | X |   |
| LED controllers         | X | X | X | X | X | X | X |  |  |  |  |   |  | X | X |
| LED drivers             | X | X | X | X | X | X | X |  |  |  |  |   |  | X | X |
| PN junction             |   |   |   |   |   |   |   |  |  |  |  | X |  |   |   |
| Power input             | X | X | X | X |   | X | X |  |  |  |  |   |  | X | X |
| Power supplies          | X | X | X | X |   | X | X |  |  |  |  |   |  | X | X |
| TRIACs                  | X |   |   |   |   |   |   |  |  |  |  |   |  |   |   |

## Mobile Devices

|                    |   |   |   |   |  |   |   |  |  |   |   |  |  |  |   |
|--------------------|---|---|---|---|--|---|---|--|--|---|---|--|--|--|---|
| Antennae           |   |   |   |   |  |   |   |  |  | X |   |  |  |  |   |
| Audio Input/Output | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Batteries          | X | X |   |   |  | X |   |  |  |   |   |  |  |  |   |
| Buttons            | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Displays           | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| LEDs               | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Ports              | X | X | X | X |  | X | X |  |  | X | X |  |  |  |   |
| Power Input        | X | X | X | X |  | X | X |  |  |   |   |  |  |  | X |

## Personal Computers

|                        |   |   |   |   |   |   |   |  |   |   |   |  |  |  |   |
|------------------------|---|---|---|---|---|---|---|--|---|---|---|--|--|--|---|
| Antennae               | X |   |   |   |   |   |   |  | X |   |   |  |  |  |   |
| Audio Input/Output     | X | X | X | X |   | X | X |  |   | X | X |  |  |  |   |
| Batteries              | X | X |   | X | X | X | X |  |   | X | X |  |  |  |   |
| Buttons                |   |   |   |   |   |   |   |  |   | X | X |  |  |  |   |
| Displays               | X | X | X | X |   | X | X |  |   | X | X |  |  |  |   |
| Motherboard components | X | X | X | X | X | X | X |  |   | X | X |  |  |  |   |
| Ports                  | X |   |   |   |   |   |   |  |   | X | X |  |  |  |   |
| Power Input            | X | X | X | X | X | X | X |  |   |   |   |  |  |  | X |

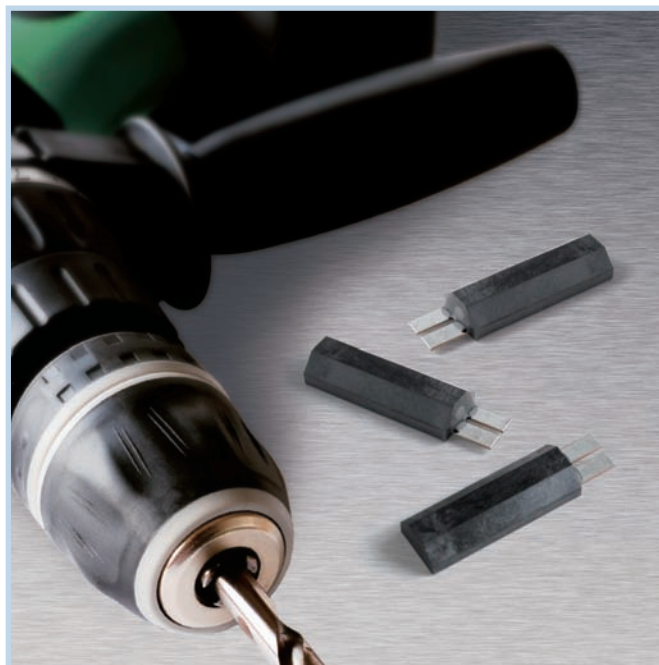




## Metal Hybrid PPTC (MHP) Devices



The rapidly expanding market for high-rate-discharge lithium ion (Li-ion) batteries used in applications such as cordless power tools, e-bikes and back-up power supplies has created the need for cost-effective circuit protection devices capable of providing 30A+ hold currents at voltage ratings over 30V<sub>DC</sub>. To meet this need, a new hybrid device has been developed that connects a bimetal protector in parallel with a PPTC (polymeric positive temperature coefficient) device. The resulting Metal Hybrid PPTC (MHP) device helps provide resettable overcurrent protection while also utilizing the low resistance of the PPTC device to help prevent arcing in the bimetal protector at higher currents.



### Benefits

- Fills market need for battery protection devices rated above 30A and 36V<sub>DC</sub>
- Provides resettable overcurrent and short circuit protection in Li-ion battery packs
- Helps protect Li-ion cells from damage due to abnormal high currents that could cause heat damage and lead to premature cell end of life and potential field returns
- Arc suppression: Current shunts to the PPTC due to its low resistance helping to suppress arcing all while helping protect the contacts from damage or welding shut
- Double make/double break contact design allows for a high current rating in a smaller device package

### Features

- RoHS compliant
- 30A hold current
- Rated at 36V<sub>DC</sub>, 100A max.
- Low device resistance (< 2mOhm) compared to other breaker devices
- Able to withstand heavy vibration and impact
- Device allows easy mounting between 18650 cells

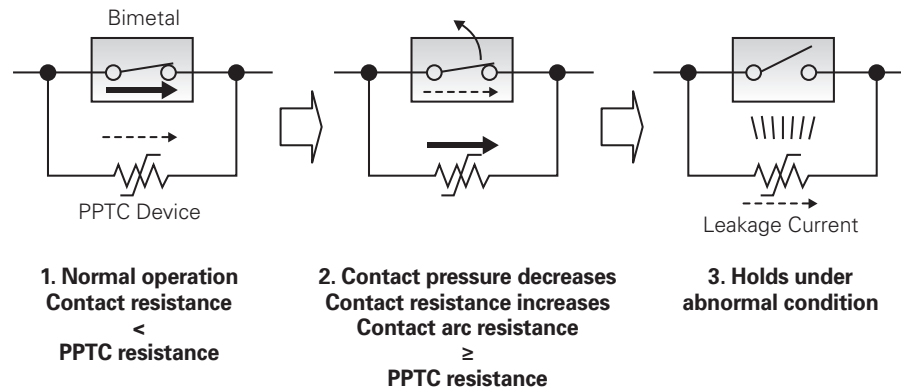
### Applications

- Li-ion battery packs for high-rate-discharge applications
  - Cordless power tools
  - E-bikes
  - Back-up power supplies (UPS)
  - Back-up power for medical devices
- Motor protection



## Design Concept for MHP Devices

In normal operation, current passes through the bimetal contact due to its low contact resistance. During an abnormal event, such as a power tool rotor lock, higher current is generated in the circuit causing the bimetal contact to open and its contact resistance to increase. At this point, the current shunts to the lower resistance PPTC device which helps prevent arcing between the contacts while also heating the bimetal, keeping it open and in a latched position. This integrated design addresses the need for compact, resettable overcurrent protection devices capable of arc suppression in high current DC power applications.

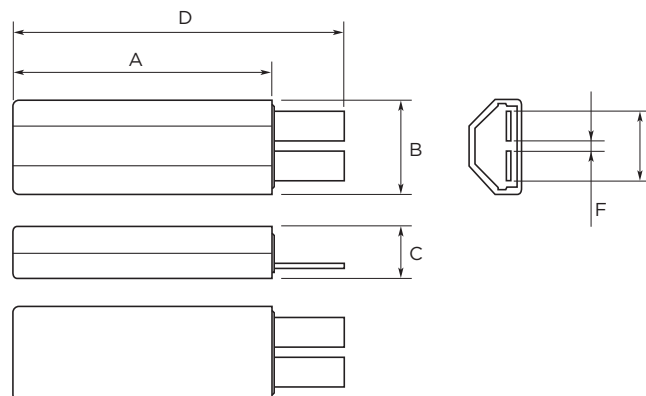


**Table M1 Electrical Characteristics (Typical) for MHP Devices**

| Part Number | Current Trip Limits |                  | Operating Voltage<br>$V_{MAX}$<br>(V <sub>DC</sub> ) | Time-to-Trip |           | $R_{Typ}$<br>(mOhms) |
|-------------|---------------------|------------------|------------------------------------------------------|--------------|-----------|----------------------|
|             | $I_{HOLD}$ @25°C    | $I_{TRIP}$ @25°C |                                                      | 100A @25°C   | 60A @25°C |                      |
|             | (A)                 | (A)              |                                                      | (Seconds)    | (Seconds) |                      |
| MHP30-36-T  | 30                  | 50               | 36                                                   | 4.5 ±1.5     | 17 ±10    | 1.6                  |

**Table M2 Dimensions for MHP Devices in Millimeters**

| Part Number | A    |      | B    |      | C    |      | D    |      | E    |      | F    |      |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|
|             | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| MHP30-36-T  | 25.8 | 26.2 | 9.2  | 9.6  | 5.1  | 5.5  | 32.8 | 33.6 | 6.8  | 7.2  | 0.9  | 1.1  |



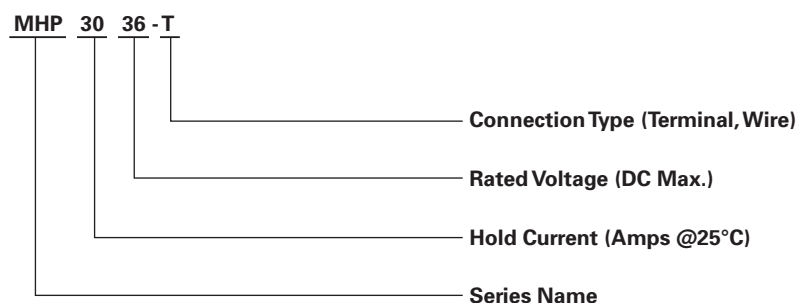
## Rated Trip Cycles for MHP Devices

DC16V, 100A (resistive) – 500 cycles  
 DC36V, 100A (resistive) – 100 cycles  
 (No welding of contacts)

## Agency Recognition for MHP Devices

UL1077 Category QVNU2, File# : E343847

## Part Numbering System for MHP Devices



## Part Marking System for MHP Devices

TE Connectivity — Manufacturer's Name  
 MHP30-36-T — Part Name  
 36V<sub>DC</sub>, 30A, trip @50A — Rated Current and Voltage  
 □□□□□□ — Lot Identification



## Warning :

### • Cautions for storage

Electrical characteristics of this product are not affected by storage under normal environmental conditions. However, terminal electrode weldability and packaging conditions may be impacted by environment. Special attentions should be paid to storage conditions.

Suggested storage temperature (except for packaging material): -20°C min., +60°C max.

The following environments should be avoided for storage:

1. Areas with salt air or with corrosive gas such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>x</sub>.
2. Areas under direct sunlight.
3. Areas outside of the suggested storage temperature as indicated above.

### • Cautions for Electrical Characteristics

Device electrical characteristics may change depending on installation conditions. Users should independently evaluate the suitability of and test each product selected for their own application.

Especially in the case of high current discharging, the device may be negatively impacted, depending on welding conditions or material of any attached extension terminals. Special attention should be paid to avoid heat being generated around the joint areas or on the extended terminals.

### • Cautions for Rating

1. Power supply voltage must be under the voltage rating. Operation beyond the voltage rating may result in device damage, smoking and flame.
2. Designs must be selected in such a manner that the device hold current is higher than the normal current value in the circuit and that the device trip current is lower than the abnormal current value which may negatively impact the circuit and therefore should be interrupted.
3. This product should not be used in an application where the maximum interrupt current can be exceeded in a short circuit condition.
4. The devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
5. The devices may not perform as specified if mechanical pressure is added in the tripped state or under temperature conditions over 100°C.

### • Additional Considerations

It is the responsibility of the user to determine the need for additional or failsafe protection to prevent damage that may occur in the event of abnormal function or failure of the MHP device, particularly in the case of using the device for critical applications where the failure of the product in the application might be reasonably expected to cause the failure or malfunction of the system or device or to affect its safety or effectiveness.

Suggested considerations for additional safety:

1. Provide additional protection circuit and/or protection devices.
2. Avoid redundant circuits.

### • Application Environment

The MHP devices are intended to be used for applications which are common for general electric devices. Usage in special environments or conditions as listed below may adversely impact the device performance and therefore requires users to carefully examine the actual performance and reliability of the device:

1. Environment where the devices are exposed to water, oil, chemical solutions, and/or organic solvents.
2. Installation in an area close to heating point or adjacent or near to inflammable objects, such as plastic wires.
3. Environment in which device is constrained by pressure, sealing or resin coating.
4. Environment where dew condenses on the devices.
5. Environment with salt air or with corrosive gas such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>x</sub>.
6. Environment with grit and dust and/or under direct sunlight
7. Environment outside of recommended operating temperature: min. -20°C, max. +85°C.



# PolyZen Devices

## Polymer Protected Zener Diode

PolyZen devices are polymer enhanced precision Zener diode micro-assemblies that help protect sensitive electronics from damage caused by inductive voltage spikes, voltage transients, use of incorrect power supplies and reverse bias.

The PolyZen micro-assembly incorporates a stable Zener diode for precise voltage clamping and a resistively non-linear, polymeric positive temperature coefficient (PPTC) layer that responds to either diode heating or overcurrent events by transitioning from a low to high resistance state.

PolyZen devices help provide resettable protection against damage caused by multi-watt fault events and require only 0.7W power dissipation. In the event of sustained high power conditions, the PPTC element of the device “trips” to limit current and generate voltage drop. This functionality helps protect both the Zener and the follow-on electronics, effectively increasing the diode’s power handling capacity.



### Benefits

- Helps shield downstream electronics from overvoltage and reverse bias
- Trip events shut out overvoltage and reverse bias sources
- Analog nature of trip events minimize upstream inductive spikes
- Helps reduce design costs with single component placement and minimal heat sinking requirements

### Features

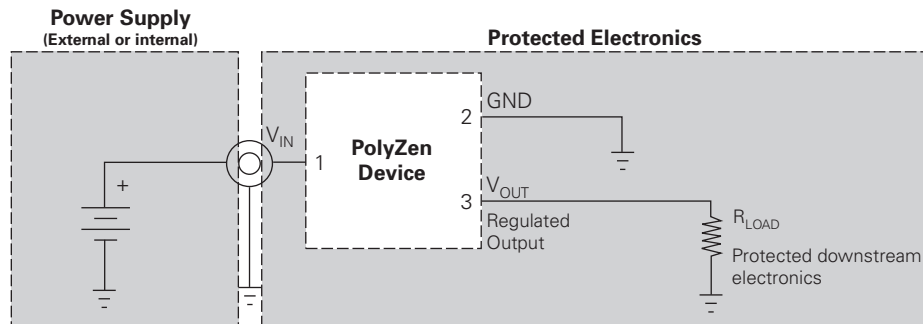
- RoHS compliant
- Overvoltage transient suppression
- Hold currents up to 2.3A
- Time delayed, overvoltage trip
- Time delayed, reverse bias trip
- Power handling on the order of 30 watts
- Integrated device construction

### Applications

- Portable media players
- Global positioning systems
- Hard disk drives 5V & 12V bus
- Solid State Drives (SSD) 5V bus
- Cellphone charger port and USB power
- Automotive peripheral input power
- DC power port protection
- Industrial handheld POS



**Figure PZ1 Typical Application Block Diagram for PolyZen Devices**



**Table PZ1 Electrical Characteristics for PolyZen Devices**

(Performance ratings @ 25°C unless otherwise specified)

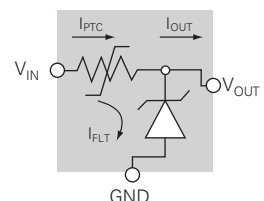
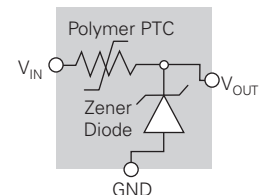
| Part Number      | V <sub>Z</sub> (V) |       |       | I <sub>Zt</sub><br>(A) | I <sub>HOLD</sub><br>@ 20°C<br>(A) | R <sub>Typ</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | V <sub>INT MAX</sub>        |                        | I <sub>FLT MAX</sub>        |                        |
|------------------|--------------------|-------|-------|------------------------|------------------------------------|-------------------------|--------------------------|-----------------------------|------------------------|-----------------------------|------------------------|
|                  | Min.               | Typ.  | Max.  |                        |                                    |                         |                          | V <sub>INT MAX</sub><br>(V) | Test<br>Current<br>(A) | I <sub>FLT MAX</sub><br>(A) | Test<br>Voltage<br>(V) |
| ZEN056V130A24LS  | 5.45               | 5.60  | 5.75  | 0.10                   | 1.30                               | 0.12                    | 0.16                     | 24V                         | 3A                     | +10/-40                     | +24/-16V               |
| ZEN059V130A24LS† | 5.80               | 5.90  | 6.00  | 0.10                   | 1.30                               | 0.12                    | 0.15                     | 24V                         | 3A                     | +6/-40                      | +24/-16V               |
| ZEN065V130A24LS  | 6.35               | 6.50  | 6.65  | 0.10                   | 1.30                               | 0.12                    | 0.16                     | 24V                         | 3A                     | +6/-40                      | +24/-16V               |
| ZEN098V130A24LS  | 9.60               | 9.80  | 10.00 | 0.10                   | 1.30                               | 0.12                    | 0.16                     | 24V                         | 3A                     | +3.5/-40                    | +24/-16V               |
| ZEN132V130A24LS  | 13.20              | 13.40 | 13.60 | 0.10                   | 1.30                               | 0.12                    | 0.16                     | 24V                         | 3A                     | +2/-40                      | +24/-16V               |
| ZEN164V130A24LS  | 16.10              | 16.40 | 16.60 | 0.10                   | 1.30                               | 0.12                    | 0.16                     | 24V                         | 3A                     | +1.25/-40                   | +24/-16V               |
| ZEN056V230A16LS  | 5.45               | 5.60  | 5.75  | 0.10                   | 2.30                               | 0.04                    | 0.06                     | 16V                         | 5A                     | +5/-40                      | +16/-12V               |
| ZEN065V230A16LS  | 6.35               | 6.50  | 6.65  | 0.10                   | 2.30                               | 0.04                    | 0.06                     | 16V                         | 5A                     | +3.5/-40                    | +16/-12V               |
| ZEN098V230A16LS  | 9.60               | 9.80  | 10.00 | 0.10                   | 2.30                               | 0.04                    | 0.06                     | 16V                         | 5A                     | +3.5/-40                    | +16/-12V               |
| ZEN132V230A16LS  | 13.20              | 13.40 | 13.60 | 0.10                   | 2.30                               | 0.04                    | 0.06                     | 16V                         | 5A                     | +2/-40                      | +20/-12V               |
| ZEN056V075A48LS  | 5.45               | 5.60  | 5.75  | 0.10                   | 0.75                               | 0.28                    | 0.45                     | 48V                         | 3A                     | +10/-40                     | +48/-16V               |
| ZEN132V075A48LS  | 13.20              | 13.40 | 13.60 | 0.10                   | 0.75                               | 0.28                    | 0.45                     | 48V                         | 3A                     | +2/-40                      | +48/-16V               |
| ZEN056V115A24LS  | 5.45               | 5.60  | 5.75  | 0.10                   | 1.15                               | 0.15                    | 0.18                     | 24V                         | 3A                     | +10/-40                     | +24/-16V               |
| ZEN056V130A24GS* | 5.45               | 5.60  | 5.75  | 0.10                   | 1.30                               | 0.12                    | 0.18                     | 24V                         | 3A                     | +6/-40                      | +24/-16V               |

\* Module height is 1.25mm. Module height of all other part numbers is 2.0mm.

† Typical operating current is 500μA @ 5.0V which meets USB suspend mode requirement.

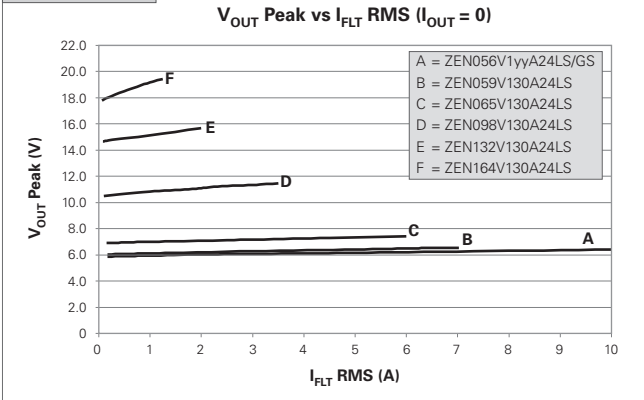
**Table PZ2 Definitions of Terms for PolyZen Devices**

|                      |                                                                                                                                                                                                                                                                          |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>Z</sub>       | Zener clamping voltage measured at current I <sub>Zt</sub> and 20°C.                                                                                                                                                                                                     |
| I <sub>Zt</sub>      | Test current at which V <sub>Z</sub> is measured.                                                                                                                                                                                                                        |
| I <sub>HOLD</sub>    | Maximum steady state current I <sub>PTC</sub> that will not generate a trip event at the specified temperature. Ratings assume I <sub>FLT</sub> = 0A.                                                                                                                    |
| R <sub>Typ</sub>     | Typical resistance between V <sub>IN</sub> and V <sub>OUT</sub> pins when the device is at room temperature.                                                                                                                                                             |
| R <sub>1MAX</sub>    | The maximum resistance between V <sub>IN</sub> and V <sub>OUT</sub> pins, at room temperature, one hour after first trip or after reflow soldering.                                                                                                                      |
| I <sub>FLT</sub>     | Current flowing through the Zener diode.                                                                                                                                                                                                                                 |
| I <sub>FLT MAX</sub> | Maximum RMS fault current the Zener diode component of the device can withstand and remain resettable; testing is conducted at rated voltage with no load connected to V <sub>OUT</sub> .                                                                                |
| V <sub>INT MAX</sub> | The voltage (V <sub>IN</sub> - V <sub>OUT</sub> "post trip") at which typical qualification devices (98% devices, 95% confidence) survived at least 100 trip cycles and 24 hours trip endurance when "tripped" at the specified voltage and current (I <sub>PTC</sub> ). |
| I <sub>PTC</sub>     | Current flowing through the PTC portion of the circuit.                                                                                                                                                                                                                  |
| I <sub>OUT</sub>     | Current flowing out the V <sub>OUT</sub> pin of the device.                                                                                                                                                                                                              |
| Trip Event           | A condition where the PTC transitions to a high resistance state, thereby limiting I <sub>PTC</sub> , and significantly increasing the voltage drop between V <sub>IN</sub> and V <sub>OUT</sub> .                                                                       |

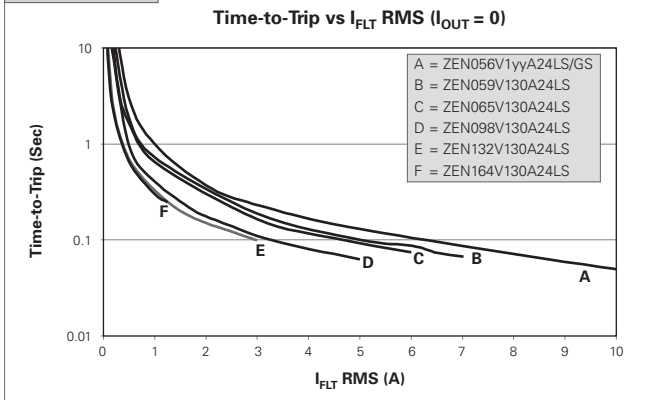


**Figure PZ2-PZ9 Typical Performance Curves for PolyZen Devices**

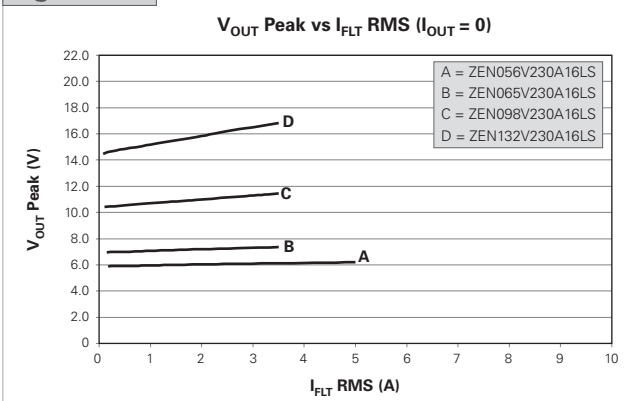
**Figure PZ2**



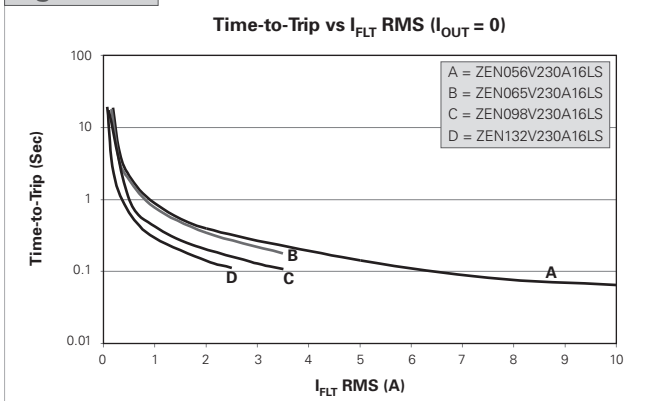
**Figure PZ3**



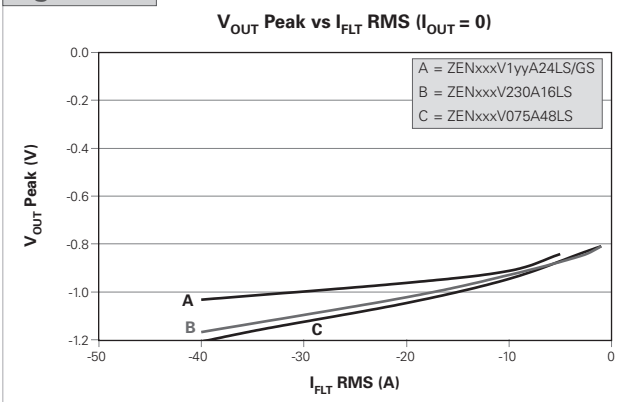
**Figure PZ4**



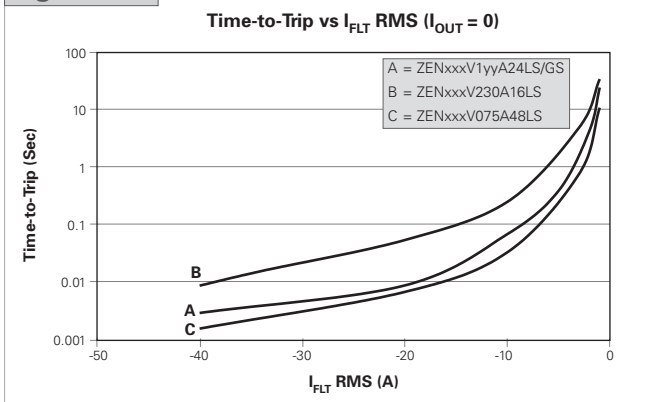
**Figure PZ5**



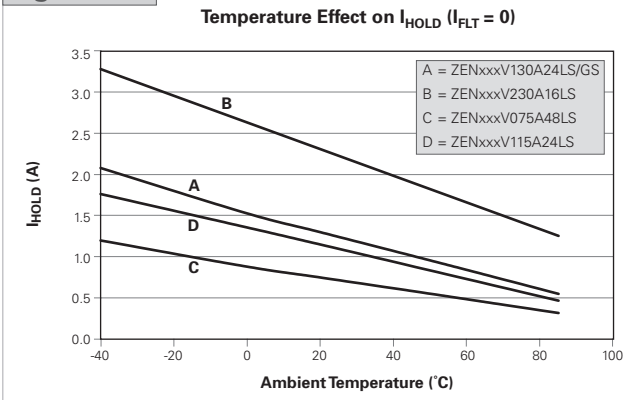
**Figure PZ6**



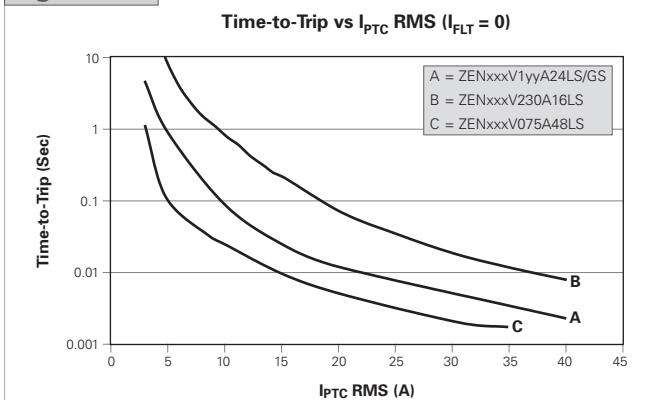
**Figure PZ7**



**Figure PZ8**

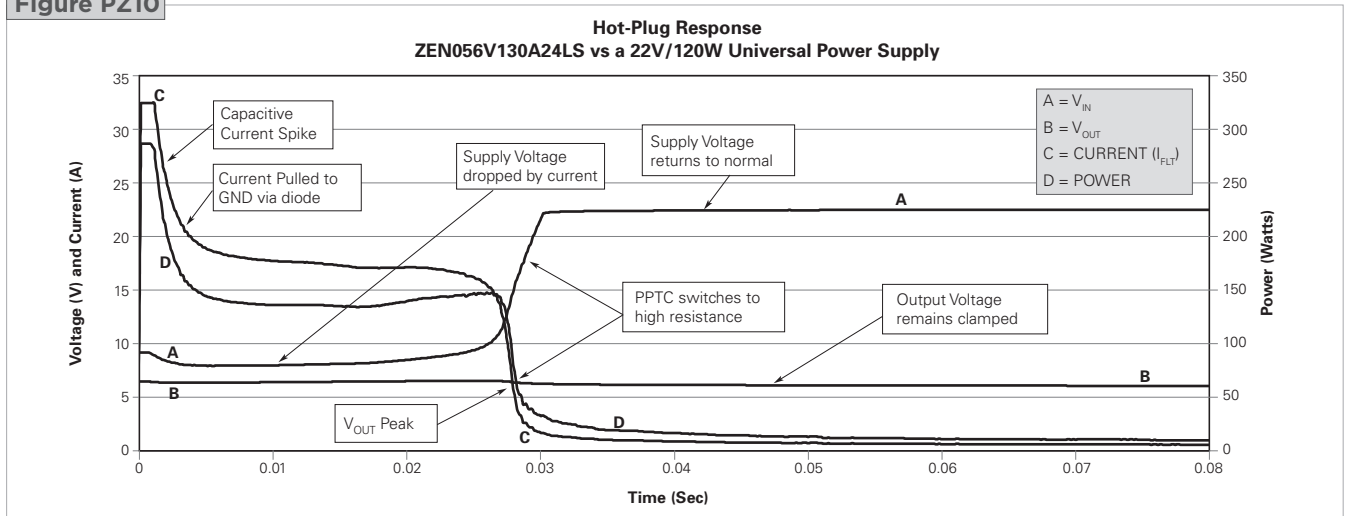
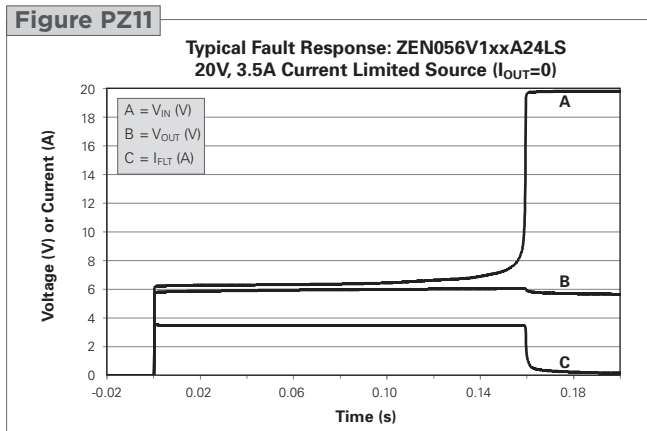
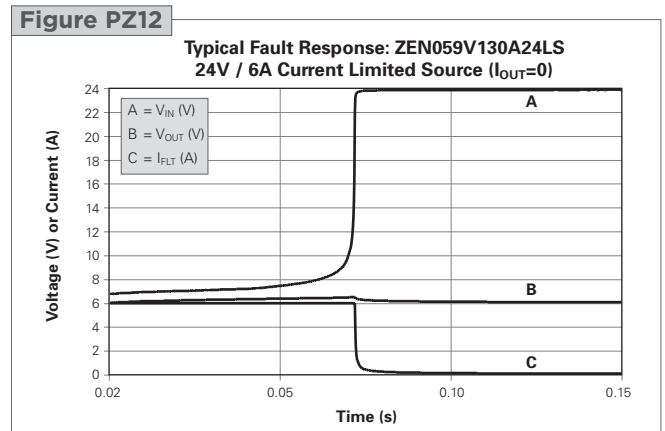
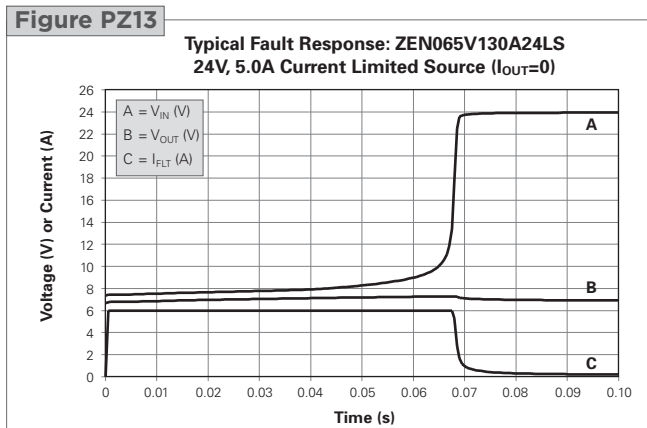
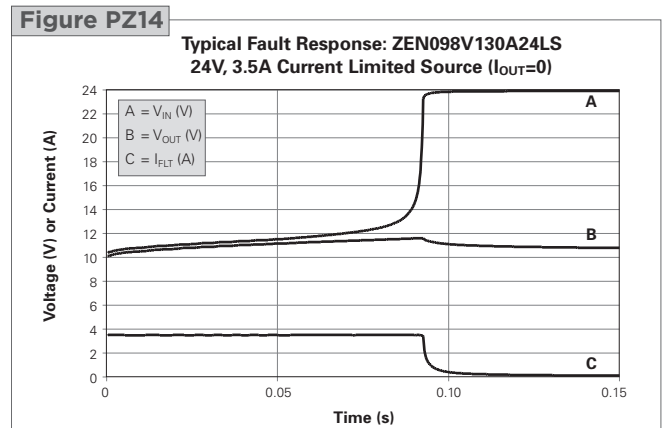


**Figure PZ9**



**Table PZ3 General Characteristics for PolyZen Devices**

|                             |                |                        |
|-----------------------------|----------------|------------------------|
| Operating temperature range | -40° to +85°C  |                        |
| Storage temperature         | -40° to +85°C  |                        |
| ESD withstand               | 15kV           | Human body model       |
| Diode capacitance           | 4200pF         | Typical @ 1MHz, 1V RMS |
| Construction                | RoHS compliant |                        |

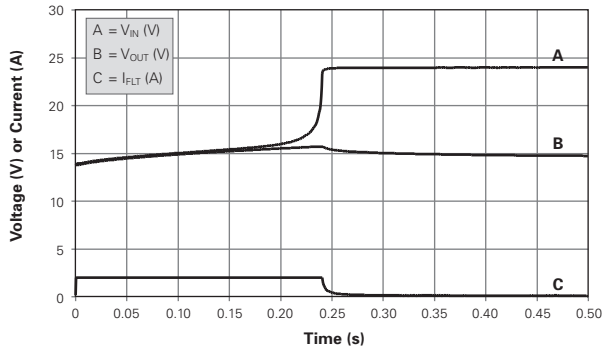
**Figure PZ10-PZ23 Basic Operation Examples for PolyZen Devices**
**Figure PZ10**

**Figure PZ11**

**Figure PZ12**

**Figure PZ13**

**Figure PZ14**


# Figure PZ16-PZ23 Basic Operation Examples for PolyZen Devices

Cont'd

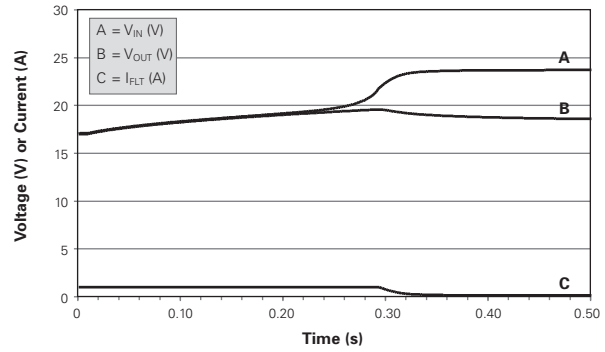
**Figure PZ15**

Typical Fault Response: ZEN132V130A24LS  
24V, 2.0A Current Limited Source ( $I_{OUT}=0$ )



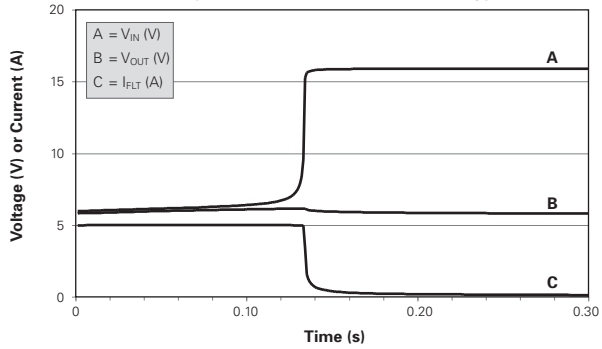
**Figure PZ16**

Typical Fault Response: ZEN164V130A24LS  
24V, 1.0A Current Limited Source ( $I_{OUT}=0$ )



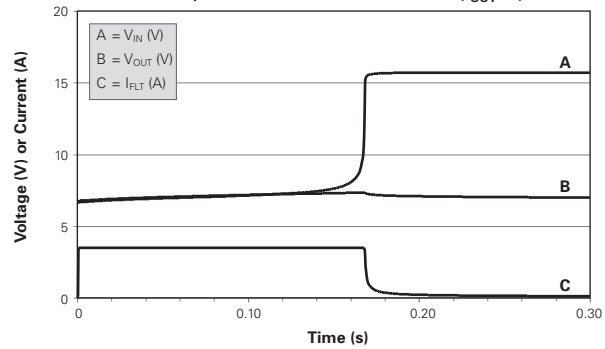
**Figure PZ17**

Typical Fault Response: ZEN056V230A16LS  
16V, 5.0A Current Limited Source ( $I_{OUT}=0$ )



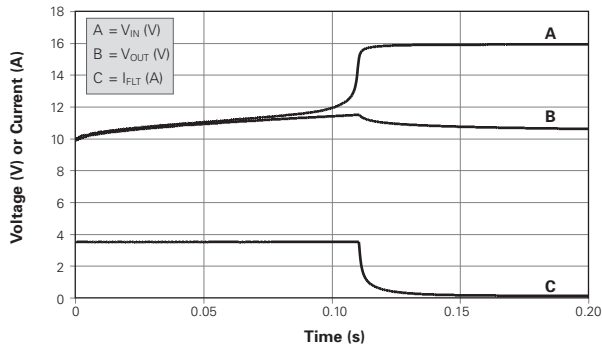
**Figure PZ18**

Typical Fault Response: ZEN065V230A16LS  
16V, 3.5A Current Limited Source ( $I_{OUT}=0$ )



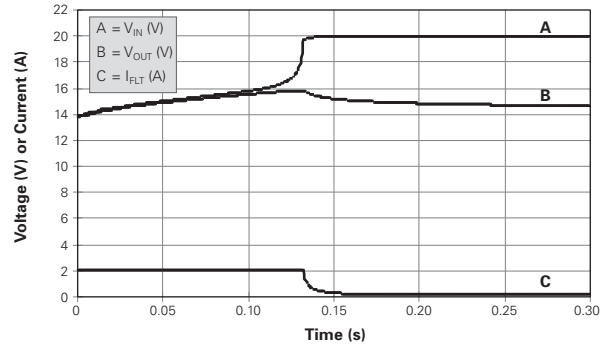
**Figure PZ19**

Typical Fault Response: ZEN098V230A16LS  
16V, 3.5A Current Limited Source ( $I_{OUT}=0$ )



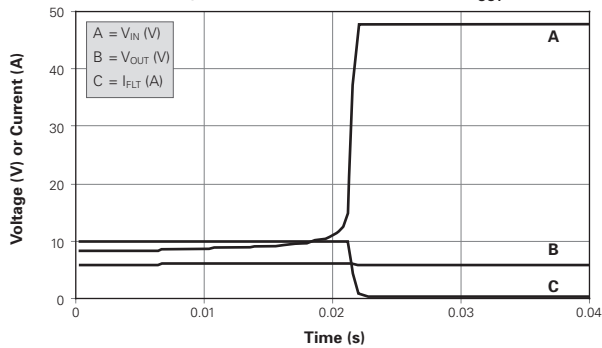
**Figure PZ20**

Typical Fault Response: ZEN132V230A16LS  
20V, 2.0A Current Limited Source ( $I_{OUT}=0$ )



**Figure PZ21**

Typical Fault Response: ZEN056V075A48LS  
48V, 10.0A Current Limited Source ( $I_{OUT}=0$ )



**Figure PZ22**

Typical Fault Response: ZEN132V075A48LS  
48V, 2.0A Current Limited Source ( $I_{OUT}=0$ )

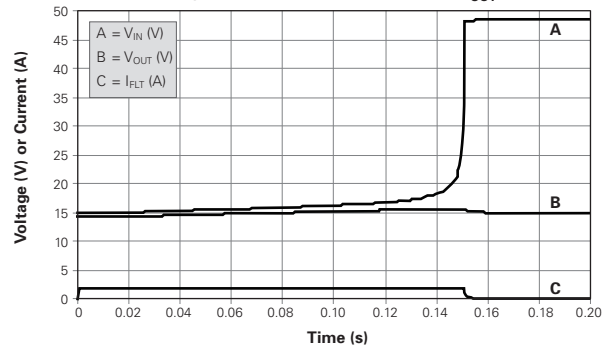


Figure PZ23

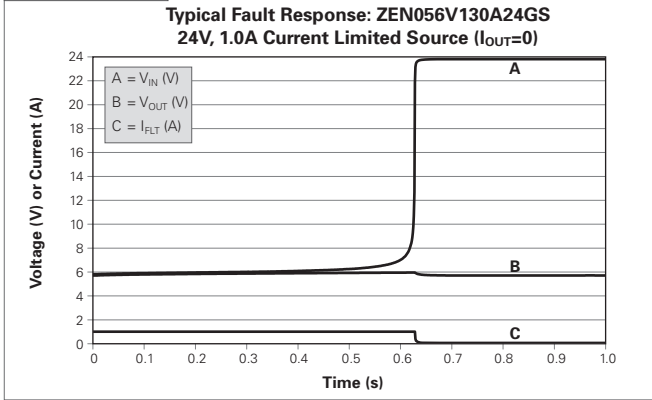


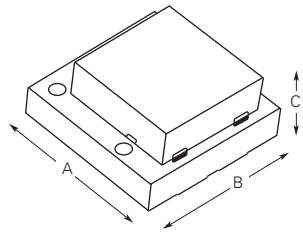
Table PZ4 Packaging and Marking Information for PolyZen Devices

| Part Number     | Bag Quantity | Tape & Reel Quantity | Standard Package |
|-----------------|--------------|----------------------|------------------|
| ZENxxxVyyyAzzLS | -            | 3,000                | 15,000           |
| ZENxxxVyyyAzzGS | -            | 4,000                | 20,000           |

Table PZ5 Dimensions for PolyZen Devices in Millimeters (Inches)

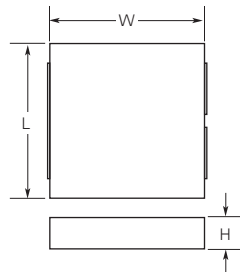
ZENxxxVyyyAzzLS Devices

|      | A       |         | B       |         | C       |         |
|------|---------|---------|---------|---------|---------|---------|
|      | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    |
| mm   | 3.85    | 4.15    | 3.85    | 4.15    | 1.40    | 2.00    |
| inch | (0.152) | (0.163) | (0.152) | (0.163) | (0.055) | (0.081) |



ZENxxxVyyyAzzGS Devices

|      | L       |         | W       |         | H       |         |
|------|---------|---------|---------|---------|---------|---------|
|      | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    |
| mm   | 3.85    | 4.15    | 3.85    | 4.15    | 1.16    | 1.25    |
| inch | (0.152) | (0.163) | (0.152) | (0.163) | (0.046) | (0.049) |





5

**Pin Configuration (Top View)**

Diagram showing the pin configuration (Top View) of the device. The package is square with pins 1, 2, and 3. Pin 1 is labeled  $V_{IN}$ , pin 2 is labeled GND, and pin 3 is labeled  $V_{OUT}$ .

Figure 1: Dimensions of the test specimen. The diagram shows a cross-section of a specimen with a total height of 2.21mm (0.087 inches) and a total width of 3.50mm (0.137 inches). The width is divided into three sections: two side sections of 0.56mm (0.022 inches) and a central section of 2.88mm (0.1135 inches). The central section contains two rectangular features, each 0.94mm (0.037 inches) high and 0.33mm (0.013 inches) wide, separated by a 0.33mm (0.013 inches) gap.

**Note:** All temperatures refer to topside of the package, measured on the package body surface.

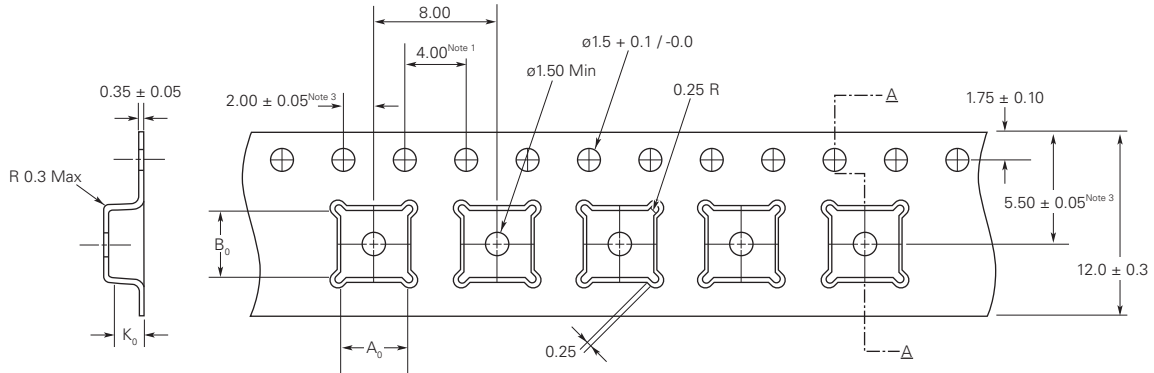
### Figure PZ24

The graph illustrates the temperature profile over time for a reflow process. The y-axis represents Temperature, and the x-axis represents Time. The profile starts at 25°C, ramps up to  $T_L$  (Preheat,  $t_s$ ), dwells at  $T_L$ , ramps up to  $T_P$  (Ramp up,  $t_p$ ), dwells at  $T_P$  (Critical Zone,  $T_L$  to  $T_P$ ), and then ramps down (Ramp down). The temperature range between  $T_L$  and  $T_P$  is divided into  $T_{S\_MAX}$  and  $T_{S\_MIN}$  zones. The total time from 25°C to the peak is  $t_{25^\circ\text{C to Peak}}$ .

## Tape and Reel Specifications for PolyZen Devices (in Millimeters)

**Figure PZ25** EIA Referenced Taped Component Dimensions for PolyZen Devices (in Millimeters)

| Description | ZENxxxVyyyAzzLS Devices | ZENxxxVyyyAzzGS Devices |
|-------------|-------------------------|-------------------------|
| $A_0$       | 4.35                    | 4.35                    |
| $B_0$       | 4.35                    | 4.35                    |
| $K_0$       | 2.30                    | 1.80                    |

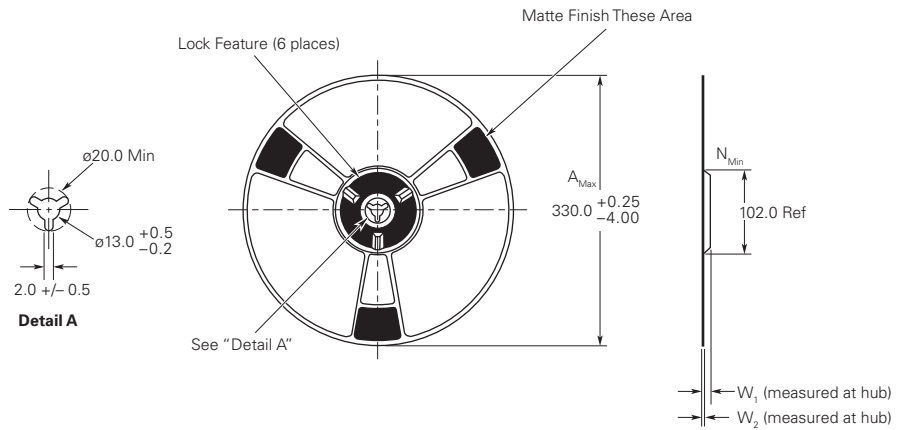


**Notes:**

1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.2$
2. Camber in compliance with EIA 481
3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole

**Figure PZ26** Reel Dimensions for PolyZen Devices (in Millimeters)

| Description      | Dimension (mm) |
|------------------|----------------|
| $A_{\text{Max}}$ | 330            |
| $N_{\text{Min}}$ | 102            |
| $W_1$            | 8.4            |
| $W_2$            | 11.1           |



## Part Numbering System for PolyZen Devices

**ZEN 056V 130A 24 LS & GS**

**Special Labeling**

LS = Module Height of 2.0mm  
GS = Module Height of 1.25mm

**$V_{\text{INT}}$  Max Rating (24 = 24V)**

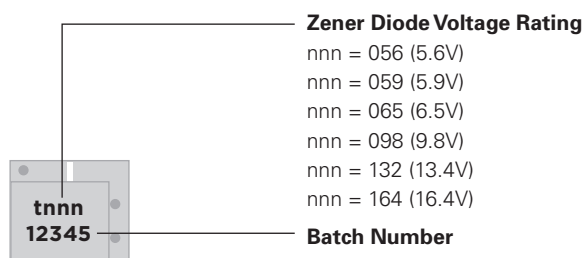
**PPTC Hold Current Group (130 = 1.3A)**

**Zener Voltage Group (056 = 5.6V)**

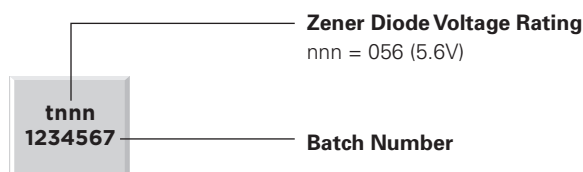
**PolyZen Series**

## Part Marking System for PolyZen Devices

### ZENxxxVyyyAzzLS Devices



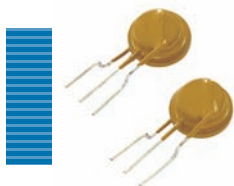
### ZENxxxVyyyAzzGS Devices



### Warning :

All information, including illustrations, is believed to be accurate and reliable. Users, however, should independently evaluate the suitability of and test each product selected for their application. Tyco Electronics Corporation and/or its Affiliates in the TE Connectivity Ltd. family of companies ("TE") makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. TE's only obligations are those in the TE Standard Terms and Conditions of Sale for this product, and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of the product. Specifications are subject to change without notice. In addition, TE reserves the right to make changes to materials or processing that do not affect compliance with any applicable specification without notification to Buyer.



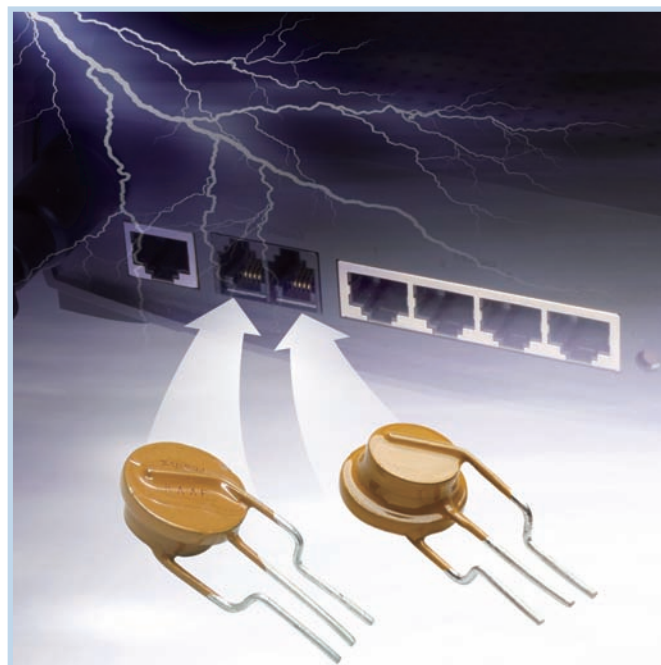


## 2Pro Devices

The 2Pro product is an integrated overcurrent/over-voltage protection device. The RoHS-compliant component incorporates PolySwitch PPTC (Polymeric Positive Temperature Coefficient) and metal oxide varistor technology in a single device to help reduce board space requirements and component count.

Damage to telephony communications equipment can be caused by various sources including lightning, electrostatic discharge (ESD), power contact and induction with AC lines. The 2Pro TM2P-10271 devices help provide current limiting during overcurrent events, and voltage clamping during overvoltage events. After a fault condition is removed and power is cycled, 2Pro devices will reset so that the equipment remains operational.

The 2Pro device helps address the need for resettable circuit protection devices for use in cost-sensitive PSTN (Public Switched Telephone Network) and VoIP (Voice over Internet Protocol) telephony equipment. The widespread use of VoIP gateways in homes and enterprise environments as the primary means of voice delivery requires the utmost safety and reliability in equipment. 2Pro circuit protection devices help manufacturers comply with global safety standards, including UL 60950, TIA-968-A, IEC 60950, and ITU-T K.20/K.21. The UL 497A listed protector also helps provide ESD protection.



### Benefits

- Single device helps reduce component count and footprint
- Helps reduce warranty returns
- Helps equipment comply with surge tests per: TIA-968-A, IEC 60950, ITU-T K.20/K.21
- Helps simplify UL 60950 testing
- Helps equipment comply with UL 60950

### Features

- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Single overcurrent, overvoltage and ESD protection device
- Resettable overcurrent protection
- UL 497A listed protector (#E258475)

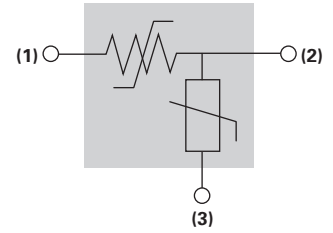
### Applications

- Cordless telephones
- VoIP gateways
- Fax machines
- Data modems
- Set-top boxes
- Security systems
- MDF modules
- Analog and ISDN linecards



**Table 2P1 Electrical Characteristics for 2Pro Devices**
**Overcurrent (terminals 1 – 2) — Performance ratings @ 20°C**

| Part Number                | $I_{HOLD}$<br>(A) | $I_{TRIP}$<br>(A) | Resistance <sup>†</sup><br>( $\Omega$ ) |           |              | Time to Trip (s) <sup>†</sup><br>@ 1A |      |
|----------------------------|-------------------|-------------------|-----------------------------------------|-----------|--------------|---------------------------------------|------|
|                            |                   |                   | $R_{MIN}$                               | $R_{MAX}$ | $R_{1MAX}^*$ | Typ.                                  | Max. |
| TM2P-10271                 | 0.15              | 0.30              | 6.5                                     | 14.0      | 16.0         | 0.9                                   | 3    |
| <b>NEW</b> LVM2P-015R10431 | 0.15              | 0.30              | 6.5                                     | 14.0      | 16.0         | 0.9                                   | 3    |

**Electrical Schematic**

**Overvoltage (terminals 2 – 3)**

| Part Number                | Varistor Voltage<br>V @ 1mA |           | DC Resistance<br>@ 100V<br>(M $\Omega$ ) | Maximum Clamping<br>Voltage @ 25A<br>(V) | Rated Wattage<br>(W) |
|----------------------------|-----------------------------|-----------|------------------------------------------|------------------------------------------|----------------------|
|                            | DC(V)                       | Tolerance |                                          |                                          |                      |
| TM2P-10271                 | 260                         | +14% -7%  | >10                                      | 455                                      | 0.25                 |
| <b>NEW</b> LVM2P-015R10431 | 430                         | +10% -10% | >10                                      | 710                                      | 0.25                 |

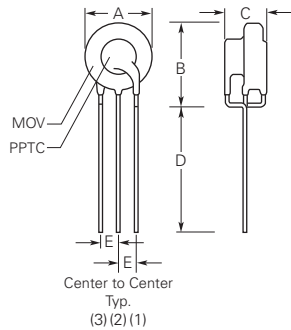
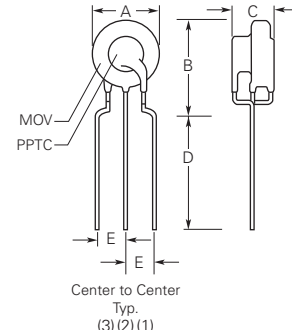
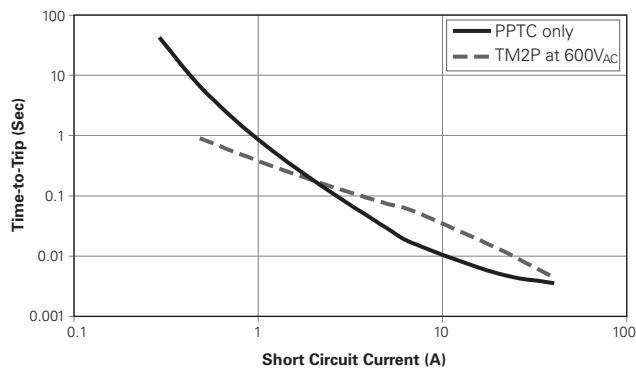
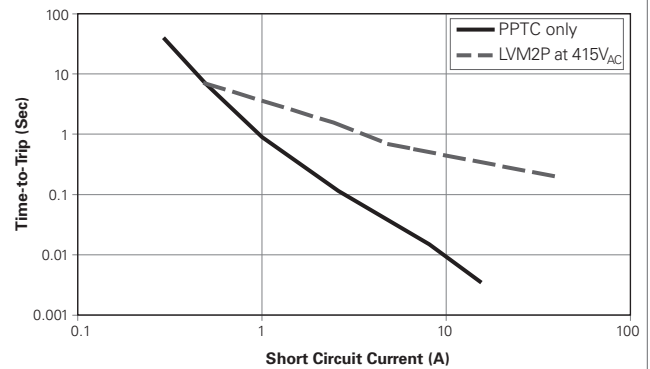
\* Maximum device resistance at 20°C measured 1 hour post trip.

† Corresponds to operation below varistor voltages.

**Table 2P2 Dimensions for 2Pro Devices in Millimeters (Inches\*)**

|                            | A    |        | B    |        | C    |        | D      |        | E      | Figure |
|----------------------------|------|--------|------|--------|------|--------|--------|--------|--------|--------|
|                            | Min. | Max.   | Min. | Max.   | Min. | Max.   | Min.   | Max.   | Nom.   |        |
| TM2P-10271                 | —    | 12.0   | —    | 15.0   | —    | 6.6    | 6.0    | —      | 2.5    | 2P1    |
|                            | —    | (0.47) | —    | (0.59) | —    | (0.26) | (0.24) | —      | (0.10) |        |
| <b>NEW</b> LVM2P-015R10431 | —    | 12.0   | —    | 17.0   | —    | 7.4    | 8.5    | 11.50  | 5.1    | 2P2    |
|                            | —    | (0.47) | —    | (0.67) | —    | (0.29) | (0.34) | (0.45) | (0.20) |        |

\* The dimensions in inches are rounded approximations.

**Figure 2P1-2P2 Dimension Figures for 2Pro Devices**
**Figure 2P1**

**Figure 2P2**

**Figure 2P3-2P4 Typical Time-to-Trip at 25°C for 2Pro Devices**
**Figure 2P3**

**Figure 2P4**


**Table 2P3 Physical Characteristics and Environmental Specifications for 2Pro Devices**
**Physical Characteristics**

|                           |                                                                                              |
|---------------------------|----------------------------------------------------------------------------------------------|
| Lead material             | Tin-plated copper, 0.33mm <sup>2</sup> (22AWG), ø0.64mm (0.025in.)                           |
| Flammability              | IEC 695-2-2 needle flame test for 20s                                                        |
| Soldering characteristics | ANSI approved IPC/EIA/JEDEC J-STD-002, Category 3                                            |
| Solder heat withstand     | per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, can withstand 10 seconds at 260°C ± 5°C |

**Environmental Specifications**

| Test               | Conditions                                       |
|--------------------|--------------------------------------------------|
| Passive aging      | 60°C, 1000 hours / 85°C, 1000 hours              |
| Humidity aging     | 85°C, 85% RH, 500 hours                          |
| Active aging       | 60°C, 90% RH, 60V <sub>DC</sub> bias, 1000 hours |
| Thermal shock      | 125°C, -55°C (10 times)                          |
| Solvent resistance | MIL-STD-202, Method 215K                         |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

6

**Table 2P4 Packaging and Marking Information for 2Pro Devices**

| Part Number                | Bag Quantity | Tape & Reel Quantity | Standard Package | Part Marking   | Agency Recognition       |
|----------------------------|--------------|----------------------|------------------|----------------|--------------------------|
| TM2P-10271                 | 500          | -                    | 10,000           | 1027 & Batch # | UL 497A/File No. E258475 |
| TM2P-10271-2               | -            | 1,000                | 5,000            | 1027 & Batch # | UL 497A/File No. E258475 |
| <b>NEW</b> LVM2P-015R10431 | 500          | -                    | 10,000           | C431 & Batch # |                          |

**Table 2P5 Ordering Information for 2Pro Devices**

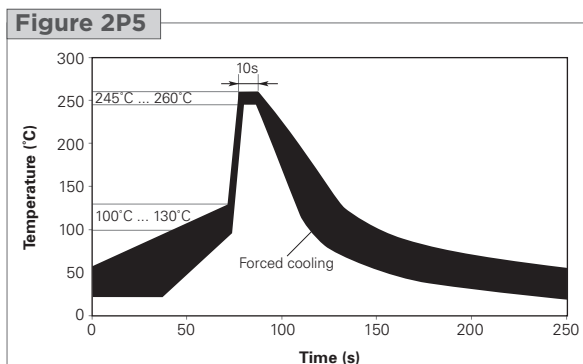
|             |                   |
|-------------|-------------------|
| Bulk        | 500 pieces/bag    |
|             | 10,000 pieces/box |
| Tape & Reel | 1,000 pieces/reel |
|             | 5,000 pieces/box  |

**Wave Soldering and Rework Recommendations for 2Pro Devices**
**Recommended Wave Soldering for Radial-leaded Devices**

- Soldering temperature profile  
Temperature characteristic at component terminal with dual wave soldering

**Rework**

- If a device is removed from the board, it should be discarded and replaced with a new device.

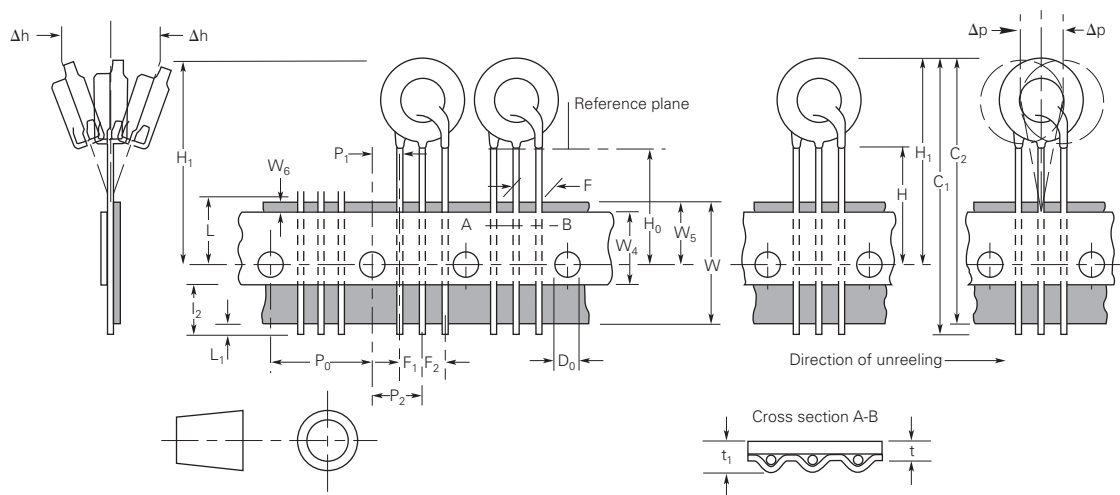


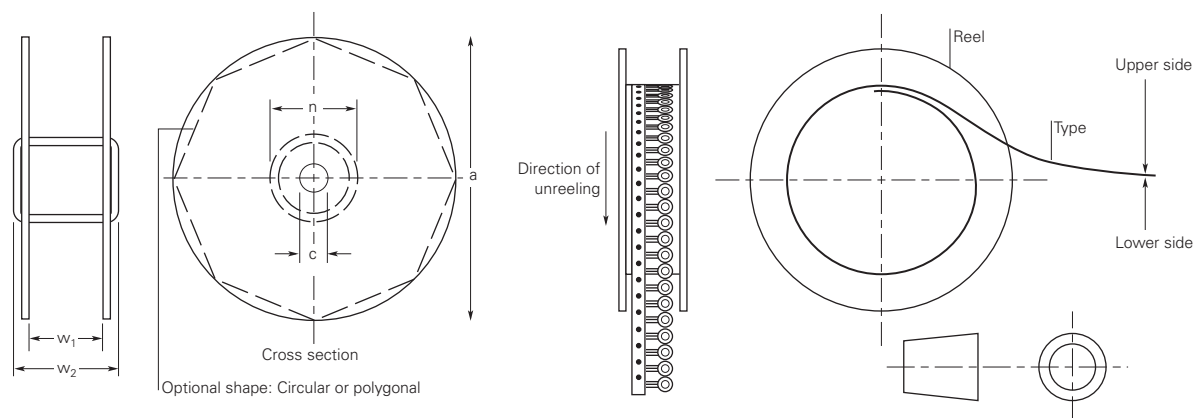
**Table 2P6 Tape and Reel Specifications for 2Pro Devices (in Millimeters)**

2Pro devices are available in tape and reel packaging per EIA 468-B standard. See Figures 2P6 and 2P7 for details.

| Description                           | EIA Mark                        | IEC Mark                        | Dimension (mm) | Tolerance   |
|---------------------------------------|---------------------------------|---------------------------------|----------------|-------------|
| Carrier tape width                    | W                               | W                               | 18             | -0.5/ +1.0  |
| Hold down tape width                  | W <sub>4</sub>                  | W <sub>0</sub>                  | 5              | Minimum     |
| Top distance between tape edges       | W <sub>6</sub>                  | W <sub>2</sub>                  | 3              | Maximum     |
| Sprocket hole position                | W <sub>5</sub>                  | W <sub>1</sub>                  | 9              | -0.5/ +0.75 |
| Sprocket hole diameter                | D <sub>0</sub>                  | D <sub>0</sub>                  | 4              | ±0.2        |
| Abcissa to plane (kinked lead)*       | H <sub>0</sub>                  | H <sub>0</sub>                  | 16             | -0.5/0.6    |
| Abcissa to top                        | H <sub>1</sub>                  | H <sub>1</sub>                  | 32.2           | Maximum     |
| Overall width with lead protrusion    | -                               | C <sub>1</sub>                  | 43.2           | Maximum     |
| Overall width without lead protrusion | -                               | C <sub>2</sub>                  | 42.5           | Maximum     |
| Lead protrusion                       | L <sub>1</sub>                  | I <sub>1</sub>                  | 1.0            | Maximum     |
| Protrusion of cut-out                 | L                               | L                               | 11             | Maximum     |
| Protrusion beyond hold down tape      | I <sub>2</sub>                  | I <sub>2</sub>                  | Not specified  | -           |
| Sprocket hole pitch                   | P <sub>0</sub>                  | P <sub>0</sub>                  | 12.7           | ±0.3        |
| Pitch tolerance                       | -                               | -                               | 20 consecutive | ±1          |
| Tape thickness                        | t                               | t                               | 0.9            | Maximum     |
| Tape thickness with splice*           | t <sub>1</sub>                  | -                               | 2.0            | Maximum     |
| Splice sprocket hole alignment        | -                               | -                               | 0              | ±0.3        |
| Body lateral deviation                | Δh                              | Δh                              | 0              | ±0.1        |
| Body tape plane deviation             | Δp                              | Δp                              | 0              | ±1.3        |
| Ordinate to component center lead     | P <sub>2</sub>                  | P <sub>2</sub>                  | 6.35           | ±0.7        |
| Lead spacing*                         | F <sub>1</sub> , F <sub>2</sub> | F <sub>1</sub> , F <sub>2</sub> | 2.54           | -0.1/+0.4   |
| Reel width                            | w <sub>2</sub>                  | w                               | 56             | Maximum     |
| Reel diameter                         | a                               | d                               | 370            | Maximum     |
| Space between flanges                 | w <sub>1</sub>                  | -                               | 51.2           | Maximum     |
| Arbor hole diameter                   | c                               | f                               | 26             | ±12.0       |
| Core diameter                         | n                               | h                               | 80             | Maximum     |
| Box                                   | -                               | -                               | 56/372/372     | Maximum     |
| Consecutive missing pieces*           | -                               | -                               | 3 maximum      | -           |
| Empty places per reel*                | -                               | -                               | Not specified  | -           |

**Note:** \*Differs from EIA specification.

**Figure 2P6 EIA Referenced Taped Component Dimensions for 2Pro Devices**


**Figure 2P7 EIA Referenced Reel Dimensions for 2Pro Devices**

**Part Numbering System for 2Pro Devices**
**TM 2P - 10 271 -2**
**Packaging**

Blank : Bulk  
-2 : Tape & reel

**Varistor voltage indicator**

The first two digits indicate voltage.  
The third digit signifies the power of ten.

For example : 220 :  $22 \times 10^0 = 22V$   
221 :  $22 \times 10^1 = 220V$   
112 :  $11 \times 10^2 = 1100V$

**Typical PPTC resistance (ohms)**
**2Pro series**
**Telecom module**
**LVM 2P - 015 R 10 431**
**MOV breakover voltage at 1mA expressed as**  
431:  $43 \times 10^1$ 
**MOV diameter in mm**
**Radial leaded**
**PTC hold current**
**2Pro series**
**Line voltage module**

**Warning :**

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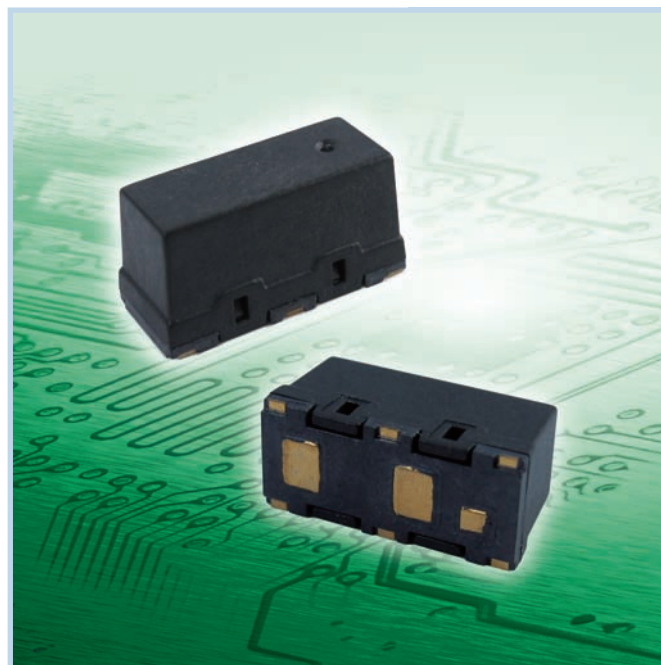


## Reflowable Thermal Protection (RTP) Devices



TE Reflowable Thermal Protection (RTP) device is a low resistance, robust surface mountable thermal protector. It has a set open temperature and can be installed using reliable, lead-free, Surface Mount Device (SMD) assembly and reflow processes. The first RTP device has an open temperature of 200°C. In the future TE is working on developing and releasing devices with several other open temperatures.

The family of RTP devices can withstand the demanding environmental, life, and reliability requirements of automotive and industrial applications, including shock, vibration, temperature cycling, and humidity exposures. In the field, the RTP device opens if its internal junction exceeds the device's specified open temperature. Temperature increases can have multiple sources, one of which is component failure (i.e. when using power components such as a powerFET, capacitor, resistor, triac, etc.). The RTP device open temperature is selected so that the device does not open within normal component operating windows, but it does open in a thermal runaway event and before the melt temperature of typical lead free solders.



To simplify installation, improve reliability, and optimize thermal coupling with the PCB, the RTP device is surface mountable. No special SMD installation is required. Instead, after installation, the RTP device utilizes a one time electronic arming process to become thermally sensitive. Before the arming procedure, the device can go through installation temperatures up to 260°C without going open. After arming, the device will open when the critical junction exceeds the open temperature. Arming can occur during test, or in the field.

### Benefits

- Helps prevent failed components from smoking, and or de-soldering in case of a thermal event
- Allows use of standard surface-mount production methods with no special assembly costs
- Low power dissipation and voltage drop
- Supports DC electronic circuits
- Suitable for rugged environment applications (automotive and industrial)
- Green design

### Features

- Opens at temperature below critical thermal threshold
- Compatible with up to 3 Pb-free solder reflow processes with peak temperatures up to 260°C
- Low series resistance
- DC interrupt voltage capable
- Robust design for harsh environment tested per stringent qualification specification
- RoHS compliant, lead and halogen free

### Applications

- Helps provide protection against thermal runaway for powerFETs and other components if failure occurs in applications such as automotive HVAC, ABS, power steering, DC/DC converters, PTC heaters, etc. or IT servers, telecom power, converters, etc.
- Other DC thermal protection





## Silicon ESD Protection Devices



Silicon ESD (SESD) devices help protect electronic circuits against damage from electrostatic discharge (ESD) events. The 0201-sized SESD device's miniature footprint – measuring 0.6mm x 0.3mm x 0.3mm – is approximately 70 percent smaller than prior-generation devices, offering designers flexibility in space-constrained applications.

The SESD0201C-006-058 device is a bi-directional and ultra-low capacitance 0.6 picofarad (pF) device that is suitable for helping to protect very-high-speed data lines, such as USB and HDMI, or low-voltage antenna ports. The device's ultra-low capacitance, low insertion loss (<0.5dB up to 3GHz), and high linearity of capacitance versus frequency helps minimize signal degradation.

The SESD0201C-120-058 (12pF) device and SESD0201P1BN-0400-090 (4pF) device are higher-capacitance bi-directional devices that can be used for low-speed generic interfaces such as keypads, power buttons, speakers, and microphone ports in portable electronics. Both SESD0201C-006-058 and SESD0201C-120-058 devices offer 8kV contact and 15kV air discharge protection per the IEC61000-4-2, level 4 standard, while the SESD0102P1BN-0400-090 device offers 10kV contact and 16kV air discharge protection per the IEC61000-4-2, level 4 standard.

The SESD0402S-005-054 device is an ultra-low-capacitance SOD-923 (0402-size package) uni-directional device with 0.5pF typical capacitance. This device offers a 10kV contact discharge rating per IEC61000-4-2, level 4 and can be used with digital applications such as USB and HDMI.

Also included in the product line is the SESD0402P1BN-0450-090 device. This device is a higher-capacitance (4.5pF), SMD bi-directional device that offers 10kV contact and 16kV air discharge protection per the IEC61000-4-2, level 4 standard.



### Benefits

- Small size SESD protection diodes for high speed signals
- ESD protection in space-constrained portable electronics and mobile handsets
- Helps protect electronic circuits against damage from ESD
- Assist equipment to pass IEC61000-4-2, level 4 testing

### Features

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Low-leakage current – 1.0μA (max)
- Capable of withstanding numerous ESD strikes
- Low capacitance and insertion loss
- SOD-923 case epoxy material meets UL 94 V-0
- SESD0402S devices meet MSL-1 requirements

### Applications

- Mobile phones and portable electronics
- High-speed data lines (low capacitance 0201 and 0402)
- Low-voltage antenna ports (bi-directional 0201)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort
- Applications requiring high ESD performance in a small package

**Table SE1 Maximum Ratings for SESD Devices**

| Part Number                      | IEC61000-4-2, level 4 (ESD Withstand) |          | Temperature    |              | Total Power Dissipation on FR-4 board† (mW) |
|----------------------------------|---------------------------------------|----------|----------------|--------------|---------------------------------------------|
|                                  | Contact (kV)                          | Air (kV) | Operating (°C) | Storage (°C) |                                             |
| SESD0201C-006-058                | ±8                                    | ±15      | -40 to +125    | -40 to +125  | 250                                         |
| SESD0201C-120-058                | ±8                                    | ±15      | -40 to +125    | -40 to +125  | 250                                         |
| SESD0402S-005-054                | ±10                                   | ±15      | -55 to +125    | -55 to +150  | 150                                         |
| <b>NEW</b> SESD0201P1BN-0400-090 | ±10*                                  | ±16      | -40 to +125    | -40 to +125  | –                                           |
| <b>NEW</b> SESD0402P1BN-0450-090 | ±10*                                  | ±16      | -40 to +125    | -40 to +125  | –                                           |

\* 10kV @ 50 ± pulses under IEC61000-4-2; 8kV @ 1,000 pulses under IEC61000-4-2

† FR-4 board = 30mm x 30mm x 2mm

**Table SE2 Electrical Characteristics @T=25°C for SESD Devices**

| Part Number                      | Input Capacitance* |              | Leakage Current (max)<br>I <sub>L</sub> @ V <sub>RWM</sub> = 5.0V (μA) | Breakdown Voltage (min)<br>V <sub>br</sub> @ I <sub>T</sub> †† = 1mA (V) | Working Reverse Voltage<br>V <sub>RWM</sub> @ peak (V) |
|----------------------------------|--------------------|--------------|------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|
|                                  | Typical (pF)       | Maximum (pF) |                                                                        |                                                                          |                                                        |
| SESD0201C-006-058                | 0.6†               | 0.9          | 1.0                                                                    | ±5.8                                                                     | 5.0                                                    |
| SESD0201C-120-058                | 12.0               | 13.5         | 1.0                                                                    | ±5.8                                                                     | 5.0                                                    |
| SESD0402S-005-054                | 0.5‡               | 0.9          | 1.0                                                                    | +5.4 / -1.0                                                              | 5.0                                                    |
| <b>NEW</b> SESD0201P1BN-0400-090 | 4.0                | 5.0          | 1.0**                                                                  | 9.0                                                                      | 6.0                                                    |
| <b>NEW</b> SESD0402P1BN-0450-090 | 4.5                | 5.5          | 1.0**                                                                  | 9.0                                                                      | 6.0                                                    |

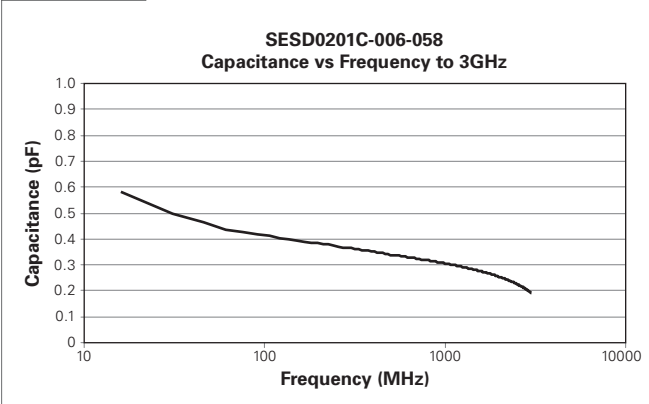
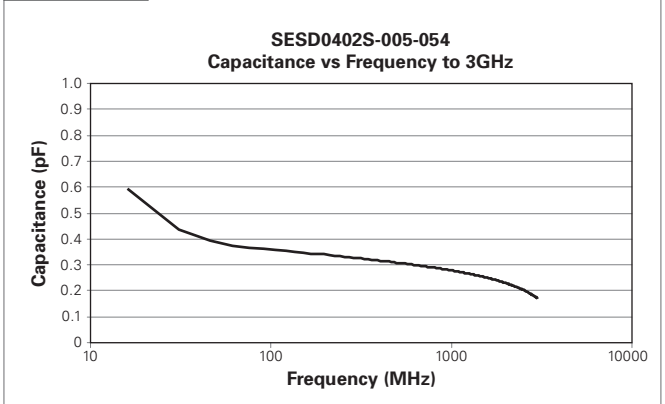
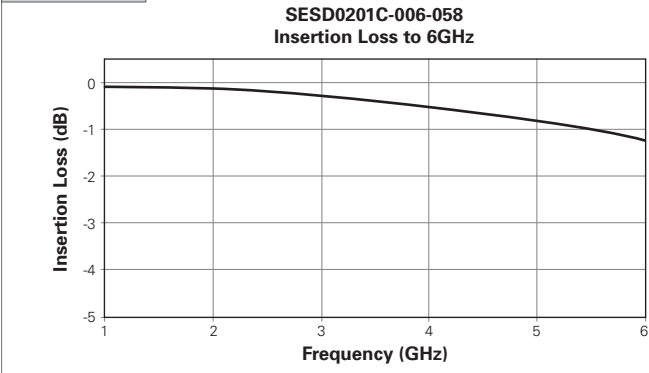
\* @ V<sub>r</sub>=0V, f=1MHz

† 0.19pF@f=3GHz

‡ 0.17pF@f=3GHz

\*\* I<sub>L</sub> @ V<sub>RWM</sub> = 6.0V (μA)

†† V<sub>br</sub> is measured at test current I<sub>T</sub>

**Figure SE1-SE2 Capacitance vs Frequency for SESD Devices**
**Figure SE1**

**Figure SE2**

**Figure SE3-SE4 Insertion Loss Diagram for SESD Devices**
**Figure SE3**


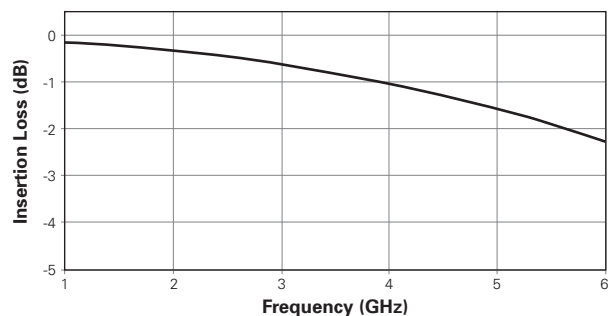
| Applications        | Insertion Loss | @Frequency (GHz) |
|---------------------|----------------|------------------|
| HDMI 1.3 (1080p)    | -0.205         | 2.25             |
| HDMI 1.3 (max spec) | -0.354         | 3.40             |
| DisplayPort         | -0.235         | 2.70             |
| USB 3.0             | -0.791         | 5.00             |

# Figure SE3-SE4 Insertion Loss Diagram for SESD Devices

Cont'd

Figure SE4

SESD0402S-005-054  
Insertion Loss to 6GHz



| Applications        | Insertion Loss | @Frequency (GHz) |
|---------------------|----------------|------------------|
| HDMI 1.3 (1080p)    | -0.300         | 2.25             |
| HDMI 1.3 (max spec) | -0.735         | 3.40             |
| DisplayPort         | -0.335         | 2.70             |
| USB 3.0             | -1.450         | 5.00             |

## Table SE3 Dimensions for SESD Devices in Millimeters (Mils)\*

| Part Number          | A                             | B                             | C                             | D                            | E                            | F                             | G                            | Figure |
|----------------------|-------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|--------|
| SESD0201C            | 0.60 ± 0.03<br>(23.62 ± 1.20) | 0.30 ± 0.03<br>(11.81 ± 1.20) | 0.27 ± 0.03<br>(10.63 ± 1.20) | 0.15 ± 0.03<br>(5.91 ± 1.20) | 0.25 ± 0.03<br>(9.84 ± 1.20) | 0.25 ± 0.03<br>(9.84 ± 1.20)  | 0.005 (max)<br>(0.197) (max) | SE5    |
| SESD0402S            | 1.00 ± 0.05<br>(39.37 ± 0.40) | 0.60 ± 0.05<br>(23.62 ± 0.40) | 0.37 ± 0.03<br>(14.57 ± 1.20) | 0.20 ± 0.05<br>(7.87 ± 2.00) | 0.10 ± 0.05<br>(3.94 ± 2.00) | 0.80 ± 0.05<br>(31.50 ± 2.00) | 0.12 ± 0.05<br>(4.72 ± 2.00) | SE6    |
| <b>NEW</b> SESD0201P | 0.60 ± 0.05<br>(23.62 ± 2.00) | 0.30 ± 0.05<br>(11.81 ± 2.00) | 0.30 ± 0.05<br>(11.81 ± 2.00) | 0.21 ± 0.07<br>(8.27 ± 2.80) | –                            | –                             | –                            | SE7    |
| <b>NEW</b> SESD0402P | 1.10 ± 0.10<br>(43.31 ± 0.40) | 0.50 ± 0.10<br>(19.69 ± 4.00) | 0.50 ± 0.10<br>(19.69 ± 4.00) | 0.25 ± 0.15<br>(9.84 ± 6.00) | –                            | –                             | –                            | SE7    |

\* Round off approximation

## Figure SE5-SE7 Dimension Figures for SESD Devices

Figure SE5

SESD0201C CSP Package

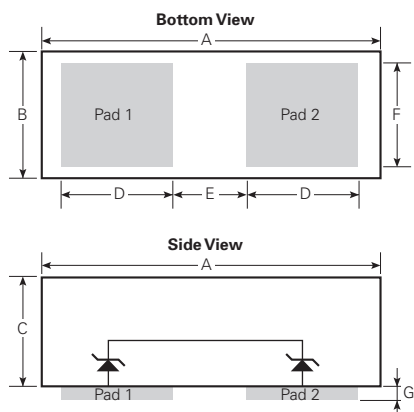


Figure SE6

SESD0402S SOD-923 Package

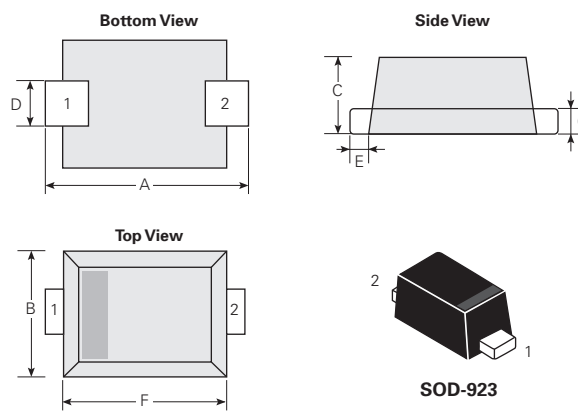
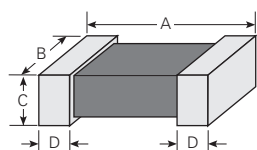


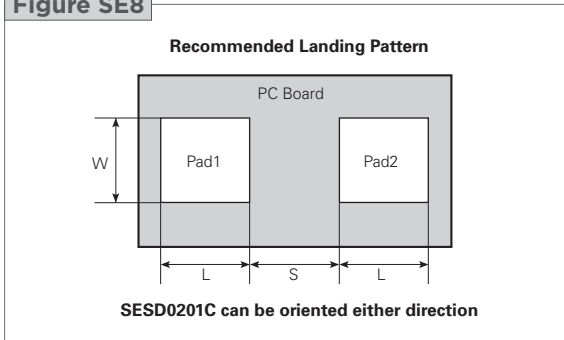
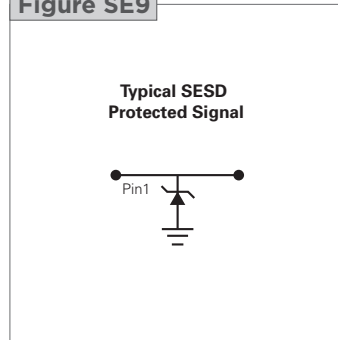
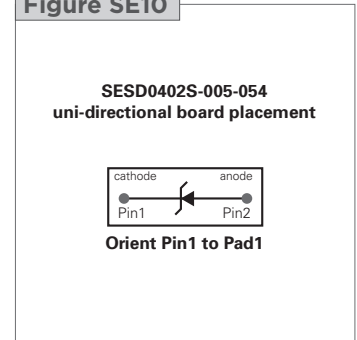
Figure SE7



**Table SE4 PCB Pad Layout for SESD Devices in Millimeters (Mils)\***

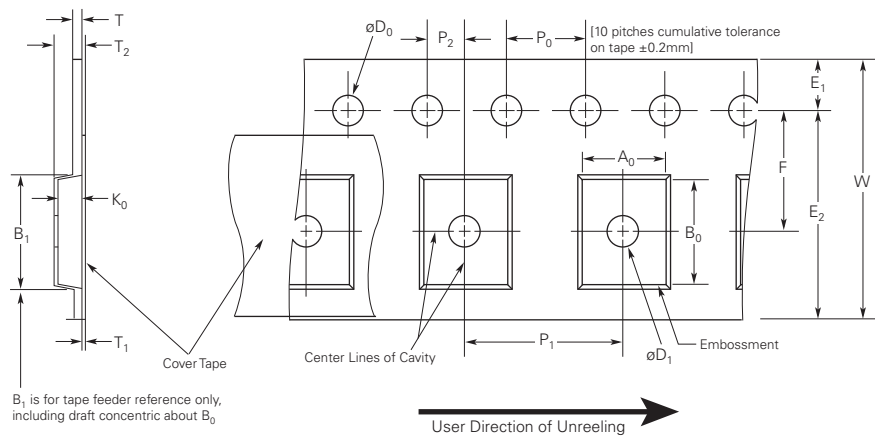
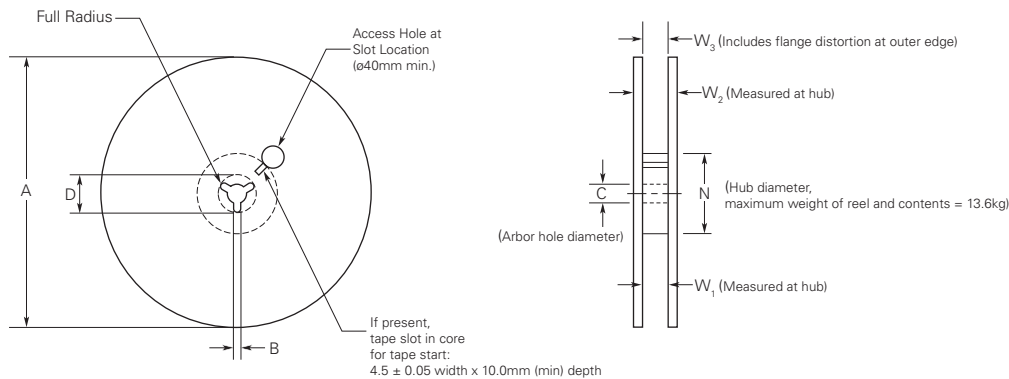
| Part Number          | L                             | S                             | W                             | Figure |
|----------------------|-------------------------------|-------------------------------|-------------------------------|--------|
| SESD0201C            | 0.28 ± 0.01<br>(11.0 ± 0.40)  | 0.19 ± 0.01<br>(7.50 ± 0.40)  | 0.30 ± 0.01<br>(11.80 ± 0.40) | SE8    |
| SESD0402S            | 0.30 ± 0.01<br>(11.80 ± 0.40) | 0.60 ± 0.01<br>(23.60 ± 0.40) | 0.40 ± 0.01<br>(15.70 ± 0.40) | SE8    |
| <b>NEW</b> SESD0201P | 0.28 ± 0.01<br>(11.00 ± 0.40) | 0.19 ± 0.01<br>(7.50 ± 0.40)  | 0.30 ± 0.01<br>(11.80 ± 0.40) | SE8    |
| <b>NEW</b> SESD0402P | 0.61 ± 0.05<br>(24.00 ± 2.00) | 0.52 ± 0.05<br>(21.00 ± 2.00) | 0.50 ± 0.05<br>(20.00 ± 2.00) | SE8    |

\* Round off approximation

**Figure SE8**

**Figure SE9**

**Figure SE10**

**Table SE5 Tape and Reel Specifications for SESD Devices**

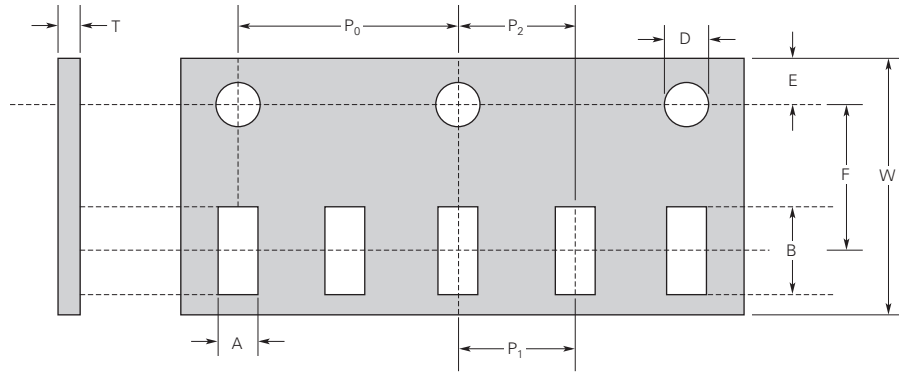
| Tape Dimension<br>EIA Mark | SESD0201C-006-058<br>Dimension (mm) | SESD0201C-120-058<br>Dimension (mm) | SESD0402S-005-054<br>Dimension (mm) |
|----------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| A <sub>0</sub>             | 0.37 ± 0.03                         | 0.37 ± 0.03                         | 0.66 ± 0.05                         |
| B <sub>0</sub>             | 0.67 ± 0.03                         | 0.67 ± 0.03                         | 1.06 ± 0.05                         |
| D <sub>0</sub>             | 1.60 (max)                          | 1.60 (max)                          | 1.60 (max)                          |
| D <sub>1</sub>             | 1.00 (min)                          | 1.00 (min)                          | 1.00 (min)                          |
| E <sub>1</sub>             | 1.75 ± 0.10                         | 1.75 ± 0.10                         | 1.75 ± 0.10                         |
| E <sub>2</sub>             | 5.85 (min)                          | 5.85 (min)                          | 5.85 (min)                          |
| F                          | 3.50 ± 0.05                         | 3.50 ± 0.05                         | 3.50 ± 0.05                         |
| P <sub>0</sub>             | 4.00 ± 0.10                         | 4.00 ± 0.10                         | 4.00 ± 0.10                         |
| P <sub>1</sub>             | 2.00 ± 0.05                         | 2.00 ± 0.05                         | 2.00 ± 0.05                         |
| P <sub>2</sub>             | 2.00 ± 0.10                         | 2.00 ± 0.10                         | 2.00 ± 0.10                         |
| W                          | 8.00 ± 0.30                         | 8.00 ± 0.30                         | 8.00 ± 0.30                         |
| <b>Tape Thickness</b>      |                                     |                                     |                                     |
| EIA Mark                   | Dimension (mm)                      | Dimension (mm)                      | Dimension (mm)                      |
| B <sub>1</sub>             | 0.67 ± 0.03                         | 0.67 ± 0.03                         | 1.06 ± 0.05                         |
| K <sub>0</sub>             | 0.35 ± 0.03                         | 0.35 ± 0.03                         | 0.48 ± 0.05                         |
| T                          | 0.60 (max)                          | 0.60 (max)                          | 0.60 (max)                          |
| T <sub>1</sub>             | 0.10 (min)                          | 0.10 (min)                          | 0.10 (min)                          |
| T <sub>2</sub>             | 1.05 ± 0.03                         | 1.05 ± 0.03                         | 1.05 ± 0.03                         |
| <b>Reel Dimension</b>      |                                     |                                     |                                     |
| EIA Mark                   | Dimension (mm)                      | Dimension (mm)                      | Dimension (mm)                      |
| A                          | 178 (max)                           | 178 (max)                           | 178 (max)                           |
| B                          | 1.60 (min)                          | 1.60 (min)                          | 1.60 (min)                          |
| C                          | 13.00 ± 0.20                        | 13.00 ± 0.20                        | 13.00 ± 0.20                        |
| D                          | 20.20 (min)                         | 20.20 (min)                         | 20.20 (min)                         |
| N                          | 50.00 (min)                         | 50.00 (min)                         | 50.00 (min)                         |
| W <sub>1</sub>             | 9.15 ± 0.75                         | 9.15 ± 0.75                         | 9.15 ± 0.75                         |
| W <sub>2</sub>             | 14.40 (max)                         | 14.40 (max)                         | 14.40 (max)                         |
| W <sub>3</sub>             | 10.90 (max)                         | 10.90 (max)                         | 10.90 (max)                         |



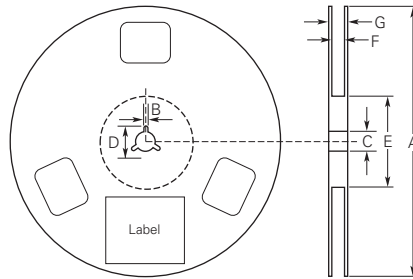
**Figure SE11 EIA Referenced Taped Component Dimensions for SESD Devices**

**Figure SE12 EIA Referenced Reel Dimensions for SESD Devices**

**Table SE6 Tape and Reel Specifications for ChipSESD Devices**

| Tape Dimension<br>EIA Mark | SESD0201P1BN-0400-090 | SESD0402P1BN-0450-090 |
|----------------------------|-----------------------|-----------------------|
|                            | Dimension (mm)        | Dimension (mm)        |
| A                          | 0.37 ± 0.03           | 0.58 ± 0.03           |
| B                          | 0.69 ± 0.03           | 1.20 ± 0.03           |
| D                          | 1.55 ± 0.05           | 1.55 ± 0.05           |
| E                          | 1.75 ± 0.05           | 1.75 ± 0.05           |
| F                          | 3.50 ± 0.05           | 3.50 ± 0.05           |
| W                          | 8.00 ± 0.10           | 8.00 ± 0.10           |
| P <sub>0</sub>             | 4.00 ± 0.10           | 4.00 ± 0.10           |
| P <sub>1</sub>             | 2.00 ± 0.05           | 2.00 ± 0.05           |
| P <sub>2</sub>             | 2.00 ± 0.05           | 2.00 ± 0.05           |
| T                          | 0.37 ± 0.03           | 0.57 ± 0.03           |
|                            | 0.40 ± 0.03           | 0.60 ± 0.03           |
| Reel Dimension<br>EIA Mark | Dimension (mm)        | Dimension (mm)        |
|                            | Dimension (mm)        | Dimension (mm)        |
| A                          | 178.0 ± 2.0           | 178.0 ± 2.0           |
| B                          | 2.0 ± 0.5             | 2.0 ± 0.5             |
| C                          | 13.0 ± 0.5            | 13.0 ± 0.5            |
| D                          | 21.0 ± 0.8            | 21.0 ± 0.8            |
| E                          | 62.0 ± 1.5            | 62.0 ± 1.5            |
| F                          | 9.0 ± 0.5             | 9.0 ± 0.5             |
| G                          | 13.0 ± 1.0            | 13.0 ± 1.0            |

**Figure SE13** EIA Referenced Taped Component Dimensions for ChipSESD Devices



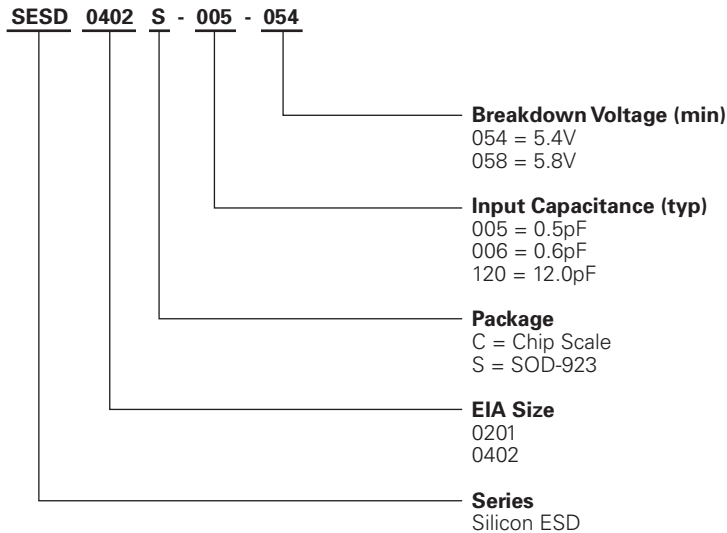
**Figure SE14** EIA Referenced Reel Dimensions for ChipSESD Devices



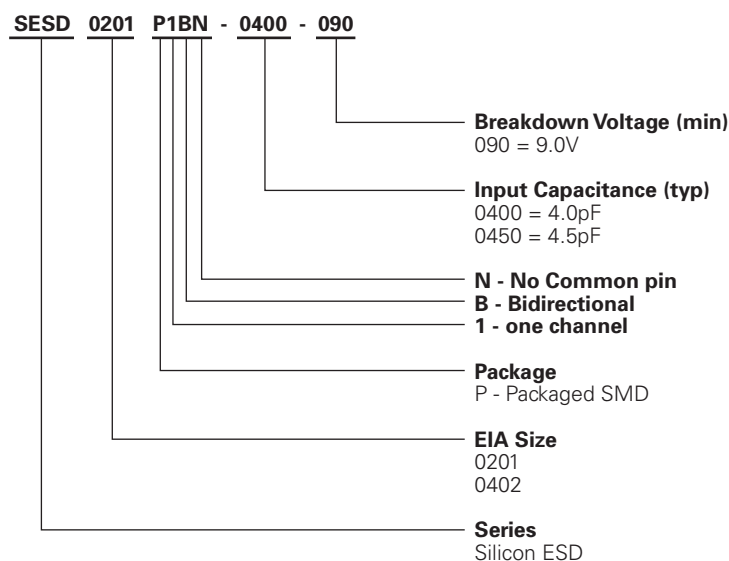
## Definitions of Terms for SESD Devices

|           |                                     |
|-----------|-------------------------------------|
| $I_L$     | Reverse Leakage Current @ $V_{RWM}$ |
| $V_{RWM}$ | Working Peak Reverse Voltage        |
| $V_{br}$  | Breakdown Voltage @ $I_T$           |
| $I_T$     | Test Current                        |

## Part Numbering System for SESD Devices



## Part Numbering System for ChipESD Devices



### Warning :

All information, including illustrations, is believed to be accurate and reliable. Users, however, should independently evaluate the suitability of and test each product selected for their application. Tyco Electronics Corporation and/or its Affiliates in the TE Connectivity Ltd. family of companies ("TE") makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. TE's only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products. Specifications are subject to change without notice. In addition, TE Connectivity reserves the right to make changes to materials or processing that do not affect compliance with any applicable specification without notification to Buyer. Without expressed or written consent by an officer of TE, TE does not authorize the use of any of its products as components in nuclear facility applications, aerospace, or in critical life support devices or systems.



## ESD Protection Devices

TE's ESD line of devices help protect I/O ports on HDMI 1.3, portable video players, LCD & plasma TVs, USB 2.0, digital visual interface (DVI), and antenna switches. ESD devices shunt electrostatic discharge away from sensitive circuitry in HDTV equipment, printers, laptops, cellular phones, and other portable devices.

ESD devices offer many advantages over traditional protection devices, such as multi layer varistors (MLVs), which may degrade or distort the signal in high data rate circuits. Compared to transient voltage suppression (TVS) diodes and miniature gas discharge tubes (GDTs), ESD devices provide a more compact form factor and an economical solution for the shrinking profiles of today's compact information appliances.

Available in a range of form factors, our ESD protection devices provide low capacitance, and meet transmission line pulse (TLP) testing, as well as IEC61000-4-2 testing.



### Benefits

- ESD protection for high frequency applications (HDMI 1.3)
- Smaller form factor for board space savings
- Helps protect sensitive electronic circuits against damage caused by electrostatic discharge (ESD) events
- Assists equipment to pass IEC 61000-4-2, level 4 testing

### Features

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- 0.25 pF (typical) capacitance
- Low-leakage current
- Low-clamping voltage
- Fast response time (< 1ns)
- Capable of withstanding numerous ESD strikes
- Compatible with standard reflow installation procedures
- Thick film technology
- Bi-directional protection

### Applications

- HDMI 1.3 interfaces
- LCD & plasma TV
- Cellular phones
- Antennas
- Portable video players
- Portable devices (PDA, DSC, BlueTooth)
- Printer ports
- Satellite radios
- USB 2.0 and IEEE 1394 interfaces
- DVI
- GPS systems

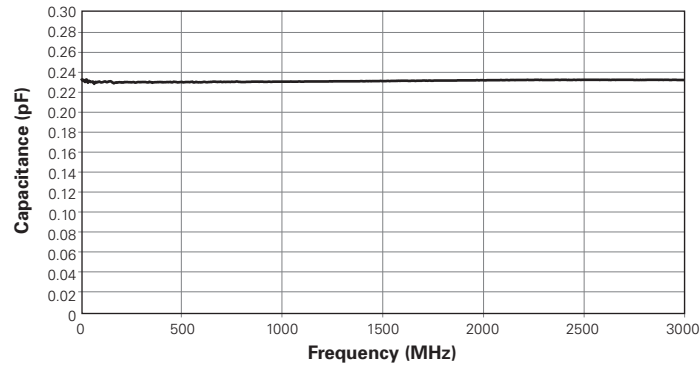
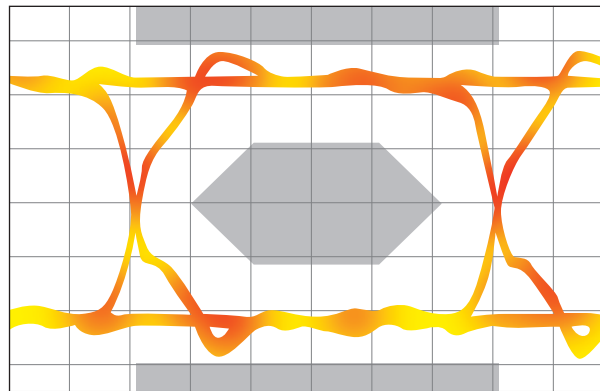
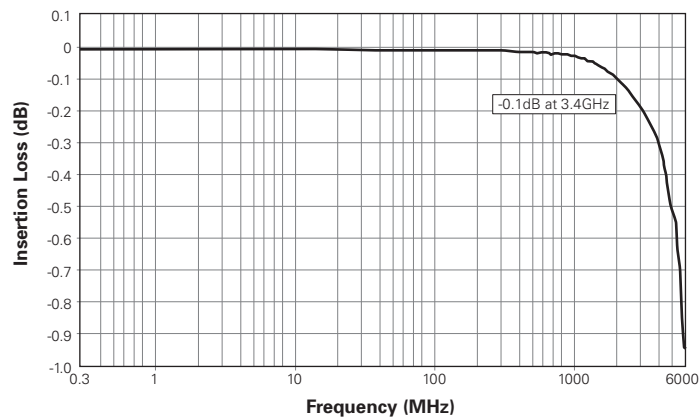
**Table E1 Electrical Characteristics for ESD Devices**

|               | Continuous Max<br>Operating Voltage | Typical<br>Trigger Voltage* | Typical<br>Clamping Voltage† | Typical Capacitance<br>@1 MHz, 1V <sub>RMS</sub> | Typical Leakage<br>Current | Max Leakage<br>Current @ Max V <sub>DC</sub> |
|---------------|-------------------------------------|-----------------------------|------------------------------|--------------------------------------------------|----------------------------|----------------------------------------------|
| Symbol        | V <sub>DC</sub>                     | V <sub>T(TLP)</sub>         | V <sub>C(TLP)</sub>          | C <sub>P</sub>                                   | I <sub>L(TYP)</sub>        | I <sub>L(MAX)</sub>                          |
| Unit          | V                                   | V                           | V                            | pF                                               | μA                         | μA                                           |
| PESD0402-140  | 14                                  | 250                         | 40                           | 0.25                                             | < 0.01                     | 10.0                                         |
| PESD0603-240  | 24                                  | 215                         | 45                           | 0.25                                             | < 0.01                     | 10.0                                         |
| PESD1206Q-240 | 24                                  | 250                         | 45                           | 0.25                                             | < 0.01                     | 10.0                                         |

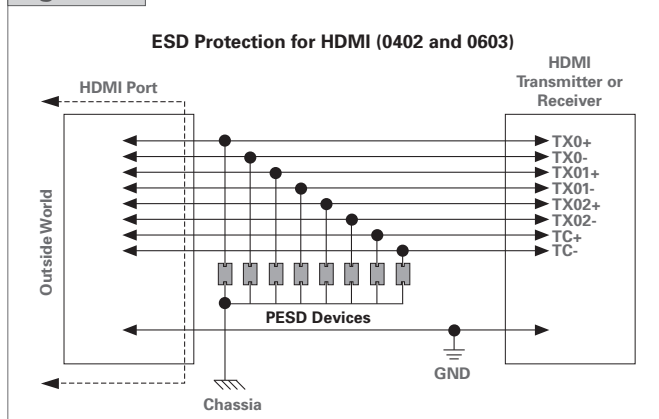
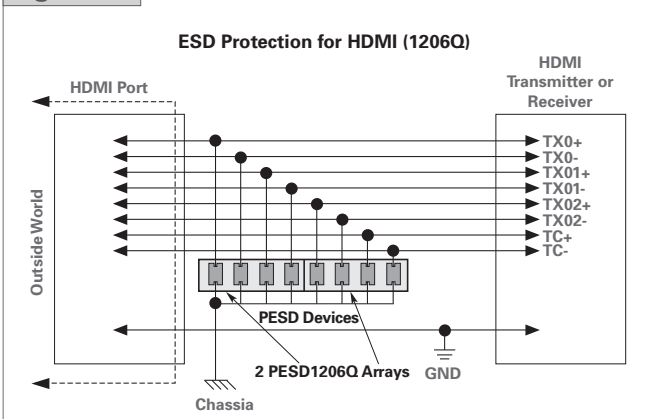
Notes : \* TLP test method at 1kV.

