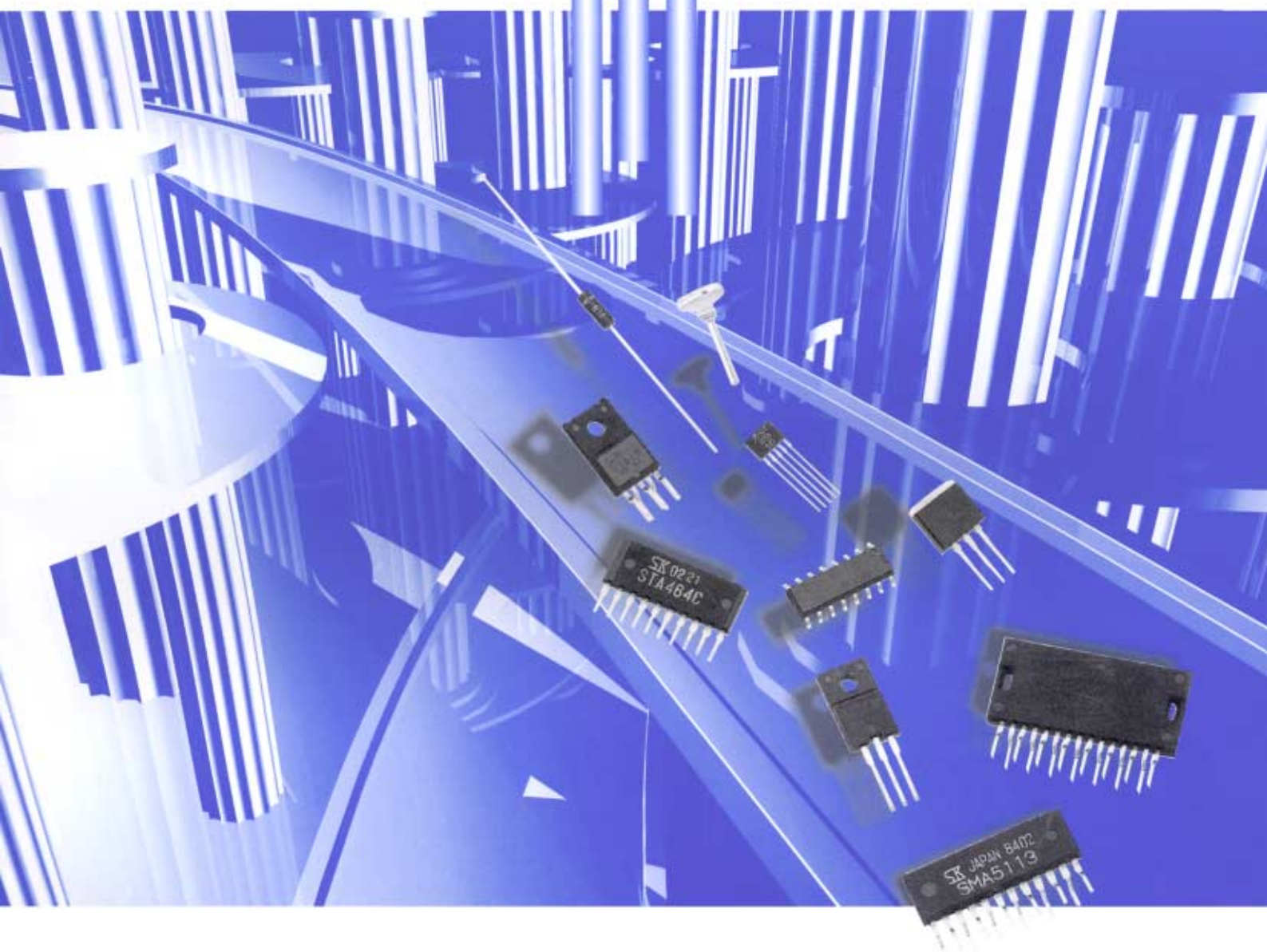


DEVICES for AUTOMOTIVE

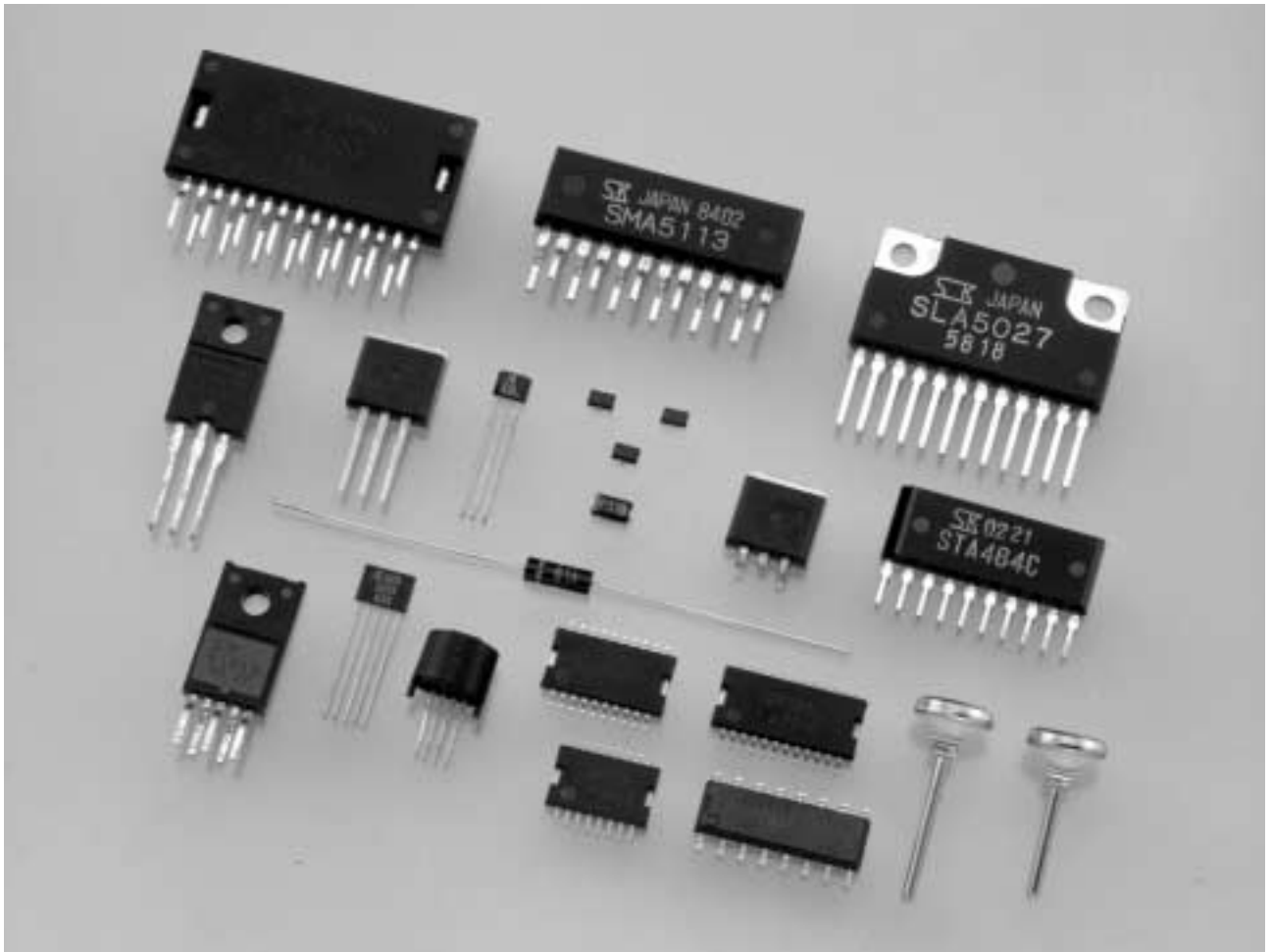


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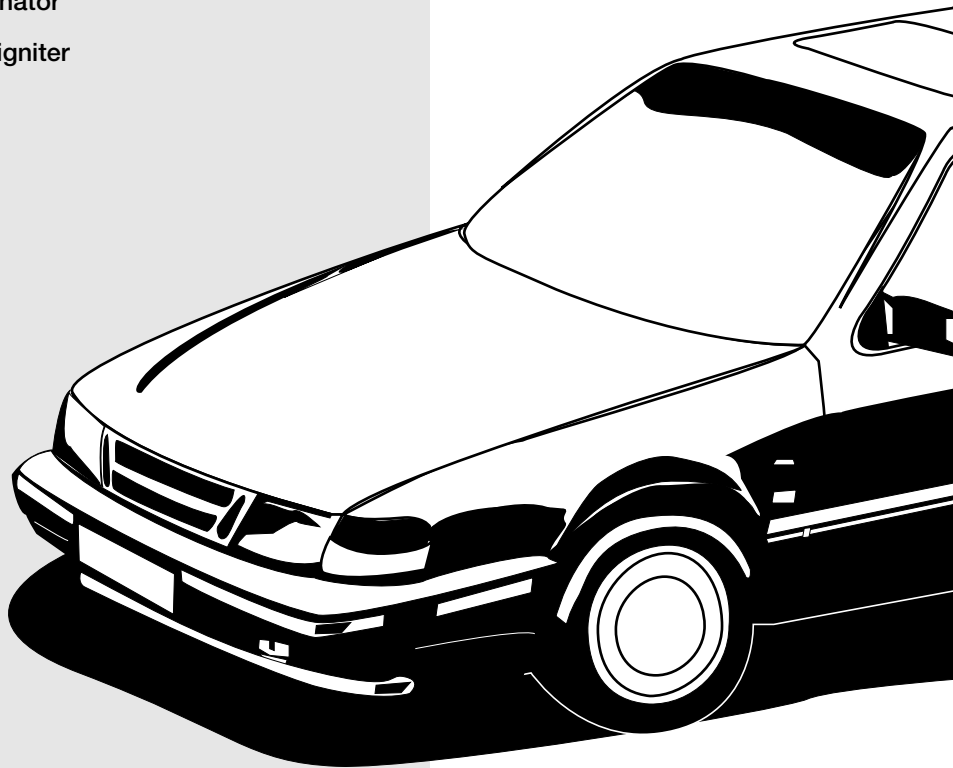
CAUTION / WARNING

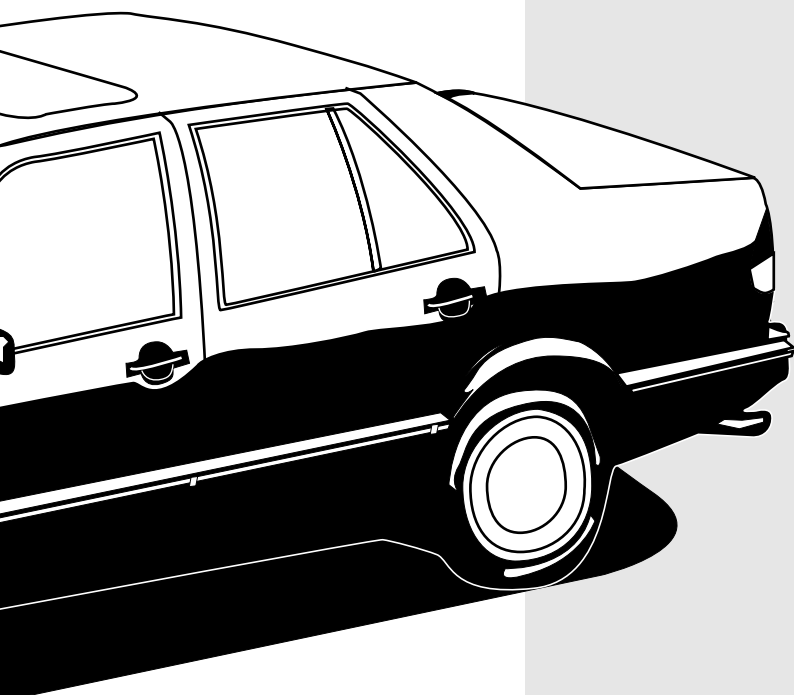
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Product Groups

- Regulator
- High-side power switch
- Low-side power switch
- Motor driver IC
- Hall-Effect IC
- Custom IC
- Transistor
- MOS FET
- Rectifier Diode for alternator
- High-voltage diode for igniter
- Power Zener diode
- General-purpose diode
- LED (visible & infrared)





Applications

[Power Train Control]

- Engine
 - Fuel injection
 - Ignition control
 - Air ratio control
 - Emission purification control
 - Idling control
 - Knocking and EGR control
 - Variable valve timing control

- Transmission
 - Fully electronic control
 - CVT control
- Alternator

[Carbody Control and Safety]

- 4WD
- 4WS
- ABS
- Power steering
- Auto cruising
- Traction control
- Stability control
- Airbag
- HID Head Lamp

[Compartment Equipment]

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- Power window
- Keyless entry
- Panel, Multi-media
 - Meter display
 - Car audio
 - Navigation
 - VICS

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Application Note for Regulator ICs

■ Temperature and Reliability

Reliability of an IC is generally heavily dependent on operating temperature. Heat radiation must be fully considered, and an ample margin should be given to the radiating area in designing heatsinks. When mounting ICs on heatsinks, always apply silicone grease and firmly tighten. Air convection should actively be used in actual heat dissipation. The reliability of capacitors and coils, the peripheral components, is also closely related to temperature. A high operating temperature may reduce the service life. Exceeding the allowable temperature may cause coils to be burned or capacitors to be damaged. Make sure that output smoothing coils and input/output capacitors do not exceed their allowable temperature limit in operation. We recommend, in particular, to provide an ample margin for the ratings of coils to minimize heat generation.

■ Power Dissipation (P_D)

1. Dropper Type

$$P_D = I_O \cdot [V_{IN}(\text{mean}) - V_O]$$

2. Switching Type

$$P_D = V_O \cdot I_O \left(\frac{100}{\eta_{\chi}} - 1 \right) - V_F \cdot I_O \left(1 - \frac{V_O}{V_{IN}} \right)$$

Efficiency η_{χ} depends on input/output conditions.

Refer to the efficiency characteristics.

V_O : Output voltage η_{χ} : Efficiency

V_{IN} : Input voltage V_F : Diode forward voltage

I_O : Output current

■ Heatsink Design

The maximum junction temperature T_j (max) and the maximum case temperature T_c (max) given in the absolute maximum ratings are specific to each product type and must be strictly met. Thus, heatsink design must be performed in consideration of the condition of use which affects the maximum power dissipation P_D (max) and the maximum ambient temperature T_a (max). To facilitate heatsink design, the relationship between these two parameters is presented in the T_a - P_D characteristic graphs. Heatsink design must be performed in the following steps:

1. Obtain the maximum ambient temperature T_a (max) (within the set).
2. Obtain the maximum power dissipation P_D (max).
3. Identify the intersection on the T_a - P_D characteristic graph and obtain the size of the heatsink to be used.

The size of a heatsink has been obtained. In actual applications, a 10 to 20% derating factor is

generally used. Moreover, the heat dissipation capacity of a heatsink is heavily dependent on how it is mounted. It is therefore important and recommended to measure the heatsink and case temperature in actual operating environments. The T_a - P_D characteristics are provided for each product type for reference purposes.

■ Setting DC Input Voltage

Observe the following precautions when setting the DC input voltage:

- $V_{IN(\text{min})}$ must be at least the set output voltage plus dropout voltage for the dropper type. It must be at least the recommended lowest input voltage for the switching type.
- $V_{IN(\text{max})}$ must not exceed the DC input voltage of the electrical characteristics.

■ Screw Torque

Screw torque should be between 0.588 to 0.686 [N • m] (6.0 to 7.0 [kgf • cm]).

■ Recommended silicone grease

Volatile type silicone grease may produce cracks after elapse of long term, resulting in reducing heat radiation effect.

Silicone grease with low consistency (hard grease) may cause cracks in the mold resin when screwing the product to a heatsink.

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	GE Toshiba Silicones Co., Ltd.
SC102	Dow Corning Toray Silicone Co., Ltd.

■ Others

This product may not be connected in parallel. The switching type may not be used for current boosting and stepping up voltage.

Dropper Type Regulator ICs [With Output ON/OFF Control] SI-3001S

Features

- Output current of 1.0A
- 5-terminal type <output on/off control, variable output voltage (rise only)>
- Voltage accuracy of $\pm 2\%$
- Low dropout voltage $\leq 1V$ at $I_O \leq 1.0A$, $\leq 0.5V$ at $I_O \leq 0.4A$
- Built-in overcurrent, overvoltage and thermal protection circuits
- Withstands external electromagnetic noises
- TO220 equivalent full-mold package

Absolute Maximum Ratings

(Ta = 25°C)

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V _{IN}	35	V	
Output Control Terminal Voltage	V _C	V _{IN}	V	
Output Current	I _O	1.0 *1	A	
Power Dissipation	P _{D1}	18	W	With infinite heatsink
	P _{D2}	1.5	W	Stand-alone without heatsink
Junction Temperature	T _J	-40 to +125	°C	
Operating Temperature	T _{OP}	-40 to +100	°C	
Storage Temperature	T _{stg}	-40 to +125	°C	
Junction to Case Thermal Resistance	θ_{J-C}	5.5	°C/W	
Junction to Ambient-Air Thermal Resistance	θ_{J-a}	66.7	°C/W	Stand-alone without heatsink

Electrical Characteristics

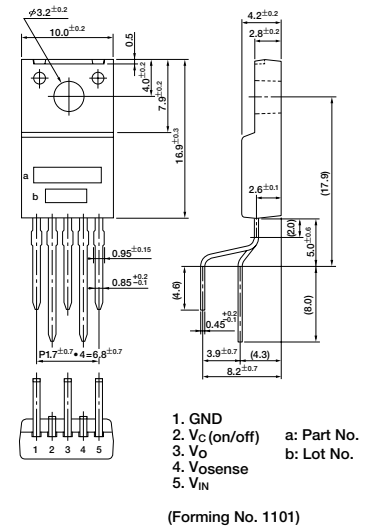
(T_J = 25°C, V_{IN} = 14V unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input Voltage	V _{IN}	6 *2		30 *1	V	
Output Voltage	V _O	4.90	5.00	5.10	V	V _{IN} = 12 to 16V, I _O = 0.4A
Dropout Voltage	V _{DIF}			0.5	V	I _O $\leq$ 0.4A
				1.0	V	I _O $\leq$ 1.0A
Line Regulation	$\Delta V_O / \Delta V_{IN}$			30	mV	I _O = 0.4A, V _{IN} = 6 to 16V
Load Regulation	$\Delta V_O / \Delta I_O$			100	mV	I _O = 0 to 0.4A
Output Voltage Temperature Coefficient	$\Delta V_O / \Delta T$		± 0.5		mV/°C	I _O = 5mA, Ta = -10 to +100°C
Ripple Rejection	R _{REJ}		54		dB	f = 100 to 120Hz
Quiescent Circuit Current	I _Q		3	10	mA	I _O = 0A
Overcurrent Protection Starting Current	I _{SI}	1.2 *3			A	
V _C Terminal	Control Voltage	Output ON	V _{C, IH}	2.0 *4	V	
		Output OFF	V _{C, IL}		0.8	V
	Control Current	Output ON	I _{C, IH}		20	μA
		Output OFF	I _{C, IL}		-0.3	mA

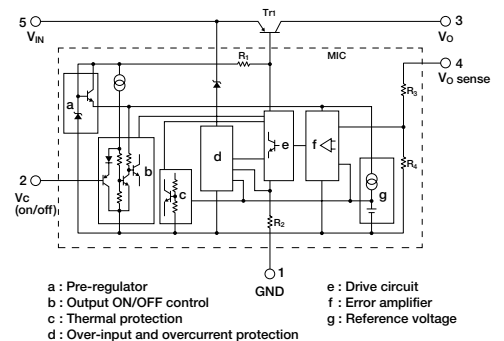
Notes:

- *1. Since $P_D(\max) = (V_{IN} - V_O) \cdot I_O = 18(W)$, V_{IN}(max) and I_O(max) may be limited depending on operating conditions. Refer to the Ta-P_D curve to compute the corresponding values.
- *2. Refer to the dropout voltage.
- *3. I_{SI} rating shall be the point at which the output voltage V_O (V_{IN} = 14V, I_O = 0.4A) drops to -5%.
- *4. The output control terminal V_C is pulled up inside the IC. Each input level can be directly driven with LS-TTL ICs. Thus, LS-TTL direct driving is also possible.

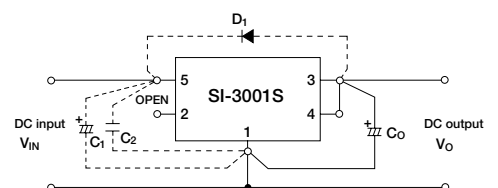
External Dimensions (unit: mm)



Equivalent Circuit Diagram



Standard Circuit Diagram



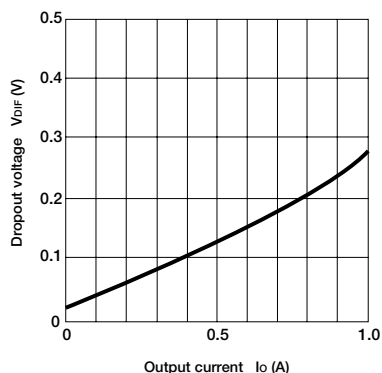
Co : Output capacitor (47 to 100μF, 50V)

C1, C2 : Input capacitors (C1: approx. 47μF, C2: approx. 0.33μF). These are required for inductive input lines or long wiring. Tantalum capacitors are recommended for C1 and Co, especially at low temperatures.

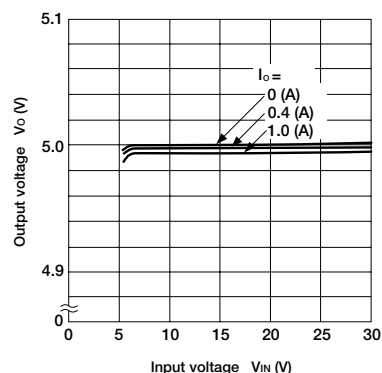
D1 : Protection diode. Required as protection against reverse biasing between input and output. (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

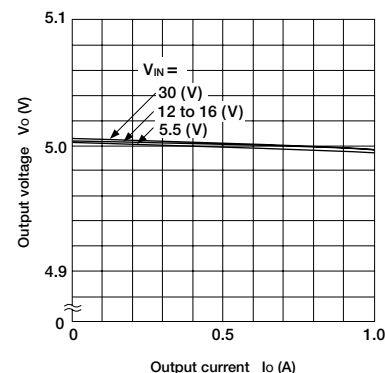
■ I_O vs V_{DIF} Characteristics



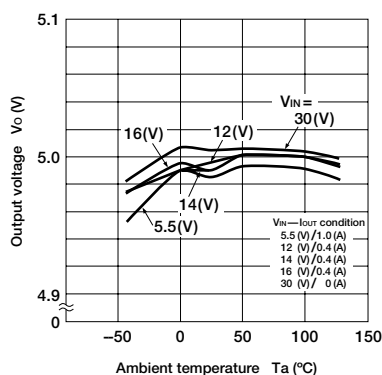
■ Line Regulation



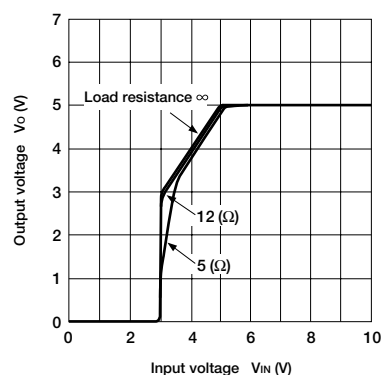
■ Load Regulation



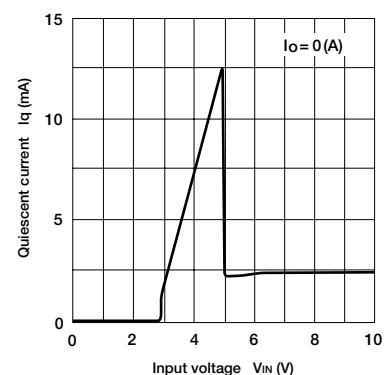
■ Output Voltage Temperature Characteristics



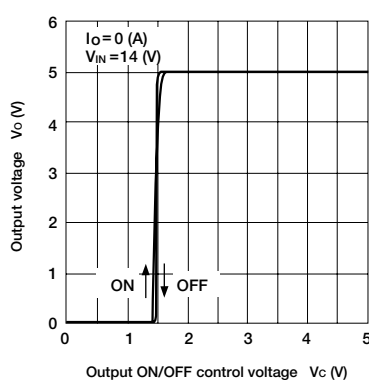
■ Rise Characteristics



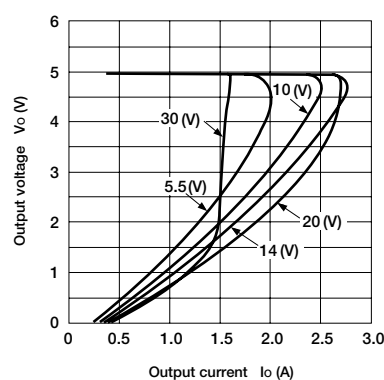
■ Quiescent Circuit Current



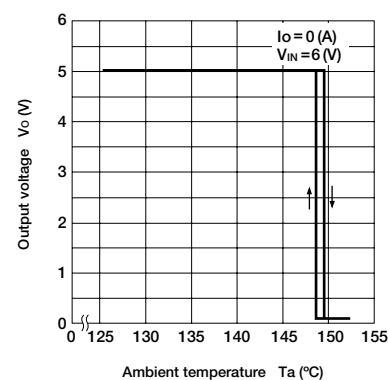
■ ON/OFF Control Characteristics



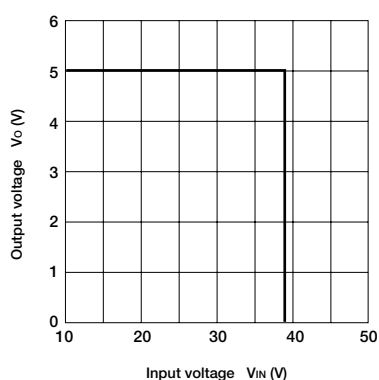
■ Overcurrent Protection Characteristics



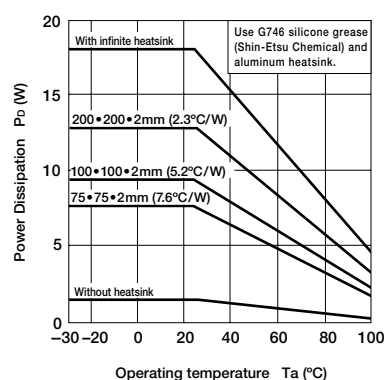
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■ T_a — P_D Characteristics



Note on Thermal Protection Characteristics:
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation, including reliability, is not guaranteed for short-circuiting over an extended period of time.

Dropper Type Regulator ICs [3-terminal] SI-3003S

Features

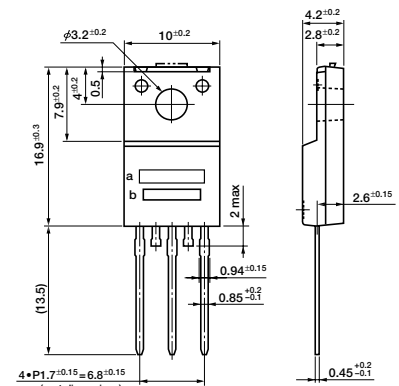
- 3-terminal IC regulator with 0.8A output current
- Voltage accuracy of $\pm 2\%$
- Low Dropout voltage $\leq 0.5V$ at $I_O \leq 0.5A$, $\leq 1V$ at $I_O \leq 0.8A$
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent full-mold package

Absolute Maximum Ratings

($T_a = 25^\circ C$)

Parameter	Symbol	Ratings	Unit	Conditions
DC input voltage	V_{IN}	35	V	
Output current	I_O	0.8 *2	A	
Power Dissipation	P_{D1}	22	W	With infinite heatsink
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_J	-40 to +150	$^\circ C$	
Operating temperature	T_{OP}	-40 to +100	$^\circ C$	
Storage temperature	T_{stg}	-40 to +150	$^\circ C$	
Junction to case thermal resistance	θ_{j-c}	5.5	$^\circ C/W$	
Junction to ambient-air thermal resistance	θ_{j-a}	66.7	$^\circ C/W$	Stand-alone without heatsink

External Dimensions (unit: mm)



Terminal connections
 1. V_{IN}
 2. (NC)
 3. GND
 4. (NC)
 5. V_O
 a: Part No.
 b: Lot No.
 (Forming No. 1115)

Electrical Characteristics

($T_J = 25^\circ C$, $V_{IN} = 14V$, $I_O = 0.5A$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input voltage	V_{IN}	6*2		30*1	V	
Output voltage	V_O	4.90	5.00	5.10	V	
Dropout voltage	V_{DIF}			0.5	V	$I_O \leq 0.5A$
				1.0	V	$I_O \leq 0.8A$
Line regulation	$\Delta V_{O LINE}$			30	mV	$V_{IN} = 8$ to $16V$
Load regulation	$\Delta V_{O LOAD}$			100	mV	$I_O = 0$ to $0.5A$
Ripple rejection	R_{REJ}		54		dB	$f = 100$ to $120Hz$
Quiescent circuit current	I_q		3	10	mA	$I_O = 0A$
Overcurrent protection starting current	I_{S1}	0.9*3			A	

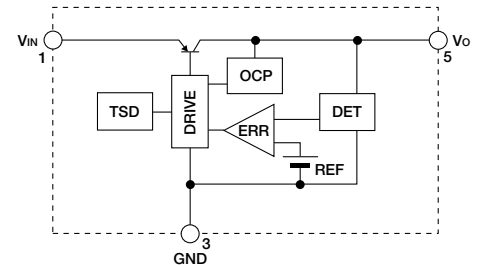
Notes:

*1. Since $P_{D(max)} = (V_{IN} - V_O) \cdot I_O = 22(W)$, $V_{IN(max)}$ and $I_{O(max)}$ may be limited depending on operating conditions. Refer to the $T_a - P_D$ curve to compute the corresponding values.

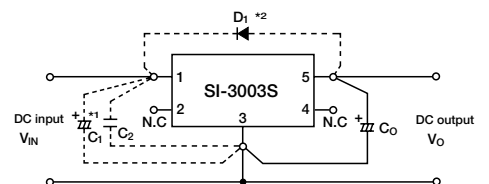
*2. Refer to the dropout voltage.

*3. I_{S1} rating shall be the point at which the output voltage V_O ($V_{IN} = 14V$, $I_O = 0.5A$) drops to -5% .

Equivalent Circuit Diagram



Standard Circuit Diagram



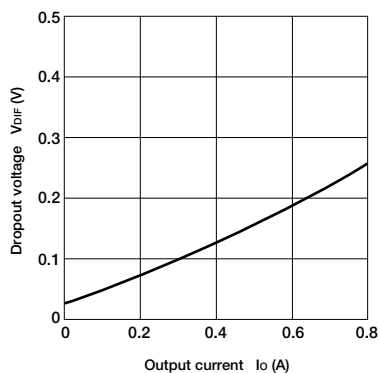
C_O : Output capacitor (47 to $100\mu F$, 50V)

*1 C_1, C_2 : Input capacitors (C_1 : approx. $47\mu F$, C_2 : approx. $0.33\mu F$). These are required for inductive input lines or long wiring. Tantalum capacitors are recommended for C_1 and C_O , especially at low temperatures.

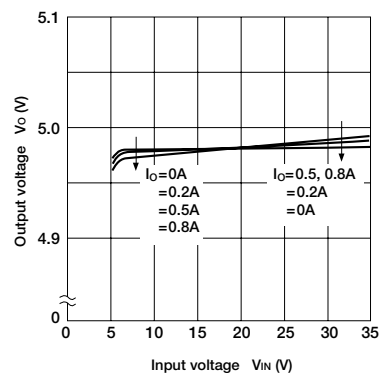
*2 D_1 : Protection diode. Required as protection against reverse biasing between input and output.
 (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

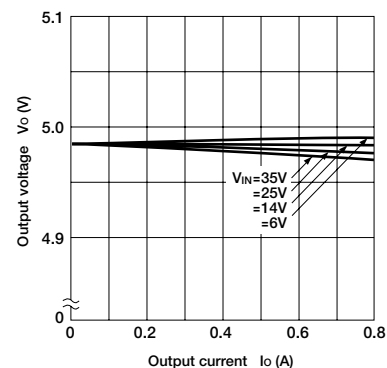
■ I_O vs V_{DIF} Characteristics



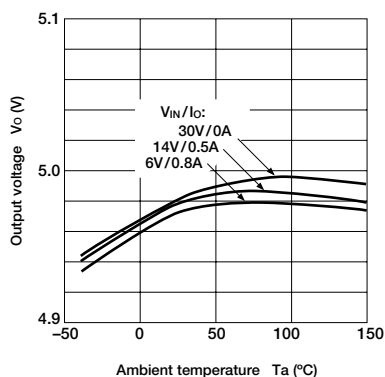
■ Line Regulation



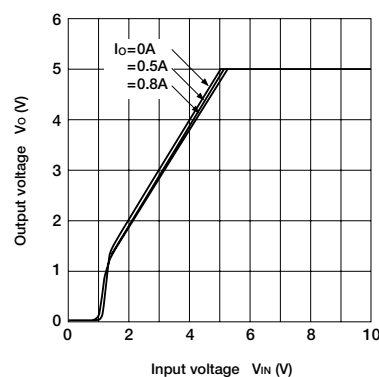
■ Load Regulation



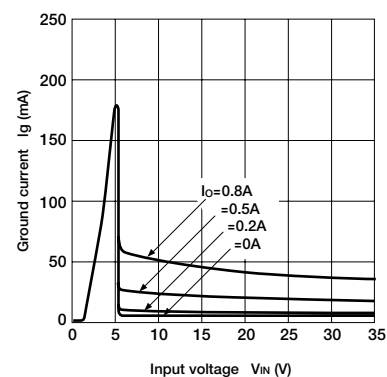
■ Output Voltage Temperature Characteristics



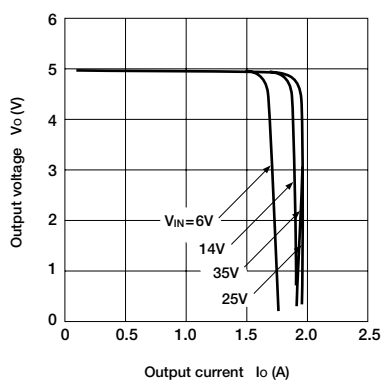
■ Rise Characteristics



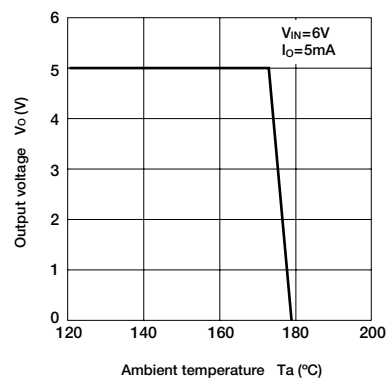
■ Circuit Current



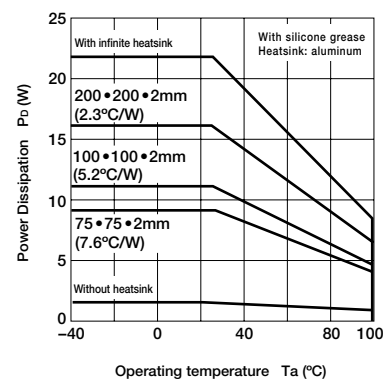
■ Overcurrent Protection Characteristics



■ Thermal Protection Characteristics



■ T_a — P_D Characteristics



Note on Thermal Protection Characteristics:

The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation, including reliability, is not guaranteed for short-circuiting over an extended period of time.

Dropper Type Regulator ICs [2-output] SI-3101S

Features

- Single input dual output <sub output (5V/0.07A), main output (5V/0.4A)>
- Main output can be externally turned ON/OFF (with ignition switch, etc.)
<most suitable as memory backup power supply>
- Low standby current ($\leq 0.8\text{mA}$)
- Low dropout voltage $\leq 1\text{V}$
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent 5-terminal full-mold package

Absolute Maximum Ratings

($T_a=25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
DC input voltage	V_{IN}	40	V	
Battery reverse connection	V_{INB}	-13 *6	V	One minute
Output control terminal voltage	V_C	V_{IN}	V	
Output current	CH1	I_{O1}	0.07 *1	A
	CH2	I_{O2}	0.4 *1	A
Power Dissipation	P_{D1}	18	W	With infinite heatsink
	P_{D2}	1.5	W	Stand-alone without heatsink
Junction Temperature	T_J	-40 to +125	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +115	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$	
Junction to case thermal resistance	θ_{J-C}	5.5	$^\circ\text{C/W}$	
Junction to ambient-air thermal resistance	θ_{J-a}	66.7	$^\circ\text{C/W}$	Stand-alone without heatsink

Electrical Characteristics

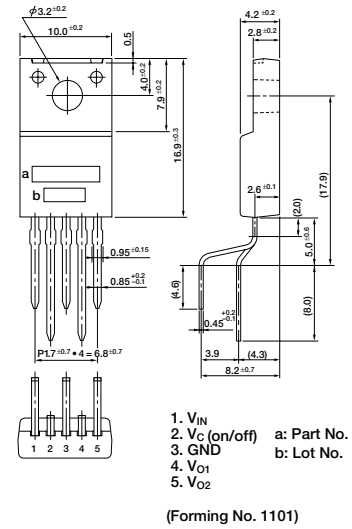
($T_J=25^\circ\text{C}$, $V_{IN}=14\text{V}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input voltage	V_{IN}	6 *2		35 *1	V	
Output voltage	CH1	V_{O1}	4.80	5.00	5.20	V $I_O=0.05\text{A}$
	CH2	V_{O2}	4.80	5.00	5.20	V $I_O=0.3\text{A}$
Channel-channel voltage difference ($V_{O1}-V_{O2}$)	ΔV_O	-0.1		0.1	V	$I_{O1}=0$ to 0.05A $I_{O2}=0$ to 0.3A
Dropout voltage	CH1	V_{DIF1}			1.0	V $I_{O1}\leq 0.05\text{A}$
	CH2	V_{DIF2}			1.0	V $I_{O2}\leq 0.4\text{A}$
Line regulation	CH1	$\Delta V_O \text{ LINE1}$	10	30	mV	$V_{IN}=6$ to 18V , $I_O=0.05\text{A}$
	CH2	$\Delta V_O \text{ LINE2}$	10	30	mV	$V_{IN}=6$ to 18V , $I_O=0.3\text{A}$
Load regulation	CH1	$\Delta V_O \text{ LOAD1}$	30	70	mV	$I_{O1}=0$ to 0.05A
	CH2	$\Delta V_O \text{ LOAD2}$	40	70	mV	$I_{O2}=0$ to 0.3A
Ripple rejection	CH1	R_{REJ1}	54		dB	$f=100$ to 120Hz
	CH2	R_{REJ2}	54		dB	$f=100$ to 120Hz
Quiescent circuit current	I_q			0.8	mA	$I_{O1}=0\text{A}$, $V_C=0\text{V}$
Overcurrent protection starting current	CH1	$I_{(SI)1}$	0.1 *3		A	
	CH2	$I_{(SI)2}$	0.5 *3		A	
Output control voltage	Output ON	V_{CH}	4.2	4.5	4.8	V
	Output OFF	V_{CL}	3.2	3.5	3.8	V
Output control current	Output ON	I_{CH}			100	μA $V_C=4.8\text{V}$
	Output OFF	I_{CL}	-100		μA	$V_C=3.2\text{V}$
Overvoltage protection starting voltage	V_{OVP}	35 *4			V	
Thermal protection starting temperature	T_{TSD}	130 *5			$^\circ\text{C}$	

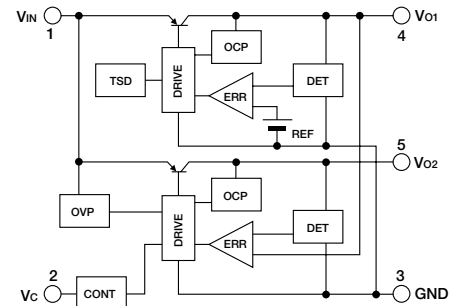
Notes:

- *1. Since $P_D(\text{max}) = (V_{IN}-V_O) \cdot I_{O1} + (V_{IN}-V_{O2}) \cdot I_{O2} = 18\text{ (W)}$, $V_{IN}(\text{max})$, $I_{O1}(\text{max})$ and $I_{O2}(\text{max})$ may be limited depending on operating conditions. Refer to the T_a-P_D curve to compute the corresponding values.
- *2. Refer to the dropout voltage.
- *3. I_{SI} rating shall be the point at which the output voltage V_{O1} or V_{O2} ($V_{IN}=14\text{V}$, $I_{O1}=0.05\text{A}$ or $I_{O2}=0.3\text{A}$) drops to -5%.
- *4. Overvoltage protection circuit is built only in CH2 (V_{O2} side).
- *5. The indicated temperatures are junction temperatures.
- *6. All terminals, except V_{IN} and GND, are open.

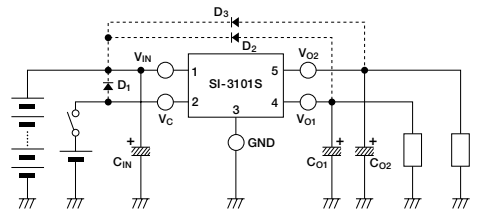
External Dimensions (unit: mm)



Equivalent Circuit Diagram



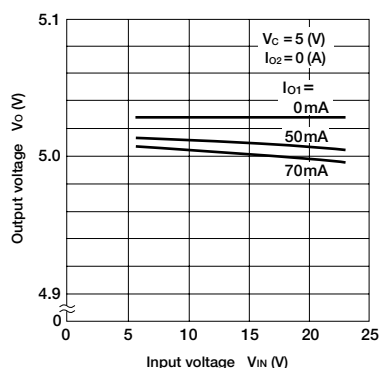
Standard Circuit Diagram



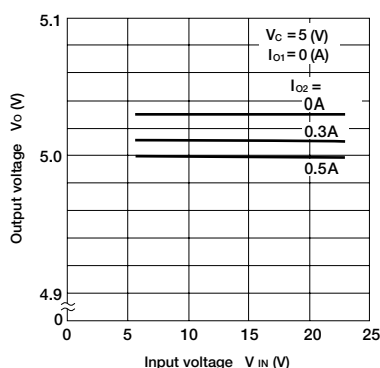
- $CO1$: Output capacitor (47 to $100\mu\text{F}$, 50V)
 $CO2$: Output capacitor (47 to $100\mu\text{F}$, 50V)
 *1 C_{IN} : Input capacitors (approx. $47\mu\text{F}$).
 Tantalum capacitors are recommended for $CO1$, $CO2$ and C_{IN} , especially at low temperatures.
 *2 $D1$, $D2$, $D3$: Protection diode.
 Required as protection against reverse biasing between input and output.
 (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

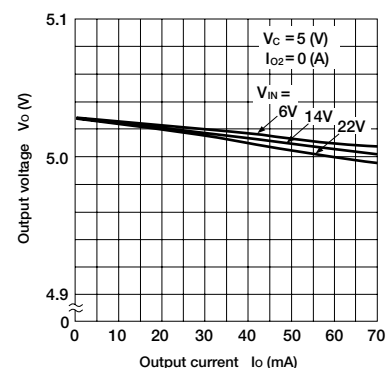
■ Line Regulation (1)



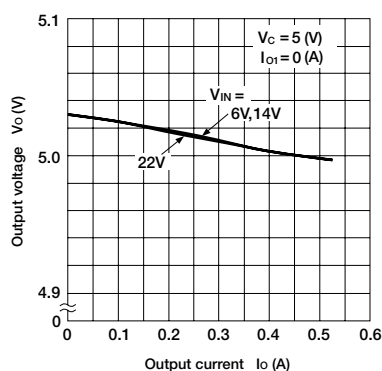
■ Line Regulation (2)



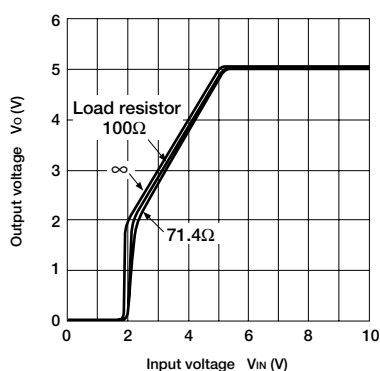
■ Load Regulation (1)



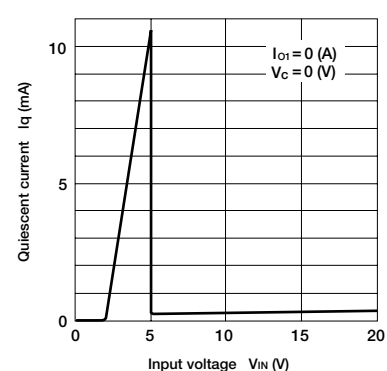
■ Load Regulation (2)



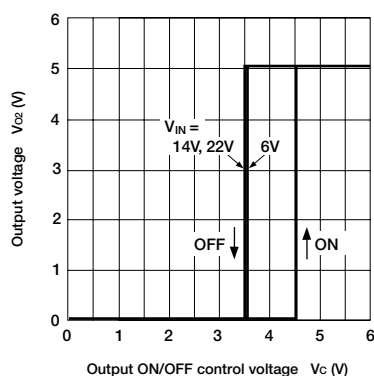
■ Rise Characteristics



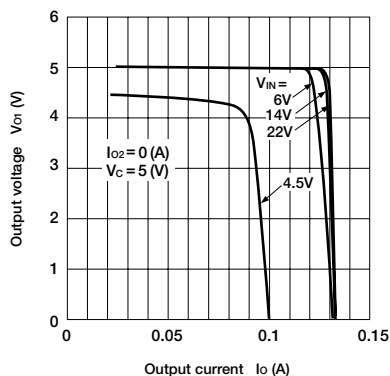
■ Quiescent Circuit Current



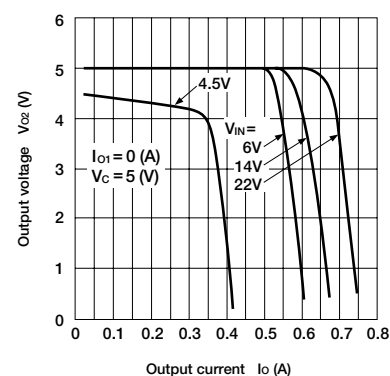
■ ON/OFF Control Characteristics



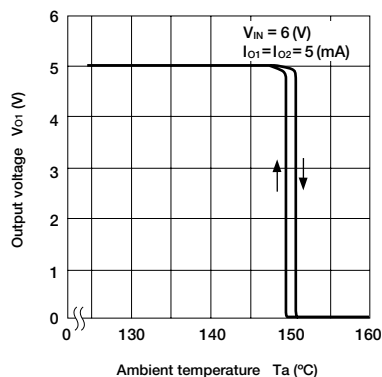
■ Overcurrent Protection Characteristics (1)



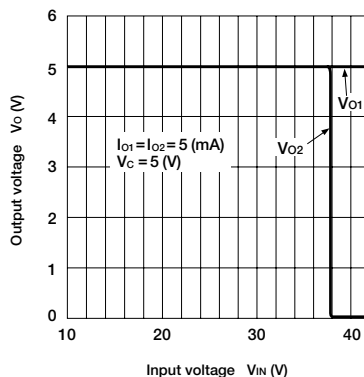
■ Overcurrent Protection Characteristics (2)



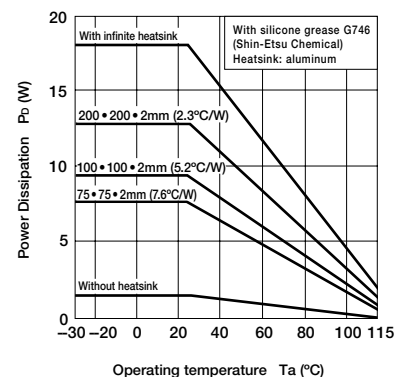
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■ T_a — P_D Characteristics



Note on Thermal Protection Characteristics:
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation, including reliability, is not guaranteed for short-circuiting over an extended period of time.

Dropper Type Regulator ICs [2-output] SI-3102S

Features

- Single input dual output <sub output (5V/0.04A), main output (5V/0.1A)>
- Main output can be externally turned ON/OFF (with ignition switch, etc.)
<most suitable as memory backup power supply>
- Low standby current ($\leq 0.8\text{mA}$)
- Low dropout voltage $\leq 1\text{V}$
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent 5-terminal full-mold miniature package

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
DC input voltage	V_{IN}	35	V	
Battery reverse connection	V_{INB}	-13 ^{*6}	V	One minute
Output control terminal voltage	V_C	V_{IN}	V	
Output current	CH1	I_{O1}	0.04 ^{*1}	A
	CH2	I_{O2}	0.1 ^{*1}	A
Power Dissipation	P_{D1}	22	W	With infinite heatsink
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_J	-40 to +150	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +105	$^\circ\text{C}$	
Storage temperature	T_{STG}	-40 to +150	$^\circ\text{C}$	
Junction to case thermal resistance	θ_{JC}	5.5	$^\circ\text{C/W}$	
Junction to ambient-air thermal resistance	θ_{JA}	66.7	$^\circ\text{C/W}$	Stand-alone without heatsink

Electrical Characteristics

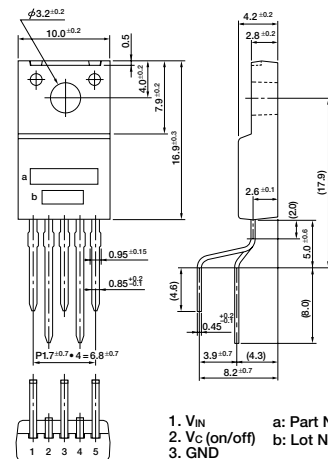
($T_J = 25^\circ\text{C}$, $V_{IN} = 14\text{V}$ unless otherwise specified)

Parameter		Symbol	Ratings			Unit	Conditions
			min	typ	max		
Input voltage		V _{IN}	6 *2		30 *1	V	
Output voltage	CH1	V _{O1}	4.80	5.00	5.20	V	I _O =0.04A
	CH2	V _{O2}	4.80	5.00	5.20	V	I _O =0.1A
Channel-channel voltage difference (V _{O1} —V _{O2})		ΔV _O	−0.1		0.1	V	I _{O1} = 0 to 0.04A I _{O2} = 0 to 0.1A
Dropout voltage	CH1	V _{DIF1}			1.0	V	I _{O1} ≦ 0.04A
	CH2	V _{DIF2}			1.0	V	I _{O2} ≦ 0.1A
Line regulation	CH1	ΔV _O LINE1		10	50	mV	V _{IN} =6 to 30V, I _O =0.04A
	CH2	ΔV _O LINE2		10	50	mV	V _{IN} =6 to 30V, I _O =0.1A
Load regulation	CH1	ΔV _O LOAD1		30	70	mV	I _{O1} = 0 to 0.04A
	CH2	ΔV _O LOAD2		40	70	mV	I _{O2} = 0 to 0.1A
Ripple rejection	CH1	R _{REJ1}		54		dB	f=100 to 120Hz
	CH2	R _{REJ2}		54		dB	f=100 to 120Hz
Quiescent circuit current		I _q			0.8	mA	I _{O1} =0A, V _C =0V
Overcurrent protection starting current	CH1	I _{(S1) 1}	0.06 *3			A	
	CH2	I _{(S1) 2}	0.15 *3			A	
Output control voltage	Output ON	V _{CH}	4.2	4.5	4.8	V	
	Output OFF	V _{CL}	3.2	3.5	3.8	V	
Output control current	Output ON	I _{CH}			100	μA	V _C =4.8V
	Output OFF	I _{CL}	−100			μA	V _C =3.2V
Overvoltage protection starting voltage		V _{OVP}	30 *4			V	
Thermal protection starting temperature		T _{TSD}	151 *5			°C	

Notes:

- *1. Since $P_{D(\text{max})} = (V_{IN} - V_O) \cdot I_{O1} + (V_{IN} - V_{O2}) \cdot I_{O2} = 22\text{ (W)}$, $V_{IN(\text{max})}$, $I_{O1(\text{max})}$ and $I_{O2(\text{max})}$ may be limited depending on operating conditions. Refer to the $T_a - P_D$ curve to compute the corresponding values.
- *2. Refer to the dropout voltage.
- *3. I_{S1} rating shall be the point at which the output voltage V_{O1} or V_{O2} ($V_{IN} = 14\text{V}$, $I_{O1} = 0.04\text{A}$ or $I_{O2} = 0.1\text{A}$) drops to -5%.
- *4. Overvoltage protection circuit is built only in CH2 (V_{O2} side).
- *5. The indicated temperatures are junction temperatures.
- *6. All terminals, except V_{IN} and GND, are open.

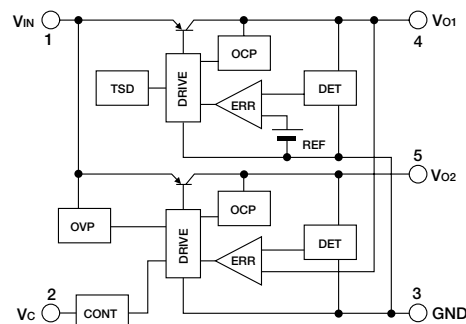
External Dimensions (unit: mm)



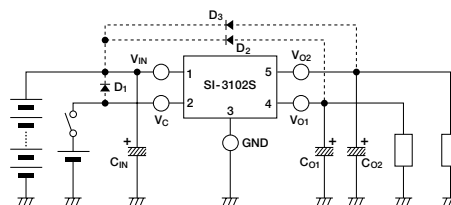
1. V_{IN}
 2. V_C (on/off)
 3. GND
 4. V_{O1}
 5. V_{O2}
- a: Part No.
b: Lot No.

(Forming No. 1101)

Equivalent Circuit Diagram



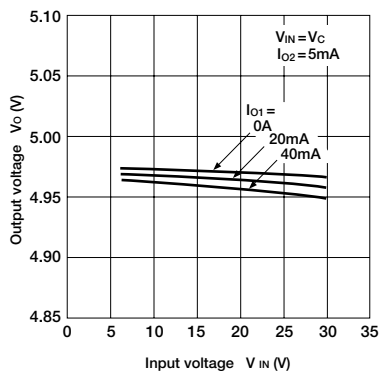
Standard Circuit Diagram



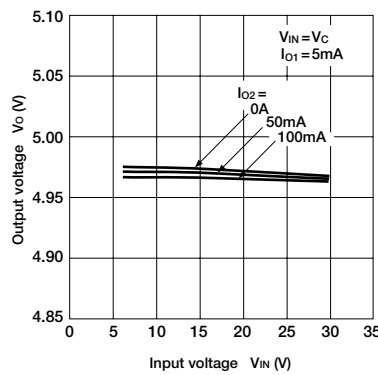
- C_{O1} : Output capacitor (47 to $100\mu\text{F}$, 50V)
 C_{O2} : Output capacitor (47 to $100\mu\text{F}$, 50V)
 $*1 C_{IN}$: Input capacitors (approx. $47\mu\text{F}$).
 Tantalum capacitors are recommended, for C_{O1} , C_{O2} and C_{IN} , especially at low temperatures.
 $*2 D_1, D_2, D_3$: Protection diode.
 Required as protection against reverse biasing between input and output.
 (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

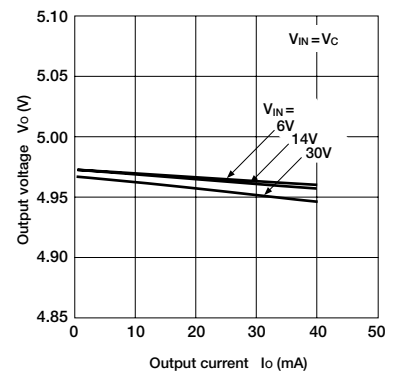
■ Line Regulation (1)



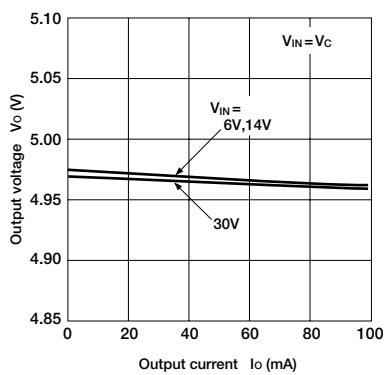
■ Line Regulation (2)



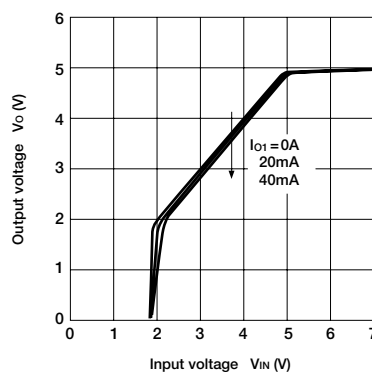
■ Load Regulation (1)



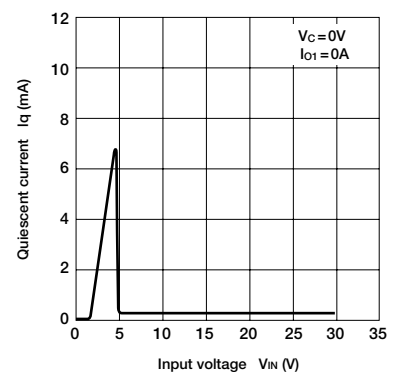
■ Load Regulation (2)



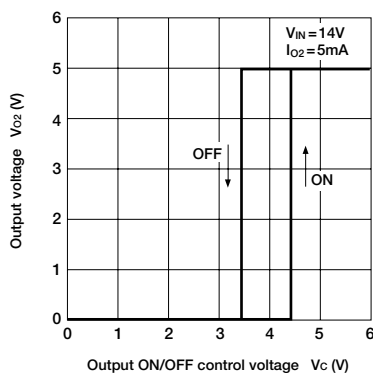
■ Rise Characteristics



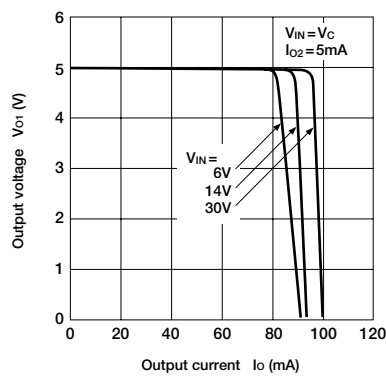
■ Quiescent Circuit Current



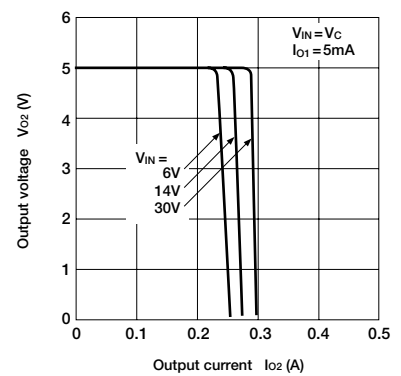
■ ON/OFF Control Characteristics



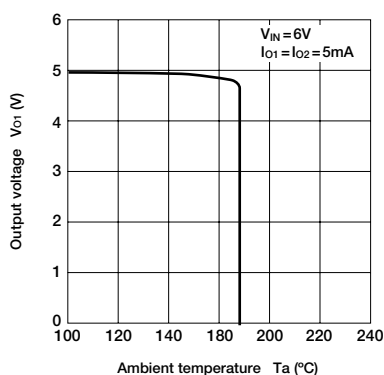
■ Overcurrent Protection Characteristics (1)



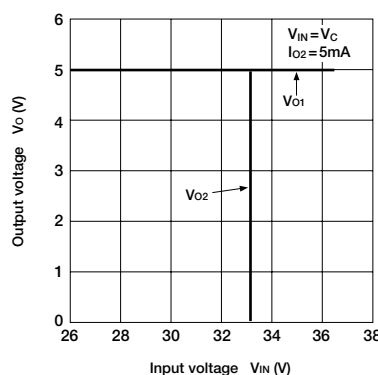
■ Overcurrent Protection Characteristics (2)



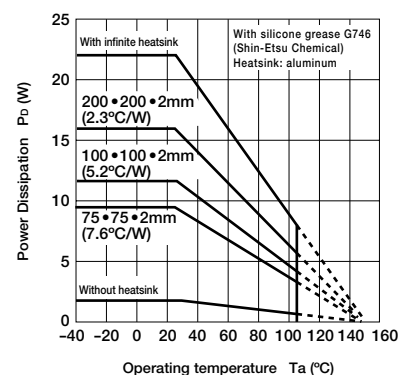
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■ Ta—Pd Characteristics



Note on Thermal Protection Characteristics:
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation, including reliability, is not guaranteed for short-circuiting over an extended period of time.

Switching Type Regulator ICs SI-3201S

Features

- Output current of 3A ($T_a = 25^\circ\text{C}$, $V_{IN} = 8$ to 18V)
- High efficiency of 82% ($V_{IN} = 14\text{V}$, $I_O = 2\text{A}$)
- Requires 5 external components only
- Built-in reference oscillator (60kHz)
- Phase internally corrected
- Output voltage internally corrected
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Input voltage	V_{IN}	35	V	
Output voltage	I_O	3	A	
SW _{OUT} terminal voltage	V_{SWOUT}	-1	V	
Power Dissipation	P_{D1}	22	W	With infinite heatsink
	P_{D2}	1.8	W	Stand-alone
Junction temperature	T_J	-40 to +150	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$	
Junction to case thermal resistance	θ_{J-C}	5.5	$^\circ\text{C/W}$	
Junction to ambient-air thermal resistance	θ_{J-A}	66.7	$^\circ\text{C/W}$	

Recommended Operating Conditions

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input voltage	V_{IN}	8		18	V	
Output current	I_O	0.5		3	A	
Operating temperature	T_{op}	-40		+85	$^\circ\text{C}$	$T_a - P_D$ characteristics

Electrical Characteristics ($V_{IN} = 14\text{V}$, $I_{OUT} = 2\text{A}$, $T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Output voltage	V_O	4.80	5.00	5.20	V	
Line regulation	$\Delta V_{O LINE}$			100	mV	$V_{IN} = 8$ to 18V
Load regulation	$\Delta V_{O LOAD}$			50	mV	$I_O = 0.5$ to 3A
Efficiency *1	η		82		%	
Oscillation frequency	f_{OSC}	50	60	70	kHz	
Quiescent circuit current	I_q		5	10	mA	$I_O = 0\text{A}$
Overcurrent protection starting current	I_S	3.1			A	*2
Soft start *3	Low level voltage	V_{SSL}		0.2	V	
	Source current when low	I_{SSL}	15	25	μA	$V_{SSL} = 0.2\text{V}$
	Discharge resistance	R_{DIS}		200	k Ω	$V_{IN} = 0\text{V}$

Notes:

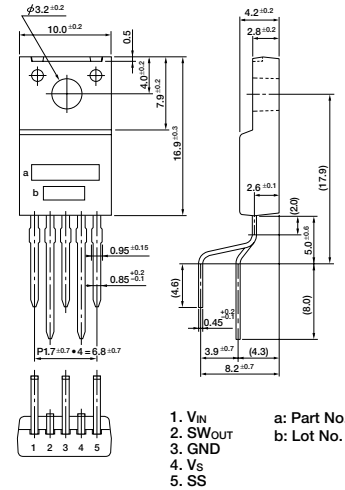
*1. Efficiency is calculated by the following equation:

$$\eta = \frac{V_O \cdot I_O}{V_{IN} \cdot I_{IN}} \cdot 100 (\%)$$

*2. A dropping-type overcurrent protection circuit is built in the IC.

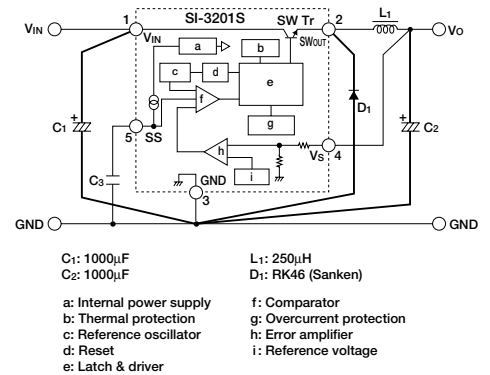
*3. An external voltage may not be applied to the soft start terminal. As shown in the diagram to the right, use this IC in the soft start mode with a capacitor or in the open-collector drive mode with a transistor. Leave the soft start terminal open when not using it since it is already pulled up in the IC.

External Dimensions (unit: mm)



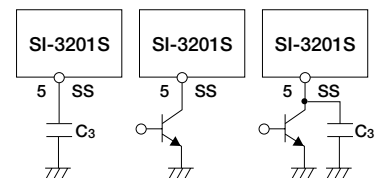
(Forming No. 1101)

Standard Circuit Diagram



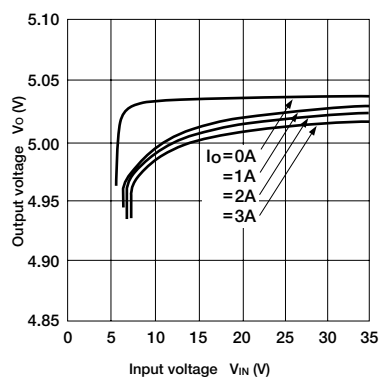
Cautions:

- (1) A high-ripple current flows through C_1 and C_2 . Use high-ripple type 1000 μF or higher capacitors with low internal resistance. Refer to the respective data books for more information on reliability and electrical characteristics of the capacitor.
- (2) C_3 is a capacitor used for soft start.
- (3) L_1 should be a choke coil with a low core loss for switching power supplies.
- (4) Use a Schottky barrier diode for D_1 and make sure that the reverse voltage applied to the 2nd terminal (SW_{OUT} terminal) is within the maximum ratings (-1V). If you use a fast-recovery diode, the recovery voltage and the ON forward voltage may cause a reversed-bias voltage exceeding the maximum ratings to be applied to the 2nd terminal (SW_{OUT} terminal). Applying a reversed-bias voltage exceeding the maximum rating to the 2nd terminal (SW_{OUT} terminal) may damage the IC.
- (5) The 4th terminal (V_S) is an output voltage detection terminal. Since this terminal has a high impedance, connect it to the positive (+) terminal of C_2 via the shortest possible route.
- (6) Leave the 5th terminal (soft start terminal) open when not using it. It is pulled up internally.
- (7) To ensure optimum operating environment, connect the high-frequency current line with minimum wiring length.

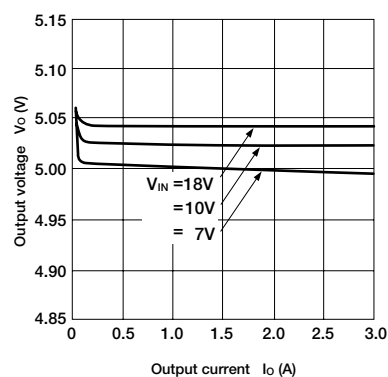


Electrical Characteristics

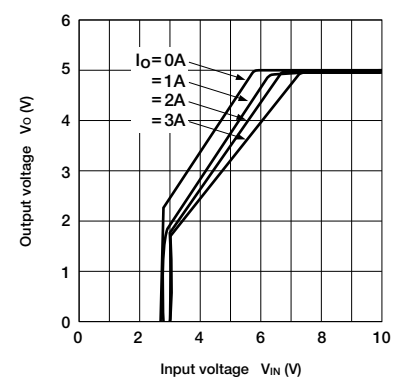
■ Line Regulation



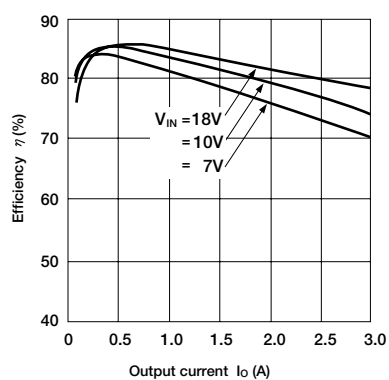
■ Load Regulation



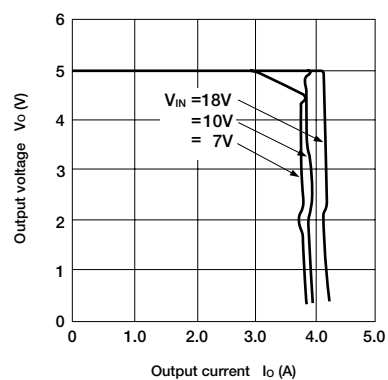
■ Rise Characteristics



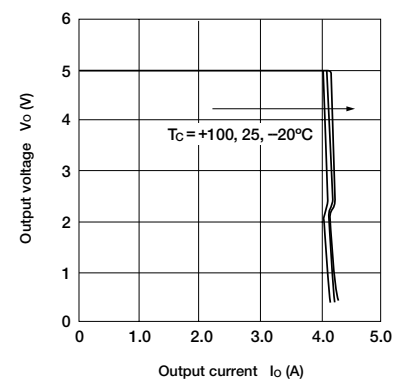
■ Efficiency Curve



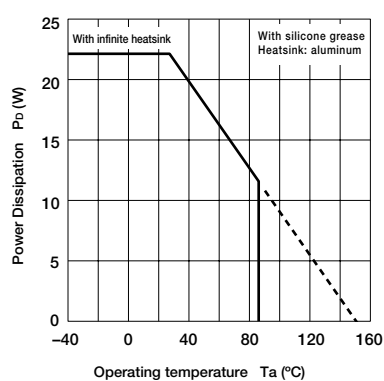
■ Overcurrent Protection Characteristics



■ Overcurrent Protection Temperature Characteristics



■ Ta—P_D Characteristics



High-side Power Switch ICs [With Diagnostic Function] SI-5151S

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent and thermal protection circuits
- Built-in protection against reverse connection of power supply
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _B	40	V	
Input terminal voltage	V _{IN}	-0.3 to V _B	V	
DIAG terminal voltage	V _{DIAG}	6	V	
Collector-emitter voltage	V _{CE}	40	V	
Output current	I _O	1.8	A	
Power Dissipation	P _{D1}	18	W	With infinite heatsink (T _C =25°C)
	P _{D2}	1.5	W	Stand-alone without heatsink (T _C =25°C)
Junction temperature	T _J	-40 to +125	°C	
Operating temperature	T _{OP}	-40 to +100	°C	
Storage temperature	T _{stg}	-40 to +125	°C	

Electrical Characteristics

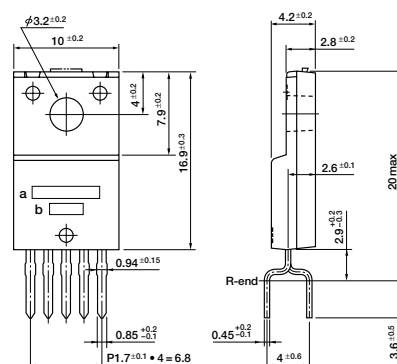
(Ta=25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V _{Bopr}	6.0		30	V	
Quiescent circuit current	I _q		5	12	mA	V _{Bopr} =14V, V _{IN} =0V
Saturation voltage of output transistor	V _{CE(sat)}			0.5	V	I _O ≤ 1.0A, V _{Bopr} =6 to 16V
				1.0	V	I _O ≤ 1.8A, V _{Bopr} =6 to 16V
Output leak current	I _{O, leak}			2	mA	V _{CE0} =16V
Input voltage	Output ON	V _{IH}	2.0		V	V _{Bopr} =6 to 16V
	Output OFF	V _{IL}	-0.3	0.8	V	V _{Bopr} =6 to 16V
Input current	Output ON	I _{IH}		1	mA	V _{IN} =5V
	Output OFF	I _{IL}	-0.1		mA	V _{IN} =0V
Overcurrent protection starting current	I _S	1.9			A	V _{Bopr} =14V, V _O =V _{Bopr} -1.5V
Thermal protection starting temperature	T _{TSD}	125	145		°C	
Open load detection resistor	R _{open}			30	kΩ	V _{Bopr} =6 to 16V
Output transfer time	T _{ON}		8	30	μs	V _{Bopr} =14V, I _O =1A
	T _{OFF}		15	30	μs	V _{Bopr} =14V, I _O =1A
DIAG output voltage	V _{DH}	4.5		6	V	V _{CC} =6V
	V _{DL}			0.3	V	V _{CC} =6V, I _{DD} =2mA
DIAG output transfer time	T _{PLH}			30	μs	V _{Bopr} =14V, I _O =1A
	T _{PHL}			30	μs	V _{Bopr} =14V, I _O =1A
Minimum load inductance	L	1			mH	

Note:

* The rule of protection against reverse connection of power supply is V_B = -13V, one minute (all terminals except, V_B and GND, are open).

