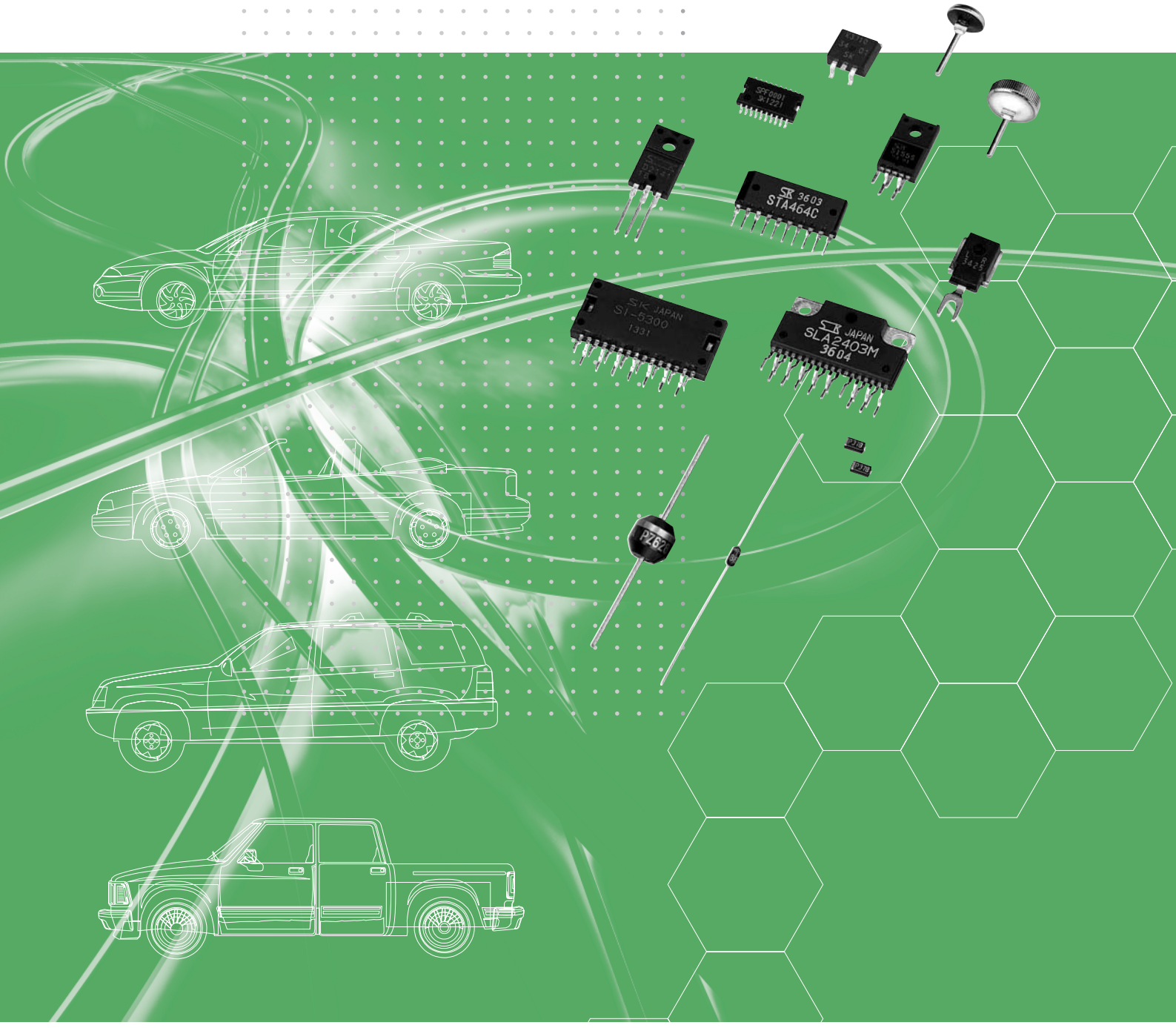
DEVICES for AUTOMOTIVE



SANKEN ELECTRIC CO.,LTD.
http://www.sanken-ele.co.jp

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Contents

Examples of Use of Typical Products by Application

Throttle System

- **DC Motor Driver ICs** (p.60 and after)
  Control IC and full bridge power stage in a single package.
  Surface-mounting type series are also available.
  SI-5300 / SPF7301
- **Motor Driver Transistor Arrays** (p.99)
  H-bridge of NPN x 2 and PNP x 2 in a single package.
  With integrated back emf. clamp diode.
  SLA8004
- **Motor driver power transistors** (p.68 and after)
  With integrated back emf. clamp diode.
  2SA1568 / 2SC4065

Alternators

- **Diodes** (p.127)
  Solder and press fit type as well as Zener type is available.
  SG-9 / SG-10 / SG-14
- **Regulator ICs**
  Custom-made (contact our sales reps.)

Fuel Injectors

- **Injector transistors** (p.84 and after)
  Transistors and MOS FETs are available in discretes and arrays in various packages.
  2SB1622 / 2SC4153 / 2SD2382 / MN611S / STA461C / STA463C / STA508A / SDC09 / SDK09 / SPF0001 / SSD103

Headlamps

- **HID lamp driver ICs** (p.64 and after)
  High-voltage controller IC and 4-circuit power stage in a single package.
  Direct drive from CPU.
  SLA2402M / SLA2403M / SMA2409M
- **Thyristors for HID lamp ignition** (p.125 and after)
  Best suited to C-discharge SW element on high-voltage primary side of an igniter.
  Integrates a reverse direction diode.
  High di/dt resistance
  TFC561D / TFC562D
- **MOS FET arrays for driving HID lamps** (p.122)
  4 circuits of N-ch MOS FETs of 450V/7A in a single package.
  SMA5113
- **2-ph stepper-motor driver ICs for AFS** (p.58 and after)
  Low output saturation voltage, integrated recovery diode, surface-mount.
  SPF7211

Ignition System

- **High-voltage diodes for ignition** (p.128)
  Withstand voltage range: 0.5 to 15kV
  SHV-01JN / SHV-05J / SHV-06JN
- **Ignition transistors** (p.89 and after)
  2SD2141 / MN638S
- **Ignition ICs**
  Custom-made (contact our sales reps.)

Room Lamp

● **Multi-chip LED modules** (p.142)

Car Navigation and Audio

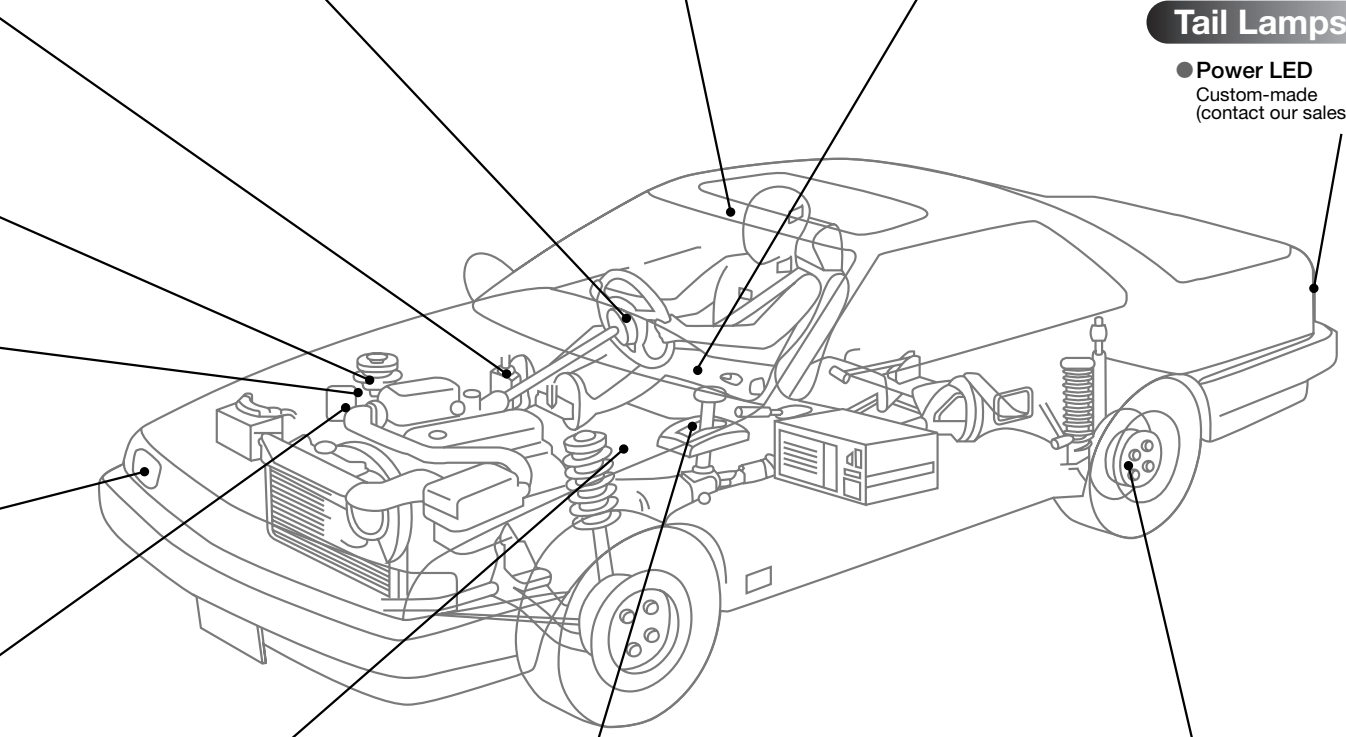
● **Various LEDs** (p.133)

Power Steering

● **Motor driver MOS FETs** (p.108 and after)
Various packages integrating low ON resistors, bidirectional Zener diodes, etc.
2SK3710 / 2SK3711 / 2SK3724 / 2SK3800 / 2SK3801 / 2SK3803 / 2SK3851

Tail Lamps

● **Power LED**
Custom-made
(contact our sales reps.)



O_2 sensor heater

● **Heater driver MOS FETs** (p.115)
Low ON resistor and integral gate protection diode.
FKV460S

Transmission

● **AT solenoid drivers (high-side power switch ICs)** (p.26 and after)
Integral diagnostic function, surface-mount, 2- and 3-circuit types and other diverse models.
SI-5151S / SPF5003 / SPF5004 / SPF5007 / SLA2502M

● **AT linear solenoid driver (high-side power switch ICs)** (p.46 and after)
Integral current detection resistor, current monitor output, surface-mount and 2-circuit types are also available.
SPF5017 / SPF5018

ABS and VDC

● **Solenoid/motor driver MOS FETs** (p.108 and after)
Various packages from discretes to arrays.
2SK3710 / FKV660S / SLA5027 / SDK08

● **Solenoid/motor driver ICs** (p.54)
Surface-mount 4-circuit type with output voltage monitor.
SPF5012

1 ICs

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

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

2. Switching Type

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

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 Tj (max) and the maximum case temperature Tc (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 Ta (max). To facilitate heatsink design, the relationship between these two parameters is presented in the Ta-P_D characteristic graphs. Heatsink design must be performed in the following steps:

1. Obtain the maximum ambient temperature Ta (max) (within the set).
2. Obtain the maximum power dissipation P_D (max).
3. Identify the intersection on the Ta-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.

■ Setting DC Input Voltage

Observe the following precautions when setting the DC input voltage:

- $V_{IN\,(min)}$ 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.
- $V_{IN\,(max)}$ 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.

Features

- Output current of 1.0A
- 5-terminal type <output on/off control, variable output voltage (rise only)>
- Voltage accuracy of ±2%
- Low dropout voltage ≦1V at I_O ≦1.0A, ≦0.5V at I_O≦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	Tj	−40 to +125	°C	
Operating Temperature	T_{OP}	−40 to +100	°C	
Storage Temperature	Tstg	−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

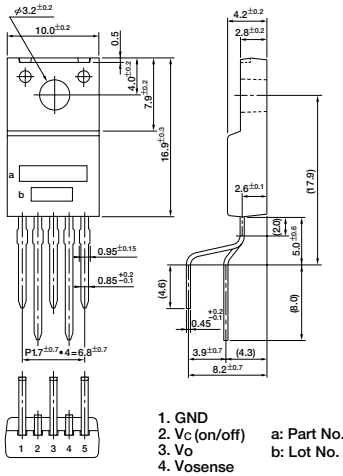
Electrical Characteristics

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

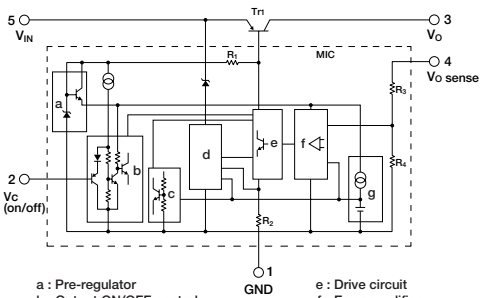
Parameter			Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Input Voltage			V_{IN}	6 *2		30 *1	V	
Output Voltage			V_O	4.90	5.00	5.10	V	V_{IN} = 12 to 16V, I_O = 0.4A
Dropout Voltage			V_{DIF}			0.5	V	I_O≦0.4A
						1.0	V	I_O≦1.0A
Line Regulation			$\Delta V_{O\ LINE}$			30	mV	I_O = 0.4A, V_{IN} = 6 to 16V
Load Regulation			$\Delta V_{O\ LOAD}$			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			Iq		3	10	mA	I_O = 0A
Overcurrent Protection Starting Current			I_{S1}	1.2 *3			A	
Vc 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	V_C = 2.7V
		Output OFF	$I_{C,\ IL}$			−0.3	mA	V_C = 0.4V

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_{S1} rating shall be the point at which the output voltage V_O (V_{IN} = 14V, Io = 0.4A) drops to −5%.
*4. The output control terminal Vc 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.

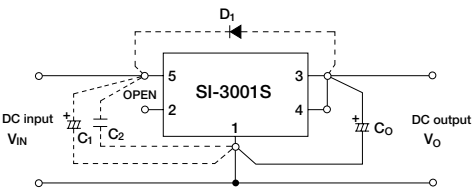
External Dimensions (unit: mm)



Equivalent Circuit Diagram



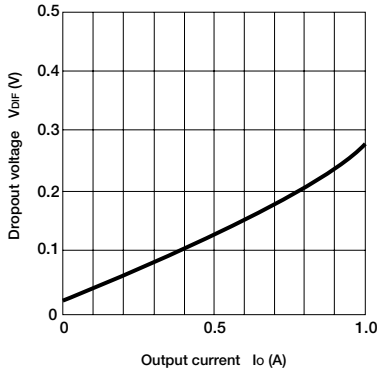
Standard Circuit Diagram



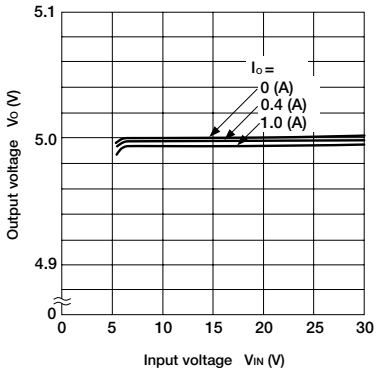
Co : Output capacitor (47 to 100μF, 50V)
C_1, C_2 : Input capacitors (C_1: approx. 47μF, C_2: approx. 0.33μF). These are required for inductive input lines or long wiring. Tantalum capacitors are recommended for C_1 and Co, especially at low temperatures.
D_1 : Protection diode. Required as protection against reverse biasing between input and output. (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

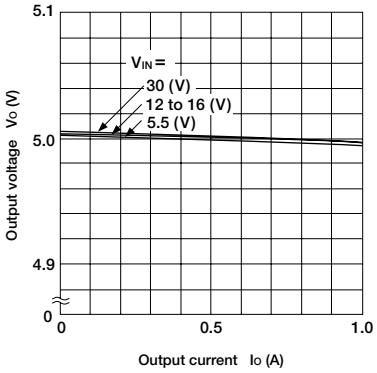
■ I_O vs V_{DIF} Characteristicsc



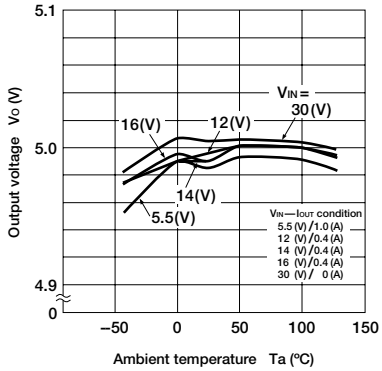
■ Line Regulation



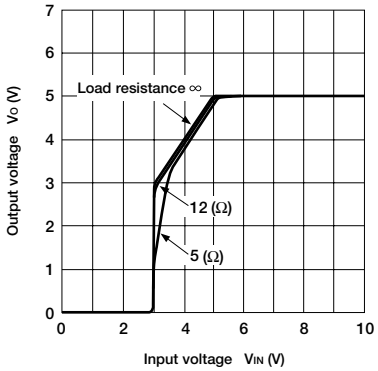
■ Load Regulation



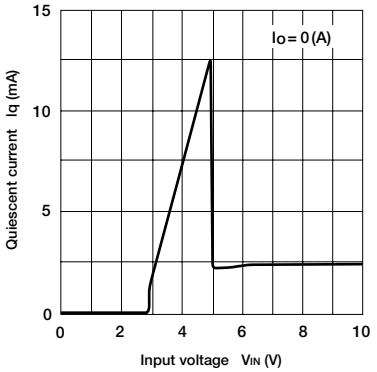
■ Output Voltage Temperature Characteristics



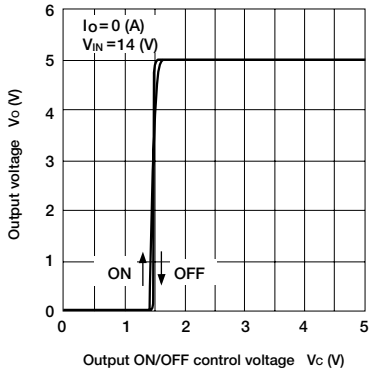
■ Rise Characteristics



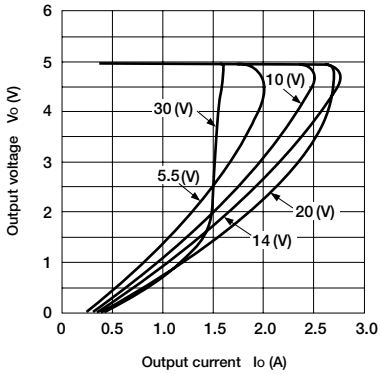
■ Quiescent Circuit Current



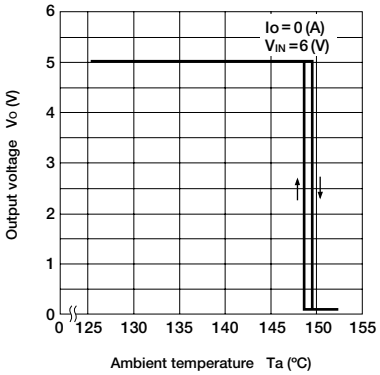
■ ON/OFF Control Characteristics



■ Overcurrent Protection Characteristics

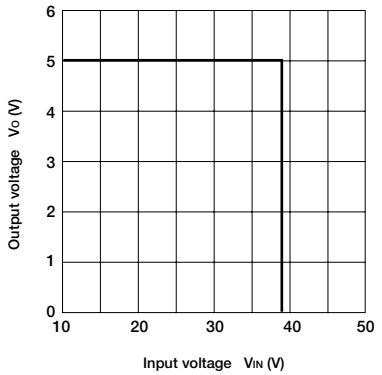


■ Thermal Protection Characteristics

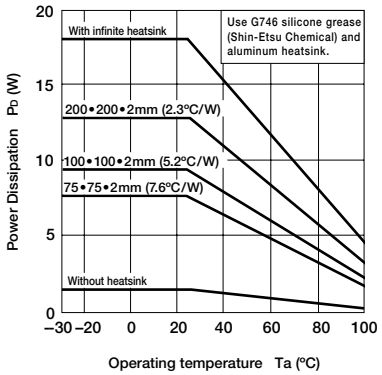


Note on Thermal Protection Characteristics:
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation, including reliability, is not guaranteed for short-circuiting over an extended period of time.

■ Overvoltage Protection Characteristics



■ Ta—P_D Characteristics



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

Features

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

Absolute Maximum Ratings

(Ta=25°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	Tj	−40 to +150	°C	
Operating temperature	T_{OP}	−40 to +100	°C	
Storage temperature	Tstg	−40 to +150	°C	
Junction to case thermal resistance	θj-c	5.5	°C/W	
Junction to ambient-air thermal resistance	θj-a	66.7	°C/W	Stand-alone without heatsink

Electrical Characteristics

(Tj=25°C, V_{IN}=14V, I_O=0.5A unless otherwise specified)

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
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≦0.5A
				1.0	V	I_O≦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	Iq		3	10	mA	I_O=0A
Overcurrent protection starting current	I_{S1}	0.9*3			A	

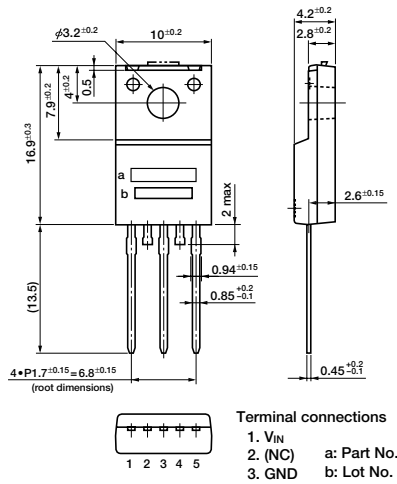
Notes:

*1. Since $P_{D(max)} = (V_{IN}-V_O) \bullet I_O$=22 (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. IS1 rating shall be the point at which the output voltage V_O (V_{IN}=14V, I_O=0.5A) drops to −5%.

External Dimensions (unit: mm)

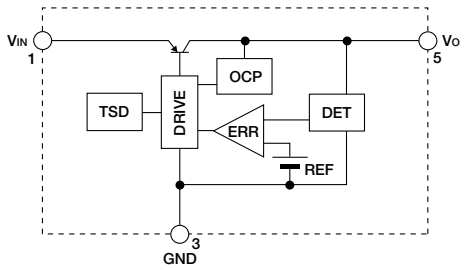


Terminal connections
1. V_{IN}
2. (NC)
3. GND
4. (NC)
5. V_O

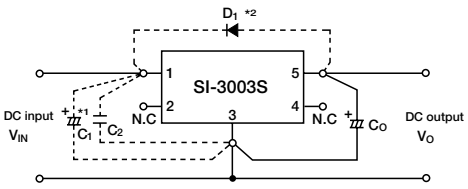
a: Part No.
b: Lot No.

(Forming No. 1115)

Equivalent Circuit Diagram



Standard Circuit Diagram



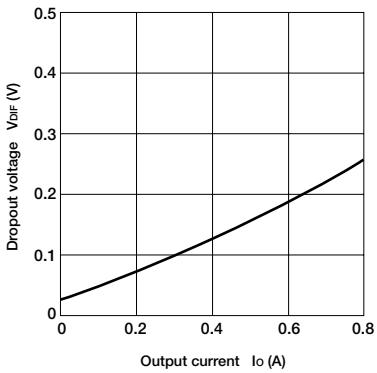
Co : Output capacitor (47 to 100μF, 50V)

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

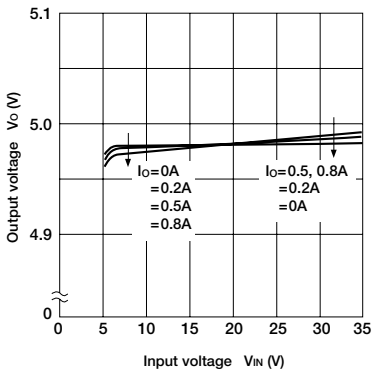
*2 D_1 : Protection diode. Required as protection against reverse biasing between input and output. (Recommended diode: Sanken EU2Z.)

Electrical Characteristics

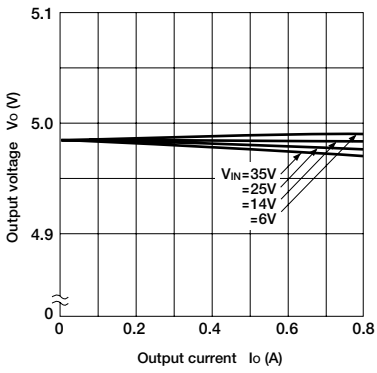
■ I_O vs V_{DIF} Characteristics



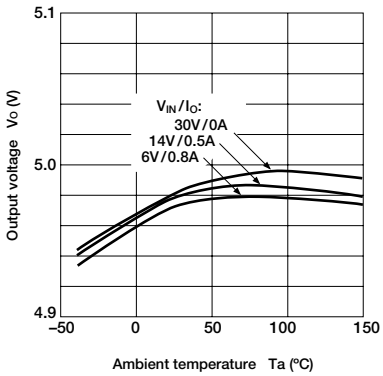
■ Line Regulation



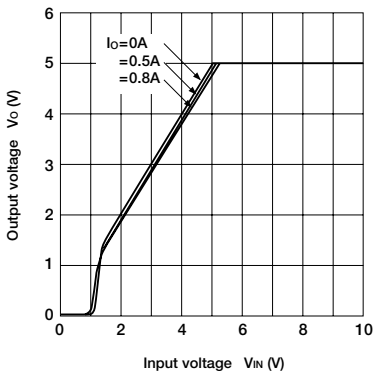
■ Load Regulation



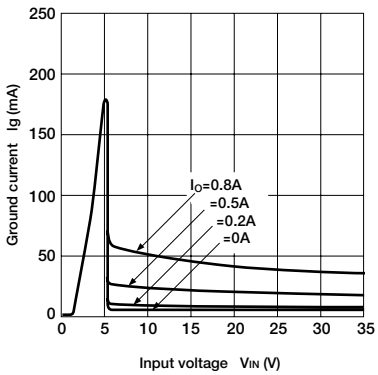
■ Output Voltage Temperature Characteristics



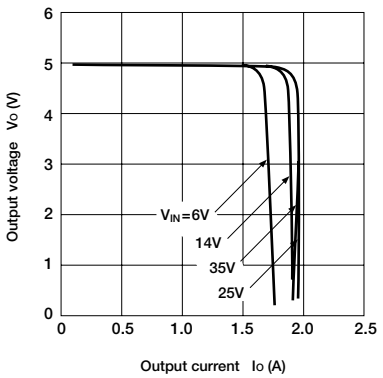
■ Rise Characteristics



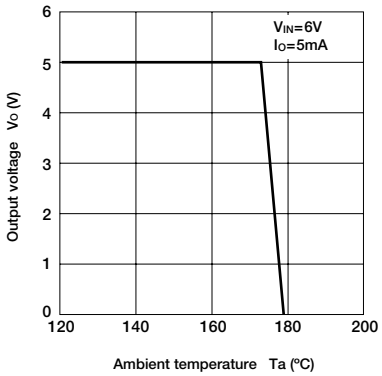
■ Circuit Current



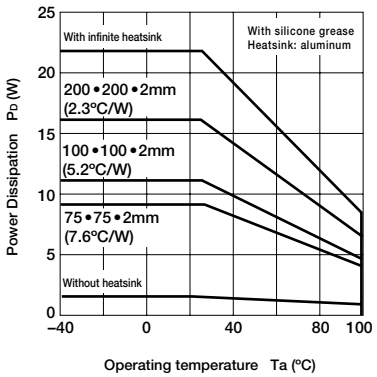
■ Overcurrent Protection Characteristics



■ Thermal Protection Characteristics



■ Ta—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.

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 (≦0.8mA)
- Low dropout voltage ≦1V
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent 5-terminal full-mold package

Absolute Maximum Ratings

(Ta=25°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		Tj	–40 to +125	°C	
Operating temperature		T_{OP}	–40 to +115	°C	
Storage temperature		Tstg	–40 to +125	°C	
Junction to case thermal resistance		$\theta_{j\text{-}c}$	5.5	°C/W	
Junction to ambient-air thermal resistance		$\theta_{j\text{-}a}$	66.7	°C/W	Stand-alone without heatsink

Electrical Characteristics

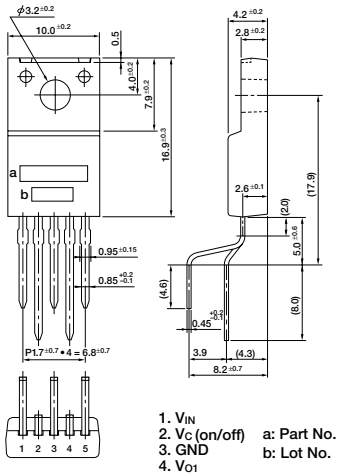
(Tj=25°C, V_{IN}=14V unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Input voltage		V_{IN}	6 *2		35 *1	V	
Output voltage	CH1	V_{O1}	4.80	5.00	5.20	V	I_O=0.05A
	CH2	V_{O2}	4.80	5.00	5.20	V	I_O=0.3A
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}≦0.05A
	CH2	V_{DIF2}			1.0	V	I_{O2}≦0.4A
Line regulation	CH1	$\Delta V_{O\ LINE1}$		10	30	mV	V_{IN}=6 to 18V, I_O=0.05A
	CH2	$\Delta V_{O\ LINE2}$		10	30	mV	V_{IN}=6 to 18V, I_O=0.3A
Load regulation	CH1	$\Delta V_{O\ LOAD1}$		30	70	mV	I_{O1}=0 to 0.05A
	CH2	$\Delta V_{O\ LOAD2}$		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		Iq			0.8	mA	I_{O1}=0A, V_C=0V
Overcurrent protection starting current	CH1	$I_{(S1)\,1}$	0.1 *3			A	
	CH2	$I_{(S1)\,2}$	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=4.8V
	Output OFF	I_{CL}	–100			μA	V_C=3.2V
Overvoltage protection starting voltage		V_{OVP}	35 *4			V	
Thermal protection starting temperature		T_{TSD}	130 *5			°C	

Notes:

*1. Since $P_{D(max)} = (V_{IN} - V_O) \bullet I_{O1} + (V_{IN} - V_{O2}) \bullet I_{O2} = 18$ (W), V_{IN} (max), I_{O1}(max) and I_{O2}(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_{S1} rating shall be the point at which the output voltage V_{O1} or V_{O2} (V_{IN}=14V, I_{O1}=0.05A or I_{O2}=0.3A) 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)

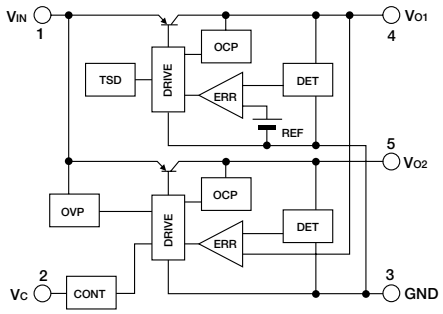


1. V_{IN}
2. V_C (on/off)
3. GND
4. V_{O1}
5. V_{O2}

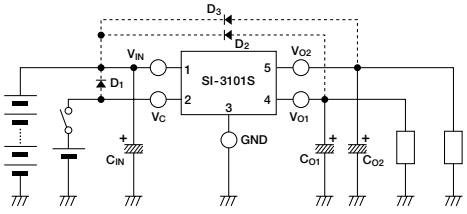
a: Part No.
b: Lot No.

(Forming No. 1101)

Equivalent Circuit Diagram



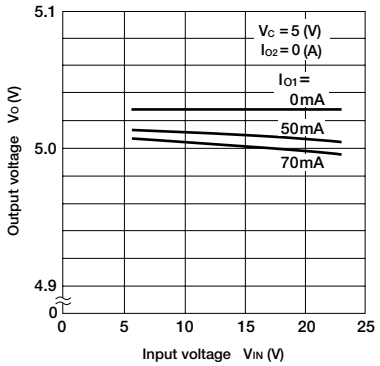
Standard Circuit Diagram



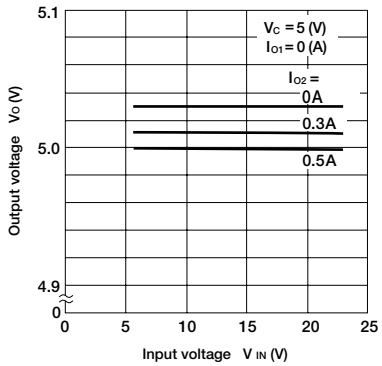
C_{O1} : Output capacitor (47 to 100μF, 50V)
C_{O2} : Output capacitor (47 to 100μF, 50V)
*1 C_{IN} : Input capacitors (approx. 47μF).
Tantalum capacitors are recommended for C_{O1}, C_{O2} and C_{IN}, especially at low temperatures.
*2 D_1, D_2, D_3 : Protection diode.
Required as protection against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

Electrical Characteristics

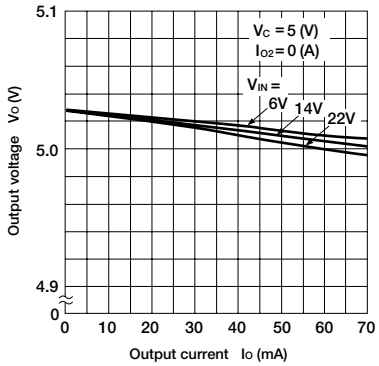
■ Line Regulation (1)



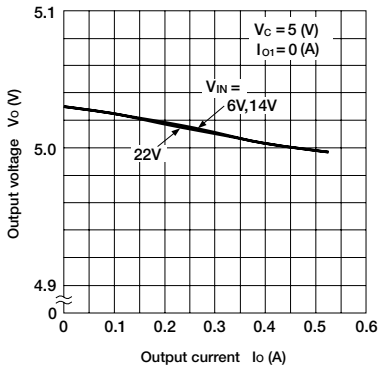
■ Line Regulation (2)



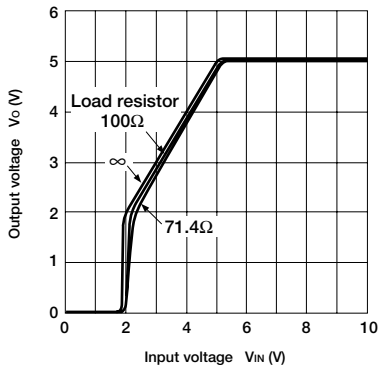
■ Load Regulation (1)



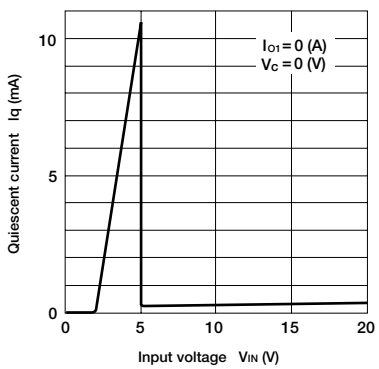
■ Load Regulation (2)



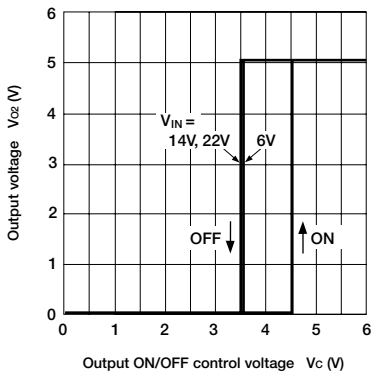
■ Rise Characteristics



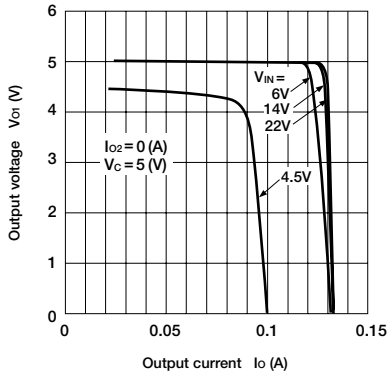
■ Quiescent Circuit Current



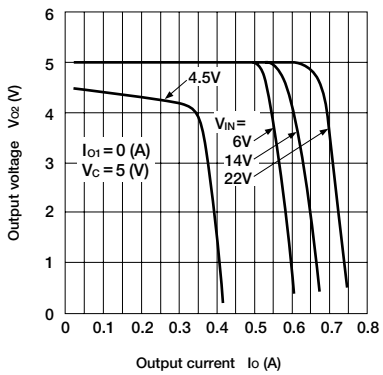
■ ON/OFF Control Characteristics



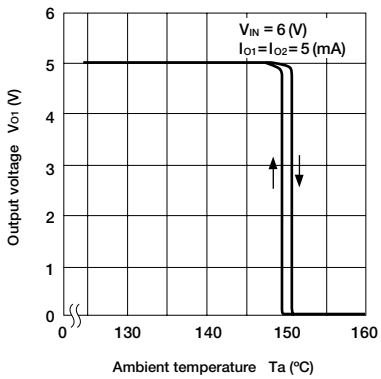
■ Overcurrent Protection Characteristics (1)



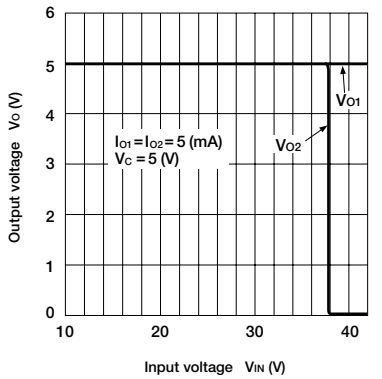
■ Overcurrent Protection Characteristics (2)



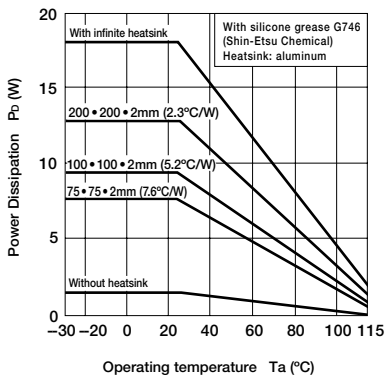
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■ Ta—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 (≦0.8mA)
- Low dropout voltage ≦1V
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent 5-terminal full-mold miniature package

