

PolySwitch RUSB devices designed to meet all USB overcurrent requirements

New PolySwitch RUSB devices are designed to meet USB and safety agency requirements. The RUSB family of leaded resettable fuses offers overcurrent protection for USB applications.

The low resistance, fast trip times, and tight trip-to-hold ratio of these devices provide flexibility for designers. The RUSB product family is available in a range of currents, from 0.75 to 2.5 amps and has a 6-volt/40-amp rating.

Features

- Low resistance
- Fast trip times
- Tighter trip-to-hold ratio

Benefits

- Meets voltage droop requirements
- Meets voltage-output limits
- Suitable in low- and high-wattage power supplies
- Suitable for self-powered and bus-powered hub port protection.

USB requirements

Overcurrent protection

The USB Specification 1.0 states that overcurrent protection is required to prevent damage in the event of:

- catastrophic device failure
- software error
- user action, such as shorting of pins

Section 7.2.1 of the specification delineates the following USB overcurrent protection requirements:

- The host and all self-powered hubs must implement overcurrent protection for safety reasons.
- The overcurrent value cannot exceed 5 A.
- The host and all self-powered hubs must have a way to detect an overcurrent condition and report it to the hub controller.

Voltage output

The USB Specification requires a minimum port output voltage (V_{OUT}) in two locations on the bus: 4.75 V out of a self-powered hub port and 4.40 V out of a bus-powered hub port. The two following tables show how typical designs meet USB voltage-drop requirements.

Self-Powered Hub (individual port protection)

Power supply	5.000 V
Trace	$20\text{ m}\Omega \times 0.5\text{ A} = 0.010$
Ferrite bead	$5\text{ m}\Omega \times 0.5\text{ A} = 0.003$
RUSB120	$80\text{ m}\Omega \times 0.5\text{ A} = 0.040$
V_{OUT}	4.947 V

Bus-Powered Hub (individual port protection)

Upstream V_{MIN}	4.750 V
Cable/connectors	$500\text{ m}\Omega \times 0.5\text{ A} = 0.250$
Trace	$5\text{ m}\Omega \times (0.5\text{ A} \& 0.1\text{ A}) = 0.002$
Ferrite bead	$5\text{ m}\Omega \times 0.1\text{ A} = 0.001$
FET	$80\text{ m}\Omega \times 0.4\text{ A} = 0.032$
RUSB075	$150\text{ m}\Omega \times 0.1\text{ A} = 0.015$
V_{OUT}	4.450 V

Voltage droop

Voltage droop occurs during a hot-plug event resulting from the connection of a peripheral and its uncharged input bulk capacitance to a USB port. Test results (shown below) on a range of devices demonstrate that PolySwitch devices meet the USB Specification's voltage droop requirement of 0.330 V maximum for host/self-powered hubs and bus-powered hubs.

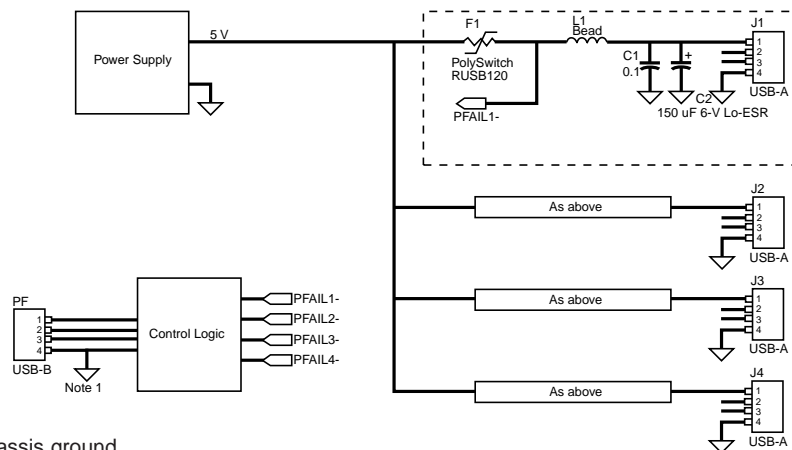
Device	Vdroop (V)	Powered hub	Port protection
RUSB075	0.116	Self or bus	Individual
RUSB120	0.140	Self	Individual
RUSB250	0.196	Self	Ganged

PolySwitch RUSB family advantages

- Conformity with USB Specification 1.0
- Compliance with:
 - UL1950/IEC950 safety requirements
 - Windows 95 and PC98 standards
- Resettable protection
- UL recognized safety device
- Highest reliability
- Lowest-cost solution