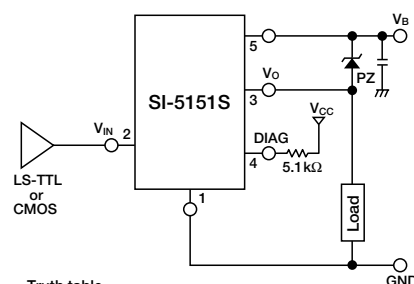
External Dimensions (unit: mm)



1. GND
 2. V_{IN}
 3. V_O
 4. DIAG
 5. V_B
- a: Part No.
b: Lot No.

(Forming No. 1123)

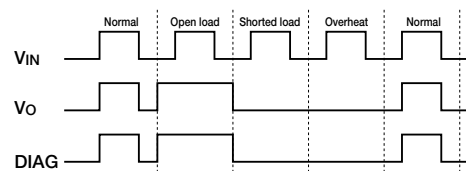
Standard Circuit Diagram



Truth table

V _{IN}	V _O
H	H
L	L

Diagnostic Function

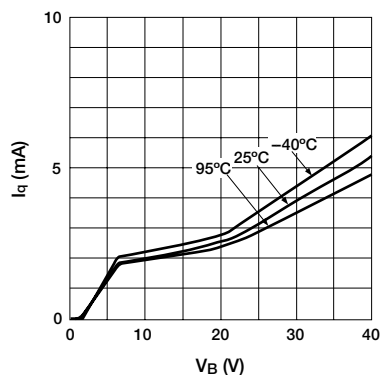


Mode	V _{IN}	V _O	DIAG
Normal	L	L	L
Open load	L	H	H
Shorted load	L	L	L
Overheat	L	L	L

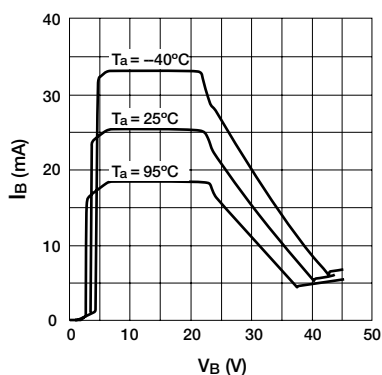
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

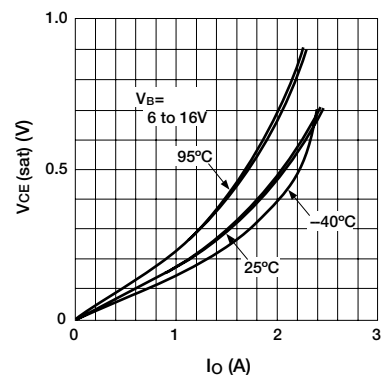
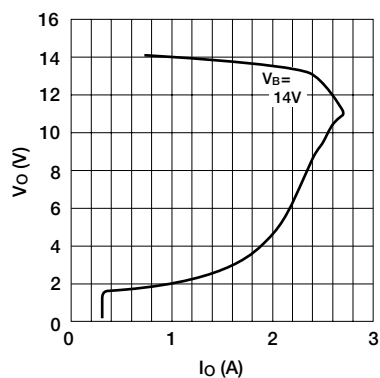
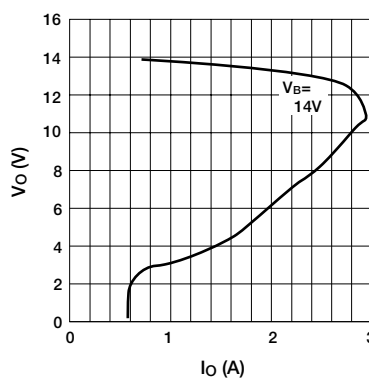
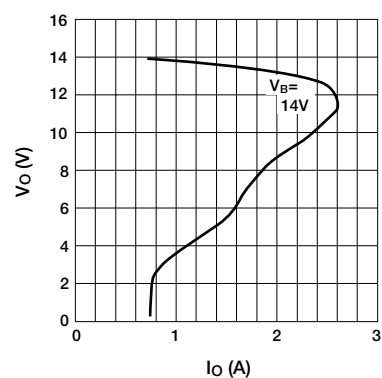
■ Quiescent Circuit Current



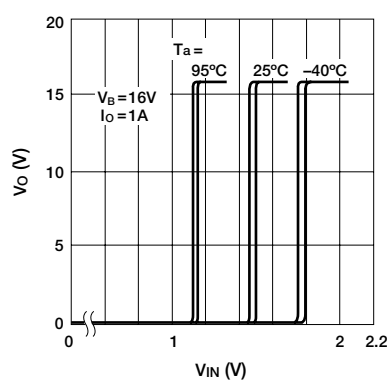
■ Circuit Current



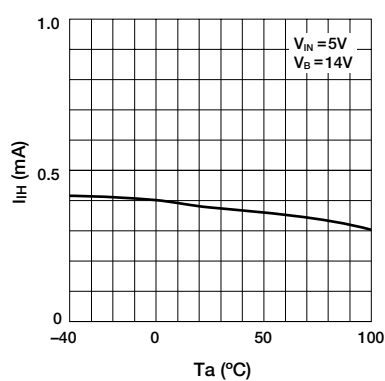
■ Saturation Voltage of Output Transistor

■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)■ Overcurrent Protection Characteristics ($T_a = 100^\circ\text{C}$)

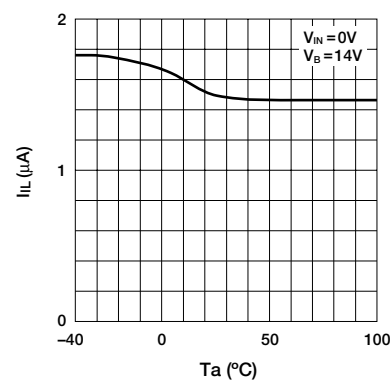
■ Threshold input voltage



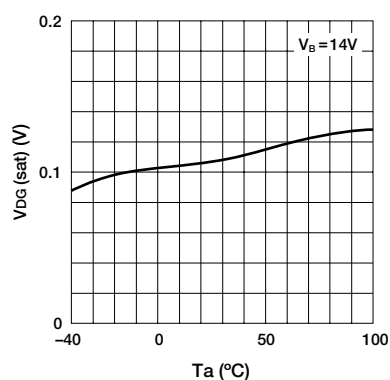
■ Input Current (Output ON)



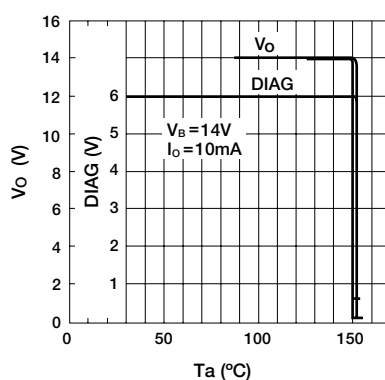
■ Input Current (Output OFF)



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



High-side Power Switch ICs [With Diagnostic Function] SI-5152S

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent and thermal protection circuits
- Built-in protection against reverse connection of power supply
- $T_J = 150^\circ\text{C}$ guaranteed
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	40	V	
Input terminal voltage	V_{IN}	-0.3 to V_B	V	
DIAG terminal voltage	V_{DIAG}	6	V	
Collector-emitter voltage	V_{CE}	40	V	
Output current	I_O	1.8	A	
Power Dissipation	P_{D1}	22	W	With infinite heatsink ($T_C = 25^\circ\text{C}$)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_J	-40 to $+150$	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to $+100$	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to $+150$	$^\circ\text{C}$	

Electrical Characteristics

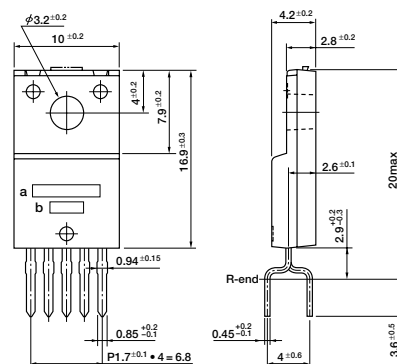
($T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		30	V	
Quiescent circuit current	I_Q		5	12	mA	$V_{Bopr} = 14\text{V}$, $V_{IN} = 0\text{V}$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.5	V	$I_O \leq 1.0\text{A}$, $V_{Bopr} = 6$ to 16V
				1.0	V	$I_O \leq 1.8\text{A}$, $V_{Bopr} = 6$ to 16V
Output leak current	$I_{O, leak}$			2	mA	$V_{CE} = 16\text{V}$, $V_{IN} = 0\text{V}$
Input voltage	Output ON	V_{IH}	2.0	V_B	V	$V_{Bopr} = 6$ to 16V
	Output OFF	V_{IL}	-0.3	0.8	V	$V_{Bopr} = 6$ to 16V
Input current	Output ON	I_{IH}		1	mA	$V_{IN} = 5\text{V}$
	Output OFF	I_{IL}	-0.1		mA	$V_{IN} = 0\text{V}$
Overcurrent protection starting current	I_S	1.9			A	$V_{Bopr} = 14\text{V}$, $V_O = V_{Bopr} - 1.5\text{V}$
Thermal protection starting temperature	T_{TSD}	150			$^\circ\text{C}$	$V_{Bopr} \geq 6\text{V}$
Open load detection resistor	R_{open}			30	$k\Omega$	$V_{Bopr} = 6$ to 16V
Output transfer time	T_{ON}		8	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{OFF}		15	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
DIAG output leak current	I_{DIAG}			100	μA	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V
Saturation voltage of DIAG output	V_{DL}			0.3	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V , $I_{DO} = 2\text{mA}$
DIAG output transfer time	T_{PLH}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{PHL}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
Minimum load inductance	L	1			mH	

Note:

* The rule of protection against reverse connection of power supply is $V_B = -13\text{V}$, one minute (all terminals except, V_B and GND, are open).

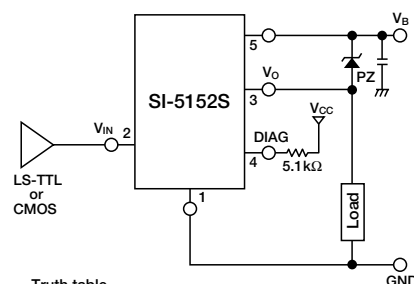
External Dimensions (unit: mm)



1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

(Forming No. 1123)

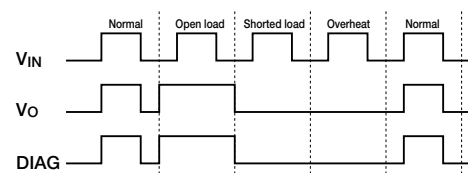
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

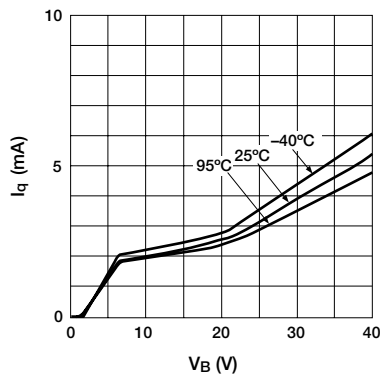


Mode	V_{IN}	V_O	DIAG
Normal	L	H	L
Open load	L	H	H
Shorted load	L	L	L
Overheat	L	L	L

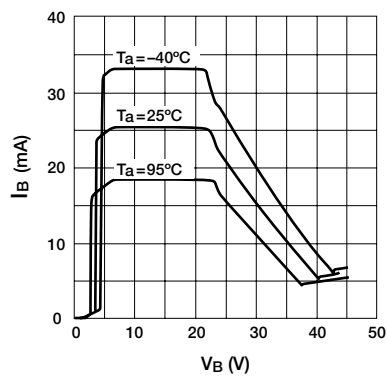
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

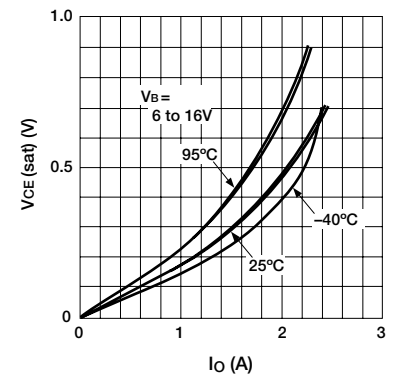
■ Quiescent Circuit Current



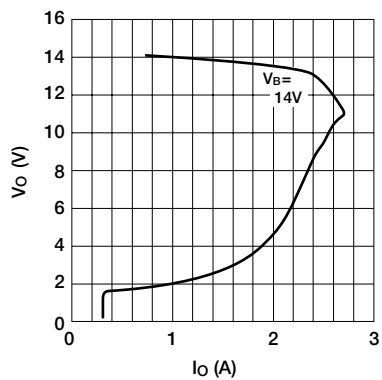
■ Circuit Current



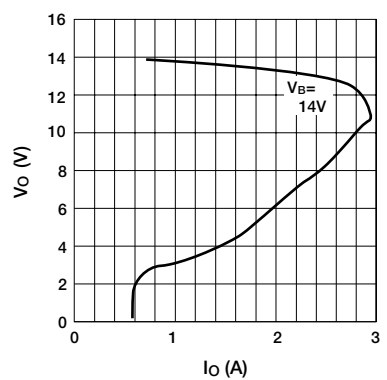
■ Saturation Voltage of Output Transistor



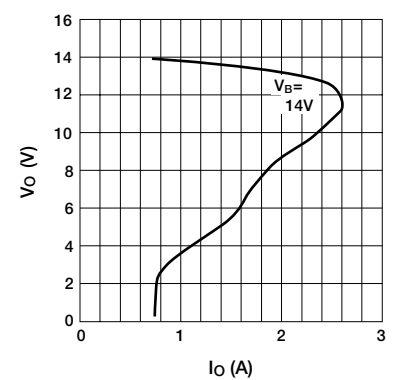
■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)



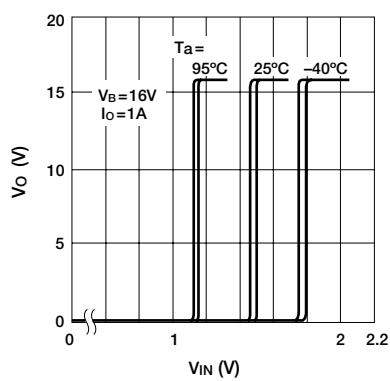
■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)



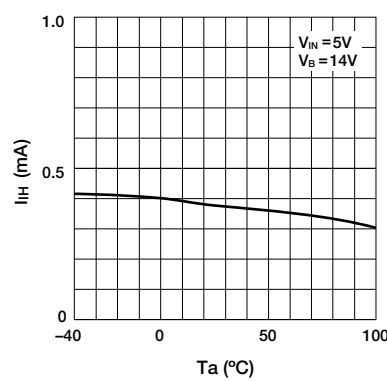
■ Overcurrent Protection Characteristics ($T_a = 100^\circ\text{C}$)



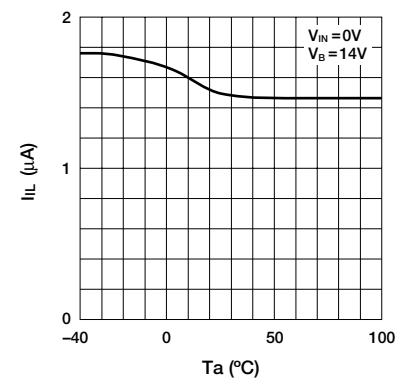
■ Threshold input voltage



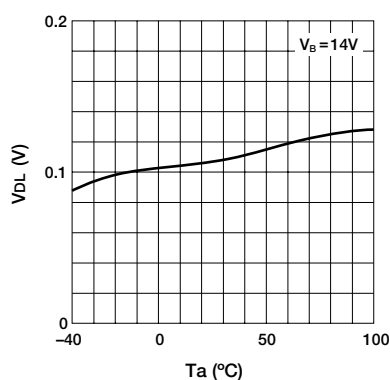
■ Input Current (Output ON)



■ Input Current (Output OFF)



■ Saturation Voltage of DIAG Output



High-side Power Switch ICs [With Diagnostic Function] SI-5155S

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent and thermal protection circuits
- Built-in protection against reverse connection of power supply
- $T_j = 150^\circ\text{C}$ guaranteed
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Input terminal voltage	V_{IN}	-0.3 to V_B	V	
DIAG terminal voltage	V_{DIAG}	6	V	
Collector-emitter voltage	V_{CE}	40	V	
Output current	I_O	2.5	A	
Power dissipation	P_{D1}	22	W	With infinite heatsink ($T_c = 25^\circ\text{C}$)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_j	-40 to +150	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +100	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	

Electrical Characteristics

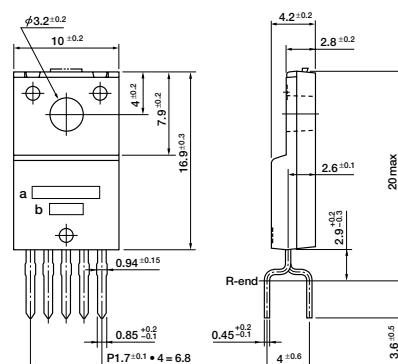
($T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		30	V	
Quiescent circuit current	I_q		5	12	mA	$V_{Bopr} = 14\text{V}$, $V_{IN} = 0\text{V}$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.3	V	$I_O \leq 1.0\text{A}$, $V_{Bopr} = 6$ to 16V
				0.72	V	$I_O \leq 2.5\text{A}$, $V_{Bopr} = 6$ to 16V
Output leak current	$I_{O, leak}$			2	mA	$V_{CEO} = 16\text{V}$, $V_{IN} = 0\text{V}$
Input voltage	Output ON	V_{IH}	2.0		V_B	V, $V_{Bopr} = 6$ to 16V
	Output OFF	V_{IL}	-0.3		0.8	V, $V_{Bopr} = 6$ to 16V
Input current	Output ON	I_{IH}		1	mA	$V_{IN} = 5\text{V}$
	Output OFF	I_{IL}	-0.1		mA	$V_{IN} = 0\text{V}$
Overcurrent protection starting current	I_S	2.6			A	$V_{Bopr} = 14\text{V}$, $V_O = V_{Bopr} - 1.5\text{V}$
Thermal protection starting temperature	T_{TSD}	150			$^\circ\text{C}$	$V_{Bopr} \geq 6\text{V}$
Open load detection resistor	R_{open}			30	k Ω	$V_{Bopr} = 6$ to 16V
Output transfer time	T_{ON}		8	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{OFF}		15	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
DIAG output voltage	V_{DH}	4.5		6	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V
	V_{DL}			0.3	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V, $I_{DO} = 2\text{mA}$
DIAG output transfer time	T_{PLH}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{PHL}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
Minimum load inductance	L	1			mH	

Note:

* The rule of protection against reverse connection of power supply is $V_B = -13\text{V}$, one minute (all terminals except, V_B and GND, are open).

External Dimensions (unit: mm)

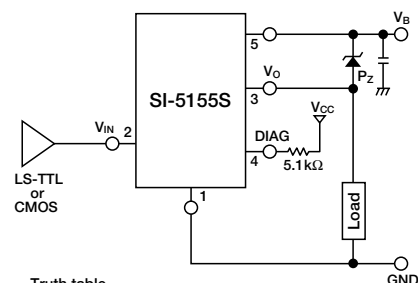


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

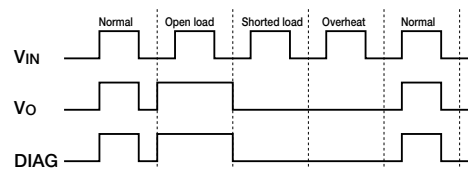
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

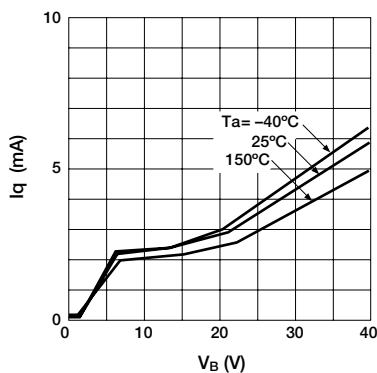


Mode	V_{IN}	V_O	DIAG
Normal	L	L	L
	H	H	H
Open load	L	H	H
	H	H	H
Shorted load	L	L	L
	H	L	L
Overheat	L	L	L
	H	L	L

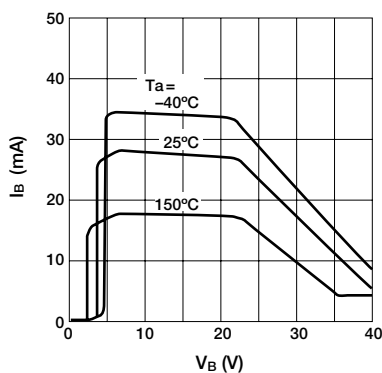
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

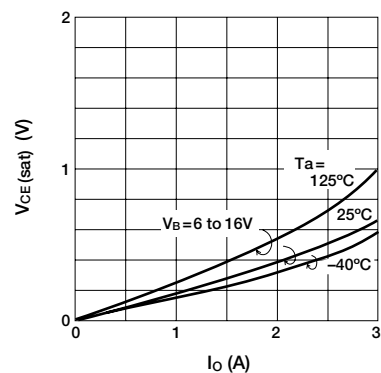
■ Quiescent Circuit Current



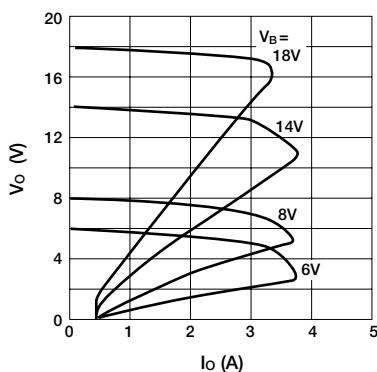
■ Circuit Current



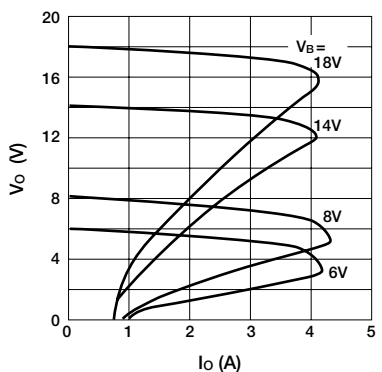
■ Saturation Voltage of Output Transistor



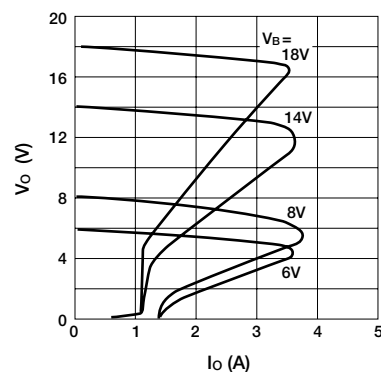
■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)



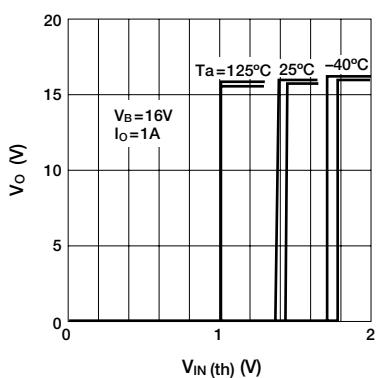
■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)



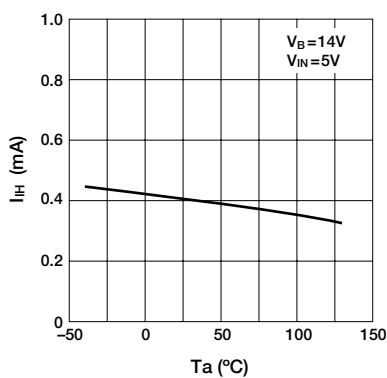
■ Overcurrent Protection Characteristics ($T_a = 125^\circ\text{C}$)



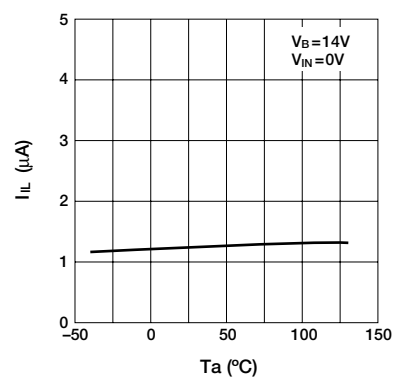
■ Threshold input voltage



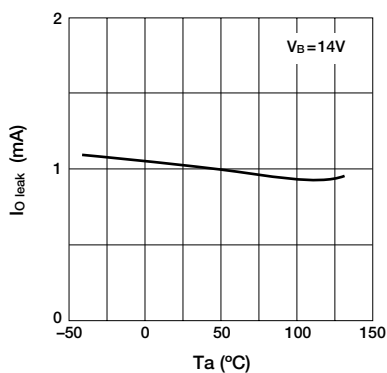
■ Input Current (Output ON)



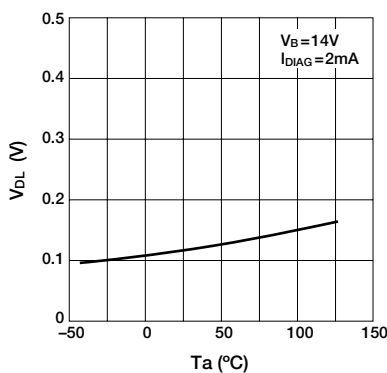
■ Input Current (Output OFF)



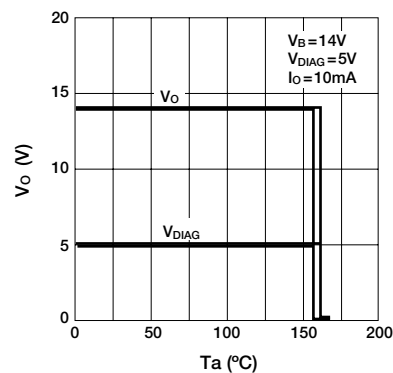
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent and thermal protection circuits
- Built-in protection against reverse connection of power supply
- $T_j = 150^\circ\text{C}$ guaranteed
- Built-in Zener diode
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Input terminal voltage	V_{IN}	-0.3 to V_B	V	
DIAG terminal voltage	V_{DIAG}	6	V	
Collector-emitter voltage	V_{CE}	$V_B - V_Z$	V	Refer to "Surge clamp voltage" in Electrical Characteristics
Output current	I_O	2.04	A	
Power Dissipation	P_{D1}	22	W	With infinite heatsink ($T_c = 25^\circ\text{C}$)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_j	-40 to +150	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +100	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	

Electrical Characteristics

($T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		30	V	
Quiescent circuit current	I_Q		5	12	mA	$V_{Bopr} = 14\text{V}$, $V_{IN} = 0\text{V}$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.47	V	$I_O \leq 2.05\text{A}$, $V_{Bopr} = 6$ to 16V
Output leak current	$I_{O, leak}$			2	mA	$V_{CE0} = 16\text{V}$, $V_{IN} = 0\text{V}$
Input voltage	Output ON	V_{IH}	2.0		V	$V_{Bopr} = 6$ to 16V
	Output OFF	V_{IL}	-0.3	0.8	V	$V_{Bopr} = 6$ to 16V
Input current	Output ON	I_{IH}		1	mA	$V_{IN} = 5\text{V}$
	Output OFF	I_{IL}	-0.1		mA	$V_{IN} = 0\text{V}$
Overcurrent protection starting current	I_S	2.05			A	$V_{Bopr} = 14\text{V}$, $V_O = V_{Bopr} - 1.5\text{V}$
Thermal protection starting temperature	T_{TSD}	150			$^\circ\text{C}$	$V_{Bopr} \geq 6\text{V}$
Open load detection resistor	R_{open}			30	k Ω	$V_{Bopr} = 6$ to 16V
Output transfer time	T_{ON}		8	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{OFF}		15	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
DIAG output voltage	V_{DH}	4.5		6	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V
	V_{DL}			0.3	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V, $I_{DO} = 2\text{mA}$
DIAG output transfer time	T_{PLH}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{PHL}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
Minimum load inductance	L	1			mH	
Surge clamp voltage	V_Z	28	34	40	V	$I_C = 5\text{mA}$

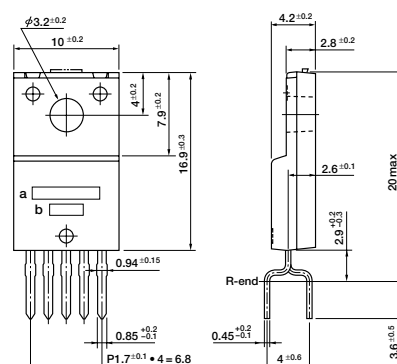
Note:

*1. The Zener diode for surge clamping has an energy capability of 140 mJ (single pulse).

* The rule of protection against reverse connection of power supply is $V_B = -13\text{V}$, one minute.

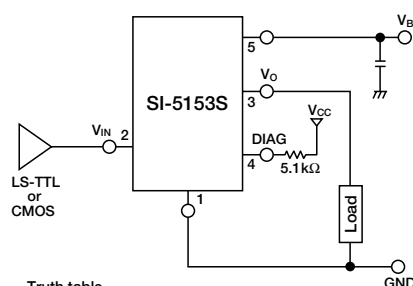
* This driver is exclusively used for ON/OFF control.

External Dimensions (unit: mm)



1. GND
 2. V_{IN}
 3. V_O
 4. DIAG
 5. V_B
- a: Part No.
b: Lot No.
- (Forming No. 1123)

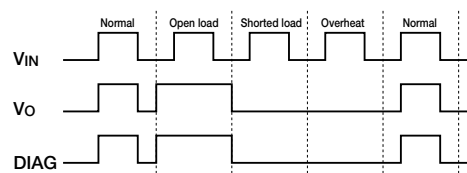
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

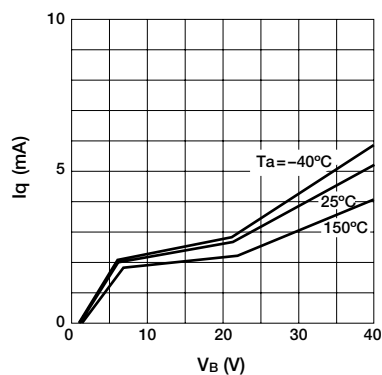


Mode	V_{IN}	V_O	DIAG
Normal	L	L	L
Open load	L	H	H
Shorted load	L	L	L
Overheat	L	L	L

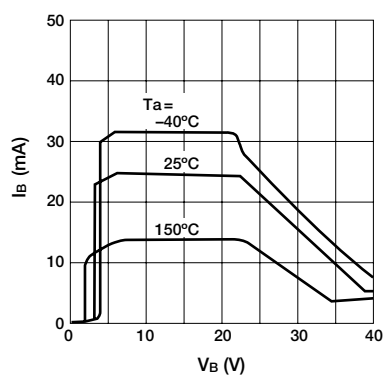
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

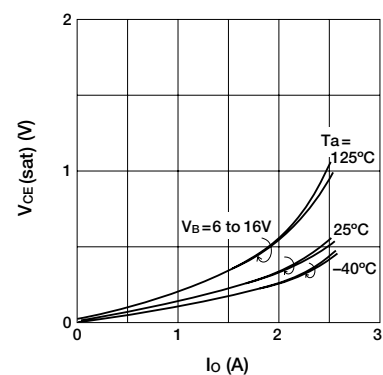
■ Quiescent Circuit Current



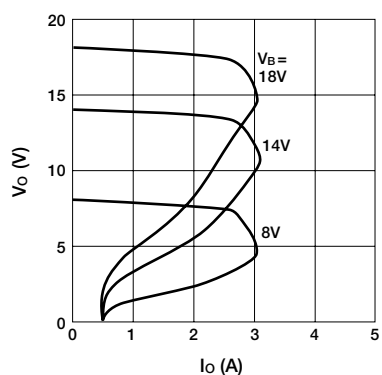
■ Circuit Current



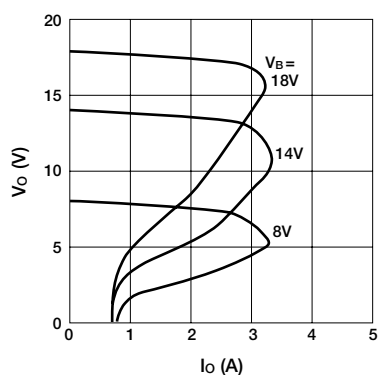
■ Saturation Voltage of Output Transistor



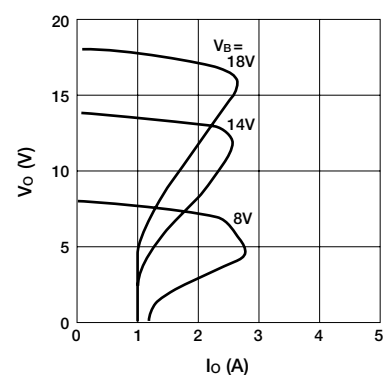
■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)



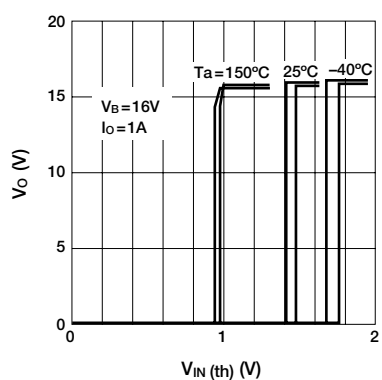
■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)



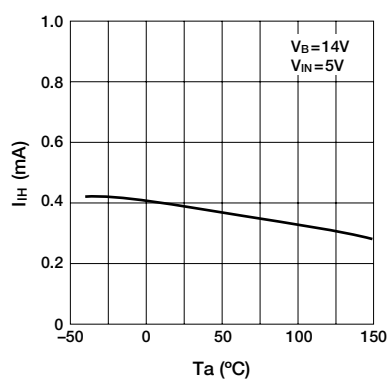
■ Overcurrent Protection Characteristics ($T_a = 125^\circ\text{C}$)



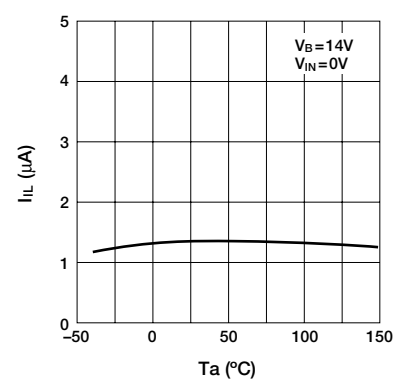
■ Threshold Characteristics of Input Voltage



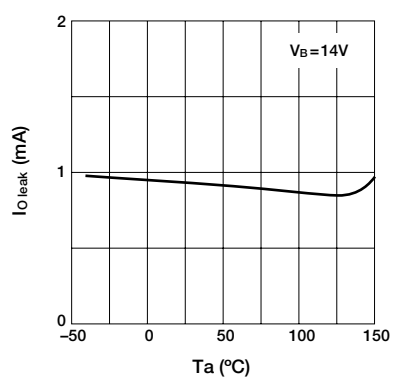
■ Input Current (Output ON)



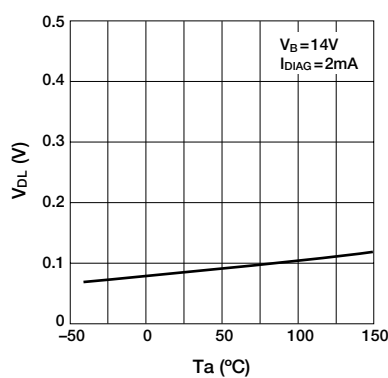
■ Input Current (Output OFF)



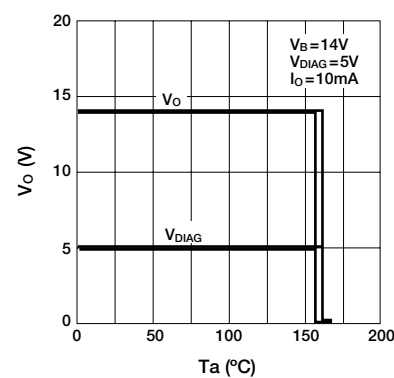
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent and thermal protection circuits
- Built-in protection against reverse connection of power supply
- $T_J = 150^\circ\text{C}$ guaranteed
- Built-in Zener diode
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Input terminal voltage	V_{IN}	-0.3 to V_B	V	
DIAG terminal voltage	V_{DIAG}	6	V	
Collector-emitter voltage	V_{CE}	$V_B - V_Z$	V	Refer to "Surge clamp voltage" in Electrical Characteristics
Output current	I_O	2.5	A	
Power Dissipation	P_{D1}	22	W	With infinite heatsink ($T_c = 25^\circ\text{C}$)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	T_J	-40 to +150	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +100	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	

Electrical Characteristics

($T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		30	V	
Quiescent circuit current	I_q		5	12	mA	$V_{Bopr} = 14\text{V}$, $V_{IN} = 0\text{V}$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.3	V	$I_O \leq 1.0\text{A}$, $V_{Bopr} = 6$ to 16V
				0.72	V	$I_O \leq 2.5\text{A}$, $V_{Bopr} = 6$ to 16V
Output leak current	$I_{O, leak}$			2	mA	$V_{CE0} = 16\text{V}$, $V_{IN} = 0\text{V}$
Input voltage	Output ON	V_{IH}	2.0	V_B	V	$V_{Bopr} = 6$ to 16V
	Output OFF	V_{IL}	-0.3	0.8	V	$V_{Bopr} = 6$ to 16V
Input current	Output ON	I_{IH}		1	mA	$V_{IN} = 5\text{V}$
	Output OFF	I_{IL}	-0.1		mA	$V_{IN} = 0\text{V}$
Overcurrent protection starting current	I_S	2.6			A	$V_{Bopr} = 14\text{V}$, $V_O = V_{Bopr} - 1.5\text{V}$
Thermal protection starting temperature	T_{TSD}	150			$^\circ\text{C}$	$V_{Bopr} \geq 6\text{V}$
Open load detection resistor	R_{open}			30	k Ω	$V_{Bopr} = 6$ to 16V
Output transfer time	T_{ON}		8	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{OFF}		15	30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
DIAG output voltage	V_{DH}	4.5		6	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V
	V_{DL}			0.3	V	$V_{CC} = 6\text{V}$, $V_{Bopr} = 6$ to 16V , $I_{DO} = 2\text{mA}$
DIAG output transfer time	T_{PLH}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
	T_{PHL}			30	μs	$V_{Bopr} = 14\text{V}$, $I_O = 1\text{A}$
Minimum load inductance	L	1			mH	
Surge clamp voltage ^{*1}	V_Z	28	34	40	V	$I_C = 5\text{mA}$

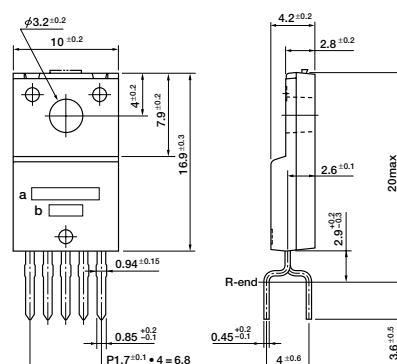
Note:

*1. The Zener diode for surge clamping has an energy capability of 200 mJ (single pulse).

* The rule of protection against reverse connection of power supply is $V_B = -13\text{V}$, one minute.

* This driver is exclusively used for ON/OFF control.

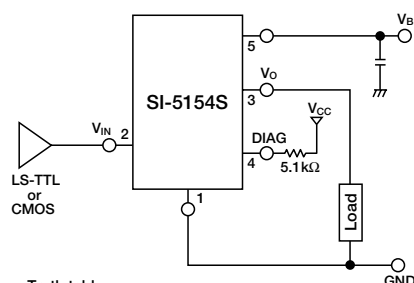
External Dimensions (unit: mm)



1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B
- a: Part No.
b: Lot No.

(Forming No. 1123)

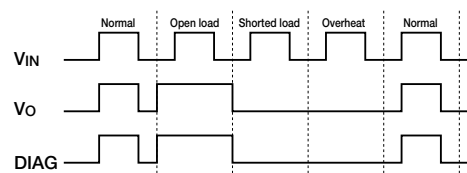
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

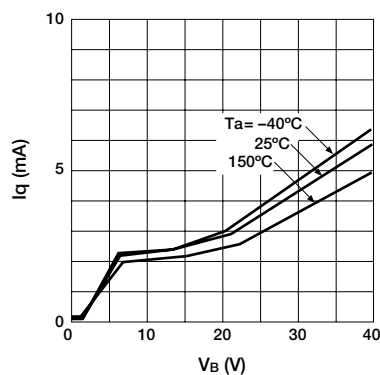


Mode	V_{IN}	V_O	DIAG
Normal	L	L	L
Open load	L	H	H
Shorted load	L	L	L
Overheat	L	L	L

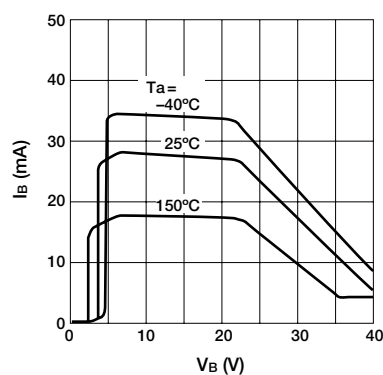
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

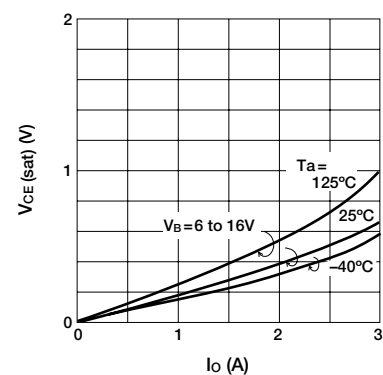
■ Quiescent Circuit Current



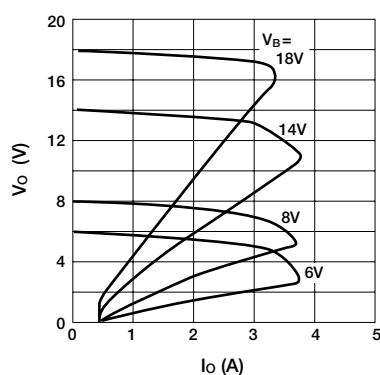
■ Circuit Current



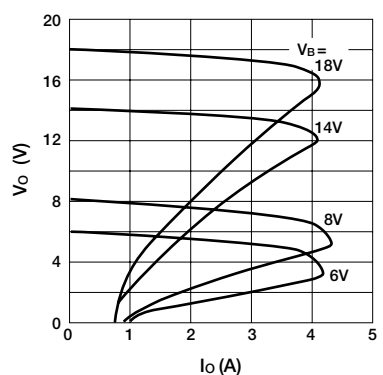
■ Saturation Voltage of Output Transistor



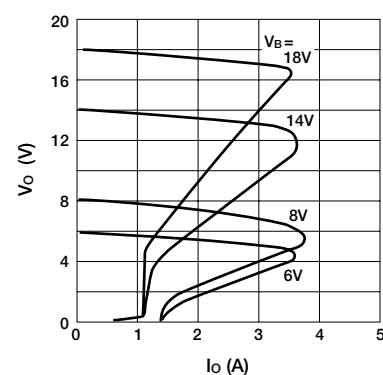
■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)



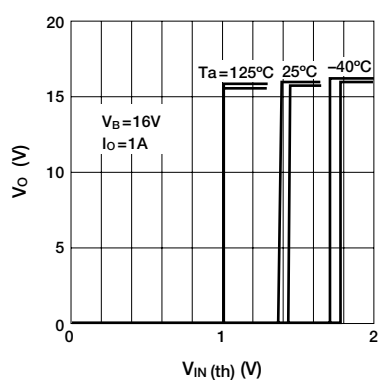
■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)



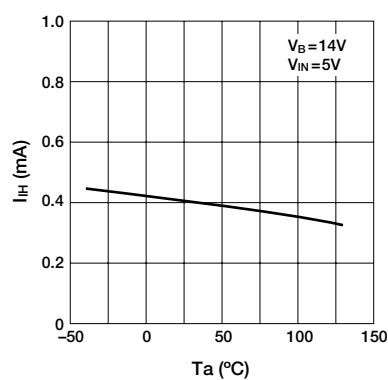
■ Overcurrent Protection Characteristics ($T_a = 125^\circ\text{C}$)



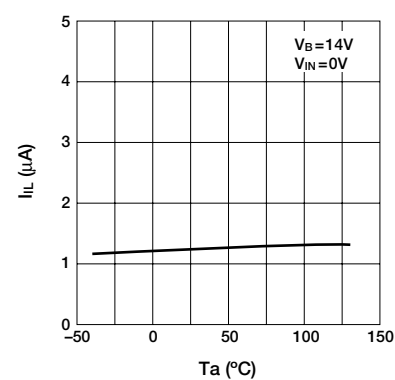
■ Threshold input voltage



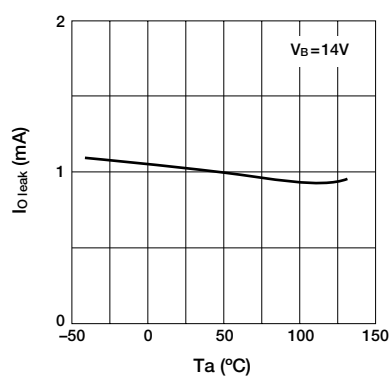
■ Input Current (Output ON)



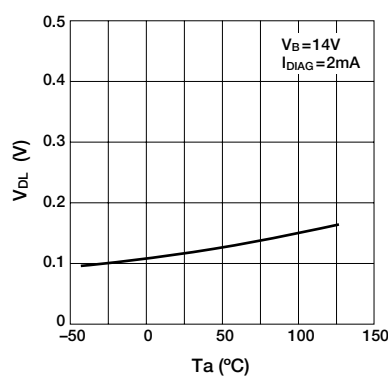
■ Input Current (Output OFF)



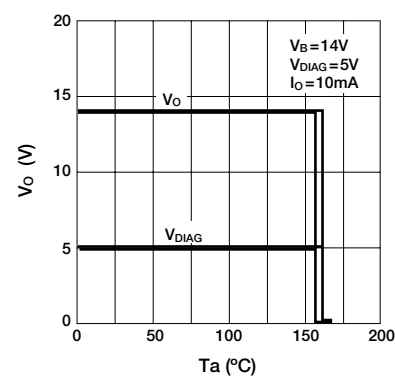
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



High-side Power Switch ICs [Surface-mount 2-circuits] SDH04

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent protection circuits
- Built-in protection against reverse connection of power supply
- $T_j = 150^\circ\text{C}$ guaranteed
- Surface-mount full-mold package

Absolute Maximum Ratings

($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Drive terminal applied voltage	V_D	-0.3 to V_B	V	
Input terminal voltage	V_{IN}	-0.3 to +7.0	V	
DIAG output applied voltage	V_{DIAG}	-0.3 to +7.0	V	
DIAG output source current	I_{DIAG}	3	mA	
Voltage across power supply and drive terminal	V_{B-D}	$V_B - 0.4$	V	
Output current	I_O	1.5	A	
Power dissipation	P_D	2.6	W	Without heatsink, all circuits operating
Junction temperature	T_j	-40 to +150	$^\circ\text{C}$	
Operating temperature	T_{OP}	-40 to +100	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	

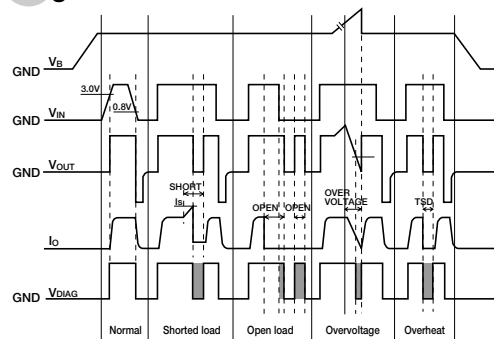
Electrical Characteristics

($V_{Bopr} = 14\text{V}$, $T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		16	V	
Quiescent circuit current	I_q		5	12	mA	I_O output
Threshold input voltage	V_{INth}	0.8		3.0	V	
Input current	Hi output	I_{IN}		1.0	mA	$V_{IN} = 5\text{V}$
	Lo output	I_{IN}	0	100	μA	$V_{IN} = 0\text{V}$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.5	V	$I_O \leq 1.0\text{A}$, $V_{Bopr} = 6$ to 16V
Output terminal sink current	$I_{O(off)}$			2.0	mA	$V_O = 0\text{V}$, $V_{IN} = 0\text{V}$
Saturation voltage of DIAG output	V_{DL}			0.3	V	$I_{DIAG} = 3\text{mA}$
Leak current of DIAG output	I_{DGH}			100	μA	$V_{DIAG} = 5\text{V}$
Open load detection resistor	R_{open}	1		30	k Ω	
Overcurrent protection starting current	I_S	1.6			A	$V_O = V_{Bopr} - 1.9\text{V}$
Output transfer time	T_{ON}		8	30	μs	$I_O = 1\text{A}$
	T_{OFF}		15	30	μs	$I_O = 1\text{A}$
DIAG output transfer time	T_{PLH}		10	30	μs	$I_O = 1\text{A}$
	T_{PHL}		15	30	μs	$I_O = 1\text{A}$

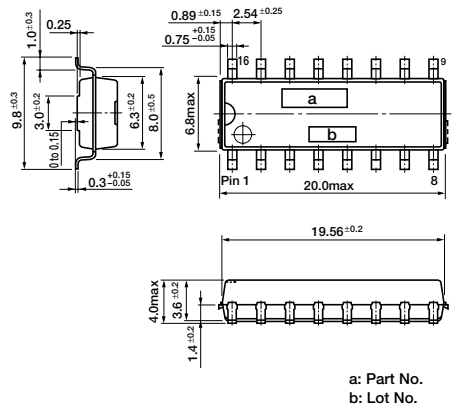
Note: * The rule of protection against reverse connection of power supply is $V_B = -13\text{V}$, one minute (all terminals except, V_B and GND, are open).

Diagnostic Function

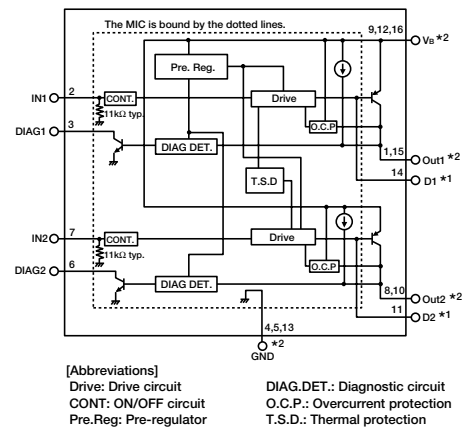


ERROR SIGNAL for CPU

External Dimensions (unit: mm) SMD-16A

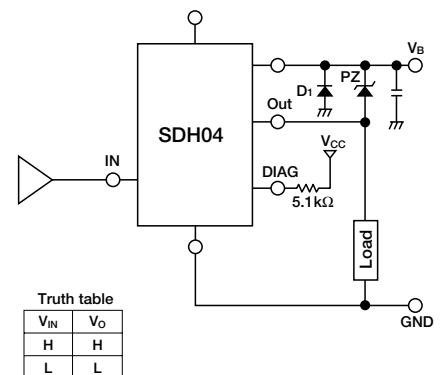


Equivalent Circuit Diagram



- *1. The base terminal (D terminal) is connected to the output transistor base. It is also connected to the control monolithic IC. Do not, therefore, apply an external voltage in operation.
 *2. SDH04 have two or three terminals of the same function (V_B , Out1, Out2, GND). The terminals of the same function must be shorted at a pattern near the product.

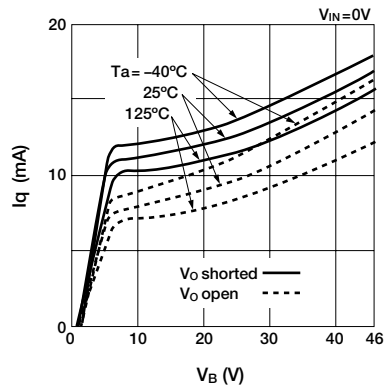
Standard Circuit Diagram



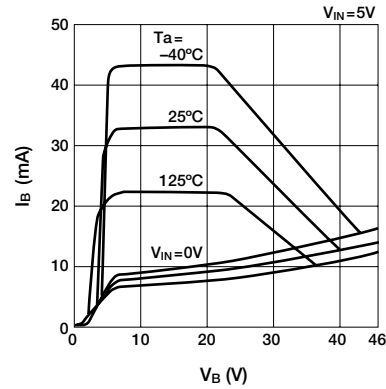
Note 1: A pull-down resistor (11 k Ω typ.) is connected to the IN terminal. V_{OUT} turns "L" when a high impedance is connected to the IN terminal in series.

Electrical Characteristics

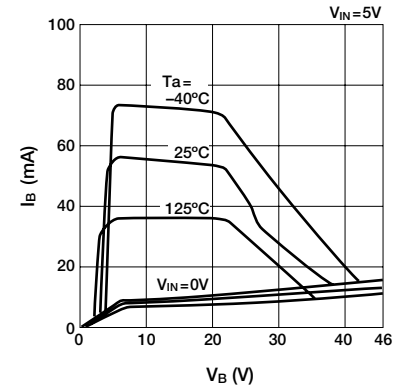
■ Quiescent Circuit Current (dual circuit)



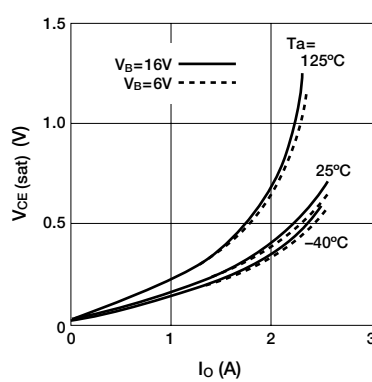
■ Circuit Current (single circuit)



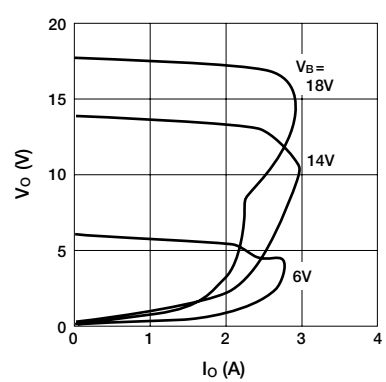
■ Circuit Current (dual circuit)



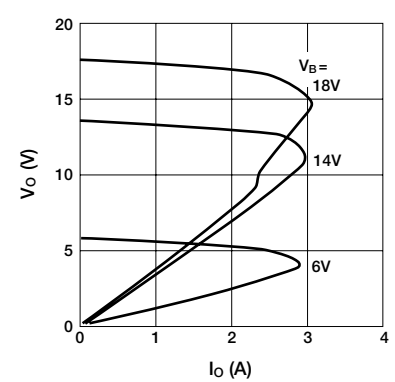
■ Saturation Voltage of Output Transistor



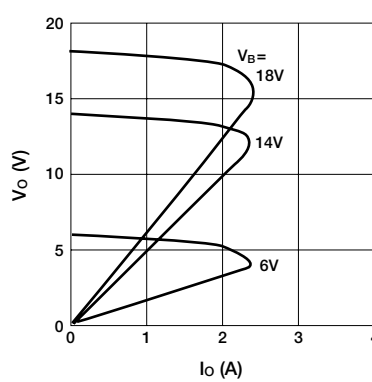
■ Overcurrent Protection Characteristics ($T_a = -40^\circ\text{C}$)



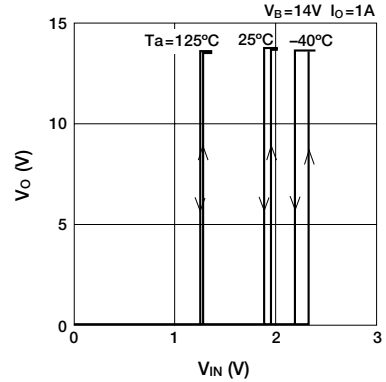
■ Overcurrent Protection Characteristics ($T_a = 25^\circ\text{C}$)



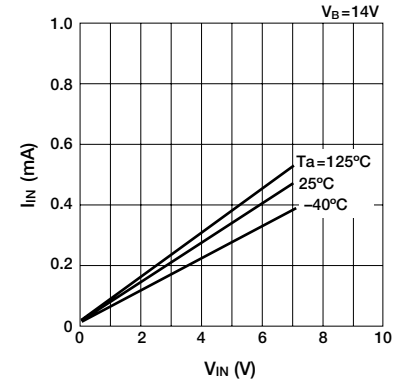
■ Overcurrent Protection Characteristics ($T_a = 125^\circ\text{C}$)



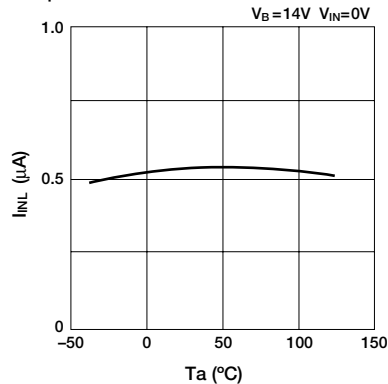
■ Threshold Characteristics of Input Voltage



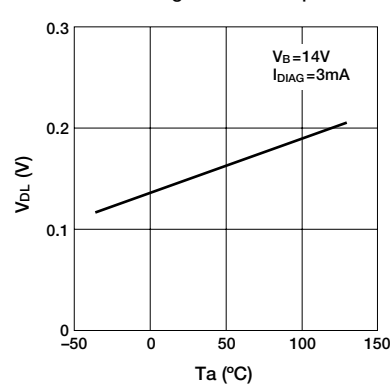
■ Input Terminal Source Current



■ Input Terminal Sink Current



■ Saturation Voltage of DIAG Output



High-side Power Switch ICs [Surface-mount 2-circuits] **SPF5003** (under development)

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- DMOS 2ch output
- Allows ON/OFF using C-MOS logic level
- Built-in overcurrent and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _B	35	V	
Input terminal voltage	V _{IN}	-0.3 to 7	V	
Input terminal current	I _{IN}	5	mA	
DG terminal voltage	V _{DG}	-0.3 to 7	V	
DG terminal current	I _{DG}	5	mA	
Drain to source voltage	V _{DS}	V _B -45	V	
Output current	I _O	1.8	A	
Power dissipation	P _D	2	W	Ta=25°C
Source to drain Di forward current	I _F	0.8	A	
Channel temperature	T _{ch}	150	°C	
Operating temperature	T _{OP}	-40 to +105	°C	
Storage temperature	T _{stg}	-40 to +150	°C	

Electrical Characteristics

(V_B=14V, Ta=25°C unless otherwise specified)

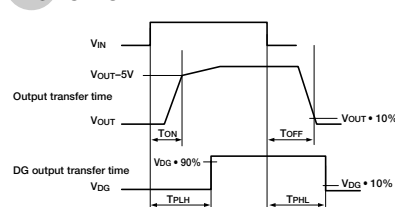
Parameter		Symbol	Ratings			Unit	Conditions
			min	typ	max		
Operating power supply voltage		V _{B (opr)}	5.5		35	V	
Quiescent circuit current		I _q			1	mA	V _{IN} =0V, V _{OUT} =0V
Output ON resistance		R _{DS (ON)}			200	mΩ	I _O =1A
					300	mΩ	I _O =1A, Ta=80°C
Output leak current		I _{O, leak}		50	100	μA	V _{OUT} =0V
Input threshold voltage	Output ON	V _{IHth}	1.4	2.0	3.0	V	Ta= −40 to +105°C
	Output OFF	V _{ILth}	1.0	1.8		V	Ta= −40 to +105°C
Inpup current	Output ON	I _{IH}		70	200	μA	V _{IN} =5V
	Output OFF	I _{IL}			12	μA	V _{IN} =0V
Overcurrent protection starting current		I _S	1.9	3		A	V _{OUT} =V _O −1.5V
Internal current limit		I _{Lim}		5		A	V _{OUT} =0V
Thermal shutdown operating temperature		T _{TS} D	155	165		°C	
Load open detection threshold voltage		V _{open}	1.5	3	4.5	V	
Output transfer time	*1	T _{ON}		70	140	μs	R _L =14Ω, V _O = −5V
		T _{OFF}		35	90	μs	R _L =14Ω, V _O •10%
DG leak current		I _{DG}			20	μA	V _{DG} =5.5V
Low level DG output voltage		V _{DGL}		0.15	0.5	V	I _{DG} =1.6mA
DG output transfer time	*1	T _{PLH}		70	140	μs	
		T _{PHL}		45	120	μs	

Note: *1. Transient time is showed Wave Form below.

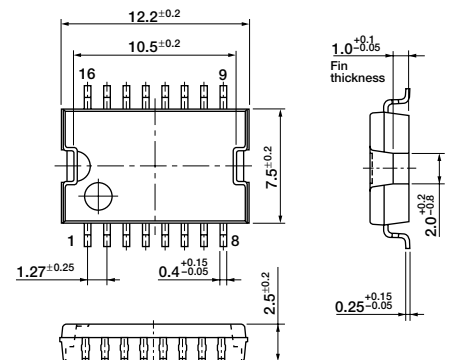
Recommended Operating Conditions (for one channel)

Parameter	Ratings		Unit
	min	max	
Power supply voltage	5.5	16	V
V _{IH}	4	5.5	V
V _{IL}	-0.3	0.9	V
I _O		1	A
R _{IN}	10	20	kΩ
R _{DG}	10	20	kΩ

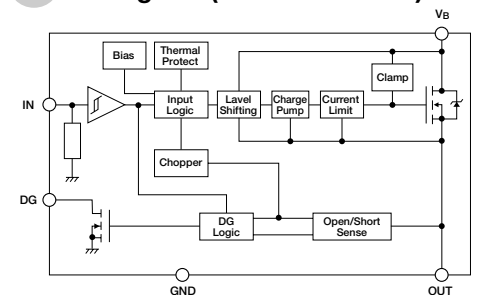
Wave Form



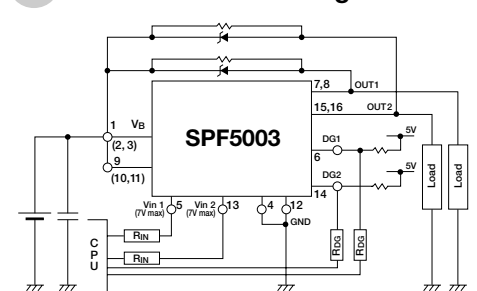
External Dimensions (unit: mm)



Block Diagram (for one channel)

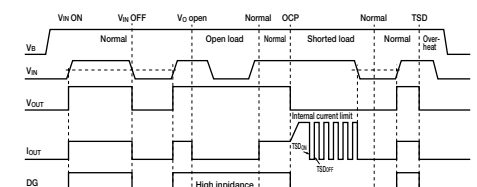


Standard Connection Diagram



* R_{IN} and R_{DG} are needed to protect CPU and SPF5003 in case of reverse connection of V_B terminal.
* Make V_B of 1Pin and 9Pin short from the fin to be plated by solder.

Timing Chart



Mode	V _{IN}	DG	V _O
Normal	H	L	H
Open load	H	H	H
Shorted load	H	L	L (Limiting)
Overheat	H	L	L

High-side Power Switch ICs [Surface-mount 2-circuits] **SPF5004** (under development)

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- DMOS 2ch output
- Allows ON/OFF using C-MOS logic level
- Built-in overcurrent and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _B	35	V	
Input terminal voltage	V _{IN}	-0.3 to 7	V	
Input terminal current	I _{IN}	5	mA	
DG terminal voltage	V _{DG}	-0.3 to 7	V	
DG terminal current	I _{DG}	5	mA	
Drain to source voltage	V _{DS}	V _B -45	V	
Output current	I _O	2.5	A	
Power dissipation	P _D	2.7	W	Ta=25°C
Source to drain Di forward current	I _F	0.8	A	
Channel temperature	T _{ch}	150	°C	
Operating temperature	T _{OP}	-40 to +105	°C	
Storage temperature	T _{stg}	-40 to +150	°C	

Electrical Characteristics

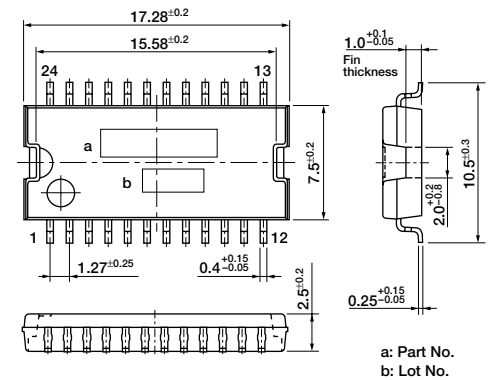
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V _{B (opr)}	5.5		35	V	
Quiescent circuit current	I _q			1	mA	V _{IN} =0V, V _{OUT} =0V
Output ON resistance	R _{DS (ON)}			150	mΩ	I _O =2A
				250	mΩ	I _O =1A, Ta=80°C
Output leak current	I _{O, leak}		50		μA	V _{OUT} =0V
Input voltage	Output ON	V _{IH}	2.0	3.0	V	Ta= -40 to +105°C
	Output OFF	V _{IL}	1.0	1.8	V	Ta= -40 to +105°C
Input current	Output ON	I _{IH}	70		μA	V _{IN} =5V
Overcurrent protection starting current	I _S	2.6			A	V _{OUT} =V _O -1.5V
Internal current limit	I _{Lim}		10		A	V _{OUT} =0V
Thermal shutdown operating temperature	T _{SD}	155	165		°C	
Load open detection threshold voltage	V _{open}		3		V	
Output transfer time	T _{ON}		165		μs	
	T _{OFF}		60		μs	
DG leak current	I _{DG}			20	μA	V _{DG} =5.5V
Low level DG output voltage	V _{DGL}		0.15		V	I _{DG} =1.6mA
DG output transfer time	T _{PLH}		70		μs	
	T _{PHL}		45		μs	

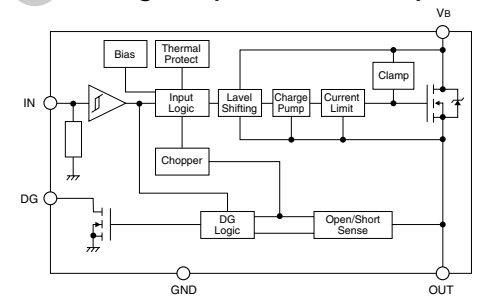
Recommended Operating Conditions (for one channel)

Parameter	Ratings		Unit
	min	max	
Power supply voltage	5.5	16	V
V _{IH}	4	5.5	V
V _{IL}	-0.3	0.9	V
I _O		1.15	A
R _{IN}	10	20	kΩ
R _{DG}	10	20	kΩ

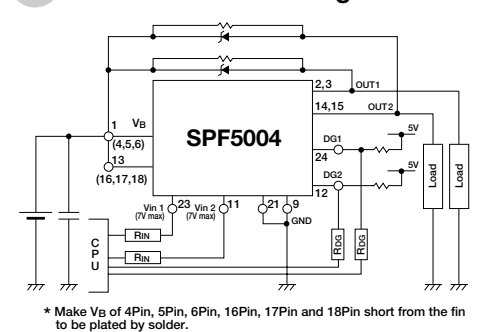
External Dimensions (unit: mm)



Block Diagram (for one channel)

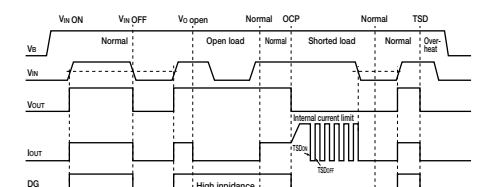


Standard Connection Diagram



* Make V_B of 4Pin, 5Pin, 6Pin, 16Pin, 17Pin and 18Pin short from the fin to be plated by solder.