Absolute Maximum Ratings

(Ta=25°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		Tj	–40 to +150	°C	
Operating temperature		T_{OP}	–40 to +105	°C	
Storage temperature		Tstg	–40 to +150	°C	
Junction to case thermal resistance		$\theta_{j\text{-}c}$	5.5	°C/W	
Junction to ambient-air thermal resistance		$\theta_{j\text{-}a}$	66.7	°C/W	Stand-alone without heatsink

Electrical Characteristics

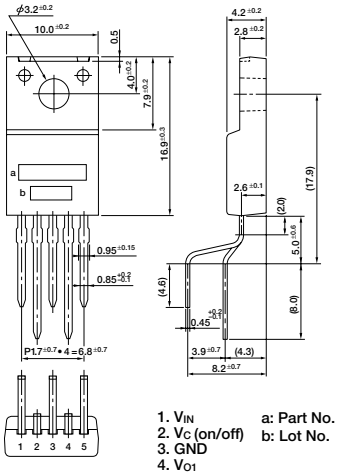
(Tj=25°C, V_{IN}=14V unless otherwise specified)

Parameter		Symbol	Ratings			Unit	Conditions
			min	typ	max		
Input voltage		V_{IN}	6 *2		30 *1	V	
Output voltage	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	$\Delta V_{O\ LINE1}$		10	50	mV	V_{IN}=6 to 30V, I_O=0.04A
	CH2	$\Delta V_{O\ LINE2}$		10	50	mV	V_{IN}=6 to 30V, I_O=0.1A
Load regulation	CH1	$\Delta V_{O\ LOAD1}$		30	70	mV	I_{O1}=0 to 0.04A
	CH2	$\Delta V_{O\ LOAD2}$		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		Iq			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:

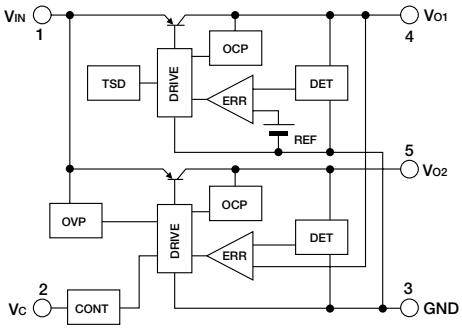
*1. Since P_D(max) = (V_{IN} – V_O) • I_{O1} + (V_{IN} – V_{O2}) • I_{O2} = 22 (W), V_{IN} (max), I_{O1}(max) and I_{O2}(max) may be limited depending on operating conditions. Refer to the Ta—P_D curve to compute the corresponding values.
*2. Refer to the dropout voltage.
*3. I_{S1} rating shall be the point at which the output voltage V_{O1} or V_{O2} (V_{IN}=14V, I_{O1}=0.04A or I_{O2}=0.1A) 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)

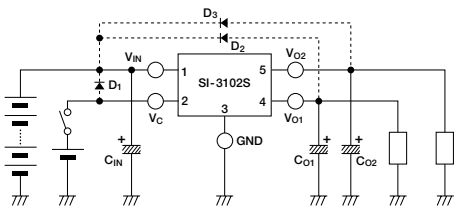


(Forming No. 1101)

Equivalent Circuit Diagram



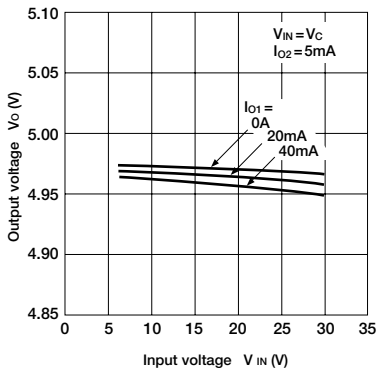
Standard Circuit Diagram



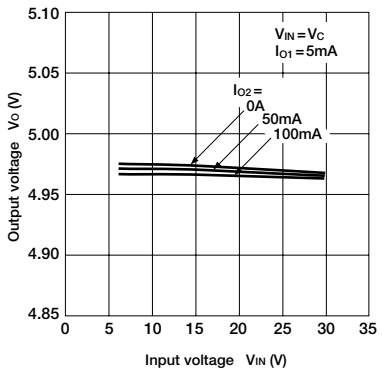
C_{O1} : Output capacitor (47 to 100μF, 50V)
C_{O2} : Output capacitor (47 to 100μF, 50V)
*1 C_{IN} : Input capacitors (approx. 47μF).
Tantalum capacitors are recommended, for C_{O1}, C_{O2} and C_{IN}, especially at low temperatures.
*2 D_1, D_2, D_3 : Protection diode.
Required as protection against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

Electrical Characteristics

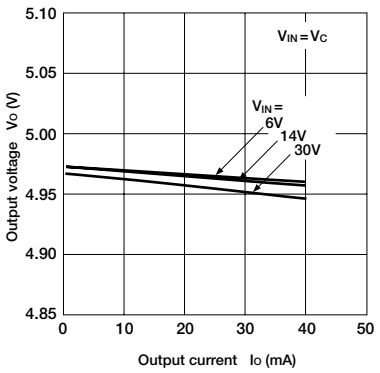
■ Line Regulation (1)



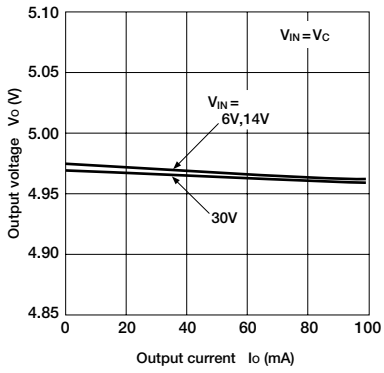
■ Line Regulation (2)



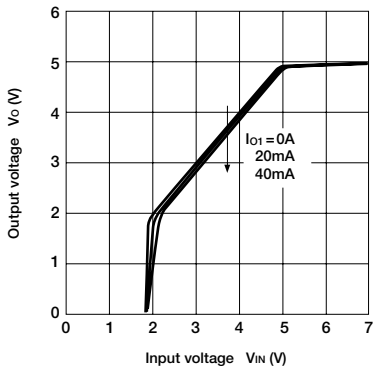
■ Load Regulation (1)



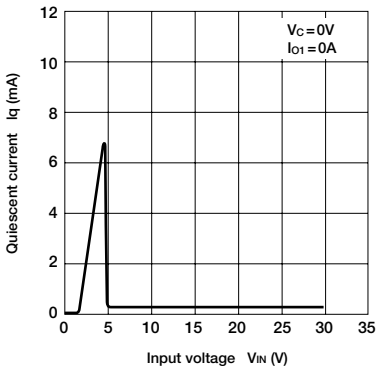
■ Load Regulation (2)



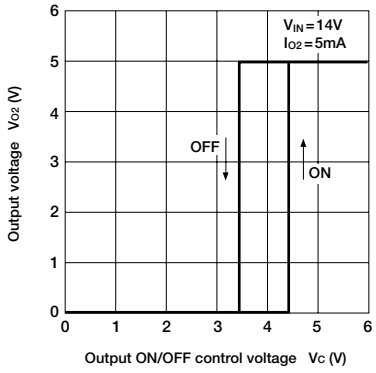
■ Rise Characteristics



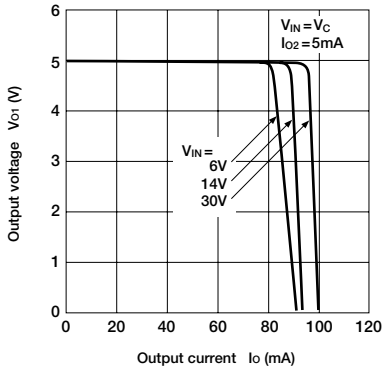
■ Quiescent Circuit Current



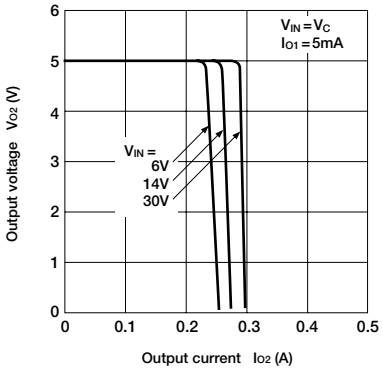
■ ON/OFF Control Characteristics



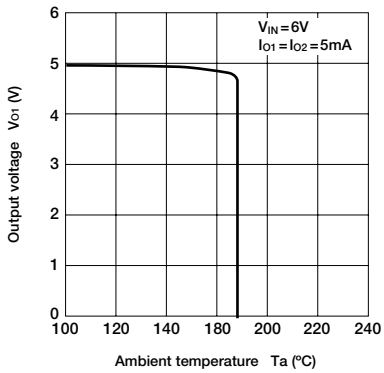
■ Overcurrent Protection Characteristics (1)



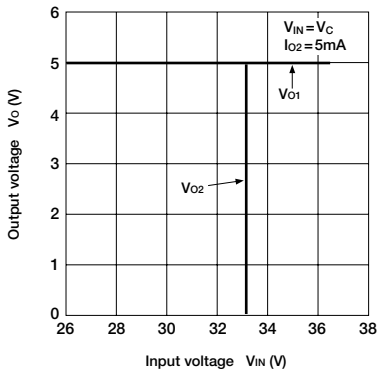
■ Overcurrent Protection Characteristics (2)



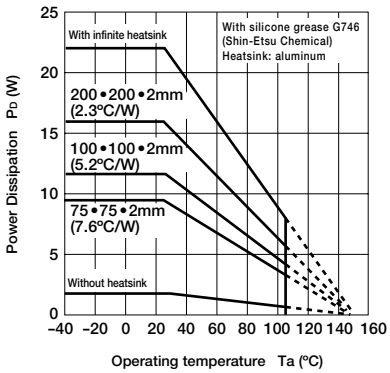
■ Thermal Protection Characteristics



■ 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.

Dropper Type System Regulator ICs SI-3322S

Features

- High accuracy output of 5V±30mV
- Memory backup power supply 4V±0.2V
- Power on reset function
- Supply voltage monitor function
- Watch dog timer
- CR not required for setting external time constant

Absolute Maximum Ratings

Parameter	Symbol	Applicable terminals	Ratings	Unit	Conditions
Terminal voltage	V_{IN} (1)	BAI, V_{CC}, V_{NMIC}	–0.3 to 32	V	
	V_{IN} (2)	V_S, NMIC, RSTTC, OUTE	–0.3 to 7	V	
		V_{SC}, $\overline{NMI}$, $\overline{RESET}$, $\overline{OUTE}$			
		W/D, $\overline{STBY}$			
Storage temperature	Tstg	—	–40 to +125	°C	
Operating temperature	Top	—	–40 to +105	°C	
Power dissipation	P_D	—	1.4	W	Ta= 25°C

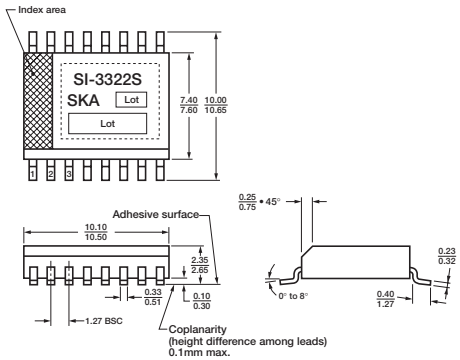
Electrical Characteristics

(Ta = 25°C unless otherwise specified)

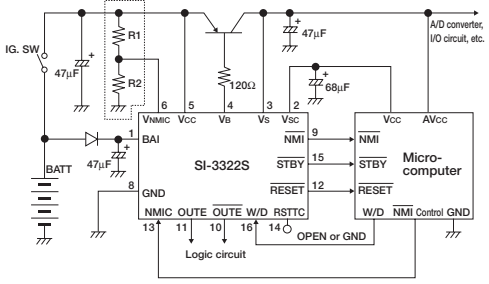
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
V_{SC} output voltage		V_{SC}	3.8	4	4.2	V	BAI = 4.2 to 16V, I_{SC} = –0.2mA
V_S output voltage		V_S	4.97	5	5.03	V	V_{CC} = 5.2 to 16V, I_O = –350mA
V_S–V_{SC} voltage difference		ΔV_S			0.3	V	V_{CC} = 5.2V, I_{SC} = –50mA
BAI input current		I_{BAI}			0.6	mA	BAI = 4.9 to 16V, I_{SC} = –0.2mA
V_{CC} input current		I_{CC}			5	mA	V_{CC} = 3 to 16V
V_B input current		I_B			25	mA	V_{CC} = 3 to 16V
V_S input current		I_S			20	mA	V_{CC} = BAI = 3 to 16V, I_{SC} = 0mA
NMIC input current		I_{NMIC}	–0.04	–0.1	–0.4	mA	V_{CC} = BAI = 14V
W/D input current		$I_{W/D}$	–0.04	–0.1	–0.4	mA	V_{CC} = BAI = 14V
RSTTC input current		I_{RTC}	–0.04	–0.1	–0.4	mA	V_{CC} = BAI = 14V
$\overline{NMI}$ judge voltage	Lo	V_{NIL}	4.9	5	5.1	V	NMIC = 0V
	Hysteresis	ΔV_N	0.12		0.3	V	
$\overline{NMI}$ output voltage	Hi	V_{NOH}	V_S–0.5			V	Isource = –1mA
	Lo	V_{NOL}			0.6	V	Isink = 0.5mA
$\overline{STBY}$ output voltage	Hi	V_{SOH}	V_S–0.5			V	Isource = –1mA
	Lo	V_{SOL}			0.6	V	Isink = 0.5mA
$\overline{RESET}$ output voltage	Hi	V_{ROH}	V_S–0.5			V	Isource = –1mA
	Lo	V_{ROL}			0.6	V	Isink = 0.5mA
OUTE output voltage	Hi	V_{UOH}	V_S–0.5			V	Isource = –1mA
	Lo	V_{UOL}			0.6	V	Isink = 0.5mA
$\overline{OUTE}$ output voltage	Hi	V_{TOH}	V_S–0.5			V	Isource = –1mA
	Lo	V_{TOL}			0.6	V	Isink = 0.5mA
Standby release time		T_{ST}	5	10	20	ms	
Reset release time		T_{RE}	60	75	90	ms	
Reset cycle		T_{RC}	40	50	60	ms	
Reset period		T_{RP}	20	25	30	ms	
W/D signal stop detect period		T_{WS}	10	12.5	15	ms	
Reset signal output time		T_{NR}	80			µs	
Standby signal output time		T_{RS}	10			µs	
W/D fail judge frequency		F_{FH}	2		5	kHz	
Out enable release time		T_{WE}	40	50	10	ms	

Notes: The direction of current flowing into the IC is positive (+).

External Dimensions (unit: mm)



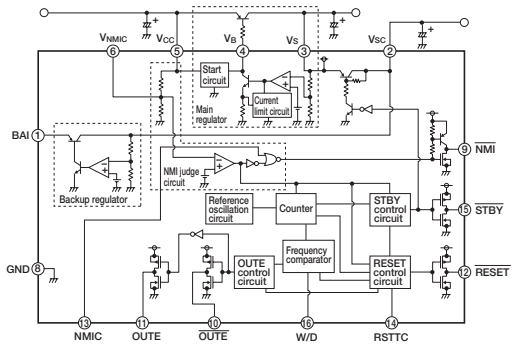
Standard Connection Diagram



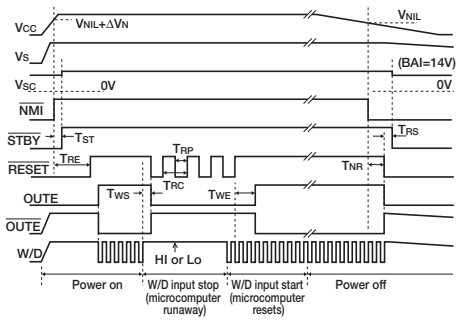
R1, R2: $\overline{NMI}$ judge voltage (5V typ) variable resistor
$\overline{NMI}$ judge voltage ≒ (R1 + R2) • 2.5V/R2
R1, R2 ≦ 2k
Normally, VNMIC terminal is open.

RSTTC: Normally open.
GND connected when TRE is to be halved.

Circuit Block Diagram

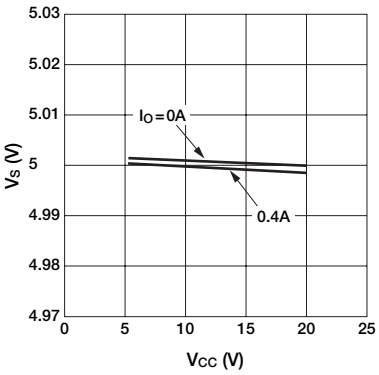


Timing Chart

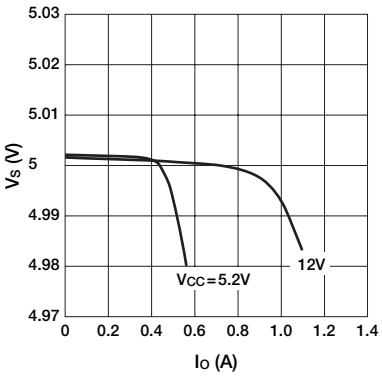


Electrical Characteristics

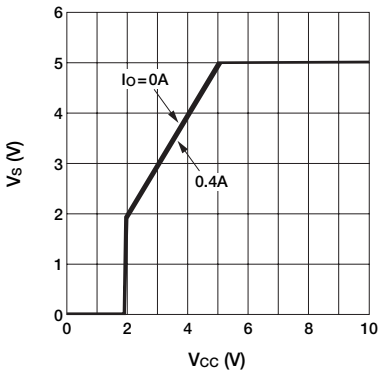
■ V_S Line Regulation



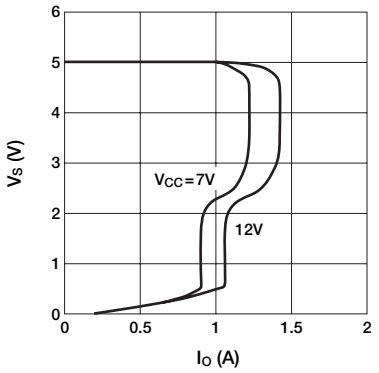
■ V_S Load Regulation



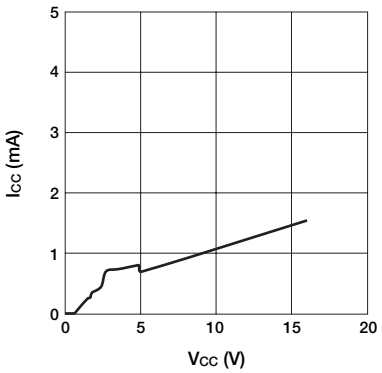
■ V_S Rise Characteristics



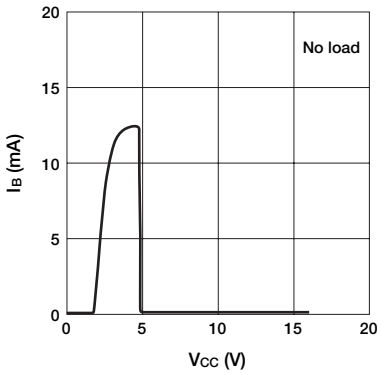
■ V_S Overcurrent Protection Characteristics



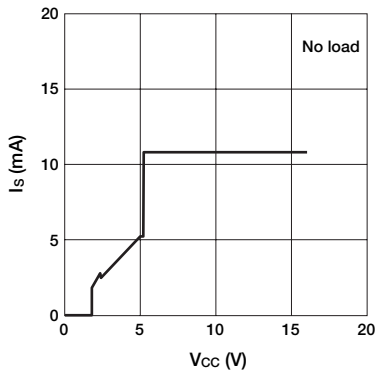
■ V_{CC} Input Current



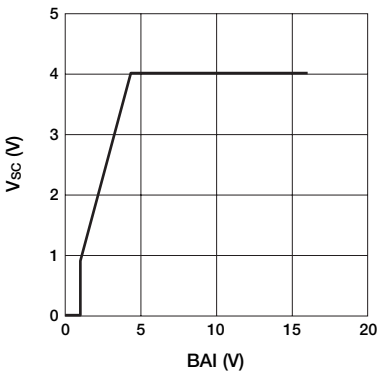
■ V_B Input Current



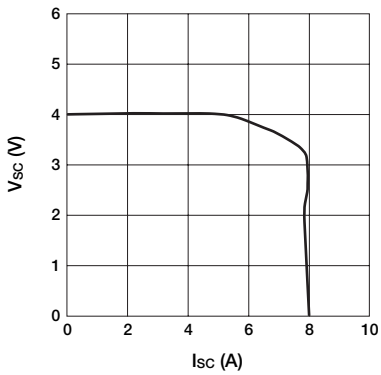
■ V_S Input Current



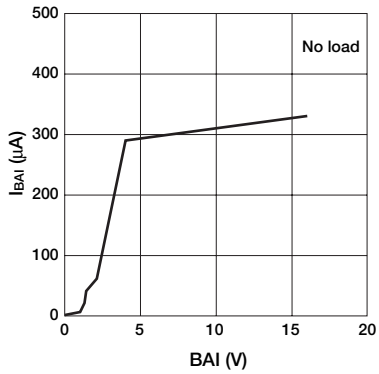
■ V_{SC} Rise Characteristics



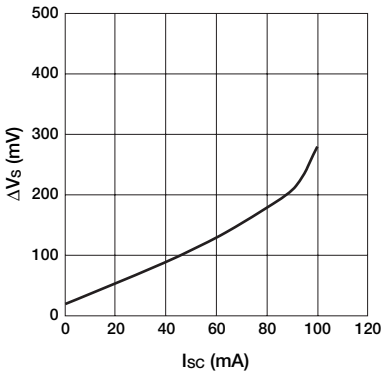
■ V_{SC} Overcurrent Protection Characteristics



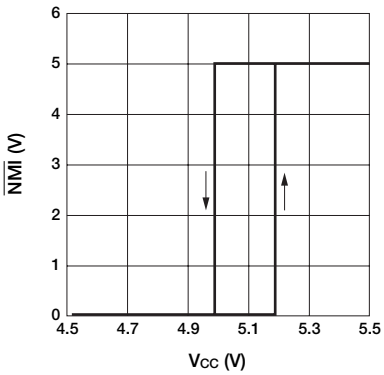
■ BAI Input Current



■ V_S-V_{SC} Voltage Difference



■ $\overline{NMI}$ Judge Voltage Characteristics



Features

- Single input dual output (ch1: 5V/0.4A, ch2: 3.3V/0.2A)
- Power on reset function
- Watchdog timer
- Built-in drooping type overcurrent and thermal protection circuits (ch1)

Absolute Maximum Ratings

(Ta=25ºC)

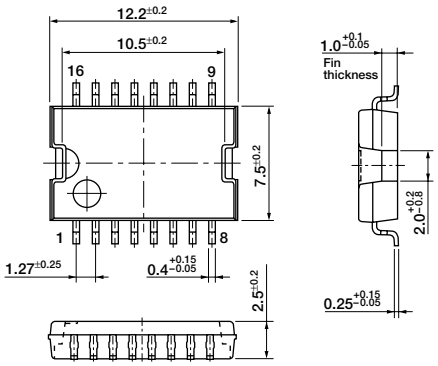
Parameter		Symbol	Ratings	Unit	Remarks
DC input voltage		V_{IN}	–13 to 35	V	Reverse connection 1 min max.
			40		＜400mS
Output control terminal voltage		EN	–0.3 to 35	V	
			40		＜400mS
Output current	CH1	I_{o1}	0.4	A	
	CH2	I_{o2}	0.2		
MODE terminal input voltage		MODE	–0.3 to 7	V	
W/D/C terminal input voltage		W/D/C			
TC terminal input voltage		TC			
CK terminal input voltage		CK			
Vo1-fail terminal output voltage		Vo1-fail			
Reset terminal output voltage		RESET			
Junction temperature		Tj	–40 to 150	°C	
Storage temperature		Tstg	–40 to 150	°C	
Thermal resistance (junction to case)		θj-c	4.1	°C/W	With infinite heatsink
Thermal resistance (junction to ambient air)		θj-a	38	°C/W	With glass epoxy + copper foil board (size 5.0 x 7.4cm; t: glass epoxy = 1.6mm/copper foil = 18μm)

Electrical Characteristics

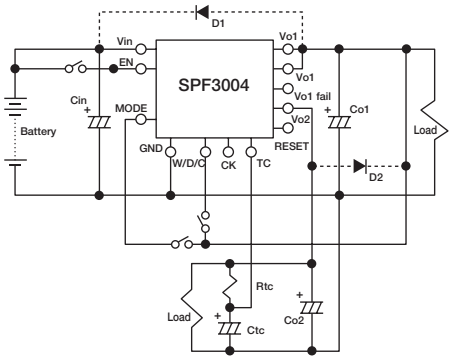
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Input voltage		V_{IN}	Vo1+V_{DIF1} *3		35 *4	V	
Output voltage	CH1	Vo1	4.90	5.00	5.10	V	V_{IN}=Vo1+V_{DIF1} to 18V, I_{o1}=0 to 0.4A, Tj=–40 to 125°C
	CH1	Vo1	4.85	5.00	5.15	V	V_{IN}=Vo1+V_{DIF1} to 18V, I_{o1}=0 to 0.4A, Tj=–40 to 150°C
	CH2	Vo2	3.15	3.30	3.45		V_{IN}=Vo2+V_{DIF1}+V_{DIF2} to 18V, I_{o1}=0 to 0.2A
Dropout voltage	CH1	V_{DIF11}			0.5	V	I_{o1}=0.4A
	CH1	V_{DIF12}			0.25		I_{o1}=0.2A, Tj=25°C
	CH2	V_{DIF2}			0.5		I_{o2}=0.2A
Ripple rejection	CH1	R_{REJ1}		54		db	f=100 to 200Hz
	CH2	R_{REJ2}		54			
Quiescent circuit current		Iq		10	50	μA	V_{IN}=16V, EN=0V
				50	250		V_{IN}=35V, EN=0V
				5	10	mA	
GND current		I_{GND}		70	100	mA	I_{o1}=I_{o2}=0.2A
Overcurrent protection starting current	CH1	Is11	0.402		1.80	A	Vo1=4.5V
	CH2	Is21	0.201		0.80		Vo2=2.8V
Residual current at a short	CH1	Is21	0.402		1.80	A	Vo1=0V
	CH2	Is22	0.201		0.80		Vo2=0V
EN output control voltage		V_{ENth}	1.0		3.5	V	Tj=–40 to 125°C
			0.9		3.5		*8
EN output control current	ON	I_{ENH1}			50	μA	EN=6.4V, Tj=–40 to 125°C
		I_{ENH2}			30		EN=3.51V, Tj=–40 to 125°C
	OFF	I_{ENL}	–1.0		1.0		EN=0V, Tj=–40 to 125°C
Vo1-fail terminal LOW voltage		V_{failL}			0.5	V	Isink=250μA, (Pull-up resistance 20kΩ typ)
Vo1-fail terminal HI voltage		V_{failH}	Vo1–0.8V *5			V	Isource=15μA
Reset terminal LOW voltage		V_{RSL}			0.5	V	Isink=250μA, (Pull-up resistance 20kΩ typ)
Reset terminal HI voltage		V_{RSH}	Vo1–0.8V *5			V	Isource=15μA
Reset detect voltage	CH1	Vo1thH			Vo1•0.97	V	Vrs, Vfail ＞4.5V
		Vo1thL	4.05			V	Vrs, Vfail ＜0.8V
	CH2	Vo2thH			Vo2•0.985	V	Vrs ＞3.0V
		Vo2thL	3.00			V	Vrs ＜0.8V
Reset detect voltage hysteresis width	CH1	ΔVo1th			0.255	V	ΔVo1th=Vo1thH-Vo1thL
	CH2	ΔVo2th			0.105	V	ΔVo2th=Vo2thH-Vo2thL
Power on reset delay time		t_{dly}	0.70•Rtc•Ctc	0.72•Rtc•Ctc	0.74•Rtc•Ctc	S	Min. set time: 6mS
W/D time		t_{wd}	0.52•Rtc•Ctc	0.54•Rtc•Ctc	0.56•Rtc•Ctc	S	Min. set time: 4mS
W/D pulse time		t_{wdp}	0.04•Rtc•Ctc	0.06•Rtc•Ctc	0.08•Rtc•Ctc	S	Min. set time: 400μS
MODE terminal control voltage		Vmodeth	1.0		3.0	V	
MODE terminal control current	ON	ImodeH			200	μA	MODE=5V
	OFF	ImodeL	–1.0		1.0		MODE=0V, Tj=–40 to 125°C
W/D/C terminal control voltage		Vw/d/cth	1.0		3.0	V	*7
W/D/C terminal control current	ON	Iw/d/cH			200	μA	W/D/C=5V
	OFF	Iw/d/cL	–1.0		1.0		W/D/C=0V, Tj=–40 to 125°C
CK terminal control voltage		Vckth	1.0		3.0	V	Min. clock pulse time=5μS (Duty 50%)
CK terminal control current	ON	IckH			200	μA	CK=5V
	OFF	IckL	–1.0		1.0		CK=0V, Tj=–40 to 125°C

Notes:
*3: Refer to dropout voltage.
*4: Since $P_{D(max)}$ = {(V_{IN}–V_O1) • (I_O1+ I_O2)} + (V_{IN} • Iq) + {(V_O1–V_O2) • I_O2}=30W, V_{IN}(max), I_O1(max) and I_O2(max) may be limited depending on operating conditions.
*5: The Vo1-fail and RESET terminals are pulled up in the IC; may be directly connected to logic circuits.
*6: The thermal protection function is built in V_{O1} (CH1 side) only. The design thermal protection starting temperature is 155 °C (min.) and 165°C (typ). These values represent the design warranty.
*7: The threshold voltage at the W/D/C terminals is determined by the presence/absence of WD operation (occurrence of RESET signal pulses). The W/D/C function is assumed to be OFF during the period when RESET pulses occur.
*8: The TOFF-EN operation (VEN: 5V⇒0V) for Tj=150°C is 16mS (0.32V/mS) max.

External Dimensions (unit: mm)

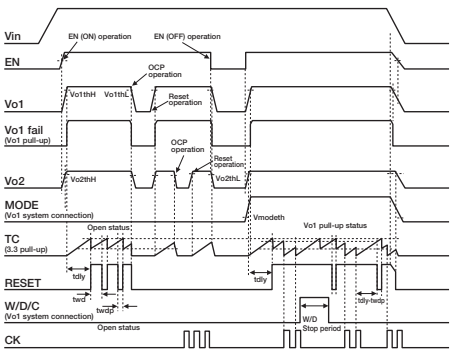


Standard Connection Diagram



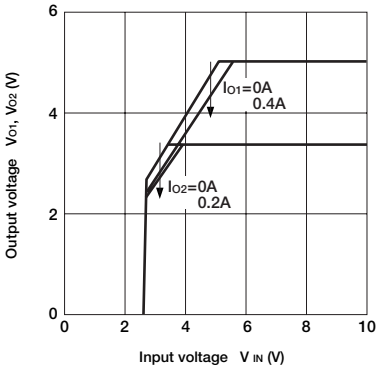
Cin: Capacitor (39μF) for oscillation prevention
C_O1: Output capacitor (39μF)
C_O2: Output capacitor (39μF)
Tantalum capacitors are recommended especially for low temperatures.
D1, D2: Protection diodes.
Required as protection against reverse biasing between input and output (Recommended diode: SANKEN EU2Z).

Timing Chart

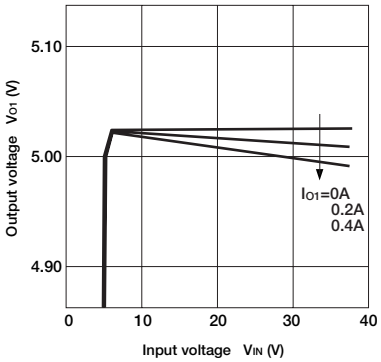


Electrical Characteristics

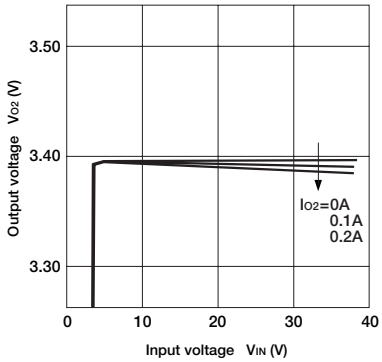
■ Rise Characteristics of Output Voltage



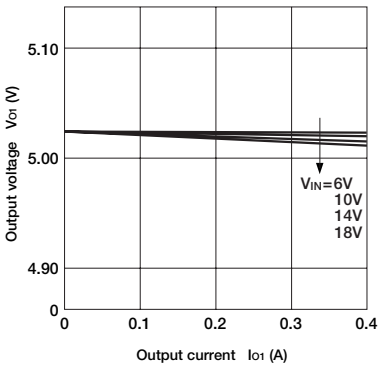
■ Line Regulation (V_{01})



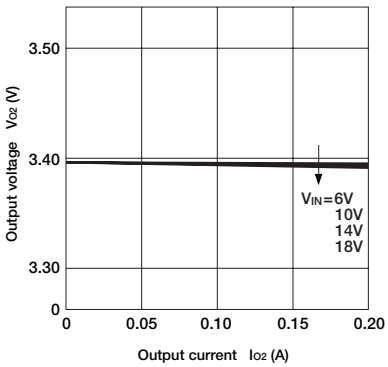
■ Line Regulation (V_{02})



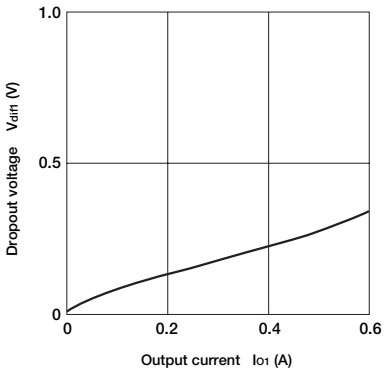
■ Load Regulation (V_{01})



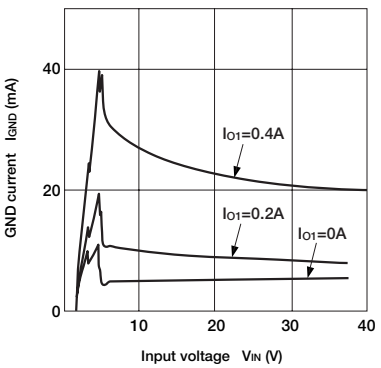
■ Load Regulation (V_{02})



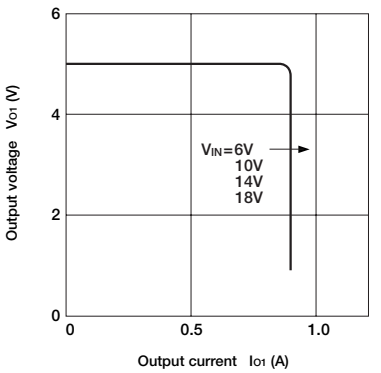
■ Dropout Voltage (V_{01})



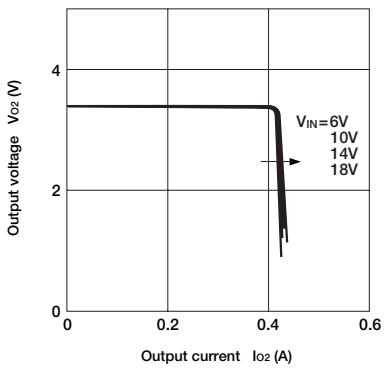
■ GND Current



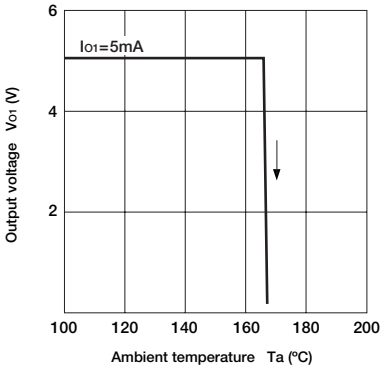
■ Overcurrent Protection Characteristics (V_{01})



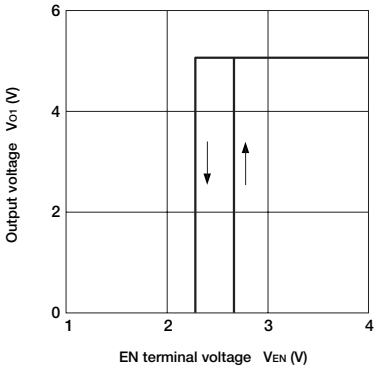
■ Overcurrent Protection Characteristics (V_{02})



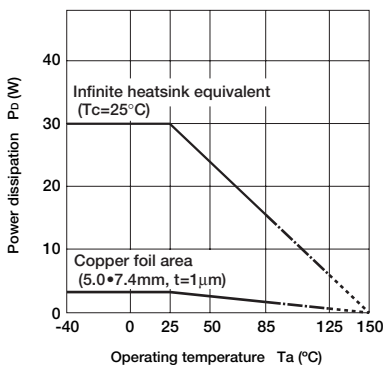
■ Thermal Protection Characteristics



■ EN Terminal Output Voltage



■ Ta—P_D Characteristics



Features

- Dual input and dual output (ch1: 5V/0.4A, ch2: 5V/0.2A)
- Power on reset function
- Watchdog timer
- Built-in drooping type overcurrent and thermal protection circuits (ch1)

Absolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Ratings	Unit	Remarks
DC input voltage		$V_{IN}1$	–13 to 35	V	Reverse connection 1 min max.
		$V_{IN}2$			
Vo1, Vo2 output control terminal voltage		EN	–0.3 to 35	V	
Vo2 output control terminal voltage		VC	–0.3 to 35	V	
Output current	CH1	Io1	0.4	A	
	CH2	Io2	0.2		
TC terminal input voltage		TC	–0.3 to 7	V	
CK terminal input voltage		CK			
W/D/C terminal input voltage		W/D/C			
Reset terminal output voltage		RESET			
Power dissipation		P_D1	18.6	W	With an infinite heatsink mounted.
		P_D2	2.97		*1
Junction temperature		Tj	–40 to 150	°C	
Operating temperature		Top	–40 to 105	°C	
Storage temperature		Tstg	–40 to 150	°C	
Thermal resistance (junction to case)		θj-c	6.7	°C/W	With an infinite heatsink mounted.
Thermal resistance (junction to ambient air)		θj-a	42	°C/W	*1

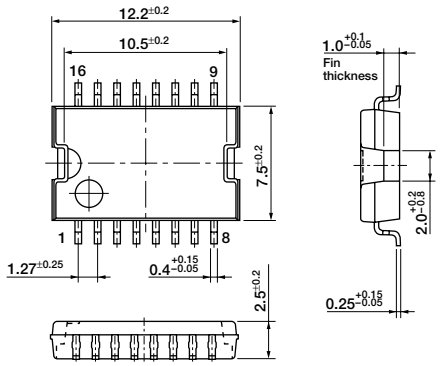
Notes: *1: With glass epoxy + copper foil board (size 5.0•7.4cm; t: glass epoxy=1.6mm / copper foil=18μm)

Electrical Characteristics

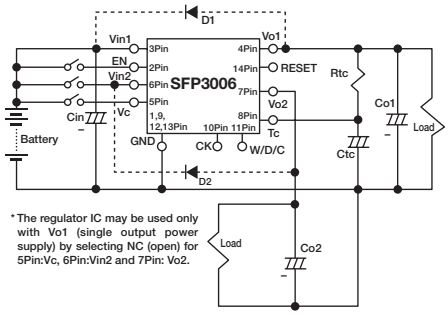
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Input voltage		$V_{IN}1, 2$	$V_{O1}+V_{DIF}1$		35	V	*2, 3
Output voltage	CH1	Vo1	4.85	5.00	5.15	V	$V_{IN}1$=6 to 18V, Io=0 to 0.3A
	CH2	Vo2	4.85	5.00	5.15		$V_{IN}2$=6 to 18V, Io=0 to 0.3A
Dropout voltage	CH1	$V_{DIF}1$			0.5	V	
	CH2	$V_{DIF}2$			0.5		
Ripple rejection	CH1	$R_{REJ}1$		54		db	f=100 to 120Hz
	CH2	$R_{REJ}2$		54			
Quiescent circuit current		Iq		10	50	μA	$V_{IN}1$=16V, V_{EN}=0V
				50	250		$V_{IN}1$=35V, V_{EN}=0V
				5	10	mA	
GND current		I_{GND}		70	100	mA	Io1=Io2=0.2A
Overcurrent protection starting current	CH1	Is11	0.402		1.8	A	Vo1=4.5V
	CH2	Is21	0.201		0.8		Vo2=4.5V
Residual current at a short	CH1	Is21	0.402		1.8	A	Vo1=0V
	CH2	Is22	0.201		0.8		Vo2=0V
EN output control voltage		V_{EN}th	0.9		3.5	V	
EN output control current	ON	I_{EN}H			50	μA	EN=5V
	OFF	I_{EN}L	–1.0		1.0		EN=0V
Reset terminal LOW voltage		V_{RS}L			0.5	V	Isink=250μA (Pull-up resistance 20kΩ typ)
Reset terminal HI voltage		V_{RS}H	Vo1-0.8V			V	Isource=15μA *4
Reset detect voltage	CH	Vo1thH			Vo1•0.97	V	Vrs＞4.5V
		Vo1thL	4.05			V	Vrs＜0.8V
Power on reset delay time		t_{dly}	1.18•Rtc•Ctc	1.26•Rtc•Ctc	1.35•Rtc•Ctc	S	Min. set time: 6mS
W/D time		t_{wd}	0.93•Rtc•Ctc	1.03•Rtc•Ctc	1.13•Rtc•Ctc	S	Min. set time: 4mS
W/D pulse time		t_{wdp}	0.07•Rtc•Ctc	0.13•Rtc•Ctc	0.19•Rtc•Ctc	S	Min. set time: 400μS
CK terminal control voltage		Vckth	1.0		3.0	V	Min. clock pulse time: 5μs (Duty 50%)
CK terminal control current	ON	IckH			200	μA	V_{CK}=5V
	OFF	IckL	–1.0		1.0		V_{CK}=0V
Vc output control voltage		Vcth	1.0		3.5	V	
Vc output control current		IcH			300	μA	Vc=5V
		IcL	–1.0		1.0		Vc=0V
W/D/C terminal control voltage		Vw/d/cth	1.0		3.0	V	
W/D/C terminal control current	ON	Iw/d/cH			200	μA	$V_{W/D/C}$=5V
	OFF	Iw/d/cL	–1.0		1.0		$V_{W/D/C}$=0V

Notes:
*2: Refer to Dropout Voltage.
*3: Since $P_D(max) = (V_{IN}–V_O1) • I_O1 + (V_{IN}2–V_O2) • I_O2 + (V_{IN} • Iq) = 22W$, $V_{IN}(max)$, $I_O1(max)$ and $I_O2(max)$ may be limited depending on operating conditions.
*4: The RESET terminal is pulled up in the IC; may be directly connected to logic circuits.
*6: The thermal protection function is built in V_{O1} (CH1 side) only. The design thermal protection starting temperature is 151 °C (min.) and 165°C (typ). These values represent the design warranty.