Hub designs using PolySwitch devices

Self-powered hub design



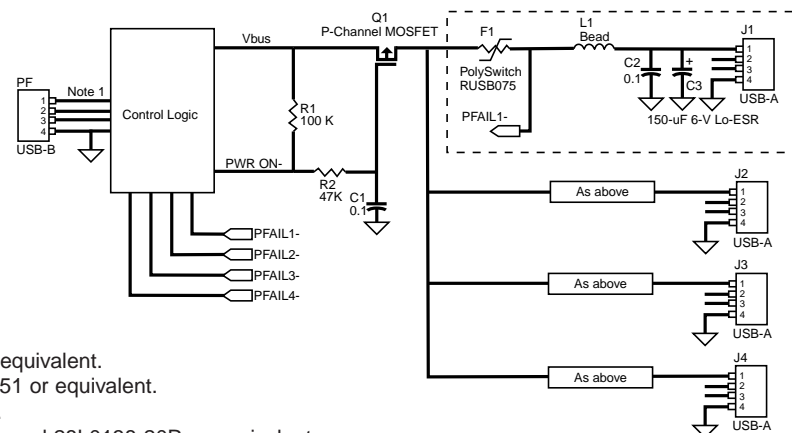
Note 1: Ground is common power/signal ground, not host chassis ground.

Ground is referred to host Vbus cable ground only.

Note 2: Only Vbus power connections shown.

C1, C2, C5, C7	Panasonic ECUS1J104MEA or equivalent.
C2, C4, C6, C8	150-μF Lo-ESR Panasonic EEUFA1V151 or equivalent.
F1, F2, F3, F4	Raychem RUSB120 PolySwitch device.
L1, L2, L3, L4	Ferrite bead >50 ohms at 100-MHz Steward 28L0138-20R or equivalent.

Bus-powered hub design



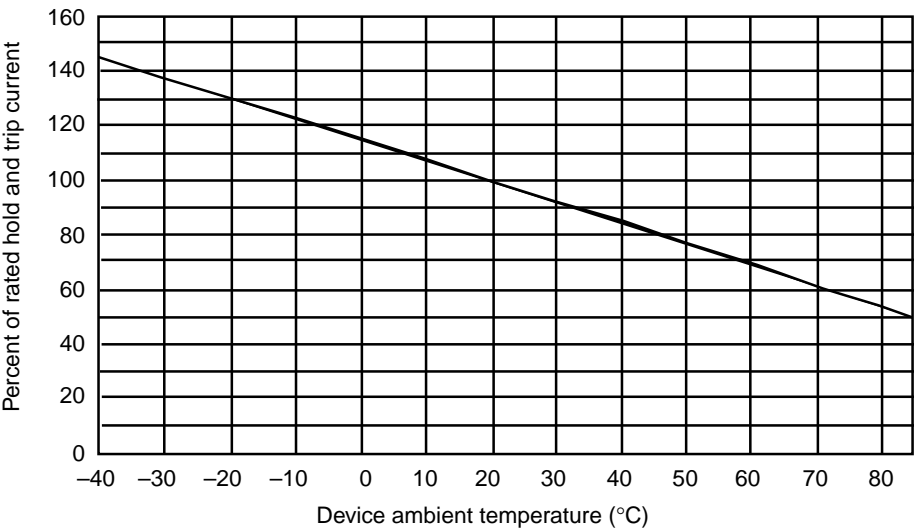
R1	100 K 1/8 W 10%
R2	47K 1/8 W 10%
C1, C2, C4, C6, C8	0.1 μF Panasonic ECUS1J104MEA or equivalent.
C3, C5, C7, C9	150-μF Lo-ESR Panasonic EEUFA1V151 or equivalent.
F1, F2, F3, F4	Raychem RUSB075 PolySwitch device.
L1, L2, L3, L4	Ferrite bead >50 ohms at 100-MHz Steward 28L0138-20R or equivalent.
Q1	P-channel logic MOSFET Temic Si9434DY or equivalent.

RUSB product data

This section provides the following product data for RUSB devices:

- Thermal derating curve
- Product dimensions
- Electrical characteristics
- Time-to-trip curve
- Physical characteristics
- Environmental characteristics
- Ordering information
- Part numbering system
- Part marking system

RUSB thermal derating curve



Product dimensions (millimeters/inches)

Operating/storage temperature range: -40°C to 85°C
Device surface temperature in the tripped state: 125°C

Figure 1

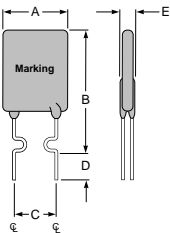
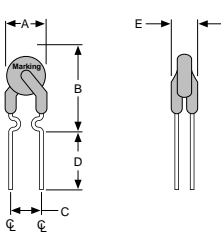