Timing Chart



Mode	V _{IN}	DG	V _O
Normal	H	L	H
Open load	H	H	H
Shorted load	H	L	L (Limiting)
Overheat	H	L	L

High-side Power Switch ICs [3-circuits] SLA2501M

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use ($V_{CE(sat)} \leq 0.2V$)
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in Zener diode in transistor eliminates the need of (or simplifies) external surge absorption circuit
- Built-in independent overcurrent and thermal protection circuit in each circuit
- Built-in protection against reverse connection of power supply
- $T_j = 150^\circ C$ guaranteed

Absolute Maximum Ratings

($T_a = 25^\circ C$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Drive terminal applied voltage	V_D	-0.3 to V_B	V	
Input terminal voltage	V_{IN}	-0.3 to +7.0	V	
DIAG output applied voltage	V_{DIAG}	-0.3 to +7.0	V	
DIAG output source current	I_{DIAG}	-3	mA	
Voltage across power supply and output terminal	V_{B-O}	$V_B - 34$	V	
Voltage across power supply and drive terminal	V_{B-D}	-0.4	V	
Output current	I_O	1.5	A	
Output reverse current	I_O	-1.8	A	
Electrostatic resistance	E_S/A	± 250	V	$C = 200pF, R = 0\Omega$
Power Dissipation	P_D	4.8	W	Stand-alone without heatsink, all circuits operating
Junction temperature	T_j	-40 to +150	$^\circ C$	
Operating temperature	T_{OP}	-40 to +115	$^\circ C$	
Storage temperature	T_{stg}	-50 to +150	$^\circ C$	

Electrical Characteristics

($V_{Bopr} = 14V, T_j = -40$ to $+150^\circ C$ unless otherwise specified)

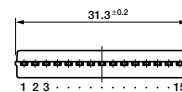
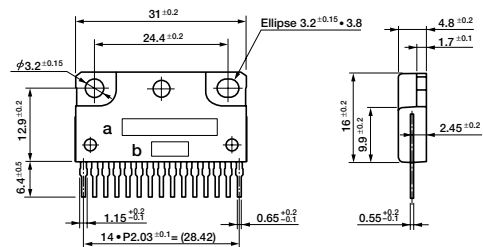
Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		16	V	
Quiescent circuit current (per circuit)	I_q		0.8	1.6	mA	I_O output
Circuit current (per circuit)	I_B		19.3		mA	$T_j = 25^\circ C$
Threshold input voltage	V_{INth}	0.8		3.0	V	
Input voltage	Hi output	V_{IN}	3.7		V	
	Lo output	V_{IN}		1.5	V	
Input current	Hi output	I_{IN}		-1.0	mA	$V_{IN} = 5V$
	Lo output	I_{IN}	100		μA	$V_{IN} = 0V$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.2	V	$I_O \leq 1.2A, V_{Bopr} = 6$ to $16V$
	$V_{CE(sat)}$		1.0		V	$I_O \leq 1.5A, V_{Bopr} = 6$ to $16V$
Output terminal sink current	$I_{O(off)}$		2.5	5	mA	$T_j = 25^\circ C, V_{CE0} = 14V$
	$I_{O(off)}$					$T_j = 25^\circ C, I_C = 10mA$
Surge clamp voltage	V_{B-O}	29	34	39	V	$T_j = 25^\circ C, I_C = 10mA$
	V_{B-O}	28	34	40	V	$I_C = 5mA$
Saturation voltage of DIAG output	V_{DL}			0.4	V	$I_{DGH} = -2mA, V_{Bopr} = 6$ to $16V$
Leak current of DIAG output	I_{DGH}			-100	μA	$V_{CC} = 7V$
Open load detection resistor	R_{open}	5.5			k Ω	
Overcurrent protection starting current	I_S	1.6			A	$V_O = V_{Bopr} - 1.5V$
Thermal protection starting temperature	T_{TSD}				$^\circ C$	$V_{Bopr} \geq 6V$
Output transfer time	T_{ON}			30	μs	$I_O = 1A$
	T_{OFF}			100	μs	$I_O = 1A$
DIAG output transfer time	T_{PLH}			30	μs	$I_O = 1A$
	T_{PHL}			100	μs	$I_O = 1A$
Minimum load inductance	L_O	1.0			mH	
Maximum ON duty	$D_{(ON)}$	0		60	%	

Note:

* The Zener diode has an energy capability of 200 mJ (single pulse).

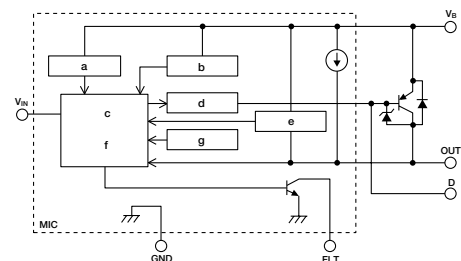
* A start failure may occur if a short OFF signal of 10 ms or below is input in the V_{IN} terminal.

External Dimensions (unit: mm)



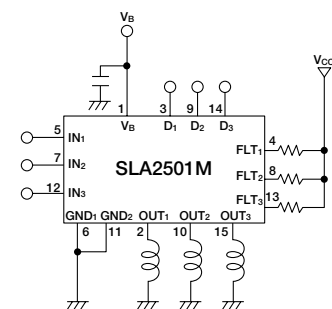
a: Part No.
b: Lot No.

Equivalent Circuit Diagram

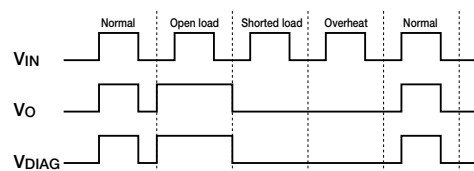


- a: Pre-regulator
b: Overvoltage protection circuit
c: Control circuit
d: Driver circuit
e: Overcurrent protection circuit
f: Diagnostic circuit
g: Thermal protection circuit

Standard Circuit Diagram

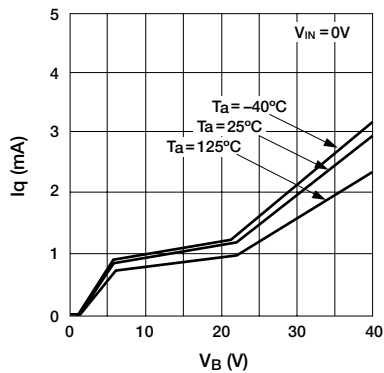


Diagnostic Function

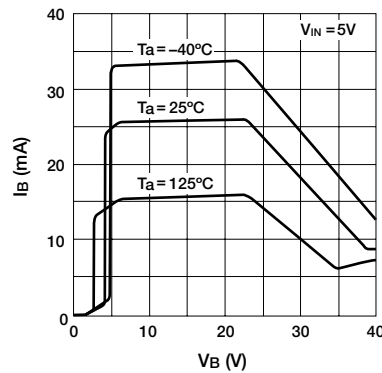


Electrical Characteristics

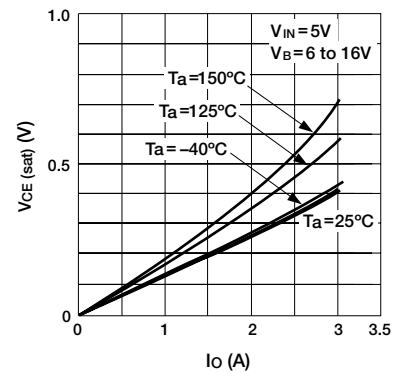
■ Quiescent Circuit Current (single circuit)



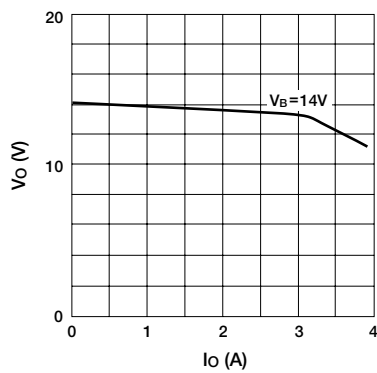
■ Circuit Current (single circuit)



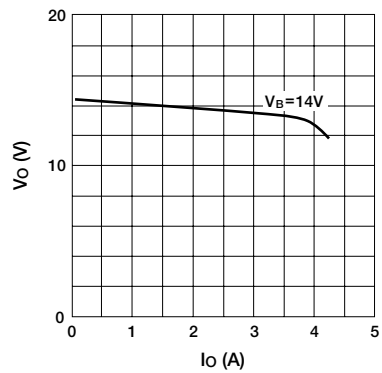
■ Saturation Voltage of Output Transistor



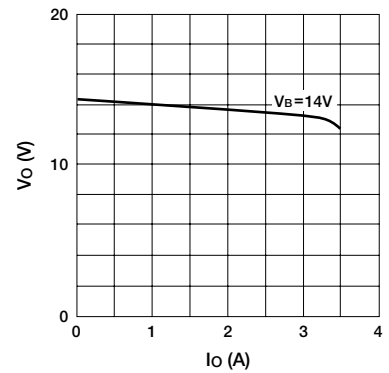
■ Overcurrent Protection Characteristics (Ta=-40°C)



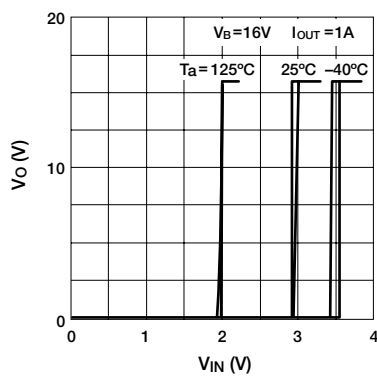
■ Overcurrent Protection Characteristics (Ta=25°C)



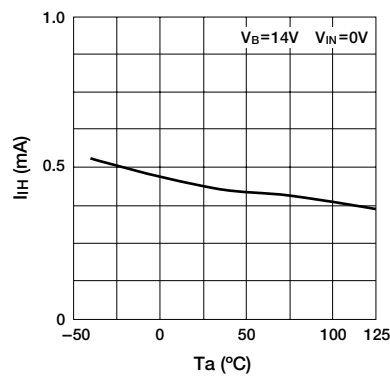
■ Overcurrent Protection Characteristics (Ta=125°C)



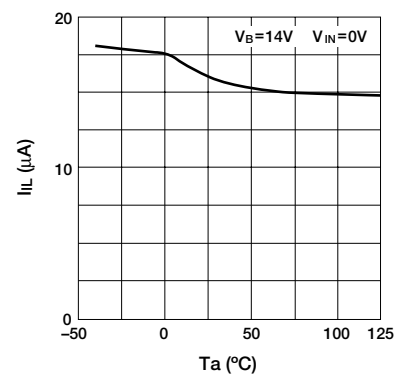
■ Threshold Input Voltage



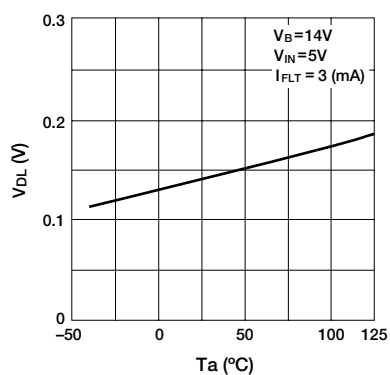
■ Input Current (Output ON)



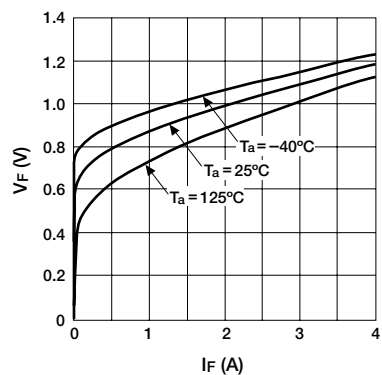
■ Input Current (Output OFF)



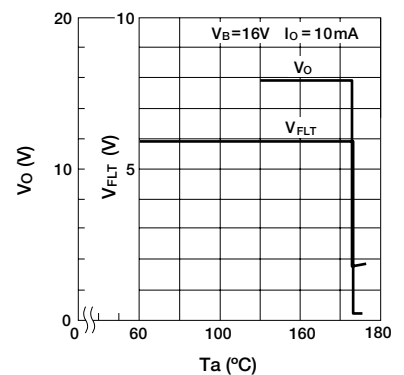
■ Saturation Voltage of DIAG Output



■ Output Reverse Current



■ Thermal Protection



High-side Power Switch ICs [Surface-mount 3-circuits] **SPF5007** (under development)

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- DMOS 3ch output
- Allows ON/OFF using C-MOS logic level
- Built-in overcurrent and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	35	V	
Input terminal voltage	V_{IN}	-0.3 to 7	V	
Input terminal current	I_{IN}	5	mA	
DG terminal voltage	V_{DG}	-0.3 to 7	V	
DG terminal current	I_{DG}	5	mA	
Drain to source voltage	V_{DS}	V_B-45	V	
Output current	I_O	1.8	A	
Power dissipation	P_D	2.7	W	$T_a=25^{\circ}\text{C}$, all circuit operating
Source to drain D_i forward current	I_F	0.8	A	
Channel temperature	T_{ch}	150	$^{\circ}\text{C}$	
Operating temperature	T_{OP}	-40 to +105	$^{\circ}\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$	

Electrical Characteristics

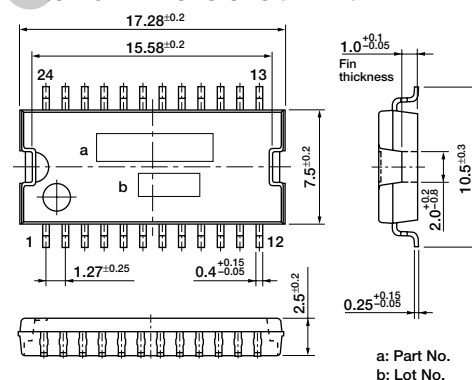
($V_B=14V$, $T_a=25^{\circ}C$ unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions	
		min	typ	max			
Operating power supply voltage	V _{B (opr)}	5.5		35	V		
Quiescent circuit current	I _q			1	mA	V _{IN} =0V, V _{OUT} =0V	
Output ON resistance	R _{DS (ON)}			200	mΩ	I _O =1A	
				350	mΩ	I _O =1A, Ta=80°C	
Output leak current	I _{o, leak}		50	100	μA	V _{OUT} =0V	
Input threshold voltage	Output ON	V _{Bth}	1.4	2.0	3.0	V	Ta= -40 to +105°C
	Output OFF	V _{ILth}	1.0	1.8		V	Ta= -40 to +105°C
Inpup current	Output ON	I _{IH}		70	200	μA	V _{IN} =5V
	Output OFF	I _{IL}			12	μA	V _{IN} =0V
Overcurrent protection starting current	I _S	1.9	3		A	V _{OUT} =V _O -1.5V	
Internal current limit	I _{Lim}		5		A	V _{OUT} =0V	
Thermal shutdown operating temperature	T _{TSD}	155	165		°C		
Load open detection threshold voltage	V _{open}	1.5	3	4.5	V		
Output transfer time	T _{ON}		70	140	μs	R _L =14Ω, V _{OUT} =V _B -5V	
	T _{OFF}		35	90	μs	R _L =14Ω, V _B •10%	
DG leak current	I _{DG}			20	μA	V _{DG} =5.5V	
Low level DG output voltage	V _{DGL}		0.15	0.5	V	I _{DG} =1.6mA	
DG output transfer time	T _{PLH}		70	140	μs		
	T _{PHL}		45	120	μs		

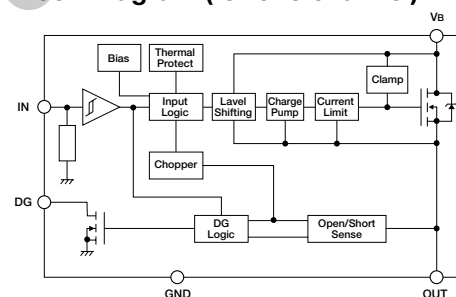
Recommended Operating Conditions (for one channel)

Parameter	Ratings		Unit
	min	max	
Power supply voltage	5.5	16	V
V_{IH}	4	5.5	V
V_{IL}	-0.3	0.9	V
I_O		1	A
R_{IN}	10	20	k Ω
R_{DG}	10	20	k Ω

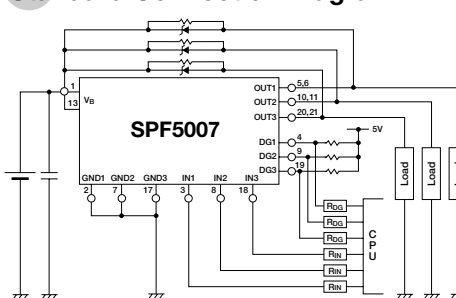
External Dimensions (unit: mm)



Block Diagram (for one channel)

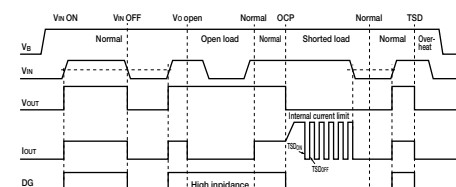


Standard Connection Diagram



* Make V_B of 1Pin and 13Pin short from the fin to be plated by solder.

Timing Chart



Mode	V _{IN}	DG	V _O
Normal	H L	H L	H L
Open load	H L	H H	H H
Shorted load	H L	L L	L (Limiting) L
Overheat	H L	L L	L L

High-side Power Switch ICs [4-circuits] SLA2502M

Features

- Built-in diagnostic function to detect short and open circuiting of loads and output status signals
- Low saturation PNP transistor use ($V_{CE(sat)} \leq 0.5V$)
- Allows direct driving using LS-TTL and C-MOS logic levels
- Built-in overcurrent protection circuits
- Built-in protection against reverse connection of power supply
- $T_J = 150^\circ C$ guaranteed

Absolute Maximum Ratings

($T_a = 25^\circ C$)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	-13 to +40	V	
Input terminal voltage	V_{IN}	-0.3 to +7.0	V	
DIAG output applied voltage	V_{DIAG}	-0.3 to +7.0	V	
DIAG output source current	I_{DIAG}	3	mA	
Output current	I_O	1.2	A	
Power Dissipation	P_D	4.8	W	Stand-alone operation without heatsink; all circuits operating
Junction temperature	T_J	-40 to +150	$^\circ C$	
Operating temperature	T_{OP}	-40 to +100	$^\circ C$	
Storage temperature	T_{stg}	-50 to +150	$^\circ C$	

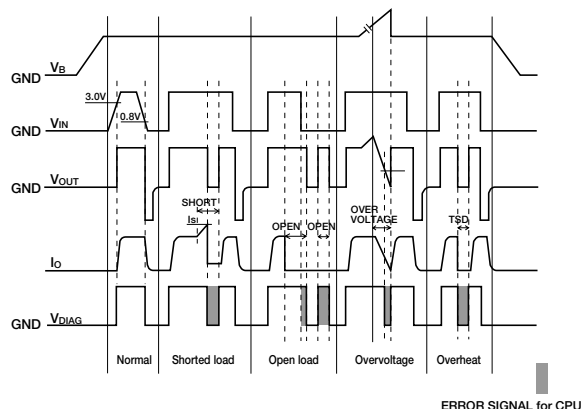
Electrical Characteristics

($V_{Bopr} = 14V$, $T_a = 25^\circ C$ unless otherwise specified)

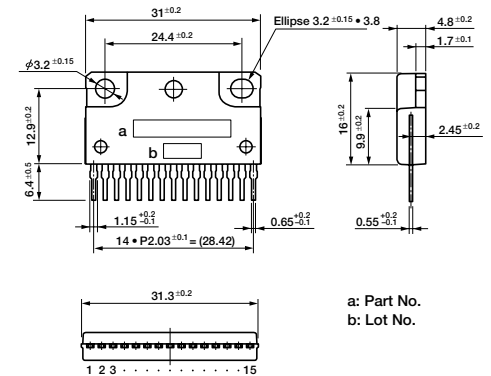
Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Operating power supply voltage	V_{Bopr}	6.0		16	V	
Quiescent circuit current (per circuit)	I_q		5	12	mA	$V_{IN} = 0V$
Threshold input voltage	V_{INth}	0.8		3.0	V	
Input current	Hi output	I_{IN}		1.0	mA	$V_{IN} = 5V$
	Lo output	I_{IN}	0	100	μA	$V_{IN} = 0V$
Saturation voltage of output transistor	$V_{CE(sat)}$			0.5	V	$I_O \leq 1.0A$, $V_{Bopr} = 6$ to $16V$
Output terminal sink current	$I_{O(off)}$			2.0	mA	$V_O = 0V$, $V_{IN} = 0V$
Saturation voltage of DIAG output	V_{DL}			0.3	V	$I_{DIAG} = 3mA$
Leak current of DIAG output	I_{DGH}			100	μA	$V_{DIAG} = 5V$
Open load detection resistor	R_{open}			30	k Ω	
Overcurrent protection starting current	I_S	1.6			A	$V_O = V_{Bopr} - 1.9V$
Output transfer time	T_{ON}		8	30	μs	$I_O = 1A$
	T_{OFF}		15	30	μs	$I_O = 1A$
DIAG output transfer time	T_{PLH}		10	30	μs	$I_O = 1A$
	T_{PHL}		15	30	μs	$I_O = 1A$

Note: * The rule of protection against reverse connection of power supply is $V_B = -13V$, one minute (all terminals except V_B and GND should be open).

Diagnostic Function

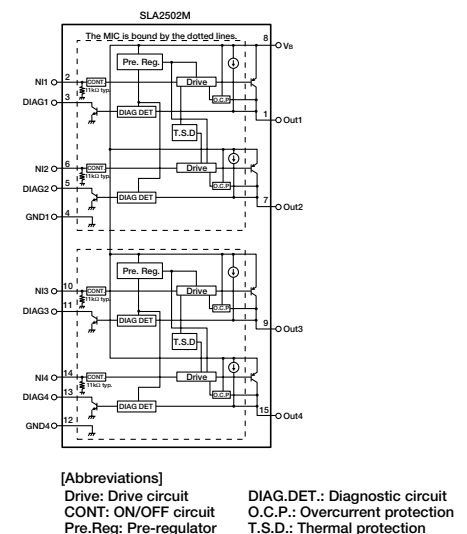


External Dimensions (unit: mm)

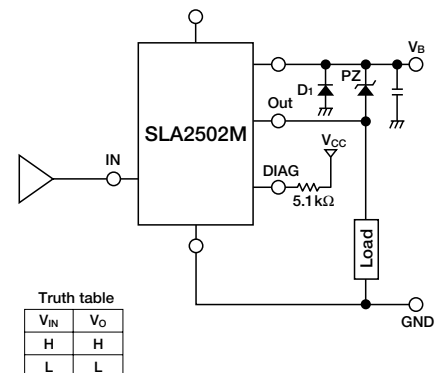


a: Part No.
b: Lot No.

Equivalent Circuit Diagram



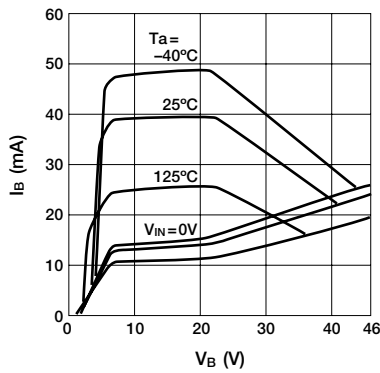
Standard Circuit Diagram



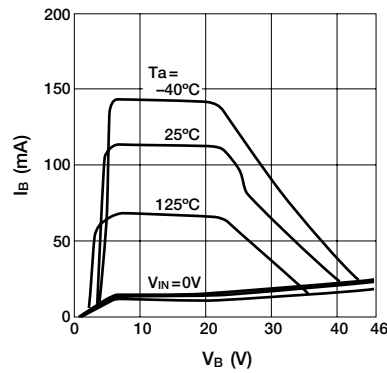
- Note 1: A pull-down resistor (11k Ω typ.) is connected to the IN terminal. V_{OUT} turns "L" when a high impedance is connected to the IN terminal in series.
- Note 2: Grounds GND1 and GND2 are not wired internally. They must be shorted at a pattern near the product.

Electrical Characteristics

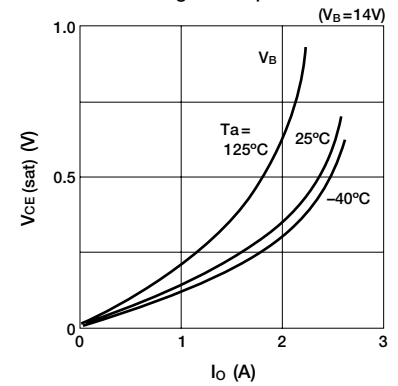
■ Circuit Current (single circuit)



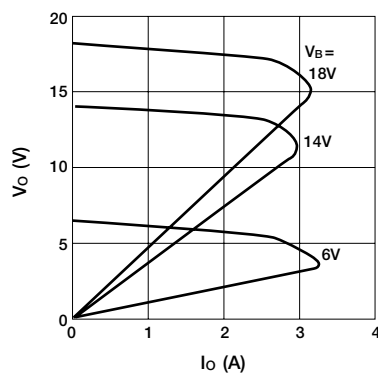
■ Circuit Current (4 circuits)



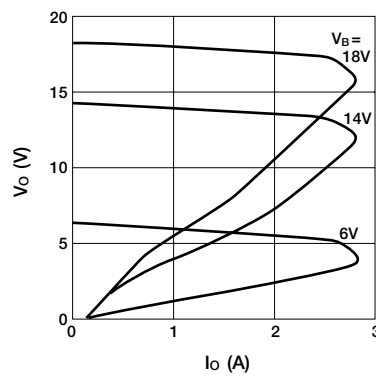
■ Saturation Voltage of Output Transistor



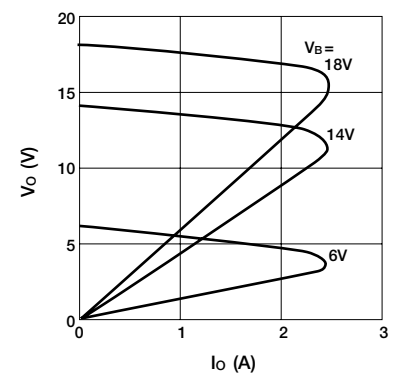
■ Overcurrent Protection Characteristics (Ta=-40°C)



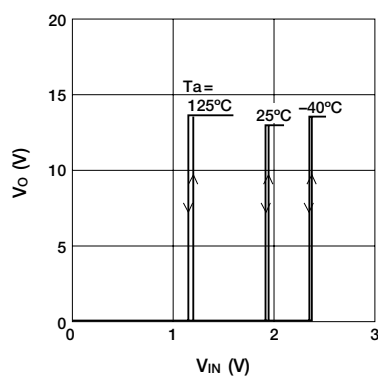
■ Overcurrent Protection Characteristics (Ta=25°C)



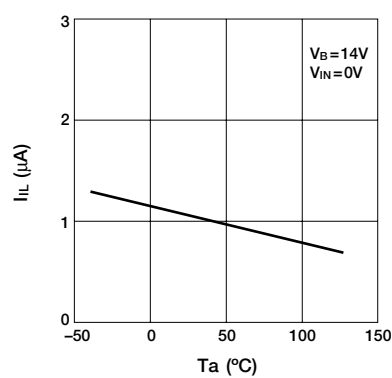
■ Overcurrent Protection Characteristics (Ta=125°C)



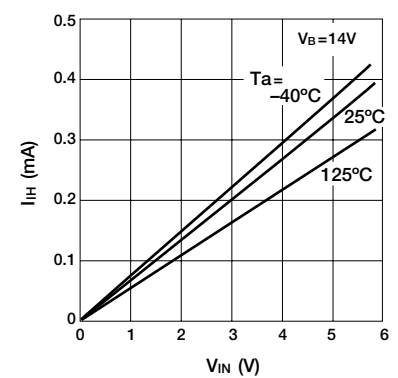
■ Threshold Input Voltage



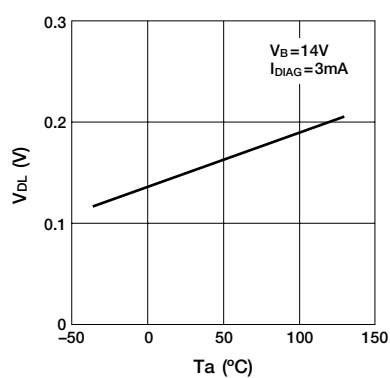
■ Input Current (Output OFF)



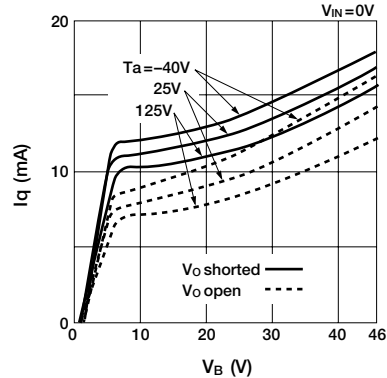
■ Input Current (Output Hi)



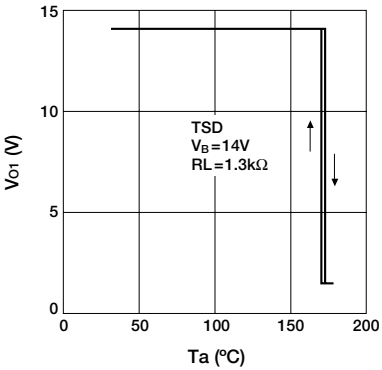
■ Saturation Voltage of DIAG Output



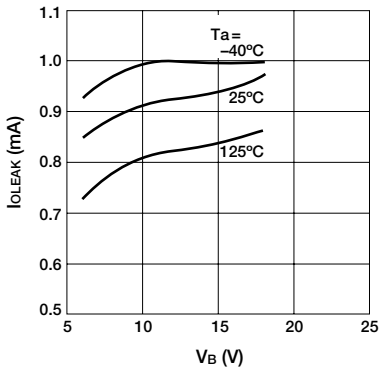
■ Quiescent Circuit Current (dual circuit)



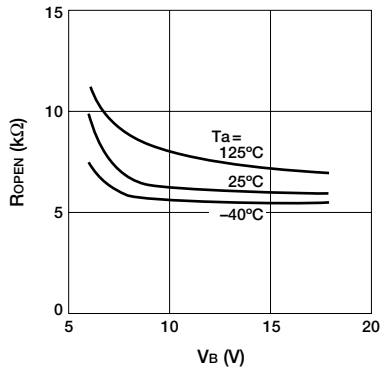
■ Thermal Protection Characteristics



■ Output Terminal Leak Current ($V_O=0V$)



■ Open Load Detection Resistor



Low-side Switch ICs [Surface-mount 4-circuits] **SPF5002A**

Features

- DMOS 4ch output
- Allows ON/OFF using C-MOS logic level
- Built-in overcurrent, overvoltage and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

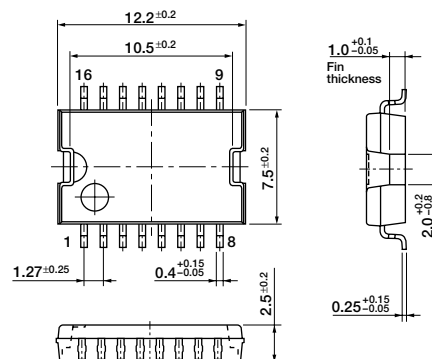
Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _B	40	V	
Output terminal voltage	V _{OUT}	37	V	
Input terminal voltage	V _{IN}	-0.5 to +7.5	V	
Output current	I _O	1.8	A	
Power Dissipation	P _D	2	W	
Storage temperature	T _{stg}	-40 to +150	°C	
Channel temperature	T _{ch}	150	°C	
Output avalanche capability	E _{AV}	50	mJ	Single pulse

Electrical Characteristics

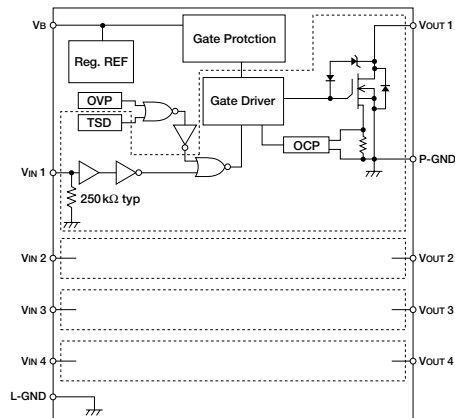
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Power supply voltage	V _{Bop}	5.5		25	V	
Quiescent circuit current	I _q		5	7	mA	V _{IN} =0V (all inputs)
Operating circuit current	I _{cc}		8	12	mA	V _{IN} =5V (all inputs)
Input voltage	Hi output V _{IN}	3.5		5.5	V	I _O =1A
	Lo output V _{IN}	-0.5		1.5	V	
Input current	Hi output I _{IN}			50	μA	V _{IN} =5V
	Lo output I _{IN}			30	μA	V _{IN} =0V
Output ON resistance	R _{DS(ON)}		0.4	0.6	Ω	
			0.5	0.7	Ω	V _B =5.5V
Output clamp voltage	V _{OUT(clamp)}	41	50	55	V	I _O =1A
Output leak current	I _{OH}			10	μA	V _O =37V
Forward voltage of output stage diode	V _F			1.6	V	I _F =0.5A
Overvoltage protection starting voltage	V _{B(ovp)}	25		40	V	
Thermal protection starting temperature	T _{TSD}	151	165		°C	
Overcurrent protection starting current	I _S	1.1			A	
Output transfer time	T _{ON}			12	μs	R _L =14Ω, I _O =1A
	T _{OFF}			8	μs	R _L =14Ω, I _O =1A
Output rise time	T _r			5	μs	R _L =14Ω, I _O =1A
Output fall time	T _f			10	μs	R _L =14Ω, I _O =1A

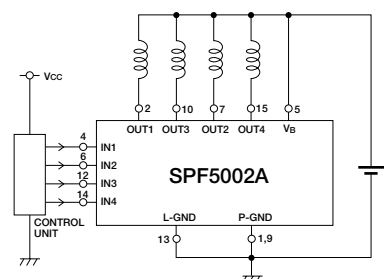
External Dimensions (unit: mm)



Equivalent Circuit Diagram



Circuit Example

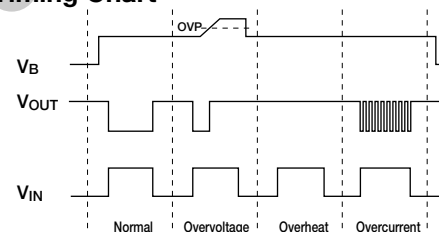


Truth table

V _{IN}	V _O
H	L
L	H

Use L-GND and P-GND being connected.

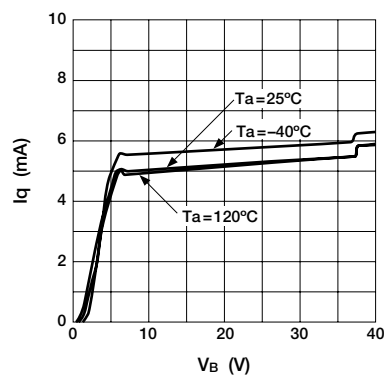
Timing Chart



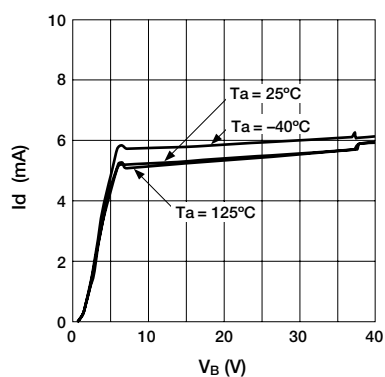
* Self-excited frequency is used in the overcurrent protection.

Electrical Characteristics

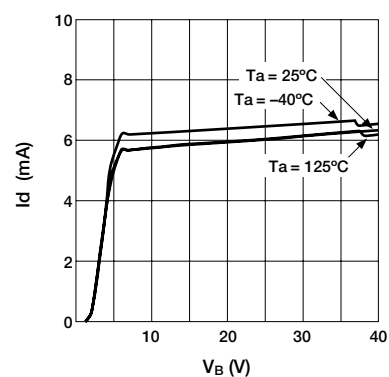
■ Quiescent Circuit Current



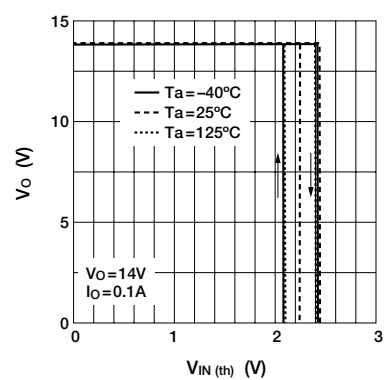
■ Circuit Current (single circuit)



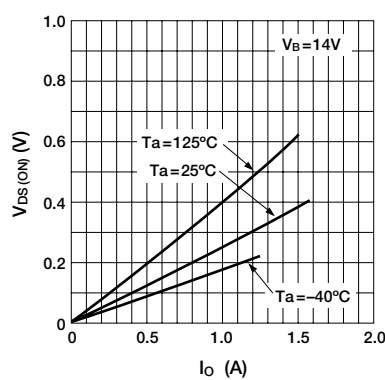
■ Circuit Current (4 circuits)



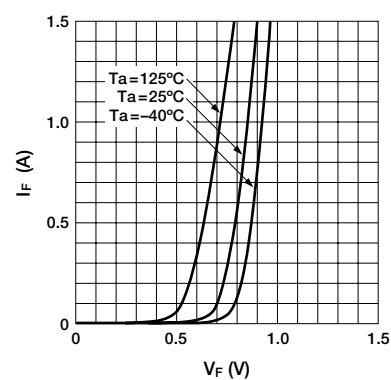
■ Threshold Input Voltage



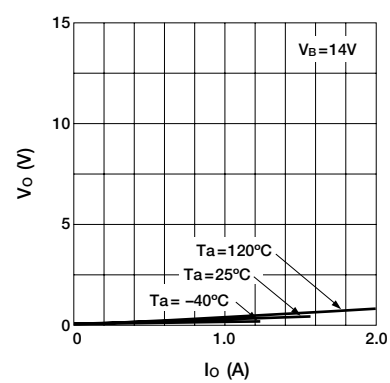
■ Output ON Voltage



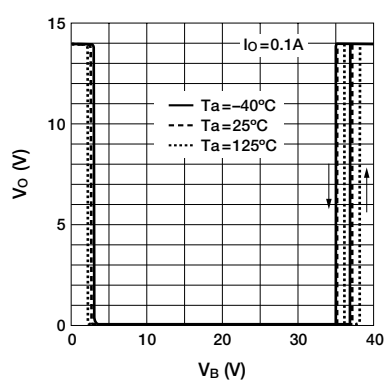
■ Forward Voltage of Output Stage Diode



■ Overcurrent Protection Characteristics



■ Overvoltage Protection Starting Voltage



Features

- DMOS 4ch output
- Allows ON/OFF using C-MOS logic level
- Built-in over current and thermal protection circuit and diagnostic function to detect open load
- Built-in output status signals (over current, over heat and open load)

Absolute Maximum Ratings

(Ta=25°C)

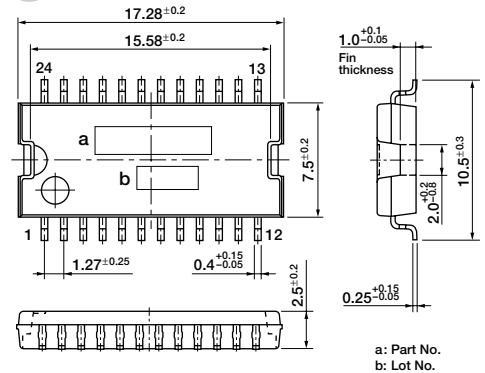
Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _B	40	V	
Output terminal voltage (DC)	V _{OUT}	50	V	
Output terminal voltage (pulse)	V _{OUT}	Output clamping (max 70V)	V	
Output current (DC)	I _{OUT}	±2.9	A	
Output current (pulse)	I _{OUT}	Over current protection starting current	A	
Input terminal voltage	V _{IN(SEL, B/U)}	-0.5 to +6.5	V	
Diag output source current	V _{DIAG}	6.5	V	
Diag output voltage	I _{DIAG}	5	mA	
Power Dissipation	P _D	2.8	W	
Storage temperature	T _{stg}	-40 to +150	°C	
Channel temperature	T _{ch}	150	°C	
Output avalanche capability	E _{AV}	80	mJ	Single pulse

Electrical Characteristics

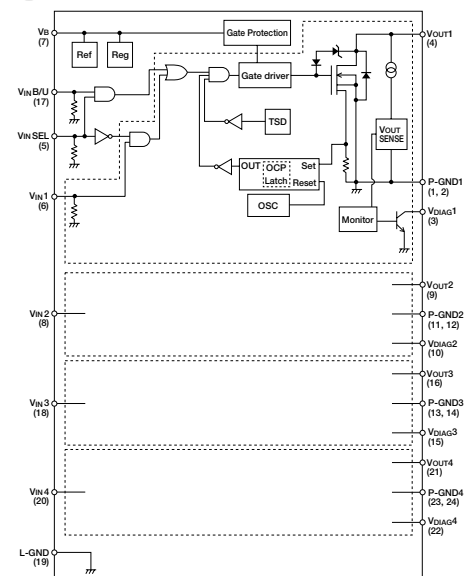
(V_B = 14V, Ta = 25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Power supply voltage	V _{B (opr)}	5.5		40	V	
Quiescent circuit current	I _q		9	12	mA	V _B =14V, V _{IN} =0V
Operating circuit current	I _d		12	15	mA	V _B =14V, V _{IN} =5V (all inputs)
Input voltage (1 to 4, SEL, B/U)	V _{IN (H)}	3.5		6.5	V	V _B =14V, V _O =1A
	V _{IN (L)}	-0.5		1.5	V	V _B =14V
Input current (single circuit) (1 to 4, SEL, B/U)	I _{IN (H)}			200	μA	V _B =14V, V _{IN} =5V
	I _{IN (L)}			30	μA	V _B =14V, V _{IN} =0V
Output ON resistance	R _{DS (ON)}			0.18	Ω	V _B =14V, I _O =1A
Output clamp voltage	V _{OUT (clamp)}	60	65	70	V	V _B =14V, I _O =1A
Output leak current	I _{OH}			50	μA	V _B =14V, V _O =50V
Forward voltage of output stage diode	V _F			1.5	V	I _F =1A
Output monitor threshold voltage	V _{thM}			2	V	V _B =14V
DIAG output voltage	V _{DIAG (H)}	6.4		6.5	V	V _B =14V, V _{DIAG} =6.5V
	V _{DIAG (L)}			0.5	V	V _B =14V, I _{DIAG} =5mA
DIAG output leak current	I _{OH}			10	μA	V _B =14V, V _{DIAG} =6.5V
Thermal shutdown operating temperature	T _{TSD}	151	165		°C	V _B =14V
Overcurrent protection starting current	I _S	3.0			A	V _B =14V
Output transfer time	T _{ON}			12	μs	V _B =14V, R _L =14Ω, I _O =1A
	T _{OFF}			8	μs	V _B =14V, R _L =14Ω, I _O =1A
Output rise time	T _r			5	μs	V _B =14V, R _L =14Ω, I _O =1A
Output fall time	T _f			10	μs	V _B =14V, R _L =14Ω, I _O =1A
DIAG output transfer time	t _{DON}			12	μs	V _B =14V, R _L =14Ω, I _O =1A
	t _{DOFF}			8	μs	V _B =14V, R _L =14Ω, I _O =1A

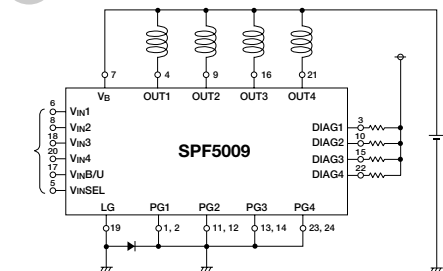
External Dimensions (unit: mm)



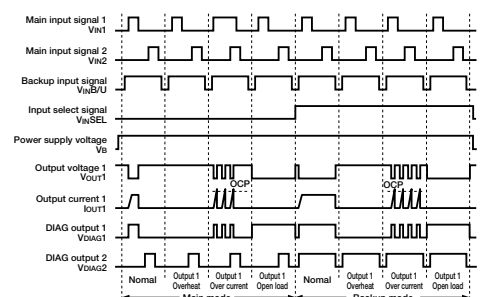
Equivalent Circuit Diagram



Circuit Example



Timing Chart



Low-side Switch ICs [Surface-mount 4-circuits with Output Monitor] **SPF5012** (under development)

Features

- Output monitor circuit (DIAG)
- DMOS 4ch output
- Allows ON/OFF using C-MOS logic level
- Built-in overcurrent, overvoltage and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
DC input voltage	V _B	40	V	
	V _{CC}	7.5	V	
Output voltage	V _O	40 (DC)	V	*1
Logic input voltage	V _{IN}	-0.5 to +7.5	V	
Output current	I _O	Self Limited	A	
Diag output voltage	V _{DIAG}	0 to V _{CC}	V	
Power Dissipation	P _D	2.8 to 5	W	*2
Storage temperature	T _{stg}	-40 to +150	°C	
Channel temperature	T _{ch}	150	°C	
Output avalanche capability	E _{AV}	100	mJ	Single pulse

*1. At the clamping operation, refer to the section of V_{OUT (clamp)} in electrical characteristics

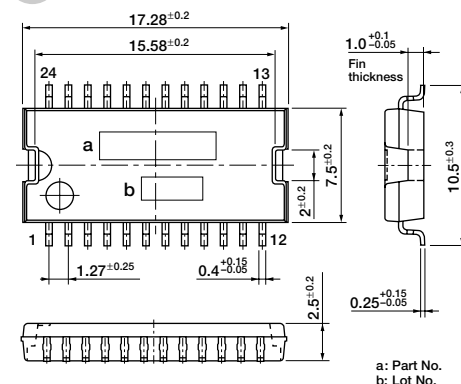
*2. Changes by the pattern of mounted substrate

Electrical Characteristics

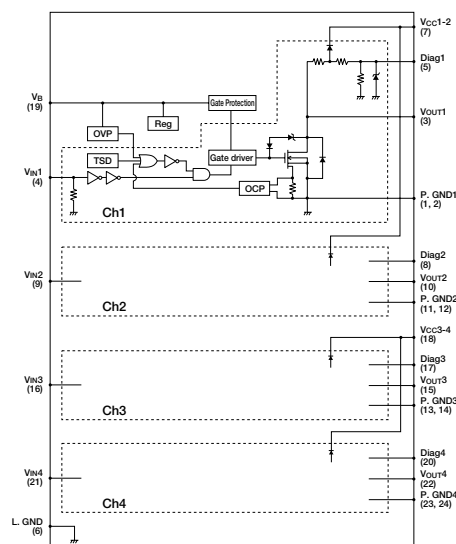
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Power supply voltage	V _{B (opr)}	5.5		40	V	
	V _{CC (opr)}	4.5		5.5	V	
Quiescent circuit current	I _q		4	6	mA	V _B =14V, V _{IN} =0V
Operating circuit current	I _d		8	12	mA	V _B =14V, V _{IN} =5V
Input voltage	Hi output	V _{IN}	3.5	5.5	V	V _B =14V, V _O =1A
	Lo output	V _{IN}	-0.5	1.5	V	V _B =14V
Input current	Hi output	I _{IN}		50	μA	V _B =14V, V _{IN} =5V
	Lo output	I _{IN}		-30	μA	V _B =14V, I _O =1A
Output ON resistance	R _{DS (ON)}			0.3	Ω	V _B =14V, I _O =1A, Ta=125°C
				0.2	Ω	V _B =14V, I _O =1A, Ta=25°C
Output clamp voltage	V _{OUT (clamp)}	45	50	55	V	V _B =14V, I _O =1A
Output leak current	I _{OH}			2.8	mA	V _B =14V, V _{CC} =5V, V _{IN} =0V, V _O =40V, Ta=25°C
				900	μA	V _B =14V, V _{CC} =5V, V _{IN} =0V, V _O =14V, Ta=25°C
Forward voltage of output stage diode	V _F			1.6	V	I _F =1A
Overvoltage protection starting voltage	V _{B (ovp)}	25		40	V	
Overvoltage protection hysteresis voltage	V _{B (ovp+hys)}		8		V	
Thermal shutdown operating temperature	T _{SD}	151	165		°C	V _B =14V
Overcurrent protection operating current	I _S	6			A	V _B =14V, Ta=-40°C
		6			A	V _B =14V, Ta=25°C
		5			A	V _B =14V, Ta=125°C
Output transfer time	T _{ON}			12	μs	V _B =14V, R _L =14Ω, I _O =1A
	T _{OFF}			8	μs	
Output rise time	T _r			5	μs	
Output fall time	T _f			10	μs	
Output-diag voltage ratio	r _a (DIAG)	0.195	0.2	0.205		V _B =14V, V _O =1 to 14V, R _{diag} =500kΩ
Diag output clamping voltage	V _{DIAG (clamp)}			4.85	V	V _B =14V, V _{CC} =5V, V _O =40V

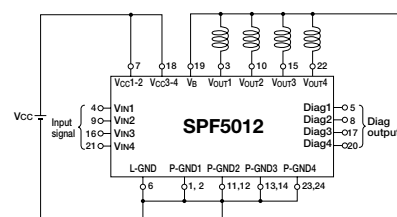
External Dimensions (unit: mm)



Equivalent Circuit Diagram



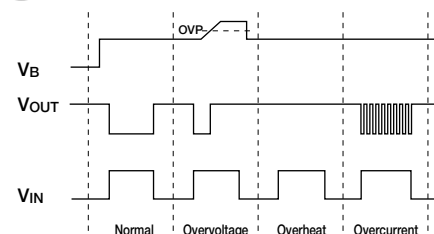
Circuit Example



Truth table

V _{IN}	V _O
H	L
L	H

Timing Chart



* Self-excited frequency is used in the overcurrent protection.

Stepper-motor Driver ICs SLA4708M

Features

- High output breakdown voltage of 50V
- Affluent output current of 1.5A
- Built-in overcurrent, overvoltage and thermal protection circuits
- Low standby current of 50μA

Absolute Maximum Ratings

(Ta=25°C)

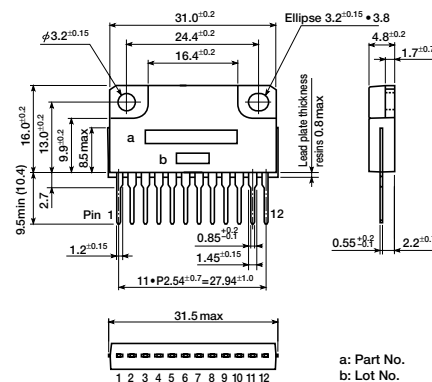
Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V _S	35	V	
Breakdown voltage	V _O	50	V	
Input voltage	V _{IN}	-0.3 to +7	V	
Output current	I _{O,AVE}	1.5	A	
Diagnostic output sink current	I _{DIAG}	10	mA	
Diagnostic output withstand voltage	I _{DIAG, H}	7	V	
Operating temperature	T _{OP}	-40 to +85	°C	
Storage temperature	T _{STG}	-40 to +150	°C	
Power Dissipation	P _D	3.5 (Ta=25°C)	W	Without heatsink

Electrical Characteristics

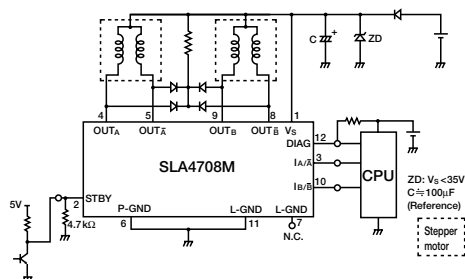
(V_S=12V, Ta=25°C)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input voltage (I _A /I _B standby)	V _{IL}			0.8	V	
	V _{IH}	2.4			V	
Input current	I _{IL}			-0.8	mA	V _{IN} =0.4V
	I _{IH}			50	μA	V _{IN} =2.4V
Output saturation voltage	V _{O,STA}			1.3	V	I _O =1A, Ta=25°C
	V _{O,STA}			1.5	V	I _O =1.5A, Ta=25°C
Output leak current	I _{O,LEAK}			100	μA	V _O =16V
Overcurrent detection	I _{SD}	1.8			A	
Overvoltage detection	V _{SD}	27.5			V	
Saturation voltage of diagnostic output	V _{DIAG,L}			0.3	V	I _{DIAG} =5mA
Standby current	I _{STB}		50		μA	V _S =12V

External Dimensions (unit: mm)

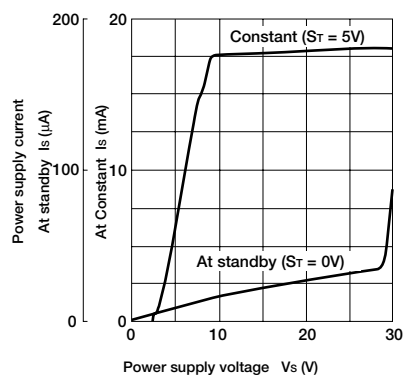


Standard Circuit Diagram

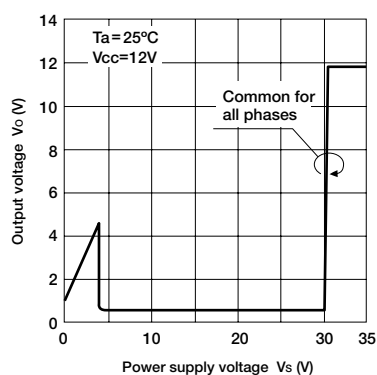


Electrical Characteristics

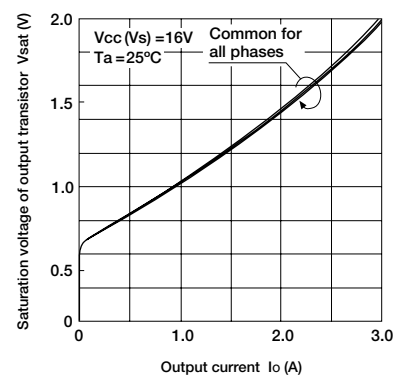
Power Supply Current Characteristics



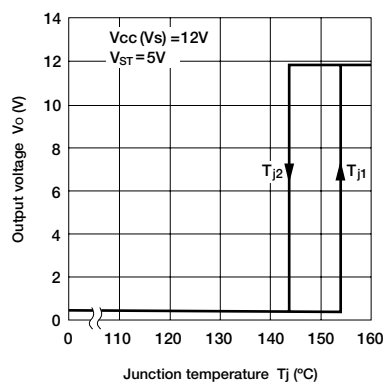
Overvoltage Protection Characteristics



Saturation Voltage of Output Transistor Characteristics



Thermal Protection Characteristics



Full Bridge PWM Control DC Motor Driver IC SI-5300

Features

- P-ch MOS for high side and N-ch MOS for low side in one package
- Enable to drive DC±5V
- Possible to drive a motor at the LS-TTL, C-MOS Logic level
- Guarantee $T_J=T_{CH}=150^{\circ}\text{C}$
- Built-in over current protection and thermal shut down circuits
- Built-in diagnosis function to monitor and signal the state of each protection circuits
- Built-in vertical current prevention circuits (Dead time is defined internally.)
- No insulator required for Sanken's original package (SPM package)

Absolute Maximum Ratings

($T_a=25^{\circ}\text{C}$)

Parameter	Symbol	Ratings	Unit	Conditions
Motor supply voltage	V_M	40	V	
Input terminal voltage	IN1	-0.3 to 7	V	
	IN2	-0.3 to 7	V	
	PWM	-0.3 to 7	V	
Output current	I_O	±5	A	
	I_O (p-p)	±17	A	$P_W \leq 1\text{ms}$, Duty $\leq 50\%$
PWM control frequency	f_{PWM}	20	kHz	Duty=20% to 80%
Forward * reverse rotation switch frequency*	f_{CW}	500	Hz	
Operating temperature	T_{OP}	-40 to +85	$^{\circ}\text{C}$	
Junction and channel temperature	T_J, T_{CH}	-40 to +150	$^{\circ}\text{C}$	
Storage temperature	T_{STG}	-40 to +150	$^{\circ}\text{C}$	
Thermal resistance	θ_{J-C}	3.7	$^{\circ}\text{C/W}$	
	θ_{J-A}	35	$^{\circ}\text{C/W}$	
Power dissipation	P_{D1}	3.6	W	Without heatsink
	P_{D2}	33.7	W	With infinite heatsink

Note: * The dead time for the length current prevention in positive and the reversing switch is set by internal control IC. The set point in internal IC at the dead time is 20μs (typical). Please take into account the dead time and consider the load conditions when you use the IC.

Electrical Characteristics

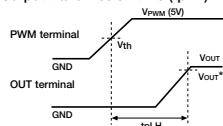
(Unless, otherwise specified, $T_J=T_{CH}=25^{\circ}\text{C}$, $V_M=14\text{V}$, $I_O=3\text{A}$)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Motor supply voltage	V_{IN}	6		18	V	$V_M=24\text{V}$ (2 min.)
Output saturation voltage	V_{I, V_M-V_O}			0.8	V	$I_O=3\text{A}$
	V_{I, V_O-PG}			0.3	V	$I_O=3\text{A}$
Output leakage current	$I_{L, L}$			100	μA	$V_M=40\text{V}$
	$I_{L, H}$			100	μA	$V_M=40\text{V}$
Output transmission time	tpLH			10 *2	μs	$V_{PWM}: L \rightarrow H$ ($V_{th}=2.5\text{V typ}$)
	tpHL			15 *3	μs	$V_{PWM}: H \rightarrow L$ ($V_{th}=2.5\text{V typ}$)
	tpHL-tpLH			10	μs	
Forward voltage characteristic of diode between drain and source	$V_F \cdot L$		0.8		V	$I_O=3\text{A}$
			1.0		V	$I_O=10\text{A}$
	$V_F \cdot H$		0.8		V	$I_O=3\text{A}$
			1.0		V	$I_O=10\text{A}$
Static circuit current	IM1		22		mA	Stop mode
	IM2		22		mA	Forward and reverse mode
	IM3		16		mA	Brake mode
Input terminal voltage	$V_{IN, H}$	3.0			V	$V_{IN1}=V_{IN2}=V_{PWM}$
	$V_{IN, L}$			2.0	V	$V_{IN1}=V_{IN2}=V_{PWM}$
Input terminal current	$I_{IN, L}$	-100			μA	$V_{IN1}=V_{IN2}=V_{PWM}=0\text{V}$
	$I_{IN, H}$			200	μA	$V_{IN1}=V_{IN2}=V_{PWM}=5\text{V}$
OPC start current	I_{OCP}	16			A	*1
DIAG output pulse width	t_{DIAG}	20			ms	$C=1\mu\text{F}$ (typ)
DIAG terminal voltage	$V_{O \cdot L}$			0.3	V	$I_D \cdot \text{SINK}=1\text{mA}$ *4

Note:

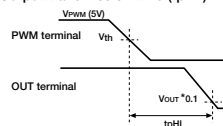
*1: The standard value of I_{OCP} is assumed to be a value by which the output of each Power MOS FET cuts off. When the protection circuit of OCP and TSD operates, Power MOS FETs keeps cutoff. When a signal (5V: H → 0V: L) is input to the terminal PWM, the cutoff operation will be released. Moreover, three minutes ($T_a=25^{\circ}\text{C}$, $f_{PWM}=10\text{kHz}$, $V_M=14\text{V}$) are assumed to be max at the overcurrent state continuance time in the V_M operation and the ground of output terminal (OUT1, OUT2). It is not the one to assure the operation including reliability in the state that the short-circuit continues for a long time.

*2: Output transmission time (tpLH)



Output transmission time tpLH is time from V_{th} (2.5V typ) of the terminal of PWM to output ($V_{OUT} \cdot 0.9$) of the output terminal.

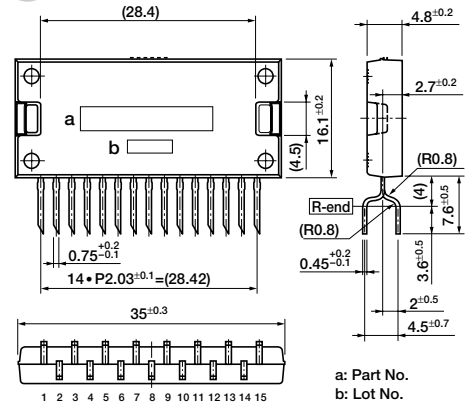
*3: Output transmission time (tpHL)



Output transmission time tpHL is time from V_{th} (2.5V typ) of the terminal of PWM to output ($V_{OUT} \cdot 0.1$) of the output terminal.

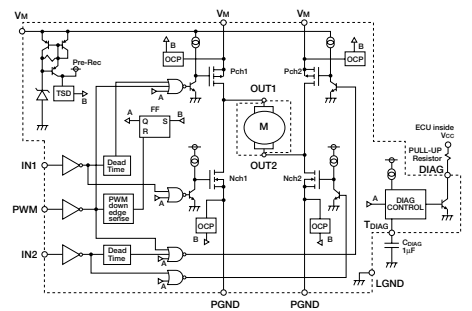
*4: DIAG signal output terminal is an open collector output. Use a pull-up resistor when connecting it to a logic circuit.

External Dimensions (unit: mm)

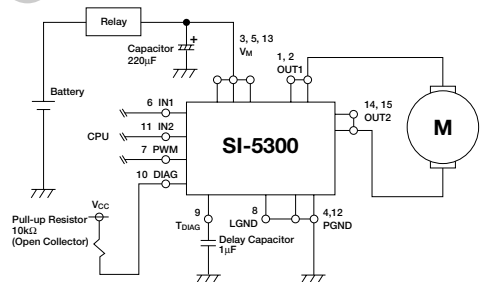


a: Part No.
b: Lot No.

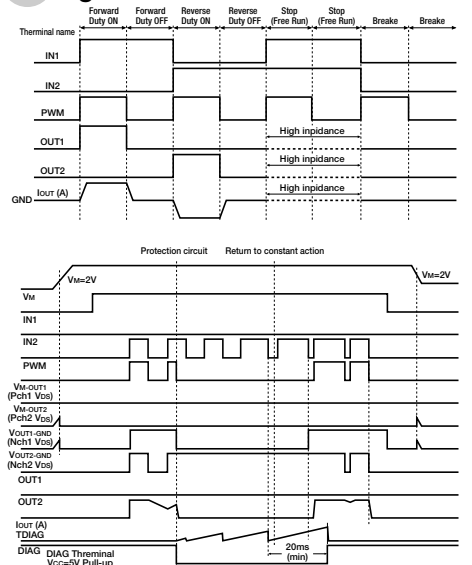
Equivalent Circuit



Standard Connection Diagram

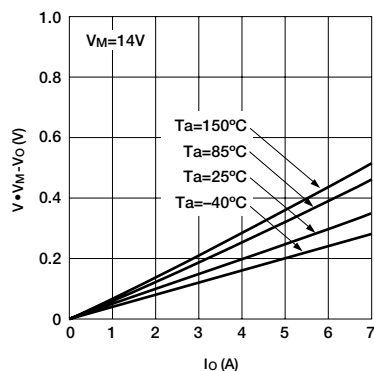


Timing Chart

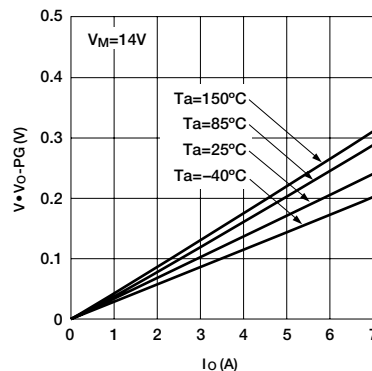


Electrical Characteristics

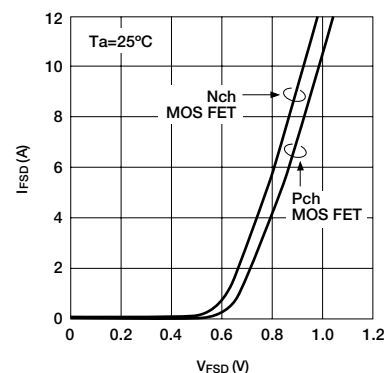
■ Output saturation voltage (Pch)



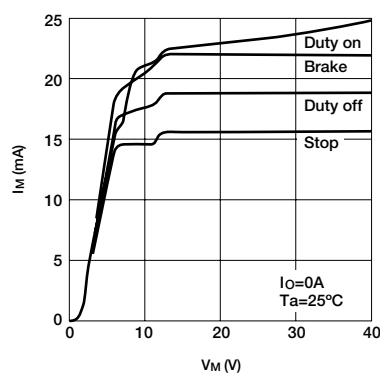
■ Output saturation voltage (Nch)



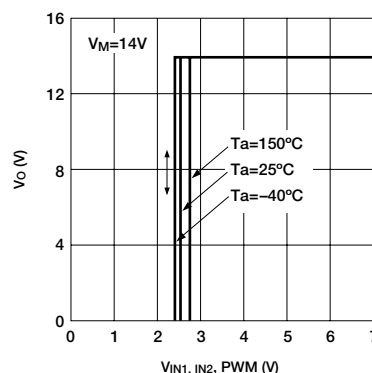
■ Forward voltage of Diode between drain and source



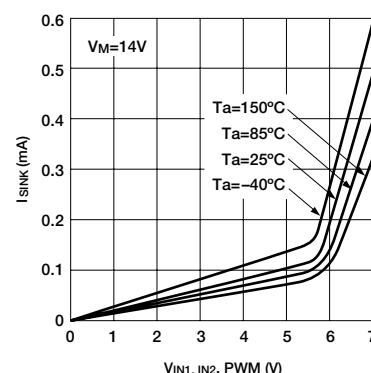
■ Quiescent circuit current



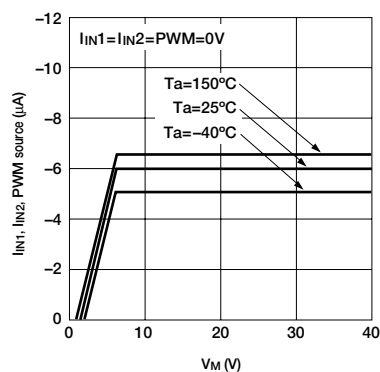
■ Voltage of input terminal (Threshold voltage)



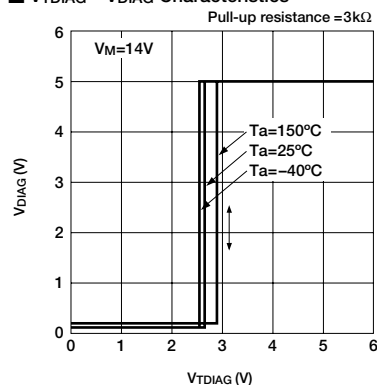
■ Current of input terminal (SINK current)



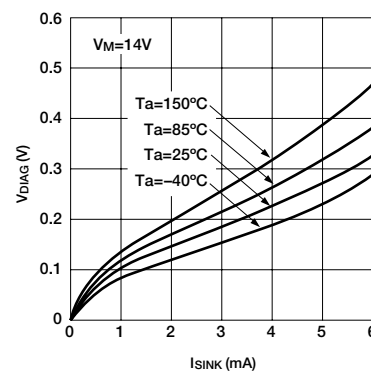
■ Current of input terminal (Source current)



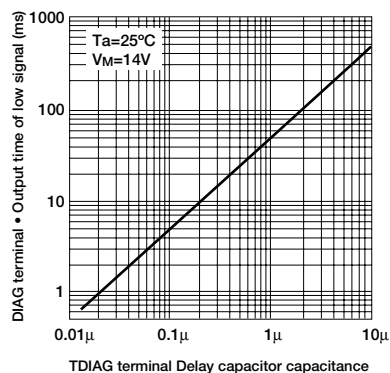
■ V_TDIAG - V_DIAG Characteristics



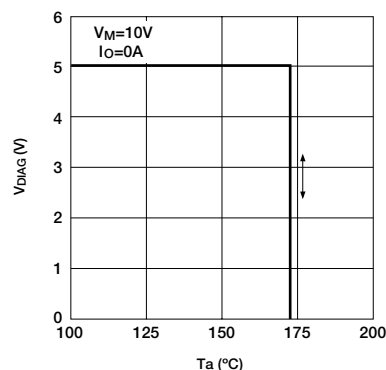
■ DIAG terminal • Saturation voltage



■ DIAG terminal • Output pulse width

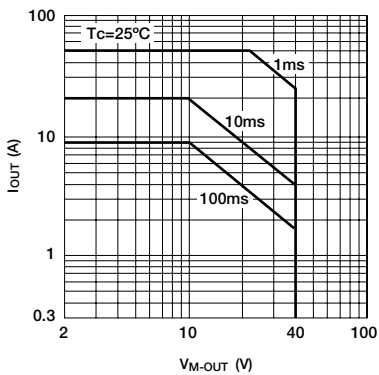


■ Thermal shut down protection

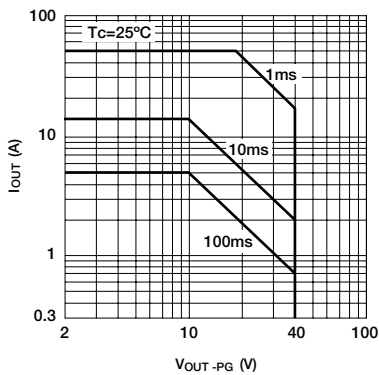


Electrical Characteristics

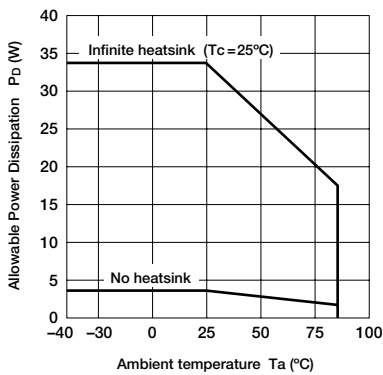
■ Pch MOS FET Safe Operating Area (SOA)



■ Nch MOS FET Safe Operating Area (SOA)



■ P_D — T_a Characteristics



High Voltage Full Bridge Drive IC SLA2402M

Features

- One Package Full Bridge Driver Consisted of High Voltage IC and Power MOS FETs (4 pieces)
- High Voltage Driver which accepts direct connection to the input signal line
- External components such as high voltage diodes and capacitors are not required

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Power source voltage *	V_M	500	V	
Input voltage	V_{IN}	15	V	
Output voltage	V_O	500	V	
Output current	I_O	15	A	$P_W \leq 250\mu s$
Power dissipation	P_D	5 ($T_a=25^\circ C$)	W	Without heatsink
Storage temperature	T_{stg}	-40 to +125	$^\circ C$	
Operation temperature	T_{opr}	-40 to +105	$^\circ C$	

* Power GND (D terminal) to -HV (-HV terminal) voltage.