External Dimensions (unit: mm)



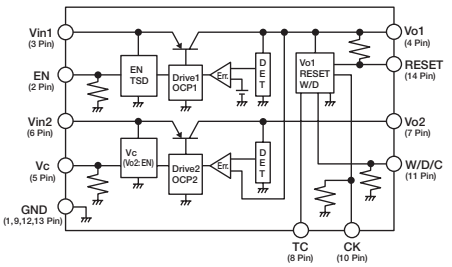
Standard Connection Diagram



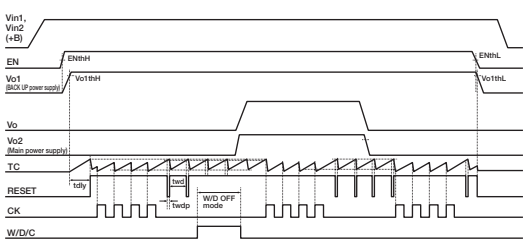
*The regulator IC may be used only with Vo1 (single output power supply) by selecting NC (open) for 5Pin:Vc, 6Pin:Vin2 and 7Pin: Vo2.

Cin: Capacitor (39μF) for oscillation prevention
C_O1: Output capacitor (39μF)
C_O2: Output capacitor (39μF)
Tantalum capacitors are recommended particularly for low temperatures (tantalum capacitors of about 0.47μ F in parallel).
D1, D2: Protection diodes.
Required for protection against reverse biasing between input and output (Recommended diode: SANKEN EU2Z).

Circuit Block Diagram

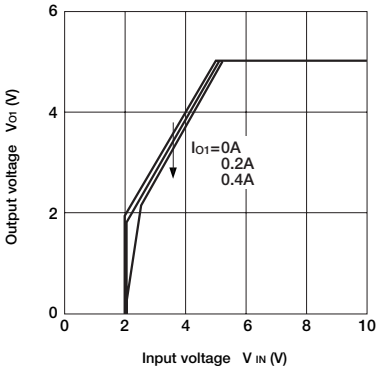


Timing Chart

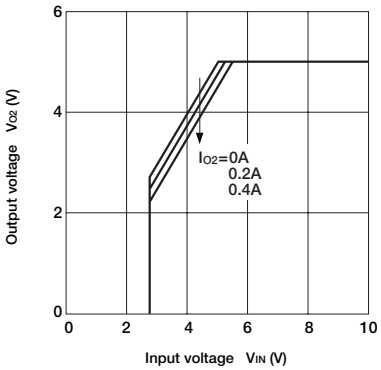


Electrical Characteristics

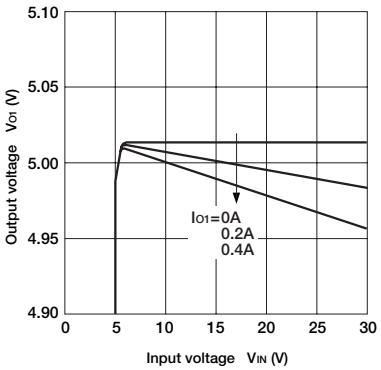
■ Rise Characteristics of Output Voltage (V_{O1})



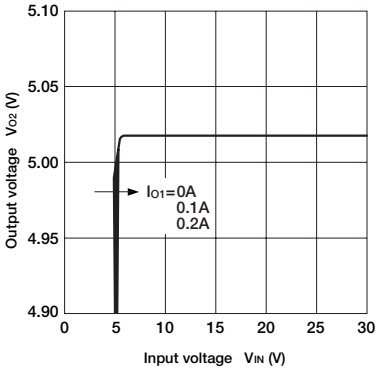
■ Rise Characteristics of Output Voltage (V_{O2})



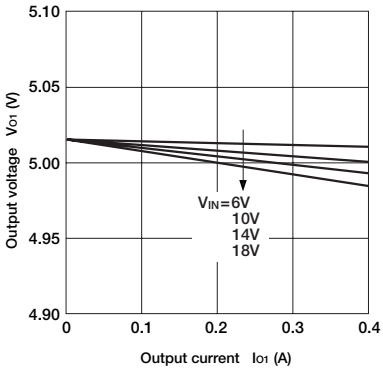
■ Line Regulation (V_{O1})



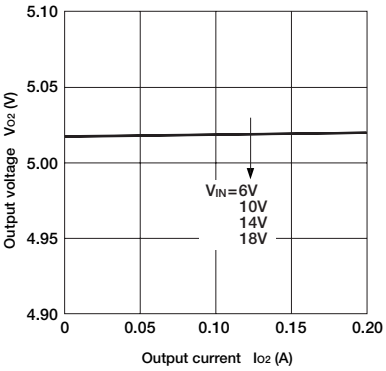
■ Line Regulation (V_{O2})



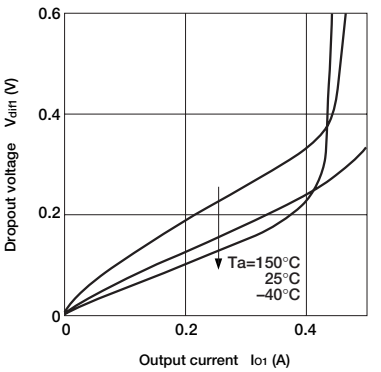
■ Load Regulation (V_{O1})



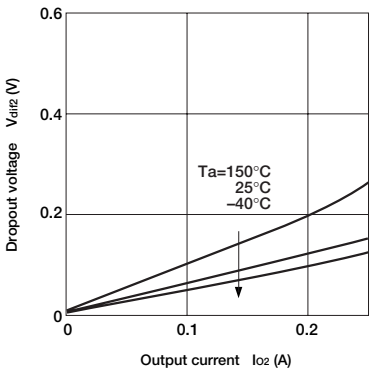
■ Load Regulation (V_{O2})



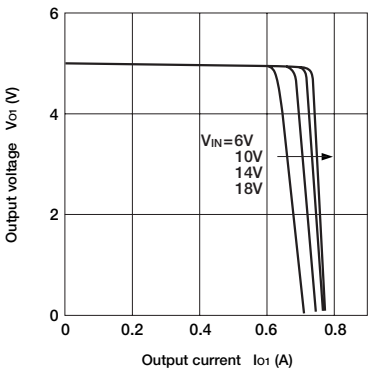
■ Dropout Voltage (V_{O1})



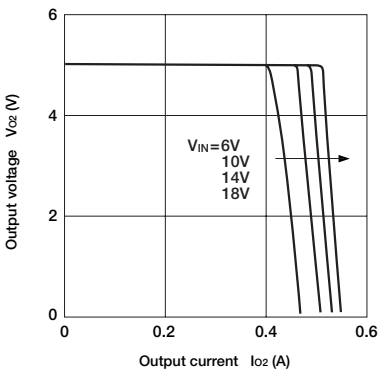
■ Dropout Voltage (V_{O2})



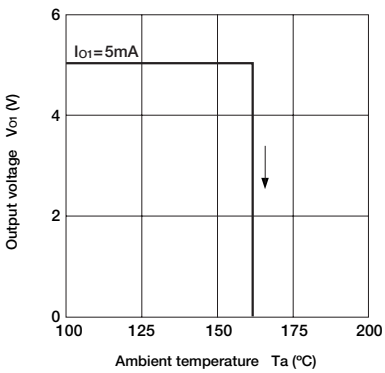
■ Overcurrent Protection Characteristics (V_{O1})



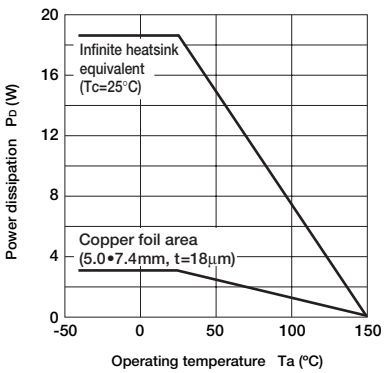
■ Overcurrent Protection Characteristics (V_{O2})



■ Thermal Protection Characteristics



■ Ta—P_D Characteristics



Features

- Output current of 3A (Ta = 25ºC, V_{IN} = 8 to 18V)
- High efficiency of 82% (V_{IN} = 14V, I_O = 2A)
- 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

(Ta=25ºC)

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	Tj	–40 to +150	ºC	
Storage temperature	Tstg	–40 to +125	ºC	
Junction to case thermal resistance	θ_{j-c}	5.5	ºC/W	
Junction to ambient-air thermal resistance	θ_{j-a}	66.7	ºC/W	

Recommended Operating Conditions

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Input voltage	V_{IN}	8		18	V	
Output current	I_O	0.5		3	A	
Operating temperature	Top	–40		+85	ºC	Ta—P_D characteristics

Electrical Characteristics

(V_{IN} = 14V, I_{OUT} = 2A, Tj = 25ºC unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
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		Iq		5	10	mA	I_O = 0A
Overcurrent protection starting current		I_S	3.1			A	*2
Soft start terminal *3	Low level voltage	V_{SSL}			0.2	V	
	Source current when low	I_{SSL}	15	25	35	µA	V_{SSL} = 0.2V
	Discharge resistance	R_{DIS}		200		kΩ	V_{IN} = 0V

Notes:

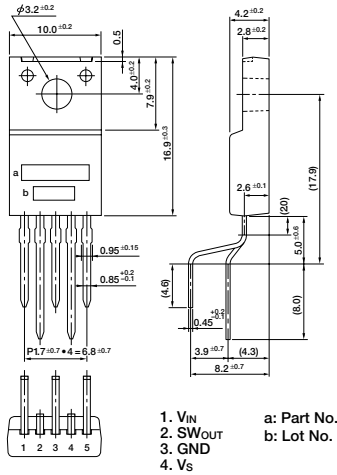
*1. Efficiency is calculated by the following equation:

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

*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)

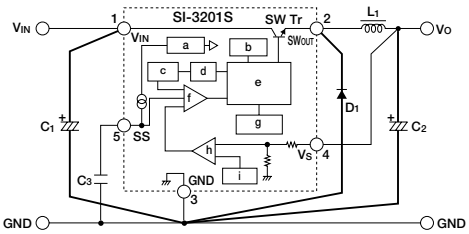


1. V_{IN}
2. SW_{OUT}
3. GND
4. V_S
5. SS

a: Part No.
b: Lot No.

(Forming No. 1101)

Standard Circuit Diagram

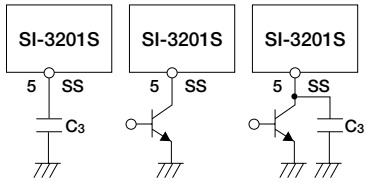


C_1: 1000µF
C_2: 1000µF
L_1: 250µH
D_1: RK46 (Sanken)

a: Internal power supply
b: Thermal protection
c: Reference oscillator
d: Reset
e: Latch & driver
f: Comparator
g: Overcurrent protection
h: Error amplifier
i: Reference voltage

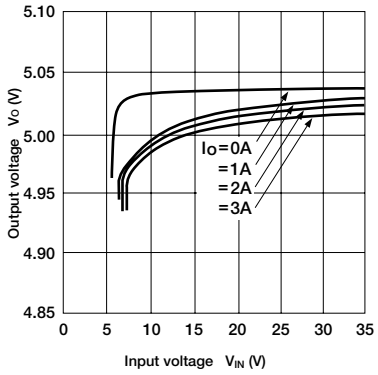
Cautions:

(1) A high-ripple current flows through C_1 and C_2. Use high-ripple type 1000µF 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.

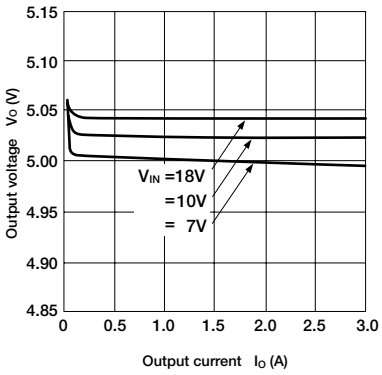


Electrical Characteristics

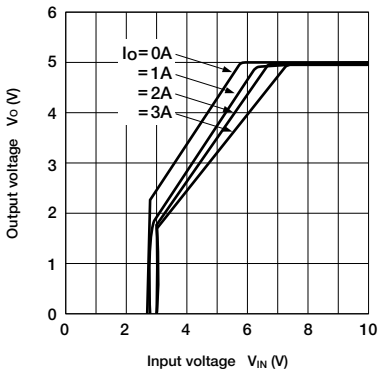
■ Line Regulation



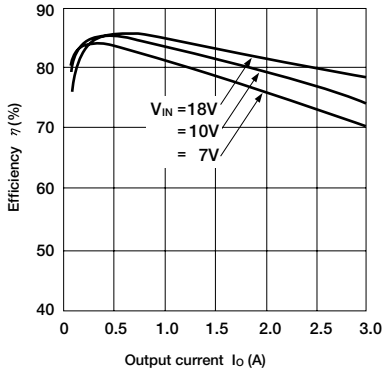
■ Load Regulation



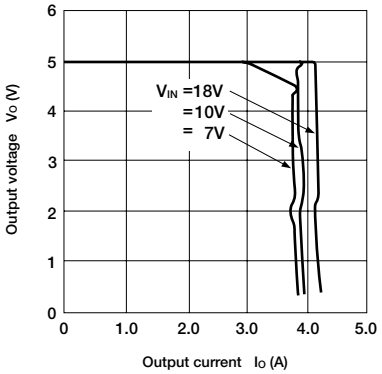
■ Rise Characteristics



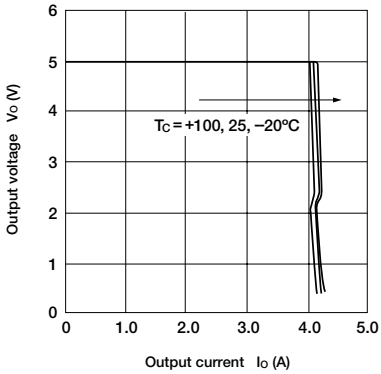
■ Efficiency Curve



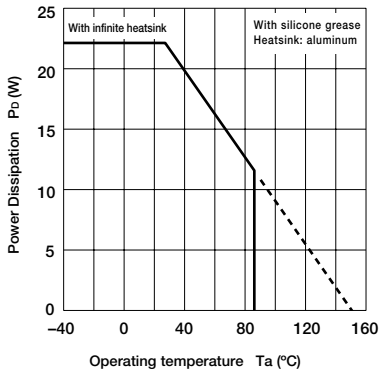
■ Overcurrent Protection Characteristics



■ Overcurrent Protection Temperature Characteristics



■ Ta—P_D Characteristics



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
- Tj = 150ºC guaranteed
- Surface-mount full-mold package

Absolute Maximum Ratings

(Ta=25ºC)

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	Tj	–40 to +150	ºC	
Operating temperature	T_{OP}	–40 to +100	ºC	
Storage temperature	Tstg	–40 to +150	ºC	

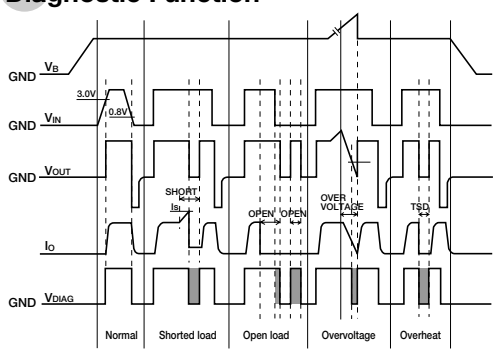
Electrical Characteristics

(V_{Bopr}=14V, Ta=25ºC unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		16	V	
Quiescent circuit current		Iq		5	12	mA	Lo output
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≦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		Ropen	1		30	kΩ	
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

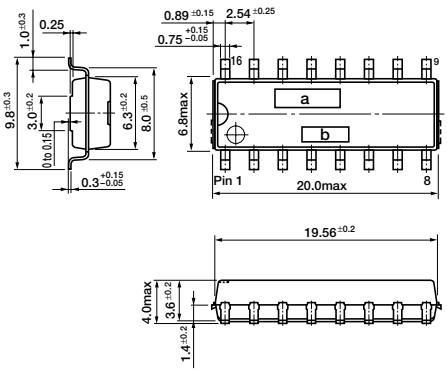
Note: * The rule of protection against reverse connection of power supply is V_B= –13V, one minute (all terminals except, V_B and GND, are open).

Diagnostic Function



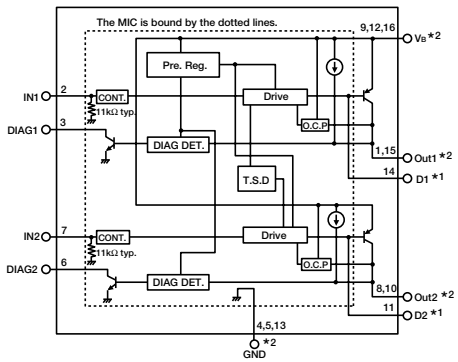
ERROR SIGNAL for CPU

External Dimensions (unit: mm) SMD-16A



a: Part No.
b: Lot No.

Equivalent Circuit Diagram



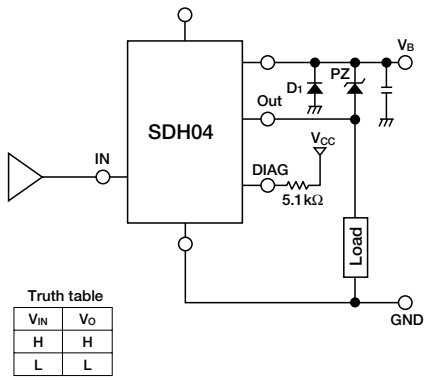
[Abbreviations]

Drive: Drive circuit	DIAG.DET.: Diagnostic circuit
CONT: ON/OFF circuit	O.C.P.: Overcurrent protection
Pre.Reg: Pre-regulator	T.S.D.: Thermal protection

*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



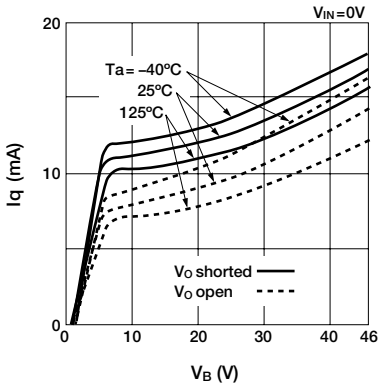
Truth table

V_{IN}	V_O
H	H
L	L

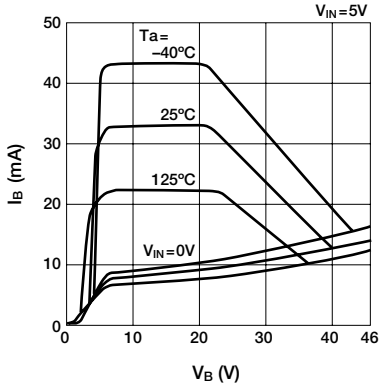
Note 1: A pull-down resistor (11 kΩ typ.) is connected to the IN terminal. V_{OUT} turns "L" when a high impedance is connected to the IN terminal in series.

Electrical Characteristics

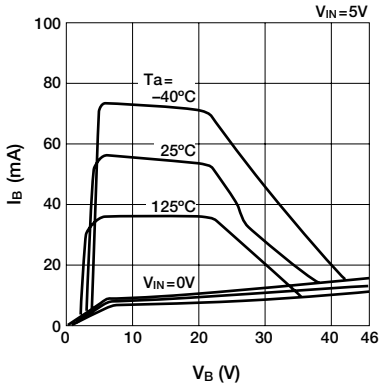
■ Quiescent Circuit Current (dual circuit)



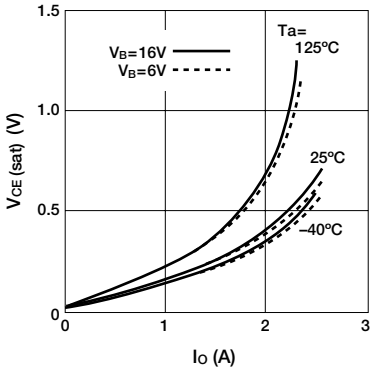
■ Circuit Current (single circuit)



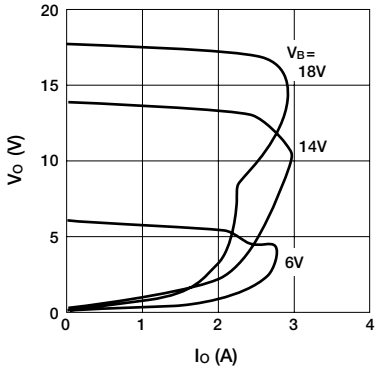
■ Circuit Current (dual circuit)



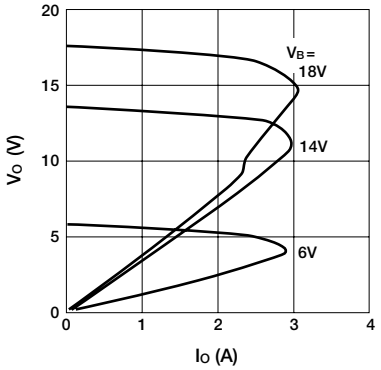
■ Saturation Voltage of Output Transistor



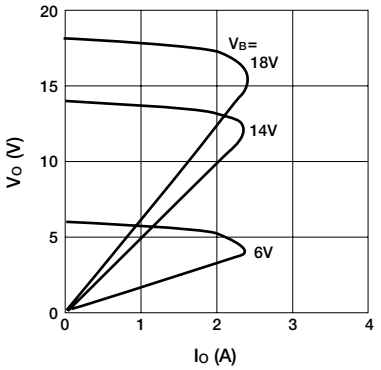
■ Overcurrent Protection Characteristics (Ta=–40°C)



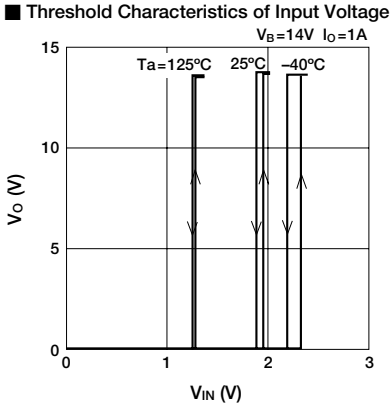
■ Overcurrent Protection Characteristics (Ta=25°C)



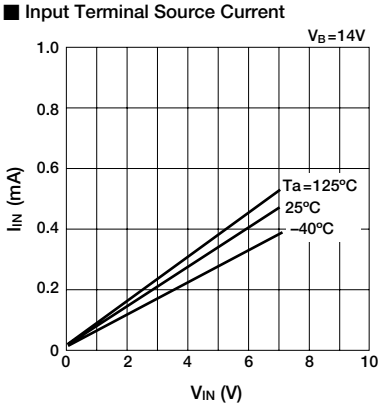
■ Overcurrent Protection Characteristics (Ta=125°C)



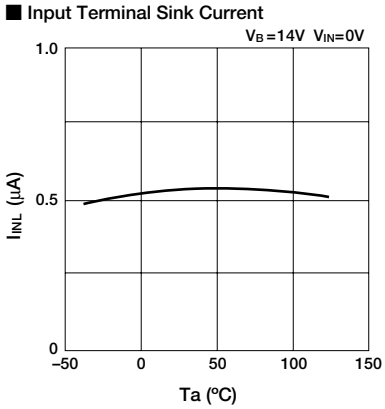
■ Threshold Characteristics of Input Voltage



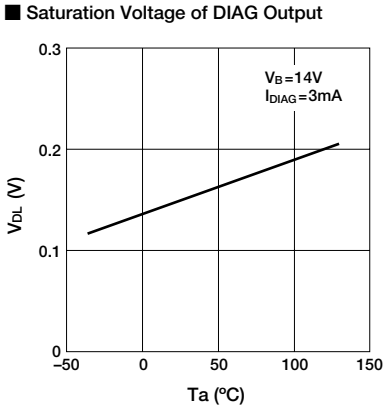
■ Input Terminal Source Current



■ Input Terminal Sink Current



■ Saturation Voltage of DIAG Output



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=25ºC)

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 (Tc=25ºC)
	P_{D2}	1.5	W	Stand-alone without heatsink (Tc=25ºC)
Junction temperature	Tj	–40 to +125	ºC	
Operating temperature	T_{OP}	–40 to +100	ºC	
Storage temperature	Tstg	–40 to +125	ºC	

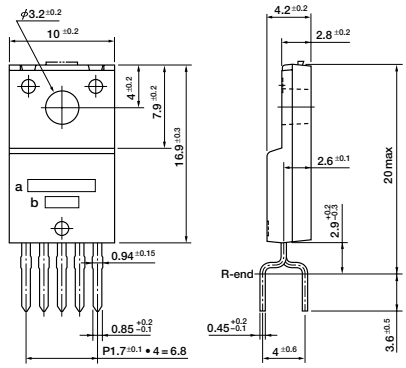
Electrical Characteristics

(Ta=25ºC unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		30	V	
Quiescent circuit current		Iq		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_{CEO}=16V
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}=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		ºC	
Open load detection resistor		Ropen			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)

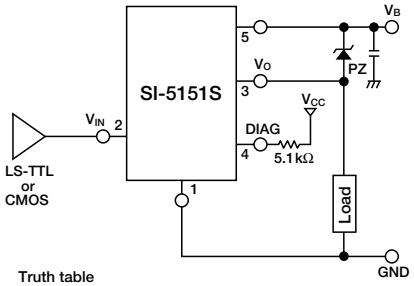


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

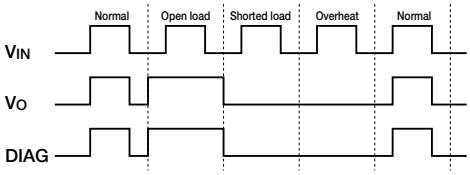
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

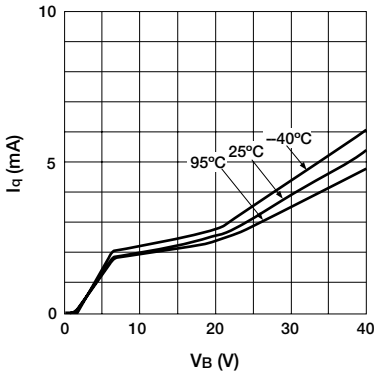


Mode	V_{IN}	V_O	DIAG
Normal	L / H	L / H	L / H
Open load	L / H	H / H	H / H
Shorted load	L / H	L / L	L / L
Overheat	L / H	L / L	L / L

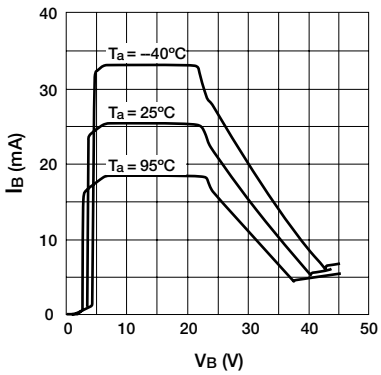
● DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

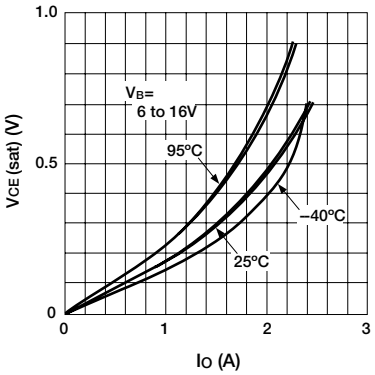
■ Quiescent Circuit Current



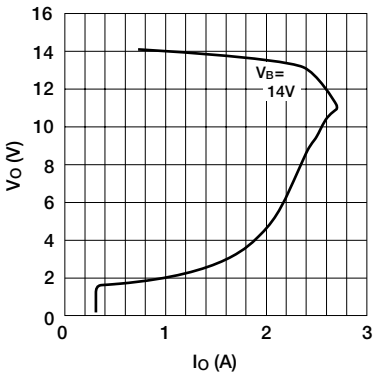
■ Circuit Current



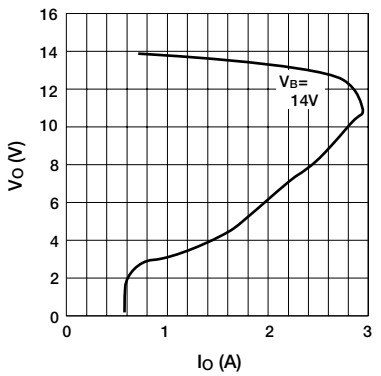
■ Saturation Voltage of Output Transistor



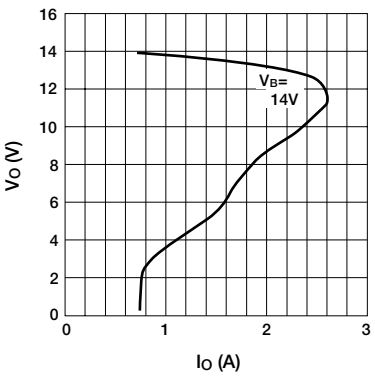
■ Overcurrent Protection Characteristics (Ta= –40°C)



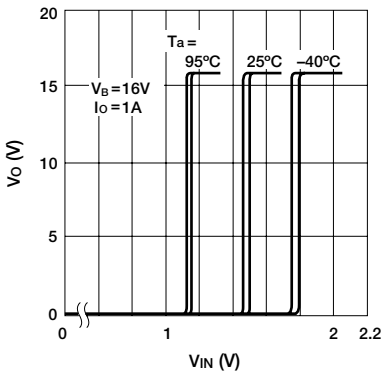
■ Overcurrent Protection Characteristics (Ta=25°C)



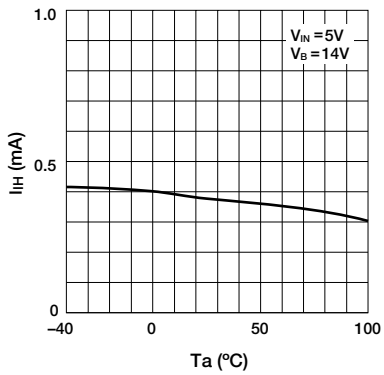
■ Overcurrent Protection Characteristics (Ta=100°C)



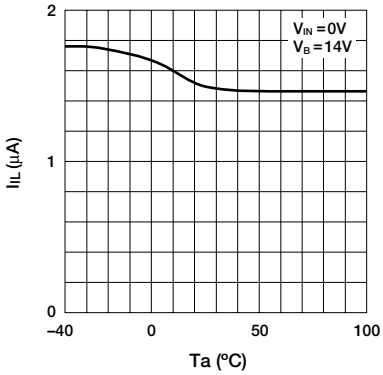
■ Threshold input voltage



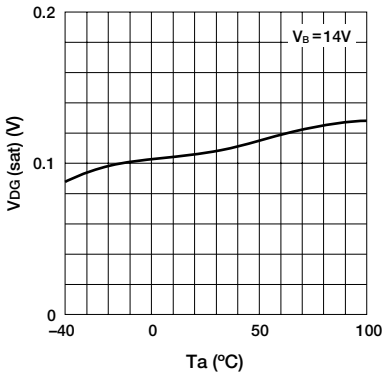
■ Input Current (Output ON)



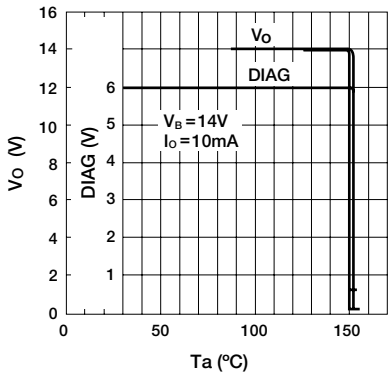
■ Input Current (Output OFF)



■ 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
- Tj = 150ºC guaranteed
- TO220 equivalent full-mold package not require insulation mica

Absolute Maximum Ratings

(Ta = 25ºC)

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 (Tc=25ºC)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	Tj	–40 to +150	ºC	
Operating temperature	T_{OP}	–40 to +100	ºC	
Storage temperature	Tstg	–40 to +150	ºC	