† Measured 30ns after pulse initiation.

Typical capacitance value is at 0V and Max Operating Voltage bias.

**Figure E1 Capacitance vs. Frequency for ESD Devices**

**Figure E2 Eye Diagram Performance at 3.4 GHz for ESD Devices**

**Figure E3 Insertion Loss Diagram for ESD Devices**


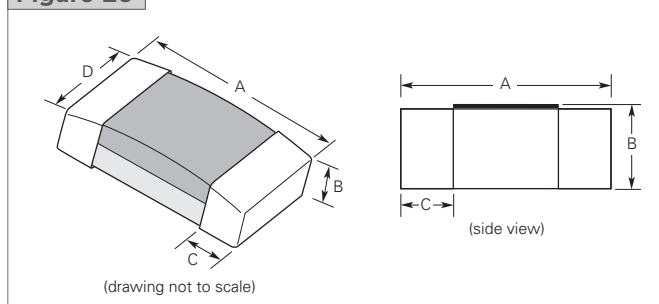
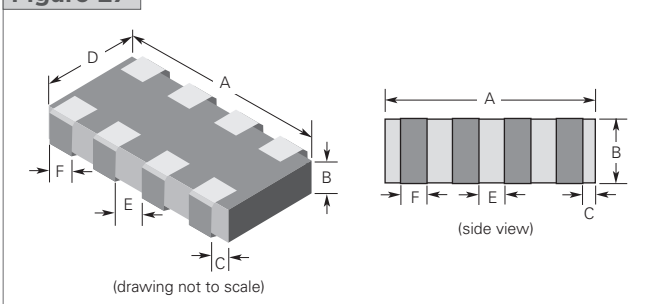


**Figure E4-E5 ESD Protection for HDMI**
**Figure E4**

**Figure E5**

**Table E2 Dimensions for ESD Devices in Millimeters (Inches)\***

| Part Number   | A               |                 | B               |                 | C               |                 | D               |                 | E               |                 | F               |                 | Figure |
|---------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
|               | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            |        |
| PESD0402-140  | 0.90<br>(0.035) | 1.10<br>(0.043) | 0.23<br>(0.009) | 0.43<br>(0.017) | 0.10<br>(0.004) | 0.30<br>(0.012) | 0.40<br>(0.016) | 0.60<br>(0.024) | —               | —               | —               | —               | E6     |
| PESD0603-240  | 1.50<br>(0.059) | 1.70<br>(0.067) | 0.45<br>(0.018) | 0.55<br>(0.022) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.70<br>(0.028) | 1.00<br>(0.039) | —               | —               | —               | —               | E6     |
| PESD1206Q-240 | 3.10<br>(0.122) | 3.30<br>(0.130) | 0.40<br>(0.016) | 0.60<br>(0.024) | 0.10<br>(0.004) | 0.30<br>(0.012) | 1.50<br>(0.059) | 1.70<br>(0.067) | 0.20<br>(0.008) | 0.60<br>(0.024) | 0.20<br>(0.008) | 0.60<br>(0.024) | E7     |

\*The dimensions in inches are rounded approximations.

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**Figure E6-E7 Dimension Figures for ESD Devices**
**Figure E6**

**Figure E7**

**Table E3 Environmental Specifications for ESD Devices**

|                    | Test Conditions                                      | Pass / Fail Criteria |
|--------------------|------------------------------------------------------|----------------------|
| Bias humidity test | 85°C, 85% RH, $V_{DC(max)}$ , 1000 hrs               | $I_L \leq 10 \mu A$  |
| Thermal shock      | -55°C to 125°C, 30 min dwell, 1000 cycles            | $I_L \leq 10 \mu A$  |
| Bias heat test     | 125°C, $V_{DC(max)}$ , 1000 hrs                      | $I_L \leq 10 \mu A$  |
| Bias low temp test | -55°C, $V_{DC(max)}$ , 1000 hrs                      | $I_L \leq 10 \mu A$  |
| Solderability      | 250°C $\pm$ 5°C, 3 $\pm$ 1s                          | 95% coverage         |
| Solder heat        | 260°C, 10s                                           | 90% coverage         |
| Vibration          | 10 to 50Hz, 60s cycle, 2 hrs each in X-Y-Z-direction | No physical damage   |
| Solvent resistance | IPA ultrasonic 300s                                  | No physical damage   |
| Shock              | 1500G, 0.5ms each, X-Y-Z axis 3 times each axis      | No physical damage   |

**Table E4 General Characteristics for ESD Devices**

|                                                      |                                                                                                                                       |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Storage temperature                                  | -40°C to +85°C                                                                                                                        |
| Operating temperature                                | -55°C to +125°C                                                                                                                       |
| ESD voltage capability<br>(tested per IEC 61000-4-2) | Contact discharge mode : 8kV (typical), 15kV (max)<br>Air discharge mode : 15kV (typical), 25kV (max) [1 pulse: per customer request] |
| ESD pulse withstand                                  | 100 pulses<br>(tested per IEC 61000-4-2, level 4, contact method)                                                                     |

**Table E5 Materials Information for ESD Devices**

|                |                                                             |
|----------------|-------------------------------------------------------------|
| RoHS compliant | Directive 2002/95/EC compliant                              |
| ELV compliant  | Directive 2000/53/EC compliant                              |
| Halogen free   | Halogen free refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm |

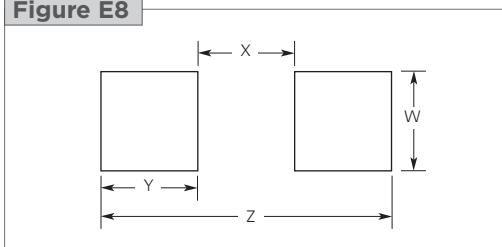
**Table E6 Recommended Pad Layout for ESD Devices in Millimeters (Inches)\***

| Part Number  | V    |      | W               |                 | X               |                 | Y               |                 | Z               |                 | Figure |
|--------------|------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
|              | Min. | Max. | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            |        |
| PESD0402-140 | —    | —    | 0.60<br>(0.024) | 0.70<br>(0.028) | 0.30<br>(0.012) | 0.40<br>(0.016) | 0.80<br>(0.031) | 0.90<br>(0.035) | 2.10<br>(0.083) | 2.20<br>(0.087) | E8     |
| PESD0603-240 | —    | —    | 0.90<br>(0.035) | 1.00<br>(0.039) | 0.50<br>(0.020) | 0.60<br>(0.024) | 1.00<br>(0.039) | 1.10<br>(0.043) | 2.70<br>(0.106) | 2.80<br>(0.110) | E8     |

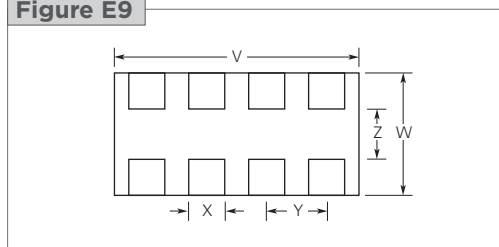
  

| Part Number   | V               | W               | X               | Y               | Z               | Figure |
|---------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
|               | Typ.            | Typ.            | Typ.            | Typ.            | Typ.            |        |
| PESD1206Q-240 | 3.20<br>(0.126) | 2.20<br>(0.087) | 0.50<br>(0.020) | 0.80<br>(0.031) | 1.00<br>(0.039) | E9     |

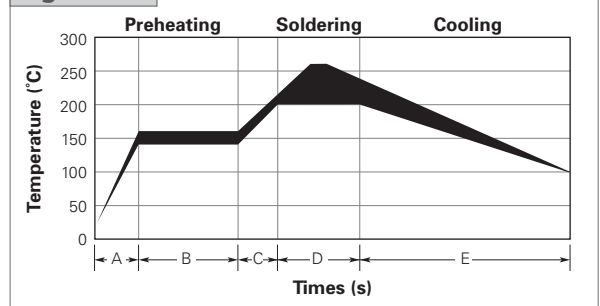
\*The dimensions in inches are rounded approximations.

**Figure E8**


Note: Solder thickness 0.15 to 0.2 mm

**Figure E9**

**Table E7 Solder Reflow Recommendations for ESD Devices**

|   |                       |                                              |                                                     |
|---|-----------------------|----------------------------------------------|-----------------------------------------------------|
| A | Temperature ramp up 1 | From ambient to preheating temperature       | 30s to 60s                                          |
| B | Preheating            | 140°C - 160°C                                | 60s to 120s                                         |
| C | Temperature ramp up 2 | From preheating to main heating temperature  | 20s to 40s                                          |
| D | Main heating          | at 200°C<br>at 220°C<br>at 240°C<br>at 260°C | 60s to 70s<br>50s to 60s<br>30s to 40s<br>5s to 10s |
| E | Cooling               | From main heating temperature to 100°C       | 4°C/s max                                           |

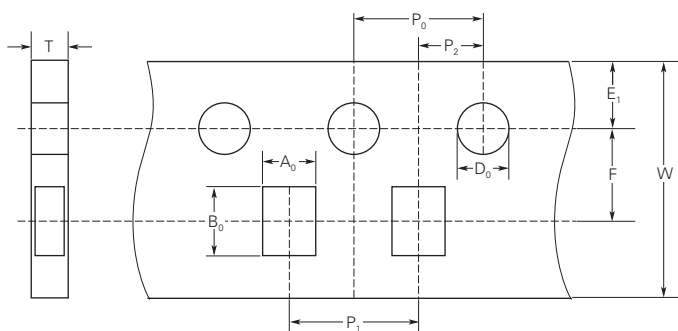
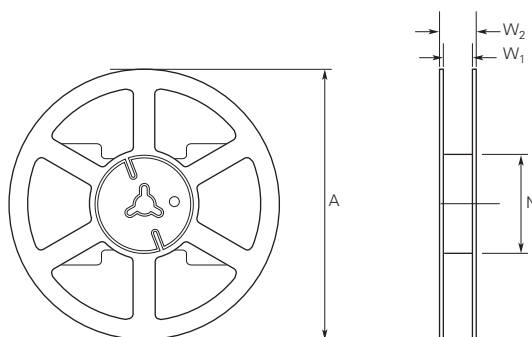
**Figure E10**


**Table E8** Tape and Reel Specifications for ESD Devices

| Tape Dimension<br>EIA Mark | 0402           |           | 0603           |           | 1206Q          |           |
|----------------------------|----------------|-----------|----------------|-----------|----------------|-----------|
|                            | Dimension (mm) | Tolerance | Dimension (mm) | Tolerance | Dimension (mm) | Tolerance |
| W                          | 8.00           | ±0.30     | 8.00           | ±0.30     | 8.00           | ±0.30     |
| P <sub>0</sub>             | 4.00           | ±0.10     | 4.00           | ±0.10     | 4.00           | ±0.10     |
| P <sub>1</sub>             | 2.00           | ±0.05     | 4.00           | ±0.05     | 4.00           | ±0.05     |
| P <sub>2</sub>             | 2.00           | ±0.05     | 2.00           | ±0.05     | 2.00           | ±0.05     |
| A <sub>0</sub>             | 0.69           | ±0.05     | 1.27           | ±0.15     | 2.02           | ±0.20     |
| B <sub>0</sub>             | 1.19           | ±0.05     | 2.02           | ±0.20     | 3.62           | ±0.20     |
| D <sub>0</sub>             | 1.50           | ±0.10     | 1.50           | ±0.10     | 1.50           | ±0.10     |
| F                          | 3.50           | ±0.05     | 3.50           | ±0.05     | 3.50           | ±0.05     |
| E <sub>1</sub>             | 1.75           | ±0.10     | 1.75           | ±0.10     | 1.75           | ±0.10     |
| T                          | 0.48           | ±0.03     | 0.60           | ±0.03     | 0.75           | ±0.03     |

**Reel Dimensions (0402, 0603 & 1206Q)**

| EIA Mark            | Dimension (mm) |
|---------------------|----------------|
| A max.              | 180.0          |
| N min.              | 60.5           |
| W <sub>1</sub> max. | 9.5            |
| W <sub>2</sub> max. | 14.0           |

**Figure E11** EIA Referenced Taped Component Dimensions for ESD Devices

**Figure E12** EIA Referenced Reel Dimensions for ESD Devices


## Parameter Definitions for ESD Devices

### Operation Voltage ( $V_{DC}$ )

Defined as DC voltage, under which device is in OFF state and leakage current below certain threshold.

### Leakage Current ( $I_L$ )

Current through device under Operation Voltage  $V_{DC}$ .

### Trigger Voltage ( $V_T$ )

Voltage at which the device switches from the OFF to the ON state, during the IEC waveform or the TLP system.

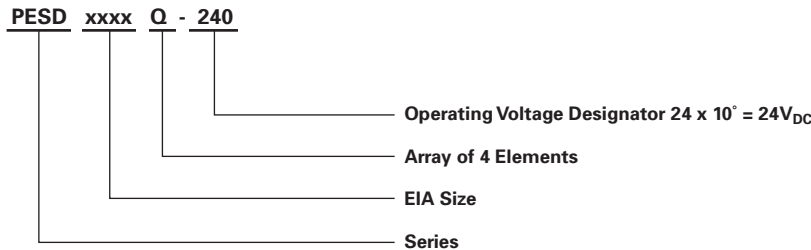
### Clamping Voltage ( $V_C$ )

Voltage across device under 8 kV per IEC or measured by TLP system. Typically measured 30 ns after initiation of the ESD pulse (for TLP, both 30ns and 60ns are sometimes used).

### Capacitance ( $C_P$ )

Capacitance of the device measured at 1 MHz with 0V and max operating voltage bias.

## Part Numbering System for ESD Devices



### Warning :

**Application Limitations for PESD0402-140, PESD0603-240 and PESD1206Q-240: These parts are not intended to be used under power bus applications. Users should independently evaluate the suitability of and test each product selected for their own application.**

All information, including illustrations, is believed to be accurate and reliable. Users, however, should independently evaluate the suitability of and test each product selected for their application. Tyco Electronics Corporation and/or its Affiliates in the TE Connectivity Ltd. family of companies ("TE") makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. TE's only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products. Specifications are subject to change without notice. In addition, TE Connectivity reserves the right to make changes to materials or processing that do not affect compliance with any applicable specification without notification to Buyer. Without expressed or written consent by an officer of TE, TE does not authorize the use of any of its products as components in nuclear facility applications, aerospace, or in critical life support devices or systems.



## Gas Discharge Tubes

TE Circuit Protection's GDTs (Gas Discharge Tubes) are placed in front of, and in parallel with, sensitive telecom equipment such as power lines, communication lines, signal lines and data transmission lines to help protect them from damage caused by transient surge voltages that may result from lightning strikes and equipment switching operations. These devices do not influence the signal in normal operation. However, in the event of an overvoltage surge, such as a lightning strike, the GDT switches to a low impedance state and diverts the energy away from the sensitive equipment.

Our GDTs offer a high level of surge protection, a broad voltage range, low capacitance, and many form factors including new surface mount devices, which makes them suitable for applications such as MDF (Main Distribution Frame) modules, high data-rate telecom applications (e.g. ADSL, VDSL), and surge protection on power lines. Their low capacitance also results in less signal distortion. When used in a coordinated circuit protection solution with PolySwitch devices, they can help equipment manufacturers meet stringent safety regulatory standards.



### Benefits

- Helps provide overvoltage fault protection against damage caused by high energy surges
- Suitable for use in sensitive equipment due to impulse sparkover response
- Suitable for high-frequency applications
- Highly reliable performance
- New surface-mount devices for automated manufacturing

### Features

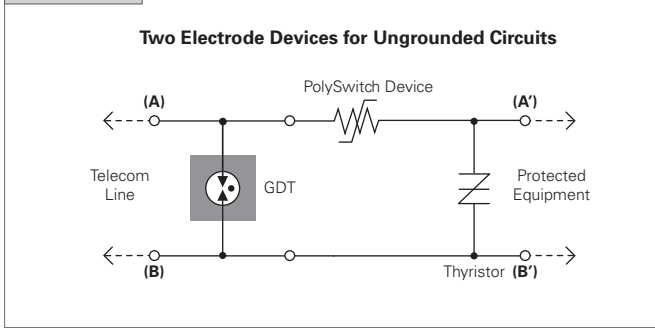
- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Wide range of voltages (75V-4000V)
- Wide range of form factors  
(3mm, 5mm, 6mm, 7mm, 8mm diameter devices)
- Low capacitance and insertion loss
- Crowbar device with low arc voltage
- High accuracy spark-over voltages for high precision designs
- Devices tested per ITU K.12 recommendations
- Various lead configurations and surface-mount options
- Optional fail-short mechanism
- Non radioactive materials
- Devices certified to UL497B and UL1449

### Applications

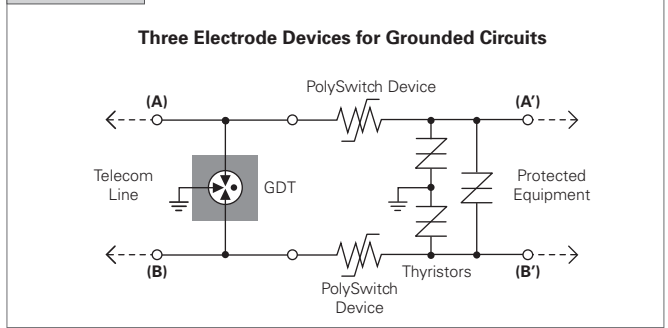
- Telecommunications
  - MDF modules, xDSL equipment, RF systems, antenna, base stations
- Industrial and Consumer Electronics
  - Power supplies, surge protectors, alarm systems, irrigation systems

**Figure G1-G2 Typical Circuits for Gas Discharge Tubes**

**Figure G1**



**Figure G2**



**Table G1 Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance, and Agency Approval for Two Electrode Gas Discharge Tubes**

| Part Number       | DC Sparkover Voltage        | Impulse Sparkover Voltage | Impulse Discharge Current                   |                                                | Impulse Withstanding Voltage                   | Capacitance | Insulation Resistance            | UL Rating          |
|-------------------|-----------------------------|---------------------------|---------------------------------------------|------------------------------------------------|------------------------------------------------|-------------|----------------------------------|--------------------|
|                   | @ 100V/s<br>± 20% Tolerance | @ 1kV/μs                  | 8x20μs<br>10 hits<br>(5 hits each polarity) | 8x20μs<br>300 hits<br>(150 hits each polarity) | 10/700μs<br>10 hits<br>(5 times each polarity) | @1MHz       | @100V <sub>DC</sub> <sup>†</sup> | UL497B<br>#E179610 |
| GTCS23-XXXM-R01-2 | 75*                         | 600                       | 1kA                                         | 100A                                           | 4kV                                            | <0.5pF      | 1,000 (MΩ)                       | All Devices        |
|                   | 90                          | 600                       |                                             |                                                |                                                |             |                                  |                    |
|                   | 140                         | 600                       |                                             |                                                |                                                |             |                                  |                    |
|                   | 150                         | 600                       |                                             |                                                |                                                |             |                                  |                    |
| GTCC23-XXXM-R01-2 | 200                         | 700                       | 1kA                                         | 100A                                           | 6kV <sup>‡</sup>                               | <0.5pF      | 1,000 (MΩ)                       | All Devices        |
|                   | 230                         | 700                       |                                             |                                                |                                                |             |                                  |                    |
|                   | 300                         | 900                       |                                             |                                                |                                                |             |                                  |                    |
|                   | 350                         | 1000                      |                                             |                                                |                                                |             |                                  |                    |
|                   | 400                         | 1000                      |                                             |                                                |                                                |             |                                  |                    |

\* DCSO 60~105

<sup>†</sup> Devices <=150V measured @ 50V<sub>DC</sub>

<sup>‡</sup> Effective output impedance: 40ohms

| Part Number       | DC Sparkover Voltage        | Impulse Sparkover Voltage |          | DC Holdover Voltage | On-State Voltage  | Impulse Discharge Current | Impulse Life          | AC Discharge Current (1sec duration; 10 hits) | Capacitance        | Insulation Resistance | UL Rating          |
|-------------------|-----------------------------|---------------------------|----------|---------------------|-------------------|---------------------------|-----------------------|-----------------------------------------------|--------------------|-----------------------|--------------------|
|                   | @ 100V/s<br>± 20% Tolerance | @ 100V/μs                 | @ 1kV/μs | Per ITU K.12        | Nominal (@1A) (V) | 8x20μs<br>10 hits         | 10x1000μs<br>300 hits | @ 50 Hz                                       | @ 1MHz             | @ 100V <sub>DC</sub>  | UL497B<br>#E179610 |
| GTCX25-XXXM-R02   | 75                          | 450                       | 550      | <52                 | 20                | 2.5kA                     | 100A                  | 2.5Arms                                       | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 90                          | 450                       | 550      | <52                 | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 140                         | 500                       | 600      | <80                 | 20                |                           |                       |                                               |                    |                       |                    |
| GTCX26-XXXM-R05   | 150                         | 500                       | 600      | <80                 | 20                | 5kA                       | 100A                  | 5Arms                                         | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 200                         | 600                       | 700      | <135                | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 230                         | 600                       | 700      | <135                | 20                |                           |                       |                                               |                    |                       |                    |
| GTCX28-XXXM-R05   | 250                         | 600                       | 700      | <135                | 20                | 5kA                       | 100A                  | 5Arms                                         | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 260                         | 700                       | 800      | <135                | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 300                         | 800                       | 900      | <150                | 20                |                           |                       |                                               |                    |                       |                    |
| GTCX28-XXXM-R10   | 350                         | 900                       | 1000     | <150                | 20                | 10kA                      | 100A                  | 10Arms                                        | <1pF <sup>††</sup> | 10,000 (MΩ)           | All Devices        |
|                   | 400                         | 900                       | 1000     | <150                | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 420                         | 900                       | 1000     | <150                | 20                |                           |                       |                                               |                    |                       |                    |
| GTCX28-XXXM-R20** | 470                         | 1050                      | 1150     | <150                | 20                | 20kA                      | 100A                  | 20Arms                                        | <1.5pF             | 10,000 (MΩ)           | All Devices        |
|                   | 500                         | 1100                      | 1200     | <150                | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 550                         | 1300                      | 1400     | <150                | 20                |                           |                       |                                               |                    |                       |                    |
|                   | 600                         | 1300                      | 1400     | <150                | 20                |                           |                       |                                               |                    |                       |                    |

\*\* GTCX28-XXXM-R20 parts only up to 350V

<sup>††</sup> <1.2pF for 75V and 90V devices.



**Table G2** Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance, and Agency Approval for Two Electrode High Voltage Gas Discharge Tubes

| Part Number     | DC Sparkover Voltage    | Impulse Sparkover Voltage | Impulse Life   | AC Discharge Current, 50 Hz          |                      | Impulse Discharge Current 8/20µs |       | Capacitance | UL Rating       |
|-----------------|-------------------------|---------------------------|----------------|--------------------------------------|----------------------|----------------------------------|-------|-------------|-----------------|
|                 | @100V/s ± 20% Tolerance | @ 100 V/µs                | 10/1000µs 100A | Multiple hits (1s duration: 10 hits) | Single hit, 9 cycles | 10 hits (5 hits each polarity)   | 1 hit | @ 1MHz      | UL1449 #E332226 |
| GTCA28-801M-R05 | 800                     | 1400                      | 300 times      | 5A                                   | N/A                  | 5kA                              | N/A   | <1pF        | ✓               |
| GTCA28-102M-R03 | 1000                    | 1700                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-122M-R03 | 1200                    | 1900                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-152L-R03 | 1500 (± 15%)            | 2200                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-212M-R03 | 2100                    | 2700                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-242M-R03 | 2400                    | 3300                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-252M-R03 | 2500                    | 3500                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-272L-R03 | 2700 (± 15%)*           | 3700                      | 300 times†     | N/A                                  | N/A                  | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-302M-R03 | 3000                    | 4000                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-312L-R03 | 3100 (± 15%)*           | 3700‡                     | 300 times†     | N/A                                  | N/A                  | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-362M-R03 | 3600                    | 4600                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |
| GTCA28-402M-R03 | 4000                    | 5000                      | N/A            | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓               |

**Note:** Insulation resistance: ≥10,000MΩ (all parts measured @ 1000V<sub>DC</sub>, except 800V/1000V/1200V @250V<sub>DC</sub>; 1500V/2100V @ 500V<sub>DC</sub>)

\* DC Sparkover Voltage measured at 5kV/s

† Measured with 8/20µs, 100A impulse

‡ Measured at 1000V/µs

**Table G3** Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance, and Agency Approval for Three Electrode Gas Discharge Tubes

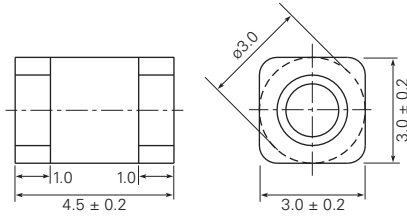
| Part Number     | DC Sparkover Voltage (A-E) (B-E) | Impulse Sparkover Voltage (A-E) (B-E) |          | DC Holdover Voltage | On-State Voltage  | Impulse Discharge Current (A+B-E) | Impulse Life (A+B-E) | AC Discharge Current (1sec duration; 10 hits) (A+B-E) | Capacitance | Insulation Resistance  | UL Rating       |
|-----------------|----------------------------------|---------------------------------------|----------|---------------------|-------------------|-----------------------------------|----------------------|-------------------------------------------------------|-------------|------------------------|-----------------|
|                 | @ 100V/s ± 20% Tolerance         | @ 100V/µs                             | @ 1kV/µs | Per ITU K.12        | Nominal (@1A) (V) | 8x20µs 10 hits                    | 10x1000µs 300 hits   | @ 50 Hz                                               | @ 1MHz      | @ 100V <sub>DC</sub> * | UL497B #E179610 |
| GTCX35-XXXM-R05 | 75                               | 450                                   | 550      | <52                 | 20                | 5kA                               | 100A                 | 5Arms                                                 | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 90                               | 450                                   | 550      | <52                 | 20                |                                   |                      |                                                       |             |                        |                 |
|                 | 140                              | 500                                   | 600      | <80                 | 20                |                                   |                      |                                                       |             |                        |                 |
| GTCX36-XXXM-R05 | 150                              | 500                                   | 600      | <80                 | 20                | 5kA                               | 200A                 | 5Arms                                                 | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 200                              | 600                                   | 700      | <135                | 20                |                                   |                      |                                                       |             |                        |                 |
|                 | 230                              | 600                                   | 700      | <135                | 20                |                                   |                      |                                                       |             |                        |                 |
| GTCX36-XXXM-R10 | 250                              | 600                                   | 700      | <135                | 20                | 10kA                              | 200A                 | 10Arms                                                | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 260                              | 700                                   | 800      | <135                | 20                |                                   |                      |                                                       |             |                        |                 |
|                 | 300                              | 800                                   | 900      | <150                | 20                |                                   |                      |                                                       |             |                        |                 |
| GTCX37-XXXM-R10 | 350                              | 900                                   | 1000     | <150                | 20                | 10kA                              | 200A                 | 10Arms                                                | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 400                              | 900                                   | 1000     | <150                | 20                |                                   |                      |                                                       |             |                        |                 |
|                 | 420                              | 900                                   | 1000     | <150                | 20                |                                   |                      |                                                       |             |                        |                 |
| GTCX38-XXXM-R10 | 470                              | 1050                                  | 1150     | <150                | 20                | 10kA                              | 200A                 | 10Arms                                                | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 500                              | 1100                                  | 1200     | <150                | 20                |                                   |                      |                                                       |             |                        |                 |
|                 | 550                              | 1300                                  | 1400     | <150                | 20                |                                   |                      |                                                       |             |                        |                 |
| GTCX38-XXXM-R10 | 600                              | 1300                                  | 1400     | <150                | 20                | 10kA                              | 200A                 | 10Arms                                                | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 |                                  |                                       |          |                     |                   |                                   |                      |                                                       |             |                        |                 |

\* Insulation resistance measured at 50V for devices less than 150V.  
Insulation resistance measured at 250V for devices more than 500V.

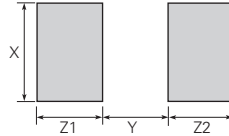
**Figure G3-G11** Dimensions for Gas Discharge Tubes

**Figure G3** Two Electrode 3mm Product Dimensions

**Surface-mount  
(GTCS23-XXXM-R01)**



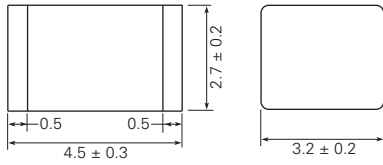
**Pad Layout - Surface-mount Devices  
(GTCS23-XXXM-R01)**



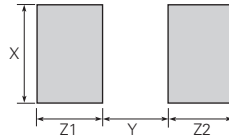
|     | <b>X</b>    | <b>Y</b>    | <b>Z1</b>   | <b>Z2</b>   |
|-----|-------------|-------------|-------------|-------------|
|     | <b>Nom.</b> | <b>Nom.</b> | <b>Nom.</b> | <b>Nom.</b> |
| mm  | 3.0         | 2.0         | 2.0         | 2.0         |
| in* | (0.118)     | (0.079)     | (0.079)     | (0.079)     |

\* The dimensions in inches are rounded approximations.

**Chip GDT  
(GTCC23-XXXM-R01)**



**Pad Layout - Chip GDT Devices  
(GTCC23-XXXM-R01)**

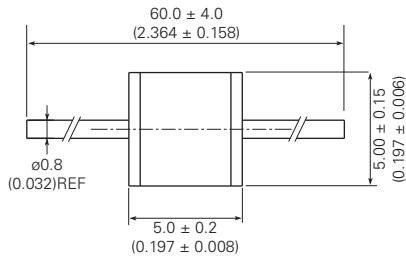


|     | <b>X</b>    | <b>Y</b>    | <b>Z1</b>   | <b>Z2</b>   |
|-----|-------------|-------------|-------------|-------------|
|     | <b>Nom.</b> | <b>Nom.</b> | <b>Nom.</b> | <b>Nom.</b> |
| mm  | 3.5         | 2.7         | 2.0         | 2.0         |
| in* | (0.138)     | (0.106)     | (0.079)     | (0.079)     |

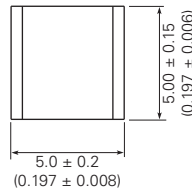
\* The dimensions in inches are rounded approximations.

**Figure G4** Two Electrode 5mm Product Dimensions

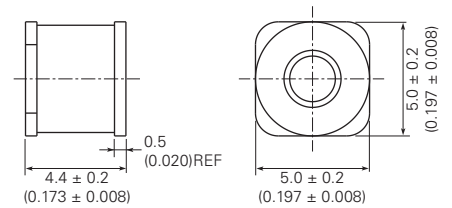
**Axial Leads  
(GTCA25-XXXM-R02)**



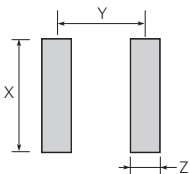
**No Leads  
(GTCN25-XXXM-R02)†**



**Surface-mount  
(GTCS25-XXXM-R02)**



**Pad Layout - Surface-mount Devices  
(GTCS25-XXXM-R02)**



|     | <b>X</b>    | <b>Y</b>    | <b>Z</b>    |
|-----|-------------|-------------|-------------|
|     | <b>Nom.</b> | <b>Nom.</b> | <b>Nom.</b> |
| mm  | 6.0         | 3.9         | 1.3         |
| in* | (0.197)     | (0.154)     | (0.051)     |

\* The dimensions in inches are rounded approximations.

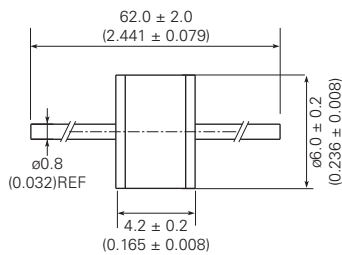
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

# Figure G3-G11 Dimensions for Gas Discharge Tubes

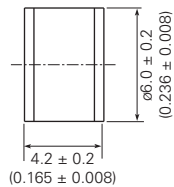
Cont'd

## Figure G5 Two Electrode 6mm Product Dimensions

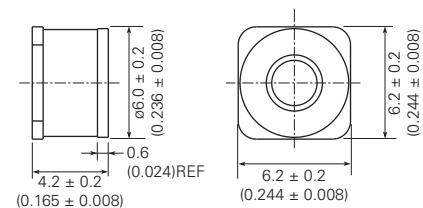
### Axial Leads (GTCA26-XXXM-R05)



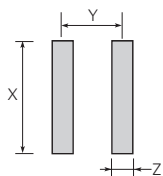
### No Leads (GTCN26-XXXM-R05)<sup>†</sup>



### Surface-mount (GTCS26-XXXM-R05)



### Pad Layout - Surface-mount Devices (GTCS26-XXXM-R05)



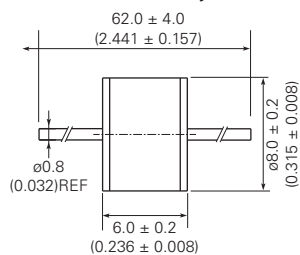
|     | X       | Y       | Z       |
|-----|---------|---------|---------|
|     | Nom.    | Nom.    | Nom.    |
| mm  | 7.0     | 3.7     | 1.3     |
| in* | (0.276) | (0.146) | (0.051) |

\* The dimensions in inches are rounded approximations.

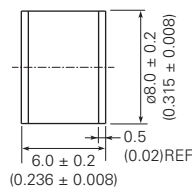
<sup>†</sup> Parts with no leads are not solderable and are meant for insertion into magazine clips.

## Figure G6 Two Electrode 8mm Product Dimensions

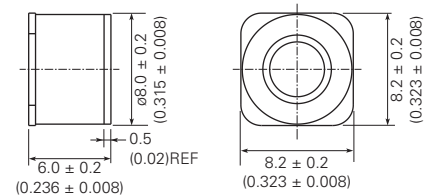
### Axial Leads (GTCA28-XXXM-R05, R10 & R20)



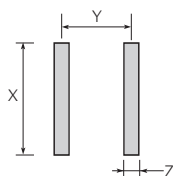
### No Leads (GTCN28-XXXM-R05, R10 & R20)<sup>†</sup>



### Surface-mount (GTCS28-XXXM-R05, R10 & R20)



### Pad Layout - Surface-mount Devices (GTCS28-XXXM-R05, R10 & R20)



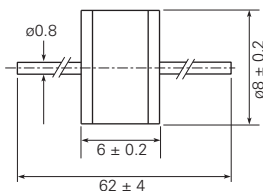
|     | X       | Y      | Z       |
|-----|---------|--------|---------|
|     | Nom.    | Nom.   | Nom.    |
| mm  | 9.0     | 5.6    | 1.2     |
| in* | (0.354) | (0.22) | (0.047) |

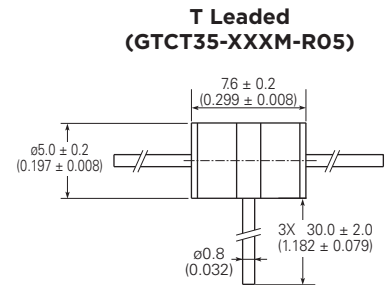
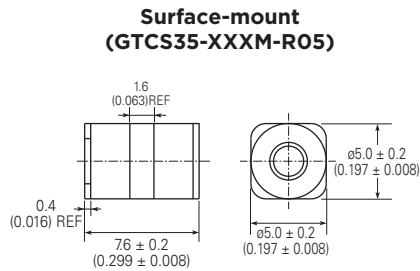
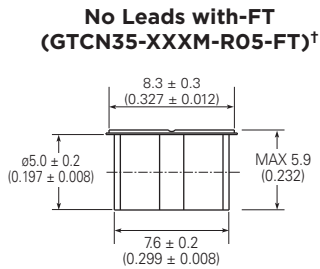
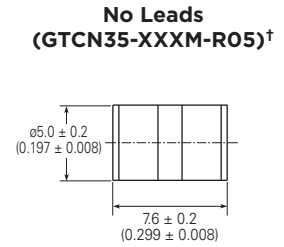
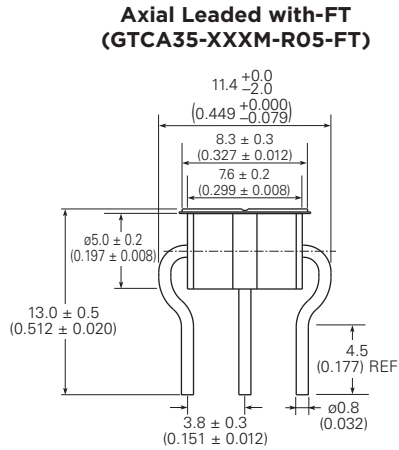
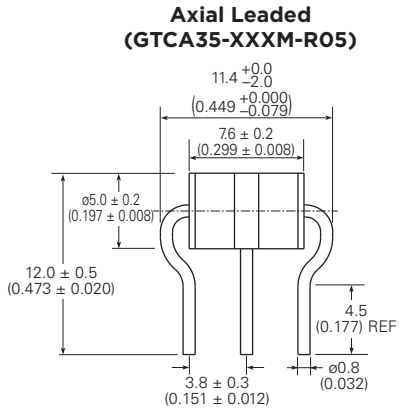
\* The dimensions in inches are rounded approximations.

<sup>†</sup> Parts with no leads are not solderable and are meant for insertion into magazine clips.

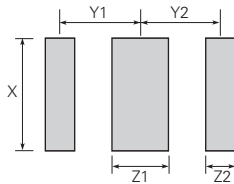
## Figure G7 Two Electrode 8mm High Voltage Product Dimensions

### Axial Leads (GTCA28-XXXM-R0X)



**Figure G8 Three Electrode 5mm Product Dimensions**


### Pad Layout - Surface-mount Devices (GTCS35-XXXM-R05)



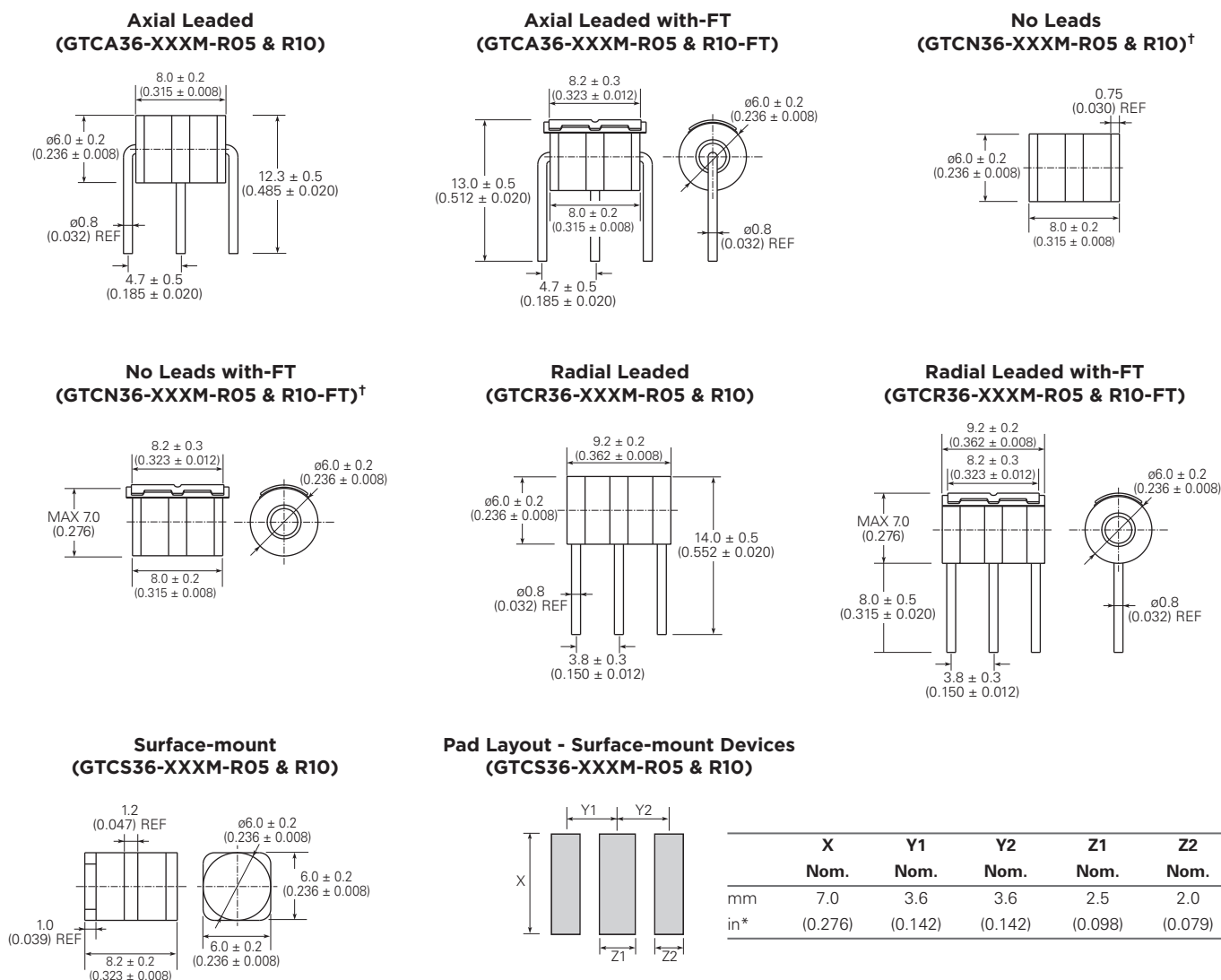
|     | X       | Y1      | Y2      | Z1      | Z2      |
|-----|---------|---------|---------|---------|---------|
|     | Nom.    | Nom.    | Nom.    | Nom.    | Nom.    |
| mm  | 6.0     | 3.6     | 3.6     | 2.5     | 1.3     |
| in* | (0.236) | (0.142) | (0.142) | (0.098) | (0.051) |

\* The dimensions in inches are rounded approximations.

<sup>†</sup> Parts with no leads are not solderable and are meant for insertion into magazine clips.

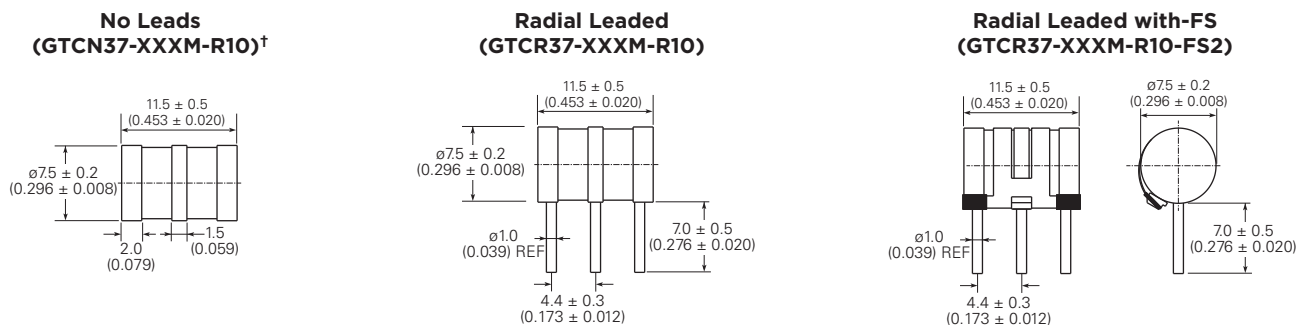
**Figure G3-G11** Dimensions for Gas Discharge Tubes

Cont'd

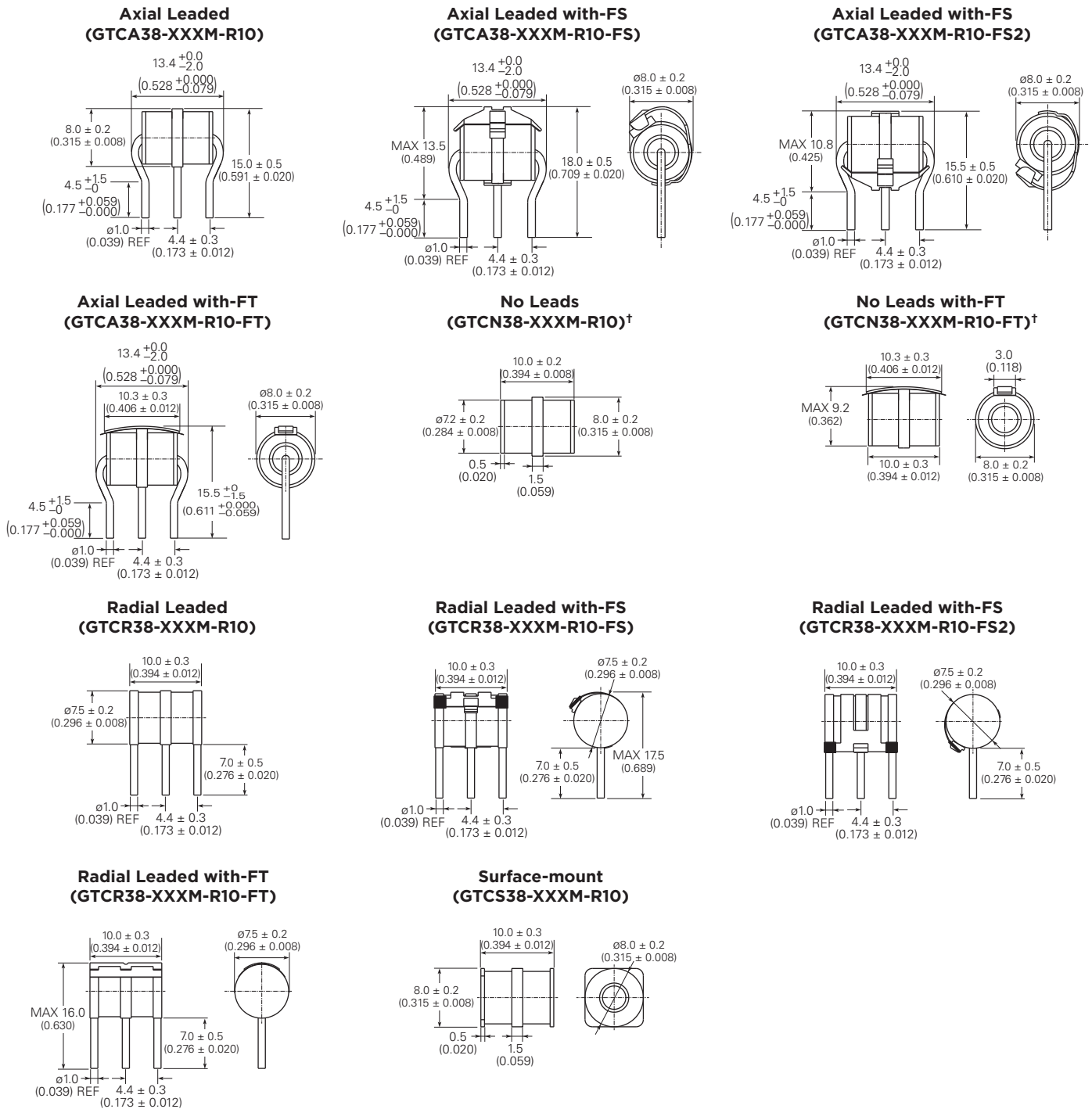
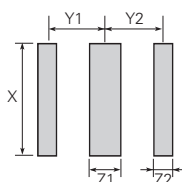
**Figure G9** Three Electrode 6mm Product Dimensions


\* The dimensions in inches are rounded approximations.

<sup>†</sup> Parts with no leads are not solderable and are meant for insertion into magazine clips.

**Figure G10** Three Electrode 7mm Product Dimensions


<sup>†</sup> Parts with no leads are not solderable and are meant for insertion into magazine clips.

**Figure G11 Three Electrode 8mm Product Dimensions**

**Pad Layout - Surface-mount Devices (GTCS38-XXXM-R10)**


|     | X       | Y1      | Y2      | Z1      | Z2      |
|-----|---------|---------|---------|---------|---------|
|     | Nom.    | Nom.    | Nom.    | Nom.    | Nom.    |
| mm  | 9.0     | 4.65    | 4.65    | 2.5     | 1.5     |
| in* | (0.354) | (0.183) | (0.183) | (0.098) | (0.059) |

\* The dimensions in inches are rounded approximations.

† Parts with no leads are not solderable and are meant for insertion into magazine clips.



## Fail-Short Mechanism for Gas Discharge Tubes

### Fail-Short Mechanism (FS)

The FS fail-short mechanism is a short circuit spring mounted onto a solder pellet located at the center electrode of the gas tube. Under normal operating conditions, the pellet is positioned to make the spring float above the outer electrodes, as shown in Figure G11.

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the solder, the pellet softens allowing the short circuit spring to contact with both outer electrodes. This process results in a permanent short-circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.

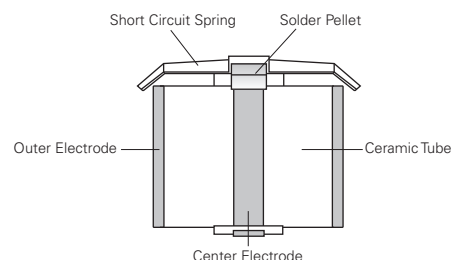


Figure G11

### Fail-Short Mechanism (FT)

The FT fail-short mechanism is a short circuit spring with a piece of plastic foil spot welded onto the center electrode. Under normal operating conditions, the plastic foil makes the spring insulated from the two outer electrodes.

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the plastic foil, the plastic foil melts allowing the short circuit spring to contact both outer electrodes. This process results in a permanent short-circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.

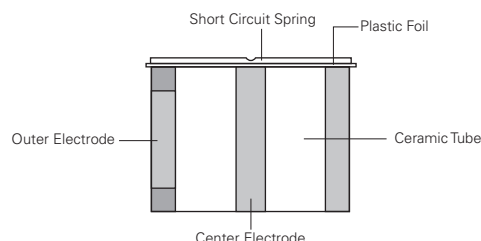


Figure G12

## Operation and Storage Temperatures for Gas Discharge Tubes

### Operation Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C  
Models with Fail-Short Mechanism : -20°C/+65°C

### Storage Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C  
Models with Fail-Short Mechanism : -20°C/+65°C

## Packaging Information for Gas Discharge Tubes

| Part Description        | Parts in Bulk      |              | Parts in Tape and Reel         |              |
|-------------------------|--------------------|--------------|--------------------------------|--------------|
|                         | Min Order Quantity | Box Quantity | Tape & Reel Min Order Quantity | Box Quantity |
| 3mm 2Pole Surface-mount | -                  | -            | 2000                           | 16000        |
| 5mm 2Pole No leads      | 5000               | 20000        | -                              | -            |
| 5mm 2Pole, Leads        | 1000               | 5000         | -                              | -            |
| 5mm 2Pole Surface-mount | 5000               | 20000        | 1500                           | 12000        |
| 6mm 2Pole No leads      | 2000               | 10000        | -                              | -            |
| 6mm 2Pole, Leads        | 1000               | 5000         | -                              | -            |
| 6mm 2Pole Surface-mount | 2000               | 10000        | 750                            | 6000         |
| 8mm 2pole No leads      | 2000               | 10000        | -                              | -            |
| 8mm 2Pole, Leads        | 1000               | 5000         | -                              | -            |
| 8mm 2Pole Surface-mount | 2000               | 10000        | 500                            | 4000         |
| 5mm 3Pole No leads      | 2500               | 10000        | -                              | -            |
| 5mm 3Pole, Leads        | 1000               | 5000         | -                              | -            |
| 5mm 3Pole Surface-mount | 2500               | 10000        | 1000                           | 8000         |
| 6mm 3Pole No leads      | 2500               | 10000        | -                              | -            |
| 6mm 3Pole, Leads        | 1000               | 5000         | -                              | -            |
| 6mm 3Pole Surface-mount | 2500               | 10000        | 750                            | 4500         |
| 7mm 3Pole, Leads        | 1000               | 5000         | -                              | -            |
| 8mm 3Pole No leads      | 1000               | 5000         | -                              | -            |
| 8mm 3Pole, Leads        | 1000               | 5000         | -                              | -            |
| 8mm 3Pole Surface-mount | 1000               | 5000         | 500                            | 2500         |

## Installation for Gas Discharge Tubes

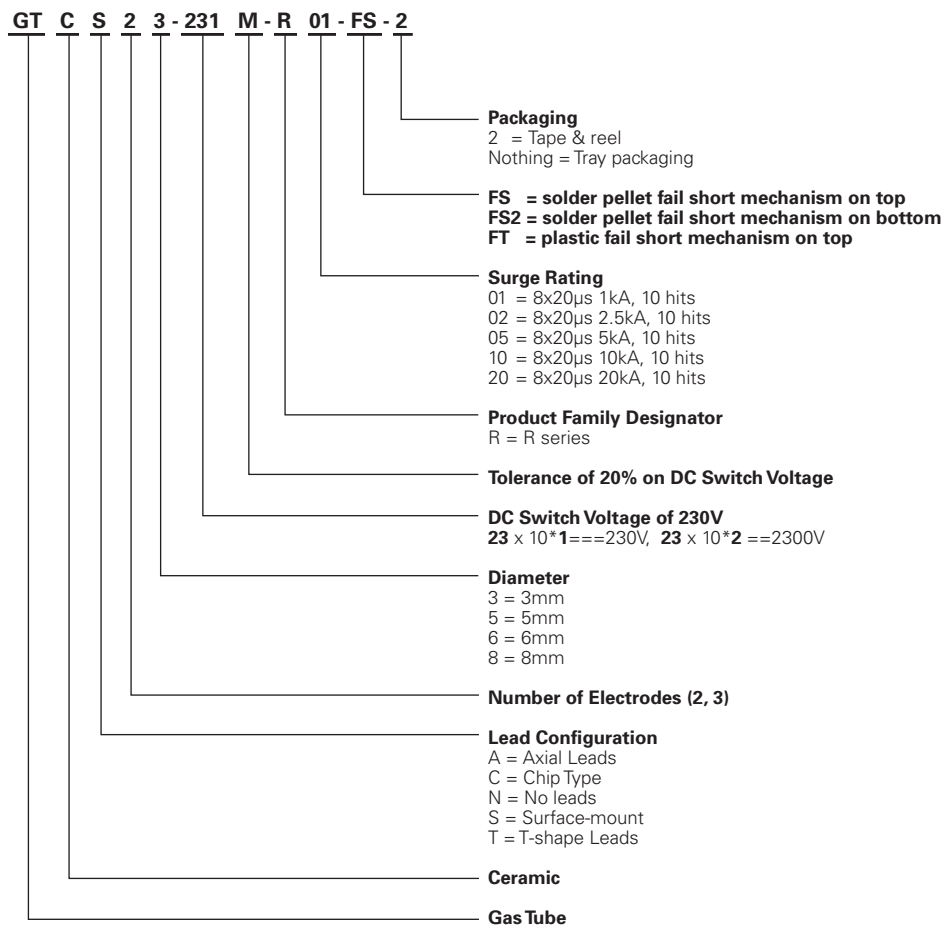
Care should be taken when installing Gas Discharge Tubes equipped with Fail-Short Mechanisms into arrester magazines, printed circuit boards, etc. Too much downward pressure may force the short circuit spring through the thin insulation tube creating a shorted condition.

## Solder Reflow Recommendations for Surface-mount GDT Devices

Surface-mount GDTs can be soldered using standard Pb-free reflow profile.

## Part Numbering System for Gas Discharge Tubes

### Example Part Number for Gas Discharge Tubes

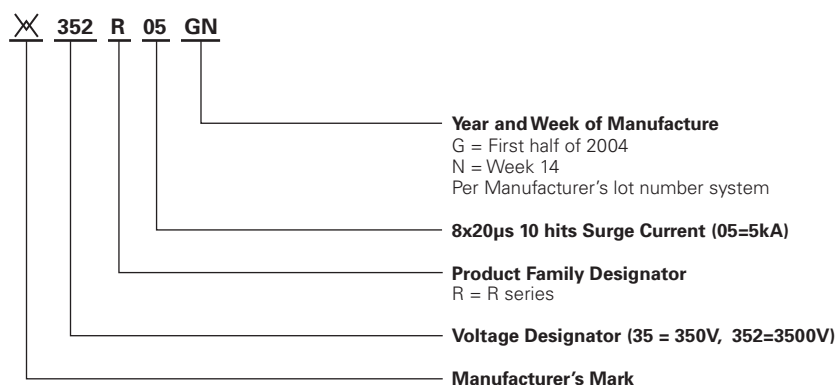


**NOTE:** GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts available only in surface-mount and tape and reel packaging

# Part Numbering System for Gas Discharge Tubes

Cont'd

## Marking Reference Guide - Example



**NOTES:** GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts will have no marking.  
Devices with no leads (GTCNxx-xxxx-xx) are not able to be soldered as their electrodes are Nickel plated.  
They should be installed by insertion into a magazine clip.



## Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- The devices are intended for protection against damage caused by occasional overvoltage fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.



# Surface-mount Fuses Fundamentals

## Overview

TE Circuit Protection offers the widest selection of surface-mount fuses available for addressing a broad range of overcurrent protection applications. Helping to prevent costly damage and promote a safe environment for electronic and electrical equipment, our single-use chip fuses provide performance stability to support applications with current ratings from .5A up to 20A.

TE Circuit Protection also offers the telecom FT600 fuse for telecommunications applications. This telecom fuse helps comply with North American overcurrent protection requirements, including Telcordia, GR-1089, TIA-968-A (formerly FCC Part 68), and UL60950 3rd edition.



## Multi-layer Design for Chip Fuses

The multi-layer design has the benefit of exposing more fuse element surface area to the glass-ceramic absorption material. When the fuse elements open, there is more material for the vaporizing fuse metals to absorb into, resulting in a very efficient and effective quenching of the fuse arc.

Figure 1 compared the multi-layer design of our SFF fuses with standard glass coated designs. The glass coated designs rely on the coating on only one side of the fuse element to absorb the vaporizing fuse material when it opens. Therefore, there is much less absorption material available to absorb the fuse metals. The result can be prolonged arcing and possible coating breach.

Figure 2 shows how the absorption characteristics of the two designs differ. The multi-layer design indicates a clean separation with the fuse element evenly diffusing into the surrounding ceramic substrate. In the glass coated design, the element diffusion takes place in a small portion of the device and is only absorbed by the glass material directly above the area of failure.

Figure 1

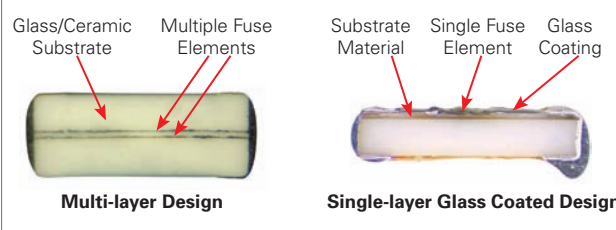
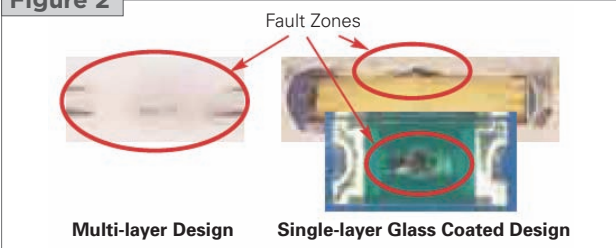


Figure 2



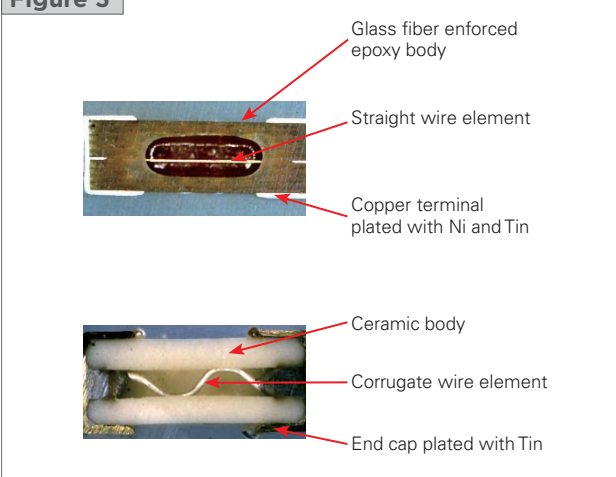
## Wire-In-Air Design for 2410SFV Fuses

The 2410(6125) is a Wire-In-Air SMD Fuse which is very suitable for secondary level over current protection applications.

Figure 3 compared our straight wire element design 2410SFV fuses with normal corrugating wire design fuse. The straight wire element in air performs consistent fusing and cutting characteristics together with excellent inrush current withstanding capability.

Introduced PCB assembly technology into 2410SFV fuses design and manufacture, we achieved on lead free completely and no end cap falling off risk comparing with traditional ceramic body with end cap fuse.

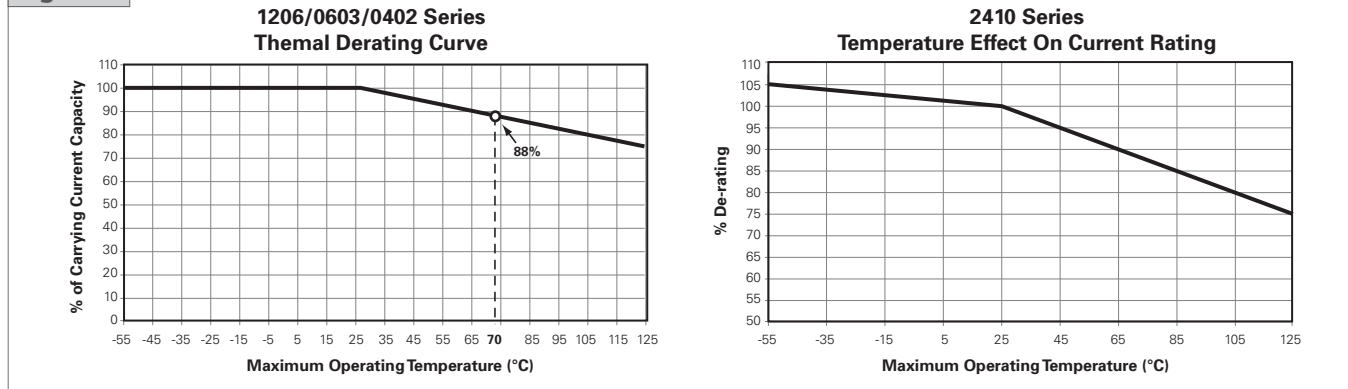
Figure 3



## Temperature Derating

A fuse is a temperature sensitive device. Therefore, operating temperature will have an effect on fuse performance and lifetime. Operating temperature should be taken into consideration when selecting the fuse current rating. The Thermal Derating Curve for surface mount fuses is presented in Figure 4. Use it to determine the derating percentage based on operating temperature and apply it to the derated system current.

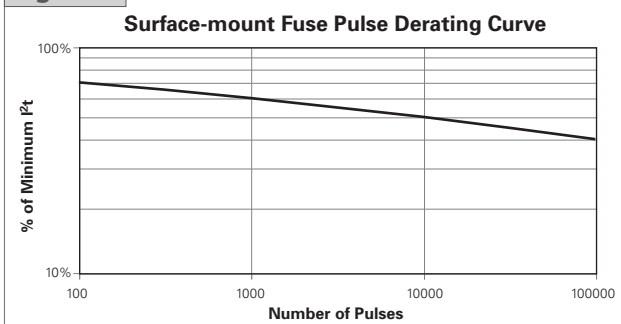
**Figure 4**



## Pulse Cycle Derating

Once the  $I^2t$  value for the application waveform has been determined, it must be derated based on the number of cycles expected over the system lifetime. Since the stress induced by the current pulse is mechanical in nature, the number of times the stress is applied has significant bearing on how much derating must be applied to the fuse rating. Figure 5 presents the current pulse derating curve for our surface-mount chip fuses up to 100,000 cycles.

**Figure 5**



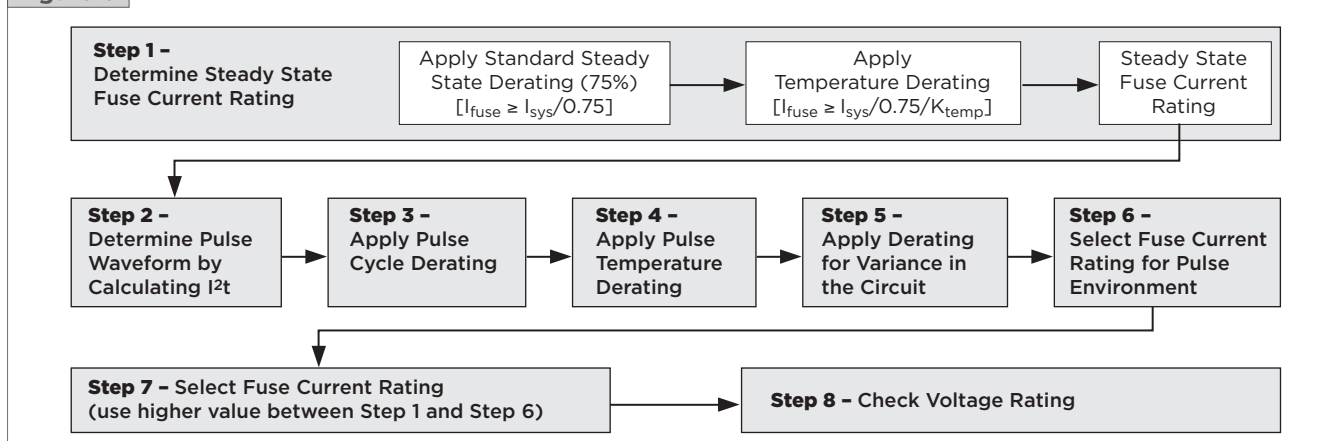
## Selecting Surface-mount Fuses

Fuse selection seems straightforward, in that, you pick one which has a current rating just a bit higher than your worstcase system operating current. Unfortunately, it's not that simple. There are derating considerations for operating current and application temperature. Turn-on and other system operations (like processor speed changes or motor start up) cause current surges or spikes that also require consideration when selecting a fuse. So selecting the right fuse for your application is not as simple as knowing the nominal current drawn by the system.

## Fuse Selection Flowchart

However, the basic considerations for fuse selection are shown in the flowchart presented in Figure 6. Following this flow chart will help you select a fuse best suited for your application conditions.

**Figure 6**





# Surface-mount Fuses

## Pulse Tolerant Chip Fuses



Pulse Tolerant chip fuses has high inrush current withstand capability and provide overcurrent protection on DC power systems. Silver fusing element, monolithic and multilayer design provides strong arc suppression characteristics.

These RoHS-compliant surface-mount devices facilitate the development of more reliable, high performance consumer electronics such as laptops, multimedia devices, cell phones, and other portable electronics.



### Benefits

- High inrush current withstanding capability
- Ceramic Monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- Excellent temperature stability
- Strong arc suppression characteristics

### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- |                   |                        |                |
|-------------------|------------------------|----------------|
| • Laptops         | • Printers             | • Game systems |
| • Digital cameras | • DVD players          | • LCD monitors |
| • Cell phones     | • Portable electronics | • Scanners     |

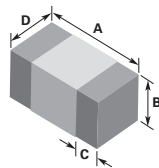


**Table FP1 Clear Time Characteristics for Pulse Tolerant Chip Fuses**

| % of rated current | Clear time at 25°C   |                     |
|--------------------|----------------------|---------------------|
| 100%               | 4 hours (min.)       |                     |
| 200%               | 1 seconds (min.)     | 60 seconds (max.)   |
| 1000%              | 0.0002 second (min.) | 0.02 seconds (max.) |

**Table FP2 Typical Electrical Characteristics and Dimensions for Pulse Tolerant Chip Fuses**
**0603 (1608 mm) Pulse Tolerant Chip Fuses**

**Shape and Dimensions**  
mm (Inch)

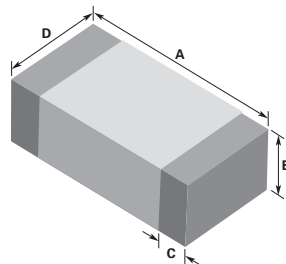


|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 1.45    | 1.75    | 0.65    | 0.95    | 0.21    | 0.51    | 0.65    | 0.95    |
| in | (0.057) | (0.069) | (0.026) | (0.037) | (0.008) | (0.020) | (0.026) | (0.037) |

| Part Number      | Typical Electrical Characteristics |                       |                                                            | Max. Interrupt Ratings     |             |
|------------------|------------------------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFP100F/32-2 | 1.0                                | 0.210                 | 0.080                                                      | 32                         | 50          |
| 0603SFP150F/32-2 | 1.5                                | 0.101                 | 0.11                                                       | 32                         | 50          |
| 0603SFP200F/32-2 | 2.0                                | 0.057                 | 0.24                                                       | 32                         | 50          |
| 0603SFP250F/32-2 | 2.5                                | 0.042                 | 0.56                                                       | 32                         | 50          |
| 0603SFP300F/32-2 | 3.0                                | 0.030                 | 0.72                                                       | 32                         | 50          |
| 0603SFP350F/32-2 | 3.5                                | 0.022                 | 1.10                                                       | 32                         | 50          |
| 0603SFP400F/32-2 | 4.0                                | 0.018                 | 2.08                                                       | 32                         | 50          |
| 0603SFP450F/32-2 | 4.5                                | 0.014                 | 2.63                                                       | 32                         | 50          |
| 0603SFP500F/32-2 | 5.0                                | 0.013                 | 3.25                                                       | 32                         | 50          |

**1206 (3216 mm) Pulse Tolerant Chip Fuses**

**Shape and Dimensions**  
mm (Inch)



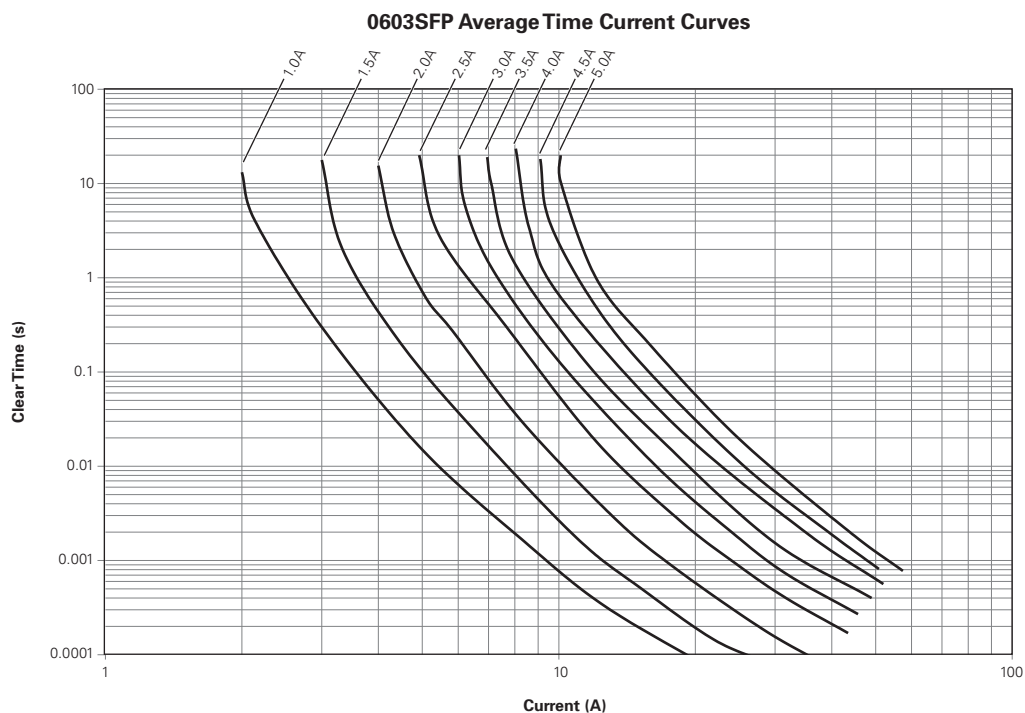
|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 3.00    | 3.40    | 0.77    | 1.17    | 0.26    | 0.76    | 1.40    | 1.80    |
| in | (0.118) | (0.134) | (0.030) | (0.046) | (0.010) | (0.030) | (0.055) | (0.071) |

| Part Number      | Typical Electrical Characteristics |                       |                                                            | Max. Interrupt Ratings     |             |
|------------------|------------------------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFP100F/63-2 | 1.0                                | 0.340                 | 0.11                                                       | 63                         | 50          |
| 1206SFP150F/63-2 | 1.5                                | 0.150                 | 0.33                                                       | 63                         | 50          |
| 1206SFP200F/63-2 | 2.0                                | 0.090                 | 0.80                                                       | 63                         | 50          |
| 1206SFP250F/32-2 | 2.5                                | 0.070                 | 1.19                                                       | 32                         | 50          |
| 1206SFP300F/32-2 | 3.0                                | 0.035                 | 1.35                                                       | 32                         | 50          |
| 1206SFP350F/32-2 | 3.5                                | 0.029                 | 1.84                                                       | 32                         | 50          |
| 1206SFP400F/32-2 | 4.0                                | 0.023                 | 2.74                                                       | 32                         | 50          |
| 1206SFP450F/32-2 | 4.5                                | 0.021                 | 3.20                                                       | 32                         | 50          |
| 1206SFP500F/32-2 | 5.0                                | 0.017                 | 5.50                                                       | 32                         | 50          |

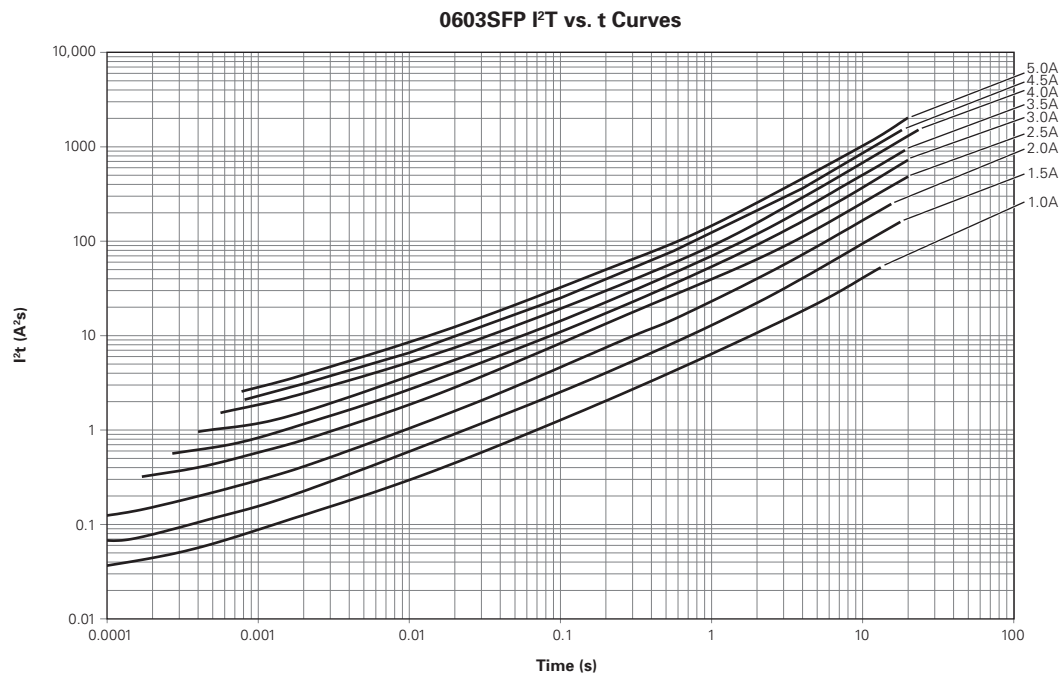
\* Measured at ≤10% of rated current and 25°C ambient temperature.  
<sup>†</sup> Melting I<sup>2</sup>t at 0.001 sec clear time.

**Figure FP1-FP4 Family Performance Curves for Pulse Tolerant Chip Fuses**

**Figure FP1**



**Figure FP2**



**Note:** Curves are nominal

Figure FP3

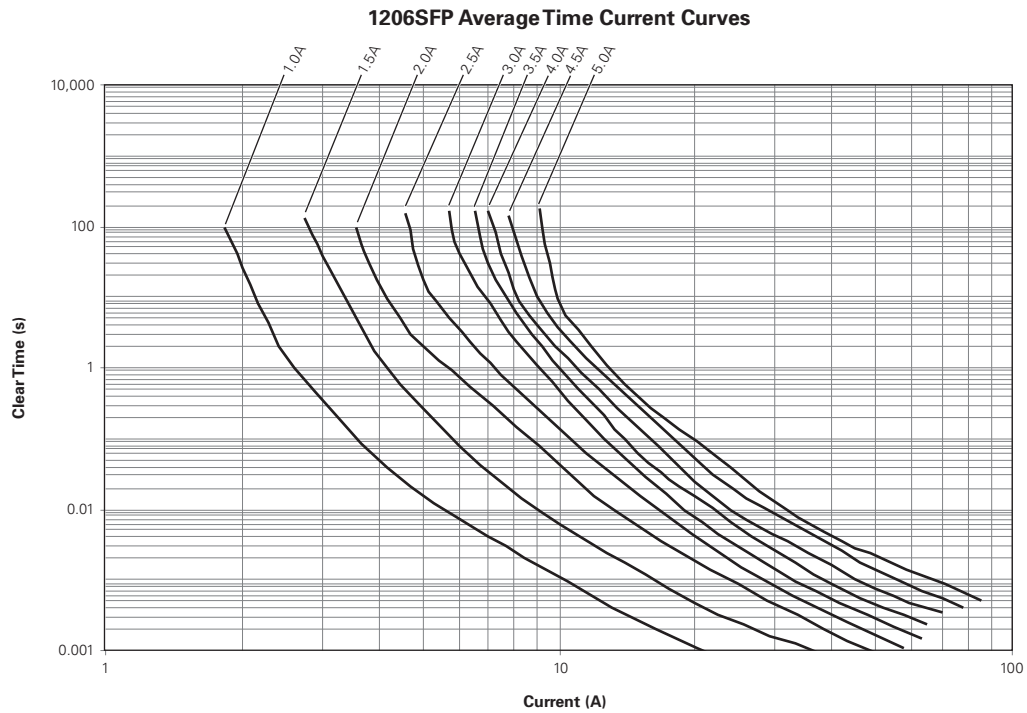
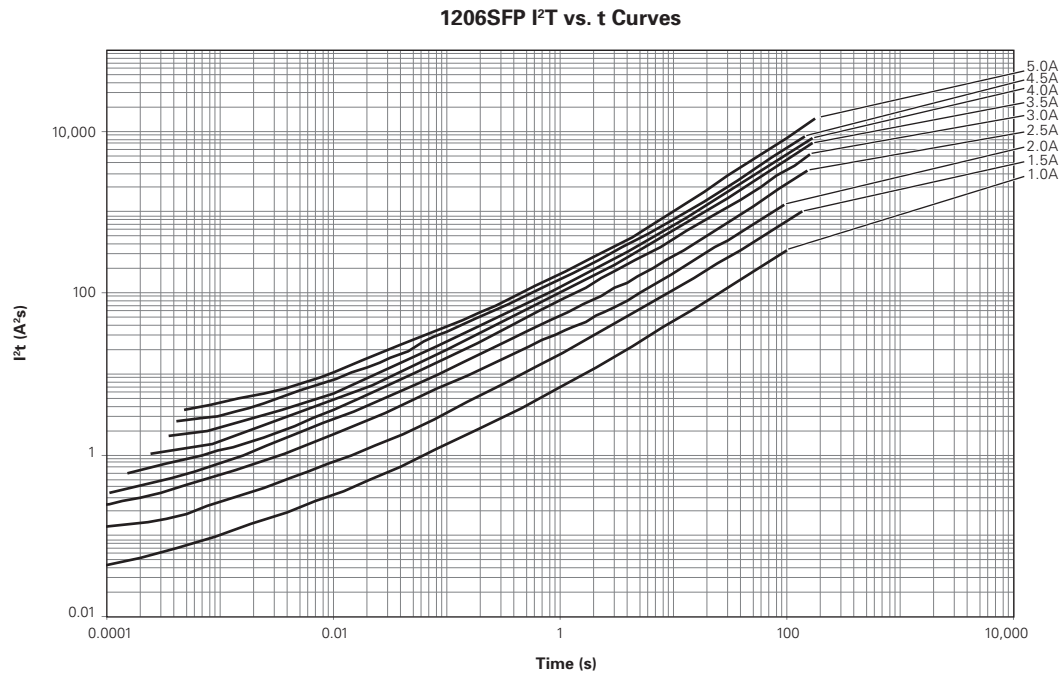


Figure FP4



Note: Curves are nominal

→ Please go to page 97 for more information for Pulse Tolerant Chip Fuses.



## Surface-mount Fuses

### 0603 Very Fast-Acting Chip Fuses



Very Fast-acting chip fuses help provide overcurrent protection on systems using DC power sources up to 63V<sub>DC</sub>. The fuse's monolithic, multilayer design provides the highest hold current in the smallest footprint, reduces diffusion-related aging, improves product reliability and resilience, and enhances high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high performance consumer electronics such as laptops, multimedia devices, cell phones, and other portable electronics.



#### Benefits

- Very fast acting at 200% and 300% overloads
- Excellent inrush current withstanding capability at high overloads
- Thin body for space limiting applications
- Glass ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- RoHS compliant and lead-free materials
- Symmetrical design with marking on both sides (optional)

#### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

#### Applications

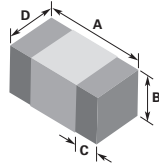
- |                   |                        |                |
|-------------------|------------------------|----------------|
| • Laptops         | • Printers             | • Game systems |
| • Digital cameras | • DVD players          | • LCD monitors |
| • Cell phones     | • Portable electronics | • Scanners     |

**Table FV1 Clear Time Characteristics for Very Fast-Acting Chip Fuses**

| % of rated current | Clear time at 25°C  |                    |
|--------------------|---------------------|--------------------|
| 100%               | 4 hours (min.)      |                    |
| 200%               | 0.01 second (min.)  | 5 seconds (max.)   |
| 300%               | 0.001 second (min.) | 0.2 seconds (max.) |

**Table FV2 Typical Electrical Characteristics and Dimensions for Very Fast-Acting Chip Fuses**
**0603 (1608 mm) Very Fast-Acting Chip Fuses**

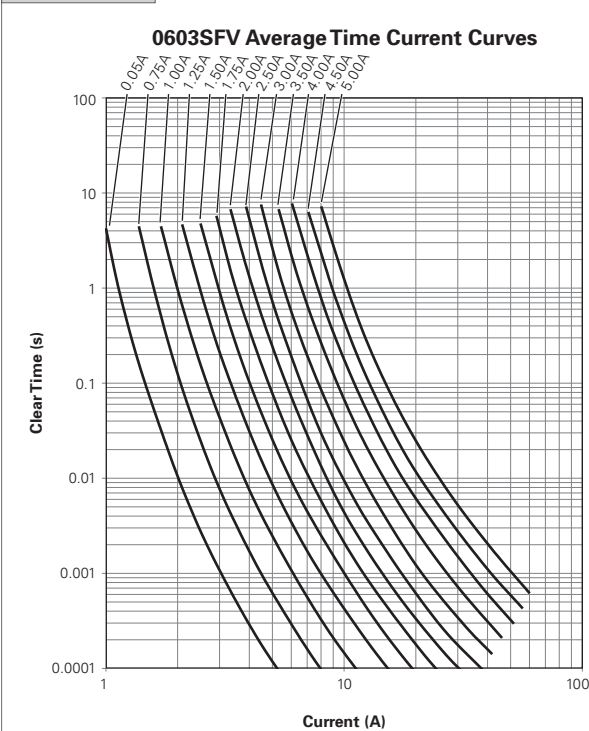
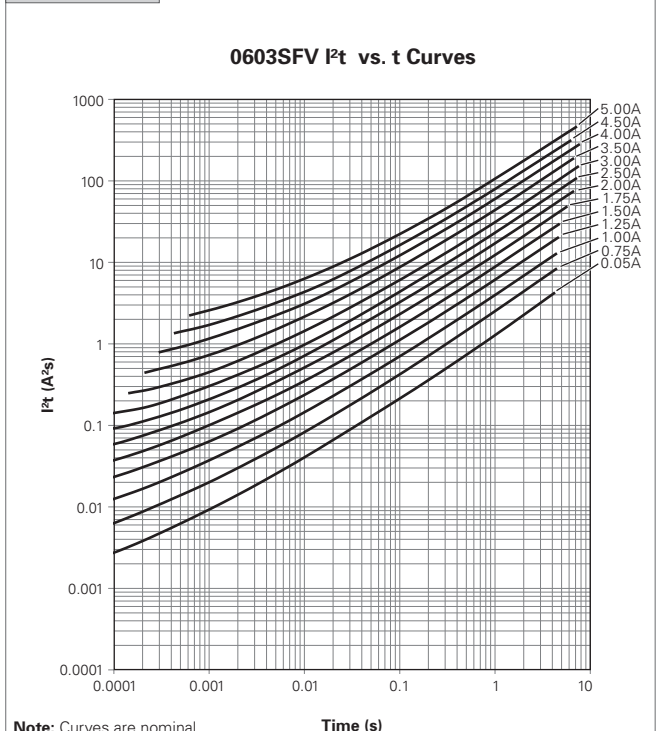
**Shape and Dimensions**  
mm (Inch)



|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 1.45    | 1.75    | 0.22    | 0.48    | 0.21    | 0.51    | 0.65    | 0.95    |
| in | (0.057) | (0.069) | (0.009) | (0.019) | (0.008) | (0.020) | (0.025) | (0.037) |

| Part Number      | Typical Electrical Characteristics |                                |                                     | Max. Interrupt Ratings     |             |
|------------------|------------------------------------|--------------------------------|-------------------------------------|----------------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR ( $\Omega$ )* | Nominal $I^2t$ (A <sup>2</sup> sec) | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFV050F/32-2 | 0.5                                | 0.860                          | 0.0093                              | 32                         | 50          |
| 0603SFV075F/32-2 | 0.8                                | 0.450                          | 0.0191                              | 32                         | 50          |
| 0603SFV100F/32-2 | 1.0                                | 0.280                          | 0.0360                              | 32                         | 50          |
| 0603SFV125F/32-2 | 1.3                                | 0.205                          | 0.0630                              | 32                         | 35          |
| 0603SFV150F/32-2 | 1.5                                | 0.143                          | 0.0950                              | 32                         | 35          |
| 0603SFV175F/32-2 | 1.8                                | 0.095                          | 0.1400                              | 32                         | 35          |
| 0603SFV200F/32-2 | 2.0                                | 0.073                          | 0.2100                              | 32                         | 35          |
| 0603SFV250F/32-2 | 2.5                                | 0.046                          | 0.3000                              | 32                         | 35          |
| 0603SFV300F/32-2 | 3.0                                | 0.039                          | 0.4600                              | 32                         | 35          |
| 0603SFV350F/32-2 | 3.5                                | 0.028                          | 0.7300                              | 32                         | 35          |
| 0603SFV400F/32-2 | 4.0                                | 0.023                          | 1.1500                              | 32                         | 35          |
| 0603SFV450F/32-2 | 4.5                                | 0.019                          | 1.6800                              | 32                         | 35          |
| 0603SFV500F/32-2 | 5.0                                | 0.015                          | 2.6200                              | 32                         | 35          |

\* Measured at 10% of rated current and 25°C

**Figure FV1-FV2 Family Performance Curves for Very Fast-Acting Chip Fuses**
**Figure FV1**

**Figure FV2**


→ Please go to page 97 for more information for Very Fast-Acting Chip Fuses.



# Surface-mount Fuses

## Fast-Acting Chip Fuses

Fast-acting chip fuses help provide overcurrent protection on systems using DC power sources up to 63V<sub>DC</sub>. The fuse's monolithic, multilayer design provides the highest hold current in the smallest footprint, reduces diffusion-related aging, improves product reliability and resilience, and enhances high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high performance consumer electronics such as laptops, multimedia devices, cell phones, and other portable electronics.



### Benefits

- Small size with high-current ratings
- Excellent temperature stability
- High reliability and resilience
- Strong arc suppression characteristics

### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- |                   |                        |                |
|-------------------|------------------------|----------------|
| • Laptops         | • Printers             | • Game systems |
| • Digital cameras | • DVD players          | • LCD monitors |
| • Cell phones     | • Portable electronics | • Scanners     |

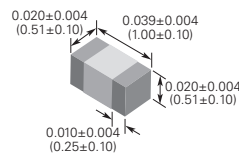


**Table FF1 Clear Time Characteristics for Fast-Acting Chip Fuses**

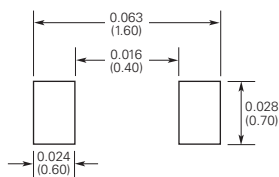
| % of rated current | Clear time at 25°C |
|--------------------|--------------------|
| 100%               | 4 hours min.       |
| 250%               | 5 seconds max.     |
| 400%               | 0.05 seconds max.  |

**Table FF2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Fast-Acting Chip Fuses**
**0402 (1005mm) Fast-Acting Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



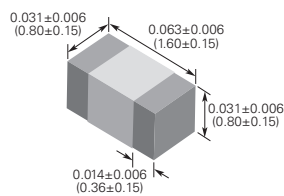
**Recommended Pad Layout**  
Inch (mm)


**Typical Electrical Characteristics**
**Max. Interrupt Ratings**

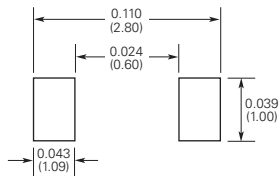
| Part Number    | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
|----------------|-------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
| 0402SFF050F/24 | 0.50              | 0.380                 | 0.0043                                                     | 24                         | 35          |
| 0402SFF075F/24 | 0.75              | 0.210                 | 0.0076                                                     | 24                         | 35          |
| 0402SFF100F/24 | 1.00              | 0.120                 | 0.0170                                                     | 24                         | 35          |
| 0402SFF150F/24 | 1.50              | 0.056                 | 0.0490                                                     | 24                         | 35          |
| 0402SFF200F/24 | 2.00              | 0.035                 | 0.0700                                                     | 24                         | 35          |
| 0402SFF300F/24 | 3.00              | 0.021                 | 0.1250                                                     | 24                         | 35          |
| 0402SFF400F/24 | 4.00              | 0.014                 | 0.2250                                                     | 24                         | 35          |

**0603 (1608mm) Fast-Acting Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



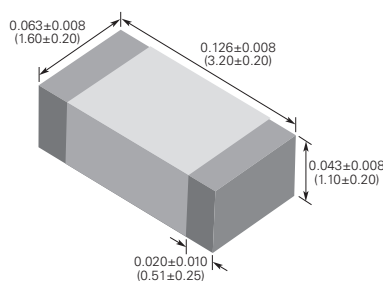
**Recommended Pad Layout**  
Inch (mm)


**Typical Electrical Characteristics**
**Max. Interrupt Ratings**

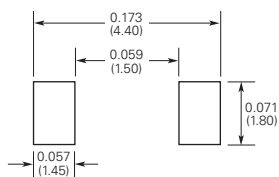
| Part Number    | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
|----------------|-------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
| 0603SFF050F/32 | 0.50              | 0.485                 | 0.0029                                                     | 32                         | 50          |
| 0603SFF075F/32 | 0.75              | 0.254                 | 0.0064                                                     | 32                         | 50          |
| 0603SFF100F/32 | 1.00              | 0.131                 | 0.0160                                                     | 32                         | 50          |
| 0603SFF150F/32 | 1.50              | 0.059                 | 0.0300                                                     | 32                         | 35          |
| 0603SFF200F/32 | 2.00              | 0.044                 | 0.0600                                                     | 32                         | 35          |
| 0603SFF250F/32 | 2.50              | 0.032                 | 0.1150                                                     | 32                         | 35          |
| 0603SFF300F/32 | 3.00              | 0.025                 | 0.1900                                                     | 32                         | 35          |
| 0603SFF350F/32 | 3.50              | 0.024                 | 0.2950                                                     | 32                         | 35          |
| 0603SFF400F/32 | 4.00              | 0.018                 | 0.4000                                                     | 32                         | 35          |
| 0603SFF500F/32 | 5.00              | 0.013                 | 0.7000                                                     | 32                         | 35          |
| 0603SFF600F/24 | 6.00              | 0.010                 | 1.1250                                                     | 24                         | 35          |

**1206 (3216mm) Fast-Acting Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



**Recommended Pad Layout**  
Inch (mm)


**Typical Electrical Characteristics**
**Max. Interrupt Ratings**

| Part Number    | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
|----------------|-------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
| 1206SFF050F/63 | 0.50              | 0.730                 | 0.0021                                                     | 63                         | 50          |
| 1206SFF075F/63 | 0.75              | 0.513                 | 0.0052                                                     | 63                         | 50          |
| 1206SFF100F/63 | 1.00              | 0.220                 | 0.0120                                                     | 63                         | 50          |
| 1206SFF150F/63 | 1.50              | 0.120                 | 0.0250                                                     | 63                         | 50          |
| 1206SFF175F/63 | 1.75              | 0.100                 | 0.0450                                                     | 63                         | 50          |
| 1206SFF200F/63 | 2.00              | 0.050                 | 0.0700                                                     | 63                         | 50          |
| 1206SFF250F/32 | 2.50              | 0.035                 | 0.1400                                                     | 32                         | 50          |
| 1206SFF300F/32 | 3.00              | 0.031                 | 0.2200                                                     | 32                         | 50          |
| 1206SFF400F/32 | 4.00              | 0.022                 | 0.3800                                                     | 32                         | 45          |
| 1206SFF500F/32 | 5.00              | 0.015                 | 0.6000                                                     | 32                         | 45          |
| 1206SFF600F/32 | 6.00              | 0.013                 | 1.0000                                                     | 32                         | 50          |
| 1206SFF700F/32 | 7.00              | 0.011                 | 1.7500                                                     | 32                         | 50          |
| 1206SFF800F/32 | 8.00              | 0.008                 | 2.5000                                                     | 32                         | 50          |
| 1206SFF600F/24 | 6.00              | 0.013                 | 1.0000                                                     | 24                         | 45          |
| 1206SFF700F/24 | 7.00              | 0.011                 | 1.7500                                                     | 24                         | 45          |
| 1206SFF800F/24 | 8.00              | 0.008                 | 2.5000                                                     | 24                         | 45          |

\* Measured at ≤10% of rated current and 25°C ambient temperature.  
† Melting I<sup>2</sup>t at 0.001 sec clear time.



Figure FF1-FF6 Family Performance Curves for Fast-Acting Chip Fuses

Figure FF1

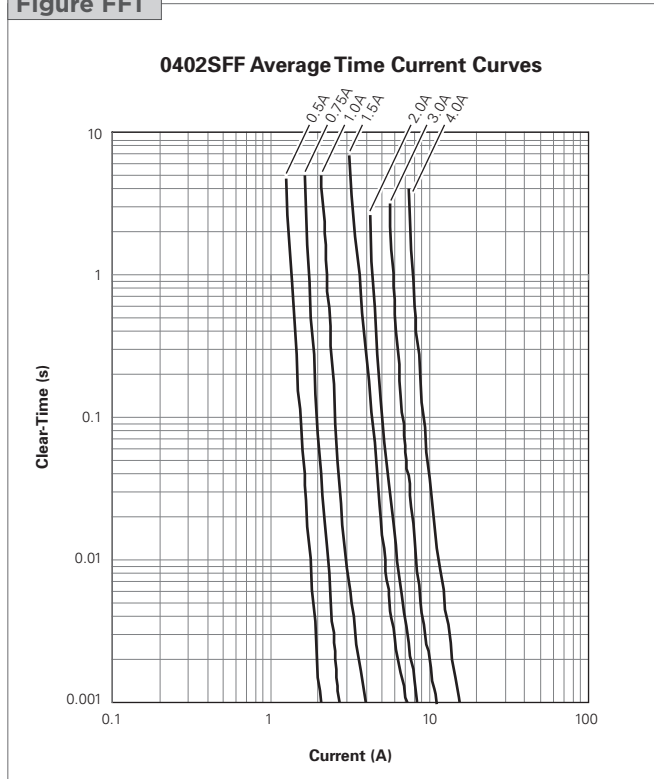


Figure FF2

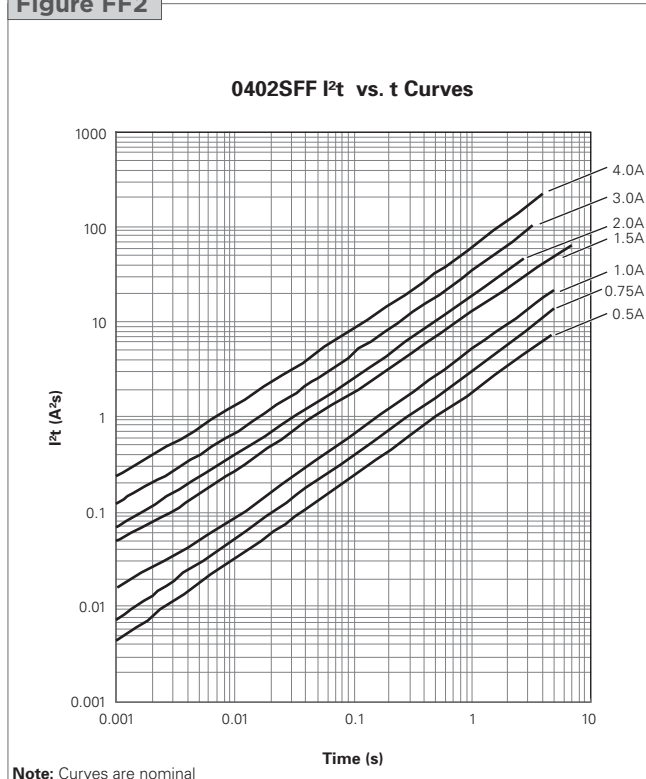


Figure FF3

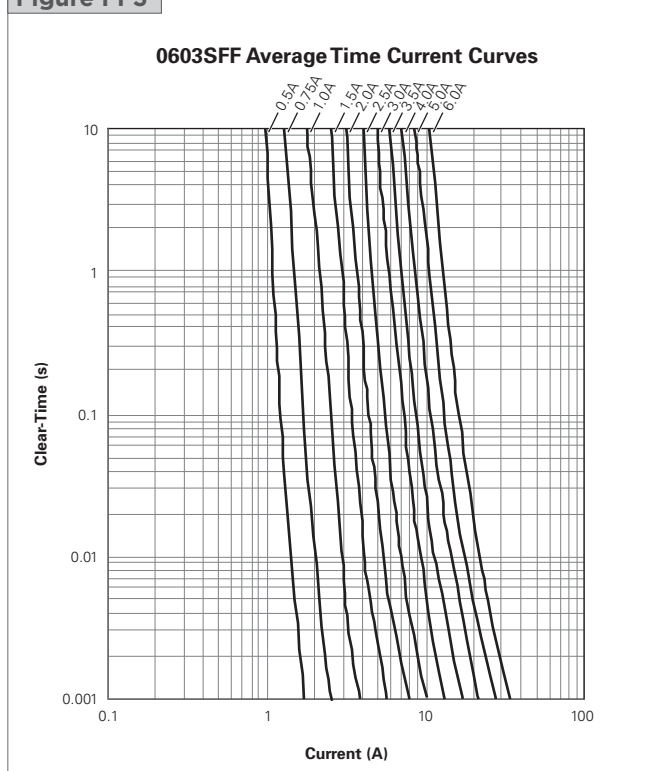
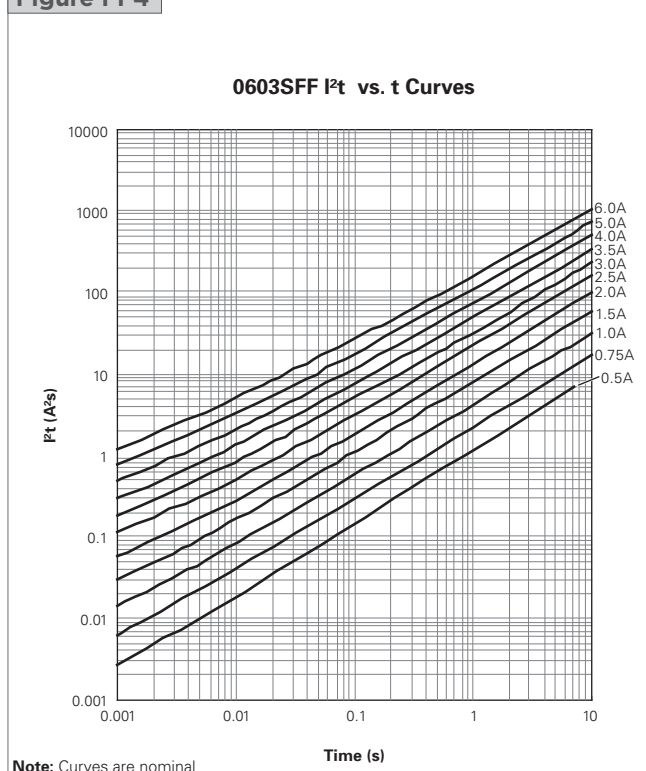
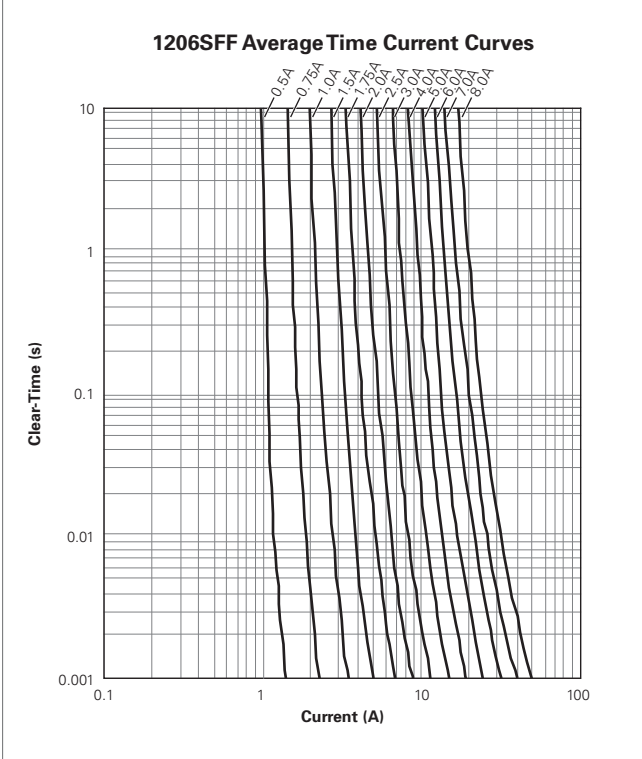


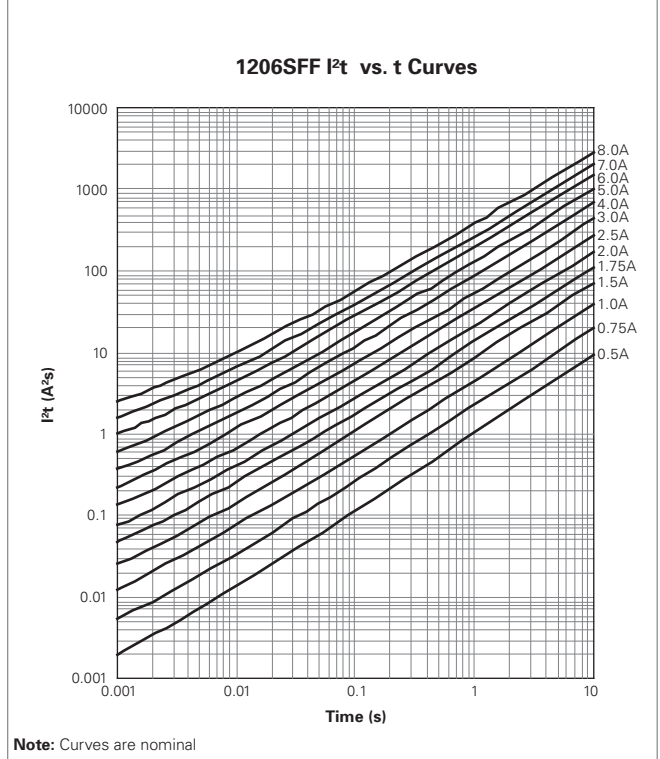
Figure FF4



**Figure FF5**



**Figure FF6**



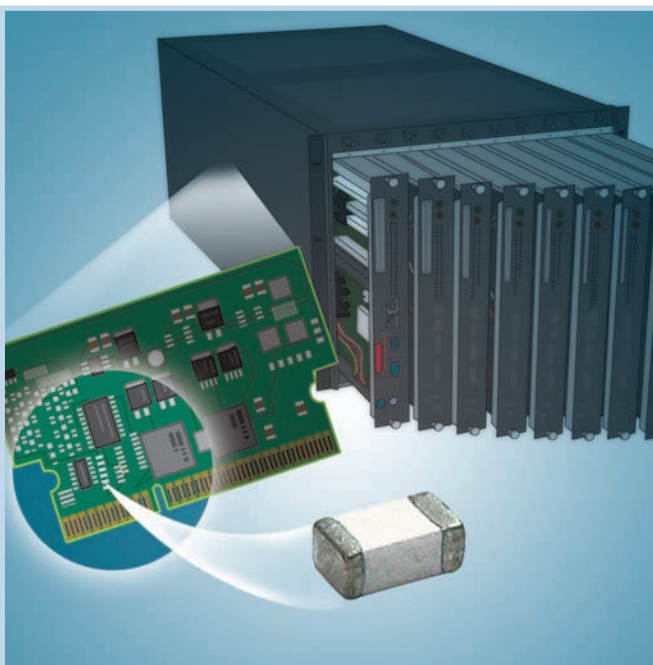
→ Please go to page 97 for more information for Fast-Acting Chip Fuses.



## Surface-mount Fuses

### High-Current-Rated Chip Fuses

The monolithic multilayer design of the TE Circuit Protection high-current-rated chip fuses helps to provide some of the highest current ratings available in the 1206 size and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, servers, communications equipment, voltage regulator modules, and other high-current, small size applications.