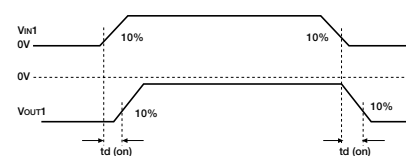
Electrical Characteristics

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Power MOS FET output breakdown voltage	BV_{OUT}	500			V	$I_O=100\mu A$
Power MOS FET output leakage voltage	$I_{OUT(off)}$			100	μA	$V_O=500V$
High-side Power MOS FET output on-state voltage	$V_{OUT(on)1}$	0.28	0.4	0.52	V	$I_O=0.4A, V_{IN}=10V$
	$V_{OUT(on)2}$	1.4	2.0	2.6	V	$I_O=2A, V_{IN}=10V$
Low-side Power MOS FET output on-state voltage	$V_{OUT(on)1}$	0.28	0.4	0.52	V	$I_O=0.4A, V_{GL}=10V$
	$V_{OUT(on)2}$	1.4	2.0	2.6	V	$I_O=2A, V_{GL}=10V$
Quiescent circuit current	I_{CC1}			3.0	mA	$V_{CC}=4.5$ to $15V$
	I_{CC2}			4.0	mA	$V_{CC}=10V, V_M=400V$
Operating circuit current	I_{CC3}			4.0	mA	$V_{CC}=10V, V_M=400V$
Input voltage (High level)	V_{IH}	$0.8V_{CC}$			V	$V_{CC}=4.5$ to $15V$
Input voltage (Low level)	V_{IL}			$0.2V_{CC}$	V	$V_{CC}=4.5$ to $15V$
Delay time *	$t_d(on)$		1.4		μs	$V_{CC}=10A, V_{IN}=10V,$ $V_M=85A,$ $I_O=0.41A$
	$t_d(off)$		3.3		μs	
	Δt			2.5	μs	
Operating voltage	V_{CC}			15	V	-40 to +105 $^\circ C$

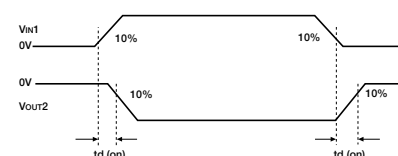
* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

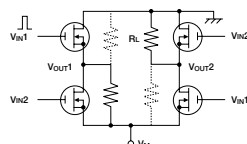


② Lowside switch turn-on, turn-off



* $\Delta t: \Delta t = t_d(on) - t_d(off)$

Measurement Circuit



Conditions

$V_{CC}=10V, V_{IN}=10V$ (pulse)

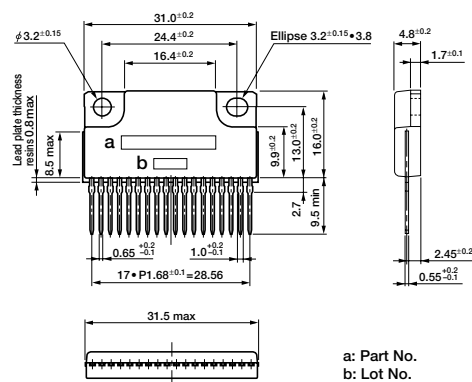
$V_M=85V$

$I_O=0.41A$ ($R_L=207\Omega$)

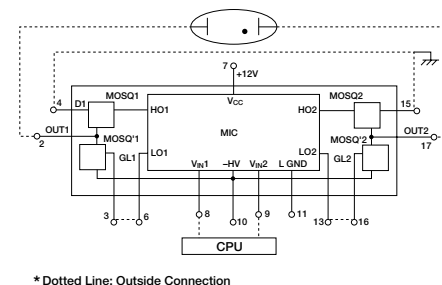
* When pulse signal is inputted to V_{IN1} , R_L on solid line is ON and dotted line R_L is off.

On the contrary, when pulse signal is inputted to V_{IN2} , R_L on dotted line is ON and solid line R_L is off.

External Dimensions (unit: mm)

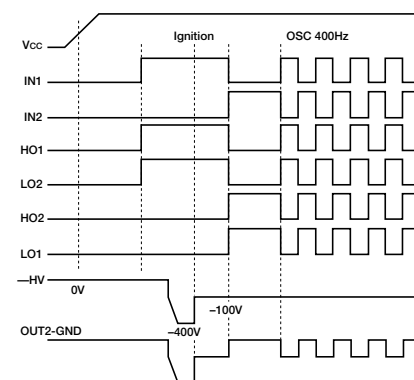


Block Diagram



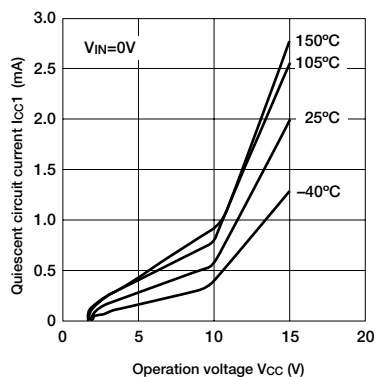
* Dotted Line: Outside Connection

Timing Chart

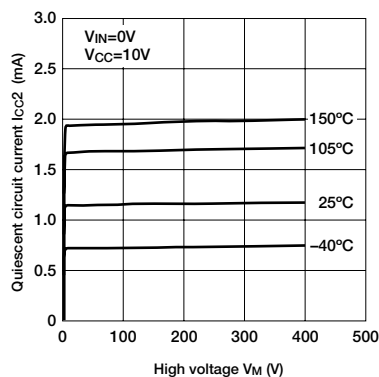


Electrical Characteristics

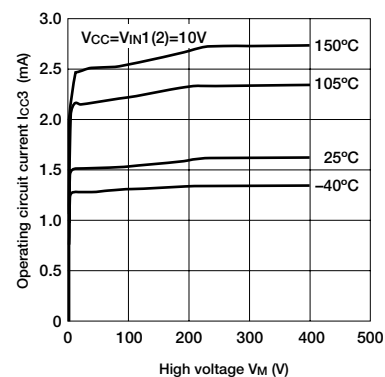
■ Quiescent circuit current



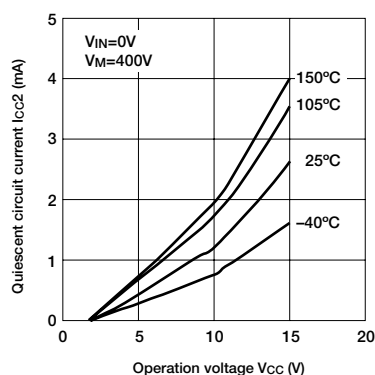
■ Quiescent circuit current supplied high voltage



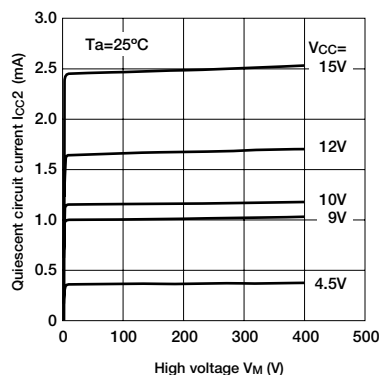
■ Operating circuit current



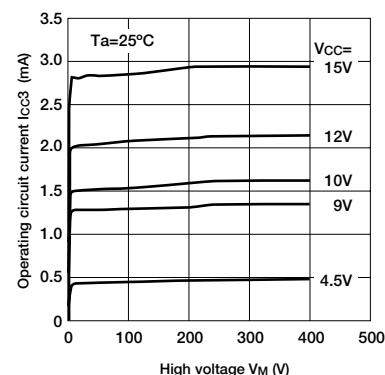
■ Quiescent circuit current supplied high voltage



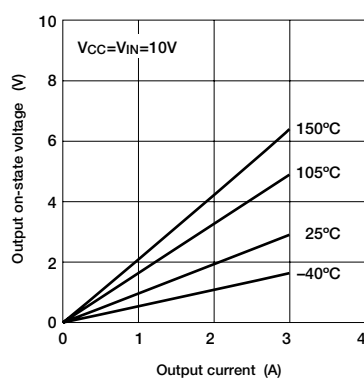
■ Quiescent circuit current



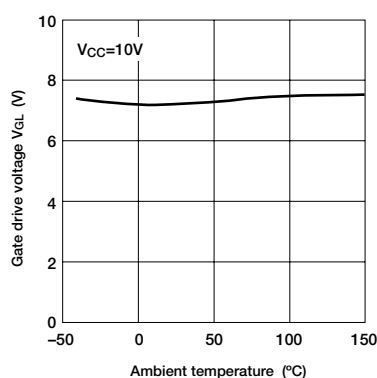
■ Operating circuit current



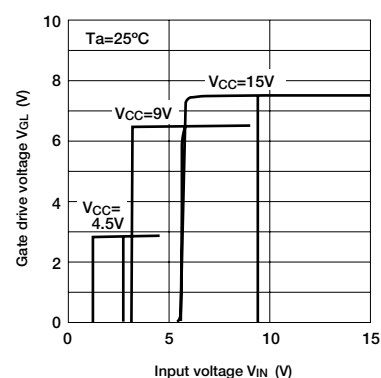
■ Output on-state voltage



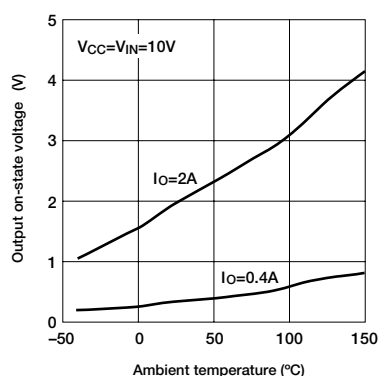
■ Gate drive voltage



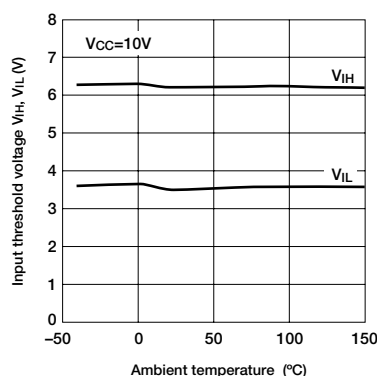
■ Gate drive voltage



■ Output on-state voltage

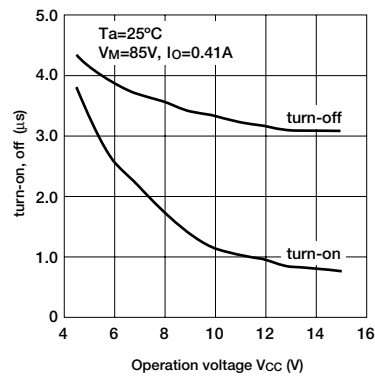


■ Input threshold voltage

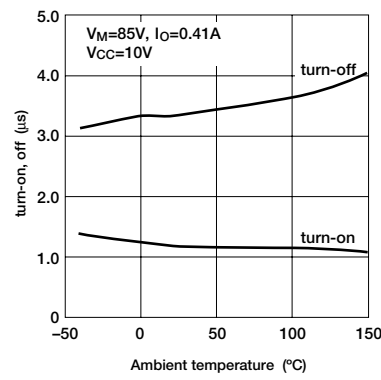


Electrical Characteristics

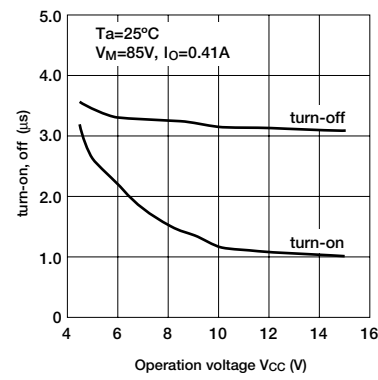
High side switch turn-on, off



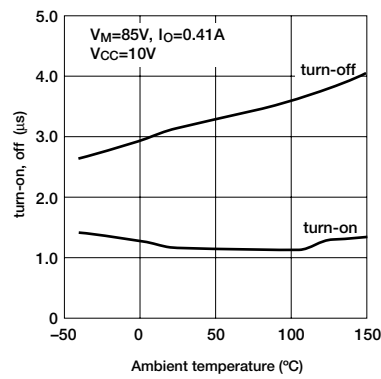
High side switch turn-on, off



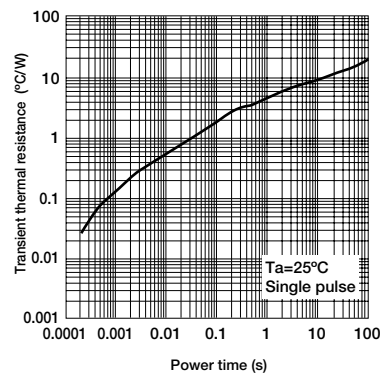
Low side switch turn-on, off



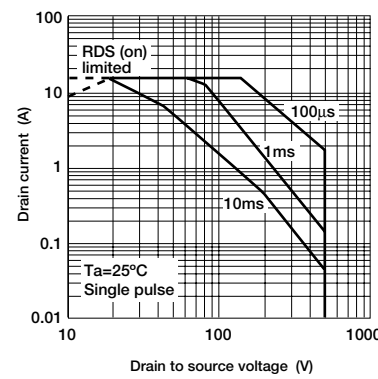
Low side switch turn-on, off



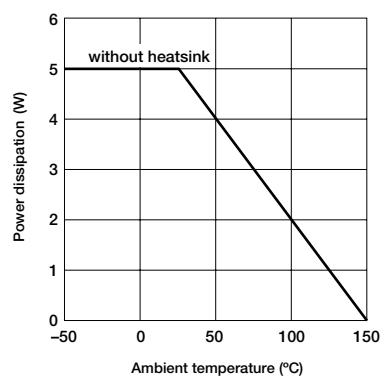
Transient thermal resistance characteristics



Safe operating area (Power MOS FET)



Power derating curve





High Voltage Full Bridge Drive IC SLA2403M

Features

- One Package Full Bridge Driver Consisted of High Voltage IC and Power MOS FETs (4 pieces)
- High Voltage Driver which accepts direct connection to the input signal line
- External components such as high voltage diodes and capacitors are not required

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Power source voltage *	V_M	500	V	
Input voltage	V_{IN}	15	V	
Output voltage	V_O	500	V	
Output current	I_O	7	A	$T_C=25^\circ\text{C}$
	I_O (peak)	15	A	$P_W \leq 250\mu\text{s}$
Power dissipation	P_D	5 ($T_a=25^\circ\text{C}$)	W	Without heatsink
		40 ($T_C=25^\circ\text{C}$)	W	With infinite heatsink
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$	
Operation temperature	T_{opr}	-40 to +125	$^\circ\text{C}$	
Junction temperature	T_J	150	$^\circ\text{C}$	

* Power GND (D terminal) to -HV (-HV terminal) voltage.

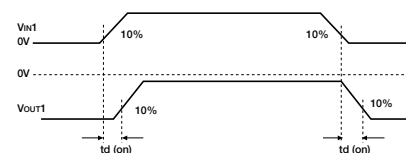
Electrical Characteristics

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Power MOS FET output breakdown voltage	BV_{OUT}	500			V	$I_O=100\mu\text{A}$
Power MOS FET output leakage voltage	$I_{OUT}(\text{off})$			100	μA	$V_O=500\text{V}$
High-side Power MOS FET output on-state voltage	$V_{OUT(\text{on})}$	0.18	0.26	0.34	V	$I_O=0.4\text{A}$, $V_{IN}=10\text{V}$
Lowside Power MOS FET output on-state voltage	$V_{OUT(\text{on})}$	0.18	0.26	0.34	V	$I_O=0.4\text{A}$, $V_{GL}=10\text{V}$
Quiescent circuit current	I_{CC1}			3.0	mA	$V_{CC}=6$ to 15V
	I_{CC2}			4.0	mA	$V_{CC}=10\text{V}$, $V_M=400\text{V}$
Operating circuit current	I_{CC3}			4.0	mA	$V_{CC}=10\text{V}$, $V_M=400\text{V}$
Input voltage (High level)	V_{IH}	$0.8V_{CC}$			V	$V_{CC}=6$ to 15V
Input voltage (Low level)	V_{IL}			$0.2V_{CC}$	V	$V_{CC}=6$ to 15V
Delay time *	$t_d(\text{on})$		2.0		μs	$V_{CC}=10\text{A}$, $V_{IN}=10\text{V}$, $V_M=85\text{V}$, $I_O=0.41\text{A}$
	$t_d(\text{off})$		3.0		μs	
Operating voltage	V_{CC}	6		15	V	-40 to +125 $^\circ\text{C}$

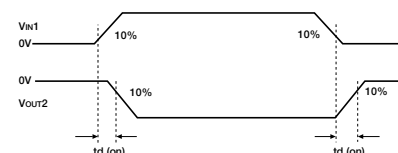
* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

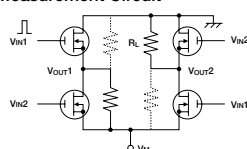


② Lowside switch turn-on, turn-off



* $\Delta t: \Delta t = t_d(\text{on}) - t_d(\text{off})$

Measurement Circuit



Conditions

$V_{CC}=10\text{V}$, $V_{IN}=10\text{V}$ (pulse)

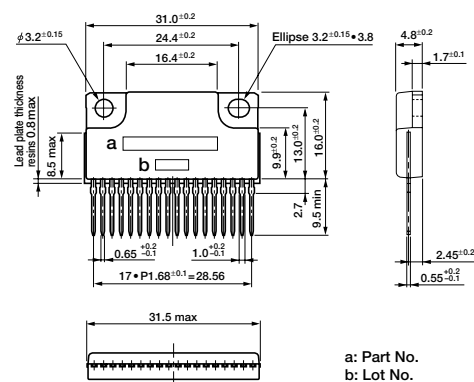
$V_M=85\text{V}$

$I_O=0.41\text{A}$ ($R_L=207\Omega$)

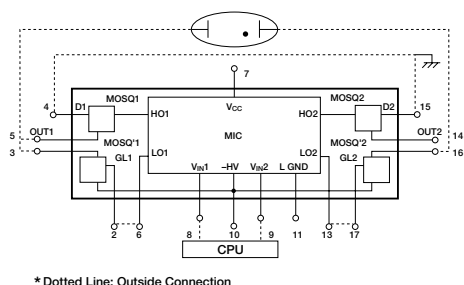
* When pulse signal is inputted to V_{IN1} , R_L on solid line is ON and dotted line is off.

On the contrary, when pulse signal is inputted to V_{IN2} , R_L on dotted line is ON and solid line is off.

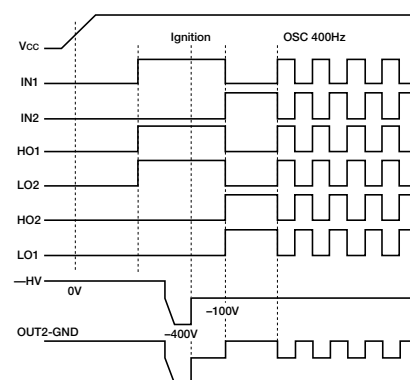
External Dimensions (unit: mm)



Block Diagram

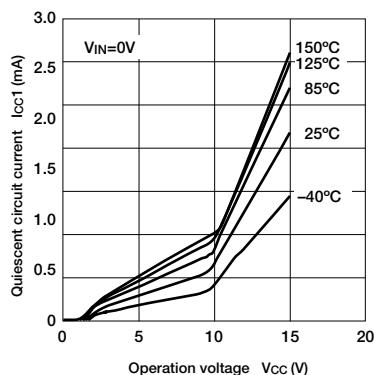


Timing Chart

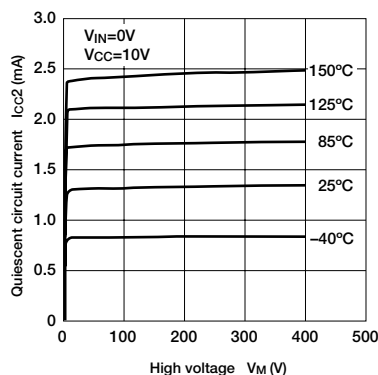


Electrical Characteristics

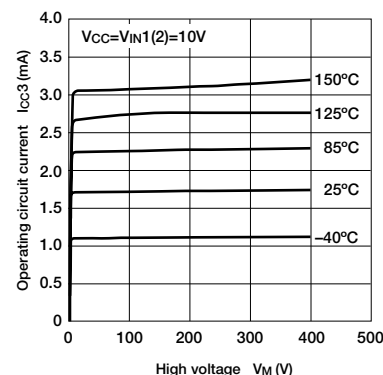
■ Quiescent circuit current



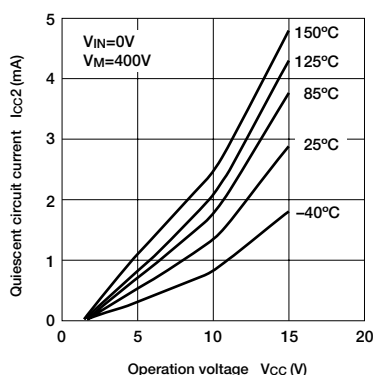
■ Quiescent circuit current supplied high voltage



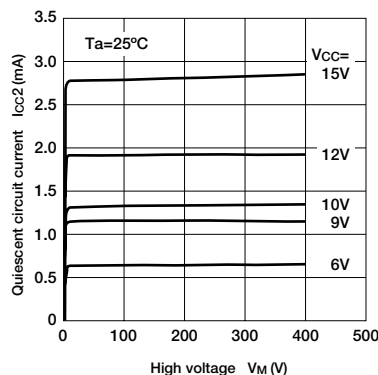
■ Operating circuit current



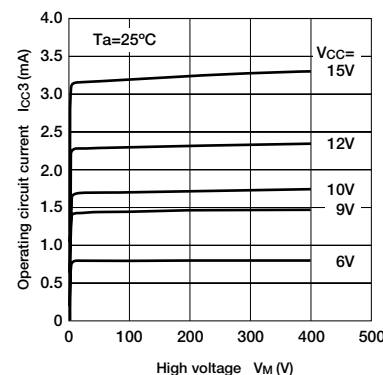
■ Quiescent circuit current supplied high voltage



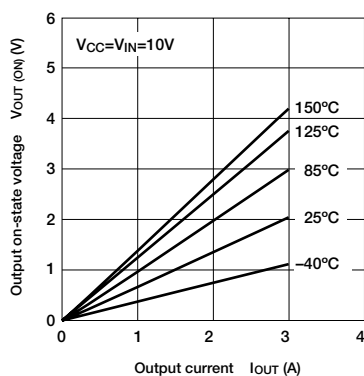
■ Quiescent circuit current supplied high voltage



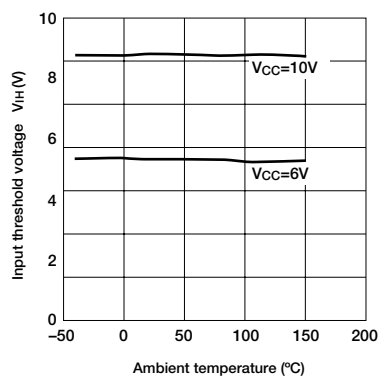
■ Operating circuit current



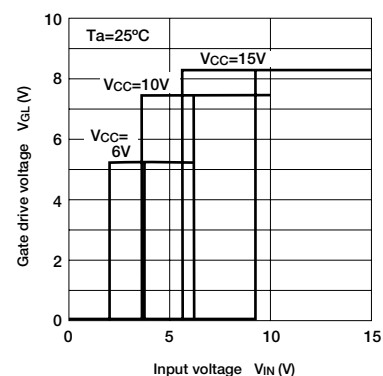
■ Output on-state voltage



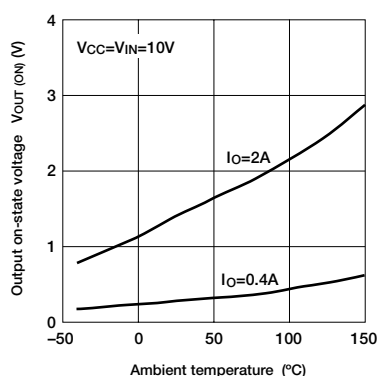
■ Input threshold voltage



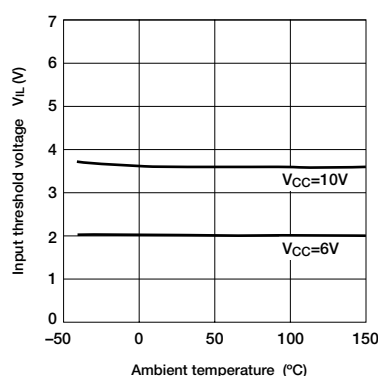
■ Gate drive voltage



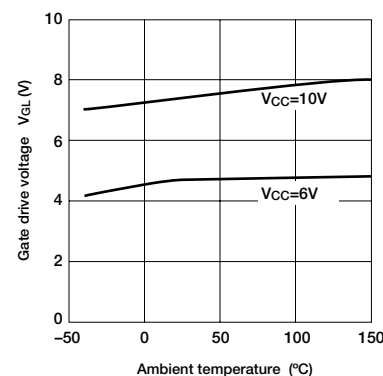
■ Output on-state voltage



■ Input threshold voltage

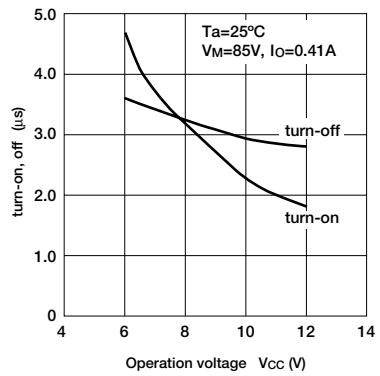


■ Gate drive voltage

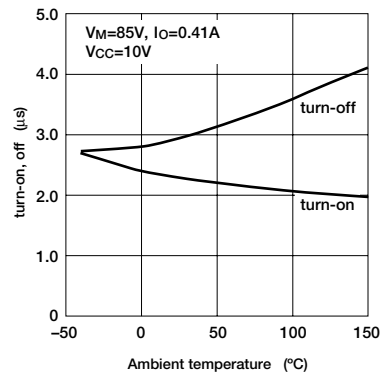


Electrical Characteristics

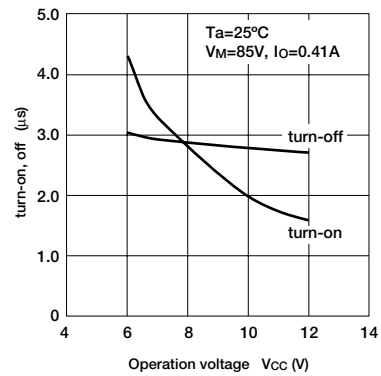
High side switch turn-on, off



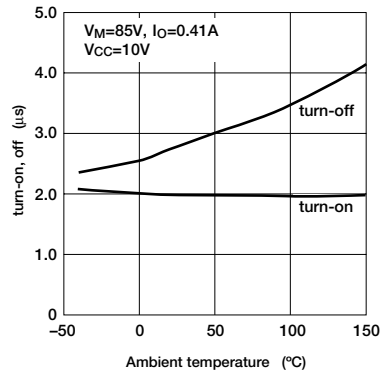
High side switch turn-on, off



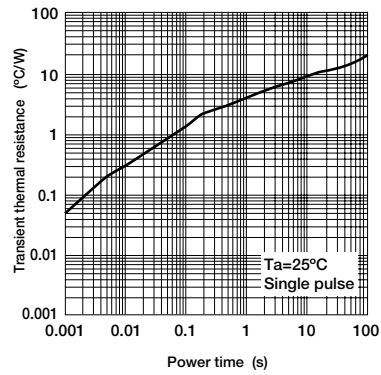
Low side switch turn-on, off



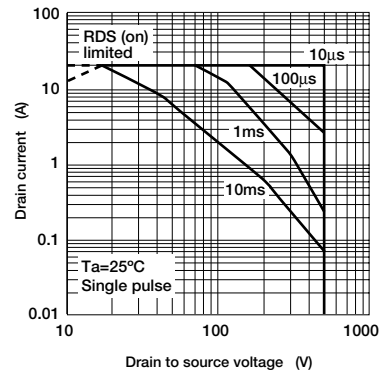
Low side switch turn-on, off



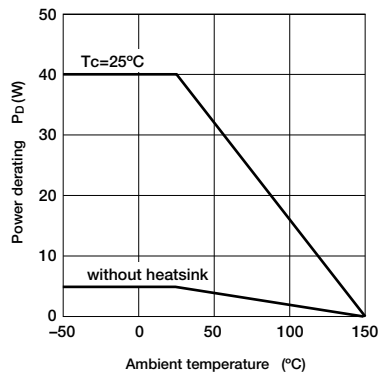
Transient thermal resistance characteristics



Safe operating area (Power MOS FET)



Power derating curve



Hall-Effect ICs

Unipolar Switch

Temperature Range (°C)	Magnetic Characteristics [mT] (Ta=25°C)			Package	Part No.	Remarks	External Dimensions
	B _{OP} (max)	B _{RP} (min)	B _{HYS} (min)				
-40 to +150	45	12.5	7	UA / LT	A3121L*		1, 2
	40	14	7	UA / LT	A3122L*		1, 2
	44	18	7	UA / LT	A3123L*		1, 2
	16	1	2	UA / LT	A3141L*	High-Sensitive	1, 2
	23	7.5	3	UA / LT	A3142L*	High-Sensitive	1, 2
	34	16.5	3	UA / LT	A3143L*	High-Sensitive	1, 2
	35	5	2	UA / LT	A3144L*	High-Sensitive	1, 2
	5	0.5	1 (typ)	UA / LT / LH	A3240L*	Ultra-High-Sensitive, Chopper-Stabilized	1, 2, 3
	Programmable	B _{OP} —B _{HYS}	0.5	UA / LT	A3250L*	Programmable, Chopper-Stabilized	1, 2

Suffix '*' is package option

Bipolar Switch

Temperature Range (°C)	Magnetic Characteristics [mT] (Ta=25°C)			Package	Part No.	Remarks	External Dimensions
	B _{OP} (max)	B _{RP} (min)	B _{HYS} (min)				
-40 to +150	5	-5	1	UA / LT	A3134L*	High-Sensitive	1, 2
-40 to +125	9.5	-9.5	3	UA / LT	UGS3132*		1, 2
	7.5	-7.5	3	UA / LT	UGS3133*		1, 2

Suffix '*' is package option

Bipolar Latch

Temperature Range (°C)	Magnetic Characteristics [mT] (Ta=25°C)			Package	Part No.	Remarks	External Dimensions
	B _{OP} (max)	B _{RP} (min)	B _{HYS} (min)				
-40 to +150	27	-27	34	UA / LT	A3185L*		1, 2
	15	-15	10	UA / LT	A3187L*		1, 2
	18	-18	20	UA / LT	A3188L*		1, 2
	23	-23	10	UA / LT	A3189L*		1, 2
	4	-4	4.5 (typ)	UA / LT / LH	A3280L*	Chopper-Stabilized	1, 2, 3
	9	-9	10 (typ)	UA / LT / LH	A3281L*	Chopper-Stabilized	1, 2, 3
	18	-18	30 (typ)	UA / LT / LH	A3283L*	Chopper-Stabilized	1, 2, 3

Suffix '*' is package option

Gear Tooth Sensor

Temperature Range (°C)	Magnetic Characteristics [mT]			Part No.	External Dimensions
	B _{OP} (max)	B _{RP} (min)	B _{HYS} (min)		
-40 to +150	10	-10	2	UGS3059KA	4
	3.5	-3.5	1	UGS3060KA	4

Ratiometric, Linear Sensors

Temperature Range (°C)	Magnetic Characteristics [mT]	Part No.	Remarks	External Dimensions
	Sense			
-40 to +150	50mV / mT	A3515LUA	Chopper-Stabilized	1
	25mV / mT	A3516LUA	Chopper-Stabilized	1

Subassembly

Part No.	Application	External Dimensions
ATS610LSA	Large-tooth, gear-position sensing-crank angle, cam angle	5
ATS611LSB	Fine-pitch, large air gap, gear speed sensing-transmission speed ABS	6
ATS612LSB	Large / small-tooth gear-position sensing-crank angle, transmission speed, cam angle	6

External Dimensions (unit: mm)

Figure 1 (UA)

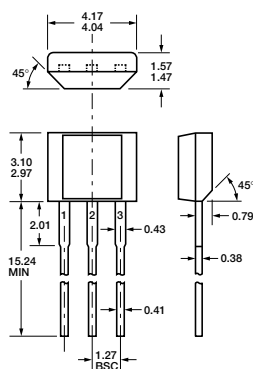


Figure 2 (LT)

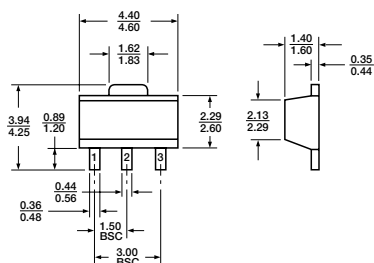


Figure 3 (LH)

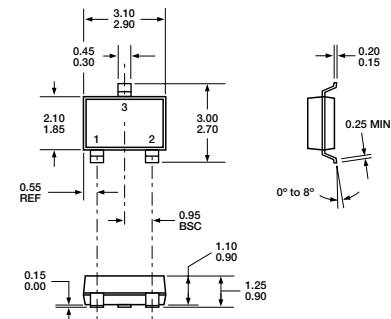


Figure 4 (KA)

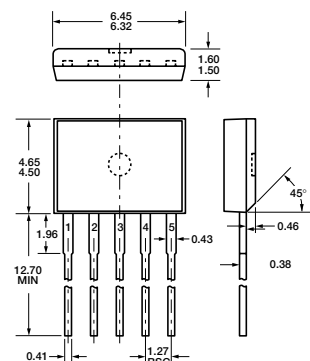


Figure 5 (SA)

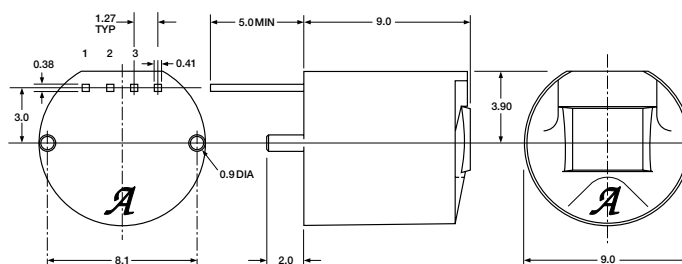
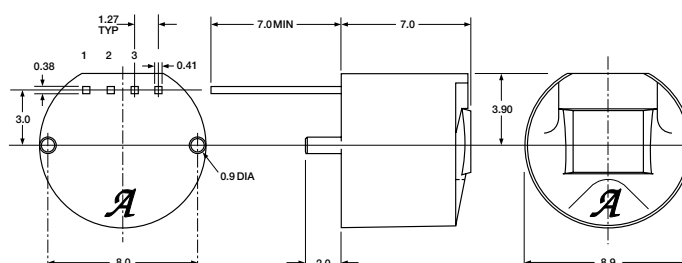


Figure 6 (SB)



- Various processing technologies of BIP, BiCMOS, CMOS and BCD can be used for the semiconductor chips.
- Meets detailed user needs, especially power ICs. A wide range of general-purpose ICs is also available.
- Employs a monolithic chip with flip-chip construction for increased reliability making it ideal for car electronic devices.
- Also available in hybrid ICs with transfer mold construction, multi-chip IC configuration and power monolithic IC configuration.

Features

- All semiconductor chips used are manufactured by Sanken.
- Main product lineup consists of power ICs produced out of many years' experience of Sanken.
- Uses monolithic chips with flip-chip construction.
- Mainly available in miniature transfer-mold packages.

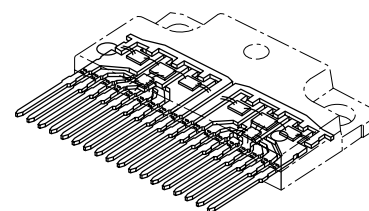
Examples of Custom Hybrid IC Products

- Regulators for alternators
- Igniters
- Power supply for microcomputer system
- Power steering control IC
- Motor and actuator driver
- Others

Examples of Sanken Automotive Hybrid ICs

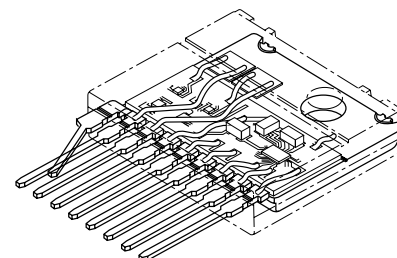
Lead frame type
multi-chip power IC

- One-chip power IC

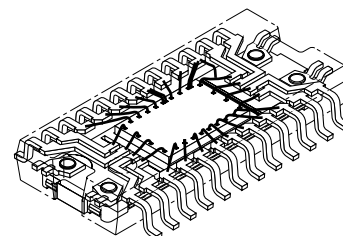


Lead frame type
power hybrid IC with
ceramic substrate

- High-output high-breakdown voltage IC
- Simplified integration of custom circuits
- Distribution of unit functions
(Actuators may be built in the device)

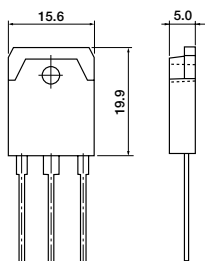


Surface-mount
power IC

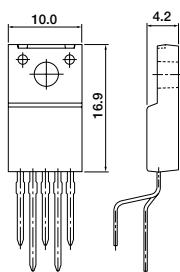


External Dimensions (unit: mm)

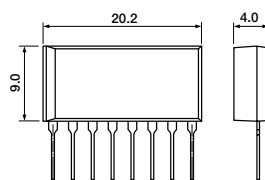
MT-100



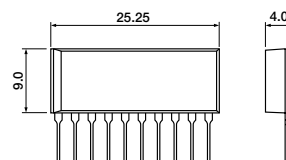
FM205



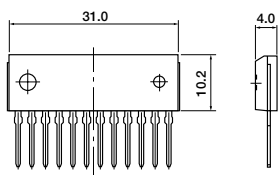
STA 8pin



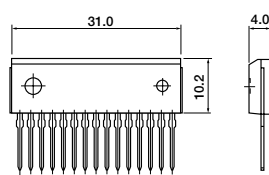
STA 10pin



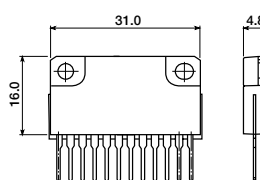
SMA12pin



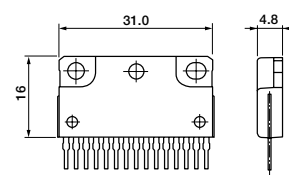
SMA15pin



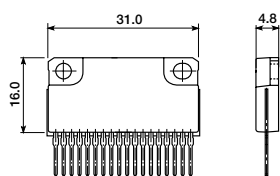
SLA12pin



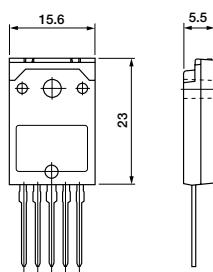
SLA15pin



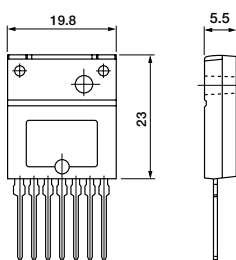
SLA18pin



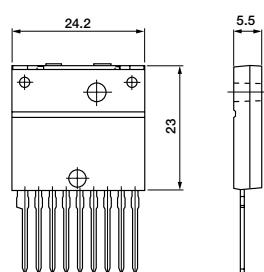
3GR-F



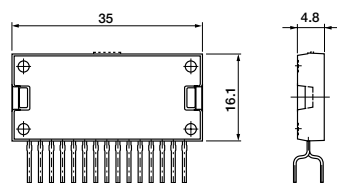
3GR-M



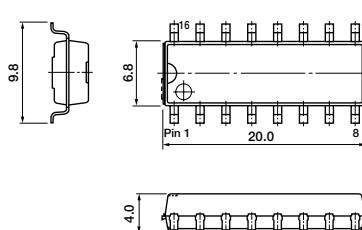
STR-S



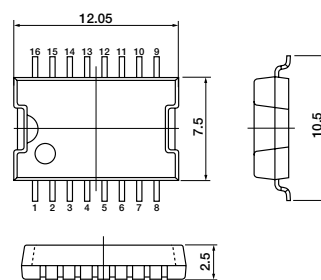
SPM



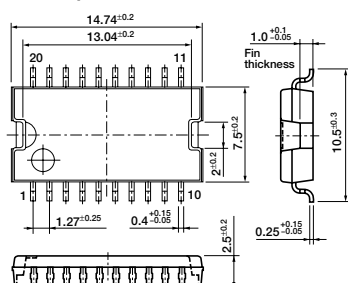
SMD16pin



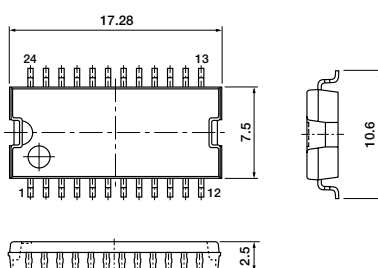
SPF16pin



SPF20pin



SPF24pin



Transistors and MOS FETs

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Load Current	Part No.	Chip	Avalanche Diode	Single Package		Multi-chip Package					Remarks
				TO220F	TO220S	SPF (Surface-mount)	SD (Surface-mount)	STA	SMA	SLA	
Approx. 0.5A	2SA1488A	Single		25W							
	2SC3851	Single		25W							
	2SC3852	Single		25W							
	STA315A	Single • 3	35V					13.5W			Es/b=50mJ
	STA335A	Single • 2	35V					12W			Es/b=150mJ
	STA415A	Single • 4	35V					18W			Es/b=50mJ
	STA509A	MOS • 4	52V					20W			Es/b=40mJ
	SDK06	MOS • 4	52V				3W				Es/b=40mJ
Approx. 1.2A	2SA1488	Single		25W							
	2SC3851	Single		25W							
	2SC4153	Single		30W							V _{CE0} =120V
	MN611S	Single	115V		60W						Es/b=45mJ
	SPF0001	Single • 2				2.5W					Es/b=45mJ
	SDA03	Single • 4					3W				
	SDA04	Single • 2					2.5W				
	SDC09	Single • 2	65V				2.8W				Es/b=80mJ
	SDK08	MOS • 4					3W				
	SDK09	MOS					3W				
	STA461C	Single • 2	65V					18W			Es/b=80mJ
	STA463C	Single • 2	115V					18W			Es/b=45mJ
	STA464C	Single • 4						4W			Es/b=80mJ
	STA508A	MOS • 4						20W			
	SMA5113	MOS • 4							35W		V _{DSS} =450V
Approx. 3A	2SA1567	Single		35W							
	2SD2382	Single	65V	30W							Es/b=200mJ
	2SK2701	MOS		35W							V _{DSS} =450V
	FP812	Single		35W							
	FN812	Single		35W							
	SLA8004	Single • 4								40W	
Approx. 5A	2SA1568	Single		35W							
	2SC4024	Single		35W							
	2SC4065	Single		35W							
	2SD2141	Darlington	380V	35W							Es/b=210mJ
	2SD2633	Darlington		35W							
	MN638S	Darlington	380V		60W						
	SLA5027	MOS • 4								40W	
10A and over	FKV460	MOS		40W							R _{DS(ON)} = 9mΩ max
	FKV560	MOS		40W							R _{DS(ON)} = 11mΩ max
	FKV660	MOS		40W							R _{DS(ON)} = 14mΩ max
	FKV460S	MOS			60W						R _{DS(ON)} = 9mΩ max
	FKV560S	MOS			60W						R _{DS(ON)} = 11mΩ max
	FKV660S	MOS			60W						R _{DS(ON)} = 14mΩ max

Power Transistor 2SA1488/1488A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings		Unit
	2SA1488	2SA1488A	
V _{CB0}	-60	-80	V
V _{CE0}	-60	-80	V
V _{EB0}	-6		V
I _C	-4		A
I _B	-1		A
P _C	25 (T _C = 25°C)		W
T _J	150		°C
T _{stg}	-55 to +150		°C

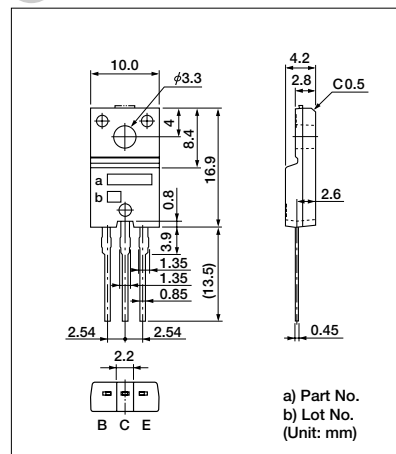
Electrical Characteristics (Ta = 25°C)

Symbol	Test Conditions	Ratings		Unit
		2SA1488	2SA1488A	
I _{CB0}	V _{CB} =	-100max	-100max	μA
I _{EB0}	V _{EB} = -6V	-100max	-80	μA
V _{(BR) CE0}	I _C = -25mA	-60min	-80min	V
h _{FE}	V _{CE} = -4V, I _C = -1A	40min		
V _{CE} (sat)	I _C = -2A, I _B = -0.2A	-0.5max		V
f _T	V _{CE} = -12V, I _E = -0.2A	15typ		MHz
C _{0B}	V _{CB} = -10V, f = 1MHz	90typ		pF

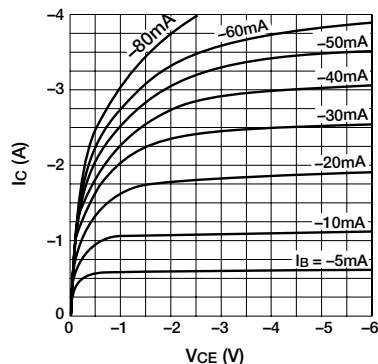
Typical Switching Characteristics (common emitter)

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-12	6	-2	-10	5	-200	200	0.25typ	0.75typ	0.25typ

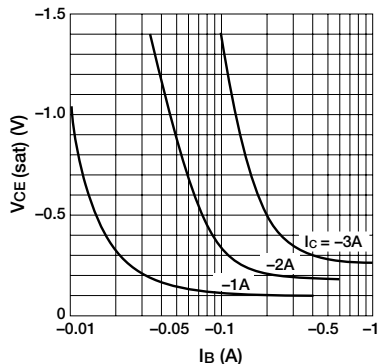
External Dimensions TO220F (full-mold)



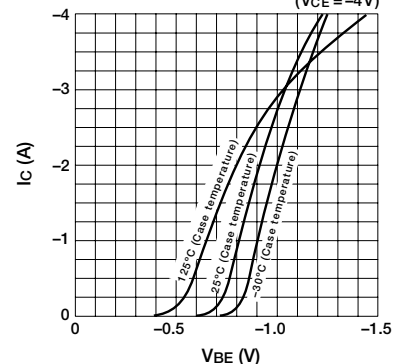
■ I_C—V_{CE} Characteristics (typ.)



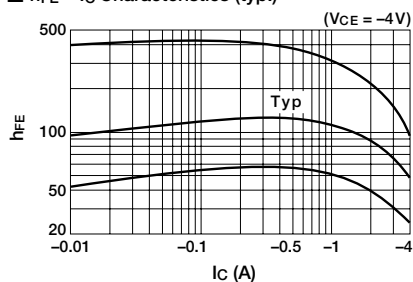
■ V_{CE} (sat)—I_B Characteristics (typ.)



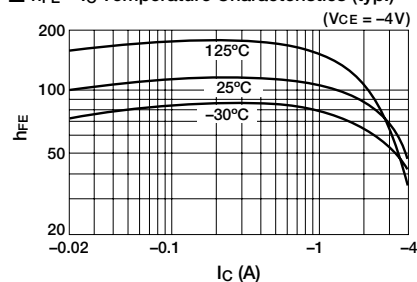
■ I_C—V_{BE} Temperature Characteristics (typ.)



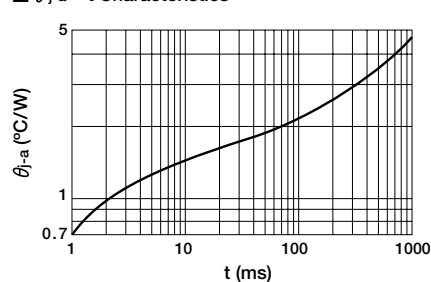
■ h_{FE}—I_C Characteristics (typ.)



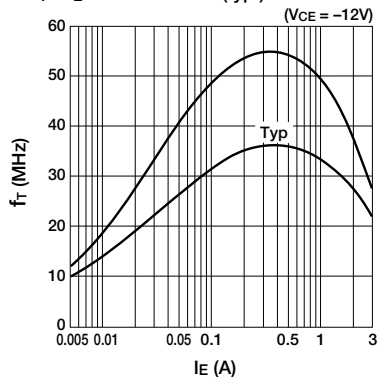
■ h_{FE}—I_C Temperature Characteristics (typ.)



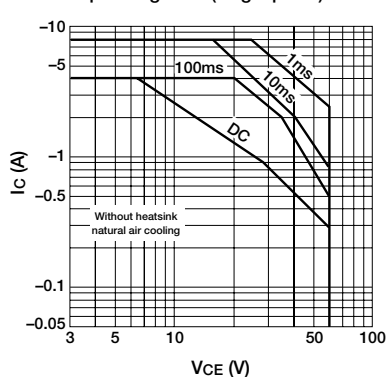
■ θ_{JA}—t Characteristics



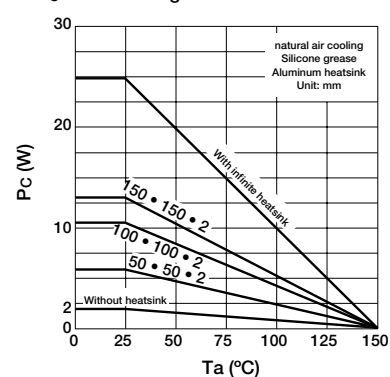
■ f_T—I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C—T_a Derating



Power Transistor 2SA1567

Absolute Maximum Ratings (Ta = 25°C)

Symbol	Ratings	Unit
V _{CB0}	-50	V
V _{CE0}	-50	V
V _{EB0}	-6	V
I _C	-12	A
I _B	-3	A
P _C	35 (T _C = 25°C)	W
T _J	150	°C
Tstg	-55 to +150	°C

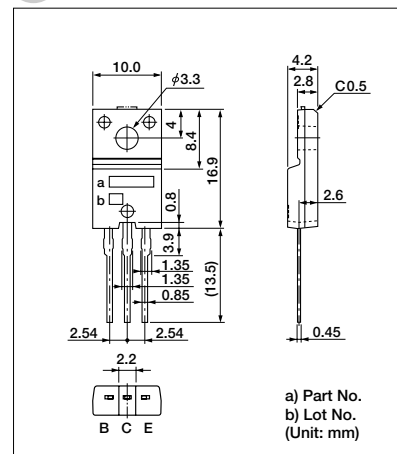
Electrical Characteristics (Ta = 25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = -50V	-100max	μA
I _{EB0}	V _{EB} = -6V	-100max	μA
V _{(BR) CEO}	I _C = -25mA	-50min	V
h _{FE}	V _{CE} = -1V, I _C = -6A	50min	
V _{CE(sat)}	I _C = -6A, I _B = -0.3A	-0.35max	V
f _T	V _{CE} = -12V, I _E = -0.5A	40typ	MHz
C _{OB}	V _{CB} = -10V, f = 1MHz	330typ	pF

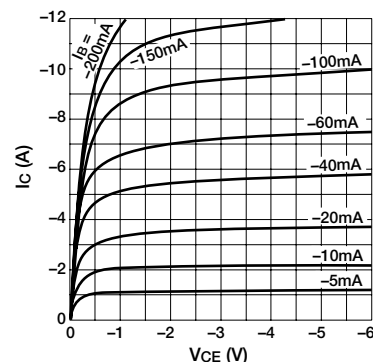
Typical Switching Characteristics (common emitter)

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-24	4	-6	-10	5	-120	120	0.4typ	0.4typ	0.2typ

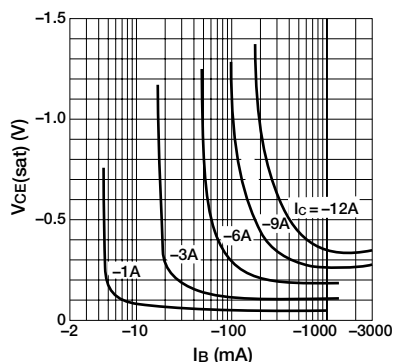
External Dimensions TO220F (full-mold)



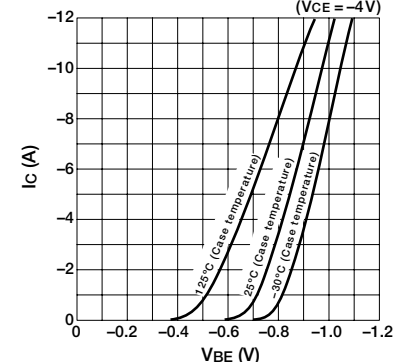
I_C—V_{CE} Characteristics (typ.)



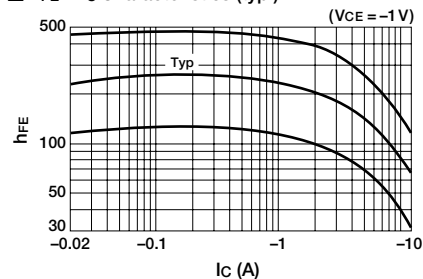
V_{CE(sat)}—I_B Characteristics (typ.)



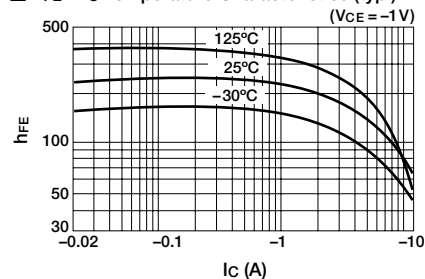
I_C—V_{BE} Temperature Characteristics (typ.)



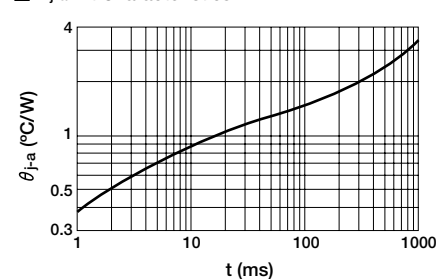
h_{FE}—I_C Characteristics (typ.)



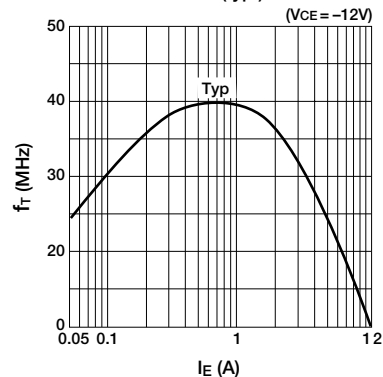
h_{FE}—I_C Temperature Characteristics (typ.)



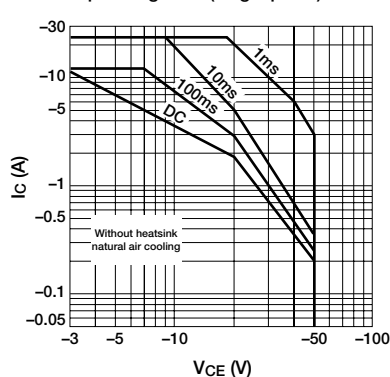
θ_{JA}—t Characteristics



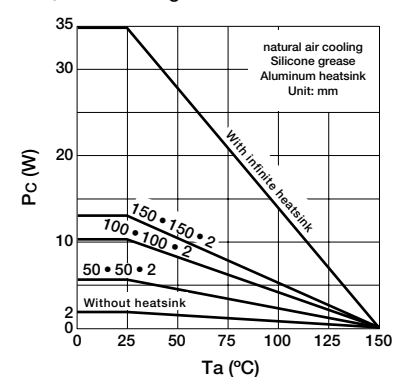
f_T—I_E Characteristics (typ.)



Safe Operating Area (single pulse)



P_C—Ta Derating



Power Transistor 2SA1568

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	-60	V
V _{CE0}	-60	V
V _{EB0}	-6	V
I _C	±12	A
I _B	-3	A
P _C	35 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

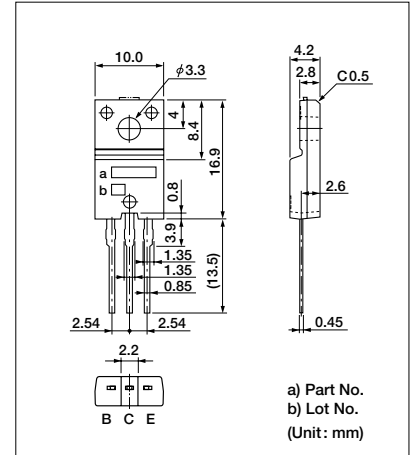
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = -60V	-100max	μA
I _{EB0}	V _{EB} = -6V	-60max	mA
V _{(BR) CEO}	I _C = -25mA	-60min	V
h _{FE}	V _{CE} = -1V, I _C = -6A	50min	
V _{CE (sat)}	I _C = -6A, I _B = -0.3A	-0.35max	V
V _{FEC}	I _{ECO} = -10A	-2.5max	V
f _T	V _{CE} = -12V, I _E = 0.5A	40typ	MHz
C _{OB}	V _{CB} = -10V, f = 1MHz	330typ	pF

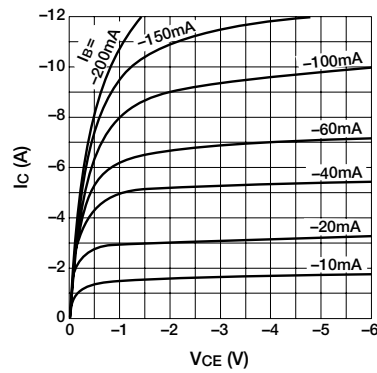
Typical Switching Characteristics (common emitter)

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-24	4	-6	-10	5	-120	120	0.4typ	0.4typ	0.2typ

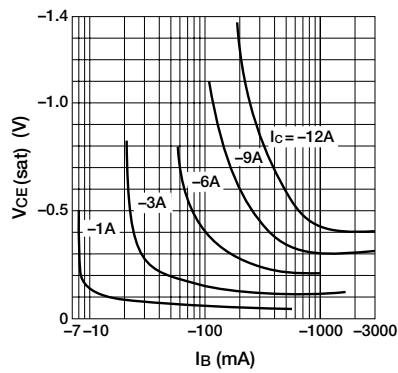
External Dimensions TO220F (full-mold)



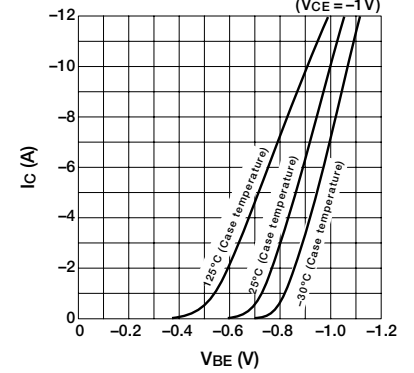
■ I_C—V_{CE} Characteristics (typ.)



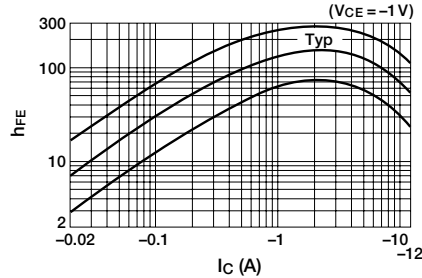
■ V_{CE (sat)}—I_B Characteristics (typ.)



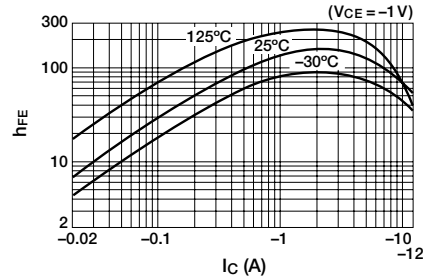
■ I_C—V_{BE} Temperature Characteristics (typ.)



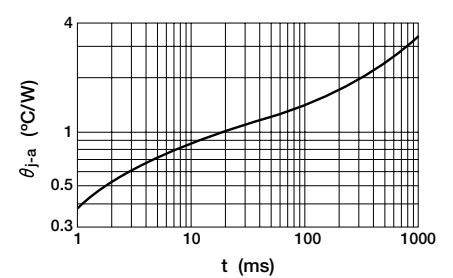
■ h_{FE}—I_C Characteristics (typ.)



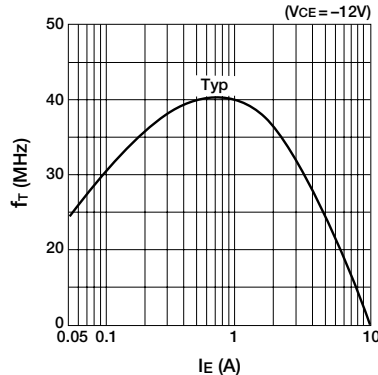
■ h_{FE}—I_C Temperature Characteristics (typ.)



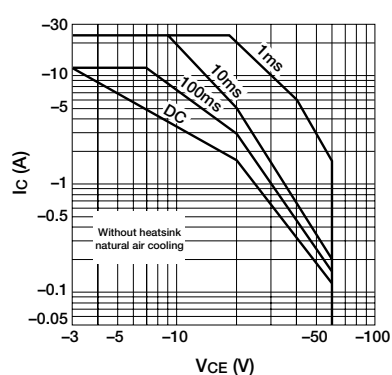
■ θ_{J-A}—t Characteristics



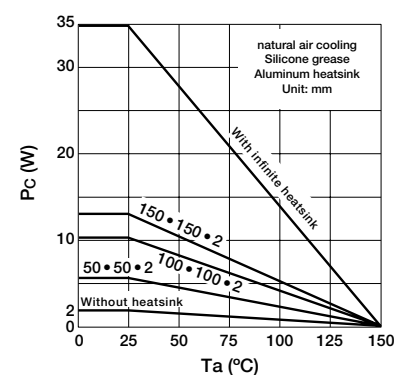
■ f_T—I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C—T_a Derating



Power Transistor 2SC3851

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	80	V
VCEO	60	V
VEBO	6	V
IC	4	A
IB	1	A
PC	25 (Tc=25°C)	W
TJ	150	°C
Tstg	-55 to +150	°C

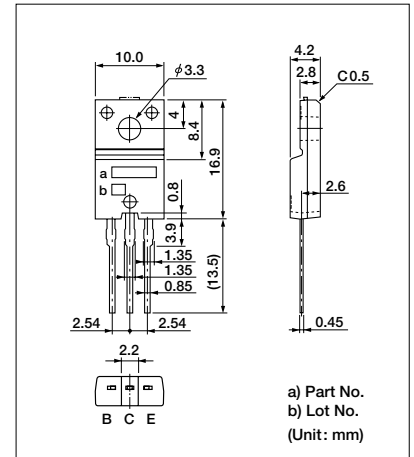
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
ICBO	VCB = 80V	100max	μA
IEBO	VEB = 6V	100max	μA
V(BR) CEO	IC = 25mA	60min	V
hFE	VCE = 4V, IC = 1A	40 to 320	
VCE(sat)	IC = 2A, IB = 0.2A	0.5max	V
fr	VCE = 12V, IE = -0.2A	15typ	MHz
COB	VCB = 10V, f = 1MHz	60typ	pF

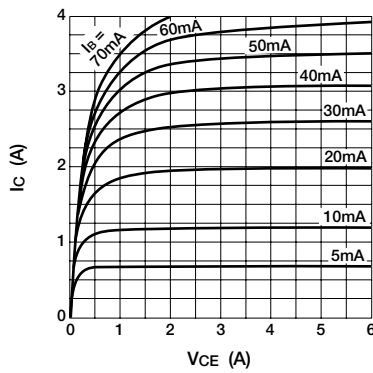
Typical Switching Characteristics (common emitter)

VCC (V)	RL (Ω)	IC (A)	VBB1 (V)	VBB2 (V)	IB1 (mA)	IB2 (mA)	ton (μs)	tstg (μs)	tf (μs)
12	6	2	10	-5	200	-200	0.2typ	1typ	0.3typ

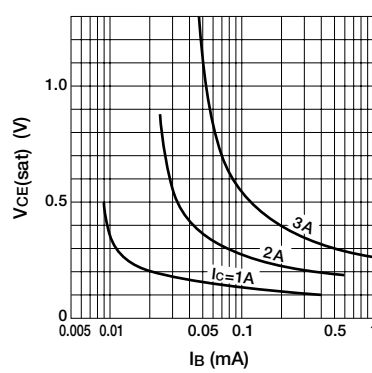
External Dimensions TO220F (full-mold)



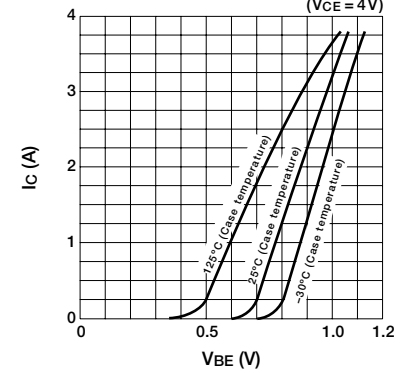
IC—VCE Characteristics (typ.)



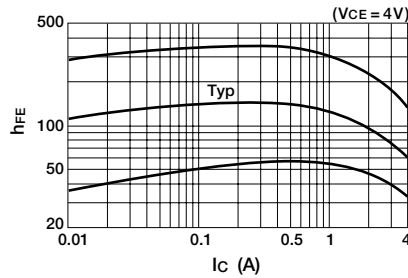
VCE(sat)—IB Characteristics (typ.)



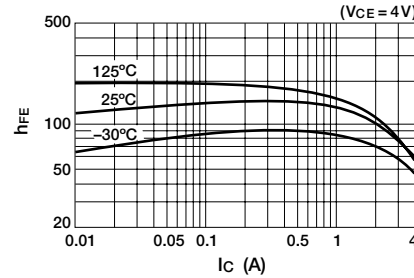
IC—VBE Temperature Characteristics (typ.)



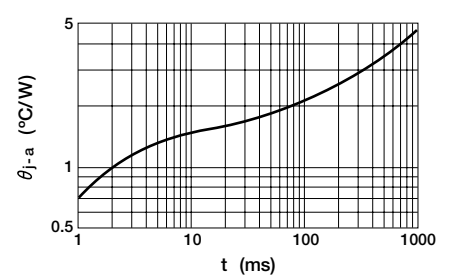
hFE—IC Characteristics (typ.)



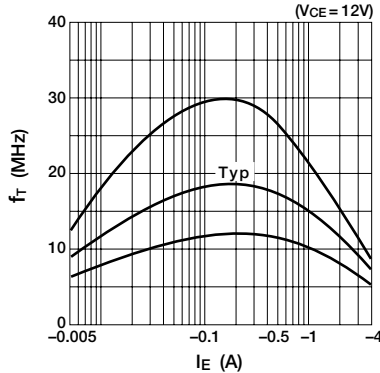
hFE—IC Temperature Characteristics (typ.)



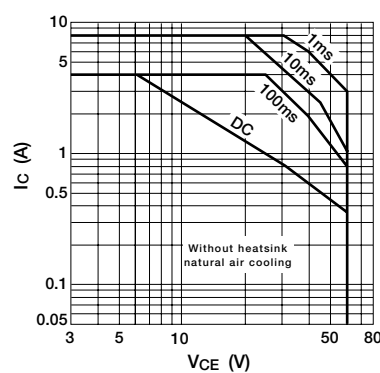
θJA—t Characteristics



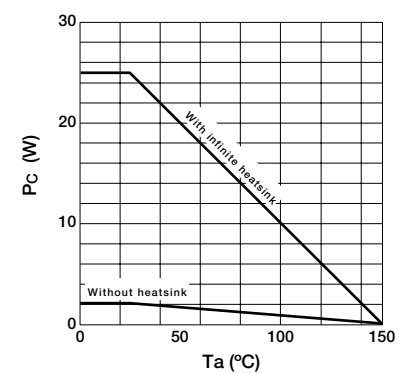
fr—IE Characteristics (typ.)



Safe Operating Area (single pulse)



PC—Ta Derating



Power Transistor 2SC3852

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	80	V
VCEO	60	V
VEBO	6	V
IC	3	A
IB	1	A
PC	25 (Tc=25°C)	W
Tj	150	°C
Tstg	-55 to +150	°C

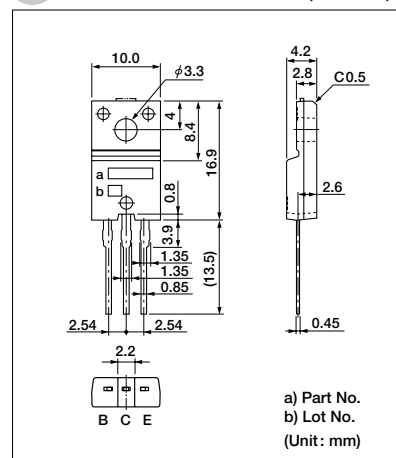
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
ICBO	VCB = 80V	10max	μA
IEBO	VEB = 6V	100max	μA
V(BR) CEO	IC = 25mA	60min	V
hFE	VCE = 4V, IC = 0.5A	500min	
VCE(sat)	IC = 2A, IB = 50mA	0.5max	V
fT	VCE = 12V, IE = -0.2A	15typ	MHz
COB	VCB = 10V, f = 1MHz	50typ	pF

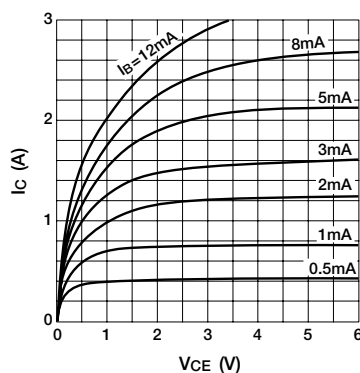
Typical Switching Characteristics (common emitter)

VCC (V)	RL (Ω)	IC (A)	VBB1 (V)	VBB2 (V)	IB1 (mA)	IB2 (mA)	ton (μs)	tstg (μs)	tT (μs)
20	20	1.0	10	-5	15	-30	0.8typ	3.0typ	1.2typ

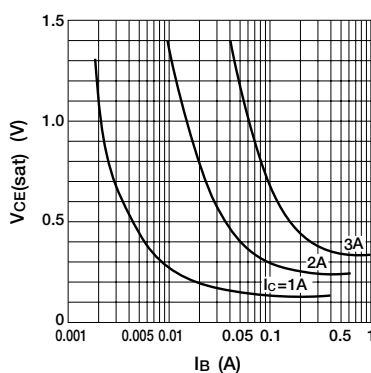
External Dimensions TO220F (full-mold)



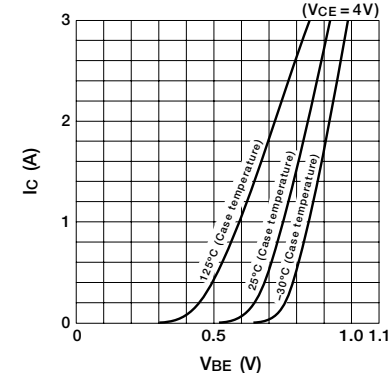
■ IC—VCE Characteristics (typ.)