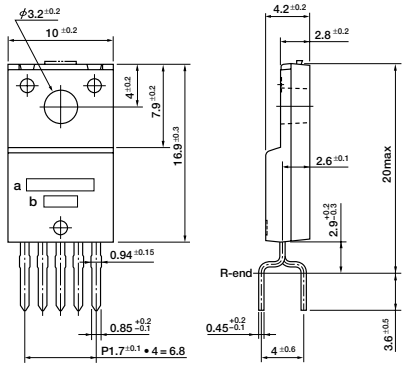
Electrical Characteristics

(Ta=25ºC unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		30	V	
Quiescent circuit current		Iq		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_{CEO}=16V, V_{IN}=0V
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}=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}	150			ºC	V_{Bopr}≧6V
Open load detection resistor		Ropen			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 leak current		I_{DIAG}			100	µA	V_{CC}=6V, V_{Bopr}=6 to 16V
Saturation voltage of DIAG output		V_{DL}			0.3	V	V_{CC}=6V, V_{Bopr}=6 to 16V, I_{DO}=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)

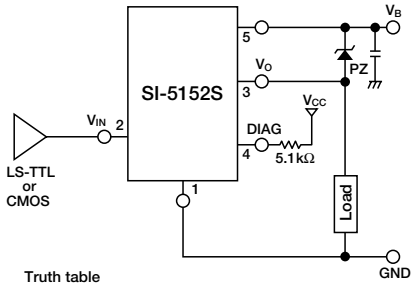


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

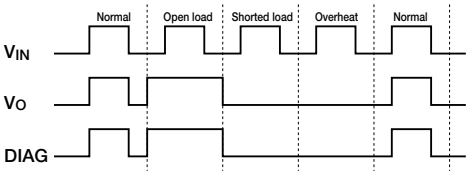
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

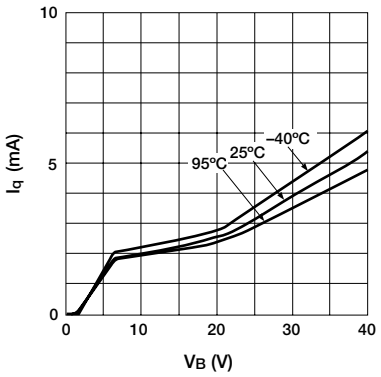


Mode	V_{IN}	V_O	DIAG
Normal	L H	L H	L H
Open load	L H	H H	H H
Shorted load	L H	L L	L L
Overheat	L H	L L	L L

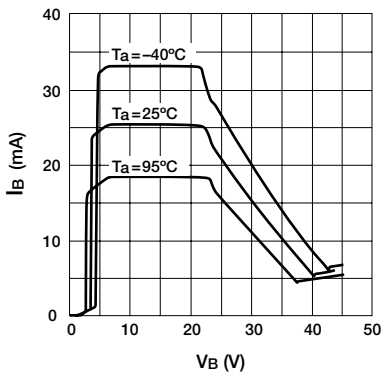
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

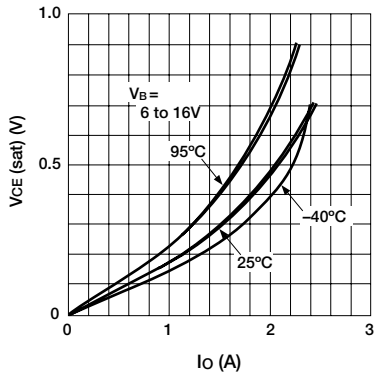
■ Quiescent Circuit Current



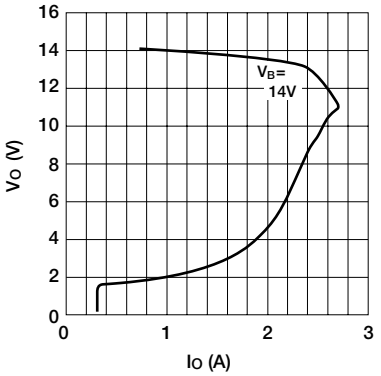
■ Circuit Current



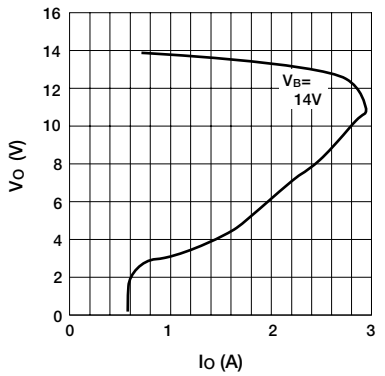
■ Saturation Voltage of Output Transistor



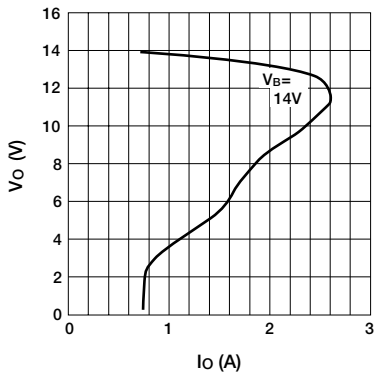
■ Overcurrent Protection Characteristics (Ta=–40°C)



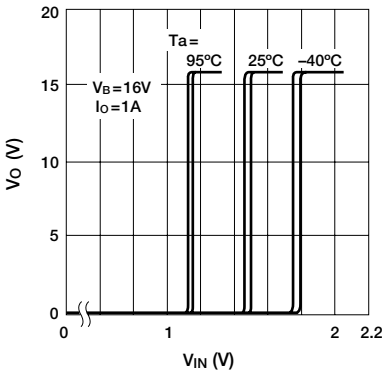
■ Overcurrent Protection Characteristics (Ta=25°C)



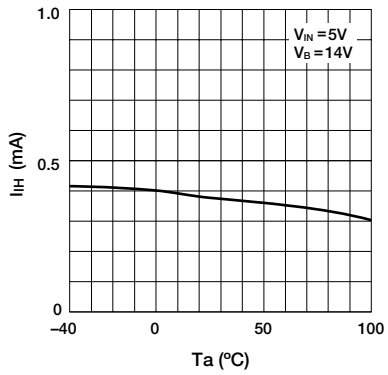
■ Overcurrent Protection Characteristics (Ta=100°C)



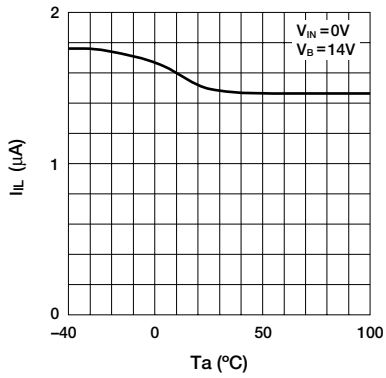
■ Threshold input voltage



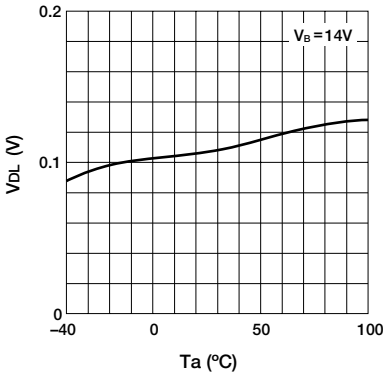
■ Input Current (Output ON)



■ Input Current (Output OFF)



■ Saturation Voltage of DIAG Output



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
- Tj = 150°C guaranteed
- Built-in Zener diode
- 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	–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 (Tc=25°C)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	Tj	–40 to +150	°C	
Operating temperature	T_{OP}	–40 to +100	°C	
Storage temperature	Tstg	–40 to +150	°C	

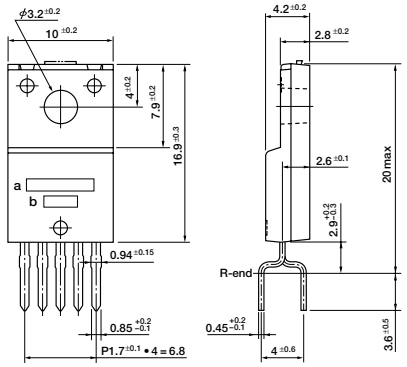
Electrical Characteristics

(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		30	V	
Quiescent circuit current		Iq		5	12	mA	V_{Bopr}=14V, V_{IN}=0V
Saturation voltage of output transistor		$V_{CE\ (sat)}$			0.47	V	I_O≦2.05A, V_{Bopr}=6 to 16V
Output leak current		$I_{O,\ leak}$			2	mA	V_{CEO}=16V, V_{IN}=0V
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}=5V
	Output OFF	I_{IL}	–0.1			mA	V_{IN}=0V
Overcurrent protection starting current		I_S	2.05			A	V_{Bopr}=14V, V_O=V_{Bopr}–1.5V
Thermal protection starting temperature		T_{TSD}	150			°C	V_{Bopr}≧6V
Open load detection resistor		Ropen			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_{Bopr}=6 to 16V
		V_{DL}			0.3	V	V_{CC}=6V, V_{Bopr}=6 to 16V, I_{DO}=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	
Surge clamp voltage	*1	V_Z	28	34	40	V	I_C=5mA

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= –13V, one minute.
* This driver is exclusively used for ON/OFF control.

External Dimensions (unit: mm)

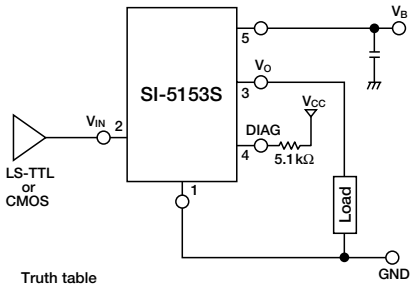


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

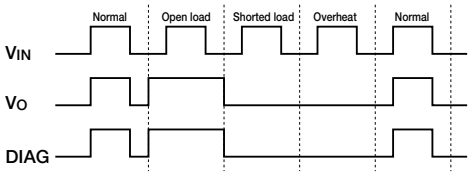
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

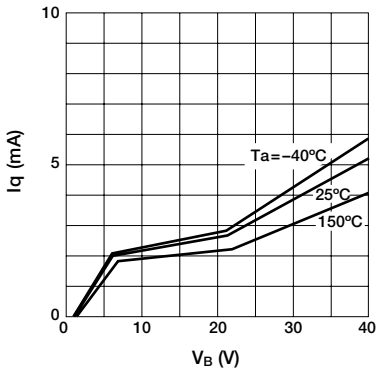


Mode	V_{IN}	V_O	DIAG
Normal	L H	L H	L H
Open load	L H	H H	H H
Shorted load	L H	L L	L L
Overheat	L H	L L	L L

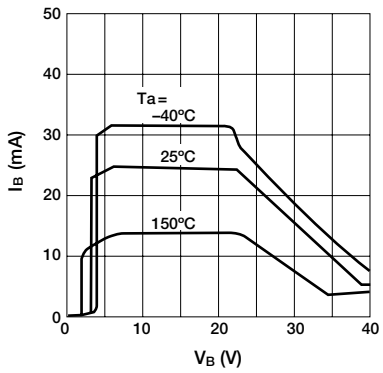
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

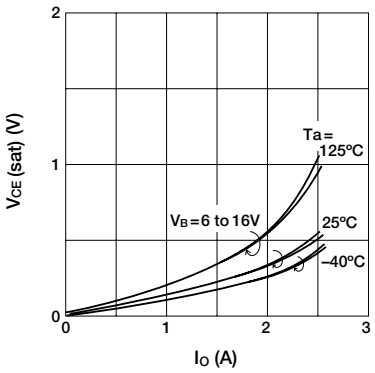
■ Quiescent Circuit Current



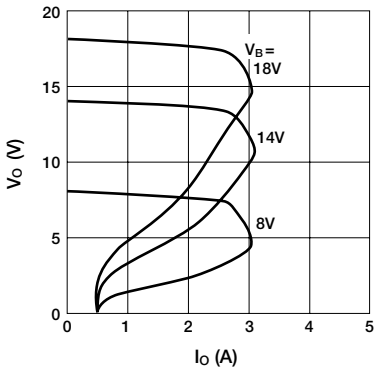
■ Circuit Current



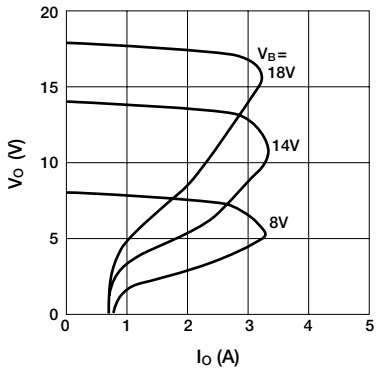
■ Saturation Voltage of Output Transistor



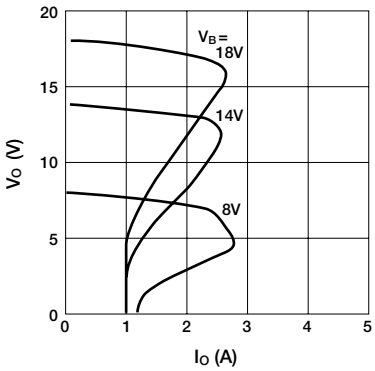
■ Overcurrent Protection Characteristics (Ta=–40°C)



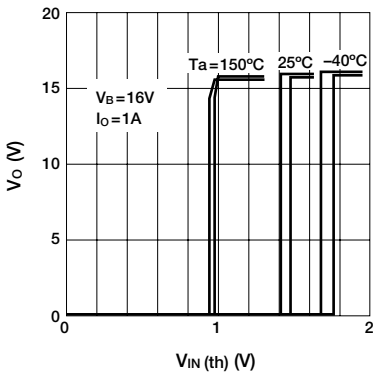
■ Overcurrent Protection Characteristics (Ta=25°C)



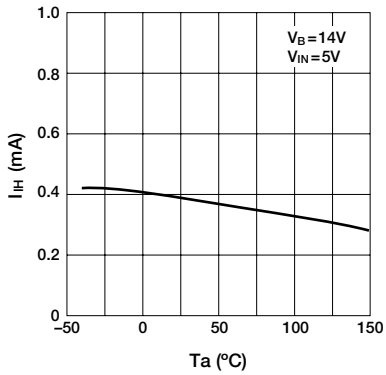
■ Overcurrent Protection Characteristics (Ta=125°C)



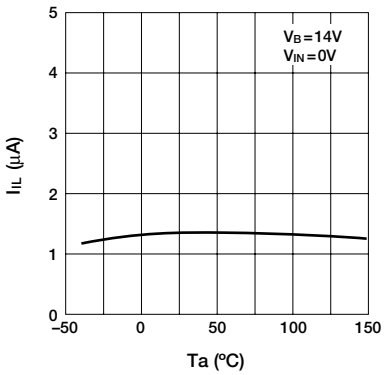
■ Threshold Characteristics of Input Voltage



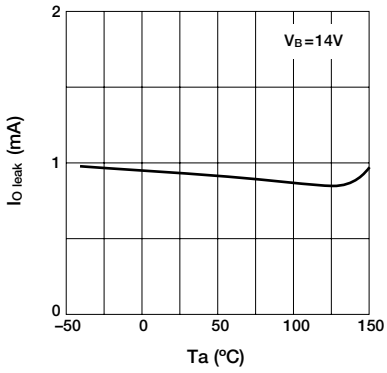
■ Input Current (Output ON)



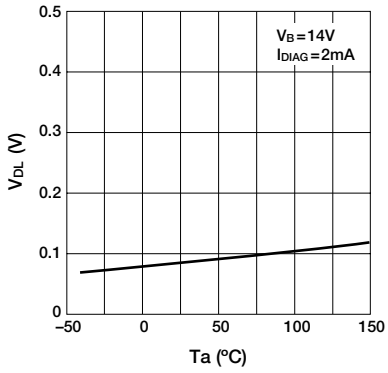
■ Input Current (Output OFF)



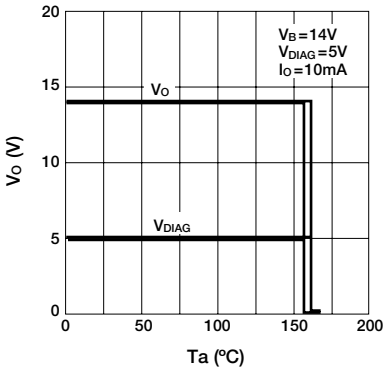
■ Output Terminal Leak Current



■ 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
- Tj = 150°C guaranteed
- Built-in Zener diode
- 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	–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 (Tc=25°C)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	Tj	–40 to +150	°C	
Operating temperature	T_{OP}	–40 to +100	°C	
Storage temperature	Tstg	–40 to +150	°C	

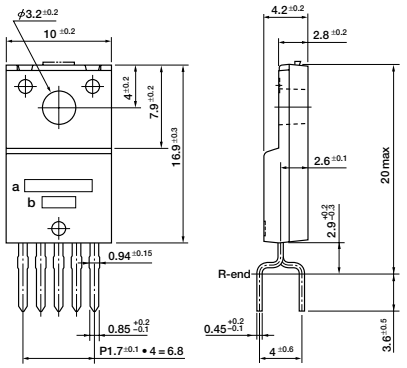
Electrical Characteristics

(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		30	V	
Quiescent circuit current		Iq		5	12	mA	V_{Bopr}=14V, V_{IN}=0V
Saturation voltage of output transistor		$V_{CE(sat)}$			0.3	V	$I_O \leqq$1.0A, V_{Bopr}=6 to 16V
					0.72	V	$I_O \leqq$2.5A, V_{Bopr}=6 to 16V
Output leak current		I_O, leak			2	mA	V_{CEO}=16V, V_{IN}=0V
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}=5V
	Output OFF	I_{IL}	–0.1			mA	V_{IN}=0V
Overcurrent protection starting current		I_S	2.6			A	V_{Bopr}=14V, $V_O = V_{Bopr} - 1.5$V
Thermal protection starting temperature		T_{TSD}	150			°C	$V_{Bopr} \geqq$6V
Open load detection resistor		Ropen			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_{Bopr}=6 to 16V
		V_{DL}			0.3	V	V_{CC}=6V, V_{Bopr}=6 to 16V, I_{DO}=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	
Surge clamp voltage	*1	V_Z	28	34	40	V	I_C=5mA

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=–13V, one minute.
* This driver is exclusively used for ON/OFF control.

External Dimensions (unit: mm)

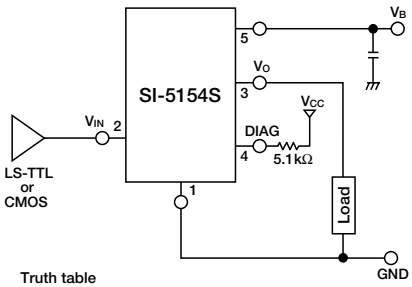


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

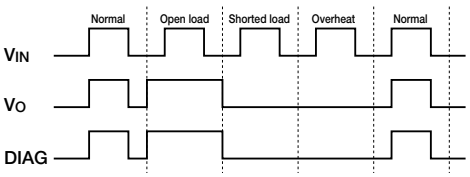
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

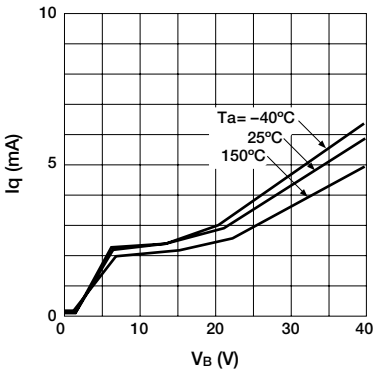


Mode	V_{IN}	V_O	DIAG
Normal	L H	L H	L H
Open load	L H	H H	H H
Shorted load	L H	L L	L L
Overheat	L H	L L	L L

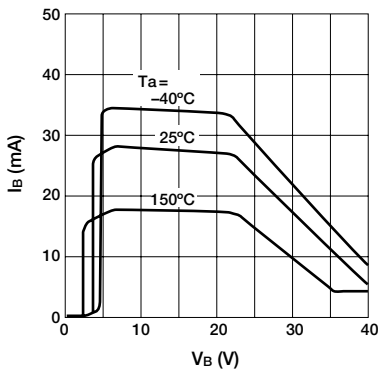
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

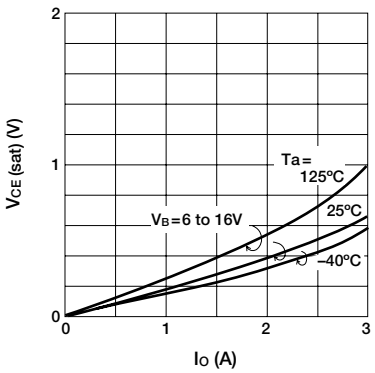
■ Quiescent Circuit Current



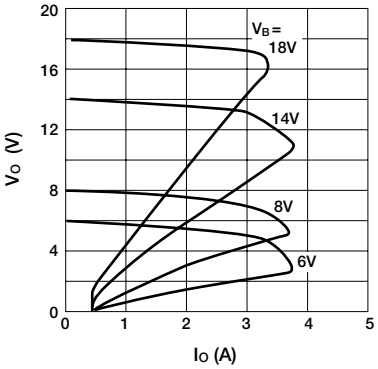
■ Circuit Current



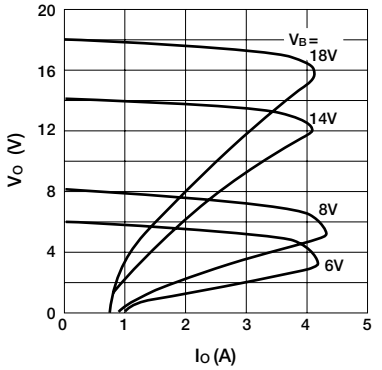
■ Saturation Voltage of Output Transistor



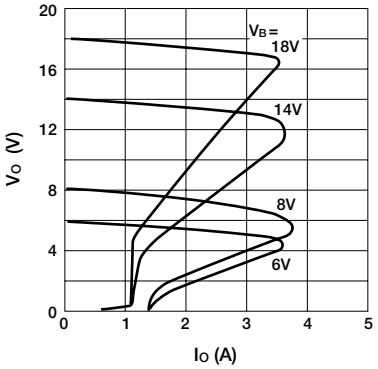
■ Overcurrent Protection Characteristics (Ta=–40°C)



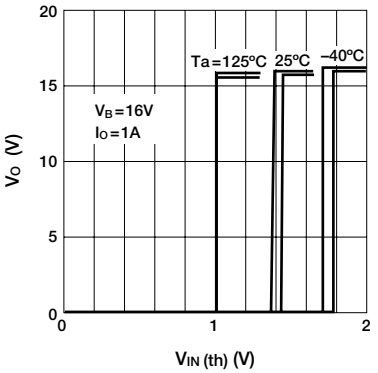
■ Overcurrent Protection Characteristics (Ta=25°C)



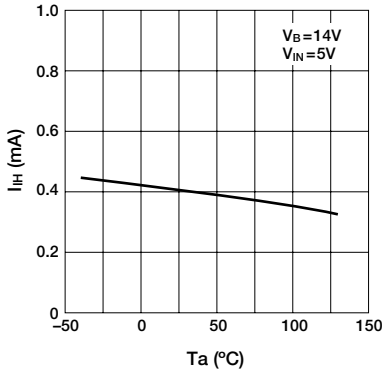
■ Overcurrent Protection Characteristics (Ta=125°C)



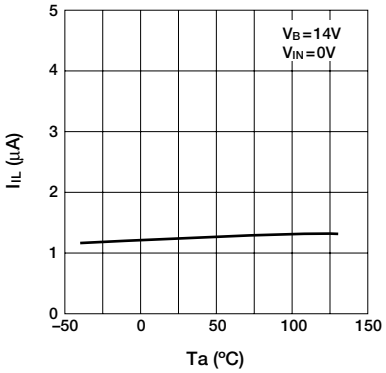
■ Threshold input voltage



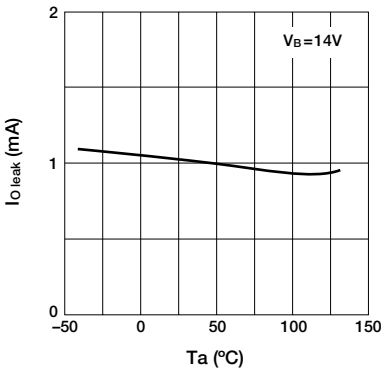
■ Input Current (Output ON)



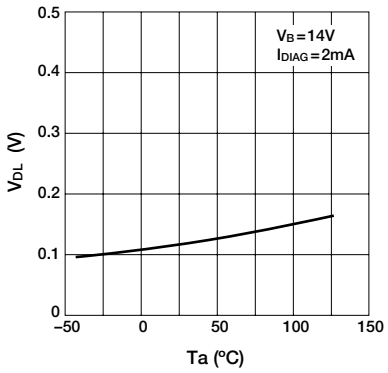
■ Input Current (Output OFF)



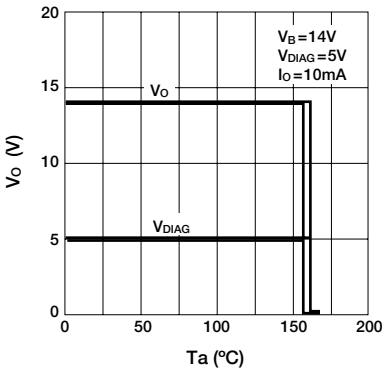
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



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
- Tj = 150°C guaranteed
- 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	–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 (Tc=25°C)
	P_{D2}	1.8	W	Stand-alone without heatsink
Junction temperature	Tj	–40 to +150	°C	
Operating temperature	T_{OP}	–40 to +100	°C	
Storage temperature	Tstg	–40 to +150	°C	

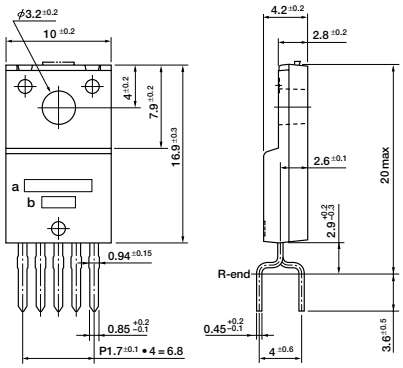
Electrical Characteristics

(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		30	V	
Quiescent circuit current		Iq		5	12	mA	V_{Bopr}=14V, V_{IN}=0V
Saturation voltage of output transistor		$V_{CE\ (sat)}$			0.3	V	I_O≦1.0A, V_{Bopr}=6 to 16V
					0.72	V	I_O≦2.5A, V_{Bopr}=6 to 16V
Output leak current		$I_{O,\ leak}$			2	mA	V_{CEO}=16V, V_{IN}=0V
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}=5V
	Output OFF	I_{IL}	–0.1			mA	V_{IN}=0V
Overcurrent protection starting current		I_S	2.6			A	V_{Bopr}=14V, V_O=V_{Bopr} –1.5V
Thermal protection starting temperature		T_{TSD}	150			°C	V_{Bopr}≧6V
Open load detection resistor		Ropen			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_{Bopr}=6 to 16V
		V_{DL}			0.3	V	V_{CC}=6V, V_{Bopr}=6 to 16V, I_{DO}=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)

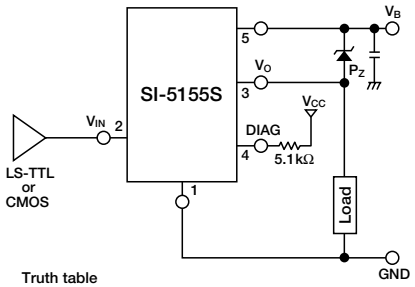


1. GND
2. V_{IN}
3. V_O
4. DIAG
5. V_B

a: Part No.
b: Lot No.

(Forming No. 1123)

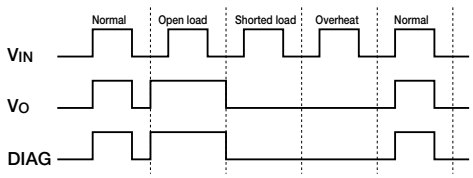
Standard Circuit Diagram



Truth table

V_{IN}	V_O
H	H
L	L

Diagnostic Function

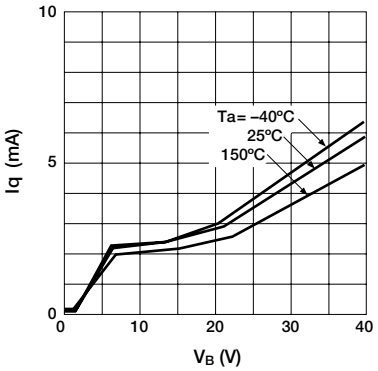


Mode	V_{IN}	V_O	DIAG
Normal	L H	L H	L H
Open load	L H	H H	H H
Shorted load	L H	L L	L L
Overheat	L H	L L	L L

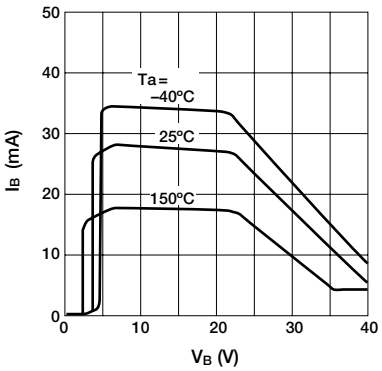
- DIAG output will be undetermined when a voltage exceeding 25V is applied to V_B terminal.

Electrical Characteristics

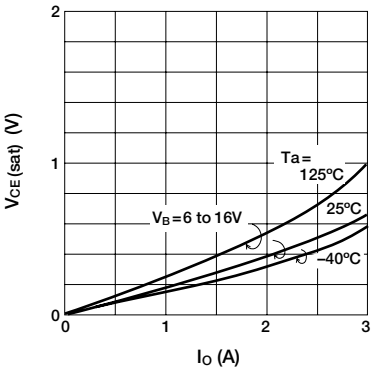
■ Quiescent Circuit Current



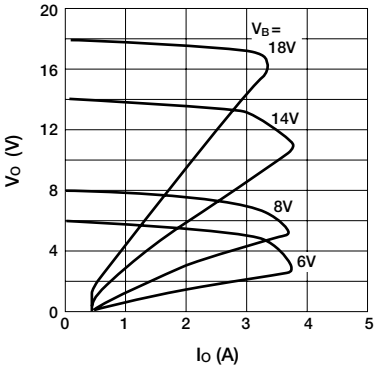
■ Circuit Current



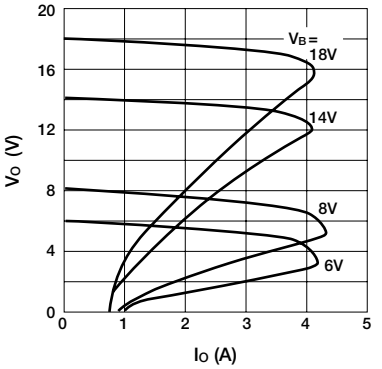
■ Saturation Voltage of Output Transistor



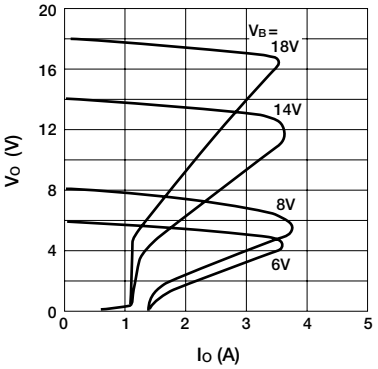
■ Overcurrent Protection Characteristics (Ta=–40ºC)



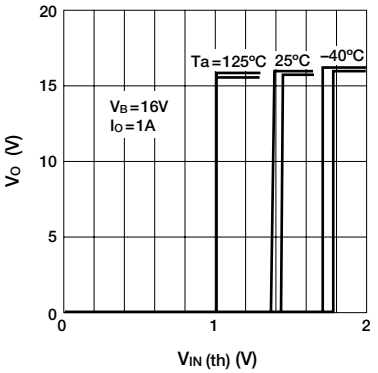
■ Overcurrent Protection Characteristics (Ta=25ºC)



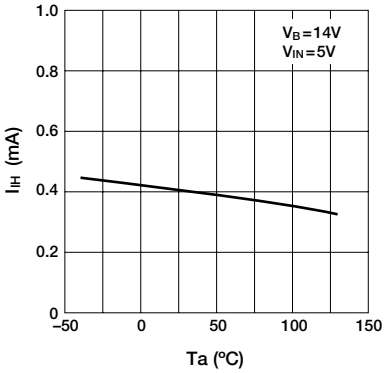
■ Overcurrent Protection Characteristics (Ta=125ºC)



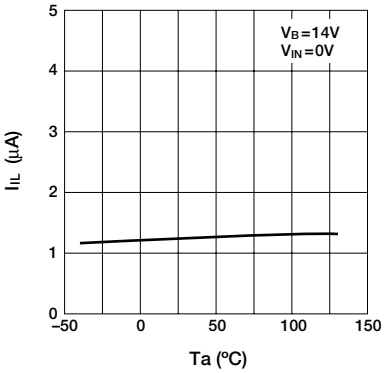
■ Threshold input voltage



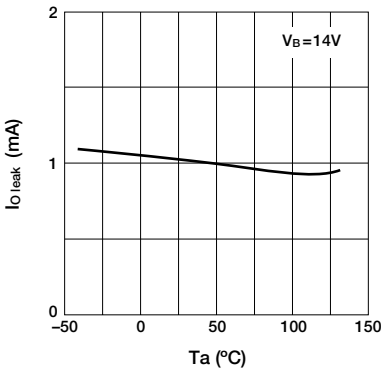
■ Input Current (Output ON)



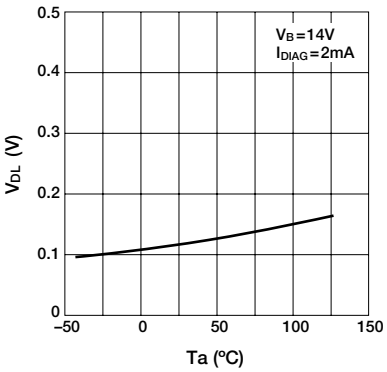
■ Input Current (Output OFF)



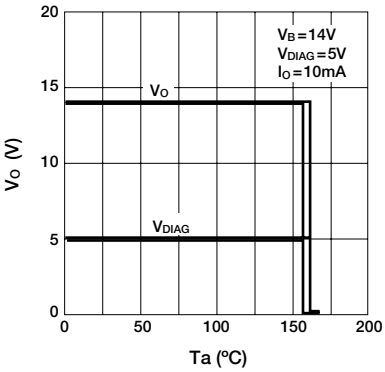
■ Output Terminal Leak Current



■ 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 ($V_{CE\ (sat)} \leqq 0.2V$)
- 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
- Tj = 150°C guaranteed

Absolute Maximum Ratings

(Ta=25°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=0Ω
Power Dissipation	P_D	4.8	W	Stand-alone without heatsink, all circuits operating
Junction temperature	Tj	–40 to +150	°C	
Operating temperature	T_{OP}	–40 to +115	°C	
Storage temperature	Tstg	–50 to +150	°C	

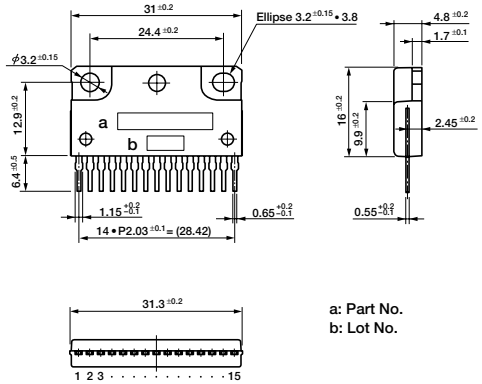
Electrical Characteristics

(V_{Bopr}=14V, Tj=–40 to +150°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		16	V	
Quiescent circuit current (per circuit)		Iq		0.8	1.6	mA	Lo output
Circuit current (per circuit)		I_B		19.3		mA	Tj=25°C
Threshold input voltage		V_{IN}th	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	$I_O \leqq 1.2A$, V_{Bopr}=6 to 16V
		$V_{CE\ (sat)}$		1.0		V	$I_O \leqq 1.5A$, V_{Bopr}=6 to 16V
Output terminal sink current		$I_{O\ (off)}$		2.5	5	mA	Tj=25°C, V_{CEO}=14V
Surge clamp voltage		V_{B-O}	29	34	39	V	Tj=25°C, I_C=10mA
			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		Ropen	5.5			kΩ	
Overcurrent protection starting current		I_S	1.6			A	V_O=V_{Bopr}–1.5V
Thermal protection starting temperature		T_{TSD}				°C	$V_{Bopr} \geqq 6V$
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		Lo	1.0			mH	
Maximum ON duty		$D_{(ON)}$	0		60	%	

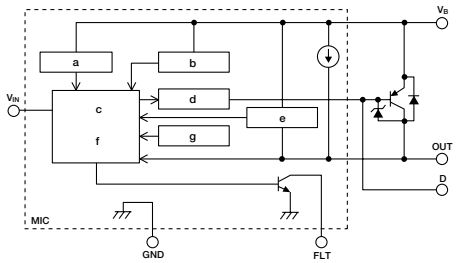
Note:
* The Zener diode has an energy capability of 200 mJ (single pulse).
* A start failure may occur if a short OFF signal of 10 ms or below is input in the V_{IN} terminal.

External Dimensions (unit: mm)



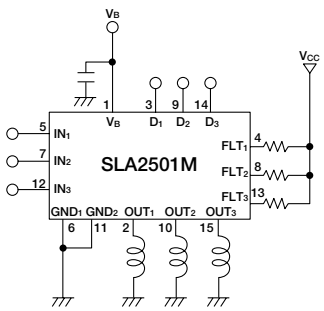
a: Part No.
b: Lot No.