#### Benefits

- Glass ceramic monolithic structure provides stability in application cycling
- High-current rating in a small package allows more efficient use in system space
- Strong arc suppression in overcurrent conditions

#### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

#### Applications

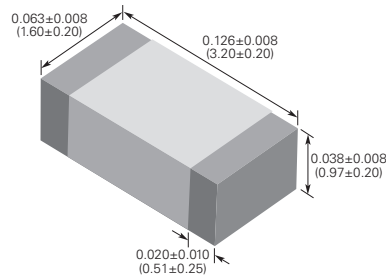
- Communications equipment
- Voltage regulator modules
- Power supplies
- Servers

**Table FH1 Clear Time Characteristics for High-Current-Rated Chip Fuses**
**1206SFH Series**

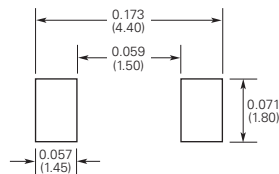
| % of rated current | Clear time at 25°C |
|--------------------|--------------------|
| 100%               | 4 hours (min.)     |
| 250%               | 5 seconds (max.)   |

**Table FH2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for High-Current-Rated Chip Fuses**
**1206 (3216mm) High-Current-Rated Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



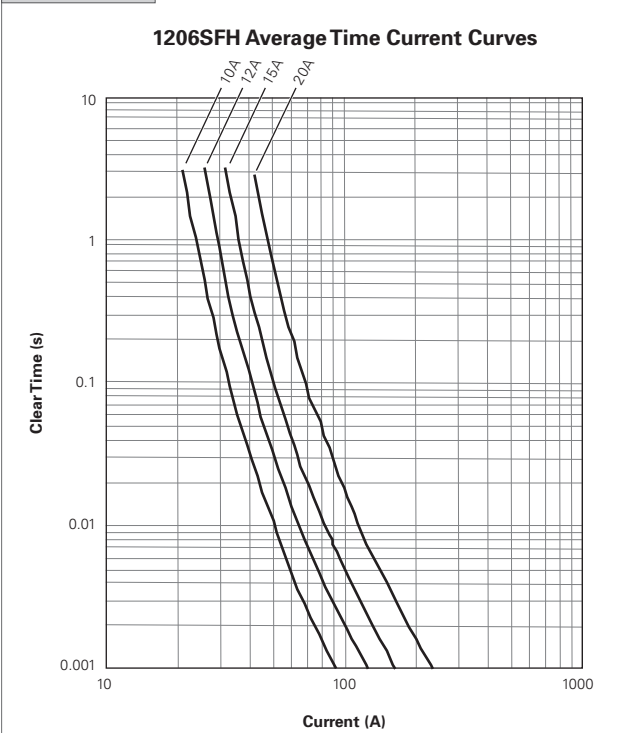
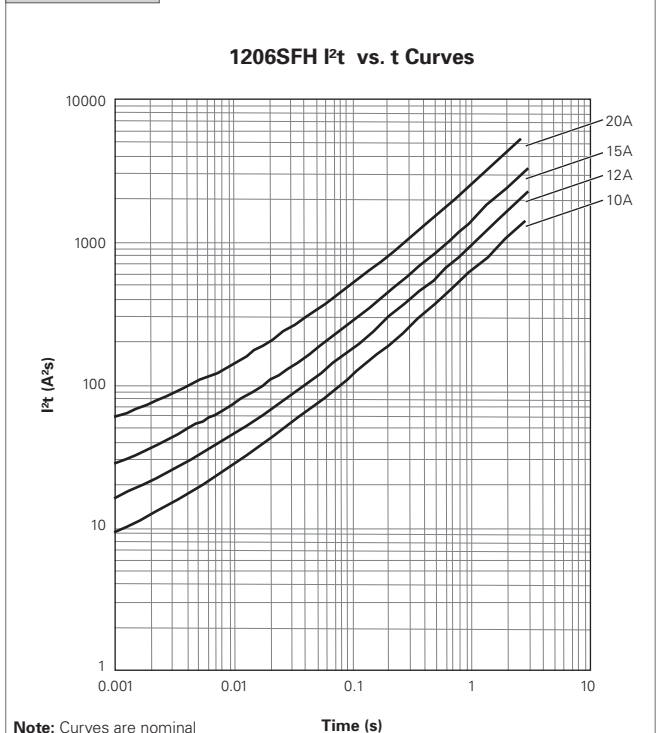
**Recommended Pad Layout**  
Inch (mm)


**Typical Electrical Characteristics**
**Max. Interrupt Ratings**

| Part Number    | Rated Current (A) | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
|----------------|-------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
| 1206SFH100F/24 | 10                | 0.010                 | 9                                                          | 24                         | 100         |
| 1206SFH120F/24 | 12                | 0.008                 | 14                                                         | 24                         | 100         |
| 1206SFH150F/24 | 15                | 0.005                 | 26                                                         | 24                         | 100         |
| 1206SFH200F/24 | 20                | 0.003                 | 56                                                         | 24                         | 100         |

\* Measured at ≤10% of rated current and 25°C ambient temperature.

† Melting I<sup>2</sup>t at 0.001 sec clear time.

**Figure FH1-FH2 Family Performance Curves for High-Current-Rated Chip Fuses**
**Figure FH1**

**Figure FH2**


→ Please go to page 97 for more information for High-Current-Rated Chip Fuses.



## Surface-mount Fuses Slow-Blow Chip Fuses

Available in industry standard 1206 and 0603 chip sizes, TE Circuit Protection's slow-blow chip fuses help provide overcurrent protection on systems that experience large and frequent current surges as part of their normal operation.

The slow-blow chip fuse's monolithic, multilayer design helps provide some of the highest current ratings available in the 1206 and 0603 footprints and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, capacitor filter banks, LCD (Liquid Crystal Display) backlight inverters, electric motors and portable electronics.



### Benefits

- Time-delayed design prevents nuisance openings in pulsed and high inrush current applications
- Small size with high-current ratings
- Strong arc suppression characteristics

### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### Applications

- |                        |                             |                   |
|------------------------|-----------------------------|-------------------|
| • Small motors systems | • Power over Ethernet (POE) | • Computer drives |
| • Portable electronics | • Test equipment            | • Displays        |
| • Input power ports    | • POL converter protection  | • Printers        |

**Table FS1 Clear Time Characteristics for Slow-Blow Chip Fuses**
**0603SFS Series**

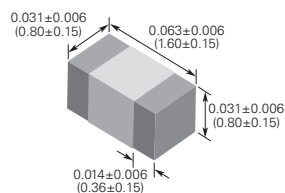
| % of rated current | Clear time at 25°C   |                     |
|--------------------|----------------------|---------------------|
| 100%               | 4 hours (min.)       |                     |
| 200%               | 1 second (min.)      | 120 seconds (max.)  |
| 300%               | 0.1 second (min.)    | 3 seconds (max.)    |
| 800%(1.0A-1.5A)    | 0.0005 second (min.) | 0.05 seconds (max.) |
| 800%(2.0A-5.0A)    | 0.001 second (min.)  | 0.05 seconds (max.) |

**1206SFS Series**

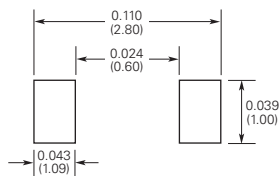
| % of rated current | Clear time at 25°C   |                     |
|--------------------|----------------------|---------------------|
| 100%               | 4 hours (min.)       |                     |
| 200%               | 1 second (min.)      | 120 seconds (max.)  |
| 300%               | 0.1 second (min.)    | 3 seconds (max.)    |
| 800%(1.0A-1.5A)    | 0.0016 second (min.) | 0.05 seconds (max.) |
| 800%(2.0A-8.0A)    | 0.002 second (min.)  | 0.05 seconds (max.) |

**Table FS2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Slow-Blow Chip Fuses**
**0603 (1608mm) Slow-Blow Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



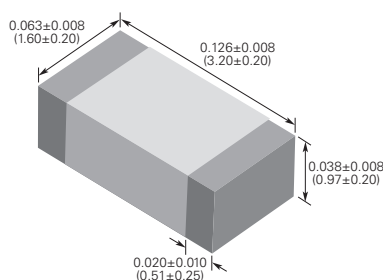
**Recommended Pad Layout**  
Inch (mm)



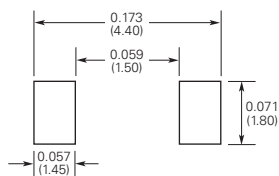
| Part Number    | Typical Electrical Characteristics |                       |                                                            | Max. Interrupt Ratings     |             |
|----------------|------------------------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFS100F/32 | 1.0                                | 0.200                 | 0.093                                                      | 32                         | 50          |
| 0603SFS150F/32 | 1.5                                | 0.100                 | 0.18                                                       | 32                         | 50          |
| 0603SFS200F/32 | 2.0                                | 0.052                 | 0.32                                                       | 32                         | 50          |
| 0603SFS250F/32 | 2.5                                | 0.041                 | 0.63                                                       | 32                         | 50          |
| 0603SFS300F/32 | 3.0                                | 0.031                 | 0.87                                                       | 32                         | 50          |
| 0603SFS350F/32 | 3.5                                | 0.021                 | 1.20                                                       | 32                         | 50          |
| 0603SFS400F/32 | 4.0                                | 0.017                 | 2.30                                                       | 32                         | 50          |
| 0603SFS450F/32 | 4.5                                | 0.015                 | 2.70                                                       | 32                         | 50          |
| 0603SFS500F/32 | 5.0                                | 0.013                 | 3.20                                                       | 32                         | 50          |

**1206 (3216mm) Slow-Blow Chip Fuses**

**Shape and Dimensions**  
Inch (mm)



**Recommended Pad Layout**  
Inch (mm)



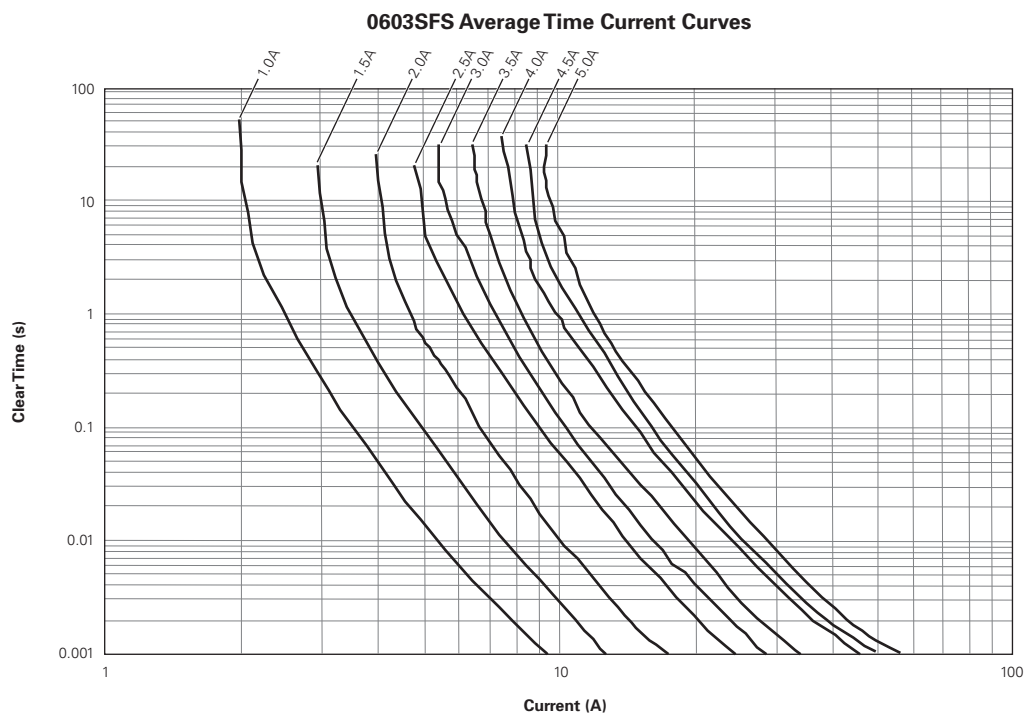
| Part Number    | Typical Electrical Characteristics |                       |                                                            | Max. Interrupt Ratings     |             |
|----------------|------------------------------------|-----------------------|------------------------------------------------------------|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFS100F/63 | 1.0                                | 0.360                 | 0.11                                                       | 63                         | 50          |
| 1206SFS125F/63 | 1.25                               | 0.200                 | 0.22                                                       | 63                         | 50          |
| 1206SFS150F/63 | 1.5                                | 0.150                 | 0.23                                                       | 63                         | 50          |
| 1206SFS200F/63 | 2.0                                | 0.088                 | 0.63                                                       | 63                         | 50          |
| 1206SFS250F/32 | 2.5                                | 0.065                 | 0.90                                                       | 32                         | 50          |
| 1206SFS300F/32 | 3.0                                | 0.034                 | 1.20                                                       | 32                         | 50          |
| 1206SFS350F/32 | 3.5                                | 0.028                 | 1.60                                                       | 32                         | 50          |
| 1206SFS400F/32 | 4.0                                | 0.024                 | 2.20                                                       | 32                         | 50          |
| 1206SFS450F/32 | 4.5                                | 0.020                 | 3.60                                                       | 32                         | 50          |
| 1206SFS500F/32 | 5.0                                | 0.016                 | 5.30                                                       | 32                         | 50          |
| 1206SFS550F/24 | 5.5                                | 0.014                 | 6.40                                                       | 24                         | 50          |
| 1206SFS600F/24 | 6.0                                | 0.011                 | 8.50                                                       | 24                         | 60          |
| 1206SFS700F/24 | 7.0                                | 0.010                 | 10.00                                                      | 24                         | 60          |
| 1206SFS800F/24 | 8.0                                | 0.009                 | 16.90                                                      | 24                         | 60          |

\* Measured at ≤10% of rated current and 25°C ambient temperature.

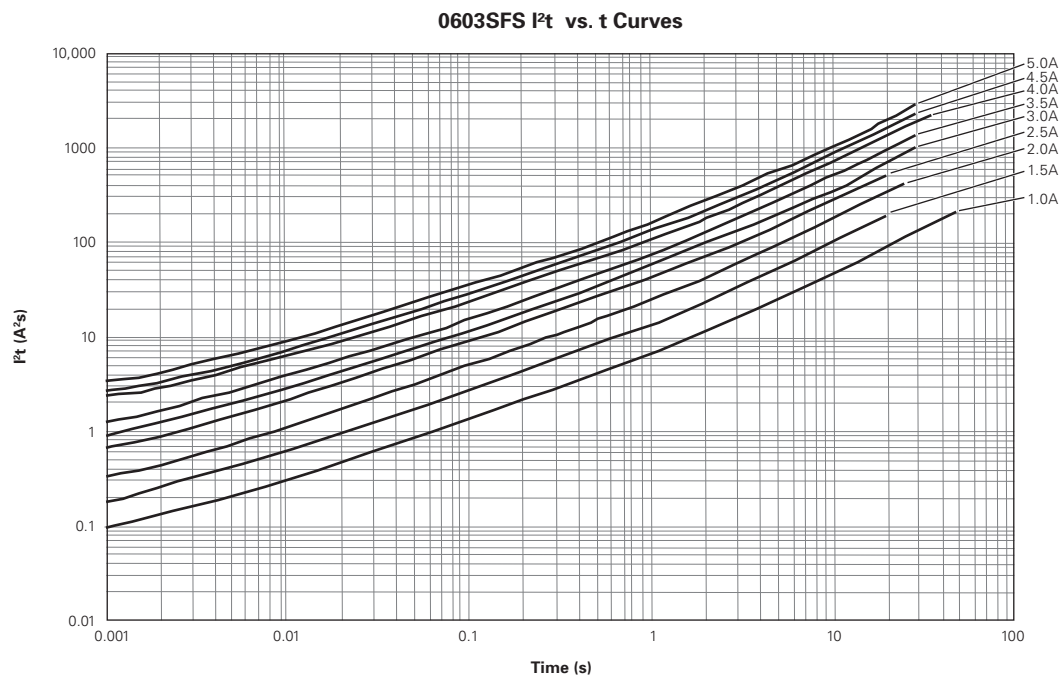
† Melting I<sup>2</sup>t at 0.001 sec clear time.

**Figure FS1-FS4 Family Performance Curves for Slow-Blow Chip Fuses**

**Figure FS1**



**Figure FS2**



**Note:** Curves are nominal



Figure FS3

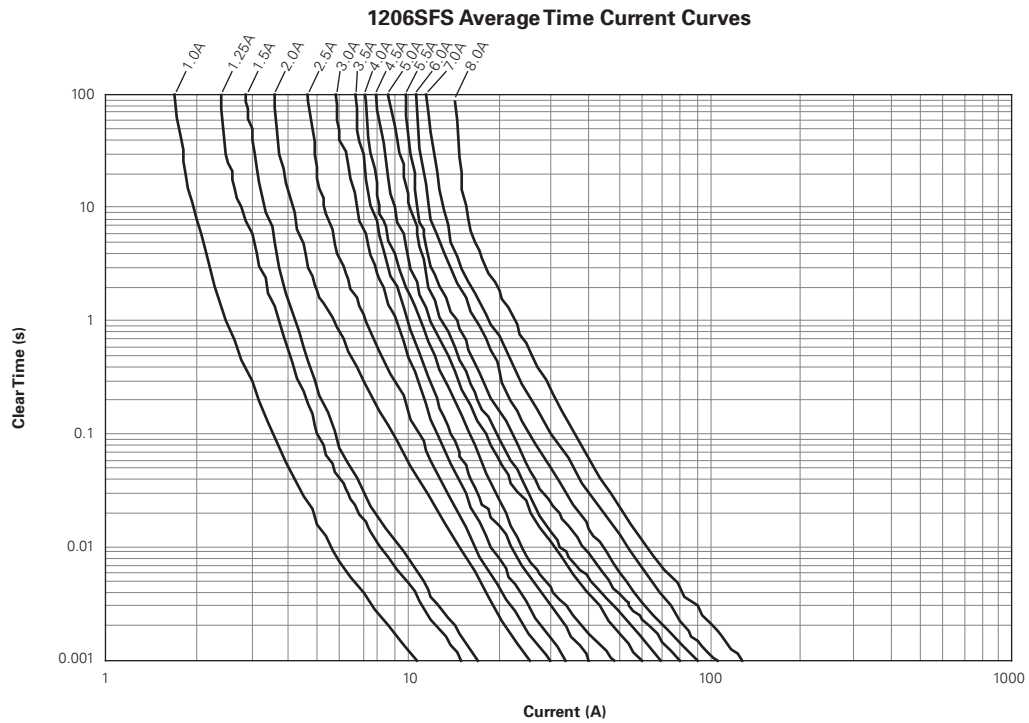
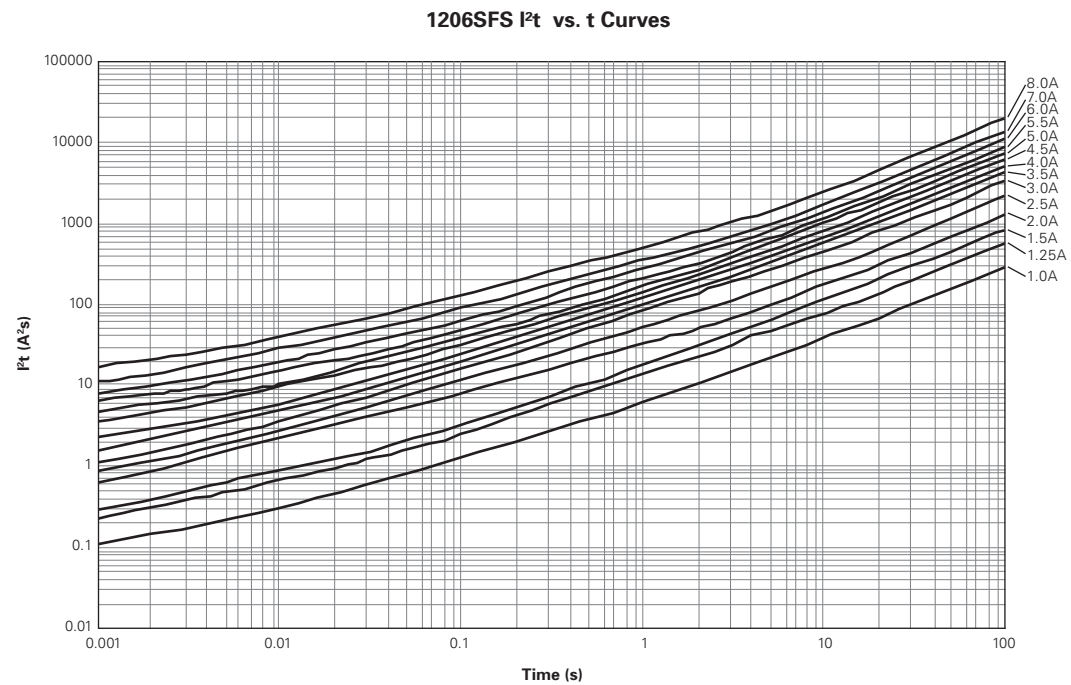


Figure FS4



Note: Curves are nominal

→ Please go to page 97 for more information for Slow-Blow Chip Fuses.



## Surface-mount Fuses

### 2410 Very Fast-Acting Fuses



The 2410(6125) is Wire-in Air SMD Fuse which is very suitable for secondary level overcurrent protection applications.

These lead-free surface mount devices offer more reliability and have no end cap falling off risk. Straight wire element in air performs consistent fusing and cutting characteristics.



#### Benefits

- Very fast acting at 200% overload current level
- Excellent inrush current withstanding capability
- High reliability and resilience
- Strong arc suppression characteristics
- Copper terminal with nickel and tin plated

#### Features

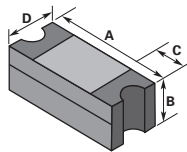
- Halogen free, RoHS compliant and 100% lead-free
- Copper or copper alloy composite fuse link
- Fiberglass enforced epoxy fuse body
- Wide range of current rating
- -55°C to +125°C operating temperature range (with de-rating)

#### Applications

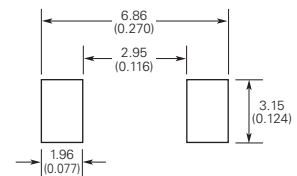
- |                        |                  |                |
|------------------------|------------------|----------------|
| • Industrial equipment | • Power supplier | • Game systems |
| • LCD/PDP TV           | • Telecom system | • White goods  |
| • Backlight inverter   | • Networking     | • Automotive   |

**Table SFV1 Clear Time Characteristics for 2410 Very Fast-Acting Fuses**

| % of rated current | Clear time at 25°C |                   |
|--------------------|--------------------|-------------------|
| 100%               | 4 hours (min.)     |                   |
| 200% (0.5A-10.0A)  | 0.01 second (min.) | 5 seconds (max.)  |
| 200% (12.0A-20.0A) | 0.01 second (min.) | 20 seconds (max.) |

**Table SFV2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for 2410 Very Fast-Acting Fuses**
**2410 (6125 mm) Very Fast-Acting Fuse**
**Shape and Dimensions**  
mm (Inch)


|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 5.95    | 6.25    | 1.96    | 2.36    | 0.97    | 1.73    | 2.34    | 2.64    |
| in | (0.234) | (0.246) | (0.077) | (0.093) | (0.038) | (0.068) | (0.092) | (0.104) |

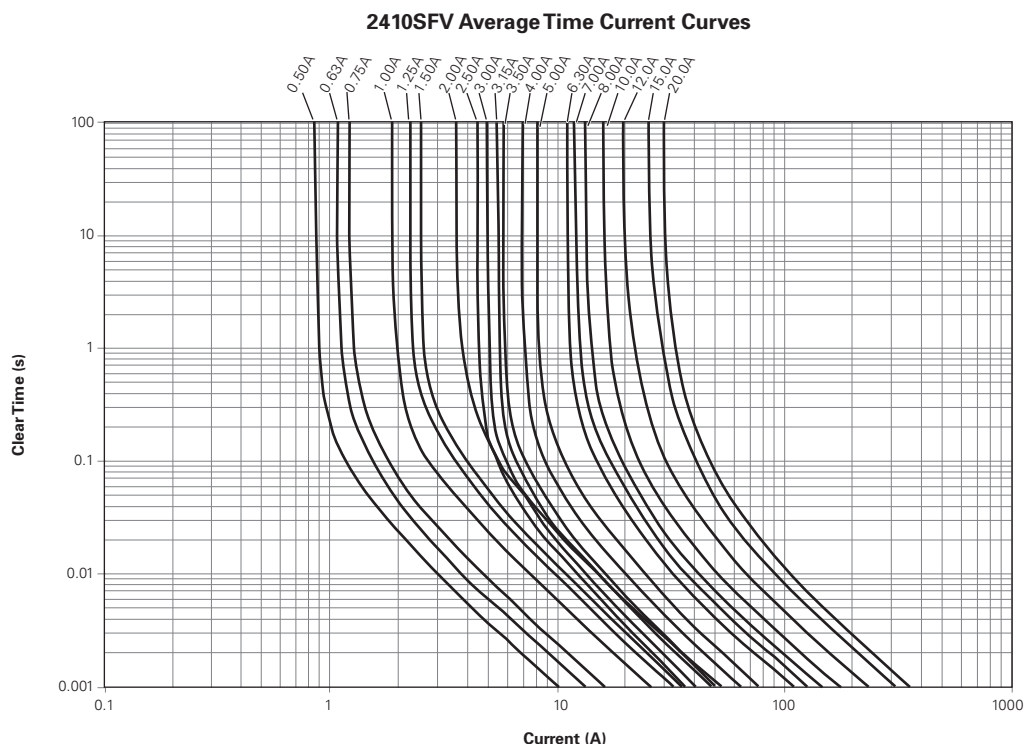
**Recommended Pad Layout**  
mm (Inch)


| Part Number         | Marking Code | Typical Electrical Characteristics |                                |                                     | Max. Interrupt Ratings |                    |                                                                                  |
|---------------------|--------------|------------------------------------|--------------------------------|-------------------------------------|------------------------|--------------------|----------------------------------------------------------------------------------|
|                     |              | Rated Current (A)                  | Nominal Cold DCR ( $\Omega$ )* | Nominal $I^2t$ (A <sup>2</sup> sec) | Voltage                |                    | Current (A)                                                                      |
|                     |              |                                    |                                |                                     | (V <sub>AC</sub> )     | (V <sub>DC</sub> ) |                                                                                  |
| 2410SFV0.50FM/125-2 | C            | 0.5                                | 0.2310                         | 0.10                                | 250                    | 125                | 50A @ 250V <sub>AC</sub><br>50A @ 125V <sub>DC</sub><br>300A @ 32V <sub>DC</sub> |
| 2410SFV0.63FM/125-2 | S            | 0.6                                | 0.1740                         | 0.16                                | 250                    | 125                |                                                                                  |
| 2410SFV0.75FM/125-2 | D            | 0.8                                | 0.1480                         | 0.23                                | 250                    | 125                |                                                                                  |
| 2410SFV1.00FM/125-2 | E            | 1.0                                | 0.0930                         | 0.59                                | 250                    | 125                |                                                                                  |
| 2410SFV1.25FM/125-2 | F            | 1.3                                | 0.0700                         | 0.96                                | 250                    | 125                |                                                                                  |
| 2410SFV1.50FM/125-2 | G            | 1.5                                | 0.0620                         | 1.19                                | 125                    | 125                | 50A @ 125V <sub>AC</sub><br>50A @ 125V <sub>DC</sub><br>300A @ 32V <sub>DC</sub> |
| 2410SFV2.00FM/125-2 | I            | 2.0                                | 0.0420                         | 2.75                                | 125                    | 125                |                                                                                  |
| 2410SFV2.50FM/125-2 | J            | 2.5                                | 0.0310                         | 1.21                                | 125                    | 125                |                                                                                  |
| 2410SFV3.00FM/125-2 | K            | 3.0                                | 0.0249                         | 1.73                                | 125                    | 125                |                                                                                  |
| 2410SFV3.15FM/125-2 | V            | 3.2                                | 0.0232                         | 2.20                                | 125                    | 125                |                                                                                  |
| 2410SFV3.50FM/125-2 | L            | 3.5                                | 0.0220                         | 2.50                                | 125                    | 125                |                                                                                  |
| 2410SFV4.00FM/125-2 | M            | 4.0                                | 0.0172                         | 4.10                                | 125                    | 125                |                                                                                  |
| 2410SFV5.00FM/125-2 | N            | 5.0                                | 0.0143                         | 5.90                                | 125                    | 125                |                                                                                  |
| 2410SFV6.30FM/125-2 | O            | 6.3                                | 0.0100                         | 12.50                               | 125                    | 125                |                                                                                  |
| 2410SFV7.00FM/125-2 | P            | 7.0                                | 0.0094                         | 14.20                               | 125                    | 125                |                                                                                  |
| 2410SFV8.00FM/125-2 | R            | 8.0                                | 0.0086                         | 20.30                               | 125                    | 125                |                                                                                  |
| 2410SFV10.0FM/125-2 | Q            | 10.0                               | 0.0066                         | 29.20                               | 125                    | 125                | 35A @ 125V <sub>AC</sub><br>50A @ 125V <sub>DC</sub><br>300A @ 32V <sub>DC</sub> |
| 2410SFV12.0FM/065-2 | X            | 12.0                               | 0.0053                         | 49.20                               | 65                     | 65                 | 50A @ 65V <sub>AC</sub><br>50A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   |
| 2410SFV15.0FM/065-2 | Y            | 15.0                               | 0.0038                         | 102.50                              | 65                     | 65                 | 50A @ 65V <sub>AC</sub><br>50A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   |
| 2410SFV20.0FM/065-2 | Z            | 20.0                               | 0.0034                         | 126.20                              | 65                     | 65                 | 50A @ 65V <sub>AC</sub><br>50A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   |

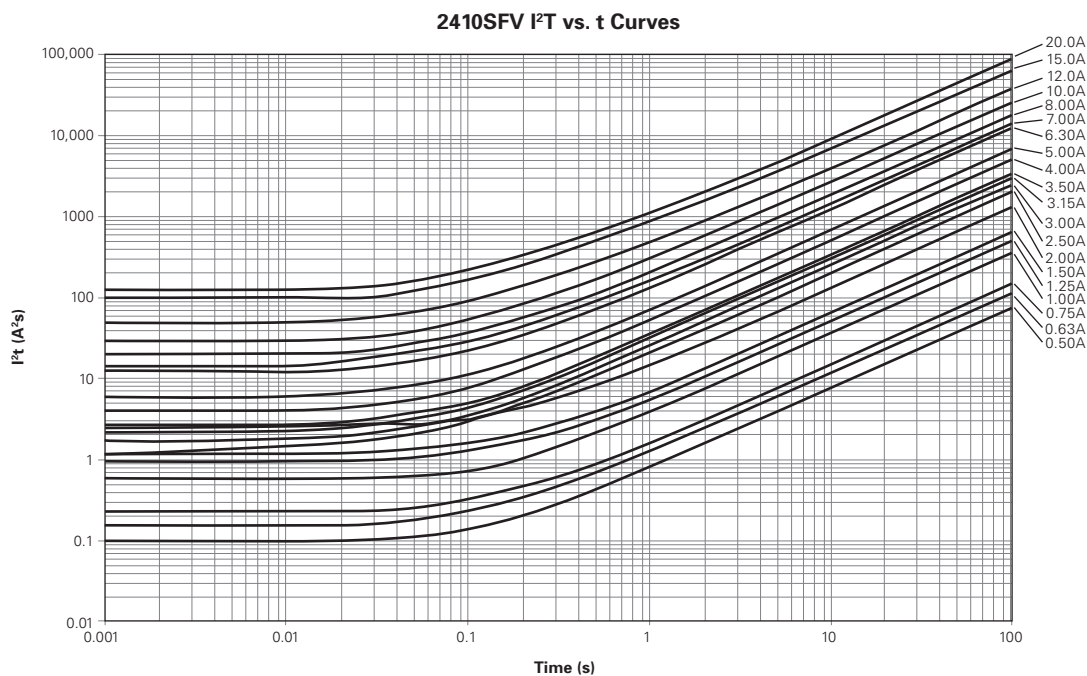
\* Measured at  $\leq 10\%$  of rated current and 25°C ambient temperature.

**Figure SFV1-SFV2 Family Performance Curves for 2410 Very Fast-Acting Fuses**

**Figure SFV1**



**Figure SFV2**



**Note:** Curves are nominal

→ Please go to page 97 for more information for 2410 Fast-Acting Fuses.



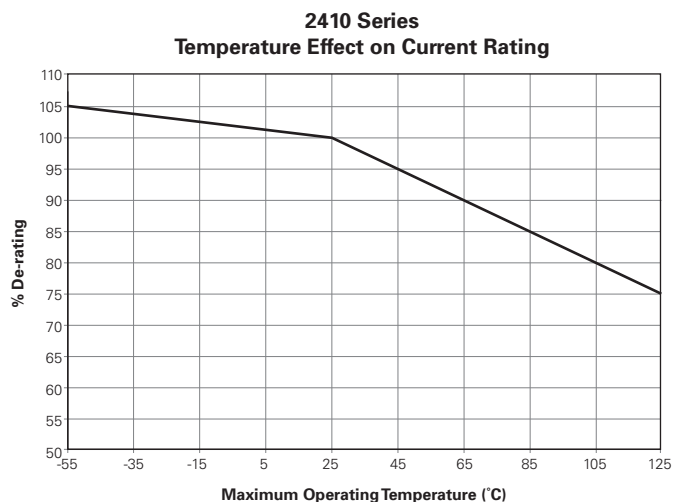
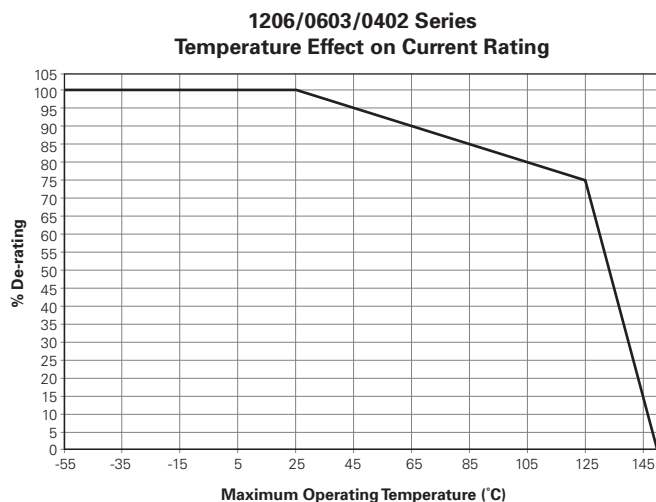
# Specifications, Packaging Information, Agency Approvals and Part Numbering Systems for All Fuses

**Table F1 Environmental Specifications for All Fuses**

|                              |                                                                                                   |
|------------------------------|---------------------------------------------------------------------------------------------------|
| Operating temperature        | -55°C to +125°C                                                                                   |
| Mechanical vibration         | Withstands 5-3000 Hz at 30 Gs when evaluated per Method 204 of MIL-STD-202                        |
| Mechanical shock             | Withstands 1500 Gs, 0.5 millisecond half-sine pulses when evaluated per Method 213 of MIL-STD-202 |
| Thermal shock                | Withstands 100 cycles from -65°C to +125°C when evaluated per Method 107 of MIL-STD-202           |
| Resistance to soldering heat | Withstands 60 seconds at +260°C when evaluated per Method 210 of MIL-STD-202                      |
| Solderability                | Meets 95% minimum coverage requirement when evaluated per Method 208 of MIL-STD-202               |
| Moisture resistance          | Withstands 10 cycles when evaluated per Method 106 of MIL-STD-202                                 |
| Salt spray                   | Withstands 48-hour exposure when evaluated per Method 101 of MIL-STD-202                          |
| Storage temperature          | ≤30°C/ 85% RH                                                                                     |
| Storage humidity             | Per MIL-STD-202F, Method 106F                                                                     |

**Table F2 Material Specifications for All Fuses**

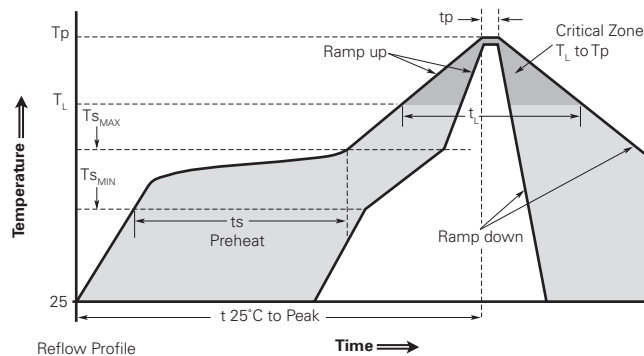
|                            |                                                    |
|----------------------------|----------------------------------------------------|
| Construction body material | Ceramic (1206/0603/0402); Fiberglass/Epoxy (2410)  |
| Termination material       | Silver, Nickel, Tin                                |
| Fuse element               | Silver(1206/0603/0402); Copper/Copper Alloy (2410) |

**Figure F1 Thermal Derating Current for All Fuses**

**Table F3 Electrical Specifications for All Fuses**

|                                     |                                                                                                                                                                                                                                                               |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insulation resistance after opening | 20,000Ω minimum @ rated voltage. Fuse clearing under low voltage conditions may result in lower - post-clearing insulation values. Under normal fault conditions TE Circuit Protection fuses provide sufficient insulation resistance for circuit protection. |
| Current carrying capacity           | Withstands 100% rated current at +25°C ambient for 4 hours when evaluated per MIL-PRF-23419.                                                                                                                                                                  |

**Table F4 Packaging Information for All Fuses**

| Size          | Reel Quantity (pcs) | Reel Diameter       | Reel Width   | Carrier Tape Size | Tape Type | Reels per Outside Shipment Box | Outside Shipment Boxes per Overpack |
|---------------|---------------------|---------------------|--------------|-------------------|-----------|--------------------------------|-------------------------------------|
| 0402(1005)    | 10,000              | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 0603(1608)    | 4,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 0603SFV(1608) | 6,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 1206(3216)    | 3,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Plastic   | 5                              | 1 to 10                             |
| 2410(6125)    | 2,000               | 178mm white plastic | 13.4 ± 0.5mm | 12.00 ± 0.10mm    | Plastic   | 4                              | 1 to 10                             |

**Figure F2 Recommended Soldering Temperature Profile for All Fuses**

**Classification Reflow Profiles**

| Profile Feature                                                            | 1206/0603/0402  | 2410            |
|----------------------------------------------------------------------------|-----------------|-----------------|
| <b>Average ramp up rate (<math>T_{S_{MAX}}</math> to <math>T_p</math>)</b> | 3°C/second max. | 3°C/second max. |
| <b>Preheat</b>                                                             |                 |                 |
| • Temperature min. ( $T_{S_{MIN}}$ )                                       | 150°C           | 150°C           |
| • Temperature max. ( $T_{S_{MAX}}$ )                                       | 200°C           | 200°C           |
| • Time ( $t_{S_{MIN}}$ to $t_{S_{MAX}}$ )                                  | 60-180 seconds  | 40-100 seconds  |
| <b>Time maintained above:</b>                                              |                 |                 |
| • Temperature ( $T_L$ )                                                    | 217°C           | 200°C           |
| • Time ( $t_L$ )                                                           | 60-150 seconds  | 30-90 seconds   |
| <b>Peak/Classification temperature (<math>T_p</math>)</b>                  | 260°C max.      | 250°C max.      |
| <b>Time within 5°C of actual peak temperature</b>                          |                 |                 |
| Time ( $t_p$ )                                                             | 20-40 seconds   | 30-40 seconds   |
| <b>From 25°C to preheating (150°C)</b>                                     | 8 minutes max.  | 40-100 seconds  |
| <b>Ramp down rate</b>                                                      | 4°C/second max. | Natural cooling |

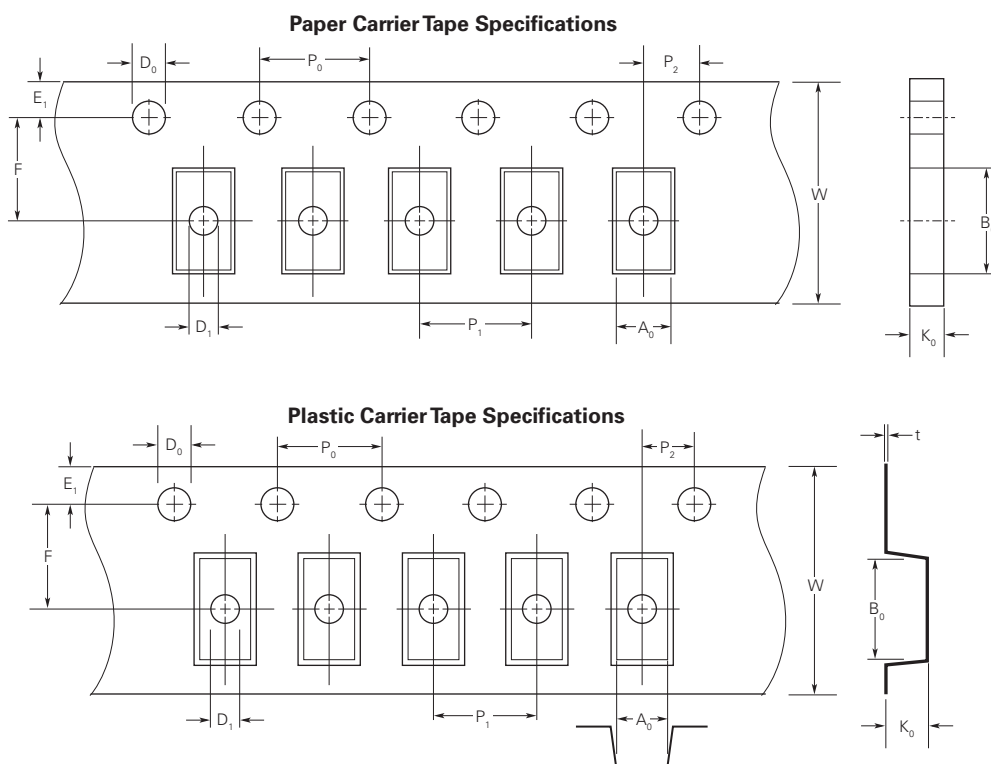
**Recommended conditions for hand soldering:**

- Using hot air rework station that can reflow the solder on both terminations at the same time is strongly recommended, do not directly contact the chip termination with the tip of soldering iron.
- Preheating: 150°C, 60s (min).  
Appropriate temperature (max) of soldering iron tip/soldering time (max): 280°C / 10s or 350°C / 3s.



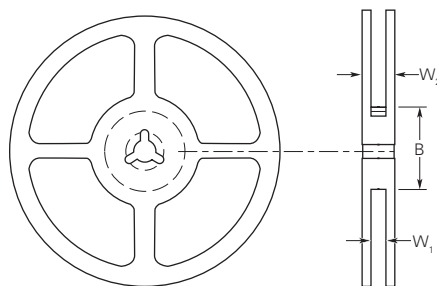
**Table F5** Tape and Reel Specifications for All Fuses

| Mark           | Dimension in inches (mm)           |                                    |                                    |                                    |                                    |
|----------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
|                | 0402 (1005)                        | 0603 (1608)                        | 1206 (3216)                        | 0603SFV (1608)                     | 2410 (6125)                        |
| E <sub>1</sub> | 0.069 ± 0.004<br>(1.75 ± 0.10)     | 0.069 ± 0.004<br>(1.75 ± 0.10)     | 0.069 ± 0.004<br>(1.75 ± 0.10)     | 0.069 ± 0.004<br>(1.75 ± 0.10)     | 0.069 ± 0.004<br>(1.75 ± 0.10)     |
| F              | 0.138 ± 0.002<br>(3.50 ± 0.05)     | 0.138 ± 0.002<br>(3.50 ± 0.05)     | 0.138 ± 0.002<br>(3.50 ± 0.05)     | 0.138 ± 0.002<br>(3.50 ± 0.05)     | 0.217 ± 0.004<br>(5.50 ± 0.10)     |
| W              | 0.315 ± 0.004<br>(8.00 ± 0.10)     | 0.315 ± 0.004<br>(8.00 ± 0.10)     | 0.315 ± 0.004<br>(8.00 ± 0.10)     | 0.315 ± 0.004<br>(8.00 ± 0.10)     | 0.472 ± 0.004<br>(12.00 ± 0.10)    |
| P <sub>1</sub> | 0.079 ± 0.004<br>(2.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     |
| P <sub>0</sub> | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)     |
| P <sub>2</sub> | 0.079 ± 0.002<br>(2.00 ± 0.05)     | 0.079 ± 0.002<br>(2.00 ± 0.05)     | 0.079 ± 0.002<br>(2.00 ± 0.05)     | 0.079 ± 0.002<br>(2.00 ± 0.05)     | 0.079 ± 0.004<br>(2.00 ± 0.10)     |
| D <sub>0</sub> | 0.059 ± 0.004<br>(1.50+0.10/-0.00) | 0.059 ± 0.004<br>(1.50+0.10/-0.00) | 0.059 ± 0.004<br>(1.50+0.10/-0.00) | 0.059 ± 0.004<br>(1.50+0.10/-0.00) | 0.059 ± 0.004<br>(1.50+0.10/-0.00) |
| D <sub>1</sub> | —                                  | —                                  | 0.039 max<br>(1.00 max)            | —                                  | 0.61 ± 0.004<br>(1.55 ± 0.10)      |
| t              | —                                  | —                                  | 0.009 ± 0.001<br>(0.23 ± 0.02)     | —                                  | 0.010 ± 0.002<br>(0.25 ± 0.05)     |
| A <sub>0</sub> | 0.026 ± 0.004<br>(0.67 ± 0.10)     | 0.039 ± 0.004<br>(0.98 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.039 ± 0.004<br>(0.98 ± 0.10)     | 0.112 ± 0.004<br>(2.85 ± 0.10)     |
| B <sub>0</sub> | 0.046 ± 0.004<br>(1.17 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.138 ± 0.004<br>(3.50 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.252 ± 0.004<br>(6.40 ± 0.10)     |
| K <sub>0</sub> | 0.025 ± 0.004<br>(0.63 ± 0.10)     | 0.037 ± 0.003<br>(0.95 ± 0.08)     | 0.050 ± 0.004<br>(1.27 ± 0.10)     | 0.024 ± 0.003<br>(0.60 ± 0.08)     | 0.093 ± 0.004<br>(2.35 ± 0.10)     |

**Figure F3** Component Tape Dimensions for All Fuses


**Figure F4 Reel Dimensions for All Fuses**

| Dimension Description | Mark           | Dimension (mm) |      |
|-----------------------|----------------|----------------|------|
|                       |                | 1206/0603/0402 | 2410 |
| Hub outer diameter    | B              | 60             | 60.2 |
| Reel inside width     | W <sub>1</sub> | 9              | 13.4 |
| Reel outside width    | W <sub>2</sub> | 11.4           | 16   |
| Tape width            |                | 8              |      |

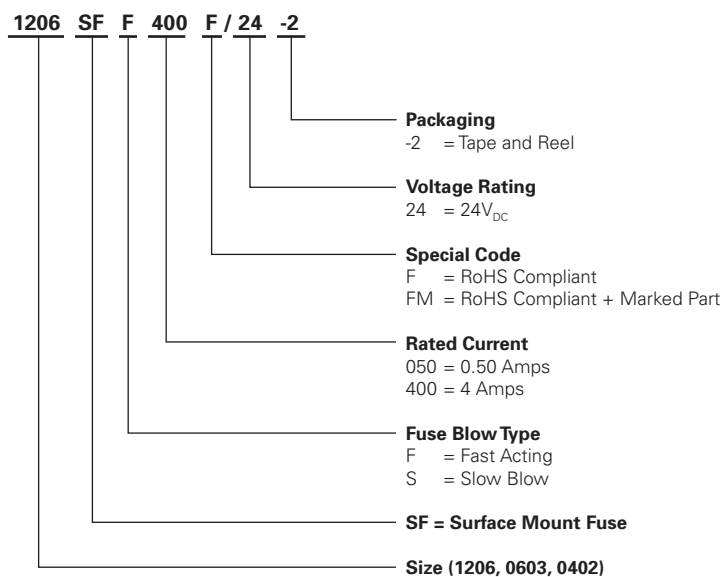


### Agency Approvals for All Fuses

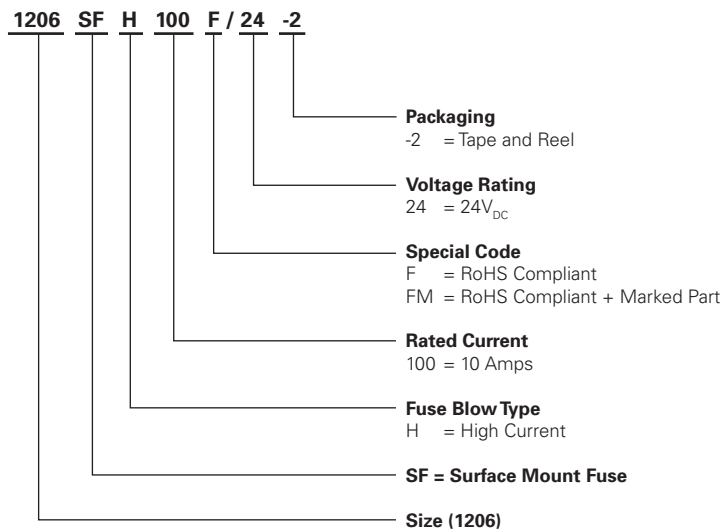
UL

File # E197536

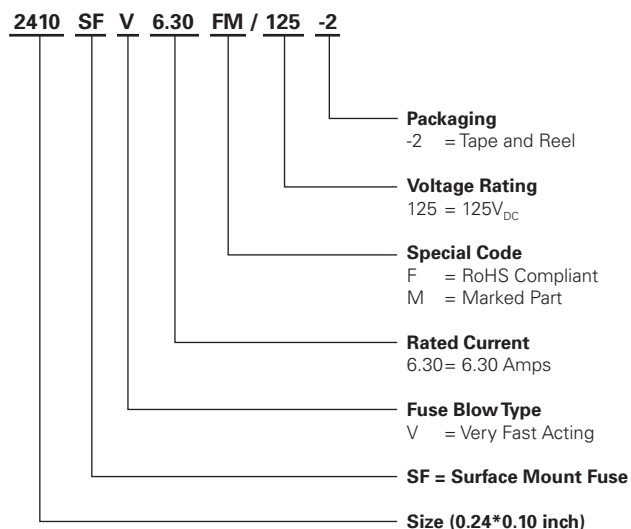
### Part Numbering System for Fast-Acting, Slow-Blow And 0603 Very Fast-Acting Chip Fuses



### Part Numbering System for High-Current-Rated Chip Fuses



## Part Numbering System for 2410 Very Fast-Acting Fuses



### Warning :

All information, including illustrations, is believed to be accurate and reliable. Users, however, should independently evaluate the suitability of and test each product selected for their application. Tyco Electronics Corporation and/or its Affiliates in the TE Connectivity Ltd. family of companies ("TE") makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. TE's only obligations are those in the TE Standard Terms and Conditions of Sale for this product, and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of the product. Specifications are subject to change without notice. In addition, TE reserves the right to make changes to materials or processing that do not affect compliance with any applicable specification without notification to Buyer.





## Surface-mount Fuses Telecom Fuses

The telecom FT600 fuse helps telecommunications equipment manufacturers comply with North American overcurrent protection requirements, including Telcordia GR-1089, TIA-968-A (formerly FCC Part 68), and UL60950 3rd edition.

TE Circuit Protection's telecom fuses offer low temperature-rise performance under sneak current fault events to help prevent damage to circuit traces or multilayer boards, and their low profile and small footprint make them suitable for high-density and space-constrained applications.



### Benefits

- High density placement in multi-port system designs
- Improved temperature rise performance over other similar surface-mount fuse devices under sneak current testing
- The FT600, in conjunction with a thyristor surge suppression device, assists designers to meet regulatory standards without additional series components

### Features

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Low profile and small footprint
- The lightning robust surface-mount fuse offers overcurrent protection in case of power fault events
- Enables the design of equipment complying with applicable telecom specifications including UL60950, TIA-968-A, and Telcordia GR-1089
- Low resistance

### Applications

- ADSL, ADSL2, ADSL2plus, SHDSL, VDSL linecards and modems
- T1/E1 systems
- Twisted-pair telecom ports requiring Telcordia GR-1089, UL60950 and FCC Part TIA-968-A compliance

## Protection Application Guide for Telecommunications and Networking Devices

To use this guide, follow the steps below:

1. Select your equipment type from the guide below.
2. Use the Key Device Selection Criteria (time-to-open, surface temperature) to determine best suitability for your application.
3. Use Agency Specification / Selection Guide to select a specific part number for each application based on the agency requirements.

### Key Device Selection Criteria

| Application                                                                                                                                                                                            | Specification     | Faster Time-To-Open | Cooler Surface Temperature |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------|----------------------------|
| <b>Customer premises equipment, IT equipment</b>                                                                                                                                                       | UL 60950          | FT600-0500          | FT600-2000                 |
| Analog modems, V.90 modems,<br>ISDN modems, xDSL modems,<br>ADSL splitters, phone sets, fax machines,<br>answering machines, caller ID, internet<br>appliances, PBX systems, POS terminals, wall plugs | TIA-968-A         | FT600-1250          |                            |
| <b>Access network equipment</b>                                                                                                                                                                        | Telcordia GR-1089 | FT600-1250          | FT600-2000                 |
| Remote terminals, line repeaters, multiplexers,<br>cross-connects, WAN equipment                                                                                                                       | TIA-968-A         |                     |                            |
| <b>Central office switching equipment</b>                                                                                                                                                              | Telcordia GR-1089 | FT600-1250          | FT600-2000                 |
| Analog/POTS linecards, ISDN linecards, xDSL modems,<br>ADSL/VDSL splitters, T1/E1 linecards,<br>multiplexers, CSU/DSU, servers                                                                         | TIA-968-A         |                     |                            |

**Note:** This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for overcurrent protection of telecom applications.

## Agency Specification/Selection Guide for FT600 Devices

Use the guide below to select FT600 devices appropriate for use in your application. The following pages contain specifications for part numbers recommended below. FT600 devices enable telecommunication equipment to meet the applicable protection requirements of these industry specifications. Refer to individual agency specifications for test procedures and circuit schematics. Users should independently evaluate the suitability of, and test each product for their application.

| Family | Product    | Lightning                         | Power Cross                                   |
|--------|------------|-----------------------------------|-----------------------------------------------|
| FT600  | FT600-0500 | TIA-968-A – Types A & B           | UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A   |
|        | FT600-1250 | Telcordia GR-1089 – Level 1 and 2 | Telcordia GR-1089 – 600 V <sub>AC</sub> , 40A |
|        | FT600-2000 | TIA-968-A                         | UL60950                                       |

**Notes:** FT600-1250 and FT600-2000 assist equipment in complying with Telcordia GR-1089 specifications. In-circuit testing is strongly recommended. The FT600-0500, FT600-1250 and FT600-2000 help meet the UL60950 Power Cross and FCC TIA-968-A 68 lightning surge requirements. Note that Type A tests allow for an overcurrent protection component to fuse open during the surge.

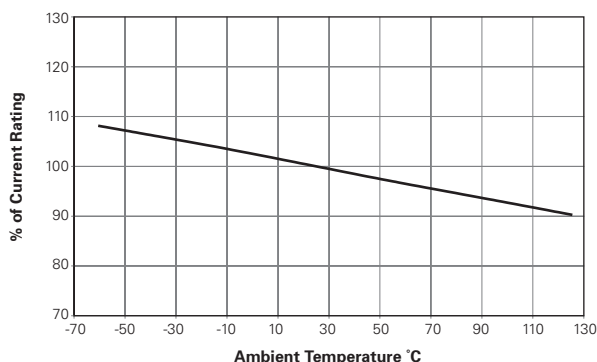
## Table FT1 Interrupt Voltage and Current Ratings for FT600 Devices

| Part Number | Ampere Rating (A) | Voltage Rating (V) | Typical Resistance (Ω) | Typical I <sup>2</sup> t (A <sup>2</sup> s)* |
|-------------|-------------------|--------------------|------------------------|----------------------------------------------|
| FT600-0500  | 0.50              | 250                | 0.50                   | 1                                            |
| FT600-1250  | 1.25              | 250                | 0.10                   | 16                                           |
| FT600-2000  | 2.00              | 250                | 0.05                   | 18                                           |

**Note:** The FT600-xxxx devices carry 100% of rated current for 4 hours minimum and 250% of rated current for 1 second minimum, 120 seconds maximum. Resistance measured at 10% of rated current.

\*I<sup>2</sup>t is calculated at 10 ms or less.

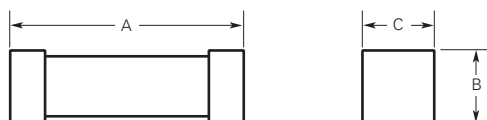
## Figure FT1 Thermal Derating Curve (Normalized) for FT600 Devices



**Table FT2** Dimensions for FT600 Devices in Millimeters (Inches)

| Part Number | A    |                 | B    |                | C    |                | Figure |
|-------------|------|-----------------|------|----------------|------|----------------|--------|
|             | Min. | Max.            | Min. | Max.           | Min. | Max.           |        |
| FT600-0500  | —    | 10.2<br>(0.402) | —    | 3.1<br>(0.122) | —    | 3.1<br>(0.122) | FT2    |
| FT600-1250  | —    | 10.2<br>(0.402) | —    | 3.1<br>(0.122) | —    | 3.1<br>(0.122) | FT2    |
| FT600-2000  | —    | 10.2<br>(0.402) | —    | 3.1<br>(0.122) | —    | 3.1<br>(0.122) | FT2    |

**Figure FT2** Dimension Figures for FT600 Devices

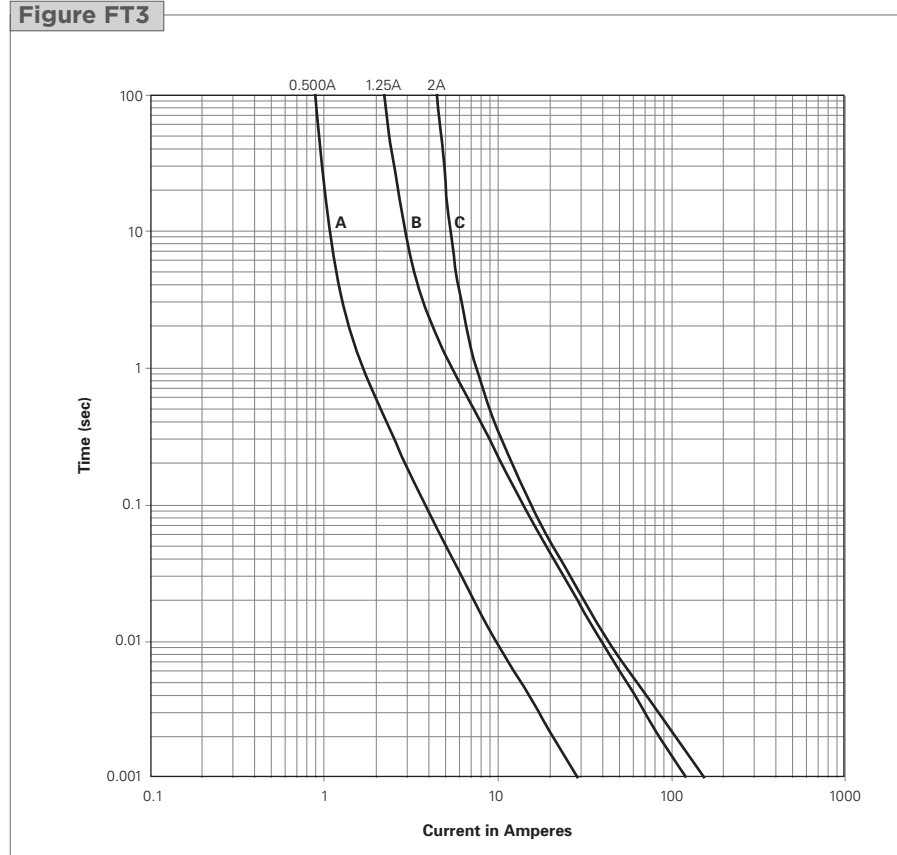


**Figure FT3** Typical Time-to-open Characteristics (at 20°C) for FT600 Devices

**FT600**

- A = FT600-0500
- B = FT600-1250
- C = FT600-2000

**Figure FT3**





**Table FT3 Physical Characteristics and Environmental Specifications for FT600 Devices**

**Physical Characteristics**

|                           |                      |
|---------------------------|----------------------|
| Terminal material         | Silver-plated brass* |
| Body material             | Ceramic              |
| Termination solderability | Per IEC-60127-4      |

\*FT600 devices use high Pb content solder for internal construction. They are RoHS compliant.

**Environmental Specifications**

| Test                  | Conditions                                    |
|-----------------------|-----------------------------------------------|
| Solder heat withstand | Per MIL-STD-202, Method 210, Test Condition J |
| Solvent resistance    | Per MIL-STD-202F, Method 215J                 |
| Storage temperature   | ≤30°C/ 85% RH                                 |
| Storage humidity      | Per MIL-STD-202F, Method 106F                 |

**Table FT4 Packaging and Marking Information for FT600 Devices**

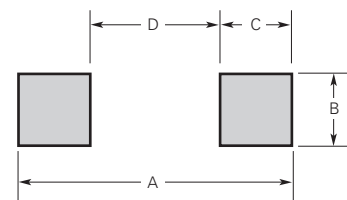
| Part Number  | Bag Quantity | Tape & Reel Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|--------------|--------------|----------------------|---------------------------|--------------|--------------------|
| FT600-0500-2 | —            | 2,500                | 10,000                    | 500          | UL, CSA            |
| FT600-1250-2 | —            | 2,500                | 10,000                    | 1250         | UL, CSA            |
| FT600-2000-2 | —            | 2,500                | 10,000                    | 2000         | UL, CSA            |

**Note:** The -2 designates tape and reel, the package style for this product.

**Table FT5 Recommended Pad Layouts for FT600 Devices in Millimeters (Inches) Nominal**

| Device     | A               | B              | C              | D              | Figure for Dimensions |
|------------|-----------------|----------------|----------------|----------------|-----------------------|
| FT600-0500 | 12.6<br>(0.496) | 4.0<br>(0.157) | 3.7<br>(0.145) | 5.2<br>(0.204) | FT4                   |
| FT600-1250 | 12.6<br>(0.496) | 4.0<br>(0.157) | 3.7<br>(0.145) | 5.2<br>(0.204) | FT4                   |
| FT600-2000 | 12.6<br>(0.496) | 4.0<br>(0.157) | 3.7<br>(0.145) | 5.2<br>(0.204) | FT4                   |

**Figure FT4**



**Solder Reflow and Rework Recommendations for FT600 Devices**

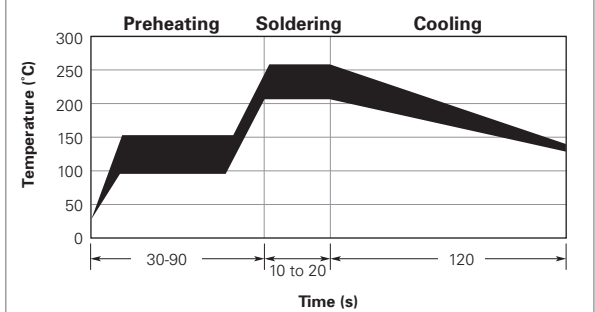
**Solder Reflow**

- Recommended reflow methods: IR, vapor phase oven, hot air oven
- Devices can be cleaned using standard industry methods and solvents

**Rework**

- If a device is removed from the board, it should be discarded and replaced by a new device

**Figure FT5**

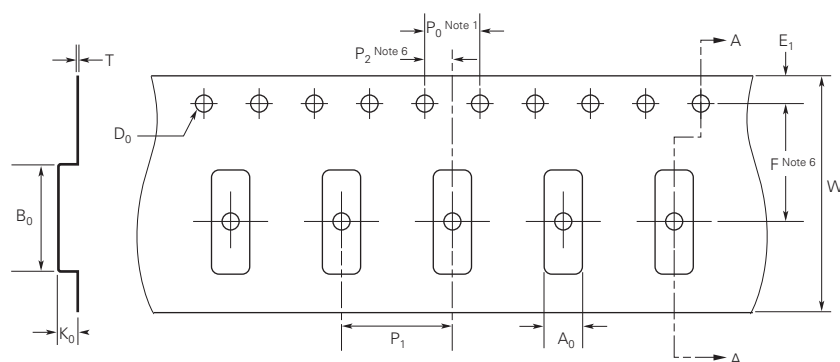


**Table FT6** Tape and Reel Specifications for FT600 Devices

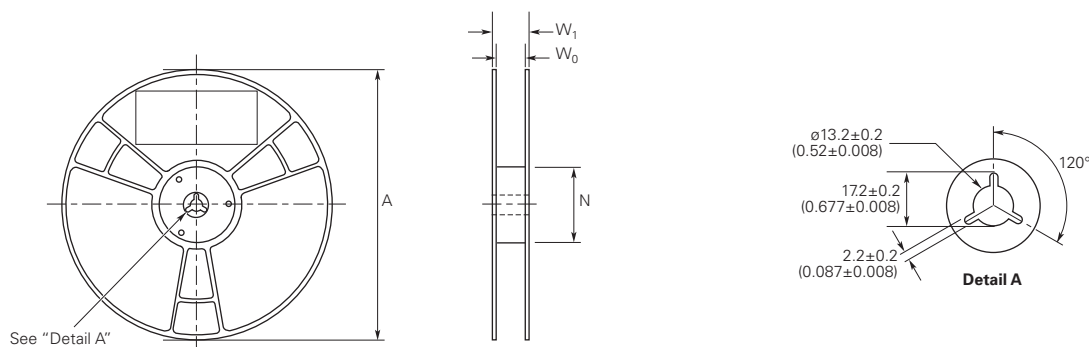
| Dimension Description  | EIA Mark       | Dimension (mm) | Tolerance      |
|------------------------|----------------|----------------|----------------|
| Carrier tape width     | W              | 24             | $\pm 0.3$      |
| Sprocket hole pitch    | P <sub>0</sub> | 4              | $\pm 0.1$      |
|                        | P <sub>1</sub> | 8              | $\pm 0.1$      |
|                        | P <sub>2</sub> | 2              | $\pm 0.1$      |
|                        | A <sub>0</sub> | 3.68           | $\pm 0.1$      |
|                        | B <sub>0</sub> | 10.44          | $\pm 0.1$      |
| Sprocket hole diameter | D <sub>0</sub> | 1.5            | $+0.1 / -0.0$  |
|                        | F              | 11.5           | $\pm 0.1$      |
|                        | E <sub>1</sub> | 1.75           | $\pm 0.1$      |
| Tape thickness         | T max.         | 0.3            | $\pm 0.05$     |
|                        | K <sub>0</sub> | 3.25           | $+1.0 / -0.05$ |

**Reel Dimensions**

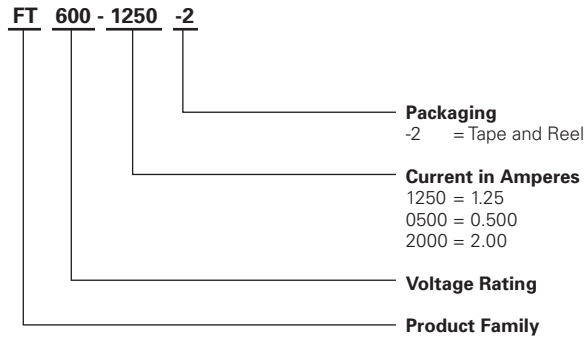
|                                    |                     |       |           |
|------------------------------------|---------------------|-------|-----------|
| Reel diameter                      | A max.              | 331.5 |           |
| Core diameter                      | N min.              | 98.5  |           |
| Space between flanges less devices | W <sub>0</sub>      | 25    | $\pm 0.5$ |
| Reel width                         | W <sub>1</sub> max. | 31    |           |

**Figure FT6** EIA Referenced Taped Component Dimensions for FT600 Devices

**Notes:**

1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.2$
2. Allowable camber to be 1mm/250mm
3. Material: Black conductive
4. A<sub>0</sub> and B<sub>0</sub> measured on a plane 0.3mm above the bottom of the pocket
5. K<sub>0</sub> measured from the plane on the inside bottom of the pocket to the top surface of the carrier
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole
7. Quantity per reel to be 174m

**Figure FT7** EIA Referenced Reel Dimensions for FT600 Devices


## Part Numbering System for FT600 Devices



### Warning :

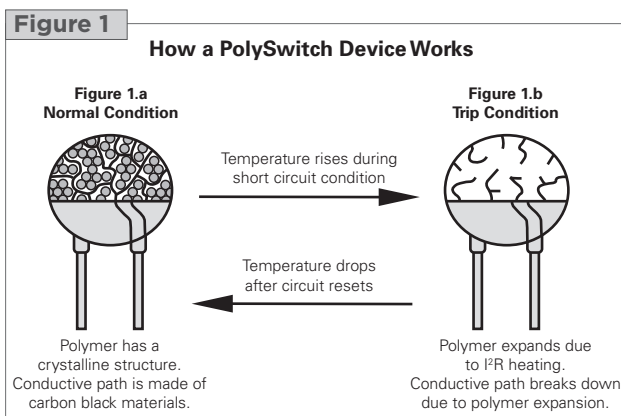
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# PolySwitch Resettable Devices Fundamentals

## Overview

PolySwitch PPTC (Polymeric Positive Temperature Coefficient) devices help protect against damage caused by harmful overcurrent surges and overtemperature faults. Like traditional fuses, these devices limit the flow of dangerously high current during fault conditions. The PolySwitch device, however, resets after the fault is cleared and power to the circuit is removed, thereby helping to reduce warranty, service and repair costs.

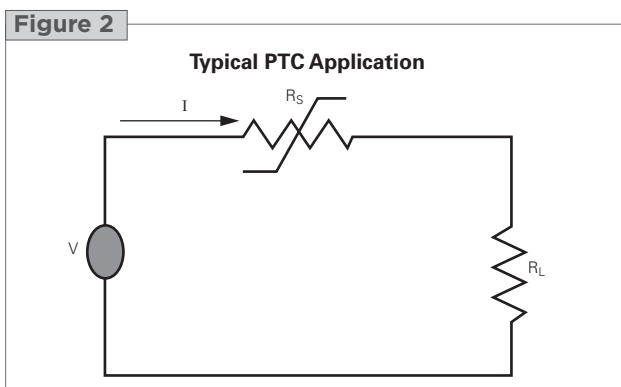
PolySwitch circuit protection devices are made from a composite of semi-crystalline polymer and conductive particles. At normal temperature, the conductive particles form low-resistance networks in the polymer (Figure 1.a). However, if the temperature rises above the device's switching temperature ( $T_{sw}$ ) either from high current through the part or from an increase in the ambient temperature, the crystallites in the polymer melt and become amorphous. The increase in volume during melting of the crystalline phase separates the conductive particles resulting in a large non-linear increase in the resistance of the device.



## Overcurrent Protection using a PPTC Device

The PPTC device is a series element in a circuit. The PPTC device helps protect the circuit by going from a low-resistance to a high-resistance state in response to an overcurrent condition, as shown in Figure 2. This is referred to as “tripping” the device.

In normal operation the device has a resistance that is much lower than that of the circuit. In response to an overcurrent condition, the device increases in resistance (trips), reducing the current in the circuit to a value that can be safely carried by any of the circuit elements. This change is the result of a rapid increase in the temperature of the device, caused by  $I^2R$  heating.

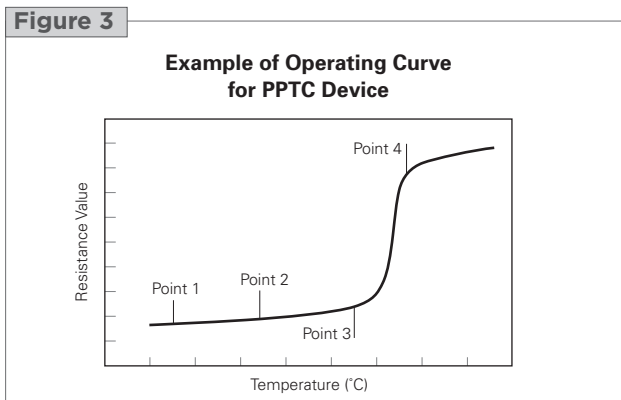


## Principles of operation

PolySwitch device operation is based on an overall energy balance, as shown in Figure 3. Under normal operating conditions, the heat generated by the device and the heat lost by the device to the environment are in balance at a relatively low temperature, as shown between Point 1 and 2.

If the current through the device is increased while the ambient temperature is kept constant, the temperature of the device increases. Further increases in either current, ambient temperature, or both will cause the device to reach a temperature where the resistance rapidly increases, as shown in Point 3.

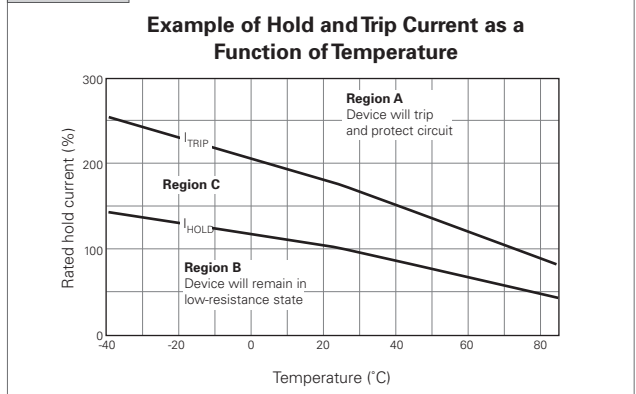
Any further increase in current or ambient temperature will cause the device to generate heat at a rate greater than the rate at which heat can be dissipated, thus causing the device to heat up rapidly. At this stage, a very large increase in resistance occurs for a very small change in temperature, between points 3 and 4. This is the normal operating region for a device in the tripped state. This large change in resistance causes a corresponding decrease in the current flowing to the circuit. This relation holds until the device resistance reaches the upper knee of the curve (Point 4). As long as the applied voltage remains at this level, the device will remain in the tripped state (that is, the device will remain latched in its protective state). Once the voltage decreases, the power is removed, and the device cools, the device will reset.



## Example of Hold and Trip Current as a Function of Temperature

Figure 4 illustrates the hold- and trip-current behavior of a PolySwitch device as a function of temperature. One such curve can be defined for each available device. Region A describes the combinations of current and temperature at which the PolySwitch device will trip (go into the high-resistance state) and protect the circuit. Region B describes the combinations of current and temperature at which the PolySwitch device will allow for normal operation of the circuit. In Region C, it is possible for the device to either trip or remain in the low-resistance state (depending on individual device resistance).

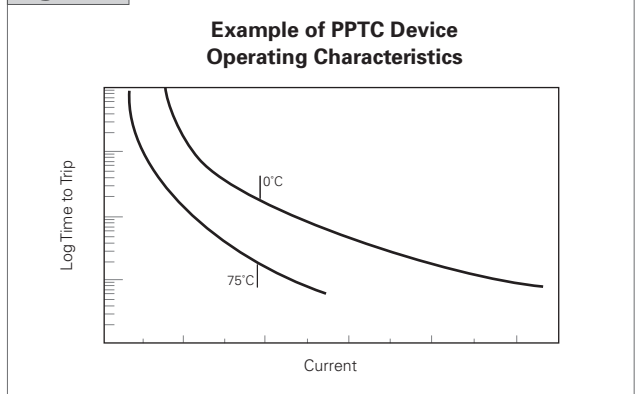
**Figure 4**



## Operating Characteristics of a PPTC Device

Figure 5 shows a typical pair of operating curves for a PolySwitch device in still air at 0°C and 75°C. The curves are different because the heat required to trip the device comes both from electrical  $I^2R$  heating and from the device environment. At 75°C the heat input from the environment is substantially greater than it is at 0°C, so the additional  $I^2R$  needed to trip the device is correspondingly less, resulting in a lower trip current at a given trip time (or a faster trip at given trip current).

**Figure 5**

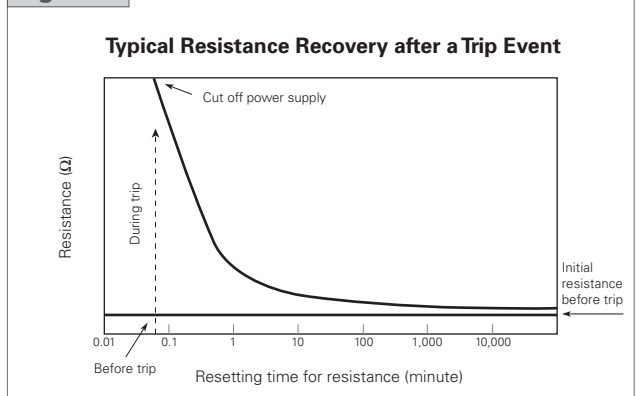


## Typical Resistance Recovery after a Trip Event

Figure 6 shows typical behavior of a PolySwitch device that is tripped and then allowed to cool. This figure illustrates how, even after a number of hours, the device resistance is still greater than the initial resistance. Over an extended period of time, device resistance will continue to fall and will eventually approach initial resistance.

However, since this time can be days, months, or years, it is not practical to expect that the device resistance will reach the original value for operation purposes. Therefore, when PolySwitch devices are chosen  $R_{1MAX}$  should be taken into consideration when determining hold current.  $R_{1MAX}$  is the resistance of the device one hour after the thermal event.

**Figure 6**



# PolySwitch Resettable Devices

## Product Selection Guide

**Table 1 PolySwitch Device Characteristics**

| PolySwitch Device Family | V <sub>MAX</sub> Operating (V <sub>DC</sub> ) | V <sub>MAX</sub> Interrupt (V <sub>RMS</sub> ) | I <sub>H</sub> (A) | Temp. Range  | Form Factor   | Agency Spec. | Application                  |
|--------------------------|-----------------------------------------------|------------------------------------------------|--------------------|--------------|---------------|--------------|------------------------------|
| LVR                      | 120V/240V                                     | 135V/265V                                      | 0.05 to 2A         | -20 to 85°C  | Radial-leaded | UL, CSA, TÜV | Line Voltage                 |
| LVRL                     | 120V                                          | 135V                                           | 0.75 to 2A         | -20 to 85°C  | Radial-leaded | UL, CSA, TÜV | Line Voltage                 |
| RGEF                     | 16V                                           | -                                              | 2.5 to 14.0A       | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | General Electronics          |
| RHEF                     | 16 to 30V                                     | -                                              | 0.5 to 15A         | -40 to 125°C | Radial-leaded | UL, CSA, TÜV | General Electronics          |
| RUEF                     | 30V                                           | -                                              | 0.9 to 9.0A        | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | General Electronics          |
| RKEF                     | 60V                                           | -                                              | 0.50 to 5A         | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | General Electronics          |
| RXEF                     | 60 to 72V                                     | -                                              | 0.05 to 3.75A      | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | General Electronics          |
| RUSBF                    | 6 to 16V                                      | -                                              | 0.75 to 2.5A       | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | Computer/General Electronics |
| femtoSMDC                | 6 to 15V                                      | -                                              | 0.05 to 0.35A      | -40 to 85°C  | Surface-mount | UL, CSA      | Computer/General Electronics |
| microSMD                 | 6 to 30V                                      | -                                              | 0.05 to 2.0A       | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| midSMD                   | 6 to 60V                                      | -                                              | 0.3 to 2.0A        | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| miniSMDC                 | 6 to 60V                                      | -                                              | 0.10 to 3A         | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| miniSMDE                 | 16V                                           | -                                              | 1.9A               | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| nanoSMDC                 | 6 to 48V                                      | -                                              | 0.12 to 2.0A       | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| picoSMDC                 | 6 to 15V                                      | -                                              | 0.10 to 1.1A       | -40 to 85°C  | Surface-mount | UL, CSA      | Computer/General Electronics |
| SMD                      | 6 to 60V                                      | -                                              | 0.3 to 3.0A        | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| SMD2                     | 15 to 33V                                     | -                                              | 1.5 to 2.5A        | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Computer/General Electronics |
| BD                       | 14V                                           | -                                              | 8 to 21A           | -40 to 125°C | Plug-in       | -            | Automotive                   |
| AGRF                     | 16V                                           | -                                              | 4.0 to 14.0A       | -40 to 85°C  | Radial-leaded | -            | Automotive                   |
| AHRF                     | 16 to 30V                                     | -                                              | 0.50 to 15A        | -40 to 125°C | Radial-leaded | -            | Automotive                   |
| AHS                      | 16V                                           | -                                              | 0.80 to 3.0A       | -40 to 125°C | Surface-mount | -            | Automotive                   |
| ASMD                     | 16 to 60V                                     | -                                              | 0.23 to 1.97A      | -40 to 85°C  | Surface-mount | -            | Automotive                   |
| AHEF                     | 32V                                           | -                                              | 0.50 to 10A        | -40 to 125°C | Radial-leaded | -            | Automotive                   |
| nanoASMD                 | 16 to 48V                                     | -                                              | 0.12 to 0.35A      | -40 to 85°C  | Surface-mount | -            | Automotive                   |
| microASMD                | 30V                                           | -                                              | 0.05 to 0.1A       | -40 to 85°C  | Surface-mount | -            | Automotive                   |
| miniASMD                 | 16 to 60V                                     | -                                              | 0.1 to 2.6A        | -40 to 85°C  | Surface-mount | -            | Automotive                   |
| BBRF                     | 99V                                           | -                                              | 0.55A              | -40 to 85°C  | Radial-leaded | UL, CSA      | Telecom & Networking         |
| TCF                      | 60V                                           | 250V                                           | 0.10 to 0.18A      | -40 to 85°C  | Chip          | -            | Telecom & Networking         |
| TRF250                   | 60 to 100V                                    | 250V                                           | 0.055 to 0.184A    | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | Telecom & Networking         |
| TRF600                   | 60 to 250V                                    | 600V                                           | 0.15 to 0.40A      | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV | Telecom & Networking         |
| TS250/TSV250             | 60V                                           | 250V                                           | 0.13A              | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Telecom & Networking         |
| TSL250                   | 80V                                           | 250V                                           | 0.08A              | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Telecom & Networking         |
| TS600/TSM600             | 60 to 250V                                    | 600V                                           | 0.17 to 0.40A      | -40 to 85°C  | Surface-mount | UL, CSA, TÜV | Telecom & Networking         |
| MXP                      | 6V                                            | -                                              | 1.9 to 3.7A        | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |
| LR4                      | 15 to 20V                                     | -                                              | 1.9 to 13.0A       | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |
| SRP                      | 15 to 30V                                     | -                                              | 1.2 to 4.2A        | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |
| VLP                      | 16V                                           | -                                              | 1.2 to 2.7A        | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |
| VLR                      | 12V                                           | -                                              | 1.7 to 2.3A        | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |
| VTP                      | 16V                                           | -                                              | 1.1 to 2.1A        | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV | Battery                      |

**Table 2 Thermal Derating**

| PolySwitch Device Family | -40°C | -20°C | 0°C  | 20°C | 25°C | 30°C | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
|--------------------------|-------|-------|------|------|------|------|------|------|------|------|------|-------|
| LVR005-055               | -     | 1.48  | 1.24 | 1.00 | 0.99 | 0.93 | 0.82 | 0.72 | 0.60 | 0.51 | 0.35 | -     |
| LVR075-200               | -     | 1.69  | 1.34 | 1.00 | 0.99 | 0.95 | 0.88 | 0.80 | 0.73 | 0.66 | 0.55 | -     |
| LVRL                     | -     | 1.43  | 1.21 | 1.00 | 0.99 | 0.95 | 0.86 | 0.78 | 0.70 | 0.62 | 0.50 | -     |
| RGEF                     | 1.54  | 1.37  | 1.21 | 1.04 | 1.00 | 0.96 | 0.88 | 0.79 | 0.71 | 0.63 | 0.50 | -     |
| RHEF                     | 1.50  | 1.35  | 1.19 | 1.04 | 1.00 | 0.96 | 0.88 | 0.81 | 0.73 | 0.65 | 0.54 | 0.23  |
| RUEF                     | 1.48  | 1.32  | 1.16 | 1.00 | 0.96 | 0.92 | 0.84 | 0.76 | 0.68 | 0.60 | 0.48 | -     |
| RKEF                     | 1.45  | 1.30  | 1.15 | 1.00 | 0.97 | 0.92 | 0.83 | 0.77 | 0.68 | 0.61 | 0.52 | -     |
| RXEF                     | 1.56  | 1.37  | 1.19 | 1.00 | 0.95 | 0.91 | 0.82 | 0.72 | 0.63 | 0.54 | 0.40 | -     |
| RUSBF                    | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | -     |
| femtoSMDC                | 1.59  | 1.39  | 1.18 | 1.05 | 1.00 | 0.86 | 0.78 | 0.66 | 0.61 | 0.47 | 0.41 | -     |
| microSMD                 | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| midSMD                   | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | -     |
| miniSMD                  | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| nanoSMD                  | 1.56  | 1.39  | 1.15 | 1.04 | 1.00 | 0.96 | 0.87 | 0.79 | 0.70 | 0.61 | 0.49 | -     |
| picoSMD                  | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| SMD                      | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| BD                       | 1.50  | 1.35  | 1.19 | 1.04 | 1.00 | 0.96 | 0.88 | 0.81 | 0.73 | 0.65 | 0.54 | 0.23  |
| AGRF                     | 1.54  | 1.37  | 1.21 | 1.04 | 1.00 | 0.96 | 0.88 | 0.79 | 0.71 | 0.63 | 0.50 | -     |
| AHRF                     | 1.50  | 1.35  | 1.19 | 1.04 | 1.00 | 0.96 | 0.88 | 0.81 | 0.73 | 0.65 | 0.54 | 0.23  |
| AHS                      | 1.41  | 1.28  | 1.16 | 1.03 | 1.00 | 0.97 | 0.91 | 0.84 | 0.78 | 0.72 | 0.62 | 0.37  |
| ASMD                     | 1.59  | 1.41  | 1.23 | 1.05 | 1.00 | 0.95 | 0.86 | 0.77 | 0.68 | 0.59 | 0.45 | -     |
| AHEF                     | 1.36  | 1.25  | 1.14 | 1.03 | 1.00 | 0.96 | 0.89 | 0.81 | 0.74 | 0.66 | 0.55 | 0.20  |
| nanoASMDC                | 1.56  | 1.39  | 1.15 | 1.04 | 1.00 | 0.96 | 0.87 | 0.79 | 0.70 | 0.61 | 0.49 | -     |
| microASMD                | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| miniASMDC                | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | -     |
| BBRF                     | 1.56  | 1.37  | 1.19 | 1.00 | 0.95 | 0.91 | 0.82 | 0.72 | 0.63 | 0.54 | 0.40 | -     |
| TCF                      | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | -     |
| TRF                      | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | -     |
| TS                       | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | -     |
| MXP                      | 1.99  | 1.68  | 1.37 | 1.07 | 1.00 | 0.91 | 0.76 | 0.61 | 0.45 | 0.30 | 0.07 | -     |
| LR4                      | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | -     |
| SRP                      | 1.47  | 1.31  | 1.16 | 1.00 | 0.96 | 0.92 | 0.85 | 0.77 | 0.69 | 0.61 | 0.50 | -     |
| VLP                      | 1.88  | 1.67  | 1.43 | 1.05 | 1.00 | 0.95 | 0.76 | 0.62 | 0.48 | 0.33 | 0.04 | -     |
| VLR                      | 2.05  | 1.70  | 1.41 | 1.08 | 1.00 | 0.92 | 0.74 | 0.59 | 0.41 | 0.18 | -    | -     |
| VTP                      | 1.88  | 1.67  | 1.43 | 1.05 | 1.00 | 0.95 | 0.76 | 0.62 | 0.48 | 0.33 | 0.04 | -     |



## PolySwitch Device Selection Guide

### Step 1. Determine your circuit's parameters

You will need to determine the following parameters of your circuit:

- Maximum ambient operating temperature
- Normal operating current
- Maximum operating voltage
- Maximum interrupt current

### Step 2. Select a PolySwitch device that will accommodate the circuit's maximum ambient temperature and normal operating current.

Use the Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] table and choose the temperature that most closely matches the circuit's maximum ambient temperature. Look down that column to find the value equal to or greater than the circuit's normal operating current. Now look to the far left of that row to find the part number that will best accommodate that current.

### Step 3. Compare the selected device's maximum electrical ratings with the circuit's maximum operating voltage and interrupt current.

Use the Electrical Characteristics table to verify the part you selected in Step 2 will handle your circuit's maximum operating voltage and interrupt current. Find the device's maximum operating voltage ( $V_{MAX}$ ) and maximum interrupt current ( $I_{MAX}$ ). Ensure that  $V_{MAX}$  and  $I_{MAX}$  are greater than or equal to the circuit's maximum operating voltage and maximum fault current.

### Step 4. Determine time-to-trip

Time-to-trip is the amount of time it takes for a device to switch to a high-resistance state once a fault current has been applied through the device. Identifying the PolySwitch device's time-to-trip is important in order to provide the desired protection capabilities. If the chosen device trips too fast, undesired or nuisance tripping may occur. If the device trips too slowly, the components being protected may be damaged before the device can trip and limit the current.

Use the Typical Time-to-trip Curves at 20°C to determine if the PolySwitch device's time-to-trip characteristics are acceptable at expected fault levels. If not, go back to Step 2 and choose an alternate device.

### Step 5. Verify ambient operating temperature

Ensure that your application's minimum and maximum ambient temperatures are within the operating temperature of the PolySwitch device. Most PolySwitch devices have an operating temperature range from -40°C to 85°C with some exceptions to 125°C.

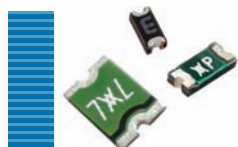
### Step 6. Verify the PolySwitch device dimensions

Use the Dimensions table to compare the dimensions of the PolySwitch device you selected with the application's space considerations.

### Definitions of terms

|                   |                                                                                                                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_H$             | the maximum steady state current at 20°C that can be passed through a PolySwitch device without causing the device to trip                                                                |
| $I_T$             | the minimum current that will cause the PolySwitch device to trip at 20°C                                                                                                                 |
| $V_{MAX}$         | the maximum voltage that can safely be dropped across a PolySwitch device in its tripped state also called:<br>Maximum Device Voltage, Maximum Voltage, $V_{max}$ , Max Interrupt Voltage |
| $I_{MAX}$         | the maximum fault current that can safely be used to trip a PolySwitch device                                                                                                             |
| $P_D$             | the power (in watts) dissipated by a PolySwitch device in its tripped state                                                                                                               |
| $R_{MAX}$         | the maximum resistance prior to the trip of PolySwitch device                                                                                                                             |
| $R_{MIN}$         | the minimum resistance prior to the trip of PolySwitch device                                                                                                                             |
| $R_{1MAX}$        | the maximum resistance of a PolySwitch device at 20°C 1 hour after being tripped and reset or after reflow soldering                                                                      |
| $R_{Tripped Typ}$ | the typical resistance of PolySwitch 1 hour after the initial trip and reset                                                                                                              |





# PolySwitch Resettable Devices Surface-mount Devices

PolySwitch surface-mount devices are the preferred circuit protection method for computer, consumer, multimedia, portable, and automotive electronics applications.

In an effort to reduce the size and cost of surface-mount devices, we introduced the miniSMD product series in 1995. Subsequently, we developed the microSMD, nanoSMD, picoSMD and femtoSMD family of products. The femtoSMD series reduced the device size to a 1608mm (0603 mils) footprint, one twelfth the size of the popular miniSMD series.

Recent additions to the PolySwitch surface-mount series include 0.5A picoSMD 1210mm (0805 mils) and 0.35A femtoSMD 1608mm (0603 mils) devices.



## Benefits

- Smaller size saves board space and cost
- Many product choices give engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

## Features

- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Broadest range of resettable devices available in the industry
- Current ratings from 0.05 to 3A
- Voltage ratings from 6V computer and electronic applications to 60V telecom applications
- Agency recognition: UL, CSA, TÜV
- Small footprint
- Fast time-to-trip
- Low resistance

## Applications

- |                        |                           |                       |
|------------------------|---------------------------|-----------------------|
| • Computer             | • Game machines           | • Automotive          |
| • Portable electronics | • Telephony and broadband | • Industrial controls |
| • Multimedia           | • Mobile phones           | • Battery             |

## Application Selection Table for Surface-mount Devices

- The table below lists PolySwitch surface-mount devices typically used in these applications.
- Specifications for the suggested PolySwitch surface-mount device part numbers can be found in this section.
- Once a part has been selected, the user should evaluate and test each product for the intended application.

| Protection Application      | Additional Comments  | Overcurrent<br>Overvoltage | PolySwitch Resettable Devices - Key Selection Criteria |                   |                                               |
|-----------------------------|----------------------|----------------------------|--------------------------------------------------------|-------------------|-----------------------------------------------|
|                             |                      |                            | Small Size                                             | Low Resistance    | Fast Time-to-trip<br>(Temperature Protection) |
| AC adapter input power      | use w/ Zener & triac |                            | SMD250F                                                | SMD250F           | SMD200F                                       |
| Battery pack protection     |                      |                            | nanoSMDC150F                                           | miniSMDC260F      | miniSMDE190F                                  |
| Charger protection          |                      |                            | nanoSMDC050F                                           | miniSMDC110F/16   | nanoSMDC075F                                  |
| CPU/IC protection           |                      |                            | nanoSMDC110F                                           | nanoSMDC150F      | nanoSMDC075F                                  |
| Data acquisition/sensor     |                      |                            | microSMD005F                                           | -                 | microSMD005F                                  |
| DC input/output power       | ≤6V                  |                            | nanoSMDC075F                                           | nanoSMDC150F      | nanoSMDC050F/13.2                             |
|                             | ≤12V                 |                            | miniSMDC075F                                           | miniSMDC110F/16   | miniSMDC075F                                  |
| DDC                         |                      |                            | nanoSMDC075F                                           | nanoSMDC110F      | nanoSMDC050F/13.2                             |
| Device bay system           | DB12, DB20           |                            | miniSMDC200F                                           | miniSMDC260F      | miniSMDC200F                                  |
|                             | DB32                 |                            | miniSMDC260F                                           | SMD300F           | miniSMDC200F                                  |
| Ethernet/LAN                |                      |                            | nanoSMDC050F/13.2                                      | miniSMDC110F/16   | nanoSMDC075F                                  |
| Fan                         |                      |                            | microSMD035F                                           | microSMD050F      | microSMD035F                                  |
| HDMI                        |                      |                            | picoSMDC035S                                           | picoSMDC035S      | picoSMDC035S                                  |
| IEEE 802.3af                | VOIP                 |                            | decaSMDC050F/60                                        | decaSMDC050F/60   | decaSMDC050F/60                               |
| IEEE-1394                   | power provider       |                            | SMD100F/33                                             | SMD185F           | SMD100F/33                                    |
|                             | alt. power provider  |                            | SMD185F                                                | SMD185F           | SMD150F/33                                    |
|                             | self-powered         |                            | SMD185F                                                | SMD185F           | SMD150F/33                                    |
| LCD inverter                |                      |                            | nanoSMDC050F/13.2                                      | miniSMDC110F/16   | nanoSMDC075F                                  |
| LCD screen power            |                      |                            | nanoSMDC050F/13.2                                      | nanoSMDC050F/13.2 | microSMD035F                                  |
| LNB (Low Noise Block)       |                      |                            | SMD075F                                                | SMD075F           | SMD050F                                       |
| Motor                       | ≤6V                  |                            | nanoSMDC110F                                           | nanoSMDC150F      | microSMD075F                                  |
|                             | ≤13.2V               |                            | miniSMDC075F                                           | miniSMDC110F/16   | miniSMDC075F                                  |
| PS/2 mouse/keyboard         |                      |                            | nanoSMDC075F                                           | nanoSMDC110F      | nanoSMDC050F/13.2                             |
| Signal - data communication | ≤6V                  |                            | nanoSMDC075F                                           | nanoSMDC075F      | nanoSMDC075F                                  |
|                             | ≤13.2V               |                            | miniSMDC050F                                           | miniSMDC075F      | miniSMDC020F                                  |
|                             | ≤30V                 |                            | SMD030F-2018                                           | SMD075F           | SMD050F                                       |
| SCSI                        |                      |                            | nanoSMDC110F                                           | nanoSMDC150F      | nanoSMDC075F                                  |
| SIM/Smart card reader       |                      |                            | femtoSMDC010F                                          | femtoSMDC010F     | femtoSMDC005F                                 |
| Telecom - modem             | Digital line         | OC                         | miniSMDC014F                                           | miniSMDC014F      | miniSMDC014F                                  |
| Telecom - PBX               | Subscriber           | OC                         | miniSMDC014F                                           | miniSMDC014F      | miniSMDC014F                                  |
| Temperature sensor          | CPU                  |                            | nanoSMDC050F/13.2                                      | nanoSMDC075F      | nanoSMDC050F/13.2                             |
| USB                         | Individual Port      |                            | nanoSMDC075F                                           | nanoSMDC110F      | nanoSMDC050F/13.2                             |
|                             | 2 port ganged        |                            | nanoSMDC150F                                           | miniSMDC150F      | miniSMDC125F                                  |
|                             | 3 port ganged        |                            | miniSMDC200F                                           | miniSMDC200F      | miniSMDC200F                                  |

**Note :** This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

**Table S1** Product Series: Size, Current Rating, Voltage Rating/Maximum Resistance for Surface-mount Devices

|                         | femtoSMD                  | picoSMD                   | nanoSMD                    | microSMD                   | miniSMD                     | midSMD                   | SMD                      | SMD2                      | miniSMDE                 | decaSMD                  |
|-------------------------|---------------------------|---------------------------|----------------------------|----------------------------|-----------------------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|
| <b>Size mm</b>          | 1608                      | 2012                      | 3216                       | 3225                       | 4532                        | 5050                     | 7555                     | 8763                      | 11550                    | 5050                     |
| <b>(mils)</b>           | (0603)                    | (0805)                    | (1206)                     | (1210)                     | (1812)                      | (2018)                   | (2920)                   | (3425)                    | (4420)                   | (2018)                   |
| <b>Hold Current (A)</b> |                           |                           |                            |                            |                             |                          |                          |                           |                          |                          |
| 0.050                   | 15V <sub>DC</sub> /30.00Ω | —                         | —                          | 30V <sub>DC</sub> /50Ω     | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.080                   | 12V <sub>DC</sub> /14.00Ω | —                         | —                          | —                          | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.100                   | 12V <sub>DC</sub> /8.00Ω  | 15V <sub>DC</sub> /11.00Ω | —                          | 30V <sub>DC</sub> /15Ω     | 60V <sub>DC</sub> /12.70Ω   | —                        | —                        | —                         | —                        | —                        |
| 0.120                   | 9V <sub>DC</sub> /5.80Ω   | 15V <sub>DC</sub> /9.00Ω  | 48V <sub>DC</sub> /6.50Ω   | —                          | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.140                   | —                         | —                         | —                          | —                          | 60V <sub>DC</sub> /6.00Ω    | —                        | —                        | —                         | —                        | —                        |
| 0.160                   | 9V <sub>DC</sub> /4.20Ω   | —                         | 48V <sub>DC</sub> /5.00Ω   | —                          | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.200                   | 9V <sub>DC</sub> /3.00Ω   | 9V <sub>DC</sub> /3.20Ω   | 24V <sub>DC</sub> /3.10Ω   | —                          | 30V <sub>DC</sub> /3.30Ω    | —                        | —                        | —                         | —                        | —                        |
| 0.250                   | —                         | —                         | 16V <sub>DC</sub> /2.30Ω   | —                          | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.300                   | —                         | —                         | —                          | —                          | 30V <sub>DC</sub> /1.75Ω    | 60V <sub>DC</sub> /2.30Ω | 60V <sub>DC</sub> /4.80Ω | —                         | —                        | —                        |
| 0.350                   | 6V <sub>DC</sub> /1.00Ω   | 6V <sub>DC</sub> /1.40Ω   | 16V <sub>DC</sub> /1.35Ω   | 6V <sub>DC</sub> /1.30Ω    | —                           | —                        | —                        | —                         | —                        | —                        |
| 0.500                   | —                         | 6V <sub>DC</sub> /0.80Ω   | 13.2V <sub>DC</sub> /0.75Ω | 13.2V <sub>DC</sub> /0.90Ω | 24V <sub>DC</sub> /1.00Ω    | —                        | 60V <sub>DC</sub> /1.40Ω | —                         | —                        | 60V <sub>DC</sub> /1.10Ω |
| 0.750                   | —                         | 6V <sub>DC</sub> /0.31Ω*  | 6V <sub>DC</sub> /0.30Ω    | 6V <sub>DC</sub> /0.40Ω    | 13.2V <sub>DC</sub> /0.45Ω  | —                        | 30V <sub>DC</sub> /1.00Ω | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.29Ω    | —                        | 60V <sub>DC</sub> /1.00Ω | —                         | —                        | —                        |
| 1.000                   | —                         | —                         | —                          | —                          | —                           | 15V <sub>DC</sub> /0.40Ω | 30V <sub>DC</sub> /0.48Ω | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | —                           | —                        | 33V <sub>DC</sub> /0.41Ω | —                         | —                        | —                        |
| 1.100                   | —                         | 6V <sub>DC</sub> /0.16Ω*  | 6V <sub>DC</sub> /0.20Ω    | 6V <sub>DC</sub> /0.21Ω    | 8V <sub>DC</sub> /0.21Ω     | —                        | —                        | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.18Ω    | —                        | —                        | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.18Ω    | —                        | —                        | —                         | —                        | —                        |
| 1.200                   | —                         | —                         | —                          | —                          | —                           | —                        | 16V <sub>DC</sub> /0.34Ω | —                         | —                        | —                        |
| 1.250                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.14Ω     | —                        | 15V <sub>DC</sub> /0.25Ω | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.14Ω    | —                        | —                        | —                         | —                        | —                        |
| 1.500                   | —                         | —                         | 6V <sub>DC</sub> /0.11Ω    | 6V <sub>DC</sub> /0.11Ω    | 6V <sub>DC</sub> /0.11Ω     | 15V <sub>DC</sub> /0.18Ω | —                        | 15V <sub>DC</sub> /0.25Ω  | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 12V <sub>DC</sub> /0.11Ω    | —                        | —                        | 33V <sub>DC</sub> /0.23Ω  | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.11Ω    | —                        | —                        | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.12Ω    | —                        | —                        | —                         | —                        | —                        |
| 1.600                   | —                         | —                         | —                          | —                          | 9V <sub>DC</sub> /0.10Ω     | —                        | —                        | 16V <sub>DC</sub> /0.15Ω  | —                        | —                        |
| 1.750                   | —                         | —                         | —                          | 6V <sub>DC</sub> /0.08Ω    | —                           | —                        | —                        | —                         | —                        | —                        |
| 1.850                   | —                         | —                         | —                          | —                          | —                           | —                        | —                        | 33V <sub>DC</sub> /0.165Ω | —                        | —                        |
| 1.900                   | —                         | —                         | —                          | —                          | —                           | —                        | —                        | —                         | 16V <sub>DC</sub> /0.08Ω | —                        |
| 2.000                   | —                         | —                         | 6V <sub>DC</sub> /0.072Ω   | 6V <sub>DC</sub> /0.06Ω    | 8V <sub>DC</sub> /0.07Ω     | 6V <sub>DC</sub> /0.10Ω  | —                        | 15V <sub>DC</sub> /0.125Ω | —                        | —                        |
| 2.500                   | —                         | —                         | —                          | —                          | —                           | —                        | —                        | 15V <sub>DC</sub> /0.85Ω  | —                        | —                        |
| 2.600                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.043Ω    | —                        | 6V <sub>DC</sub> /0.075Ω | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 12V <sub>DC</sub> /0.047Ω   | —                        | —                        | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 13.2V <sub>DC</sub> /0.050Ω | —                        | —                        | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.050Ω   | —                        | —                        | —                         | —                        | —                        |
| 3.000                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.036Ω    | —                        | 6V <sub>DC</sub> /0.048Ω | —                         | —                        | —                        |
|                         | —                         | —                         | —                          | —                          | —                           | —                        | 15V <sub>DC</sub> /0.05Ω | —                         | —                        | —                        |

\* Data is preliminary

**Table S2 Thermal Derating for Surface-mount Devices**  
[Hold Current (A) at Ambient Temperature (°C)]

|                               |  | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |       |
|-------------------------------|--|-----------------------------|-------|------|------|------|------|------|------|------|------|------|-------|
| Part Number                   |  | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C | 125°C |
| <b>femtoSMDC Series</b>       |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 1608 mm/0603 mils</b> |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| NEW femtoSMDC005F             |  | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | —     |
| NEW femtoSMDC008F             |  | 0.13                        | 0.11  | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | 0.06 | 0.05 | 0.04 | 0.04 | —     |
| NEW femtoSMDC010F             |  | 0.16                        | 0.14  | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | —     |
| NEW femtoSMDC012F             |  | 0.18                        | 0.16  | 0.14 | 0.12 | 0.12 | 0.11 | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | —     |
| femtoSMDC016F                 |  | 0.25                        | 0.22  | 0.18 | 0.17 | 0.16 | 0.14 | 0.12 | 0.11 | 0.10 | 0.08 | 0.07 | —     |
| NEW femtoSMDC020F             |  | 0.30                        | 0.27  | 0.24 | 0.20 | 0.20 | 0.17 | 0.16 | 0.14 | 0.12 | 0.11 | 0.10 | —     |
| NEW femtoSMDC035F             |  | 0.53                        | 0.47  | 0.41 | 0.36 | 0.35 | 0.30 | 0.27 | 0.25 | 0.22 | 0.19 | 0.17 | —     |
| <b>picoSMDC Series</b>        |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 2012 mm/0805 mils</b> |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| NEW picoSMDC010S              |  | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.05 | —     |
| NEW picoSMDC012S              |  | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | —     |
| picoSMDC020S                  |  | 0.30                        | 0.27  | 0.24 | 0.21 | 0.20 | 0.18 | 0.16 | 0.15 | 0.13 | 0.12 | 0.11 | —     |
| picoSMDC035S                  |  | 0.55                        | 0.49  | 0.44 | 0.37 | 0.35 | 0.31 | 0.28 | 0.26 | 0.23 | 0.20 | 0.18 | —     |
| NEW picoSMDC050S              |  | 0.70                        | 0.62  | 0.55 | 0.55 | 0.50 | 0.43 | 0.38 | 0.33 | 0.30 | 0.28 | 0.26 | —     |
| coming soon picoSMDC075S*     |  | 1.17                        | 1.05  | 0.94 | 0.81 | 0.75 | 0.68 | 0.62 | 0.57 | 0.50 | 0.44 | 0.41 | —     |
| coming soon picoSMDC110S*     |  | 1.61                        | 1.46  | 1.21 | 1.15 | 1.10 | 0.94 | 0.84 | 0.75 | 0.72 | 0.68 | 0.64 | —     |
| <b>nanoSMDC Series</b>        |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 3216 mm/1206 mils</b> |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| nanoSMDC012F                  |  | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | —     |
| nanoSMDC016F                  |  | 0.21                        | 0.20  | 0.18 | 0.16 | 0.16 | 0.14 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | —     |
| nanoSMDC020F                  |  | 0.34                        | 0.30  | 0.26 | 0.22 | 0.20 | 0.17 | 0.15 | 0.13 | 0.11 | 0.09 | 0.08 | —     |
| NEW nanoSMDC025F              |  | 0.38                        | 0.33  | 0.30 | 0.26 | 0.25 | 0.22 | 0.20 | 0.19 | 0.16 | 0.13 | 0.11 | —     |
| nanoSMDC035F                  |  | 0.58                        | 0.51  | 0.44 | 0.38 | 0.35 | 0.31 | 0.28 | 0.24 | 0.21 | 0.18 | 0.16 | —     |
| nanoSMDC050F/13.2             |  | 0.78                        | 0.69  | 0.61 | 0.52 | 0.50 | 0.44 | 0.39 | 0.35 | 0.30 | 0.25 | 0.24 | —     |
| nanoSMDC075F                  |  | 1.15                        | 1.04  | 0.92 | 0.78 | 0.75 | 0.69 | 0.63 | 0.58 | 0.51 | 0.46 | 0.43 | —     |
| nanoSMDC110F                  |  | 1.64                        | 1.46  | 1.30 | 1.10 | 1.06 | 0.92 | 0.83 | 0.80 | 0.65 | 0.56 | 0.52 | —     |
| nanoSMDC150F                  |  | 2.20                        | 1.99  | 1.77 | 1.55 | 1.50 | 1.34 | 1.23 | 1.10 | 1.01 | 0.90 | 0.84 | —     |
| nanoSMDC200F                  |  | 2.92                        | 2.64  | 2.35 | 2.07 | 2.00 | 1.79 | 1.64 | 1.50 | 1.36 | 1.22 | 1.15 | —     |
| <b>microSMD Series</b>        |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 3225 mm/1210 mils</b> |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| microSMD005F                  |  | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | —     |
| microSMD010F                  |  | 0.15                        | 0.13  | 0.12 | 0.10 | 0.10 | 0.09 | 0.08 | 0.06 | 0.06 | 0.05 | 0.05 | —     |
| microSMD035F                  |  | 0.51                        | 0.46  | 0.40 | 0.35 | 0.34 | 0.30 | 0.27 | 0.24 | 0.22 | 0.19 | 0.18 | —     |
| microSMD050F                  |  | 0.76                        | 0.66  | 0.58 | 0.50 | 0.48 | 0.42 | 0.38 | 0.35 | 0.29 | 0.25 | 0.23 | —     |
| microSMD075F                  |  | 1.10                        | 0.97  | 0.86 | 0.75 | 0.72 | 0.64 | 0.58 | 0.55 | 0.47 | 0.42 | 0.39 | —     |
| microSMD110F                  |  | 1.60                        | 1.42  | 1.26 | 1.10 | 1.06 | 0.94 | 0.86 | 0.80 | 0.70 | 0.62 | 0.58 | —     |
| microSMD150F                  |  | 2.30                        | 2.02  | 1.76 | 1.50 | 1.43 | 1.24 | 1.11 | 1.00 | 0.85 | 0.72 | 0.65 | —     |
| microSMD175F                  |  | 2.80                        | 2.45  | 2.10 | 1.75 | 1.70 | 1.55 | 1.45 | 1.35 | 1.25 | 1.15 | 1.10 | —     |
| microSMD200F                  |  | 2.60                        | 2.44  | 2.35 | 2.00 | 1.96 | 1.78 | 1.67 | 1.50 | 1.45 | 1.15 | 1.10 | —     |
| <b>miniSMDC Series</b>        |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 4532 mm/1812 mils</b> |  |                             |       |      |      |      |      |      |      |      |      |      |       |
| miniSMDC010F                  |  | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | —     |
| miniSMDC014F                  |  | 0.23                        | 0.20  | 0.17 | 0.14 | 0.13 | 0.11 | 0.10 | 0.09 | 0.07 | 0.06 | 0.05 | —     |
| miniSMDC020F                  |  | 0.30                        | 0.27  | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | —     |
| miniSMDC030F                  |  | 0.49                        | 0.44  | 0.39 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.18 | 0.16 | 0.14 | —     |
| miniSMDC050F                  |  | 0.59                        | 0.57  | 0.55 | 0.50 | 0.48 | 0.45 | 0.43 | 0.35 | 0.30 | 0.25 | 0.23 | —     |
| miniSMDC075F                  |  | 1.10                        | 0.99  | 0.87 | 0.75 | 0.72 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.35 | —     |
| miniSMDC075F/24               |  | 1.50                        | 1.25  | 1.00 | 0.75 | 0.73 | 0.65 | 0.60 | 0.55 | 0.50 | 0.45 | 0.43 | —     |
| miniSMDC100F                  |  | 1.60                        | 1.45  | 1.28 | 1.10 | 1.07 | 0.92 | 0.83 | 0.71 | 0.66 | 0.57 | 0.52 | —     |