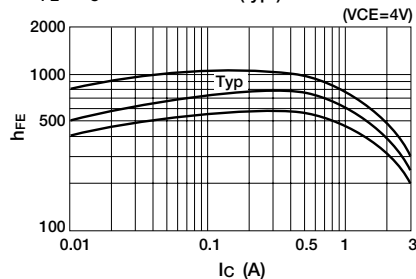
■ VCE(sat)—IB Characteristics (typ.)



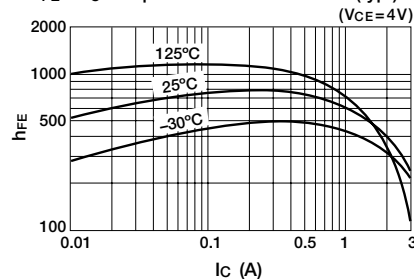
■ IC—VBE Temperature Characteristics (typ.)



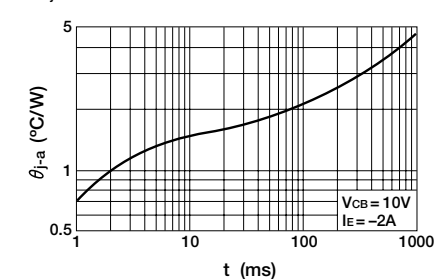
■ hFE—IC Characteristics (typ.)



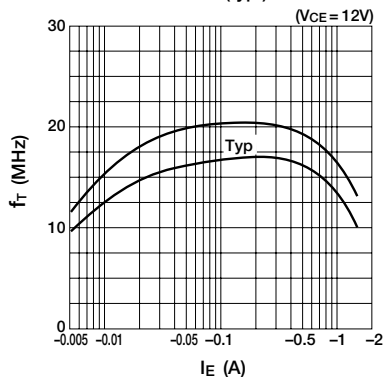
■ hFE—IC Temperature Characteristics (typ.)



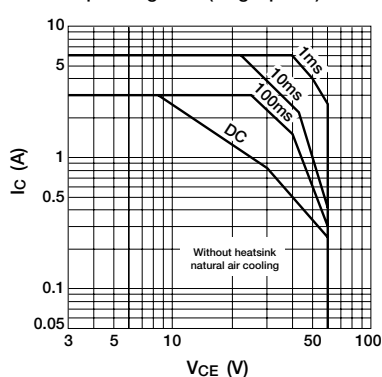
■ θJA—t Characteristics



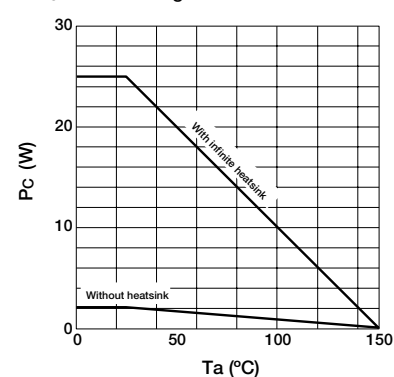
■ fT—IE Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ PC—Ta Derating



Power Transistor 2SC4024

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	100	V
VCEO	50	V
VEBO	15	V
IC	10	A
IB	3	A
PC	35 (Tc=25°C)	W
Tj	150	°C
Tstg	-55 to +150	°C

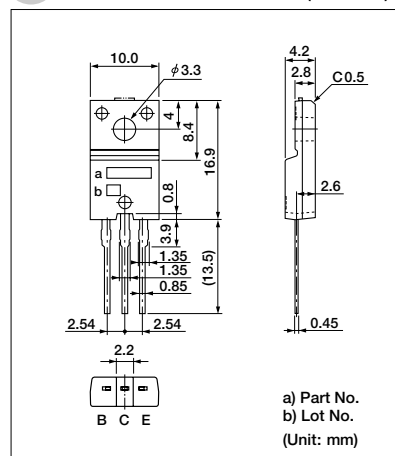
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
ICBO	VCB = 100V	10max	μA
IEBO	VEB = 15V	10max	μA
V(BR) CEO	IC = 25 mA	50min	V
hFE	VCE = 4V, IC = 1A	300 to 1600	
VCE(sat)	IC = 5A, IB = 0.1A	0.5max	V
fT	VCB = 12V, IE = -0.5A	24typ	MHz
COB	VCB = 10V, f = 1MHz	150typ	pF

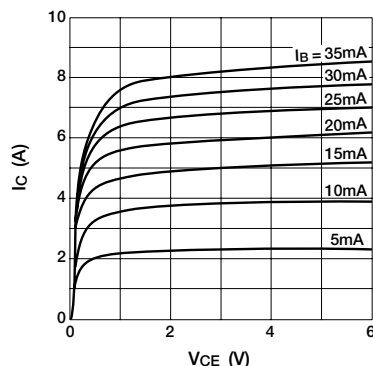
Typical Switching Characteristics (common emitter)

VCC (V)	RL (Ω)	IC (A)	IB1 (A)	IB2 (A)	ton (μs)	tstg (μs)	tr (μs)
20	4	5	0.1	-0.1	0.5typ	2.0typ	0.5typ

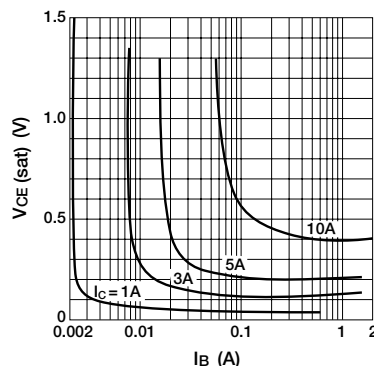
External Dimensions TO220F (full-mold)



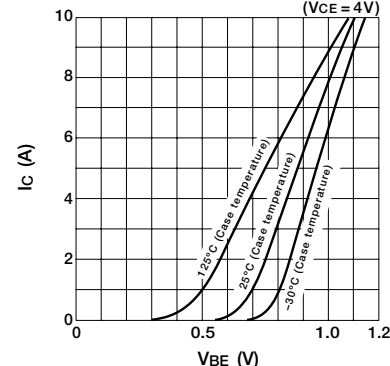
IC—VCE Characteristics (typ.)



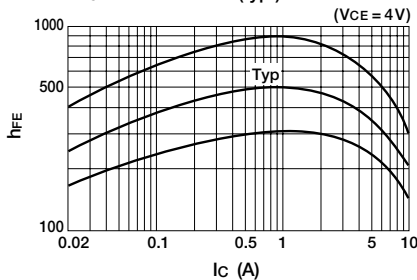
VCE(sat)—IB Characteristics (typ.)



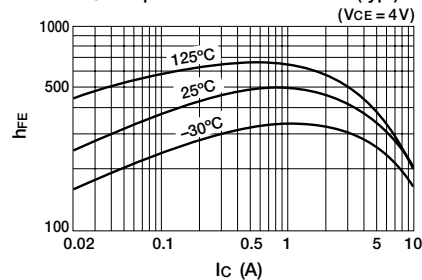
IC—VBE Temperature Characteristics (typ.)



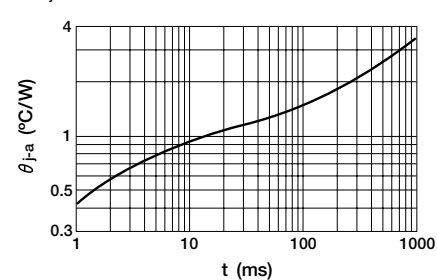
hFE—IC Characteristics (typ.)



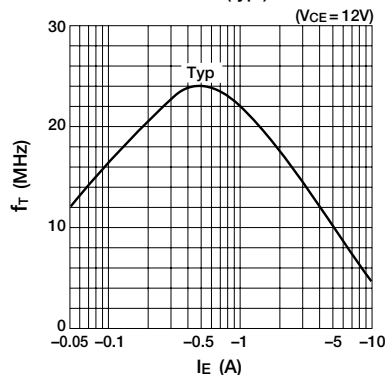
hFE—IC Temperature Characteristics (typ.)



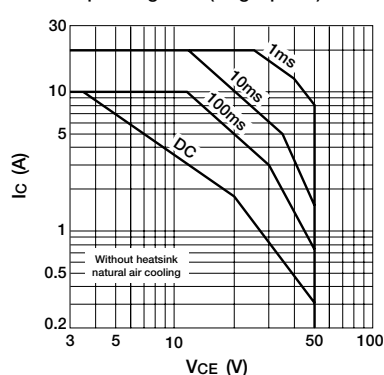
θja—t Characteristics



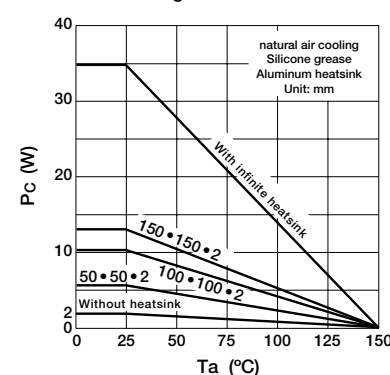
fT—IE Characteristics (typ.)



Safe Operating Area (single pulse)



PC—Ta Derating



Power Transistor 2SC4065

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CBO}	60	V
V _{CEO}	60	V
V _{EB0}	6	V
I _C	±12	A
I _B	3	A
P _C	35 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

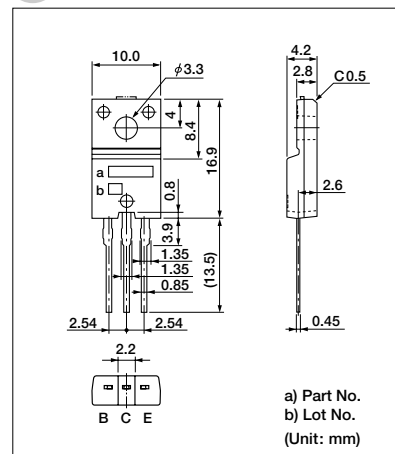
Electrical Characteristics

Symbol	Test Conditions	Ratings	Unit
I _{CBO}	V _{CB} = 60V	100max	μA
I _{EBO}	V _{EB} = 6V	60max	mA
V(BR) CEO	I _C = 25mA	60min	V
h _{FE}	V _{CE} = 1V, I _C = 6A	50min	
V _{CE} (sat)	I _C = 6A, I _B = 1.3A	0.35max	V
V _{FE}	V _{EC} = 10A	2.5max	V
f _T	V _{CE} = 12V, I _E = -0.5A	24typ	MHz
COB	V _{CB} = 10V, f = 1MHz	180typ	pF

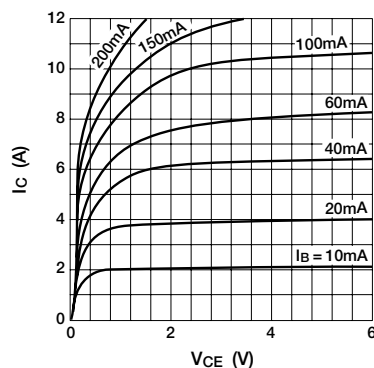
Typical Switching Characteristics (common emitter)

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (A)	I _{B2} (A)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
24	4	6	10	-5	0.12	-0.12	0.6typ	1.4typ	0.4typ

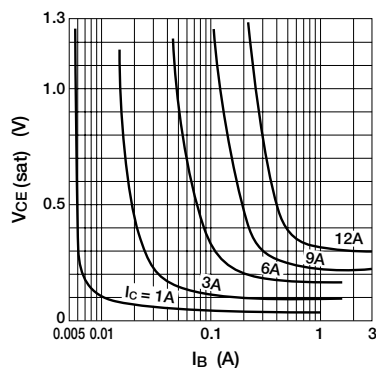
External Dimensions TO220F (full-mold)



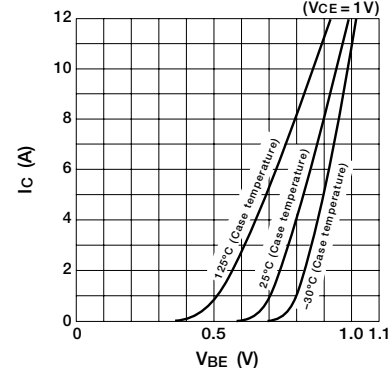
■ I_C — V_{CE} Characteristics (typ.)



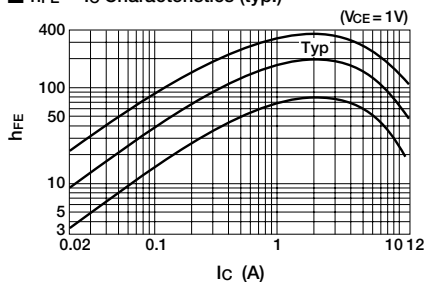
■ $V_{CE}(\text{sat}) - I_B$ Characteristics (typ.)



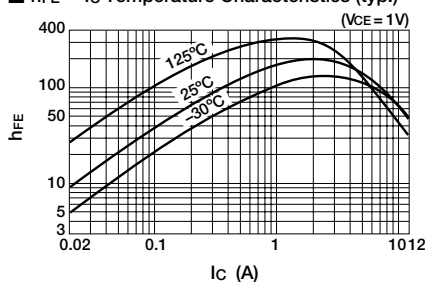
■ I_C — V_{BE} Temperature Characteristics (typ.)



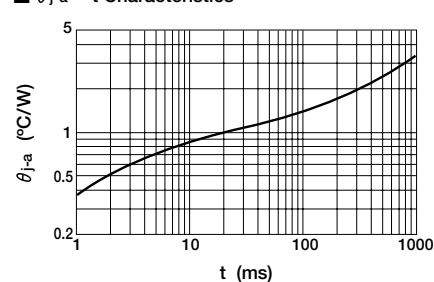
■ h_{FE} — I_C Characteristics (typ.)



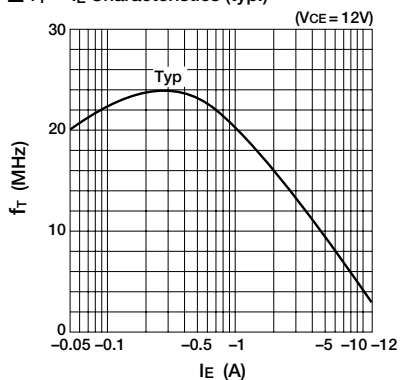
■ h_{FE} — I_C Temperature Characteristics (typ.)



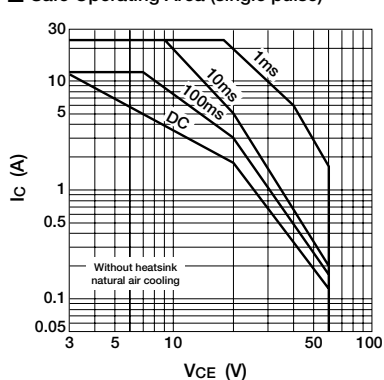
■ θ_{j-a-t} Characteristics



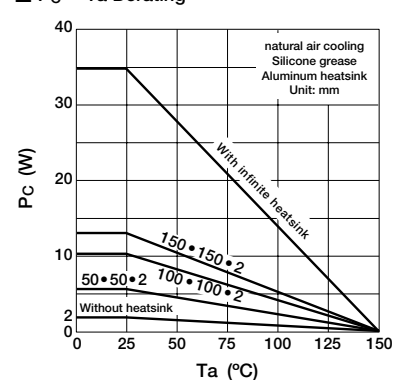
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C —Ta Derating



Power Transistor 2SC4153

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	200	V
VCEO	120	V
VEBO	8	V
IC	7 (pulse 14)	A
IB	3	A
PC	30 (Tc=25°C)	W
Tj	150	°C
Tstg	-55 to +150	°C

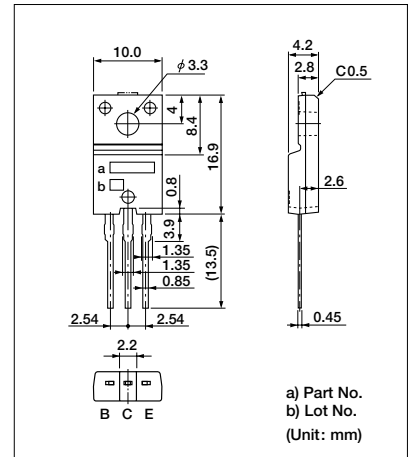
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
ICBO	VCB = 200V	100max	μA
IEBO	VEB = 8V	100max	μA
V(BR) CEO	IC = 50mA	120min	V
hFE	VCE = 4V, IC = 3A	70 to 220	
VCE (sat)	IC = 3A, IB = 0.3A	0.5max	V
VBE (sat)	IC = 3A, IB = 0.3A	1.2max	V
fT	VCE = 12V, IE = -0.5A	30typ	MHz
COB	VCB = 10V, f = 1MHz	110typ	pF

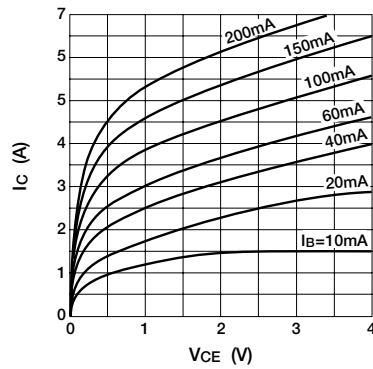
Typical Switching Characteristics (common emitter)

VCC (V)	RL (Ω)	IC (A)	VBB1 (V)	VBB2 (V)	IB1 (A)	IB2 (A)	ton (μs)	tstg (μs)	tf (μs)
50	16.7	3	10	-5	0.3	-0.6	0.5max	3max	0.5max

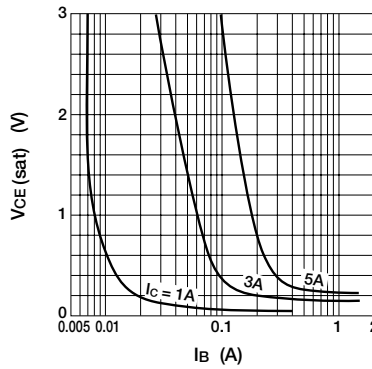
External Dimensions TO220F (full-mold)



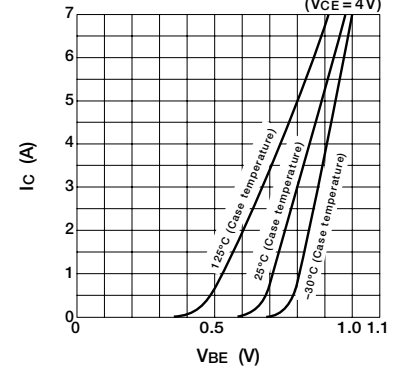
IC—VCE Characteristics (typ.)



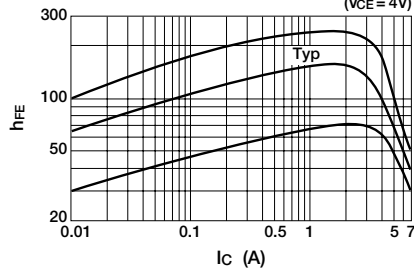
VCE (sat)—IB Characteristics (typ.)



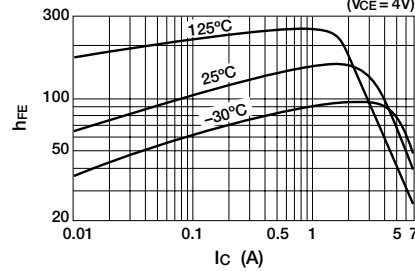
IC—VBE Temperature Characteristics (typ.)



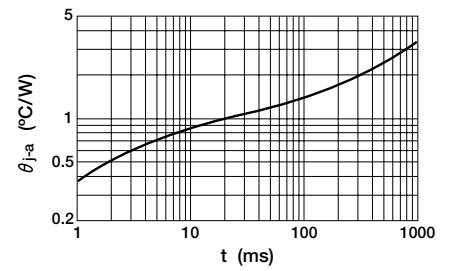
hFE—IC Characteristics (typ.)



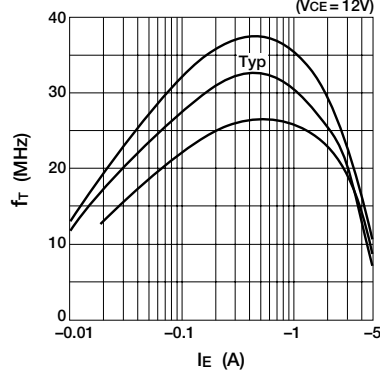
hFE—IC Temperature Characteristics (typ.)



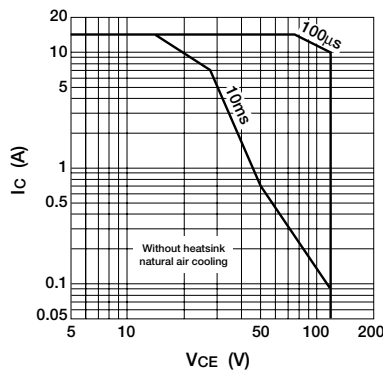
θJA—t Characteristics



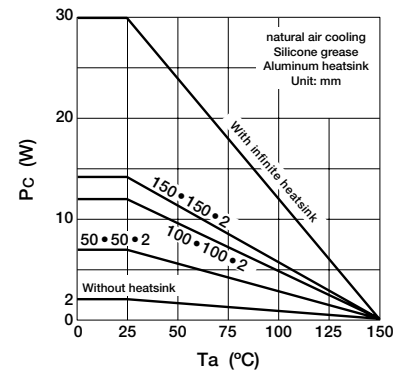
fT—IE Characteristics (typ.)



Safe Operating Area (single pulse)



PC—Ta Derating



Power Transistor 2SD2141

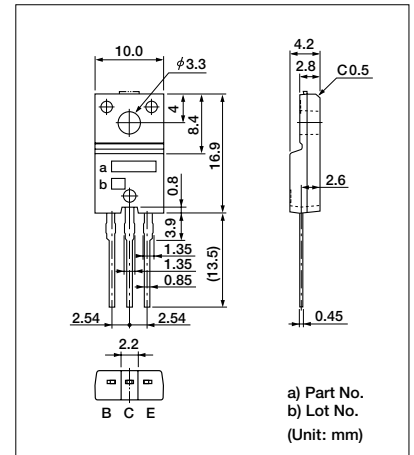
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	380±50	V
V _{CE0}	380±50	V
V _{EB0}	6	V
I _C	6 (pulse 10)	A
I _B	1	A
P _C	35 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

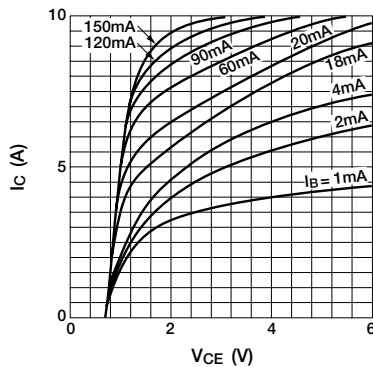
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 330V	10max	μA
I _{EB0}	V _{EB} = 6V	20max	μA
V _{(BR) CEO}	I _C = 25mA	330 to 430	V
h _{FE}	V _{CE} = 2V, I _C = 3A	1500min	
V _{CE(sat)}	I _C = 4A, I _B = 20mA	1.5max	V

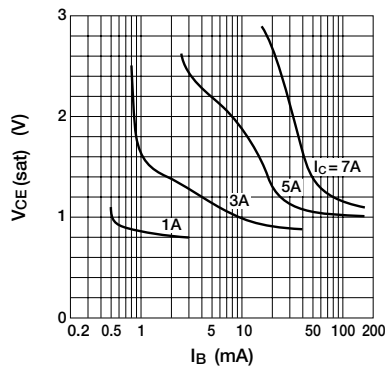
External Dimensions TO220F (full-mold)



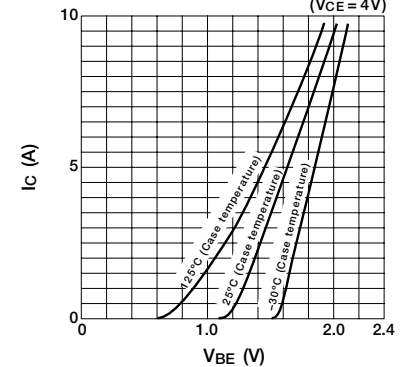
I_C—V_{CE} Characteristics (typ.)



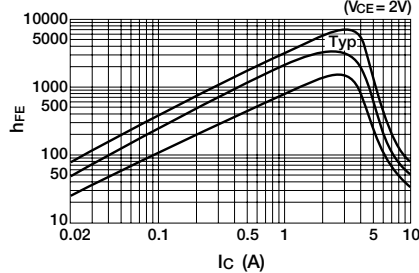
V_{CE(sat)}—I_B Characteristics (typ.)



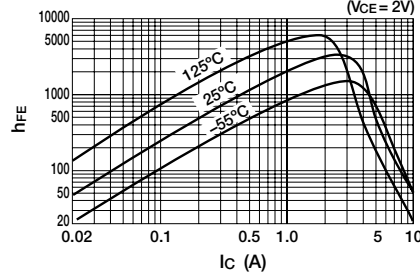
I_C—V_{BE} Temperature Characteristics (typ.)



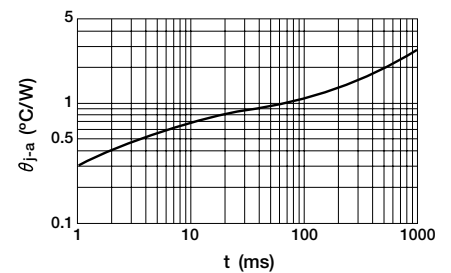
h_{FE}—I_C Characteristics (typ.)



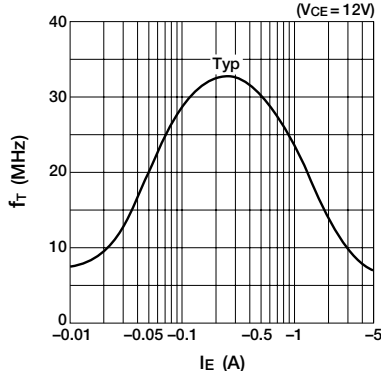
h_{FE}—I_C Temperature Characteristics (typ.)



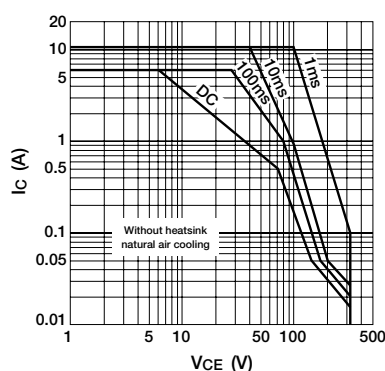
θ_{J-a}—t Characteristics



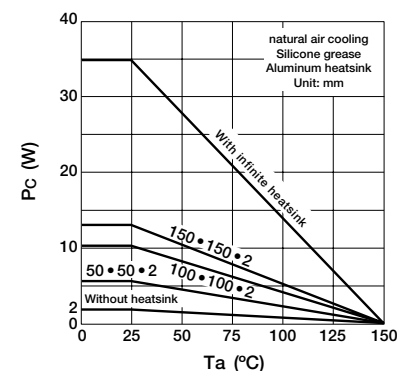
f_T—I_E Characteristics (typ.)



Safe Operating Area (single pulse)



P_C—T_a Derating



Power Transistor 2SD2382

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	65±5	V
V _{CE0}	65±5	V
V _{EB0}	6	V
I _C	±6 (pulse ±10)	A
I _B	1	A
P _C	30 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

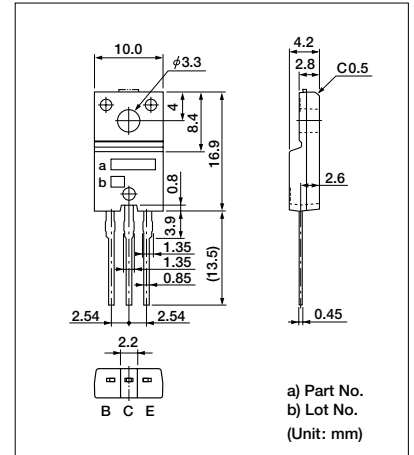
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 60V	10max	μA
I _{EB0}	V _{EB} = 6V	10max	μA
V _{CE0}	I _C = 50mA	60 to 70	V
h _{FE}	V _{CE} = 1V, I _C = 1A	700 to 3000	
V _{CE(sat)}	I _C = 1.5A, I _B = 15mA	0.15max	V
V _{FEC}	I _{FEC} = 6A	1.5max	V
Es/b	L = 10mH, single pulse	200min	mJ

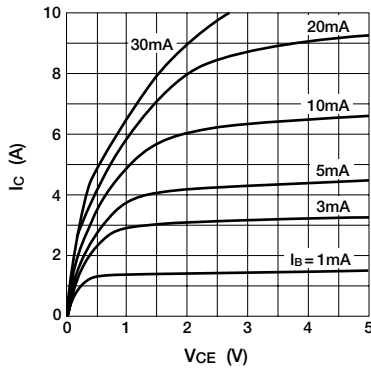
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _r (μs)
12	12	1	10	-5	30	-30	0.25	0.8	0.35

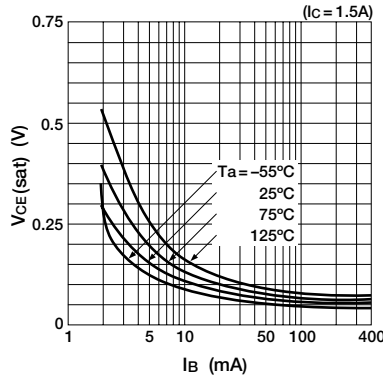
External Dimensions TO220F (full-mold)



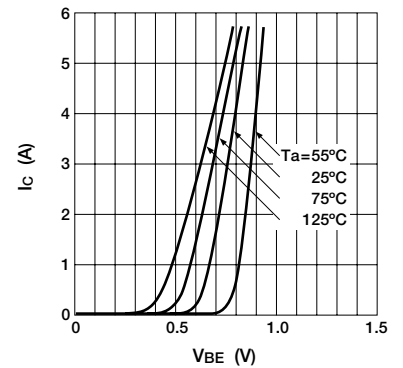
I_C—V_{CE} Characteristics (typ.)



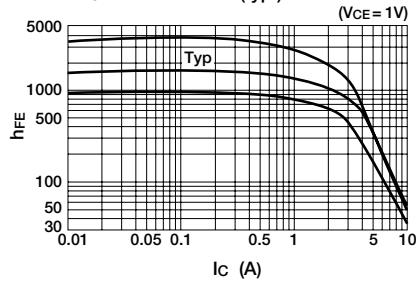
V_{CE(sat)}—I_B Temperature Characteristics (typ.)



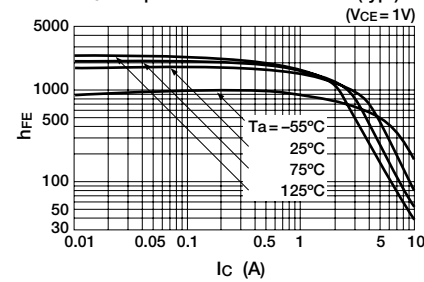
I_C—V_{BE} Temperature Characteristics (typ.)



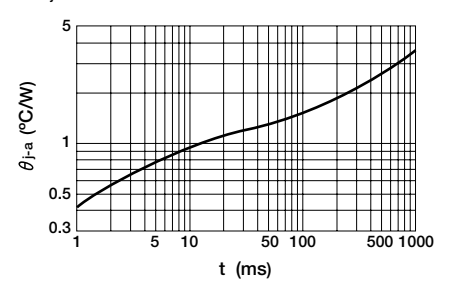
h_{FE}—I_C Characteristics (typ.)



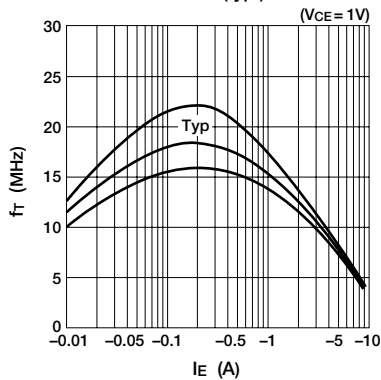
h_{FE}—I_C Temperature Characteristics (typ.)



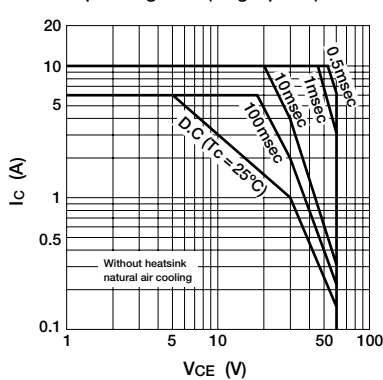
θ_{J-a}—t Characteristics



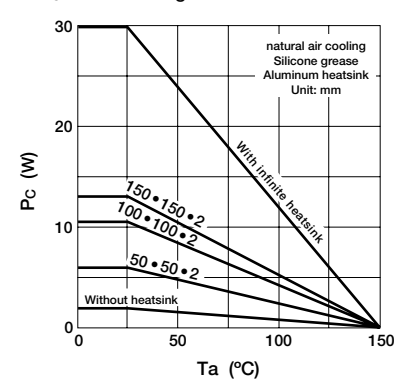
f_T—I_E Characteristics (typ.)



Safe Operating Area (single pulse)



P_C—Ta Derating



Power Transistor 2SD2633

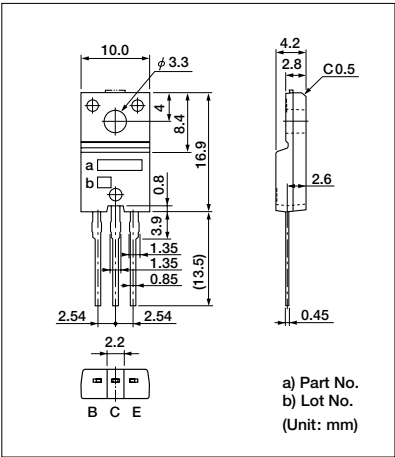
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	200	V
V _{CE0}	150	V
V _{EB0}	6	V
I _C	8	A
I _B	1	A
P _C	35 (T _C =25°C) 2 (T _a =25°C, No Fin)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} =200V	100max	μA
I _{EB0}	V _{EB} =6V	10max	mA
V _{CE0}	I _C =50mA	150min	V
h _{FE}	V _{CE} =2V, I _C =6A	2000min	
V _{CE} (sat)	I _C =6A, I _B =6mA	1.5max	V
V _{BE} (sat)	I _C =6A, I _B =6mA	2.0max	V

External Dimensions TO220F (full-mold)



Power Transistor FN812

Absolute Maximum Ratings (T_a=25°C)

Symbol	Ratings	Unit
V _{CBO}	120	V
V _{CEO}	100	V
V _{EBO}	6	V
I _C	8 (pulse 12)	A
I _B	3	A
P _C	35 (T _c =25°C)	W
T _j	150	°C
T _{stg}	-55 to +150	°C

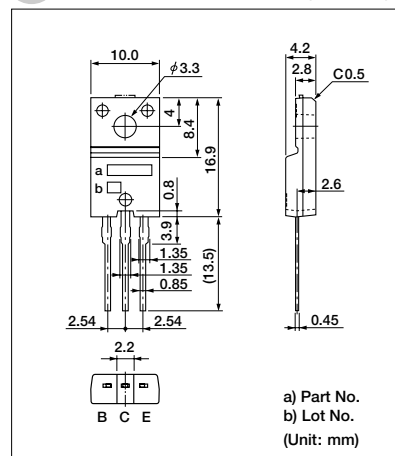
Electrical Characteristics

Symbol	Test Conditions	Ratings	Unit
ICBO	V _{CB} = 120V	10max	μA
IEBO	V _{EB} = 6V	10max	μA
V _{CEO}	I _C = 50mA	100min	V
h _{FE}	V _{CE} = 4V, I _C = 3A	70min	
V _{CE(sat)}	I _C = 4A, I _B = 0.4A	0.3max	V

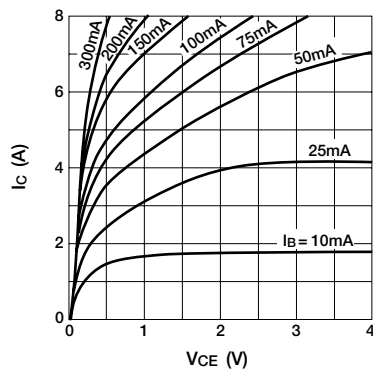
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
12	4	3	10	-5	30	-30	1.0	2.0	0.5

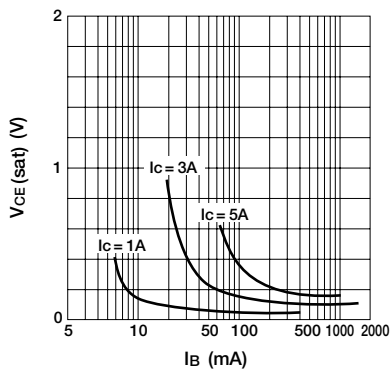
External Dimensions TO220F (full-mold)



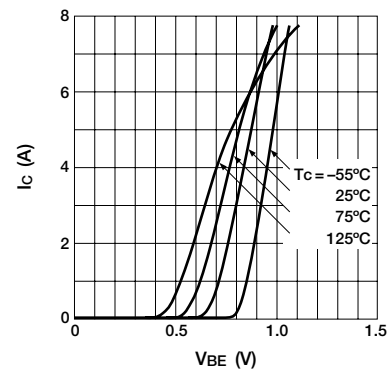
■ I_C — V_{CE} Characteristics (typ.)



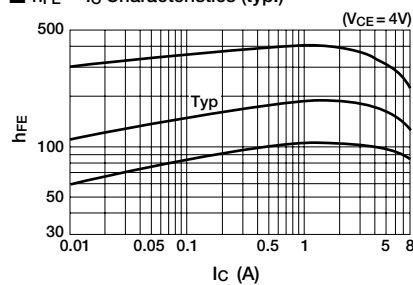
■ $V_{CE}(\text{sat})$ — I_B Characteristics (typ.)



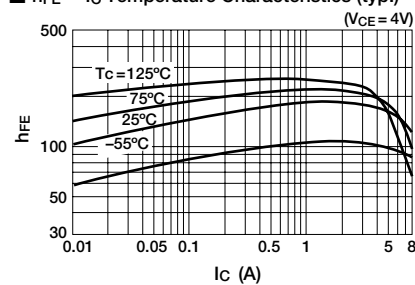
■ I_C — V_{BE} Temperature Characteristics (typ.)



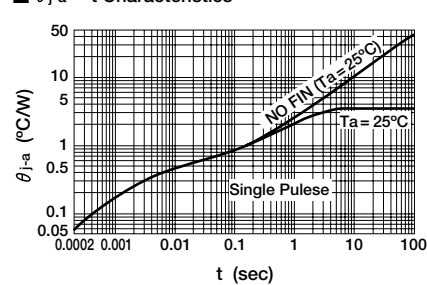
■ h_{FE} — I_C Characteristics (typ.)



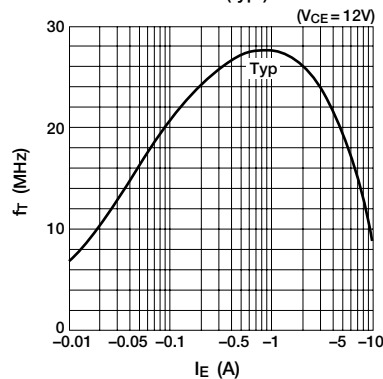
■ h_{FE} — I_C Temperature Characteristics (typ.)



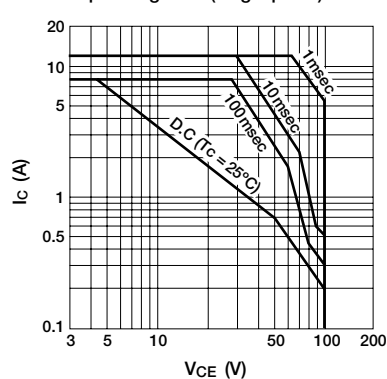
■ θ_{j-a-t} Characteristics



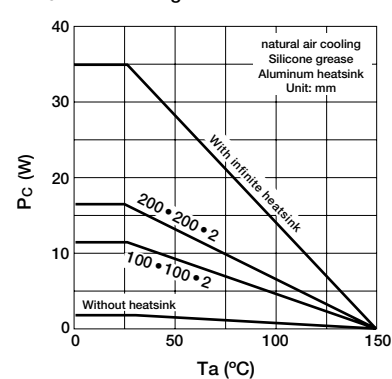
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C —Ta Derating



Power Transistor FP812

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	-120	V
V _{CE0}	-120	V
V _{EB0}	-6	V
I _C	-8 (pulse -12)	A
I _B	-3	A
P _C	35 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

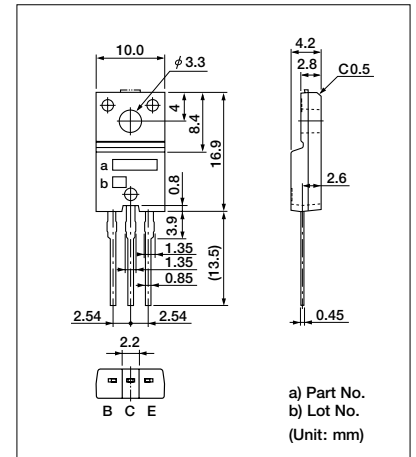
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = -120V	10max	μA
I _{EB0}	V _{EB} = -6V	10max	μA
V _{CE0}	I _C = -50mA	-120min	V
h _{FE}	V _{CE} = -4V, I _C = -3A	70min	
V _{CE(sat)}	I _C = -3A, I _B = -0.3A	-0.3max	V

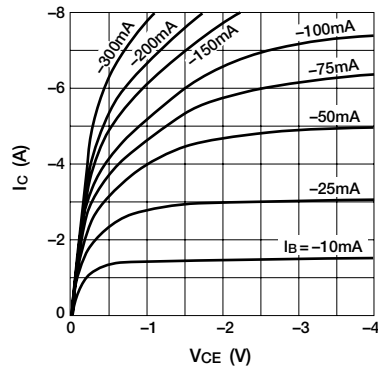
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-12	4	-3	-10	5	-30	30	2.5	0.4	0.6

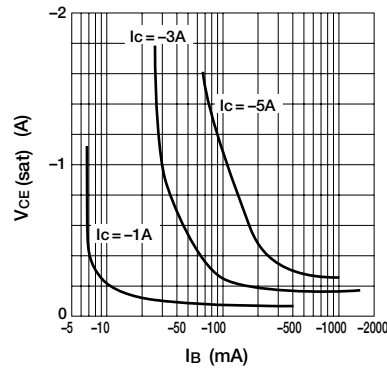
External Dimensions TO220F (full-mold)



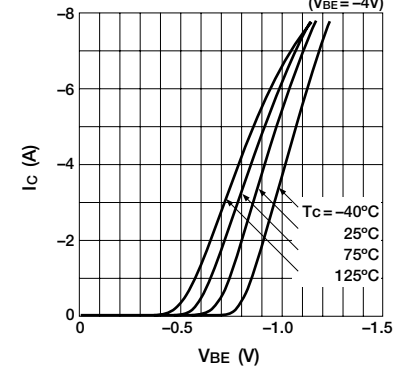
I_C—V_{CE} Characteristics (typ.)



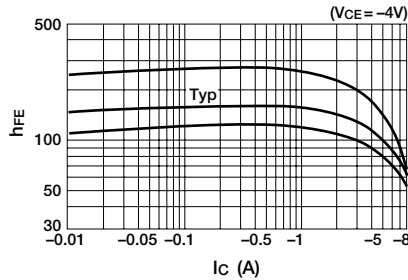
V_{CE(sat)}—I_B Characteristics (typ.)



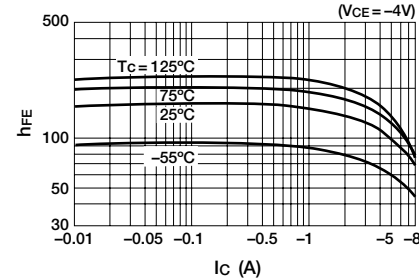
I_C—V_{BE} Temperature Characteristics (typ.)



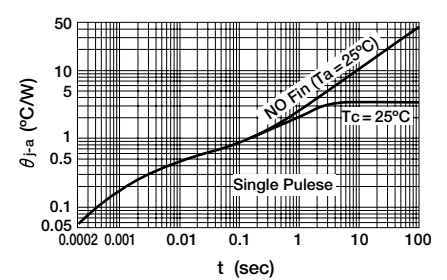
h_{FE}—I_C Characteristics (typ.)



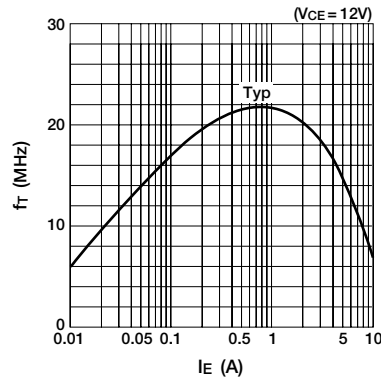
h_{FE}—I_C Temperature Characteristics (typ.)



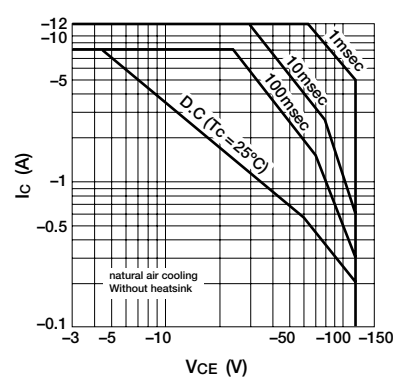
θ_{J-a}—t Characteristics



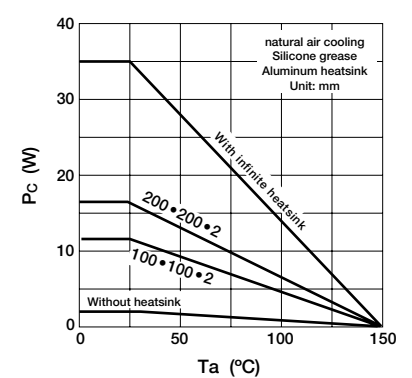
f_T—I_E Characteristics (typ.)



Safe Operating Area (single pulse)



P_C—T_a Derating



Power Transistor MN611S

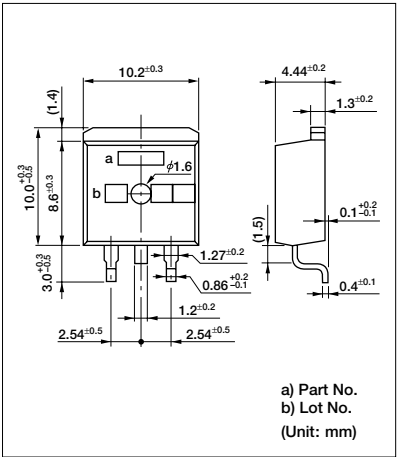
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	115±10	V
VCEO	115±10	V
VEBO	6	V
IC	±6 (pulse ±10)	A
IB	1	A
PC	50 (Tc=25°C) 1.2 (Ta=25°C, No Fin)	W
TJ	150	°C
Tstg	-55 to +150	°C

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
ICBO	VCB=105V			10	μA
IEBO	VEB=6V			10	μA
VCEO	IC=50mA	105	115	125	V
hFE	VCE=1V, IC=1A	400	800	1500	
VCE (sat)	IC=1.2A, IB=12mA		0.08	0.12	V
VFEC	IFEC=6A		1.25	1.5	V
ES/B	L=10mA	45			mJ

External Dimensions TO220S



Power Transistor MN638S

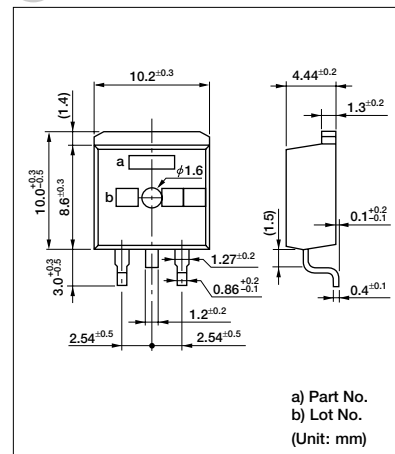
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	380±50	V
V _{CEO}	380±50	V
V _{EB0}	6	V
I _C	6 (pulse 10)	A
I _B	1	A
P _C	60 (T _C =25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

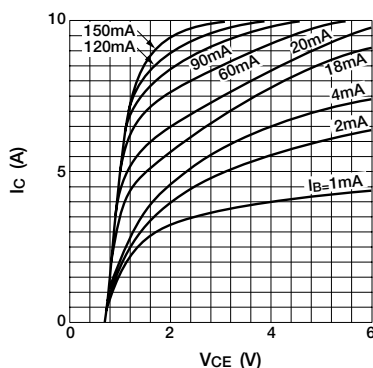
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} =330V	10max	μA
I _{EB0}	V _{EB} =6V	20max	mA
V _{(BR) CEO}	I _C =25mA	330 to 430	V
h _{FE}	V _{CE} =2V, I _C =3A	1500min	
V _{CE} (sat)	I _C =4A, I _B =20mA	1.5max	V

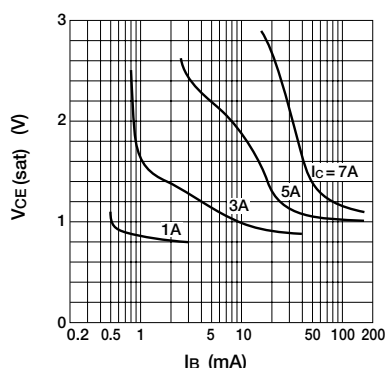
External Dimensions TO220S



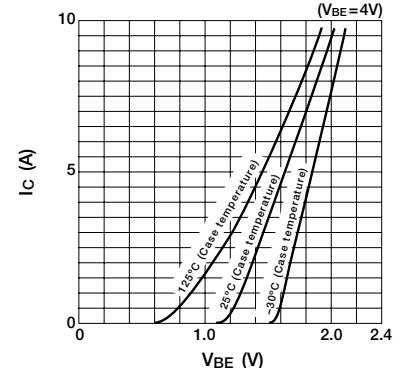
■ I_C—V_{CE} Characteristics (typ.)



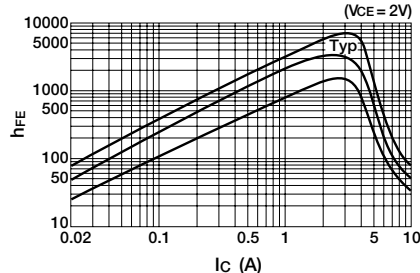
■ V_{CE}(sat)—I_B Characteristics (typ.)



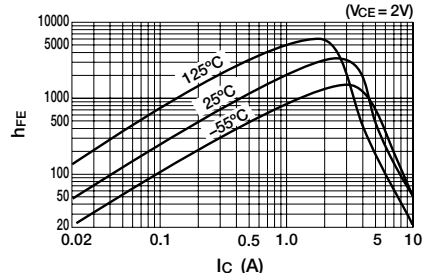
■ I_C—V_{BE} Temperature Characteristics (typ.)



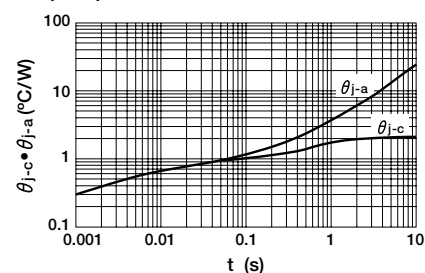
■ h_{FE}—I_C Characteristics (typ.)



■ h_{FE}—I_C Temperature Characteristics (typ.)



■ θ_{J-C}•θ_{J-A}—t Characteristics



Power Transistor Array STA315A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	35±5	V
V _{CE0}	36±5	V
V _{EB0}	6	V
I _C	2 (pulse 3*)	A
I _B	30	mA
P _T	3 (Ta=25°C) 13.5 (Tc=25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 1ms, Duty ≤ 25%

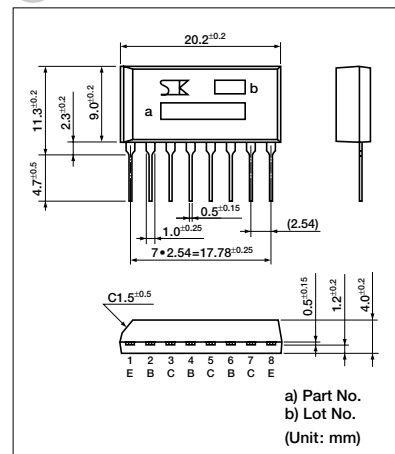
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 30V	10max	μA
I _{EB0}	V _{EB} = 6V	2.7max	mA
V _{CE0}	I _C = 25mA	31 to 41	V
h _{FE}	V _{CE} = 4V, I _C = 0.7A	400min	
V _{CE} (sat)	I _C = 0.5A, I _B = 5mA	0.2max	V
	I _C = 1A, I _B = 5mA	0.5max	V
V _{FEC}	I _{FEC} = 2A	2.5max	V
R _B		800±120	Ω
R _{BE}		2.0±0.4	kΩ
Es/b	L = 10mH, single pulse	50min	mJ

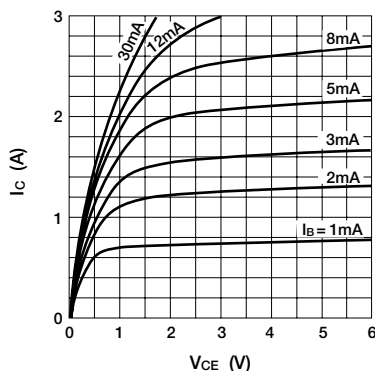
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
12	12	1	10	-5	5	0	1.0	8.5	2.5

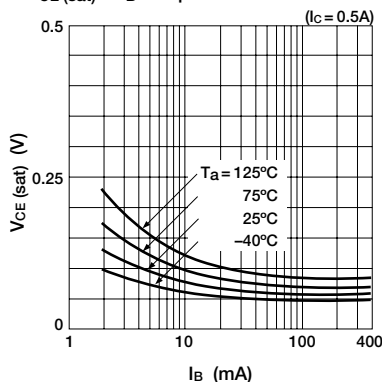
External Dimensions STA3 (LF400A)



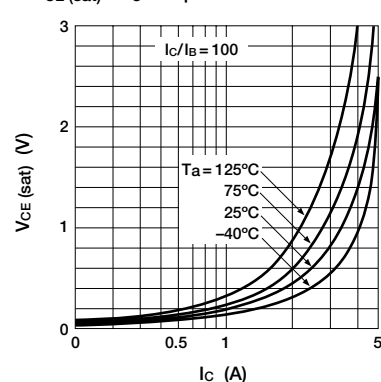
I_C — V_{CE} Characteristics (typ.)



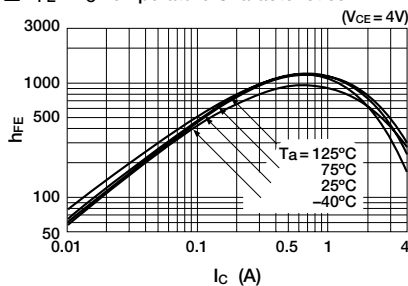
V_{CE} (sat) — I_B Temperature Characteristics



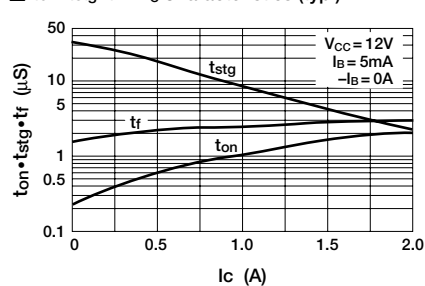
V_{CE} (sat) — I_C Temperature Characteristics



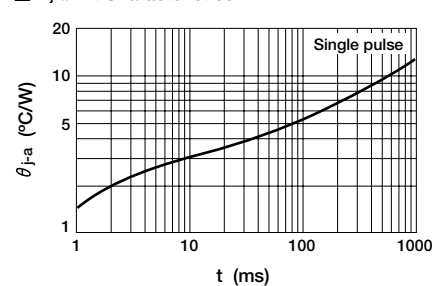
h_{FE} — I_C Temperature Characteristics



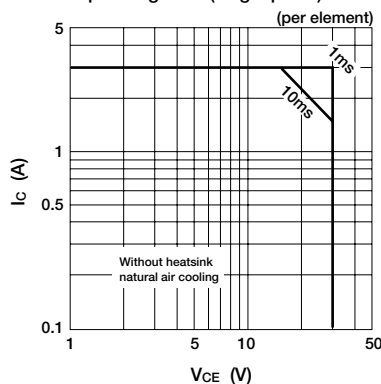
t_{on} • t_{stg} • t_f — I_C Characteristics (typ.)



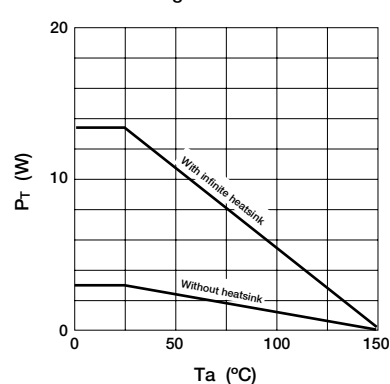
θ_{J-a} — t Characteristics



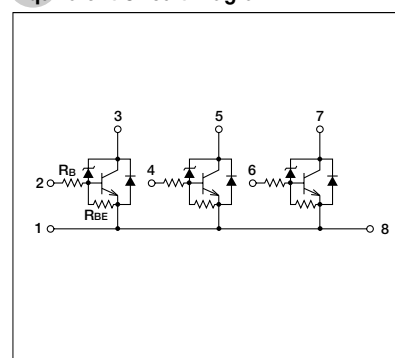
Safe Operating Area (single pulse)



P_T — T_a Derating



Equivalent Circuit Diagram



Power Transistor Array STA335A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	35±5	V
V _{CE0}	35±5	V
V _{EB0}	6	V
I _C	3	A
I _B	1	A
P _T	2.5 (Ta=25°C) 12 (Tc=25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

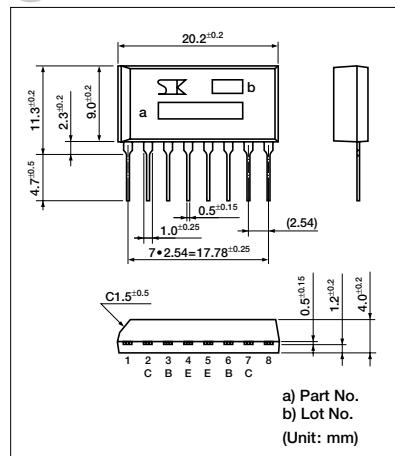
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 30V	10max	μA
I _{EB0}	V _{EB} = 6V	10max	μA
V _{CE0}	I _C = 25mA	35±5	V
h _{FE}	V _{CE} = 4V, I _C = 0.5A	500min	
V _{CE(sat)}	I _C = 1A, I _B = 5mA	0.5max	V
Es/b	L = 10mH, single pulse	150min	mJ

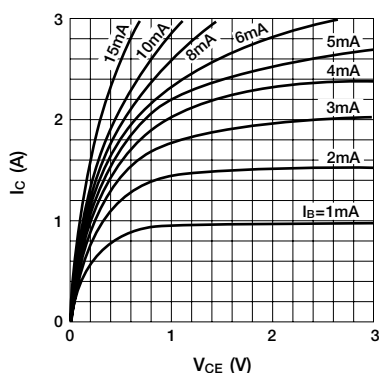
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
12	12	1	10	-5	5	5	1.3	4.7	1.2

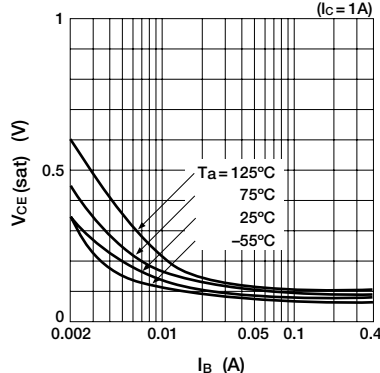
External Dimensions STA3 (LF400A)



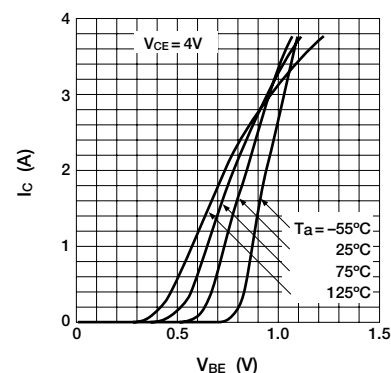
I_C — V_{CE} Characteristics (typ.)



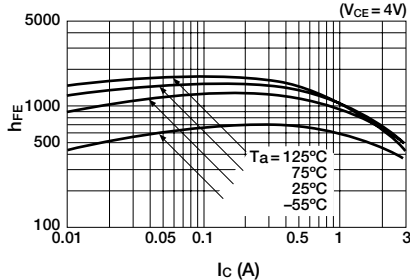
V_{CE(sat)} — I_B Temperature Characteristics



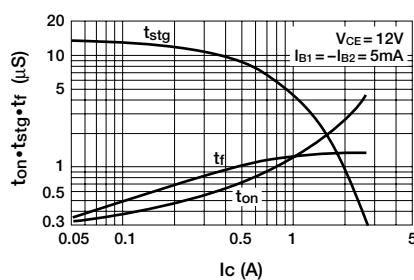
I_C — V_{BE} Temperature Characteristics (typ.)



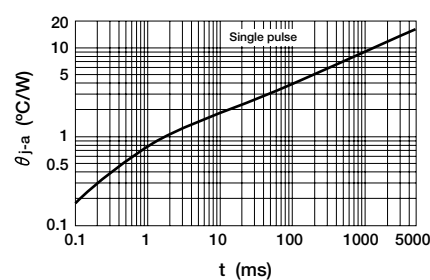
h_{FE} — I_C Temperature Characteristics (typ.)



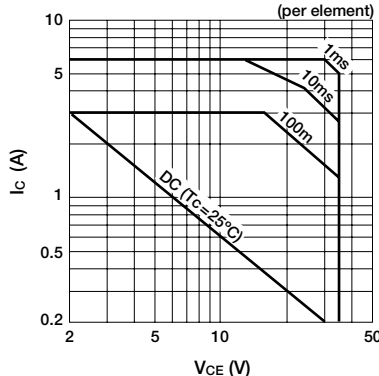
t_{on}•t_{stg}•t_f — I_C Characteristics (typ.)



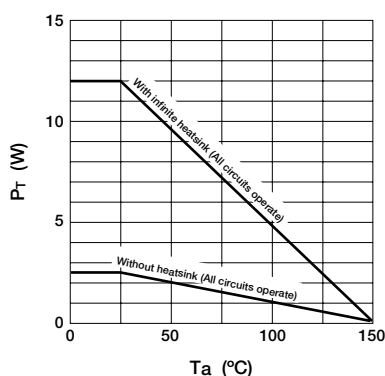
θ_{J-a} — t Characteristics



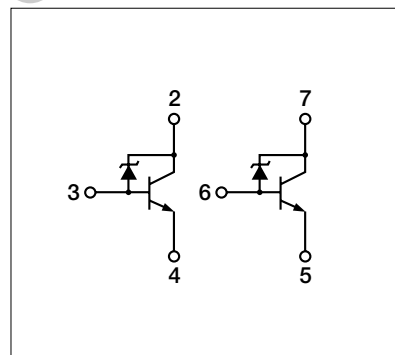
Safe Operating Area (single pulse)



P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA415A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
VCBO	35±5	V
VCEO	36±5	V
VEBO	6	V
IC	2 (pulse 3*)	A
IB	30	mA
PT	4 (Ta = 25°C) 18 (Tc = 25°C)	W
Tj	150	°C
Tstg	-55 to +150	°C

* PW ≤ 1ms, Duty ≤ 25%

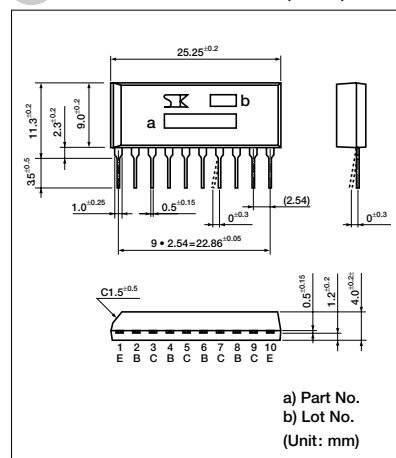
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
ICBO	VCB = 30V	10max	μA
IEBO	VEB = 6V	2.7max	mA
VCEO	IC = 25mA	31 to 41	V
hFE	VCE = 4V, IC = 0.7A	400min	
VCE(sat)	IC = 0.5A, IB = 5mA	0.2max	V
	IC = 1A, IB = 5mA	0.5max	V
VFEC	IFEC = 2A	2.5max	V
RB		800±120	Ω
RBE		2.0±0.4	kΩ
Es/b	L = 10mH, single pulse	50min	mJ

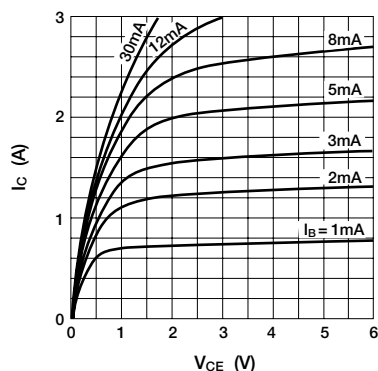
Typical Switching Characteristics

VCC (V)	RL (Ω)	IC (A)	VBB1 (V)	VBB2 (V)	IB1 (mA)	IB2 (mA)	ton (μs)	tstg (μs)	tr (μs)
12	12	1	10	-5	5	0	1.0	8.5	2.5

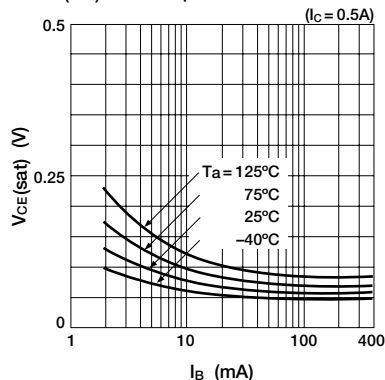
External Dimensions STA4 (LF412)



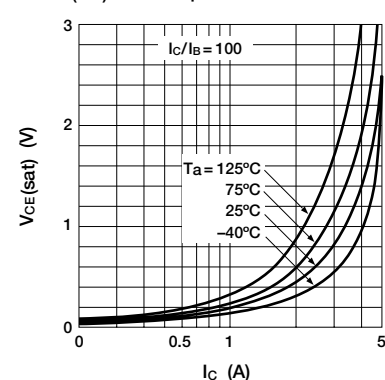
IC — VCE Characteristics (typ.)



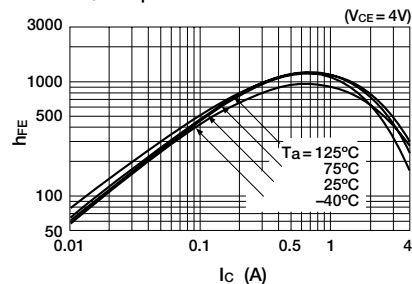
VCE(sat) — IB Temperature Characteristics



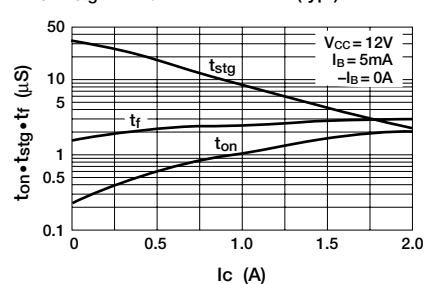
VCE(sat) — IC Temperature Characteristics



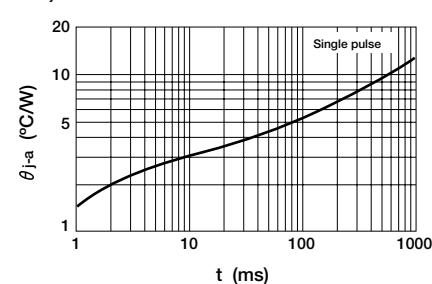
hFE — IC Temperature Characteristics



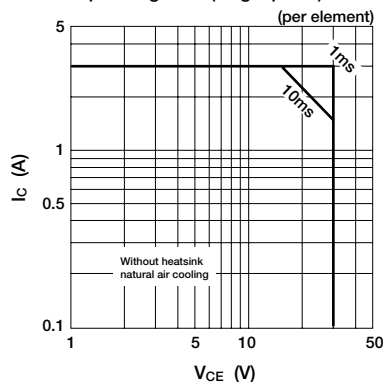
ton•tstg•tr — IC Characteristics (typ.)