Equivalent Circuit Diagram

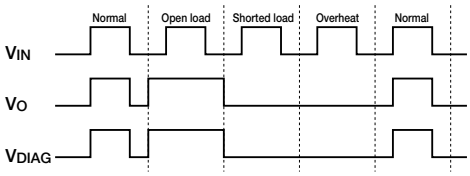


a: Pre-regulator
b: Overvoltage protection circuit
c: Control circuit
d: Driver circuit
e: Overcurrent protection circuit
f: Diagnostic circuit
g: Thermal protection circuit

Standard Circuit Diagram

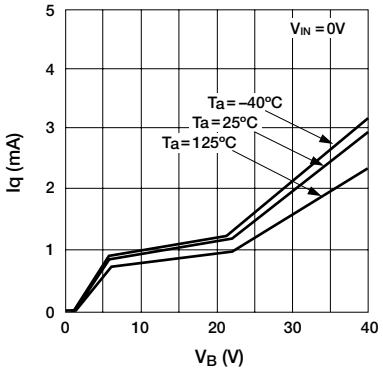


Diagnostic Function

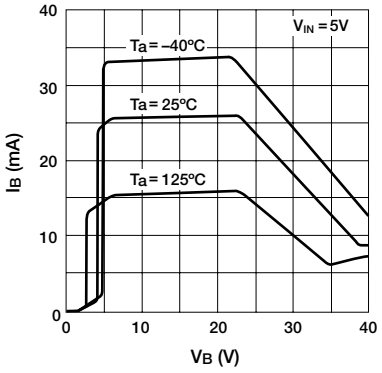


Electrical Characteristics

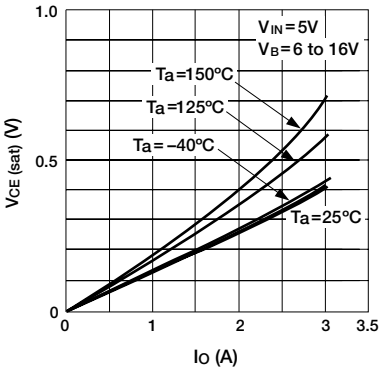
■ Quiescent Circuit Current (single circuit)



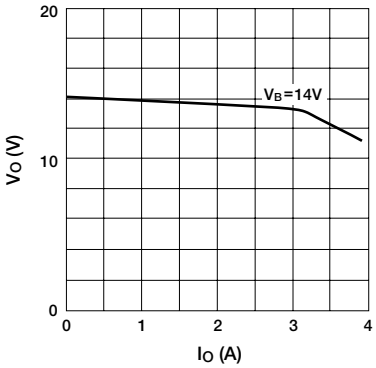
■ Circuit Current (single circuit)



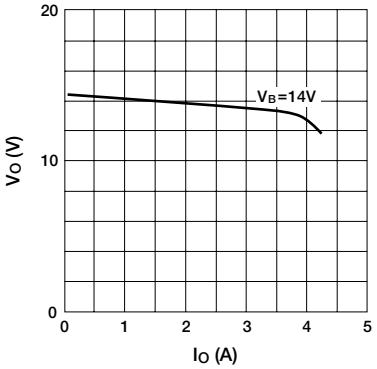
■ Saturation Voltage of Output Transistor



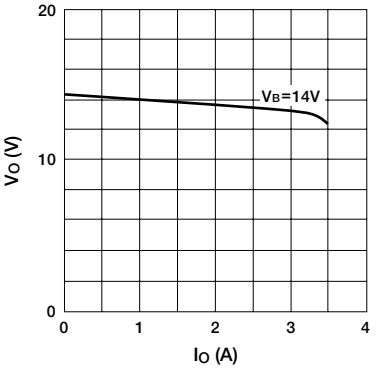
■ Overcurrent Protection Characteristics (Ta = –40°C)



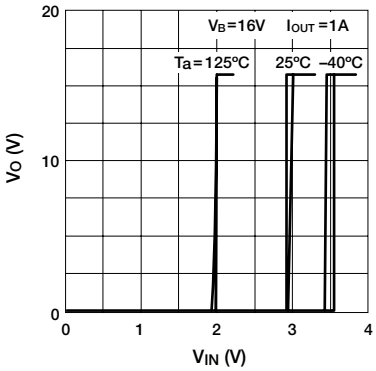
■ Overcurrent Protection Characteristics (Ta = 25°C)



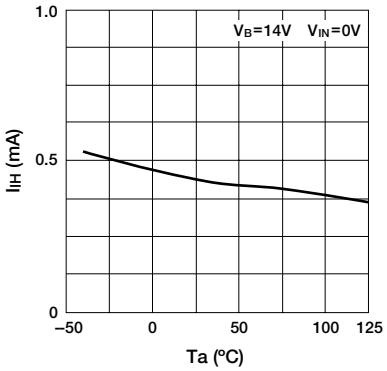
■ Overcurrent Protection Characteristics (Ta = 125°C)



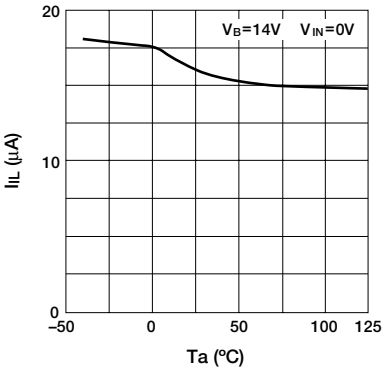
■ Threshold Input Voltage



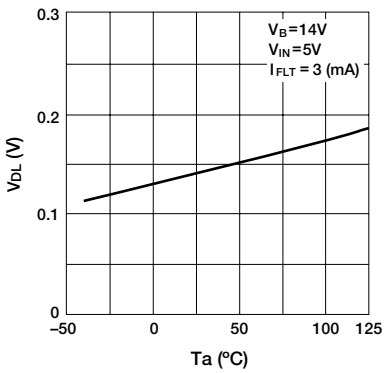
■ Input Current (Output ON)



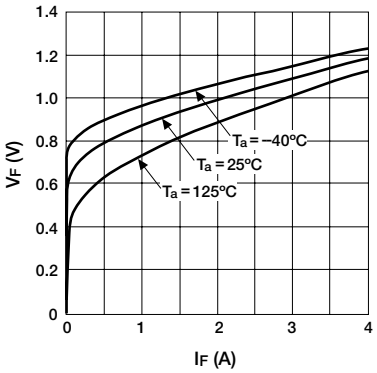
■ Input Current (Output OFF)



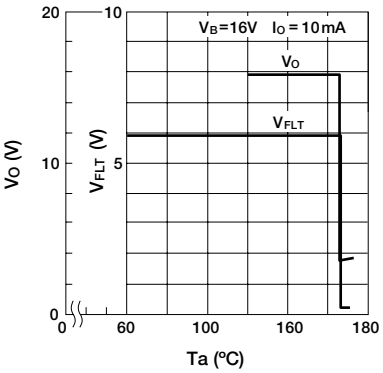
■ Saturation Voltage of DIAG Output



■ Output Reverse Current



■ Thermal Protection



High-side Power Switch ICs [With Diagnostic Function, 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 ($V_{CE\ (sat)}$ ≦ 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
- Tj = 150ºC guaranteed

Absolute Maximum Ratings

(Ta=25ºC)

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	Tj	–40 to +150	ºC	
Operating temperature	T_{OP}	–40 to +100	ºC	
Storage temperature	Tstg	–50 to +150	ºC	

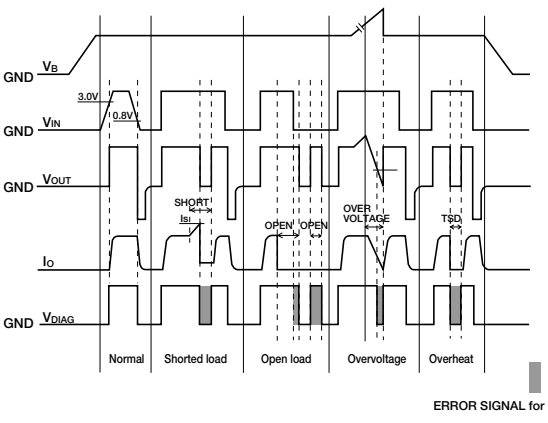
Electrical Characteristics

(V_{Bopr} =14V, Ta=25ºC unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		V_{Bopr}	6.0		16	V	
Quiescent circuit current (per circuit)		Iq		5	12	mA	V_{IN}=0V
Threshold input voltage		V_{IN}th	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≦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		Ropen			30	kΩ	
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

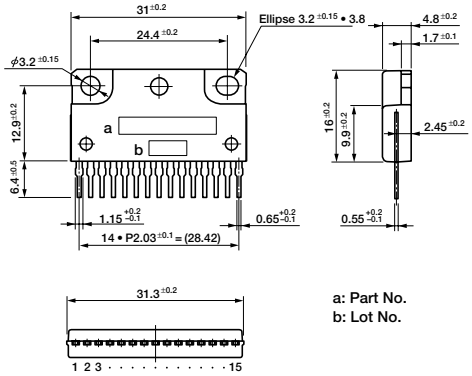
Note: * The rule of protection against reverse connection of power supply is V_B= –13V, one minute (all terminals except V_B and GND should be open).

Diagnostic Function



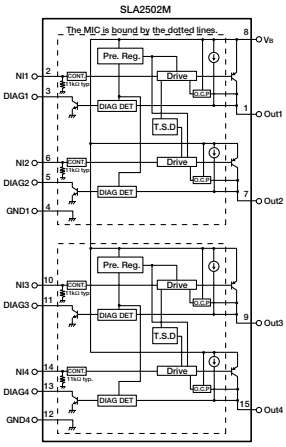
ERROR SIGNAL for CPU

External Dimensions (unit: mm)



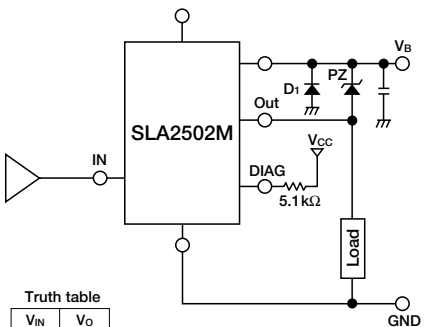
a: Part No.
b: Lot No.

Equivalent Circuit Diagram



[Abbreviations]
Drive: Drive circuit
CONT: ON/OFF circuit
Pre.Reg: Pre-regulator
DIAG.DET.: Diagnostic circuit
O.C.P.: Overcurrent protection
T.S.D.: Thermal protection

Standard Circuit Diagram



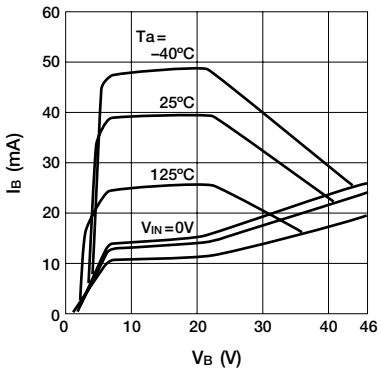
Truth table

V_{IN}	V_O
H	H
L	L

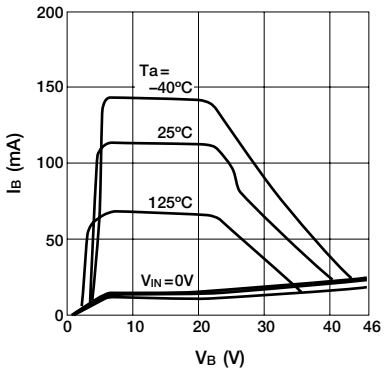
Note 1: A pull-down resistor (11kΩ typ.) is connected to the IN terminal. V_{OUT} turns "L" when a high impedance is connected to the IN terminal in series.
Note 2: Grounds GND1 and GND2 are not wired internally. They must be shorted at a pattern near the product.

Electrical Characteristics

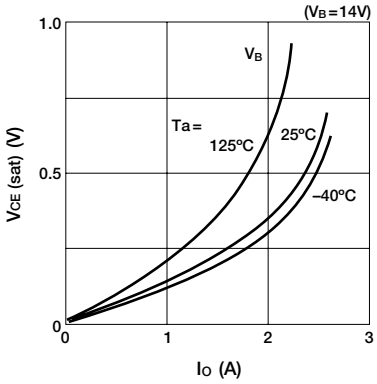
■ Circuit Current (single circuit)



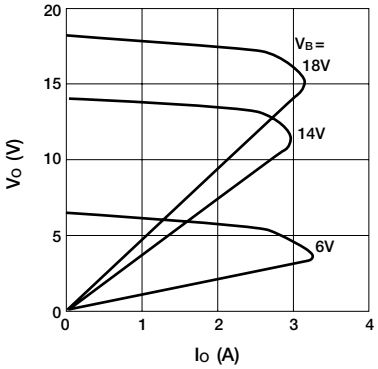
■ Circuit Current (4 circuits)



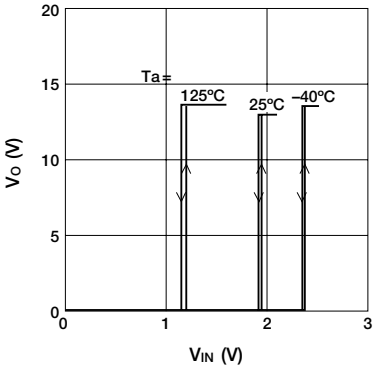
■ Saturation Voltage of Output Transistor



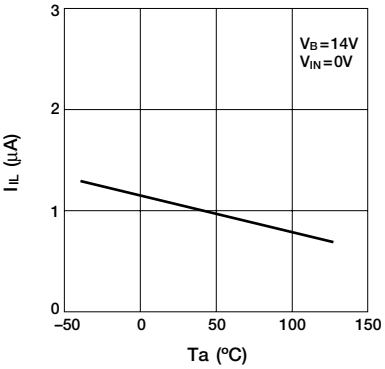
■ Overcurrent Protection Characteristics (Ta=–40°C)



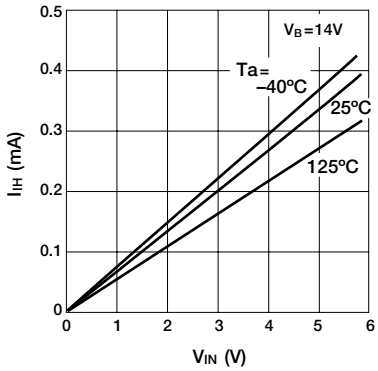
■ Threshold Input Voltage



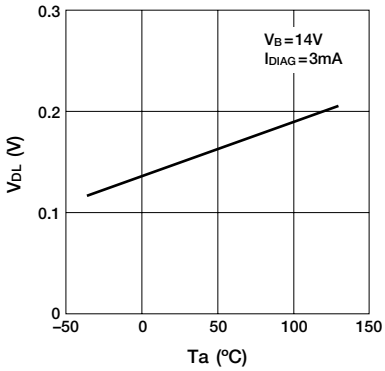
■ Input Current (Output OFF)



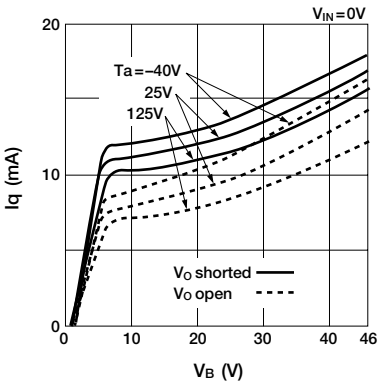
■ Input Current (Output Hi)



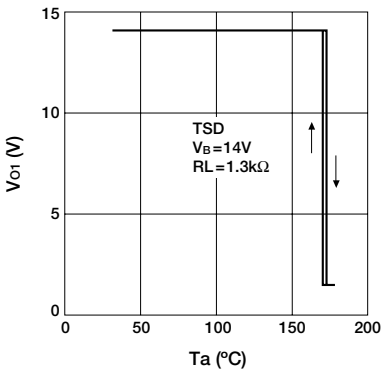
■ Saturation Voltage of DIAG Output



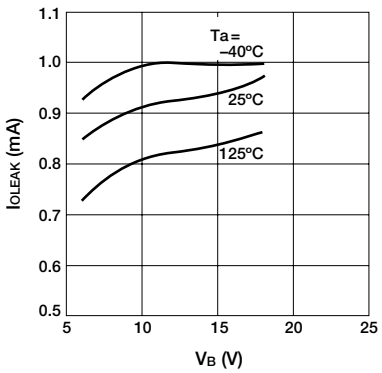
■ Quiescent Circuit Current (dual circuit)



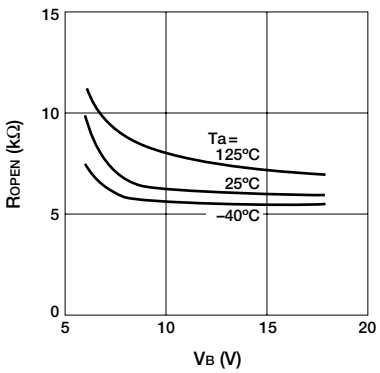
■ Thermal Protection Characteristics



■ Output Terminal Leak Current (VO=0V)



■ Open Load Detection Resistor



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	Tch	150	°C	
Operating temperature	T_{OP}	–40 to +105	°C	
Storage temperature	Tstg	–40 to +150	°C	

Electrical Characteristics

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

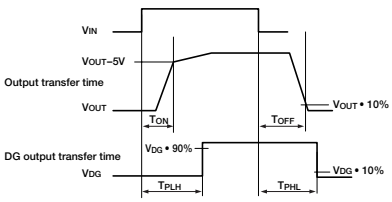
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		$V_{B\,(opr)}$	5.5		35	V	
Quiescent circuit current		Iq			1	mA	V_{IN}=0V, V_{OUT}=0V
Output ON resistance		$R_{DS\,(ON)}$			200	mΩ	I_O=1A
					300	mΩ	I_O=1A, Ta=80°C
Output leak current		I_O, leak		50	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_{TSD}	155	165		°C	
Load open detection threshold voltage		Vopen	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.

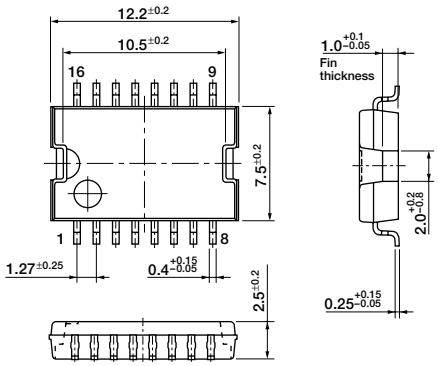
Recommended Operating Conditions (for one channel)

Parameter	Ratings min	Ratings max	Unit
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

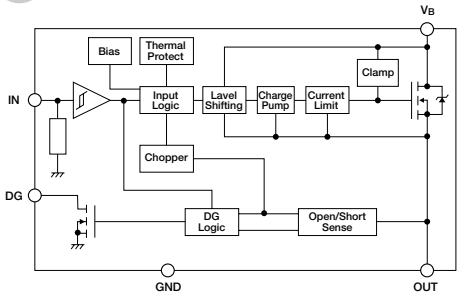
Wave Form



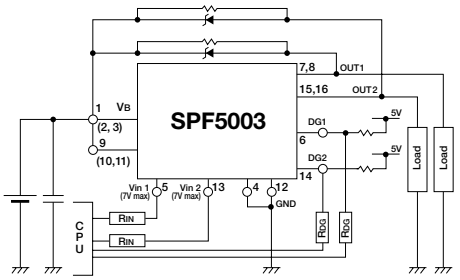
External Dimensions (unit: mm)



Block Diagram (for one channel)

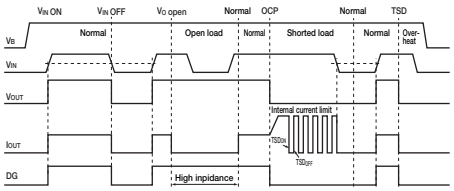


Standard Connection Diagram



* RIN and RDG are needed to protect CPU and SPF5003 in case of reverse connection of VB terminal.
* Make VB 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 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

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	Tch	150	°C	
Operating temperature	T_{OP}	–40 to +105	°C	
Storage temperature	Tstg	–40 to +150	°C	

Electrical Characteristics

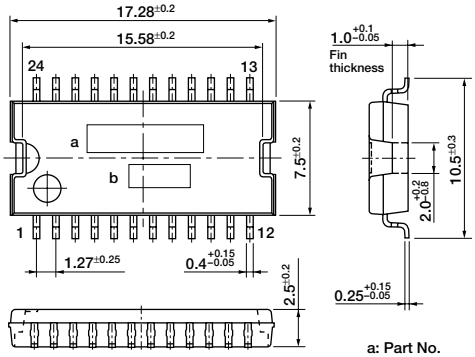
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		$V_{B\ (opr)}$	5.5		35	V	
Quiescent circuit current		Iq			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
Inpup 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_{TSD}	155	165		°C	
Load open detection threshold voltage		Vopen		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)

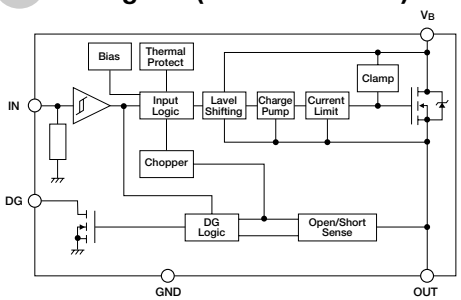
Parameter	Ratings min	Ratings max	Unit
Power supply voltage	5.5	16	V
V_{IH}	4	5.5	V
V_{IL}	–0.3	0.9	V
I_O		1.15	A
R_{IN}	10	20	kΩ
R_{DG}	10	20	kΩ

External Dimensions (unit: mm)

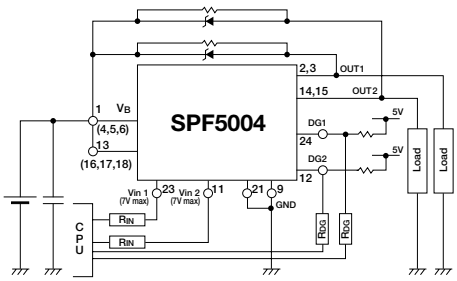


a: Part No.
b: Lot No.

Block Diagram (for one channel)

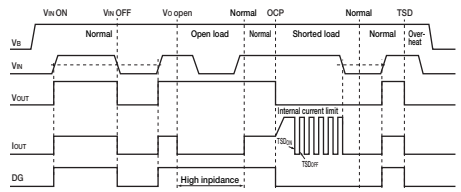


Standard Connection Diagram



* Make VB 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	H	H
	L	L	L
Open load	H	H	H
	L	H	H
Shorted load	H	L	L (Limiting)
	L	L	L
Overheat	H	L	L
	L	L	L

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	Ta=25°C, all circuit operating
Source to drain Di forward current	I_F	0.8	A	
Channel temperature	Tch	150	°C	
Operating temperature	T_{OP}	–40 to +105	°C	
Storage temperature	Tstg	–40 to +150	°C	

Electrical Characteristics

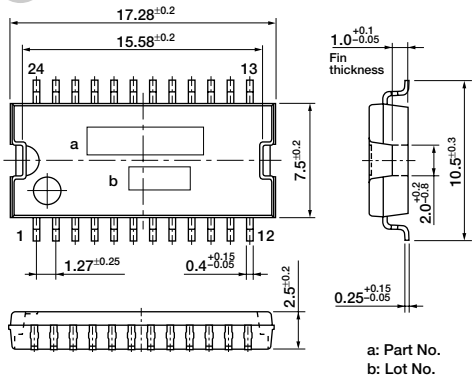
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage		$V_{B\ (opr)}$	5.5		35	V	
Quiescent circuit current		Iq			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_{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_{TSD}	155	165		°C	
Load open detection threshold voltage		Vopen	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)

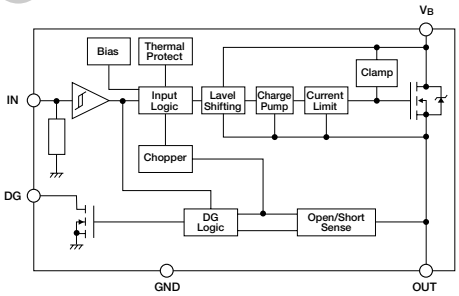
Parameter	Ratings min	Ratings max	Unit
Power supply voltage	5.5	16	V
V_{IH}	4	5.5	V
V_{IL}	–0.3	0.9	V
I_O		1	A
R_{IN}	10	20	kΩ
R_{DG}	10	20	kΩ

External Dimensions (unit: mm)

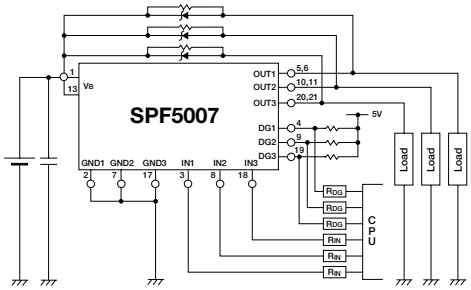


a: Part No.
b: Lot No.

Block Diagram (for one channel)

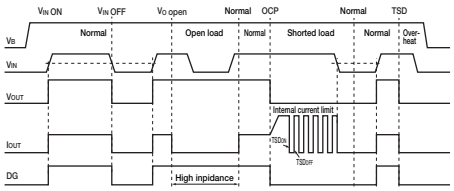


Standard Connection Diagram



* R_{IN} and R_{DG} are needed to protect CPU and SPF5007 in case of reverse connection of V_B terminal.
* 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	H	H
	L	L	L
Open load	H	H	H
	L	H	H
Shorted load	H	L	L (Limiting)
	L	L	L
Overheat	H	L	L
	L	L	L

High-side Power Switch ICs [Surface-mount 2-circuit, current monitor output function] SPF5017

Features

- Internal current sense resistor
- High accuracy current monitor output (sample & hold function)
- Built-in overcurrent and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage 1	V_B	0 to 32	V	
Power supply voltage 2	Vcc	–0.5 to 7.0	V	
Power supply voltage 3	V_B	0 to 40	V	V_B terminal, t=1 min
Current sensing voltage	$Vsense^+$	–0.8 to 6	V	
	$Vsense^-$	$Vsense^+ \pm Io \bullet Rsense$		
Output terminal voltage	V_{OUT}	–2 to 32	V	
Input terminal voltage	V_{PWM}	–0.5 to 7.0	V	
	V_{Hold}			
Output current	I_{OUT}	2.0	A	
Power dissipation	P_D	2.4 to 5.0	W	Depends on surface-mount board pattern
Storage temperature	Tstg	–40 to +150	°C	
Channel temperature	Tch	150	°C	

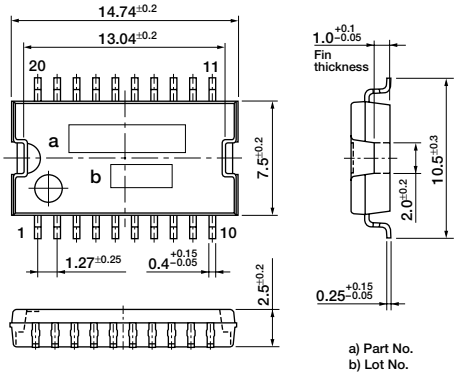
Electrical Characteristics

(V_B=14V, Ta=25°C unless otherwise specified) – One circuit equivalent

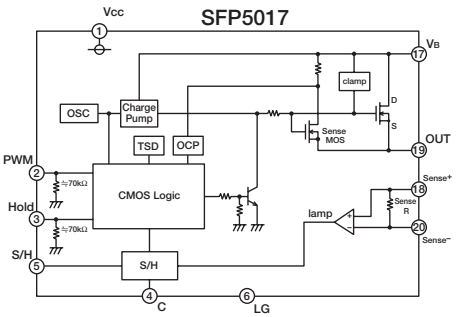
Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Min. operating power supply voltage	V_B min	6			V	Minimum operation of OUT terminal.
Operating power supply voltage 1	V_B	10	14	16	V	*1
Operating power supply voltage 2	V_{CC}		5.0		V	*2
Quiescent circuit current 1	Iqvb			7.2	mA	Vcc=5V, V_{PWM}=0V, One circuit equivalent
Quiescent circuit current 2	Iqvcc			0.2	mA	Vcc=5V, V_{PWM}=0V
PWM terminal input voltage	$V_{PWM}H$	3.5			V	Vcc=5V
	$V_{PWM}L$			1.5		
PWM terminal input current	$I_{PWM}H$		70	110	μA	Vcc=5V, V_{PWM}=5V, Active H *3
Hold terminal input voltage	$V_{Hold}H$	3.5			V	Vcc=5V
	$V_{Hold}L$			1.5		
Hold terminal input current	$I_{Hold}H$		70	110	μA	Vcc=5V, V_{PWM}=5V, Active H *3
Output ON resistance	R_{DSon}			0.14	Ω	I_{OUT}=1A
				0.21	Ω	I_{OUT}=1A, Ta=125°C
Current sensing resistance	Rsense			0.21	Ω	I_{OUT}=1A
				0.25	Ω	I_{OUT}=1A, Ta=125°C
Overcurrent protection starting current	Is	3.0			A	*4
Thermal shutdown operating temperature	Ttsd	150			°C	
Operation circuit for current monitor output	Io	0.2		1.2	A	*1
Current monitor output voltage	V_{SH}			0.2	V	Io=0A, Vcc=5V
		0.488	0.500	0.512	V	Io=0.2A, Vcc=5V
		1.219	1.250	1.281	V	Io=0.5A, Vcc=5V, Ta=–40 to 140°C
		2.925	3.000	3.075	V	Io=1.2A, Vcc=5V, Ta=–40 to 140°C
Current monitor output current	I_{SH}			5	mA	Io=1A, Vcc=5V, V_{SH}=0V
		–6			mA	Io=1A, Vcc=5V, V_{SH}=5V
Output transfer time	t_{on}			15	μs	Io=0.5A, Vcc=5V
	t_{off}			15	μs	
Output rise time	t_r			100	μs	
Output fall time	t_f			50	μs	
Current monitor output hold time	t_{sh}	500		650	μs	Io=0.5A, Vcc=5V, C1=0.033μF
Current monitor output delay time	t_{shd}			1	μs	
Hold time after inputting hold	t_{shh}			2	μs	
S/H settling time	t_{stt}			70	μs	V_B=11V, Vcc=5V, Io=1.2A, C1=0.033μF
				80	μs	V_B=11V, Vcc=5V, Io=1.2A, C1=0.033μF, Ta=125°C

Note:
*1: Accuracy warranty range for current monitor output
*2: Equivalent errors are not included in current monitor output accuracy.
*3: With built-in pull-down resistance (70kΩ typ)
*4: Self-excitation and oscillation type
*5: Accuracy of current monitor output is affected by the materials of the hold capacitor (C1).
The capacitor C1 must be of low dielectric absorption and have good bias and leak current characteristics.

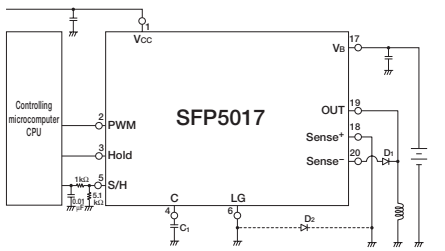
External Dimensions (unit: mm)



Block Diagram (for one channel)

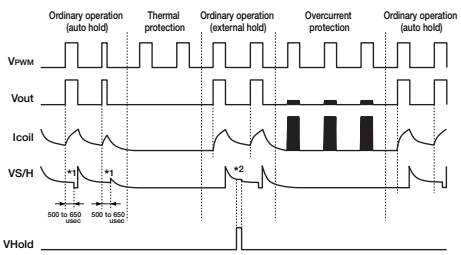


Standard Connection Diagram



* Use a Schottky Di for D2 when the Sense+ terminal is lower than the abs. max. rated voltage (–0.8V)

Timing Chart



Truth table

V_{PWM}	L	H
V_{OUT}	L	H

High-side Power Switch ICs [Surface-mount, current monitor output function] SPF5018

Features

- Internal current sense resistor
- High accuracy current monitor output (sample & hold function)
- Built-in overcurrent and thermal protection circuits

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage 1	V_B	0 to 32	V	
Power supply voltage 2	Vcc	–0.5 to 7.0	V	
Power supply voltage 3	V_B	0 to 40	V	V_B terminal, t=1 min
Current sensing voltage	$Vsense^+$	–0.8 to 6	V	
	$Vsense^-$	$Vsense^+ \pm Io \bullet Rsense$		
Output terminal voltage	V_{OUT}	–2 to 32	V	
Input terminal voltage	V_{PWM}	–0.5 to 7.0	V	
	V_{Hold}			
Output current	I_{OUT}	2.0	A	
Power dissipation	P_D	2.0	W	Depends on surface-mount board pattern
Storage temperature	Tstg	–40 to +150	°C	
Channel temperature	Tch	150	°C	

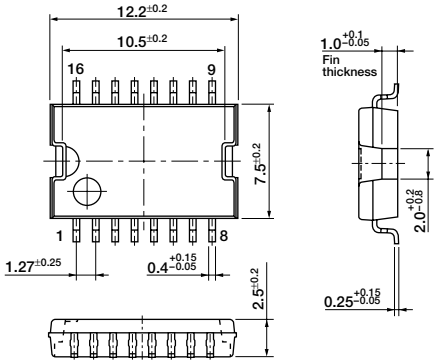
Electrical Characteristics

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

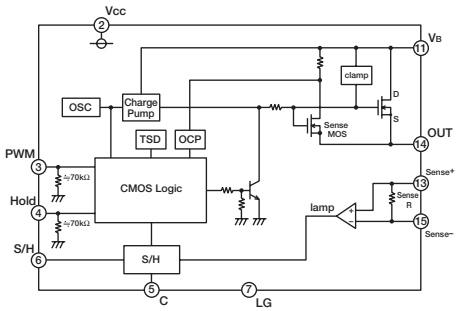
Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Min. operating power supply voltage	V_B min	6			V	Minimum operation of OUT terminal.
Operating power supply voltage 1	V_B	10	14	16	V	*1
Operating power supply voltage 2	V_{CC}		5.0		V	*2
Quiescent circuit current 1	Iqvb			7.2	mA	Vcc=5V, V_{PWM}=0V
Quiescent circuit current 2	Iqvcc			0.2	mA	Vcc=5V, V_{PWM}=0V
PWM terminal input voltage	$V_{PWM}H$	3.5			V	Vcc=5V
	$V_{PWM}L$			1.5		
PWM terminal input current	$I_{PWM}H$		70	110	μA	Vcc=5V, V_{PWM}=5V, Active H *3
Hold terminal input voltage	$V_{Hold}H$	3.5			V	Vcc=5V
	$V_{Hold}L$			1.5		
Hold terminal input current	$I_{Hold}H$		70	110	μA	Vcc=5V, V_{PWM}=5V, Active H *3
Output ON resistance	R_{DSon}			0.14	Ω	I_{OUT}=1A
				0.21	Ω	I_{OUT}=1A, Ta=125°C
Current sensing resistance	Rsense			0.21	Ω	I_{OUT}=1A
				0.25	Ω	I_{OUT}=1A, Ta=125°C
Overcurrent protection starting current	Is	3.0			A	*4
Thermal shutdown operating temperature	Ttsd	150			°C	
Operation circuit for current monitor output	Io	0.2		1.2	A	*1
Current monitor output voltage	V_{SH}			0.2	V	Io=0A, Vcc=5V
		0.488	0.500	0.512	V	Io=0.2A, Vcc=5V
		1.219	1.250	1.281	V	Io=0.5A, Vcc=5V, Ta=–40 to 140°C
		2.925	3.000	3.075	V	Io=1.2A, Vcc=5V, Ta=–40 to 140°C
Current monitor output current	I_{SH}			5	mA	Io=1A, Vcc=5V, V_{SH}=0V
		–6			mA	Io=1A, Vcc=5V, V_{SH}=5V
Output transfer time	t_{on}			15	μs	Io=0.5A, Vcc=5V
	t_{off}			15	μs	
Output rise time	t_r			100	μs	
Output fall time	t_f			50	μs	
Current monitor output hold time	t_{sh}	500		650	μs	Io=0.5A, Vcc=5V, C1=0.033μF
Current monitor output delay time	t_{shd}			1	μs	
Hold time after inputting hold	t_{shh}			2	μs	
S/H settling time	t_{stt}			70	μs	V_B=11V, Vcc=5V, Io=1.2A, C1=0.033μF
				80	μs	V_B=11V, Vcc=5V, Io=1.2A, C1=0.033μF, Ta=125°C

Note:
*1: Accuracy warranty range for current monitor output
*2: Equivalent errors are not included in current monitor output accuracy.
*3: With built-in pull-down resistance (70kΩ typ)
*4: Self-excitation and oscillation type
*5: Accuracy of current monitor output is affected by the materials of the hold capacitor (C1).
The capacitor C1 must be of low dielectric absorption and have good bias and leak current characteristics.

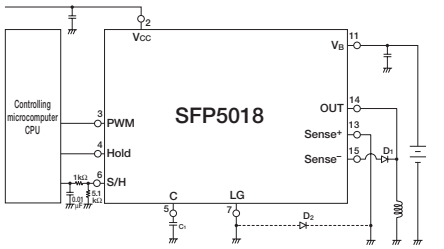
External Dimensions (unit: mm)



Block Diagram (for one channel)

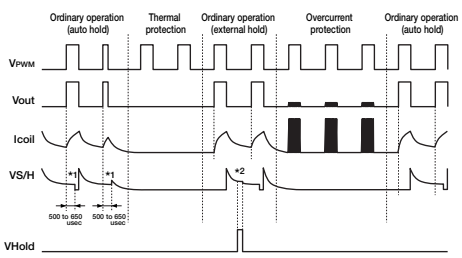


Standard Connection Diagram



* Use a Schottky Di for D2 when the Sense+ terminal is lower than the abs. max. rated voltage (–0.8V)

Timing Chart



Truth table

V_{PWM}	L	H
V_{OUT}	L	H

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	Tstg	–40 to +150	°C	
Channel temperature	Tch	150	°C	
Output avalanche capability	E_{AV}	50	mJ	Single pulse

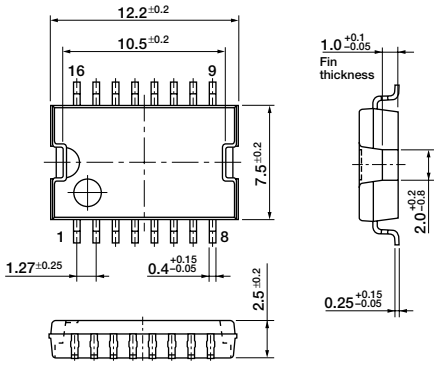
Note: * At the clamping operation, refer to VOUT (clamp) in the section of electrical characteristics.