\* Data is preliminary

**Table S2 Thermal Derating for Surface-mount Devices**  
**[Hold Current (A) at Ambient Temperature (°C)]**

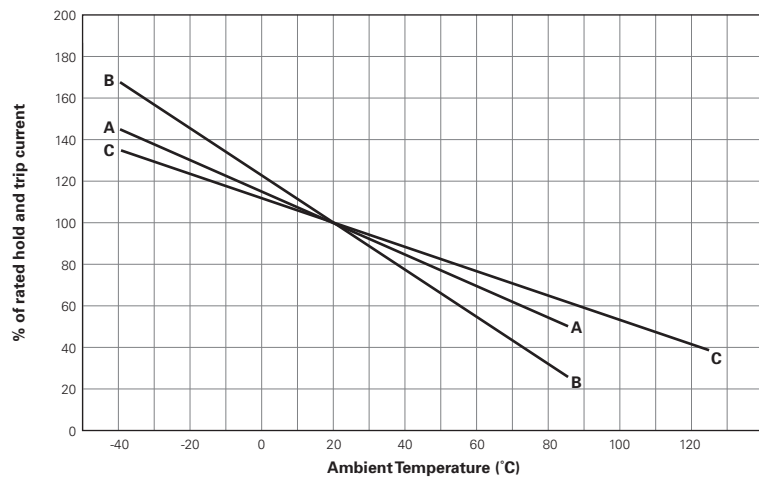
Cont'd

| Part Number                    | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |       |
|--------------------------------|-----------------------------|-------|------|------|------|------|------|------|------|------|------|-------|
|                                | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C | 125°C |
| <b>miniSMDC Series</b>         |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 4532 mm/1812 mils</b>  |                             |       |      |      |      |      |      |      |      |      |      |       |
| miniSMDC110F                   | 1.60                        | 1.45  | 1.28 | 1.10 | 1.07 | 0.92 | 0.83 | 0.71 | 0.66 | 0.57 | 0.52 | —     |
| miniSMDC110F/16                | 1.68                        | 1.49  | 1.30 | 1.10 | 1.05 | 0.92 | 0.83 | 0.75 | 0.64 | 0.55 | 0.50 | —     |
| miniSMDC110F/24                | 2.00                        | 1.70  | 1.40 | 1.10 | 1.06 | 0.95 | 0.88 | 0.80 | 0.73 | 0.65 | 0.61 | —     |
| miniSMDC125F                   | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.58 | 0.53 | —     |
| miniSMDC125F/16                | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.58 | 0.53 | —     |
| miniSMDC150F                   | 2.30                        | 2.05  | 1.77 | 1.50 | 1.44 | 1.23 | 1.09 | 0.95 | 0.82 | 0.68 | 0.61 | —     |
| miniSMDC150F/12                | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC150F/16                | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC150F/24                | 2.10                        | 1.90  | 1.70 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC160F                   | 2.50                        | 2.19  | 1.89 | 1.60 | 1.53 | 1.31 | 1.16 | 1.10 | 0.95 | 0.79 | 0.71 | —     |
| miniSMDC200F                   | 2.60                        | 2.44  | 2.22 | 2.00 | 1.96 | 1.78 | 1.67 | 1.50 | 1.45 | 1.34 | 1.29 | —     |
| miniSMDC260F                   | 3.40                        | 3.16  | 2.80 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/12                | 3.40                        | 3.16  | 3.00 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/13.2              | 3.40                        | 3.16  | 3.00 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/16                | 3.50                        | 3.20  | 3.00 | 2.60 | 2.53 | 2.30 | 2.15 | 2.00 | 1.85 | 1.70 | 1.63 | —     |
| miniSMDC300F                   | 4.13                        | 3.75  | 3.33 | 3.02 | 3.00 | 2.70 | 2.54 | 2.35 | 2.22 | 2.06 | 1.98 | —     |
| <b>miniSMDE Series</b>         |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 11550 mm/4420 mils</b> |                             |       |      |      |      |      |      |      |      |      |      |       |
| miniSMDE190F                   | 3.16                        | 2.74  | 2.20 | 1.90 | 1.74 | 1.48 | 1.27 | 1.10 | 0.80 | 0.50 | 0.35 | —     |
| <b>midSMD Series</b>           |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 5050 mm/2018 mils</b>  |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD030F-2018                   | 0.48                        | 0.42  | 0.35 | 0.30 | 0.28 | 0.24 | 0.21 | 0.17 | 0.15 | 0.12 | 0.10 | —     |
| decaSMDC050F/60                | 1.00                        | 0.85  | 0.70 | 0.55 | 0.53 | 0.45 | 0.40 | 0.35 | 0.30 | 0.25 | 0.23 | —     |
| SMD100F-2018                   | 1.59                        | 1.43  | 1.20 | 1.10 | 1.03 | 0.94 | 0.85 | 0.72 | 0.69 | 0.61 | 0.57 | —     |
| SMD150F-2018                   | 2.21                        | 1.97  | 1.70 | 1.50 | 1.43 | 1.26 | 1.15 | 1.00 | 0.91 | 0.79 | 0.73 | —     |
| SMD200F-2018                   | 2.81                        | 2.54  | 2.27 | 2.00 | 1.93 | 1.73 | 1.59 | 1.46 | 1.32 | 1.19 | 1.12 | —     |
| <b>SMD Series</b>              |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 7555 mm/2920 mils</b>  |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD030F                        | 0.44                        | 0.39  | 0.32 | 0.30 | 0.28 | 0.26 | 0.23 | 0.19 | 0.18 | 0.17 | 0.15 | —     |
| SMD050F                        | 0.73                        | 0.65  | 0.55 | 0.50 | 0.47 | 0.43 | 0.39 | 0.33 | 0.31 | 0.28 | 0.26 | —     |
| SMD075F                        | 1.11                        | 0.99  | 0.84 | 0.75 | 0.71 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.36 | —     |
| SMD075F/60                     | 1.11                        | 0.99  | 0.84 | 0.75 | 0.71 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.36 | —     |
| SMD100F                        | 1.59                        | 1.43  | 1.20 | 1.10 | 1.03 | 0.94 | 0.85 | 0.72 | 0.69 | 0.61 | 0.57 | —     |
| SMD100F/33                     | 1.48                        | 1.35  | 1.20 | 1.10 | 1.06 | 0.98 | 0.91 | 0.83 | 0.79 | 0.73 | 0.69 | —     |
| SMDH120                        | 2.34                        | 1.96  | 1.58 | 1.20 | 1.15 | 1.02 | 0.92 | 0.83 | 0.74 | 0.65 | 0.60 | 0.26  |
| SMD125F                        | 1.89                        | 1.68  | 1.50 | 1.25 | 1.21 | 1.04 | 0.93 | 0.85 | 0.71 | 0.61 | 0.55 | —     |
| SMD260F                        | 3.82                        | 3.41  | 2.90 | 2.60 | 2.45 | 2.19 | 1.99 | 1.70 | 1.58 | 1.38 | 1.28 | —     |
| SMD300F                        | 4.13                        | 3.75  | 3.30 | 3.00 | 2.87 | 2.62 | 2.43 | 2.25 | 2.00 | 1.87 | 1.78 | —     |
| SMD300F/15                     | 4.20                        | 3.80  | 3.30 | 3.00 | 2.90 | 2.62 | 2.43 | 2.25 | 2.00 | 1.87 | 1.78 | —     |
| <b>SMD2 Series</b>             |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>Size 8763 mm/3425 mils</b>  |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD150F                        | 2.30                        | 2.04  | 1.80 | 1.50 | 1.45 | 1.23 | 1.10 | 0.99 | 0.83 | 0.70 | 0.63 | —     |
| SMD150F/33                     | 2.30                        | 2.04  | 1.80 | 1.50 | 1.45 | 1.23 | 1.10 | 0.99 | 0.83 | 0.70 | 0.63 | —     |
| SMDH160                        | 2.14                        | 1.96  | 1.78 | 1.60 | 1.56 | 1.42 | 1.33 | 1.24 | 1.15 | 1.06 | 1.02 | 0.44  |
| SMD185F                        | 2.54                        | 2.29  | 2.20 | 1.85 | 1.80 | 1.55 | 1.43 | 1.31 | 1.19 | 1.06 | 1.00 | —     |
| SMD200F                        | 3.01                        | 2.67  | 2.30 | 2.00 | 1.90 | 1.66 | 1.50 | 1.30 | 1.16 | 0.99 | 0.91 | —     |
| SMD250F                        | 3.72                        | 3.31  | 2.80 | 2.50 | 2.35 | 2.09 | 1.89 | 1.60 | 1.48 | 1.28 | 1.18 | —     |



**Figure S1 Thermal Derating Curve for Surface-mount Devices**

- A = femtoSMD / picoSMD / nanoSMD / microSMD / miniSMD / decaSMD and SMD**
- B = miniSMDE190F**
- C = SMDH120 and SMDH160**

**Figure S1**

**Table S3 Electrical Characteristics for Surface-mount Devices at Room Temperature**

|                                            | Part Number       | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D MAX</sub><br>(W) | Max. Time-to-Trip<br>(A) (S) |      | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Figure for<br>Dimensions |
|--------------------------------------------|-------------------|-----------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|------------------------------|------|-------------------------|--------------------------|--------------------------|
| femtoSMDC Series<br>Size 1608 mm/0603 mils |                   |                       |                       |                                        |                         |                           |                              |      |                         |                          |                          |
| NEW                                        | femtoSMDC005F     | 0.05                  | 0.15                  | 15                                     | 40                      | 0.50                      | 0.50                         | 0.10 | 3.80                    | 30.00                    | S2                       |
| NEW                                        | femtoSMDC008F     | 0.08                  | 0.20                  | 12                                     | 40                      | 0.50                      | 0.60                         | 0.10 | 2.80                    | 14.00                    | S2                       |
| NEW                                        | femtoSMDC010F     | 0.10                  | 0.25                  | 12                                     | 40                      | 0.50                      | 0.70                         | 0.10 | 1.70                    | 8.00                     | S2                       |
| NEW                                        | femtoSMDC012F     | 0.12                  | 0.30                  | 9                                      | 40                      | 0.50                      | 0.80                         | 0.10 | 1.10                    | 5.80                     | S2                       |
|                                            | femtoSMDC016F     | 0.16                  | 0.40                  | 9                                      | 40                      | 0.50                      | 1.00                         | 0.10 | 1.00                    | 4.20                     | S2                       |
| NEW                                        | femtoSMDC020F     | 0.20                  | 0.45                  | 9                                      | 40                      | 0.50                      | 2.00                         | 0.10 | 0.70                    | 3.00                     | S2                       |
| NEW                                        | femtoSMDC035F     | 0.35                  | 0.70                  | 6                                      | 40                      | 0.50                      | 3.50                         | 0.10 | 0.28                    | 1.00                     | S2                       |
| picoSMDC Series<br>Size 2012 mm/0805 mils  |                   |                       |                       |                                        |                         |                           |                              |      |                         |                          |                          |
| NEW                                        | picoSMDC010S      | 0.10                  | 0.30                  | 15                                     | 100                     | 0.50                      | 0.50                         | 0.60 | 1.50                    | 11.00                    | S2                       |
| NEW                                        | picoSMDC012S      | 0.12                  | 0.30                  | 15                                     | 100                     | 0.50                      | 1.00                         | 0.10 | 1.50                    | 9.00                     | S2                       |
|                                            | picoSMDC020S      | 0.20                  | 0.47                  | 9                                      | 100                     | 0.50                      | 2.00                         | 0.10 | 0.75                    | 3.20                     | S2                       |
|                                            | picoSMDC035S      | 0.35                  | 0.75                  | 6                                      | 100                     | 0.50                      | 1.75                         | 0.20 | 0.35                    | 1.40                     | S2                       |
| NEW                                        | picoSMDC050S      | 0.50                  | 1.00                  | 6                                      | 100                     | 0.50                      | 8.00                         | 0.10 | 0.15                    | 0.80                     | S2                       |
| coming soon                                | picoSMDC075S*     | 0.75                  | 1.72                  | 6                                      | 40                      | 0.60                      | 8.00                         | 0.10 | 0.10                    | 0.31                     | S2                       |
| coming soon                                | picoSMDC110S*     | 1.10                  | 2.10                  | 6                                      | 40                      | 0.60                      | 8.00                         | 0.20 | 0.05                    | 0.16                     | S2                       |
| nanoSMDC Series<br>Size 3216 mm/1206 mils  |                   |                       |                       |                                        |                         |                           |                              |      |                         |                          |                          |
|                                            | nanoSMDC012F      | 0.12                  | 0.39                  | 48                                     | 10                      | 0.50                      | 1.00                         | 0.20 | 1.40                    | 6.50                     | S2                       |
|                                            | nanoSMDC016F      | 0.16                  | 0.45                  | 48                                     | 10                      | 0.50                      | 1.00                         | 0.30 | 1.10                    | 5.00                     | S2                       |
|                                            | nanoSMDC020F      | 0.20                  | 0.42                  | 24                                     | 100                     | 0.60                      | 8.00                         | 0.10 | 0.65                    | 3.10                     | S2                       |
| NEW                                        | nanoSMDC025F      | 0.25                  | 0.58                  | 16                                     | 100                     | 0.60                      | 8.00                         | 0.01 | 0.55                    | 2.30                     | S2                       |
|                                            | nanoSMDC035F      | 0.35                  | 0.75                  | 16                                     | 20                      | 0.60                      | 3.50                         | 0.10 | 0.45                    | 1.35                     | S2                       |
|                                            | nanoSMDC050F/13.2 | 0.50                  | 1.10                  | 13.2                                   | 100                     | 0.80                      | 8.00                         | 0.10 | 0.20                    | 0.75                     | S2                       |
|                                            | nanoSMDC075F      | 0.75                  | 1.50                  | 6                                      | 100                     | 0.80                      | 8.00                         | 0.10 | 0.09                    | 0.30                     | S2                       |
|                                            | nanoSMDC110F      | 1.10                  | 2.20                  | 6                                      | 100                     | 0.80                      | 8.00                         | 0.10 | 0.07                    | 0.20                     | S2                       |
|                                            | nanoSMDC150F      | 1.50                  | 3.00                  | 6                                      | 100                     | 0.80                      | 8.00                         | 0.30 | 0.04                    | 0.11                     | S2                       |
|                                            | nanoSMDC200F      | 2.00                  | 4.00                  | 6                                      | 100                     | 1.00                      | 8.00                         | 1.50 | 0.02                    | 0.072                    | S2                       |

\* Data is preliminary

Table S3 Electrical Characteristics for Surface-mount Devices at Room Temperature

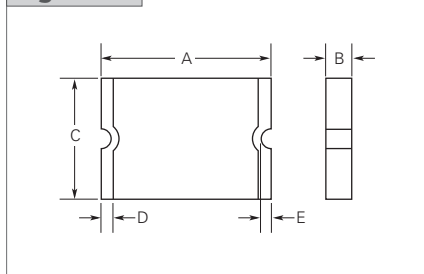
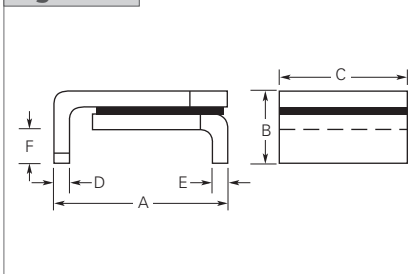
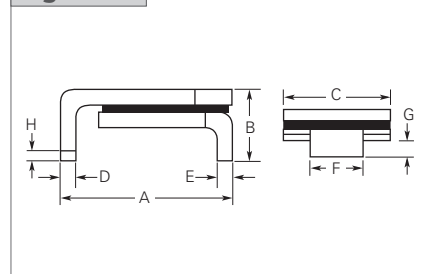
Cont'd

| Part Number                                | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D MAX</sub><br>(W) | Max. Time-to-Trip |       | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Figure for<br>Dimensions |
|--------------------------------------------|-----------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|-------------------|-------|-------------------------|--------------------------|--------------------------|
|                                            |                       |                       |                                        |                         |                           | (A)               | (S)   |                         |                          |                          |
| microSMD Series<br>Size 3225 mm/1210 mils  |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| microSMD005F                               | 0.05                  | 0.15                  | 30                                     | 10                      | 1.00                      | 0.25              | 1.50  | 3.60                    | 50.00                    | S2                       |
| microSMD010F                               | 0.10                  | 0.25                  | 30                                     | 10                      | 0.80                      | 0.50              | 1.00  | 2.10                    | 15.00                    | S2                       |
| microSMD035F                               | 0.35                  | 0.75                  | 6                                      | 40                      | 0.80                      | 8.00              | 0.20  | 0.32                    | 1.30                     | S2                       |
| microSMD050F                               | 0.50                  | 1.00                  | 13.2                                   | 40                      | 0.80                      | 8.00              | 0.05  | 0.25                    | 0.90                     | S2                       |
| microSMD075F                               | 0.75                  | 1.50                  | 6                                      | 40                      | 0.80                      | 8.00              | 0.10  | 0.11                    | 0.40                     | S2                       |
| microSMD110F                               | 1.10                  | 2.20                  | 6                                      | 40                      | 0.80                      | 8.00              | 0.20  | 0.07                    | 0.21                     | S2                       |
| microSMD150F                               | 1.50                  | 3.00                  | 6                                      | 40                      | 0.80                      | 8.00              | 1.00  | 0.04                    | 0.11                     | S2                       |
| microSMD175F                               | 1.75                  | 3.50                  | 6                                      | 40                      | 0.80                      | 8.00              | 0.80  | 0.025                   | 0.08                     | S2                       |
| microSMD200F                               | 2.00                  | 4.00                  | 6                                      | 100                     | 0.80                      | 8.00              | 2.50  | 0.020                   | 0.06                     | S2                       |
| miniSMDC Series<br>Size 4532 mm/1812 mils  |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| miniSMDC010F                               | 0.10                  | 0.30                  | 60                                     | 40                      | 0.75                      | 0.50              | 5.00  | 0.70                    | 12.70                    | S2                       |
| miniSMDC014F                               | 0.14                  | 0.28                  | 60                                     | 10                      | 0.75                      | 8.00              | 0.008 | 1.50                    | 6.00                     | S2                       |
| miniSMDC020F                               | 0.20                  | 0.40                  | 30                                     | 10                      | 0.80                      | 8.00              | 0.02  | 0.60                    | 3.30                     | S2                       |
| miniSMDC030F                               | 0.30                  | 0.60                  | 30                                     | 40                      | 0.80                      | 8.00              | 0.10  | 0.20                    | 1.75                     | S2                       |
| miniSMDC050F                               | 0.50                  | 1.00                  | 24                                     | 100                     | 0.80                      | 8.00              | 0.15  | 0.15                    | 1.00                     | S2                       |
| miniSMDC075F                               | 0.75                  | 1.50                  | 13.2                                   | 100                     | 1.00                      | 8.00              | 0.20  | 0.11                    | 0.45                     | S2                       |
| miniSMDC075F/24                            | 0.75                  | 1.50                  | 24                                     | 40                      | 0.80                      | 8.00              | 0.30  | 0.09                    | 0.29                     | S2                       |
| miniSMDC100F                               | 1.10                  | 2.20                  | 8                                      | 100                     | 1.20                      | 8.00              | 0.30  | 0.04                    | 0.21                     | S2                       |
| miniSMDC110F                               | 1.10                  | 2.20                  | 8                                      | 100                     | 1.20                      | 8.00              | 0.30  | 0.04                    | 0.21                     | S2                       |
| miniSMDC110F/16                            | 1.10                  | 2.20                  | 16                                     | 100                     | 0.80                      | 8.00              | 0.30  | 0.06                    | 0.18                     | S2                       |
| miniSMDC110F/24                            | 1.10                  | 2.20                  | 24                                     | 20                      | 0.80                      | 8.00              | 0.50  | 0.06                    | 0.18                     | S2                       |
| miniSMDC125F                               | 1.25                  | 2.50                  | 6                                      | 100                     | 0.80                      | 8.00              | 0.40  | 0.05                    | 0.14                     | S2                       |
| miniSMDC125F/16                            | 1.25                  | 2.50                  | 16                                     | 100                     | 0.80                      | 8.00              | 0.40  | 0.05                    | 0.14                     | S2                       |
| miniSMDC150F                               | 1.50                  | 3.00                  | 6                                      | 100                     | 0.80                      | 8.00              | 0.50  | 0.04                    | 0.11                     | S2                       |
| miniSMDC150F/12                            | 1.50                  | 2.80                  | 12                                     | 100                     | 0.80                      | 8.00              | 0.50  | 0.04                    | 0.11                     | S2                       |
| miniSMDC150F/16                            | 1.50                  | 2.80                  | 16                                     | 100                     | 0.80                      | 8.00              | 0.50  | 0.04                    | 0.11                     | S2                       |
| miniSMDC150F/24                            | 1.50                  | 3.00                  | 24                                     | 20                      | 1.00                      | 8.00              | 1.50  | 0.04                    | 0.12                     | S2                       |
| miniSMDC160F                               | 1.60                  | 3.20                  | 9                                      | 100                     | 0.80                      | 8.00              | 1.00  | 0.03                    | 0.10                     | S2                       |
| miniSMDC200F                               | 2.00                  | 4.00                  | 8                                      | 100                     | 1.00                      | 8.00              | 5.00  | 0.020                   | 0.070                    | S2                       |
| miniSMDC260F                               | 2.60                  | 5.00                  | 6                                      | 100                     | 1.00                      | 8.00              | 5.00  | 0.015                   | 0.043                    | S2                       |
| miniSMDC260F/12                            | 2.60                  | 5.00                  | 12                                     | 100                     | 1.00                      | 8.00              | 5.00  | 0.015                   | 0.047                    | S2                       |
| miniSMDC260F/13.2                          | 2.60                  | 5.00                  | 13.2                                   | 100                     | 1.20                      | 8.00              | 5.00  | 0.015                   | 0.050                    | S2                       |
| miniSMDC260F/16                            | 2.60                  | 5.00                  | 16                                     | 100                     | 1.20                      | 8.00              | 5.00  | 0.015                   | 0.050                    | S2                       |
| miniSMDC300F                               | 3.00                  | 6.00                  | 6                                      | 100                     | 1.00                      | 8.00              | 5.00  | 0.011                   | 0.036                    | S2                       |
| miniSMDE Series<br>Size 11550 mm/4420 mils |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| miniSMDE190F                               | 1.90                  | 3.80                  | 16                                     | 100                     | 1.50                      | 10.00             | 2.00  | 0.024                   | 0.08                     | S2                       |
| midSMD Series<br>Size 5050 mm/2018 mils    |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| SMD030F-2018                               | 0.30                  | 0.80                  | 60                                     | 20                      | 1.50                      | 1.50              | 1.50  | 0.500                   | 2.30                     | S3                       |
| decaSMDC050F/60                            | 0.55                  | 1.10                  | 60                                     | 10                      | 1.00                      | 8.00              | 0.10  | 0.200                   | 1.10                     | S2                       |
| SMD100F-2018                               | 1.10                  | 2.20                  | 15                                     | 40                      | 1.40                      | 8.00              | 0.50  | 0.100                   | 0.40                     | S3                       |
| SMD150F-2018                               | 1.50                  | 3.00                  | 15                                     | 40                      | 1.80                      | 8.00              | 1.00  | 0.070                   | 0.18                     | S3                       |
| SMD200F-2018                               | 2.00                  | 4.20                  | 6                                      | 40                      | 1.50                      | 8.00              | 3.00  | 0.048                   | 0.10                     | S3                       |

**Table S3 Electrical Characteristics for Surface-mount Devices at Room Temperature**

Cont'd

| Part Number            | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D MAX</sub><br>(W) | Max. Time-to-Trip |       | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Figure for<br>Dimensions |
|------------------------|-----------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|-------------------|-------|-------------------------|--------------------------|--------------------------|
|                        |                       |                       |                                        |                         |                           | (A)               | (S)   |                         |                          |                          |
| SMD Series             |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| Size 7555 mm/2920 mils |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| SMD030F                | 0.30                  | 0.60                  | 60                                     | 10                      | 1.70                      | 1.50              | 3.00  | 1.200                   | 4.800                    | S4                       |
| SMD050F                | 0.50                  | 1.00                  | 60                                     | 10                      | 1.70                      | 2.50              | 4.00  | 0.350                   | 1.400                    | S4                       |
| SMD075F                | 0.75                  | 1.50                  | 30                                     | 40                      | 1.70                      | 8.00              | 0.30  | 0.350                   | 1.000                    | S4                       |
| SMD075F/60             | 0.75                  | 1.50                  | 60                                     | 10                      | 1.70                      | 8.00              | 0.30  | 0.350                   | 1.000                    | S4                       |
| SMD100F                | 1.10                  | 2.20                  | 30                                     | 40                      | 1.70                      | 8.00              | 0.50  | 0.120                   | 0.480                    | S4                       |
| SMD100F/33             | 1.10                  | 2.20                  | 33                                     | 40                      | 1.70                      | 8.00              | 0.50  | 0.120                   | 0.410                    | S4                       |
| SMDH120                | 1.20                  | 2.30                  | 16                                     | 50                      | 2.00                      | 8.00              | 2.00  | 0.150                   | 0.340                    | S4                       |
| SMD125F                | 1.25                  | 2.50                  | 15                                     | 40                      | 1.70                      | 8.00              | 2.00  | 0.070                   | 0.250                    | S4                       |
| SMD260F                | 2.60                  | 5.20                  | 6                                      | 40                      | 1.70                      | 8.00              | 20.00 | 0.025                   | 0.075                    | S4                       |
| SMD300F                | 3.00                  | 6.00                  | 6                                      | 40                      | 1.50                      | 8.00              | 35.00 | 0.015                   | 0.048                    | S4                       |
| SMD300F/15             | 3.00                  | 6.00                  | 15                                     | 40                      | 1.50                      | 8.00              | 35.00 | 0.015                   | 0.050                    | S4                       |
| SMD2 Devices           |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| Size 8763 mm/3425 mils |                       |                       |                                        |                         |                           |                   |       |                         |                          |                          |
| SMD150F                | 1.50                  | 3.00                  | 15                                     | 40                      | 1.90                      | 8.00              | 5.00  | 0.060                   | 0.250                    | S4                       |
| SMD150F/33             | 1.50                  | 3.00                  | 33                                     | 40                      | 1.90                      | 8.00              | 5.00  | 0.080                   | 0.230                    | S4                       |
| SMDH160                | 1.60                  | 3.20                  | 16                                     | 70                      | 2.20                      | 8.00              | 15.00 | 0.050                   | 0.150                    | S4                       |
| SMD185F                | 1.85                  | 3.60                  | 33                                     | 40                      | 1.50                      | 8.00              | 5.00  | 0.065                   | 0.165                    | S4                       |
| SMD200F                | 2.00                  | 4.00                  | 15                                     | 40                      | 1.90                      | 8.00              | 12.00 | 0.050                   | 0.125                    | S4                       |
| SMD250F                | 2.50                  | 5.00                  | 15                                     | 40                      | 1.90                      | 8.00              | 25.00 | 0.035                   | 0.085                    | S4                       |

**Figure S2-S4 Dimension Figures for Surface-mount Devices**
**Figure S2**

**Figure S3**

**Figure S4**

**Table S4 Dimensions for Surface-mount Devices in Millimeters (Inches)**

| Part Number                                | A             |                 | B               |                 | C               |                 | D               |                 | E               |                  | F    |      | G    |      | H    |      | Figure |
|--------------------------------------------|---------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------|------|------|------|------|------|--------|
|                                            | Min.          | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.             | Min. | Max. | Min. | Max. | Min. | Max. |        |
| femtoSMDC Series<br>Size 1608 mm/0603 mils |               |                 |                 |                 |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| NEW                                        | femtoSMDC005F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
| NEW                                        | femtoSMDC008F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
| NEW                                        | femtoSMDC010F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
| NEW                                        | femtoSMDC012F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
|                                            | femtoSMDC016F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
| NEW                                        | femtoSMDC020F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
|                                            |               |                 |                 |                 |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| NEW                                        | femtoSMDC035F | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.55<br>(0.021) | 0.95<br>(0.037) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —    | —    | —    | —    | —    | —    | S2     |
|                                            |               |                 |                 |                 |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |

**Table S4 Dimensions for Surface-mount Devices in Millimeters (Inches)**

Cont'd

|                        | Part Number       | A       |         | B       |         | C       |         | D       |         | E       |      | F    |      | G    |      | H    |    | Figure |
|------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|------|------|----|--------|
|                        |                   | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    | Min.    | Max. | Min. | Max. | Min. | Max. | Min. |    |        |
| picoSMDC Series        |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
| Size 2012 mm/0805 mils |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
| NEW                    | picoSMDC010S      | 2.00    | 2.20    | 0.60    | 1.00    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.023) | (0.040) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| NEW                    | picoSMDC012S      | 2.00    | 2.20    | 0.44    | 0.68    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.017) | (0.027) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | picoSMDC020S      | 2.00    | 2.20    | 0.44    | 0.68    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.017) | (0.027) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | picoSMDC035S      | 2.00    | 2.20    | 0.44    | 0.68    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.017) | (0.027) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| NEW                    | picoSMDC050S      | 2.00    | 2.20    | 0.63    | 0.93    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.025) | (0.036) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| coming soon            | picoSMDC075S*     | 2.00    | 2.20    | 0.60    | 1.00    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.023) | (0.040) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| coming soon            | picoSMDC110S*     | 2.00    | 2.20    | 0.71    | 1.04    | 1.30    | 1.50    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.079) | (0.087) | (0.028) | (0.041) | (0.051) | (0.059) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| nanoSMDC Series        |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
| Size 3216 mm/1206 mils |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
|                        | nanoSMDC012F      | 3.00    | 3.40    | 0.62    | 1.00    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.024) | (0.039) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC016F      | 3.00    | 3.40    | 0.62    | 1.00    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.024) | (0.039) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC020F      | 3.00    | 3.40    | 0.58    | 0.82    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.023) | (0.032) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| NEW                    | nanoSMDC025F      | 3.00    | 3.40    | 0.58    | 0.82    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.023) | (0.032) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC035F      | 3.00    | 3.40    | 0.58    | 0.82    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.023) | (0.032) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC050F/13.2 | 3.00    | 3.40    | 0.50    | 0.74    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.019) | (0.029) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC075F      | 3.00    | 3.40    | 0.44    | 0.68    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.017) | (0.027) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC110F      | 3.00    | 3.40    | 0.28    | 0.67    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.011) | (0.026) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC150F      | 3.00    | 3.40    | 0.55    | 0.89    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.022) | (0.035) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | nanoSMDC200F      | 3.00    | 3.40    | 0.83    | 1.10    | 1.37    | 1.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.134) | (0.033) | (0.043) | (0.054) | (0.071) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
| microSMD Series        |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
| Size 3225 mm/1210 mils |                   |         |         |         |         |         |         |         |         |         |      |      |      |      |      |      |    |        |
|                        | microSMD005F      | 3.0     | 3.43    | 0.50    | 0.85    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.019) | (0.034) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD010F      | 3.0     | 3.43    | 0.50    | 0.85    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.019) | (0.034) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD035F      | 3.0     | 3.43    | 0.38    | 0.62    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.015) | (0.025) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD050F      | 3.0     | 3.43    | 0.38    | 0.62    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.015) | (0.025) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD075F      | 3.0     | 3.43    | 0.38    | 0.62    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.015) | (0.025) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD110F      | 3.0     | 3.43    | 0.28    | 0.48    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.011) | (0.019) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD150F      | 3.0     | 3.43    | 0.51    | 1.22    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.020) | (0.048) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD175F      | 3.0     | 3.43    | 0.40    | 0.76    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.016) | (0.030) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |
|                        | microSMD200F      | 3.0     | 3.43    | 0.79    | 1.17    | 2.35    | 2.80    | 0.25    | 0.75    | 0.076   | —    | —    | —    | —    | —    | —    | S2 |        |
|                        |                   | (0.118) | (0.135) | (0.031) | (0.046) | (0.092) | (0.110) | (0.010) | (0.030) | (0.003) | —    | —    | —    | —    | —    | —    |    |        |

**Table S4 Dimensions for Surface-mount Devices in Millimeters (Inches)**

Cont'd

| Part Number             | A                |                  | B                |                 | C               |                 | D               |                 | E                |      | F    |      | G    |      | H    | Figure |
|-------------------------|------------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------|------|------|------|------|------|--------|
|                         | Min.             | Max.             | Min.             | Max.            | Min.            | Max.            | Min.            | Max.            | Min.             | Max. | Min. | Max. | Min. | Max. | Min. |        |
| miniSMDC Series         |                  |                  |                  |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| Size 4532 mm/1812 mils  |                  |                  |                  |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| miniSMDC010F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC014F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC020F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC030F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC050F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC075F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC075F/24         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC100F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC110F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC110F/16         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC110F/24         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC125F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC125F/16         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC150F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC150F/12         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC150F/16         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC150F/24         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 1.00<br>(0.040)  | 1.94<br>(0.077) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC160F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC200F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.51<br>(0.020)  | 1.22<br>(0.048) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC260F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.48<br>(0.019)  | 0.78<br>(0.031) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC260F/12         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 1.02<br>(0.042)  | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC260F/13.2       | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 1.02<br>(0.042)  | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC260F/16         | 4.37<br>(0.172)  | 4.83<br>(0.190)  | 1.02<br>(0.042)  | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDC300F            | 4.37<br>(0.172)  | 4.73<br>(0.186)  | 0.45<br>(0.018)  | 0.76<br>(0.030) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —    | —    | —    | —    | —    | —    | S2     |
| miniSMDE Series         |                  |                  |                  |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| Size 11550 mm/4420 mils |                  |                  |                  |                 |                 |                 |                 |                 |                  |      |      |      |      |      |      |        |
| miniSMDE190F            | 11.15<br>(0.439) | 11.51<br>(0.453) | 0.33<br>(0.013)  | 0.53<br>(0.021) | 4.83<br>(0.190) | 5.33<br>(0.210) | 0.51<br>(0.020) | 1.02<br>(0.040) | 0.381<br>(0.015) | —    | —    | —    | —    | —    | —    | S2     |

**Table S4 Dimensions for Surface-mount Devices in Millimeters (Inches)**

Cont'd

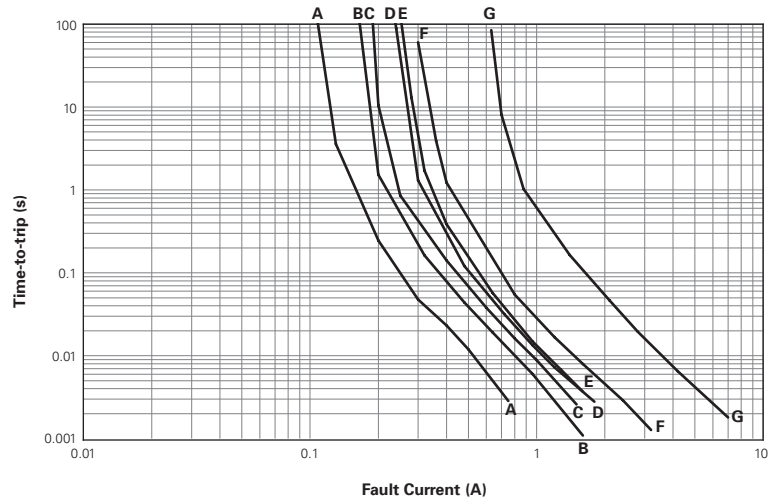
| Part Number            | A               |                 | B               |                 | C               |                 | D               |                 | E               |                 | F               |                 | G               |                 | H               |      | Figure |
|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|--------|
|                        | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max. |        |
| midSMD Series          |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| Size 5050 mm/2018 mils |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| SMD030F-2018           | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.78<br>(0.070) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —               | —               | —               | —    | S3     |
| decaSMDC050F/60        | 4.70<br>(0.185) | 5.31<br>(0.209) | 0.63<br>(0.025) | 0.89<br>(0.035) | 4.19<br>(0.165) | 4.81<br>(0.189) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.25<br>(0.010) | —               | —               | —               | —               | —               | —               | —    | S2     |
| SMD100F-2018           | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —               | —               | —               | —    | S3     |
| SMD150F-2018           | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —               | —               | —               | —    | S3     |
| SMD200F-2018           | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —               | —               | —               | —    | S3     |
| SMD Series             |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| Size 7555 mm/2920 mils |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| SMD030F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD050F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD075F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD075F/60             | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD100F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD100F/33             | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMDH120                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD125F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD260F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD300F                | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD300F/15             | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD2 Devices           |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| Size 8763 mm/3425 mils |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| SMD150F                | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD150F/33             | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMDH160                | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD185F                | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD200F                | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |
| SMD250F                | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | S4     |

**Figure S5-S12** Typical Time-to-trip Curves at 20°C for Surface-mount Devices

**femtoSMDCxxxF**

- A = femtoSMDC005F
- B = femtoSMDC008F
- C = femtoSMDC010F
- D = femtoSMDC012F
- E = femtoSMDC016F
- F = femtoSMDC020F
- G = femtoSMDC035F

**Figure S5**

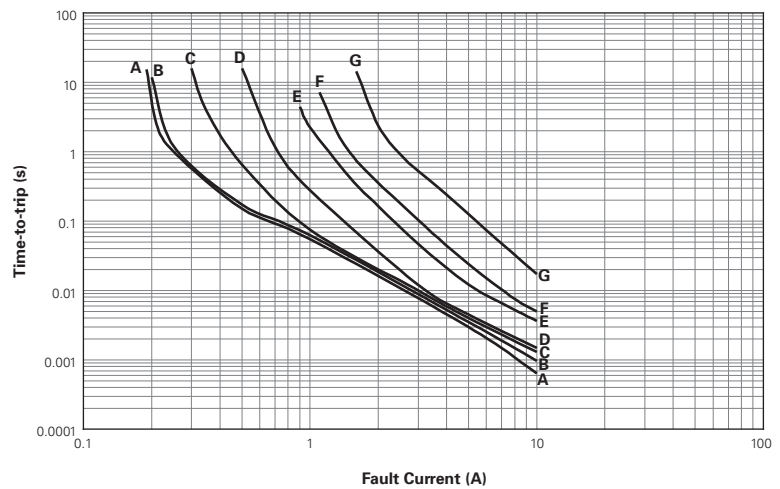


**picoSMDCxxxS**

- A = picoSMDC010S
- B = picoSMDC012S
- C = picoSMDC020S
- D = picoSMDC035S
- E = picoSMDC050S
- F = picoSMDC075S\*
- G = picoSMDC110S\*

\* Data is preliminary

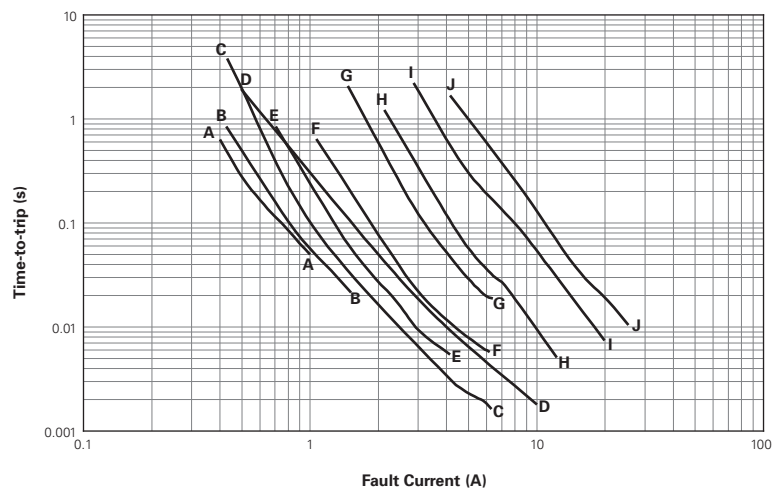
**Figure S6**



**nanoSMDCxxxF**

- A = nanoSMDC012F
- B = nanoSMDC016F
- C = nanoSMDC020F
- D = nanoSMDC025F
- E = nanoSMDC035F
- F = nanoSMDC050F/13.2
- G = nanoSMDC075F
- H = nanoSMDC110F
- I = nanoSMDC150F
- J = nanoSMDC200F

**Figure S7**

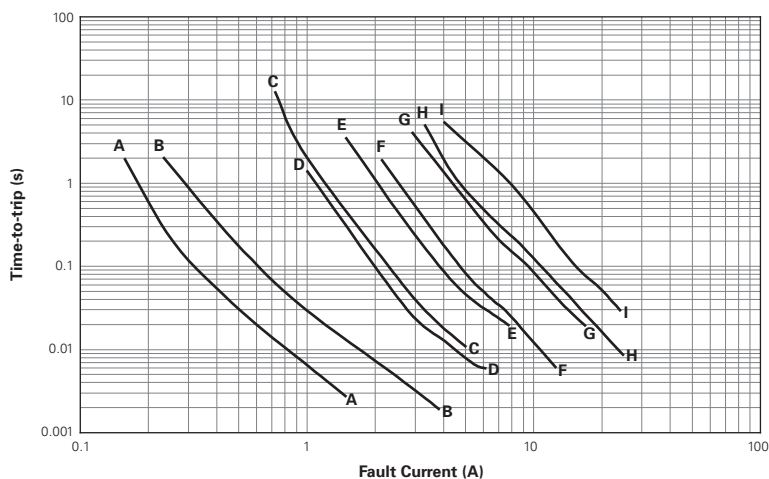




**microSMDxxxF**

- A = microSMD005F
- B = microSMD010F
- C = microSMD035F
- D = microSMD050F
- E = microSMD075F
- F = microSMD110F
- G = microSMD150F
- H = microSMD175F
- I = microSMD200F

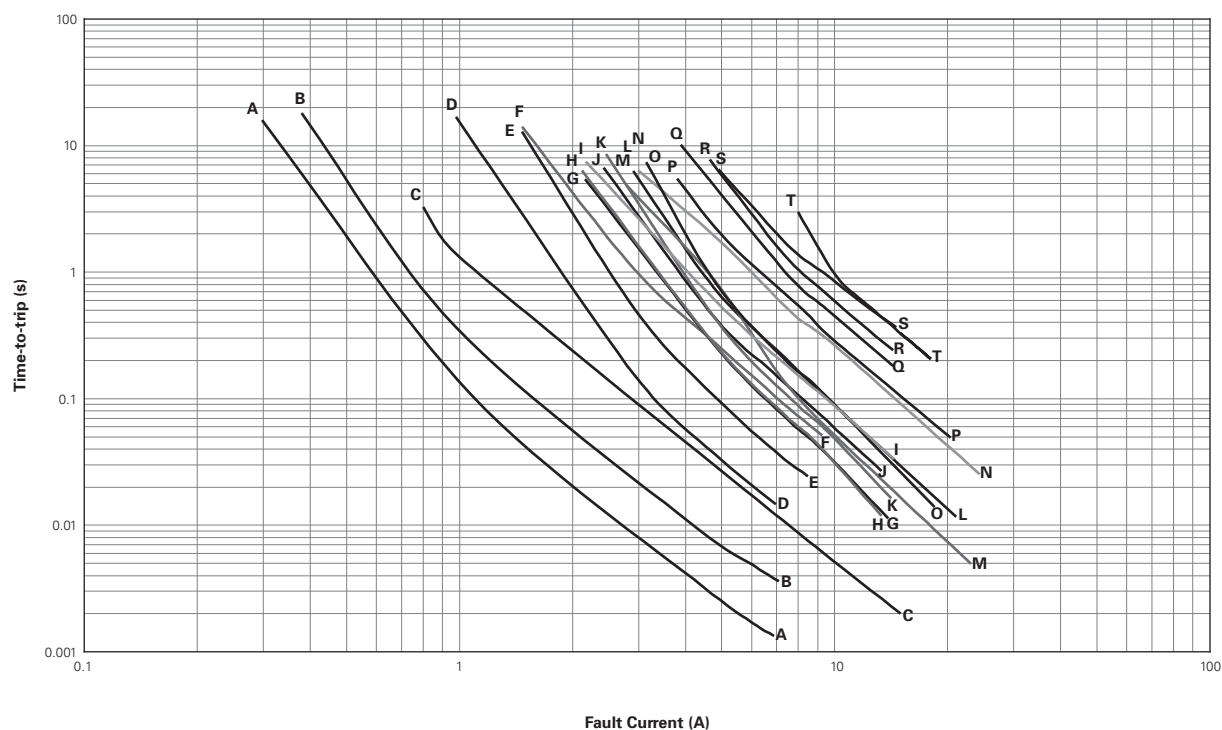
**Figure S8**



**miniSMDCxxxF and miniSMDExxxF**

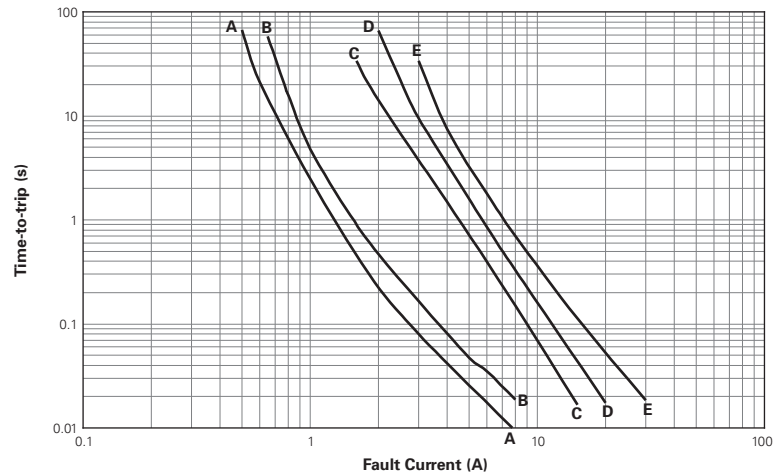
- |                                |                                   |                                                         |
|--------------------------------|-----------------------------------|---------------------------------------------------------|
| A = miniSMDC010F, miniSMDC014F | H = miniSMDC110F/16               | O = miniSMDC160F                                        |
| B = miniSMDC020F               | I = miniSMDC110F/24               | P = miniSMDE190F                                        |
| C = miniSMDC030F               | J = miniSMDC125F                  | Q = miniSMDC200F                                        |
| D = miniSMDC050F               | K = miniSMDC125F/16               | R = miniSMDC260F                                        |
| E = miniSMDC075F               | L = miniSMDC150F, miniSMDC150F/12 | S = miniSMDC260F/12, miniSMDC260F/13.2, miniSMDC260F/16 |
| F = miniSMDC075F/24            | M = miniSMDC150F/16               | T = miniSMDC300F                                        |
| G = miniSMDC100F, miniSMDC110F | N = miniSMDC150F/24               |                                                         |

**Figure S9**

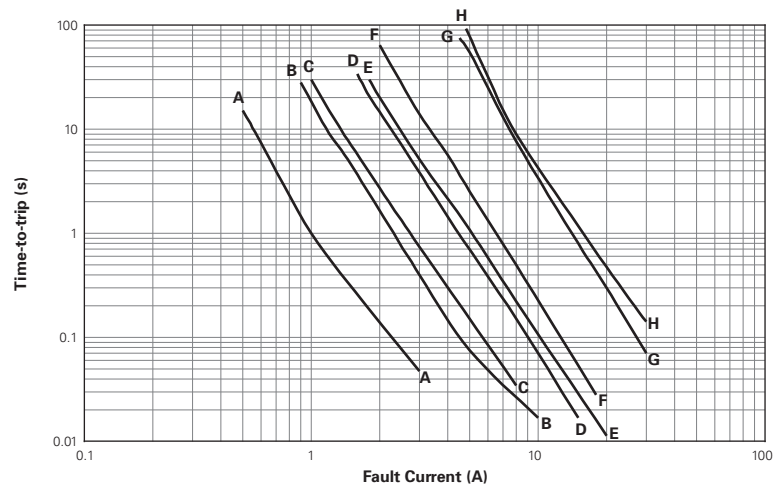


**midSMD**

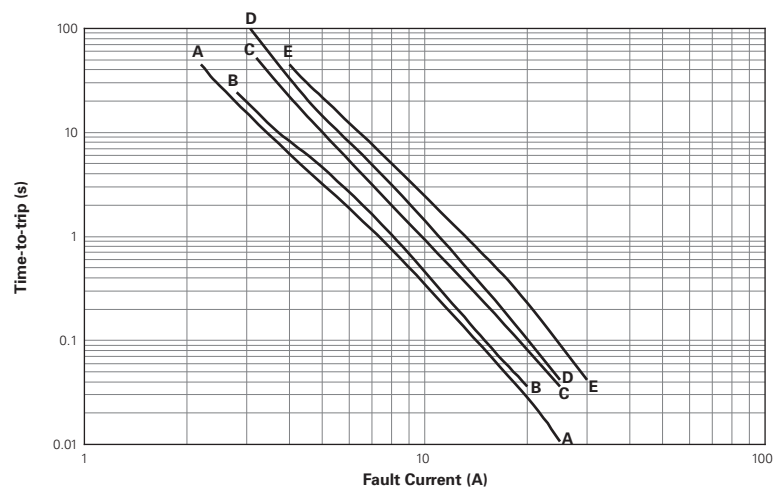
- A = SMD030F-2018
- B = decaSMD050F/60
- C = SMD100F-2018
- D = SMD150F-2018
- E = SMD200F-2018

**Figure S10**

**SMDxxxF**

- A = SMD030F
- B = SMD050F
- C = SMD075F, SMD075F/60
- D = SMD100F, SMD100F/33
- E = SMDH120
- F = SMD125F
- G = SMD260F
- H = SMD300F, SMD300F/15

**Figure S11**

**SMD2xxxF**

- A = SMD150F, SMD150F/33
- B = SMDH160
- C = SMD185F
- D = SMD200F
- E = SMD250F

**Figure S12**


**Table S5 Physical Characteristics and Environmental Specifications for Surface-mount Devices**  
 Operating temperature range -40°C to 85°C, -40°C to 125°C for SMDH120 and SMDH160

**Physical Characteristics**

|                                |                                                                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Terminal pad material          | 100% matte tin with nickel underplate                                                                                             |
| Soldering characteristics      | ANSI/J-STD-002 Category 3 for femtoSMD, picoSMD, nanoSMD, microSMD and miniSMD series<br>ANSI/J-STD-002 Category 1 for SMD series |
| Solder heat withstand          | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A                                                                                |
| Flammability resistance        | per IEC 695-2-2 Needle Flame Test for 20 sec.                                                                                     |
| Recommended storage conditions | 40°C max, 70% R.H. max; devices may not meet specified ratings if storage conditions are exceeded.                                |

**Environmental Specifications**

| Test               | Test Method                  | Conditions              | Resistance Change |
|--------------------|------------------------------|-------------------------|-------------------|
| Storage life       | Raychem PS300, Section 5.3.2 | 60°C, 1000 hours        | ±3% typical       |
|                    |                              | 85°C, 1000 hours        | ±5% typical       |
| Humidity aging     | Raychem PS300, Section 5.3.1 | 85°C, 85% RH, 100 hours | ±1.2% typical     |
| Thermal shock      | MIL-STD-202, Method 107G     | 85°C, -40°C (20 times)  | -33% typical      |
|                    |                              | 125°C, -55°C (10 times) | -33% typical      |
| Vibration          | MIL-STD-883C                 | per MIL-STD-883C        | No change         |
| Solvent resistance | Raychem PS300, Section 5.2.2 | Freon                   | No change         |
|                    |                              | Trichloroethane         | No change         |
|                    |                              | Hydrocarbons            | No change         |

**Table S6 Packaging and Marking Information for Surface-mount Devices**

|                                            |                   |                      |                  | Recommended Pad Layout Figures [mm(In.)] |                    |                    |                    |                    |
|--------------------------------------------|-------------------|----------------------|------------------|------------------------------------------|--------------------|--------------------|--------------------|--------------------|
|                                            | Part Number       | Tape & Reel Quantity | Standard Package | Part Marking                             | Dimension A (Nom.) | Dimension B (Nom.) | Dimension C (Nom.) | Agency Recognition |
| femtoSMDC Series<br>Size 1608 mm/0603 mils |                   |                      |                  |                                          |                    |                    |                    |                    |
| NEW                                        | femtoSMDC005F     | 4,000                | 20,000           | A                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| NEW                                        | femtoSMDC008F     | 4,000                | 20,000           | T                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| NEW                                        | femtoSMDC010F     | 4,000                | 20,000           | B                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| NEW                                        | femtoSMDC012F     | 4,000                | 20,000           | C                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
|                                            | femtoSMDC016F     | 4,000                | 20,000           | E                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| NEW                                        | femtoSMDC020F     | 4,000                | 20,000           | F                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| NEW                                        | femtoSMDC035F     | 4,000                | 20,000           | K                                        | 0.80 (0.032)       | 0.60 (0.024)       | 0.80 (0.032)       | UL, CSA            |
| picoSMDC Series<br>Size 2012 mm/0805 mils  |                   |                      |                  |                                          |                    |                    |                    |                    |
| NEW                                        | picoSMDC010S      | 3,000                | 15,000           | C                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | UL                 |
| NEW                                        | picoSMDC012S      | 4,000                | 20,000           | F                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | UL, CSA            |
|                                            | picoSMDC020S      | 4,000                | 20,000           | H                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | UL, CSA            |
|                                            | picoSMDC035S      | 4,000                | 20,000           | I                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | UL, CSA            |
| NEW                                        | picoSMDC050S      | 3,000                | 15,000           | K                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | UL, CSA            |
| coming soon                                | picoSMDC075S*     | 3,000                | 15,000           | M                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | Pending            |
| coming soon                                | picoSMDC110S*     | 3,000                | 15,000           | S                                        | 1.50 (0.060)       | 1.00 (0.039)       | 1.20 (0.047)       | Pending            |
| nanoSMDC Series<br>Size 3216 mm/1206 mils  |                   |                      |                  |                                          |                    |                    |                    |                    |
|                                            | nanoSMDC012F      | 3,000                | 15,000           | P                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC016F      | 3,000                | 15,000           | N                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC020F      | 3,000                | 15,000           | 02                                       | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| NEW                                        | nanoSMDC025F      | 3,000                | 15,000           | C                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA            |
|                                            | nanoSMDC035F      | 3,000                | 15,000           | 03                                       | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC050F/13.2 | 3,000                | 15,000           | M                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC075F      | 3,000                | 15,000           | L                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC110F      | 3,000                | 15,000           | K                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC150F      | 3,000                | 15,000           | 15                                       | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
|                                            | nanoSMDC200F      | 3,000                | 15,000           | T                                        | 1.60 (0.063)       | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |

\* Data is preliminary

**Table S6 Packaging and Marking Information for Surface-mount Devices**

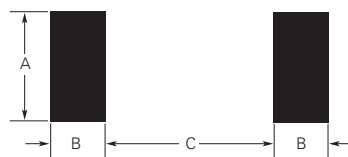
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| Part Number                                | Tape & Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm(In.)] |                    |                    | Agency Recognition |
|--------------------------------------------|----------------------|------------------|--------------|------------------------------------------|--------------------|--------------------|--------------------|
|                                            |                      |                  |              | Dimension A (Nom.)                       | Dimension B (Nom.) | Dimension C (Nom.) |                    |
| microSMD Series<br>Size 3225 mm/1210 mils  |                      |                  |              |                                          |                    |                    |                    |
| microSMD005F                               | 4,000                | 20,000           | 05           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD010F                               | 4,000                | 20,000           | 10           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD035F                               | 4,000                | 20,000           | 3            | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD050F                               | 4,000                | 20,000           | 50           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD075F                               | 4,000                | 20,000           | 75           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD110F                               | 4,000                | 20,000           | 11           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD150F                               | 4,000                | 20,000           | 15           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD175F                               | 4,000                | 20,000           | 17           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| microSMD200F                               | 3,000                | 15,000           | 20           | 2.50 (0.098)                             | 1.00 (0.039)       | 2.00 (0.079)       | UL, CSA, TÜV       |
| miniSMDC Series<br>Size 4532 mm/1812 mils  |                      |                  |              |                                          |                    |                    |                    |
| miniSMDC010F                               | 2,000                | 10,000           | 10           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA            |
| miniSMDC014F                               | 2,000                | 10,000           | 14           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC020F                               | 2,000                | 10,000           | 2            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC030F                               | 2,000                | 10,000           | 3            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA            |
| miniSMDC050F                               | 2,000                | 10,000           | 5            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC075F                               | 2,000                | 10,000           | 7            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC075F/24                            | 1,500                | 7,500            | 075F 24V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC100F                               | 2,000                | 10,000           | 1            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC110F                               | 2,000                | 10,000           | 1            | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC110F/16                            | 2,000                | 10,000           | 110F 16V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC110F/24                            | 1,500                | 7,500            | 110F 24V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC125F                               | 2,000                | 10,000           | 12           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC125F/16                            | 2,000                | 10,000           | 125F 16V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC150F                               | 2,000                | 10,000           | 15           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC150F/12                            | 2,000                | 10,000           | 150F 12V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC150F/16                            | 2,000                | 10,000           | 150 16V      | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC150F/24                            | 1,000                | 5,000            | 150F 24V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC160F                               | 2,000                | 10,000           | 16           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC200F                               | 2,000                | 10,000           | 20           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC260F                               | 2,000                | 10,000           | 260F         | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC260F/12                            | 1,500                | 7,500            | 260F 12V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC260F/13.2                          | 1,500                | 7,500            | 260F 13V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC260F/16                            | 1,500                | 7,500            | 260F 16V     | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA, TÜV       |
| miniSMDC300F                               | 2,000                | 10,000           | 30           | 3.15 (0.124)                             | 1.68 (0.066)       | 3.10 (0.122)       | UL, CSA            |
| miniSMDE Series<br>Size 11550 mm/4420 mils |                      |                  |              |                                          |                    |                    |                    |
| miniSMDE190F                               | 5,000                | 20,000           | 19           | 4.75 (0.187)                             | 1.45 (0.057)       | 9.57 (0.377)       | UL, CSA, TÜV       |
| midSMD Series<br>Size 5050 mm/2018 mils    |                      |                  |              |                                          |                    |                    |                    |
| SMD030F-2018                               | 4,000                | 20,000           | A03F         | 4.60 (0.18)                              | 1.50 (0.059)       | 3.40 (0.134)       | UL, CSA, TÜV       |
| decaSMDC050F/60                            | 1,000                | 5,000            | 050F 60V     | 4.32 (0.17)                              | 1.40 (0.055)       | 3.61 (0.142)       | UL, CSA, TÜV       |
| SMD100F-2018                               | 4,000                | 20,000           | A10F         | 4.60 (0.18)                              | 1.50 (0.059)       | 3.40 (0.134)       | UL, CSA, TÜV       |
| SMD150F-2018                               | 4,000                | 20,000           | A15F         | 4.60 (0.18)                              | 1.50 (0.059)       | 3.40 (0.134)       | UL, CSA, TÜV       |
| SMD200F-2018                               | 4,000                | 20,000           | A20F         | 4.60 (0.18)                              | 1.50 (0.059)       | 3.40 (0.134)       | UL, CSA, TÜV       |

**Table S6 Packaging and Marking Information for Surface-mount Devices**

Cont'd

| Part Number            | Tape & Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm(In.)] |                    |                    | Agency Recognition |
|------------------------|----------------------|------------------|--------------|------------------------------------------|--------------------|--------------------|--------------------|
|                        |                      |                  |              | Dimension A (Nom.)                       | Dimension B (Nom.) | Dimension C (Nom.) |                    |
| SMD Series             |                      |                  |              |                                          |                    |                    |                    |
| Size 7555 mm/2920 mils |                      |                  |              |                                          |                    |                    |                    |
| SMD030F                | 2,000                | 10,000           | 030F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD050F                | 2,000                | 10,000           | 050F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD075F                | 2,000                | 10,000           | 075F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD075F/60             | 2,000                | 10,000           | 756F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD100F                | 2,000                | 10,000           | 100F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD100F/33             | 2,000                | 10,000           | 103F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMDH120                | 2,000                | 10,000           | H12          | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD125F                | 2,000                | 10,000           | 125F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD260F                | 2,000                | 10,000           | 260F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD300F                | 2,000                | 10,000           | 300F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA, TÜV       |
| SMD300F/15             | 2,000                | 10,000           | 315F         | 3.10 (0.12)                              | 2.30 (0.09)        | 5.10 (0.201)       | UL, CSA            |
| SMD2 Devices           |                      |                  |              |                                          |                    |                    |                    |
| Size 8763 mm/3425 mils |                      |                  |              |                                          |                    |                    |                    |
| SMD150F                | 1,500                | 7,500            | 150F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |
| SMD150F/33             | 1,500                | 7,500            | 153F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |
| SMDH160                | 1,500                | 7,500            | 160F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |
| SMD185F                | 1,500                | 7,500            | 185F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |
| SMD200F                | 1,500                | 7,500            | 200F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |
| SMD250F                | 1,500                | 7,500            | 250F         | 4.60 (0.18)                              | 2.30 (0.09)        | 6.10 (0.240)       | UL, CSA, TÜV       |

**Figure S13 Recommended Pad Layout for Surface-mount Devices**


### Agency Recognition for Surface-mount Devices

|     |                                                                      |
|-----|----------------------------------------------------------------------|
| UL  | File # E74889 for all surface-mount devices                          |
| CSA | File # CA78165 for all surface-mount devices                         |
| TÜV | Certificate number available upon request (certified to IEC 60730-1) |

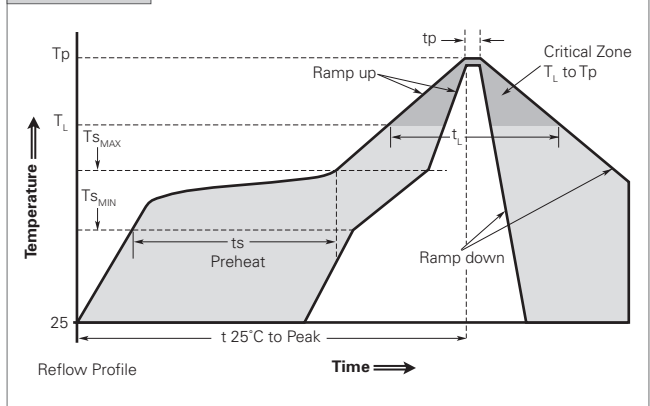
## Solder Reflow and Rework Recommendation for Surface-mount Devices

### Classification Reflow Profiles

| Profile Feature                                                            | Pb-Free Assembly |
|----------------------------------------------------------------------------|------------------|
| <b>Average ramp up rate (<math>T_{S_{MAX}}</math> to <math>T_p</math>)</b> | 3°C/second max.  |
| <b>Preheat</b>                                                             |                  |
| • Temperature min. ( $T_{S_{MIN}}$ )                                       | 150°C            |
| • Temperature max. ( $T_{S_{MAX}}$ )                                       | 200°C            |
| • Time ( $t_{S_{MIN}}$ to $t_{S_{MAX}}$ )                                  | 60-120 seconds   |
| <b>Time maintained above:</b>                                              |                  |
| • Temperature ( $T_L$ )                                                    | 217°C            |
| • Time ( $t_L$ )                                                           | 60-150 seconds   |
| <b>Peak/Classification temperature (<math>T_p</math>)</b>                  | 260°C            |
| <b>Time within 5°C of actual peak temperature</b>                          |                  |
| Time ( $t_p$ )                                                             | 30 seconds max.  |
| <b>Ramp down rate</b>                                                      | 3°C/second max.  |
| <b>Time 25°C to peak temperature</b>                                       | 8 minutes max.   |

**Note:** All temperatures refer to topside of the package, measured on the package body surface.

Figure S14



### Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010 inch)
- Devices can be cleaned using standard methods and aqueous solvents.
- We believe the optimum conditions for forming acceptable solder fillets occur when a reasonable amount of solder paste is placed underneath each device's termination. As such, we request that customers comply with our recommended solder pad layouts.
- Customer should validate that the solder paste amount and reflow recommendations meet its application.
- We request that customer board layouts refrain from placing raised features (e.g. vias, nomenclature, traces, etc.) underneath PolySwitch devices. It is possible that raised features could negatively impact solderability performance of our devices.

### Rework

- femtoSMD, picoSMD, nanoSMD, microSMD and miniSMD series: standard industry practices. Please also avoid direct contact to the device.
- SMD series: rework should be confined to removal of the installed product and replacement with a fresh device.

**Table S7 Tape and Reel Specifications for Surface-mount Devices (in Millimeters)**

| Description         | femtoSMDC   | picoSMDC    | nanoSMDC    | microSMD    | miniSMDC<br>and<br>decaSMDC050F/60 | miniSMDE190  | midSMD<br>except<br>decaSMDC050F/60 | SMD            | SMD2           |
|---------------------|-------------|-------------|-------------|-------------|------------------------------------|--------------|-------------------------------------|----------------|----------------|
|                     | EIA 481-1   | EIA 481-1   | EIA 481-1   | EIA 481-1   | EIA 481-1                          | EIA 481-2    | EIA 481-2                           | EIA 481-2      | EIA 481-2      |
| W                   | 8.0 ± 0.30  | 8.0 ± 0.30  | 8.0 ± 0.30  | 8.0 ± 0.30  | 12.0 ± 0.30                        | 24.0 ± 0.30  | 16.0 ± 0.30                         | 16.0 ± 0.30    | 16.0 ± 0.30    |
| P <sub>0</sub>      | 4.0 ± 0.10  | 4.0 ± 0.10  | 4.0 ± 0.10  | 4.0 ± 0.10  | 4.0 ± 0.10                         | 4.0 ± 0.10   | 4.0 ± 0.10                          | 4.0 ± 0.10     | 4.0 ± 0.10     |
| P <sub>1</sub>      | 4.0 ± 0.10  | 4.0 ± 0.10  | 4.0 ± 0.10  | 4.0 ± 0.10  | 8.0 ± 0.10                         | 8.0 ± 0.10   | 8.0 ± 0.10                          | 8.0 ± 0.10     | 12.0 ± 0.10    |
| P <sub>2</sub>      | 2.0 ± 0.05  | 2.0 ± 0.05  | 2.0 ± 0.05  | 2.0 ± 0.05  | 2.0 ± 0.05                         | 2.0 ± 0.10   | 2.0 ± 0.10                          | 2.0 ± 0.10     | 2.0 ± 0.10     |
| A <sub>0</sub>      | Table S8    | Table S8    | 1.95 ± 0.10 | 2.9 ± 0.10  | Table S8                           | 5.70 ± 0.10  | 5.11 ± 0.15                         | 5.6 ± 0.23     | 6.9 ± 0.23     |
| B <sub>0</sub>      | Table S8    | Table S8    | Table S8    | 3.50 ± 0.10 | Table S8                           | 11.90 ± 0.10 | 5.6 ± 0.23                          | 8.1 ± 0.15     | 9.6 ± 0.15     |
| B <sub>1</sub> max. | 4.35        | 4.35        | 4.35        | 4.35        | 8.2                                | 20.1         | 12.1                                | 12.1           | 12.1           |
| D <sub>0</sub>      | 1.55 ± .05  | 1.55 ± .05  | 1.55 ± .05  | 1.55 ± .05  | 1.5 ± 0.10/-00                     | 1.55 ± .05   | 1.5 ± 0.10/-00                      | 1.5 ± 0.10/-00 | 1.5 ± 0.10/-00 |
| F                   | 3.50 ± 0.05 | 3.50 ± 0.05 | 3.50 ± 0.05 | 3.50 ± 0.05 | 5.50 ± 0.05                        | 11.50 ± 0.10 | 7.50 ± 0.10                         | 7.50 ± 0.10    | 7.50 ± 0.10    |
| E <sub>1</sub>      | 1.75 ± 0.10 | 1.75 ± 0.10 | 1.75 ± 0.10 | 1.75 ± 0.10 | 1.75 ± 0.10                        | 1.75 ± 0.10  | 1.75 ± 0.10                         | 1.75 ± 0.10    | 1.75 ± 0.10    |
| E <sub>2</sub> min. | 6.25        | 6.25        | 6.25        | 6.25        | 10.25                              | 22.25        | 14.25                               | 14.25          | 14.25          |
| T max.              | 0.6         | 0.6         | 0.6         | 0.6         | 0.6                                | 0.6          | 0.6                                 | 0.6            | 0.6            |
| T <sub>1</sub> max. | 0.1         | 0.1         | 0.1         | 0.1         | 0.1                                | 0.1          | 0.1                                 | 0.1            | 0.1            |
| K <sub>0</sub>      | Table S8    | Table S8    | Table S8    | Table S8    | Table S8                           | 0.95 ± 0.10  | 1.8 ± 0.15                          | 3.2 ± 0.15     | 3.4 ± 0.15     |
| Leader min.         | 390         | 390         | 390         | 390         | 390                                | 400          | 400                                 | 400            | 400            |
| Trailer min.        | 160         | 160         | 160         | 160         | 160                                | 160          | 160                                 | 160            | 160            |

**Table S8** Tape and Reel Specifications for Surface-mount Devices (in Millimeters)

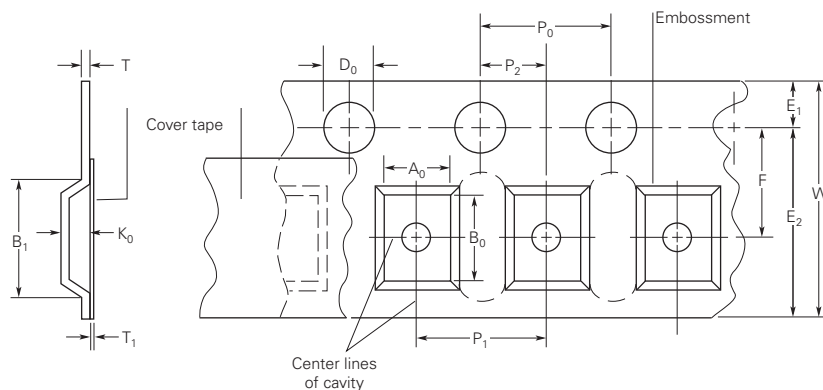
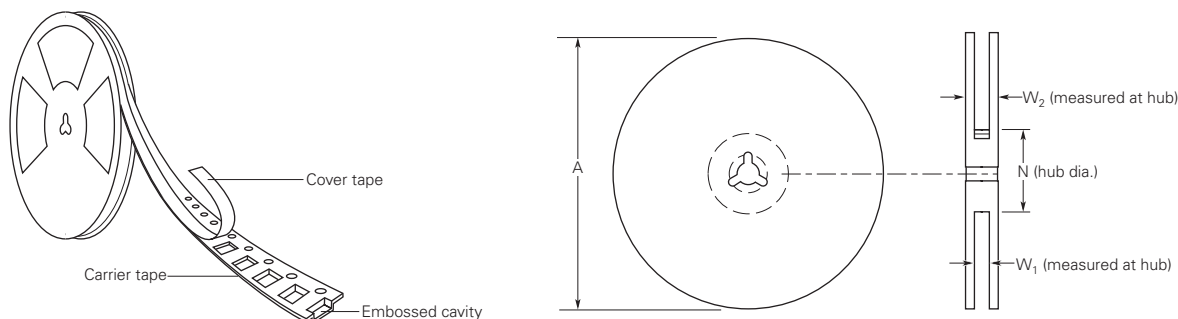
|                | femtoSMDC005F<br>femtoSMDC008F<br>femtoSMDC010F<br>femtoSMDC035F | femtoSMDC012F<br>femtoSMDC016F<br>femtoSMDC020F | picoSMDC012S<br>picoSMDC020S<br>picoSMDC035S | picoSMDC010S<br>picoSMDC050S<br>picoSMDC075S<br>picoSMDC110S | All<br>nanoSMDC series<br>except<br>nanoSMDC012F<br>nanoSMDC016F<br>nanoSMDC200F | nanoSMDC012F<br>nanoSMDC016F<br>nanoSMDC200F |
|----------------|------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------|
| A <sub>0</sub> | 1.00 ± 0.1                                                       | 1.00 ± 0.1                                      | 1.55 ± 0.1                                   | 1.60 ± 0.1                                                   | 1.95 ± 0.1                                                                       | 1.95 ± 0.1                                   |
| B <sub>0</sub> | 1.85 ± 0.1                                                       | 1.85 ± 0.1                                      | 2.50 ± 0.1                                   | 2.45 ± 0.1                                                   | 3.50 +0.1/-0.08                                                                  | 3.5 ± 0.1                                    |
| K <sub>0</sub> | 0.90 ± 0.1                                                       | 0.80 ± 0.1                                      | 0.86 ± 0.1                                   | 1.35 ± 0.1                                                   | 0.89 ± 0.1                                                                       | 1.27 ± 0.1                                   |

|                | All<br>microSMD series<br>except<br>microSMD200F | microSMD200F | miniSMDC014F~075F<br>miniSMDC100F~110F/16<br>miniSMDC125F~150F/16<br>miniSMDC160F~260F | miniSMDC075F/24<br>miniSMDC110F/24<br>miniSMDC260F/12<br>miniSMDC260F/13.2<br>miniSMDC260F/16 | miniSMDC150F/24 | decaSMDC050F/60 |
|----------------|--------------------------------------------------|--------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------|-----------------|
| A <sub>0</sub> | 2.9 ± 0.1                                        | 2.9 ± 0.1    | 3.5 ± 0.1                                                                              | 3.7 ± 0.1                                                                                     | 3.7 ± 0.1       | 5.0 ± 0.1       |
| B <sub>0</sub> | 3.5 ± 0.1                                        | 3.5 ± 0.1    | 4.95 ± 0.1                                                                             | 4.9 ± 0.1                                                                                     | 4.9 ± 0.1       | 5.4 ± 0.1       |
| K <sub>0</sub> | 0.9 ± 0.1                                        | 1.27 ± 0.1   | 0.9 ± 0.1                                                                              | 1.4 ± 0.1                                                                                     | 1.78 ± 0.1      | 1.7 ± 0.1       |

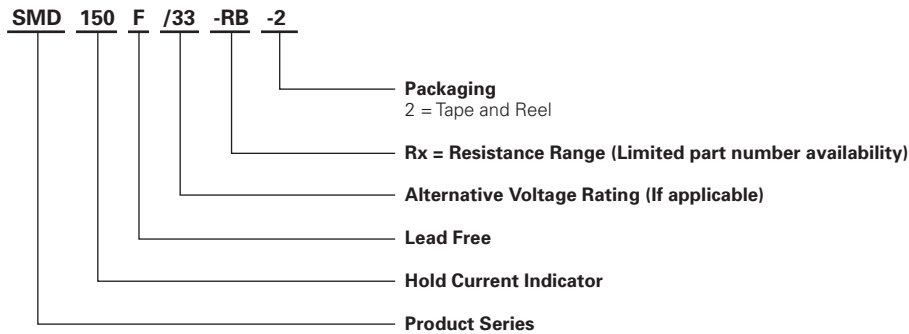
**Table S9** Reel Dimensions for Surface-mount Devices (in Millimeters)

|                     | femto/pico/nano/microSMD | miniSMDC         | miniSMDE190      | midSMD           | SMD              | SMD2             |
|---------------------|--------------------------|------------------|------------------|------------------|------------------|------------------|
| A max.              | 185                      | 185              | 330              | 330              | 330              | 330              |
| N min.              | 50                       | 50               | 60               | 50               | 50               | 50               |
| W <sub>1</sub>      | 8.4 + 1.5/-0.00          | 12.4 + 2.0/-0.00 | 24.4 + 2.0/-0.00 | 16.4 + 2.0/-0.00 | 16.4 + 2.0/-0.00 | 16.4 + 2.0/-0.00 |
| W <sub>2</sub> max. | 14.4                     | 18.4             | 30.4             | 22.4             | 22.4             | 22.4             |

**Figure S15** EIA Referenced Taped Component Dimensions for Surface-mount Devices

**Figure S16** EIA Referenced Reel Dimensions for Surface-mount Devices




## Part Numbering System for Surface-mount Devices



### Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $L di/dt$ ) above the rated voltage of the device.

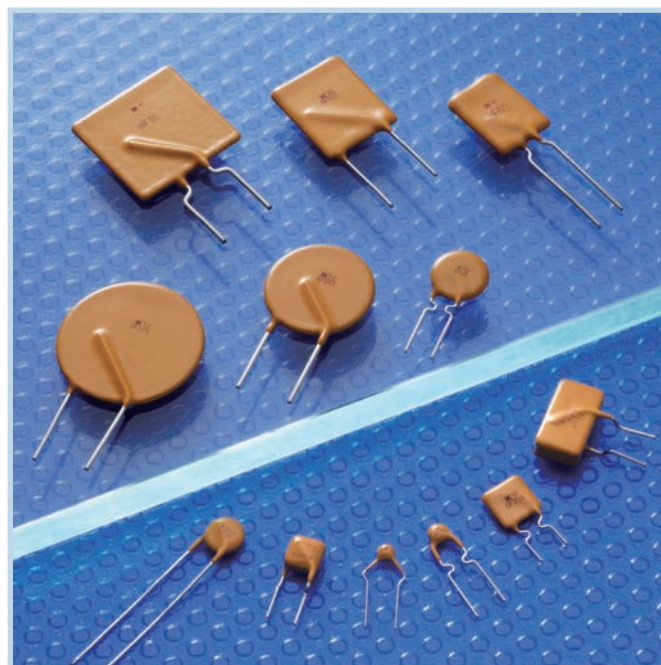




## PolySwitch Resettable Devices Radial-leaded Devices

TE Circuit Protection's PolySwitch radial-leaded products represent the most comprehensive and complete set of PPTC products available in the industry today.

- RGEF series for hold currents up to 14A
- RHEF series for flatter thermal derating and operating temperatures up to 125°C
- RUEF series for balance of voltage rating (30V) and hold current (up to 9A)
- RUSBF series for fast time-to-trip and low-resistance computer applications
- RXEF series for low hold currents (down to 50mA) and high voltage rating (up to 72V)
- RKEF series for balance of voltage rating (60V) and hold current (up to 5A)
- BBRF series for cable telephone applications
- Now offering RoHS versions of all products



### Benefits

- Many product choices give engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

### Features

- RoHS compliant
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 15A
- Voltage ratings from 6V (computer and electronic applications) to 99V
- Agency recognition : UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

### Applications

- |                             |                                  |                                 |
|-----------------------------|----------------------------------|---------------------------------|
| • Satellite video receivers | • USB hub, ports and peripherals | • Phones                        |
| • Industrial controls       | • IEEE1394 ports                 | • Fax machines                  |
| • Transformers              | • CD-ROMs                        | • Analog and digital line cards |
| • Computer motherboards     | • Game machines                  | • Printers                      |
| • Modems                    | • Battery packs                  |                                 |

## Application Selection Guide for Radial-leaded Devices

The guide below lists PolySwitch radial-leaded devices that are typically used in these applications. Specifications for the suggested device part numbers can be found in this section. Once a part number has been selected, the user should evaluate and test each product for its intended application.

### PolySwitch Resettable Devices — Key Selection Criteria

| Protection Application                      | Small Size               | Flatter Derating | Lower Current Higher Voltage |
|---------------------------------------------|--------------------------|------------------|------------------------------|
| Electromagnetic loads                       | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Halogen lighting                            | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Lighting ballast                            | RXEF (<72V), BBRF (<99V) |                  |                              |
| Loudspeakers                                | RXEF (<72V)              |                  | RXEF (<72V), RKEF (<60V)     |
| Medical equipment                           | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| MOSFET devices                              | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Motors, fans and blowers                    | RXEF (<72V), RGEF (<16V) | RHEF (<16V)      |                              |
| POS equipment                               | RXEF (<72V), RUEF (<30V) |                  |                              |
| Process and industrial controls             | RXEF (<72V), RUEF (<30V) |                  |                              |
| Satellite video receivers                   | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Security and fire alarm systems             | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Test and measurement equipment              | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Transformers                                | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| DDC computer and consumer electronics       | RUEF (<30V)              |                  |                              |
| Mouse and keyboard                          | RUEF (<30V)              |                  |                              |
| SCSI                                        | RUEF (<30V)              |                  |                              |
| USB                                         | RUSBF (<16V)             |                  |                              |
| Traces and printed circuit board protection | RGEF (<16V), RUEF (<30V) | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |

**Note:** This list is not exhaustive. TE Circuit Protection welcomes customer's input for additional application ideas for PolySwitch resettable devices.

**Table R1** Product Series - Current Rating, Voltage Rating / Typical Resistance for Radial-leaded Devices

| Voltage Rating          | BBRF 99V | RXEF 72V | RKEF 60V | RXEF 60V | RUEF 30V | RGEF 16V | RHEF 16V | RHEF 30V | RUSBF 16V | RUSBF 6V |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|
| <b>Hold Current (A)</b> |          |          |          |          |          |          |          |          |           |          |
| 0.050                   | —        | —        | —        | 9.20Ω    | —        | —        | —        | —        | —         | —        |
| 0.100                   | —        | —        | —        | 3.50Ω    | —        | —        | —        | —        | —         | —        |
| 0.170                   | —        | —        | —        | 4.30Ω    | —        | —        | —        | —        | —         | —        |
| 0.200                   | —        | 2.290Ω   | —        | —        | —        | —        | —        | —        | —         | —        |
| 0.250                   | —        | 1.600Ω   | —        | —        | —        | —        | —        | —        | —         | —        |
| 0.300                   | —        | 1.110Ω   | —        | —        | —        | —        | —        | —        | —         | —        |
| 0.400                   | —        | 0.710Ω   | —        | —        | —        | —        | —        | —        | —         | —        |
| 0.500                   | —        | 0.640Ω   | 0.425Ω   | —        | —        | —        | —        | 0.68Ω    | —         | —        |
| 0.550                   | 1.05Ω    | —        | —        | —        | —        | —        | —        | —        | —         | —        |
| 0.650                   | —        | 0.400Ω   | 0.350Ω   | —        | —        | —        | —        | —        | —         | —        |
| 0.700                   | —        | —        | —        | —        | —        | —        | —        | 0.42Ω    | —         | —        |
| 0.750                   | —        | 0.325Ω   | 0.295Ω   | —        | —        | —        | —        | —        | —         | 0.140Ω   |
| 0.900                   | —        | 0.255Ω   | 0.255Ω   | —        | 0.095Ω   | —        | —        | —        | 0.100Ω    | —        |
| 1.000                   | —        | —        | —        | —        | —        | —        | —        | 0.24Ω    | —         | —        |
| 1.100                   | —        | 0.200Ω   | 0.225Ω   | —        | 0.075Ω   | —        | —        | —        | 0.075Ω    | —        |
| 1.200                   | —        | —        | —        | —        | —        | —        | —        | —        | —         | 0.080Ω   |
| 1.350                   | —        | 0.155Ω   | 0.165Ω   | —        | 0.060Ω   | —        | —        | —        | 0.060Ω    | —        |
| 1.550                   | —        | —        | —        | —        | —        | —        | —        | —        | —         | 0.058Ω   |
| 1.600                   | —        | 0.115Ω   | 0.150Ω   | —        | 0.050Ω   | —        | —        | —        | 0.050Ω    | —        |
| 1.850                   | —        | 0.100Ω   | 0.106Ω   | —        | 0.045Ω   | —        | —        | —        | 0.045Ω    | —        |
| 1.900                   | —        | —        | —        | —        | —        | —        | —        | —        | —         | —        |

**Table R1** Product Series - Current Rating, Voltage Rating / Typical Resistance for Radial-leaded Devices Cont'd

| Voltage Rating          | BBRF<br>99V | RXEF<br>72V | RKEF<br>60V | RXEF<br>60V | RUEF<br>30V | RGEF<br>16V | RHEF<br>16V | RHEF<br>30V | RUSBF<br>16V | RUSBF<br>6V |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|
| <b>Hold Current (A)</b> |             |             |             |             |             |             |             |             |              |             |
| 2.000                   | —           | —           | —           | —           | —           | —           | 0.0610Ω     | —           | —            | —           |
| 2.500                   | —           | 0.065Ω      | 0.063Ω      | —           | 0.030Ω      | 0.0380Ω     | —           | —           | 0.030Ω       | —           |
| 3.000                   | —           | 0.050Ω      | 0.040Ω      | —           | 0.035Ω      | 0.0514Ω     | 0.0430Ω     | —           | —            | —           |
| 3.750                   | —           | 0.040Ω      | 0.029Ω      | —           | —           | —           | —           | —           | —            | —           |
| 4.000                   | —           | —           | 0.026Ω      | —           | 0.020Ω      | 0.0300Ω     | 0.0320Ω     | —           | —            | —           |
| 4.500                   | —           | —           | —           | —           | —           | —           | 0.0290Ω     | —           | —            | —           |
| 5.000                   | —           | —           | 0.021Ω      | —           | 0.020Ω      | 0.0192Ω     | —           | —           | —            | —           |
| 5.500                   | —           | —           | —           | —           | —           | —           | 0.0200Ω     | —           | —            | —           |
| 6.000                   | —           | —           | —           | —           | 0.013Ω      | 0.0145Ω     | 0.0175Ω     | —           | —            | —           |
| 6.500                   | —           | —           | —           | —           | —           | —           | 0.0144Ω     | —           | —            | —           |
| 7.000                   | —           | —           | —           | —           | 0.013Ω      | 0.0105Ω     | 0.0132Ω     | —           | —            | —           |
| 7.500                   | —           | —           | —           | —           | —           | —           | 0.0120Ω     | —           | —            | —           |
| 8.000                   | —           | —           | —           | —           | 0.013Ω      | 0.0086Ω     | 0.0110Ω     | —           | —            | —           |
| 9.000                   | —           | —           | —           | —           | 0.008Ω      | 0.0070Ω     | 0.0100Ω     | —           | —            | —           |
| 10.00                   | —           | —           | —           | —           | —           | 0.0056Ω     | 0.0083Ω     | —           | —            | —           |
| 11.00                   | —           | —           | —           | —           | —           | 0.0050Ω     | 0.0073Ω     | —           | —            | —           |
| 12.00                   | —           | —           | —           | —           | —           | 0.0046Ω     | —           | —           | —            | —           |
| 13.00                   | —           | —           | —           | —           | —           | —           | 0.0055Ω     | —           | —            | —           |
| 14.00                   | —           | —           | —           | —           | —           | 0.0040Ω     | 0.0050Ω     | —           | —            | —           |
| 15.00                   | —           | —           | —           | —           | —           | —           | 0.0050Ω     | —           | —            | —           |

**Table R2** Thermal Derating for Radial-leaded Devices [Hold Current (A) at Ambient Temperature (°C)]

| Part Number     | Maximum Ambient Temperature |       |      |      |       |      |       |       |       |      |       |
|-----------------|-----------------------------|-------|------|------|-------|------|-------|-------|-------|------|-------|
|                 | -40°C                       | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C  | 60°C  | 70°C  | 85°C | 125°C |
| <b>BBRF 99V</b> |                             |       |      |      |       |      |       |       |       |      |       |
| BBRF550         | 0.85                        | 0.75  | 0.65 | 0.55 | —     | 0.45 | 0.40  | 0.35  | 0.30  | 0.22 | —     |
| <b>RXEF 60V</b> |                             |       |      |      |       |      |       |       |       |      |       |
| RXEF005         | 0.078                       | 0.068 | 0.06 | 0.05 | 0.048 | 0.04 | 0.035 | 0.032 | 0.027 | 0.02 | —     |
| RXEF010         | 0.160                       | 0.140 | 0.11 | 0.10 | 0.096 | 0.08 | 0.072 | 0.067 | 0.050 | 0.04 | —     |
| RXEF017         | 0.260                       | 0.230 | 0.21 | 0.17 | 0.160 | 0.14 | 0.120 | 0.110 | 0.090 | 0.07 | —     |
| <b>RXEF 72V</b> |                             |       |      |      |       |      |       |       |       |      |       |
| RXEF020         | 0.31                        | 0.27  | 0.24 | 0.20 | 0.19  | 0.16 | 0.14  | 0.13  | 0.11  | 0.08 | —     |
| RXEF025         | 0.39                        | 0.34  | 0.30 | 0.25 | 0.24  | 0.20 | 0.18  | 0.16  | 0.14  | 0.10 | —     |
| RXEF030         | 0.47                        | 0.41  | 0.36 | 0.30 | 0.29  | 0.24 | 0.22  | 0.20  | 0.16  | 0.12 | —     |
| RXEF040         | 0.62                        | 0.54  | 0.48 | 0.40 | 0.38  | 0.32 | 0.29  | 0.25  | 0.22  | 0.16 | —     |
| RXEF050         | 0.78                        | 0.68  | 0.60 | 0.50 | 0.48  | 0.41 | 0.36  | 0.32  | 0.27  | 0.20 | —     |
| RXEF065         | 1.01                        | 0.88  | 0.77 | 0.65 | 0.62  | 0.53 | 0.47  | 0.41  | 0.35  | 0.26 | —     |
| RXEF075         | 1.16                        | 1.02  | 0.89 | 0.75 | 0.72  | 0.61 | 0.54  | 0.47  | 0.41  | 0.30 | —     |
| RXEF090         | 1.40                        | 1.22  | 1.07 | 0.90 | 0.86  | 0.73 | 0.65  | 0.57  | 0.49  | 0.36 | —     |
| RXEF110         | 1.71                        | 1.50  | 1.31 | 1.10 | 1.06  | 0.89 | 0.79  | 0.69  | 0.59  | 0.44 | —     |
| RXEF135         | 2.09                        | 1.84  | 1.61 | 1.35 | 1.30  | 1.09 | 0.97  | 0.85  | 0.73  | 0.54 | —     |
| RXEF160         | 2.48                        | 2.18  | 1.90 | 1.60 | 1.54  | 1.30 | 1.15  | 1.01  | 0.86  | 0.64 | —     |
| RXEF185         | 2.87                        | 2.52  | 2.20 | 1.85 | 1.78  | 1.50 | 1.33  | 1.17  | 1.00  | 0.74 | —     |
| RXEF250         | 3.88                        | 3.40  | 2.98 | 2.50 | 2.40  | 2.03 | 1.80  | 1.58  | 1.35  | 1.00 | —     |
| RXEF300         | 4.65                        | 4.08  | 3.57 | 3.00 | 2.88  | 2.43 | 2.16  | 1.89  | 1.62  | 1.20 | —     |
| RXEF375         | 5.81                        | 5.10  | 4.46 | 3.75 | 3.60  | 3.04 | 2.70  | 2.36  | 2.03  | 1.50 | —     |

**Table R2 Thermal Derating for Radial-leaded Devices**  
[Hold Current (A) at Ambient Temperature (°C)]

Cont'd

| Part Number                   | Maximum Ambient Temperature |       |       |      |       |      |      |      |      |      |       |
|-------------------------------|-----------------------------|-------|-------|------|-------|------|------|------|------|------|-------|
|                               | -40°C                       | -20°C | 0°C   | 20°C | 25°C  | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
| <b>RKEF</b>                   |                             |       |       |      |       |      |      |      |      |      |       |
| <b>60V</b>                    |                             |       |       |      |       |      |      |      |      |      |       |
| RKEF050                       | 0.73                        | 0.65  | 0.58  | 0.50 | 0.48  | 0.42 | 0.38 | 0.34 | 0.31 | 0.26 | —     |
| RKEF065                       | 0.94                        | 0.85  | 0.75  | 0.65 | 0.63  | 0.54 | 0.50 | 0.44 | 0.40 | 0.34 | —     |
| RKEF075                       | 1.09                        | 0.98  | 0.86  | 0.75 | 0.73  | 0.62 | 0.58 | 0.51 | 0.46 | 0.39 | —     |
| RKEF090                       | 1.30                        | 1.17  | 1.04  | 0.90 | 0.87  | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RKEF110                       | 1.60                        | 1.43  | 1.27  | 1.10 | 1.06  | 0.92 | 0.85 | 0.75 | 0.67 | 0.57 | —     |
| RKEF135                       | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31  | 1.12 | 1.04 | 0.92 | 0.83 | 0.71 | —     |
| RKEF160                       | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55  | 1.33 | 1.23 | 1.08 | 0.98 | 0.83 | —     |
| RKEF185                       | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79  | 1.54 | 1.43 | 1.26 | 1.13 | 0.96 | —     |
| RKEF250                       | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43  | 2.08 | 1.93 | 1.70 | 1.52 | 1.31 | —     |
| RKEF300                       | 4.35                        | 3.90  | 3.45  | 3.00 | 2.91  | 2.50 | 2.30 | 2.04 | 1.84 | 1.55 | —     |
| RKEF375                       | 5.44                        | 4.88  | 4.31  | 3.75 | 3.64  | 3.11 | 2.90 | 2.54 | 2.29 | 1.94 | —     |
| RKEF400                       | 5.80                        | 5.20  | 4.60  | 4.00 | 3.88  | 3.32 | 3.08 | 2.73 | 2.45 | 2.08 | —     |
| RKEF500                       | 7.25                        | 6.50  | 5.75  | 5.00 | 4.85  | 4.15 | 3.85 | 3.41 | 3.06 | 2.59 | —     |
| <b>RUEF</b>                   |                             |       |       |      |       |      |      |      |      |      |       |
| <b>30V</b>                    |                             |       |       |      |       |      |      |      |      |      |       |
| RUEF090                       | 1.31                        | 1.17  | 1.04  | 0.90 | 0.87  | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RUEF110                       | 1.60                        | 1.43  | 1.27  | 1.10 | 1.07  | 0.91 | 0.85 | 0.75 | 0.67 | 0.57 | —     |
| RUEF135                       | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31  | 1.12 | 1.04 | 0.92 | 0.82 | 0.70 | —     |
| RUEF160                       | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55  | 1.33 | 1.23 | 1.09 | 0.98 | 0.83 | —     |
| RUEF185                       | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79  | 1.54 | 1.42 | 1.26 | 1.13 | 0.96 | —     |
| RUEF250                       | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43  | 2.08 | 1.93 | 1.70 | 1.53 | 1.30 | —     |
| RUEF300                       | 4.35                        | 3.90  | 3.45  | 3.00 | 2.91  | 2.49 | 2.31 | 2.04 | 1.83 | 1.56 | —     |
| RUEF400                       | 5.80                        | 5.20  | 4.60  | 4.00 | 3.88  | 3.32 | 3.08 | 2.72 | 2.44 | 2.08 | —     |
| RUEF500                       | 7.25                        | 6.50  | 5.75  | 5.00 | 4.85  | 4.15 | 3.85 | 3.40 | 3.05 | 2.60 | —     |
| RUEF600                       | 8.70                        | 7.80  | 6.90  | 6.00 | 5.82  | 4.98 | 4.62 | 4.08 | 3.66 | 3.12 | —     |
| RUEF700                       | 10.15                       | 9.10  | 8.05  | 7.00 | 6.79  | 5.81 | 5.39 | 4.76 | 4.27 | 3.64 | —     |
| RUEF800                       | 11.60                       | 10.40 | 9.20  | 8.00 | 7.76  | 6.64 | 6.16 | 5.44 | 4.88 | 4.16 | —     |
| RUEF900                       | 13.05                       | 11.70 | 10.35 | 9.00 | 8.73  | 7.47 | 6.93 | 6.12 | 5.49 | 4.68 | —     |
| <b>RHEF</b>                   |                             |       |       |      |       |      |      |      |      |      |       |
| <b>30V - High Temperature</b> |                             |       |       |      |       |      |      |      |      |      |       |
| RHEF050                       | 0.68                        | 0.62  | 0.56  | 0.51 | 0.50  | 0.44 | 0.40 | 0.36 | 0.34 | 0.28 | 0.12  |
| RHEF070                       | 0.95                        | 0.87  | 0.79  | 0.72 | 0.70  | 0.62 | 0.56 | 0.51 | 0.47 | 0.39 | 0.17  |
| RHEF100                       | 1.36                        | 1.24  | 1.13  | 1.03 | 1.00  | 0.89 | 0.80 | 0.73 | 0.67 | 0.56 | 0.24  |
| <b>RUSBF</b>                  |                             |       |       |      |       |      |      |      |      |      |       |
| <b>16V</b>                    |                             |       |       |      |       |      |      |      |      |      |       |
| RUSBF090                      | 1.31                        | 1.17  | 1.04  | 0.90 | 0.87  | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RUSBF110                      | 1.60                        | 1.43  | 1.27  | 1.10 | 1.07  | 1.00 | 0.92 | 0.75 | 0.67 | 0.57 | —     |
| RUSBF135                      | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31  | 1.12 | 1.04 | 0.92 | 0.82 | 0.70 | —     |
| RUSBF160                      | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55  | 1.33 | 1.23 | 1.09 | 0.98 | 0.83 | —     |
| RUSBF185                      | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79  | 1.54 | 1.42 | 1.26 | 1.13 | 0.96 | —     |
| RUSBF250                      | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43  | 2.08 | 1.93 | 1.70 | 1.53 | 1.30 | —     |
| <b>RGEF</b>                   |                             |       |       |      |       |      |      |      |      |      |       |
| <b>16V</b>                    |                             |       |       |      |       |      |      |      |      |      |       |
| RGEF250                       | 3.7                         | 3.3   | 3.0   | 2.6  | 2.50  | 2.2  | 2.0  | 1.8  | 1.6  | 1.2  | —     |
| RGEF300                       | 4.4                         | 4.0   | 3.6   | 3.1  | 3.00  | 2.6  | 2.4  | 2.1  | 1.9  | 1.4  | —     |
| RGEF400                       | 5.9                         | 5.3   | 4.8   | 4.1  | 4.00  | 3.5  | 3.2  | 2.8  | 2.5  | 1.9  | —     |
| RGEF500                       | 7.3                         | 6.6   | 6.0   | 5.2  | 5.00  | 4.4  | 4.0  | 3.6  | 3.1  | 2.4  | —     |
| RGEF600                       | 8.8                         | 8.0   | 7.2   | 6.2  | 6.00  | 5.2  | 4.8  | 4.2  | 3.8  | 2.8  | —     |
| RGEF700                       | 10.3                        | 9.3   | 8.4   | 7.3  | 7.00  | 6.2  | 5.6  | 5.0  | 4.4  | 3.3  | —     |
| RGEF800                       | 11.7                        | 10.7  | 9.6   | 8.3  | 8.00  | 6.9  | 6.4  | 5.6  | 5.1  | 3.7  | —     |
| RGEF900                       | 13.2                        | 11.9  | 10.7  | 9.4  | 9.00  | 7.9  | 7.2  | 6.4  | 5.6  | 4.2  | —     |
| RGEF1000                      | 14.7                        | 13.3  | 12.0  | 10.3 | 10.00 | 8.7  | 8.0  | 7.0  | 6.3  | 4.7  | —     |
| RGEF1100                      | 16.1                        | 14.6  | 13.1  | 11.5 | 11.00 | 9.7  | 8.8  | 7.8  | 6.9  | 5.2  | —     |
| RGEF1200                      | 17.6                        | 16.0  | 14.4  | 12.4 | 12.00 | 10.4 | 9.6  | 8.4  | 7.6  | 5.6  | —     |
| RGEF1400                      | 20.5                        | 18.7  | 16.8  | 14.5 | 14.00 | 12.1 | 11.2 | 9.8  | 8.9  | 6.5  | —     |

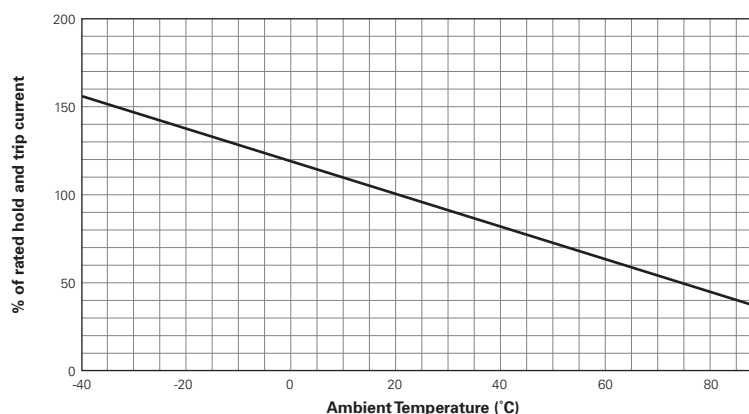
**Table R2 Thermal Derating for Radial-leaded Devices**  
**[Hold Current (A) at Ambient Temperature (°C)]** Cont'd

| Part Number                   | Maximum Ambient Temperature |       |       |       |       |       |       |       |      |      |       |
|-------------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|------|------|-------|
|                               | -40°C                       | -20°C | 0°C   | 20°C  | 25°C  | 40°C  | 50°C  | 60°C  | 70°C | 85°C | 125°C |
| <b>RHEF</b>                   |                             |       |       |       |       |       |       |       |      |      |       |
| <b>16V - High Temperature</b> |                             |       |       |       |       |       |       |       |      |      |       |
| RHEF200                       | 2.71                        | 2.49  | 2.26  | 2.06  | 2.00  | 1.77  | 1.60  | 1.46  | 1.34 | 1.11 | 0.49  |
| RHEF300                       | 4.07                        | 3.74  | 3.41  | 3.09  | 3.00  | 2.65  | 2.40  | 2.21  | 2.00 | 1.66 | 0.74  |
| RHEF400                       | 5.57                        | 5.11  | 4.65  | 4.22  | 4.00  | 3.62  | 3.29  | 3.01  | 2.73 | 2.27 | 1.01  |
| RHEF450                       | 6.10                        | 5.60  | 5.10  | 4.60  | 4.50  | 4.00  | 3.60  | 3.30  | 3.00 | 2.50 | 1.10  |
| RHEF550                       | 7.47                        | 6.86  | 6.24  | 5.66  | 5.50  | 4.85  | 4.41  | 4.04  | 3.66 | 3.05 | 1.36  |
| RHEF600                       | 8.20                        | 7.50  | 6.80  | 6.20  | 6.00  | 5.30  | 4.90  | 4.40  | 4.00 | 3.30 | 1.50  |
| RHEF650                       | 8.80                        | 8.10  | 7.40  | 6.70  | 6.50  | 5.70  | 5.30  | 4.80  | 4.30 | 3.60 | 1.60  |
| RHEF700                       | 9.51                        | 8.73  | 7.95  | 7.20  | 7.00  | 6.17  | 5.61  | 5.15  | 4.66 | 3.88 | 1.73  |
| RHEF750                       | 10.20                       | 9.40  | 8.60  | 7.70  | 7.50  | 6.60  | 6.10  | 5.60  | 5.00 | 4.10 | 1.90  |
| RHEF800                       | 10.87                       | 9.98  | 9.08  | 8.23  | 8.00  | 7.06  | 6.41  | 5.88  | 5.33 | 4.43 | 1.97  |
| RHEF900                       | 12.21                       | 11.19 | 10.16 | 9.26  | 9.00  | 7.97  | 7.20  | 6.56  | 6.04 | 5.01 | 2.19  |
| RHEF1000                      | 13.60                       | 12.50 | 11.40 | 10.30 | 10.00 | 8.80  | 8.10  | 7.40  | 6.60 | 5.50 | 2.50  |
| RHEF1100                      | 14.94                       | 13.72 | 12.49 | 11.31 | 11.00 | 9.70  | 8.82  | 8.09  | 7.32 | 6.09 | 2.71  |
| RHEF1300                      | 17.70                       | 16.30 | 14.80 | 13.40 | 13.00 | 11.40 | 10.50 | 9.60  | 8.60 | 7.20 | 3.30  |
| RHEF1400                      | 19.01                       | 17.46 | 15.89 | 14.40 | 14.00 | 12.35 | 11.22 | 10.29 | 9.32 | 7.76 | 3.45  |
| RHEF1500                      | 20.40                       | 18.80 | 17.10 | 15.50 | 15.00 | 13.20 | 12.10 | 11.10 | 9.90 | 8.30 | 3.80  |
| <b>RUSBF</b>                  |                             |       |       |       |       |       |       |       |      |      |       |
| <b>6V</b>                     |                             |       |       |       |       |       |       |       |      |      |       |
| RUSBF075                      | 1.05                        | 0.95  | 0.85  | 0.75  | 0.73  | 0.65  | 0.60  | 0.55  | 0.50 | 0.43 | —     |
| RUSBF120                      | 1.69                        | 1.52  | 1.36  | 1.20  | 1.16  | 1.04  | 0.96  | 0.88  | 0.80 | 0.68 | —     |
| RUSBF155                      | 2.17                        | 1.96  | 1.75  | 1.55  | 1.50  | 1.34  | 1.24  | 1.14  | 1.03 | 0.88 | —     |

**Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices**

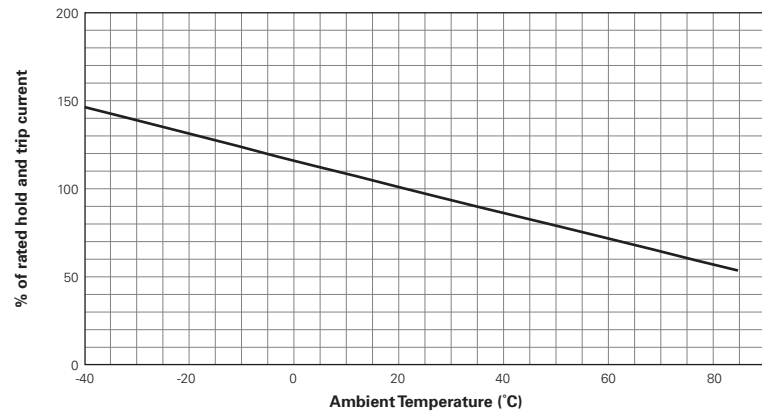
RXEF and BBRF

**Figure R1**



RKEF

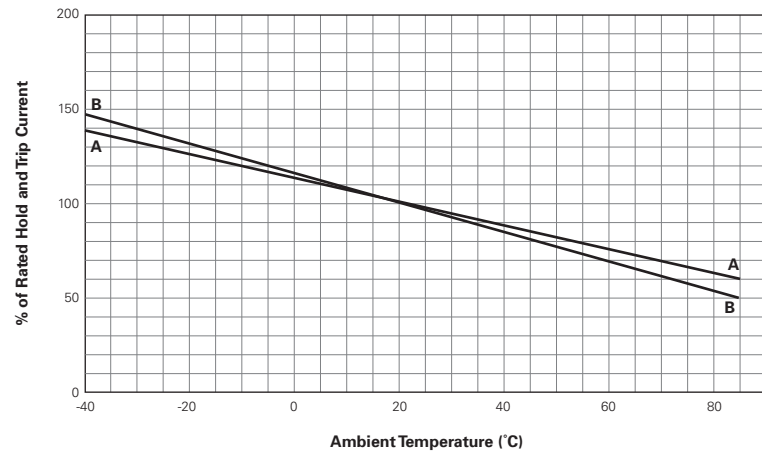
Figure R2



A = RUSBF075,  
RUSBF120,  
RUSBF155

B = RUEF,  
and all other RUSBF

Figure R3



RHEF

Figure R4

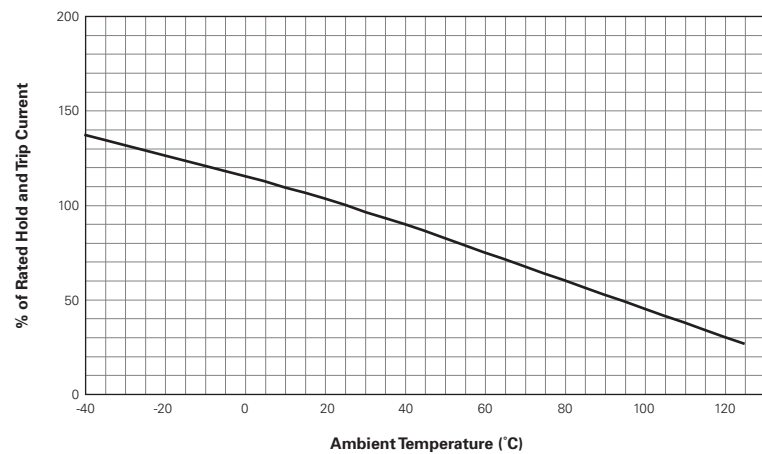




Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices

Cont'd

RGEF

Figure R5

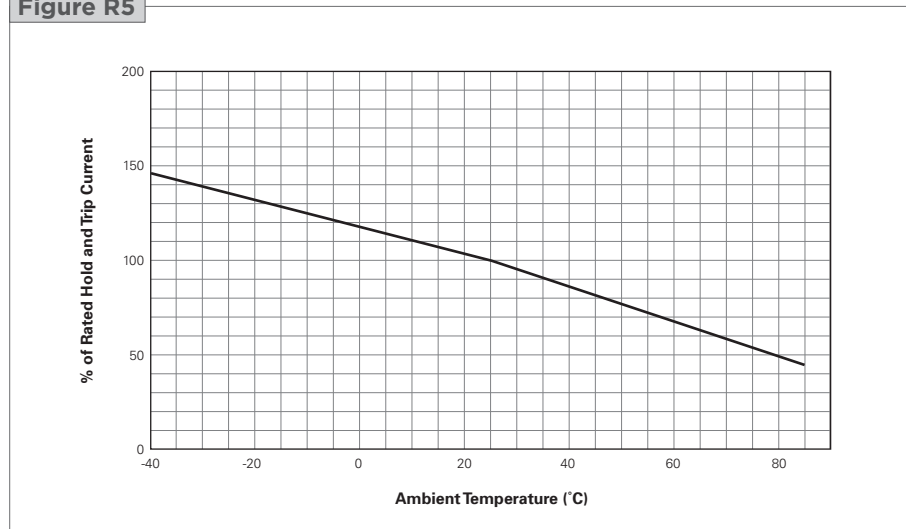


Table R3 Electrical Characteristics for Radial-leaded Devices

| Part Number | I <sub>H</sub> (A) | I <sub>T</sub> (A) | V <sub>MAX</sub> (V) | I <sub>MAX</sub> (A) | P <sub>D Typ</sub> (W) | Max. Time-to-trip<br>(A) (s) |      | R <sub>MIN</sub> (Ω) | R <sub>MAX</sub> (Ω) | R <sub>1MAX</sub> (Ω) | Lead Size<br>[mm <sup>2</sup> (AWG)] |
|-------------|--------------------|--------------------|----------------------|----------------------|------------------------|------------------------------|------|----------------------|----------------------|-----------------------|--------------------------------------|
| BBRF 99V    |                    |                    |                      |                      |                        |                              |      |                      |                      |                       |                                      |
| BBRF550     | 0.55               | 1.10               | 99                   | 20                   | 1.5                    | 1.60                         | 60   | 0.8                  | 1.30                 | 1.95                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF 60V    |                    |                    |                      |                      |                        |                              |      |                      |                      |                       |                                      |
| RXEF005     | 0.05               | 0.10               | 60                   | 40                   | 0.22                   | 0.25                         | 5.0  | 7.3                  | 11.10                | 20.00                 | [0.128mm <sup>2</sup> (26)]          |
| RXEF010     | 0.10               | 0.20               | 60                   | 40                   | 0.38                   | 0.50                         | 4.0  | 2.5                  | 4.50                 | 7.50                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF017     | 0.17               | 0.34               | 60                   | 40                   | 0.48                   | 0.85                         | 3.0  | 3.3                  | 5.21                 | 8.00                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF 72V    |                    |                    |                      |                      |                        |                              |      |                      |                      |                       |                                      |
| RXEF020     | 0.20               | 0.40               | 72                   | 40                   | 0.41                   | 1.00                         | 2.2  | 1.83                 | 2.75                 | 4.40                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF025     | 0.25               | 0.50               | 72                   | 40                   | 0.45                   | 1.25                         | 2.5  | 1.25                 | 1.95                 | 3.00                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF030     | 0.30               | 0.60               | 72                   | 40                   | 0.49                   | 1.50                         | 3.0  | 0.88                 | 1.33                 | 2.10                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF040     | 0.40               | 0.80               | 72                   | 40                   | 0.56                   | 2.00                         | 3.8  | 0.55                 | 0.86                 | 1.29                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF050     | 0.50               | 1.00               | 72                   | 40                   | 0.77                   | 2.50                         | 4.0  | 0.50                 | 0.77                 | 1.17                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF065     | 0.65               | 1.30               | 72                   | 40                   | 0.88                   | 3.25                         | 5.3  | 0.31                 | 0.48                 | 0.72                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF075     | 0.75               | 1.50               | 72                   | 40                   | 0.92                   | 3.75                         | 6.3  | 0.25                 | 0.40                 | 0.60                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF090     | 0.90               | 1.80               | 72                   | 40                   | 0.99                   | 4.50                         | 7.2  | 0.20                 | 0.31                 | 0.47                  | [0.205mm <sup>2</sup> (24)]          |
| RXEF110     | 1.10               | 2.20               | 72                   | 40                   | 1.50                   | 5.50                         | 8.2  | 0.15                 | 0.25                 | 0.38                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF135     | 1.35               | 2.70               | 72                   | 40                   | 1.70                   | 6.75                         | 9.6  | 0.12                 | 0.19                 | 0.30                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF160     | 1.60               | 3.20               | 72                   | 40                   | 1.90                   | 8.00                         | 11.4 | 0.09                 | 0.14                 | 0.22                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF185     | 1.85               | 3.70               | 72                   | 40                   | 2.10                   | 9.25                         | 12.6 | 0.08                 | 0.12                 | 0.19                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF250     | 2.50               | 5.00               | 72                   | 40                   | 2.50                   | 12.50                        | 15.6 | 0.05                 | 0.08                 | 0.13                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF300     | 3.00               | 6.00               | 72                   | 40                   | 2.80                   | 15.00                        | 19.8 | 0.04                 | 0.06                 | 0.10                  | [0.520mm <sup>2</sup> (20)]          |
| RXEF375     | 3.75               | 7.50               | 72                   | 40                   | 3.20                   | 18.75                        | 24.0 | 0.03                 | 0.05                 | 0.08                  | [0.520mm <sup>2</sup> (20)]          |

**Table R3 Electrical Characteristics for Radial-leaded Devices**

Cont'd

| Part Number                  | I <sub>H</sub> (A) | I <sub>T</sub> (A) | V <sub>MAX</sub> (V) | I <sub>MAX</sub> (A) | P <sub>D Typ</sub> (W) | Max. Time-to-trip (A) (s) |      | R <sub>MIN</sub> (Ω) | R <sub>MAX</sub> (Ω) | R <sub>1MAX</sub> (Ω) | Lead Size [mm <sup>2</sup> (AWG)] |
|------------------------------|--------------------|--------------------|----------------------|----------------------|------------------------|---------------------------|------|----------------------|----------------------|-----------------------|-----------------------------------|
| RKEF 60V                     |                    |                    |                      |                      |                        |                           |      |                      |                      |                       |                                   |
| RKEF050                      | 0.50               | 1.00               | 60                   | 40                   | 1.00                   | 8.00                      | 0.8  | 0.320                | 0.529                | 0.900                 | [0.205mm <sup>2</sup> (24)]       |
| RKEF065                      | 0.65               | 1.30               | 60                   | 40                   | 1.25                   | 8.00                      | 1.0  | 0.250                | 0.450                | 0.720                 | [0.205mm <sup>2</sup> (24)]       |
| RKEF075                      | 0.75               | 1.50               | 60                   | 40                   | 1.40                   | 8.00                      | 1.5  | 0.200                | 0.390                | 0.640                 | [0.205mm <sup>2</sup> (24)]       |
| RKEF090                      | 0.90               | 1.80               | 60                   | 40                   | 1.50                   | 8.00                      | 2.0  | 0.190                | 0.320                | 0.520                 | [0.205mm <sup>2</sup> (24)]       |
| RKEF110                      | 1.10               | 2.20               | 60                   | 40                   | 2.20                   | 8.00                      | 3.0  | 0.170                | 0.280                | 0.470                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF135                      | 1.35               | 2.70               | 60                   | 40                   | 2.30                   | 8.00                      | 4.5  | 0.110                | 0.220                | 0.370                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF160                      | 1.60               | 3.20               | 60                   | 40                   | 2.40                   | 8.20                      | 9.0  | 0.100                | 0.200                | 0.320                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF185                      | 1.85               | 3.70               | 60                   | 40                   | 2.60                   | 9.25                      | 12.6 | 0.060                | 0.152                | 0.250                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF250                      | 2.50               | 5.00               | 60                   | 40                   | 2.80                   | 12.50                     | 15.6 | 0.040                | 0.085                | 0.140                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF300                      | 3.00               | 6.00               | 60                   | 40                   | 3.20                   | 15.00                     | 19.8 | 0.030                | 0.050                | 0.080                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF375                      | 3.75               | 7.50               | 60                   | 40                   | 3.40                   | 18.75                     | 22.0 | 0.017                | 0.040                | 0.060                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF400                      | 4.00               | 8.00               | 60                   | 40                   | 3.70                   | 20.00                     | 24.0 | 0.014                | 0.038                | 0.060                 | [0.520mm <sup>2</sup> (20)]       |
| RKEF500                      | 5.00               | 10.00              | 60                   | 40                   | 5.00                   | 25.00                     | 28.0 | 0.012                | 0.030                | 0.050                 | [0.520mm <sup>2</sup> (20)]       |
| RUEF 30V                     |                    |                    |                      |                      |                        |                           |      |                      |                      |                       |                                   |
| RUEF090                      | 0.90               | 1.80               | 30                   | 100                  | 0.60                   | 4.50                      | 5.9  | 0.070                | 0.120                | 0.22                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF110                      | 1.10               | 2.20               | 30                   | 100                  | 0.70                   | 5.50                      | 6.6  | 0.070                | 0.100                | 0.17                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF135                      | 1.35               | 2.70               | 30                   | 100                  | 0.80                   | 6.75                      | 7.3  | 0.040                | 0.080                | 0.13                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF160                      | 1.60               | 3.20               | 30                   | 100                  | 0.90                   | 8.00                      | 8.0  | 0.030                | 0.070                | 0.11                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF185                      | 1.85               | 3.70               | 30                   | 100                  | 1.00                   | 9.25                      | 8.7  | 0.030                | 0.060                | 0.09                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF250                      | 2.50               | 5.00               | 30                   | 100                  | 1.20                   | 12.50                     | 10.3 | 0.020                | 0.040                | 0.07                  | [0.205mm <sup>2</sup> (24)]       |
| RUEF300                      | 3.00               | 6.00               | 30                   | 100                  | 2.00                   | 15.00                     | 10.8 | 0.020                | 0.050                | 0.08                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF400                      | 4.00               | 8.00               | 30                   | 100                  | 2.50                   | 20.00                     | 12.7 | 0.010                | 0.030                | 0.05                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF500                      | 5.00               | 10.00              | 30                   | 100                  | 3.00                   | 25.00                     | 14.5 | 0.010                | 0.030                | 0.05                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF600                      | 6.00               | 12.00              | 30                   | 100                  | 3.50                   | 30.00                     | 16.0 | 0.005                | 0.020                | 0.04                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF700                      | 7.00               | 14.00              | 30                   | 100                  | 3.80                   | 35.00                     | 17.5 | 0.005                | 0.020                | 0.03                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF800                      | 8.00               | 16.00              | 30                   | 100                  | 4.00                   | 40.00                     | 18.8 | 0.005                | 0.013                | 0.02                  | [0.520mm <sup>2</sup> (20)]       |
| RUEF900                      | 9.00               | 18.00              | 30                   | 100                  | 4.20                   | 45.00                     | 20.0 | 0.005                | 0.010                | 0.02                  | [0.520mm <sup>2</sup> (20)]       |
| RHEF* 30V - High Temperature |                    |                    |                      |                      |                        |                           |      |                      |                      |                       |                                   |
| RHEF050                      | 0.5                | 0.9                | 30                   | 40                   | 0.9                    | 2.5                       | 2.5  | 0.480                | 0.780                | 1.10                  | [0.205mm <sup>2</sup> (24)]       |
| RHEF070                      | 0.7                | 1.4                | 30                   | 40                   | 1.4                    | 3.5                       | 3.2  | 0.300                | 0.540                | 0.80                  | [0.205mm <sup>2</sup> (24)]       |
| RHEF100                      | 1.0                | 1.8                | 30                   | 40                   | 1.4                    | 5.0                       | 5.2  | 0.180                | 0.300                | 0.43                  | [0.205mm <sup>2</sup> (24)]       |
| RUSBF 16V                    |                    |                    |                      |                      |                        |                           |      |                      |                      |                       |                                   |
| RUSBF090                     | 0.90               | 1.8                | 16                   | 40                   | 0.6                    | 8.0                       | 1.2  | 0.070                | 0.120                | 0.180                 | [0.205mm <sup>2</sup> (24)]       |
| RUSBF110                     | 1.10               | 2.2                | 16                   | 40                   | 0.7                    | 8.0                       | 2.3  | 0.050                | 0.095                | 0.140                 | [0.205mm <sup>2</sup> (24)]       |
| RUSBF135                     | 1.35               | 2.7                | 16                   | 40                   | 0.8                    | 8.0                       | 4.5  | 0.040                | 0.074                | 0.112                 | [0.205mm <sup>2</sup> (24)]       |
| RUSBF160                     | 1.60               | 3.2                | 16                   | 40                   | 0.9                    | 8.0                       | 9.0  | 0.030                | 0.061                | 0.110                 | [0.205mm <sup>2</sup> (24)]       |
| RUSBF185                     | 1.85               | 3.7                | 16                   | 40                   | 1.0                    | 8.0                       | 10.0 | 0.030                | 0.051                | 0.090                 | [0.205mm <sup>2</sup> (24)]       |
| RUSBF250                     | 2.50               | 5.0                | 16                   | 40                   | 1.2                    | 8.0                       | 40.0 | 0.020                | 0.036                | 0.060                 | [0.205mm <sup>2</sup> (24)]       |
| RGEF* 16V                    |                    |                    |                      |                      |                        |                           |      |                      |                      |                       |                                   |
| RGEF250                      | 2.5                | 4.7                | 16                   | 100                  | 1.0                    | 12.5                      | 5.0  | 0.0220               | 0.0350               | 0.0530                | [0.205mm <sup>2</sup> (24)]       |
| RGEF300                      | 3.0                | 5.1                | 16                   | 100                  | 2.3                    | 15.0                      | 1.0  | 0.0380               | 0.0645               | 0.0975                | [0.520mm <sup>2</sup> (20)]       |
| RGEF400                      | 4.0                | 6.8                | 16                   | 100                  | 2.4                    | 20.0                      | 1.7  | 0.0210               | 0.0390               | 0.0600                | [0.520mm <sup>2</sup> (20)]       |
| RGEF500                      | 5.0                | 8.5                | 16                   | 100                  | 2.6                    | 25.0                      | 2.0  | 0.0150               | 0.0240               | 0.0340                | [0.520mm <sup>2</sup> (20)]       |
| RGEF600                      | 6.0                | 10.2               | 16                   | 100                  | 2.8                    | 30.0                      | 3.3  | 0.0100               | 0.0190               | 0.0280                | [0.520mm <sup>2</sup> (20)]       |
| RGEF700                      | 7.0                | 11.9               | 16                   | 100                  | 3.0                    | 35.0                      | 3.5  | 0.0077               | 0.0131               | 0.0200                | [0.520mm <sup>2</sup> (20)]       |
| RGEF800                      | 8.0                | 13.6               | 16                   | 100                  | 3.0                    | 40.0                      | 5.0  | 0.0056               | 0.0110               | 0.0175                | [0.520mm <sup>2</sup> (20)]       |
| RGEF900                      | 9.0                | 15.3               | 16                   | 100                  | 3.3                    | 45.0                      | 5.5  | 0.0047               | 0.0091               | 0.0135                | [0.520mm <sup>2</sup> (20)]       |
| RGEF1000                     | 10.0               | 17.0               | 16                   | 100                  | 3.6                    | 50.0                      | 6.0  | 0.0040               | 0.0070               | 0.0102                | [0.520mm <sup>2</sup> (20)]       |
| RGEF1100                     | 11.0               | 18.7               | 16                   | 100                  | 3.7                    | 55.0                      | 7.0  | 0.0037               | 0.0060               | 0.0089                | [0.520mm <sup>2</sup> (20)]       |
| RGEF1200                     | 12.0               | 20.4               | 16                   | 100                  | 4.2                    | 60.0                      | 7.5  | 0.0033               | 0.0057               | 0.0086                | [0.823mm <sup>2</sup> (18)]       |
| RGEF1400                     | 14.0               | 23.8               | 16                   | 100                  | 4.6                    | 70.0                      | 9.0  | 0.0026               | 0.0043               | 0.0064                | [0.823mm <sup>2</sup> (18)]       |

Table R3 Electrical Characteristics for Radial-leaded Devices

Cont'd

| Part Number                     | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V) | I <sub>MAX</sub><br>(A) | P <sub>D Typ</sub><br>(W) | Max. Time-to-trip<br>(A)      (s) |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm <sup>2</sup> (AWG)] |
|---------------------------------|-----------------------|-----------------------|-------------------------|-------------------------|---------------------------|-----------------------------------|------|-------------------------|-------------------------|--------------------------|--------------------------------------|
| RHEF*<br>16V - High Temperature |                       |                       |                         |                         |                           |                                   |      |                         |                         |                          |                                      |
| RHEF200                         | 2.0                   | 3.8                   | 16                      | 100                     | 1.4                       | 10.0                              | 4.3  | 0.0450                  | 0.07400                 | 0.1100                   | [0.205mm <sup>2</sup> (24)]          |
| RHEF300                         | 3.0                   | 6.0                   | 16                      | 100                     | 3.0                       | 15.0                              | 5.0  | 0.0330                  | 0.05300                 | 0.0790                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF400                         | 4.0                   | 7.5                   | 16                      | 100                     | 3.3                       | 20.0                              | 5.0  | 0.0240                  | 0.04000                 | 0.0600                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF450                         | 4.5                   | 7.8                   | 16                      | 100                     | 3.6                       | 22.5                              | 3.0  | 0.0220                  | 0.03600                 | 0.0540                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF550                         | 5.5                   | 10.0                  | 16                      | 100                     | 3.5                       | 27.5                              | 6.0  | 0.0150                  | 0.02500                 | 0.0370                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF600                         | 6.0                   | 10.8                  | 16                      | 100                     | 4.1                       | 30.0                              | 5.0  | 0.0130                  | 0.02150                 | 0.0320                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF650                         | 6.5                   | 12.0                  | 16                      | 100                     | 4.1                       | 32.5                              | 5.5  | 0.0110                  | 0.01750                 | 0.0260                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF700                         | 7.0                   | 13.0                  | 16                      | 100                     | 4.0                       | 35.0                              | 7.0  | 0.0100                  | 0.01640                 | 0.0250                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF750                         | 7.5                   | 13.1                  | 16                      | 100                     | 4.5                       | 37.5                              | 7.0  | 0.0094                  | 0.01530                 | 0.0220                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF800                         | 8.0                   | 15.0                  | 16                      | 100                     | 4.2                       | 40.0                              | 8.0  | 0.0080                  | 0.01350                 | 0.0200                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF900                         | 9.0                   | 16.5                  | 16                      | 100                     | 5.0                       | 45.0                              | 10.0 | 0.0074                  | 0.01200                 | 0.0170                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1000                        | 10.0                  | 18.5                  | 16                      | 100                     | 5.3                       | 50.0                              | 9.0  | 0.0062                  | 0.01050                 | 0.0150                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1100                        | 11.0                  | 20.0                  | 16                      | 100                     | 5.5                       | 55.0                              | 11.0 | 0.0055                  | 0.00900                 | 0.0130                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1300                        | 13.0                  | 24.0                  | 16                      | 100                     | 6.9                       | 65.0                              | 13.0 | 0.0041                  | 0.00690                 | 0.0100                   | [0.823mm <sup>2</sup> (18)]          |
| RHEF1400                        | 14.0                  | 27.0                  | 16                      | 100                     | 6.9                       | 70.0                              | 13.0 | 0.0030                  | 0.00600                 | 0.0090                   | [0.823mm <sup>2</sup> (18)]          |
| RHEF1500                        | 15.0                  | 28.0                  | 16                      | 100                     | 7.0                       | 75.0                              | 20.0 | 0.0032                  | 0.00613                 | 0.0092                   | [0.823mm <sup>2</sup> (18)]          |
| RUSBF<br>6V                     |                       |                       |                         |                         |                           |                                   |      |                         |                         |                          |                                      |
| RUSBF075                        | 0.75                  | 1.30                  | 6                       | 40                      | 0.3                       | 8.0                               | 0.4  | 0.110                   | 0.1750                  | 0.23                     | [0.205mm <sup>2</sup> (24)]          |
| RUSBF120                        | 1.20                  | 2.00                  | 6                       | 40                      | 0.6                       | 8.0                               | 0.5  | 0.070                   | 0.0975                  | 0.14                     | [0.205mm <sup>2</sup> (24)]          |
| RUSBF155                        | 1.55                  | 2.65                  | 6                       | 40                      | 0.6                       | 7.8                               | 2.2  | 0.040                   | 0.0705                  | 0.10                     | [0.205mm <sup>2</sup> (24)]          |

**Notes:**
 $I_H$  : Hold current: maximum current device will pass without interruption in 20°C still air.

 $I_T$  : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.

 $V_{MAX}$  : Maximum continuous voltage device can withstand without damage at rated current.

 $I_{MAX}$  : Maximum fault current device can withstand without damage at rated voltage.

 $P_D$  : Power dissipated from device when in the tripped state in 20°C still air.

 $R_{MIN}$  : Minimum resistance of device as supplied at 20°C unless otherwise specified.

 $R_{MAX}$  : Maximum resistance of device as supplied at 20°C unless otherwise specified.

 $R_{1MAX}$  : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 20°C unless otherwise specified.

\* Electrical characteristics determined at 25°C.

Figure R6-R14 Dimension Figures for Radial-leaded Devices

Figure R6

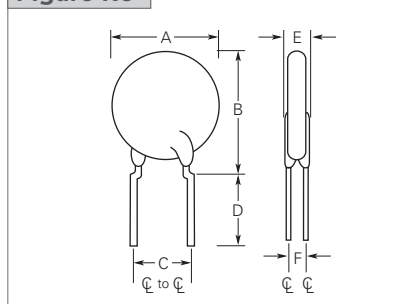


Figure R7

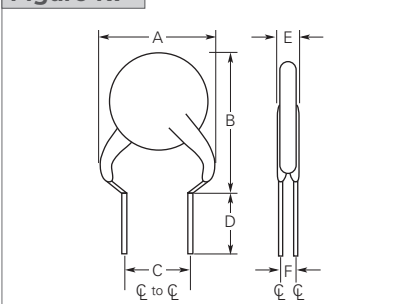


Figure R8

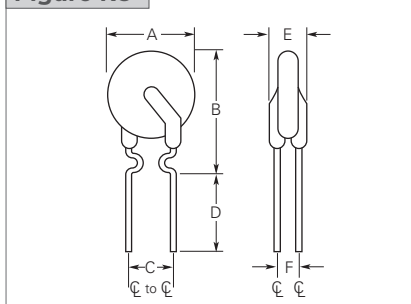


Figure R9

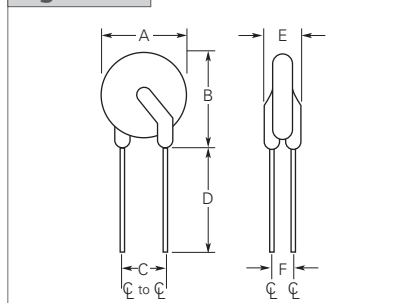


Figure R10

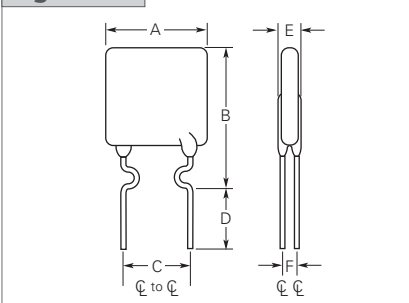
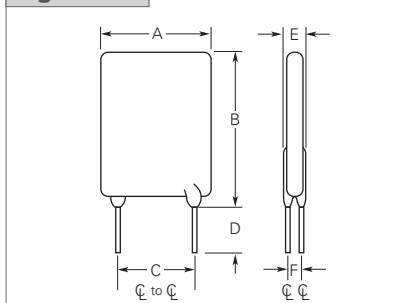
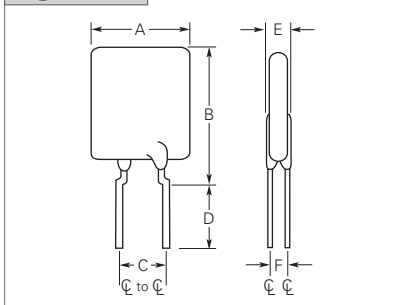
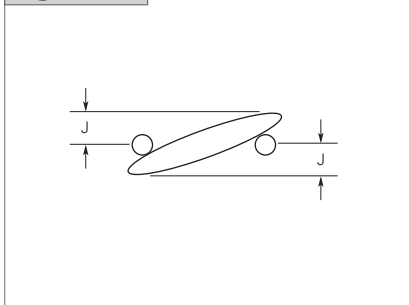
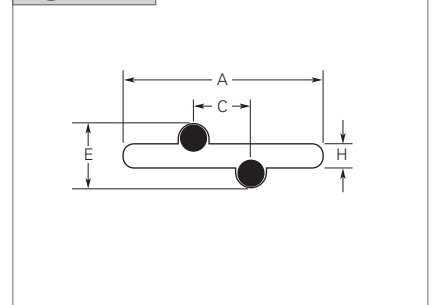


Figure R11



**Figure R12**

**Figure R13**

**Figure R14**

**Table R4 Dimensions & Weights for Radial-leaded Devices**

| Part Number | Dimensions in Millimeters (Inches) |                |      |                |               |                |               |      |      |               |      |                 | Figure        | Device Mass (g)<br>(Only for reference) |       |
|-------------|------------------------------------|----------------|------|----------------|---------------|----------------|---------------|------|------|---------------|------|-----------------|---------------|-----------------------------------------|-------|
|             | A                                  |                | B    |                | C             |                | D             |      | E    |               | F    | H               |               |                                         | J     |
|             | Min.                               | Max.           | Min. | Max.           | Min.          | Max.           | Min.          | Max. | Min. | Max.          | Typ. | Typ.            |               |                                         | Typ.  |
| BBRF 99V    |                                    |                |      |                |               |                |               |      |      |               |      |                 |               |                                         |       |
| BBRF550     | —                                  | 10.9<br>(0.43) | —    | 14.0<br>(0.55) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.3)  | —    | —    | 3.6<br>(0.14) | —    | 1.37<br>(0.054) | 1.2<br>(0.05) | R6, R13,<br>R14                         | 0.534 |
| RXEF 60V    |                                    |                |      |                |               |                |               |      |      |               |      |                 |               |                                         |       |
| RXEF005     | —                                  | 8.0<br>(0.32)  | —    | 8.3<br>(0.33)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.07<br>(0.042) | 1.0<br>(0.04) | R7, R13,<br>R14                         | 0.069 |
| RXEF010     | —                                  | 7.4<br>(0.29)  | —    | 11.6<br>(0.46) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.07<br>(0.042) | 1.0<br>(0.04) | R7, R13,<br>R14                         | 0.128 |
| RXEF017     | —                                  | 7.4<br>(0.29)  | —    | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.68<br>(0.066) | 1.7<br>(0.07) | R7, R13,<br>R14                         | 0.174 |
| RXEF 72V    |                                    |                |      |                |               |                |               |      |      |               |      |                 |               |                                         |       |
| RXEF020     | —                                  | 7.4<br>(0.29)  | —    | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14                         | 0.119 |
| RXEF025     | —                                  | 7.4<br>(0.29)  | —    | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14                         | 0.130 |
| RXEF030     | —                                  | 7.4<br>(0.29)  | —    | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14                         | 0.143 |
| RXEF040     | —                                  | 7.6<br>(0.30)  | —    | 13.5<br>(0.53) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.2<br>(0.05) | R8, R13,<br>R14                         | 0.202 |
| RXEF050     | —                                  | 7.9<br>(0.31)  | —    | 13.7<br>(0.54) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.2<br>(0.05) | R8, R13,<br>R14                         | 0.210 |
| RXEF065     | —                                  | 9.4<br>(0.37)  | —    | 14.5<br>(0.57) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14                         | 0.277 |
| RXEF075     | —                                  | 10.2<br>(0.40) | —    | 15.2<br>(0.60) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14                         | 0.310 |
| RXEF090     | —                                  | 11.2<br>(0.44) | —    | 15.8<br>(0.62) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14                         | 0.365 |
| RXEF110     | —                                  | 12.8<br>(0.50) | —    | 17.5<br>(0.69) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.2<br>(0.05) | R9, R13,<br>R14                         | 0.546 |
| RXEF135     | —                                  | 14.5<br>(0.57) | —    | 19.1<br>(0.75) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.2<br>(0.05) | R9, R13,<br>R14                         | 0.653 |
| RXEF160     | —                                  | 16.3<br>(0.64) | —    | 20.8<br>(0.82) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.5<br>(0.06) | R9, R13,<br>R14                         | 0.684 |
| RXEF185     | —                                  | 17.5<br>(0.69) | —    | 22.4<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.5<br>(0.06) | R9, R13,<br>R14                         | 0.808 |
| RXEF250     | —                                  | 20.8<br>(0.82) | —    | 25.4<br>(1.00) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14                         | 1.139 |
| RXEF300     | —                                  | 23.9<br>(0.94) | —    | 28.6<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14                         | 1.379 |
| RXEF375     | —                                  | 27.2<br>(1.07) | —    | 31.8<br>(1.25) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | —    | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14                         | 1.708 |

**Table R4 Dimensions & Weights for Radial-leaded Devices**

Cont'd

| Part Number                   | Dimensions in Millimeters (Inches) |                 |      |                 |                |                 |                |      |      |                |               |                 | Figure        | Device Mass (g)<br>(Only for reference) |       |
|-------------------------------|------------------------------------|-----------------|------|-----------------|----------------|-----------------|----------------|------|------|----------------|---------------|-----------------|---------------|-----------------------------------------|-------|
|                               | A                                  |                 | B    |                 | C              |                 | D              |      | E    |                | F             | H               |               |                                         | J     |
|                               | Min.                               | Max.            | Min. | Max.            | Min.           | Max.            | Min.           | Max. | Min. | Max.           | Typ.          | Typ.            |               |                                         | Typ.  |
| <b>RKEF</b>                   |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| <b>60V</b>                    |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| RKEF050                       | —                                  | 7.10<br>(0.28)  | —    | 11.43<br>(0.45) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.56<br>(0.14) | —             | —               | —             | R10, R13,<br>R14                        | 0.166 |
| RKEF065                       | —                                  | 7.11<br>(0.28)  | —    | 12.20<br>(0.48) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.56<br>(0.14) | —             | —               | —             | R10, R13,<br>R14                        | 0.182 |
| RKEF075                       | —                                  | 7.87<br>(0.31)  | —    | 12.20<br>(0.48) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.56<br>(0.14) | —             | —               | —             | R10, R13,<br>R14                        | 0.201 |
| RKEF090                       | —                                  | 7.87<br>(0.31)  | —    | 13.97<br>(0.55) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.56<br>(0.14) | —             | —               | —             | R10, R13,<br>R14                        | 0.235 |
| RKEF110                       | —                                  | 7.60<br>(0.30)  | —    | 15.00<br>(0.59) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 4.10<br>(0.16) | —             | —               | —             | R10, R13,<br>R14                        | 0.353 |
| RKEF135                       | —                                  | 10.20<br>(0.40) | —    | 17.00<br>(0.67) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.81<br>(0.15) | —             | —               | —             | R11, R13,<br>R14                        | 0.438 |
| RKEF160                       | —                                  | 12.20<br>(0.48) | —    | 18.30<br>(0.72) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.81<br>(0.15) | —             | —               | —             | R11, R13,<br>R14                        | 0.546 |
| RKEF185                       | —                                  | 13.00<br>(0.51) | —    | 18.80<br>(0.74) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.81<br>(0.15) | —             | —               | —             | R11, R13,<br>R14                        | 0.538 |
| RKEF250                       | —                                  | 14.00<br>(0.55) | —    | 20.60<br>(0.81) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.00<br>(0.12) | —             | —               | —             | R11, R13,<br>R14                        | 0.775 |
| RKEF300                       | —                                  | 16.50<br>(0.65) | —    | 21.20<br>(0.83) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —    | —    | 3.00<br>(0.12) | —             | —               | —             | R11, R13,<br>R14                        | 0.971 |
| RKEF375                       | —                                  | 16.50<br>(0.65) | —    | 25.20<br>(0.99) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —    | —    | 3.00<br>(0.12) | —             | —               | —             | R11, R13,<br>R14                        | 1.142 |
| RKEF400                       | —                                  | 21.00<br>(0.83) | —    | 24.90<br>(0.98) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —    | —    | 3.00<br>(0.12) | —             | —               | —             | R11, R13,<br>R14                        | 1.391 |
| RKEF500                       | —                                  | 24.10<br>(0.95) | —    | 29.00<br>(1.14) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —    | —    | 3.00<br>(0.12) | —             | —               | —             | R11, R13,<br>R14                        | 1.783 |
| <b>RUEF</b>                   |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| <b>30V</b>                    |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| RUEF090                       | —                                  | 7.4<br>(0.29)   | —    | 12.2<br>(0.48)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14                        | 0.183 |
| RUEF110                       | —                                  | 7.4<br>(0.29)   | —    | 14.2<br>(0.56)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14                        | 0.204 |
| RUEF135                       | —                                  | 8.9<br>(0.35)   | —    | 13.5<br>(0.53)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.255 |
| RUEF160                       | —                                  | 8.9<br>(0.35)   | —    | 15.2<br>(0.60)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.289 |
| RUEF185                       | —                                  | 10.2<br>(0.40)  | —    | 15.7<br>(0.62)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.379 |
| RUEF250                       | —                                  | 11.4<br>(0.45)  | —    | 18.3<br>(0.72)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 0.89<br>(0.035) | 1.2<br>(0.05) | R10, R13,<br>R14                        | 0.493 |
| RUEF300                       | —                                  | 11.4<br>(0.45)  | —    | 16.5<br>(0.65)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 0.516 |
| RUEF400                       | —                                  | 14.0<br>(0.55)  | —    | 19.3<br>(0.76)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.7<br>(0.07) | R11, R13,<br>R14                        | 0.670 |
| RUEF500                       | —                                  | 14.0<br>(0.55)  | —    | 24.1<br>(0.95)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.0<br>(0.04) | R11, R13,<br>R14                        | 0.926 |
| RUEF600                       | —                                  | 16.5<br>(0.65)  | —    | 24.1<br>(0.95)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.0<br>(0.04) | R11, R13,<br>R14                        | 1.352 |
| RUEF700                       | —                                  | 19.1<br>(0.75)  | —    | 25.9<br>(1.02)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.2<br>(0.05) | R11, R13,<br>R14                        | 1.543 |
| RUEF800                       | —                                  | 21.6<br>(0.85)  | —    | 28.4<br>(1.12)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 1.852 |
| RUEF900                       | —                                  | 24.1<br>(0.95)  | —    | 29.0<br>(1.14)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 2.104 |
| <b>RHEF</b>                   |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| <b>30V - High Temperature</b> |                                    |                 |      |                 |                |                 |                |      |      |                |               |                 |               |                                         |       |
| RHEF050                       | —                                  | 7.4<br>(0.29)   | —    | 12.7<br>(0.50)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | 1.2<br>(0.05) | —               | —             | R8, R13,<br>R14                         | 0.177 |
| RHEF070                       | —                                  | 6.9<br>(0.27)   | —    | 10.8<br>(0.43)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05) | R10, R13,<br>R14                        | 0.259 |
| RHEF100                       | —                                  | 9.7<br>(0.38)   | —    | 13.6<br>(0.54)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —    | —    | 3.0<br>(0.12)  | —             | —               | —             | R8, R13,<br>R14                         | 0.312 |

**Table R4 Dimensions & Weights for Radial-leaded Devices**

Cont'd

| Part Number            | Dimensions in Millimeters (Inches) |                 |                |                |               |                |                |                |               |               |               |                 |                | Figure           | Device Mass (g)<br>(Only for reference) |
|------------------------|------------------------------------|-----------------|----------------|----------------|---------------|----------------|----------------|----------------|---------------|---------------|---------------|-----------------|----------------|------------------|-----------------------------------------|
|                        | A                                  |                 | B              |                | C             |                | D              |                | E             |               | F             | H               | J              |                  |                                         |
|                        | Min.                               | Max.            | Min.           | Max.           | Min.          | Max.           | Min.           | Max.           | Min.          | Max.          | Typ.          | Typ.            | Typ.           |                  |                                         |
| RUSBF                  |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| 16V                    |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| RUSBF090               | —                                  | 7.4<br>(0.29)   | —              | 12.2<br>(0.48) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.1<br>(0.12) | —             | 0.89<br>(0.035) | 0.8<br>(0.03)  | R10, R13,<br>R14 | 0.183                                   |
| RUSBF110               | —                                  | 7.4<br>(0.29)   | —              | 14.2<br>(0.56) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 0.8<br>(0.03)  | R10, R13,<br>R14 | 0.204                                   |
| RUSBF135               | —                                  | 8.9<br>(0.35)   | —              | 13.5<br>(0.53) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04)  | R10, R13,<br>R14 | 0.240                                   |
| RUSBF160               | —                                  | 8.9<br>(0.35)   | —              | 15.2<br>(0.60) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04)  | R10, R13,<br>R14 | 0.300                                   |
| RUSBF185               | —                                  | 10.2<br>(0.40)  | —              | 15.7<br>(0.62) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04)  | R10, R13,<br>R14 | 0.368                                   |
| RUSBF250               | —                                  | 11.4<br>(0.45)  | —              | 18.3<br>(0.72) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.2<br>(0.05)  | R10, R13,<br>R14 | 0.467                                   |
| RGEF                   |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| 16V                    |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| RGEF250                | —                                  | 8.9<br>(0.35)   | —              | 12.8<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 3.18<br>(0.13) | 6.18<br>(0.24) | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05)  | R10, R13,<br>R14 | 0.277                                   |
| RGEF300                | 6.1<br>(0.24)                      | 7.1<br>(0.28)   | 6.1<br>(0.24)  | 11.0<br>(0.43) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05)  | R11, R13,<br>R14 | 0.323                                   |
| RGEF400                | 7.9<br>(0.31)                      | 8.9<br>(0.35)   | 7.9<br>(0.31)  | 12.8<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.4<br>(0.06)  | R11, R13,<br>R14 | 0.417                                   |
| RGEF500                | 9.4<br>(0.37)                      | 10.4<br>(0.41)  | 9.4<br>(0.37)  | 14.3<br>(0.56) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06)  | R11, R13,<br>R14 | 0.540                                   |
| RGEF600                | 9.7<br>(0.38)                      | 10.7<br>(0.42)  | 12.2<br>(0.48) | 17.1<br>(0.67) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06)  | R11, R13,<br>R14 | 0.604                                   |
| RGEF700                | 10.2<br>(0.40)                     | 11.2<br>(0.44)  | 14.7<br>(0.58) | 19.7<br>(0.78) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.7<br>(0.07)  | R11, R13,<br>R14 | 0.701                                   |
| RGEF800                | 11.7<br>(0.46)                     | 12.7<br>(0.50)  | 16.0<br>(0.63) | 20.9<br>(0.82) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.8<br>(0.07)  | R11, R13,<br>R14 | 0.829                                   |
| RGEF900                | 13.0<br>(0.51)                     | 14.0<br>(0.55)  | 16.8<br>(0.66) | 21.7<br>(0.85) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08)  | R11, R13,<br>R14 | 0.887                                   |
| RGEF1000               | 15.5<br>(0.61)                     | 16.5<br>(0.65)  | 21.1<br>(0.83) | 25.2<br>(0.99) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08)  | R11, R13,<br>R14 | 1.219                                   |
| RGEF1100               | 16.5<br>(0.65)                     | 17.5<br>(0.69)  | 21.1<br>(0.83) | 26.0<br>(1.02) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.4<br>(0.09)  | R11, R13,<br>R14 | 1.408                                   |
| RGEF1200               | 16.4<br>(0.65)                     | 17.5<br>(0.69)  | 22.6<br>(0.89) | 28.0<br>(1.10) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30)  | —              | 2.3<br>(0.09) | 3.5<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.5<br>(0.06)  | R11, R13,<br>R14 | 1.650                                   |
| RGEF1400               | 22.4<br>(0.88)                     | 23.5<br>(0.925) | 22.6<br>(0.89) | 27.9<br>(1.10) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30)  | —              | 2.3<br>(0.09) | 3.5<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.08)  | R11, R13,<br>R14 | 2.146                                   |
| RHEF                   |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| 16V - High Temperature |                                    |                 |                |                |               |                |                |                |               |               |               |                 |                |                  |                                         |
| RHEF200                | —                                  | 9.4<br>(0.37)   | —              | 14.4<br>(0.57) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.1<br>(0.12) | —             | —               | —              | R8, R13,<br>R14  | 0.278                                   |
| RHEF300                | —                                  | 8.8<br>(0.35)   | —              | 13.8<br>(0.55) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 0.433                                   |
| RHEF400                | —                                  | 10.0<br>(0.39)  | —              | 15.0<br>(0.59) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06)  | R12, R13,<br>R14 | 0.509                                   |
| RHEF450                | —                                  | 10.4<br>(0.41)  | —              | 15.6<br>(0.61) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06)  | R12, R13,<br>R14 | 0.605                                   |
| RHEF550                | —                                  | 11.2<br>(0.44)  | —              | 18.9<br>(0.74) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 0.704                                   |
| RHEF600                | —                                  | 11.2<br>(0.44)  | —              | 21.0<br>(0.83) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.7<br>(0.067) | R12, R13,<br>R14 | 0.792                                   |
| RHEF650                | —                                  | 12.7<br>(0.50)  | —              | 22.2<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.8<br>(0.07)  | R12, R13,<br>R14 | 0.952                                   |
| RHEF700                | —                                  | 14.0<br>(0.55)  | —              | 21.9<br>(0.86) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 0.850                                   |
| RHEF750                | —                                  | 14.0<br>(0.55)  | —              | 23.5<br>(0.93) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08)  | R12, R13,<br>R14 | 1.054                                   |
| RHEF800                | —                                  | 16.5<br>(0.65)  | —              | 22.5<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.073                                   |
| RHEF900                | —                                  | 16.5<br>(0.65)  | —              | 25.7<br>(1.01) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.516                                   |

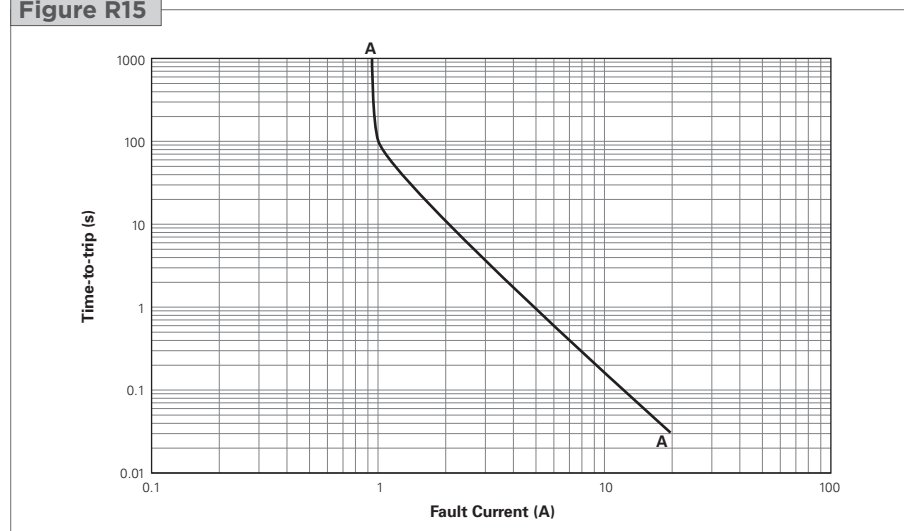
**Table R4 Dimensions & Weights for Radial-leaded Devices**

Cont'd

| Part Number            | Dimensions in Millimeters (Inches) |                 |      |                |               |                |               |      |      |               |               |                 |                | Figure           | Device Mass (g)<br>(Only for reference) |
|------------------------|------------------------------------|-----------------|------|----------------|---------------|----------------|---------------|------|------|---------------|---------------|-----------------|----------------|------------------|-----------------------------------------|
|                        | A                                  |                 | B    |                | C             |                | D             |      | E    |               | F             | H               | J              |                  |                                         |
|                        | Min.                               | Max.            | Min. | Max.           | Min.          | Max.           | Min.          | Max. | Min. | Max.          | Typ.          | Typ.            | Typ.           |                  |                                         |
| RHEF                   |                                    |                 |      |                |               |                |               |      |      |               |               |                 |                |                  |                                         |
| 16V - High Temperature |                                    |                 |      |                |               |                |               |      |      |               |               |                 |                |                  |                                         |
| RHEF1000               | —                                  | 17.5<br>(0.69)  | —    | 26.5<br>(1.04) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.5<br>(0.06)  | R12, R13,<br>R14 | 1.791                                   |
| RHEF1100               | —                                  | 21.0<br>(0.83)  | —    | 26.1<br>(1.03) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.570                                   |
| RHEF1300               | —                                  | 23.5<br>(0.925) | —    | 28.7<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.6<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.084) | R12, R13,<br>R14 | 2.257                                   |
| RHEF1400               | —                                  | 23.5<br>(0.925) | —    | 28.6<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.6<br>(0.14) | 1.4<br>(0.06) | —               | —              | R12, R13,<br>R14 | 2.051                                   |
| RHEF1500               | —                                  | 23.5<br>(0.925) | —    | 28.7<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 3.6<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.084) | R12, R13,<br>R14 | 2.257                                   |
| RUSBF                  |                                    |                 |      |                |               |                |               |      |      |               |               |                 |                |                  |                                         |
| 6V                     |                                    |                 |      |                |               |                |               |      |      |               |               |                 |                |                  |                                         |
| RUSBF075               | —                                  | 6.9<br>(0.27)   | —    | 11.4<br>(0.45) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.123                                   |
| RUSBF120               | —                                  | 6.9<br>(0.27)   | —    | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.111                                   |
| RUSBF155               | —                                  | 6.9<br>(0.27)   | —    | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.135                                   |

**Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices**
**BBRF**

A = BBRF550

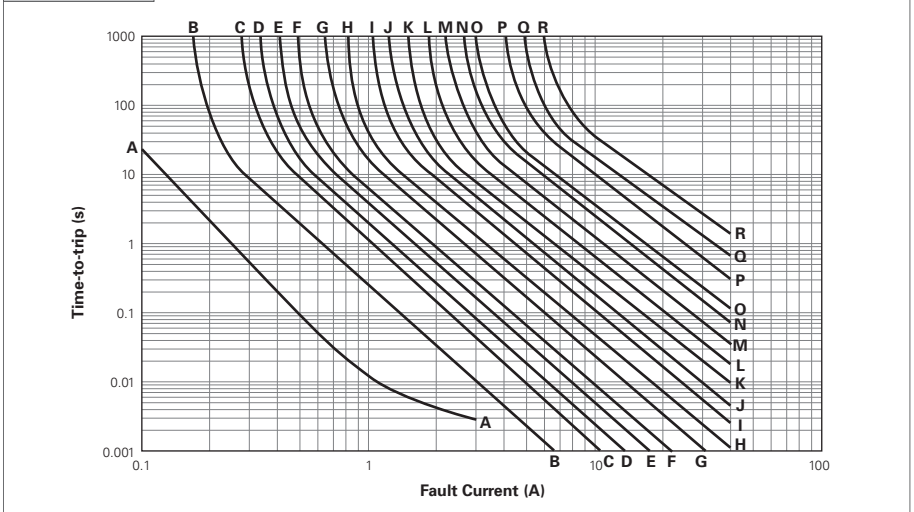
**Figure R15**




**RXEF**

|             |             |
|-------------|-------------|
| A = RXEF005 | J = RXEF075 |
| B = RXEF010 | K = RXEF090 |
| C = RXEF017 | L = RXEF110 |
| D = RXEF020 | M = RXEF135 |
| E = RXEF025 | N = RXEF160 |
| F = RXEF030 | O = RXEF185 |
| G = RXEF040 | P = RXEF250 |
| H = RXEF050 | Q = RXEF300 |
| I = RXEF065 | R = RXEF375 |

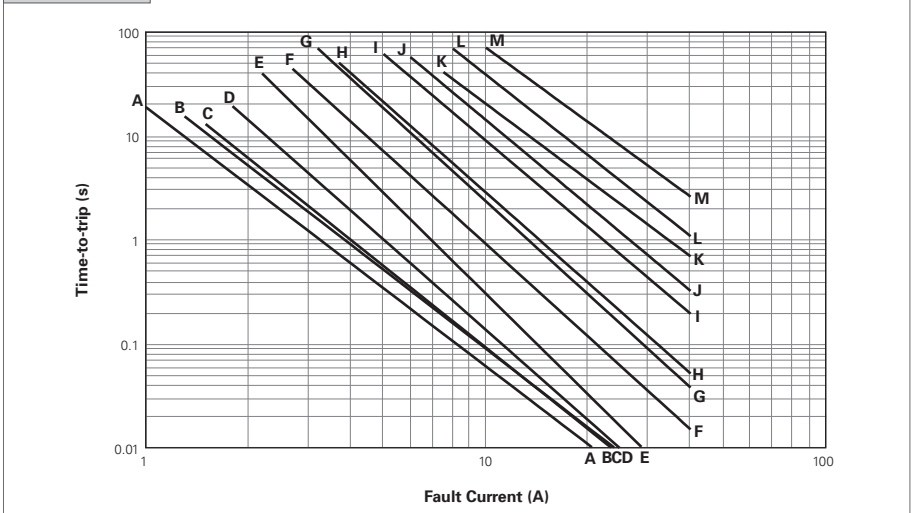
**Figure R16**



**RKEF**

|             |             |
|-------------|-------------|
| A = RKEF050 | J = RKEF300 |
| B = RKEF065 | K = RKEF375 |
| C = RKEF075 | L = RKEF400 |
| D = RKEF090 | M = RKEF500 |
| E = RKEF110 |             |
| F = RKEF135 |             |
| G = RKEF160 |             |
| H = RKEF185 |             |
| I = RKEF250 |             |

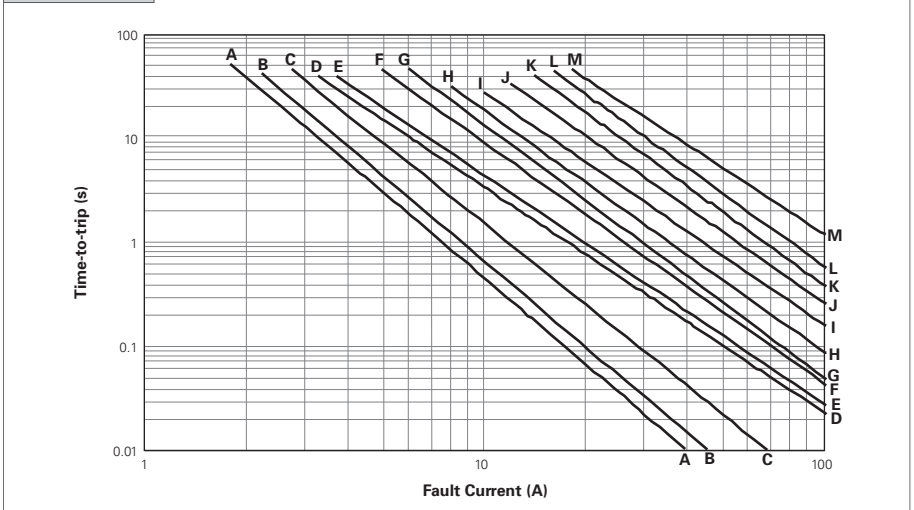
**Figure R17**



**RUEF**

|             |             |
|-------------|-------------|
| A = RUEF090 | H = RUEF400 |
| B = RUEF110 | I = RUEF500 |
| C = RUEF135 | J = RUEF600 |
| D = RUEF160 | K = RUEF700 |
| E = RUEF185 | L = RUEF800 |
| F = RUEF250 | M = RUEF900 |
| G = RUEF300 |             |

**Figure R18**

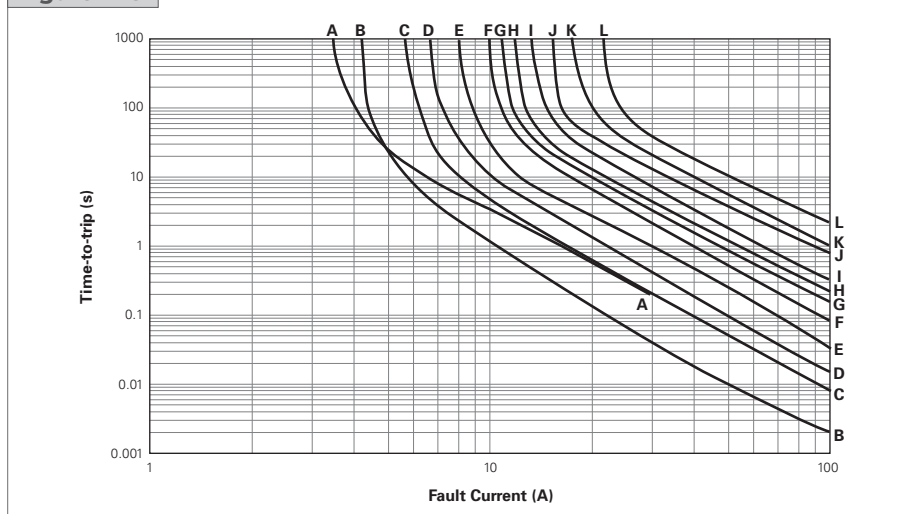


**Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices**

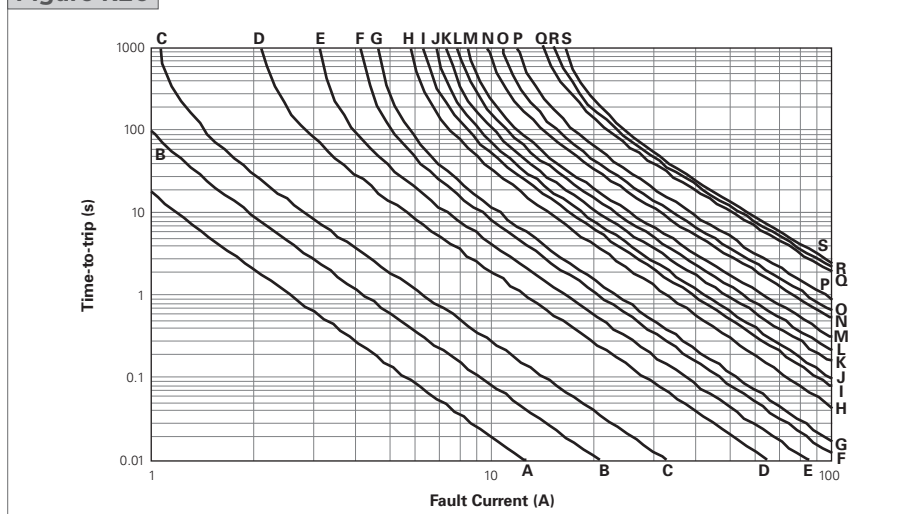
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**RGEF (data at 25°C)**

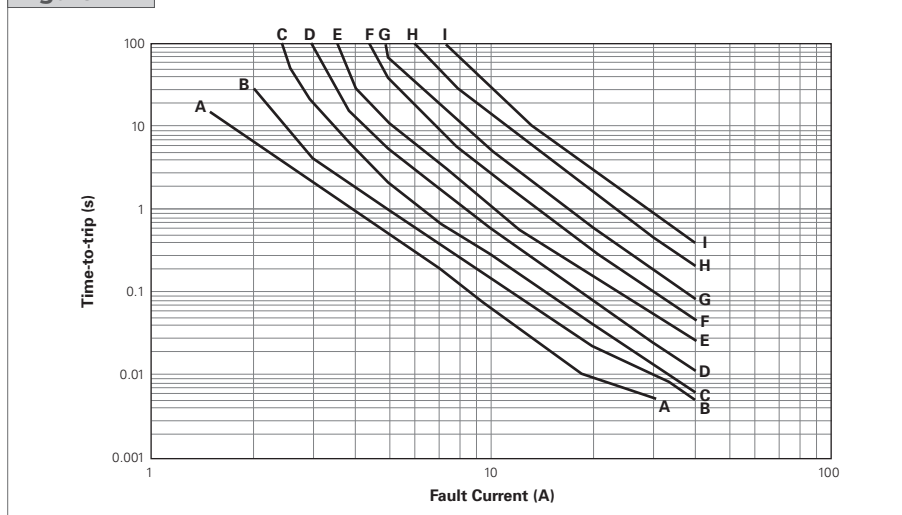
- A = RGEF250
- B = RGEF300
- C = RGEF400
- D = RGEF500
- E = RGEF600
- F = RGEF700
- G = RGEF800
- H = RGEF900
- I = RGEF1000
- J = RGEF1100
- K = RGEF1200
- L = RGEF1400

**Figure R19**

**RHEF (data at 25°C)**

- |             |              |
|-------------|--------------|
| A = RHEF050 | K = RHEF700  |
| B = RHEF070 | L = RHEF750  |
| C = RHEF100 | M = RHEF800  |
| D = RHEF200 | N = RHEF900  |
| E = RHEF300 | O = RHEF1000 |
| F = RHEF400 | P = RHEF1100 |
| G = RHEF450 | Q = RHEF1300 |
| H = RHEF550 | R = RHEF1400 |
| I = RHEF600 | S = RHEF1500 |
| J = RHEF650 |              |

**Figure R20**

**RUSBF**

- A = RUSBF075
- B = RUSBF090
- C = RUSBF110
- D = RUSBF120
- E = RUSBF135
- F = RUSBF155
- G = RUSBF160
- H = RUSBF185
- I = RUSBF250

**Figure R21**


**Table R5 Physical Characteristics and Environmental Specifications for Radial-leaded Devices**
**BBRF**
**Physical Characteristics**

|                           |                                                                                              |
|---------------------------|----------------------------------------------------------------------------------------------|
| Lead material             | Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in.)                           |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                  |
| Solder heat withstand     | per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B, can withstand 10 seconds at 260°C ±5°C |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                         |
| Operation temperature     | -40°C~85°C                                                                                   |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±5%               |
| Thermal shock      | 85°C, -40°C (10 times)   | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**RXEF**
**Physical Characteristics**

|                           |                                                                                                                                                                                                                                      |                                                                                    |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Lead material             | RXEF005                                                                                                                                                                                                                              | : Tin-plated nickel-copper alloy, 0.128mm <sup>2</sup> (26AWG), ø0.40mm (0.016in.) |
|                           | RXEF010                                                                                                                                                                                                                              | : Tin-plated nickel-copper alloy, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in.) |
|                           | RXEF017 to 040                                                                                                                                                                                                                       | : Tin-plated copper-clad steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in.)   |
|                           | RXEF050 to 090                                                                                                                                                                                                                       | : Tin-plated copper, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in.)              |
|                           | RXEF110 to 375                                                                                                                                                                                                                       | : Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in.)               |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3<br>RXEF005, RXEF010 meet ANSI/J-STD-002 Category 1                                                                                                                                       |                                                                                    |
| Solder heat withstand     | RXEF005- RXEF025: per IEC-STD 68-2-20, Test Tb, Method 1a, condition a;<br>can withstand 5 seconds at 260°C ±5°C<br>All other sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, condition b;<br>can withstand 10 seconds at 260°C ±5°C |                                                                                    |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                                                                                                                                                                 |                                                                                    |
| Operation temperature     | -40°C~85°C                                                                                                                                                                                                                           |                                                                                    |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | -40°C, 1000 hours        | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±10%              |
| Thermal shock      | 85°C, -40°C (10 times)   | ±10%              |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**RKEF**
**Physical Characteristics**

|                           |                                                                                                                                                                                                                                           |                                                                       |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Lead material             | RKEF050 to 090                                                                                                                                                                                                                            | : Tin-plated copper, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in.) |
|                           | RKEF110 to 500                                                                                                                                                                                                                            | : Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in.)  |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                                                                                                                                                               |                                                                       |
| Solder heat withstand     | RKEF050-RKEF185 : per IEC-STD 68-2-20, Test Tb, Method 1a, condition a;<br>can withstand 5 seconds at 260°C ±5°C<br>All other sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, condition b;<br>RKEF can withstand 10 seconds at 260°C ±5°C |                                                                       |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                                                                                                                                                                      |                                                                       |
| Operation temperature     | -40°C~85°C                                                                                                                                                                                                                                |                                                                       |

**Note:** Devices are not designed to be placed through a reflow process.

**Table R5 Physical Characteristics and Environmental Specifications for Radial-leaded Devices**

Cont'd

**RKEF**
**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | -40°C, 1000 hours        | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±10%              |
| Thermal shock      | 85°C, -40°C (10 times)   | ±10%              |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**RUEF**
**Physical Characteristics**

|                           |                                                                                             |
|---------------------------|---------------------------------------------------------------------------------------------|
| Lead material             | RUEF090 to RUEF250: Tin-plated copper-clad steel, 0.205mm <sup>2</sup> (24AWG)              |
|                           | RUEF300 to RUEF900: Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in.)      |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                 |
| Solder heat withstand     | per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, can withstand 10 seconds at 260°C ±5°C |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                        |
| Operation temperature     | -40°C~85°C                                                                                  |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±5%               |
| Thermal shock      | 85°C, -40°C (10 times)   | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**RUSBF**
**Physical Characteristics**

|                           |                                                                                                          |
|---------------------------|----------------------------------------------------------------------------------------------------------|
| Lead material             | RUSBF075: Tin-plated nickel-copper alloy, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in.                 |
|                           | RUSBF090 to RUSBF250: Tin-plated copper clad-steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in.       |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3 except<br>RUSBF075 meet ANSI/J-STD-002 Category 1            |
| Solder heat withstand     | RUSBF120: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition A; can withstand 5 seconds at 260°C ±5°C    |
|                           | All others: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds at 260°C ±5°C |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                                     |
| Operation temperature     | -40°C~85°C                                                                                               |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±5%               |
| Thermal shock      | 85°C, -40°C (10 times)   | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Table R5 Physical Characteristics and Environmental Specifications for Radial-leaded Devices**

Cont'd

**RGEF**
**Physical Characteristics**

|                           |                                                                                                                  |
|---------------------------|------------------------------------------------------------------------------------------------------------------|
| Lead material             | RGEF250: Tin-plated copper-clad steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in.                            |
|                           | RGEF300 to RGEF1100 : Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm/0.032in.                           |
|                           | RGEF1200 to RGEF1400 : Tin-plated copper, 0.82mm <sup>2</sup> (18AWG), ø1.0mm/0.04in.                            |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                                      |
| Solder heat withstand     | RGEF250 and RGEF400: per IEC 68-2-20, Test Tb, Method 1a, condition a;<br>can withstand 5 seconds at 260°C ±5°C  |
|                           | RGEF500 to RGEF1400: per IEC 68-2-20, Test Tb, Method 1a, condition b;<br>can withstand 10 seconds at 260°C ±5°C |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                                             |
| Operation temperature     | -40°C~85°C                                                                                                       |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | -40°C, 1000 hours        | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±5%               |
| Thermal shock      | 85°C, -40°C (10 times)   | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**RHEF**
**Physical Characteristics**

|                           |                                                                                                   |
|---------------------------|---------------------------------------------------------------------------------------------------|
| Lead material             | RHEF050 to RHEF200 : Tin-plated copper clad steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in. |
|                           | RHEF300 to RHEF1100 : Tin-plated copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm/0.032in.            |
|                           | RHEF1300 to RHEF1500 : Tin-plated copper, 0.82mm <sup>2</sup> (18AWG), ø1.0mm/0.04in.             |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                       |
| Solder heat withstand     | per IEC 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds at 260°C ±5°C          |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                              |
| Operation temperature     | -40°C~125°C                                                                                       |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±5%               |
| Thermal shock      | 125°C, -40°C (10 times)  | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Storage Conditions for Radial-leaded Devices**

|                    |                                                                                                                                                                        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage conditions | 40°C max., 70% RH max.; devices should remain in original sealed bags prior to use.<br>Devices may not meet specified values if these storage conditions are exceeded. |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Note:** For the TR devices series, see the telecommunications and networking devices section.

**Table R6 Packaging and Marking Information for Radial-leaded Devices**

| Part Number     | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-----------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>BBRF 99V</b> |              |                      |                    |                           |              |                    |
| BBRF550         | 500          | —                    | —                  | 10,000                    | BF550        | UL, CSA            |
| BBRF550-2       | —            | 1,500                | —                  | 7,500                     | BF550        | UL, CSA            |
| <b>RXEF 60V</b> |              |                      |                    |                           |              |                    |
| RXEF005         | 500          | —                    | —                  | 10,000                    | —            | UL, CSA, TÜV       |
| RXEF005-2       | —            | 3,000                | —                  | 15,000                    | —            | UL, CSA, TÜV       |
| RXEF005-AP      | —            | —                    | 2,000              | 10,000                    | —            | UL, CSA, TÜV       |
| RXEF010         | 500          | —                    | —                  | 10,000                    | XF010        | UL, CSA, TÜV       |
| RXEF010-2       | —            | 3,000                | —                  | 15,000                    | XF010        | UL, CSA, TÜV       |
| RXEF010-AP      | —            | —                    | 2,000              | 10,000                    | XF010        | UL, CSA, TÜV       |
| RXEF017         | 500          | —                    | —                  | 10,000                    | XF017        | UL, CSA, TÜV       |
| RXEF017-2       | —            | 2,500                | —                  | 12,500                    | XF017        | UL, CSA, TÜV       |
| RXEF017-AP      | —            | —                    | 2,000              | 10,000                    | XF017        | UL, CSA, TÜV       |
| <b>RXEF 72V</b> |              |                      |                    |                           |              |                    |
| RXEF020         | 500          | —                    | —                  | 10,000                    | XF020        | UL, CSA, TÜV       |
| RXEF020-2       | —            | 3,000                | —                  | 15,000                    | XF020        | UL, CSA, TÜV       |
| RXEF020-AP      | —            | —                    | 2,000              | 10,000                    | XF020        | UL, CSA, TÜV       |
| RXEF025         | 500          | —                    | —                  | 10,000                    | XF025        | UL, CSA, TÜV       |
| RXEF025-2       | —            | 3,000                | —                  | 15,000                    | XF025        | UL, CSA, TÜV       |
| RXEF025-AP      | —            | —                    | 2,000              | 10,000                    | XF025        | UL, CSA, TÜV       |
| RXEF030         | 500          | —                    | —                  | 10,000                    | XF030        | UL, CSA, TÜV       |
| RXEF030-2       | —            | 3,000                | —                  | 15,000                    | XF030        | UL, CSA, TÜV       |
| RXEF030-AP      | —            | —                    | 2,000              | 10,000                    | XF030        | UL, CSA, TÜV       |
| RXEF040         | 500          | —                    | —                  | 10,000                    | XF040        | UL, CSA, TÜV       |
| RXEF040-2       | —            | 3,000                | —                  | 15,000                    | XF040        | UL, CSA, TÜV       |
| RXEF040-AP      | —            | —                    | 2,000              | 10,000                    | XF040        | UL, CSA, TÜV       |
| RXEF050         | 500          | —                    | —                  | 10,000                    | XF050        | UL, CSA, TÜV       |
| RXEF050-2       | —            | 3,000                | —                  | 15,000                    | XF050        | UL, CSA, TÜV       |
| RXEF050-AP      | —            | —                    | 2,000              | 10,000                    | XF050        | UL, CSA, TÜV       |
| RXEF065         | 500          | —                    | —                  | 10,000                    | XF065        | UL, CSA, TÜV       |
| RXEF065-2       | —            | 3,000                | —                  | 15,000                    | XF065        | UL, CSA, TÜV       |
| RXEF065-AP      | —            | —                    | 2,000              | 10,000                    | XF065        | UL, CSA, TÜV       |
| RXEF075         | 500          | —                    | —                  | 10,000                    | XF075        | UL, CSA, TÜV       |
| RXEF075-2       | —            | 3,000                | —                  | 15,000                    | XF075        | UL, CSA, TÜV       |
| RXEF075-AP      | —            | —                    | 2,000              | 10,000                    | XF075        | UL, CSA, TÜV       |
| RXEF090         | 500          | —                    | —                  | 10,000                    | XF090        | UL, CSA, TÜV       |
| RXEF090-2       | —            | 3,000                | —                  | 15,000                    | XF090        | UL, CSA, TÜV       |
| RXEF090-AP      | —            | —                    | 2,000              | 10,000                    | XF090        | UL, CSA, TÜV       |
| RXEF110         | 500          | —                    | —                  | 10,000                    | XF110        | UL, CSA, TÜV       |
| RXEF110-2       | —            | 1,500                | —                  | 7,500                     | XF110        | UL, CSA, TÜV       |
| RXEF110-AP      | —            | —                    | 1,000              | 5,000                     | XF110        | UL, CSA, TÜV       |
| RXEF135         | 500          | —                    | —                  | 10,000                    | XF135        | UL, CSA, TÜV       |
| RXEF135-2       | —            | 1,500                | —                  | 7,500                     | XF135        | UL, CSA, TÜV       |
| RXEF135-AP      | —            | —                    | 1,000              | 5,000                     | XF135        | UL, CSA, TÜV       |
| RXEF160         | 500          | —                    | —                  | 10,000                    | XF160        | UL, CSA, TÜV       |
| RXEF160-2       | —            | 1,500                | —                  | 7,500                     | XF160        | UL, CSA, TÜV       |
| RXEF160-AP      | —            | —                    | 1,000              | 5,000                     | XF160        | UL, CSA, TÜV       |
| RXEF185         | 500          | —                    | —                  | 10,000                    | XF185        | UL, CSA, TÜV       |
| RXEF185-2       | —            | 1,500                | —                  | 7,500                     | XF185        | UL, CSA, TÜV       |
| RXEF185-AP      | —            | —                    | 1,000              | 5,000                     | XF185        | UL, CSA, TÜV       |

**Table R6 Packaging and Marking Information for Radial-leaded Devices**

Cont'd

| Part Number | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RXEF</b> |              |                      |                    |                           |              |                    |
| <b>72V</b>  |              |                      |                    |                           |              |                    |
| RXEF250     | 250          | —                    | —                  | 5,000                     | XF250        | UL, CSA, TÜV       |
| RXEF250-2   | —            | 1,000                | —                  | 5,000                     | XF250        | UL, CSA, TÜV       |
| RXEF250-AP  | —            | —                    | 1,000              | 5,000                     | XF250        | UL, CSA, TÜV       |
| RXEF300     | 250          | —                    | —                  | 5,000                     | XF300        | UL, CSA, TÜV       |
| RXEF300-2   | —            | 1,000                | —                  | 5,000                     | XF300        | UL, CSA, TÜV       |
| RXEF300-AP  | —            | —                    | 1,000              | 5,000                     | XF300        | UL, CSA, TÜV       |
| RXEF375     | 250          | —                    | —                  | 5,000                     | XF375        | UL, CSA, TÜV       |
| <b>RKEF</b> |              |                      |                    |                           |              |                    |
| <b>60V</b>  |              |                      |                    |                           |              |                    |
| RKEF050     | 500          | —                    | —                  | 10,000                    | KF050        | UL, CSA, TÜV       |
| RKEF065     | 500          | —                    | —                  | 10,000                    | KF065        | UL, CSA, TÜV       |
| RKEF075     | 500          | —                    | —                  | 10,000                    | KF075        | UL, CSA, TÜV       |
| RKEF090     | 500          | —                    | —                  | 10,000                    | KF090        | UL, CSA, TÜV       |
| RKEF110     | 500          | —                    | —                  | 10,000                    | KF110        | UL, CSA, TÜV       |
| RKEF135     | 500          | —                    | —                  | 10,000                    | KF135        | UL, CSA, TÜV       |
| RKEF160     | 500          | —                    | —                  | 10,000                    | KF160        | UL, CSA, TÜV       |
| RKEF185     | 500          | —                    | —                  | 10,000                    | KF185        | UL, CSA, TÜV       |
| RKEF250     | 500          | —                    | —                  | 10,000                    | KF250        | UL, CSA, TÜV       |
| RKEF300     | 250          | —                    | —                  | 5,000                     | KF300        | UL, CSA, TÜV       |
| RKEF375     | 250          | —                    | —                  | 5,000                     | KF375        | UL, CSA, TÜV       |
| RKEF400     | 250          | —                    | —                  | 5,000                     | KF400        | UL, CSA, TÜV       |
| RKEF500     | 250          | —                    | —                  | 5,000                     | KF500        | UL, CSA, TÜV       |
| <b>RUEF</b> |              |                      |                    |                           |              |                    |
| <b>30V</b>  |              |                      |                    |                           |              |                    |
| RUEF090     | 500          | —                    | —                  | 10,000                    | UF090        | UL, CSA, TÜV, CQC  |
| RUEF090-2   | —            | 3,000                | —                  | 15,000                    | UF090        | UL, CSA, TÜV, CQC  |
| RUEF090-AP  | —            | —                    | 2,000              | 10,000                    | UF090        | UL, CSA, TÜV, CQC  |
| RUEF110     | 500          | —                    | —                  | 10,000                    | UF110        | UL, CSA, TÜV, CQC  |
| RUEF110-2   | —            | 3,000                | —                  | 15,000                    | UF110        | UL, CSA, TÜV, CQC  |
| RUEF110-AP  | —            | —                    | 2,000              | 10,000                    | UF110        | UL, CSA, TÜV, CQC  |
| RUEF135     | 500          | —                    | —                  | 10,000                    | UF135        | UL, CSA, TÜV, CQC  |
| RUEF135-2   | —            | 3,000                | —                  | 15,000                    | UF135        | UL, CSA, TÜV, CQC  |
| RUEF135-AP  | —            | —                    | 2,000              | 10,000                    | UF135        | UL, CSA, TÜV, CQC  |
| RUEF160     | 500          | —                    | —                  | 10,000                    | UF160        | UL, CSA, TÜV, CQC  |
| RUEF160-2   | —            | 3,000                | —                  | 15,000                    | UF160        | UL, CSA, TÜV, CQC  |
| RUEF160-AP  | —            | —                    | 2,000              | 10,000                    | UF160        | UL, CSA, TÜV, CQC  |
| RUEF185     | 500          | —                    | —                  | 10,000                    | UF185        | UL, CSA, TÜV, CQC  |
| RUEF185-2   | —            | 3,000                | —                  | 15,000                    | UF185        | UL, CSA, TÜV, CQC  |
| RUEF185-AP  | —            | —                    | 2,000              | 10,000                    | UF185        | UL, CSA, TÜV, CQC  |
| RUEF250     | 500          | —                    | —                  | 10,000                    | UF250        | UL, CSA, TÜV, CQC  |
| RUEF250-2   | —            | 3,000                | —                  | 15,000                    | UF250        | UL, CSA, TÜV, CQC  |
| RUEF250-AP  | —            | —                    | 2,000              | 10,000                    | UF250        | UL, CSA, TÜV, CQC  |
| RUEF300     | 500          | —                    | —                  | 10,000                    | UF300        | UL, CSA, TÜV, CQC  |
| RUEF300-2   | —            | 2,500                | —                  | 12,500                    | UF300        | UL, CSA, TÜV, CQC  |
| RUEF300-AP  | —            | —                    | 1,000              | 5,000                     | UF300        | UL, CSA, TÜV, CQC  |
| RUEF400     | 500          | —                    | —                  | 10,000                    | UF400        | UL, CSA, TÜV, CQC  |
| RUEF400-2   | —            | 1,500                | —                  | 7,500                     | UF400        | UL, CSA, TÜV, CQC  |
| RUEF400-AP  | —            | —                    | 1,000              | 5,000                     | UF400        | UL, CSA, TÜV, CQC  |
| RUEF500     | 250          | —                    | —                  | 5,000                     | UF500        | UL, CSA, TÜV, CQC  |
| RUEF500-2   | —            | 1,500                | —                  | 7,500                     | UF500        | UL, CSA, TÜV, CQC  |
| RUEF500-AP  | —            | —                    | 1,000              | 5,000                     | UF500        | UL, CSA, TÜV, CQC  |
| RUEF600     | 250          | —                    | —                  | 5,000                     | UF600        | UL, CSA, TÜV, CQC  |
| RUEF600-2   | —            | 1,000                | —                  | 5,000                     | UF600        | UL, CSA, TÜV, CQC  |
| RUEF600-AP  | —            | —                    | 1,000              | 5,000                     | UF600        | UL, CSA, TÜV, CQC  |

**Table R6 Packaging and Marking Information for Radial-leaded Devices**

Cont'd

| Part Number                   | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RUEF</b>                   |              |                      |                    |                           |              |                    |
| <b>30V</b>                    |              |                      |                    |                           |              |                    |
| RUEF700                       | 250          | —                    | —                  | 5,000                     | UF700        | UL, CSA, TÜV, CQC  |
| RUEF700-2                     | —            | 1,000                | —                  | 5,000                     | UF700        | UL, CSA, TÜV, CQC  |
| RUEF700-AP                    | —            | —                    | 1,000              | 5,000                     | UF700        | UL, CSA, TÜV, CQC  |
| RUEF800                       | 250          | —                    | —                  | 5,000                     | UF800        | UL, CSA, TÜV, CQC  |
| RUEF800-2                     | —            | 1,000                | —                  | 5,000                     | UF800        | UL, CSA, TÜV, CQC  |
| RUEF800-AP                    | —            | —                    | 1,000              | 5,000                     | UF800        | UL, CSA, TÜV, CQC  |
| RUEF900                       | 250          | —                    | —                  | 5,000                     | UF900        | UL, CSA, TÜV, CQC  |
| RUEF900-2                     | —            | 1,000                | —                  | 4,000                     | UF900        | UL, CSA, TÜV, CQC  |
| RUEF900-AP                    | —            | —                    | 1,000              | 4,000                     | UF900        | UL, CSA, TÜV, CQC  |
| <b>RHEF</b>                   |              |                      |                    |                           |              |                    |
| <b>30V - High Temperature</b> |              |                      |                    |                           |              |                    |
| RHEF050                       | 500          | —                    | —                  | 10,000                    | HF0.5        | UL, CSA, TÜV       |
| RHEF050-2                     | —            | 2,500                | —                  | 12,500                    | HF0.7        | UL, CSA, TÜV       |
| RHEF070                       | 500          | —                    | —                  | 10,000                    | HF0.7        | UL, CSA, TÜV       |
| RHEF070-2                     | —            | 2,500                | —                  | 12,500                    | HF0.7        | UL, CSA, TÜV       |
| RHEF100                       | 500          | —                    | —                  | 10,000                    | HF1.0        | UL, CSA, TÜV       |
| RHEF100-2                     | —            | 2,500                | —                  | 12,500                    | HF1.0        | UL, CSA, TÜV       |
| <b>RUSBF</b>                  |              |                      |                    |                           |              |                    |
| <b>16V</b>                    |              |                      |                    |                           |              |                    |
| RUSBF090                      | 500          | —                    | —                  | 10,000                    | RF090        | UL, CSA, TÜV       |
| RUSBF090-2                    | —            | 3,000                | —                  | 15,000                    | RF090        | UL, CSA, TÜV       |
| RUSBF090-AP                   | —            | —                    | 2,000              | 10,000                    | RF090        | UL, CSA, TÜV       |
| RUSBF110                      | 500          | —                    | —                  | 10,000                    | RF110        | UL, CSA, TÜV       |
| RUSBF110-2                    | —            | 3,000                | —                  | 15,000                    | RF110        | UL, CSA, TÜV       |
| RUSBF110-AP                   | —            | —                    | 2,000              | 10,000                    | RF110        | UL, CSA, TÜV       |
| RUSBF135                      | 500          | —                    | —                  | 10,000                    | RF135        | UL, CSA, TÜV       |
| RUSBF135-2                    | —            | 3,000                | —                  | 15,000                    | RF135        | UL, CSA, TÜV       |
| RUSBF135-AP                   | —            | —                    | 2,000              | 10,000                    | RF135        | UL, CSA, TÜV       |
| RUSBF160                      | 500          | —                    | —                  | 10,000                    | RF160        | UL, CSA, TÜV       |
| RUSBF160-2                    | —            | 3,000                | —                  | 15,000                    | RF160        | UL, CSA, TÜV       |
| RUSBF160-AP                   | —            | —                    | 2,000              | 10,000                    | RF160        | UL, CSA, TÜV       |
| RUSBF185                      | 500          | —                    | —                  | 10,000                    | RF185        | UL, CSA, TÜV       |
| RUSBF185-2                    | —            | 3,000                | —                  | 15,000                    | RF185        | UL, CSA, TÜV       |
| RUSBF185-AP                   | —            | —                    | 2,000              | 10,000                    | RF185        | UL, CSA, TÜV       |
| RUSBF250                      | 500          | —                    | —                  | 10,000                    | RF250        | UL, CSA, TÜV       |
| RUSBF250-2                    | —            | 3,000                | —                  | 15,000                    | RF250        | UL, CSA, TÜV       |
| RUSBF250-AP                   | —            | —                    | 2,000              | 10,000                    | RF250        | UL, CSA, TÜV       |
| <b>RGEF</b>                   |              |                      |                    |                           |              |                    |
| <b>16V</b>                    |              |                      |                    |                           |              |                    |
| RGEF250                       | 500          | —                    | —                  | 10,000                    | GF250        | UL, CSA, TÜV       |
| RGEF250-2                     | —            | 3,000                | —                  | 15,000                    | GF250        | UL, CSA, TÜV       |
| RGEF250-AP                    | —            | —                    | 2,000              | 10,000                    | GF250        | UL, CSA, TÜV       |
| RGEF300                       | 500          | —                    | —                  | 10,000                    | GF300        | UL, CSA, TÜV       |
| RGEF300-2                     | —            | 2,500                | —                  | 12,500                    | GF300        | UL, CSA, TÜV       |
| RGEF300-AP                    | —            | —                    | 2,000              | 10,000                    | GF300        | UL, CSA, TÜV       |
| RGEF400                       | 500          | —                    | —                  | 10,000                    | GF400        | UL, CSA, TÜV       |
| RGEF400-2                     | —            | 2,500                | —                  | 12,500                    | GF400        | UL, CSA, TÜV       |
| RGEF400-AP                    | —            | —                    | 2,000              | 10,000                    | GF400        | UL, CSA, TÜV       |
| RGEF500                       | 500          | —                    | —                  | 10,000                    | GF500        | UL, CSA, TÜV       |
| RGEF500-2                     | —            | 2,000                | —                  | 10,000                    | GF500        | UL, CSA, TÜV       |
| RGEF500-AP                    | —            | —                    | 2,000              | 10,000                    | GF500        | UL, CSA, TÜV       |
| RGEF600                       | 500          | —                    | —                  | 10,000                    | GF600        | UL, CSA, TÜV       |
| RGEF600-2                     | —            | 2,000                | —                  | 10,000                    | GF600        | UL, CSA, TÜV       |
| RGEF600-AP                    | —            | —                    | 2,000              | 10,000                    | GF600        | UL, CSA, TÜV       |



**Table R6 Packaging and Marking Information for Radial-leaded Devices**

Cont'd

| Part Number                   | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RGEF</b>                   |              |                      |                    |                           |              |                    |
| <b>16V</b>                    |              |                      |                    |                           |              |                    |
| RGEF700                       | 500          | —                    | —                  | 10,000                    | GF700        | UL, CSA, TÜV       |
| RGEF700-2                     | —            | 1,500                | —                  | 7,500                     | GF700        | UL, CSA, TÜV       |
| RGEF700-AP                    | —            | —                    | 1,500              | 7,500                     | GF700        | UL, CSA, TÜV       |
| RGEF800                       | 500          | —                    | —                  | 10,000                    | GF800        | UL, CSA, TÜV       |
| RGEF800-2                     | —            | 1,000                | —                  | 5,000                     | GF800        | UL, CSA, TÜV       |
| RGEF800-AP                    | —            | —                    | 1,000              | 5,000                     | GF800        | UL, CSA, TÜV       |
| RGEF900                       | 500          | —                    | —                  | 10,000                    | GF900        | UL, CSA, TÜV       |
| RGEF900-2                     | —            | 1,000                | —                  | 5,000                     | GF900        | UL, CSA, TÜV       |
| RGEF900-AP                    | —            | —                    | 1,000              | 5,000                     | GF900        | UL, CSA, TÜV       |
| RGEF1000                      | 250          | —                    | —                  | 5,000                     | GF1000       | UL, CSA, TÜV       |
| RGEF1000-2                    | —            | 1,000                | —                  | 5,000                     | GF1000       | UL, CSA, TÜV       |
| RGEF1000-AP                   | —            | —                    | 1,000              | 5,000                     | GF1000       | UL, CSA, TÜV       |
| RGEF1100                      | 250          | —                    | —                  | 5,000                     | GF1100       | UL, CSA, TÜV       |
| RGEF1100-2                    | —            | 1,000                | —                  | 5,000                     | GF1100       | UL, CSA, TÜV       |
| RGEF1100-AP                   | —            | —                    | 1,000              | 5,000                     | GF1100       | UL, CSA, TÜV       |
| RGEF1200                      | 250          | —                    | —                  | 5,000                     | GF1200       | UL, CSA, TÜV       |
| RGEF1200-2                    | —            | 1,000                | —                  | 5,000                     | GF1200       | UL, CSA, TÜV       |
| RGEF1200-AP                   | —            | —                    | 1,000              | 5,000                     | GF1200       | UL, CSA, TÜV       |
| RGEF1400                      | 250          | —                    | —                  | 5,000                     | GF1400       | UL, CSA, TÜV       |
| RGEF1400-2                    | —            | 1,000                | —                  | 5,000                     | GF1400       | UL, CSA, TÜV       |
| RGEF1400-AP                   | —            | —                    | 1,000              | 5,000                     | GF1400       | UL, CSA, TÜV       |
| <b>RHEF</b>                   |              |                      |                    |                           |              |                    |
| <b>16V - High Temperature</b> |              |                      |                    |                           |              |                    |
| RHEF200                       | 500          | —                    | —                  | 10,000                    | HF2.0        | UL, CSA, TÜV       |
| RHEF200-2                     | —            | 2,500                | —                  | 12,500                    | HF2.0        | UL, CSA, TÜV       |
| RHEF200-AP                    | —            | —                    | 2,500              | 12,500                    | HF2.0        | UL, CSA, TÜV       |
| RHEF300                       | 500          | —                    | —                  | 10,000                    | HF3          | UL, CSA, TÜV       |
| RHEF300-2                     | —            | 2,000                | —                  | 10,000                    | HF3          | UL, CSA, TÜV       |
| RHEF300-AP                    | —            | —                    | 2,000              | 10,000                    | HF3          | UL, CSA, TÜV       |
| RHEF400                       | 500          | —                    | —                  | 10,000                    | HF4          | UL, CSA, TÜV       |
| RHEF400-2                     | —            | 1,500                | —                  | 7,500                     | HF4          | UL, CSA, TÜV       |
| RHEF400-AP                    | —            | —                    | 1,500              | 7,500                     | HF4          | UL, CSA, TÜV       |
| RHEF450                       | 500          | —                    | —                  | 10,000                    | HF4.5        | UL, CSA, TÜV       |
| RHEF450-2                     | —            | 1,500                | —                  | 7,500                     | HF4.5        | UL, CSA, TÜV       |
| RHEF450-AP                    | —            | —                    | 1,500              | 7,500                     | HF4.5        | UL, CSA, TÜV       |
| RHEF550                       | 500          | —                    | —                  | 10,000                    | HF5.5        | UL, CSA, TÜV       |
| RHEF550-2                     | —            | 2,000                | —                  | 10,000                    | HF5.5        | UL, CSA, TÜV       |
| RHEF550-AP                    | —            | —                    | 2,000              | 10,000                    | HF5.5        | UL, CSA, TÜV       |
| RHEF600                       | 500          | —                    | —                  | 10,000                    | HF6          | UL, CSA, TÜV       |
| RHEF600-2                     | —            | 1,500                | —                  | 7,500                     | HF6          | UL, CSA, TÜV       |
| RHEF600-AP                    | —            | —                    | 1,500              | 7,500                     | HF6          | UL, CSA, TÜV       |
| RHEF650                       | 500          | —                    | —                  | 10,000                    | HF6.5        | UL, CSA, TÜV       |
| RHEF650-2                     | —            | 1,500                | —                  | 7,500                     | HF6.5        | UL, CSA, TÜV       |
| RHEF650-AP                    | —            | —                    | 1,500              | 7,500                     | HF6.5        | UL, CSA, TÜV       |
| RHEF700                       | 500          | —                    | —                  | 10,000                    | HF7          | UL, CSA, TÜV       |
| RHEF700-2                     | —            | 1,500                | —                  | 7,500                     | HF7          | UL, CSA, TÜV       |
| RHEF700-AP                    | —            | —                    | 1,500              | 7,500                     | HF7          | UL, CSA, TÜV       |
| RHEF750                       | 500          | —                    | —                  | 10,000                    | HF7.5        | UL, CSA, TÜV       |
| RHEF750-2                     | —            | 1,000                | —                  | 5,000                     | HF7.5        | UL, CSA, TÜV       |
| RHEF750-AP                    | —            | —                    | 1,000              | 5,000                     | HF7.5        | UL, CSA, TÜV       |
| RHEF800                       | 500          | —                    | —                  | 10,000                    | HF8          | UL, CSA, TÜV       |
| RHEF800-2                     | —            | 1,000                | —                  | 5,000                     | HF8          | UL, CSA, TÜV       |
| RHEF800-AP                    | —            | —                    | 1,000              | 5,000                     | HF8          | UL, CSA, TÜV       |

**Table R6 Packaging and Marking Information for Radial-leaded Devices**

Cont'd

| Part Number                   | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RHEF</b>                   |              |                      |                    |                           |              |                    |
| <b>16V - High Temperature</b> |              |                      |                    |                           |              |                    |
| RHEF900                       | 250          | —                    | —                  | 5,000                     | HF9          | UL, CSA, TÜV       |
| RHEF900-2                     | —            | 1,000                | —                  | 5,000                     | HF9          | UL, CSA, TÜV       |
| RHEF900-AP                    | —            | —                    | 1,000              | 5,000                     | HF9          | UL, CSA, TÜV       |
| RHEF1000                      | 250          | —                    | —                  | 5,000                     | HF10         | UL, CSA, TÜV       |
| RHEF1000-2                    | —            | 1,000                | —                  | 5,000                     | HF10         | UL, CSA, TÜV       |
| RHEF1000-AP                   | —            | —                    | 1,000              | 5,000                     | HF10         | UL, CSA, TÜV       |
| RHEF1100                      | 250          | —                    | —                  | 5,000                     | HF11         | UL, CSA, TÜV       |
| RHEF1100-2                    | —            | 1,000                | —                  | 5,000                     | HF11         | UL, CSA, TÜV       |
| RHEF1100-AP                   | —            | —                    | 1,000              | 5,000                     | HF11         | UL, CSA, TÜV       |
| RHEF1300                      | 250          | —                    | —                  | 5,000                     | HF13         | UL, CSA, TÜV       |
| RHEF1300-2                    | —            | 1,000                | —                  | 5,000                     | HF13         | UL, CSA, TÜV       |
| RHEF1300-AP                   | —            | —                    | 1,000              | 5,000                     | HF13         | UL, CSA, TÜV       |
| RHEF1400                      | 250          | —                    | —                  | 5,000                     | HF14         | UL, CSA, TÜV       |
| RHEF1400-2                    | —            | 1,000                | —                  | 5,000                     | HF14         | UL, CSA, TÜV       |
| RHEF1400-AP                   | —            | —                    | 1,000              | 5,000                     | HF14         | UL, CSA, TÜV       |
| RHEF1500                      | 250          | —                    | —                  | 5,000                     | HF15         | UL, CSA, TÜV       |
| RHEF1500-2                    | —            | 1,000                | —                  | 5,000                     | HF15         | UL, CSA, TÜV       |
| RHEF1500-AP                   | —            | —                    | 1,000              | 5,000                     | HF15         | UL, CSA, TÜV       |
| <b>RUSBF</b>                  |              |                      |                    |                           |              |                    |
| <b>6V</b>                     |              |                      |                    |                           |              |                    |
| RUSBF075                      | 500          | —                    | —                  | 10,000                    | RF075        | UL, CSA, TÜV       |
| RUSBF075-2                    | —            | 3,000                | —                  | 15,000                    | RF075        | UL, CSA, TÜV       |
| RUSBF075-AP                   | —            | —                    | 2,000              | 10,000                    | RF075        | UL, CSA, TÜV       |
| RUSBF120                      | 500          | —                    | —                  | 10,000                    | RF120        | UL, CSA, TÜV       |
| RUSBF120-2                    | —            | 3,000                | —                  | 15,000                    | RF120        | UL, CSA, TÜV       |
| RUSBF120-AP                   | —            | —                    | 2,000              | 10,000                    | RF120        | UL, CSA, TÜV       |
| RUSBF155                      | 500          | —                    | —                  | 10,000                    | RF155        | UL, CSA, TÜV       |
| RUSBF155-2                    | —            | 3,000                | —                  | 15,000                    | RF155        | UL, CSA, TÜV       |
| RUSBF155-AP                   | —            | —                    | 2,000              | 10,000                    | RF155        | UL, CSA, TÜV       |

**Agency Recognitions for Radial-leaded Devices**

|     |                                                            |
|-----|------------------------------------------------------------|
| UL  | File # E74889                                              |
| CSA | File # CA78165                                             |
| TÜV | Certificate number available on request (per IEC 60730-1). |

**Table R7 Tape and Reel Specifications for Radial-leaded Devices**

RXEF, BBRF and RKEF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.  
See Figures R22 and R23 for details.

| Description                                                                             | EIA Mark       | Dimension (mm) | Tolerance  |
|-----------------------------------------------------------------------------------------|----------------|----------------|------------|
| Carrier tape width                                                                      | W              | 18             | -0.5/+1.0  |
| Hold-down tape width                                                                    | W <sub>4</sub> | 11             | Minimum    |
| Top distance between tape edges                                                         | W <sub>6</sub> | 3              | Maximum    |
| Sprocket hole position                                                                  | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket hole diameter                                                                  | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to plane (straight lead) (RXEF110 to RXEF300, RKEF135 to RKEF500)              | H              | 18.5           | ± 2.5      |
| Abscissa to plane (kinked lead) (RXEF010 to RXEF090, BBRF550, RKEF050 to RKEF110)       | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to top (RXEF010 to RXEF090, BBRF550, RKEF050 to RKEF185)                       | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to top* (RXEF110 to RXEF300, RKEF250 to RKEF500)                               | H <sub>1</sub> | 47.5           | Maximum    |
| Overall width with lead protrusion (RXEF010 to RXEF090, BBRF550, RKEF050 to RKEF185)    | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width with lead protrusion* (RXEF110 to RXEF300, RKEF250 to RKEF500)            | C <sub>1</sub> | 58             | Maximum    |
| Overall width without lead protrusion (RXEF010 to RXEF090, BBRF550, RKEF050 to RKEF185) | C <sub>2</sub> | 42.5           | Maximum    |
| Overall width without lead protrusion* (RXEF110 to RXEF300, RKEF250 to RKEF500)         | C <sub>2</sub> | 57             | Maximum    |
| Lead protrusion                                                                         | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                                                                   | L              | 11.0           | Maximum    |
| Protrusion beyond hold-down tape                                                        | I <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                                                                     | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device pitch (RXEF010 to RXEF090, BBRF550, RKEF050 to RKEF185)                          | —              | 12.7           | ± 0.3      |
| Device pitch (RXEF110 to RXEF300, RKEF250 to RKEF500)                                   | —              | 25.4           | ± 0.61     |
| Pitch tolerance                                                                         | —              | 20 consecutive | ± 1        |
| Tape thickness                                                                          | t              | 0.9            | Maximum    |
| Overall tape and lead thickness (RXEF010 to RXEF090, RKEF050 to RKEF185)                | t <sub>1</sub> | 1.5            | Maximum    |
| Overall tape and lead thickness (RXEF110 to RXEF300, BBRF550, RKEF250 to RKEF500)       | t <sub>1</sub> | 2.3            | Maximum    |
| Splice sprocket hole alignment                                                          | —              | 0              | ± 0.3      |
| Body lateral deviation                                                                  | Δh             | 0              | ± 1.0      |
| Body tape plane deviation                                                               | Δp             | 0              | ± 1.3      |
| Ordinate to adjacent component lead (RXEF010 to RXEF185, BBRF550, RKEF050 to RKEF300)   | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to adjacent component lead (RXEF250 to RXEF300, RKEF375 to RKEF500)            | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead spacing* (RXEF010 to RXEF185, BBRF550, RKEF050 to RKEF300)                         | F              | 5.05           | ± 0.75     |
| Lead spacing* (RXEF250 to RXEF300, RKEF375 to RKEF500)                                  | F              | 10.15          | ± 0.75     |
| Reel width (RXEF010 to RXEF090, RKEF050 to RKEF185)                                     | w <sub>2</sub> | 56.0           | Maximum    |
| Reel width* (RXEF110 to RXEF300, RKEF250 to RKEF500)                                    | w <sub>2</sub> | 63.5           | Maximum    |
| Reel diameter                                                                           | a              | 370.0          | Maximum    |
| Space between flanges* (RXEF010 to RXEF090, RKEF050 to RKEF185)                         | w <sub>1</sub> | 48.00          | Maximum    |
| Space between flanges* (RXEF110 to RXEF300, RKEF250 to RKEF500)                         | w <sub>1</sub> | 55.00          | Maximum    |
| Arbor hold diameter                                                                     | c              | 26.0           | ± 12.0     |
| Core diameter*                                                                          | n              | 91.0           | Maximum    |
| Box                                                                                     | —              | 64/372/362     | Maximum    |
| Consecutive missing places                                                              | —              | None           | —          |
| Empty places per reel                                                                   | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

**Table R7 Tape and Reel Specifications for Radial-leaded Devices**

Cont'd

RUEF and RUSBF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards. See Figures R22 and R23 for details.

| Description                                                                      | EIA Mark       | Dimension (mm) | Tolerance  |
|----------------------------------------------------------------------------------|----------------|----------------|------------|
| Carrier tape width                                                               | W              | 18             | -0.5/+1.0  |
| Hold-down tape width                                                             | W <sub>4</sub> | 11             | Minimum    |
| Top distance between tape edges                                                  | W <sub>6</sub> | 3              | Maximum    |
| Sprocket hole position                                                           | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket hole diameter                                                           | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to plane (straight lead)* (RUEF300 to RUEF900)                          | H              | 18.5           | ± 2.5      |
| Abscissa to plane (kinked lead) (RUSBF075 to RUSBF250, RUEF090 to RUEF250)       | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to top (RUSBF075 to RUSBF250, RUEF090 to RUEF300)                       | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to top* (RUEF400 to RUEF900)                                            | H <sub>1</sub> | 45.0           | Maximum    |
| Overall width with lead protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300)    | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width with lead protrusion (RUEF400 to RUEF900)                          | C <sub>1</sub> | 56             | Maximum    |
| Overall width without lead protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300) | C <sub>2</sub> | 42.5           | Maximum    |
| Overall width without lead protrusion (RUEF400 to RUEF900)                       | C <sub>2</sub> | 56             | Maximum    |
| Lead protrusion                                                                  | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                                                            | L              | 11             | Maximum    |
| Protrusion beyond hold-down tape                                                 | I <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                                                              | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device pitch (RUSBF075 to RUSBF250, RUEF090 to RUEF300)                          | —              | 12.7           | ± 0.3      |
| Device pitch (RUEF400 to RUEF900)                                                | —              | 25.4           | ± 0.6      |
| Pitch tolerance                                                                  | —              | 20 consecutive | ± 1        |
| Tape thickness                                                                   | t              | 0.9            | Maximum    |
| Overall tape and lead thickness (RUSBF075 to RUSBF250, RUEF090 to RUEF250)       | t <sub>1</sub> | 1.5            | Maximum    |
| Overall tape and lead thickness* (RUEF300 to RUEF900)                            | t <sub>1</sub> | 2.3            | Maximum    |
| Splice sprocket hole alignment                                                   | —              | 0              | ± 0.3      |
| Body lateral deviation                                                           | Δh             | 0              | ± 1.0      |
| Body tape plane deviation                                                        | Δp             | 0              | ± 1.3      |
| Ordinate to adjacent component lead (RUSBF075 to RUSBF250, RUEF090 to RUEF300)   | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to adjacent component lead (RUEF400 to RUEF900)                         | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead spacing* (RUSBF075 to RUSBF250, RUEF090 to RUEF400)                         | F              | 5.05           | ± 0.75     |
| Lead spacing* (RUEF500 to RUEF900)                                               | F              | 10.15          | ± 0.75     |
| Reel width (RUEF090 to RUEF400, RUSBF075 to RUSBF250)                            | w <sub>2</sub> | 56.0           | Maximum    |
| Reel width (RUEF500* to RUEF900)                                                 | w <sub>2</sub> | 63.5           | Maximum    |
| Reel diameter                                                                    | a              | 370.0          | Maximum    |
| Space between flanges* (RUEF090 to RUEF400, RUSBF075 to RUSBF250)                | w <sub>1</sub> | 48.0           | Maximum    |
| Space between flanges* (RUEF500 to RUEF900)                                      | w <sub>1</sub> | 55.0           | Maximum    |
| Arbor hold diameter                                                              | c              | 26.0           | ± 12.0     |
| Core diameter*                                                                   | n              | 91.0           | Maximum    |
| Box                                                                              | —              | 64/372/362     | Maximum    |
| Consecutive missing places                                                       | —              | None           | —          |
| Empty places per reel                                                            | —              | 0.1 %          | Maximum    |

\*Differs from EIA specification.

**Table R7 Tape and Reel Specifications for Radial-leaded Devices**

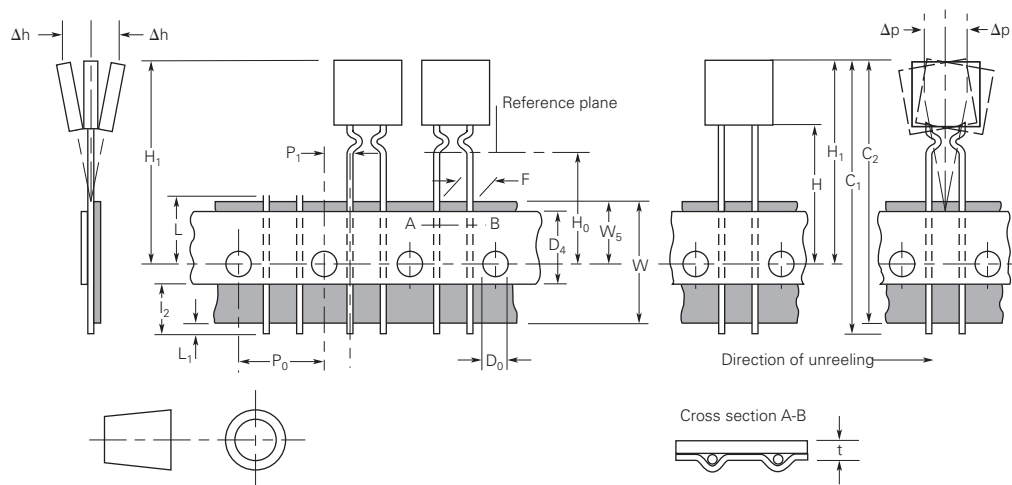
Cont'd

RGEF and RHEF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.  
See Figures R22 and R23 for details.