Figure 2



	A	B	C		D	E	Fig.
	max.	max.	min.	max.	min.	max.	
RUSB075	6.9 (0.27)	11.4 (0.45)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	2
RUSB090	7.4 (0.29)	12.2 (0.48)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1
RUSB110	7.4 (0.29)	14.2 (0.56)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1
RUSB120	6.9 (0.27)	11.7 (0.46)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	2
RUSB135	8.9 (0.35)	13.5 (0.53)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1
RUSB160	8.9 (0.35)	15.2 (0.60)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1
RUSB185	10.2 (0.40)	15.7 (0.62)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1
RUSB250	11.4 (0.45)	18.3 (0.72)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	3.1 (0.12)	1

Electrical characteristics (20°C)

Part number	I_H (A)	I_T (A)	Initial resistance		Max. time to trip (s)			P_d (W)
			R typ. (Ω)	R max. (Ω)	2A	3A	8A	
RUSB075	0.75	1.30	0.14	0.23	6.0	2.3	0.4	0.3
RUSB090	0.90	1.80	0.10	0.18	—	—	1.2	0.6
RUSB110	1.10	2.20	0.08	0.14	—	—	2.3	0.7
RUSB120	1.20	2.00	0.08	0.14	30.0	4.0	0.5	0.6
RUSB135	1.35	2.70	0.06	0.12	—	—	4.5	0.8
RUSB160	1.60	3.20	0.05	0.11	—	—	9.0	0.9
RUSB185	1.85	3.70	0.05	0.09	—	—	10.0	1.0
RUSB250	2.50	5.00	0.03	0.06	—	—	40.0	1.2

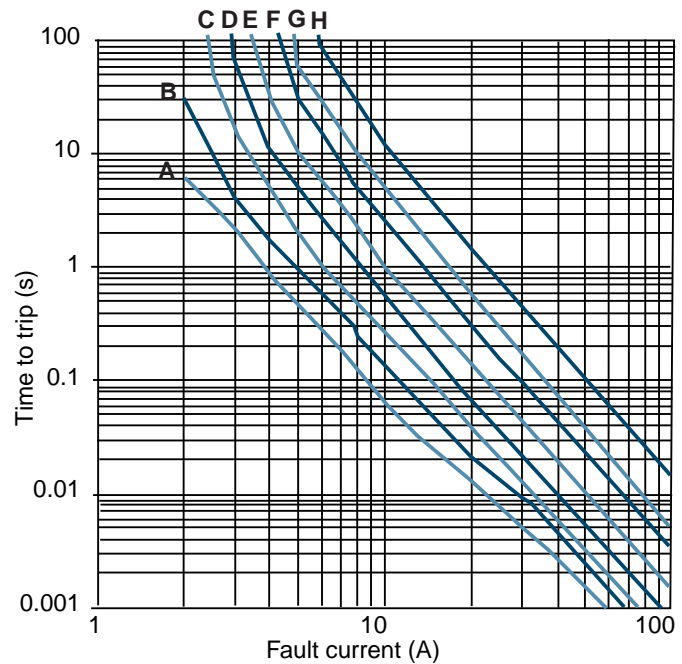
I_H = Hold current—maximum current at which the device will not trip at 20°C still air.

I_T = Trip current—minimum current at which the device will always trip at 20°C still air.

P_d = Typical power dissipation—typical amount of power dissipated by the device when in tripped state in 20°C still air environment.

Typical time-to-trip curve (20°C)

- A = RUSB075
- B = RUSB120
- C = RUSB090
- D = RUSB110
- E = RUSB135
- F = RUSB160
- G = RUSB185
- H = RUSB250



Physical characteristics

Lead material	RUSB075: Tin/lead-plated nickel/copper alloy RUSB090-250: Tin/lead-plated copper-clad steel
Soldering characteristics	Solderability per ANSI/J-STD 002 Solder heat withstand per IEC 68-2-20 RUSB120: Test Tb, Method 1a, condition a; can withstand 5 seconds at 260°C \pm 5°C All others: Test Tb, Method 1a, condition b; can withstand 10 seconds at 260°C \pm 5°C
Insulating material	Cured, flame-retardant epoxy polymer; meets UL94V-0 requirements

Agency recognition

UL	File #E74889
CSA	Pending
TÜV	Pending

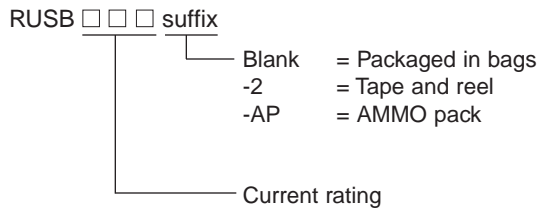
Environmental characteristics

Test	Test method	Conditions	Resistance change
Passive aging	Raychem PS300	–40°C, 1000 hours	± 10%
		85°C, 1000 hours	± 10%
Humidity aging	Raychem PS300	85°C, 85% R.H., 1000 hours	± 10%
Thermal shock	Raychem PS300	85°C, –40°C (10 times)	± 10%
Solvent resistance	Raychem PS300	MIL-STD-202, Method 215F	No change