Electrical Characteristics

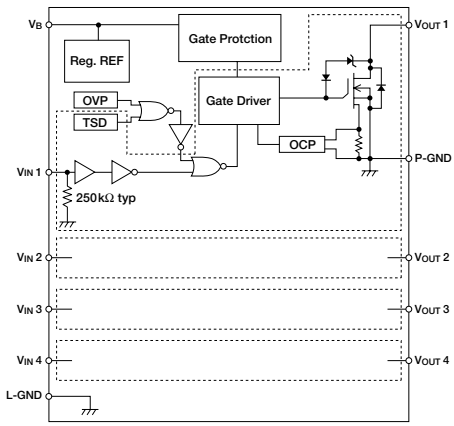
(V_B=14V, Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Power supply voltage		V_{Bopr}	5.5		25	V	
Quiescent circuit current		Iq		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

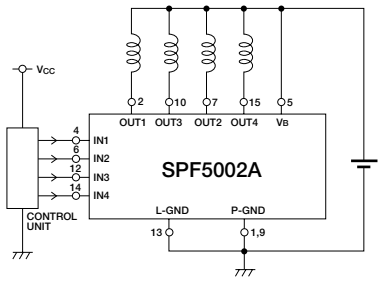
External Dimensions (unit: mm)



Equivalent Circuit Diagram



Circuit Example

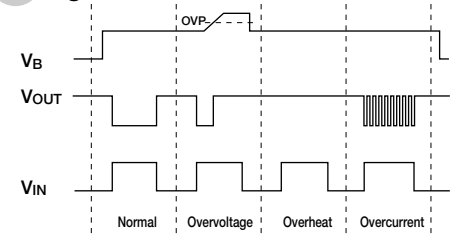


Use L-GND and P-GND being connected.

Truth table

V_{IN}	V_O
H	L
L	H

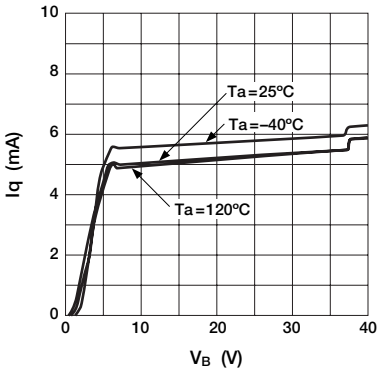
Timing Chart



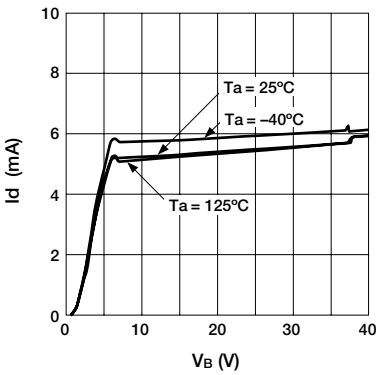
* Self-excited frequency is used in the overcurrent protection.

Electrical Characteristics

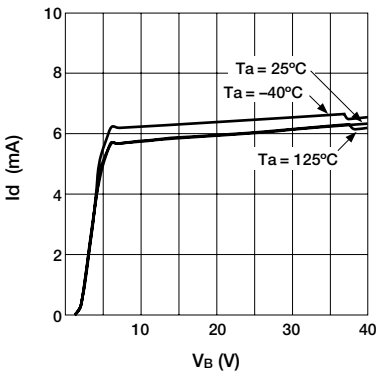
■ Quiescent Circuit Current



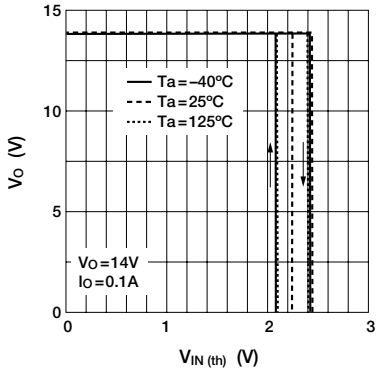
■ Circuit Current (single circuit)



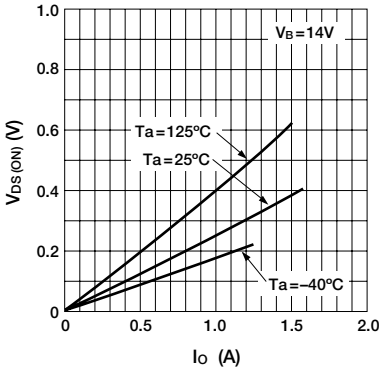
■ Circuit Current (4 circuits)



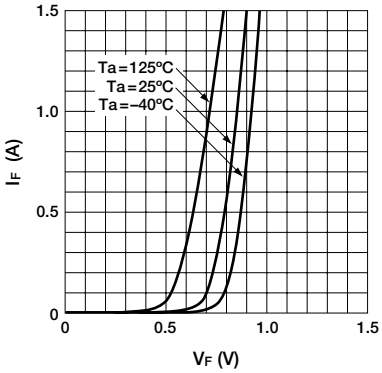
■ Threshold Input Voltage



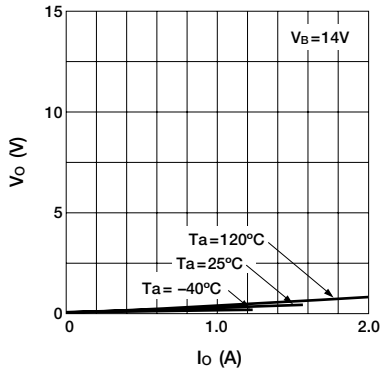
■ Output ON Voltage



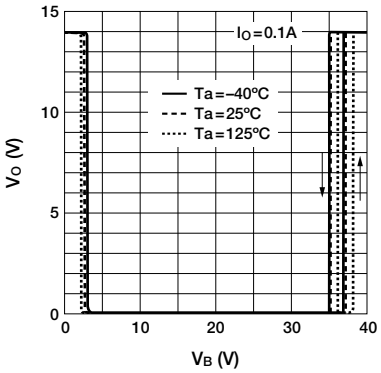
■ Forward Voltage of Output Stage Diode



■ Overcurrent Protection Characteristics



■ Overvoltage Protection Starting Voltage



Low-side Switch ICs [Surface-mount 4-circuits] SPF5009 (under development)

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)

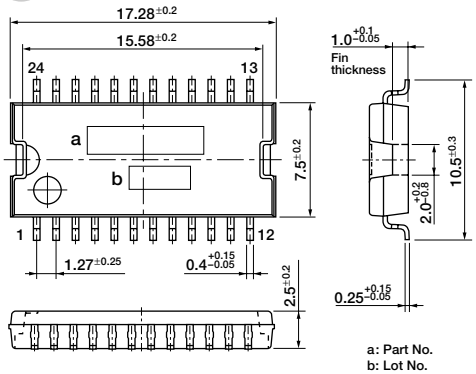
Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_B	40	V	
Output terminal voltage (DC)	V_{OUT}	50	V	
Output terminal voltage (pulse)	V_{OUT}	Output clamping (max 70V)	V	
Output current (DC)	I_{OUT}	±2.9	A	
Output current (pulse)	I_{OUT}	Over current protection starting current	A	
Input 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	Tstg	–40 to +150	°C	
Channel temperature	Tch	150	°C	
Output avalanche capability	E_{AV}	80	mJ	Single pulse

Electrical Characteristics

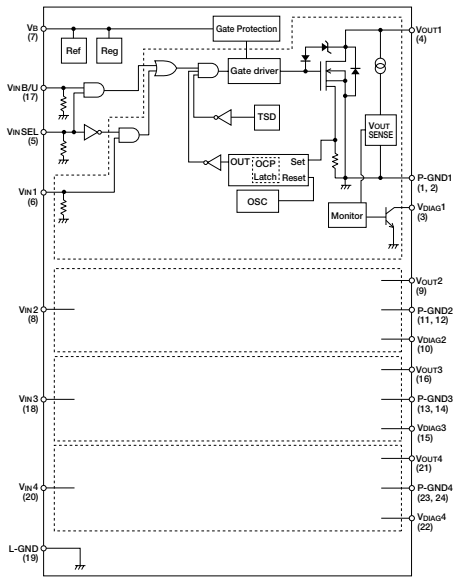
(V_B =14V, Ta= 25°C unless otherwise specified)

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 moniter threshold voltage	$V_{th}M$			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_{DH}			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

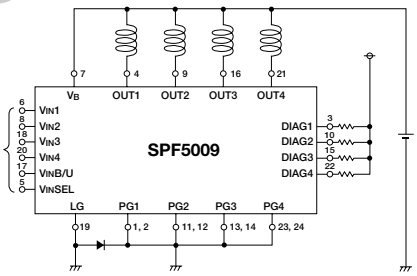
External Dimensions (unit: mm)



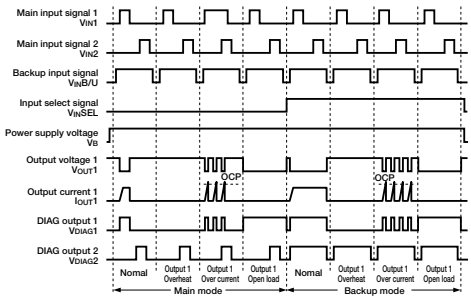
Equivalent Circuit Diagram



Circuit Example



Timing Chart



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
Power supply voltage 1	V_B	40	V	
Power supply voltage 2	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	Tstg	–40 to +150	°C	
Channel temperature	Tch	150	°C	
Output avalanche capability	E_{AV}	100	mJ	Single pulse

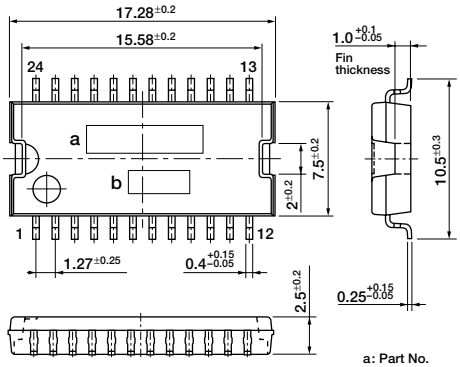
*1. At the clamping operation, refer to the section of $V_{OUT\ (clamp)}$ in electrical characteristics
*2. Changes by the patern of mounted substrate

Electrical Characteristics

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

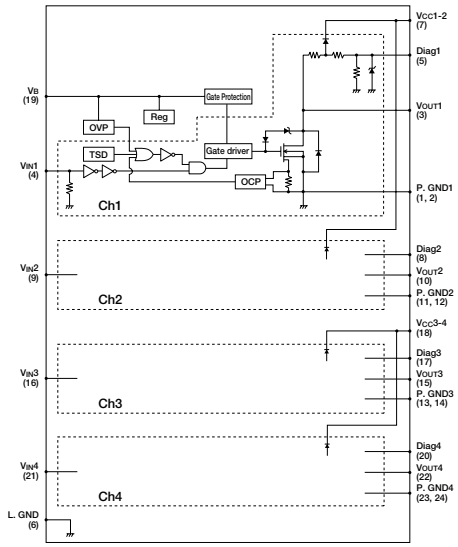
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Operating power supply voltage 1		$V_{B\ (opr)}$	5.5		40	V	
Operating power supply voltage 2		$V_{CC\ (opr)}$	4.5		5.5	V	
Quiescent circuit current		Iq		4	6	mA	V_B=14V, V_{IN}=0V
Operating circuit current		Id		8	12	mA	V_B=14V, V_{IN}=5V
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_{TSD}	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, Rdiag=500kΩ
Diag output clamping voltage		$V_{DIAG\ (clamp)}$			4.85	V	V_B=14V, V_{CC}=5V, V_O=40V

External Dimensions (unit: mm)

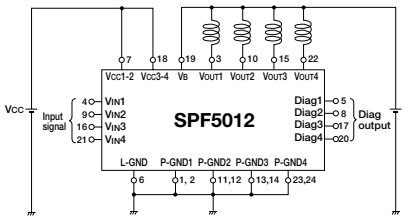


a: Part No.
b: Lot No.

Equivalent Circuit Diagram



Circuit Example

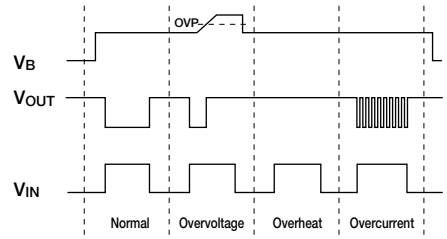


Truth table

V_{IN}	V_O
H	L
L	H

Short L-GND and P-GND in a pattern near the product.

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=25ºC)

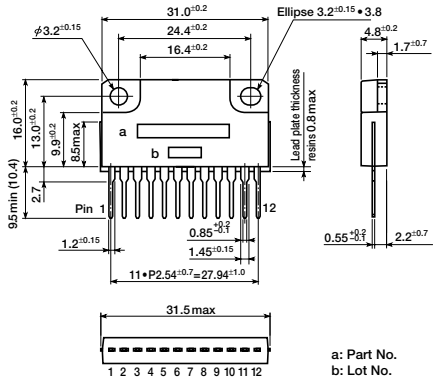
Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_S	35	V	
Breakdown voltage	V_O	50	V	
Input voltage	V_{IN}	–0.3 to +7	V	
Output current	$I_{O, AVE}$	1.5	A	
Diagnostic output sink current	I_{DIAG}	10	mA	
Diagnostic output withstand voltage	$I_{DIAG. H}$	7	V	
Operating temperature	Top	–40 to +85	ºC	
Storage temperature	Tstg	–40 to +150	ºC	
Power Dissipation	P_D	3.5 (Ta=25ºC)	W	Without heatsink

Electrical Characteristics

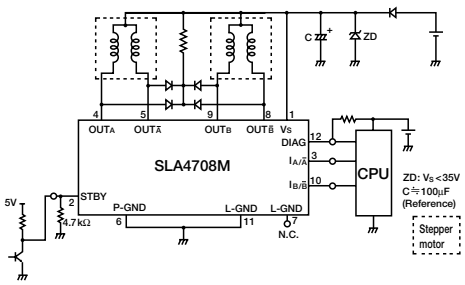
(V_S=12V, Ta=25ºC)

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Input voltage ($I_{A/\bar{A}}$, $I_{B/\bar{B}}$ 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=25ºC
	$V_{O.STA}$			1.5	V	I_O=1.5A, Ta=25ºC
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)

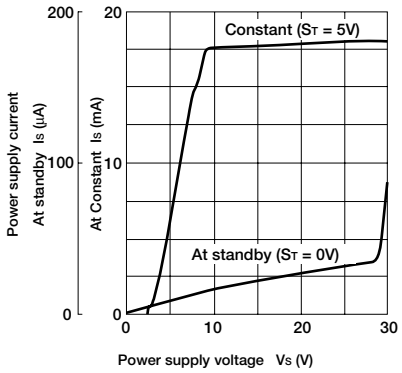


Standard Circuit Diagram

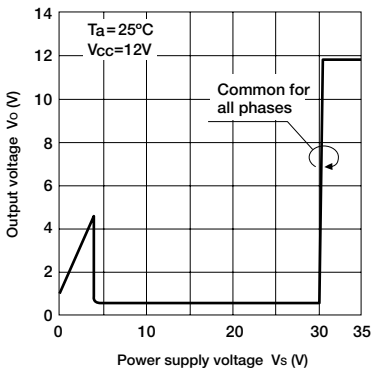


Electrical Characteristics

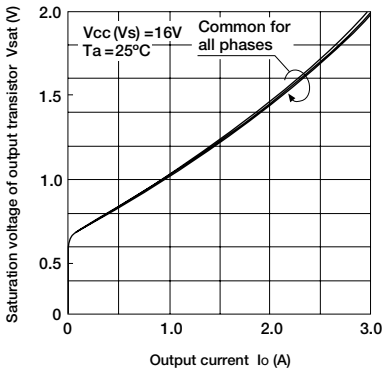
■ Power Supply Current Characteristics



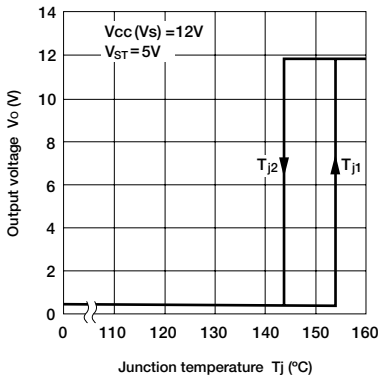
■ Overvoltage Protection Characteristics



■ Saturation Voltage of Output Transistor Characteristics



■ Thermal Protection Characteristics



2-ph Stepper-motor Driver ICs SPF7211

Features

- Low output saturation voltage (high-side: 1.5V max.; low-side: 0.8V max.)
- Built-in recovery diode
- Built-in standby function
- Built-in overcurrent and thermal protection circuits and low voltage input shutoff function
- Built-in overload and disconnection detection function

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Remarks
Main power supply voltage	V_{BB}	40	V	
Input voltage	V_{IN}	–0.3 to 15	V	$V_{IN} \leqq V_{BB}$
Output current	Io	±0.8	A	
	IoPeak	±1.0		$T_w < 1$mS
Flag terminal withstand voltage	V_{Flag}	7	V	$V_{Flag} \leqq V_{BB}$
Flag terminal current	I_{Flag}	3	mA	
Detect voltage	V_{Rs}	–2 to 2	V	
Power dissipation	P_D	4.1	W	For Ta = 25°C *1
		39		For Tc (Ttab) = 25°C
Junction temperature	Tj	150	°C	
Operating temperature	Top	–40 to 110	°C	
Storage temperature	Tstg	–40 to 150	°C	

Note: *1: With glass epoxy + copper foil board (size 5.0•7.4cm; t: glass epoxy = 1.6mm/copper foil = 18μm)

Recommended Operation Range

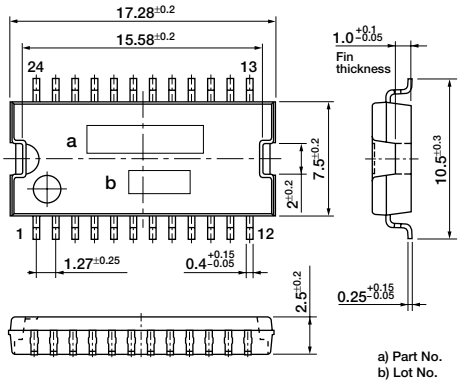
Parameter	Symbol	Ratings	Unit	Remarks
Main power supply voltage	V_{BB}	6 to 18	V	
Input voltage	V_{IN}	–0.3 to 7.0	V	$V_{IN} \leqq V_{BB}$
Output current	Io	±0.5	A	Continuous
Flag terminal withstand voltage	V_{Flag}	0 to 7.0	V	$V_{Flag} \leqq V_{BB}$
Flag terminal current	I_{Flag}	0 to 1.0	mA	
Detect voltage	V_{Rs}	–1 to 1	V	
Operating temperature	Top	–40 to 110	°C	

Electrical Characteristics

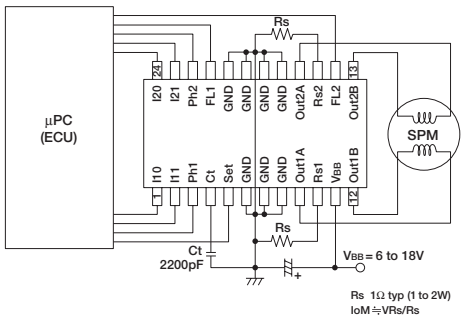
Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Main power supply current		I_{BB}			50	mA	In ordinary operation (no load)
		I_{BBS}			50	μA	At sleep
Low voltage protection operation voltage		V_{UVLO}	3.5		4.5	V	
UVLO hysteresis voltage		$V_{UVLOhys}$		0.5		V	
Output leak current		IoleakL	–100			μA	V_{BB} = 40V, Vo = 0V
		IoleakH			100	μA	V_{BB} = Vo = 40V
Output saturation voltage		VsatL			0.5	V	Io = 0.5A
					0.8	V	Io = 0.8A
		VsatH			1.2	V	Io = –0.5A
					1.5	V	Io = –0.8A
Recovery diode forward voltage		V_FL			1.2	V	Io = 0.5A
		V_FH			1.3	V	Io = –0.5A
		V_FGO	1.2			V	Io = –0.5A
Input terminal	Input voltage	V_{IL}			0.8	V	
		V_{IH}	2.0			V	
	Hysteresis voltage	V_{Ihys}		0.5		V	
Ph terminal	Input current	I_{IL}	–5		5	μA	
		I_{IH}	–5		5	μA	
Ixx, Set terminals	Input current	I_{IL}	–30			μA	VIL = 0.8V
		I_{IH}			50	μA	VIH = 2.0V
Detect voltage		VRs	660	700	740	mV	Ix0 = High, Ix1 = High
			420	450	480	mV	Ix0 = Low, Ix1 = High
			40	70	90	mV	Ix0 = High, Ix1 = Low
Oscillation frequency		Fosc	28.8	48	72	kHz	Ct = 2200pF±20%
PWM frequency		F_{PWM}	14.4	24	36	kHz	Ct = 2200pF±20%
Ct terminal threshold voltage		VctL		0.5		V	*1
		VctH		1.5		V	
Ct terminal current		Ictsink		720		μA	
		Ictsouce		–120		μA	
Overcurrent detection voltage		VocpL	1.5	3.0	4.2	V	Out voltage
		VocpH	V_{BB}–2.5	V_{BB}–2.0	V_{BB}–1.7	V	Out voltage
		VocpL	1.0		1.85	V	V_{BB} = 5.5V
		VocpH	V_{BB}–2.3		V_{BB}–1.5	V	V_{BB} = 5.5V
Open detection voltage		Vopen		–60		mV	Sence voltage
Flag terminal leak current		$I_{leakFlag}$			10	μA	V_{Flag} = 7V
Flag terminal saturation voltage		V_{FlagL}			0.5	V	I_{Flag} = 1mA
Flag terminal current		I_{Flag}			3	mA	
Set terminal	Response pulse width	Tpw	10			μS	In ordinary operation
		Tpws	100			μS	At sleep
	Pulse rate	Fclock	17	24	31	Hz	Ct = 2200pF
	Pulse number	Pulse		256		—	
Flag response time	OCP operation	tocp1	2.5	5.0	10.0	μS	In ordinary operation; Ct = 2200pF
		tocp2	5.0	10.0	20.0	μS	At switching the phase
		tocp3	5.0	10.0	20.0	μS	When Ixx shifts from L to H
	Open operation	topen1	2.5	5.0	10.0	μS	In ordinary operation
		topen2	2.5	5.0	10.0	μS	When Ixx shifts from L to H
I/O propagation time		tonH1		1.5		μS	
		toffH1		1.5		μS	
		tonH2	100			μS	
		toffH2	100			μS	
		tonL1		2.0		μS	
		toffL1		0.5		μS	
		tonL2	100			μS	
		toffL2	100			μS	
Thermal protection temperature		Tj	150			°C	*2
Thermal protection hysteresis		ΔTj		20		°C	
Thermal alarm temperature		Talarm	120	130	140	°C	
Thermal alarm hysteresis		ΔTalarm		20		°C	

Note:
*1: The Ct terminal threshold voltage and current are the design values. Warranty is based on the oscillation frequency.
*2: Thermal protection and alarm temperatures are design values.

External Dimensions (unit: mm)



Standard Circuit Diagram



Excitation Signal Time Chart

2-phase excitation

Clock	0	1	2	3	0	1
Ph1	L	H	H	L	L	H
I10, I11	H	H	H	H	H	H
Ph2	L	L	H	H	L	L
I20, I21	H	H	H	H	H	H

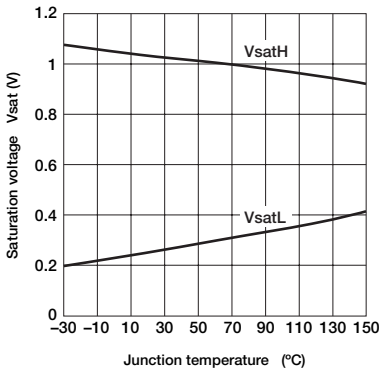
1 to 2-phase excitation

Clock	0	1	2	3	4	5	6	7	0	1	2	3
Ph1	L	H	H	H	H	L	L	L	L	H	H	H
I10, I11	H	L	H	H	H	L	H	H	H	L	H	H
Ph2	L	L	L	H	H	H	H	L	L	L	L	H
I20, I21	H	H	H	L	H	H	H	L	H	H	H	L

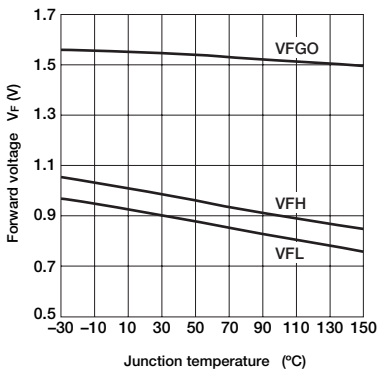
* For the 1 to 2-phase excitation application, switch the Ph signal in the step of 1-ph excitation (Ixx turns from high to low).
The OPEN detection function is invalid except in this sequence.

Electrical Characteristics

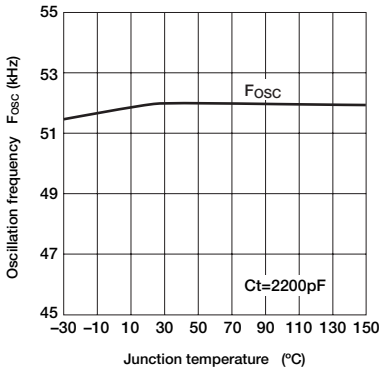
■ Vsat Temperature Characteristics (Io=0.5A)



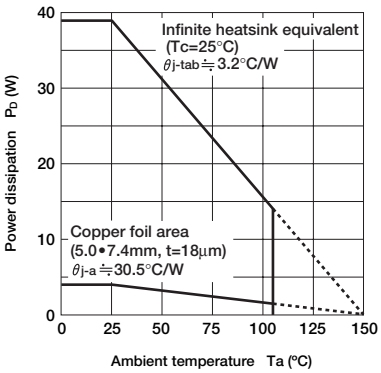
■ Diode V_F Characteristics (I_F=0.5A)



■ OSC Temperature Characteristics



■ Ta-P_D Characteristics

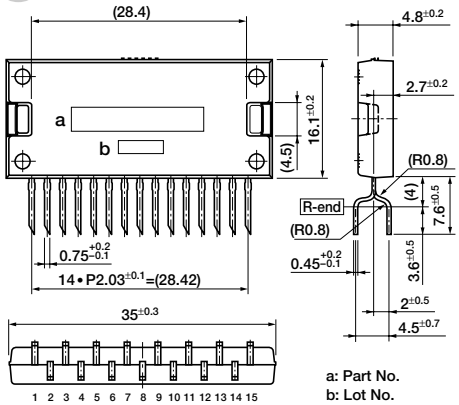


Full Bridge PWM Control DC Motor Driver ICs SI-5300

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 Tj=Tch=150°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)

External Dimensions (unit: mm)



Absolute Maximum Ratings

(Ta=25°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	
	$I_{O\ (p\text{-}p)}$	±17	A	P_W≦1ms, Duty≦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	°C	
Junction and channel temperature	Tj, Tch	–40 to +150	°C	
Storage temperature	Tstg	–40 to +150	°C	
Thermal resistance	θj-c	3.7	°C/W	
	θj-a	35	°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.

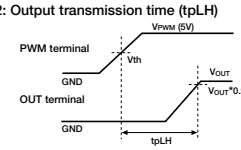
Electrical Characteristics

(Unless, otherwise specified, Tj=Tch=25°C, V_M=14V, I_O=3A)

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Motor supply voltage	V_{IN}	6		18	V	V_M=24V (2 min.)
Output saturation voltage	V, V_M-V_O			0.8	V	I_O=3A
	V, V_O-PG			0.3	V	I_O=3A
Output leakage current	I_L, L			100	μA	V_M=40V
	I_L, H			100	μA	V_M=40V
Output transmission time	tpLH			10 *2	μs	V_{PWM}: L→H (Vth=2.5V typ)
	tpHL			15 *3	μs	V_{PWM}: H→L (Vth=2.5V typ)
	tpHL-tpLH			10	μs	
Forward voltage characteristic of diode between drain and source	V_F•L		0.8		V	I_O=3A
			1.0		V	I_O=10A
	V_F•H		0.8		V	I_O=3A
			1.0		V	I_O=10A
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	$V_{IN}1=V_{IN}2=V_{PWM}$
	$V_{IN,\ L}$			2.0	V	$V_{IN}1=V_{IN}2=V_{PWM}$
Input terminal current	$I_{IN,\ L}$	–100			μA	$V_{IN}1=V_{IN}2=V_{PWM}$=0V
	$I_{IN,\ H}$			200	μA	$V_{IN}1=V_{IN}2=V_{PWM}$=5V
OPC start current	I_{OCP}	16			A	*1
DIAG output pulse width	t_{DIAG}	20			ms	C=1μF (typ)
DIAG terminal voltage	V_D•L			0.3	V	ID•SINK=1mA *4

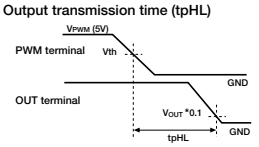
Note:
*1: The standard value of I_{OCP} is assumed to be a value by which the output of each Power MOS FET cuts off. When the protection circuit of OCP and TSD operates, Power MOS FETs keeps cutoff. When a signal (5V: H → 0V: L) is input to the terminal PWM, the cutoff operation will be released. Moreover, three minutes (Ta=25°C, f_{PWM}=10kHz, V_M=14V) 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 Vth (2.5V typ) of the terminal of PWM to output (V_{OUT} *0.9) of the output terminal.

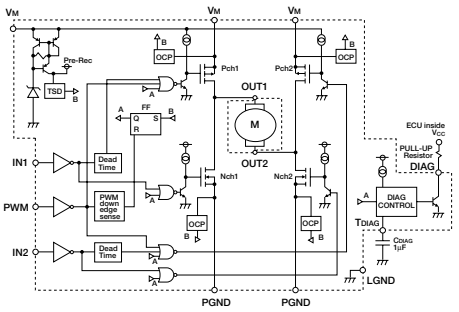
*3: Output transmission time (tpHL)



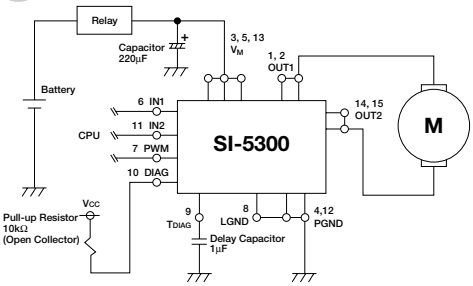
Output transmission time tpHL is time from Vth (2.5V typ) of the terminal of PWM to output (V_{OUT} *0.1) of the output terminal.

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

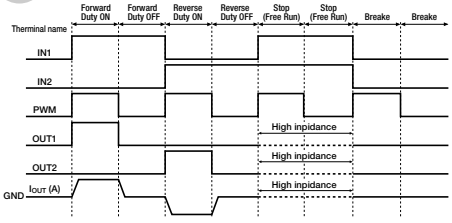
Equivalent Circuit

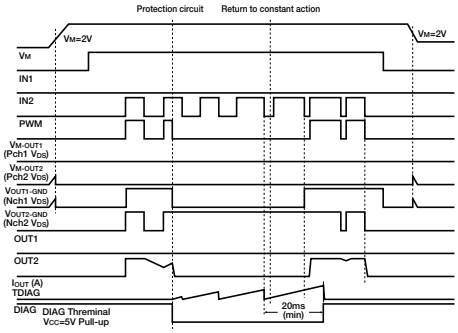


Standard Connection Diagram



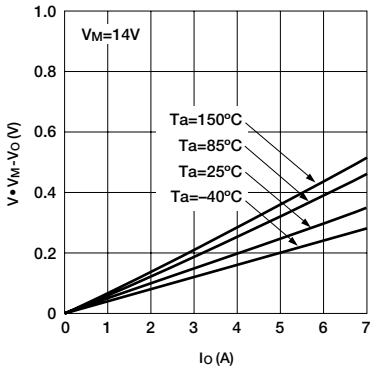
Timing Chart



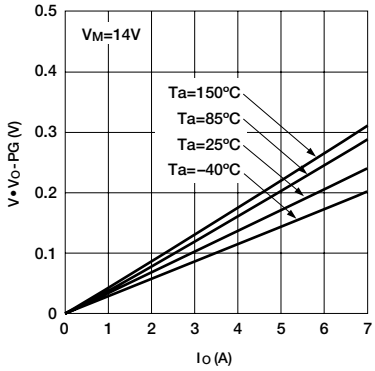


Electrical Characteristics

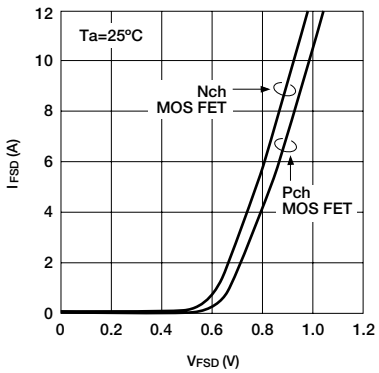
■ Output saturation voltage (Pch)



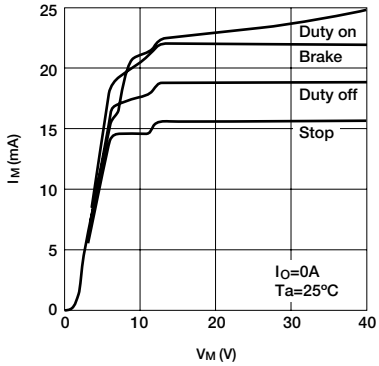
■ Output saturation voltage (Nch)



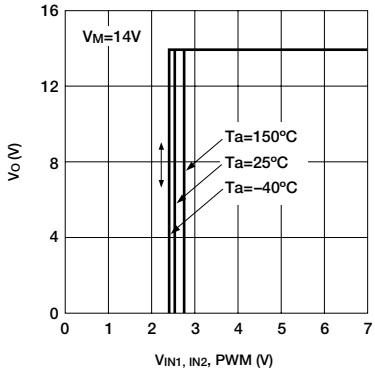
■ Forward voltage of Diode between drain and source



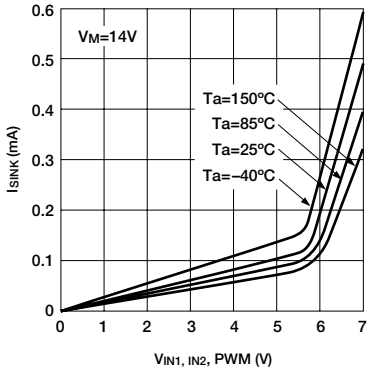
■ Quiescent circuit current



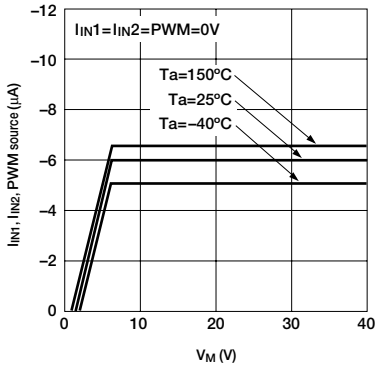
■ Voltage of input terminal (Threshold voltage)



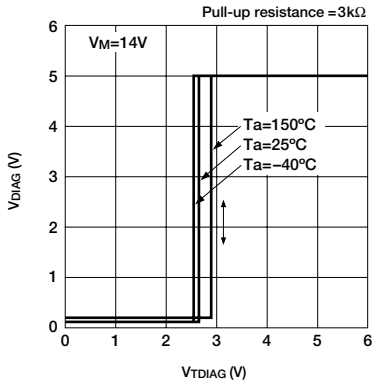
■ Current of input terminal (SINK current)



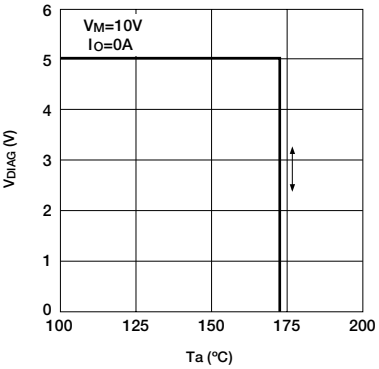
■ Current of input terminal (Source current)