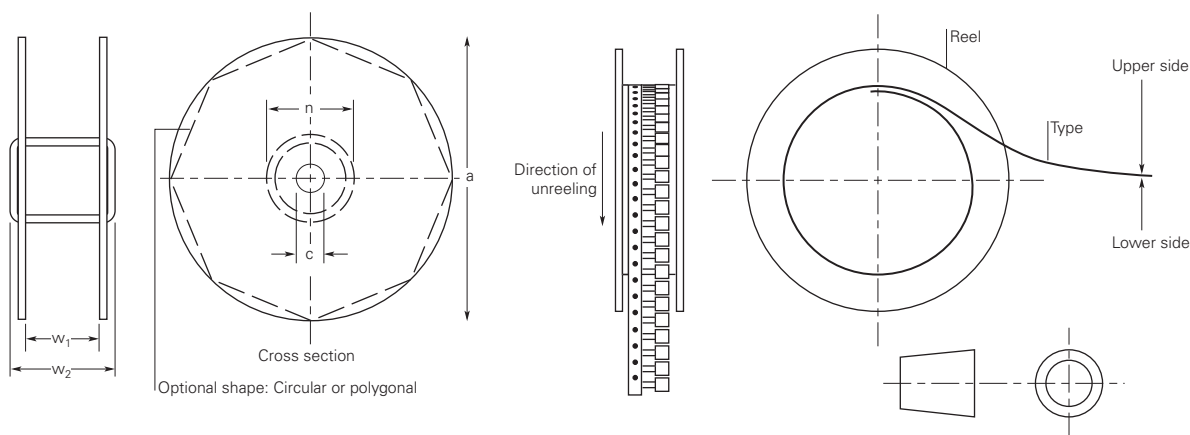
| Description                                                                      | EIA Mark       | Dimension (mm) | Tolerance  |
|----------------------------------------------------------------------------------|----------------|----------------|------------|
| Carrier tape width                                                               | W              | 18             | -0.5/+1.0  |
| Hold-down tape width                                                             | W <sub>4</sub> | 11             | Minimum    |
| Top distance between tape edges                                                  | W <sub>6</sub> | 3              | Maximum    |
| Sprocket hole position                                                           | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket hole diameter                                                           | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to plane (straight lead) (RGEF250 to RGEF1400)                          | H              | 18.5           | ± 2.5      |
| Abscissa to plane (kinked lead) (RHEF050 to RHEF1500)                            | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to top (RGEF250 to RGEF500, RHEF050 to RHEF450)                         | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to top* (RGEF600 to RGEF1400, RHEF550 to RHEF1500)                      | H <sub>1</sub> | 45.0           | Maximum    |
| Overall width with lead protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)      | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width with lead protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500)    | C <sub>1</sub> | 55             | Maximum    |
| Overall width without lead protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)   | C <sub>2</sub> | 42.5           | Maximum    |
| Overall width without lead protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500) | C <sub>2</sub> | 54             | Maximum    |
| Lead protrusion                                                                  | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                                                            | L              | 11             | Maximum    |
| Protrusion beyond hold-down tape                                                 | I <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                                                              | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device pitch (RGEF250 to RGEF700, RHEF050 to RHEF600)                            | —              | 25.4           | ± 0.61     |
| Device pitch (RGEF800 to RGEF1400, RHEF650 to RHEF1500)                          | —              | 25.4           | ± 0.6      |
| Pitch tolerance                                                                  | —              | 20 consecutive | ± 1        |
| Tape thickness                                                                   | t              | 0.9            | Maximum    |
| Overall tape and lead thickness* (RGEF250 to RGEF1100, RHEF050 to RHEF1100)      | t <sub>1</sub> | 2.0            | Maximum    |
| Overall tape and lead thickness* (RGEF1200 to RGEF1400, RHEF1300 to RHEF1500)    | t <sub>1</sub> | 2.3            | Maximum    |
| Splice sprocket hole alignment                                                   | —              | 0              | ± 0.3      |
| Body lateral deviation                                                           | Δh             | 0              | ± 1.0      |
| Body tape plane deviation                                                        | Δp             | 0              | ± 1.3      |
| Ordinate to adjacent component lead (RGEF250 to RGEF1100, RHEF050 to RHEF900)    | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to adjacent component lead (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500) | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead spacing* (RGEF250 to RGEF1100, RHEF050 to RHEF900)                          | F              | 5.05           | ± 0.75     |
| Lead spacing* (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500)                       | F              | 10.15          | ± 0.75     |
| Reel width (RGEF250 to RGEF600, RHEF050 to RHEF450)                              | w <sub>2</sub> | 56.0           | Maximum    |
| Reel width* (RGEF700 to RGEF1400 & RHEF550 to RHEF1500)                          | w <sub>2</sub> | 63.5           | Maximum    |
| Reel diameter                                                                    | a              | 370.0          | Maximum    |
| Space between flanges* (RGEF250 to RGEF600, RHEF050 to RHEF450)                  | w <sub>1</sub> | 48.0           | Maximum    |
| Space between flanges* (RGEF700 to RGEF1400, RHEF550 to RHEF1500)                | w <sub>1</sub> | 55.0           | Maximum    |
| Arbor hold diameter                                                              | c              | 26.0           | ± 12.0     |
| Core diameter*                                                                   | n              | 91.0           | Maximum    |
| Box                                                                              | —              | 64/372/362     | Maximum    |
| Consecutive missing places                                                       | —              | None           | —          |
| Empty places per reel                                                            | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

**Figure R22 EIA Referenced Taped Component Dimensions for Radial-leaded Devices**



**Figure R23 EIA Referenced Reel Dimensions for Radial-leaded Devices**



## Part Numbering System for Radial-leaded Devices

**RUEF 250 U 2**

### Packaging

- Blank = Packaged in bags
- 1 = 25.4mm (1.0 inch) minimum lead length
- 2 = Tape and reel
- AP = Ammo pack
- X.X = Special lead cut length (inch)

### Modifier

- K = Standard kinked lead
- B = Special kinked lead
- S = Straight lead
- U = Uncoated device

### Hold Current Indicator

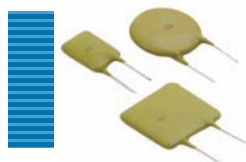
### Product Series

An "F" at the end of product series indicates Pb-free version of product.

**Note:** Kinked part is recommended to well control the height of part on the PCB in non-auto PCB application.

**Warning :**

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.



## PolySwitch Resettable Devices Line-Voltage-Rated Devices

PolySwitch LVR devices help protect electric motors and transformers used in commercial and home appliances from damage caused by mechanical overloads, overheating, stall, lost neutral and other potentially harmful conditions.

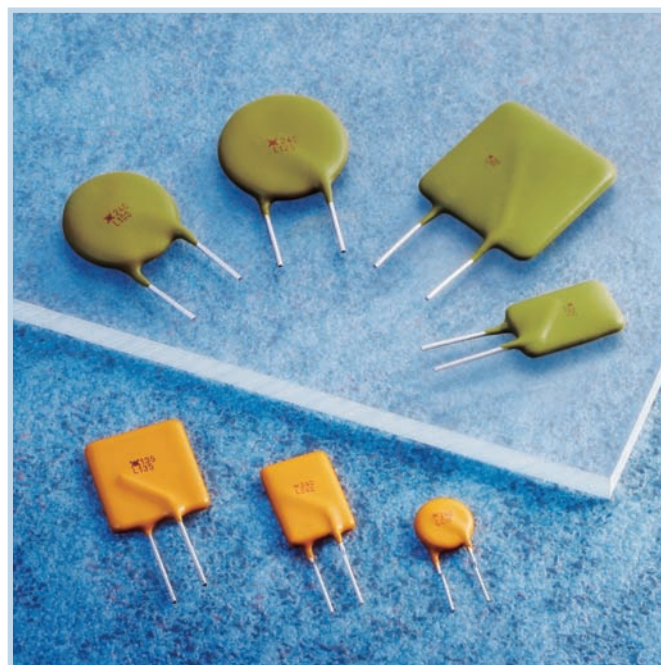
The LVR line-voltage product line of polymeric positive temperature coefficient (PPTC) devices includes components that are rated for line voltages of 120V<sub>AC</sub> and 240V<sub>AC</sub>, for up to 2A of operating current at 20°C. They help protect against damage caused by both overcurrent surges and overtemperature faults, offer low resistance, and are compatibly sized with fuse solutions.

Unlike traditional fuses, PolySwitch devices do not require replacement after a fault event. After power has been removed and the overcurrent condition eliminated, the circuit is restored to normal operating condition. Compared to bimetal breakers, they offer greater flexibility, longer lifespan, and lower electromagnetic interference (EMI).

The PolySwitch LVR devices' resettable functionality and latching attributes make them a reliable, cost-effective circuit protection solution for both intermittent- and continuous-operation motor applications. Their low resistance, fast time-to-trip, and low profile help circuit designers provide a safe and dependable product, comply with regulatory agency requirements, and reduce warranty repair costs.

LVR/LVRL series are suitable for line-voltage applications up to a continuous operating voltage of 240V<sub>AC</sub>/120V<sub>AC</sub>.

RoHS versions of all products are available.



### Benefits

- Many product choices give engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assist in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

### Features

- RoHS compliant
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 2A
- Line voltage rating of 120V<sub>AC</sub> and 240V<sub>AC</sub>
- Agency recognition : UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

### Applications

- Electromagnetic loads
- Game machines
- Industrial controls
- Lighting ballast
- Loudspeakers
- Medical equipment
- Motors, fans and blowers
- POS equipment
- Satellite video receivers
- Security and fire alarm systems
- Test and measurement equipment
- Transformers
- USB hubs, ports and peripherals



**Table L1 Product Series - Current Rating, Voltage Rating / Typical Resistance for LVR Devices**

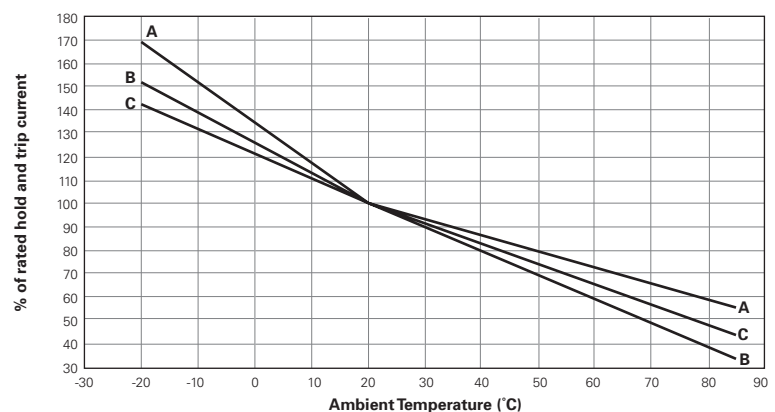
| Voltage Rating          | LVR<br>240V <sub>AC</sub> / 120V <sub>AC</sub> | LVRL<br>120V <sub>AC</sub> |
|-------------------------|------------------------------------------------|----------------------------|
| <b>Hold Current (A)</b> |                                                |                            |
| 0.050                   | 25.00Ω                                         | —                          |
| 0.080                   | 9.800Ω                                         | —                          |
| 0.120                   | 4.800Ω                                         | —                          |
| 0.160                   | 3.400Ω                                         | —                          |
| 0.250                   | 1.700Ω                                         | —                          |
| 0.330                   | 1.000Ω                                         | —                          |
| 0.400                   | 0.800Ω                                         | —                          |
| 0.550                   | 0.590Ω                                         | —                          |
| 0.750                   | 0.400Ω                                         | 0.325Ω                     |
| 1.000                   | 0.276Ω                                         | 0.224Ω                     |
| 1.250                   | 0.209Ω                                         | 0.148Ω                     |
| 1.350                   | —                                              | 0.138Ω                     |
| 2.000                   | 0.110Ω                                         | 0.097Ω                     |

**Table L2 Thermal Derating for LVR Devices [Hold Current (A) at Ambient Temperature (°C)]**

| Part Number     | Maximum Ambient Temperature |      |      |      |      |      |      |      |      |
|-----------------|-----------------------------|------|------|------|------|------|------|------|------|
|                 | -20°C                       | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 85°C |
| <b>LVR/LVRL</b> |                             |      |      |      |      |      |      |      |      |
| LVR005N         | 0.08                        | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 |
| LVR008N         | 0.12                        | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | 0.03 |
| LVR012          | 0.18                        | 0.15 | 0.12 | 0.12 | 0.10 | 0.09 | 0.07 | 0.06 | 0.04 |
| LVR016          | 0.24                        | 0.20 | 0.16 | 0.16 | 0.13 | 0.11 | 0.10 | 0.08 | 0.05 |
| LVR025          | 0.38                        | 0.32 | 0.25 | 0.25 | 0.21 | 0.18 | 0.15 | 0.13 | 0.09 |
| LVR033          | 0.50                        | 0.42 | 0.33 | 0.33 | 0.27 | 0.23 | 0.20 | 0.17 | 0.11 |
| LVR040          | 0.61                        | 0.51 | 0.40 | 0.40 | 0.33 | 0.28 | 0.24 | 0.20 | 0.14 |
| LVR055          | 0.80                        | 0.68 | 0.55 | 0.54 | 0.46 | 0.40 | 0.35 | 0.29 | 0.22 |
| LVR075          | 1.23                        | 0.98 | 0.75 | 0.74 | 0.60 | 0.56 | 0.49 | 0.45 | 0.41 |
| LVR100          | 1.65                        | 1.30 | 1.00 | 0.94 | 0.80 | 0.75 | 0.65 | 0.60 | 0.55 |
| LVR125          | 2.06                        | 1.63 | 1.25 | 1.20 | 1.00 | 0.94 | 0.81 | 0.75 | 0.69 |
| LVR200          | 3.30                        | 2.60 | 2.00 | 1.97 | 1.60 | 1.50 | 1.30 | 1.20 | 1.10 |
| LVRL075         | 1.08                        | 0.93 | 0.75 | 0.74 | 0.64 | 0.57 | 0.51 | 0.44 | 0.35 |
| LVRL100         | 1.40                        | 1.19 | 1.00 | 0.94 | 0.82 | 0.73 | 0.65 | 0.57 | 0.45 |
| LVRL125         | 1.80                        | 1.53 | 1.25 | 1.20 | 1.04 | 0.94 | 0.83 | 0.73 | 0.60 |
| LVRL135         | 2.00                        | 1.65 | 1.35 | 1.29 | 1.12 | 1.01 | 0.90 | 0.78 | 0.65 |
| LVRL200         | 3.05                        | 2.55 | 2.00 | 1.97 | 1.72 | 1.55 | 1.39 | 1.22 | 0.98 |

**Figure L1 Thermal Derating Curve for LVR Devices**

- A = LVR075-LVR200**  
**B = LVRL075-LVRL200**  
**C = LVR005N-LVR055**

**Figure L1**


**Table L3 Electrical Characteristics for LVR Devices\***

| Part Number | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub> <sup>†</sup>   |                                 | I <sub>MAX</sub> <sup>†</sup><br>Interrupt<br>(A) | P <sub>D Typ</sub><br>(W) | Max. Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm (AWG)] |
|-------------|-----------------------|-----------------------|---------------------------------|---------------------------------|---------------------------------------------------|---------------------------|-------------------|------|-------------------------|-------------------------|--------------------------|-------------------------|
|             |                       |                       | Operating<br>(V <sub>AC</sub> ) | Interrupt<br>(V <sub>AC</sub> ) |                                                   |                           | (A)               | (s)  |                         |                         |                          |                         |
| LVR/LVRL    |                       |                       |                                 |                                 |                                                   |                           |                   |      |                         |                         |                          |                         |
| LVR005NK    | 0.05                  | 0.12                  | 240<br>120                      | 265<br>135                      | 1.0<br>20.0                                       | 0.9                       | 0.25              | 10.0 | 18.500                  | 31.000                  | 65.000                   | [0.51mm(24)]            |
| LVR005NS    | 0.05                  | 0.12                  | 240<br>120                      | 265<br>135                      | 1.0<br>20.0                                       | 0.9                       | 0.25              | 10.0 | 18.500                  | 31.000                  | 65.000                   | [0.51mm(24)]            |
| LVR008NK    | 0.08                  | 0.19                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 0.9                       | 0.40              | 10.0 | 7.400                   | 12.000                  | 26.000                   | [0.51mm(24)]            |
| LVR008NS    | 0.08                  | 0.19                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 0.9                       | 0.40              | 10.0 | 7.400                   | 12.000                  | 26.000                   | [0.51mm(24)]            |
| LVR012K     | 0.12                  | 0.30                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 1.0                       | 0.60              | 15.0 | 3.000                   | 6.500                   | 12.000                   | [0.51mm(24)]            |
| LVR012S     | 0.12                  | 0.30                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 1.0                       | 0.60              | 15.0 | 3.000                   | 6.500                   | 12.000                   | [0.51mm(24)]            |
| LVR016K     | 0.16                  | 0.37                  | 240<br>120                      | 265<br>135                      | 2.0<br>20.0                                       | 1.4                       | 0.80              | 15.0 | 2.500                   | 4.100                   | 7.800                    | [0.51mm(24)]            |
| LVR016S     | 0.16                  | 0.37                  | 240<br>120                      | 265<br>135                      | 2.0<br>20.0                                       | 1.4                       | 0.80              | 15.0 | 2.500                   | 4.100                   | 7.800                    | [0.51mm(24)]            |
| LVR025K     | 0.25                  | 0.56                  | 240<br>120                      | 265<br>135                      | 3.5<br>20.0                                       | 1.5                       | 1.25              | 18.5 | 1.300                   | 2.100                   | 3.800                    | [0.64mm(22)]            |
| LVR025S     | 0.25                  | 0.56                  | 240<br>120                      | 265<br>135                      | 3.5<br>20.0                                       | 1.5                       | 1.25              | 18.5 | 1.300                   | 2.100                   | 3.800                    | [0.64mm(22)]            |
| LVR033K     | 0.33                  | 0.74                  | 240<br>120                      | 265<br>135                      | 4.5<br>20.0                                       | 1.7                       | 1.65              | 21.0 | 0.770                   | 1.240                   | 2.600                    | [0.64mm(22)]            |
| LVR033S     | 0.33                  | 0.74                  | 240<br>120                      | 265<br>135                      | 4.5<br>20.0                                       | 1.7                       | 1.65              | 21.0 | 0.770                   | 1.240                   | 2.600                    | [0.64mm(22)]            |
| LVR040K     | 0.40                  | 0.90                  | 240<br>120                      | 265<br>135                      | 5.5<br>20.0                                       | 2.0                       | 2.00              | 24.0 | 0.600                   | 0.970                   | 1.900                    | [0.64mm(22)]            |
| LVR040S     | 0.40                  | 0.90                  | 240<br>120                      | 265<br>135                      | 5.5<br>20.0                                       | 2.0                       | 2.00              | 24.0 | 0.600                   | 0.970                   | 1.900                    | [0.64mm(22)]            |
| LVR055K     | 0.55                  | 1.25                  | 240<br>120                      | 265<br>135                      | 7.0<br>20.0                                       | 3.4                       | 2.75              | 26.0 | 0.450                   | 0.730                   | 1.450                    | [0.81mm(20)]            |
| LVR055S     | 0.55                  | 1.25                  | 240<br>120                      | 265<br>135                      | 7.0<br>20.0                                       | 3.4                       | 2.75              | 26.0 | 0.450                   | 0.730                   | 1.450                    | [0.81mm(20)]            |
| LVR075S     | 0.75                  | 1.50                  | 240                             | 265                             | 7.5                                               | 2.6                       | 3.75              | 18.0 | 0.316                   | 0.483                   | 0.839                    | [0.81mm(20)]            |
| LVR100S     | 1.00                  | 2.00                  | 240                             | 265                             | 10.0                                              | 2.9                       | 5.00              | 21.0 | 0.218                   | 0.334                   | 0.580                    | [0.81mm(20)]            |
| LVR125S     | 1.25                  | 2.50                  | 240                             | 265                             | 12.5                                              | 3.3                       | 6.25              | 23.0 | 0.165                   | 0.253                   | 0.440                    | [0.81mm(20)]            |
| LVR200S     | 2.00                  | 4.00                  | 240                             | 265                             | 20.0                                              | 4.5                       | 10.00             | 28.0 | 0.089                   | 0.131                   | 0.221                    | [0.81mm(20)]            |
| LVRL075S    | 0.75                  | 1.52                  | 120                             | 135                             | 7.5                                               | 1.8                       | 3.75              | 14.0 | 0.250                   | 0.400                   | 0.690                    | [0.81mm(20)]            |
| LVRL100S    | 1.00                  | 2.00                  | 120                             | 135                             | 10.0                                              | 2.2                       | 5.00              | 13.6 | 0.179                   | 0.269                   | 0.470                    | [0.81mm(20)]            |
| LVRL125S    | 1.25                  | 2.50                  | 120                             | 135                             | 12.5                                              | 2.0                       | 6.25              | 18.0 | 0.117                   | 0.179                   | 0.320                    | [0.81mm(20)]            |
| LVRL135S    | 1.35                  | 2.70                  | 120                             | 135                             | 13.5                                              | 2.8                       | 6.75              | 20.0 | 0.109                   | 0.167                   | 0.300                    | [0.81mm(20)]            |
| LVRL200S    | 2.00                  | 4.20                  | 120                             | 135                             | 20.0                                              | 3.9                       | 10.00             | 36.0 | 0.075                   | 0.117                   | 0.205                    | [0.81mm(20)]            |

**Notes:**

- I<sub>H</sub> : Hold current: maximum current device will pass without interruption in 20°C still air.  
 I<sub>T</sub> : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.  
 V<sub>MAX</sub> Operating: Maximum continuous voltage device can withstand without damage at rated current.  
 V<sub>MAX</sub> Interrupt : Under specified conditions this is the highest voltage that can be applied to the device at the maximum interrupt current.  
 I<sub>MAX</sub> Interrupt : Maximum fault current device can withstand without damage at rated voltage.  
 P<sub>D</sub> : Power dissipated from device when in the tripped state in 20°C still air.  
 R<sub>MIN</sub> : Minimum resistance of device as supplied at 20°C unless otherwise specified.  
 R<sub>MAX</sub> : Maximum resistance of device as supplied at 20°C unless otherwise specified.  
 R<sub>1MAX</sub> : Maximum resistance of device when measured one hour post trip at 20°C unless otherwise specified.

\* Electrical characteristics determined at 20°C.

† See Application Limitations on next page.

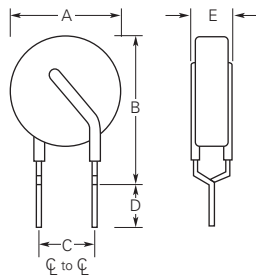


## Warning : Application Limitations for the LVR Product Line

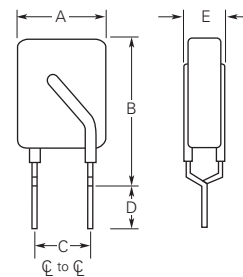
- 1) Users should independently evaluate the suitability of and test each product selected for their own application.
- 2) This product should not be used in an application where the maximum interrupt voltage or maximum interrupt current can be exceeded in a fault condition. Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- 3) A PPTC device is not a fuse - it is a nonlinear thermistor that limits current. Under a fault condition all PPTC devices go into a high resistance state but do not open circuit, so hazardous voltage may be present at PPTC locations.
- 4) The devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- 5) In most applications power must be removed and the fault condition cleared in order to reset a PPTC device; however under certain unusual conditions, a PPTC device may automatically reset. PPTC devices should not be used in an application where an automatic reset could create a safety hazard, such as garbage disposals and blenders. Appropriate qualification testing should be performed.
- 6) It is the responsibility of the user to determine the need for back up or failsafe protection to prevent damage that may occur in the event of abnormal function or failure of the PPTC device.
- 7) Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of a PPTC device. This product should not be used in an application where the maximum interrupt voltage or maximum interrupt current can be exceeded by inductive spikes.
- 8) Devices are not recommended for reflow soldering.
- 9) Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, or mechanical procedures for electronic components.
- 10) PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- 11) Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.

**Figure L2-L5 Dimension Figures for LVR Devices**

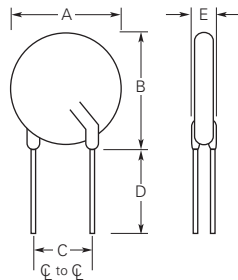
**Figure L2**



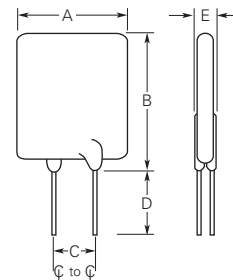
**Figure L3**



**Figure L4**



**Figure L5**



**Table L4 Dimensions for LVR Devices in Millimeters (Inches)**

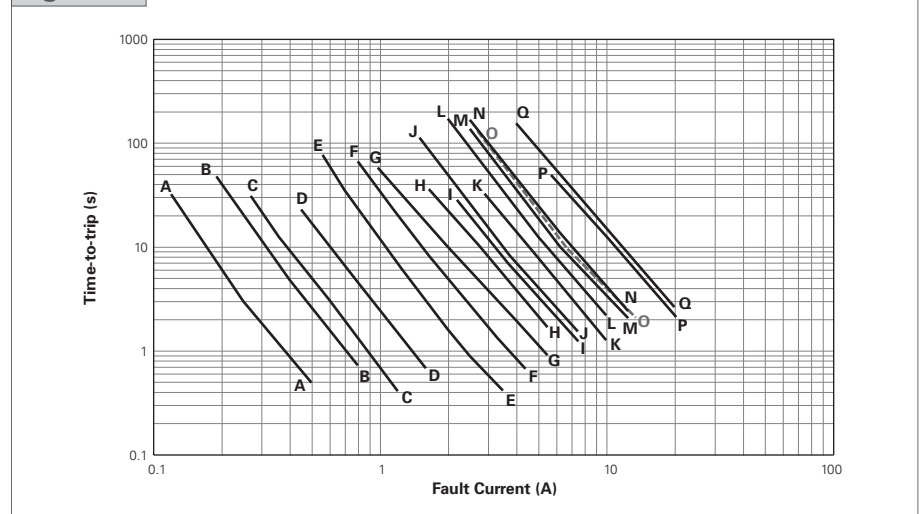
| Part Number | A    |                | B    |                | C             |                | D             |      | E    |               | Figure |
|-------------|------|----------------|------|----------------|---------------|----------------|---------------|------|------|---------------|--------|
|             | Min. | Max.           | Min. | Max.           | Min.          | Max.           | Min.          | Max. | Min. | Max.          |        |
| LVR/LVRL    |      |                |      |                |               |                |               |      |      |               |        |
| LVR005NK    | —    | 6.9<br>(0.27)  | —    | 12.1<br>(0.48) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.6<br>(0.18) | L2     |
| LVR005NS    | —    | 6.9<br>(0.27)  | —    | 9.9<br>(0.39)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.6<br>(0.18) | L4     |
| LVR008NK    | —    | 7.2<br>(0.28)  | —    | 12.4<br>(0.49) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.6<br>(0.18) | L2     |
| LVR008NS    | —    | 7.2<br>(0.28)  | —    | 10.2<br>(0.40) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.6<br>(0.18) | L4     |
| LVR012K     | —    | 8.3<br>(0.33)  | —    | 12.9<br>(0.51) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L2     |
| LVR012S     | —    | 8.3<br>(0.33)  | —    | 10.7<br>(0.43) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L4     |
| LVR016K     | —    | 9.9<br>(0.39)  | —    | 13.8<br>(0.54) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L2     |
| LVR016S     | —    | 9.9<br>(0.39)  | —    | 12.5<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L4     |
| LVR025K     | —    | 9.6<br>(0.38)  | —    | 18.8<br>(0.74) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L3     |
| LVR025S     | —    | 9.6<br>(0.38)  | —    | 17.4<br>(0.69) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L5     |
| LVR033K     | —    | 11.4<br>(0.45) | —    | 19.0<br>(0.75) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L3     |
| LVR033S     | —    | 11.4<br>(0.45) | —    | 16.5<br>(0.65) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L5     |
| LVR040K     | —    | 11.5<br>(0.46) | —    | 20.9<br>(0.82) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L3     |
| LVR040S     | —    | 11.5<br>(0.46) | —    | 19.5<br>(0.77) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 3.8<br>(0.15) | L5     |
| LVR055K     | —    | 14.0<br>(0.55) | —    | 22.4<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L3     |
| LVR055S     | —    | 14.0<br>(0.55) | —    | 21.7<br>(0.85) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |
| LVR075S     | —    | 11.5<br>(0.45) | —    | 23.4<br>(0.92) | 4.1<br>(0.16) | 6.1<br>(0.24)  | 5.1<br>(0.20) | —    | —    | 4.8<br>(0.19) | L5     |
| LVR100S     | —    | 18.7<br>(0.74) | —    | 24.4<br>(0.96) | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —    | —    | 5.1<br>(0.20) | L4     |
| LVR125S     | —    | 21.2<br>(0.84) | —    | 27.4<br>(1.08) | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —    | —    | 5.3<br>(0.21) | L4     |
| LVR200S     | —    | 24.9<br>(0.98) | —    | 33.8<br>(1.33) | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —    | —    | 6.1<br>(0.24) | L5     |
| LVRL075S    | —    | 10.9<br>(0.43) | —    | 17.0<br>(0.67) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |
| LVRL100S    | —    | 11.5<br>(0.45) | —    | 20.1<br>(0.79) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |
| LVRL125S    | —    | 14.0<br>(0.55) | —    | 21.7<br>(0.85) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |
| LVRL135S    | —    | 16.3<br>(0.64) | —    | 21.7<br>(0.85) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |
| LVRL200S    | —    | 23.5<br>(0.93) | —    | 31.8<br>(1.25) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —    | —    | 4.1<br>(0.16) | L5     |

**Figure L6** Typical Time-to-trip curves at 20°C for LVR Devices

**LVR/LVRL**

|             |             |
|-------------|-------------|
| A = LVR005N | K = LVRL100 |
| B = LVR008N | L = LVR100  |
| C = LVR012  | M = LVRL125 |
| D = LVR016  | N = LVR125  |
| E = LVR025  | O = LVRL135 |
| F = LVR033  | P = LVRL200 |
| G = LVR040  | Q = LVR200  |
| H = LVR055  |             |
| I = LVRL075 |             |
| J = LVR075  |             |

**Figure L6**



**Table L5** Physical Characteristics and Environmental Specifications for LVR Devices

**LVR/LVRL**

**Physical Characteristics**

|                           |                                                                                              |
|---------------------------|----------------------------------------------------------------------------------------------|
| Lead material             | LVR005N-016 : Tin-plated copper, (24AWG), ø0.51mm (0.020in.)                                 |
|                           | LVR025-040 : Tin-plated copper, (22AWG), ø0.64mm (0.025in.)                                  |
|                           | LVR055-200 : Tin-plated copper, (20AWG), ø0.81mm (0.032in.)                                  |
|                           | LVRL : Tin-plated copper, (20AWG), ø0.81mm (0.032in.)                                        |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                  |
| Solder heat withstand     | Per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B, can withstand 10 seconds at 260°C ±5°C |
| Insulating material       | LVR005N-055 : Cured, flame-retardant epoxy polymer, meets UL 94V-0                           |
|                           | LVR075-200 : Cured, flame-retardant modified silicone, meets UL 94V-0                        |
|                           | LVRL : Cured, flame-retardant epoxy polymer, meets UL 94V-0                                  |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±10%              |
|                    | 85°C, 1000 hours         | ±10%              |
| Humidity aging     | 85°C, 85%RH, 1000 hours  | ±20%              |
| Thermal shock      | 85°C, -40°C (10 times)   | ±15%              |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Agency Recognitions for LVR Devices**

|     |                                                            |
|-----|------------------------------------------------------------|
| UL  | File # E74889                                              |
| CSA | File # CA78165                                             |
| TÜV | Certificate number available on request (per IEC 60730-1). |

**Table L6 Packaging and Marking Information for LVR Devices**

| Part Number     | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-----------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>LVR/LVRL</b> |              |                      |                    |                           |              |                    |
| LVR005NK        | 500          | —                    | —                  | 10,000                    | L005         | UL, CSA, TÜV       |
| LVR005NK-2      | —            | 1,500                | —                  | 7,500                     | L005         | UL, CSA, TÜV       |
| LVR005NS        | 500          | —                    | —                  | 10,000                    | L005         | UL, CSA, TÜV       |
| LVR005NS-2      | —            | 1,500                | —                  | 7,500                     | L005         | UL, CSA, TÜV       |
| LVR008NK        | 500          | —                    | —                  | 10,000                    | L008         | UL, CSA, TÜV       |
| LVR008NK-2      | —            | 1,500                | —                  | 7,500                     | L008         | UL, CSA, TÜV       |
| LVR008NS        | 500          | —                    | —                  | 10,000                    | L008         | UL, CSA, TÜV       |
| LVR008NS-2      | —            | 1,500                | —                  | 7,500                     | L008         | UL, CSA, TÜV       |
| LVR012K         | 500          | —                    | —                  | 10,000                    | L012         | UL, CSA, TÜV       |
| LVR012K-2       | —            | 2,000                | —                  | 10,000                    | L012         | UL, CSA, TÜV       |
| LVR012S         | 500          | —                    | —                  | 10,000                    | L012         | UL, CSA, TÜV       |
| LVR012S-2       | —            | 2,000                | —                  | 10,000                    | L012         | UL, CSA, TÜV       |
| LVR016K         | 500          | —                    | —                  | 10,000                    | L016         | UL, CSA, TÜV       |
| LVR016K-2       | —            | 2,000                | —                  | 10,000                    | L016         | UL, CSA, TÜV       |
| LVR016S         | 500          | —                    | —                  | 10,000                    | L016         | UL, CSA, TÜV       |
| LVR016S-2       | —            | 2,000                | —                  | 10,000                    | L016         | UL, CSA, TÜV       |
| LVR025K         | 500          | —                    | —                  | 10,000                    | L025         | UL, CSA, TÜV       |
| LVR025K-2       | —            | 2,000                | —                  | 10,000                    | L025         | UL, CSA, TÜV       |
| LVR025S         | 500          | —                    | —                  | 10,000                    | L025         | UL, CSA, TÜV       |
| LVR025S-2       | —            | 2,000                | —                  | 10,000                    | L025         | UL, CSA, TÜV       |
| LVR033K         | 500          | —                    | —                  | 10,000                    | L033         | UL, CSA, TÜV       |
| LVR033K-2       | —            | 2,000                | —                  | 10,000                    | L033         | UL, CSA, TÜV       |
| LVR033S         | 500          | —                    | —                  | 10,000                    | L033         | UL, CSA, TÜV       |
| LVR033S-2       | —            | 2,000                | —                  | 10,000                    | L033         | UL, CSA, TÜV       |
| LVR040K         | 500          | —                    | —                  | 10,000                    | L040         | UL, CSA, TÜV       |
| LVR040K-2       | —            | 2,000                | —                  | 10,000                    | L040         | UL, CSA, TÜV       |
| LVR040S         | 500          | —                    | —                  | 10,000                    | L040         | UL, CSA, TÜV       |
| LVR040S-2       | —            | 2,000                | —                  | 10,000                    | L040         | UL, CSA, TÜV       |
| LVR055K         | 500          | —                    | —                  | 10,000                    | L055         | UL, CSA, TÜV       |
| LVR055S         | 500          | —                    | —                  | 10,000                    | L055         | UL, CSA, TÜV       |
| LVR055S-2       | —            | 1,000                | —                  | 5,000                     | L055         | UL, CSA, TÜV       |
| LVR075S         | 500          | —                    | —                  | 10,000                    | L075         | UL, CSA, TÜV       |
| LVR100S         | 250          | —                    | —                  | 5,000                     | L100         | UL, CSA, TÜV       |
| LVR125S         | 250          | —                    | —                  | 5,000                     | L125         | UL, CSA, TÜV       |
| LVR200S         | 250          | —                    | —                  | 5,000                     | L200         | UL, CSA, TÜV       |
| LVRL075S        | 500          | —                    | —                  | 10,000                    | L075         | UL, CSA, TÜV       |
| LVRL100S        | 500          | —                    | —                  | 10,000                    | L100         | UL, CSA, TÜV       |
| LVRL125S        | 500          | —                    | —                  | 10,000                    | L125         | UL, CSA, TÜV       |
| LVRL135S        | 500          | —                    | —                  | 10,000                    | L135         | UL, CSA, TÜV       |
| LVRL200S        | 250          | —                    | —                  | 5,000                     | L200         | UL, CSA, TÜV       |

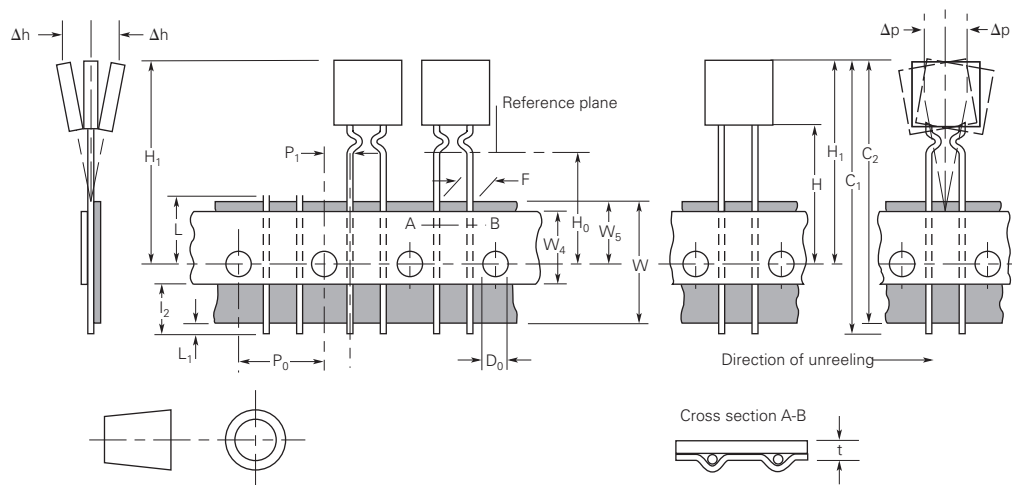
**Table L7 Tape and Reel Specifications for LVR Devices**

LVR devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.  
See Figures L7 and L8 for details.

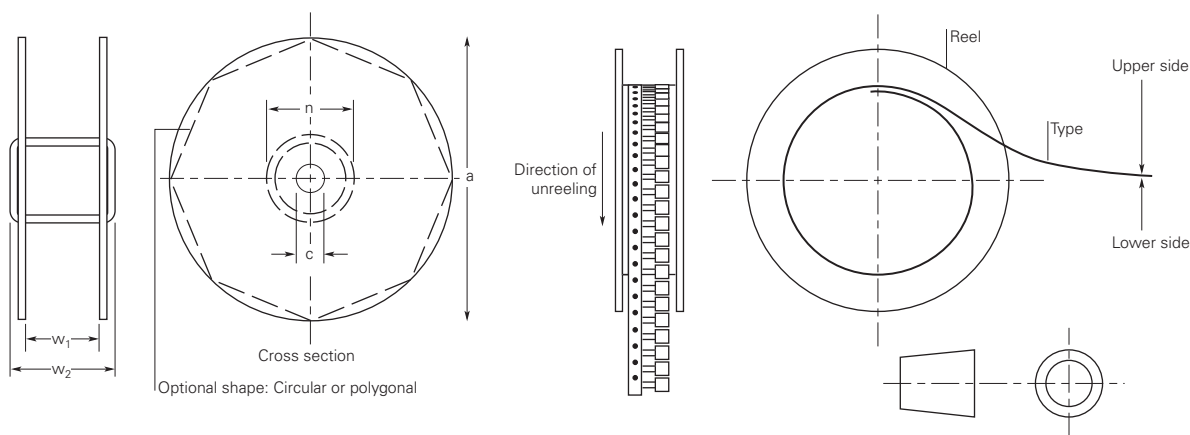
| Description                                               | EIA Mark       | Dimension (mm) | Tolerance  |
|-----------------------------------------------------------|----------------|----------------|------------|
| Carrier tape width                                        | W              | 18             | -0.5/+1.0  |
| Hold-down tape width                                      | W <sub>4</sub> | 11             | Minimum    |
| Top distance between tape edges                           | W <sub>6</sub> | 3              | Maximum    |
| Sprocket hole position                                    | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket hole diameter                                    | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to plane (straight lead) (LVR005N to LVR016)     | H              | 18.5           | ± 2.5      |
| Abscissa to plane (kinked lead) (LVR005N to LVR016)       | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to top (LVR005N to LVR016)                       | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to top* (LVR025 to LVR055)                       | H <sub>1</sub> | 45.0           | Maximum    |
| Overall width with lead protrusion (LVR005N to LVR016)    | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width with lead protrusion (LVR025 to LVR055)     | C <sub>1</sub> | 56.0           | Maximum    |
| Overall width without lead protrusion (LVR005N to LVR016) | C <sub>2</sub> | 42.5           | Maximum    |
| Overall width without lead protrusion (LVR025 to LVR055)  | C <sub>2</sub> | 56.0           | Maximum    |
| Lead protrusion                                           | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                                     | L              | 11.0           | Maximum    |
| Protrusion beyond hold-down tape                          | I <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                                       | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device pitch (LVR005N to LVR040)                          | —              | 12.7           | ± 0.3      |
| Device pitch (LVR055)                                     | —              | 25.4           | ± 0.6      |
| Pitch tolerance                                           | —              | 20 consecutive | ± 1        |
| Tape thickness                                            | t              | 0.9            | Maximum    |
| Overall tape and lead thickness (LVR005N to LVR040)       | t <sub>1</sub> | 1.5            | Maximum    |
| Overall tape and lead thickness (LVR055)                  | t <sub>1</sub> | 2.3            | Maximum    |
| Splice sprocket hole alignment                            | —              | 0              | ± 0.3      |
| Body lateral deviation                                    | Δh             | 0              | ± 1.0      |
| Body tape plane deviation                                 | Δp             | 0              | ± 1.3      |
| Ordinate to adjacent component lead                       | P <sub>1</sub> | 3.81           | ± 0.7      |
| Lead spacing*                                             | F              | 5.08           | +0.75/-0.5 |
| Reel width (LVR005N to LVR040)                            | w <sub>2</sub> | 56.0           | Maximum    |
| Reel width* (LVR055)                                      | w <sub>2</sub> | 63.5           | Maximum    |
| Reel diameter                                             | a              | 370.0          | Maximum    |
| Space between flanges* (LVR005N to LVR040)                | w <sub>1</sub> | 48.0           | Maximum    |
| Space between flanges* (LVR055)                           | w <sub>1</sub> | 55.0           | Maximum    |
| Arbor hold diameter                                       | c              | 26.0           | ± 12.0     |
| Core diameter*                                            | n              | 91.0           | Maximum    |
| Box                                                       | —              | 64/372/362     | Maximum    |
| Consecutive missing places                                | —              | None           | —          |
| Empty places per reel                                     | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

**Figure L7** EIA Referenced Taped Component Dimensions for LVR Devices



**Figure L8** EIA Referenced Reel Dimensions for LVR Devices



## Part Numbering System for LVR Devices

**LVR 075 S 2**

### Packaging

Blank = Packaged in bags  
-1 = 25.4mm (1.0 inch) minimum lead length  
-2 = Tape and reel  
-X.X = Special lead cut length (inch)

### Modifier

K = Standard kinked lead  
S = Straight lead

### Hold Current Indicator

### Product Series

LVR = 240V rated  
LVRL = 120V rated

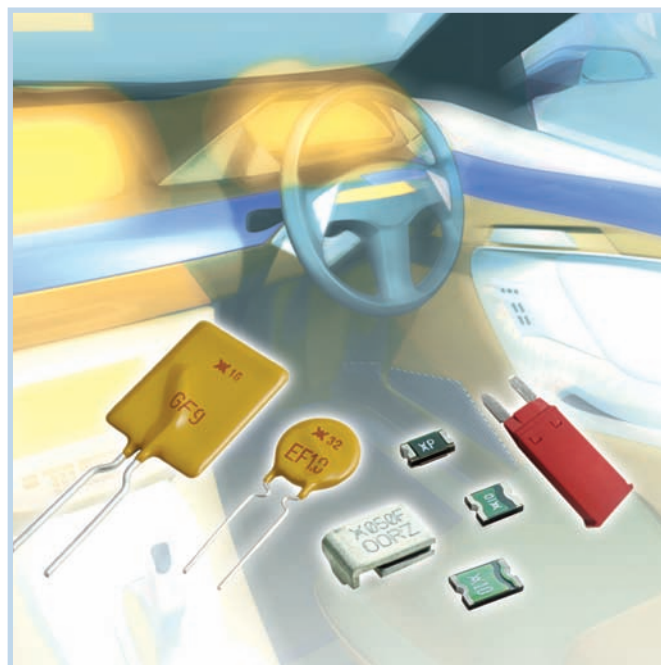






# PolySwitch Resettable Devices Automotive Devices

We have provided PPTC resettable devices for the automotive industry for over 25 years. With the advent of TS16949 and our continued involvement in the automotive industry, we developed automotive specific versions of our PolySwitch PPTC devices (nanoASMD, microASMD, miniASMD, AHS, ASMD, AHRF, AHEF, AGRF and BD). These products are qualified and sold under PS400 specification which is derived from AEC-Q200, the standard for electronic components used in the automotive industry. The key difference between these product families and other protection devices in our circuit protection product portfolio is the qualification process followed according to a series of rigorous tests related to the automotive environment. As a result, they are characterized by specific additional values determined post automotive related testing.



## Benefits

- Expertise from the world's leading resettable overcurrent protection manufacturer
- High quality products from the world's largest passive component manufacturer
- Worldwide team dedicated to support automotive applications
- Wide range of dedicated automotive surface-mount and radial-leaded resettable overcurrent devices
- High performance transient voltage protection devices

## Features

- RoHS compliant
- Overcurrent and overvoltage circuit protection devices
- Resettable and single-use overcurrent devices
- Wide range of form factor and termination methods
- Products meet applicable automotive industry standards
- Devices compatible with high-volume electronics assembly

## Applications

- Motor and motor circuit protection including power door-locks, mirrors, lumbar pumps, seats, sunroofs and windows
- Electronic Control Unit (ECU) I/O protection
- Heating Ventilation and Cooling (HVAC) motor and I/O protection
- Telematics, infotainment and navigations systems
- Liquid Crystal Display (LCD) back-light heaters
- Power and cigarette lighter outlets, plugs and adapter/chargers
- Powered networks and busses
- Air-flow detection and overcurrent protection in HVAC and cooling fan systems
- Stall detection in express window and sunroof circuits
- Power distribution, electrical centers and junction box resettable overcurrent protection
- Wire downsizing
- Motor Electromagnetic Interference (EMI) suppression
- Electrostatic Discharge (ESD) damage protection
- Load dump and other transient voltage protection

**Table A1** Product Series - Current Rating, Voltage Rating / Typical Resistance for Automotive Devices

| Voltage Rating          | AGRF<br>16V | AHRF<br>16V | AHRF<br>30V | AHEF<br>32V | AHS<br>16V | ASMD<br>16V | ASMD<br>30V | ASMD<br>60V | BD<br>14V |
|-------------------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-----------|
| <b>Hold Current (A)</b> |             |             |             |             |            |             |             |             |           |
| 0.30                    | —           | —           | —           | —           | —          | —           | —           | 2.90Ω       | —         |
| 0.50                    | —           | —           | 0.565Ω      | 0.5650Ω     | —          | —           | —           | 0.90Ω       | —         |
| 0.70                    | —           | —           | 0.385Ω      | 0.3850Ω     | —          | —           | —           | —           | —         |
| 0.75                    | —           | —           | —           | —           | —          | —           | 0.60Ω       | —           | —         |
| 0.80                    | —           | —           | —           | —           | 0.25Ω      | —           | —           | —           | —         |
| 1.00                    | —           | —           | 0.225Ω      | 0.2250Ω     | —          | —           | 0.30Ω       | —           | —         |
| 1.25                    | —           | —           | —           | —           | —          | 0.160Ω      | —           | —           | —         |
| 1.50                    | —           | —           | —           | —           | —          | 0.140Ω      | —           | —           | —         |
| 1.60                    | —           | —           | —           | —           | 0.10Ω      | —           | —           | —           | —         |
| 1.85                    | —           | —           | —           | —           | —          | 0.079Ω      | —           | —           | —         |
| 2.00                    | —           | 0.0565Ω     | —           | —           | 0.07Ω      | 0.090Ω      | —           | —           | —         |
| 2.50                    | —           | —           | —           | —           | —          | 0.060Ω      | —           | —           | —         |
| 3.00                    | —           | 0.0410Ω     | —           | 0.0520Ω     | 0.05Ω      | —           | —           | —           | —         |
| 4.00                    | 0.0300Ω     | 0.0305Ω     | —           | —           | —          | —           | —           | —           | —         |
| 4.50                    | —           | 0.0290Ω     | —           | —           | —          | —           | —           | —           | —         |
| 5.00                    | 0.0192Ω     | —           | —           | 0.0200Ω     | —          | —           | —           | —           | —         |
| 5.50                    | —           | 0.0190Ω     | —           | —           | —          | —           | —           | —           | —         |
| 6.00                    | 0.0145Ω     | 0.0180Ω     | —           | —           | —          | —           | —           | —           | —         |
| 6.50                    | —           | 0.0140Ω     | —           | —           | —          | —           | —           | —           | —         |
| 7.00                    | 0.0105Ω     | 0.0126Ω     | —           | —           | —          | —           | —           | —           | —         |
| 7.50                    | —           | 0.0120Ω     | —           | 0.0120Ω     | —          | —           | —           | —           | —         |
| 8.00                    | 0.0086Ω     | 0.0104Ω     | —           | —           | —          | —           | —           | —           | 0.0115Ω   |
| 9.00                    | 0.0070Ω     | 0.0100Ω     | —           | —           | —          | —           | —           | —           | —         |
| 10.00                   | 0.0056Ω     | 0.0083Ω     | —           | 0.0083Ω     | —          | —           | —           | —           | —         |
| 11.00                   | 0.0050Ω     | 0.0069Ω     | —           | —           | —          | —           | —           | —           | —         |
| 12.00                   | 0.0046Ω     | —           | —           | —           | —          | —           | —           | —           | 0.0060Ω   |
| 13.00                   | —           | 0.0055Ω     | —           | —           | —          | —           | —           | —           | —         |
| 14.00                   | 0.0040Ω     | 0.0050Ω     | —           | —           | —          | —           | —           | —           | —         |
| 15.00                   | —           | 0.0050Ω     | —           | —           | —          | —           | —           | —           | —         |
| 16.00                   | —           | —           | —           | —           | —          | —           | —           | —           | 0.00365Ω  |
| 20.00                   | —           | —           | —           | —           | —          | —           | —           | —           | 0.00285Ω  |
| 21.00                   | —           | —           | —           | —           | —          | —           | —           | —           | 0.00260Ω  |

| Voltage Rating          | nanoASMDC<br>48V | nanoASMDC<br>24V | nanoASMDC<br>16V | microASMDC<br>30V | miniASMDC<br>60V | miniASMDC<br>30V | miniASMDC<br>24V | miniASMDC<br>16V |
|-------------------------|------------------|------------------|------------------|-------------------|------------------|------------------|------------------|------------------|
| <b>Hold Current (A)</b> |                  |                  |                  |                   |                  |                  |                  |                  |
| 0.05                    | —                | —                | —                | 26.80Ω            | —                | —                | —                | —                |
| 0.10                    | —                | —                | —                | 8.55Ω             | 6.70Ω            | —                | —                | —                |
| 0.12                    | 3.95Ω            | —                | —                | —                 | —                | —                | —                | —                |
| 0.14                    | —                | —                | —                | —                 | 3.75Ω            | —                | —                | —                |
| 0.16                    | 3.05Ω            | —                | —                | —                 | —                | —                | —                | —                |
| 0.20                    | —                | 1.875Ω           | —                | —                 | —                | 1.950Ω           | —                | —                |
| 0.30                    | —                | —                | —                | —                 | —                | 0.975Ω           | —                | —                |
| 0.35                    | —                | —                | 0.90Ω            | —                 | —                | —                | —                | —                |
| 0.50                    | —                | —                | —                | —                 | —                | —                | 0.575Ω           | —                |
| 0.75                    | —                | —                | —                | —                 | —                | —                | 0.190Ω           | —                |
| 1.10                    | —                | —                | —                | —                 | —                | —                | 0.120Ω           | 0.1200Ω          |
| 1.25                    | —                | —                | —                | —                 | —                | —                | —                | 0.0950Ω          |
| 1.50                    | —                | —                | —                | —                 | —                | —                | 0.080Ω           | 0.0750Ω          |
| 2.60                    | —                | —                | —                | —                 | —                | —                | —                | 0.0325Ω          |

**Table A2 Thermal Derating for Automotive Devices**  
**[Hold Current (A) at Ambient Temperature (°C)]**

| Part Number                    | Maximum Ambient Temperature |       |       |      |       |      |       |      |      |       |       |
|--------------------------------|-----------------------------|-------|-------|------|-------|------|-------|------|------|-------|-------|
|                                | -40°C                       | -20°C | 0°C   | 20°C | 25°C  | 40°C | 50°C  | 60°C | 70°C | 85°C  | 125°C |
| <b>AGRF</b>                    |                             |       |       |      |       |      |       |      |      |       |       |
| <b>16V — Radial-leaded</b>     |                             |       |       |      |       |      |       |      |      |       |       |
| AGRF400                        | 5.9                         | 5.3   | 4.8   | 4.1  | 4.0   | 3.5  | 3.2   | 2.8  | 2.5  | 1.9   | —     |
| AGRF500                        | 7.3                         | 6.6   | 6.0   | 5.2  | 5.0   | 4.4  | 4.0   | 3.6  | 3.1  | 2.4   | —     |
| AGRF600                        | 8.8                         | 8.0   | 7.2   | 6.2  | 6.0   | 5.2  | 4.8   | 4.2  | 3.8  | 2.8   | —     |
| AGRF700                        | 10.3                        | 9.3   | 8.4   | 7.3  | 7.0   | 6.2  | 5.6   | 5.0  | 4.4  | 3.3   | —     |
| AGRF800                        | 11.7                        | 10.7  | 9.6   | 8.3  | 8.0   | 6.9  | 6.4   | 5.6  | 5.1  | 3.7   | —     |
| AGRF900                        | 13.2                        | 11.9  | 10.7  | 9.4  | 9.0   | 7.9  | 7.2   | 6.4  | 5.6  | 4.2   | —     |
| AGRF1000                       | 14.7                        | 13.3  | 12.0  | 10.3 | 10.0  | 8.7  | 8.0   | 7.0  | 6.3  | 4.7   | —     |
| AGRF1100                       | 16.1                        | 14.6  | 13.1  | 11.5 | 11.0  | 9.7  | 8.8   | 7.8  | 6.9  | 5.2   | —     |
| AGRF1200                       | 17.6                        | 16.0  | 14.4  | 12.4 | 12.0  | 10.4 | 9.6   | 8.4  | 7.6  | 5.6   | —     |
| AGRF1400                       | 20.5                        | 18.7  | 16.8  | 14.5 | 14.0  | 12.1 | 11.2  | 9.8  | 8.9  | 6.5   | —     |
| <b>AHRF (High Temperature)</b> |                             |       |       |      |       |      |       |      |      |       |       |
| <b>30V — Radial-leaded</b>     |                             |       |       |      |       |      |       |      |      |       |       |
| AHRF050                        | 0.7                         | 0.6   | 0.6   | 0.5  | 0.5   | 0.4  | 0.4   | 0.4  | 0.3  | 0.3   | 0.1   |
| AHRF070                        | 1.0                         | 0.9   | 0.8   | 0.7  | 0.7   | 0.6  | 0.6   | 0.5  | 0.5  | 0.4   | 0.2   |
| AHRF100                        | 1.4                         | 1.2   | 1.1   | 1.0  | 1.0   | 0.9  | 0.8   | 0.7  | 0.7  | 0.6   | 0.2   |
| <b>AHRF (High Temperature)</b> |                             |       |       |      |       |      |       |      |      |       |       |
| <b>16V — Radial-leaded</b>     |                             |       |       |      |       |      |       |      |      |       |       |
| AHRF200                        | 2.7                         | 2.5   | 2.3   | 2.1  | 2.00  | 1.8  | 1.6   | 1.5  | 1.3  | 1.1   | 0.5   |
| AHRF300                        | 4.1                         | 3.7   | 3.4   | 3.1  | 3.00  | 2.7  | 2.4   | 2.2  | 2.0  | 1.7   | 0.7   |
| AHRF400                        | 5.6                         | 5.1   | 4.7   | 4.2  | 4.00  | 3.6  | 3.3   | 3.0  | 2.7  | 2.3   | 1.0   |
| AHRF450                        | 6.1                         | 5.6   | 5.1   | 4.6  | 4.50  | 4.0  | 3.6   | 3.3  | 3.0  | 2.5   | 1.1   |
| AHRF550                        | 7.5                         | 6.9   | 6.2   | 5.7  | 5.50  | 4.9  | 4.4   | 4.0  | 3.7  | 3.1   | 1.4   |
| AHRF600                        | 8.2                         | 7.5   | 6.8   | 6.2  | 6.00  | 5.3  | 4.9   | 4.4  | 4.0  | 3.3   | 1.5   |
| AHRF650                        | 8.8                         | 8.1   | 7.4   | 6.7  | 6.50  | 5.7  | 5.3   | 4.8  | 4.3  | 3.6   | 1.6   |
| AHRF700                        | 9.5                         | 8.7   | 8.0   | 7.2  | 7.00  | 6.2  | 5.6   | 5.2  | 4.7  | 3.9   | 1.7   |
| AHRF750                        | 10.2                        | 9.4   | 8.6   | 7.7  | 7.50  | 6.6  | 6.1   | 5.6  | 5.0  | 4.1   | 1.9   |
| AHRF800                        | 10.9                        | 10.0  | 9.1   | 8.2  | 8.00  | 7.1  | 6.4   | 5.9  | 5.3  | 4.4   | 2.0   |
| AHRF900                        | 12.2                        | 11.2  | 10.2  | 9.3  | 9.00  | 8.0  | 7.2   | 6.6  | 6.0  | 5.0   | 2.2   |
| AHRF1000                       | 13.6                        | 12.5  | 11.4  | 10.3 | 10.00 | 8.8  | 8.1   | 7.4  | 6.6  | 5.5   | 2.5   |
| AHRF1100                       | 14.9                        | 13.7  | 12.5  | 11.3 | 11.00 | 9.7  | 8.8   | 8.1  | 7.3  | 6.1   | 2.7   |
| AHRF1300                       | 17.7                        | 16.3  | 14.8  | 13.4 | 13.00 | 11.4 | 10.5  | 9.6  | 8.6  | 7.2   | 3.3   |
| AHRF1400                       | 19.0                        | 17.5  | 15.9  | 14.4 | 14.00 | 12.4 | 11.2  | 10.3 | 9.3  | 7.8   | 3.5   |
| AHRF1500                       | 20.4                        | 18.8  | 17.1  | 15.5 | 15.00 | 13.2 | 12.1  | 11.1 | 9.9  | 8.3   | 3.8   |
| <b>AHEF (High Temperature)</b> |                             |       |       |      |       |      |       |      |      |       |       |
| <b>32V — Radial-leaded</b>     |                             |       |       |      |       |      |       |      |      |       |       |
| AHEF050                        | 0.7                         | 0.6   | 0.60  | 0.5  | 0.5   | 0.4  | 0.400 | 0.40 | 0.30 | 0.300 | 0.1   |
| AHEF070                        | 1.0                         | 0.9   | 0.80  | 0.7  | 0.7   | 0.6  | 0.600 | 0.50 | 0.50 | 0.400 | 0.2   |
| AHEF100                        | 1.4                         | 1.2   | 1.10  | 1.0  | 1.0   | 0.9  | 0.800 | 0.70 | 0.70 | 0.600 | 0.2   |
| AHEF300                        | 4.1                         | 3.8   | 3.42  | 3.1  | 3.0   | 2.7  | 2.430 | 2.22 | 1.98 | 1.650 | 0.6   |
| AHEF500                        | 6.8                         | 6.3   | 5.70  | 5.2  | 5.0   | 4.5  | 4.050 | 3.70 | 3.30 | 2.750 | 1.0   |
| AHEF750                        | 10.2                        | 9.4   | 8.55  | 7.7  | 7.5   | 6.7  | 6.075 | 5.55 | 4.95 | 4.125 | 1.5   |
| AHEF1000                       | 13.6                        | 12.5  | 11.40 | 10.3 | 10.0  | 8.9  | 8.100 | 7.40 | 6.60 | 5.500 | 2.0   |
| <b>AHS (High Temperature)</b>  |                             |       |       |      |       |      |       |      |      |       |       |
| <b>16V — Surface-mount</b>     |                             |       |       |      |       |      |       |      |      |       |       |
| AHS080-2018                    | 1.20                        | 1.04  | 0.90  | 0.80 | 0.77  | 0.68 | 0.62  | 0.60 | 0.53 | 0.46  | 0.26  |
| AHS160                         | 2.15                        | 1.96  | 1.78  | 1.60 | 1.55  | 1.42 | 1.33  | 1.24 | 1.15 | 1.01  | 0.64  |
| AHS200                         | 2.90                        | 2.50  | 2.20  | 2.00 | 1.94  | 1.80 | 1.75  | 1.70 | 1.40 | 1.18  | 0.67  |
| AHS300                         | 4.20                        | 3.80  | 3.70  | 3.00 | 2.92  | 2.63 | 2.44  | 2.10 | 2.00 | 1.76  | 1.00  |

**Table A2 Thermal Derating for Automotive Devices**  
[Hold Current (A) at Ambient Temperature (°C)]

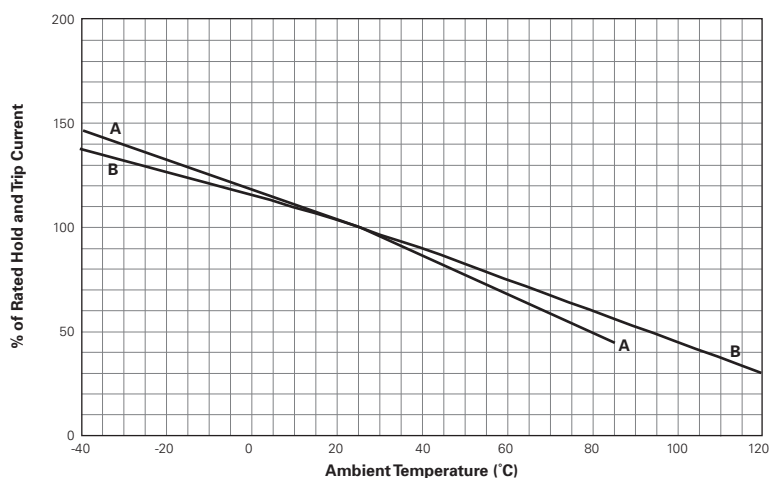
Cont'd

| Part Number                   | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |       |
|-------------------------------|-----------------------------|-------|------|------|------|------|------|------|------|------|-------|
|                               | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
| <b>ASMD</b>                   |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-60V — Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| ASMD030F                      | 0.35                        | 0.31  | 0.27 | 0.23 | 0.22 | 0.19 | 0.17 | 0.15 | 0.13 | 0.11 | —     |
| ASMD050F                      | 0.59                        | 0.53  | 0.46 | 0.39 | 0.37 | 0.33 | 0.29 | 0.26 | 0.23 | 0.18 | —     |
| ASMD075F                      | 0.91                        | 0.81  | 0.71 | 0.60 | 0.58 | 0.50 | 0.45 | 0.40 | 0.35 | 0.28 | —     |
| ASMD100F                      | 1.37                        | 1.22  | 1.06 | 0.90 | 0.86 | 0.76 | 0.68 | 0.60 | 0.52 | 0.41 | —     |
| ASMD125F                      | 1.58                        | 1.40  | 1.23 | 1.04 | 1.00 | 0.87 | 0.78 | 0.70 | 0.60 | 0.48 | —     |
| ASMD150F                      | 1.93                        | 1.70  | 1.50 | 1.27 | 1.22 | 1.07 | 0.95 | 0.85 | 0.74 | 0.58 | —     |
| NEW ASMD185F                  | 2.93                        | 2.58  | 2.30 | 1.93 | 1.85 | 1.62 | 1.44 | 1.30 | 1.12 | 0.88 | —     |
| ASMD200F                      | 2.63                        | 2.34  | 2.04 | 1.73 | 1.66 | 1.45 | 1.30 | 1.16 | 1.00 | 0.80 | —     |
| ASMD250F                      | 3.00                        | 2.66  | 2.32 | 1.97 | 1.89 | 1.65 | 1.48 | 1.32 | 1.14 | 0.91 | —     |
| <b>nanoASMD</b>               |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-48V — Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| NEW nanoASMD012F              | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | —     |
| NEW nanoASMD016F              | 0.21                        | 0.20  | 0.18 | 0.16 | 0.16 | 0.14 | 0.13 | 0.12 | 0.11 | 0.09 | —     |
| NEW nanoASMD020F              | 0.34                        | 0.30  | 0.26 | 0.22 | 0.20 | 0.17 | 0.15 | 0.13 | 0.11 | 0.08 | —     |
| NEW nanoASMD035F              | 0.58                        | 0.51  | 0.44 | 0.38 | 0.35 | 0.31 | 0.28 | 0.24 | 0.21 | 0.16 | —     |
| <b>microASMD</b>              |                             |       |      |      |      |      |      |      |      |      |       |
| <b>30V — Surface-mount</b>    |                             |       |      |      |      |      |      |      |      |      |       |
| NEW microASMD005F             | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | —     |
| NEW microASMD010F             | 0.15                        | 0.13  | 0.12 | 0.10 | 0.10 | 0.09 | 0.08 | 0.06 | 0.06 | 0.05 | —     |
| <b>miniASMD</b>               |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-60V — Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| NEW miniASMD010F              | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.04 | —     |
| NEW miniASMD014F              | 0.23                        | 0.20  | 0.17 | 0.14 | 0.13 | 0.11 | 0.10 | 0.09 | 0.07 | 0.05 | —     |
| NEW miniASMD020F              | 0.30                        | 0.27  | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 0.13 | 0.12 | 0.09 | —     |
| NEW miniASMD030F              | 0.49                        | 0.44  | 0.39 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.18 | 0.14 | —     |
| NEW miniASMD050F              | 0.59                        | 0.57  | 0.55 | 0.50 | 0.48 | 0.45 | 0.43 | 0.35 | 0.30 | 0.23 | —     |
| NEW miniASMD075F/24           | 1.50                        | 1.25  | 1.00 | 0.75 | 0.73 | 0.65 | 0.60 | 0.55 | 0.50 | 0.43 | —     |
| NEW miniASMD110F/16           | 1.68                        | 1.49  | 1.30 | 1.10 | 1.05 | 0.92 | 0.83 | 0.75 | 0.64 | 0.50 | —     |
| NEW miniASMD110F/24           | 2.00                        | 1.70  | 1.40 | 1.10 | 1.06 | 0.95 | 0.88 | 0.80 | 0.73 | 0.61 | —     |
| NEW miniASMD125F/16           | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.53 | —     |
| NEW miniASMD150F/16           | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.69 | —     |
| NEW miniASMD150F/24           | 2.10                        | 1.90  | 1.70 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.69 | —     |
| NEW miniASMD260F/16           | 3.50                        | 3.20  | 3.00 | 2.60 | 2.53 | 2.30 | 2.15 | 2.00 | 1.85 | 1.63 | —     |
| <b>BD</b>                     |                             |       |      |      |      |      |      |      |      |      |       |
| <b>14V — Bladed Device</b>    |                             |       |      |      |      |      |      |      |      |      |       |
| BD280-1130-10/16              | 12.4                        | 11.0  | 9.7  | 8.3  | 8.0  | 7.0  | 6.3  | 5.6  | 5.0  | 4.0  | —     |
| BD280-1130-15/16              | 17.4                        | 15.7  | 14.1 | 12.4 | 12.0 | 10.8 | 9.9  | 9.1  | 8.3  | 7.0  | —     |
| BD280-1130-20/16              | 24.0                        | 21.6  | 19.1 | 16.6 | 16.0 | 14.1 | 12.9 | 11.7 | 10.4 | 8.6  | —     |
| BD280-1927-25/16-W            | 32.0                        | 28.3  | 24.6 | 20.9 | 20.0 | 17.2 | 15.4 | 13.5 | 11.7 | 8.9  | —     |
| BD280-1927-30/16-W            | 34.1                        | 30.1  | 26.0 | 22.0 | 21.0 | 18.0 | 16.0 | 14.0 | 11.9 | 9.1  | —     |

# Figure A1-A4 Thermal Derating Curves for Automotive Devices

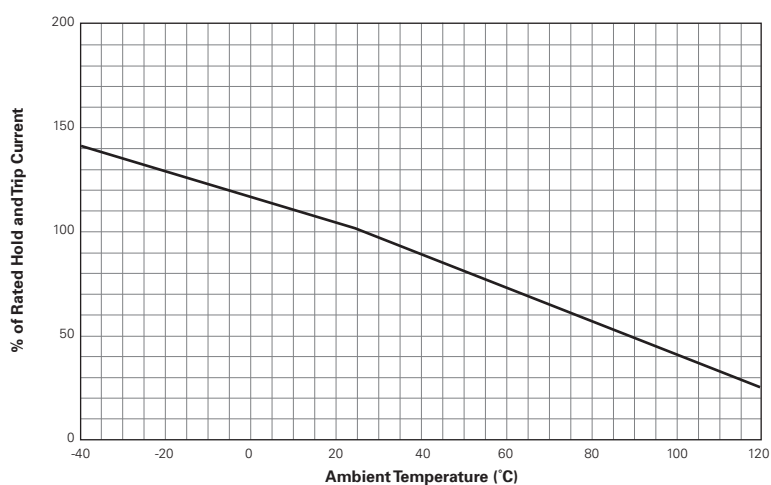
A = AGRF  
B = AHRF

Figure A1



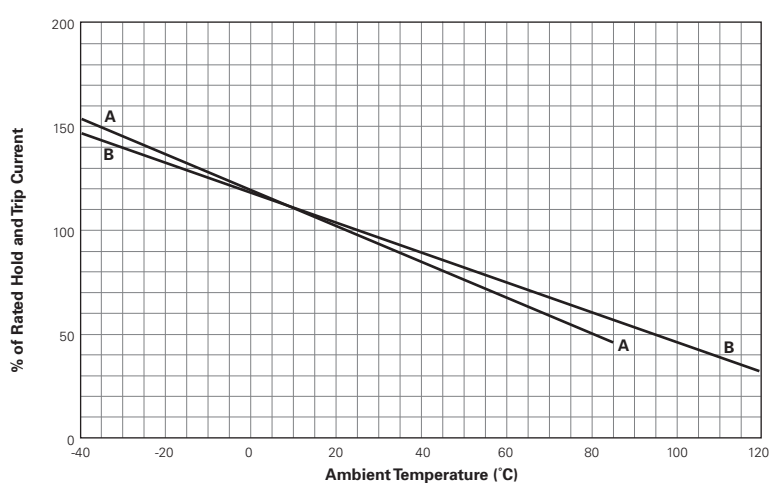
AHEF

Figure A2

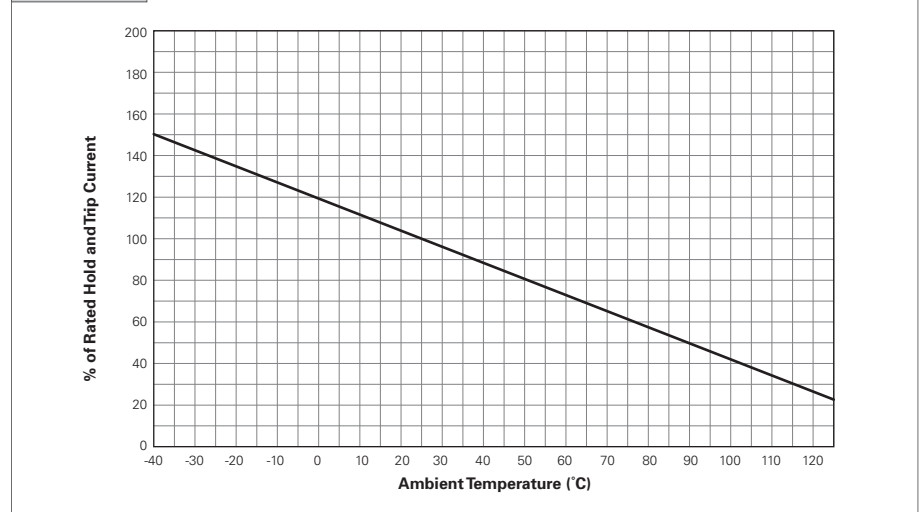


A = ASMD, nanoASMD, microASMD, miniASMD  
B = AHS

Figure A3



BD

**Figure A4**

**Table A3 Electrical Characteristics for Automotive Devices**

| Part Number             | I <sub>H</sub> (A)@<br>R <sub>1</sub> MAX | I <sub>H</sub> (A)@<br>R <sub>a</sub> MAX | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D Typ</sub><br>(W) | Max. Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>1</sub> MAX<br>(Ω) | R <sub>a</sub> MAX<br>(Ω) | Figure for<br>Dimensions |
|-------------------------|-------------------------------------------|-------------------------------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|-------------------|------|-------------------------|---------------------------|---------------------------|--------------------------|
| AGRF                    |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| 16V — Radial-leaded     |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| AGRF400                 | 4.0                                       | 3.0                                       | 7.6                   | 16                                     | 100                     | 2.5                       | 20.0              | 2.0  | 0.0186                  | 0.0610                    | 0.0850                    | A5, A8, A9               |
| AGRF500                 | 5.0                                       | 4.3                                       | 9.4                   | 16                                     | 100                     | 2.7                       | 25.0              | 2.5  | 0.0140                  | 0.0340                    | 0.0480                    | A5, A8, A9               |
| AGRF600                 | 6.0                                       | 5.3                                       | 10.7                  | 16                                     | 100                     | 2.8                       | 30.0              | 3.5  | 0.0095                  | 0.0280                    | 0.0320                    | A5, A8, A9               |
| AGRF700                 | 7.0                                       | 6.5                                       | 13.2                  | 16                                     | 100                     | 3.0                       | 35.0              | 4.0  | 0.0066                  | 0.0200                    | 0.0220                    | A5, A8, A9               |
| AGRF800                 | 8.0                                       | 7.6                                       | 15.0                  | 16                                     | 100                     | 3.2                       | 40.0              | 5.5  | 0.0049                  | 0.0175                    | 0.0181                    | A5, A8, A9               |
| AGRF900                 | 9.0                                       | 8.6                                       | 16.5                  | 16                                     | 100                     | 3.4                       | 45.0              | 6.0  | 0.0041                  | 0.0135                    | 0.0140                    | A5, A8, A9               |
| AGRF1000                | 10.0                                      | 9.6                                       | 18.5                  | 16                                     | 100                     | 3.6                       | 50.0              | 7.0  | 0.0034                  | 0.0102                    | 0.0106                    | A5, A8, A9               |
| AGRF1100                | 11.0                                      | 10.5                                      | 20.3                  | 16                                     | 100                     | 3.7                       | 55.0              | 7.5  | 0.0033                  | 0.0089                    | 0.0093                    | A5, A8, A9               |
| AGRF1200                | 12.0                                      | 11.5                                      | 22.1                  | 16                                     | 100                     | 4.2                       | 60.0              | 8.0  | 0.0030                  | 0.0086                    | 0.0091                    | A5, A8, A9               |
| AGRF1400                | 14.0                                      | 13.0                                      | 27.3                  | 16                                     | 100                     | 4.6                       | 70.0              | 9.0  | 0.0022                  | 0.0064                    | 0.0067                    | A5, A8, A9               |
| AHRF (High Temperature) |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| 30V — Radial-leaded     |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| AHRF050                 | 0.5                                       | 0.5                                       | 1.0                   | 30                                     | 40                      | 0.9                       | 2.5               | 3.0  | 0.3500                  | 1.100                     | 1.100                     | A8, A9, A10              |
| AHRF070                 | 0.7                                       | 0.7                                       | 1.4                   | 30                                     | 40                      | 1.4                       | 3.5               | 3.2  | 0.2300                  | 0.800                     | 0.800                     | A5, A8, A9               |
| AHRF100                 | 1.0                                       | 1.0                                       | 1.9                   | 30                                     | 40                      | 1.4                       | 5.0               | 6.2  | 0.1500                  | 0.430                     | 0.430                     | A8, A9, A10              |
| AHRF (High Temperature) |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| 16V — Radial-leaded     |                                           |                                           |                       |                                        |                         |                           |                   |      |                         |                           |                           |                          |
| AHRF200                 | 2.0                                       | 2.0                                       | 3.8                   | 16                                     | 100                     | 1.4                       | 10.0              | 4.8  | 0.0390                  | 0.110                     | 0.110                     | A8, A9, A10              |
| AHRF300                 | 3.0                                       | 3.0                                       | 6.5                   | 16                                     | 100                     | 3.0                       | 15.0              | 5.0  | 0.0290                  | 0.079                     | 0.079                     | A5, A8, A9               |
| AHRF400                 | 4.0                                       | 4.0                                       | 7.4                   | 16                                     | 100                     | 3.3                       | 20.0              | 5.0  | 0.0210                  | 0.060                     | 0.060                     | A5, A8, A9               |
| AHRF450                 | 4.5                                       | 4.5                                       | 8.7                   | 16                                     | 100                     | 3.6                       | 22.5              | 4.0  | 0.0170                  | 0.054                     | 0.054                     | A5, A8, A9               |
| AHRF550                 | 5.5                                       | 5.5                                       | 10.0                  | 16                                     | 100                     | 3.5                       | 27.5              | 6.0  | 0.0130                  | 0.037                     | 0.037                     | A5, A8, A9               |
| AHRF600                 | 6.0                                       | 6.0                                       | 12.0                  | 16                                     | 100                     | 4.1                       | 30.0              | 6.5  | 0.0100                  | 0.032                     | 0.032                     | A5, A8, A9               |
| AHRF650                 | 6.5                                       | 6.5                                       | 13.7                  | 16                                     | 100                     | 4.3                       | 32.5              | 7.0  | 0.0090                  | 0.026                     | 0.026                     | A5, A8, A9               |
| AHRF700                 | 7.0                                       | 7.0                                       | 13.1                  | 16                                     | 100                     | 4.0                       | 35.0              | 7.0  | 0.0087                  | 0.025                     | 0.025                     | A5, A8, A9               |
| AHRF750                 | 7.5                                       | 7.5                                       | 14.8                  | 16                                     | 100                     | 4.5                       | 37.5              | 8.0  | 0.0074                  | 0.022                     | 0.022                     | A5, A8, A9               |
| AHRF800                 | 8.0                                       | 8.0                                       | 15.0                  | 16                                     | 100                     | 4.2                       | 40.0              | 8.0  | 0.0072                  | 0.020                     | 0.020                     | A5, A8, A9               |
| AHRF900                 | 9.0                                       | 9.0                                       | 18.5                  | 16                                     | 100                     | 5.0                       | 45.0              | 11.5 | 0.0061                  | 0.017                     | 0.017                     | A5, A8, A9               |
| AHRF1000                | 10.0                                      | 10.0                                      | 20.5                  | 16                                     | 100                     | 5.3                       | 50.0              | 10.5 | 0.0051                  | 0.015                     | 0.015                     | A5, A8, A9               |
| AHRF1100                | 11.0                                      | 11.0                                      | 21.2                  | 16                                     | 100                     | 5.5                       | 55.0              | 11.0 | 0.0048                  | 0.013                     | 0.013                     | A5, A8, A9               |
| AHRF1300                | 13.0                                      | 13.0                                      | 27.0                  | 16                                     | 100                     | 6.9                       | 65.0              | 15.0 | 0.0034                  | 0.010                     | 0.010                     | A5, A8, A9               |
| AHRF1400                | 14.0                                      | 14.0                                      | 28.3                  | 16                                     | 100                     | 6.9                       | 70.0              | 15.5 | 0.0029                  | 0.009                     | 0.009                     | A5, A8, A9               |
| AHRF1500                | 15.0                                      | 15.0                                      | 33.0                  | 16                                     | 100                     | 7.0                       | 75.0              | 20.0 | 0.0027                  | 0.0092                    | 0.0092                    | A5, A8, A9               |

Table A3 Electrical Characteristics for Automotive Devices

Cont'd

| Part Number                                    | I <sub>H</sub> (A)@<br>R <sub>1MAX</sub> | I <sub>H</sub> (A)@<br>R <sub>aMAX</sub> | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D</sub> Typ<br>(W) | Max. Time-to-trip |       | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | R <sub>aMAX</sub><br>(Ω) | Figure for<br>Dimensions |
|------------------------------------------------|------------------------------------------|------------------------------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|-------------------|-------|-------------------------|--------------------------|--------------------------|--------------------------|
| AHEF (High Temperature)<br>32V — Radial-leaded |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| AHEF050                                        | 0.5                                      | 0.5                                      | 1.0                   | 32                                     | 100                     | 0.9                       | 2.5               | 3.0   | 0.3500                  | 1.100                    | 1.100                    | A8, A9, A10              |
| AHEF070                                        | 0.7                                      | 0.7                                      | 1.4                   | 32                                     | 100                     | 0.9                       | 3.5               | 3.2   | 0.2300                  | 0.800                    | 0.800                    | A8, A9, A11              |
| AHEF100                                        | 1.0                                      | 1.0                                      | 1.9                   | 32                                     | 100                     | 1.4                       | 5.0               | 6.2   | 0.1500                  | 0.430                    | 0.430                    | A8, A9, A10              |
| AHEF300                                        | 3.0                                      | 3.0                                      | 6.0                   | 32                                     | 100                     | 3.2                       | 15.0              | 5.0   | 0.0350                  | 0.110                    | 0.110                    | A8, A9, A12              |
| AHEF500                                        | 5.0                                      | 5.0                                      | 10.0                  | 32                                     | 100                     | 5.3                       | 25.0              | 9.0   | 0.0150                  | 0.040                    | 0.040                    | A8, A9, A12              |
| AHEF750                                        | 7.5                                      | 7.5                                      | 15.0                  | 32                                     | 100                     | 6.5                       | 37.5              | 13.0  | 0.0074                  | 0.023                    | 0.023                    | A8, A9, A12              |
| AHEF1000                                       | 10.0                                     | 10.0                                     | 20.0                  | 32                                     | 100                     | 7.0                       | 50.0              | 15.0  | 0.0060                  | 0.016                    | 0.016                    | A8, A9, A12              |
| AHS (High Temperature)<br>16V — Surface-mount  |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| AHS080-2018                                    | 0.80                                     | 0.80                                     | 2.00                  | 16                                     | 70                      | 1.5                       | 8.0               | 9.0   | 0.130                   | 0.550                    | 0.550                    | A6                       |
| AHS160                                         | 1.60                                     | 1.60                                     | 3.20                  | 16                                     | 70                      | 2.2                       | 8.0               | 15.0  | 0.050                   | 0.150                    | 0.150                    | A7                       |
| AHS200                                         | 2.00                                     | 2.00                                     | 4.00                  | 16                                     | 70                      | 2.3                       | 8.0               | 13.4  | 0.050                   | 0.140                    | 0.140                    | A7                       |
| AHS300                                         | 3.00                                     | 3.00                                     | 6.00                  | 16                                     | 70                      | 3.0                       | 15.0              | 8.0   | 0.024                   | 0.083                    | 0.083                    | A7                       |
| ASMD<br>16-60V — Surface-mount                 |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| ASMD030F                                       | 0.23                                     | 0.23                                     | 0.59                  | 60                                     | 10                      | 1.1                       | 1.15              | 12.0  | 0.980                   | 4.800                    | 4.800                    | A7                       |
| ASMD050F                                       | 0.37                                     | 0.37                                     | 0.98                  | 60                                     | 10                      | 1.7                       | 1.95              | 20.0  | 0.290                   | 1.400                    | 1.400                    | A7                       |
| ASMD075F                                       | 0.60                                     | 0.60                                     | 1.48                  | 30                                     | 40                      | 1.1                       | 3.00              | 20.0  | 0.290                   | 1.000                    | 1.000                    | A7                       |
| ASMD100F                                       | 0.90                                     | 0.90                                     | 2.16                  | 30                                     | 40                      | 1.1                       | 4.50              | 20.0  | 0.098                   | 0.480                    | 0.480                    | A7                       |
| ASMD125F                                       | 1.04                                     | 1.04                                     | 2.46                  | 16                                     | 40                      | 1.1                       | 5.20              | 20.0  | 0.057                   | 0.250                    | 0.250                    | A7                       |
| ASMD150F                                       | 1.27                                     | 1.27                                     | 2.95                  | 16                                     | 40                      | 1.2                       | 6.35              | 25.0  | 0.049                   | 0.250                    | 0.250                    | A7                       |
| NEW ASMD185F                                   | 1.85                                     | 1.85                                     | 3.70                  | 16                                     | 40                      | 1.5                       | 9.25              | 11.3  | 0.032                   | 0.126                    | 0.126                    | A7                       |
| ASMD200F                                       | 1.73                                     | 1.73                                     | 3.93                  | 16                                     | 40                      | 1.2                       | 8.65              | 30.0  | 0.050                   | 0.120                    | 0.120                    | A7                       |
| ASMD250F                                       | 1.97                                     | 1.97                                     | 5.00                  | 16                                     | 40                      | 1.2                       | 9.85              | 30.0  | 0.035                   | 0.085                    | 0.085                    | A7                       |
| nanoASMDC<br>16-48V — Surface-mount            |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| NEW nanoASMDC012F                              | 0.12                                     | 0.12                                     | 0.39                  | 48                                     | 10                      | 0.5                       | 1.0               | 0.2   | 1.400                   | 6.500                    | 6.500                    | A15                      |
| NEW nanoASMDC016F                              | 0.16                                     | 0.16                                     | 0.45                  | 48                                     | 10                      | 0.5                       | 1.0               | 0.3   | 1.100                   | 5.000                    | 5.000                    | A15                      |
| NEW nanoASMDC020F                              | 0.20                                     | 0.20                                     | 0.42                  | 24                                     | 100                     | 0.6                       | 8.0               | 0.1   | 0.650                   | 3.100                    | 3.100                    | A15                      |
| NEW nanoASMDC035F                              | 0.35                                     | 0.75                                     | 0.75                  | 16                                     | 20                      | 0.6                       | 3.5               | 0.1   | 0.450                   | 1.350                    | 1.350                    | A15                      |
| microASMD<br>30V — Surface-mount               |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| NEW microASMD005F                              | 0.05                                     | 0.05                                     | 0.15                  | 30                                     | 10                      | 1.0                       | 0.25              | 1.5   | 3.60                    | 50.000                   | 50.000                   | A15                      |
| NEW microASMD010F                              | 0.10                                     | 0.10                                     | 0.25                  | 30                                     | 10                      | 0.8                       | 0.5               | 1.0   | 2.10                    | 15.000                   | 15.000                   | A15                      |
| miniASMDC<br>16-60V — Surface-mount            |                                          |                                          |                       |                                        |                         |                           |                   |       |                         |                          |                          |                          |
| NEW miniASMDC010F                              | 0.10                                     | 0.10                                     | 0.30                  | 60                                     | 40                      | 0.75                      | 0.5               | 5.000 | 0.700                   | 12.700                   | 12.700                   | A15                      |
| NEW miniASMDC014F                              | 0.14                                     | 0.14                                     | 0.28                  | 60                                     | 10                      | 0.75                      | 8.0               | 0.008 | 1.500                   | 6.000                    | 6.000                    | A15                      |
| NEW miniASMDC020F                              | 0.20                                     | 0.20                                     | 0.40                  | 30                                     | 10                      | 0.8                       | 8.0               | 0.020 | 0.600                   | 3.300                    | 3.300                    | A15                      |
| NEW miniASMDC030F                              | 0.30                                     | 0.30                                     | 0.60                  | 30                                     | 40                      | 0.8                       | 8.0               | 0.100 | 0.200                   | 1.750                    | 1.750                    | A15                      |
| NEW miniASMDC050F                              | 0.50                                     | 0.50                                     | 1.00                  | 24                                     | 100                     | 0.8                       | 8.0               | 0.150 | 0.150                   | 1.000                    | 1.000                    | A15                      |
| NEW miniASMDC075F/24                           | 0.75                                     | 0.75                                     | 1.50                  | 24                                     | 40                      | 0.8                       | 8.0               | 0.300 | 0.090                   | 0.290                    | 0.290                    | A15                      |
| NEW miniASMDC110F/16                           | 1.10                                     | 1.10                                     | 2.20                  | 16                                     | 100                     | 0.8                       | 8.0               | 0.300 | 0.060                   | 0.180                    | 0.180                    | A15                      |
| NEW miniASMDC110F/24                           | 1.10                                     | 1.10                                     | 2.20                  | 24                                     | 20                      | 0.8                       | 8.0               | 0.500 | 0.060                   | 0.180                    | 0.180                    | A15                      |
| NEW miniASMDC125F/16                           | 1.25                                     | 1.25                                     | 2.50                  | 16                                     | 100                     | 0.8                       | 8.0               | 0.400 | 0.050                   | 0.140                    | 0.140                    | A15                      |
| NEW miniASMDC150F/16                           | 1.50                                     | 1.50                                     | 2.80                  | 16                                     | 100                     | 0.8                       | 8.0               | 0.500 | 0.040                   | 0.110                    | 0.110                    | A15                      |
| NEW miniASMDC150F/24                           | 1.50                                     | 1.50                                     | 3.00                  | 24                                     | 20                      | 1.0                       | 8.0               | 1.500 | 0.040                   | 0.120                    | 0.120                    | A15                      |
| NEW miniASMDC260F/16                           | 2.60                                     | 2.60                                     | 5.00                  | 16                                     | 100                     | 1.2                       | 8.0               | 5.000 | 0.015                   | 0.050                    | 0.050                    | A15                      |



**Table A3 Electrical Characteristics for Automotive Devices**

Cont'd

| Part Number         | I <sub>H</sub> (A)@<br>R <sub>1MAX</sub> | I <sub>H</sub> (A)@<br>R <sub>aMAX</sub> | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D Typ</sub><br>(W) | Max. Time-to-trip |     | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | R <sub>aMAX</sub><br>(Ω) | Figure for Dimensions |
|---------------------|------------------------------------------|------------------------------------------|-----------------------|----------------------------------------|-------------------------|---------------------------|-------------------|-----|-------------------------|--------------------------|--------------------------|-----------------------|
|                     |                                          |                                          |                       |                                        |                         |                           | (A)               | (s) |                         |                          |                          |                       |
| BD                  |                                          |                                          |                       |                                        |                         |                           |                   |     |                         |                          |                          |                       |
| 14V — Bladed Device |                                          |                                          |                       |                                        |                         |                           |                   |     |                         |                          |                          |                       |
| BD280-1130-10/16    | 8                                        | 8                                        | 13                    | 14                                     | 100                     | 4.4                       | 40                | 8   | 0.0095                  | 0.0185                   | 0.0185                   | A13                   |
| BD280-1130-15/16    | 12                                       | 12                                       | 20                    | 14                                     | 100                     | 4.5                       | 60                | 8   | 0.0050                  | 0.0070                   | 0.0070                   | A13                   |
| BD280-1130-20/16    | 16                                       | 16                                       | 26                    | 14                                     | 100                     | 5.2                       | 80                | 10  | 0.0028                  | 0.0064                   | 0.0064                   | A13                   |
| BD280-1927-25/16-W  | 20                                       | 20                                       | 32                    | 14                                     | 100                     | 6.0                       | 100               | 13  | 0.0024                  | 0.0042                   | 0.0042                   | A14                   |
| BD280-1927-30/16-W  | 21                                       | 21                                       | 38                    | 14                                     | 100                     | 6.2                       | 120               | 13  | 0.0021                  | 0.0043                   | 0.0043                   | A14                   |

**Notes:**
 $I_H$  : Hold current: maximum current device will pass without interruption in 25°C, unless otherwise specified (20°C for ASMD).

 $I_T$  : Trip current: minimum current that will switch the device from low resistance to high resistance in 25°C still air, unless otherwise specified.

 $V_{MAX}$  : Maximum voltage device can withstand without damage at rated current.

 $I_{MAX}$  : Maximum fault current device can withstand without damage at rated voltage.

 $P_D$  : Power dissipated from device when in the tripped state in 25°C still air, unless otherwise specified.

 $R_{MIN}$  : Minimum resistance of device as supplied at 25°C, unless otherwise specified.

 $R_{1MAX}$  : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 25°C unless otherwise specified.

 $R_{aMAX}$  : Maximum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.

 $R_{aMIN}$  : Minimum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.

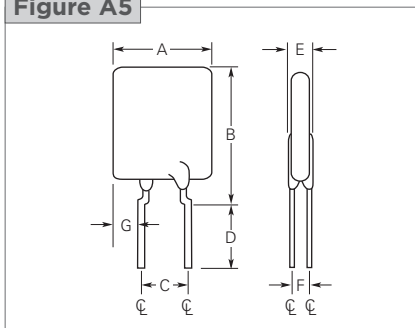
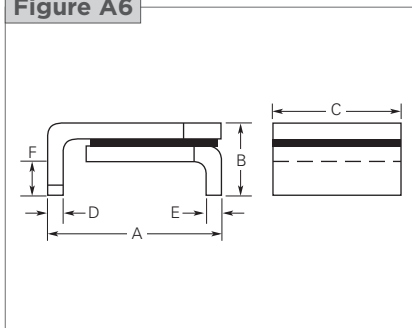
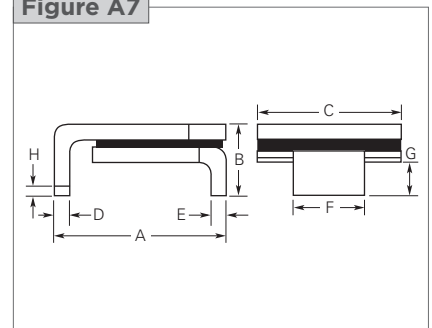
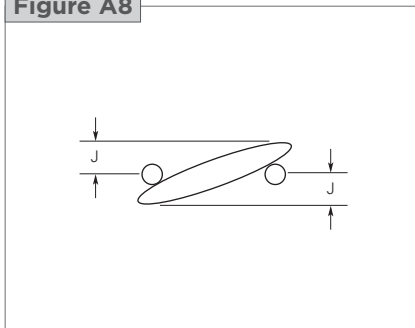
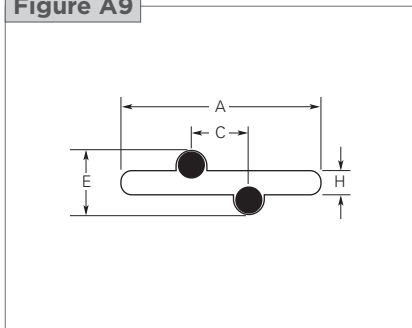
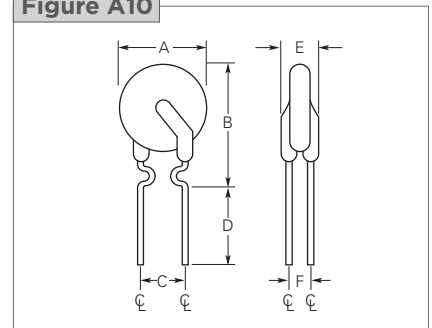
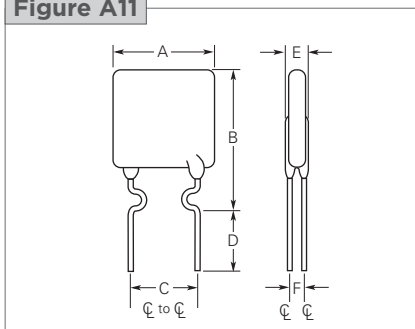
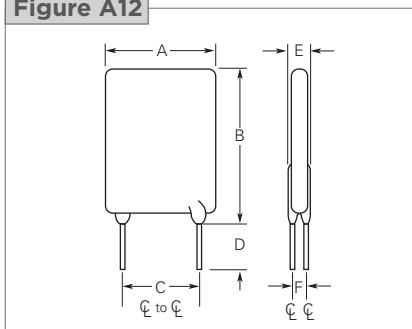
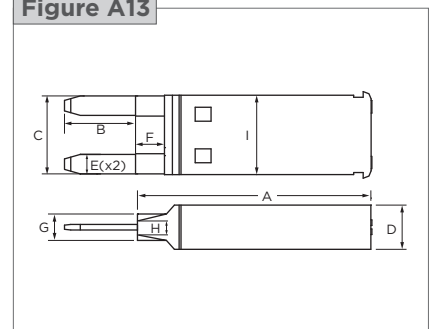
**Figure A5-A15 Dimension Figures for Automotive Devices**
**Figure A5**

**Figure A6**

**Figure A7**

**Figure A8**

**Figure A9**

**Figure A10**

**Figure A11**

**Figure A12**

**Figure A13**


Figure A5-A15 Dimension Figures for Automotive Devices

Cont'd

Figure A14

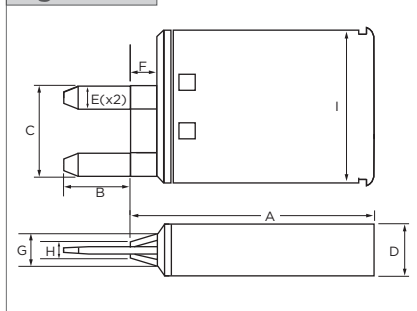


Figure A15

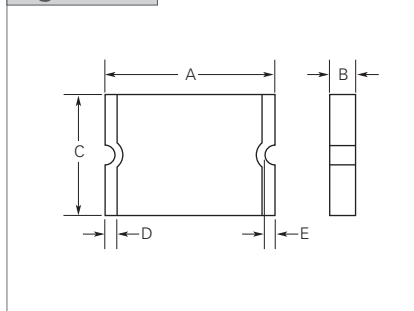


Table A4 Dimensions for Automotive Devices in Millimeters (Inches)

| Part Number             | A    |                 | B    |                | C    |               | D             |      | E             |                | F             |      | G    |                 | H               |               | J              |  |
|-------------------------|------|-----------------|------|----------------|------|---------------|---------------|------|---------------|----------------|---------------|------|------|-----------------|-----------------|---------------|----------------|--|
|                         | Min. | Max.            | Min. | Max.           | Min. | Max.          | Min.          | Max. | Min.          | Max.           | Min.          | Max. | Min. | Max.            | Typ.            | Max.          | Figure         |  |
| AGRF                    |      |                 |      |                |      |               |               |      |               |                |               |      |      |                 |                 |               |                |  |
| 16V — Radial-leaded     |      |                 |      |                |      |               |               |      |               |                |               |      |      |                 |                 |               |                |  |
| AGRF400                 | —    | 8.9<br>(0.35)   | —    | 14.1<br>(0.56) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.15) | —    | —    | 3.10<br>(0.120) | 1.24<br>(0.049) | 1.4<br>(0.06) | A5, A8,<br>A9  |  |
| AGRF500                 | —    | 10.4<br>(0.41)  | —    | 15.6<br>(0.61) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 3.94<br>(0.155) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |  |
| AGRF600                 | —    | 10.7<br>(0.42)  | —    | 18.4<br>(0.73) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 4.07<br>(0.160) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |  |
| AGRF700                 | —    | 11.2<br>(0.44)  | —    | 21.0<br>(0.73) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 4.49<br>(0.177) | 1.24<br>(0.049) | 1.7<br>(0.07) | A5, A8,<br>A9  |  |
| AGRF800                 | —    | 12.7<br>(0.50)  | —    | 22.2<br>(0.88) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 5.08<br>(0.200) | 1.24<br>(0.049) | 1.8<br>(0.07) | A5, A8,<br>A9  |  |
| AGRF900                 | —    | 14.0<br>(0.55)  | —    | 23.0<br>(0.91) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 5.69<br>(0.224) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |  |
| AGRF1000                | —    | 16.51<br>(0.65) | —    | 25.7<br>(1.01) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 6.96<br>(0.274) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |  |
| AGRF1100                | —    | 17.5<br>(0.69)  | —    | 26.5<br>(1.04) | —    | 3.0<br>(0.12) | 7.6<br>(0.3)  | —    | 4.3<br>(0.17) | 5.8<br>(0.20)  | 1.2<br>(0.05) | —    | —    | 7.47<br>(0.294) | 1.24<br>(0.049) | 2.4<br>(0.09) | A5, A8,<br>A9  |  |
| AGRF1200                | —    | 17.5<br>(0.69)  | —    | 28.8<br>(1.14) | —    | 3.5<br>(0.14) | 7.6<br>(0.3)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.4<br>(0.06) | —    | —    | 4.83<br>(0.190) | 1.45<br>(0.057) | 1.5<br>(0.06) | A5, A8,<br>A9  |  |
| AGRF1400                | —    | 23.5<br>(0.925) | —    | 28.7<br>(1.13) | —    | 3.5<br>(0.14) | 7.6<br>(0.3)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.4<br>(0.06) | —    | —    | 7.82<br>(0.308) | 1.45<br>(0.057) | 1.9<br>(0.07) | A5, A8,<br>A9  |  |
| AHRF (High Temperature) |      |                 |      |                |      |               |               |      |               |                |               |      |      |                 |                 |               |                |  |
| 30V — Radial-leaded     |      |                 |      |                |      |               |               |      |               |                |               |      |      |                 |                 |               |                |  |
| AHRF050                 | —    | 7.4<br>(0.29)   | —    | 12.7<br>(0.50) | —    | 3.3<br>(0.13) | 7.6<br>(0.30) | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —<br>(0.049)    | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |  |
| AHRF070                 | —    | 6.9<br>(0.27)   | —    | 10.8<br>(0.43) | —    | 3.3<br>(0.13) | 7.6<br>(0.30) | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —<br>(0.049)    | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |  |
| AHRF100                 | —    | 9.7<br>(0.38)   | —    | 13.6<br>(0.54) | —    | 3.0<br>(0.12) | 7.6<br>(0.30) | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —<br>(0.049)    | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |  |

**Table A4 Dimensions for Automotive Devices in Millimeters (Inches)**

Cont'd

| Part Number             | A    |                 | B    |                | C              |                | D              |      | E             |                | F             |      | G    |                 | H               | J             | Figure         |
|-------------------------|------|-----------------|------|----------------|----------------|----------------|----------------|------|---------------|----------------|---------------|------|------|-----------------|-----------------|---------------|----------------|
|                         | Min. | Max.            | Min. | Max.           | Min.           | Max.           | Min.           | Max. | Min.          | Max.           | Min.          | Max. | Min. | Max.            | Typ.            | Max.          |                |
| AHRF (High Temperature) |      |                 |      |                |                |                |                |      |               |                |               |      |      |                 |                 |               |                |
| 16V — Radial-leaded     |      |                 |      |                |                |                |                |      |               |                |               |      |      |                 |                 |               |                |
| AHRF200                 | —    | 9.4<br>(0.37)   | —    | 14.4<br>(0.57) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |
| AHRF300                 | —    | 8.8<br>(0.35)   | —    | 13.8<br>(0.55) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF400                 | —    | 10.0<br>(0.39)  | —    | 15.0<br>(0.59) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF450                 | —    | 10.4<br>(0.41)  | —    | 15.6<br>(0.61) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | 3.94<br>(0.155) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF550                 | —    | 11.2<br>(0.44)  | —    | 18.9<br>(0.74) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF600                 | —    | 11.2<br>(0.44)  | —    | 21.0<br>(0.73) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | 4.49<br>(0.177) | 1.24<br>(0.049) | 1.7<br>(0.07) | A5, A8,<br>A9  |
| AHRF650                 | —    | 12.7<br>(0.50)  | —    | 22.2<br>(0.88) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | 5.08<br>(0.200) | 1.24<br>(0.049) | 1.8<br>(0.07) | A5, A8,<br>A9  |
| AHRF700                 | —    | 14.0<br>(0.55)  | —    | 21.9<br>(0.86) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF750                 | —    | 14.0<br>(0.55)  | —    | 23.5<br>(0.93) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | 5.69<br>(0.224) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |
| AHRF800                 | —    | 16.5<br>(0.65)  | —    | 22.5<br>(0.88) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF900                 | —    | 16.5<br>(0.65)  | —    | 25.7<br>(1.01) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 4.3<br>(0.17) | 5.8<br>(0.23)  | 1.2<br>(0.05) | —    | —    | —               | —               | —             | A5, A8,<br>A9  |
| AHRF1000                | —    | 17.5<br>(0.69)  | —    | 26.5<br>(1.04) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.2<br>(0.05) | —    | —    | 7.47<br>(0.294) | 1.24<br>(0.049) | 1.5<br>(0.06) | A5, A8,<br>A9  |
| AHRF1100                | —    | 21.0<br>(0.83)  | —    | 26.1<br>(1.03) | —              | 3.0<br>(0.12)  | 7.6<br>(0.30)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.2<br>(0.05) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF1300                | —    | 23.5<br>(0.925) | —    | 28.7<br>(1.13) | —              | 3.5<br>(0.14)  | 7.6<br>(0.30)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.4<br>(0.06) | —    | —    | 7.82<br>(0.308) | 1.45<br>(0.057) | 1.9<br>(0.08) | A5, A8,<br>A9  |
| AHRF1400                | —    | 23.5<br>(0.93)  | —    | 28.7<br>(1.13) | —              | 3.6<br>(0.14)  | 7.6<br>(0.30)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.4<br>(0.06) | —    | —    | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF1500                | —    | 23.5<br>(0.93)  | —    | 28.7<br>(1.13) | —              | 3.5<br>(0.14)  | 7.6<br>(0.30)  | —    | 9.4<br>(0.37) | 10.9<br>(0.43) | 1.4<br>(0.06) | —    | —    | 7.82<br>(0.308) | —               | —             | A5, A8,<br>A9  |
| AHEF (High Temperature) |      |                 |      |                |                |                |                |      |               |                |               |      |      |                 |                 |               |                |
| 32V — Radial-leaded     |      |                 |      |                |                |                |                |      |               |                |               |      |      |                 |                 |               |                |
| AHEF050                 | —    | 7.4<br>(0.29)   | —    | 12.7<br>(0.50) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —    | —             | 3.3<br>(0.13)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A10 |
| AHEF070                 | —    | 6.9<br>(0.27)   | —    | 10.8<br>(0.43) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —    | —             | 3.0<br>(0.12)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A11 |
| AHEF100                 | —    | 9.7<br>(0.38)   | —    | 13.6<br>(0.54) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —    | —             | 3.0<br>(0.12)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A10 |
| AHEF300                 | —    | 10.2<br>(0.40)  | —    | 15.5<br>(0.61) | 4.32<br>(0.17) | 5.84<br>(0.23) | 7.6<br>(0.30)  | —    | —             | 3.8<br>(0.15)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A12 |
| AHEF500                 | —    | 14.0<br>(0.55)  | —    | 24.1<br>(0.95) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 11.5<br>(0.45) | —    | —             | 3.8<br>(0.15)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A12 |
| AHEF750                 | —    | 21.1<br>(0.83)  | —    | 24.9<br>(0.98) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —    | —             | 3.8<br>(0.15)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A12 |
| AHEF1000                | —    | 23.5<br>(0.93)  | —    | 27.9<br>(1.10) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —    | —             | 4.0<br>(0.16)  | —             | —    | —    | —               | —               | —             | A8, A9,<br>A12 |

**Table A4 Dimensions for Automotive Devices in Millimeters (Inches)**

Cont'd

| Part Number            | A               |                 | B    |                 | C               |                 | D               |                 | E               |                 | F               |                 | G               |                 | H               |      | Figure |
|------------------------|-----------------|-----------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|--------|
|                        | Min.            | Max.            | Min. | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max. |        |
| AHS (High Temperature) |                 |                 |      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| 16V — Surface-mount    |                 |                 |      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| AHS080-2018            | 4.72<br>(0.186) | 5.44<br>(0.214) | —    | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —               | —               | —               | —    | A6     |
| AHS160                 | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| AHS200                 | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.240)  | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| AHS300                 | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.240)  | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD                   |                 |                 |      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| 16-60V — Surface-mount |                 |                 |      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |      |        |
| ASMD030F               | 6.73<br>(0.265) | 7.98<br>(0.314) | —    | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD050F               | 6.73<br>(0.265) | 7.98<br>(0.314) | —    | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD075F               | 6.73<br>(0.265) | 7.98<br>(0.314) | —    | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD100F               | 6.73<br>(0.265) | 7.98<br>(0.314) | —    | 3.00<br>(0.118) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD125F               | 6.73<br>(0.265) | 7.98<br>(0.314) | —    | 3.00<br>(0.118) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD150F               | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD185F               | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD200F               | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |
| ASMD250F               | 8.00<br>(0.315) | 9.40<br>(0.370) | —    | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | —    | A7     |

| Part Number                | A               |                 | B               |                 | C               |                 | D               |                 | E                |              | Figure |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|--------------|--------|
|                            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.             | Max.         |        |
| <b>nanoASMD</b>            |                 |                 |                 |                 |                 |                 |                 |                 |                  |              |        |
| <b>30V — Surface-mount</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |              |        |
| nanoASMD012F               | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.62<br>(0.024) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |
| nanoASMD016F               | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.62<br>(0.024) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |
| nanoASMD020F               | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.58<br>(0.023) | 0.82<br>(0.032) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |
| nanoASMD035F               | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.58<br>(0.023) | 0.82<br>(0.032) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |
| <b>microASMD</b>           |                 |                 |                 |                 |                 |                 |                 |                 |                  |              |        |
| <b>30V — Surface-mount</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |              |        |
| microASMD005F              | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.50<br>(0.019) | 0.85<br>(0.034) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |
| microASMD010F              | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.50<br>(0.019) | 0.85<br>(0.034) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —<br>(0.003) | A15    |