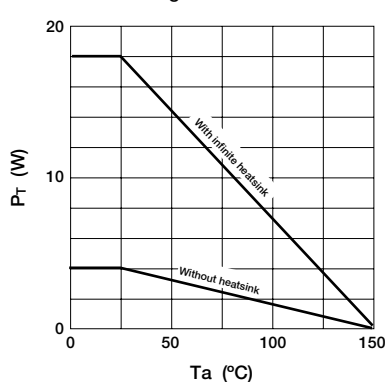
θJA — t Characteristics



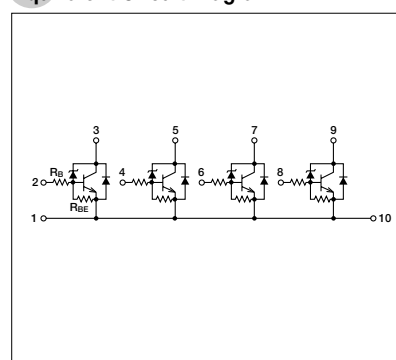
Safe Operating Area (single pulse)



PT — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA461C

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	65±5	V
V _{CEO}	65±5	V
V _{EB0}	6	V
I _C	±6 (pulse ±10)	A
I _B	1	A
P _T	3.2 (Ta = 25°C)	W
	18 (Tc = 25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

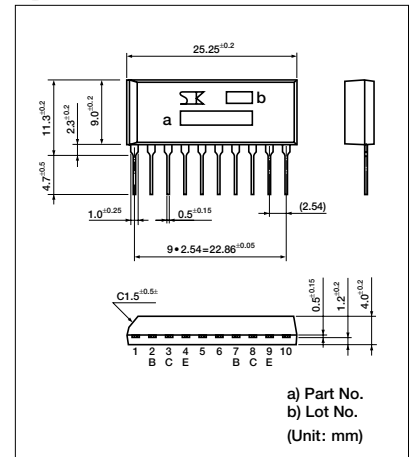
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 60V	10max	μA
I _{EB0}	V _{EB} = 6V	10max	μA
V _{CEO}	I _C = 50mA	60 to 70	V
h _{FE}	V _{CE} = 1V, I _C = 1A	400 to 1500	
V _{CE(sat)}	I _C = 1.5A, I _B = 15mA	0.15max	V
V _{FEC}	I _{FEC} = 6A	1.5max	V
Es/b	L = 10mH, single pulse	80min	mJ

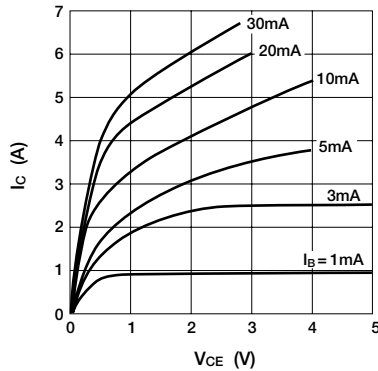
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
12	12	1	10	-5	30	-30	0.2	3.9	0.2

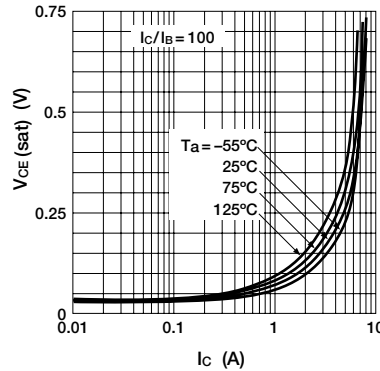
External Dimensions STA4 (LF400B)



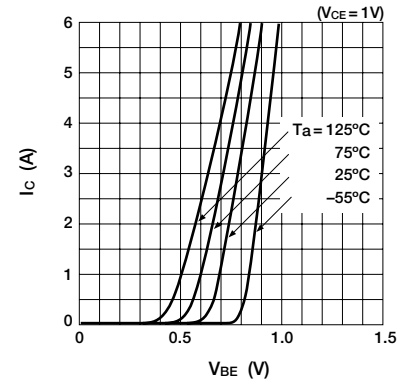
I_C—V_{CE} Characteristics (typ.)



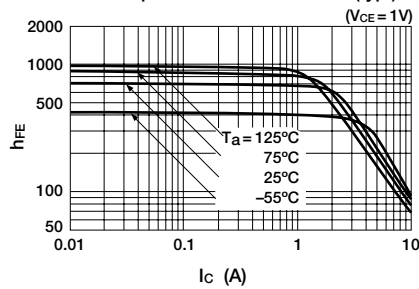
V_{CE(sat)}—I_C Temperature Characteristics (typ.)



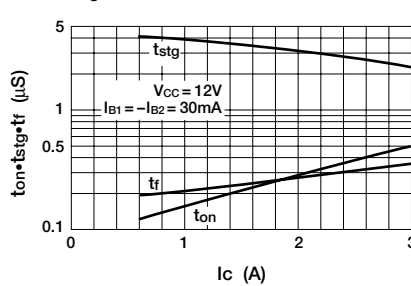
I_C—V_{BE} Temperature Characteristics (typ.)



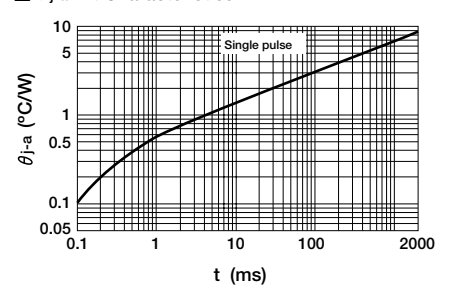
h_{FE}—I_C Temperature Characteristics (typ.)



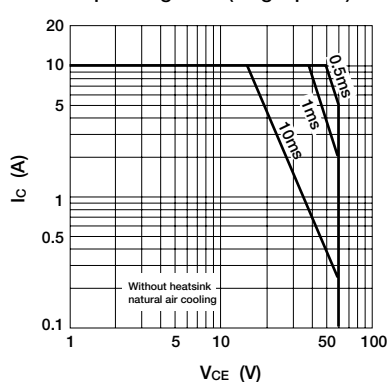
t_{on}•t_{stg}•t_f—I_C Characteristics



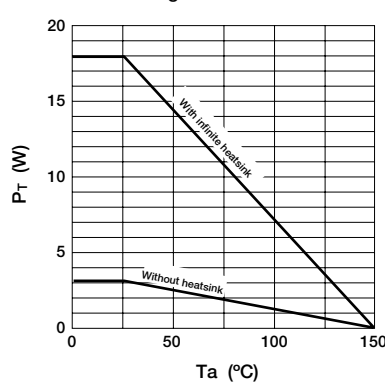
θ_{J-a}—t Characteristics



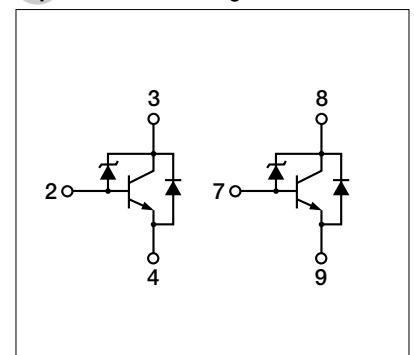
Safe Operating Area (single pulse)



P_T—T_a Derating



Equivalent Circuit Diagram



Power Transistor Array STA463C

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	115±10	V
V _{CEO}	115±10	V
V _{EB0}	6	V
I _C	±6 (pulse ±10)	A
I _B	1	A
P _T	3.2 (Ta=250°C) 18 (Tc=25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

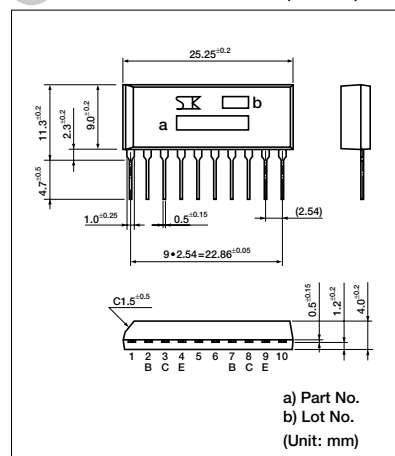
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 105V	10max	μA
I _{EB0}	V _{EB} = 6V	10max	μA
V _{CEO}	I _C = 50mA	105 to 125	V
h _{FE}	V _{CE} = 1V, I _C = 1A	400 to 1500	
V _{CE(sat)}	I _C = 1.2A, I _B = 12mA	0.12max	V
V _{FEC}	I _{FEC} = 6A	1.5max	V
Es/b	L = 10mH, single pulse	45min	mJ

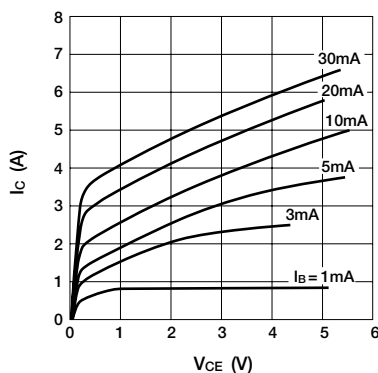
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
12	12	1	10	-5	30	-30	0.2	5.7	0.4

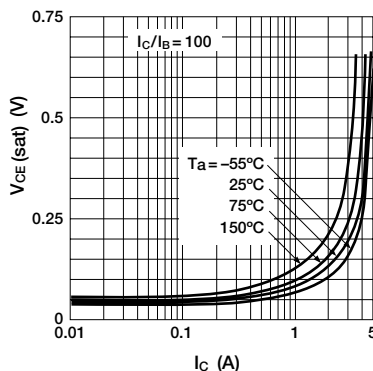
External Dimensions STA4 (LF400B)



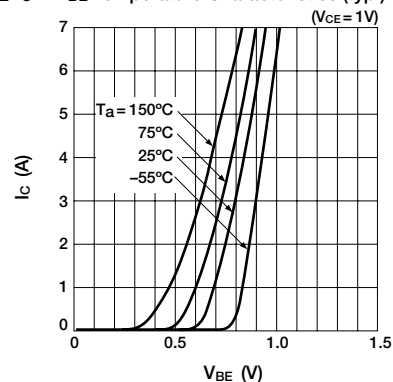
I_C — V_{CE} Characteristics (typ.)



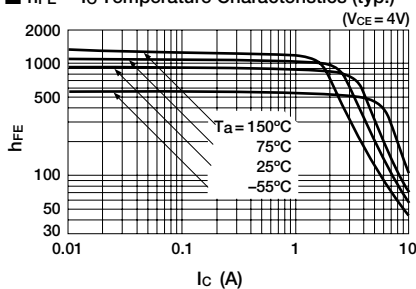
V_{CE(sat)} — I_C Temperature Characteristics (typ.)



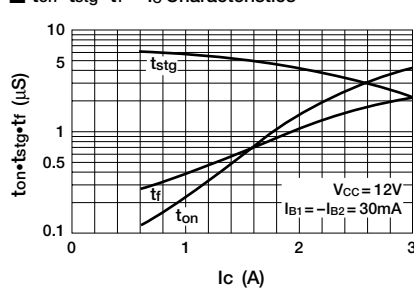
I_C — V_{BE} Temperature Characteristics (typ.)



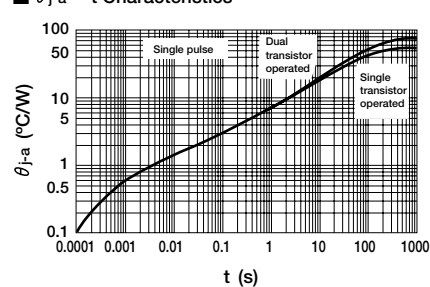
h_{FE} — I_C Temperature Characteristics (typ.)



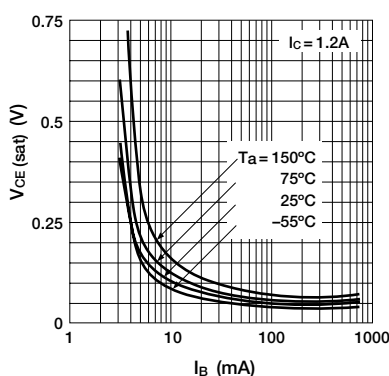
t_{on} • t_{stg} • t_f — I_C Characteristics



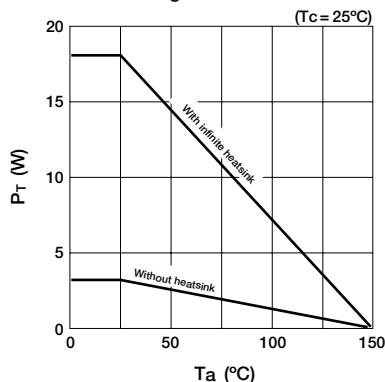
θ_{J-a} — t Characteristics



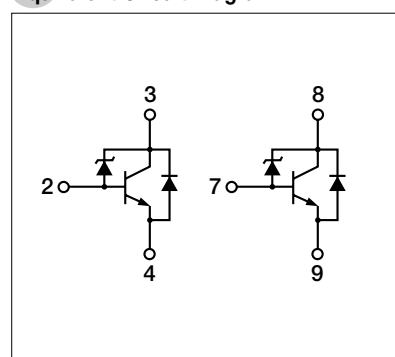
V_{CE(sat)} — I_B Temperature Characteristics (typ.)



P_T — T_a Derating



Equivalent Circuit Diagram



Power Transistor Array STA464C

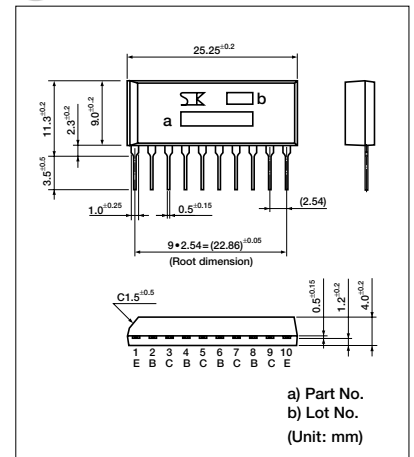
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	65±5	V
V _{CEO}	65±5	V
V _{EB0}	6	V
I _C	6 (pulse 10)	A
I _B	1	A
P _C	20 (Tc=25°C) 4 (Ta=25°C)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

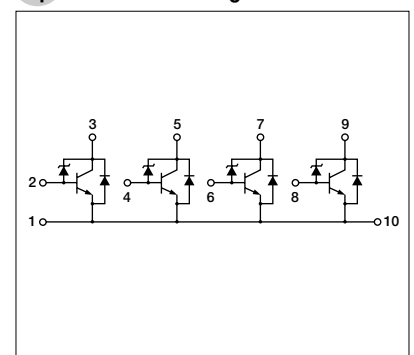
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
I _{CB0}	V _{CB} =60V			10	μA
I _{EB0}	V _{EB} =6V			10	μA
V _{CEO}	I _C =50mA	60	65	70	V
h _{FE}	V _{CE} =1V, I _C =1A	400	800	1500	
V _{CE (sat)}	I _C =1.5A, I _B =15mA		0.09	0.15	V
V _{FEC}	I _{FEC} =6A		1.25	1.5	V
Es/b	L=10mH	80			mJ

External Dimensions STA4



Equivalent Circuit Diagram



Power Transistor Array SLA8004

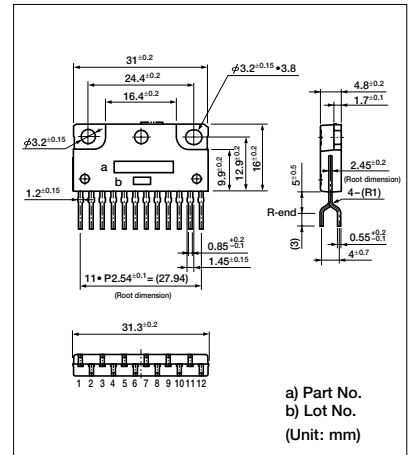
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings		Unit
	NPN	PNP	
VCBO	60	-55	V
VCEO	60	-55	V
VEBO	6	-6	V
IC	12	-12	A
IB	3	-3	A
Pr	5 (Tc=25°C, No Fin)		W
	40 (Tc=25°C)		W
Tj	150		°C
Tstg	-55 to +150		°C

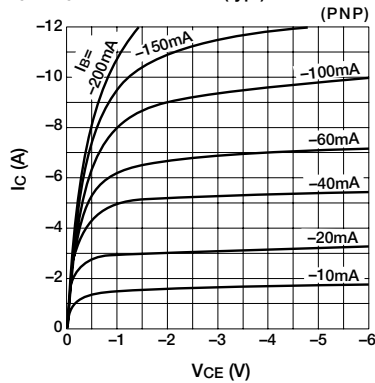
Electrical Characteristics (Ta=25°C)

Symbol	NPN		PNP		Unit
	Test Conditions	Ratings	Test Conditions	Ratings	
ICBO	VCB = 60V	100max	VCB = -55V	-100max	μA
IEBO	VEB = 6V	60max	VEB = -6V	-60max	mA
VCEO	IC = 25mA	60min	IC = -25mA	-55min	V
hFE	VCE = 1V, IC = 3A	150min	VCE = -1V, IC = -3A	80min	
VCE(sat)	IC = 6A, IB = 0.3A	0.35max	IC = -6A, IB = -0.3A	-0.35max	V
VFEC	IFEC = 10A	2.5max	IFEC = 10A	2.5max	V

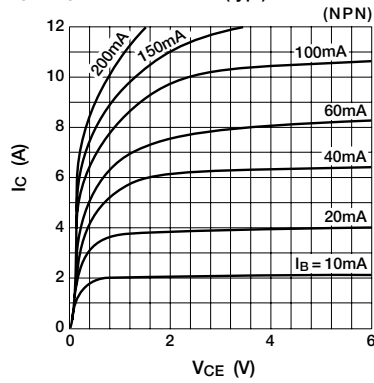
External Dimensions SLA (LF817)



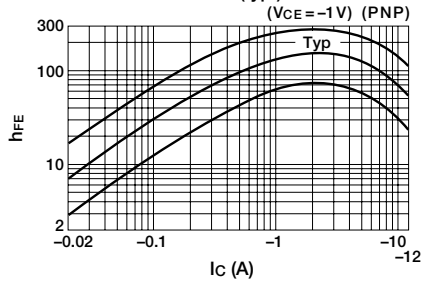
IC—VCE Characteristics (typ.) (PNP)



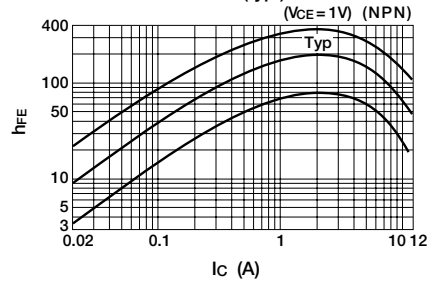
IC—VCE Characteristics (typ.) (NPN)



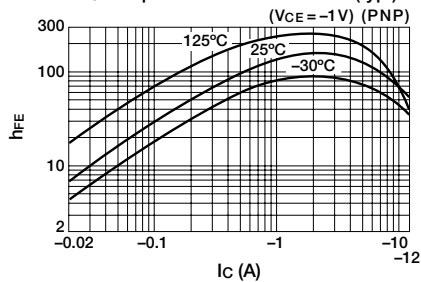
hFE—IC Characteristics (typ.) (PNP)



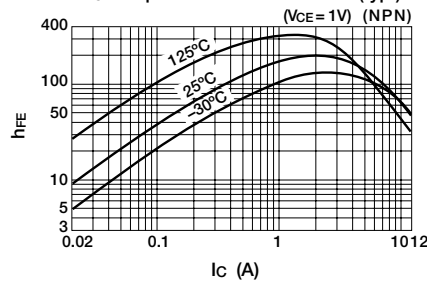
hFE—IC Characteristics (typ.) (NPN)



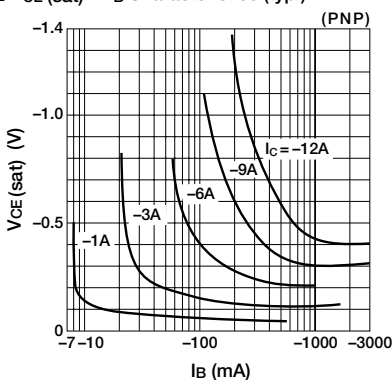
hFE—IC Temperature Characteristics (typ.) (PNP)



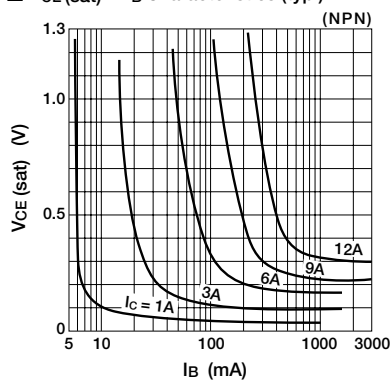
hFE—IC Temperature Characteristics (typ.) (NPN)



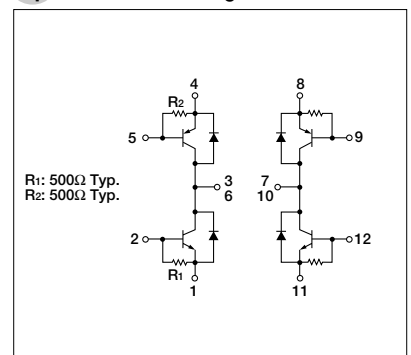
VCE(sat)—IB Characteristics (typ.) (PNP)



VCE(sat)—IB Characteristics (typ.) (NPN)



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDA03

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	-60	V
V _{CE0}	-60	V
V _{EB0}	-6	V
I _C	-6 (pulse -12)	A
I _B	-1	A
P _T	3 (No Fin)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

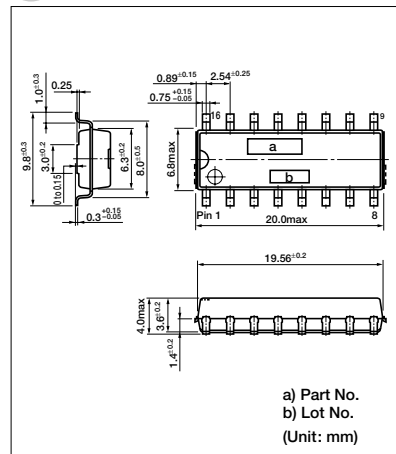
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = -60V	-10max	μA
I _{EB0}	V _{EB} = -6V	-10max	μA
V _{CE0}	I _C = -25mA	-60min	V
h _{FE}	V _{CE} = -4V, I _C = -2A	100min	
V _{CE(sat)}	I _C = -2A, I _B = -0.1A	-0.4max	V

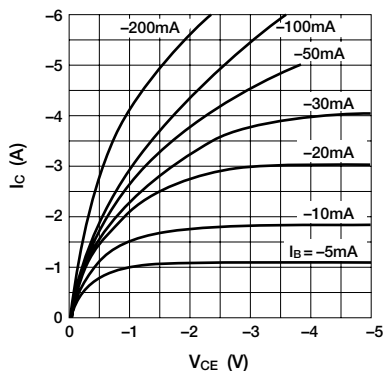
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-12	12	-1	-10	5	-50	50	0.4	1.75	0.22

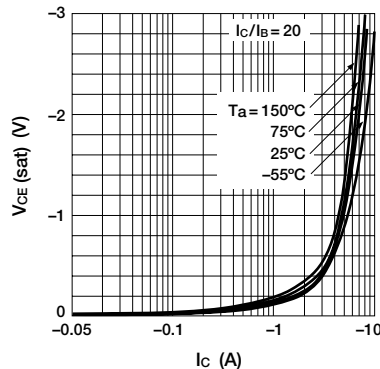
External Dimensions SMD-16A



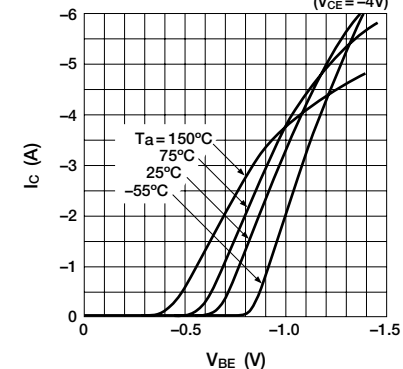
I_C — V_{CE} Characteristics



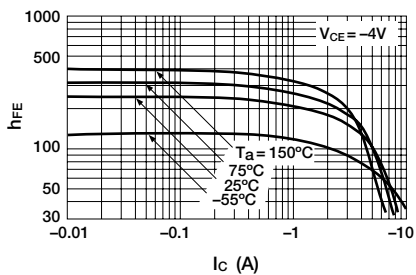
V_{CE(sat)} — I_C Temperature Characteristics (typ.)



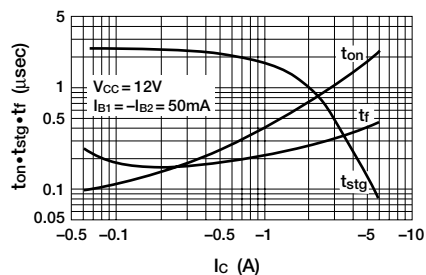
I_C — V_{BE} Temperature Characteristics (typ.)



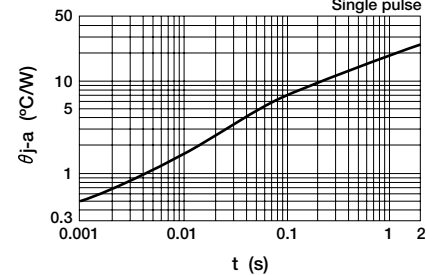
h_{FE} — I_C Temperature Characteristics



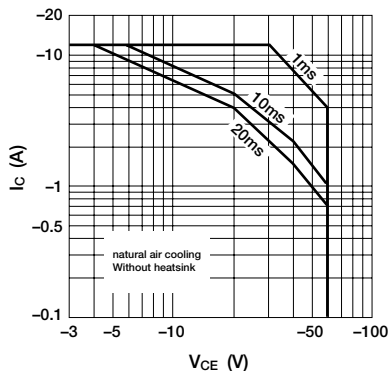
t_{on} • t_{stg} • t_f — I_C Characteristics



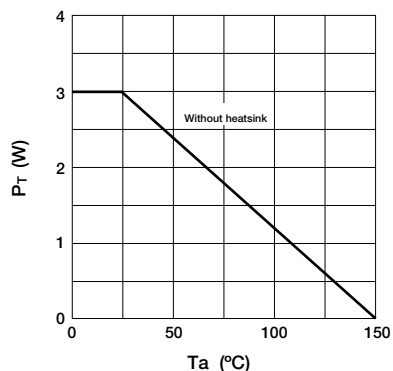
θ_{JA} — t Characteristics



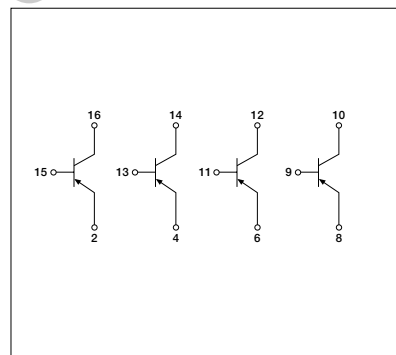
Safe Operating Area (single pulse)



P_T — Ta Derating



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDA04

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{CB0}	-60	V
V _{CE0}	-60	V
V _{EB0}	-6	V
I _C	-6 (pulse -12)	A
I _B	-1	A
P _T	2.5 (No Fin)	W
T _J	150	°C
T _{stg}	-55 to +150	°C

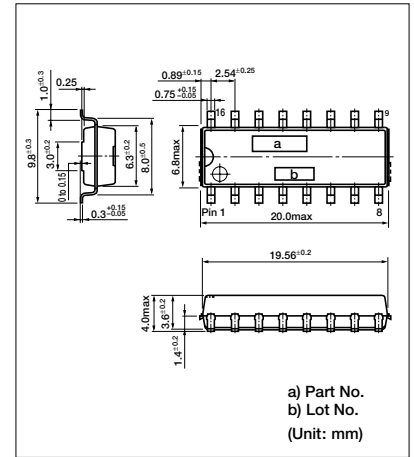
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CBO}	V _{CB} = -60V	-10max	μA
I _{EB0}	V _{EB} = -6V	-10max	μA
V _{CE0}	I _C = -25mA	-60min	V
h _{FE}	V _{CE} = -4V, I _C = -2A	100min	
V _{CE(sat)}	I _C = -2A, I _B = -0.1A	-0.4max	V

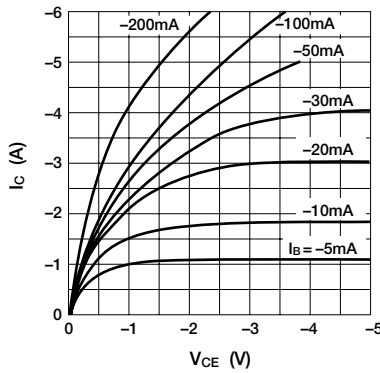
Typical Switching Characteristics

V _{CC} (V)	R _L (Ω)	I _C (A)	V _{BB1} (V)	V _{BB2} (V)	I _{B1} (mA)	I _{B2} (mA)	t _{on} (μs)	t _{stg} (μs)	t _f (μs)
-12	12	-1	-10	5	-50	50	0.4	1.75	0.22

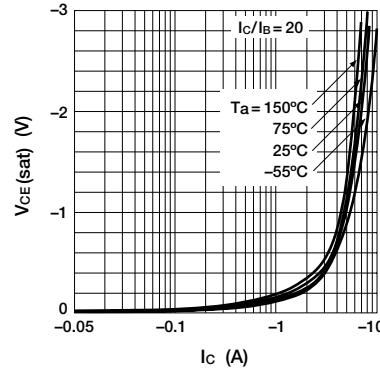
External Dimensions SMD-16A



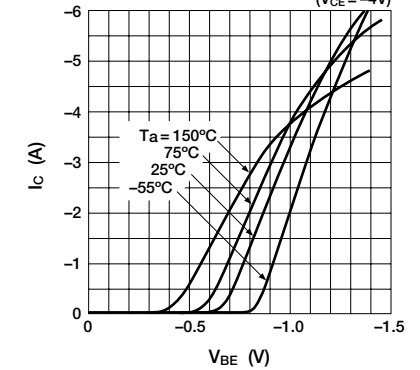
I_C — V_{CE} Characteristics



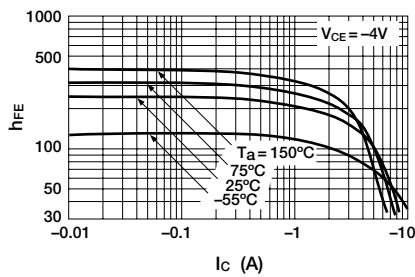
V_{CE(sat)} — I_C Temperature Characteristics (typ.)



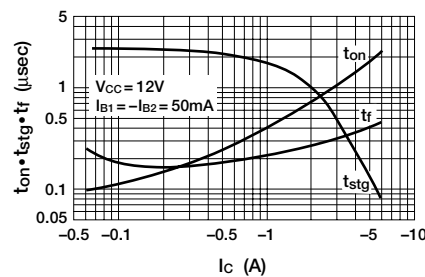
I_C — V_{BE} Temperature Characteristics (typ.)



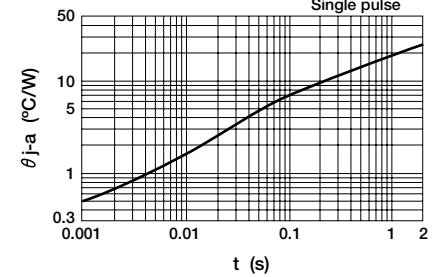
h_{FE} — I_C Temperature Characteristics



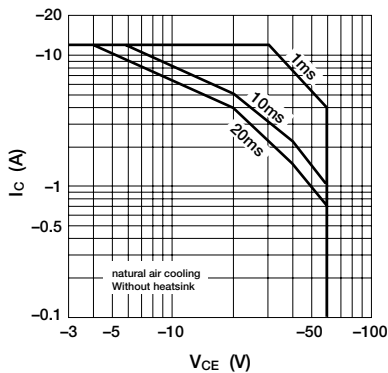
t_{on}•t_{stg}•t_f — I_C Characteristics



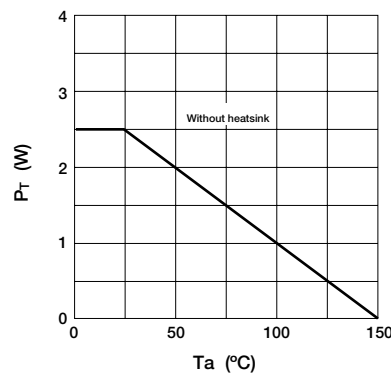
θ_{J-A} — t Characteristics



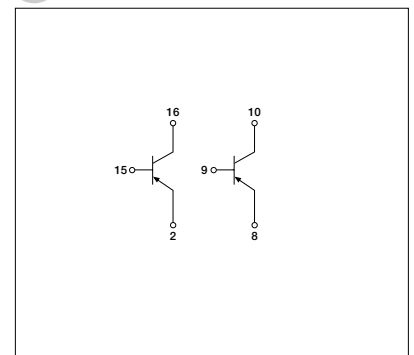
Safe Operating Area (single pulse)



P_T — Ta Derating



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDC09

Absolute Maximum Ratings (Ta=25°C)

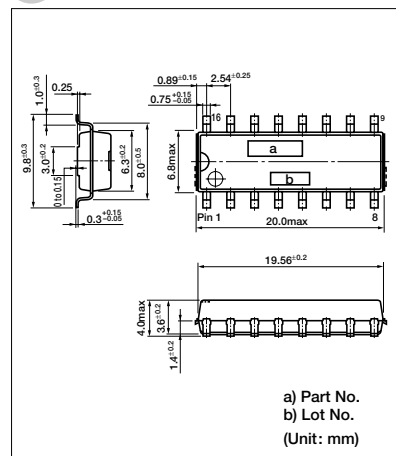
Symbol	Ratings	Unit
V _{CB0}	65±5	V
V _{CE0}	65±5	V
V _{EB0}	6	V
I _C	6 (pulse 10*)	A
I _B	1	A
P _T	2.8	W
T _J	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, Duty ≤ 1%

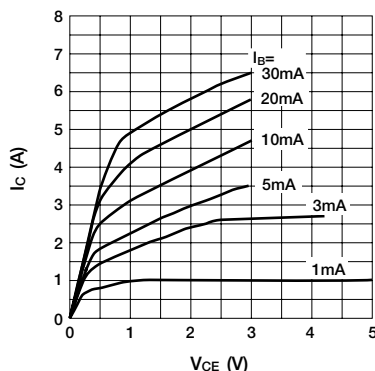
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I _{CB0}	V _{CB} = 60V	10max	μA
I _{EB0}	V _{EB} = 6V	10max	μA
V _{CE0}	I _C = 50mA	60 to 70	V
h _{FE}	V _{CE} = 1V, I _C = 1A	400 to 1500	
V _{CE(sat)}	I _C = 1.5A, I _B = 15mA	0.15max	V
V _{FEC}	I _{FEC} = 6A	1.5max	V
Es/b	L = 10mH, single pulse	80min	mJ

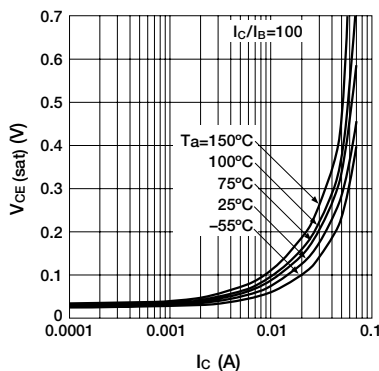
External Dimensions SMD-16A



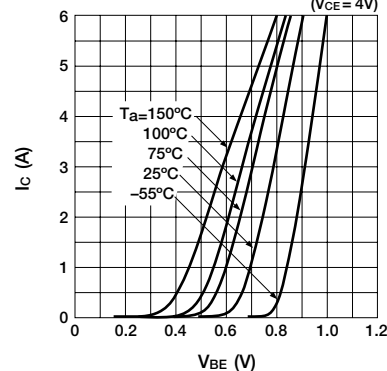
I_C—V_{CE} Characteristics



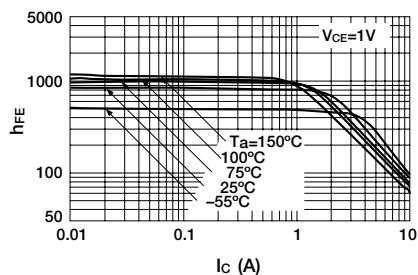
V_{CE(sat)}—I_C Temperature Characteristics (typ.)



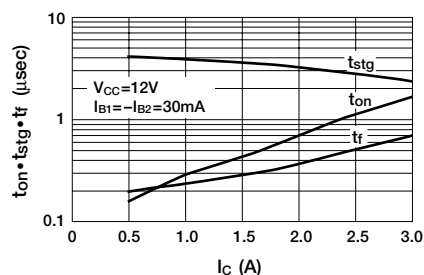
I_C—V_{BE} Temperature Characteristics (typ.)



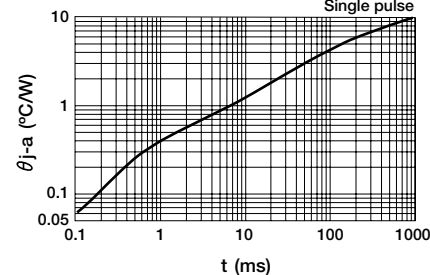
h_{FE}—I_C Temperature Characteristics



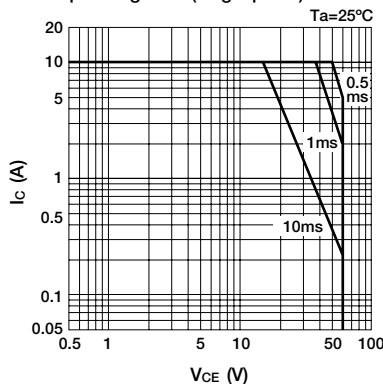
ton·tstg·tr—I_C Characteristics



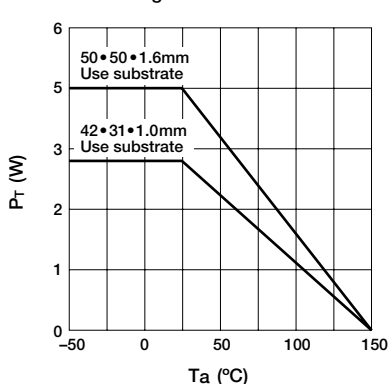
θ_{j-a}—t Characteristics



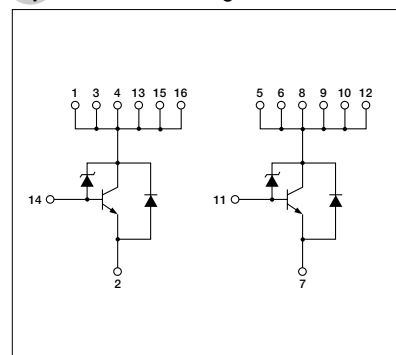
Safe Operating Area (single pulse)



P_T—Ta Derating



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SPF0001

Absolute Maximum Ratings (Ta=25°C)

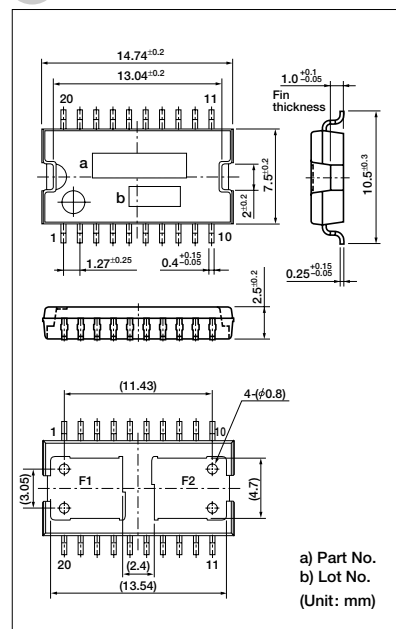
Symbol	Ratings	Unit
V _{CB0}	115±10	V
V _{CEO}	115±10	V
V _{EB0}	6	V
I _C	±6 (pulse ±10)	A
I _B	1	A
P _T *	2.5 (Ta=25°C)	W
T _J	150	°C
Tstg	-55 to +150	°C

* Use glass epoxy substrate (FR4) 70mm•100mm•1.6mm

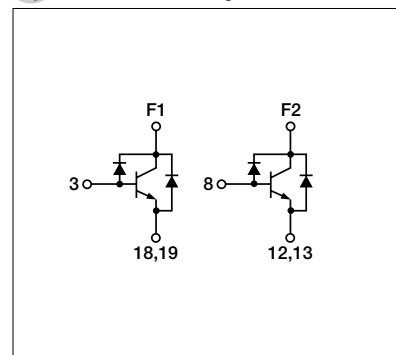
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
I _{CB0}	V _{CB} =105V			10	μA
I _{EB0}	V _{EB} =6V			10	μA
V _{CEO}	I _C =50mA	105	115	125	V
h _{FE}	V _{CE} =1V, I _C =1A	400	800	1500	
V _{CE (sat)}	I _C =1.2A, I _B =12mA		0.08	0.12	V
V _{FEC}	I _{FEC} =6A		1.25	1.5	V
Es/b	L=10mH	45			mJ

External Dimensions SMD-16A



Equivalent Circuit Diagram



MOS FET 2SK2701

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	450	V
V _{GSS}	±30	V
I _D	±7	A
I _D (pulse)*1	±28	A
P _T	35 (Tc=25°C)	W
EAS*2	130	mJ
I _{AS}	7	A
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

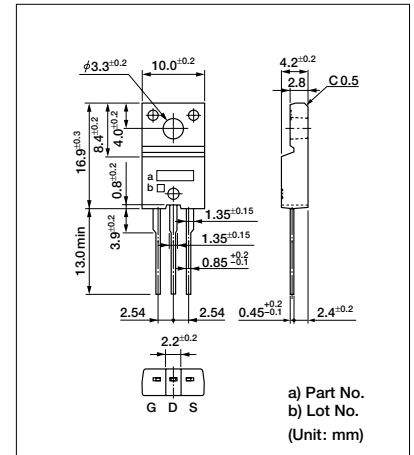
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DD} = 30V, L = 5mH, I_L = 7A, unclamped, R_G = 50Ω

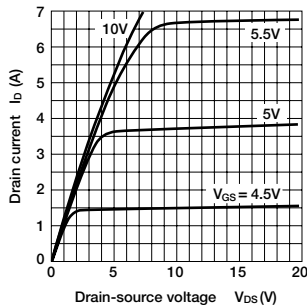
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 100μA, V _{GS} = 0V	450			V
I _{GSS}	V _{GS} = ±30V			±100	nA
I _{DSS}	V _{DS} = 450V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 1mA	2.0	3.0	4.0	V
Re (yfs)	V _{DS} = 20V, I _D = 3.5A	3.5	5		S
R _{DS} (ON)	V _{DS} = 10V, I _D = 3.5A		0.84	1.10	Ω
Ciss	V _D = 10V f = 1.0MHz		720		pF
Coss	V _{GS} = 0V		150		pF
Crss	V _{GS} = 0V		65		pF
t _d (on)	I _D = 3.5A		25		ns
t _r	V _{DD} = 200V R _L = 57Ω		40		ns
t _d (off)	V _{GS} = 10V		70		ns
t _f	V _{GS} = 10V		50		ns
V _{SD}	I _{SD} = 7A, V _{GS} = 0V		1.0	1.5	V

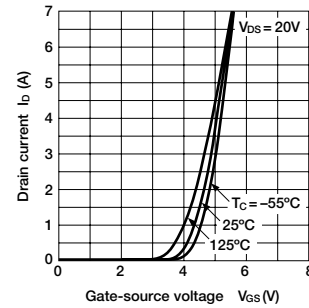
External Dimensions FM20 (full-mold)



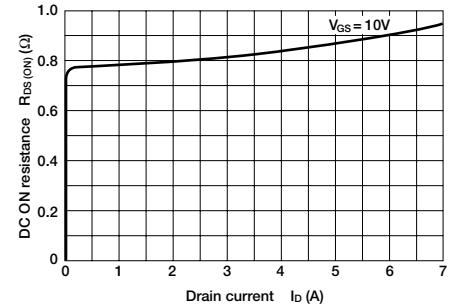
I_D—V_{DS} Characteristics



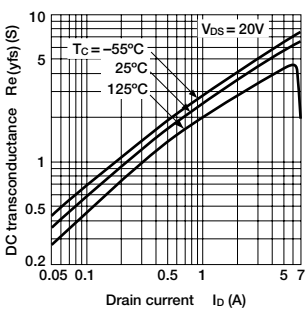
I_D—V_{GS} Characteristics



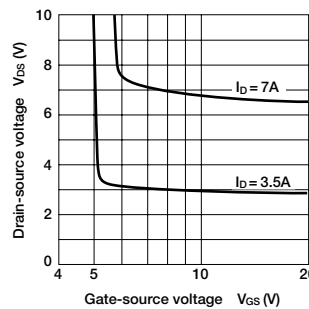
R_{DS} (ON)—I_D Characteristics



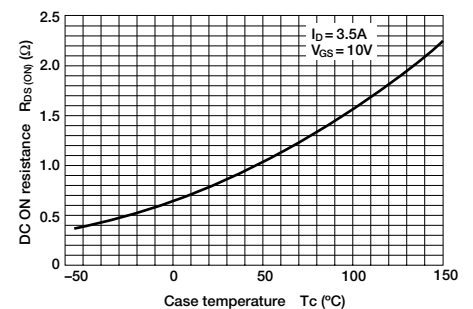
Re (yfs)—I_D Characteristics



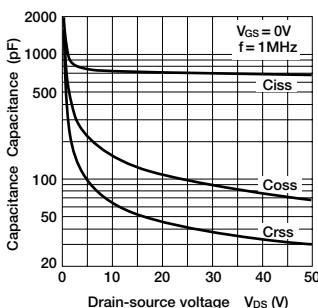
V_{DS}—V_{GS} Characteristics



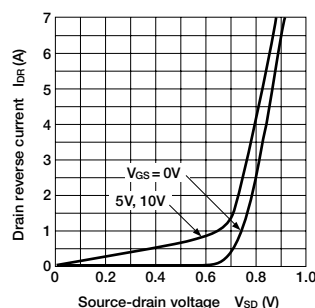
R_{DS} (ON)—T_C Characteristics



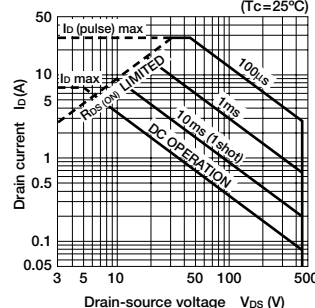
Capacitance—V_{DS} Characteristics



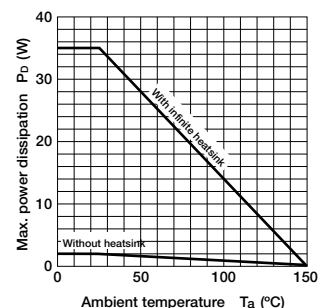
I_{DR}—V_{SD} Characteristics



Safe Operating Area (single pulse) (Tc=25°C)



P_D—T_a Derating



MOS FET FKV460 (under development)

Absolute Maximum Ratings (Ta=25°C)

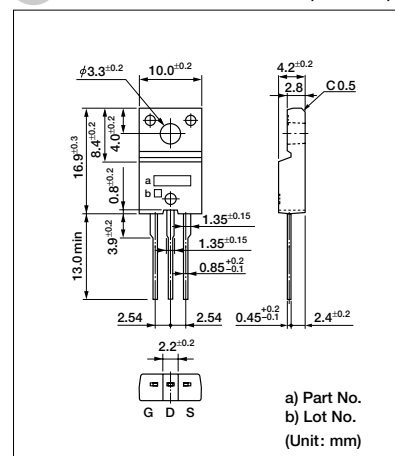
Symbol	Ratings	Unit
V _{DSS}	40	V
V _{GSS}	+20, -10	V
I _D	±60	A
I _{D (pulse)*}	±180	A
P _D	40 (Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, duty ≤ 1%

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR) DSS}	I _D = 100μA, V _{GS} = 0V	40			V
I _{GSS}	V _{GS} = +20V			+10	μA
	V _{GS} = -10V			-5	μA
I _{DSS}	V _{DS} = 40V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.3		2.3	V
R _{e (yfs)}	V _{DS} = 10V, I _D = 25A	20			S
R _{DS (ON)}	V _{GS} = 10V, I _D = 25A		6	9	mΩ
C _{iss}	V _{DS} = 10V		2000		pF
C _{oss}	f = 1.0MHz		1200		pF
C _{rss}	V _{GS} = 0V		200		pF
t _{d (on)}	I _D = 25A		To be defined		ns
t _r	V _{DD} ÷ 12V				ns
t _{d (off)}	R _L = 0.48Ω				ns
t _f	V _{GS} = 10V				ns
V _{SD}	I _{SD} = 50A, V _{GS} = 0V		1.0	1.5	V

External Dimensions TO220F (full-mold)



MOS FET FKV460S

Absolute Maximum Ratings (Ta=25°C)

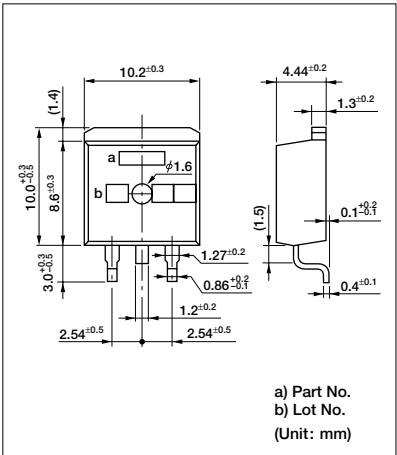
Symbol	Ratings	Unit
V _{DSS}	40	V
V _{GSS}	+20, -10	V
I _D	±60	A
I _D (pulse)*	±180	A
P _D	60 (Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, duty ≤ 1%

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 100μA, V _{GS} = 0V	40			V
I _{GSS}	V _{GS} = +20V			+10	μA
	V _{GS} = -10V			-5	μA
I _{DSS}	V _{DS} = 40V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.3		2.3	V
R _e (yfs)	V _{DS} = 10V, I _D = 25A	20.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 25A		7	9	mΩ
C _{iss}	V _{DS} = 10V		2800		pF
C _{oss}	f = 1.0MHz		1400		pF
C _{rss}	V _{GS} = 0V		600		pF
t _d (on)	I _D = 25A		20		ns
t _r	V _{DD} = 12V		600		ns
t _d (off)	R _L = 0.48Ω		250		ns
t _f	V _{GS} = 10V		100		ns
V _{SD}	I _{SD} = 50A, V _{GS} = 0V		1.0	1.5	V

External Dimensions TO220S



MOS FET FKV560

Absolute Maximum Ratings (Ta=25°C)

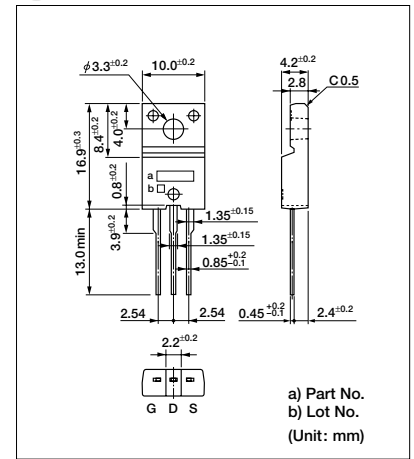
Symbol	Ratings	Unit
V _{DSS}	50	V
V _{GSS}	+20, -10	V
I _D	±60	A
I _D (pulse)*	±180	A
P _D	35 (Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, duty ≤ 1%

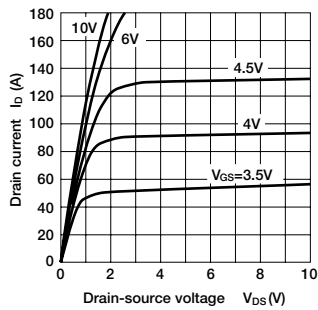
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR) DSS}	I _D = 100μA, V _{GS} = 0V	50			V
I _{GSS}	V _{GS} = +20V			+10	μA
	V _{GS} = -10V			-5	μA
I _{DSS}	V _{DS} = 50V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0		2.5	V
Re (yfs)	V _{DS} = 10V, I _D = 25A	20			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 25A		9	11	mΩ
C _{iss}	V _{DS} = 10V		2700		pF
C _{oss}	f = 1.0MHz		1100		pF
C _{rss}	V _{GS} = 0V		500		pF
t _d (on)	I _D = 25A		20		ns
t _r	V _{DD} = 12V		600		ns
t _d (off)	R _L = 0.48Ω		300		ns
t _f	V _{GS} = 10V		100		ns
V _{SD}	I _{SD} = 50A, V _{GS} = 0V	1.0		1.5	V
Di, t _{rr}	I _F = 25A, di/dt = 100A/μs	110			ns

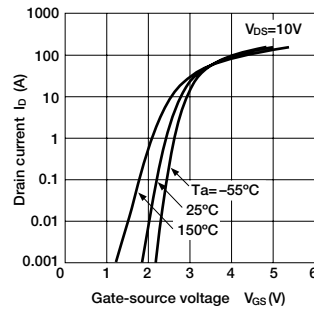
External Dimensions TO220F (full-mold)



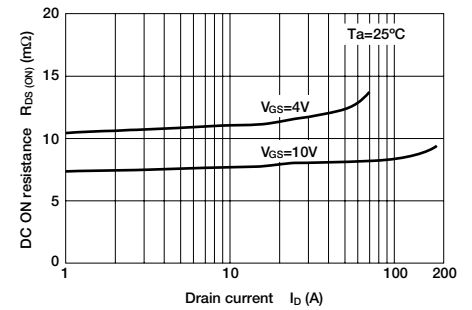
I_D — V_{DS} Characteristics



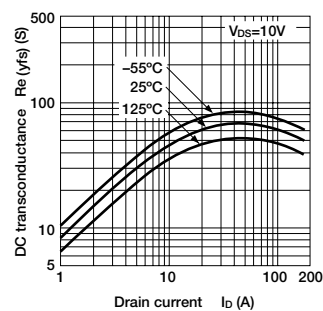
I_D — V_{GS} Characteristics



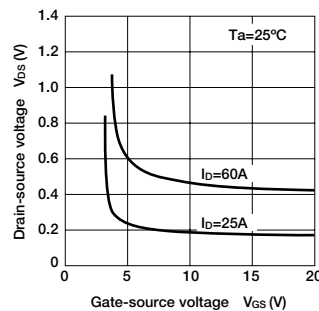
R_{DS} (ON) — I_D Characteristics



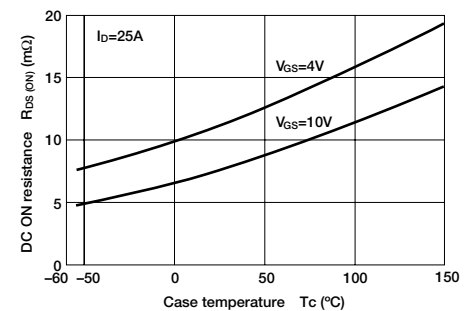
Re (yfs) — I_D Characteristics



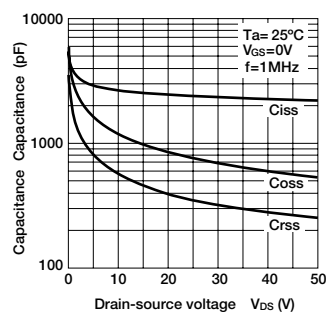
V_{DS} — V_{GS} Characteristics



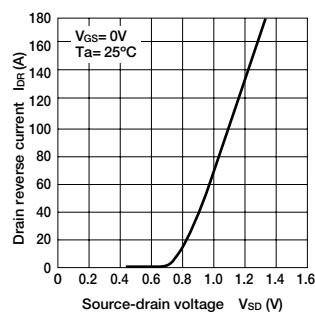
R_{DS} (ON) — T_C Characteristics



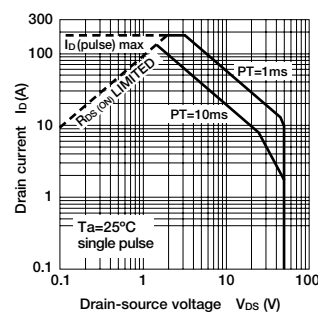
Capacitance — V_{DS} Characteristics



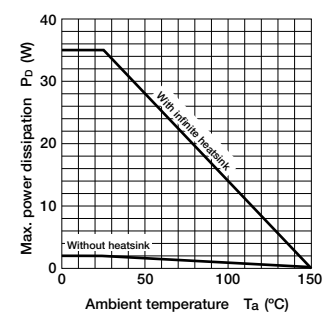
I_{DR} — V_{SD} Characteristics



Safe Operating Area



P_D — T_a Derating



MOS FET FKV560S

Absolute Maximum Ratings (Ta=25°C)

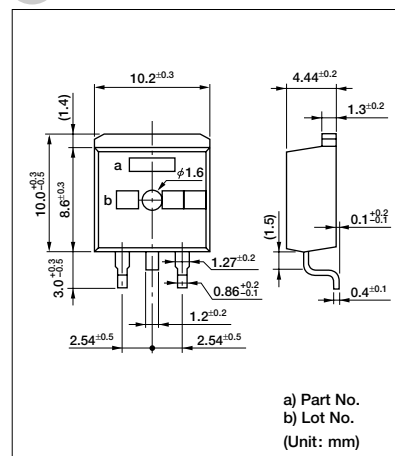
Symbol	Ratings	Unit
V _{DSS}	50	V
V _{GSS}	±20	V
I _D	±45	A
I _D (pulse)*	±135	A
P _D	60 (Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, duty ≤ 1%

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR) DSS}	I _D = 100μA, V _{GS} = 0V	50			V
I _{GSS}	V _{GS} = +20V			+10	μA
	V _{GS} = -20V			-5	μA
I _{DSS}	V _{DS} = 50V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0		2.0	V
R _e (yfs)	V _{DS} = 10V, I _D = 25A	20.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 25A		9	11	mΩ
C _{iss}	V _{DS} = 10V		2000		pF
C _{oss}	f = 1.0MHz		1000		pF
C _{rss}	V _{GS} = 0V		150		pF
t _d (on)	I _D = 25A				ns
t _r	V _{DD} ÷ 12V		To be defined		ns
t _d (off)	R _L = 0.48Ω				ns
t _f	V _{GS} = 10V				ns
V _{SD}	I _{SD} = 50A, V _{GS} = 0V		1.0	1.5	V

External Dimensions TO220S



MOS FET FKV660 (under development)

Absolute Maximum Ratings (Ta=25°C)

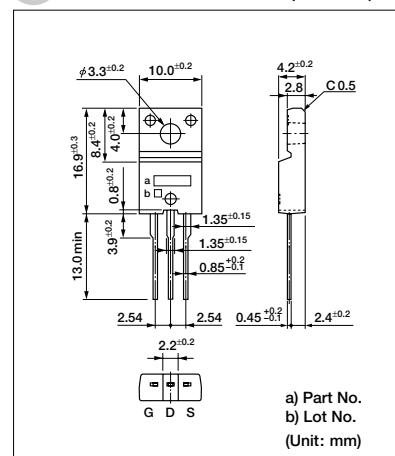
Symbol	Ratings	Unit
V _{DSS}	60	V
V _{GSS}	±20	V
I _D	±50	A
I _D (pulse)*	±150	A
P _D	40 (Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

* P_W ≤ 100μs, duty ≤ 1%

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR) DSS}	I _D = 100μA, V _{GS} = 0V	60			V
I _{GSS}	V _{GS} = +20V			+10	μA
	V _{GS} = -20V			-5	μA
I _{DSS}	V _{DS} = 60V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0		2.0	V
R _e (yfs)	V _{DS} = 10V, I _D = 25A	20.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 25A		11	14	mΩ
C _{iss}	V _{DS} = 10V		2000		pF
C _{oss}	f = 1.0MHz		900		pF
C _{rss}	V _{GS} = 0V		100		pF
t _d (on)	I _D = 25A		To be defined		ns
t _r	V _{DD} ≐ 12V				ns
t _d (off)	R _L = 0.48Ω				ns
t _f	V _{GS} = 10V				ns
V _{SD}	I _{SD} = 50A, V _{GS} = 0V		1.0	1.5	V

External Dimensions FM20 (full-mold)



MOS FET FKV660S

Absolute Maximum Ratings (Ta=25°C)

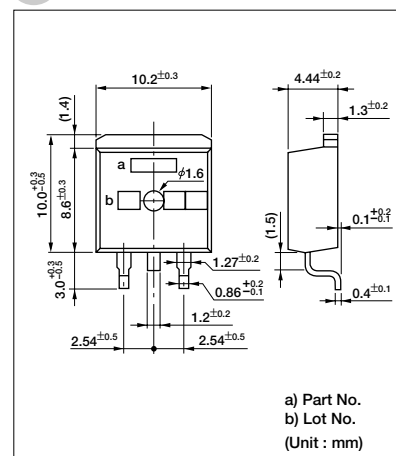
Symbol	Ratings	Unit
V _{DSS}	60	V
V _{GSS}	+20, -10	V
I _D	±60	A
I _{D(pulse)} ※	±180	A
P _D	60(Tc=25°C)	W
T _{ch}	150	°C
T _{stg}	-40 to +150	°C

※P_w ≤ 100μs, duty ≤ 1%

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR)DSS}	I _D =100μA, V _{GS} =0V	60			V
I _{GSS}	V _{GS} =+20V			+10	μA
	V _{GS} =-10V			-5	μA
I _{DSS}	V _{DS} =60V, V _{GS} =0V			100	μA
V _{TH}	V _{DS} =10V, I _D =250μA	1.0		2.5	V
R _e (yfs)	V _{DS} =10V, I _D =25A	20			S
R _{DS(ON)}	V _{GS} =10V, I _D =25A		11	14	mΩ
C _{iss}	V _{DS} =10V		2500		pF
C _{oss}	f=1.0MHz		900		pF
C _{rss}	V _{GS} =0V		150		pF
t _{d(on)}	I _D =25A		50		ns
t _r	V _{DD} =12V		400		ns
t _{d(off)}	R _L =0.48Ω		400		ns
t _f	V _{GS} =10V		300		ns
V _{SD}	I _{SD} =50A, V _{GS} =0V	1.0	1.5		V

External Dimensions TO220S



MOS FET Array STA508A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{DS}	120	V
V_{GS}	± 20	V
I_D	± 6	A
I_D (pulse)*1	± 10	A
P_T	4 (Ta=25°C) 20 (Tc=25°C)	W
E_{AS} *2	80	mJ
T_{ch}	150	°C
T_{stg}	-55 to +150	°C

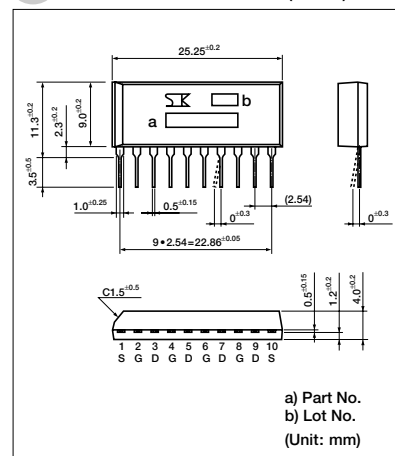
*1 $P_W \leq 100\mu s$, duty $\leq 1\%$

*2 $V_{DD} = 12V$, $L = 10mH$, unclamped, $R_G = 50\Omega$

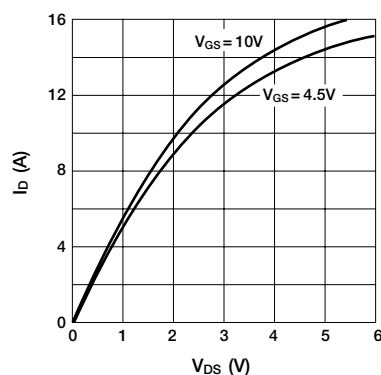
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
$V_{(BR) DSS}$	$I_D = 100\mu A$, $V_{GS} = 0V$	120			V
I_{GSS}	$V_{GS} = \pm 20V$			± 5	μA
I_{DSS}	$V_{DS} = 120V$, $V_{GS} = 0V$			100	μA
V_{TH}	$V_{DS} = 10V$, $I_D = 250\mu A$	1.0		2.0	V
R_e (yfs)	$V_{DS} = 10V$, $I_D = 4.0A$	5.0			S
$R_{DS(ON)}$	$V_{GS} = 10V$, $I_D = 4.0A$		0.15	0.2	Ω
	$V_{GS} = 4V$, $I_D = 4.0A$		0.2	0.25	Ω
C_{iss}	$V_{DS} = 10V$		400		pF
C_{oss}	$f = 1.0MHz$		130		pF
C_{rss}	$V_{GS} = 0V$		30		pF
t_d (on)	$I_D = 4A$		100		ns
t_r	$V_{DD} = 12V$		300		ns
t_d (off)	$R_L = 3\Omega$				ns
t_f	$V_{GS} = 5V$		250		ns
	$R_G = 50\Omega$		200		ns
V_{SD}	$I_{SD} = 6A$, $V_{GS} = 0V$	1.0	1.5		V

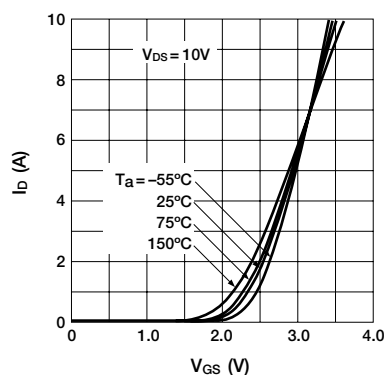
External Dimensions STA4 (LF412)



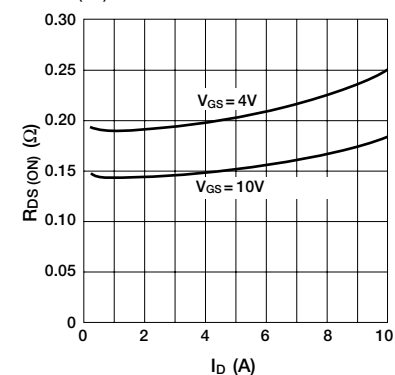
$I_D - V_{DS}$ Characteristics



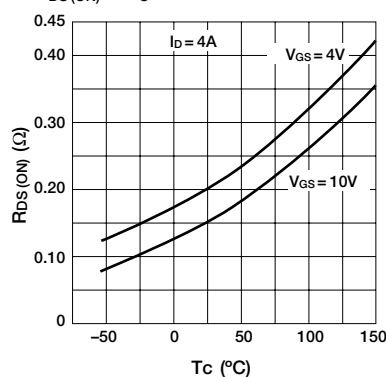
$I_D - V_{GS}$ Characteristics



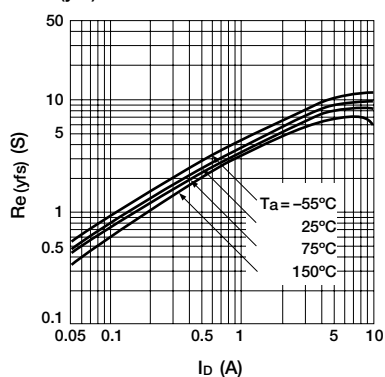
$R_{DS(ON)} - I_D$ Characteristics



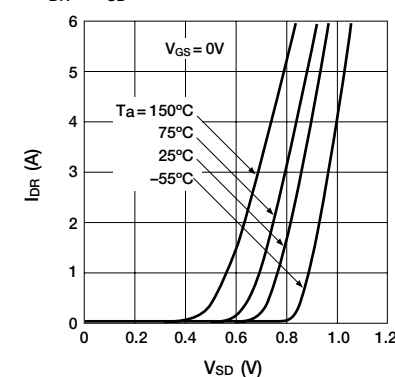
$R_{DS(ON)} - T_C$ Characteristics



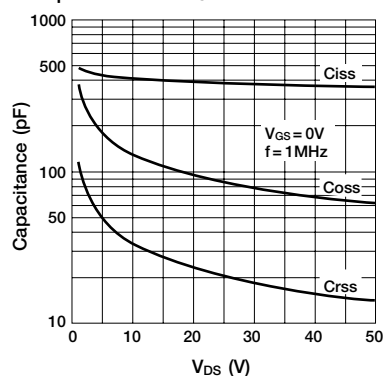
R_e (yfs) — I_D Characteristics



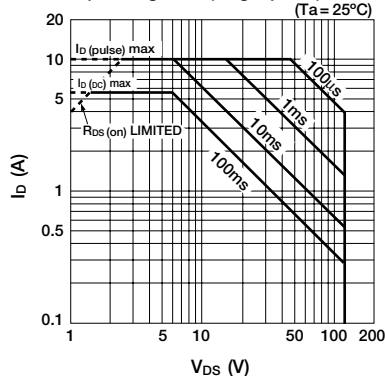
$I_{DR} - V_{SD}$ Characteristics



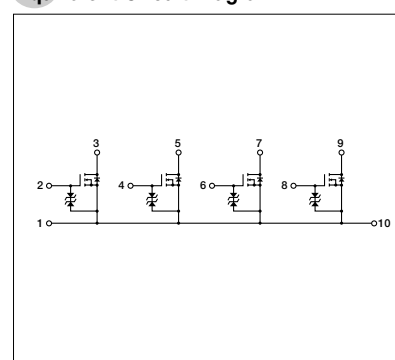
Capacitance — V_{DS} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



MOS FET Array STA509A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	52±5	V
V _{GSS}	±20	V
I _D	±3	A
I _D (pulse) *1	±6	A
P _T	4 (Ta=25°C) 20 (Tc=25°C)	W
E _{AS} *2	40	mJ
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

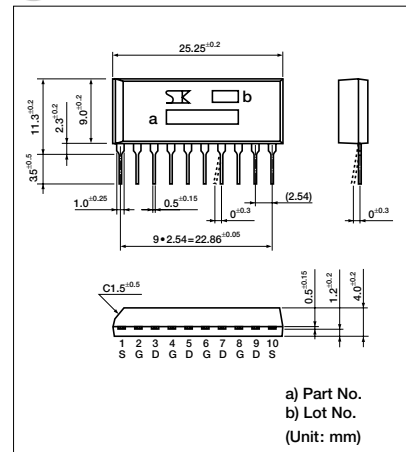
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DD} = 12V, L = 10mH, unclamped, R_G = 10Ω

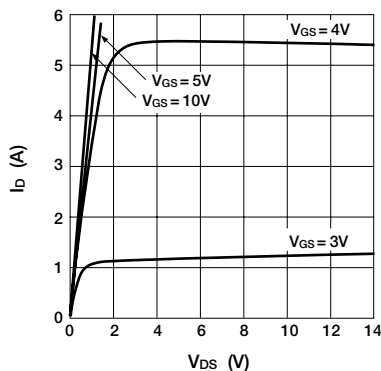
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 1mA, V _{GS} = 0V	47	52	57	V
I _{GSS}	V _{GS} = ±20V			±1.0	μA
I _{DSS}	V _{DS} = 40V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0		2.5	V
R _e (yfs)	V _{DS} = 10V, I _D = 1.0A	1.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 1.0A		0.2	0.25	Ω
	V _{GS} = 4V, I _D = 1.0A		0.25	0.3	Ω
C _{iss}	V _{DS} = 10V		200		pF
C _{oss}	f = 1.0MHz		120		pF
C _{rss}	V _{GS} = 0V		20		pF
t _d (on)	I _D = 1A V _{DD} = 12V		2.0		μs
t _r	R _L = 12Ω		7.4		μs
t _d (off)	V _{GS} = 5V		3.3		μs
t _f	R _{G1} = 50Ω, R _{G2} = 10Ω		4.2		μs
V _{SD}	I _{SD} = 6A, V _{GS} = 0V	1.0	1.5		V