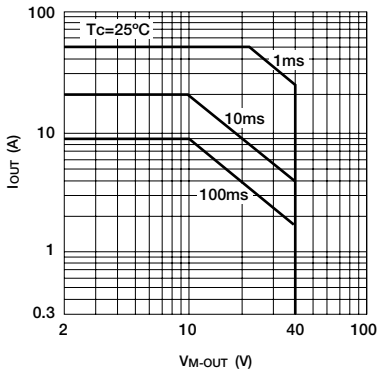
■ VTDIAG – VDIAG Characteristics



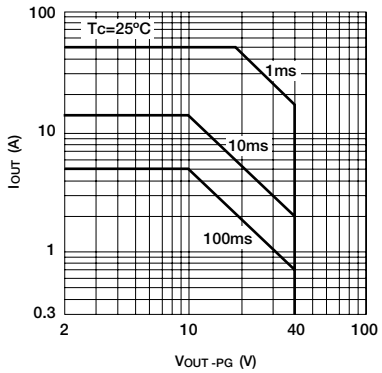
■ Thermal shut down protection



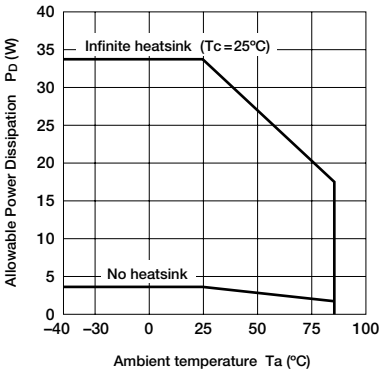
■ Pch MOS FET Safe Operating Area (SOA)



■ Nch MOS FET Safe Operating Area (SOA)



■ PD—Ta Characteristics



Full Bridge DC Motor Driver ICs SPF7301(under development)

Features

- A DMOS of low ON resistance (0.1Ω typ) is mounted on the high and low side power elements
- Two input signals control the forward/reverse/brake of a DC motor
- Current limit and overcurrent protection circuits
- Low voltage and thermal protection, excess input detecting output and input terminal open protection

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Remarks
Main power supply voltage	V_B	–0.3 to 36	V	
Input terminal input voltage	$V_{IN}1, V_{IN}2$	–0.3 to 6	V	
EN terminal voltage	V_{EN}	–0.3 to 12	V	
Disable terminal input voltage	V_{DI}	–0.3 to 6	V	
Output current	Io	±7	A	
	IoPeak	±15	A	1kHz, Duty＜1%, Pulse＜10μS
DIAG output current	V_{DIAG}	–0.3 to 6	V	
DIAG inflow current	I_{DIAG}	–3	mA	DIAG terminal sink current
Power dissipation	P_D1	39	W	With an infinite heatsink mounted
	P_D2	4	W	*1
Junction temperature	Tj	–40 to 150	°C	
Operating temperature	Top	–40 to 105	°C	
Storage temperature	Tstg	–40 to 150	°C	
Thermal resistance (junction to case)	θj-c	3.2	°C/W	
Thermal resistance (junction to ambient air)	θj-a	31	°C/W	

Note: *1: With glass epoxy + copper foil board (size 5.0•7.4cm; t: glass epoxy=1.6mm/copper foil=18μm)

Recommended Operation Range

Parameter	Symbol	Ratings	Unit	Remarks
Main power supply voltage	V_B	8 to 18	V	
DI terminal input voltage	V_{DI}	–0.3 to 5.3	V	
Input terminal input voltage	V_{INx}	–0.3 to 5.3	V	
Output current	Io	±1	A	
DIAG terminal voltage	V_{DIAG}	–0.3 to 5.3	V	
Operating temperature	Top	–40 to 105	°C	

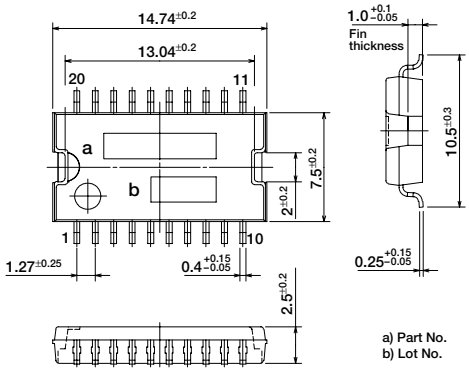
Electrical Characteristics

(Tj=30 to 125°C, V_B=14V, EN=DI=5V, Ccp=33nF, R_{DIAG}=20kΩ unless otherwise specified) *2

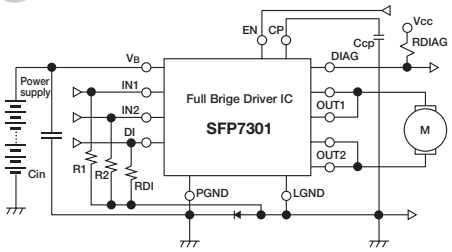
Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Main power supply current	$I_{BB}1$		15		mA	
	$I_{BB}2$			100	μA	For V_{EN}=0V
Low voltage protection operation voltage	VuvloH	5.0		7.0	V	
	VuvloL	4.5		6.5	V	
UVLO hysteresis voltage	ΔUVLO		0.5		V	
Output terminal leak current	IleakHS	–100			μA	
	IleakLS			100	μA	
Output DMOS RDS (ON)	$R_{DS(ON)}$_1H		100	200	mΩ	
	$R_{DS(ON)}$_2H		100	200	mΩ	
	$R_{DS(ON)}$_1L		100	200	mΩ	
	$R_{DS(ON)}$_2L		100	200	mΩ	
Forward voltage characteristics between output DMOS and DS	V_F_H1		1.5		V	Io1=1A
	V_F_H2		1.5		V	Io2=1A
	V_F_L1		1.5		V	Io1=–1A
	V_F_L2		1.5		V	Io2=–1A
Overcurrent limiting operation current	Iocp1_H1	4.5	7	10	A	
	Iocp1_H2	4.5	7	10	A	
	Iocp1_L1	4.5	7	10	A	
	Iocp1_L2	4.5	7	10	A	
OPC start current	Iocp2_H1		15		A	
	Iocp2_H2		15		A	
	Iocp2_L1		15		A	
	Iocp2_L2		15		A	
Input terminal voltage $V_{IN}1$, $V_{IN}2$	V_{INx}H	2			V	
	V_{INx}L			0.8	V	
Input terminal current $V_{IN}1$, $V_{IN}2$	I_{INx}H	–100			μA	V_{DI}=5V
	I_{INx}L	–100			μA	V_{DI}=0V
DI terminal voltage	V_{DIx}H	2			V	
	V_{DIx}L			0.8	V	
DI terminal current	I_{DIx}H	–100			μA	V_{DI}=5V
	I_{DIx}L	–100			μA	V_{DI}=0V
EN terminal input voltage	V_{EN}th	0.8		4	V	
EN terminal input current	I_{EN}H			100	μA	V_{EN}=5V
	I_{EN}L	–10		10	μA	V_{EN}=0V
DIAG terminal output voltage	V_{DIAG}			0.8	V	I_{DIAG}=0.5mA
DIAG terminal output current	I_{DIAG}	1.5			mA	For V_{DIAG}=1.6V
DIAG terminal leak current	I_{DIAG}L	–10		15	μA	
Input delay time	Td_{ON}			20	μS	Time from V_{INx}H to Voutx•0.2
	Td_{OFF}			15	μS	Time from V_{INx}L to Voutx•0.8
	Tr			6	μS	Time of Voutx from 20% to 80%
	Tf			6	μS	Time of Voutx from 80% to 20%
	Tddis			4	μS	Time from DIthH to Voutx•0.2
Overvoltage protection operation voltage	V_{OVP}	35	40	45	V	
OVP hysteresis width	ΔV_{OVP}		5		V	
Thermal protection starting temperature	Ttsd_ON	151	165		°C	*3
Thermal protection hysteresis width	ΔTtsd		15		°C	*3

Note:
*2: For the electrical characteristics for Tj=–40 to 150°C, the design warranty applies to the above specification values.
*3: Thermal protection starting temperature is 165°C (typ) by design. The above parameters are the design specifications.

External Dimensions (unit: mm)



Standard Circuit Diagram



* Recommended connection parts
Pressure rise capacitor for charge pump circuits (CP to GND) Cp 33nF
DIAG terminal pull-up resistance RDIAG: 20kΩ
Input terminal pull-down resistance R1, R2, RDI: 10kΩ

High Voltage Full Bridge Drive ICs 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	$P_W \leqq 250\mu s$
Power dissipation	P_D	5 (Ta=25°C)	W	Without heatsink
Storage temperature	Tstg	–40 to +125	°C	
Operation temperature	Topr	–40 to +105	°C	

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

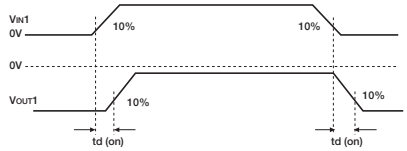
Electrical Characteristics

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Power MOS FET output breakdown voltage	BV_{OUT}	500			V	I_O=100μA
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_{CC} 1			3.0	mA	V_{CC}=4.5 to 15V
	I_{CC} 2			4.0	mA	V_{CC}=10V, V_M=400V
Operating circuit current	I_{CC} 3			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°C

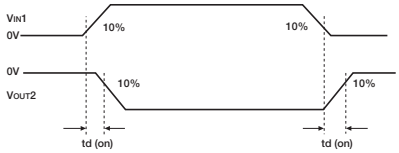
* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

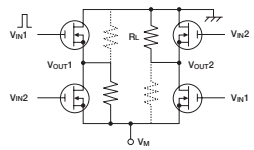


② Lowside switch turn-on, turn-off



* Δt: Δt = td (on) – td (off)

Measurement Circuit



Conditions

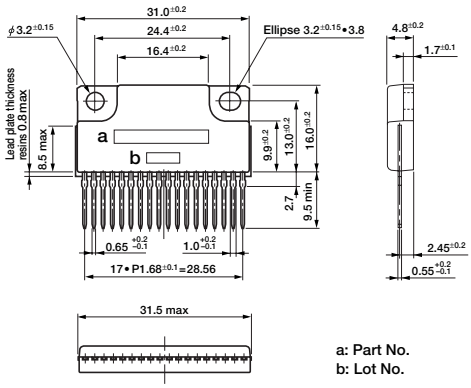
V_{CC}=10V, V_{IN}=10V (pulse)

V_M=85V

I_O=0.41A (R_L=207Ω)

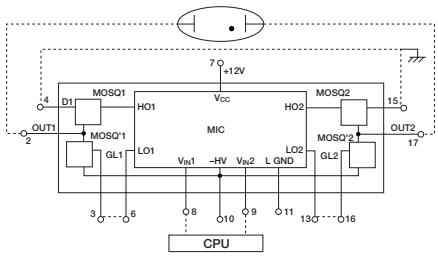
* When pulse signal is inputted to V_{IN1}, R_L on solid line is ON and dotted line R_L is off.
On the contrary, when pulse signal is inputted to V_{IN2}, R_L on dotted line is ON and dotted line R_L is off.

External Dimensions (unit: mm)



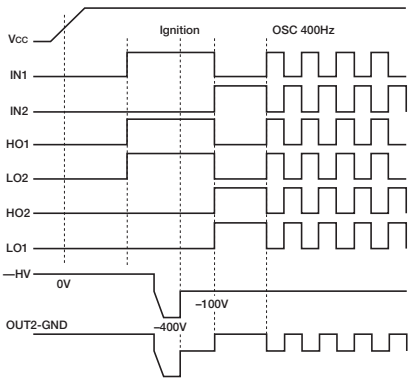
a: Part No.
b: Lot No.

Block Diagram



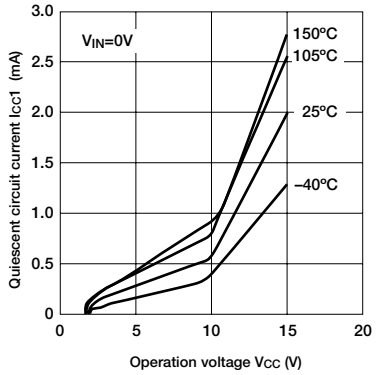
* Dotted Line: Outside Connection

Timing Chart

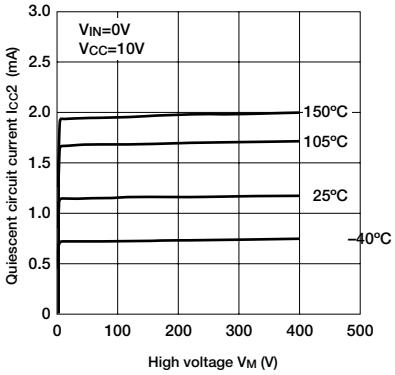


Electrical Characteristics

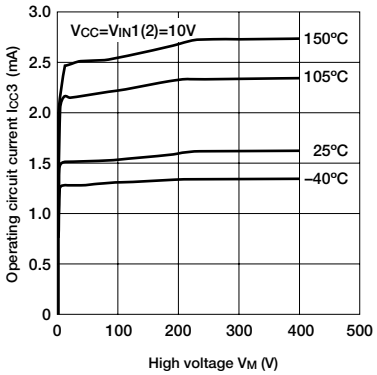
■ Quiescent circuit current



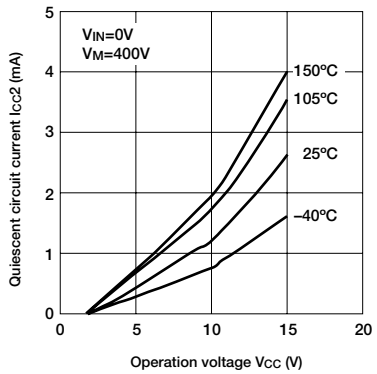
■ Quiescent circuit current supplied high voltage



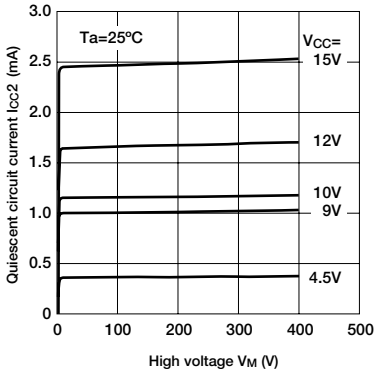
■ Operating circuit current



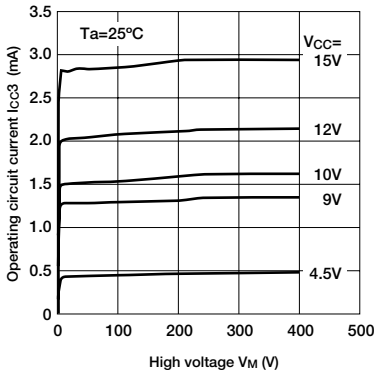
■ Quiescent circuit current supplied high voltage



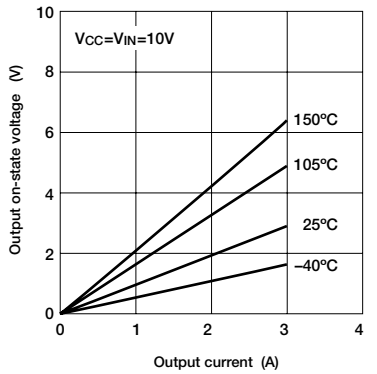
■ Quiescent circuit current



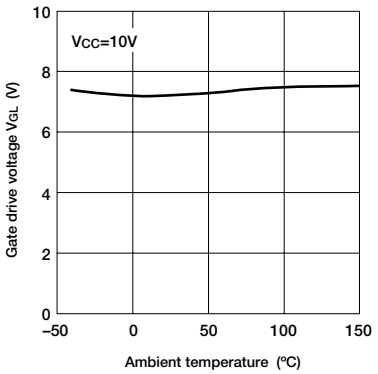
■ Operating circuit current



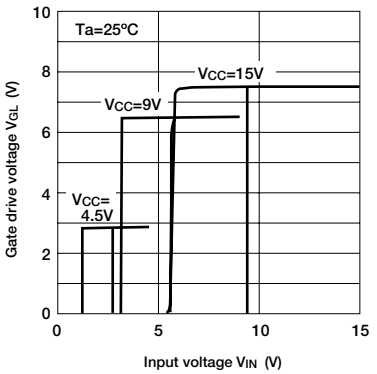
■ Output on-state voltage



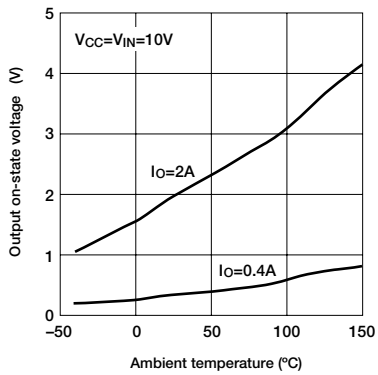
■ Gate drive voltage



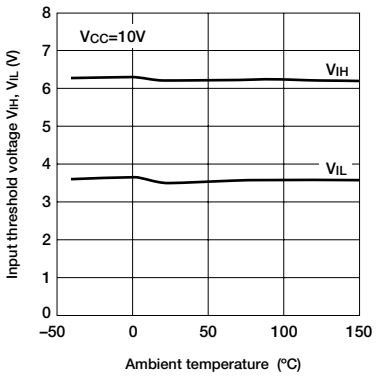
■ Gate drive voltage



■ Output on-state voltage

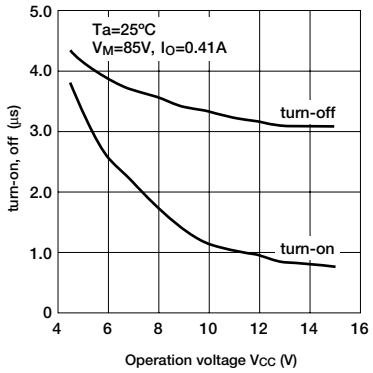


■ Input threshold voltage

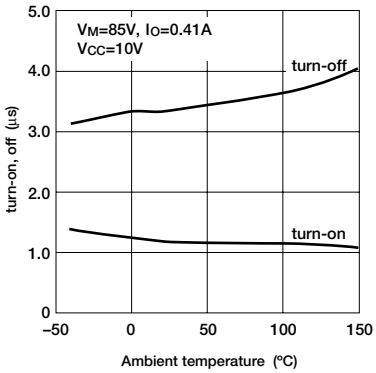


Electrical Characteristics

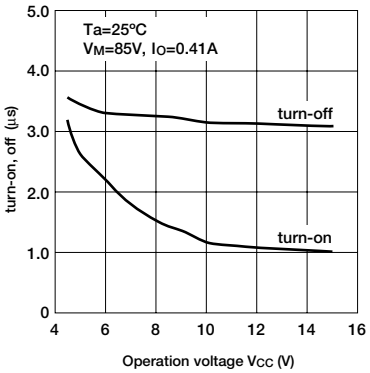
■ High side switch turn-on, off



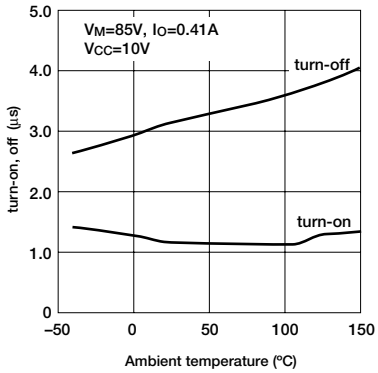
■ High side switch turn-on, off



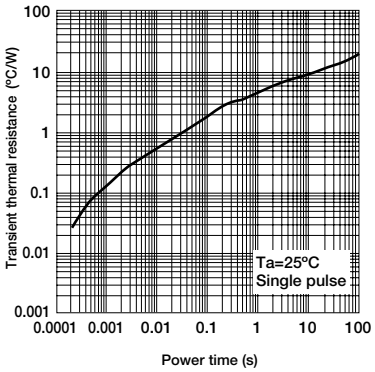
■ Low side switch turn-on, off



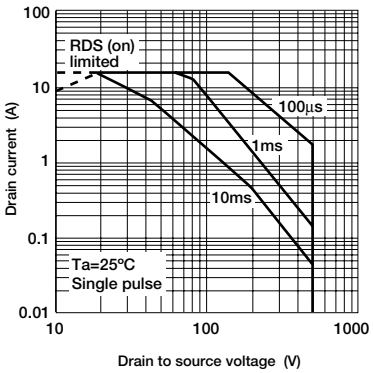
■ Low side switch turn-on, off



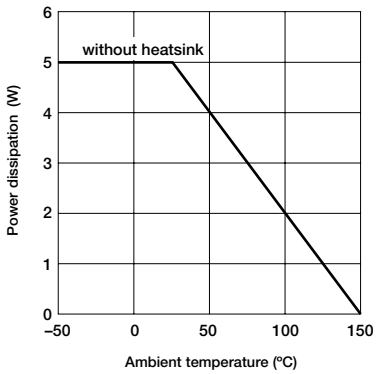
■ Transient thermal resistance characteristics



■ Safe operating area (Power MOS FET)



■ Power derating curve



High Voltage Full Bridge Drive ICs 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	Tc=25°C
	$I_{O\ (peak)}$	15	A	$P_W \leqq 250\mu s$
Power dissipation	P_D	5 (Ta=25°C)	W	Without heatsink
		40 (Tc=25°C)	W	With infinite heatsink
Storage temperature	Tstg	–40 to +125	°C	
Operation temperature	Topr	–40 to +125	°C	
Junction temperature	Tj	150	°C	

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

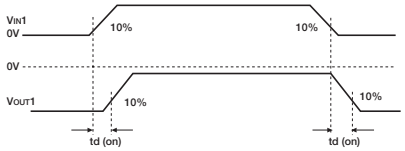
Electrical Characteristics

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Power MOS FET output breakdown voltage	BV_{OUT}	500			V	I_O=100μA
Power MOS FET output leakage voltage	$I_{OUT\ (off)}$			100	μA	V_O=500V
High-side Power MOS FET output on-state voltage	$V_{OUT\ (on)}$	0.18	0.26	0.34	V	I_O=0.4A, V_{IN}=10V
Lowside Power MOS FET output on-state voltage	$V_{OUT\ (on)}$	0.18	0.26	0.34	V	I_O=0.4A, V_{GL}=10V
Quiescent circuit current	I_{CC} 1			3.0	mA	V_{CC}=6 to 15V
	I_{CC} 2			4.0	mA	V_{CC}=10V, V_M=400V
Operating circuit current	I_{CC} 3			4.0	mA	V_{CC}=10V, V_M=400V
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 *	$t_{d\ (on)}$		2.0		μs	V_{CC}=10A, V_{IN}=10V, V_M=85V, I_O=0.41A
	$t_{d\ (off)}$		3.0		μs	
Operating voltage	V_{CC}	6		15	V	–40 to +125°C

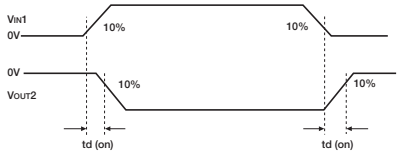
* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

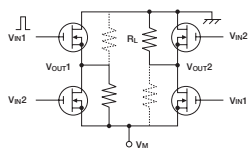


② Lowside switch turn-on, turn-off



* Δt: Δt = td (on) – td (off)

Measurement Circuit



Conditions

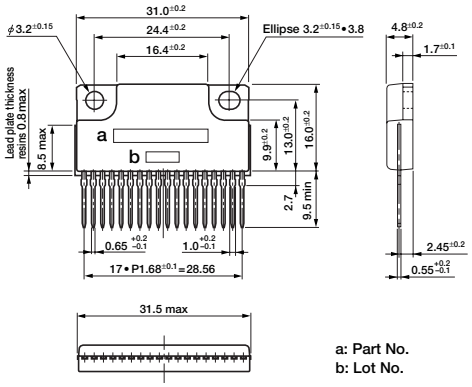
V_{CC}=10V, V_{IN}=10V (pulse)

V_M=85V

I_O=0.41A (R_L=207Ω)

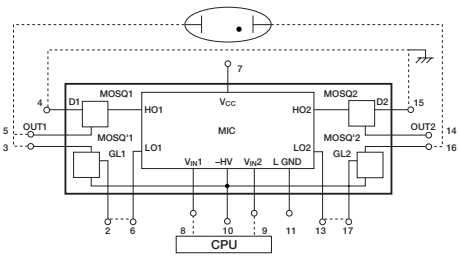
* When pulse signal is inputted to V_{IN1}, R_L on solid line is ON and dotted line R_L is off.
On the contrary, when pulse signal is inputted to V_{IN2}, R_L on dotted line is ON and dotted line R_L is off.

External Dimensions (unit: mm)



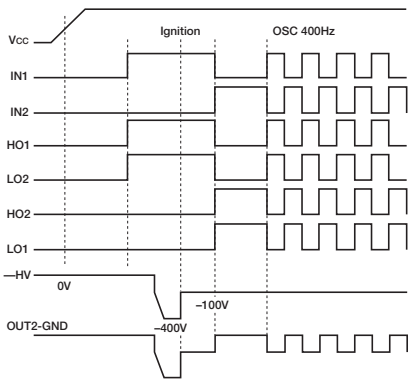
a: Part No.
b: Lot No.

Block Diagram



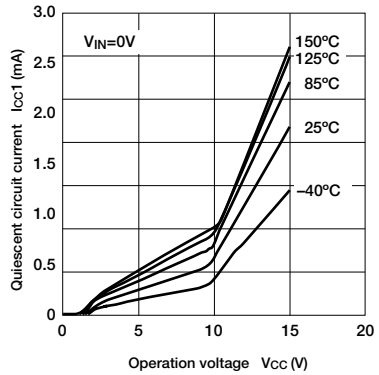
* Dotted Line: Outside Connection

Timing Chart

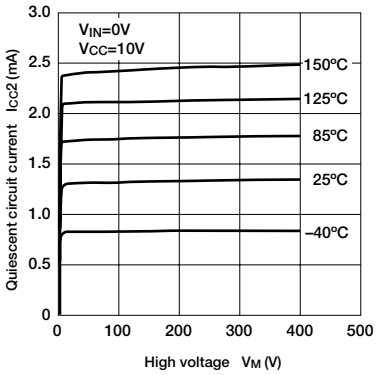


Electrical Characteristics

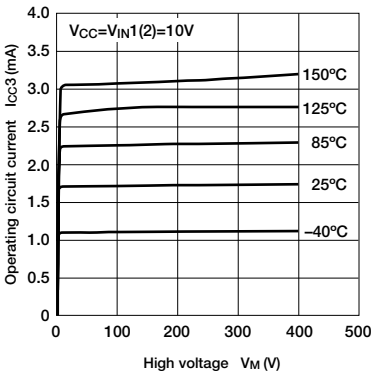
■ Quiescent circuit current



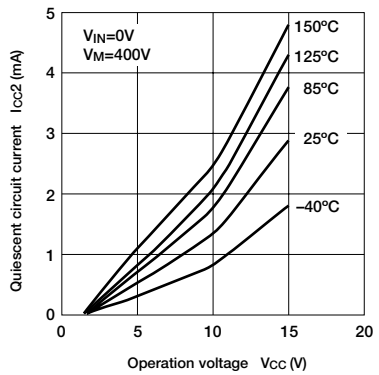
■ Quiescent circuit current supplied high voltage



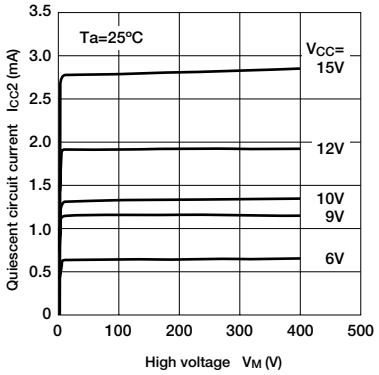
■ Operating circuit current



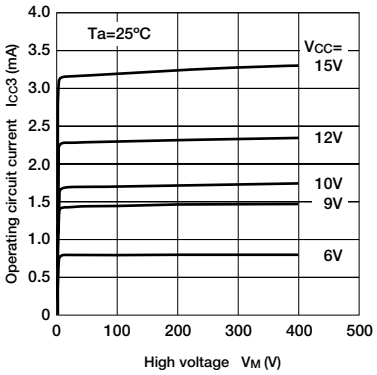
■ Quiescent circuit current supplied high voltage



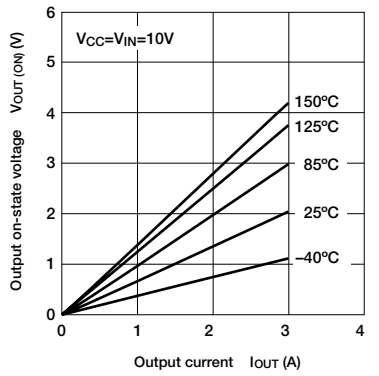
■ Quiescent circuit current supplied high voltage



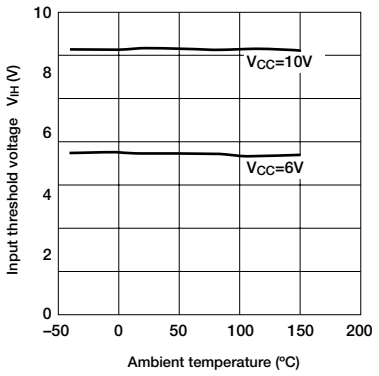
■ Operating circuit current



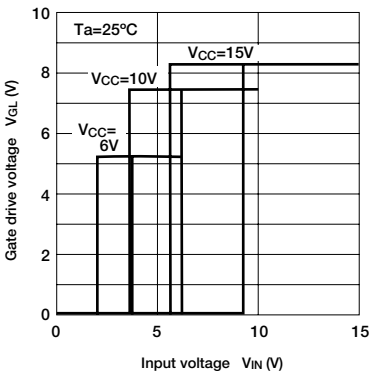
■ Output on-state voltage



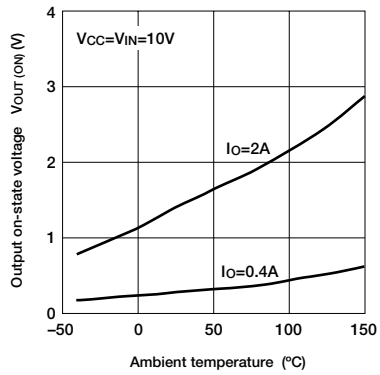
■ Input threshold voltage



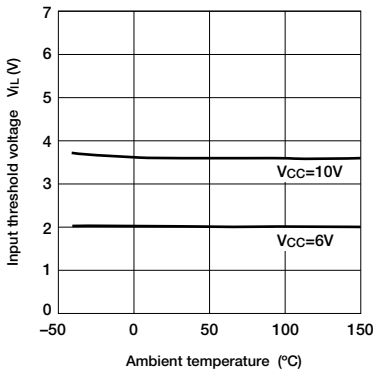
■ Gate drive voltage



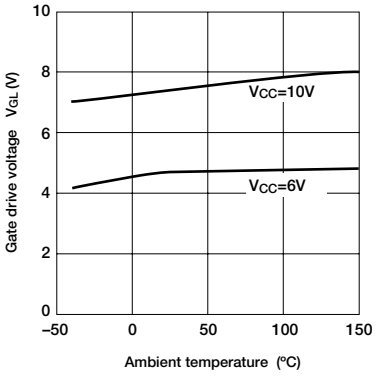
■ Output on-state voltage



■ Input threshold voltage

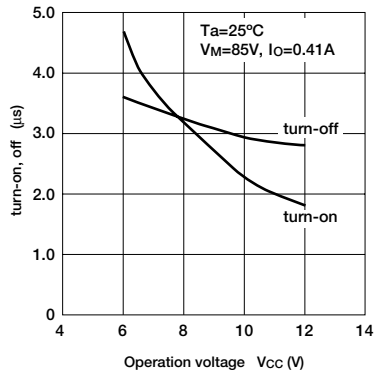


■ Gate drive voltage

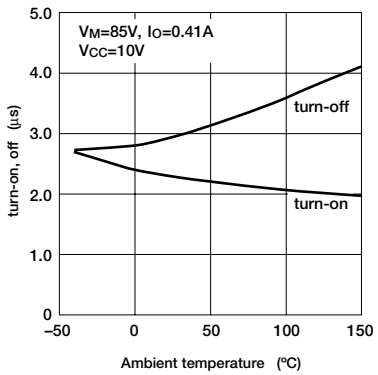


Electrical Characteristics

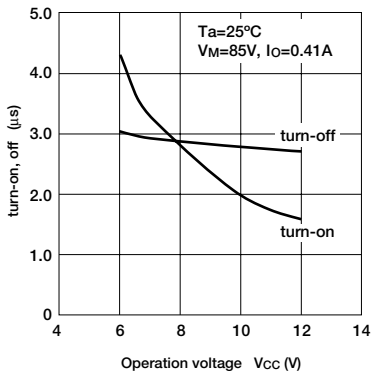
■ High side switch turn-on, off



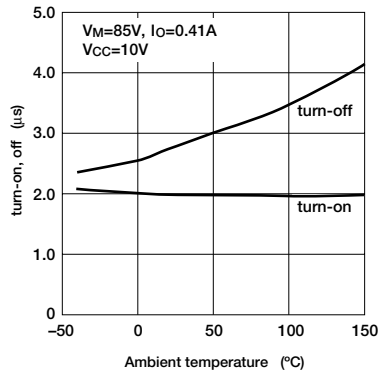
■ High side switch turn-on, off



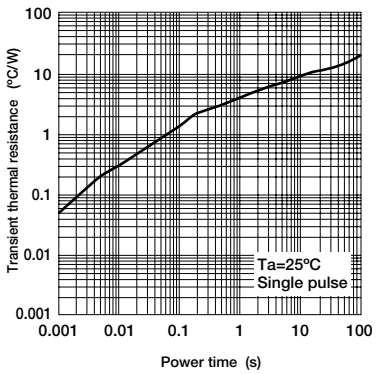
■ Low side switch turn-on, off



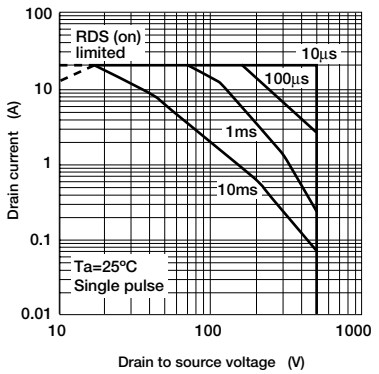
■ Low side switch turn-on, off



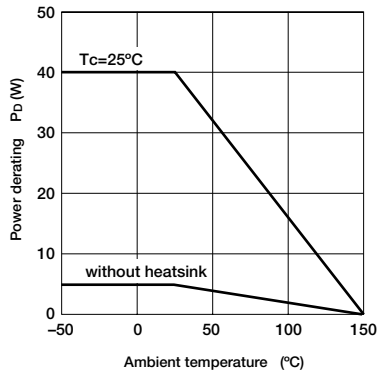
■ Transient thermal resistance characteristics



■ Safe operating area (Power MOS FET)



■ Power derating curve



High Voltage Full Bridge Drive ICs SMA2409M

Features

- One Package Full Bridge Driver Consisted of High Voltage IC and Power IGBT (4 pieces)
- High Voltage Driver which accepts direct connection to the input signal line

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_M	500	V	Power GNG to HV
Input voltage	V_{IN}	15	V	
Operation voltage	Vcc	15	V	
Output voltage	Vo	500	V	
Output current (DC)	$I_{O(DC)}$	7	A	
Output current (pulses)	$I_{O(pulse)}$	15	A	Single pulse (PW=50μs max.)
Power dissipation	P_D	4	W	
		20		Tc=25°C
Thermal resistance	θj-a	31.2	°CW	
	θj-c	6.2		Tc=25°C
Operating temperature	Topr	–40 to +105	°C	
Storage temperature	Tstg	–40 to +150	°C	
Junction temperature	Tj	150	°C	
IGBT single pulse avalanche resistance	E_{AS}	5	mJ	V_{DD}=30V, L=1mH, Unclamped, Ic=3.2A
ESD protection	E_{SD}	±2	kV	Human body model (C=100pF, R=1.5kΩ)

Electrical Characteristics

(Ta=25°C)

Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
IGBT output breakdown voltage		BV_{OUT}	570			V	Io=100μA, Tj=25°C
IGBT output leak current		$I_{OUT\ (off)}$			100	μA	Vo=500V
IGBT output ON voltage		$V_{OUT\ (on)}$		1.0	1.2	V	Io=0.4A, V_{IN} (or V_{GL})=10V
				1.3	1.8	V	Io=2.0A, V_{IN} (or V_{GL})=10V
Quiescent circuit current		Icc1			3.0	mA	Vcc=10V, V_M=V_{IN}=0V
		Icc2			4.0	mA	Vcc=10V, V_M=400V, V_{IN}=0V
Operating circuit current		Icc3			4.0	mA	Vcc=10V, V_M=400V, V_{IN1} (or V_{IN2})=10V
Input threshold voltage		V_{IH}	0.8•Vcc			V	Vcc=9 to 15V
		V_{IL}			0.2•Vcc	V	
Low-side IGBT gate drive voltage		V_{GL}	0.8•Vcc		16	V	Vcc=9 to 15V
Delay time*	High side	$t_{d\ (on)}$	0.6	0.7	0.8	μs	V_M=85V, Io=0.41A Vcc=10V V_{IN}=10V (Out Stage=ON) V_{IN}=0V (Out Stage=OFF)
		$t_{d\ (off)}$	1.8	2.2	2.6	μs	
	Low side	$t_{d\ (on)}$	0.8	0.9	1.0	μs	
		$t_{d\ (off)}$	1.3	1.6	1.9	μs	
		Δt_d			2.5	μs	Δt_d=H/S $t_{d\ (off)}$ - L/S $t_{d\ (on)}$ or L/S $t_{d\ (off)}$ - H/S $t_{d\ (on)}$
Operating voltage		Vcc	9		15	V	Ta=–40 to +105°C

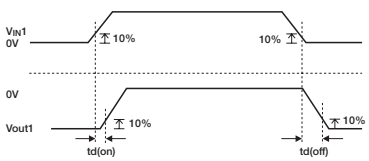
Recommended Operation Range

Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Unit	Conditions
Dead time	t_d	5.0			μs	Ta=–40 to +105°C

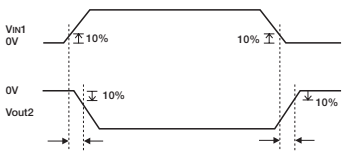
* About delay time

Signal input waveform vs output waveform

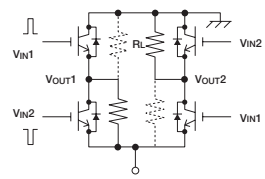
① Highside switch turn-on, turn-off



② Lowside switch turn-on, turn-off



Measurement Circuit



Conditions

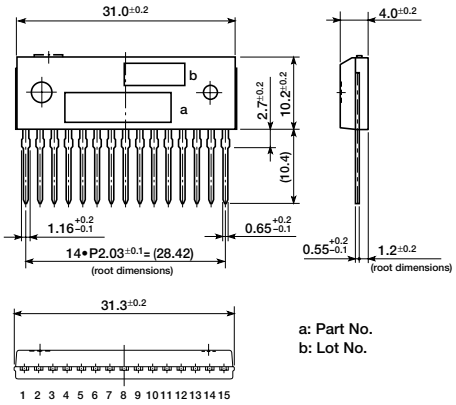
V_{CC}=10V, V_{IN}=10V (pulse)

V_M=85V

I_O=0.41A (R_L=206Ω)

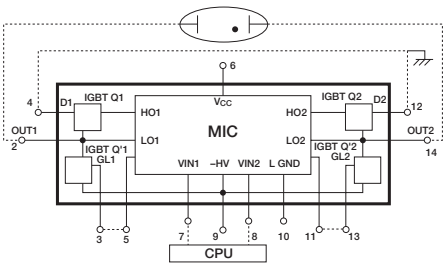
* When pulse signal is inputted to V_{IN1}, R_L on solid line is ON and dotted line R_L is off.
On the contrary, when pulse signal is inputted to V_{IN2}, R_L on dotted line is ON and dotted line R_L is off.