**Table A4 Dimensions for Automotive Devices in Millimeters (Inches)**

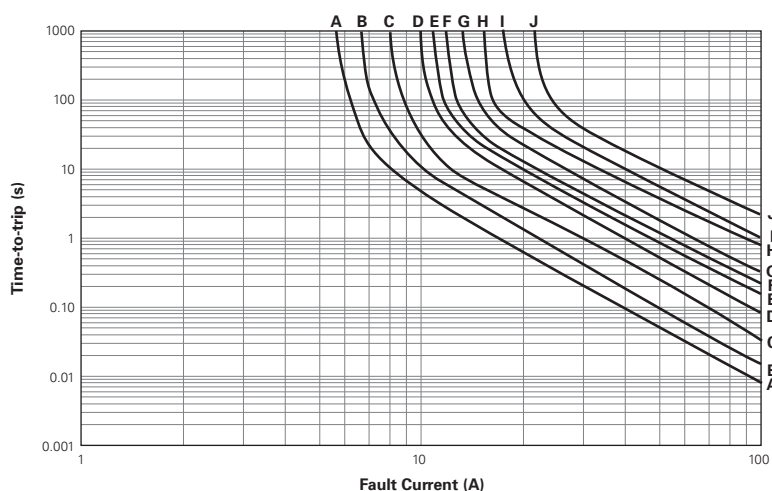
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| Part Number                         | A                |         | B       |         | C       |         | D       |         | E       |         | Figure |     |
|-------------------------------------|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|-----|
|                                     | Min.             | Max.    | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    | Min.    | Max.    |        |     |
| miniASMDC<br>16-60V — Surface-mount |                  |         |         |         |         |         |         |         |         |         |        |     |
| NEW                                 | miniASMDC010F    | 4.37    | 4.73    | 0.635   | 0.89    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.186) | (0.025) | (0.035) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC014F    | 4.37    | 4.73    | 0.635   | 0.89    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.186) | (0.025) | (0.035) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC020F    | 4.37    | 4.73    | 0.635   | 0.89    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.186) | (0.025) | (0.035) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC030F    | 4.37    | 4.73    | 0.635   | 0.89    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.186) | (0.025) | (0.035) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC050F    | 4.37    | 4.73    | 0.38    | 0.62    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.186) | (0.015) | (0.025) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC075F/24 | 4.37    | 4.83    | 0.81    | 1.46    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.032) | (0.057) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC110F/16 | 4.37    | 4.83    | 0.28    | 0.48    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.011) | (0.019) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC110F/24 | 4.37    | 4.83    | 0.81    | 1.46    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.032) | (0.057) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC125F/16 | 4.37    | 4.83    | 0.28    | 0.48    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.011) | (0.019) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC150F/16 | 4.37    | 4.83    | 0.28    | 0.48    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.011) | (0.019) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC150F/24 | 4.37    | 4.83    | 1.00    | 1.94    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.040) | (0.077) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |
| NEW                                 | miniASMDC260F/16 | 4.37    | 4.83    | 1.02    | 1.52    | 3.07    | 3.41    | 0.25    | 0.95    | 0.20    | —      | A15 |
|                                     |                  | (0.172) | (0.190) | (0.042) | (0.060) | (0.121) | (0.134) | (0.010) | (0.040) | (0.008) | —      |     |

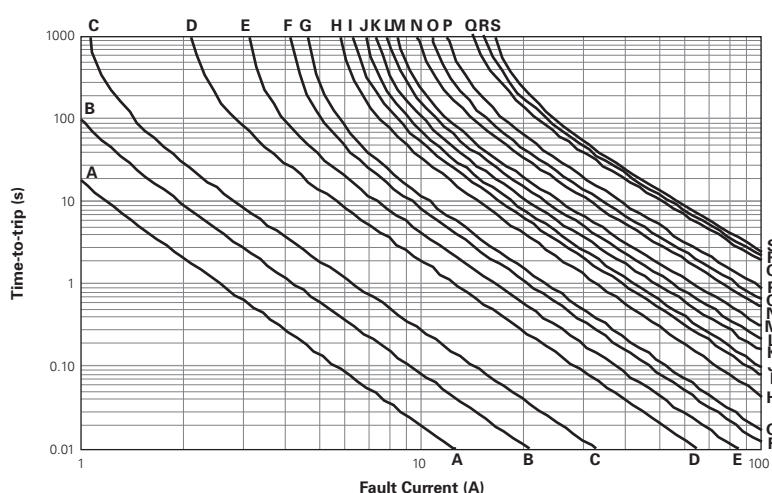
| Part Number         | A                |                  | B               |                 | C                |                  | D               |                 | E(x2)           |                 | F               |                 | G               |                 | H               |                 | I                |                  | Figure |
|---------------------|------------------|------------------|-----------------|-----------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|--------|
|                     | Min.             | Max.             | Min.            | Max.            | Min.             | Max.             | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.            | Max.            | Min.             | Max.             |        |
| BD                  |                  |                  |                 |                 |                  |                  |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                  |        |
| 14V — Bladed Device |                  |                  |                 |                 |                  |                  |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                  |        |
| BD280-1130-10/16    | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1130-15/16    | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1130-20/16    | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1927-25/16-W  | 26.65<br>(1.049) | 27.35<br>(1.077) | 8.60<br>(0.339) | 9.20<br>(0.362) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 1.80<br>(0.071) | 2.20<br>(0.087) | 3.50<br>(0.138) | 3.90<br>(0.154) | 1.70<br>(0.067) | 2.30<br>(0.091) | 19.00<br>(0.748) | 19.40<br>(0.764) | A14    |
| BD280-1927-30/16-W  | 26.65<br>(1.049) | 27.35<br>(1.077) | 8.60<br>(0.339) | 9.20<br>(0.362) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 1.80<br>(0.071) | 2.20<br>(0.087) | 3.50<br>(0.138) | 3.90<br>(0.154) | 1.70<br>(0.067) | 2.30<br>(0.091) | 19.00<br>(0.748) | 19.40<br>(0.764) | A14    |

**Figure A16-A24 Typical Time-to-trip at 25°C for Automotive Devices**
**AGRF**

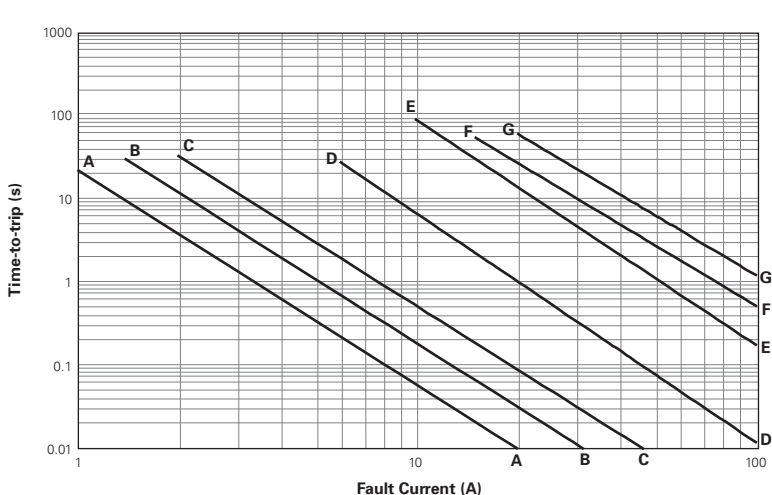
A = AGRF400  
 B = AGRF500  
 C = AGRF600  
 D = AGRF700  
 E = AGRF800  
 F = AGRF900  
 G = AGRF1000  
 H = AGRF1100  
 I = AGRF1200  
 J = AGRF1400

**Figure A16**

**AHRF**

A = AHRF050      K = AHRF700  
 B = AHRF070      L = AHRF750  
 C = AHRF100      M = AHRF800  
 D = AHRF200      N = AHRF900  
 E = AHRF300      O = AHRF1000  
 F = AHRF400      P = AHRF1100  
 G = AHRF450      Q = AHRF1300  
 H = AHRF550      R = AHRF1400  
 I = AHRF600      S = AHRF1500  
 J = AHRF650

**Figure A17**

**AHEF**

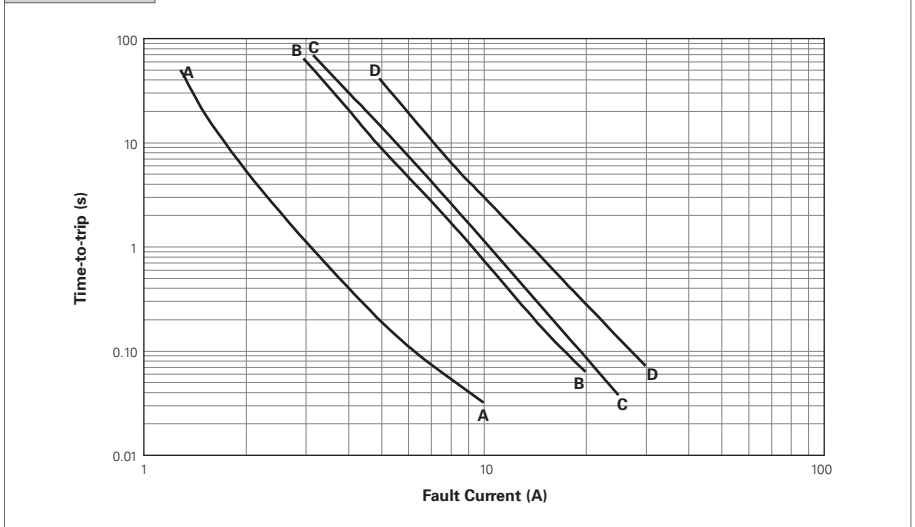
A = AHEF050  
 B = AHEF070  
 C = AHEF100  
 D = AHEF300  
 E = AHEF500  
 F = AHEF750  
 G = AHEF1000

**Figure A18**


**AHS**

- A = AHS080-2018
- B = AHS160
- C = AHS200
- D = AHS300

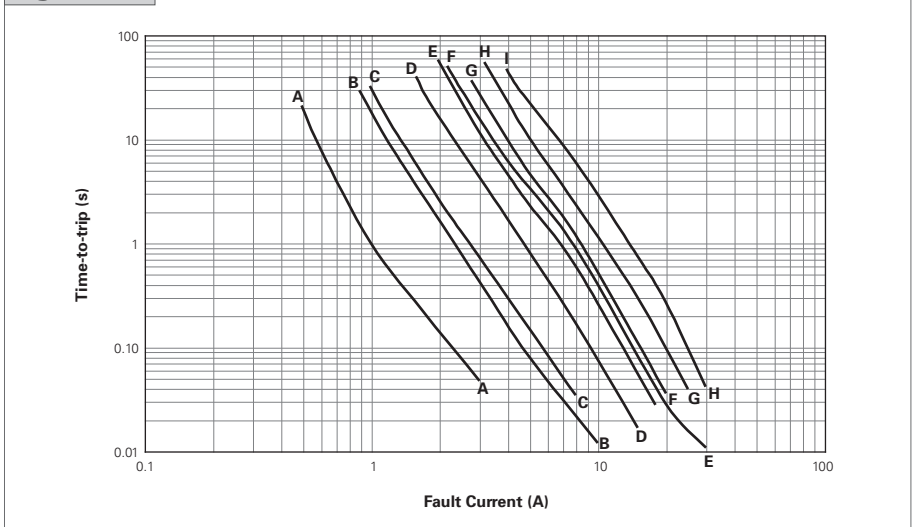
**Figure A19**



**ASMD**

- A = ASMD030F
- B = ASMD050F
- C = ASMD075F
- D = ASMD100F
- E = ASMD125F
- F = ASMD150F
- G = ASMD185F
- H = ASMD200F
- I = ASMD250F

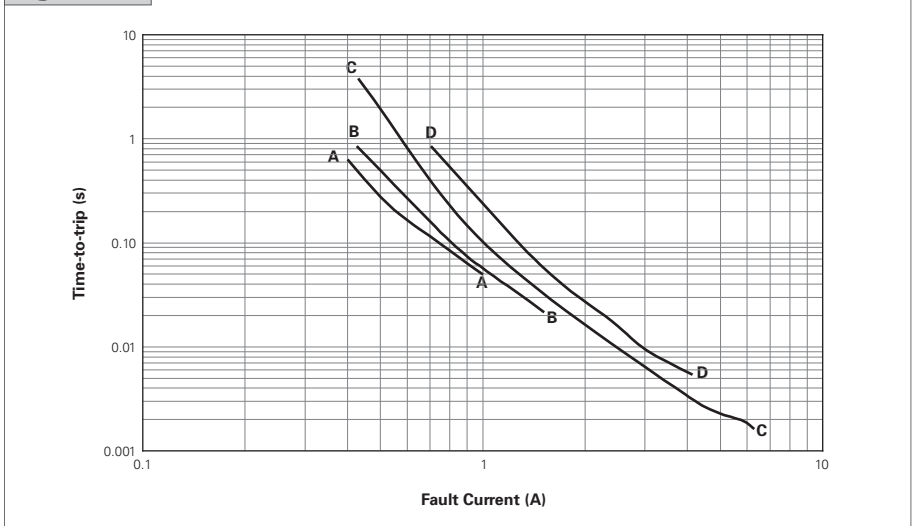
**Figure A20**



**nanoASMDC**

- A = nanoASMDC012F
- B = nanoASMDC016F
- C = nanoASMDC020F
- D = nanoASMDC035F

**Figure A21**



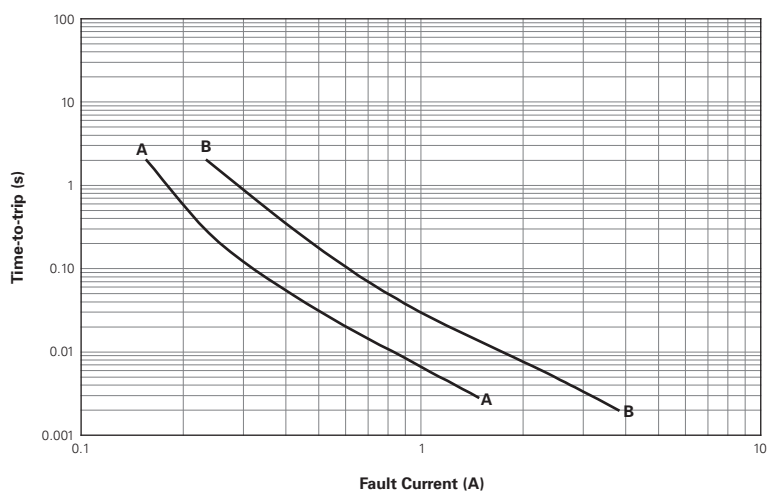
**Figure A16-A24** Typical Time-to-trip at 25°C for Automotive Devices

Cont'd

**microASMD**

- A = microASMD005F
- B = microASMD010F

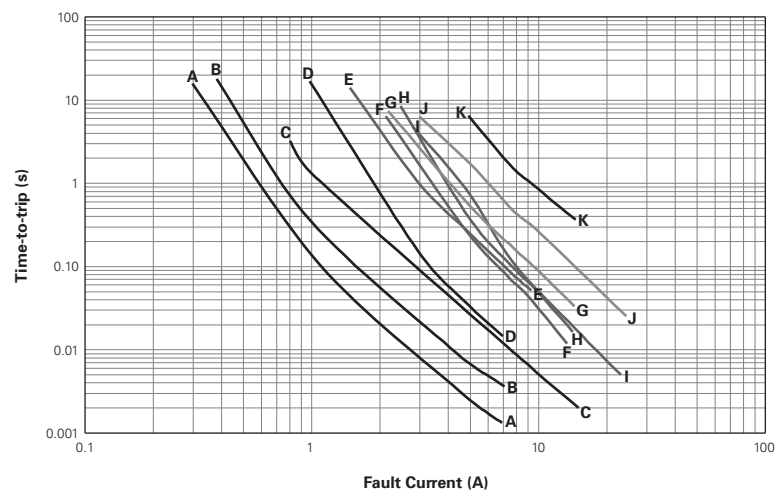
**Figure A22**



**miniASMDC**

- A = miniASMDC010F, miniASMDC014F
- B = miniASMDC020F
- C = miniASMDC030F
- D = miniASMDC050F
- E = miniASMDC075F/24
- F = miniASMDC110F/16
- G = miniASMDC110F/24
- H = miniASMDC125F/16
- I = miniASMDC150F/16
- J = miniASMDC150F/24
- K = miniASMDC260F/16

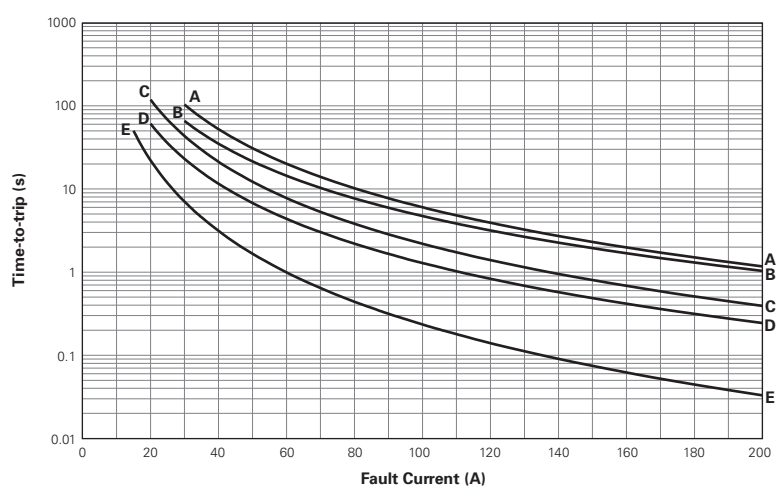
**Figure A23**



**BD**

- A = BD30A
- B = BD25A
- C = BD20A
- D = BD15A
- E = BD10A

**Figure A24**





**Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices**
**AGRF**
**Physical Characteristics**

|                           |                                                                                                                                                                                                              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lead material             | AGRF400 to AGRF1100 : Tin Plated Copper, 0.52mm <sup>2</sup> (20AWG) ø 0.8 mm/0.032in<br>AGRF1200 to AGRF1400 : Tin Plated Copper, 0.82mm <sup>2</sup> (18AWG) ø 1.0mm/0.040in                               |
| Soldering characteristics | Solderability per ANSI/J-STD-002 Category 3                                                                                                                                                                  |
| Solder heat withstand     | AGRF400: per IEC68-2-20 Test Tb, Method 1A, Condition A: can withstand 5 seconds at 260°C ± 5°C<br>AGRF500-AGRF1400: per IEC68-2-20 Test Tb, Method 1A, Condition B: can withstand 10 seconds at 260°C ± 5°C |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0                                                                                                                                                         |
| Operation temperature     | -40°C~85°C                                                                                                                                                                                                   |

**Note:** See PS400 for other physical characteristics.  
Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85% RH, 1000 hours | ±5%               |
| Thermal shock      | 85°C, -40°C (10 times)   | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Note:** See PS400 for other environmental specifications.

**AHRF**
**Physical Characteristics**

|                           |                                                                                                                                                                                                                                                                                         |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lead material             | AHRF050 to AHRF200 : Tin-plated Copper Clad Steel, 0.205mm <sup>2</sup> (24 AWG), ø 0.51mm/0.020in<br>AHRF300 to AHRF1100 : Tin-plated copper 0.52mm <sup>2</sup> (20 AWG), ø 0.81mm/0.032 in<br>AHRF1300 to AHRF1500 : Tin-plated copper 0.82mm <sup>2</sup> (18 AWG), ø 1.0mm/0.04 in |
| Soldering characteristics | Solderability per ANSI/J-STD 002 Category 3                                                                                                                                                                                                                                             |
| Solder heat withstand     | per IEC 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds at 260°C ± 5°C                                                                                                                                                                                               |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0 requirements                                                                                                                                                                                                                       |
| Operation temperature     | -40°C~125°C                                                                                                                                                                                                                                                                             |

**Note:** See PS400 for other physical characteristics.  
Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85% RH, 1000 hours | ±5%               |
| Thermal shock      | 125°C, -40°C (10 times)  | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Note:** See PS400 for other environmental specifications.

**AHEF**
**Physical Characteristics**

|                           |                                                                                                                                                                                                                                                                            |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lead material             | AHEF050 to AHEF100 : Tin-plated Copper Clad Steel, 0.205mm <sup>2</sup> (24 AWG), ø 0.51mm/0.020in.<br>AHEF300 to AHEF750 : Tin-plated Copper 0.52mm <sup>2</sup> (20 AWG), ø 0.81mm/0.032in<br>AHEF1000 : Tin-plated copper 0.82mm <sup>2</sup> (18 AWG), ø 1.0mm/0.04 in |
| Soldering characteristics | Solderability per ANSI/J-STD 002 Category 3                                                                                                                                                                                                                                |
| Solder heat withstand     | per IEC 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds at 260°C ± 5°C                                                                                                                                                                                  |
| Insulating material       | Cured, flame-retardant epoxy polymer; meets UL 94V-0 requirements                                                                                                                                                                                                          |
| Operation temperature     | -40°C~125°C                                                                                                                                                                                                                                                                |

**Note:** See PS400 for other physical characteristics.  
Devices are not designed to be placed through a reflow process.

**Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices** Cont'd

**AHEF**
**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±5%               |
|                    | 85°C, 1000 hours         | ±5%               |
| Humidity aging     | 85°C, 85% RH, 1000 hours | ±5%               |
| Thermal shock      | 125°C, -40°C (10 times)  | ±5%               |
| Solvent resistance | MIL-STD-202, Method 215F | No change         |

**Note:** See PS400 for other environmental specifications.

**AHS**
**Physical Characteristics**

|                           |                                                    |
|---------------------------|----------------------------------------------------|
| Lead material             | Tin-plated brass to MIL-T-10727B                   |
| Soldering characteristics | Solderability per ANSI-J-STD-002 Category 1        |
| Solder heat withstand     | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A |
| Flammability              | per IEC 695-2-2 Needle flame test for 20 seconds   |
| Operation temperature     | -40°C~125°C                                        |

**Note:** See PS400 for other physical characteristics.

**Environmental Specifications**

| Test               | Conditions               | Resistance Change |
|--------------------|--------------------------|-------------------|
| Passive aging      | 70°C, 1000 hours         | ±3% Typical       |
|                    | 85°C, 1000 hours         | ±5% Typical       |
| Humidity aging     | 85°C, 85% RH, 1000 hours | ±1.2% Typical     |
| Thermal shock      | 125°C, -40°C (20 times)  | -33% Typical      |
| Solvent resistance | Freon                    | No change         |
|                    | Trichloroethane          | No change         |
|                    | Hydrocarbons             | No change         |

**Note:** See PS400 for other environmental specifications.

**ASMD**
**Physical Characteristics**

|                                |                                                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------|
| Terminal pad material          | 98%+ Tin-plated Brass                                                                           |
| Soldering characteristics      | Solderability per ANSI-J-STD-002 Category 1                                                     |
| Solder heat withstand          | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A                                              |
| Flammability resistance        | per IEC 695-2-2 Needle flame test for 20 seconds                                                |
| Recommended storage conditions | 40°C max, 70% RH max; devices may not meet specified ratings if storage conditions are exceeded |
| Operation temperature          | -40°C~85°C                                                                                      |

**Note:** See PS400 for other physical characteristics.

**Environmental Specifications**

| Test               | Conditions              | Resistance Change |
|--------------------|-------------------------|-------------------|
| Passive aging      | 60°C, 1000 hours        | ±3% typical       |
|                    | 85°C, 1000 hours        | ±5% typical       |
| Humidity aging     | 85°C, 85% RH, 100 hours | ±1.2% typical     |
| Thermal shock      | 85°C, -40°C (20 times)  | -33% typical      |
|                    | 125°C, -55°C (10 times) | -33% typical      |
| Solvent resistance | Freon                   | No change         |
|                    | Trichloroethane         | No change         |
|                    | Hydrocarbons            | No change         |

**Note:** See PS400 for other environmental specifications.

**Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices** Cont'd
**nanoASMDC/microASMD/miniASMDC**
**Physical Characteristics**

|                                |                                                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------|
| Terminal pad material          | 100% matte tin with nickel underplate                                                           |
| Soldering characteristics      | Solderability per ANSI-J-STD-002 Category 3                                                     |
| Solder heat withstand          | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A                                              |
| Flammability resistance        | per IEC 695-2-2 Needle flame test for 20 seconds                                                |
| Recommended storage conditions | 40°C max, 70% RH max; devices may not meet specified ratings if storage conditions are exceeded |
| Operation temperature          | -40°C~85°C                                                                                      |

**Note:** See PS400 for other physical characteristics.

**Environmental Specifications**

| Test               | Conditions              | Resistance Change |
|--------------------|-------------------------|-------------------|
| Passive aging      | 60°C, 1000 hours        | ±3% typical       |
|                    | 85°C, 1000 hours        | ±5% typical       |
| Humidity aging     | 85°C, 85% RH, 100 hours | ±1.2% typical     |
| Thermal shock      | 85°C, -40°C (20 times)  | -33% typical      |
|                    | 125°C, -55°C (10 times) | -33% typical      |
| Solvent resistance | Freon                   | No change         |
|                    | Trichloroethane         | No change         |
|                    | Hydrocarbons            | No change         |

**Note:** See PS400 for other environmental specifications.

**BD**
**Physical Characteristics**

|                           |                                                          |
|---------------------------|----------------------------------------------------------|
| Lead material             | Brass H65, thickness: 0.8mm , tin plating thickness: 5µm |
| Soldering characteristics | NA                                                       |
| Solder heat withstand     | NA                                                       |
| Insulating material       | Colored PBT, meets UL94V-0 requirements                  |
| Operation temperature     | -40°C~125°C                                              |

**Note:** See PS400 for other physical characteristics.

**Environmental Specifications**

| Test               | Conditions                                            | Resistance Change |
|--------------------|-------------------------------------------------------|-------------------|
| Passive aging      | 85°C, 1000 hours                                      | ±5%               |
| Humidity aging     | 85°C, 85% RH, 1000 hours                              | ±5%               |
|                    | 85°C, 85% RH (with 10% I <sub>HOLD</sub> ), 500 hours | ±5%               |
| Thermal shock      | 85°C to -40°C (5 times)                               | meet SCD          |
| Solvent resistance | MIL-STD-202, Method 215F                              | No change         |

**Note:** See PS400 for other environmental specifications.

**Table A6 Packaging and Marking Information for Automotive Devices**

| Part Number                    | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|--------------------------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>AGRF</b>                    |              |                      |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                      |                    |                           |              |                    |
| AGRF400                        | 500          | —                    | —                  | 10,000                    | GF4          | *                  |
| AGRF400-2                      | —            | 2,500                | —                  | 12,500                    | GF4          | *                  |
| AGRF400-AP                     | —            | —                    | 2,000              | 10,000                    | GF4          | *                  |
| AGRF500                        | 500          | —                    | —                  | 10,000                    | GF5          | *                  |
| AGRF500-2                      | —            | 2,000                | —                  | 10,000                    | GF5          | *                  |
| AGRF500-AP                     | —            | —                    | 2,000              | 10,000                    | GF5          | *                  |
| AGRF600                        | 500          | —                    | —                  | 10,000                    | GF6          | *                  |
| AGRF600-2                      | —            | 2,000                | —                  | 10,000                    | GF6          | *                  |
| AGRF600-AP                     | —            | —                    | 2,000              | 10,000                    | GF6          | *                  |
| AGRF700                        | 500          | —                    | —                  | 10,000                    | GF7          | *                  |
| AGRF700-2                      | —            | 1,500                | —                  | 7,500                     | GF7          | *                  |
| AGRF700-AP                     | —            | —                    | 1,500              | 7,500                     | GF7          | *                  |
| AGRF800                        | 500          | —                    | —                  | 10,000                    | GF8          | *                  |
| AGRF800-2                      | —            | 1,000                | —                  | 5,000                     | GF8          | *                  |
| AGRF800-AP                     | —            | —                    | 1,000              | 5,000                     | GF8          | *                  |
| AGRF900                        | 500          | —                    | —                  | 10,000                    | GF9          | *                  |
| AGRF900-2                      | —            | 1,000                | —                  | 5,000                     | GF9          | *                  |
| AGRF900-AP                     | —            | —                    | 1,000              | 5,000                     | GF9          | *                  |
| AGRF1000                       | 250          | —                    | —                  | 5,000                     | GF10         | *                  |
| AGRF1000-2                     | —            | 1,000                | —                  | 5,000                     | GF10         | *                  |
| AGRF1000-AP                    | —            | —                    | 1,000              | 5,000                     | GF10         | *                  |
| AGRF1100                       | 250          | —                    | —                  | 5,000                     | GF11         | *                  |
| AGRF1100-2                     | —            | 1,000                | —                  | 5,000                     | GF11         | *                  |
| AGRF1100-AP                    | —            | —                    | 1,000              | 5,000                     | GF11         | *                  |
| AGRF1200                       | 250          | —                    | —                  | 5,000                     | GF12         | *                  |
| AGRF1200-2                     | —            | 1,000                | —                  | 5,000                     | GF12         | *                  |
| AGRF1200-AP                    | —            | —                    | 1,000              | 5,000                     | GF12         | *                  |
| AGRF1400                       | 250          | —                    | —                  | 5,000                     | GF14         | *                  |
| AGRF1400-2                     | —            | 1,000                | —                  | 5,000                     | GF14         | *                  |
| AGRF1400-AP                    | —            | —                    | 1,000              | 5,000                     | GF14         | *                  |
| <b>AHRF (High Temperature)</b> |              |                      |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                      |                    |                           |              |                    |
| AHRF050                        | 500          | —                    | —                  | 10,000                    | HF0.5        | *                  |
| AHRF050-2                      | —            | 2,500                | —                  | 12,500                    | HF0.7        | *                  |
| AHRF050-AP                     | —            | —                    | 2,500              | 12,500                    | HF0.7        | *                  |
| AHRF070                        | 500          | —                    | —                  | 10,000                    | HF0.7        | *                  |
| AHRF070-2                      | —            | 2,500                | —                  | 12,500                    | HF0.7        | *                  |
| AHRF070-AP                     | —            | —                    | 2,500              | 12,500                    | HF0.7        | *                  |
| AHRF100                        | 500          | —                    | —                  | 10,000                    | HF1.0        | *                  |
| AHRF100-2                      | —            | 2,500                | —                  | 12,500                    | HF1.0        | *                  |
| AHRF100-AP                     | —            | —                    | 2,500              | 12,500                    | HF1.0        | *                  |
| AHRF200                        | 500          | —                    | —                  | 10,000                    | HF2          | *                  |
| AHRF200-2                      | —            | 2,500                | —                  | 12,500                    | HF2          | *                  |
| AHRF200-AP                     | —            | —                    | 2,500              | 12,500                    | HF2          | *                  |
| AHRF300                        | 500          | —                    | —                  | 10,000                    | HF3          | *                  |
| AHRF300-2                      | —            | 2,000                | —                  | 10,000                    | HF3          | *                  |
| AHRF300-AP                     | —            | —                    | 2,000              | 10,000                    | HF3          | *                  |
| AHRF400                        | 500          | —                    | —                  | 10,000                    | HF4          | *                  |
| AHRF400-2                      | —            | 1,500                | —                  | 7,500                     | HF4          | *                  |
| AHRF400-AP                     | —            | —                    | 1,500              | 7,500                     | HF4          | *                  |

\* These devices have been designed for use in automotive applications.

For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

**Table A6 Packaging and Marking Information for Automotive Devices**

Cont'd

| Part Number                    | Bag Quantity | Tape & Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|--------------------------------|--------------|----------------------|--------------------|---------------------------|--------------|--------------------|
| <b>AHRF (High Temperature)</b> |              |                      |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                      |                    |                           |              |                    |
| AHRF450                        | 500          | —                    | —                  | 10,000                    | HF4.5        | *                  |
| AHRF450-2                      | —            | 1,500                | —                  | 7,500                     | HF4.5        | *                  |
| AHRF450-AP                     | —            | —                    | 1,500              | 7,500                     | HF4.5        | *                  |
| AHRF550                        | 500          | —                    | —                  | 10,000                    | HF5.5        | *                  |
| AHRF550-2                      | —            | 2,000                | —                  | 10,000                    | HF5.5        | *                  |
| AHRF550-AP                     | —            | —                    | 2,000              | 10,000                    | HF5.5        | *                  |
| AHRF600                        | 500          | —                    | —                  | 10,000                    | HF6          | *                  |
| AHRF600-2                      | —            | 2,000                | —                  | 10,000                    | HF6          | *                  |
| AHRF600-AP                     | —            | —                    | 2,000              | 10,000                    | HF6          | *                  |
| AHRF650                        | 500          | —                    | —                  | 10,000                    | HF6.5        | *                  |
| AHRF650-2                      | —            | 1,500                | —                  | 7,500                     | HF6.5        | *                  |
| AHRF650-AP                     | —            | —                    | 1,500              | 7,500                     | HF6.5        | *                  |
| AHRF700                        | 500          | —                    | —                  | 10,000                    | HF7          | *                  |
| AHRF700-2                      | —            | 1,500                | —                  | 7,500                     | HF7          | *                  |
| AHRF700-AP                     | —            | —                    | 1,500              | 7,500                     | HF7          | *                  |
| AHRF750                        | 500          | —                    | —                  | 10,000                    | HF7.5        | *                  |
| AHRF750-2                      | —            | 1,000                | —                  | 5,000                     | HF7.5        | *                  |
| AHRF750-AP                     | —            | —                    | 1,000              | 5,000                     | HF7.5        | *                  |
| AHRF800                        | 500          | —                    | —                  | 10,000                    | HF8          | *                  |
| AHRF800-2                      | —            | 1,000                | —                  | 5,000                     | HF8          | *                  |
| AHRF800-AP                     | —            | —                    | 1,000              | 5,000                     | HF8          | *                  |
| AHRF900                        | 250          | —                    | —                  | 5,000                     | HF9          | *                  |
| AHRF900-2                      | —            | 1,000                | —                  | 5,000                     | HF9          | *                  |
| AHRF900-AP                     | —            | —                    | 1,000              | 5,000                     | HF9          | *                  |
| AHRF1000                       | 250          | —                    | —                  | 5,000                     | HF10         | *                  |
| AHRF1000-2                     | —            | 1,000                | —                  | 5,000                     | HF10         | *                  |
| AHRF1000-AP                    | —            | —                    | 1,000              | 5,000                     | HF10         | *                  |
| AHRF1100                       | 250          | —                    | —                  | 5,000                     | HF11         | *                  |
| AHRF1100-2                     | —            | 1,000                | —                  | 5,000                     | HF11         | *                  |
| AHRF1100-AP                    | —            | —                    | 1,000              | 5,000                     | HF11         | *                  |
| AHRF1300                       | 250          | —                    | —                  | 5,000                     | HF13         | *                  |
| AHRF1300-2                     | —            | 1,000                | —                  | 5,000                     | HF13         | *                  |
| AHRF1300-AP                    | —            | —                    | 1,000              | 5,000                     | HF13         | *                  |
| AHRF1400                       | 250          | —                    | —                  | 5,000                     | HF14         | *                  |
| AHRF1400-2                     | —            | 1,000                | —                  | 5,000                     | HF14         | *                  |
| AHRF1400-AP                    | —            | —                    | 1,000              | 5,000                     | HF14         | *                  |
| AHRF1500                       | 250          | —                    | —                  | 5,000                     | HF15         | *                  |
| AHRF1500-2                     | —            | 1,000                | —                  | 5,000                     | HF15         | *                  |
| AHRF1500-AP                    | —            | —                    | 1,000              | 5,000                     | HF15         | *                  |
| <b>AHEF (High Temperature)</b> |              |                      |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                      |                    |                           |              |                    |
| AHEF050                        | 500          | —                    | —                  | 10,000                    | EF0.5        | *                  |
| AHEF070                        | 500          | —                    | —                  | 10,000                    | EF0.7        | *                  |
| AHEF100                        | 500          | —                    | —                  | 10,000                    | EF1.0        | *                  |
| AHEF300                        | 500          | —                    | —                  | 10,000                    | EF3          | *                  |
| AHEF500                        | 250          | —                    | —                  | 5,000                     | EF5          | *                  |
| AHEF750                        | 250          | —                    | —                  | 5,000                     | EF7.5        | *                  |
| AHEF1000                       | 250          | —                    | —                  | 5,000                     | EF10         | *                  |

\* These devices have been designed for use in automotive applications.  
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

**Table A6 Packaging and Marking Information for Automotive Devices**

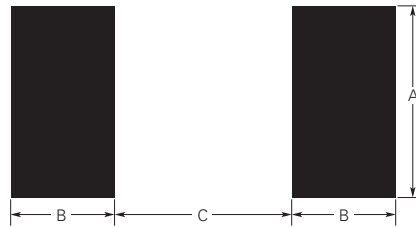
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|                        |                      |                           |              | Recommended Pad Layouts [mm(in)] See Figure A25] |                    |                    |                    |
|------------------------|----------------------|---------------------------|--------------|--------------------------------------------------|--------------------|--------------------|--------------------|
| Part Number            | Tape & Reel Quantity | Standard Package Quantity | Part Marking | Dimension A (Min.*/Nom.)                         | Dimension B (Nom.) | Dimension C (Nom.) | Agency Recognition |
| AHS (High Temperature) |                      |                           |              |                                                  |                    |                    |                    |
| Surface-mount          |                      |                           |              |                                                  |                    |                    |                    |
| AHS080-2018            | 4,000                | 20,000                    | H08          | 4.6 (0.18)                                       | 1.5 (0.06)         | 3.4 (0.134)        | *                  |
| AHS160                 | 1,500                | 7,500                     | 160          | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| AHS200                 | 1,500                | 7,500                     | H200         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| AHS300                 | 1,500                | 7,500                     | H300         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| ASMD                   |                      |                           |              |                                                  |                    |                    |                    |
| Surface-mount          |                      |                           |              |                                                  |                    |                    |                    |
| ASMD030F               | 2,000                | 10,000                    | 030F         | 3.1 (0.12)                                       | 2.3 (0.09)         | 5.1 (0.201)        | *                  |
| ASMD050F               | 2,000                | 10,000                    | 050F         | 3.1 (0.12)                                       | 2.3 (0.09)         | 5.1 (0.201)        | *                  |
| ASMD075F               | 2,000                | 10,000                    | 075F         | 3.1 (0.12)                                       | 2.3 (0.09)         | 5.1 (0.201)        | *                  |
| ASMD100F               | 2,000                | 10,000                    | 100F         | 3.1 (0.12)                                       | 2.3 (0.09)         | 5.1 (0.201)        | *                  |
| ASMD125F               | 2,000                | 10,000                    | 125F         | 3.1 (0.12)                                       | 2.3 (0.09)         | 5.1 (0.201)        | *                  |
| ASMD150F               | 1,500                | 7,500                     | 150F         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| NEW ASMD185F           | 1,500                | 7,500                     | 185A         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| ASMD200F               | 1,500                | 7,500                     | 200F         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| ASMD250F               | 1,500                | 7,500                     | 250F         | 4.6 (0.18)                                       | 2.3 (0.09)         | 6.1 (0.240)        | *                  |
| nanoASMDC              |                      |                           |              |                                                  |                    |                    |                    |
| Surface-mount          |                      |                           |              |                                                  |                    |                    |                    |
| NEW nanoASMDC012F      | 3,000                | 15,000                    | P            | 1.60 (0.063)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| NEW nanoASMDC016F      | 3,000                | 15,000                    | N            | 1.60 (0.063)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| NEW nanoASMDC020F      | 3,000                | 15,000                    | 02           | 1.60 (0.063)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| NEW nanoASMDC035F      | 3,000                | 15,000                    | 03           | 1.60 (0.063)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| microASMD              |                      |                           |              |                                                  |                    |                    |                    |
| Surface-mount          |                      |                           |              |                                                  |                    |                    |                    |
| NEW microASMD005F      | 4,000                | 20,000                    | 05           | 2.50 (0.098)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| NEW microASMD010F      | 4,000                | 20,000                    | 10           | 2.50 (0.098)                                     | 1.00 (0.039)       | 2.00 (0.079)       | *                  |
| miniASMDC              |                      |                           |              |                                                  |                    |                    |                    |
| Surface-mount          |                      |                           |              |                                                  |                    |                    |                    |
| NEW miniASMDC010F      | 2,000                | 10,000                    | 10           | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC014F      | 2,000                | 10,000                    | 14           | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC020F      | 2,000                | 10,000                    | 2            | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC030F      | 2,000                | 10,000                    | 3            | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC050F      | 2,000                | 10,000                    | 5            | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC075F/24   | 1,500                | 7,500                     | 075F 24V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC110F/16   | 2,000                | 10,000                    | 110F 16V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC110F/24   | 1,500                | 7,500                     | 110F 24V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC125F/16   | 2,000                | 10,000                    | 125F 16V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC150F/16   | 2,000                | 10,000                    | 150 16V      | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC150F/24   | 1,000                | 5,000                     | 150F 24V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |
| NEW miniASMDC260F/16   | 1,500                | 7,500                     | 260F 16V     | 3.15 (0.124)                                     | 1.68 (0.066)       | 3.10 (0.122)       | *                  |

\* These devices have been designed for use in automotive applications.  
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

| Part Number          | Bag Quantity | Standard Package Quantity | Part Marking  | Agency Recognition |
|----------------------|--------------|---------------------------|---------------|--------------------|
| <b>BD</b>            |              |                           |               |                    |
| <b>Bladed Device</b> |              |                           |               |                    |
| BD280-1130-10/16     | 200          | 1600                      | BD280-1130-10 | *                  |
| BD280-1130-15/16     | 200          | 1600                      | BD280-1130-15 | *                  |
| BD280-1130-20/16     | 200          | 1600                      | BD280-1130-20 | *                  |
| BD280-1927-25/16-W   | 200          | 1600                      | BD280-1927-25 | *                  |
| BD280-1927-30/16-W   | 200          | 1600                      | BD280-1927-30 | *                  |

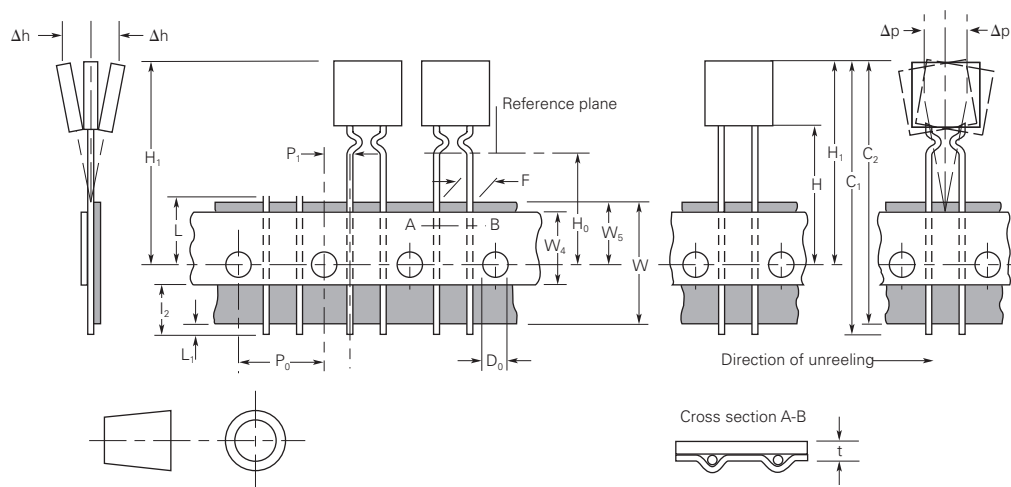
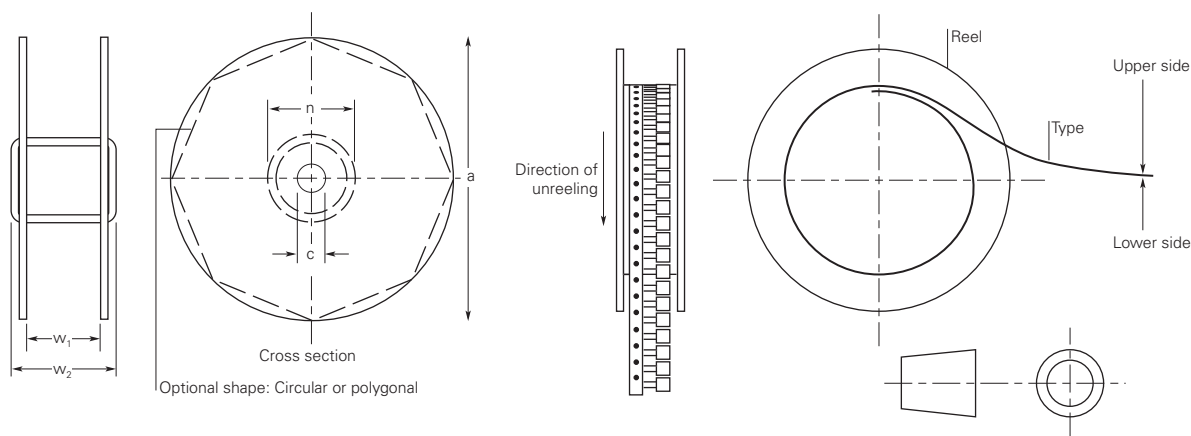
\* These devices have been designed for use in automotive applications.  
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

**Figure A25 Recommended Pad Layout for Automotive Devices**

**Table A7 Tape and Reel Specifications for AGRF/AHRF/AHEF Automotive Devices**

AGRF, AHRF and AHEF devices are available in tape and reel packaging per EIA468-B/IEC286-2 and EIA 481-2 standards. See Figures A26 and A27 for details.

| Description                                                                                           | EIA Mark       | Dimension (mm) | Tolerance  |
|-------------------------------------------------------------------------------------------------------|----------------|----------------|------------|
| Carrier tape width                                                                                    | W              | 18.0           | -0.5/+1.0  |
| Hold down tape width                                                                                  | W <sub>4</sub> | 11.0           | Minimum    |
| Top distance between tape edges                                                                       | W <sub>6</sub> | 3.0            | Maximum    |
| Sprocket hole position                                                                                | W <sub>5</sub> | 9.0            | -0.5/+0.75 |
| Sprocket hole diameter                                                                                | D <sub>0</sub> | 4.0            | ±0.2       |
| Abscissa to plane                                                                                     | H <sub>0</sub> | 16.0           | ±0.5       |
| Abscissa to top (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)                          | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to top (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)                      | H <sub>1</sub> | 45.0           | Maximum    |
| Overall width with lead protrusion (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)      | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width with lead protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000)    | C <sub>1</sub> | 55.0           | Maximum    |
| Overall width without lead protrusion (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)    | C <sub>2</sub> | 42.5           | Maximum    |
| Overall width without lead protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000) | C <sub>2</sub> | 54.0           | Maximum    |
| Lead protrusion                                                                                       | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                                                                                 | L              | 11.0           | Maximum    |
| Protrusion beyond hold-down tape                                                                      | l <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                                                                                   | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device pitch (AGRF400 to AGRF700, AHRF050 to AHRF600, AHEF050 to AHEF300)                             | —              | 12.7           | ± 0.3      |
| Device pitch (AGRF800 to AGRF1400, AHRF650 to AHRF1500, AHEF500 to AHEF1000)                          | —              | 25.4           | ± 0.6      |
| Pitch tolerance                                                                                       | —              | 20 consec.     | ± 0.1      |
| Tape thickness                                                                                        | t              | 0.9            | Maximum    |
| Overall tape and lead thickness (AGRF400 to AGRF1100, AHRF050 to AHRF1100*, AHEF050 to AHEF750)       | t <sub>1</sub> | 2.0            | Maximum    |
| Overall tape and lead thickness (AGRF1200 to AGRF1400, AHRF1300 to AHRF1500*, AHEF1000)               | t <sub>1</sub> | 2.3            | Maximum    |
| Splice sprocket hole alignment                                                                        | —              | 0              | ± 0.3      |
| Body lateral deviation                                                                                | Δh             | 0              | ± 1.0      |
| Body tape plane deviation                                                                             | Δp             | 0              | ± 1.3      |
| Ordinate to adjacent component lead (AGRF400 to AGRF1100, AHRF050 to AHRF900, AHEF050 to AHEF500)     | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to adjacent component lead (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500, AHEF750 to AHEF1000) | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead spacing (AGRF400 to AGRF1100, AHRF050 to AHRF900*, AHEF050 to AHEF500)                           | F              | 5.05           | ± 0.75     |
| Lead spacing (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500*, AHEF750 to AHEF1000)                       | F              | 10.15          | ± 0.75     |
| Reel width (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)                              | w <sub>2</sub> | 56.0           | Maximum    |
| Reel width (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)                           | w <sub>2</sub> | 63.5           | Maximum    |
| Reel diameter                                                                                         | a              | 370.0          | Maximum    |
| Space between flanges* (AHEF050 to AHEF300)                                                           | w <sub>1</sub> | 48.0           | Maximum    |
| Space between flanges* (AHEF500 to AHEF1000)                                                          | w <sub>1</sub> | 55.0           | Maximum    |
| Arbor hold diameter                                                                                   | c              | 26.0           | ±12.0      |
| Core diameter*                                                                                        | n              | 91.0           | Maximum    |
| Box                                                                                                   | —              | 64/372/362     | Maximum    |
| Consecutive missing places                                                                            | —              | None           | —          |
| Empty places per reel                                                                                 | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

**Figure A26 EIA Referenced Taped Component Dimensions for AGRF/AHRF/AHEF Automotive Devices**

**Figure A27 EIA Referenced Reel Dimensions for AGRF/AHRF/AHEF Automotive Devices**

**Table A8 Tape and Reel Specifications for AHS/ASMD/nanoASMD/microASMD/miniASMD Automotive Devices (in Millimeters)**

| Description         | nanoASMD<br>EIA 481-1 | microASMD<br>EIA 481-1 | miniASMD<br>EIA 481-1 | AHS080-2018<br>EIA 481-2 | ASMD030F~ASMD125F<br>EIA 481-2 | AHS160~AHS300<br>ASMD150F~ASMD250F<br>EIA 481-2 |
|---------------------|-----------------------|------------------------|-----------------------|--------------------------|--------------------------------|-------------------------------------------------|
| W                   | 8.0 ± 0.30            | 8.0 ± 0.30             | 12.0 ± 0.30           | 16.0 ± 0.30              | 16.0 ± 0.30                    | 16.0 ± 0.30                                     |
| P <sub>0</sub>      | 4.0 ± 0.10            | 4.0 ± 0.10             | 4.0 ± 0.10            | 4.0 ± 0.10               | 4.0 ± 0.10                     | 4.0 ± 0.10                                      |
| P <sub>1</sub>      | 4.0 ± 0.10            | 4.0 ± 0.10             | 8.0 ± 0.10            | 8.0 ± 0.10               | 8.0 ± 0.10                     | 12.0 ± 0.10                                     |
| P <sub>2</sub>      | 2.0 ± 0.05            | 2.0 ± 0.05             | 2.0 ± 0.05            | 2.0 ± 0.10               | 2.0 ± 0.10                     | 2.0 ± 0.10                                      |
| A <sub>0</sub>      | 1.95 ± 0.10           | 2.9 ± 0.10             | Table A9              | 5.11 ± 0.15              | 5.6 ± 0.23                     | 6.9 ± 0.23                                      |
| B <sub>0</sub>      | Table A9              | 3.50 ± 0.10            | Table A9              | 5.6 ± 0.23               | 8.1 ± 0.15                     | 9.6 ± 0.15                                      |
| B <sub>1</sub> max. | 4.35                  | 4.35                   | 8.2                   | 12.1                     | 12.1                           | 12.1                                            |
| D <sub>0</sub>      | 1.55 ± .05            | 1.55 ± .05             | 1.5 + 0.10/- .00      | 1.5 + 0.10/- .00         | 1.5 + 0.10/- .00               | 1.5 + 0.10/- .00                                |
| F                   | 3.50 ± 0.05           | 3.50 ± 0.05            | 5.50 ± 0.05           | 7.50 ± 0.10              | 7.50 ± 0.10                    | 7.50 ± 0.10                                     |
| E <sub>1</sub>      | 1.75 ± 0.10           | 1.75 ± 0.10            | 1.75 ± 0.10           | 1.75 ± 0.10              | 1.75 ± 0.10                    | 1.75 ± 0.10                                     |
| E <sub>2</sub> min. | 6.25                  | 6.25                   | 10.25                 | 14.25                    | 14.25                          | 14.25                                           |
| T max.              | 0.6                   | 0.6                    | 0.6                   | 0.6                      | 0.6                            | 0.6                                             |
| T <sub>1</sub> max. | 0.1                   | 0.1                    | 0.1                   | 0.1                      | 0.1                            | 0.1                                             |
| K <sub>0</sub>      | Table A9              | 0.9 ± 0.1              | Table A9              | 1.8 ± 0.15               | 3.2 ± 0.15                     | 3.4 ± 0.15                                      |
| Leader min.         | 390                   | 390                    | 390                   | 400                      | 400                            | 400                                             |
| Trailer min.        | 160                   | 160                    | 160                   | 160                      | 160                            | 160                                             |



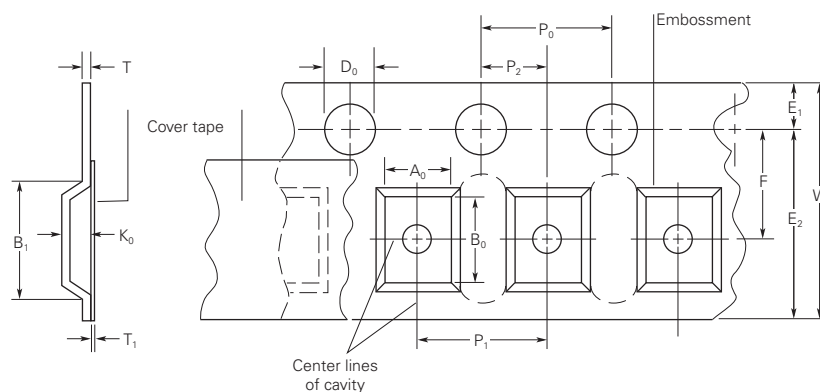
**Table A9** Tape and Reel Specifications for nanoASMDC/miniASMDC Automotive Devices (in Millimeters)

| Description    | nanoASMDC020F<br>nanoASMDC035F | nanoASMDC012F<br>nanoASMDC016F | miniASMDC010F~050F<br>miniASMDC110F/16<br>miniASMDC125F/16<br>miniASMDC150F/16 | miniASMDC075F/24<br>miniASMDC110F/24<br>miniASMDC260F/16 | miniASMDC150F/24 |
|----------------|--------------------------------|--------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------|------------------|
| A <sub>0</sub> | 1.95 ± 0.1                     | 1.95 ± 0.1                     | 3.5 ± 0.1                                                                      | 3.7 ± 0.1                                                | 3.7 ± 0.1        |
| B <sub>0</sub> | 3.50 +0.1/-0.08                | 3.5 ± 0.1                      | 4.95 ± 0.1                                                                     | 4.9 ± 0.1                                                | 4.9 ± 0.1        |
| K <sub>0</sub> | 0.89 ± 0.1                     | 1.27 ± 0.1                     | 0.9 ± 0.1                                                                      | 1.4 ± 0.1                                                | 1.78 ± 0.1       |

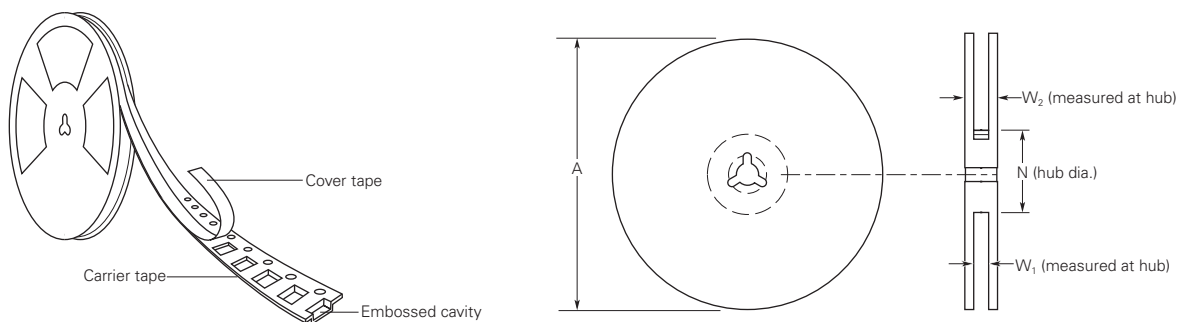
**Table A10** Reel Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC Automotive Devices (in Millimeters)

| Description         | nanoASMDC<br>microASMD | miniASMDC        | AHS<br>ASMD      |
|---------------------|------------------------|------------------|------------------|
| A max.              | 185                    | 185              | 330              |
| N min.              | 50                     | 50               | 50               |
| W <sub>1</sub>      | 8.4 + 1.5/-0.00        | 12.4 + 2.0/-0.00 | 16.4 + 2.0/-0.00 |
| W <sub>2</sub> max. | 14.4                   | 18.4             | 22.4             |

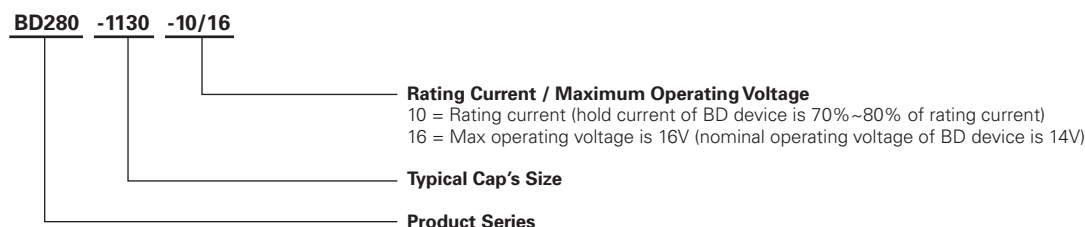
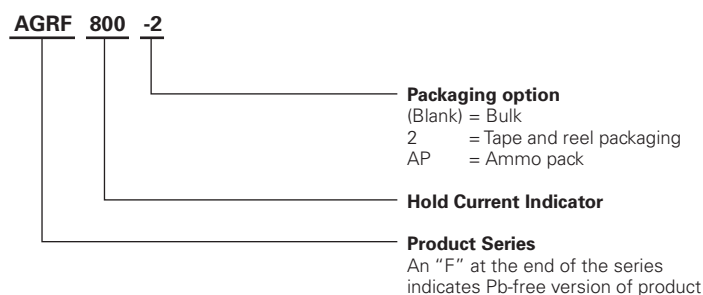
**Figure A28** EIA Referenced Taped Component Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC Automotive Devices



**Figure A29** EIA Referenced Reel Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC Automotive Devices



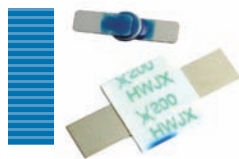
## Part Numbering System for Automotive Devices



### Warning :

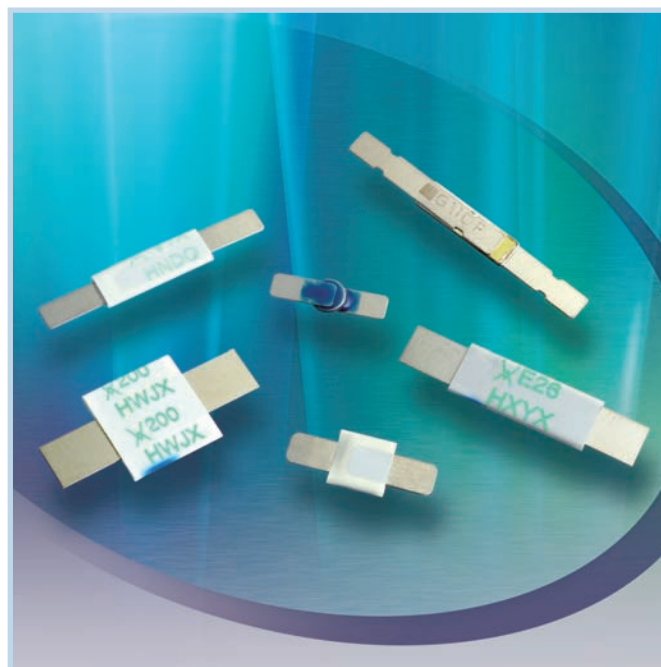
- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.





# PolySwitch Resettable Devices Strap Battery Devices

TE Circuit Protection, a pioneer of polymeric positive temperature coefficient resettable devices, has developed several material platforms to help protect battery applications. Each of these material platforms offers different performance characteristics, allowing the engineer greater design flexibility. PolySwitch devices for battery protection include SRP, LR4, VTP, VLP, VLR and MXP series, disc, and special application strap devices.



## Benefits

- Many material platforms and device form factors give engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Low resistance devices increase battery operating time

## Features

- RoHS compliant
- Lead free versions of all devices are available
- Broad range of resettable devices available
- Current ratings from 1.1A to 13A
- Voltage ratings from 6V to 30V
- Agency recognition, UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

## Applications

- Mobile phone and smart phone battery packs
- Tablet PC battery packs
- Mobile radio battery packs
- Computer battery packs
- Digital camera battery packs
- Portable media player battery packs
- Power tools (charge line)

## Application Selection Guide for Strap Battery Devices

The guide below lists PolySwitch strap battery devices which are typically used in these applications. The following pages contain the specifications for the part numbers recommended below. Once a device is selected, the user should evaluate and test each product for its intended application.

| Protection Application       | Additional Comments  | PolySwitch Resettable Devices — Key Device Selection Criteria |                                                |                        |
|------------------------------|----------------------|---------------------------------------------------------------|------------------------------------------------|------------------------|
|                              |                      | Installation Method                                           | Lowest Resistance                              | Lowest Thermal Cut-off |
| Mobile phone battery packs   | Li-ion               | Surface Mount                                                 | refer to Surface-mount section of this catalog |                        |
|                              |                      | Prismatic                                                     | MXP370BD                                       | VLR175F                |
| Cordless phone battery packs | NiMH                 | Cylindrical                                                   | VLP210F                                        | —                      |
|                              |                      |                                                               | SRP175F                                        |                        |
| Mobile radio battery packs   | NiMH                 | Cylindrical                                                   | LR4-380F                                       | —                      |
|                              |                      |                                                               | SRP350F                                        |                        |
| Computer battery packs       | NiMH                 | Cylindrical                                                   | LR4-900F                                       | —                      |
|                              | Li-ion               | Cylindrical                                                   | LR4-1300SSF                                    | —                      |
|                              |                      | Prismatic                                                     | Consult local Rep                              | Consult local Rep      |
| Camcorder battery packs      | NiMH or Li-ion       | Prismatic                                                     | VLP270F                                        | VTP210GF               |
|                              |                      |                                                               | LR4-380F                                       | —                      |
| PDA battery packs            | Li-ion               | Prismatic                                                     | VLP220F                                        | VLR175F                |
| Power tools (charge line)    | NiCd, NiMH or Li-ion | Cylindrical                                                   | custom LR4                                     | custom VTP             |

**Table B1** Product Series - Current Rating, Voltage Rating / Typical Resistance for Strap Battery Devices

| Hold Current (A) | VLR                            | VLP        | VTP        | MXP       | SRP        | LR4        |
|------------------|--------------------------------|------------|------------|-----------|------------|------------|
|                  | Typical Activation Temperature |            | 90°C       | 120°C     | 125°C      | 125°C      |
|                  | 85°C                           | 90°C       |            |           |            |            |
| 1.10             | —                              | —          | 16V/0.054Ω | —         | —          | —          |
| 1.20             | —                              | 16V/0.053Ω | —          | —         | 15V/0.123Ω | —          |
| 1.70             | 12V/0.025Ω                     | —          | 16V/0.041Ω | —         | —          | —          |
| 1.75             | 12V/0.024Ω                     | 16V/0.040Ω | 16V/0.040Ω | —         | 15V/0.070Ω | —          |
| 1.90             | —                              | —          | —          | 6V/0.010Ω | —          | 15V/0.056Ω |
| 2.00             | —                              | —          | —          | —         | 30V/0.045Ω | —          |
| 2.10             | —                              | 16V/0.024Ω | 16V/0.024Ω | —         | —          | —          |
| 2.20             | —                              | 16V/0.023Ω | —          | —         | —          | —          |
| 2.30             | 12V/0.015Ω                     | —          | —          | —         | —          | —          |
| 2.60             | —                              | —          | —          | —         | —          | 15V/0.031Ω |
| 2.70             | —                              | 16V/0.015Ω | —          | —         | —          | —          |
| 3.50             | —                              | —          | —          | —         | 30V/0.024Ω | —          |
| 3.70             | —                              | —          | —          | 6V/0.013Ω | —          | —          |
| 3.80             | —                              | —          | —          | —         | —          | 15V/0.020Ω |
| 4.20             | —                              | —          | —          | —         | 30V/0.018Ω | —          |
| 4.50             | —                              | —          | —          | —         | —          | 20V/0.016Ω |
| 5.50             | —                              | —          | —          | —         | —          | 20V/0.013Ω |
| 6.00             | —                              | —          | —          | —         | —          | 20V/0.011Ω |
| 7.30             | —                              | —          | —          | —         | —          | 20V/0.009Ω |
| 9.00             | —                              | —          | —          | —         | —          | 20V/0.008Ω |
| 13.00            | —                              | —          | —          | —         | —          | 20V/0.006Ω |

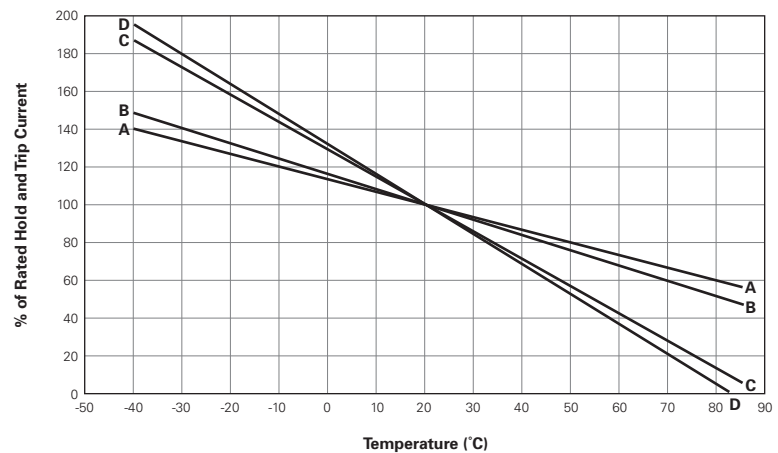
**Table B2 Thermal Derating for Strap Battery Devices**  
**[Hold Current (A) at Ambient Temperature (°C)]**

| Part Number                     | Maximum Ambient Temperature |       |      |      |       |      |      |      |      |      |      |
|---------------------------------|-----------------------------|-------|------|------|-------|------|------|------|------|------|------|
|                                 | -40°C                       | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C |
| <b>85°C Typical Activation</b>  |                             |       |      |      |       |      |      |      |      |      |      |
| <b>VLR*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |
| VLR170F                         | 3.5                         | 2.9   | 2.4  | 1.84 | 1.70  | 1.2  | 1.0  | 0.7  | 0.3  | —    | —    |
| VLR170LF                        | 3.5                         | 2.9   | 2.4  | 1.84 | 1.70  | 1.2  | 1.0  | 0.7  | 0.3  | —    | —    |
| VLR170UF                        | 3.5                         | 2.9   | 2.4  | 1.84 | 1.70  | 1.2  | 1.0  | 0.7  | 0.3  | —    | —    |
| VLR175F                         | 3.5                         | 2.9   | 2.4  | 1.87 | 1.75  | 1.3  | 1.0  | 0.8  | 0.3  | —    | —    |
| VLR175LF                        | 3.5                         | 2.9   | 2.4  | 1.87 | 1.75  | 1.3  | 1.0  | 0.8  | 0.3  | —    | —    |
| VLR175UF                        | 3.5                         | 2.9   | 2.4  | 1.87 | 1.75  | 1.3  | 1.0  | 0.8  | 0.3  | —    | —    |
| VLR230F                         | 5.0                         | 4.2   | 3.4  | 2.52 | 2.30  | 1.7  | 1.3  | 0.9  | 0.4  | —    | —    |
| <b>90°C Typical Activation</b>  |                             |       |      |      |       |      |      |      |      |      |      |
| <b>VLP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |
| VLP120UF                        | 2.4                         | 2.1   | 1.8  | 1.30 | 1.20  | 1.0  | 0.7  | 0.6  | 0.3  | 0.2  | 0.1  |
| VLP175UF                        | 3.2                         | 2.7   | 2.3  | 1.70 | 1.75  | 1.2  | 1.0  | 0.8  | 0.5  | 0.2  | 0.1  |
| VLP210F                         | 4.3                         | 3.6   | 2.9  | 2.31 | 2.10  | 1.6  | 1.3  | 1.0  | 0.6  | 0.3  | 0.1  |
| VLP220F                         | 4.5                         | 3.8   | 3.0  | 2.45 | 2.20  | 1.7  | 1.4  | 1.1  | 0.7  | 0.3  | 0.1  |
| VLP270F                         | 5.6                         | 4.7   | 4.0  | 3.05 | 2.70  | 2.2  | 1.7  | 1.4  | 0.9  | 0.4  | 0.1  |
| <b>VTP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |
| VTP110F                         | 2.0                         | 1.7   | 1.4  | 1.12 | 1.10  | 0.85 | 0.75 | 0.7  | 0.4  | 0.2  | 0.1  |
| VTP170F                         | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP170SSF                       | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP170XF                        | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP170XSF                       | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP175F                         | 3.2                         | 2.7   | 2.2  | 1.84 | 1.75  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP175LF                        | 3.2                         | 2.7   | 2.2  | 1.84 | 1.75  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |
| VTP210GF                        | 4.1                         | 3.5   | 2.9  | 2.26 | 2.10  | 1.6  | 1.3  | 1.0  | 0.7  | 0.4  | 0.1  |
| VTP210SF                        | 4.1                         | 3.5   | 2.9  | 2.26 | 2.10  | 1.6  | 1.3  | 1.0  | 0.7  | 0.4  | 0.1  |
| <b>120°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |
| <b>MXP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |
| MXP190BB                        | —                           | —     | 2.6  | —    | 1.90  | —    | —    | 0.85 | —    | —    | —    |
| MXP370BD                        | —                           | —     | 5.0  | —    | 3.70  | —    | —    | 1.90 | —    | —    | —    |
| <b>125°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |
| <b>SRP</b>                      |                             |       |      |      |       |      |      |      |      |      |      |
| SRP120F                         | 1.9                         | 1.7   | 1.5  | 1.20 | 1.17  | 1.0  | 0.9  | 0.8  | 0.6  | 0.5  | 0.4  |
| SRP120LF                        | 1.9                         | 1.7   | 1.5  | 1.20 | 1.17  | 1.0  | 0.9  | 0.8  | 0.6  | 0.5  | 0.4  |
| SRP120SF                        | 1.9                         | 1.7   | 1.5  | 1.20 | 1.17  | 1.0  | 0.9  | 0.8  | 0.6  | 0.5  | 0.4  |
| SRP175F                         | 2.5                         | 2.2   | 2.0  | 1.75 | 1.68  | 1.4  | 1.3  | 1.2  | 1.0  | 0.9  | 0.8  |
| SRP175LF                        | 2.5                         | 2.2   | 2.0  | 1.75 | 1.68  | 1.4  | 1.3  | 1.2  | 1.0  | 0.9  | 0.8  |
| SRP175SF                        | 2.5                         | 2.2   | 2.0  | 1.75 | 1.68  | 1.4  | 1.3  | 1.2  | 1.0  | 0.9  | 0.8  |
| SRP200F                         | 3.1                         | 2.8   | 2.5  | 2.00 | 1.97  | 1.7  | 1.5  | 1.4  | 1.2  | 1.0  | 0.9  |
| SRP350F                         | 5.3                         | 4.8   | 4.3  | 3.50 | 3.44  | 3.0  | 2.7  | 2.5  | 2.1  | 1.8  | 1.7  |
| SRP420F                         | 6.3                         | 5.7   | 5.1  | 4.20 | 4.11  | 3.6  | 3.3  | 3.0  | 2.6  | 2.2  | 2.1  |
| <b>LR4</b>                      |                             |       |      |      |       |      |      |      |      |      |      |
| LR4-190F                        | 2.8                         | 2.5   | 2.3  | 1.9  | 1.86  | 1.6  | 1.5  | 1.4  | 1.2  | 1.1  | 1.0  |
| LR4-260F                        | 3.8                         | 3.4   | 3.1  | 2.6  | 2.54  | 2.2  | 2.0  | 1.9  | 1.7  | 1.4  | 1.3  |
| LR4-260SF                       | 3.8                         | 3.4   | 3.1  | 2.6  | 2.54  | 2.2  | 2.0  | 1.9  | 1.7  | 1.4  | 1.3  |
| LR4-380F                        | 5.4                         | 4.9   | 4.4  | 3.8  | 3.64  | 3.3  | 3.0  | 2.8  | 2.5  | 2.3  | 2.1  |
| LR4-380XF                       | 5.4                         | 4.9   | 4.4  | 3.8  | 3.64  | 3.3  | 3.0  | 2.8  | 2.5  | 2.3  | 2.1  |
| LR4-450F                        | 6.5                         | 5.8   | 5.3  | 4.5  | 4.38  | 3.9  | 3.6  | 3.3  | 2.9  | 2.6  | 2.4  |
| LR4-550F                        | 7.6                         | 6.9   | 6.2  | 5.5  | 5.32  | 4.7  | 4.3  | 4.0  | 3.6  | 3.2  | 3.0  |
| LR4-600F                        | 8.7                         | 7.8   | 7.1  | 6.0  | 5.86  | 5.2  | 4.7  | 4.4  | 3.9  | 3.4  | 3.2  |
| LR4-600XF                       | 8.7                         | 7.8   | 7.1  | 6.0  | 5.86  | 5.2  | 4.7  | 4.4  | 3.9  | 3.4  | 3.2  |
| LR4-730F                        | 10.5                        | 9.5   | 8.6  | 7.3  | 7.13  | 6.3  | 5.7  | 5.4  | 4.7  | 4.2  | 4.0  |
| LR4-900F                        | 12.7                        | 11.4  | 10.0 | 9.0  | 8.50  | 7.5  | 6.8  | 6.2  | 5.5  | 4.9  | 4.5  |
| LR4-1300SSF                     | 17.9                        | 16.2  | 14.5 | 13.0 | 12.40 | 11.1 | 10.3 | 9.5  | 8.6  | 7.7  | 7.2  |

\* Product electrical characteristics determined at 25°C.

**Figure B1 Thermal Derating Curve for Strap Battery Devices**

- A = LR4**  
**B = SRP**  
**C = VTP, VLP, MXP**  
**D = VLR**

**Figure B1**

**Table B3 Electrical Characteristics for Strap Battery Devices**

| Part Number                   | I <sub>H</sub> (A) | I <sub>T</sub> (A) | V <sub>MAX</sub> (V <sub>DC</sub> ) | I <sub>MAX</sub> (A) | P <sub>D</sub> MAX (W) | Max. Time-to-trip (A) (s) |     | R <sub>MIN</sub> (Ω) | R <sub>MAX</sub> (Ω) | R <sub>1MAX</sub> (Ω) | Figure for Dimensions |
|-------------------------------|--------------------|--------------------|-------------------------------------|----------------------|------------------------|---------------------------|-----|----------------------|----------------------|-----------------------|-----------------------|
| 85°C Typical Activation VLR*  |                    |                    |                                     |                      |                        |                           |     |                      |                      |                       |                       |
| VLR170F                       | 1.70               | 4.1                | 12                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.018                | 0.032                | 0.064                 | B3                    |
| VLR170LF                      | 1.70               | 4.1                | 12                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.018                | 0.032                | 0.064                 | B3                    |
| VLR170UF                      | 1.70               | 4.1                | 12                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.018                | 0.032                | 0.064                 | B5                    |
| VLR175F                       | 1.75               | 4.2                | 12                                  | 100                  | 1.4                    | 8.75                      | 5.0 | 0.017                | 0.031                | 0.062                 | B3                    |
| VLR175LF                      | 1.75               | 4.2                | 12                                  | 100                  | 1.4                    | 8.75                      | 5.0 | 0.017                | 0.031                | 0.062                 | B3                    |
| VLR175UF                      | 1.75               | 4.2                | 12                                  | 100                  | 1.4                    | 8.75                      | 5.0 | 0.017                | 0.031                | 0.062                 | B5                    |
| VLR230F                       | 2.30               | 5.0                | 12                                  | 100                  | 2.5                    | 10.00                     | 5.0 | 0.012                | 0.018                | 0.036                 | B3                    |
| 90°C Typical Activation VLP*  |                    |                    |                                     |                      |                        |                           |     |                      |                      |                       |                       |
| VLP120UF                      | 1.20               | 3.6                | 16                                  | 60                   | 1.6                    | 7.00                      | 5.0 | 0.039                | 0.067                | 0.134                 | B5                    |
| VLP175UF                      | 1.75               | 3.9                | 16                                  | 60                   | 1.6                    | 8.75                      | 5.0 | 0.030                | 0.050                | 0.100                 | B5                    |
| VLP210F                       | 2.10               | 5.0                | 16                                  | 60                   | 1.8                    | 10.50                     | 5.0 | 0.018                | 0.030                | 0.060                 | B2                    |
| VLP220F                       | 2.20               | 5.3                | 16                                  | 60                   | 1.8                    | 11.00                     | 5.0 | 0.017                | 0.029                | 0.058                 | B3                    |
| VLP270F                       | 2.70               | 6.5                | 16                                  | 60                   | 2.5                    | 13.50                     | 5.0 | 0.012                | 0.018                | 0.036                 | B3                    |
| VTP*                          |                    |                    |                                     |                      |                        |                           |     |                      |                      |                       |                       |
| VTP110F                       | 1.10               | 2.7                | 16                                  | 100                  | 1.3                    | 5.50                      | 5.0 | 0.038                | 0.070                | 0.140                 | B5                    |
| VTP170F                       | 1.70               | 3.4                | 16                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.030                | 0.052                | 0.105                 | B2                    |
| VTP170SSF                     | 1.70               | 3.4                | 16                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.030                | 0.052                | 0.105                 | B7                    |
| VTP170XF                      | 1.70               | 3.4                | 16                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.030                | 0.052                | 0.105                 | B3                    |
| VTP170XSF                     | 1.70               | 3.4                | 16                                  | 100                  | 1.4                    | 8.50                      | 5.0 | 0.030                | 0.052                | 0.105                 | B4                    |
| VTP175F                       | 1.75               | 3.6                | 16                                  | 100                  | 1.4                    | 8.75                      | 5.0 | 0.029                | 0.051                | 0.102                 | B3                    |
| VTP175LF                      | 1.75               | 3.6                | 16                                  | 100                  | 1.4                    | 8.75                      | 5.0 | 0.029                | 0.051                | 0.102                 | B3                    |
| VTP210GF                      | 2.10               | 4.7                | 16                                  | 100                  | 1.5                    | 10.00                     | 5.0 | 0.018                | 0.030                | 0.060                 | B3                    |
| VTP210SF                      | 2.10               | 4.7                | 16                                  | 100                  | 1.5                    | 10.00                     | 5.0 | 0.018                | 0.030                | 0.060                 | B4                    |
| 120°C Typical Activation MXP* |                    |                    |                                     |                      |                        |                           |     |                      |                      |                       |                       |
| MXP190BB                      | 1.90               | 4.9                | 6                                   | 50                   | 1.0                    | 9.50                      | 2.0 | 0.007                | 0.015                | 0.024                 | B12                   |
| MXP370BD                      | 3.70               | 9.0                | 6                                   | 50                   | 1.3                    | 18.50                     | 5.0 | 0.004                | 0.010                | 0.016                 | B12                   |

\* Product electrical characteristics determined at 25°C.

**Table B3 Electrical Characteristics for Strap Battery Devices**

Cont'd

| Part Number                  | I <sub>H</sub> (A) | I <sub>T</sub> (A) | V <sub>MAX</sub> (V <sub>DC</sub> ) | I <sub>MAX</sub> (A) | P <sub>D MAX</sub> (W) | Max. Time-to-trip (A) (s) |     | R <sub>MIN</sub> (Ω) | R <sub>MAX</sub> (Ω) | R <sub>1MAX</sub> (Ω) | Figure for Dimensions |
|------------------------------|--------------------|--------------------|-------------------------------------|----------------------|------------------------|---------------------------|-----|----------------------|----------------------|-----------------------|-----------------------|
| 125°C Typical Activation SRP |                    |                    |                                     |                      |                        |                           |     |                      |                      |                       |                       |
| SRP120F                      | 1.20               | 2.7                | 15                                  | 100                  | 1.2                    | 6.00                      | 5.0 | 0.085                | 0.160                | 0.220                 | B6                    |
| SRP120LF                     | 1.20               | 2.7                | 15                                  | 100                  | 1.2                    | 6.00                      | 5.0 | 0.085                | 0.160                | 0.220                 | B6                    |
| SRP120SF                     | 1.20               | 2.7                | 15                                  | 100                  | 1.2                    | 6.00                      | 5.0 | 0.085                | 0.160                | 0.220                 | B10                   |
| SRP175F                      | 1.75               | 3.8                | 15                                  | 100                  | 1.5                    | 8.75                      | 5.0 | 0.050                | 0.090                | 0.120                 | B6                    |
| SRP175LF                     | 1.75               | 3.8                | 15                                  | 100                  | 1.5                    | 8.75                      | 5.0 | 0.050                | 0.090                | 0.120                 | B6                    |
| SRP175SF                     | 1.75               | 3.8                | 15                                  | 100                  | 1.5                    | 8.75                      | 5.0 | 0.050                | 0.090                | 0.120                 | B10                   |
| SRP200F                      | 2.00               | 4.4                | 30                                  | 100                  | 1.9                    | 10.00                     | 4.0 | 0.030                | 0.060                | 0.100                 | B6                    |
| SRP350F                      | 3.50               | 6.3                | 30                                  | 100                  | 2.5                    | 20.00                     | 3.0 | 0.017                | 0.031                | 0.050                 | B6                    |
| SRP420F                      | 4.20               | 7.6                | 30                                  | 100                  | 2.9                    | 20.00                     | 6.0 | 0.012                | 0.024                | 0.040                 | B6                    |

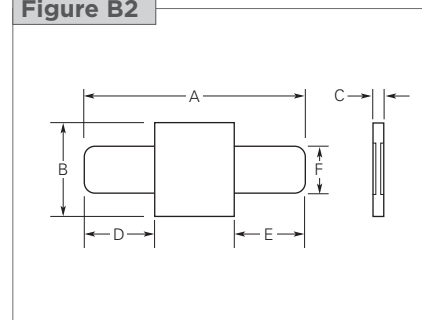
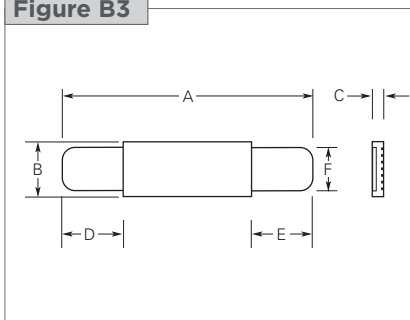
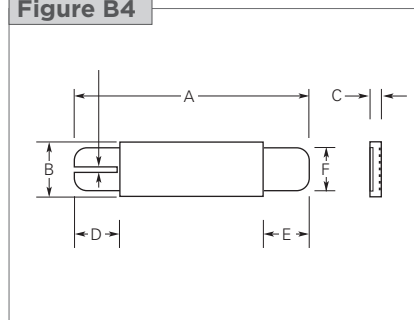
**LR4**

|             |       |      |    |     |     |      |      |        |        |       |     |
|-------------|-------|------|----|-----|-----|------|------|--------|--------|-------|-----|
| LR4-190F    | 1.90  | 3.9  | 15 | 100 | 1.2 | 9.5  | 5.0  | 0.0390 | 0.0720 | 0.102 | B8  |
| LR4-260F    | 2.60  | 5.8  | 15 | 100 | 2.5 | 13.0 | 5.0  | 0.0200 | 0.0420 | 0.063 | B8  |
| LR4-260SF   | 2.60  | 5.8  | 15 | 100 | 2.5 | 13.0 | 5.0  | 0.0200 | 0.0420 | 0.063 | B9  |
| LR4-380F    | 3.80  | 8.3  | 15 | 100 | 2.5 | 19.0 | 5.0  | 0.0130 | 0.0260 | 0.037 | B8  |
| LR4-380XF   | 3.80  | 8.3  | 15 | 100 | 2.5 | 19.0 | 5.0  | 0.0130 | 0.0260 | 0.037 | B8  |
| LR4-450F    | 4.50  | 8.9  | 20 | 100 | 2.3 | 22.5 | 5.0  | 0.0110 | 0.0200 | 0.028 | B8  |
| LR4-550F    | 5.50  | 10.5 | 20 | 100 | 2.8 | 27.5 | 5.0  | 0.0090 | 0.0160 | 0.022 | B8  |
| LR4-600F    | 6.00  | 11.7 | 20 | 100 | 2.8 | 30.0 | 5.0  | 0.0070 | 0.0140 | 0.019 | B8  |
| LR4-600XF   | 6.00  | 11.7 | 20 | 100 | 2.8 | 30.0 | 5.0  | 0.0075 | 0.0140 | 0.019 | B8  |
| LR4-730F    | 7.30  | 14.1 | 20 | 100 | 3.3 | 30.0 | 5.0  | 0.0060 | 0.0120 | 0.015 | B8  |
| LR4-900F    | 9.00  | 16.7 | 20 | 100 | 3.8 | 45.0 | 5.0  | 0.0060 | 0.0100 | 0.014 | B8  |
| LR4-1300SSF | 13.00 | 21.2 | 20 | 100 | 4.5 | 50.0 | 10.0 | 0.0035 | 0.0065 | 0.009 | B11 |

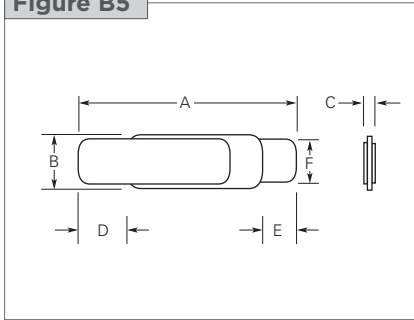
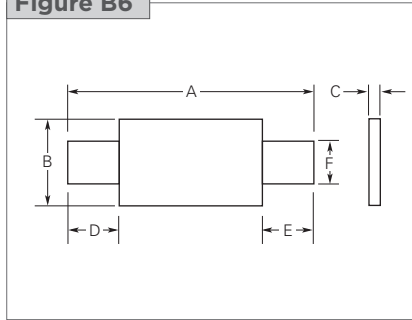
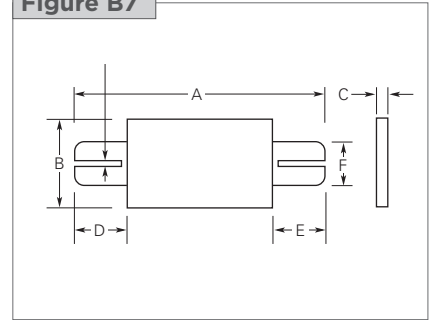
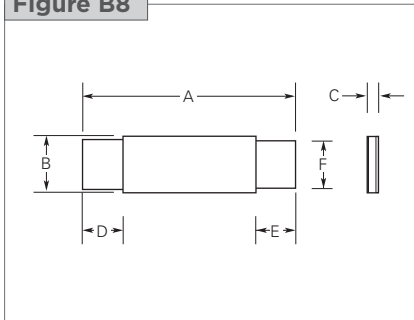
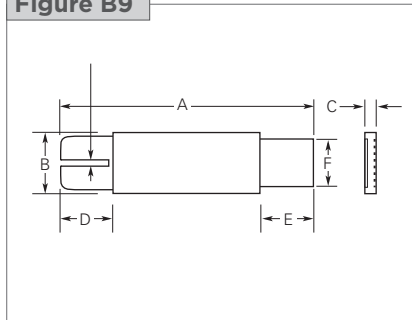
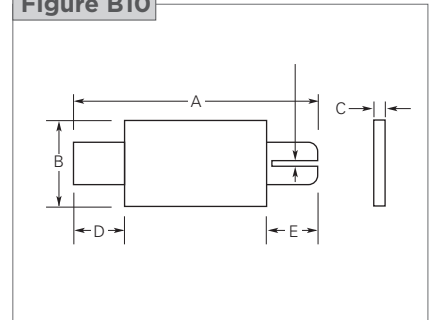
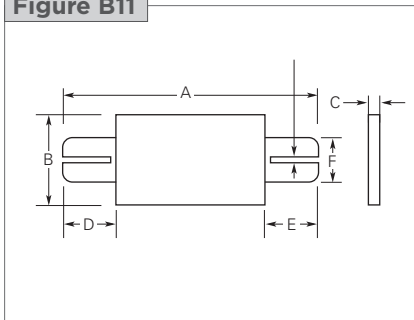
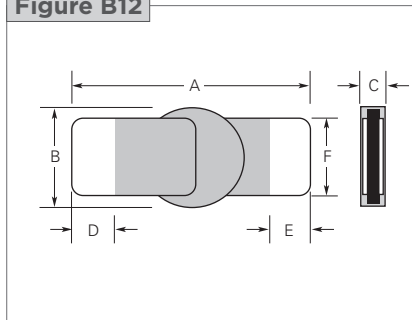
\* Product electrical characteristics determined at 25°C.

**Notes:**

- $I_H$  : Hold current: maximum current device will pass without interruption in 20°C still air unless otherwise specified.
- $I_T$  : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air unless otherwise specified.
- $V_{MAX}$  : Maximum voltage device can withstand without damage at rated current.
- $I_{MAX}$  : Maximum fault current device can withstand without damage at rated voltage.
- $P_D$  : Power dissipated from device when in the tripped state in 20°C still air unless otherwise specified.
- $R_{MIN}$  : Minimum resistance of device as supplied at 20°C unless otherwise specified.
- $R_{MAX}$  : Maximum resistance of device as supplied at 20°C unless otherwise specified.
- $R_{1MAX}$  : Maximum resistance, measured at 20°C unless otherwise specified, of device one hour after being tripped the first time.

**Figure B2-B12 Dimension Figures for Strap Battery Devices**
**Figure B2**

**Figure B3**

**Figure B4**




**Figure B5**

**Figure B6**

**Figure B7**

**Figure B8**

**Figure B9**

**Figure B10**

**Figure B11**

**Figure B12**

**Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)**

| Part Number             | A               |                 | B              |                | C              |                 | D              |                 | E               |                 | F              |                | Figure |
|-------------------------|-----------------|-----------------|----------------|----------------|----------------|-----------------|----------------|-----------------|-----------------|-----------------|----------------|----------------|--------|
|                         | Min.            | Max.            | Min.           | Max.           | Min.           | Max.            | Min.           | Max.            | Min.            | Max.            | Min.           | Max.           |        |
| 85°C Typical Activation |                 |                 |                |                |                |                 |                |                 |                 |                 |                |                |        |
| VLR                     |                 |                 |                |                |                |                 |                |                 |                 |                 |                |                |        |
| VLR170F                 | 20.8<br>(0.832) | 23.2<br>(0.928) | 3.5<br>(0.140) | 3.9<br>(0.156) | —<br>(—)       | 0.8<br>(0.032)  | 4.5<br>(0.180) | 6.5<br>(0.260)  | 4.5<br>(0.180)  | 6.5<br>(0.260)  | 2.4<br>(0.096) | 2.6<br>(0.104) | B3     |
| VLR170LF                | 38.8<br>(1.552) | 41.2<br>(1.648) | 3.5<br>(0.140) | 3.9<br>(0.156) | —<br>(—)       | 0.8<br>(0.032)  | 8.7<br>(0.348) | 10.3<br>(0.412) | 18.7<br>(0.748) | 20.3<br>(0.812) | 2.4<br>(0.096) | 2.6<br>(0.104) | B3     |
| VLR170UF                | 20.8<br>(0.832) | 23.2<br>(0.928) | 3.5<br>(0.140) | 3.7<br>(0.148) | —<br>(—)       | 0.07<br>(0.003) | 5.3<br>(0.212) | 6.7<br>(0.268)  | 5.3<br>(0.212)  | 6.7<br>(0.268)  | 2.4<br>(0.096) | 2.6<br>(0.104) | B5     |
| VLR175F                 | 23.0<br>(0.920) | 24.5<br>(0.980) | 2.9<br>(0.116) | 3.3<br>(0.132) | 0.5<br>(0.020) | 0.8<br>(0.032)  | 4.7<br>(0.188) | 7.2<br>(0.288)  | 3.8<br>(0.152)  | 5.4<br>(0.216)  | 2.4<br>(0.096) | 2.6<br>(0.104) | B3     |
| VLR175LF                | 29.3<br>(1.172) | 31.7<br>(1.268) | 2.9<br>(0.116) | 3.3<br>(0.132) | —<br>(—)       | 0.8<br>(0.032)  | 5.2<br>(0.208) | 6.8<br>(0.272)  | 10<br>(0.400)   | 12.5<br>(0.500) | 2.4<br>(0.096) | 2.6<br>(0.104) | B3     |
| VLR175UF                | 23.0<br>(0.920) | 24.5<br>(0.980) | 2.9<br>(0.116) | 3.1<br>(0.124) | —<br>(—)       | 0.7<br>(0.028)  | 5.2<br>(0.208) | 7.5<br>(0.300)  | 4.3<br>(0.172)  | 5.7<br>(0.228)  | 2.4<br>(0.096) | 2.6<br>(0.104) | B5     |
| VLR230F                 | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196) | 5.3<br>(0.212) | —<br>(—)       | 0.8<br>(0.032)  | 4.1<br>(0.164) | 5.8<br>(0.232)  | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B3     |

**Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)**

Cont'd

| Part Number              | A               |                 | B               |                 | C              |                | D               |                 | E               |                 | F              |                | Figure |
|--------------------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|--------|
|                          | Min.            | Max.            | Min.            | Max.            | Min.           | Max.           | Min.            | Max.            | Min.            | Max.            | Min.           | Max.           |        |
| 90°C Typical Activation  |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| VLP                      |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| VLP120UF                 | 10.9<br>(0.430) | 11.8<br>(0.460) | 4.4<br>(0.170)  | 4.6<br>(0.180)  | —<br>(0.028)   | 0.7<br>(0.028) | 5.5<br>(0.220)  | 6.5<br>(0.260)  | 1.65<br>(0.065) | 1.9<br>(0.075)  | 2.3<br>(0.091) | 2.5<br>(0.098) | B5     |
| VLP175UF                 | 19.0<br>(0.750) | 21.0<br>(0.830) | 3.4<br>(0.130)  | 3.6<br>(0.140)  | —<br>(0.030)   | 0.7<br>(0.030) | 10.0<br>(0.390) | 11.0<br>(0.430) | 2.5<br>(0.100)  | 3.5<br>(0.140)  | 2.9<br>(0.110) | 3.1<br>(0.120) | B5     |
| VLP210F                  | 15.4<br>(0.616) | 17.5<br>(0.700) | 6.9<br>(0.276)  | 7.3<br>(0.292)  | 0.6<br>(0.024) | 0.8<br>(0.032) | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B2     |
| VLP220F                  | 21.1<br>(0.844) | 23.3<br>(0.932) | 3.5<br>(0.140)  | 3.9<br>(0.156)  | 0.6<br>(0.024) | 0.8<br>(0.032) | 5.1<br>(0.204)  | 6.8<br>(0.272)  | 5.1<br>(0.204)  | 6.8<br>(0.272)  | 2.9<br>(0.116) | 3.1<br>(0.124) | B3     |
| VLP270F                  | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.6<br>(0.024) | 0.8<br>(0.032) | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B3     |
| VTP                      |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| VTP110F                  | 23.6<br>(0.944) | 25.6<br>(1.024) | 2.7<br>(0.108)  | 2.9<br>(0.116)  | —<br>(0.028)   | 0.7<br>(0.028) | 7.0<br>(0.280)  | 8.0<br>(0.320)  | 7.0<br>(0.280)  | 8.0<br>(0.320)  | 2.3<br>(0.092) | 2.5<br>(0.100) | B5     |
| VTP170F                  | 15.4<br>(0.616) | 17.5<br>(0.700) | 7.0<br>(0.280)  | 7.4<br>(0.296)  | 0.5<br>(0.020) | 0.8<br>(0.032) | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B2     |
| VTP170SSF                | 15.4<br>(0.616) | 17.5<br>(0.700) | 7.0<br>(0.280)  | 7.4<br>(0.296)  | 0.5<br>(0.020) | 0.8<br>(0.032) | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B7     |
| VTP170XF                 | 20.9<br>(0.836) | 22.9<br>(0.916) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.5<br>(0.020) | 0.8<br>(0.032) | 6.0<br>(0.240)  | 8.6<br>(0.344)  | 6.0<br>(0.240)  | 8.6<br>(0.344)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B3     |
| VTP170XSF                | 20.9<br>(0.836) | 22.9<br>(0.916) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.5<br>(0.020) | 0.8<br>(0.032) | 6.0<br>(0.240)  | 8.6<br>(0.344)  | 6.0<br>(0.240)  | 8.6<br>(0.344)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B4     |
| VTP175F                  | 21.2<br>(0.848) | 23.2<br>(0.928) | 3.5<br>(0.140)  | 3.9<br>(0.156)  | —<br>(0.032)   | 0.8<br>(0.032) | 4.6<br>(0.184)  | 6.6<br>(0.264)  | 4.6<br>(0.184)  | 6.6<br>(0.264)  | 2.9<br>(0.116) | 3.1<br>(0.124) | B3     |
| VTP175LF                 | 25.8<br>(1.032) | 28.2<br>(1.128) | 3.5<br>(0.140)  | 3.9<br>(0.156)  | —<br>(0.032)   | 0.8<br>(0.032) | 5.7<br>(0.228)  | 7.3<br>(0.292)  | 8.7<br>(0.348)  | 10.3<br>(0.412) | 2.4<br>(0.096) | 2.6<br>(0.104) | B3     |
| VTP210GF                 | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | —<br>(0.032)   | 0.8<br>(0.032) | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B3     |
| VTP210SF                 | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.6<br>(0.024) | 0.8<br>(0.032) | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B4     |
| 120°C Typical Activation |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| MXP                      |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| MXP190BB                 | 9.2<br>(0.368)  | 10.8<br>(0.432) | 2.96<br>(0.118) | 3.26<br>(0.130) | 0.7<br>(0.028) | 1.1<br>(0.044) | 1.6<br>(0.064)  | 3.1<br>(0.124)  | 1.6<br>(0.064)  | 3.1<br>(0.124)  | 2.2<br>(0.088) | 2.4<br>(0.096) | B12    |
| MXP370BD                 | 10.5<br>(0.420) | 11.3<br>(0.452) | 2.96<br>(0.118) | 3.26<br>(0.130) | 0.7<br>(0.028) | 1.1<br>(0.044) | 5.0<br>(0.200)  | —<br>(0.080)    | 2.0<br>(0.080)  | —<br>(0.080)    | 2.2<br>(0.088) | 2.4<br>(0.096) | B12    |
| 125°C Typical Activation |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| SRP                      |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                |                |        |
| SRP120F                  | 19.9<br>(0.796) | 22.1<br>(0.884) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B6     |
| SRP120LF                 | 24.9<br>(0.996) | 27.1<br>(1.084) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 10.5<br>(0.420) | 12.5<br>(0.500) | 3.9<br>(0.156) | 4.1<br>(0.164) | B6     |
| SRP120SF                 | 19.9<br>(0.796) | 22.1<br>(0.884) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B10    |
| SRP175F                  | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164)  | 5.5<br>(0.220)  | 4.1<br>(0.164)  | 5.5<br>(0.220)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B6     |
| SRP175LF                 | 29.9<br>(1.196) | 32.1<br>(1.284) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 10.5<br>(0.420) | 12.5<br>(0.500) | 5.5<br>(0.220)  | 7.5<br>(0.300)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B6     |
| SRP175SF                 | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164)  | 5.5<br>(0.220)  | 4.1<br>(0.164)  | 5.5<br>(0.220)  | 3.9<br>(0.156) | 4.1<br>(0.164) | B10    |
| SRP200F                  | 21.3<br>(0.852) | 23.4<br>(0.936) | 10.2<br>(0.408) | 11.0<br>(0.440) | 0.5<br>(0.020) | 1.1<br>(0.044) | 5.0<br>(0.200)  | 7.6<br>(0.304)  | 5.0<br>(0.200)  | 7.6<br>(0.304)  | 4.8<br>(0.192) | 5.4<br>(0.216) | B6     |
| SRP350F                  | 28.4<br>(1.136) | 31.8<br>(1.272) | 13.0<br>(0.520) | 13.5<br>(0.540) | 0.5<br>(0.020) | 1.1<br>(0.044) | 6.3<br>(0.252)  | 8.9<br>(0.356)  | 6.3<br>(0.252)  | 8.9<br>(0.356)  | 6.0<br>(0.240) | 6.6<br>(0.264) | B6     |
| SRP420F                  | 30.6<br>(1.224) | 32.4<br>(1.296) | 12.9<br>(0.516) | 13.6<br>(0.544) | 0.5<br>(0.020) | 1.1<br>(0.044) | 5.0<br>(0.200)  | 7.5<br>(0.300)  | 5.0<br>(0.200)  | 7.5<br>(0.300)  | 6.0<br>(0.240) | 6.7<br>(0.268) | B6     |

**Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)**

Cont'd

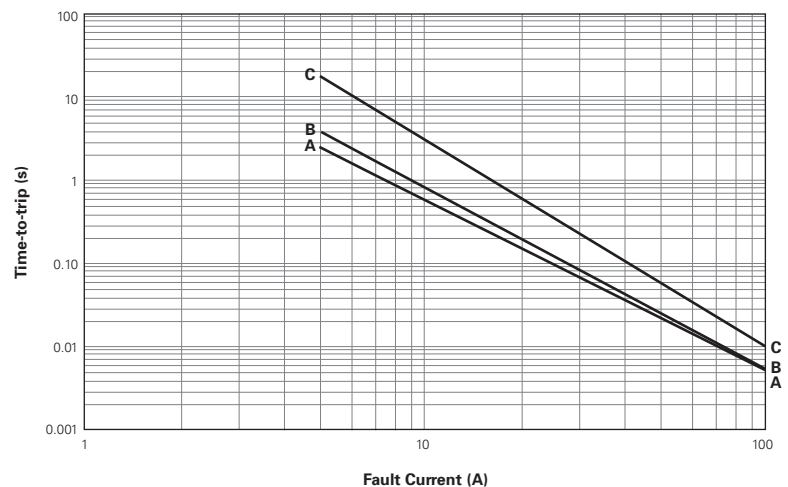
| Part Number | A               |                 | B               |                 | C              |                | D              |                | E              |                | F              |                | Figure |
|-------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
|             | Min.            | Max.            | Min.            | Max.            | Min.           | Max.           | Min.           | Max.           | Min.           | Max.           | Min.           | Max.           |        |
| LR4         |                 |                 |                 |                 |                |                |                |                |                |                |                |                |        |
| LR4-190F    | 19.9<br>(0.796) | 22.1<br>(0.884) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220) | 7.5<br>(0.300) | 5.5<br>(0.220) | 7.5<br>(0.300) | 3.9<br>(0.156) | 4.1<br>(0.164) | B8     |
| LR4-260F    | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 3.9<br>(0.156) | 4.1<br>(0.164) | B8     |
| LR4-260SF   | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 3.9<br>(0.156) | 4.1<br>(0.164) | B9     |
| LR4-380F    | 24.0<br>(0.960) | 26.0<br>(1.040) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.9<br>(0.196) | 5.1<br>(0.204) | B8     |
| LR4-380XF   | 32.2<br>(1.288) | 35.8<br>(1.432) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220) | 7.5<br>(0.300) | 5.5<br>(0.220) | 7.5<br>(0.300) | 3.9<br>(0.156) | 4.1<br>(0.164) | B8     |
| LR4-450F    | 24.0<br>(0.960) | 26<br>(1.040)   | 9.9<br>(0.396)  | 10.5<br>(0.420) | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.9<br>(0.236) | 6.1<br>(0.244) | B8     |
| LR4-550F    | 35.0<br>(1.400) | 37.0<br>(1.480) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.3<br>(0.212) | 6.7<br>(0.268) | 4.9<br>(0.196) | 5.1<br>(0.204) | B8     |
| LR4-600F    | 24.0<br>(0.960) | 26.0<br>(1.040) | 13.9<br>(0.556) | 14.5<br>(0.580) | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 5.9<br>(0.236) | 6.1<br>(0.244) | B8     |
| LR4-600XF   | 40.5<br>(1.620) | 42.7<br>(1.708) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.2<br>(0.208) | 6.8<br>(0.272) | 5.2<br>(0.208) | 6.8<br>(0.272) | 4.9<br>(0.196) | 5.1<br>(0.204) | B8     |
| LR4-730F    | 27.1<br>(1.084) | 29.1<br>(1.164) | 13.9<br>(0.556) | 14.5<br>(0.580) | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 5.9<br>(0.236) | 6.1<br>(0.244) | B8     |
| LR4-900F    | 45.4<br>(1.816) | 47.6<br>(1.904) | 7.9<br>(0.316)  | 8.5<br>(0.340)  | 0.9<br>(0.036) | 1.3<br>(0.052) | 4.6<br>(0.184) | 6.2<br>(0.248) | 4.6<br>(0.184) | 6.2<br>(0.248) | 5.9<br>(0.236) | 6.1<br>(0.244) | B8     |
| LR4-1300SSF | 61.5<br>(2.460) | 66.5<br>(2.660) | 9.4<br>(0.376)  | 10.0<br>(0.400) | 0.9<br>(0.036) | 1.3<br>(0.052) | 5.0<br>(0.200) | 7.5<br>(0.300) | 5.0<br>(0.200) | 7.5<br>(0.300) | 5.9<br>(0.236) | 6.1<br>(0.244) | B11    |

**Figure B13-B18 Typical Time-to-trip Curves at 20°C for Strap Battery Devices**
**VLR (data at 25°C)**

A = VLR170F

B = VLR175F

C = VLR230F

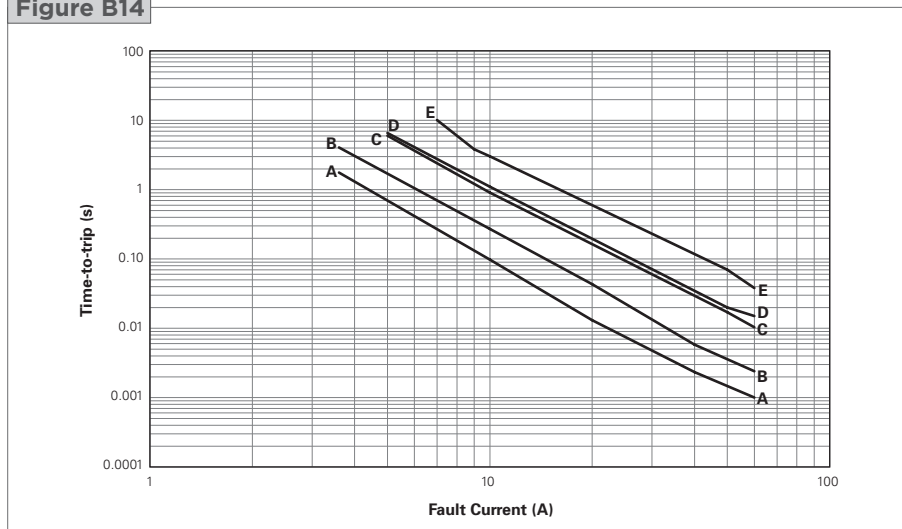
**Figure B13**


**Figure B13-B18 Typical Time-to-trip Curves at 20°C for Strap Battery Devices**

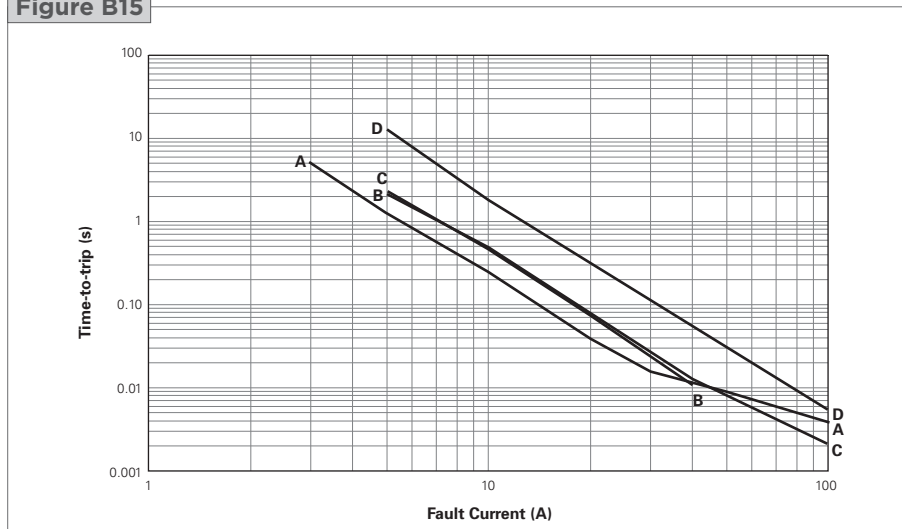
Cont'd

**VLP (data at 25°C)**

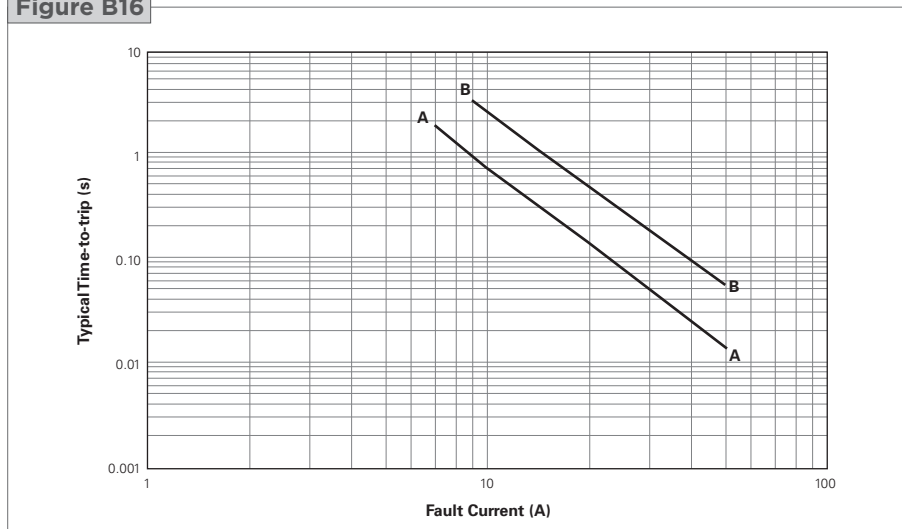
- A = VLP120UF
- B = VLP175UF
- C = VLP210F
- D = VLP220F
- E = VLP270F

**Figure B14**

**VTP (data at 25°C)**

- A = VTP110F
- B = VTP170F
- C = VTP175F
- D = VTP210GF

**Figure B15**

**MXP (data at 25°C)**

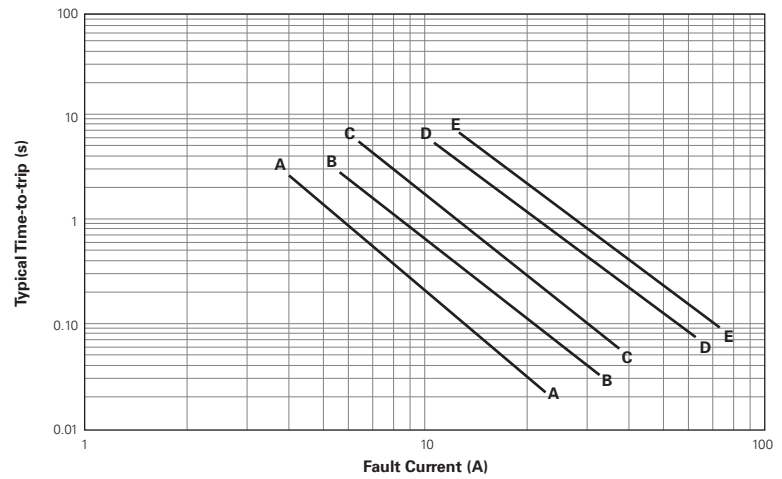
- A = MXP190BB
- B = MXP370BD

**Figure B16**


**SRP**

- A = SRP120F
- B = SRP175F
- C = SRP200F
- D = SRP350F
- E = SRP420F

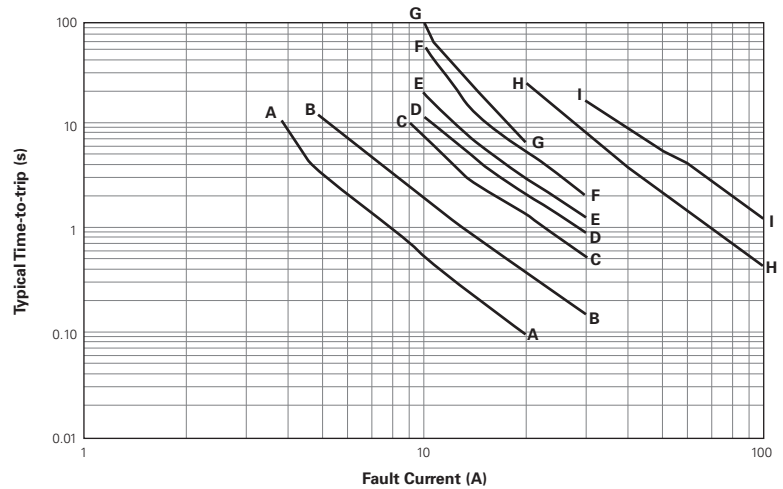
**Figure B17**



**LR4**

- A = LR4-190F
- B = LR4-260F
- C = LR4-380F
- D = LR4-450F
- E = LR4-550F
- F = LR4-600F
- G = LR4-730F
- H = LR4-900F
- I = LR4-1300SSF

**Figure B18**



**Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices**

**VLR**

**Physical Characteristics**

|               |                                                |
|---------------|------------------------------------------------|
| Lead material | 0.125mm nominal thickness, quarter-hard nickel |
| Tape material | Polyester                                      |

**Environmental Specifications**

| Test           | Conditions                | Resistance Change |
|----------------|---------------------------|-------------------|
| Passive aging  | -40°C, 1000 hours         | ±5% typical       |
|                | 60°C, 1000 hours          | ±20% typical      |
| Humidity aging | 60°C/95% RH, 1000 hours   | ±30% typical      |
| Thermal shock  | 85°C, -40°C (10 times)    | ±5% typical       |
| Vibration      | MIL-STD-883D, Method 2026 | No change         |

**Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices**

Cont'd

**VLP and VTP**
**Physical Characteristics**

|               |                                                |
|---------------|------------------------------------------------|
| Lead material | 0.125mm nominal thickness, quarter-hard nickel |
| Tape material | Polyester                                      |

**Environmental Specifications**

| Test           | Conditions                | Resistance Change |
|----------------|---------------------------|-------------------|
| Passive aging  | -40°C, 1000 hours         | ±5% typical       |
|                | 60°C, 1000 hours          | ±10% typical      |
| Humidity aging | 60°C/95% RH, 1000 hours   | ±10% typical      |
| Thermal shock  | 85°C, -40°C (10 times)    | ±5% typical       |
| Vibration      | MIL-STD-883D, Method 2026 | No change         |

**MXP**
**Physical Characteristics**

|                  |                                           |
|------------------|-------------------------------------------|
| Lead material    | 0.1mm nominal thickness, half-hard nickel |
| Coating material | Epoxy                                     |

**Environmental Specifications**

| Test           | Conditions                | Resistance Change |
|----------------|---------------------------|-------------------|
| Passive aging  | -40°C, 1000 hours         | ±5% typical       |
|                | 60°C, 1000 hours          | ±20% typical      |
| Humidity aging | 60°C/95% RH, 1000 hours   | ±30% typical      |
| Thermal shock  | 85°C, -40°C (10 times)    | ±5% typical       |
| Vibration      | MIL-STD-883D, Method 2026 | No change         |

**SRP**
**Physical Characteristics**

|               |                                                |
|---------------|------------------------------------------------|
| Lead material | 0.125mm nominal thickness, quarter-hard nickel |
| Tape material | Polyester                                      |

**Environmental Specifications**

| Test           | Conditions                     | Resistance Change |
|----------------|--------------------------------|-------------------|
| Passive aging  | 70°C, 1000 hours               | ±10% typical      |
| Humidity aging | 85°C/85% RH, 7 days            | ±5% typical       |
| Vibration      | MIL-STD-883C, Test Condition A | No change         |

**LR4**
**Physical Characteristics**

|               |                                                |
|---------------|------------------------------------------------|
| Lead material | 0.125mm nominal thickness, quarter-hard nickel |
| Tape material | Polyester                                      |

**Environmental Specifications**

| Test           | Conditions                | Resistance Change |
|----------------|---------------------------|-------------------|
| Passive aging  | 70°C, 1000 hours          | ±10% typical      |
| Humidity aging | 85°C/85% RH, 7 days       | ±5% typical       |
| Vibration      | MIL-STD-883D, Method 2026 | No change         |

**Note:** Storage conditions: 40°C max., 70% RH max.; devices should remain in original sealed bags prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**Table B6 Packaging and Marking Information/Agency Recognition for Strap Battery Devices**

| Part Number                     | Bag Quantity | Tape & Reel Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|---------------------------------|--------------|----------------------|---------------------------|--------------|--------------------|
| <b>85°C Typical Activation</b>  |              |                      |                           |              |                    |
| <b>VLR</b>                      |              |                      |                           |              |                    |
| VLR170F                         | 1,000        | —                    | 10,000                    | R17          | UL, CSA, TÜV       |
| VLR170LF                        | 1,000        | —                    | 10,000                    | R17          | UL, CSA, TÜV       |
| VLR170UF                        | 1,000        | —                    | 10,000                    | —            | UL, CSA, TÜV       |
| VLR175F                         | 1,000        | —                    | 10,000                    | R1X          | UL, CSA, TÜV       |
| VLR175LF                        | 1,000        | —                    | 10,000                    | R1X          | UL, CSA, TÜV       |
| VLR175UF                        | 1,000        | —                    | 10,000                    | —            | UL, CSA, TÜV       |
| VLR230F                         | 1,000        | —                    | 10,000                    | R23          | UL, CSA, TÜV       |
| <b>90°C Typical Activation</b>  |              |                      |                           |              |                    |
| <b>VLP</b>                      |              |                      |                           |              |                    |
| VLP120UF                        | 1,000        | —                    | 10,000                    | —            | UL, CSA, TÜV       |
| VLP175UF                        | 1,000        | —                    | 10,000                    | —            | UL, CSA, TÜV       |
| VLP210F                         | 1,000        | —                    | 10,000                    | W21          | UL, CSA, TÜV       |
| VLP220F                         | 1,000        | —                    | 10,000                    | W22          | UL, CSA, TÜV       |
| VLP270F                         | 1,000        | —                    | 10,000                    | W27          | UL, CSA, TÜV       |
| <b>VTP</b>                      |              |                      |                           |              |                    |
| VTP110F                         | 1,000        | —                    | 10,000                    | —            | UL, CSA, TÜV       |
| VTP170F                         | 1,000        | —                    | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP170SSF                       | 1,000        | —                    | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP170XF                        | 1,000        | —                    | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP170XSF                       | 1,000        | —                    | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP175F                         | 1,000        | —                    | 10,000                    | V1X          | UL, CSA, TÜV       |
| VTP175LF                        | 1,000        | —                    | 10,000                    | V1X          | UL, CSA, TÜV       |
| VTP210GF                        | 1,000        | —                    | 10,000                    | V21          | UL, CSA, TÜV       |
| VTP210SF                        | 1,000        | —                    | 10,000                    | V21          | UL, CSA, TÜV       |
| <b>120°C Typical Activation</b> |              |                      |                           |              |                    |
| <b>MXP</b>                      |              |                      |                           |              |                    |
| MXP190BB                        | 4,000        | —                    | 8,000                     | —            | UL, CSA, TÜV       |
| MXP370BD                        | 2,000        | —                    | 4,000                     | —            | UL, CSA, TÜV       |
| <b>125°C Typical Activation</b> |              |                      |                           |              |                    |
| <b>SRP</b>                      |              |                      |                           |              |                    |
| SRP120F                         | 1,000        | —                    | 10,000                    | 120          | UL, CSA, TÜV       |
| SRP120LF                        | 1,000        | —                    | 10,000                    | 120          | UL, CSA, TÜV       |
| SRP120SF                        | 2,000        | —                    | 10,000                    | 120          | UL, CSA, TÜV       |
| SRP175F                         | 2,000        | —                    | 10,000                    | 175          | UL, CSA, TÜV       |
| SRP175LF                        | 1,000        | —                    | 10,000                    | 175          | UL, CSA, TÜV       |
| SRP175SF                        | 2,000        | —                    | 10,000                    | 175          | UL, CSA, TÜV       |
| SRP200F                         | 1,000        | —                    | 10,000                    | 200          | UL, CSA, TÜV       |
| SRP350F                         | 500          | —                    | 10,000                    | 350          | UL, CSA, TÜV       |
| SRP420F                         | 500          | —                    | 10,000                    | 420          | UL, CSA, TÜV       |
| <b>LR4</b>                      |              |                      |                           |              |                    |
| LR4-190F                        | 2,000        | —                    | 10,000                    | E19          | UL, CSA, TÜV       |
| LR4-260F                        | 1,000        | —                    | 10,000                    | E26          | UL, CSA, TÜV       |
| LR4-260SF                       | 1,000        | —                    | 10,000                    | E26          | UL, CSA, TÜV       |
| LR4-380F                        | 1,000        | —                    | 10,000                    | E38          | UL, CSA, TÜV       |
| LR4-380XF                       | 1,000        | —                    | 10,000                    | E38          | UL, CSA, TÜV       |
| LR4-450F                        | 1,000        | —                    | 10,000                    | E45          | UL, CSA, TÜV       |
| LR4-550F                        | 1,000        | —                    | 10,000                    | E55          | UL, CSA, TÜV       |
| LR4-600F                        | 1,000        | —                    | 10,000                    | E60          | UL, CSA, TÜV       |
| LR4-600XF                       | 1,000        | —                    | 10,000                    | E60          | UL, CSA, TÜV       |
| LR4-730F                        | 1,000        | —                    | 10,000                    | E73          | UL, CSA, TÜV       |
| LR4-900F                        | 500          | —                    | 10,000                    | E90          | UL, CSA, TÜV       |
| LR4-1300SSF                     | 250          | —                    | 10,000                    | EX3          | UL, CSA, TÜV       |

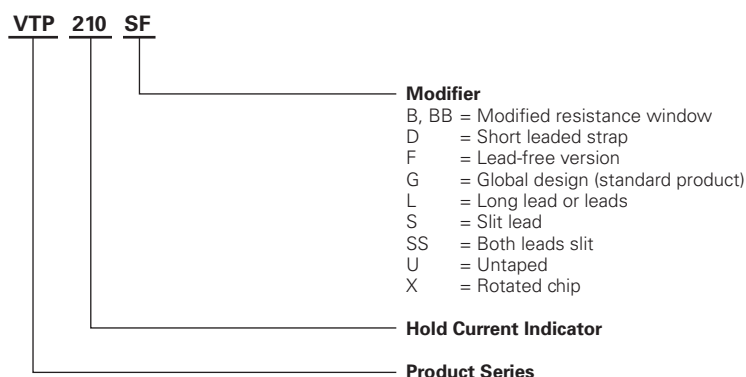
## Agency Recognition for Strap Battery Devices

|     |                                         |
|-----|-----------------------------------------|
| UL  | File # E74889                           |
| CSA | File # 78165C                           |
| TÜV | Certificate number available on request |

## Installation Guidelines for the Strap Family

- PPTC devices operate by thermal expansion of the conductive polymer. If devices are placed under pressure or installed in spaces that would prevent thermal expansion, they may not properly protect against damage caused by fault conditions. Designs must be selected in such a manner that adequate space is maintained over the life of the product.
- Twisting, bending, or placing the PPTC device in tension will decrease the ability of the device to protect against damage caused by electrical faults. No residual force should remain on device after installation. Mechanical damage to the PPTC device may affect device performance and should be avoided.
- Chemical contamination of PPTC devices should be avoided. Certain greases, solvents, hydraulic fluids, fuels, industrial cleaning agents, volatile components of adhesives, silicones, and electrolytes can have an adverse effect on device performance.
- PPTC strap devices are designed to be resistance welded to battery cells or to pack interconnect straps, yet some precautions must be taken when doing so. In order for the PPTC device to exhibit its specified performance, weld placement should be a minimum of 2mm from the edge of the PPTC device, weld splatter must not touch the PPTC device, and welding conditions must not heat the PPTC device above its maximum operating temperature.
- PPTC strap devices are not designed for applications where reflow onto flex circuits or rigid circuit boards is required.
- The polyester tape on PPTC strap devices is intended for marking and identification purposes only, not for electrical insulation.
- The coating on MXP devices is intended to prevent oxidization/aging of the devices. Damaging the coating or causing the coating to delaminate can have negative effects on device performance and should be avoided.
- MXP devices have small PPTC chip size and therefore have weaker peel strength between polymer and Ni-foil of the chip. Excessive mechanical force to the device may cause delamination of Ni-foil from polymer.