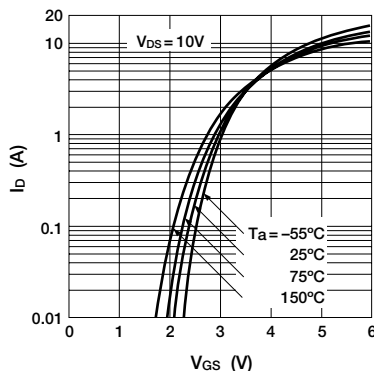
External Dimensions STA



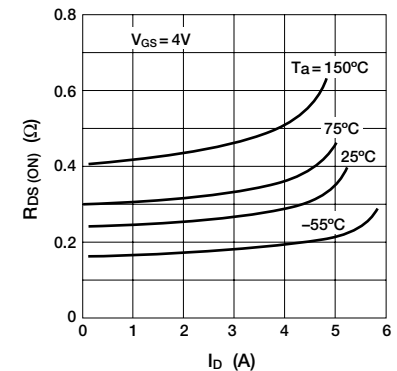
I_D — V_{DS} Characteristics



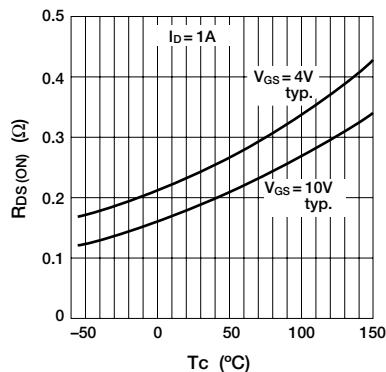
I_D — V_{GS} Characteristics



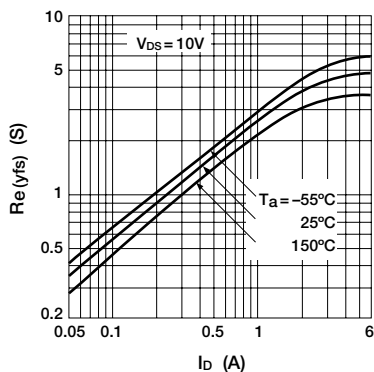
R_{DS} (ON) — I_D Characteristics



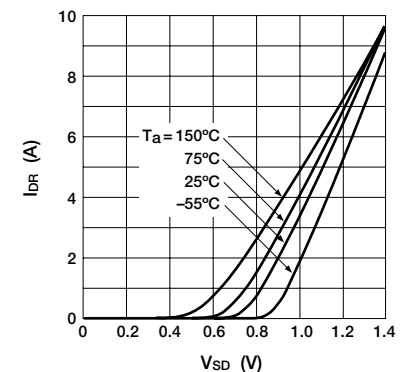
R_{DS} (ON) — T_C Characteristics



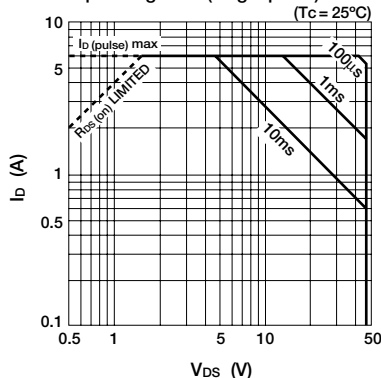
R_e (yfs) — I_D Characteristics



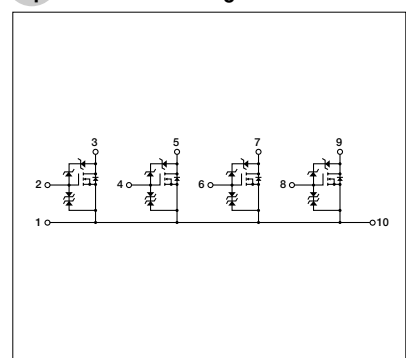
I_{DR} — V_{SD} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



MOS FET Array SMA5113

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	450	V
V _{GSS}	±30	V
I _D	±7	A
I _D (pulse)*1	±28	A
P _T	4 (Ta=25°C, All circuits operate, No Fin) 35 (Tc=25°C, All circuits operate, ∞ Fin)	W
EAS*2	130	mJ
I _{AS}	7	A
θj-a	31.2 (Junction - Ambient, Ta=25°C, All circuits operate)	°C/W
θj-c	3.57 (Junction - Case, Ta=25°C, All circuits operate)	°C/W
T _{ch}	150	°C
Tstg	-55 to +150	°C

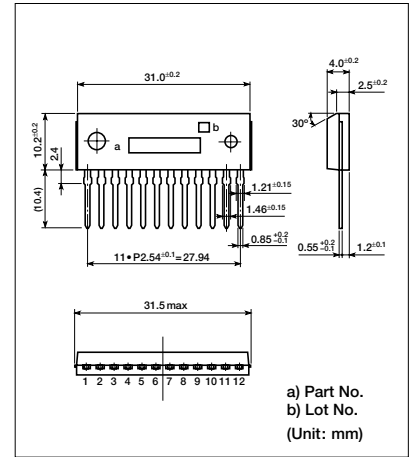
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DD} = 30V, L = 5mH, I_L = 7A, unclamped, R_G = 50Ω

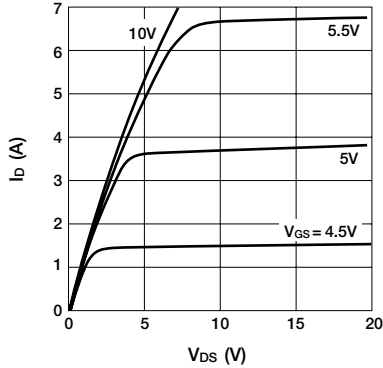
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 100μA, V _{GS} = 0V	450			V
I _{GSS}	V _{GS} = ±30V			±100	nA
I _{DSS}	V _{DS} = 450V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 1mA	2.0		4.0	V
Re (yfs)	V _{DS} = 20V, I _D = 3.5A	3.5	5.0		S
R _{DS} (ON)	V _{GS} = 10V, I _D = 3.5A		0.84	1.1	Ω
Ciss	V _{DS} = 10V f = 1.0MHz		720		pF
Coss	V _{GS} = 0V		150		pF
Crss	V _{GS} = 0V		65		pF
td (on)	I _D = 3.5A V _{DD} = 200V R _L = 57Ω		25		ns
tr	V _{GS} = 10V		40		ns
td (off)	V _{GS} = 10V		70		ns
tf	R _G = 50Ω		50		ns
V _{SD}	I _{SD} = 7A, V _{GS} = 0V		1.0	1.5	V

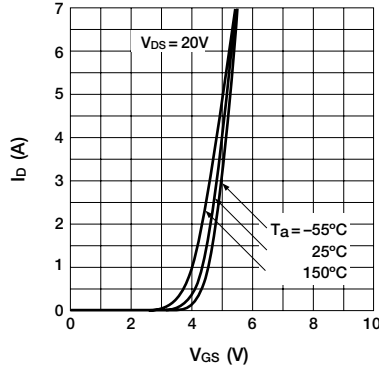
External Dimensions SMA (LF1000)



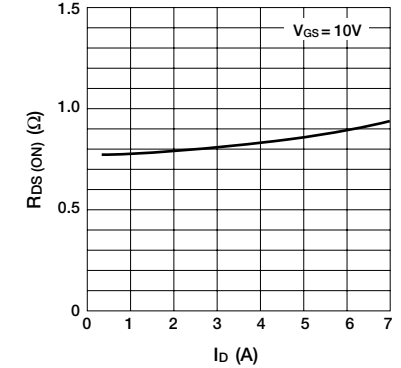
I_D — V_{DS} Characteristics



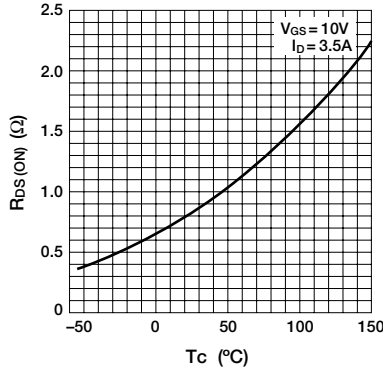
I_D — V_{GS} Characteristics



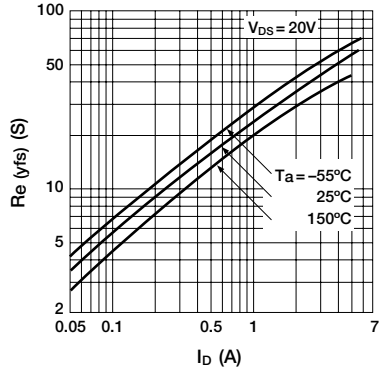
R_{DS} (ON) — I_D Characteristics



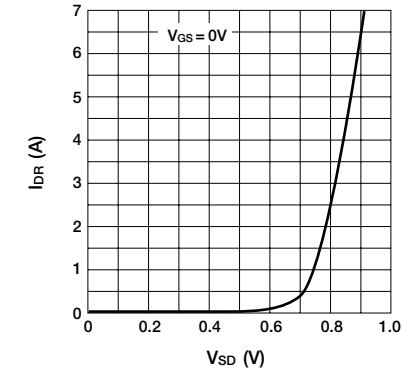
R_{DS} (ON) — T_C Characteristics



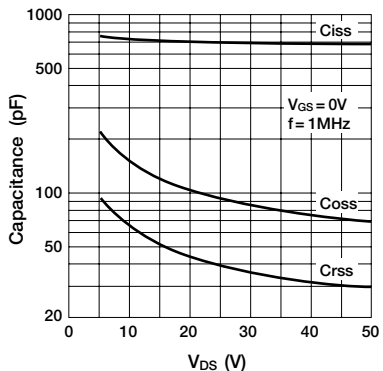
Re (yfs) — I_D Characteristics



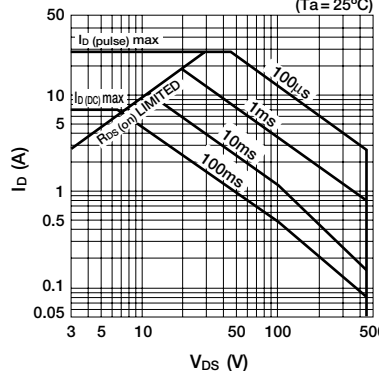
I_{DR} — V_{SD} Characteristics



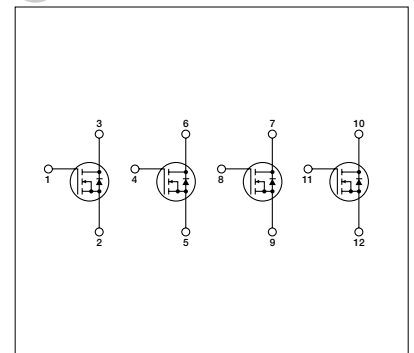
Capacitance — V_{DS} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



MOS FET Array SLA5027

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	60	V
V _{GSS}	±20	V
I _D	±12	A
I _D (pulse)*1	±48	A
P _T	5 (Ta=25°C, 4 circuits operate) 60 (Tc=25°C, 4 circuits operate)	W
EAS*2	250	mJ
θ _{J-C}	2.08	°C/W
V _{ISO}	(Fin to lead terminal) AC1000	V _{rms}
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

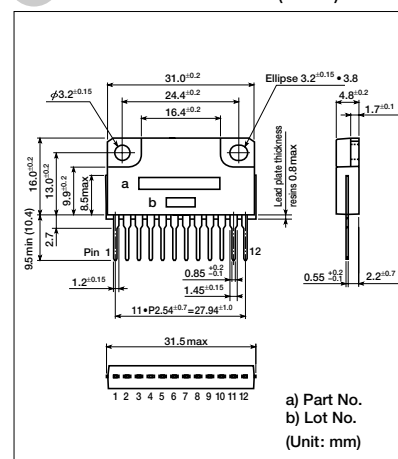
*1 P_W ≤ 250μs, duty ≤ 1%

*2 V_{DD} = 30V, L = 10mH, unclamped, R_G = 50Ω

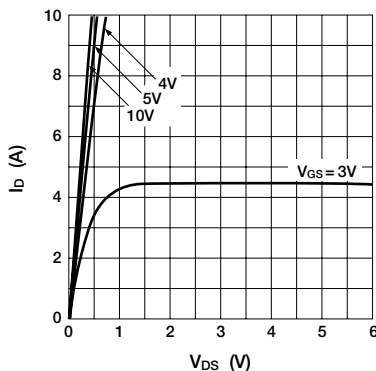
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _{(BR) DSS}	I _D = 100μA, V _{GS} = 0V	60			V
I _{GSS}	V _{GS} = ±20V			±100	μA
I _{DSS}	V _{DS} = 60V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 1mA	1.0	1.5	2.0	V
R _e (yfs)	V _{DS} = 10V, I _D = 8A	6.0	12.0		S
R _{DS} (ON)	V _{GS} = 4V, I _D = 8A		0.07	0.08	Ω
C _{iss}	V _{DS} = 10V		1100		pF
C _{oss}	f = 1.0MHz		500		pF
C _{rss}	V _{GS} = 0V		170		pF
t _d (on)	I _D = 8A V _{DD} = 30V		50		ns
t _r	R _L = 3.75Ω		250		ns
t _d (off)	V _{GS} = 5V		250		ns
t _f	R _G = 50Ω		180		ns
V _{SD}	I _{SD} = 10A, V _{GS} = 0V	1.0	1.5		V

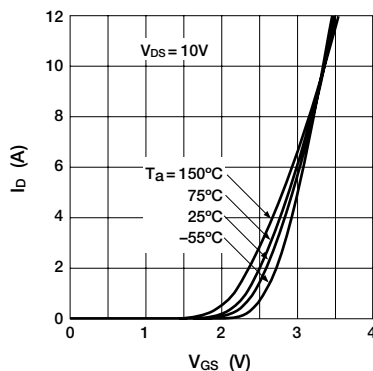
External Dimensions SLA (LF800)



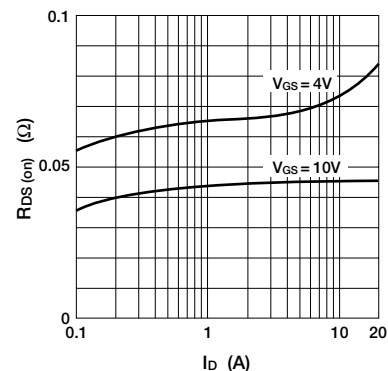
I_D — V_{DS} Characteristics



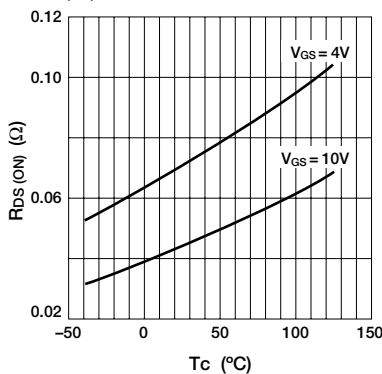
I_D — V_{GS} Characteristics



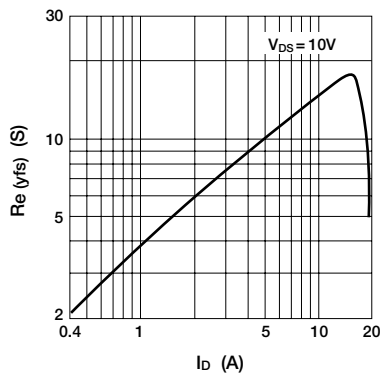
R_{DS} (ON) — I_D Characteristics



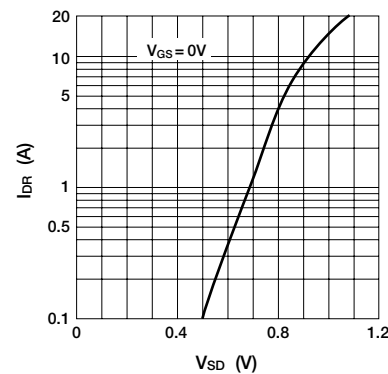
R_{DS} (ON) — T_C Characteristics



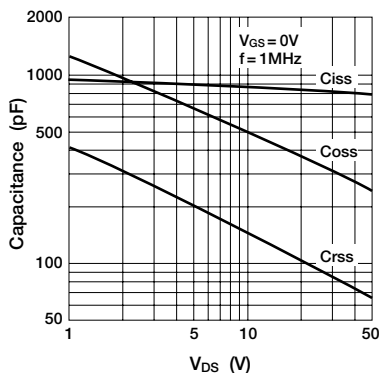
R_e (yfs) — I_D Characteristics



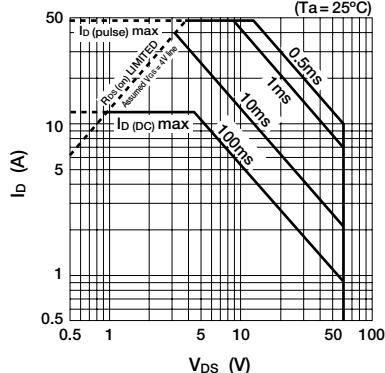
I_{DR} — V_{SD} Characteristics



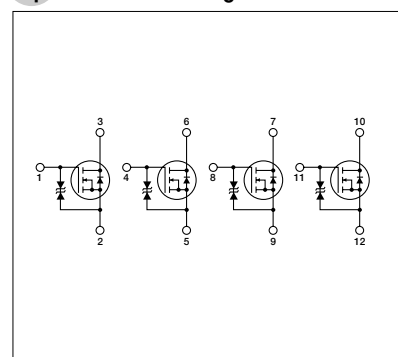
Capacitance — V_{DS} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



Surface-mount MOS FET Array SDK06

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	52±5	V
V _{GSS}	±20	V
I _D	±3	A
I _D (pulse) *1	±6	A
P _T	3 (Tc=25°C, 4 circuits operate)	W
E _{AS} *2	40	mJ
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

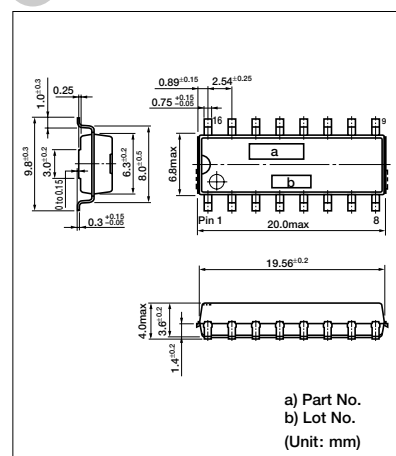
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DD} = 12V, L = 10mH, unclamped, R_G = 10Ω

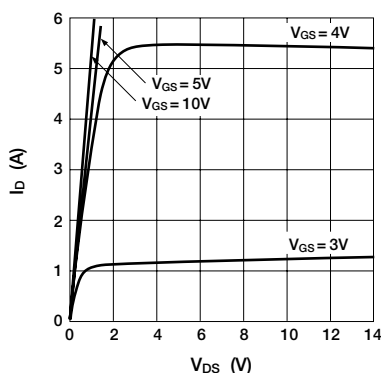
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 1mA, V _{GS} = 0V	47	52	57	V
I _{GSS}	V _{GS} = ±20V			±1.0	μA
I _{DSS}	V _{DS} = 40V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0	1.8	2.5	V
Re (yfs)	V _{DS} = 10V, I _D = 1.0A	1.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 1.0A		0.2	0.25	Ω
	V _{GS} = 4V, I _D = 1.0A		0.25	0.3	Ω
Ciss	V _{DS} = 10V		200		pF
Coss	f = 1.0MHz		120		pF
Crss	V _{GS} = 0V		20		pF
t _d (on)	I _D = 1A V _{DD} = 12V		2.0		μs
t _r	R _L = 12Ω		7.4		μs
t _d (off)	V _{GS} = 5V		3.3		μs
t _f	R _{G1} = 50Ω, R _{G2} = 10kΩ		4.2		μs
V _{SD}	I _{SD} = 1A, V _{GS} = 0V	1.0	1.5		V

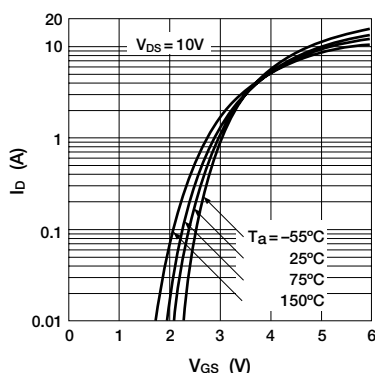
External Dimensions SMD-16A



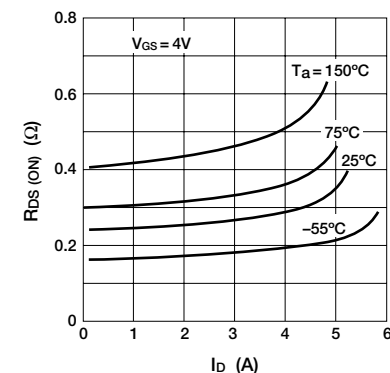
I_D—V_{DS} Characteristics



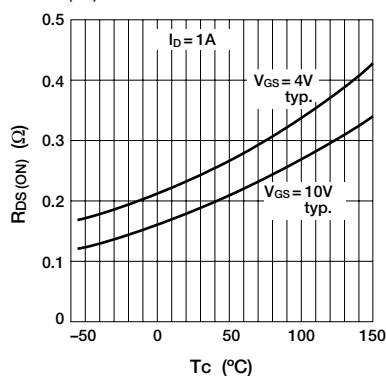
I_D—V_{GS} Characteristics



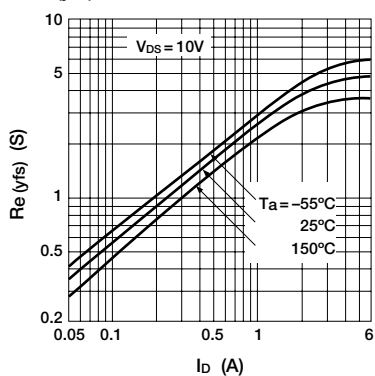
R_{DS} (ON)—I_D Characteristics



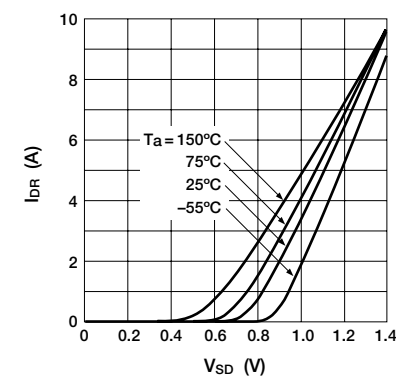
R_{DS} (ON)—T_c Characteristics



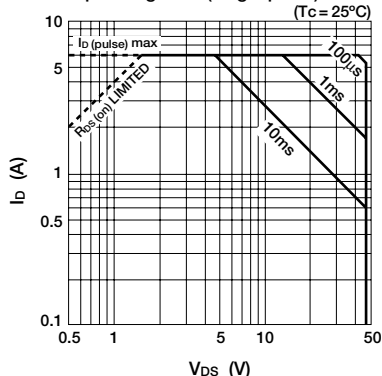
Re (yfs)—I_D Characteristics



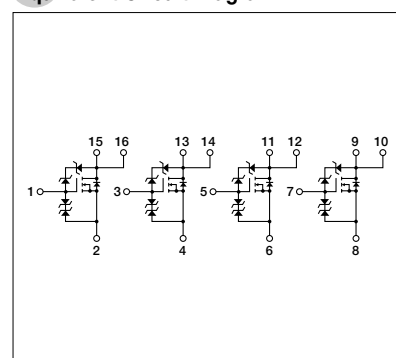
I_{DR}—V_{SD} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



Surface-mount MOS FET Array SDK08

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DSS}	50	V
V _{GSS}	±20	V
I _D	±4.5	A
I _D (pulse) *1	±9	A
P _T	4 (Tc=25°C, 4 circuits operate)	W
E _{AS} *2	80	mJ
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

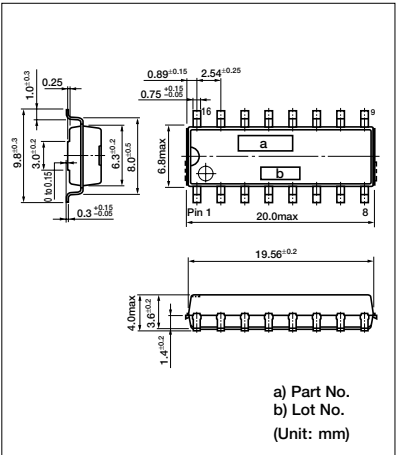
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DD} = 12V, L = 10mH, unclamped, R_G = 50Ω

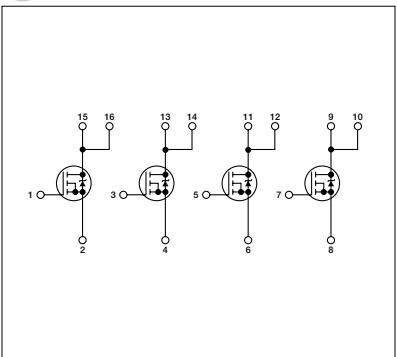
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 100μA, V _{GS} = 0V	50			V
I _{GSS}	V _{GS} = ±20V			±100	nA
I _{DSS}	V _{DS} = 50V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 1mA	1.3	1.8	2.3	V
R _e (y/s)	V _{DS} = 10V, I _D = 4.0A	5.0	9.0	13.0	S
R _{DS} (ON)	V _{GS} = 10V, I _D = 4.0A		0.07	0.08	Ω
	V _{GS} = 4V, I _D = 4.0A		0.09	0.1	Ω
C _{iss}	V _{DS} = 10V		700		pF
C _{oss}	f = 1.0MHz		300		pF
C _{rss}	V _{GS} = 0V		90		pF
t _d (on)	I _D = 4A		50		ns
t _r	V _{DD} = 12V		80		ns
t _d (off)	R _L = 3Ω		60		ns
t _f	V _{GS} = 5V		40		ns
V _{SD}	I _{SD} = 6A, V _{GS} = 0V	1.0	1.5		V

External Dimensions SMD-16A



Equivalent Circuit Diagram



Surface-mount MOS FET Array SDK09 (under development)

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V _{DS}	120	V
V _{GS}	±20	V
I _D	±6	A
I _D (pulse)*1	±10	A
P _T	3 (Tc=25°C, 4 circuits operate)	W
E _{AS} *2	80	mJ
T _{ch}	150	°C
T _{stg}	-55 to +150	°C

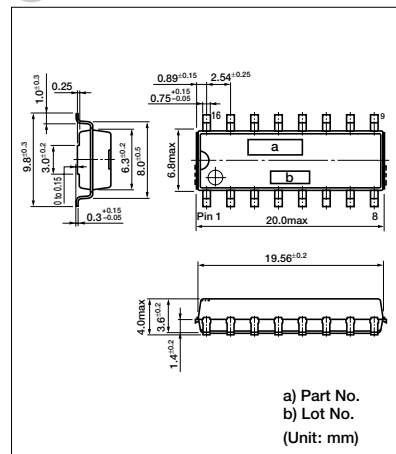
*1 P_W ≤ 100μs, duty ≤ 1%

*2 V_{DS} = 12V, L = 10mH, unclamped, R_G = 50Ω

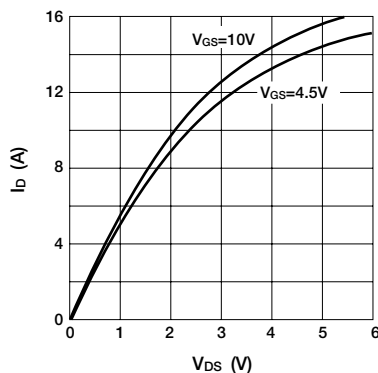
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
V _(BR) DSS	I _D = 100μA, V _{GS} = 0V	120			V
I _{GSS}	V _{GS} = ±20V			±5	μA
I _{DSS}	V _{DS} = 120V, V _{GS} = 0V			100	μA
V _{TH}	V _{DS} = 10V, I _D = 250μA	1.0		2.0	V
R _e (yfs)	V _{DS} = 10V, I _D = 4A	5.0			S
R _{DS} (ON)	V _{GS} = 10V, I _D = 4A		0.15	0.2	Ω
	V _{GS} = 4V, I _D = 4A		0.2	0.25	
C _{iss}	V _{DS} = 10V		400		pF
C _{oss}	f = 1.0MHz		130		pF
C _{rss}	V _{GS} = 0V		30		pF
t _d (on)	I _D = 4A		100		ns
t _r	V _{DS} = 12V		300		ns
t _d (off)	R _L = 3Ω		250		ns
t _f	V _{GS} = 5V		200		ns
V _{SD}	I _{SD} = 6A, V _{GS} = 0V	1.0	1.5		V

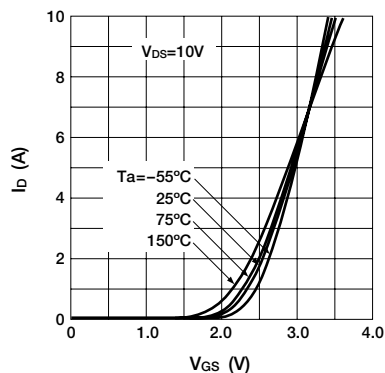
External Dimensions SMD-16A



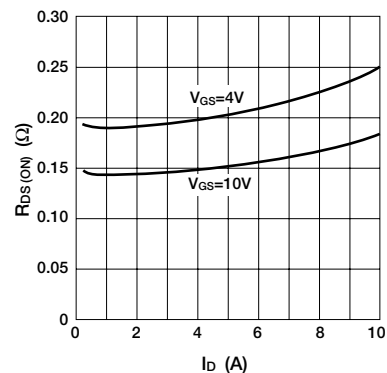
I_D — V_{DS} Characteristics



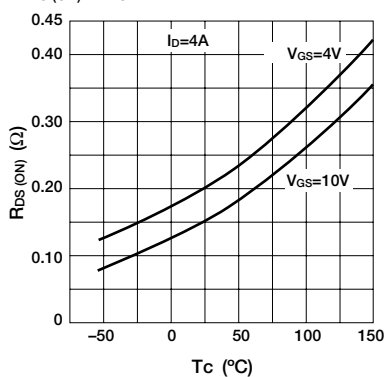
I_D — V_{GS} Characteristics



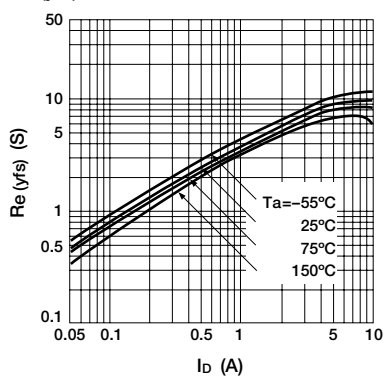
R_{DS} (ON) — I_D Characteristics



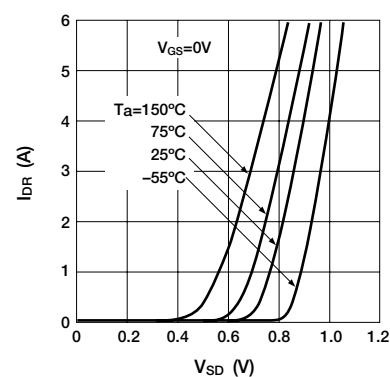
R_{DS} (ON) — T_C Characteristics



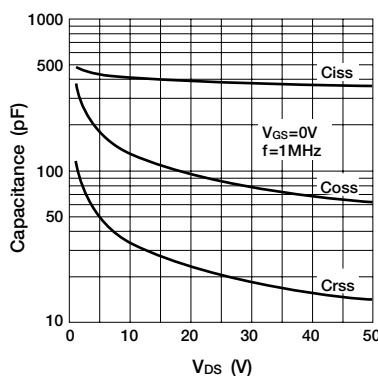
R_e (yfs) — I_D Characteristics



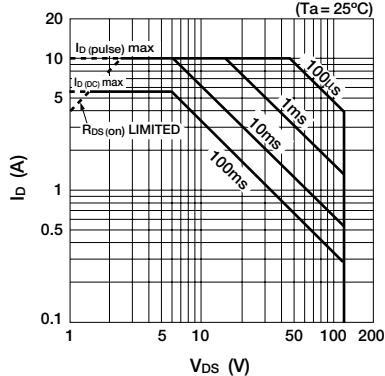
I_{DR} — V_{SD} Characteristics



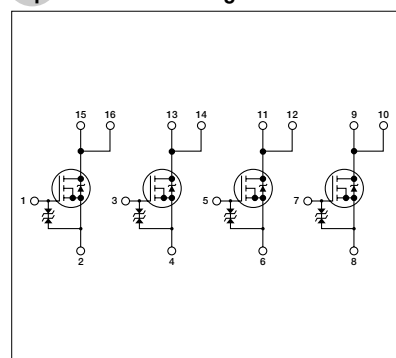
Capacitance — V_{DS} Characteristics



Safe Operating Area (single pulse)



Equivalent Circuit Diagram



Thyristor with built-in reverse diode for HID lamp ignition TFC561D

Features

- Repetitive peak off-state voltage: $V_{DRM}=600V$
- Repetitive peak surge on-state current: $I_{TRM}=430A$
- Critical rate-of-rise of on-state current: $di/dt=1200A/\mu s$
- Gate trigger current: $I_{GT}=20mA$ max
- With built-in reverse diode

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Repetitive peak off-state voltage	V_{DRM}	600	V	$T_J=-40$ to $+125^{\circ}C$, $R_{GK}=1k\Omega$
Repetitive surge peak on-state current	I_{TRM}	430	A	$V_D \leq 430V$, 100kcycle, * $W_p=1.3\mu s$, $T_a=125^{\circ}C$
Critical rate-of-rise of on-state current	di/dt	1200	A/ μs	*
Peak forward gate current	I_{FGM}	2.0	A	$f \geq 50Hz$, duty $\leq 10\%$
Peak gate power loss	P_{GM}	5.0	W	$f \geq 50Hz$, duty $\leq 10\%$
Average gate power loss	$P_G(AV)$	0.5	W	
Peak reverse gate voltage	V_{RGM}	5	V	$f \geq 50Hz$
Diode repetitive peak surge forward current	I_{FRM}	240	A	$V_D \leq 430V$, 100kcycle, * $W_p=1.3\mu s$, $T_a=125^{\circ}C$
Junction temperature	T_J	-40 to $+125$	$^{\circ}C$	
Storage temperature	T_{stg}	-40 to $+125$	$^{\circ}C$	

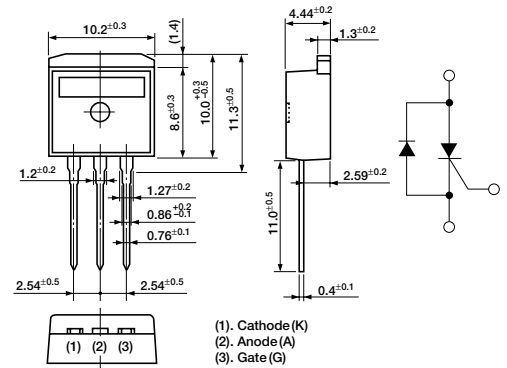
* The surge current for $T=10ms$ /cycle shall be applied 50 cycles successively, and an interval time shall follow to cool down the junction temperature of the device to $125^{\circ}C$. This process shall be repeated up to 100K cycles.

Electrical Characteristics

($T_J=25^{\circ}C$)

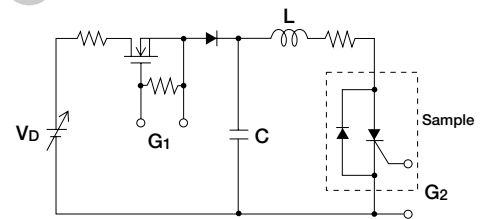
Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
On-state voltage	V_{TM}			1.4	V	$I_T=10A$
Gate trigger voltage	V_{GT}			1.5	V	$V_D=6V$, $R_L=10\Omega$
Gate trigger current	I_{GT}			20	mA	$V_D=6V$, $R_L=10\Omega$
Gate non-trigger voltage	V_{GD}	0.1			V	$V_D=480V$, $T_J=125^{\circ}C$
Holding current	I_H	2	10.0		mA	$R_{G-K}=1k\Omega$, $T_J=25^{\circ}C$
Off-state current (1)	$I_{DRM}(1)$			100	μA	$V_D=V_{DRM}$, $R_{G-K}=1k\Omega$, $T_J=25^{\circ}C$
Off-state current (2)	$I_{DRM}(2)$			1	mA	$V_D=V_{DRM}$, $R_{G-K}=1k\Omega$, $T_J=125^{\circ}C$
Thermal resistance	R_{th}			4.0	$^{\circ}C/W$	Junction to case
Diode forward voltage	V_F			1.4	V	$I_F=10A$

External Dimensions (unit: mm)



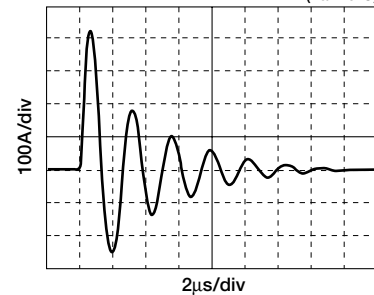
Weight: Approx. 1.5g

Measurement circuit



Current waveform (1cycle)

($T_a=25^{\circ}C$)



Rectifier Diodes for Alternators

Part No.	Absolute maximum ratings				Electrical Characteristics					Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_{stg} (°C)	V_F (V) max	Condition I_F (A)	I_R (mA) max	V_Z (V)	Condition I_Z (mA)	
SG-9CNS	200	20	200	-40 to +150	1.10	20	0.25	—	—	1
SG-9CNR										
SG-9LCNS	200	20	300	-40 to +150	1.10	30	0.25	—	—	2
SG-9LCNR										
SG-9LLCNS	200	35	350	-40 to +150	1.10	35	0.25	—	—	2
SG-9LLCNR										

External Dimensions (unit: mm)

Fig. 1

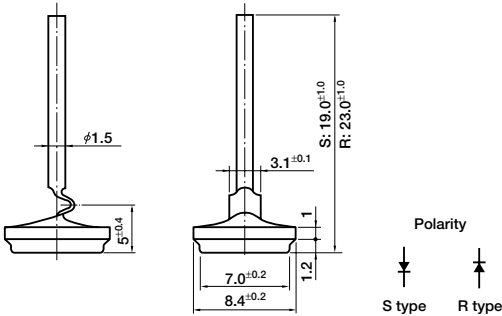
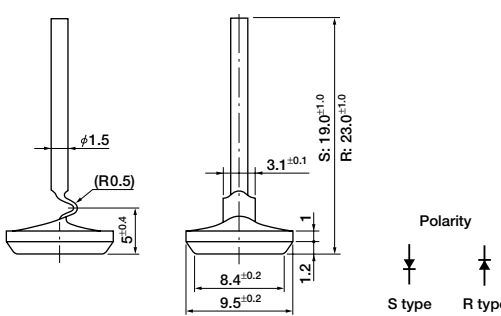


Fig. 2



High-voltage Diodes for Igniters

Part No.	Absolute Maximum Ratings					Electrical Characteristics (Ta=25°C)				Fig. No.	
	V _{RM} (kV)	I _F (AV) (mA) 50 Hz half-wave signal average	I _{RSM} (mA) Peak value of single shot triangular wave with 100μs half-power bandwidth	I _{RSM} (A) Peak value of 50 Hz half-wave signal	T _j	T _{stg}	V _F (V) max	Condition I _F (mA)	I _R (μA) V _R =V _{RM} max		V _Z (kV) I _R =100μA
					(°C)						
SHV-05JS	2.5	30	30	3	-40 to +150		5	10	10	2.6 to 5.0	1
SHV-08J	4.0	30	30	3			8			4.5 to 8.0	2
SHV-30J	15.0	30	10	3			30			16.0 to 30.0	3

External Dimensions (unit: mm)

Fig. 1 (SHV-05JS)

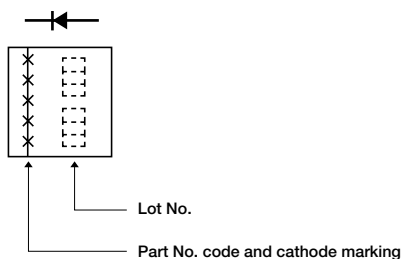
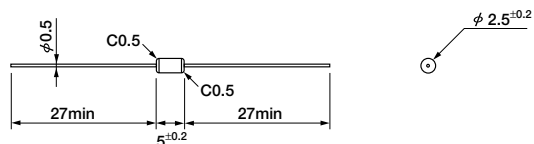


Fig. 2 (SHV-08J)

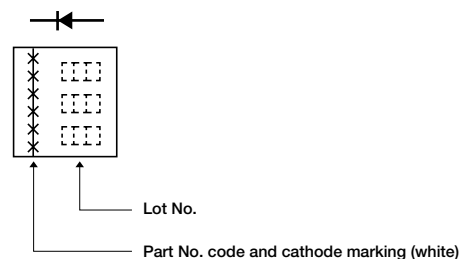
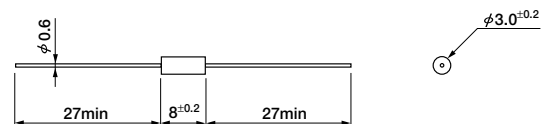
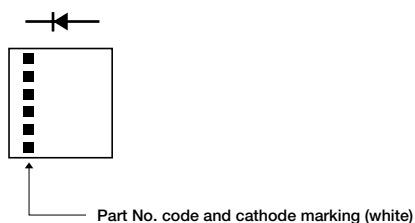
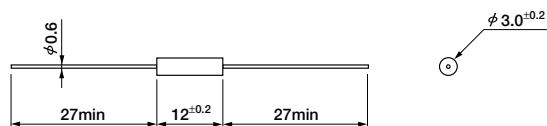


Fig. 3 (SHV-30J)



Power Zener Diode

(Ta=25°C)

Part No.	Absolute Maximum Ratings					Electrical Characteristics			External dimensions	Remarks
	P _R (W)	V _{DC} (V)	I _{ZSM} (A) 10ms rectangular wave single shot	T _j T _{stg} (°C)		V _Z (V) 1mA instantaneous current	I _R (μA) max	I _R (H) (mA) max		
SFPZ-68	50	20	2	-40 to +150		28±3.0	10	1.0	1	Surface-mount type
SPZ-G36	450	30	11			36±3.6	5	0.1	2	
PZ 628	1500	20	65			28±3.0	500	1.0	3	

External Dimensions (unit: mm)

Fig. 1

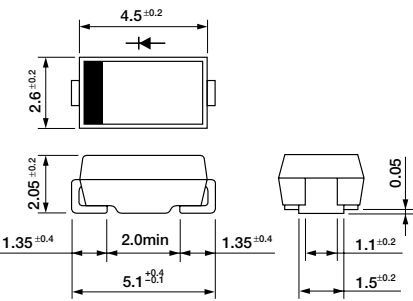


Fig. 2

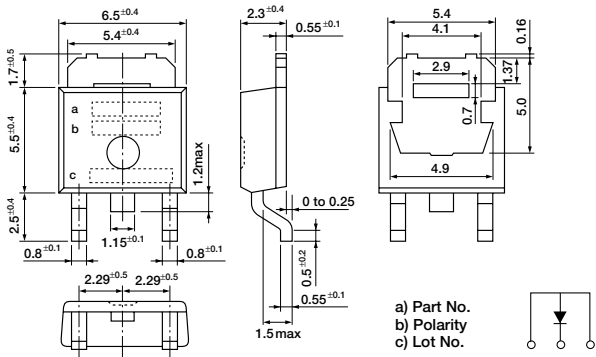
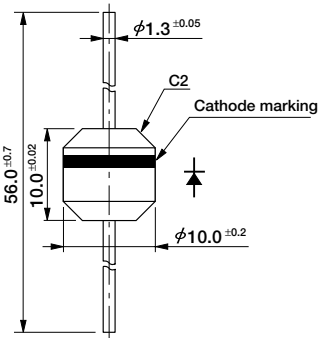


Fig. 3



General-purpose Diodes

Rectifier Diodes

■ Surface-mount Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg}	V_F (V) max	Condition I_F (A)	I_R (μ A) max	
SFPM-52	200	0.9	30	-40 to +150		1.0	1.0	10	1
SFPM-62		1.0	45	-40 to +150		0.98	1.0	10	
SFPM-54	400	0.9	30	-40 to +150		1.0	1.0	10	1
SFPM-64		1.0	45	-40 to +150		0.98	1.0	10	

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg}	V_F (V) max	Condition I_F (A)	I_R (μ A) max	
RM 1C	1000	0.8	40	-40 to +150		1.2	1.0	5	5
EM 1C		1.0	35	-40 to +150		0.97	1.0	20	4
RO 2C		1.2	80	-40 to +150		0.92	1.5	10	6
RM 11C			100	-40 to +150		0.92	1.5	10	5
RM 2C				-40 to +150		0.91	1.5	10	6
RM 3C		2.0	150	-40 to +150		0.95	2.5	10	7
RM 4C		3.0	150	-40 to +150		0.95	3.0	10	8

■ Axial Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg}	V_F (V) max	Condition I_F (A)	I_R (μ A) max	
EM 1Y	100	1.0	45	-40 to +150		0.97	1.0	10	4
RM 4Y		3.0	200	-40 to +150		0.95	3.0	10	8
AM01Z	200	1.0	35	-40 to +150		0.98	1.0	10	2
EM01Z			45	-40 to +150		0.97	1.0	10	3
EM 1Z				-40 to +150		0.97	1.0	10	4
RM 1Z			50	-40 to +150		0.95	1.0	5	5
RO 2Z		1.2	80	-40 to +150		0.92	1.5	10	6
RM 2Z			100	-40 to +150		0.91	1.5	10	
RM 10Z		1.5	120	-40 to +150		0.91	1.5	10	5
RM 4Z		3.0	200	-40 to +150		0.95	3.0	10	8
AM01	400	1.0	35	-40 to +150		0.98	1.0	10	2
EM01			45	-40 to +150		0.97	1.0	10	3
EM 1				-40 to +150		0.97	1.0	10	4
RM 1			50	-40 to +150		0.95	1.0	5	5
EM 2		1.2	80	-40 to +150		0.92	1.2	10	4
RO 2			100	-40 to +150		0.92	1.5	10	6
RM 2				-40 to +150		0.91	1.5	10	
RM 10			150	-40 to +150		0.91	1.5	10	5
RM 3		2.5	150	-40 to +150		0.95	2.5	10	7
RM 4		3.0	200	-40 to +150		0.95	3.0	10	8
AM01A	600	1.0	35	-40 to +150		0.98	1.0	10	2
EM01A			45	-40 to +150		0.97	1.0	10	3
EM 1A				-40 to +150		0.97	1.0	10	4
RM 1A			50	-40 to +150		0.95	1.0	5	5
EM 2A		1.2	80	-40 to +150		0.92	1.2	10	4
RO 2A			100	-40 to +150		0.92	1.5	10	6
RM 11A				-40 to +150		0.92	1.5	10	
RM 2A			150	-40 to +150		0.91	1.5	10	5
RM 10A		2.5	150	-40 to +150		0.95	2.5	10	7
RM 3A				-40 to +150		0.95	2.5	10	
RM 4A		3.0	200	-40 to +150		0.95	3.0	10	8
RM 4AM		3.2	350	-40 to +150		0.92	3.5	10	
RM 1B	800	0.8	40	-40 to +150		1.2	1.0	5	5
EM 1B		1.0	35	-40 to +150		0.97	1.0	20	4
EM 2B		1.2	80	-40 to +150		0.92	1.2	10	
RO 2B				-40 to +150		0.92	1.5	10	6
RM 11B			100	-40 to +150		0.92	1.5	10	5
RM 2B				-40 to +150		0.91	1.5	10	6
RM 10B		2.0	150	-40 to +150		0.91	1.5	10	5
RM 3B				-40 to +150		0.95	2.5	10	7
RM 4B		3.0	150	-40 to +150		0.95	3.0	10	8

■ Center-tap Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg}	V_F (V) max	Condition I_F (A)	I_R (μ A) max	
FMM-31S,R	100	20	120	-40 to +150		1.10	10	10	10
FMM-22S,R	200	10	100	-40 to +150		1.10	5.0	10	9
FMM-32S,R		20	120	-40 to +150		1.10	10	10	10
FMM-24S,R	400	10	100	-40 to +150		1.10	5.0	10	9
FMM-34S,R		20	120	-40 to +150		1.10	10	10	10
FMM-26S,R	600	10	100	-40 to +150		1.10	5.0	10	9
FMM-36S,R		20	120	-40 to +150		1.10	10	10	10

Fast Recovery Rectifier Diodes

Axial Type

● trr1=I_F/I_{RP}=1:1, trr2=I_F/I_{RP}=1:2

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	T _{stg}	V _F (V) max	I _R (μA) max	trr1 (μs) max	trr2 (μs) max	
				(°C)						
EU 2YX	100	1.2	25	−40 to +150		0.9	10	0.2	0.08	4
RU 2YX		1.5	30	−40 to +150		0.95	10	0.2	0.08	5
RU 3YX		2.0	50	−40 to +150		0.95	10	0.2	0.08	6
RU 4Y		3.5	70	−40 to +150		1.3	10	0.4	0.18	8
RU 30Y			80	−40 to +150		0.97	10	0.4	0.18	7
RU 4YX		4.0	70	−40 to +150		1.3	10	0.4	0.18	8
EU01Z	200	0.25	15	−40 to +150		2.5	10	0.4	0.18	3
EU 1Z				−40 to +150		2.5	10	0.4	0.18	4
AU01Z		0.5	15	−40 to +150		1.7	10	0.4	0.18	2
RF 1Z				−40 to +150		2.0	10	0.4	0.18	5
AS01Z		0.6	20	−40 to +150		1.5	10	1.5	0.6	2
EH 1Z				−40 to +150		1.35	10	4.0	1.3	4
RH 1Z				−40 to +150		1.3	5	4.0	1.3	5
ES01Z		0.7	30	−40 to +150		2.5	10	1.5	0.6	3
ES 1Z				−40 to +150		2.5	10	1.5	0.6	4
AU02Z		0.8	25	−40 to +150		1.3	10	0.4	0.18	2
EU02Z				−40 to +150		1.4	10	0.4	0.18	3
EU 2Z		1.0	15	−40 to +150		1.4	10	0.4	0.18	4
RU 2Z				−40 to +150		1.5	10	0.4	0.18	5
RU 4Z		3.5	70	−40 to +150		1.3	10	0.4	0.18	8
RU 30Z				−40 to +150		0.97	10	0.4	0.18	7
RU 1	400	0.25	15	−40 to +150		2.5	10	0.4	0.18	5
EU01				−40 to +150		2.5	10	0.4	0.18	3
EU 1				−40 to +150		2.5	10	0.4	0.18	4
AU01		0.5	15	−40 to +150		1.7	10	0.4	0.18	2
RF 1				−40 to +150		2.0	10	0.4	0.18	5
AS01				−40 to +150		1.5	10	1.5	0.6	2
EH 1		0.6	20	−40 to +150		1.35	10	4.0	1.3	4
RH 1				−40 to +150		1.3	5	4.0	1.3	5
ES01				−40 to +150		2.5	10	1.5	0.6	4
ES 1		−40 to +150		2.5	10	1.5	0.6			
AU02		0.8	25	−40 to +150		1.3	10	0.4	0.18	2
EU02				−40 to +150		1.4	10	0.4	0.18	3
EU 2		1.0	15	−40 to +150		1.4	10	0.4	0.18	4
RU 2M				−40 to +150		1.2	10	0.4	0.18	5
RU 3		1.5	20	−40 to +150		1.5	10	0.4	0.18	6
RU 3M				−40 to +150		1.1	10	0.4	0.18	
RU 30		2.0	200	−40 to +150		0.95	10	0.4	0.18	7
RU 4				−40 to +150		1.5	10	0.4	0.18	8
RU 31		3.0	50	−40 to +150		1.5	10	0.4	0.18	8
RU 31				−40 to +150		1.2	50	0.4	0.18	7
RU 4M	3.5	70	−40 to +150		1.3	10	0.4	0.18	8	
RU 1A	600	0.25	15	−40 to +150		2.5	10	0.4	0.18	5
EU01A				−40 to +150		2.5	10	0.4	0.18	3
EU 1A				−40 to +150		2.5	10	0.4	0.18	4
RF 1A		0.6	15	−40 to +150		2.0	10	0.4	0.18	5
AS01A				−40 to +150		1.5	10	1.5	0.6	2
EH 1A				−40 to +150		1.35	10	4.0	1.3	4
RH 1A		0.7	30	−40 to +150		1.3	5	4.0	1.3	5
ES01A				−40 to +150		2.5	10	1.5	0.6	3
ES 1A		0.7	30	−40 to +150		2.5	10	1.5	0.6	4
RS 1A				−40 to +150		2.5	10	1.5	0.6	5

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (μA) max	trr1 (μs) max	trr2 (μs) max	
				(°C)						
EU02A	600	1.0	15	-40 to +150		1.4	10	0.4	0.18	3
EU 2A				-40 to +150		1.4	10	0.4	0.18	4
RU 2		2.0	20	-40 to +150		1.5	10	0.4	0.18	5
RU 2AM				-40 to +150		1.2	10	0.4	0.18	
RU 3A		1.1	20	-40 to +150		1.5	10	0.4	0.18	6
RU 20A				-40 to +150		1.1	10	0.4	0.18	5
RU 3AM		1.5	50	-40 to +150		1.1	10	0.4	0.18	6
RU 30A				-40 to +150		0.95	10	0.4	0.18	7
RU 4A		3.0	50	-40 to +150		1.5	10	0.4	0.18	8
RU 31A				-40 to +150		1.2	50	0.4	0.18	7
RU 4AM	3.5	70	-40 to +150		1.3	10	0.4	0.18	8	
RU 1B	800	0.25	15	-40 to +150		2.5	10	0.4	0.18	5
RF 1B				-40 to +150		2.0	10	0.4	0.18	
RH 1B		0.6	35	-40 to +150		1.3	5	4.0	1.3	
RS 1B				-40 to +150		2.5	10	1.5	0.6	
RU 2B		1.0	20	-40 to +150		1.5	10	0.4	0.18	6
RU 3B				-40 to +150		1.5	10	0.4	0.18	
RU 4B		3.0	50	-40 to +150		1.6	10	0.4	0.18	8
RU 1C	1000	0.2	15	-40 to +150		3.0	10	0.4	0.18	5
RH 1C				-40 to +150		1.3	5	4.0	1.3	
RU 2C		0.8	20	-40 to +150		1.5	10	0.4	0.18	
RU 3C				-40 to +150		2.5	10	0.4	0.18	6
RU 4C		2.5	50	-40 to +150		1.6	50	0.4	0.18	8
ES01F	1500	0.5	20	-40 to +150		2.0	10	1.5	0.6	3
ES 1F				-40 to +150		2.0	10	1.5	0.6	4
RC 2	2000	0.2	20	-40 to +150		2.0	10	4.0	1.3	5

Frame 2-pin Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (μA) max	trr1 (μs) max	trr2 (μs) max	
				(°C)						
FMU-G2YXS	100	10.0	100	-40 to +150		1.0	50	0.2	0.08	11

Center-tap Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (μA) max	trr1 (μs) max	trr2 (μs) max	
				(°C)						
FMU-21S,R	100	10.0	40	-40 to +150		1.5	50	0.4	0.18	9
FMU-12S,R	200	5.0	30	-40 to +150		1.5	50	0.4	0.18	9
FMU-22S,R		10.0	40	-40 to +150		1.5	50	0.4	0.18	
FMU-32S,R		20.0	80	-40 to +150		1.5	50	0.4	0.18	10
FMU-14S,R	400	5.0	30	-40 to +150		1.5	50	0.4	0.18	9
FMU-24S,R		10.0	40	-40 to +150		1.5	50	0.4	0.18	
FMU-34S,R		20.0	80	-40 to +150		1.5	50	0.4	0.18	10

Ultra Fast Recovery Rectifier Diodes

■ Surface-mount Type

 $\bullet \text{trr1} = I_F / I_{RP} = 1:1, \text{trr2} = I_F / I_{RP} = 1:2$

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg} (°C)	V_F (V) max	I_R (μ A) max	trr1 (μ s) max	trr2 (μ s) max	
SFPL-52	200	0.9	25	-40 to +150		0.98	10	50	35	1
SFPL-62	200	1.0	25	-40 to +150		0.98	10	50	35	

■ Axial Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V _{RM} (V)	I _F (A) (A)	I _{FSM} (A)	T _J	T _{stg}	V _F (V) max	I _R (μA) max	trr1 (ns) max	trr2 (ns) max	
				(°C)						
AG01Y	70	1.0	25	-40 to +150		1.2	100	100	50	2
EG01Y			30	-40 to +150		1.2	100	100	50	3
EG 1Y		1.1	30	-40 to +150		1.2	100	100	50	4
RG 10Y		1.5	50	-40 to +150		1.1	500	100	50	5
RG 2Y				-40 to +150		1.1	500	100	50	6
RG 4Y		3.5	100	-40 to +150		1.3	1000	100	50	8
AG01Z	200	0.7	15	-40 to +150		1.8	100	100	50	2
EG01Z				-40 to +150		1.9	50	100	50	3
EG 1Z		0.8	15	-40 to +150		1.7	50	100	50	4
AL01Z		1.0	25	-40 to +150		0.98	100	50	35	2
EN 01Z			50	-40 to +150		0.92	10	100	50	3
RG 10Z		1.2	50	-40 to +150		1.5	500	100	50	5
RG 2Z			-40 to +150		1.5	500	100	50	6	
EL 1Z		1.5	20	-40 to +150		0.98	100	100	50	4
EL02Z			25	-40 to +150		0.98	50	40	30	3
RN 1Z		2.0	60	-40 to +150		0.92	20	100	50	5
RL 10Z			30	-40 to +150		0.98	50	50	35	
RL 2Z		70		-40 to +150		0.98	100	50	35	6
RN 2Z			-40 to +150		0.92	50	100	50		
RN 3Z		3.0	80	-40 to +150		0.92	50	100	50	7
RG 4Z				-40 to +150		1.7	1000	100	50	8
RL 3Z		3.5	80	-40 to +150		0.95	50	50	35	7
RL 4Z				-40 to +150		0.95	150	50	35	8
RN 4Z			120	-40 to +150		0.92	50	100	50	
AG01	400	0.7	15	-40 to +150		1.8	100	100	50	2
EG01				-40 to +150		2.0	50	100	50	3
EG 1		0.8	15	-40 to +150		1.8	50	100	50	4
RG 10				-40 to +150		1.8	500	100	50	5
RG 2		1.2	50	-40 to +150		1.8	500	100	50	6
EL 1				-40 to +150		1.3	10	100	50	4
RL 2		2.0	40	-40 to +150		1.3	10	50	35	6
RG 4		3.0	80	-40 to +150		1.8	500	100	50	8
RL 3		3.5	80	-40 to +150		1.3	100	50	35	7
EG01A	600	0.5	10	-40 to +150		2.0	100	100	50	3
AG01A			15	-40 to +150		1.8	100	100	50	2
EG 1A		0.6	10	-40 to +150		2.0	100	100	50	4
RG 10A		1.0	50	-40 to +150		2.0	500	100	50	5
RG 2A				-40 to +150		2.0	500	100	50	6
RL 2A		1.2	30	-40 to +150		1.55	50	50	35	
RG 4A		2.0	50	-40 to +150		2.0	500	100	50	8
RL 3A			60	-40 to +150		1.7	50	50	35	7
RL 4A		3.0	80	-40 to +150		1.5	50	50	35	8
AP01C	1000	0.2	5	-40 to +150		4.0	100	200	80	2
EP01C				-40 to +150		4.0	5	200	80	3
RU 1P		0.4	10	-40 to +150		4.0	5	100	50	5
EG01C				-40 to +150		3.3	50	100	50	3
RG 1C		0.7	10	-40 to +150		3.3	20	100	50	5
RG 4C				-40 to +150		3.0	500	100	50	8
RP 1H	2000	0.1	5	-40 to +150		7.0	20	200	80	5

■ Frame 2-pin Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg} (°C)	V_F (V) max	I_R (μ A) max	trr1 (ns) max	trr2 (ns) max	
FMP-G12S	200	5.0	65	-40 to +150		1.15	50	150	70	11
FML-G12S			100	-40 to +150		0.98	250	40	30	
FMN-G12S		10.0	150	-40 to +150		0.92	100	100	50	
FML-G22S			150	-40 to +150		0.98	500	40	30	
FML-G13S	300	5.0	70	-40 to +150		1.3	100	50	35	11
FMN-G14S	400	5.0	70	-40 to +150		1.0	50	100	50	11
FML-G14S				-40 to +150		1.3	100	50	35	
FMG-G26S	600	4.0	50	-40 to +150		2.5	500	100	50	11
FMN-G16S		5.0	50	-40 to +150		1.2	50	100	50	
FML-G16S				-40 to +150		1.5	100	50	35	
FMG-G36S		8.0	80	-40 to +150		2.5	500	100	50	12
FML-G26S				-40 to +150		1.7	100	65	40	
FMD-G26S		10.0	100	-40 to +150		1.7	100	50	30	11
FMG-G2CS	1000	4.0	30	-40 to +150		4.0	50	100	50	11
FMG-G3CS		5.0	60	-40 to +150		3.5	100	150	70	12

■ Center-tap Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg} (°C)	V_F (V) max	I_R (μ A) max	trr1 (ns) max	trr2 (ns) max	
FMG-12S,R	200	5.0	35	-40 to +150		1.8	500	100	50	9
FML-12S				-40 to +150		0.98	150	40	30	
FMG-22S,R		10.0	65	-40 to +150		1.8	500	100	50	
FML-22S				-40 to +150		0.98	250	40	30	
FMG-32S,R	300	20.0	150	-40 to +150		1.8	1000	100	50	10
FML-32S				-40 to +150		0.98	600	40	30	
FMG-13S,R		5.0	35	-40 to +150		1.8	500	100	50	
FML-13S				-40 to +150		1.3	50	50	35	
FMG-23S,R	400	10.0	65	-40 to +150		1.8	500	100	50	9
FML-23S				-40 to +150		1.3	100	50	35	
FMG-33S,R		20.0	150	-40 to +150		1.8	1000	100	50	10
FML-33S				-40 to +150		1.3	200	50	35	
FMG-14S,R	600	5.0	35	-40 to +150		2.0	500	100	50	9
FML-14S				-40 to +150		1.3	50	50	35	
FMG-24S,R		8.0	65	-40 to +150		2.0	500	100	50	
FML-24S				-40 to +150		1.3	100	50	35	
FMG-34S,R	1000	16.0	100	-40 to +150		2.0	1000	100	50	10
FML-34S				-40 to +150		1.3	200	50	35	
FMG-26S,R		6.0	50	-40 to +150		2.2	500	100	50	9
FMG-36S,R				-40 to +150		2.2	1000	100	50	
FML-36S	2000	20.0	100	-40 to +150		1.7	100	65	35	10
				-40 to +150						

■ Bridge Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics				Fig. No.
	V_{RM} (V)	I_F (AV) (A)	I_{FSM} (A)	T_J (°C)	T_{stg} (°C)	V_F (V) max	I_R (μ A) max	trr1 (ns) max	trr2 (ns) max	
RBV-602L	200	6	100	-40 to +150		1	250	50	35	13

Schottky Barrier Diodes

■ Surface-mount Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (mA) max	H•I _R (mA) Ta=100°C max	
				(°C)					
SFPJ-53	30	1.0	30	-40 to +150		0.45	1.0	10	1
SFPE-63		2.0	40	-40 to +150		0.55	0.2	20 (T _J =150°C)	
SFPJ-63				-40 to +150		0.45	2.0	20	
SFPJ-73		3.0	50	-40 to +150		0.45	3.0	30	
SPJ-63S		6.0	50	-40 to +150		0.45	3	30 (T _J =125°C)	14
SFPB-54	40	1.0	30	-40 to +150		0.55	1	50	1
SFPB-64		1.5	60	-40 to +150		0.55	5	50	
SFPE-64		2.0	40	-40 to +150		0.6	0.2	20 (T _J =150°C)	
SFPB-74			60	-40 to +150		0.5	5	50	
SPB-G34S		3.0	50	-40 to +150		0.55	3.5	50	
SPB-G54S		5.0	60	-40 to +150		0.55	5	50	
SPB-64S	6.0	50	-40 to +150		0.55	3.5	50	14	
SFPB-56	60	0.7	10	-40 to +150		0.62	1	7.5	1
SFPB-66		2.0	25	-40 to +150		0.69	1	15	
SFPB-76			40	-40 to +150		0.62	2	20	
SPB-G56S		5.0	60	-40 to +150		0.7	3	50	
SFPB-59	90	0.7	10	-40 to +150		0.81	1	5	1
SFPB-69		1.5	40	-40 to +150		0.81	2	10	

■ Axial Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (mA) max	H•I _R (mA) Ta=100°C max	
				(°C)					
AK 03	30	1.0	25	−40 to +150	0.55	1	50 (T _J =100°C)	2	
EK 03			40	−40 to +150	0.55	5	50	3	
EK 13		1.5	40	−40 to +150	0.55	5	50	4	
RK 13			60	−40 to +150	0.55	5	50	5	
RK 33		2.5	50	−40 to +150	0.55	5	50	6	
RJ 43			3.0	50	−40 to +150	0.45	3	30	8
RK 43	80	−40 to +150		0.55	5	50			
AK 04	40	1.0	25	−40 to +150	0.55	1	50 (T _J =100°C)	2	
EK 04			40	−40 to +150	0.55	5	50	3	
EK 14		1.5	40	−40 to +150	0.55	5	50	4	
RK 14			60	−40 to +150	0.55	5	50	5	
RK 34		2.5	50	−40 to +150	0.55	5	50	6	
RK 44			80	−40 to +150	0.55	5	50	8	
AK 06	60	0.7	10	−40 to +150	0.62	1	7.5	2	
EK 06				−40 to +150	0.62	1	7.5	3	
EK 16		1.5	25	−40 to +150	0.62	1	15	4	
RK 16					−40 to +150	0.62	1	15	5
RK 36		2.0	40	−40 to +150	0.62	2	20	6	
RK 46			70	−40 to +150	0.62	3	35	8	
AK 09	90	0.7	10	−40 to +150	0.81	1	5	2	
EK 09				−40 to +150	0.81	1	5	3	
EK 19		1.5	40	−40 to +150	0.81	2	10	4	
RK 19					−40 to +150	0.81	2	10	5
RK 39		2.0	50	−40 to +150	0.81	3	15	6	
RK 49			60	−40 to +150	0.81	5	35	8	

■ Frame 2-pin Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (mA) max	H•I _R (mA) Ta=100°C max	
				(°C)					
FMB-G14	40	3.0	60	-40 to +150		0.55	5	100	11
FMB-G14L		5.0	60	-40 to +150		0.55	5	100	
FMB-G24H		10.0	150	-40 to +150		0.55	10	65	
FMB-G16L	60	6.0	50	-40 to +150		0.62	5	50	11
FMB-G19L	90	4.0	60	-40 to +150		0.81	5	35	11

■ Center-tap Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (mA) max	H•I _R (mA) T _a =100°C max	
				(°C)					
FMB-24	40	4.0	50	-40 to +150		0.55	5	35	9
FMB-24M		6.0	60	-40 to +150		0.55	5	35	
FMB-24L		10	60	-40 to +150		0.55	5	35	
FME-24L			80	-40 to +150		0.6	0.5	30	
FMB-34S		12	75	-40 to +150		0.58	5	35	10
FMB-24H		15	100	-40 to +150		0.55	7.5	50	9
FME-24H				-40 to +150		0.6	0.75	50	
MPE-24H				-40 to +150		0.6	0.75	50 (T _J =150°C)	
FMB-34			150	-40 to +150		0.55	10	65	10
FMB-34M		30	300	-40 to +150		0.55	20	100	
FMB-26	60	4.0	40	-40 to +150		0.62	1	20	9
FMB-26L		10	50	-40 to +150		0.62	2.5	50	
FMB-36		15	100	-40 to +150		0.62	5	75	10
FMB-36M		30	150	-40 to +150		0.62	10	150	
FMB-29	90	4.0	50	-40 to +150		0.81	3	15	9
FMB-29L		8.0	60	-40 to +150		0.81	5	35	
FMB-39		15	60	-40 to +150		0.81	10	50	10
FMB-39M		20	150	-40 to +150		0.81	15	60	

■ Bridge Type

Part No.	Absolute Maximum Ratings					Electrical Characteristics			Fig. No.
	V _{RM} (V)	I _F (AV) (A)	I _{FSM} (A)	T _J	Tstg	V _F (V) max	I _R (mA) max	H•I _R (mA) Ta=100°C max	
				(°C)					
RBV-406B	60	4.0	40	-40 to +150		0.62	2	20	13

General-purpose Diodes - External Dimensions

(Unit: mm)

Fig. 1

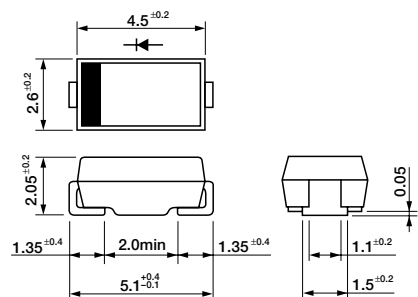


Fig. 2

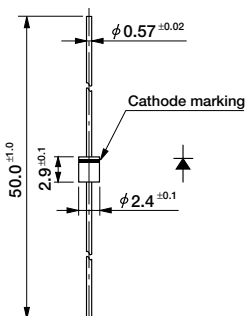


Fig. 3

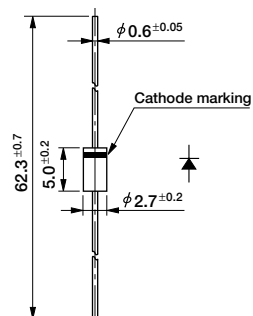


Fig. 4

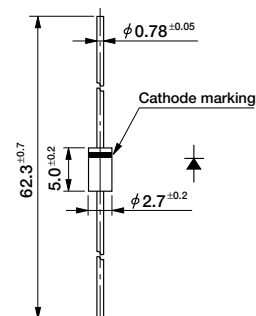


Fig. 5

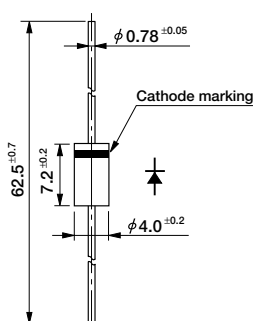


Fig. 6

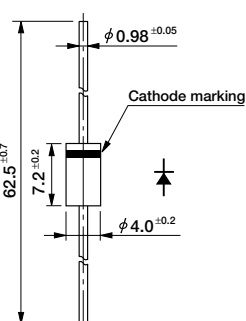


Fig. 7

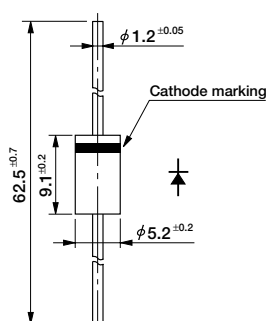


Fig. 8

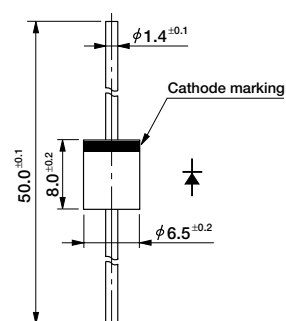
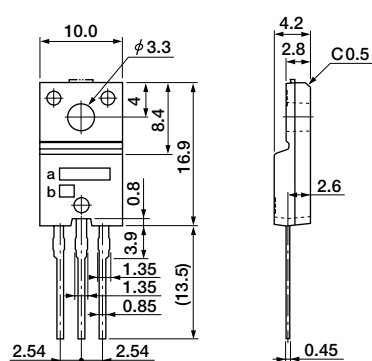


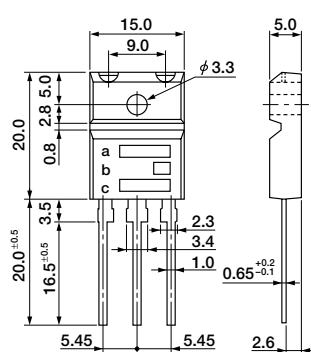
Fig. 9



S type (SBD) R type

a) Part No.
b) Lot No.