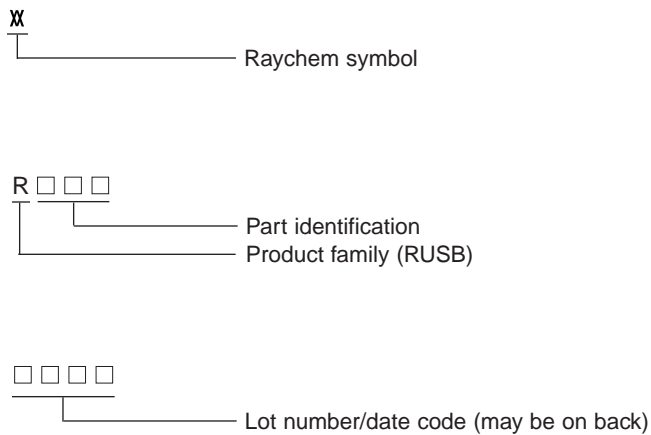
Ordering information

Product description	Bag quantity	Tape and reel quantity	AMMO pack	Standard package
RUSB075	500			10,000
RUSB075-2		3000		15,000
RUSB075-AP			2000	10,000
RUSB090	500			10,000
RUSB090-2		3000		15,000
RUSB090-AP			2000	10,000
RUSB110	500			10,000
RUSB110-2		3000		15,000
RUSB110-AP			2000	10,000
RUSB120	500			10,000
RUSB120-2		3000		15,000
RUSB120-AP			2000	10,000
RUSB135	500			10,000
RUSB135-2		3000		15,000
RUSB135-AP			2000	10,000
RUSB160	500			10,000
RUSB160-2		3000		15,000
RUSB160-AP			2000	10,000
RUSB185	500			10,000
RUSB185-2		3000		15,000
RUSB185-AP			2000	10,000
RUSB250	500			10,000
RUSB250-2		3000		15,000
RUSB250-AP			2000	10,000

Part numbering system



Part marking system



WARNING!

- Operation beyond maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against occasional overcurrent fault conditions and should not be used when repeated fault conditions are anticipated.
- Operation in circuits with inductive spikes can generate voltages above the rated voltage of the devices, so devices should be evaluated for suitability of use in such circuits.

Worldwide Corporate Headquarters:

300 Constitution Drive
Menlo Park, CA 94025-1164
Tel (800) 227-7040 or (650) 361-6900
Fax (800) 611-2323 or (650) 361-5579

Regional Offices:

Europe

Austria

Tel 0660 312073
Fax 0660 312074

Belgium

Tel (32) 16351714
Fax (32) 16351727

Denmark

Tel 800 17031
Fax 800 17070

Finland

Tel 0 800 113274
Fax 0 800 113273

France

Tel 0800 018 372
Fax 0800 021 672

Germany

Tel 0130 822990
Fax 0130 822909

Italy

Tel (39) 257576205
Fax (39) 257576229

The Netherlands

Tel 060226632
Fax 060222528

Norway

Tel 800 11473
Fax 800 11747

Spain

Tel (34) 16630431
Fax (34) 16630436

Sweden

Tel 020 794482
Fax 020 794479

Switzerland

Tel 0 800 837354
Fax 0 800 837355

United Kingdom

Tel (44) 1793 572438
Fax (44) 1793 572606

Middle East

Israel

Tel (972) 3/571-2211
Fax (972) 3/571-4758

Asia/Pacific

Australia, Melbourne

Tel 61/3/9897-4526
Fax 61/3/9897-4527

Australia, Sydney

Tel 61/2/9648-4666
Fax 61/2/9648-4333

China, Beijing

Tel 86/10/6515-5844
Fax 86/10/6515-5859

China, Guangzhou

Tel 86/20/8330-9933
Fax 86/20/8385-6139

China, Hong Kong

Tel 852/2738-3388
Fax 852/2735-1185

China, Shanghai

Tel 86/21/6485-3288
Fax 86/21/6485-0361

India, Bangalore

Tel 91/80/558-8167
Fax 91/80/558-6039

Japan

Tel (81) 45/972-7100
Fax (81) 45/972-1862

Korea

Tel 82/2/3468-1341
Fax 82/2/538-6720

Singapore

Tel 65/277-4126
Fax 65/276-2994

Taiwan

Tel 886/2/2662-9788
Fax 886/2/2662-4684

Thailand

Tel 66/2/251-5007
Fax 66/2/254-6370



www.raychem.com/go/circuitprotection

All information, including illustrations, is believed to be reliable. Users, however, should independently evaluate the suitability of each product for their application. Raychem makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. Raychem's only obligations are those in the Raychem Standard Terms and Conditions of Sale for this product, and in no case will Raychem 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, Raychem reserves the right to make changes—without notification to Buyer—to materials or processing that do not affect compliance with any applicable specification.