## Part Numbering System for Strap Battery Devices



## Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $L di/dt$ ) above the rated voltage of the device.







# PolySwitch Resettable Devices

## Telecommunications & Networking Devices

This family of telecommunication and networking devices was initially designed to meet the growing demand for resettable overcurrent protection. These product families help provide protection against damage caused by power cross and power induction surges as defined in ITU, Telcordia GR1089, and UL60950. Available in chip, surface-mount, and radial-leaded configurations, TE's PolySwitch devices help improve the reliability of customer premise and network equipment world wide.



### Benefits

- Many product choices give engineers more design flexibility
- Compatible with high volume electronics assembly
- Assist in meeting regulatory equipment requirements
- Improved line balance
- Applicable for legacy POTS and modern digital communications equipment

### Features

- RoHS compliant
- Resettable overcurrent protection
- Surface-mount, radial-leaded, and chip form factors
- Fast time-to-trip
- Agency recognition: UL, CSA, TÜV
- Resistance sorted and matched devices available
- Low parasitic capacitance/flat impedance with frequency

### Applications

- |                      |                                 |                                                 |
|----------------------|---------------------------------|-------------------------------------------------|
| • Modems             | • PBX systems                   | • Powered ethernet systems                      |
| • Phone sets         | • MDF modules                   | • VoIP (Voice over Internet Protocol) equipment |
| • Fax machines       | • Analog and digital line cards | • LAN, WAN equipment                            |
| • Phone wall outlets | • T1/E1 equipment               | • Customer premise equipment                    |
| • Alarm systems      | • xDSL modems and splitters     | • Access network hardware                       |

## Application Guide for Telecommunications and Networking Devices\*

To use this guide, follow the steps below:

1. Select your equipment type from the guide below.
2. Select the type of protection depending on the agency and regional specifications in the second column.
3. Select the form factor for your application.
4. Use the Agency Specification/ PolySwitch Device Selection Guide on the next page to select a specific part number for each application based on the agency requirements.
5. Parts with fast time-to-trip or low resistance are available. Please consult a TE Circuit Protection representative.

| Application                                                  | Region/<br>Specification        | Overcurrent Protection |               |             |
|--------------------------------------------------------------|---------------------------------|------------------------|---------------|-------------|
|                                                              |                                 | Form Factor            |               |             |
|                                                              |                                 | Radial-leaded          | Surface-mount | Chip        |
| <b>Customer Premises equipment</b>                           | <b>North America</b>            | TRF600-150             | TS600-170F    |             |
| <b>IT equipment</b>                                          | TIA-968-A,                      | TR600-150F-EX          | TS600-200F    |             |
| Analog modems, V.90 modems,                                  | UL 60950,                       | TRF600-160             | TSM600-250F   |             |
| ISDN modems, xDSL modems,                                    | GR1089 Port Type 3 <sup>‡</sup> | TRF600-400             | TSM600-400F   |             |
| ADSL splitters, phone sets, fax machines,                    | <b>Europe/Asia/</b>             | TRF250-120             | TS250-130F    |             |
| answering machines, caller ID, internet                      | <b>South America</b>            | TRF250-120T            | TSV250-130F   |             |
| appliances, PBX systems, POS terminals,                      | ITU K.21                        | TRF250-145             |               |             |
| wall plugs                                                   |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |
| <b>Access network equipment (†)</b>                          | <b>North America</b>            | TRF600-160             | TS600-170F    |             |
| Remote terminals, line repeaters,                            | GR1089 Port Type 5 <sup>‡</sup> | TRF600-400             | TS600-200F    |             |
| multiplexers, cross-connects,                                |                                 |                        | TS600-400F    |             |
| WAN equipment                                                |                                 |                        | TSM600-250F   |             |
|                                                              |                                 |                        | TSM600-400F   |             |
|                                                              |                                 |                        | FT600-1250**  |             |
|                                                              | <b>Europe/Asia/</b>             | TRF250-120             | TS250-130F    |             |
|                                                              | <b>South America</b>            | TRF250-120T            | TSV250-130F   |             |
|                                                              | ITU K.45                        | TRF250-145             |               |             |
|                                                              |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |
| <b>Central office switching equipment (†)</b>                | <b>North America</b>            | TRF600-160             | TS600-170F    |             |
| Analog/POTS linecards, ISDN linecards,                       | GR1089 Port Type 1 <sup>‡</sup> | TRF600-400             | TS600-200F    |             |
| xDSL modems, ADSL/VDSL splitters,                            |                                 |                        | TS600-400F    |             |
| T1/E1 linecards, multiplexers,                               |                                 |                        | TSM600-250F   |             |
| CSU/DSU, servers                                             |                                 |                        | TSM600-400F   |             |
|                                                              |                                 |                        | FT600-1250**  |             |
|                                                              | <b>Europe/Asia/</b>             | TRF250-120             | TS250-130F    | TCF250-180  |
|                                                              | <b>South America</b>            | TRF250-120T            | TSV250-130F   |             |
|                                                              | ITU K.20                        | TRF250-145             |               |             |
|                                                              |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |
| <b>Primary protection modules (†)</b>                        | <b>North America</b>            | TRF250-183             |               |             |
| MDF modules, Network Interface                               | Telcordia GR-974                | TRF250-184             |               |             |
| Devices (NID)                                                | <b>Europe/Asia/</b>             | TRF250-055UT           | TSL250-080F   | TCF250-100T |
|                                                              | <b>South America</b>            | TRF250-080U            | TS250-130F    | TCF250-120T |
|                                                              | ITU K.20                        | TRF250-110U            | TSV250-130F   | TCF250-145T |
|                                                              |                                 | TRF250-120             |               | TCF250-180  |
|                                                              |                                 | TRF250-120T            |               |             |
|                                                              |                                 | TRF250-145             |               |             |
|                                                              |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |
| <b>Short-haul/intrabuilding communications equipment (†)</b> | <b>North America</b>            | TRF250-080U            | TSL250-080F   |             |
| LAN equipment, VoIP cards, cable                             | GR1089 Port Type 2 <sup>‡</sup> | TRF250-120             | TS250-130F    |             |
| telephony NIUs, wireless local loop                          | GR1089 Port Type 4 <sup>‡</sup> | TRF250-120T            | TSV250-130F   |             |
| handsets                                                     |                                 | TRF250-145             |               |             |
|                                                              |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |
|                                                              | <b>Europe/Asia/</b>             | TRF250-120             | TS250-130F    |             |
|                                                              | <b>South America</b>            | TRF250-120T            | TSV250-130F   |             |
|                                                              | ITU K.21                        | TRF250-145             |               |             |
|                                                              |                                 | TRF250-183             |               |             |
|                                                              |                                 | TRF250-184             |               |             |

## Protection Application Guide for Telecommunications and Networking Devices\*

Cont'd

| Application                                                                                                                                                                            | Region/<br>Specification                                | Overcurrent Protection |                                |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------|--------------------------------|------|
|                                                                                                                                                                                        |                                                         | Form Factor            |                                |      |
|                                                                                                                                                                                        |                                                         | Radial-leaded          | Surface-mount                  | Chip |
| <b>LAN intrabuilding power cross protection</b><br>LAN equipment, VoIP cards, IP phones                                                                                                | <b>North America</b><br>GR1089 Port Type 4 <sup>‡</sup> | TRF250-080U            | TSL250-080F                    |      |
|                                                                                                                                                                                        |                                                         | TRF250-120             | TS250-130F                     |      |
|                                                                                                                                                                                        |                                                         | TRF250-120T            | TSV250-130F                    |      |
|                                                                                                                                                                                        |                                                         | TRF250-145             |                                |      |
|                                                                                                                                                                                        |                                                         | TRF250-183             |                                |      |
|                                                                                                                                                                                        |                                                         | TRF250-184             |                                |      |
| <b>IEEE 802.3AF/AT Power over Ethernet protection</b><br>Powered Ethernet switches and terminals,<br>IP phones, wireless LAN base stations,<br>microcellular base stations, VoIP cards |                                                         |                        | decaSMD050F/60-2 <sup>††</sup> |      |
| <b>Cable telephony powering system</b><br>Power passing taps                                                                                                                           |                                                         | BBRF550 <sup>††</sup>  |                                |      |

\* This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

† For improved line balance in these applications, resistance-matched parts are recommended.

‡ May require additional impedance or coordination with primary protector.

\*\* FT600-1250 are surface mount telecom fuse devices. FT600-0500 and FT600-2000 reference also available. See telecom fuses section.

†† For details on decaSMD050F/60-2, see surface-mount devices section.

†† For details on BBRF series, see radial-leaded devices section.

## Agency Specification/Selection Guide for Telecommunications and Networking Devices

Use the guide below to select the PolySwitch devices which are typically used in your application. The following pages contain the specifications for the part numbers recommended below. PolySwitch devices assist telecommunication equipment in meeting the applicable protection requirements of these industry specifications. Refer to individual agency specifications for test procedures and circuit schematics. Users should independently evaluate the suitability of, and test each product for their application.

| Family        | Product*           | Lightning                                    | Power Cross/Contact/Induction                    |
|---------------|--------------------|----------------------------------------------|--------------------------------------------------|
| <b>TCF250</b> | <b>TCF250-100T</b> | ITU K.20 – 1.0kV 10/700µs                    | PRC YD/T694                                      |
|               |                    | GR-1089 Port Types 2 & 4 – 1st Level         | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|               |                    |                                              | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|               |                    |                                              | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|               | <b>TCF250-120T</b> | ITU K.20/21/45 – 1.5kV 10/700µs              | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |
|               | <b>TCF250-145T</b> | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup> | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|               | <b>TCF250-180</b>  | GR-1089 Port Types 2 & 4 – 1st Level         | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|               |                    |                                              | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |
|               |                    |                                              | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |

\* Applies to all products which share the same prefix.

† Tested with 230V gas discharge tube primary protector.

| Family              | Product*               | Lightning                                                                                                               | Power Cross/Contact/Induction                                                                                                                                                                                                                   |
|---------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRF250              | TRF250-055UT           | ITU K.20 – 1.0kV 10/700µs                                                                                               | ITU K.20 – 230V <sub>AC</sub> , 10Ω                                                                                                                                                                                                             |
|                     | TRF250-080U            | ITU K.20 – 1.0kV 10/700µs<br>GR-1089 Port Types 2 & 4 – 1st Level                                                       | ITU K.20 – 230V <sub>AC</sub> , 10Ω<br>ITU K.20 – 0.2A <sup>2</sup> s<br>ITU K.20 – 1A <sup>2</sup> s <sup>†</sup><br>GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc                                                                          |
|                     | TRF250-110U            | ITU K.20/21/45 – 1.5kV 10/700µs                                                                                         | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω                                                                                                                                                                                                       |
|                     | TRF250-120             | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup>                                                                            | ITU K.20/21/45 – 0.2A <sup>2</sup> s                                                                                                                                                                                                            |
|                     | TRF250-120T            | GR-1089 Port Types 2 & 4 – 1st Level                                                                                    | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>                                                                                                                                                                                                 |
|                     | TRF250-120U            |                                                                                                                         | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup>                                                                                                                                                                                                |
|                     | TRF250-120UT           |                                                                                                                         | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc                                                                                                                                                                                                |
|                     | TRF250-145             |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     | TRF250-145U            |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     | TRF250-183             |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     | TRF250-184             | ITU K.20/21/45 – 1.5kV 10/700µs<br>ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup><br>GR-1089 Port Types 2 & 4 – 1st Level | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω **<br>ITU K.20/21/45 – 0.2A <sup>2</sup> s<br>ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup><br>ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup><br>GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
| TS250/TSV250        | TSV250-130F            | ITU K.20/21/45 – 1.5kV 10/700µs                                                                                         | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω                                                                                                                                                                                                       |
|                     | TS250-130F             | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup><br>GR-1089 Port Types 2 & 4 – 1st Level                                    | ITU K.20/21/45 – 0.2A <sup>2</sup> s<br>ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup><br>ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup><br>GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc                                                 |
|                     | TS250-130F-RB          | ITU K.20/21/45 – 1.5kV 10/700µs<br>ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup><br>GR-1089 Port Types 2 & 4 – 1st Level | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω<br>ITU K.20/21/45 – 0.2A <sup>2</sup> s<br>ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup><br>ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup><br>GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc    |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
| TSL250              | TSL250-080F            | GR-1089 Port Types 2 & 4 – 1st Level<br>ITU K.20 – 1.0kV 10/700µs                                                       | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc<br>ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω<br>ITU K.20/21/45 – 0.2A <sup>2</sup> s<br>ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>                                                        |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     |                        |                                                                                                                         |                                                                                                                                                                                                                                                 |
| TRF600              | TRF600-150             | TIA-968-A Types A & B                                                                                                   | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | TR600-150F-EX          | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level <sup>††</sup>                                                            | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | TR600-150F-EX-RA-B-0.5 | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level <sup>††</sup>                                                            | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | TRF600-160             | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level <sup>††</sup>                                                            | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                                                                  |
|                     | TRF600-400             | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level                                                                          | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                                                                  |
| TS600               | TS600-170F             | TIA-968-A Types A & B                                                                                                   | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | TS600-200F-RA          | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level <sup>††</sup>                                                            | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                                                                  |
|                     | TS600-400F             |                                                                                                                         |                                                                                                                                                                                                                                                 |
| TSM600              | TSM600-250F            | TIA-968-A Types A & B                                                                                                   | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | TSM600-250F-RA         | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level <sup>††</sup>                                                            | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                                                                  |
|                     | TSM600-400F            | TIA-968-A Types A & B<br>GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level                                                 | UL60950 – 600V <sub>AC</sub> , 40Asc<br>Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                          |
| FT600 <sup>††</sup> | FT600-0500             | TIA-968-A -Types A & B                                                                                                  | UL60950 – 600V <sub>AC</sub> , 40Asc                                                                                                                                                                                                            |
|                     | FT600-1250             |                                                                                                                         |                                                                                                                                                                                                                                                 |
|                     | FT600-2000             | GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level                                                                          | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc                                                                                                                                                                                                  |

\* Applies to all products which share the same prefix.

† Tested with 230V gas discharge tube primary protector.

‡ Tested with 350V gas discharge tube primary protector.

\*\* See SCD for additional application fault ratings.

†† May require additional series resistor to help telecommunication equipment pass Surge 3 (1kV, 10/1000µs).

‡‡ See telecom fuses section.

**Table T1** Product Series: Size, Current Rating, Voltage Rating, Typical Resistance for Telecommunications and Networking Devices

|                                                         | TCF250                        | TRF250                        | TS250                         | TSV250                        | TSL250                 | TS600<br>TSM600                       | TRF600                                |
|---------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|------------------------|---------------------------------------|---------------------------------------|
| <b>Voltage Rating (V<sub>AC</sub>)*<br/>(Interrupt)</b> | 250                           | 250                           | 250                           | 250                           | 250                    | 600                                   | 600                                   |
| <b>Specification</b>                                    | ITU<br>GR-1089<br>Ports 2 & 4 | ITU<br>GR-1089<br>Ports 2 & 4 | ITU<br>GR-1089<br>Ports 2 & 4 | ITU<br>GR-1089<br>Ports 2 & 4 | GR-1089<br>Ports 2 & 4 | UL60950<br>GR-1089<br>Ports 1, 3, & 5 | UL60950<br>GR-1089<br>Ports 1, 3, & 5 |
| <b>Hold Current (A)</b>                                 |                               |                               |                               |                               |                        |                                       |                                       |
| 0.055                                                   | —                             | 20.0Ω                         | —                             | —                             | —                      | —                                     | —                                     |
| 0.080                                                   | —                             | 17.0Ω                         | —                             | —                             | 8.0Ω                   | —                                     | —                                     |
| 0.100                                                   | 11.0Ω                         | —                             | —                             | —                             | —                      | —                                     | —                                     |
| 0.110                                                   | —                             | 7.0Ω                          | —                             | —                             | —                      | —                                     | —                                     |
| 0.120                                                   | 10.5Ω                         | 8.0Ω                          | —                             | —                             | —                      | —                                     | —                                     |
| 0.130                                                   | —                             | —                             | 9.0Ω                          | 5.5Ω                          | —                      | —                                     | —                                     |
| 0.145                                                   | 7.0Ω                          | 4.5Ω                          | —                             | —                             | —                      | —                                     | —                                     |
| 0.150                                                   | —                             | —                             | —                             | —                             | —                      | —                                     | 8.0Ω                                  |
| 0.160                                                   | —                             | —                             | —                             | —                             | —                      | —                                     | 6.0Ω                                  |
| 0.170                                                   | —                             | —                             | —                             | —                             | —                      | 11.0Ω                                 | —                                     |
| 0.183                                                   | —                             | 1.3Ω                          | —                             | —                             | —                      | —                                     | —                                     |
| 0.184                                                   | —                             | 1.9Ω                          | —                             | —                             | —                      | —                                     | —                                     |
| 0.200                                                   | —                             | —                             | —                             | —                             | —                      | 8.5Ω                                  | —                                     |
| 0.250                                                   | —                             | —                             | —                             | —                             | —                      | 3.5Ω                                  | —                                     |
| 0.400                                                   | —                             | —                             | —                             | —                             | —                      | 1.2Ω                                  | 1.2Ω                                  |

### Voltage Ratings for Telecommunications and Networking Devices

For circuit protection telecommunications devices there are two applicable voltage ratings. These are **V<sub>MAX</sub> Operating** and **V<sub>MAX</sub> Interrupt**. To help understand the nature of these two different voltage ratings, the following definitions are provided:

**V<sub>MAX</sub> Operating** : For telecommunications devices this is the voltage used to obtain component recognition under UL1434. Most circuit protection devices are certified at 60V but can withstand higher V<sub>MAX</sub> Interrupt conditions as noted above. See Table T3 for its V<sub>MAX</sub> Operating.

**\*V<sub>MAX</sub> Interrupt** : Under specified conditions this is the highest voltage that can be applied to the device at the maximum current. Devices have been designed to trip safely under higher power level cross conditions, as listed above, to assist equipment in meeting the appropriate industry conditions.

**Table T2 Thermal Derating for Telecommunications and Networking Devices**  
[Hold Current (A) at Ambient Temperature (°C)]

| Part Number                               | Maximum Ambient Temperature |       |       |       |       |       |       |       |       |
|-------------------------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                           | -40°C                       | -20°C | 0°C   | 20°C  | 40°C  | 50°C  | 60°C  | 70°C  | 85°C  |
| <b>Chip* — 250V<sub>AC</sub></b>          |                             |       |       |       |       |       |       |       |       |
| <b>TCF250</b>                             |                             |       |       |       |       |       |       |       |       |
| TCF250-100T                               | 0.155                       | 0.138 | 0.119 | 0.100 | 0.083 | 0.073 | 0.064 | 0.055 | 0.042 |
| TCF250-120T                               | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TCF250-145T                               | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TCF250-180†                               | 0.269                       | 0.240 | 0.211 | 0.180 | 0.153 | 0.138 | 0.123 | 0.109 | 0.087 |
| <b>Radial-led* — 250V<sub>AC</sub></b>    |                             |       |       |       |       |       |       |       |       |
| <b>TRF250</b>                             |                             |       |       |       |       |       |       |       |       |
| <b>NEW</b> TRF250-055UT                   | 0.085                       | 0.076 | 0.065 | 0.055 | 0.045 | 0.041 | 0.035 | 0.030 | 0.023 |
| TRF250-080U                               | 0.124                       | 0.110 | 0.095 | 0.080 | 0.066 | 0.059 | 0.051 | 0.044 | 0.033 |
| TRF250-110U                               | 0.171                       | 0.151 | 0.131 | 0.110 | 0.091 | 0.081 | 0.071 | 0.061 | 0.046 |
| TRF250-120                                | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TRF250-145                                | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TRF250-183‡                               | 0.284                       | 0.251 | 0.217 | 0.183 | 0.149 | 0.133 | 0.117 | 0.101 | 0.075 |
| <b>NEW</b> TRF250-184‡                    | 0.286                       | 0.252 | 0.218 | 0.184 | 0.150 | 0.134 | 0.118 | 0.102 | 0.075 |
| <b>Surface-mount* — 250V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TS250/TSL250/TSV250</b>                |                             |       |       |       |       |       |       |       |       |
| TSL250-080F                               | 0.124                       | 0.110 | 0.095 | 0.080 | 0.066 | 0.059 | 0.051 | 0.044 | 0.033 |
| TS250-130F                                | 0.208                       | 0.182 | 0.156 | 0.130 | 0.104 | 0.091 | 0.078 | 0.065 | 0.045 |
| TSV250-130F                               | 0.208                       | 0.182 | 0.156 | 0.130 | 0.104 | 0.091 | 0.078 | 0.065 | 0.045 |
| <b>Radial-led† — 600V<sub>AC</sub></b>    |                             |       |       |       |       |       |       |       |       |
| <b>TRF600</b>                             |                             |       |       |       |       |       |       |       |       |
| TRF600-150                                | 0.239                       | 0.209 | 0.180 | 0.150 | 0.121 | 0.107 | 0.093 | 0.079 | 0.057 |
| TR600-150F-EX                             | 0.239                       | 0.209 | 0.180 | 0.150 | 0.121 | 0.107 | 0.093 | 0.079 | 0.057 |
| TR600-150F-EX-RA                          | 0.239                       | 0.209 | 0.180 | 0.150 | 0.121 | 0.107 | 0.093 | 0.079 | 0.057 |
| TRF600-160                                | 0.255                       | 0.223 | 0.192 | 0.160 | 0.129 | 0.114 | 0.099 | 0.084 | 0.061 |
| <b>NEW</b> TRF600-400                     | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |
| <b>Surface-mount† — 600V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TS600/TSM600</b>                       |                             |       |       |       |       |       |       |       |       |
| TS600-170F                                | 0.264                       | 0.230 | 0.200 | 0.170 | 0.140 | 0.125 | 0.109 | 0.094 | 0.070 |
| TS600-200F-RA-B-0.5                       | 0.310                       | 0.275 | 0.238 | 0.200 | 0.165 | 0.147 | 0.128 | 0.110 | 0.083 |
| TS600-400F                                | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |
| TSM600-250F                               | 0.400                       | 0.350 | 0.300 | 0.250 | 0.198 | 0.170 | 0.140 | 0.117 | 0.083 |
| TSM600-250F-RA                            | 0.400                       | 0.350 | 0.300 | 0.250 | 0.198 | 0.170 | 0.140 | 0.117 | 0.083 |
| TSM600-400F                               | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

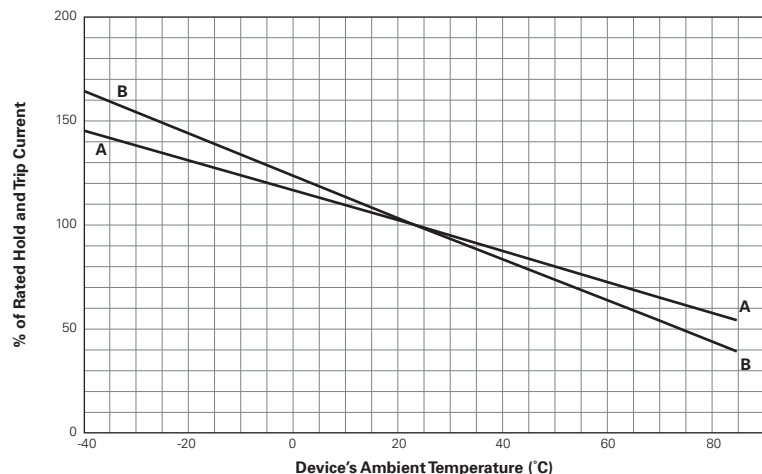
† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

‡ Product is not currently available in a resistance matched or sorted option.

**Figure T1 Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]**

- A = TCF250-180  
B = All other TCF, TRF, TSx, TSM series devices

**Figure T1**



**Table T3 Electrical Characteristics for Telecommunications and Networking Devices**

| Part Number                         | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>                |                                  | I <sub>MAX</sub> *†<br>Interrupt<br>(A) | P <sub>D</sub> TYP<br>(W) | Typical Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) |
|-------------------------------------|-----------------------|-----------------------|---------------------------------|----------------------------------|-----------------------------------------|---------------------------|----------------------|------|-------------------------|-------------------------|--------------------------|
|                                     |                       |                       | Operating<br>(V <sub>DC</sub> ) | Interrupt<br>(V <sub>RMS</sub> ) |                                         |                           | (A)                  | (s)  |                         |                         |                          |
| Chip* — 250V <sub>AC</sub>          |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TCF250                              |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TCF250-100T                         | 0.100                 | 0.150                 | 60                              | 250                              | 3.0                                     | 0.6                       | 1.0                  | 0.2  | 14.0                    | 18.0                    | 24.0                     |
| TCF250-120T                         | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.0                  | 0.6  | 6.3                     | 12.0                    | 18.0                     |
| TCF250-145T                         | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.0                  | 1.5  | 5.0                     | 9.0                     | 14.0                     |
| TCF250-180‡                         | 0.180                 | 0.650                 | 60                              | 250                              | 3.0                                     | 0.9                       | 1.0                  | 15.5 | 1.0                     | 2.2                     | 4.0                      |
| Radial-leaded* — 250V <sub>AC</sub> |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TRF250                              |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| NEW TRF250-055UT                    | 0.055                 | 0.170                 | 60                              | 250                              | 3.0                                     | 0.6                       | 0.28                 | 3.0  | 15.0                    | 25.0                    | 35.0                     |
| TRF250-080T                         | 0.080                 | 0.160                 | 60                              | 250                              | 3.0                                     | 0.6                       | 0.35                 | 2.5  | 15.0                    | 22.0                    | 33.0                     |
| TRF250-080U                         | 0.080                 | 0.160                 | 60                              | 250                              | 3.0                                     | 0.6                       | 0.35                 | 2.5  | 14.0                    | 20.0                    | 33.0                     |
| TRF250-110U                         | 0.110                 | 0.220                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 0.8  | 5.0                     | 9.0                     | 16.0                     |
| TRF250-120                          | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.5  | 4.0                     | 8.0                     | 16.0                     |
| TRF250-120T                         | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 0.35                 | 0.7  | 7.0                     | 12.0                    | 16.0                     |
| TRF250-120T-RA                      | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.2  | 7.0                     | 9.0                     | 16.0                     |
| TRF250-120T-RC                      | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.5  | 5.4                     | 7.5                     | 14.0                     |
| TRF250-120T-RF                      | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 0.9  | 6.0                     | 10.5                    | 16.0                     |
| TRF250-120T-R1                      | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.0  | 6.0                     | 9.0                     | 16.0                     |
| TRF250-120T-R2                      | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 0.8  | 8.0                     | 10.5                    | 16.0                     |
| TRF250-120U                         | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.0  | 6.0                     | 10.0                    | 16.0                     |
| TRF250-120UT                        | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 0.7  | 7.0                     | 12.0                    | 16.0                     |
| TRF250-145                          | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 2.5  | 3.0                     | 6.0                     | 14.0                     |
| TRF250-145-RA                       | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 2.5  | 3.0                     | 5.5                     | 12.0                     |
| TRF250-145-RB                       | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 2.0  | 4.5                     | 6.0                     | 14.0                     |
| TRF250-145T                         | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 1.5  | 5.4                     | 7.5                     | 14.0                     |
| TRF250-145U                         | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                                     | 1.0                       | 1.00                 | 2.0  | 3.5                     | 6.5                     | 14.0                     |
| TRF250-183‡                         | 0.183                 | 0.685                 | 100                             | 250                              | 10.0                                    | 0.9                       | 3.00                 | 0.6  | 0.8                     | 2.2                     | 3.4                      |
| NEW TRF250-184‡                     | 0.184                 | 1.000                 | 100                             | 250                              | 10.0                                    | 0.9                       | 3.00                 | 0.5  | 1.2                     | 2.4                     | 3.1                      |
| Surface-mount* — 250V <sub>AC</sub> |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TS250/TSL250/TSV250                 |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TSL250-080F                         | 0.080                 | 0.240                 | 80                              | 250                              | 3.0                                     | 1.2                       | 1.0                  | 0.8  | 5.0                     | 11.0                    | 20.0**                   |
| TS250-130F                          | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.1                       | 1.0                  | 0.9  | 6.5                     | 12.0                    | 20.0**                   |
|                                     | —                     | —                     | 60                              | 600                              | 1.0                                     | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RA                       | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.1                       | 1.0                  | 1.4  | 6.5                     | 9.0                     | 15.0**                   |
|                                     | —                     | —                     | 60                              | 600                              | 1.0                                     | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RB                       | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.1                       | 1.0                  | 0.7  | 9.0                     | 12.0                    | 20.0**                   |
|                                     | —                     | —                     | 60                              | 600                              | 1.0                                     | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RC                       | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.1                       | 1.0                  | 1.1  | 7.0                     | 10.0                    | 17.0**                   |
|                                     | —                     | —                     | 60                              | 600                              | 1.0                                     | —                         | —                    | —    | —                       | —                       | —                        |
| TSV250-130F                         | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                                     | 1.5                       | 1.0                  | 2.0  | 4.0                     | 7.0                     | 12.0**                   |
| Radial-leaded† — 600V <sub>AC</sub> |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TRF600                              |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TRF600-150                          | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                                     | 1.0                       | 1.0                  | 1.4  | 6.0                     | 10.0                    | 17.0                     |
| TRF600-150-RB                       | 0.130                 | 0.260                 | 250                             | 600                              | 3.0                                     | 1.0                       | 1.0                  | 1.0  | 9.0                     | 12.0                    | 22.0                     |
| TR600-150F-EX                       | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                                     | 1.4                       | 1.0                  | 5.0  | 6.0                     | 12.0                    | 22.0                     |
| TR600-150F-EX-RA-B-0.5              | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                                     | 1.4                       | 1.0                  | 5.0  | 7.0                     | 10.0                    | 20.0                     |
| TRF600-160                          | 0.160                 | 0.320                 | 250                             | 600                              | 3.0                                     | 1.7                       | 1.0                  | 7.5  | 4.0                     | 10.0                    | 18.0                     |
| TRF600-160-RA                       | 0.160                 | 0.320                 | 250                             | 600                              | 3.0                                     | 1.7                       | 1.0                  | 9.5  | 4.0                     | 7.0                     | 16.0                     |
| TRF600-160-R1                       | 0.160                 | 0.320                 | 250                             | 600                              | 3.0                                     | 1.7                       | 1.0                  | 9.0  | 4.0                     | 8.0                     | 17.0                     |
| NEW TRF600-400                      | 0.400                 | 1.000                 | 60                              | 600                              | 3.0                                     | 2.4                       | 3.0                  | 4.0  | 0.95                    | 1.45                    | 1.90                     |

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

‡ Product is not currently available in a resistance matched or sorted option.

\*\* R<sub>1MAX</sub> measured 1 hour post-trip, or 24 hours post-reflow at 20°C.



**Table T3 Electrical Characteristics for Telecommunications and Networking Devices**

Cont'd

| Part Number                                         | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>                |                                  | I <sub>MAX</sub> *†<br>Interrupt<br>(A) | P <sub>D</sub> Typ<br>(W) | Typical Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) |
|-----------------------------------------------------|-----------------------|-----------------------|---------------------------------|----------------------------------|-----------------------------------------|---------------------------|----------------------|------|-------------------------|-------------------------|--------------------------|
|                                                     |                       |                       | Operating<br>(V <sub>DC</sub> ) | Interrupt<br>(V <sub>RMS</sub> ) |                                         |                           | (A)                  | (s)  |                         |                         |                          |
| Surface-mount† — 600V <sub>AC</sub><br>TS600/TSM600 |                       |                       |                                 |                                  |                                         |                           |                      |      |                         |                         |                          |
| TS600-170F                                          | 0.170                 | 0.400                 | 60                              | 600                              | 3.0                                     | 2.5                       | 1.0                  | 10.0 | 4.0                     | 9.0                     | 18.0                     |
| TS600-200F-RA-B-0.5                                 | 0.200                 | 0.400                 | 60                              | 600                              | 3.0                                     | 2.5                       | 1.0                  | 12.0 | 4.0                     | 7.5                     | 13.5                     |
| TS600-400F                                          | 0.400                 | 1.000                 | 60                              | 600                              | 3.0                                     | 2.0                       | 3.0                  | 5.0  | 0.5                     | 1.5                     | 2.0                      |
| TSM600-250F                                         | 0.250                 | 0.860                 | 250                             | 600                              | 3.0                                     | 2.0                       | 3.0                  | 0.8  | 1.0                     | 3.5                     | 7.0                      |
| TSM600-250F-RA                                      | 0.250                 | 0.860                 | 250                             | 600                              | 3.0                                     | 2.0                       | 3.0                  | 1.0  | 1.0                     | 3.0                     | 5.0                      |
| TSM600-400F                                         | 0.400                 | 1.000                 | 250                             | 600                              | 3.0                                     | 2.0                       | 3.0                  | 5.0  | 0.5                     | 1.5                     | 2.0                      |

**Notes:**

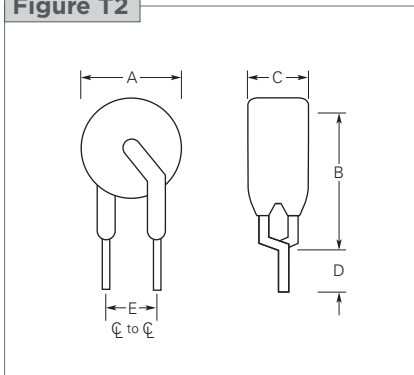
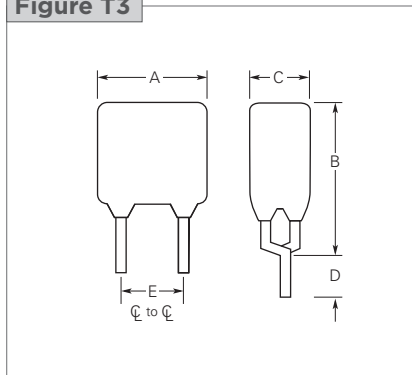
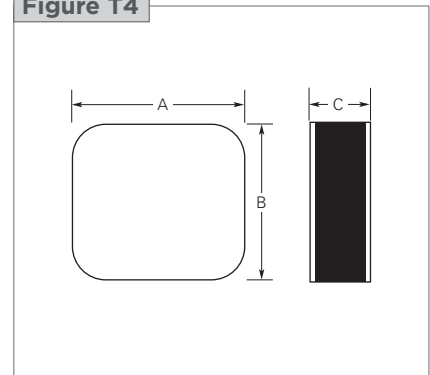
- $I_H$  : Hold current: maximum current device will pass without interruption in 20°C still air.  
 $I_T$  : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.  
 $V_{MAX}$  Operating : Maximum continuous voltage device can withstand without damage at rated current. This voltage is used for component recognition under UL1434.  
 $V_{MAX}$  Interrupt : Maximum voltage that can be safely placed across a device in its tripped state. Devices have been designed to trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950, or GR1089 industry requirements.  
 $I_{MAX}$  Interrupt : Maximum fault current device can withstand without damage at rated operating voltage. This current is used for component recognition under UL1434. Devices have been designed to trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950, or GR1089 industry requirements.  
 $P_D$  : Power dissipated from device when in the tripped state in 20°C still air.  
 $R_{MIN}$  : Minimum resistance of device as supplied at 20°C unless otherwise specified.  
 $R_{MAX}$  : Maximum resistance of device as supplied at 20°C unless otherwise specified.  
 $R_{1MAX}$  : Maximum resistance measured one hour post-trip or post-reflow at 20°C.

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

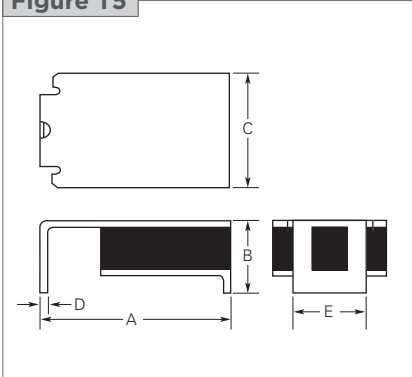
† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.


**Warning :**

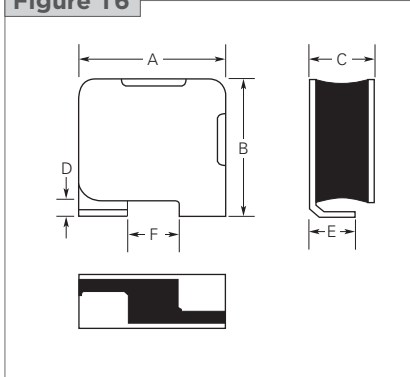
- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $L di/dt$ ) above the rated voltage of the device.

**Figure T2-T13 Dimension Figures for Telecommunications and Networking Devices**
**Figure T2**

**Figure T3**

**Figure T4**


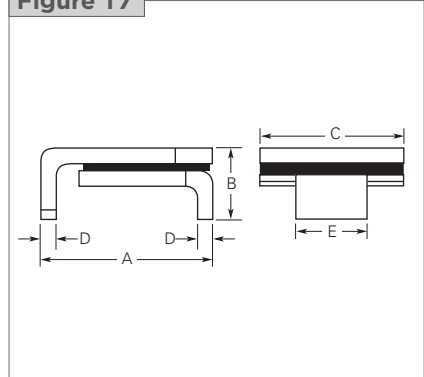
**Figure T5**



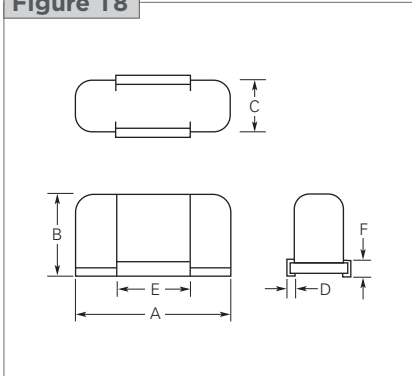
**Figure T6**



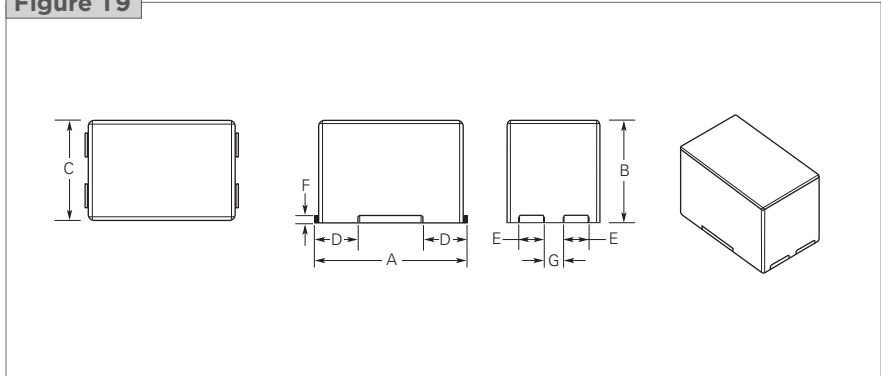
**Figure T7**



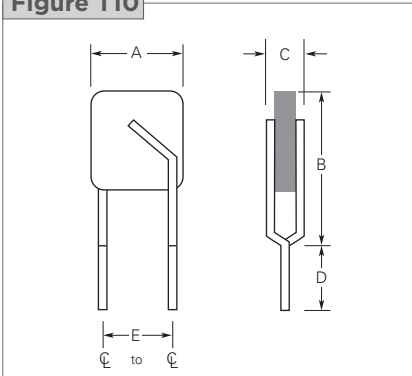
**Figure T8**



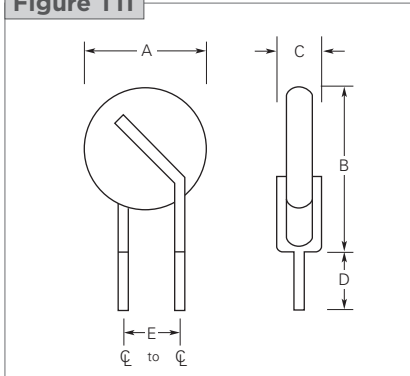
**Figure T9**



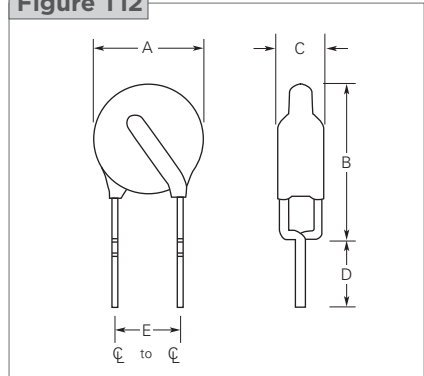
**Figure T10**



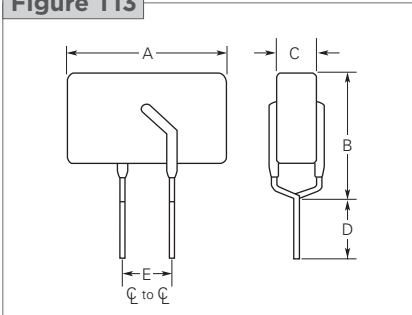
**Figure T11**



**Figure T12**



**Figure T13**



**Table T4 Dimensions & Weights for Telecommunications and Networking Devices**

| Part Number               |              | Dimensions in Millimeters (Inches) |                |               |                |               |               |                            |               |                            |               |               |                |      |      | Figure | Device Mass (g)<br>(Only for reference) |
|---------------------------|--------------|------------------------------------|----------------|---------------|----------------|---------------|---------------|----------------------------|---------------|----------------------------|---------------|---------------|----------------|------|------|--------|-----------------------------------------|
|                           |              | A                                  |                | B             |                | C             |               | D                          |               | E                          |               | F             |                | G    |      |        |                                         |
|                           |              | Min.                               | Max.           | Min.          | Max.           | Min.          | Max.          | Min.                       | Max.          | Min.                       | Max.          | Min.          | Max.           | Min. | Max. |        |                                         |
| TCF 250V*                 |              |                                    |                |               |                |               |               |                            |               |                            |               |               |                |      |      |        |                                         |
| TCF250-100T               |              | 4.6<br>(0.18)                      | 4.9<br>(0.19)  | 4.6<br>(0.18) | 4.9<br>(0.19)  | 2.0<br>(0.08) | 2.3<br>(0.09) | —                          | —             | —                          | —             | —             | —              | —    | —    | T4     | 0.24                                    |
| TCF250-120T               |              | 5.4<br>(0.21)                      | 5.6<br>(0.22)  | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.3<br>(0.09) | —                          | —             | —                          | —             | —             | —              | —    | —    | T4     | 0.28                                    |
| TCF250-145T               |              | 5.4<br>(0.21)                      | 5.6<br>(0.22)  | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.5<br>(0.10) | —                          | —             | —                          | —             | —             | —              | —    | —    | T4     | 0.28                                    |
| TCF250-180                |              | 6.9<br>(0.27)                      | 7.1<br>(0.28)  | 6.9<br>(0.27) | 7.1<br>(0.28)  | 1.3<br>(0.05) | 1.6<br>(0.06) | —                          | —             | —                          | —             | —             | —              | —    | —    | T4     | 0.35                                    |
| TRF250 250V*              |              |                                    |                |               |                |               |               |                            |               |                            |               |               |                |      |      |        |                                         |
| NEW                       | TRF250-055UT | —                                  | 4.8<br>(0.19)  | —             | 9.3<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T2     | 0.13                                    |
| TRF250-080T               |              | —                                  | 5.8<br>(0.23)  | —             | 9.9<br>(0.39)  | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T2     | 0.28                                    |
| TRF250-080U               |              | —                                  | 4.8<br>(0.19)  | —             | 9.3<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T11    | 0.13                                    |
| TRF250-110U               |              | —                                  | 5.3<br>(0.21)  | —             | 9.4<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T11    | 0.13                                    |
| TRF250-120                |              | —                                  | 6.5<br>(0.26)  | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T3     | 0.38                                    |
| TRF250-120U               |              | —                                  | 6.0<br>(0.24)  | —             | 10.0<br>(0.39) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T10    | 0.19                                    |
| TRF250-145                |              | —                                  | 6.5<br>(0.26)  | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T3     | 0.38                                    |
| TRF250-145U               |              | —                                  | 6.0<br>(0.24)  | —             | 10.0<br>(0.39) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T10    | 0.19                                    |
| TRF250-183                |              | —                                  | 7.5<br>(0.29)  | —             | 10.5<br>(0.41) | —             | 4.1<br>(0.16) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T2     | 0.30                                    |
| NEW                       | TRF250-184   | —                                  | 7.7<br>(0.30)  | —             | 10.5<br>(0.41) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T12    | 0.32                                    |
| TS250/TSL250/TSV250 250V* |              |                                    |                |               |                |               |               |                            |               |                            |               |               |                |      |      |        |                                         |
| TSL250-080F               |              | 6.7<br>(0.27)                      | 7.9<br>(0.31)  | 2.7<br>(0.11) | 3.7<br>(0.15)  | 4.8<br>(0.19) | 5.3<br>(0.21) | 0.2<br>(0.01)              | 0.4<br>(0.02) | 2.5<br>(0.10)              | 3.1<br>(0.12) | —             | —              | —    | —    | T7     | 2.80                                    |
| TS250-130F                |              | 8.5<br>(0.34)                      | 9.4<br>(0.37)  | —             | 3.4<br>(0.14)  | —             | 7.4<br>(0.29) | 0.3 <sup>‡</sup><br>(0.01) | —             | 3.8 <sup>‡</sup><br>(0.15) | —             | —             | —              | —    | —    | T5     | 3.60                                    |
| TSV250-130F               |              | —                                  | 6.1<br>(0.24)  | —             | 6.9<br>(0.27)  | —             | 3.2<br>(0.13) | 0.56<br>(0.02)             | —             | —                          | 1.9<br>(0.08) | 1.6<br>(0.07) | 2.3<br>(0.09)  | —    | —    | T6     | 2.80                                    |
| TRF600 600V <sup>†</sup>  |              |                                    |                |               |                |               |               |                            |               |                            |               |               |                |      |      |        |                                         |
| TRF600-150                |              | —                                  | 9.0<br>(0.35)  | —             | 12.5<br>(0.49) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0<br>(0.20)              | —             | —             | 9.0<br>(0.35)  | —    | —    | T3     | 0.37                                    |
| TR600-150F-EX             |              | —                                  | 13.5<br>(0.53) | —             | 12.6<br>(0.50) | —             | 6.0<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0<br>(0.20)              | —             | —             | —              | —    | —    | T3     | 0.80                                    |
| TR600-150F-EX-RA-B-0.5    |              | —                                  | 13.5<br>(0.53) | —             | 12.6<br>(0.50) | —             | 6.0<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0<br>(0.20)              | —             | —             | —              | —    | —    | T3     | 0.80                                    |
| TRF600-160                |              | —                                  | 16.0<br>(0.63) | —             | 12.6<br>(0.50) | —             | 6.0<br>(0.24) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | 10.0<br>(0.39) | —    | —    | T3     | 0.90                                    |
| NEW                       | TRF600-400   | —                                  | 14.8<br>(0.58) | —             | 13.1<br>(0.52) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —             | —              | —    | —    | T13    | 0.85                                    |

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

‡ Indicates dimension is typical, not minimum.

**Table T4 Dimensions & Weights for Telecommunications and Networking Devices**

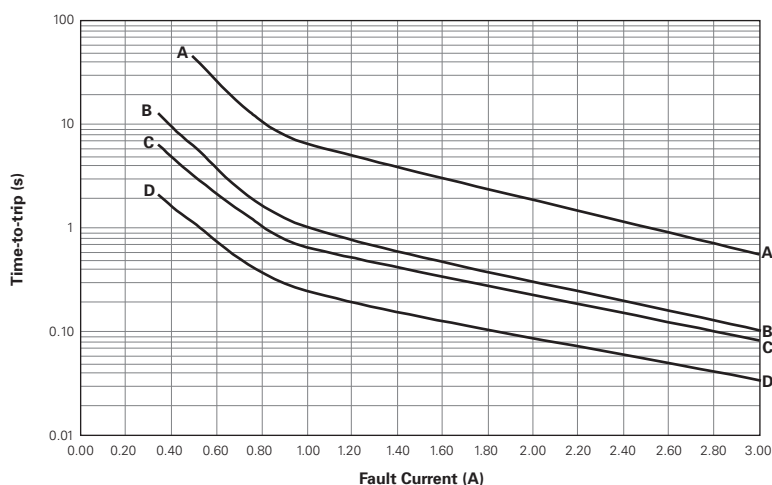
Cont'd

| Part Number        | Dimensions in Millimeters (Inches) |                 |                 |                 |                 |                 |                |                |                |                |                |               |               |               | Figure | Device Mass (g)<br>(Only for reference) |
|--------------------|------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|---------------|---------------|---------------|--------|-----------------------------------------|
|                    | A                                  |                 | B               |                 | C               |                 | D              |                | E              |                | F              |               | G             |               |        |                                         |
|                    | Min.                               | Max.            | Min.            | Max.            | Min.            | Max.            | Min.           | Max.           | Min.           | Max.           | Min.           | Max.          | Min.          | Max.          |        |                                         |
| TS600/TSM600 600V† |                                    |                 |                 |                 |                 |                 |                |                |                |                |                |               |               |               |        |                                         |
| TS600-170F         | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)  | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09) | —             | —             | T8     | 23.6                                    |
| TS600-200F-RA      | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)  | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09) | —             | —             | T8     | 23.6                                    |
| TS600-400F         | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)  | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09) | —             | —             | T8     | 19.8                                    |
| TSM600-250F        | 17.00<br>(0.67)                    | 17.60<br>(0.69) | 11.20<br>(0.44) | 11.70<br>(0.46) | 10.40<br>(0.41) | 11.20<br>(0.44) | 4.80<br>(0.19) | 5.20<br>(0.20) | 2.50<br>(0.10) | 2.80<br>(0.11) | 0.60<br>(0.02) | 1.0<br>(0.04) | 2.2<br>(0.09) | 3.1<br>(0.12) | T9     | 31.2                                    |
| TSM600-250F-RA     | 17.00<br>(0.67)                    | 17.60<br>(0.69) | 11.20<br>(0.44) | 11.70<br>(0.46) | 10.40<br>(0.41) | 11.20<br>(0.44) | 4.80<br>(0.19) | 5.20<br>(0.20) | 2.50<br>(0.10) | 2.80<br>(0.11) | 0.60<br>(0.02) | 1.0<br>(0.04) | 2.2<br>(0.09) | 3.1<br>(0.12) | T9     | 31.2                                    |
| TSM600-400F        | 17.00<br>(0.67)                    | 17.60<br>(0.69) | 11.20<br>(0.44) | 11.70<br>(0.46) | 10.40<br>(0.41) | 11.20<br>(0.44) | 4.80<br>(0.19) | 5.20<br>(0.20) | 2.50<br>(0.10) | 2.80<br>(0.11) | 0.60<br>(0.02) | 1.0<br>(0.04) | 2.2<br>(0.09) | 3.1<br>(0.12) | T9     | 31.2                                    |

 † 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

**Figure T14-T17 Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices**
**TCF250**

- A = TCF250-180
- B = TCF250-145T
- C = TCF250-120T
- D = TCF250-100T

**Figure T14**

**TRF250**

- A = TRF250-180/183/184
- B = TRF250-145/145U
- C = TRF250-120/120U
- D = TRF250-110U/120UT/120T
- E = TRF250-080T/080U/080US

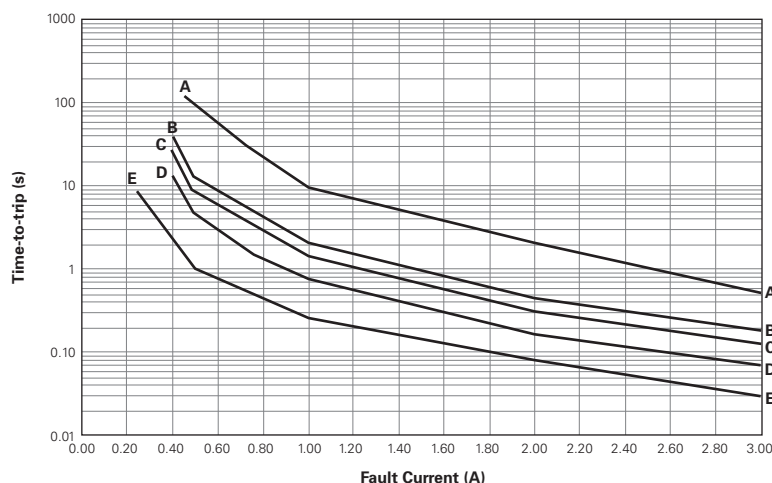
**Figure T15**


Figure T14-T17

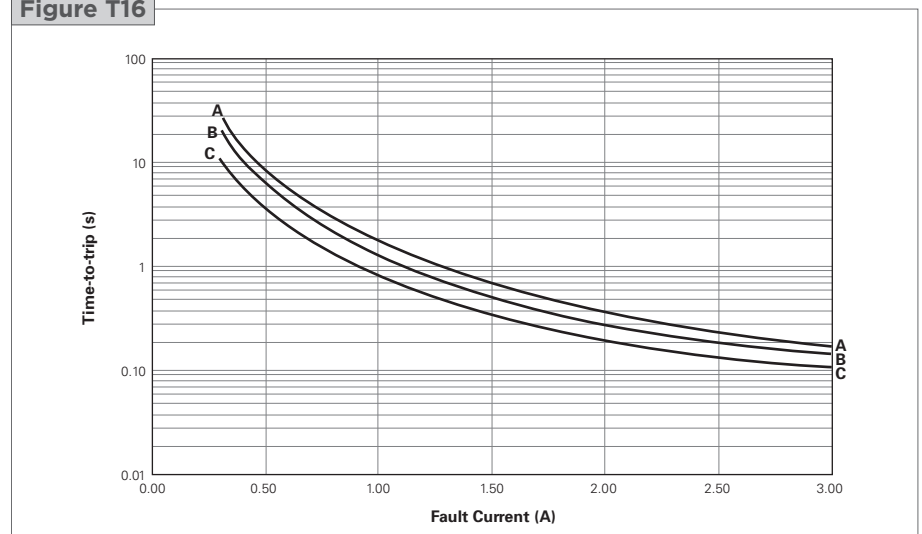
Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

Cont'd

**TS250/TSV250/TSL250**

- A = TSV250-130F
- B = TS250-130F
- C = TSL250-080F

**Figure T16**



**TRF600/TS600/TSM600**

- A = TRF600-400/TS600-400/  
TSM600-400F
- B = TSM600-250F/  
TS600-170F/200F
- C = TRF600-160
- D = TR600-150F-EX
- E = TRF600-150

**Figure T17**

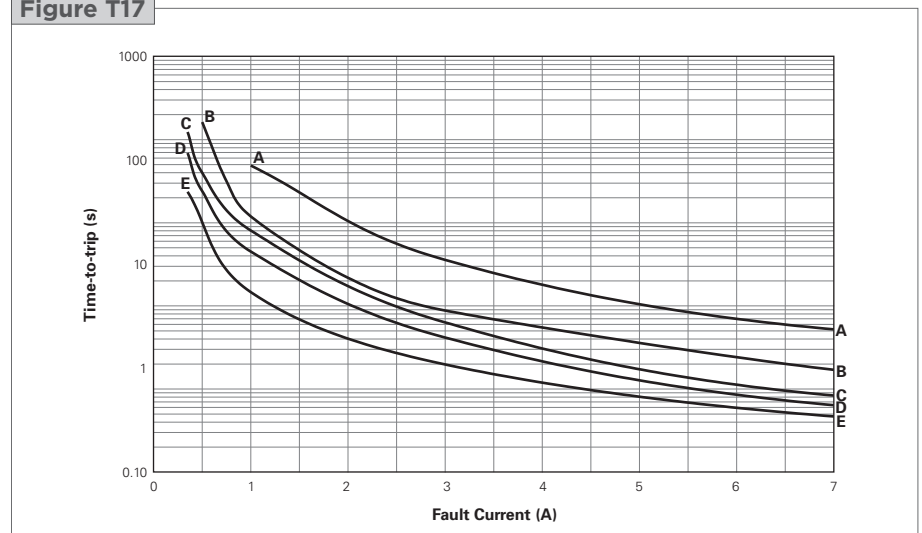


Table T5

Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

**TCF250\***

**Physical Characteristics**

Terminal material      Nickel-plated copper foil

**Environmental Specifications**

| Test               | Conditions                           |
|--------------------|--------------------------------------|
| Passive aging      | 60°C, 1000 hours<br>85°C, 1000 hours |
| Humidity aging     | 85°C, 85% RH, 1000 hours             |
| Thermal shock      | 125°C, -55°C (10 times)              |
| Solvent resistance | MIL-STD-202, Method 215F             |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

**Table T5 Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices**

Cont'd

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

**TRF250\***
**Physical Characteristics**

|                           |                                                                                                   |
|---------------------------|---------------------------------------------------------------------------------------------------|
| Lead material             | Tin-plated copper, 22AWG                                                                          |
| Insulating material       | Cured epoxy polymer                                                                               |
| Flammability              | per IEC 695-2-2 Needle Flame Test for 20s                                                         |
| Soldering characteristics | ANSI/J-STD-002, Category 3                                                                        |
| Solder heat withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: can withstand 10 seconds at 260°C±5°C |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions               |
|--------------------|--------------------------|
| Passive aging      | 60°C, 1000 hours         |
|                    | 85°C, 1000 hours         |
| Humidity aging     | 85°C, 85% RH, 1000 hours |
| Thermal shock      | 125°C, -55°C (10 times)  |
| Solvent resistance | MIL-STD-202, Method 215F |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TS250/TSV250/TSL250\***
**Physical Characteristics**

|                           |                                        |
|---------------------------|----------------------------------------|
| Terminal material         | Tin-plated brass, Nickel under-plating |
| Soldering characteristics | IEC 60008-2-58                         |

**Environmental Specifications**

| Test               | Conditions               |
|--------------------|--------------------------|
| Passive aging      | 60°C, 1000 hours         |
|                    | 85°C, 1000 hours         |
| Humidity aging     | 85°C, 85% RH, 500 hours  |
| Thermal shock      | 125°C, -55°C (10 times)  |
| Solvent resistance | MIL-STD-202, Method 215F |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TRF600†**
**Physical Characteristics**

|                           |                                                                                                   |
|---------------------------|---------------------------------------------------------------------------------------------------|
| Lead material             | Tin-plated copper, 22AWG                                                                          |
| Insulating material       | Cured epoxy polymer†                                                                              |
| Flammability              | per IEC 695-2-2 Needle flame test for 20s                                                         |
| Soldering characteristics | ANSI/J-STD-002, Category 3                                                                        |
| Solder heat withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: can withstand 10 seconds at 260°C±5°C |

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions                |
|--------------------|---------------------------|
| Passive aging      | 60°C, 1000 hours          |
|                    | 85°C, 1000 hours          |
| Humidity aging     | 85°C, 85% RH, 1000 hours‡ |
| Thermal shock      | 125°C, -55°C (10 times)   |
| Solvent resistance | MIL-STD-202, Method 215F  |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

 \* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

 † 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

‡ Excluding TRF600-150 and TRF600-400, which have a coating that is not rated for dielectric withstand and can withstand 500h at 85°C/85% RH or 1000h at 60°C/90% RH.

|                 |                                                                                                                |        |
|-----------------|----------------------------------------------------------------------------------------------------------------|--------|
| <b>Table T5</b> | <b>Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices</b> | Cont'd |
|-----------------|----------------------------------------------------------------------------------------------------------------|--------|

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

**TS600<sup>†</sup>**

**Physical Characteristics**

|                           |                                                |
|---------------------------|------------------------------------------------|
| Terminal material         | Tin-plated brass                               |
| Insulating material       | Nylon resin (UL94V-0), 1000V dielectric rating |
| Flammability              | IEC 695-2-2 Needle Flame Test for 20s          |
| Soldering characteristics | ANSI/J-STD-002, Category 3                     |
| Solder heat withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A  |

**Environmental Specifications**

| Test               | Conditions               |
|--------------------|--------------------------|
| Passive aging      | 60°C, 1000 hours         |
|                    | 85°C, 1000 hours         |
| Humidity aging     | 85°C, 85% RH, 1000 hours |
| Thermal shock      | 125°C, -55°C (10 times)  |
| Solvent resistance | MIL-STD-202, Method 215F |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TSM600<sup>†</sup>**

**Physical Characteristics**

|                           |                                                |
|---------------------------|------------------------------------------------|
| Terminal material         | Tin-plated brass                               |
| Insulating material       | Nylon resin (UL94V-0), 1000V dielectric rating |
| Flammability              | IEC 695-2-2 Needle Flame Test for 20s          |
| Soldering characteristics | EIC60068-2-58, Method 7                        |
| Solder heat withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A  |

**Environmental Specifications**

| Test               | Conditions                        |
|--------------------|-----------------------------------|
| Passive aging      | 60°C, 1000 hours                  |
|                    | 85°C, 1000 hours                  |
| Humidity aging     | 85°C, 85% RH, 1000 hours          |
| Storage humidity   | Per IPC/JEDEC J-STD-020A Level 2a |
| Thermal shock      | 125°C, -55°C (10 times)           |
| Solvent resistance | MIL-STD-202, Method 215J          |

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

<sup>†</sup> 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

**Table T6 Packaging and Marking Information for Telecommunications and Networking Devices**

|                                           | Part Number            | Bag Quantity | Tape & Reel Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------------------|------------------------|--------------|----------------------|---------------------------|--------------|--------------------|
| <b>Chip* — 250V<sub>AC</sub></b>          |                        |              |                      |                           |              |                    |
| <b>TCF250</b>                             |                        |              |                      |                           |              |                    |
|                                           | TCF250-100T            | 2,500        | —                    | 10,000                    | —            | —                  |
|                                           | TCF250-120T            | 2,500        | —                    | 10,000                    | —            | —                  |
|                                           | TCF250-145T            | 2,500        | —                    | 10,000                    | —            | —                  |
|                                           | TCF250-180             | 2,500        | —                    | 10,000                    | —            | UL                 |
| <b>Radial-leaded* — 250V<sub>AC</sub></b> |                        |              |                      |                           |              |                    |
| <b>TRF250</b>                             |                        |              |                      |                           |              |                    |
| NEW                                       | TRF250-055UT           | 500          | —                    | 10,000                    | —            | —                  |
|                                           | TRF250-080U            | 500          | —                    | 10,000                    | —            | UL, CSA, TÜV       |
|                                           | TRF250-080U-2          | —            | 1,500                | 7,500                     | —            | UL, CSA, TÜV       |
|                                           | TRF250-080T            | 500          | —                    | 10,000                    | 08F          | UL, CSA, TÜV       |
|                                           | TRF250-110U            | 500          | —                    | 10,000                    | —            | UL, CSA, TÜV       |
|                                           | TRF250-120             | 500          | —                    | 10,000                    | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120-2           | —            | 1,500                | 7,500                     | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120T            | 500          | —                    | 10,000                    | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120T-2          | —            | 1,500                | 7,500                     | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120U            | 500          | —                    | 10,000                    | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120U-2          | —            | 1,500                | 7,500                     | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-120UT           | 500          | —                    | 10,000                    | 20F          | UL, CSA, TÜV       |
|                                           | TRF250-145             | 500          | —                    | 10,000                    | 45F          | UL, CSA, TÜV       |
|                                           | TRF250-145-2           | —            | 1,500                | 7,500                     | 45F          | UL, CSA, TÜV       |
|                                           | TRF250-145-RA          | 500          | —                    | 10,000                    | 45F          | UL, CSA, TÜV       |
|                                           | TRF250-145U            | 500          | —                    | 10,000                    | 45F          | UL, CSA, TÜV       |
|                                           | TRF250-145U-2          | —            | 1,500                | 7,500                     | 45F          | UL, CSA, TÜV       |
|                                           | TRF250-183             | 500          | —                    | 10,000                    | 83F          | UL, CSA, TÜV       |
|                                           | TRF250-183-2           | —            | 1,500                | 7,500                     | 83F          | UL, CSA, TÜV       |
| NEW                                       | TRF250-184             | 500          | —                    | 10,000                    | 84F          | UL, CSA, TÜV       |
| <b>Surface-mount* — 250V<sub>AC</sub></b> |                        |              |                      |                           |              |                    |
| <b>TS250/TSL250/TSV250</b>                |                        |              |                      |                           |              |                    |
|                                           | TSL250-080F-2          | —            | 1,500                | 7,500                     | T08          | UL, CSA, TÜV       |
|                                           | TS250-130F-2           | —            | 1,500                | 7,500                     | T13          | UL, CSA, TÜV       |
|                                           | TSV250-130F-2          | —            | 1,200                | 6,000                     | T13V         | UL, CSA, TÜV       |
| <b>Radial-leaded† — 600V<sub>AC</sub></b> |                        |              |                      |                           |              |                    |
| <b>TRF600</b>                             |                        |              |                      |                           |              |                    |
|                                           | TRF600-150             | 500          | —                    | 10,000                    | 150F         | UL, CSA, TÜV       |
|                                           | TRF600-150-2           | —            | 1,500                | 7,500                     | 150F         | UL, CSA, TÜV       |
|                                           | TR600-150F-EX          | 500          | —                    | 10,000                    | 150F         | UL, CSA            |
|                                           | TR600-150F-EX-2        | —            | 600                  | 3,000                     | 150F         | UL, CSA            |
|                                           | TR600-150F-EX-RA-B-0.5 | 500          | —                    | 10,000                    | 150F         | UL, CSA            |
|                                           | TRF600-160             | 500          | —                    | 10,000                    | 160F         | UL, CSA, TÜV       |
|                                           | TRF600-160-2           | —            | 600                  | 3,000                     | 160F         | UL, CSA, TÜV       |
| NEW                                       | TRF600-400             | 500          | —                    | 10,000                    | 400F         | UL, CSA            |
| <b>Surface-mount† — 600V<sub>AC</sub></b> |                        |              |                      |                           |              |                    |
| <b>TSM600/TSM600</b>                      |                        |              |                      |                           |              |                    |
|                                           | TS600-170F-2           | —            | 300                  | 900                       | T20          | UL, CSA            |
|                                           | TS600-200F-RA-2        | —            | 300                  | 900                       | T20          | UL, CSA            |
|                                           | TS600-400F-2           | —            | 300                  | 900                       | T40          | UL, CSA            |
|                                           | TSM600-250F-2          | —            | 200                  | 1,000                     | TSM600       | UL, CSA            |
|                                           | TSM600-250F-RA-2       | —            | 200                  | 1,000                     | TSM600       | UL, CSA            |
|                                           | TSM600-400F-2          | —            | 200                  | 1,000                     | TSM600       | UL                 |

\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.



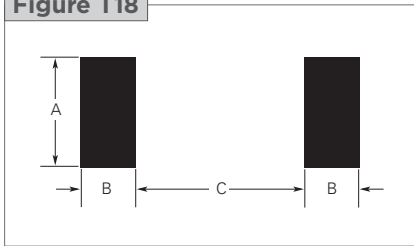
## Agency Recognition for Telecommunications and Networking Devices

|     |                |                                                               |
|-----|----------------|---------------------------------------------------------------|
| UL  | File # E74889  |                                                               |
| CSA | File #78165C   |                                                               |
| TÜV | Per IEC60730-1 | Certificate # for individual products available upon request. |

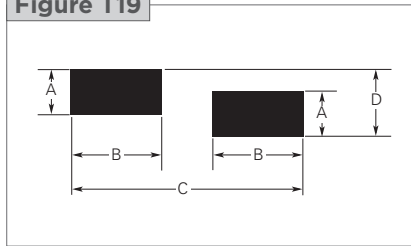
**Table T7 Recommended Pad Layouts for Surface-mount Telecommunications and Networking Devices in millimeters (inches) Nominal**

| Device       | A                | B                | C               | D               | E               | F               | G               | Figure |
|--------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
| TS250 (All)  | 4.60<br>(0.180)  | 1.80<br>(0.070)  | 6.10<br>(0.240) | —               | —               | —               | —               | T18    |
| TSV250 (All) | 2.29<br>(0.090)  | 2.41<br>(0.095)  | 6.35<br>(0.250) | 3.43<br>(0.135) | —               | —               | —               | T19    |
| TSL250 (All) | 3.60<br>(0.140)  | 1.80<br>(0.070)  | 5.50<br>(0.220) | —               | —               | —               | —               | T18    |
| TS600 (All)  | 10.42<br>(0.410) | 3.30<br>(0.130)  | 3.35<br>(0.132) | —               | —               | —               | —               | T18    |
| TSM600 (All) | 5.20<br>(0.205)  | 17.80<br>(0.701) | 5.54<br>(0.218) | 6.75<br>(0.266) | 2.08<br>(0.082) | 3.12<br>(0.123) | 8.39<br>(0.331) | T20    |

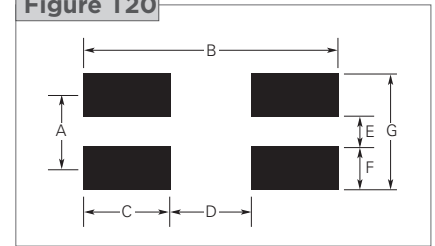
**Figure T18**



**Figure T19**



**Figure T20**



## Solder Reflow and Rework Recommendations for Telecommunications Surface-mount Devices

| Profile Feature                                           | Pb-Free Assembly |
|-----------------------------------------------------------|------------------|
| Average ramp up rate ( $T_{S_{MAX}}$ to $T_p$ )           | 3°C/second max.  |
| <b>Preheat</b>                                            |                  |
| • Temperature min. ( $T_{S_{MIN}}$ )                      | 150°C            |
| • Temperature max. ( $T_{S_{MAX}}$ )                      | 200°C            |
| • Time ( $t_{S_{MIN}}$ to $t_{S_{MAX}}$ )                 | 60-180 seconds   |
| <b>Time maintained above:</b>                             |                  |
| • Temperature ( $T_L$ )                                   | 217°C            |
| • Time ( $t_L$ )                                          | 60-150 seconds   |
| <b>Peak/Classification temperature (<math>T_p</math>)</b> | 260°C            |
| <b>Time within 5°C of actual peak temperature</b>         |                  |
| Time ( $t_p$ )                                            | 20-40 seconds    |
| <b>Ramp down rate</b>                                     | 6°C/second max.  |
| <b>Time 25°C to peak temperature</b>                      | 8 minutes max.   |

**Note:** All temperatures refer to topside of the package, measured on the package body surface.

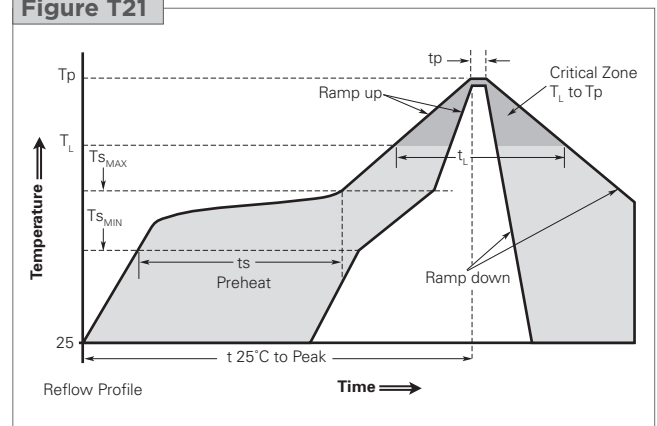
### Solder Reflow

- Recommended reflow method: IR, vapor phase oven, hot air oven.
- Surface-mount devices are not designed to be wave soldered to the bottom side of the board.
- Recommended maximum paste thickness of 0.25mm (0.010 in).
- Devices can be cleaned using standard industry methods and solvents.

### Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

**Figure T21**



# Wave Soldering and Rework Recommendations for Telecommunications Radial-leaded Devices

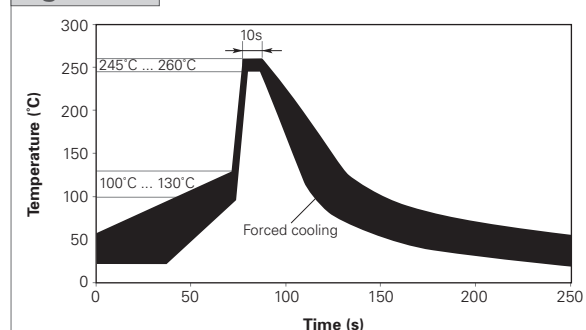
## Recommended Wave Soldering

- Soldering temperature profile  
Temperature characteristic at component terminal with dual wave soldering

## Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

Figure T22



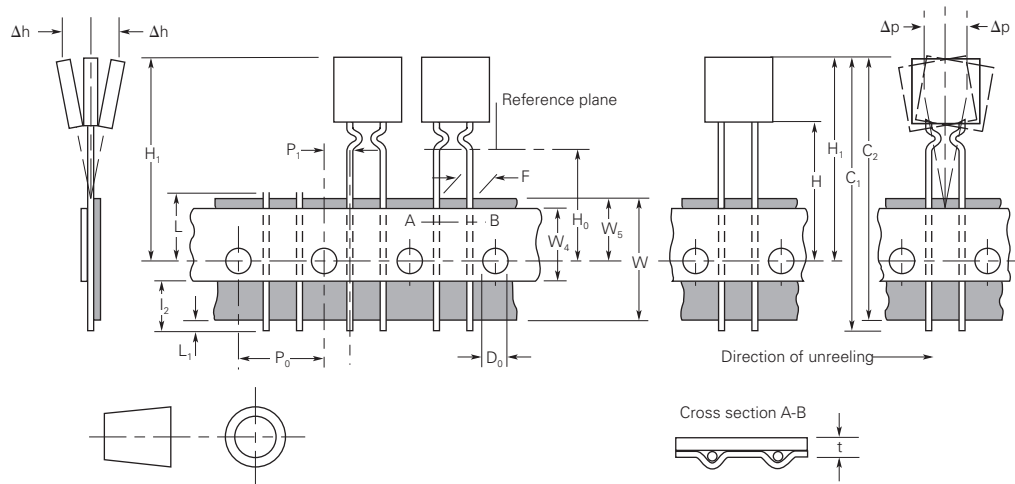
**Table T8** TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device

TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T23 and T24 for details.

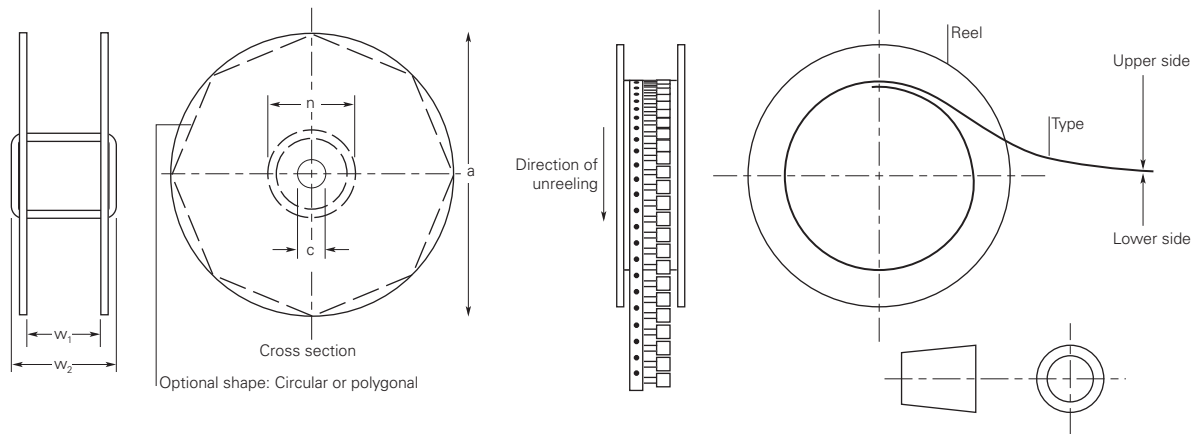
| Dimension Description                 | EIA Mark        | IEC Mark       | Dimension (mm) | Tolerance  |
|---------------------------------------|-----------------|----------------|----------------|------------|
| Carrier tape width                    | W               | W              | 18             | -0.5/+1.0  |
| Hold down tape width                  | W <sub>4</sub>  | W <sub>0</sub> | 5              | Minimum    |
| Top distance between tape edges       | W <sub>6</sub>  | W <sub>2</sub> | 3              | Maximum    |
| Sprocket hole position                | W <sub>5</sub>  | W <sub>1</sub> | 9              | -0.5/+0.75 |
| Sprocket hole diameter                | D <sub>0</sub>  | D <sub>0</sub> | 4              | ±0.2       |
| Abcissa to plane (straight lead)      | H               | H              | 18.5           | ±3.0       |
| Abcissa to plane (kinked lead)*       | H <sub>0</sub>  | H <sub>0</sub> | 16             | -0.5/+0.6  |
| Abcissa to top                        | H <sub>1</sub>  | H <sub>1</sub> | 32.2           | Maximum    |
| Overall width with lead protrusion    | —               | C <sub>1</sub> | 43.2           | Maximum    |
| Overall width without lead protrusion | —               | C <sub>2</sub> | 42.5           | Maximum    |
| Lead protrusion                       | L <sub>1</sub>  | I <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of cut-out                 | L               | L              | 11             | Maximum    |
| Protrusion beyond hold down tape      | I <sub>2</sub>  | I <sub>2</sub> | Not specified  | —          |
| Sprocket hole pitch                   | P <sub>0</sub>  | P <sub>0</sub> | 12.7           | ±0.3       |
| Device pitch (TRF250 & TRF600-150)    | —               | —              | 12.7           | —          |
| Device pitch (TRF600-160/400)         | —               | —              | 25.4           | —          |
| Pitch tolerance                       | —               | —              | 20 consecutive | ±1         |
| Tape thickness                        | t               | t              | 0.9            | Maximum    |
| Tape thickness with splice*           | t <sub>1</sub>  | —              | 2.0            | Maximum    |
| Splice sprocket hole alignment        | —               | —              | 0              | ±0.3       |
| Body lateral deviation                | Δh              | Δh             | 0              | ±1.0       |
| Body tape plane deviation             | Δp              | Δp             | 0              | ±1.3       |
| Lead spacing plane deviation          | ΔP <sub>1</sub> | P <sub>1</sub> | 0              | ±0.7       |
| Lead spacing*                         | F               | F              | 5.08           | ±0.6       |
| Reel width                            | w <sub>2</sub>  | w              | 56             | Maximum    |
| Reel diameter                         | a               | d              | 370            | Maximum    |
| Space between flanges less device     | w <sub>1</sub>  | —              | 4.75           | ±3.25      |
| Arbor hole diameter                   | c               | f              | 26             | ±12.0      |
| Core diameter                         | n               | h              | 80             | Maximum    |
| Box                                   | —               | —              | 56/372/372     | Maximum    |
| Consecutive missing pieces*           | —               | —              | 3 maximum      | —          |
| Empty places per reel*                | —               | —              | Not specified  | —          |

\* Differs from EIA specification.

**Figure T23 EIA Referenced Taped Component Dimensions for TRF Devices**



**Figure T24 Reel Dimensions for TRF Devices**



**Table T9 TS Tape and Reel Specifications for Telecommunications and Networking Devices**

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T25 and T26 for details.

**TS250/TSL250/TSV250**

| Dimension<br>Description                           | EIA Mark            | TS250         |               | TSV250        |               | TSL250        |               |
|----------------------------------------------------|---------------------|---------------|---------------|---------------|---------------|---------------|---------------|
|                                                    |                     | Dimension(mm) | Tolerance(mm) | Dimension(mm) | Tolerance(mm) | Dimension(mm) | Tolerance(mm) |
| Carrier tape width                                 | W                   | 16            | ±0.30         | 16.0          | ±0.30         | 16            | ±0.30         |
| Sprocket hole pitch                                | P <sub>0</sub>      | 4.0           | ±0.10         | 4.0           | ±0.10         | 4.0           | ±0.10         |
|                                                    | P <sub>1</sub>      | 12.0          | ±0.10         | 8.0           | ±0.10         | 8.0           | ±0.10         |
|                                                    | P <sub>2</sub>      | 2.0           | ±0.10         | 2.0           | ±0.10         | 2.0           | ±0.10         |
|                                                    | A <sub>0</sub>      | 6.9           | ±0.23         | 5.5           | ±0.10         | 5.5           | ±0.10         |
|                                                    | B <sub>0</sub>      | 9.6           | ±0.15         | 6.2           | ±0.10         | 7.9           | ±0.10         |
| Sprocket hole diameter                             | B <sub>1</sub> max. | 12.1          | —             | 8.0           | —             | 9.2           | —             |
|                                                    | D <sub>0</sub>      | 1.5           | -0/+0.1       | 1.55          | ±0.05         | 1.55          | ±0.05         |
|                                                    | F                   | 7.5           | ±0.10         | 7.5           | ±0.10         | 7.5           | ±0.10         |
|                                                    | E <sub>1</sub>      | 1.75          | ±0.10         | 1.75          | ±0.10         | 1.75          | ±0.10         |
| Tape thickness                                     | E <sub>2</sub> min. | 14.25         | —             | —             | —             | —             | —             |
|                                                    | T max.              | 0.4           | —             | 0.45          | —             | 0.35          | —             |
| Tape thickness with<br>splice cover tape thickness | T <sub>1</sub> max. | 0.1           | —             | 0.1           | —             | 0.1           | —             |
|                                                    | K <sub>0</sub>      | 3.4           | ±0.15         | 7.0           | ±0.10         | 3.70          | ±0.10         |
|                                                    | Leader min.         | 300           | —             | 390           | —             | 390           | —             |
|                                                    | Trailer min.        | 300           | —             | 160           | —             | 160           | —             |

**Reel dimensions**

|                                   |                     |      |         |      |         |      |         |
|-----------------------------------|---------------------|------|---------|------|---------|------|---------|
| Reel diameter                     | A max.              | 340  | —       | 340  | —       | 340  | —       |
| Core diameter                     | N min.              | 50   | —       | 50   | —       | 50   | —       |
| Space between flanges less device | W <sub>1</sub>      | 16.4 | -0/+2.0 | 16.4 | -0/+2.0 | 16.4 | -0/+2.0 |
| Reel width                        | W <sub>2</sub> max. | 22.4 | —       | 22.4 | —       | 22.4 | —       |

**TS600**

| Dimension<br>Description   | EIA Mark            | Dimension (mm) | Tolerance |
|----------------------------|---------------------|----------------|-----------|
| Carrier tape width         | W                   | 32             | ±0.3      |
| Sprocket hole pitch        | P <sub>0</sub>      | 4.0            | ±0.1      |
|                            | P <sub>1</sub>      | 16             | ±0.1      |
|                            | P <sub>2</sub>      | 2.0            | ±0.1      |
|                            | A <sub>0</sub>      | 10             | ±0.1      |
|                            | B <sub>0</sub>      | 19.2           | ±0.1      |
|                            | B <sub>1</sub> max. | 21.6           | —         |
| Sprocket hole diameter     | D <sub>0</sub>      | 1.5            | -0/+1.0   |
|                            | F                   | 14.2           | ±0.1      |
|                            | E <sub>1</sub>      | 1.75           | ±0.1      |
|                            | E <sub>2</sub> min. | 28.4           | ±0.1      |
| Tape thickness             | T max.              | 0.50           | ±0.5      |
| Tape thickness with splice | T <sub>1</sub> max. | 0.1            | —         |
|                            | K <sub>0</sub>      | 13.2           | ±0.1      |
|                            | Leader min.         | 390            | —         |
|                            | Trailer min.        | 160            | —         |

**Reel Dimensions**

|                                   |                     |      |         |
|-----------------------------------|---------------------|------|---------|
| Reel diameter                     | A max.              | 360  | —       |
| Core diameter                     | N min.              | 50   | —       |
| Space between flanges less device | W <sub>1</sub>      | 32.4 | -0/+2.0 |
| Reel width                        | W <sub>2</sub> max. | 40   | —       |

**Table T9 TS Tape and Reel Specifications for Telecommunications and Networking Devices** Cont'd

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T25 and T26 for details.

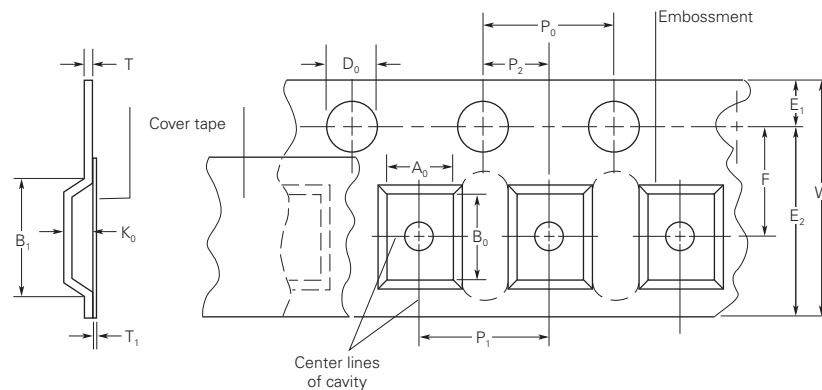
**TSM600**

| Dimension Description      | EIA Mark            | Dimension (mm) | Tolerance |
|----------------------------|---------------------|----------------|-----------|
| Carrier tape width         | W                   | 32             | ±0.3      |
| Sprocket hole pitch        | P <sub>0</sub>      | 4.0            | ±0.1      |
|                            | P <sub>1</sub>      | 24             | ±0.1      |
|                            | P <sub>2</sub>      | 2.0            | ±0.1      |
|                            | A <sub>0</sub>      | 11.2           | ±0.1      |
|                            | B <sub>0</sub>      | 17.8           | ±0.1      |
|                            | B <sub>1</sub> max. | 23.45          |           |
| Sprocket hole diameter     | D                   | 1.5            | -0/+1.0   |
|                            | F                   | 14.2           | ±0.1      |
|                            | E <sub>1</sub>      | 1.74           | ±0.1      |
|                            | E <sub>2</sub> max. | 28.4           | ±0.1      |
| Tape thickness             | T max.              | 0.5            | ±0.5      |
| Tape thickness with splice | T <sub>1</sub> max. | 0.1            |           |
|                            | K <sub>0</sub>      | 11.9           | ±0.1      |
|                            | Leader min.         | 390            |           |
|                            | Trailer min.        | 160            |           |

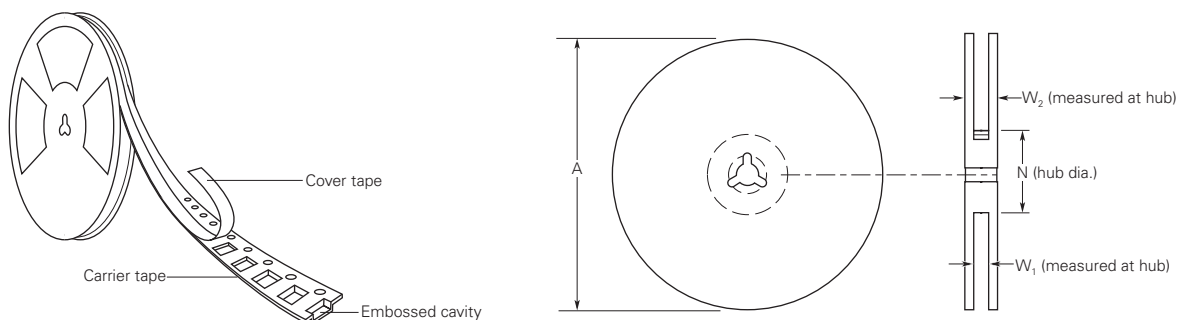
**Reel Dimensions**

|                                   |                     |      |         |
|-----------------------------------|---------------------|------|---------|
| Reel diameter                     | A max.              | 360  |         |
| Core diameter                     | N min.              | 50   |         |
| Space between flanges less device | W <sub>1</sub>      | 32.4 | -0/+2.0 |
| Reel width                        | W <sub>2</sub> max. | 40   |         |

**Figure T25 EIA Referenced Taped Component Dimensions for TS Devices**



**Figure T26 EIA Referenced Reel Dimensions for TS Devices**



## Resistance-sorted and Resistance-matched Devices

Most TCF, TRF and TS devices are available in resistance-sorted and/or resistance-matched versions.

### Resistance-sorted Devices

Resistance-sorted devices (part number suffix “Rx”, where x = 1, 2, A, B, C, F etc.) are supplied with resistance values that are within specified segments of the device’s full range of resistance.

#### Feature

- Narrow resistance range.

#### Benefits

- Greater flexibility for design engineers.
- Lower resistance devices can allow for increased loop length on line card designs.
- Higher resistance devices may provide greater protection by offering faster time-to-trip.

### Resistance-matched Devices

Resistance-matched devices are supplied such that all parts in one particular package (or reel) are within  $0.5\Omega$  of each other ( $1.0\Omega$  for TRF250-080T devices). Individual matched packages are supplied from the full resistance range of the specified device.

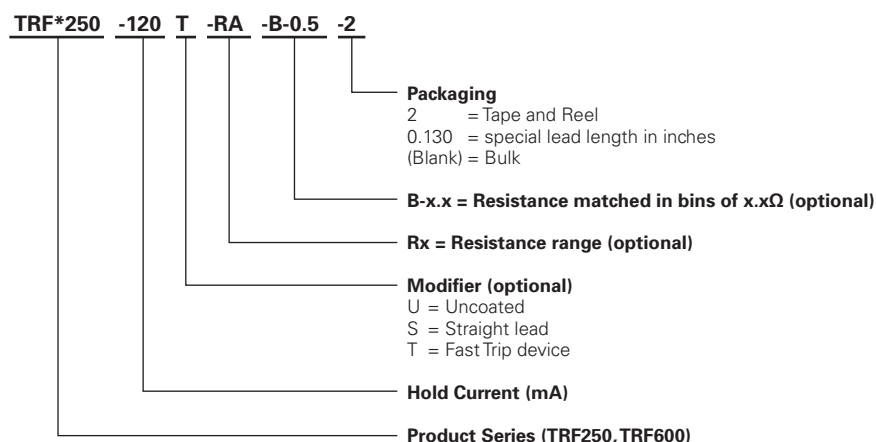
#### Feature

- Tighter resistance balance between any two parts in a package.

#### Benefits

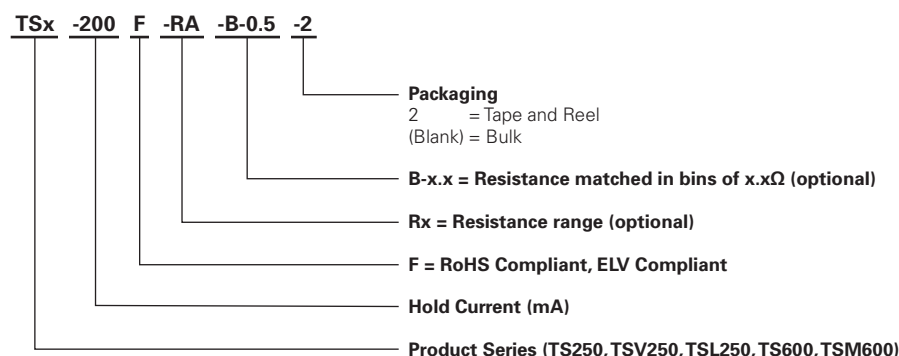
- Resistance-matched devices may reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

## Part Numbering System for Radial-leaded Telecommunications and Networking Devices

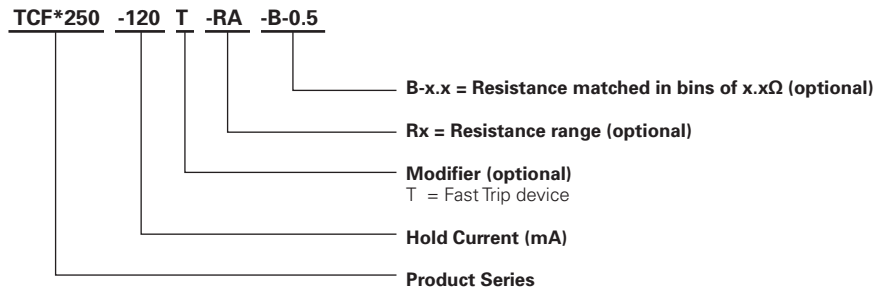


\* F = RoHS compliant, ELV compliant

## Part Numbering System for Surface-mount Telecommunications and Networking Devices



## Part Numbering System for Chip Telecommunications and Networking Devices



\* F = RoHS compliant, ELV compliant



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