Fig. 10



S type (SBD) R type

a) Part No.
b) Polarity
c) Lot No.

(Unit: mm)

Fig. 11 Full-mold

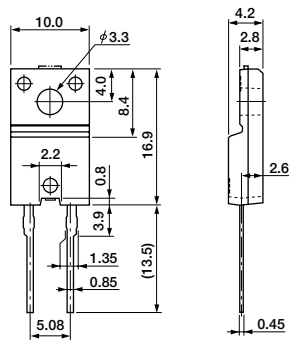
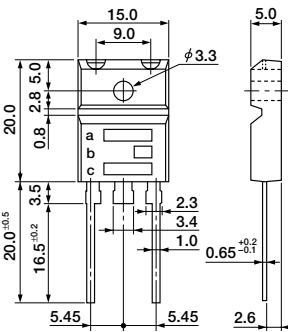
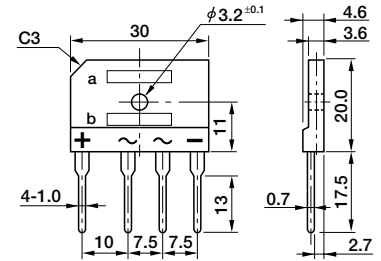


Fig. 12 Full-mold



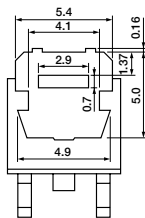
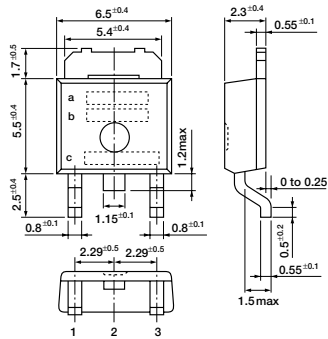
a) Part No.
b) Polarity
c) Lot No.

Fig. 13



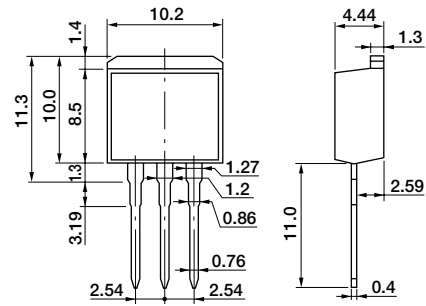
a) Part No.
b) Lot No.

Fig. 14



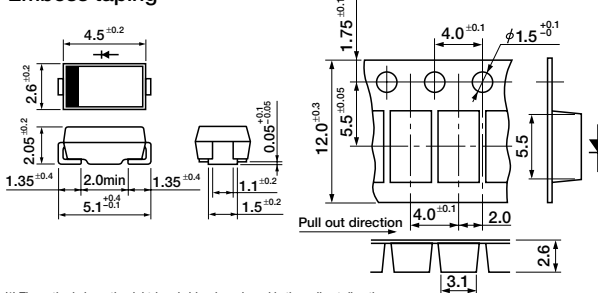
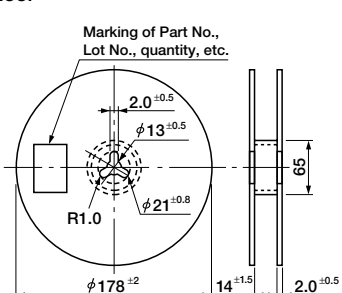
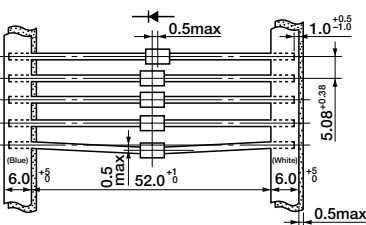
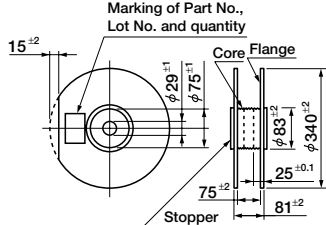
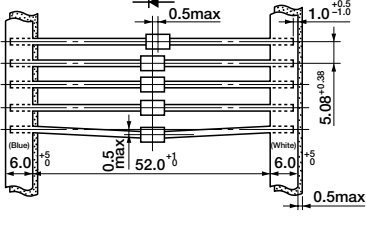
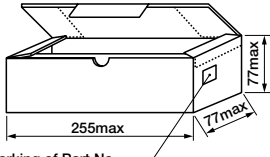
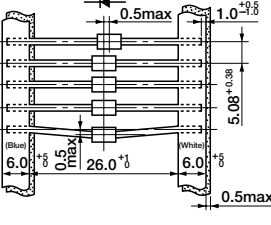
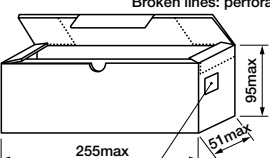
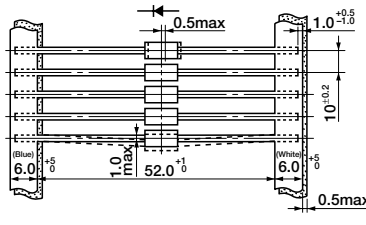
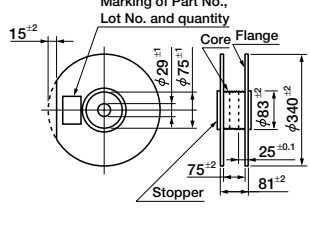
a) Part No.
b) Polarity
c) Lot No.

Fig. 15



General-purpose Diodes - Taping Specifications

Taping Specifications

Taping Name	Taping Dimensions (mm)	Packaging Dimensions (mm) and Markings	Packaging Quantity
V A suffix "V" is added to Part No. for tape packaging.	Emboss taping  (1) The cathode is on the right-hand side when viewed in the pull out direction. (2) The electrode side of the product is on the bottom when casing. (3) A leader tape of 150 to 200 mm in length is provided. (4) The leading and trailing edge of the leader tape are provided with a pitch of at least 10 mm. (5) Reversed polarity taping available on request (specify taping name "VL").	Reel  Marking of Part No., Lot No., quantity, etc.	1,800 pcs. per reel
V A suffix "V" is added to Part No. for tape packaging.	Axial taping 	Reel  Marking of Part No., Lot No. and quantity	5,000 pcs. per reel (2.7φ body) (2.4φ body) 3,000 pcs. (4φ body)
V1 A suffix "V1" is added to Part No. for tape packaging.	Axial taping 	Ammunition (Ammo) pack Broken lines: perforations  Marking of Part No., Lot No. and quantity	2,000 pcs. per box (2.7φ body) 3000 pcs. (2.4φ body) 1000 pcs. (4φ body)
V0 A suffix "V0" is added to Part No. for tape packaging.	Axial taping 	Ammunition (Ammo) pack Broken lines: perforations  Marking of Part No., Lot No. and quantity	2,000 pcs. per box (2.7φ body) 3000 pcs. (2.4φ body)
V3 A suffix "V3" is added to Part No. for tape packaging.	Axial taping 	Reel  Marking of Part No., Lot No. and quantity	1,500 pcs. per reel (5.2φ body)

Taping Specifications

Taping Name	Taping Dimensions (mm)	Packaging Dimensions (mm) and Markings	Packaging Quantity
V4 A suffix "V4" is added to Part No. for tape packaging.	Axial taping 	Ammunition (Ammo) pack 	1,000 pcs. per box (5.2φ body)
W A suffix "W" is added to Part No. for tape packaging.	Radial taping 	Ammunition (Ammo) pack 	4,000 pcs. per box (2.7φ body) (0.6φ leads only)
WS A suffix "WS" is added to Part No. for tape packaging.	Radial taping (applies to A0 series) 	Ammunition (Ammo) pack 	2,500 pcs. per box (2.4φ body)
WK A suffix "WK" is added to Part No. for tape packaging.	Radial taping (applies to A0 series) 		

General-purpose Diodes - Taping Specifications

Power Surface-mount - Taping Specifications

Taping Name	Taping Dimensions (mm)	Packaging Dimensions (mm) and Markings	Packaging Quantity
VL A suffix "VL" is added to Part No. for tape packaging.		Part No. Quantity Taping name (type) Lot No. Materials Disc: both-face white corrugated cardboard Core: foamed styrol	3,000 pcs. per reel
VR A suffix "VR" is added to Part No. for tape packaging.			3,000 pcs. per reel

High-voltage Diodes - Taping Specifications

Taping Name	Taping Dimensions (mm)	Packaging Dimensions (mm) and Markings	Packaging Quantity
V1 A suffix "V1" is added to Part No. for tape packaging.	Axial taping 		5,000 pcs. per reel
VD A suffix "VD" is added to Part No. for tape packaging.	Axial taping 		8,000 pcs. per reel

General-purpose LEDs

Uni-Color LED Lamp

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings						Ratings
		GaP	GaAsP	GaAlAs	AlGaInP	InGaP	GaN	
I _F	mA	30						
ΔI _F	mA/°C	-0.45						Above 25°C
I _{FP}	mA	100					70	f=1kHz, t _w =100μs
V _R	V	3			4	5		
Top	°C	-30 to +85				-25 to +85		
Tstg	°C	-30 to +100						

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.
				V _F (V)		I _v (mcd)		λ _p (nm)	Chip material		
				typ	max	typ	Condition I _F (mA)				
5φ Round	Deep red	SEL1110R	Diffused red	2.0	2.5	2.8	5	700	GaP	×	1
		SEL1110W	Diffused white			2.8				×	
		SEL1110S	Tinted red			4.5				×	
	High-intensity red	SEL1610W	Diffused white	1.75	2.2	1000	20	660	GaAlAs	×	
		SEL1610C	Clear			1200				×	
	Red	SEL1210R	Diffused red	1.9	2.5	26	20	630	GaAsP	×	
		SEL1210S	Tinted red			75				×	
	Amber	SEL1810D	Diffused orange	1.9	2.5	18	10	610	GaAsP	×	
		SEL1810A	Tinted orange			37				×	
	Orange	SEL1910D	Diffused orange	1.9	2.5	14	10	587	GaAsP	×	
		SEL1910A	Tinted orange			25				×	
	Yellow	SEL1710Y	Diffused yellow	2.0	2.5	22	10	570	GaP	×	
		SEL1710K	Tinted yellow			65				×	
	Green	SEL1410G	Diffused green	2.0	2.5	32	20	560	GaP	×	
		SEL1410E	Tinted green			84				×	
	Pure green	SEL1510C	Clear	2.0	2.5	50	20	555	GaP	×	
	Red	SEL1210RM	Diffused red	1.9	2.5	36	20	630	GaAsP	×	2
		SEL1210SM	Tinted red			75				×	
	Amber	SEL1810DM	Diffused orange	1.9	2.5	18	10	610	GaAsP	×	
		SEL1810AM	Tinted orange			37				×	
Orange	SEL1910DM	Diffused orange	1.9	2.5	19	10	587	GaAsP	×		
	SEL1910AM	Tinted orange			34				×		
Yellow	SEL1710KM	Tinted yellow	2.0	2.5	65	10	570	GaP	×		
Green	SEL1410GM	Diffused green	2.0	2.5	30	20	560	GaP	×		
	SEL1410EM	Tinted green			84				×		
Pure green	SEL1510CM	Clear	2.0	2.5	50	20	555	GaP	×		
Ultra high-intensity red	SELU1210CXM	Clear	2.0	2.5	280	20	635	AlGaInP	×	3	
Ultra high-intensity amber	SELU1810CXM	Clear	2.0	2.5	570	20	615	AlGaInP	×		
Ultra high-intensity pure green	SELU1D10CXM	Clear	3.3	4.0	2000	20	525	InGaP	×		
Ultra high-intensity blue	SELU1E10CXM	Clear	3.3	4.0	600	20	470	InGaP	×		

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.	
				V _F (V)		I _V (mcd)		λ _p (nm)	Chip material			
				typ	max	typ	Condition I _F (mA)					
5 φ Round	Ultra high-intensity red	SELU1250CM	Clear	2.0	2.5	900	20	635	AlGaInP	○	4	
	Red	SEL1250SM	Tinted red	1.9	2.5	75	20	630	GaAsP	○		
		SEL1250RM	Diffused red			48						
	Amber	SEL1850AM	Tinted orange	1.9	2.5	90	20	610	GaAsP	○		
		SEL1850DM	Diffused orange			60						
	Orange	SEL1950KM	Tinted orange	1.9	2.5	96	20	587	GaAsP	○		
	Green	SEL1450EKM	Tinted green	2.0	2.5	190	20	560	GaP	○		
		SEL1450GM-YG	Diffused green			120						
	Pure green	SEL1550CM	Clear	2.0	2.5	72	20	555	GaP	○		
	Ultra high-intensity pure green	SELU1D50CM	Clear	3.3	4.0	6000	20	525	InGaP	×		
Ultra high-intensity blue	SELU1E50CM	Clear	3.3	4.0	1850	20	470	InGaP	×			
High-intensity red	SEL1615C	Clear	1.75	2.2	700	20	660	GaAlAs	×	5		
5 φ Cylindrical	Deep red	SEL1111R	Diffused red	2.0	2.5	1.4	10	700	GaP	×	6	
	Red	SEL1211R	Diffused red	1.9	2.5	12	20	630	GaAsP	×		
	Amber	SEL1811D	Diffused orange	1.9	2.5	8.0	10	610	GaAsP	×		
	Orange	SEL1911D	Diffused orange	1.9	2.5	8.0	10	587	GaAsP	×		
	Yellow	SEL1711Y	Diffused yellow	2.0	2.5	13	10	570	GaP	×		
	Green	SEL1411G	Diffused green	2.0	2.5	30	20	560	GaP	×		
4.6X5.6φ Egg-shaped	Ultra high-intensity red	SELU1253CMKT	Clear	2.0	2.5	200	20	635	AlGaInP	×	7	
	Ultra high-intensity amber	SELU1853CMKT	Clear	2.0	2.5	450	20	615	AlGaInP	×		
	Green	SEL1453CEMKT	Tinted green	2.0	2.5	140	20	560	GaP	×		
4φ Round	Deep red	SEL4110S	Tinted red	2.0	2.5	2.4	5	700	GaP	×	8	
		SEL4110R	Diffused red			1.7						
	Red	SEL4210S	Tinted red	1.9	2.5	30	20	630	GaAsP	×		
		SEL4210R	Diffused red			17						
	Amber	SEL4810A	Tinted orange	1.9	2.5	20	10	610	GaAsP	×		
		SEL4810D	Diffused orange			15						
	Orange	SEL4910A	Tinted orange	1.9	2.5	26	10	587	GaAsP	×		
		SEL4910D	Diffused orange			16						
	Yellow	SEL4710K	Tinted yellow	2.0	2.5	36	10	570	GaP	×		
		SEL4710Y	Diffused yellow			14						
	Green	SEL4410E	Tinted green	2.0	2.5	87	20	560	GaP	×		
		SEL4410G	Diffused green			34						
	Pure green	SEL4510C	Clear	2.0	2.5	45	20	555	GaP	×		
	Deep red	SEL4114S	Tinted red	2.0	2.5	3.8	10	700	GaP	○		
		SEL4114R	Diffused red			2.8						
	Red	SEL4214S	Tinted red	1.9	2.5	40	20	630	GaAsP	○		
		SEL4214R	Diffused red			24						
	Amber	SEL4814A	Tinted orange	1.9	2.5	20	10	610	GaAsP	○		
		SEL4814D	Diffused orange			15						
	Orange	SEL4914A	Tinted orange	1.9	2.5	26	10	587	GaAsP	○		
		SEL4914D	Diffused orange			11						
	Yellow	SEL4714K	Tinted yellow	2.0	2.5	38	10	570	GaP	○		
		SEL4714Y	Diffused yellow			27						
	Green	SEL4414E	Tinted green	2.0	2.5	69	20	560	GaP	○		
		SEL4414G	Diffused green			48						
	Pure green	SEL4514C	Clear	2.0	2.5	26	20	555	GaP	○		9

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Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)							Contact mount	Fig. No.
				V _F (V)		I _V (mcd)		λ _p (nm)	Chip material			
				typ	max	typ	Condition I _F (mA)					
3φ Round	Deep red	SEL6110S	Tinted red	2.0	2.5	3.9	10	700	GaP	○	10	
		SEL6110R	Diffused red			2.6				○		
	Red	SEL6210S	Tinted red	1.9	2.5	41	20	630	GaAsP	○		
		SEL6210R	Diffused red			18				○		
	Amber	SEL6810A	Tinted orange	1.9	2.5	22	10	610	GaAsP	○		
		SEL6810D	Diffused orange			9.6				○		
	Orange	SEL6910A	Tinted orange	1.9	2.5	22	10	587	GaAsP	○		
		SEL6910D	Diffused orange			11				○		
	Yellow	SEL6710K	Tinted yellow	2.0	2.5	37	10	570	GaP	○		
		SEL6710Y	Diffused yellow			11				○		
	Green	SEL6410E	Tinted green	2.0	2.5	90	20	560	GaP	○		
		SEL6410G	Diffused green			30				○		
	Pure green	SEL6510C	Clear	2.0	2.5	42	20	555	GaP	○		
		SEL6510G	Diffused green			9.6				○		
	Red	SEL6214S	Tinted red	1.9	2.5	18	20	630	GaAsP	○		
	Amber	SEL6814A	Tinted orange	1.9	2.5	9.0	10	610	GaAsP	○		
	Ultra-high-intensity light amber	SELS6B14C	Clear	2.0	2.5	120	20	600	AlGaInP	○		
	Orange	SEL6914A	Tinted orange	1.9	2.5	8.0	10	587	GaAsP	○		
		SEL6914W	Diffused white			5.0				○		
	Yellow	SEL6714K	Tinted yellow	2.0	2.5	66	20	570	GaP	○		
		SEL6714W	Diffused white			30				○		
	Green	SEL6414E	Tinted green	2.0	2.5	42	20	560	GaP	○		
	Deep green	SEL6414E-TG	Tinted green			18				558	○	
	Pure green	SEL6514C	Clear	2.0	2.5	12	20	555	GaP	○		
	Red	SEL6215S	Tinted red	1.9	2.5	45	20	630	GaAsP	○		
	Orange	SEL6915A	Tinted orange	1.9	2.5	60	20	587	GaAsP	○		
	Yellow	SEL6715C	Clear	2.0	2.5	90	20	570	GaP	○		
	Green	SEL6415E	Tinted green	2.0	2.5	81	20	560	GaP	○		
	Pure green	SEL6515C	Clear	2.0	2.5	44	20	555	GaP	○		
	Deep red	SEL2110S	Tinted red	2.0	2.5	4	10	700	GaP	×		
SEL2110R		Diffused red	1.8			×						
SEL2110W		Diffused white	1.8			×						
High-intensity red	SEL2610C	Clear	1.75	2.2	350	20	660	GaAlAs	×			
Red	SEL2210S	Tinted red	1.9	2.5	40	20	630	GaAsP	×			
	SEL2210R	Diffused red			15				×			
	SEL2210W	Diffused white			15				×			
Amber	SEL2810A	Tinted orange	1.9	2.5	22	10	610	GaAsP	×			
	SEL2810D	Diffused orange			9.0				×			
Orange	SEL2910A	Tinted orange	1.9	2.5	16	10	587	GaAsP	×			
	SEL2910D	Diffused orange			8.0				×			
Ultra high-intensity yellow	SELU2710C	Clear	2.0	2.5	270	20	572	AlGaInP	×			
Yellow	SEL2710K	Tinted yellow	2.0	2.5	40	10	570	GaP	×			
	SEL2710Y	Diffused yellow			14				×			
Green	SEL2410E	Tinted green	2.0	2.5	77	20	560	GaP	×			
	SEL2410G	Diffused green			20				×			
3φ Round	Pure green	SEL2510C	Clear	2.0	2.5	43	20	555	GaP	×		
		SEL2510G	Diffused green			8.2				×		
	Ultra high-intensity pure green	SELU2D10C	Clear	3.3	4.0	1200	20	525	InGaIn	×		
	Ultra high-intensity blue	SELU2E10C	Clear	3.3	4.0	400	20	470	InGaIn	×		
	Blue	SEL2E10C	Clear	3.8	4.8	60	20	430	GaN	×		
	Red	SEL2215S	Tinted red	1.9	2.5	45	20	630	GaAsP	×		
		SEL2215R	Diffused red			38				×		
	Amber	SEL2815A	Tinted orange	1.9	2.5	80	10	610	GaAsP	×		
		SEL2815D	Diffused orange			60				×		
	Orange	SEL2915A	Tinted orange	1.9	2.5	81	10	587	GaAsP	×		
SEL2915D		Diffused orange	53			×						
Yellow	SEL2715K	Tinted yellow	2.0	2.5	130	10	570	GaP	×			
	SEL2715Y	Diffused yellow			110				×			
Green	SEL2415E	Tinted green	2.0	2.5	110	20	560	GaP	×			
	SEL2415G	Diffused green			72				×			
Pure green	SEL2515C	Clear	2.0	2.5	52	20	555	GaP	×			
3φ Cylindrical	Deep red	SEL2111R	Diffused red	2.0	2.5	0.7	10	700	GaP	×		
	Orange	SEL2911D	Diffused orange	1.9	2.5	3.3	10	587	GaAsP	×		
	Green	SEL2411G	Diffused green	2.0	2.5	18	20	560	GaP	×		
2φ Round	Deep red	SEL4117R	Diffused red	2.0	2.5	1.1	10	700	GaP	×		
	Amber	SEL4817D	Diffused orange	1.9	2.5	7.5	10	610	GaAsP	×		
	Orange	SEL4917D	Diffused orange	1.9	2.5	7.5	10	587	GaAsP	×		
	Yellow	SEL4717Y	Diffused yellow	2.0	2.5	14	20	570	GaP	×		
	Green	SEL4417G	Diffused green	2.0	2.5	16	20	560	GaP	×		
	Red	SEL1213C	Tinted red	1.9	2.5	7.0	20	630	GaAsP	×		
Inverted-cone typ for surface illumination	Amber	SEL1813A	Tinted orange	1.9	2.5	8.0	20	610	GaAsP	×		
	Orange	SEL1913K	Tinted light orange	1.9	2.5	8.0	20	587	GaAsP	×		
	Yellow	SEL1713K	Tinted yellow	2.0	2.5	15	20	570	GaP	×		
	Green	SEL1413E	Tinted green	2.0	2.5	12	20	560	GaP	×		
	Pure green	SEL1513E	Tinted light green	2.0	2.5	5.0	20	555	GaP	×		
	Green	SEL6413E	Tinted green	2.0	2.5	14	20	560	GaP	○		
	Pure green	SEL6513C	Clear	2.0	2.5	5.0	20	555	GaP	○		
	High-intensity red	SEL2613CS-S	Tinted light red	1.7	2.5	80	20	660	GaAlAs	×		
	Red	SEL2213C	Clear	1.9	2.5	7.0	20	630	GaAsP	×		
	Amber	SEL2813A	Tinted orange	1.9	2.5	8.0	20	610	GaAsP	×		
3x5 Rectangular	Orange	SEL2913K	Tinted light orange	1.9	2.5	8.0	20	587	GaAsP	×		
	Yellow	SEL2713K	Tinted yellow	2.0	2.5	17	20	570	GaP	×		
	Green	SEL2413E	Tinted green	2.0	2.5	14	20	560	GaP	×		
		SEL2413G	Diffused green			12				×		
	Pure green	SEL2513E	Tinted green	2.0	2.5	5.0	20	555	GaP	×		
	Deep red	SEL1121R	Diffused red	2.0	2.5	0.9	10	700	GaP	×		
	Amber	SEL1821D	Diffused orange	1.9	2.5	3.0	10	610	GaAsP	×		
	Orange	SEL1921D	Diffused orange	1.9	2.5	3.8	10	587	GaAsP	×		
	Yellow	SEL1721Y	Diffused yellow	2.0	2.5	7.0	10	570	GaP	×		
	Green	SEL1421G	Diffused green	2.0	2.5	12	20	560	GaP	×		

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Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)							Contact mount	Fig. No.
				V _F (V)		I _V (mcd)		λ _p (nm)	Chip material			
				typ	max	typ	Condition I _F (mA)					
2.5X5 Rectangular	Red	SEL1222R	Diffused red	1.9	2.5	9.0	20	630	GaAsP	×	21	
	Amber	SEL1822D	Diffused orange	1.9	2.5	4.8	10	610	GaAsP	×		
	Orange	SEL1922D	Diffused orange	1.9	2.5	4.5	10	587	GaAsP	×		
	Yellow	SEL1722Y	Diffused yellow	2.0	2.5	7.8	10	570	GaP	×		
		SEL1722K	Tinted yellow			12				×		
	Green	SEL1422G	Diffused green	2.0	2.5	7.2	20	560	GaP	×		
2X5 Rectangular	Deep red	SEL1120R	Diffused red	2.0	2.5	0.9	10	700	GaP	×	22	
	Red	SEL1220R	Diffused red	1.9	2.5	4.8	20	630	GaAsP	×		
	Amber	SEL1820D	Diffused orange	1.9	2.5	3.0	10	610	GaAsP	×		
	Orange	SEL1920D	Diffused orange	1.9	2.5	3.8	10	587	GaAsP	×		
	Yellow	SEL1720Y	Diffused yellow	2.0	2.5	7.0	10	570	GaP	×		
	Green	SEL1420G	Diffused green	2.0	2.5	11	20	560	GaP	×		
1X5 Rectangular	Deep red	SEL1124R	Diffused red	2.0	2.5	0.5	10	700	GaP	×	23	
	Amber	SEL1824D	Diffused orange	1.9	2.5	4.0	10	610	GaAsP	×		
	Orange	SEL1924D	Diffused orange	1.9	2.5	3.0	10	587	GaAsP	×		
	Yellow	SEL1724Y	Diffused yellow	2.0	2.5	6.0	10	570	GaP	×		
	Green	SEL1424G	Diffused green	2.0	2.5	15	20	560	GaP	×		
2X4 Rectangular	Red	SEL4225C	Clear	1.9	2.5	12	20	630	GaAsP	×	24	
		SEL4225R	Diffused red			5.4				×		
	Amber	SEL4825A	Tinted orange	1.9	2.5	5.4	10	610	GaAsP	×		
		SEL4825D	Diffused orange			4.0				×		
	Orange	SEL4925A	Tinted orange	1.9	2.5	4.5	10	587	GaAsP	×		
		SEL4925D	Diffused orange			4.0				×		
	Yellow	SEL4725K	Tinted yellow	2.0	2.5	13	10	570	GaP	×		
		SEL4725Y	Diffused yellow			5.0				×		
	Green	SEL4425E	Tinted green	2.0	2.5	20	20	560	GaP	×		
		SEL4425G	Diffused green			10				×		
	Pure green	SEL4525C	Clear	2.0	2.5	6.6	20	555	GaP	×		
	Red	SEL4226C	Clear	1.9	2.5	12	20	630	GaAsP	○		
		SEL4226R	Diffused red			10				○		
	Amber	SEL4826A	Tinted orange	1.9	2.5	5.4	10	610	GaAsP	○		
		SEL4826D	Diffused orange			4.5				○		
	Orange	SEL4926A	Tinted orange	1.9	2.5	6.0	10	587	GaAsP	○		
		SEL4926D	Diffused orange			4.5				○		
	Yellow	SEL4726K	Tinted yellow	2.0	2.5	14	10	570	GaP	○		
		SEL4726Y	Diffused yellow			8.6				○		
	Green	SEL4426E	Tinted green	2.0	2.5	20	20	560	GaP	○		
		SEL4426G	Diffused green			14				○		
4 φ Bow-shaped	Red	SEL4227C	Clear	1.9	2.5	15	20	630	GaAsP	×	26	
	Green	SEL4427EP	Tinted green	2.0	2.5	19	20	560	GaP	×		
	Red	SEL6227S	Tinted red	1.9	2.5	14	20	630	GaAsP	○	27	
	Orange	SEL6927A	Tinted orange	1.9	2.5	10	10	587	GaAsP	○		
	Green	SEL6427EP	Tinted green	2.0	2.5	26	20	560	GaP	○		

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.
				V _F (V)		I _V (mcd)		λ _p (nm)	Chip material		
				typ	max	typ	Condition I _F (mA)				
3.1 φ Bow-shaped	High-intensity red	SEL4628C-S	Clear	1.7	2.2	200	20	660	GaAlAs	×	28
	Red	SEL4228C	Clear	1.9	2.5	27	20	630	GaAsP	×	
	Amber	SEL4828A	Tinted orange	1.9	2.5	14	10	610	GaAsP	×	
	Orange	SEL4928A	Tinted orange	1.9	2.5	14	10	587	GaAsP	×	
	Yellow	SEL4728K	Tinted yellow	2.0	2.5	30	10	570	GaP	×	
	Green	SEL4428E	Tinted green	2.0	2.5	63	20	560	GaP	×	
	Deep green	SEL4428B-TG	Tinted dark blue	2.0	2.5	18	20	558	GaP	×	
	Pure green	SEL4528C	Clear	2.0	2.5	30	20	555	GaP	×	29
	Red	SEL4229R	Diffused red	1.9	2.5	21	20	630	GaAsP	○	
	Amber	SEL4829A	Tinted orange	1.9	2.5	18	10	610	GaAsP	○	
	Orange	SEL4929A	Tinted orange	1.9	2.5	18	10	587	GaAsP	○	
	Yellow	SEL4729KH	Tinted yellow	2.0	2.5	60	10	570	GaP	○	
Green	SEL4429E	Tinted green	2.0	2.5	60	20	560	GaP	○		
5mm Pitch lead rectangular	High-intensity red	SEL5620C	Clear	1.7	2.2	100	20	660	GaAlAs	○	30
	Red	SEL5220S	Tinted red	1.9	2.5	20	20	630	GaAsP	○	
	Amber	SEL5820A	Tinted orange	1.9	2.5	12	20	610	GaAsP	○	
	Orange	SEL5920A	Tinted orange	1.9	2.5	12	20	587	GaAsP	○	
	Green	SEL5420E	Tinted green	2.0	2.5	20	20	560	GaP	○	
	Pure green	SEL5520C	Clear	2.0	2.5	6.0	20	555	GaP	○	
	Ultra high-intensity blue	SELU5E20C	Clear	3.3	4.0	60	10	470	InGaP	○	
5mm Pitch lead 3φ lens-type	Red	SEL5221S	Tinted red	1.9	2.5	35	20	630	GaAsP	○	31
	Amber	SEL5821A	Tinted orange	1.9	2.5	60	20	610	GaAsP	○	
	Orange	SEL5921A	Tinted orange	1.9	2.5	60	20	587	GaAsP	○	
	Yellow	SEL5721C	Clear	2.0	2.5	90	20	570	GaP	○	
	Green	SEL5421E	Tinted green	2.0	2.5	95	20	560	GaP	○	
	Pure green	SEL5521C	Clear	2.0	2.5	35	20	555	GaP	○	
5mm Pitch lead bow-shaped	Ultra high-intensity red	SELS5223C	Clear	2.0	2.5	100	20	635	AlGaInP	○	32
	Red	SEL5223S	Tinted red	1.9	2.5	25	20	630	GaAsP	○	
	Ultra high-intensity amber	SELS5823C	Clear	2.0	2.5	130	20	615	AlGaInP	○	
		SELU5823C	Clear			185				○	
	Amber	SEL5823A	Tinted orange	1.9	2.5	35	20	610	GaAsP	○	
	Ultra-high-intensity light amber	SELS5B23C	Clear	2.0	2.5	135	20	600	AlGaInP	○	
	Ultra high-intensity orange	SELS5923C	Clear	2.0	2.5	145	20	590	AlGaInP	○	
	Orange	SEL5923A	Tinted orange	1.9	2.5	35	20	587	GaAsP	○	
	Ultra high-intensity yellow	SELU5723C	Clear	2.0	2.5	155	20	572	AlGaInP	○	
	Yellow	SEL5723C	Clear	2.0	2.5	60	20	570	GaP	○	
	Green	SEL5423E	Tinted green	2.0	2.5	40	20	560	GaP	○	
	Pure green	SEL5523C	Clear	2.0	2.5	13	20	555	GaP	○	
Ultra high-intensity blue	SELU5E23C	Clear	3.6	4.0	110	10	470	InGaP	○		
Blue	SEL5E23C	Clear	4.0	4.8	20	20	430	GaN	○		
5mm Pitch lead egg-shaped	Red	SEL5255S	Tinted red	1.9	2.5	35	20	630	GaAsP	○	33
	Orange	SEL5955A	Tinted orange	1.9	2.5	25	20	587	GaAsP	○	
	Yellow	SEL5755C	Clear	2.0	2.5	140	20	570	GaP	○	

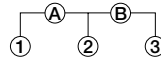
Bi-Color LED Lamp

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings	Conditions
I _F	mA	30	
ΔI _F	mA/°C	-0.45	Above 25°C
I _{FP}	mA	100	f=1kHz, tw=100μs
V _R	V	4	
Top	°C	-30 to +85	
Tstg	°C	-30 to +100	

Internal wiring diagram



Outline	Part No.	Emitting color	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.
				V _F (V)		I _v (mcd)		λ _p (nm)	Common		
				typ	max	typ	Condition I _F (mA)				
5φ Round	SML11516C	A Deep red	Clear	2.0	2.5	15	20	700	Cathode	×	34
		B Pure green		2.0	2.5	50	20	555			
	SML1216C	A Red	Clear	1.9	2.5	65	20	630	Cathode	×	
		B Green		2.0	2.5	90	20	560			
	SML1216W	A Red	Diffused white	1.9	2.5	60	20	630	Cathode	×	
		B Green		2.0	2.5	60	20	560			
	SML1516W	A Deep red	Diffused white	2.0	2.5	6.0	20	700	Cathode	×	
		B Pure green		2.0	2.5	20	20	555			
	SML16716CN	A High-intensity red	Clear	1.7	2.2	100	20	660	Anode	×	
		B Yellow		2.4	3.0	140	20	570			
	SML16716WN	A High-intensity red	Diffused white	1.7	2.2	50	20	660	Anode	×	
		B Yellow		2.4	3.0	70	20	570			
	SML1816W	A Amber	Diffused white	1.9	2.5	50	20	610	Cathode	×	
		B Green		2.0	2.5	60	20	560			
	SML19416W	A Orange	Diffused white	1.9	2.5	45	20	587	Cathode	×	
		B Green		2.0	2.5	60	20	560			
SML12451W	A Red	Diffused white	1.9	2.5	40	20	630	Cathode	×	35	
	B Green		2.0	2.5	60	20	560				
SML16751WN	A High-intensity red	Diffused white	1.7	2.2	50	20	660	Anode	×		
	B Yellow		2.4	3.0	60	20	570				
2.5X5 Rectangular	SML12460C	A Red	Clear	1.9	2.5	10	20	630	Cathode	×	36
		B Green		2.0	2.5	25	20	560			
	SML16760CN	A High-intensity red	Clear	1.7	2.2	30	20	660	Anode	×	
		B Yellow		2.4	3.0	40	20	570			
	SML19460C	A Orange	Clear	1.9	2.5	15	20	587	Cathode	×	
		B Green		2.0	2.5	25	20	560			
3.3X6 Rectangular	SML72420C	A Red	Clear	1.9	2.5	15	20	630	Cathode	○	37
		B Green		2.0	2.5	20	20	560			
	SML78420C	A Amber	Clear	1.9	2.5	10	20	610	Cathode	○	
		B Green		2.0	2.5	20	20	560			
	SML79420C	A Orange	Clear	1.9	2.5	10	20	587	Cathode	○	
		B Green		2.0	2.5	20	20	560			

Outline	Part No.	Emitting color	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.
				V _F (V)		I _v (mcd)		λ _p (nm)	Common		
				typ	max	typ	Condition I _r (mA)				
3.3X6 Bow-shaped	SML72423C	A Red	Clear	1.9	2.5	25	20	630	Cathode	○	38
		B Green		2.0	2.5	35	20	560			
	SML72923C	A Red	Clear	1.9	2.5	25	20	630	Cathode	○	
		B Orange		1.9	2.5	25	20	587			
	SML78423C	A Amber	Clear	1.9	2.5	25	20	610	Cathode	○	
		B Green		2.0	2.5	35	20	560			
	SML79423C	A Orange	Clear	1.9	2.5	25	20	587	Cathode	○	
		B Green		2.0	2.5	35	20	560			
SMLS79723C	A Ultra high-intensity orange	Clear	2.0	2.5	150	20	590	Cathode	○		
	B Yellow		2.0	2.5	40	20	570				
Egg-shaped	SML72755C	A Red	Clear	1.9	2.5	45	20	630	Cathode	○	39
		B Yellow		2.0	2.5	75	20	570			
	SML79255C	A Orange	Clear	1.9	2.5	40	20	587	Cathode	○	
		B Red		2.0	2.5	45	20	630			
	SML79455C	A Orange	Clear	1.9	2.5	45	20	587	Cathode	○	
		B Green		2.0	2.5	75	20	560			
	SML76755WN	A High-intensity red	Diffused white	1.7	2.2	50	20	660	Anode	○	
		B Yellow		2.4	3.0	50	20	570			
	SMLU72755C	A Ultra high-intensity red	Clear	2.0	2.5	160	20	635	Cathode	○	
		B Ultra high-intensity yellow		2.0	2.5	170	20	572			
SMLU78755C	A Ultra high-intensity amber	Clear	2.0	2.5	280	20	615	Cathode	○		
	B Ultra high-intensity yellow		2.0	2.5	170	20	572				

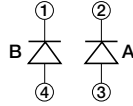
Surface Mount LED

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings						Conditions
		GaP	GaAsP	GaAlAs	AlGaInP	InGaN	GaN	
I _F	mA	30						
ΔI _F	mA/°C	-0.45						Above 25°C
I _{FP}	mA	70						f=1kHz, tw=100μs
V _R	V	4				5		
Top	°C	-30 to +85				-25 to +85		
Tstg	°C	-30 to +100						

Internal wiring diagram



Uni-Color

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Fig. No.
				V _F (V)		I _V (mcd)		λ _p (nm)	Chip material	
				typ	max	typ	Condition I _F (mA)			
Flat lens type	Deep red	SEC1101C	Clear	2.0	2.5	1.5	20	700	GaP	40
	High-intensity red	SEC1601C	Clear	1.7	2.2	100	20	660	GaAlAs	
	Red	SEC1201C	Clear	1.9	2.5	10	20	630	GaAsP	
	Amber	SEC1801C	Clear	1.9	2.5	16	20	610	GaAsP	
	Orange	SEC1901C	Clear	1.9	2.5	13	20	587	GaAsP	
	Yellow	SEC1701C-YG	Clear	2.0	2.5	25	20	570	GaP	
	Green	SEC1401C	Clear	2.0	2.5	22	20	560	GaP	
	Deep reen	SEC1401E-TG	Tinted green	2.0	2.5	11	20	558	GaP	
	Pure green	SEC1501C	Clear	2.0	2.5	8.0	20	555	GaP	
	Ultra high-intensity pure green	SECU1D01C	Clear	3.3	4.0	150	20	525	InGaIn	
	Ultra high-intensity blue	SECU1E01C	Clear	3.3	4.0	50	20	470	InGaIn	
	Blue	SEC1E01C	Clear	3.9	4.8	6.0	20	430	GaN	
Inner lens type	High-intensity red	SEC1603C	Clear	1.7	2.2	150	20	660	GaAlAs	41
	Ultra high-intensity red	SECS1203C	Clear	1.9	2.5	100	20	635	AlGaInP	
	Red	SEC1203C	Clear	1.9	2.5	15	20	630	GaAsP	
	Ultra high-intensity amber	SELS1803C	Clear	1.9	2.5	10	3	615	AlGaInP	
	Amber	SEC1803C	Clear	1.9	2.5	20	20	610	GaAsP	
	Ultra high-intensity orange	SELS1903C	Clear	1.9	2.5	10	3	590	AlGaInP	
	Orange	SEC1903C	Clear	1.9	2.5	15	20	587	GaAsP	
	Yellow	SEC1703C	Clear	2.0	2.5	35	20	570	GaP	
	Green	SEC1403C	Clear	2.0	2.5	33	20	560	GaP	
	Deep green	SEC1403E-TG	Clear	2.0	2.5	15	20	558	GaP	
	Pure green	SEC1503C	Clear	2.0	2.5	10	20	555	GaP	

Bi-Color

Outline	Part No.	Emitting color	Lens color	Electro-optical characteristics (Ta=25°C)						Fig. No.
				V _F (V)		I _V (mcd)		λ _p (nm)		
				typ	max	typ	Condition I _F (mA)			
Flat lens type	SEC2422C	A Red	Clear	1.9	2.5	10	20	630	42	
		B Green		2.0	2.5	20	20	560		
	SEC2442C	A Green	Clear	2.0	2.5	20	20	560		
		B Green		2.0	2.5	20	20	560		
	SEC2462C	A High-intensity red	Clear	1.7	2.2	20	20	660		
		B Green		2.0	2.5	20	20	560		
	SEC2492C	A Orange	Clear	1.9	2.5	10	20	587		
		B Green		2.0	2.5	20	20	560		
	SEC2552C	A Pure green	Clear	2.0	2.5	5.0	20	555		
		B Pure green		2.0	2.5	5.0	20	555		
	SEC2592C	A Orange	Clear	1.9	2.5	10	20	587		
		B Pure green		2.0	2.5	5.0	20	555		
SEC2762C-YG	A High-intensity red	Clear	1.7	2.2	20	20	660			
	B Yellow		2.0	2.5	20	20	570			
Inner lens type	SEC2484C	A Amber	Clear	1.9	2.5	20	20	610	43	
		B Green		2.0	2.5	30	20	560		
	SEC2554C	A Pure green	Clear	2.0	2.5	10	20	555		
		B Pure green		2.0	2.5	10	20	555		
	SEC2494C	A Orange	Clear	1.9	2.5	20	20	587		
		B Green		2.0	2.5	30	20	560		
	SEC2764C	A High-intensity red	Clear	1.7	2.2	50	20	660		
		B Yellow		2.0	2.5	50	20	570		
	SEC2774C	A Yellow	Clear	2.0	2.5	50	20	570		
		B Yellow		2.0	2.5	50	20	570		

Infrared LED

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings	Ratings
I_F	mA	150	
ΔI_F	mA/°C	-1.33	Above 25°C
I_{FP}	mA	1000	f=1kHz, tw=10μs
V_R	V	5	
Top	°C	-30 to +85	
Tstg	°C	-30 to +100	

Outline	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.	
			V _F (V)		I _e (mW/sr)		λ _p (nm)	Chip material			
			typ	max	typ	Condition					
5φ Round	SID1010CM	Clear	1.3	1.5	130	(Constant voltage)	940	GaAs	×	44	
	SID1K10CM	Clear	1.3	1.5	200		940	GaAs	×		
	SID1010CXM	Clear	1.3	1.5	60		940	GaAs	×		
	SID1K10CXM	Clear	1.3	1.5	110		940	GaAs	×		
	SID1050CM	Clear	1.3	1.5	250	V _{CC} =3V, R=2.2Ω	940	GaAs	○	45	
	SID303C	Clear	1.3	1.5	80		940	GaAs	×		
	SID313BP	Transparent light purpl	1.3	1.5	130		940	GaAs	×		46
	SID1003BQ	Transparent light navy blue	1.3	1.5	180		940	GaAs	×		
	SID307BR	Transparent dark navy blue	1.3	1.5	200		940	GaAs	×		
SID1G307C	Clear	1.5	1.8	50	I _f =50mA	850	GaAs	×	47		
SID2010C	Clear	1.3	1.5	7.0		940	GaAs	×			
SID2K10C	Clear	1.3	1.5	14		940	GaAs	×			

General-purpose LEDs - External Dimensions

(Unit: mm)

Fig. 1

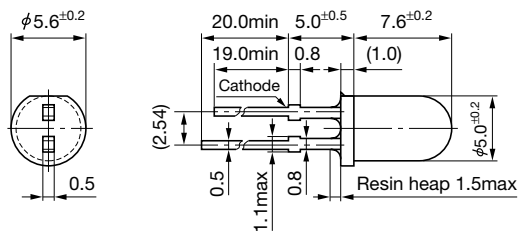


Fig. 2

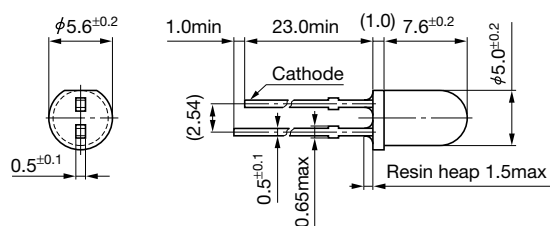


Fig. 3

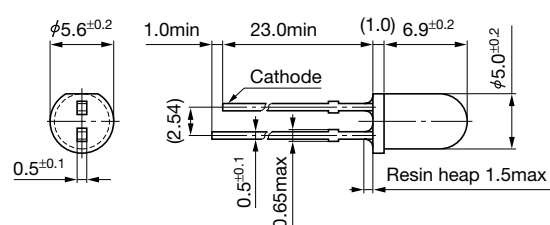


Fig. 4

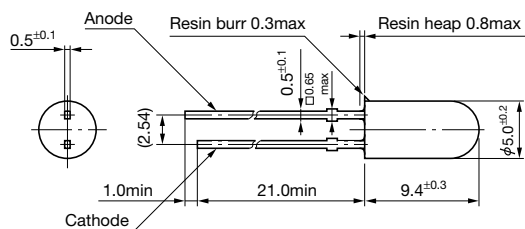


Fig. 5

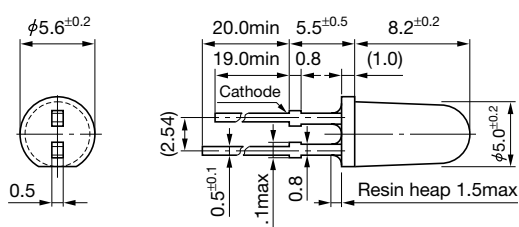


Fig. 6

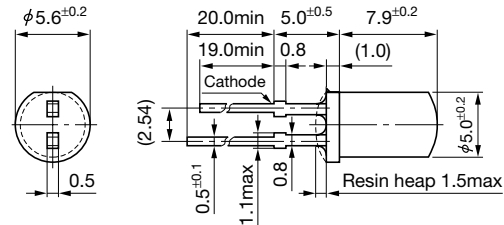


Fig. 7

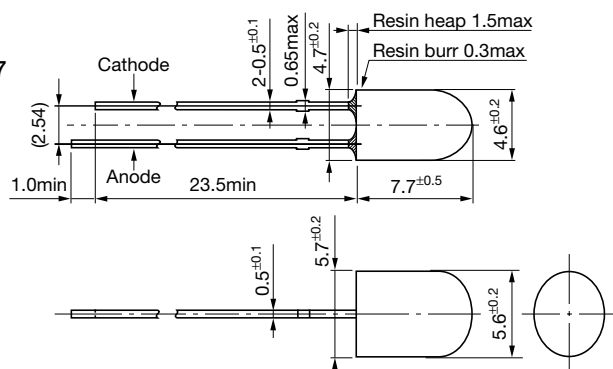


Fig. 8

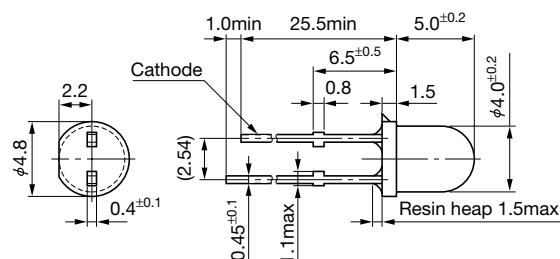


Fig. 9

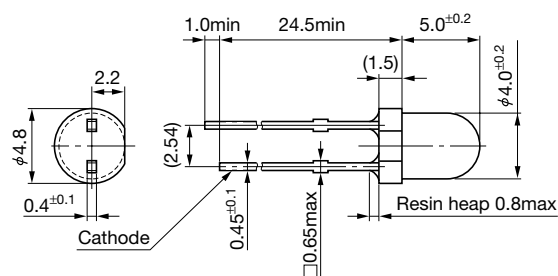
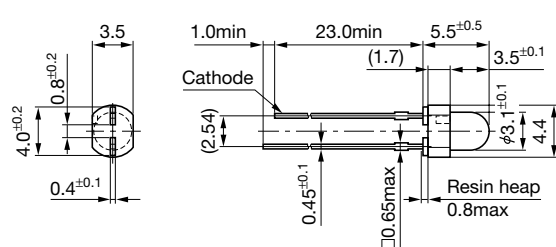


Fig. 10



(Unit: mm)

Fig. 11

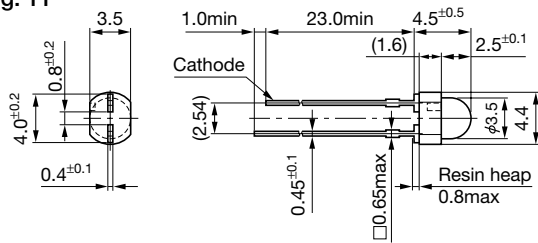


Fig. 16

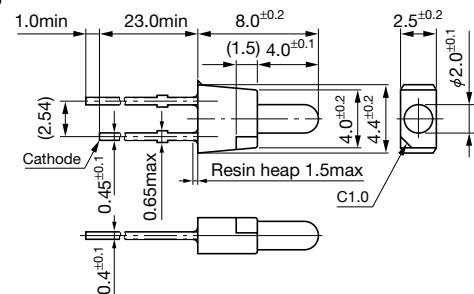


Fig. 12

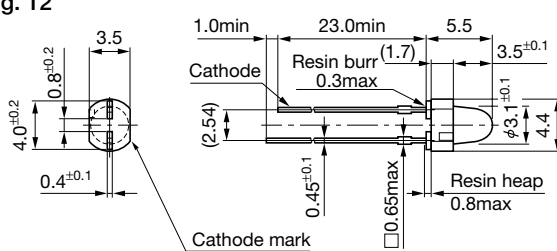


Fig. 17

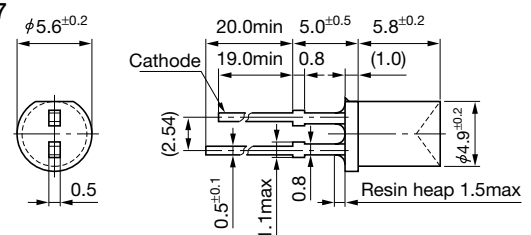


Fig. 13

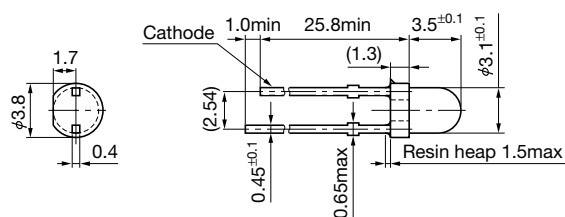


Fig. 18

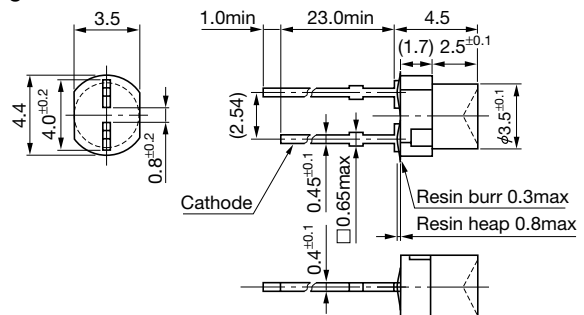


Fig. 14

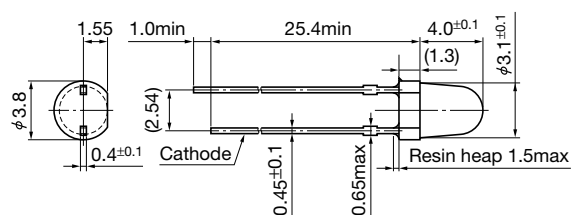


Fig. 19

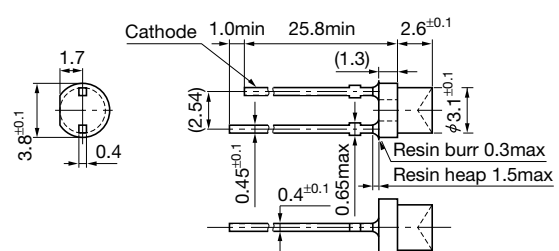


Fig. 15

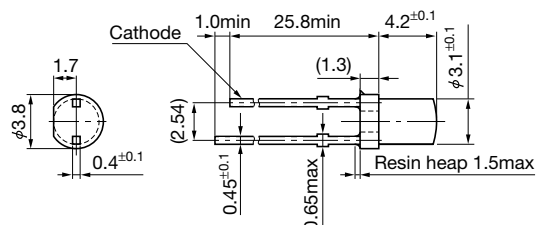
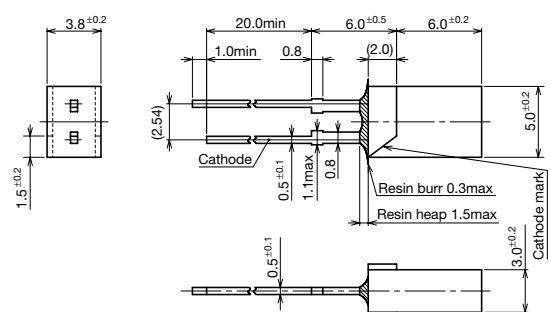


Fig. 20



(Unit: mm)

Fig. 21

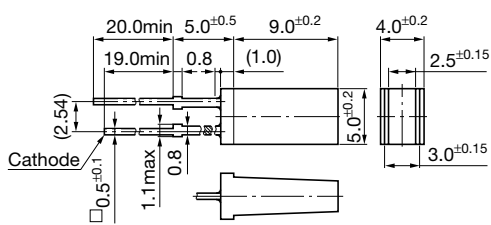


Fig. 22

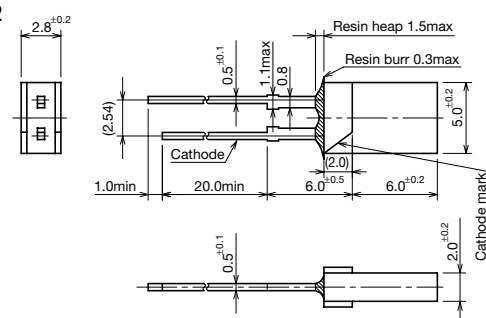


Fig. 23

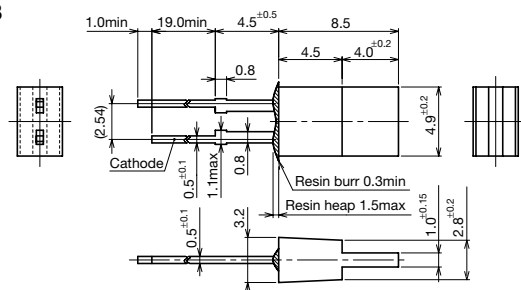


Fig. 24

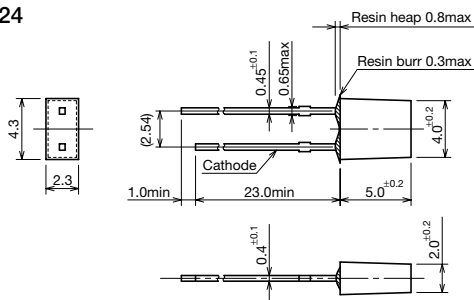


Fig. 25

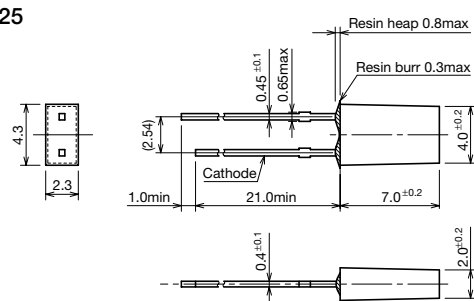


Fig. 26

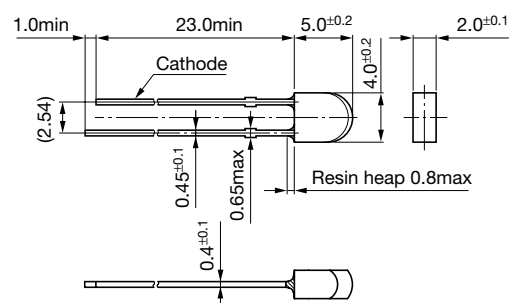


Fig. 27

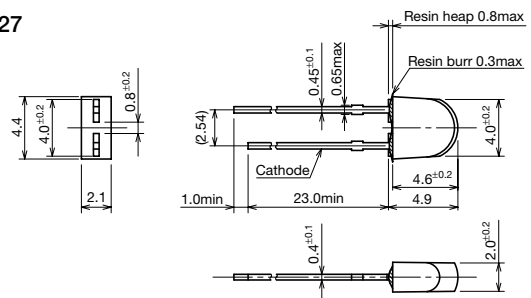


Fig. 28

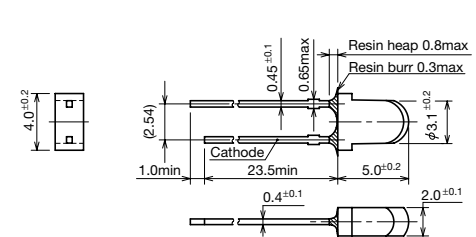


Fig. 29

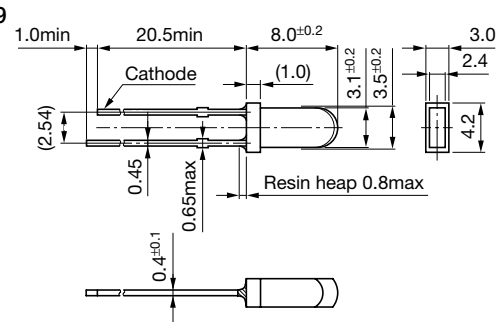
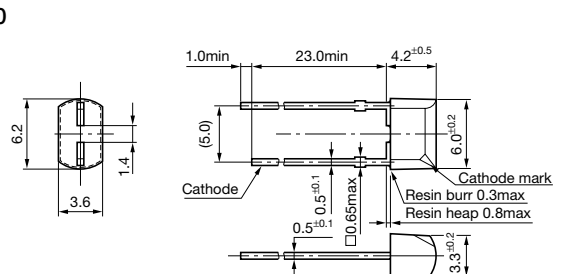


Fig. 30



General-purpose LEDs - External Dimensions

(Unit: mm)

Fig. 31

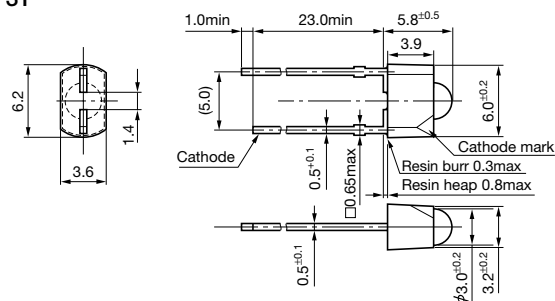


Fig. 32

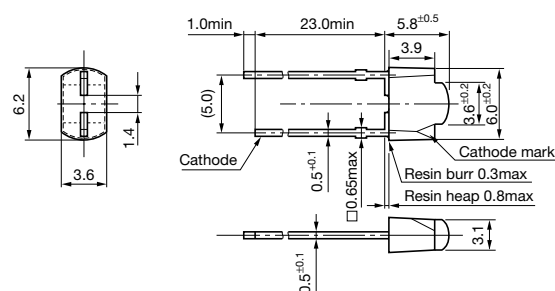


Fig. 33

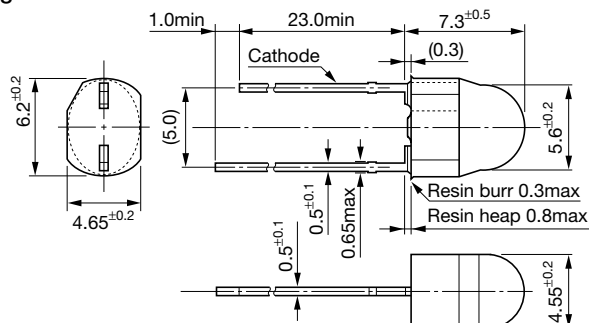


Fig. 34

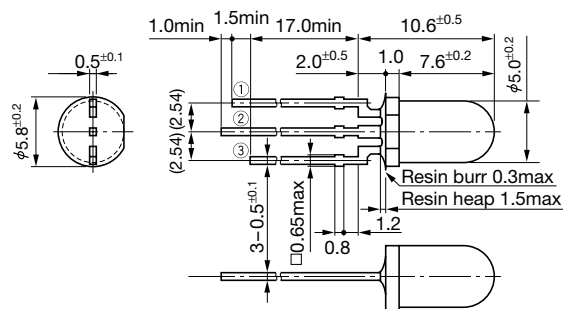


Fig. 35

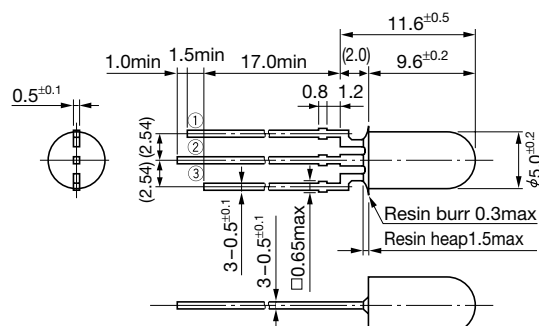


Fig. 36

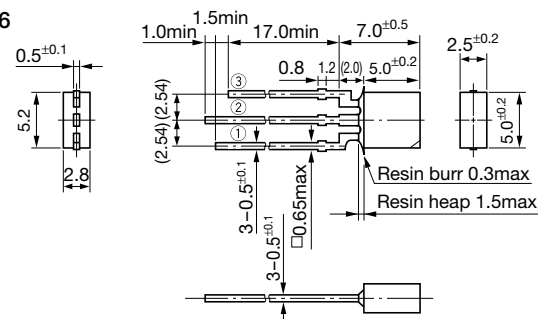


Fig. 37

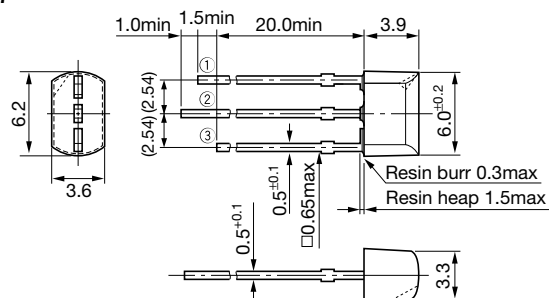


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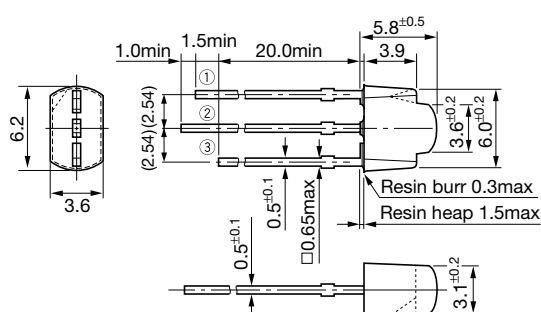


Fig. 39

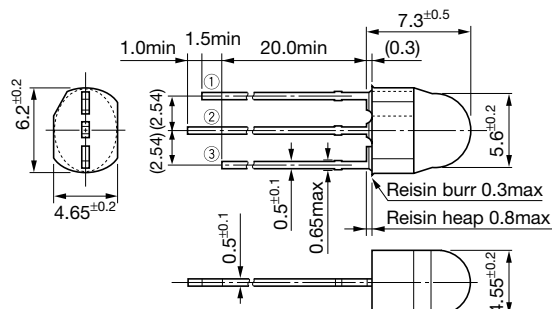
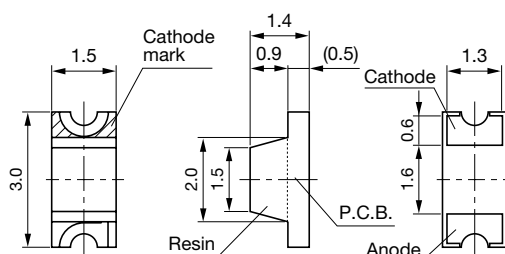


Fig. 40



(Unit: mm)

Fig. 41

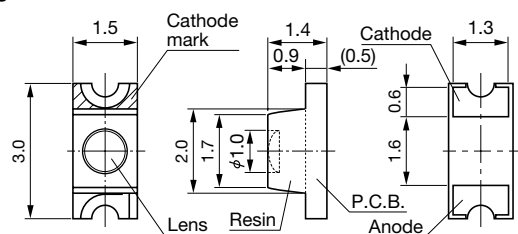


Fig. 45

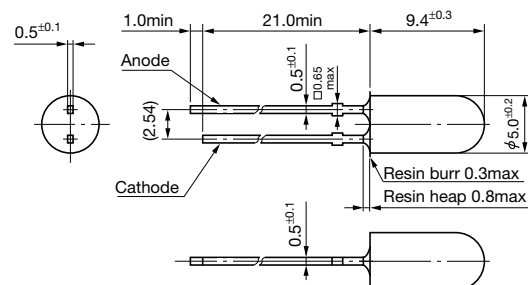


Fig. 42

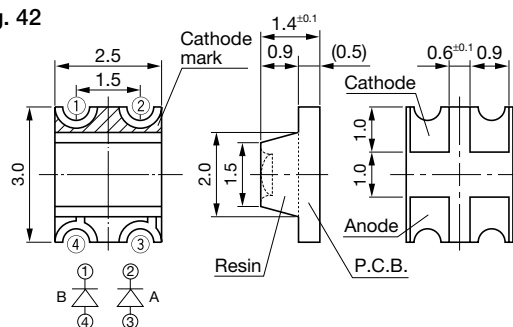


Fig. 46

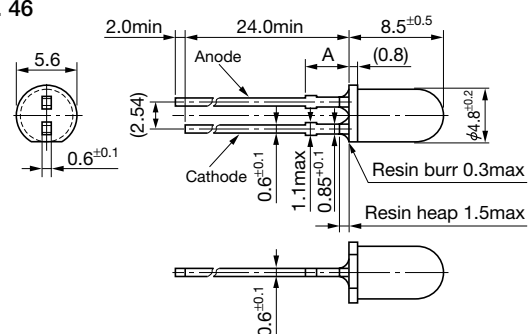


Fig. 43

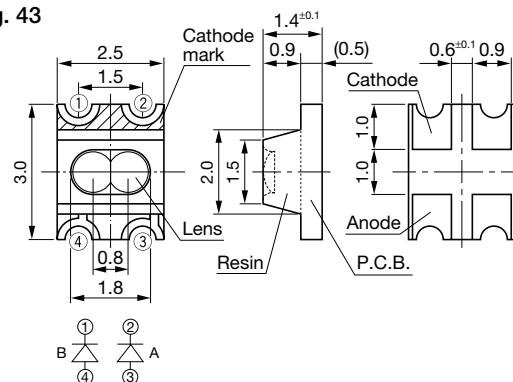


Fig. 47

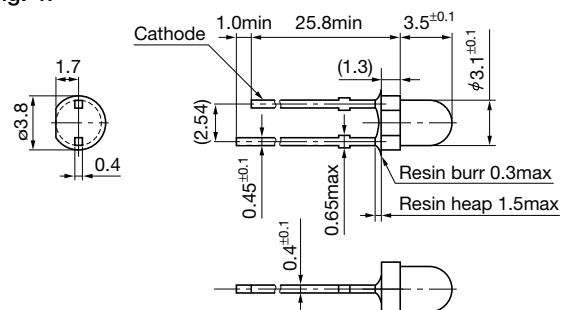
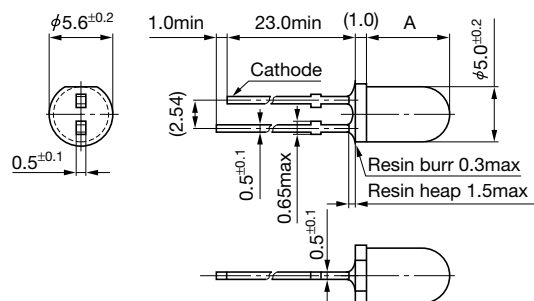


Fig. 44



Dimension A (mm)	
SID303C	3.0±0.5
SID313BP SID1003BQ	3.6±0.5
SID307BR SID1G307C	4.2±0.5

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