External Dimensions (unit: mm)



a: Part No.
b: Lot No.

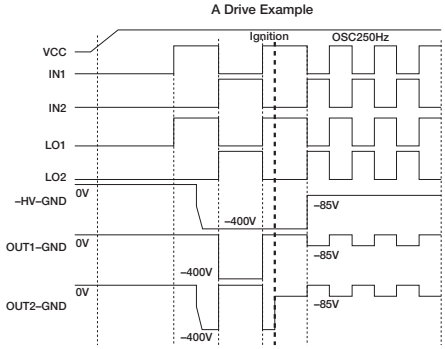
Block Diagram



* Dotted Line: Outside Connection

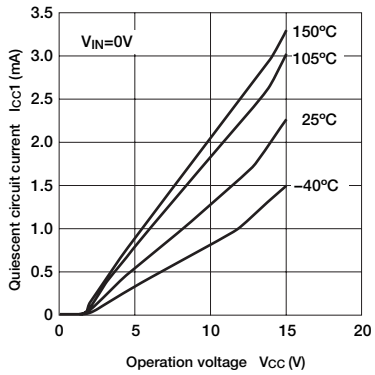
Timing Chart

A Drive Example

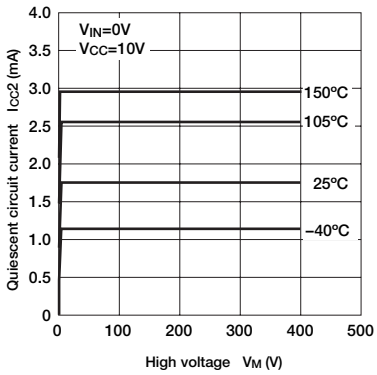


Electrical Characteristics

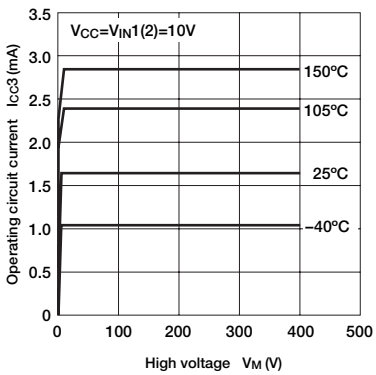
■ Quiescent circuit current



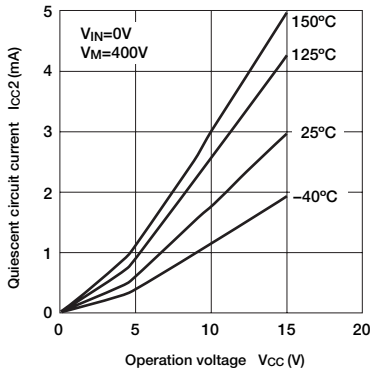
■ Quiescent circuit current supplied high voltage



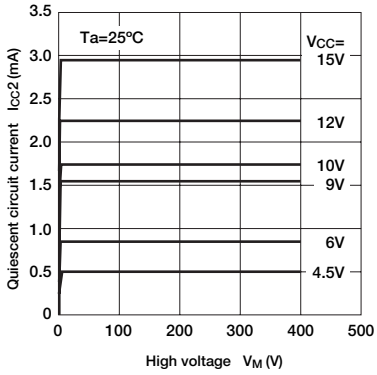
■ Operating circuit current



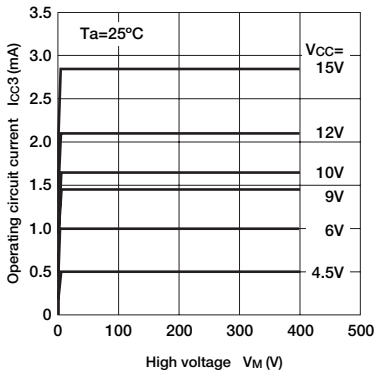
■ Quiescent circuit current supplied high voltage



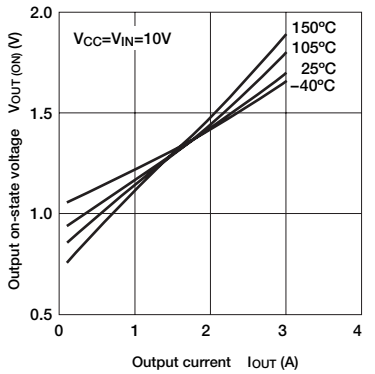
■ Quiescent circuit current supplied high voltage



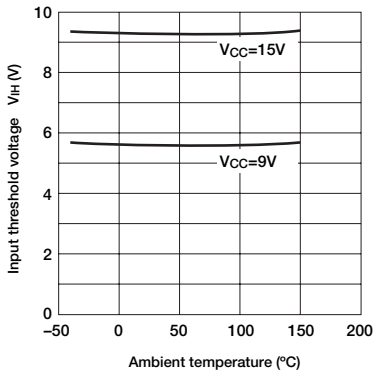
■ Operating circuit current



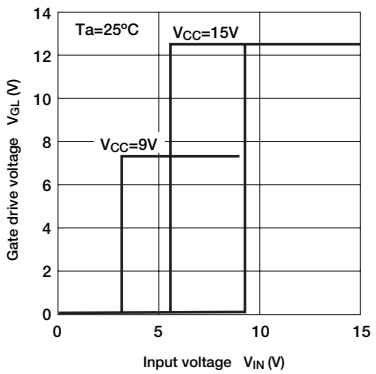
■ Output on-state voltage



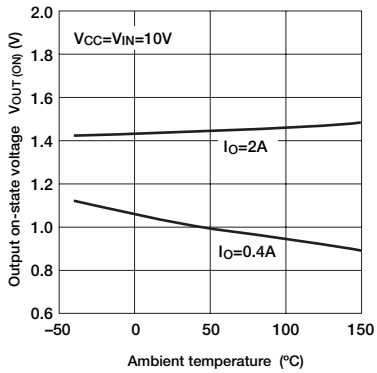
■ Input threshold voltage



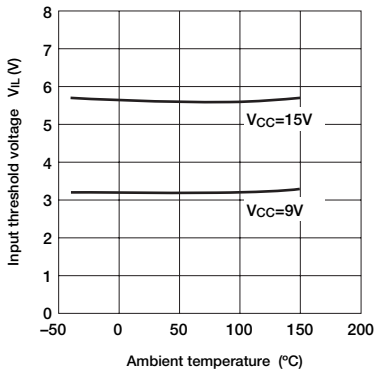
■ Gate drive voltage



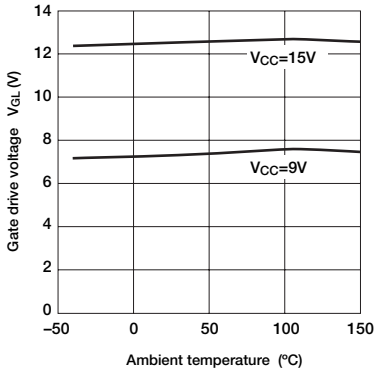
■ Output on-state voltage



■ Input threshold voltage

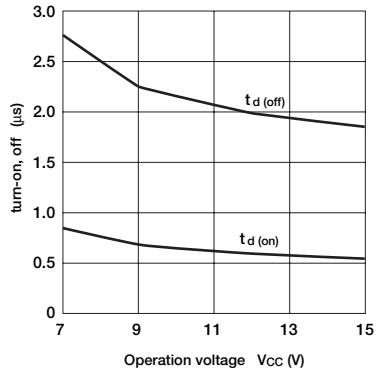


■ Gate drive voltage

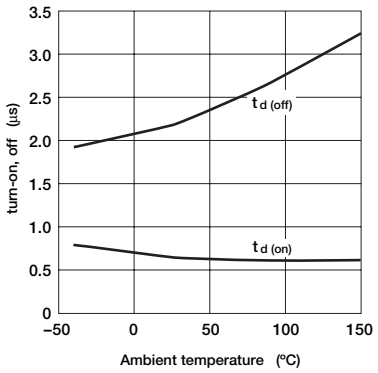


Electrical Characteristics

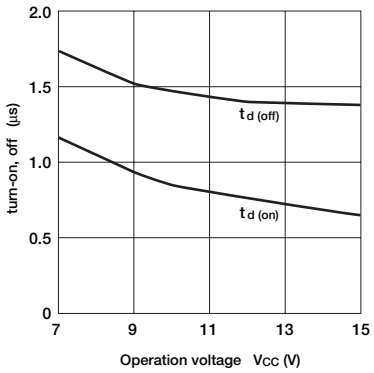
■ High side switch turn-on, off



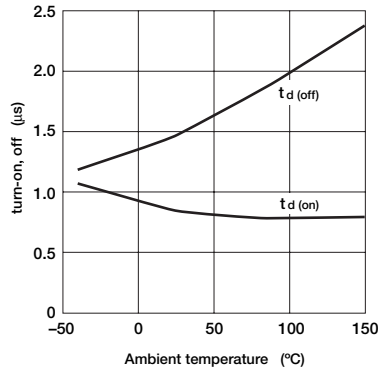
■ High side switch turn-on, off



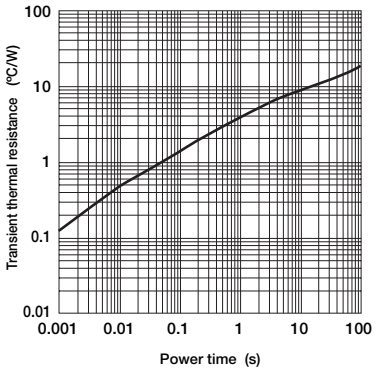
■ Low side switch turn-on, off



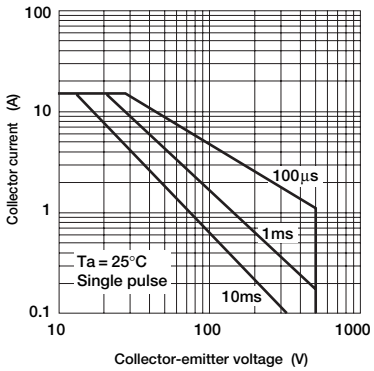
■ Low side switch turn-on, off



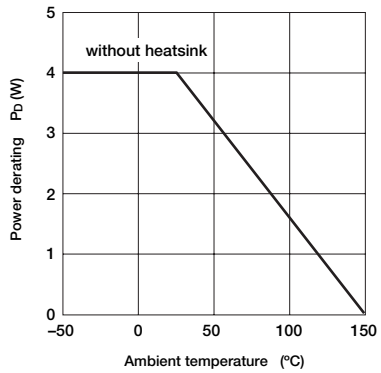
■ Transient thermal resistance characteristics



■ IGBT ASO characteristics



■ Power derating curve



Custom ICs

■ 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

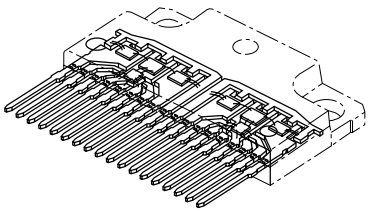
- All semiconductor chips used are manufactured by Sanken.
- Main product lineup consists of power ICs produced out of many years' experience of Sanken.
- Uses monolithic chips with flip-chip construction.
- Mainly available in miniature transfer-mold packages.

Examples of Custom Hybrid IC Products

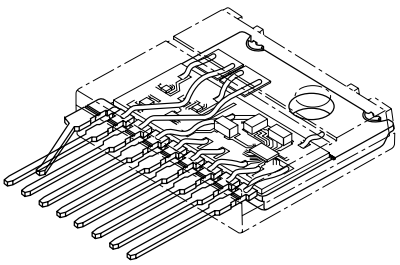
- Regulators for alternators
- Igniters
- Power supply for microcomputer system
- Power steering control IC
- Motor and actuator driver
- Others

Examples of Sanken Automotive Hybrid ICs

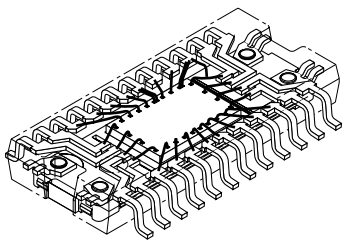
Lead frame type multi-chip power IC →
- One-chip power IC



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)

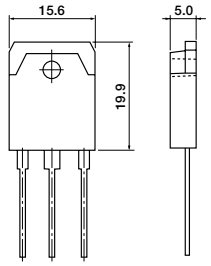


Surface-mount power IC

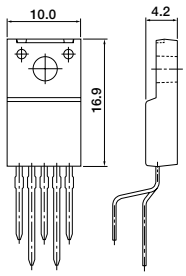


External Dimensions (unit: mm)

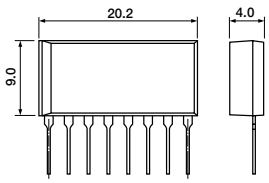
MT-100



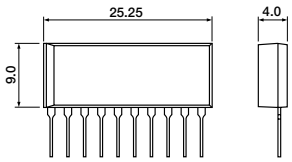
FM205



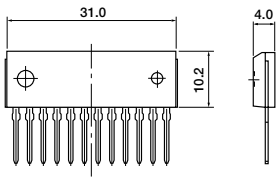
STA 8pin



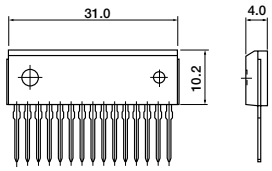
STA 10pin



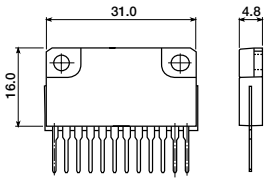
SMA12pin



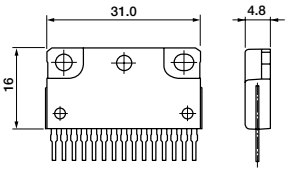
SMA15pin



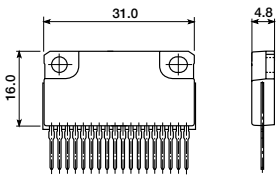
SLA12pin



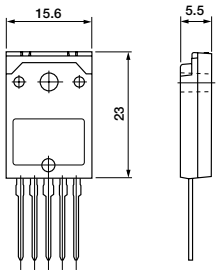
SLA15pin



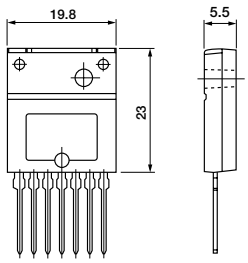
SLA18pin



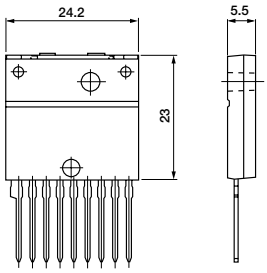
3GR-F



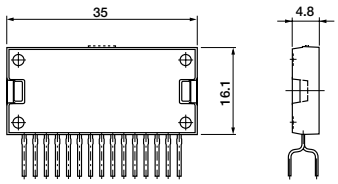
3GR-M



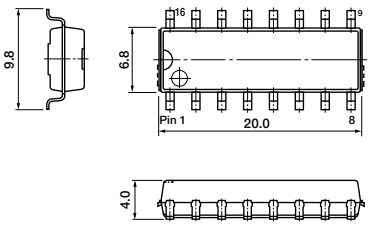
STR-S



SPM



SMD16pin



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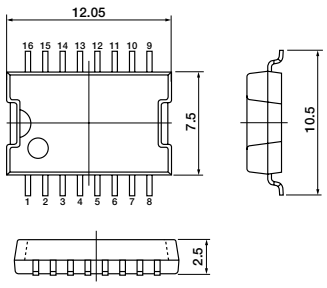
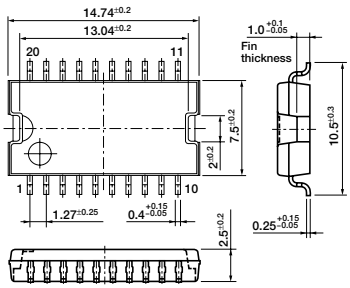
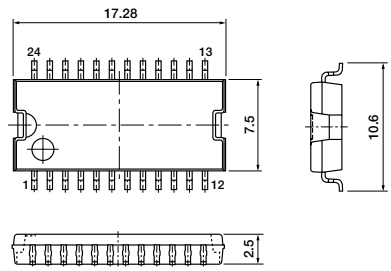


SPF20pin



SPF24pin



2 Discretes

Power Transistor 2SA1488/1488A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings		Unit
	2SA1488	2SA1488A	
V_{CBO}	–60	–80	V
V_{CEO}	–60	–80	V
V_{EBO}	–6		V
I_C	–4		A
I_B	–1		A
P_C	25 (T_C = 25°C)		W
Tj	150		°C
Tstg	–55 to +150		°C

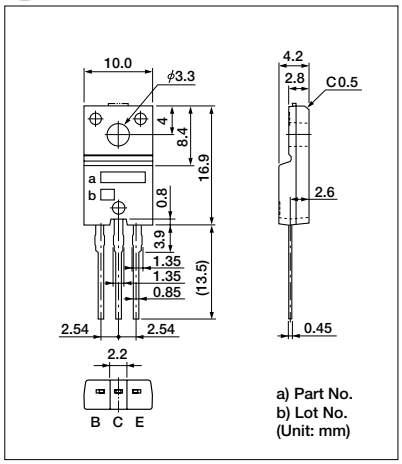
Electrical Characteristics (Ta = 25°C)

Symbol	Test Conditions	Ratings		Unit
		2SA1488	2SA1488A	
I_{CBO}		–100max	–100max	μA
	V_{CB} =	–60	–80	V
I_{EBO}	V_{EB} = –6V	–100max		μA
$V_{(BR)\ CEO}$	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_{OB}	V_{CB} = –10V, f = 1MHz	90typ		pF

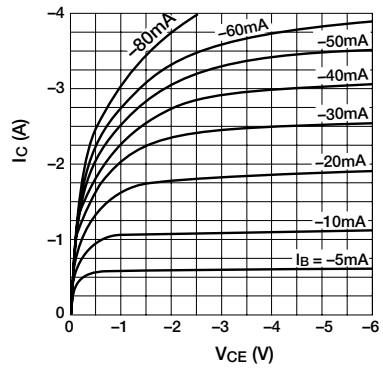
Typical Switching Characteristics (common emitter)

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

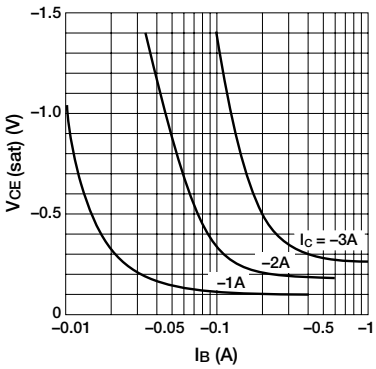
External Dimensions TO220F (full-mold)



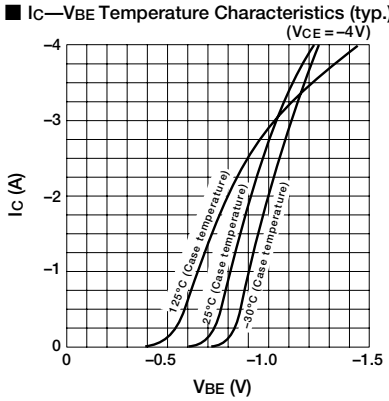
■ I_C—V_{CE} Characteristics (typ.)



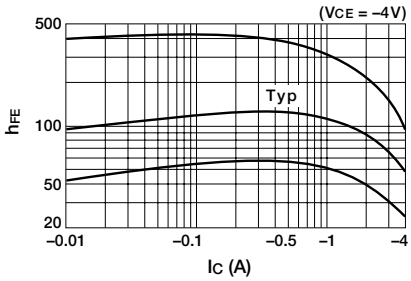
■ $V_{CE\ (sat)}$—I_B Characteristics (typ.)



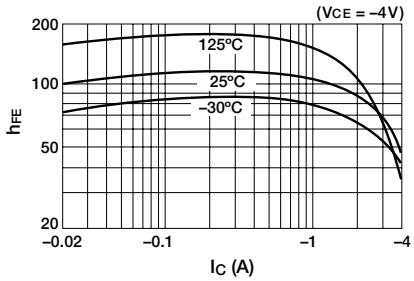
■ I_C—V_{BE} Temperature Characteristics (typ.)



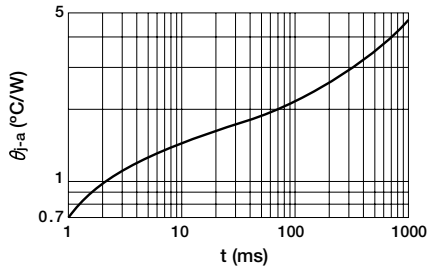
■ h_{FE}—I_C Characteristics (typ.)



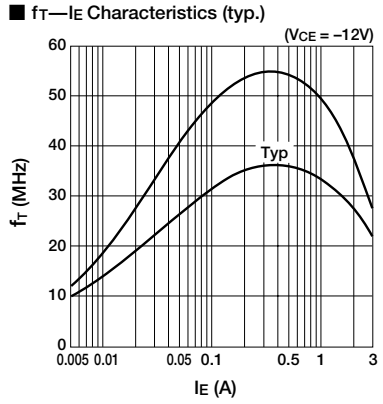
■ h_{FE}—I_C Temperature Characteristics (typ.)



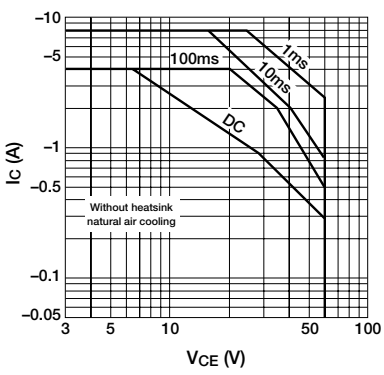
■ $\theta_{j\text{-}a}$—t Characteristics



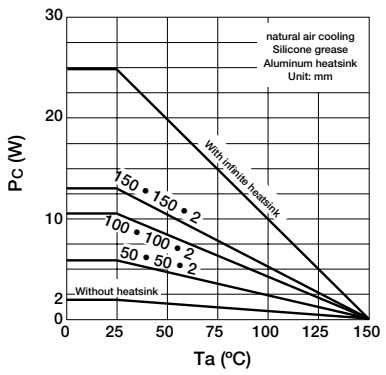
■ f_T—I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C—Ta Derating



Power Transistor 2SA1567

Absolute Maximum Ratings (Ta = 25ºC)

Symbol	Ratings	Unit
V_{CBO}	–50	V
V_{CEO}	–50	V
V_{EBO}	–6	V
I_C	–12	A
I_B	–3	A
P_C	35 (T_C = 25ºC)	W
Tj	150	ºC
Tstg	–55 to +150	ºC

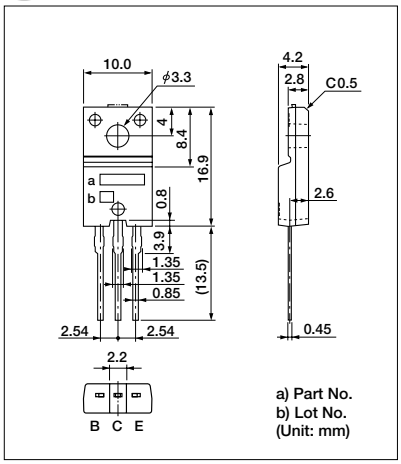
Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = –50V	–100max	μA
I_{EBO}	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

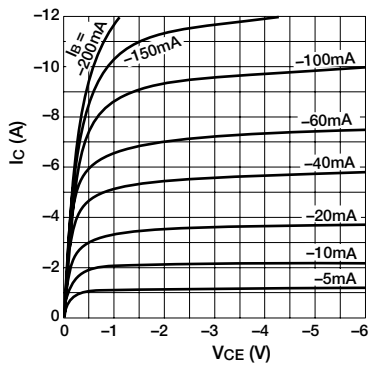
Typical Switching Characteristics (common emitter)

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

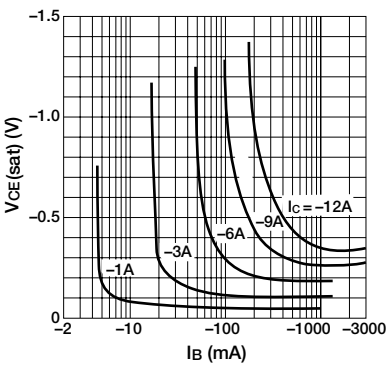
External Dimensions TO220F (full-mold)



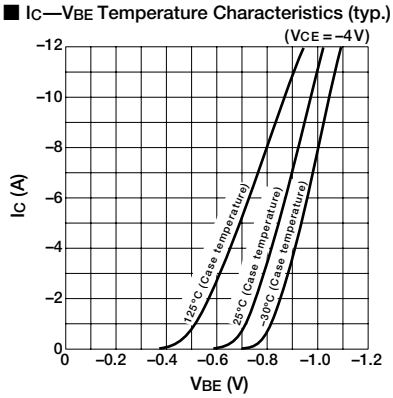
■ I_C—V_{CE} Characteristics (typ.)



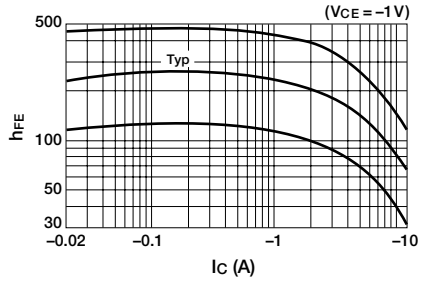
■ $V_{CE\ (sat)}$—I_B Characteristics (typ.)



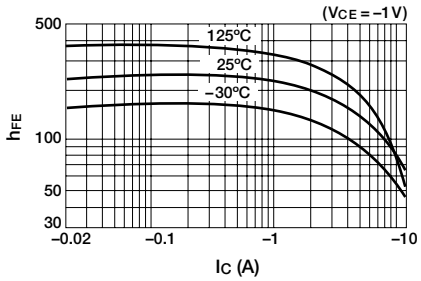
■ I_C—V_{BE} Temperature Characteristics (typ.)



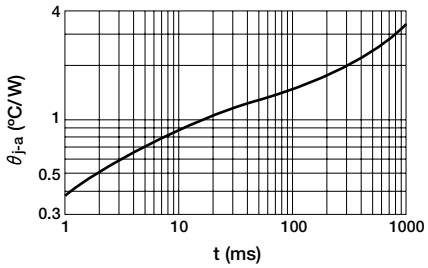
■ h_{FE}—I_C Characteristics (typ.)



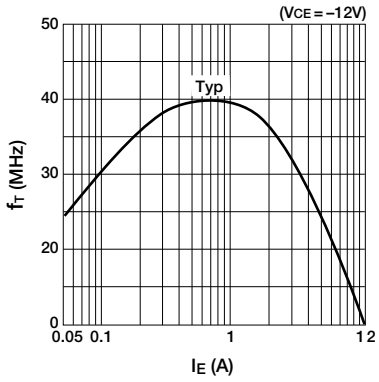
■ h_{FE}—I_C Temperature Characteristics (typ.)



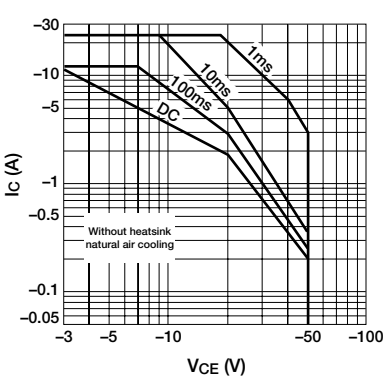
■ $\theta_{j\text{-}a}$—t Characteristics



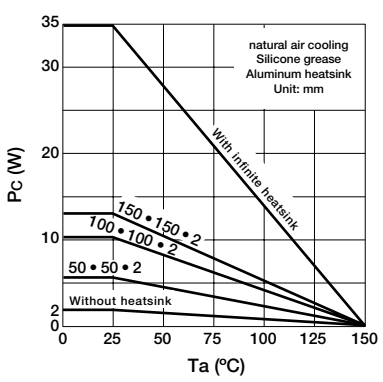
■ f_T—I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C—Ta Derating



Power Transistor 2SA1568

Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	–60	V
V_{CEO}	–60	V
V_{EBO}	–6	V
I_C	∓12	A
I_B	–3	A
P_C	35 (T_C=25ºC)	W
Tj	150	ºC
Tstg	–55 to +150	ºC

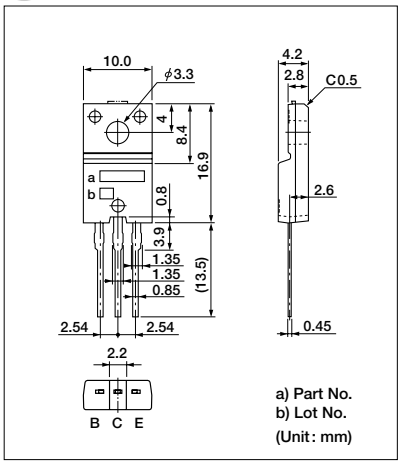
Electrical Characteristics (Ta=25ºC)

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 = –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

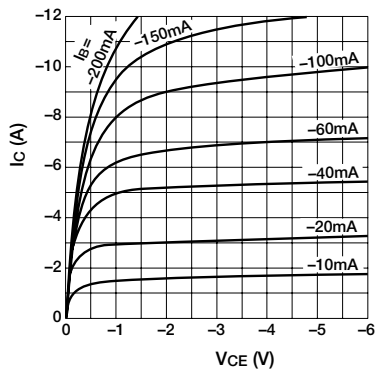
Typical Switching Characteristics (common emitter)

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

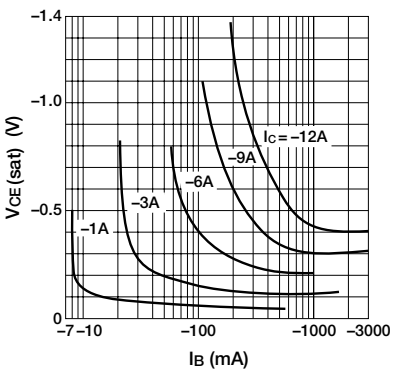
External Dimensions TO220F (full-mold)



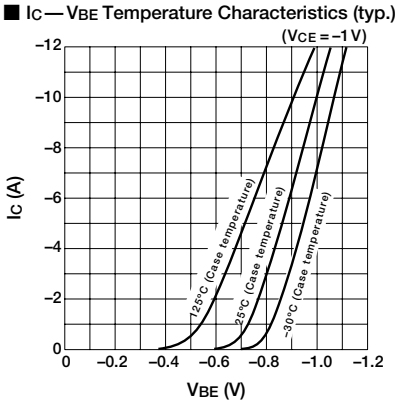
■ I_C — V_{CE} Characteristics (typ.)



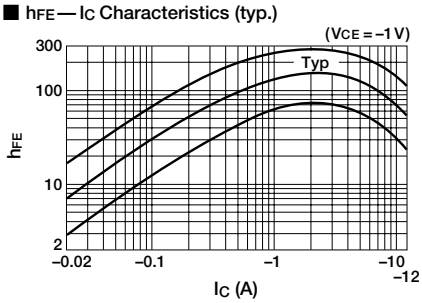
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



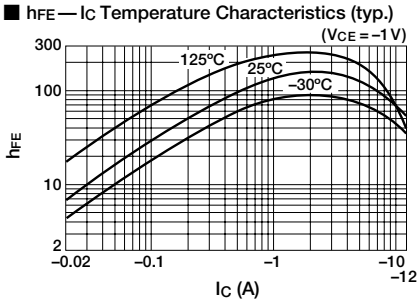
■ I_C — V_{BE} Temperature Characteristics (typ.)



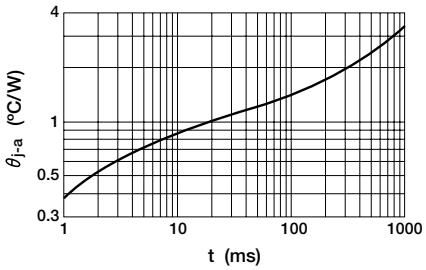
■ h_{FE} — I_C Characteristics (typ.)



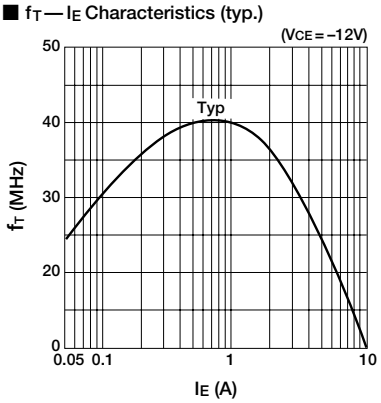
■ h_{FE} — I_C Temperature Characteristics (typ.)



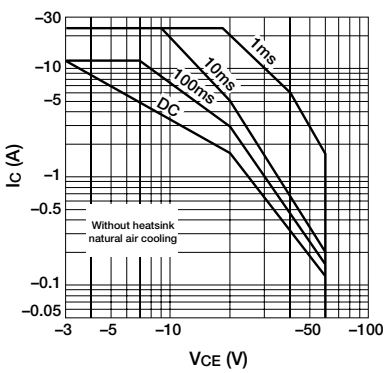
■ $\theta_{j\text{-}a}$ — t Characteristics



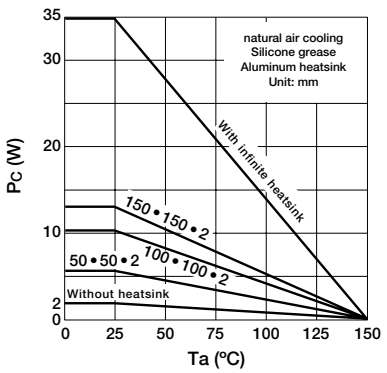
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SA1908

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	−120	V
V_{CEO}	−120	V
V_{EBO}	−6	V
I_C	−8	A
I_B	−3	A
P_C	75 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

Electrical Characteristics (Ta=25°C)

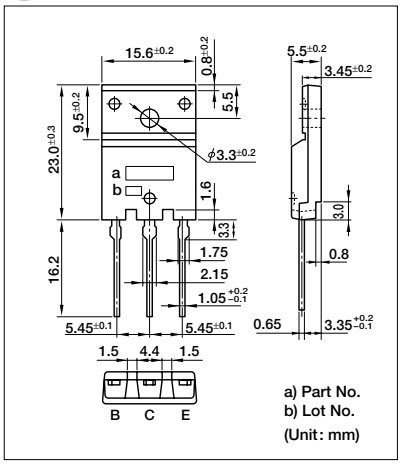
Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = −120V	−10max	μA
I_{EBO}	V_{EB} = −6V	−10max	μA
$V_{(BR)\ CEO}$	I_C = −50mA	−120min	V
h_{FE}*	V_{CE} = −4V, I_C = −3A	50min	
$V_{CE\ (sat)}$	I_C = −3A, I_B = −0.3A	−0.5max	V
f_T	V_{CE} = −12V, I_E = 0.5A	20typ	MHz
C_{OB}	V_{CB} = −10V, f = 1MHz	300typ	pF

*Rank: O (50 to 100), P (70 to 140), Y (90 to 180)

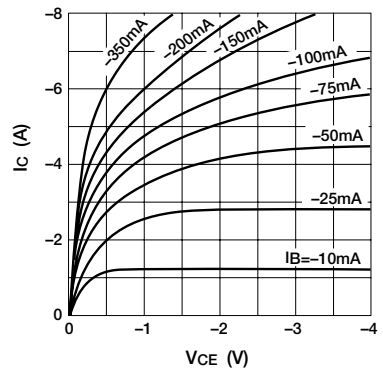
Typical Switching Characteristics (common emitter)

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)
−40	10	−4	−10	5	−400	400	0.14typ	1.40typ	0.21typ

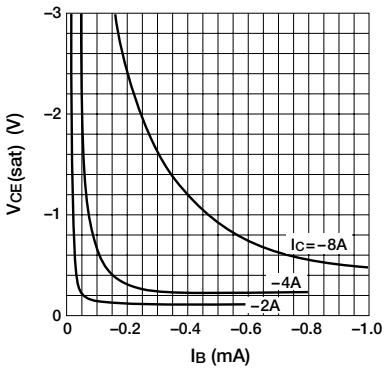
External Dimensions FM100 (T03PF)



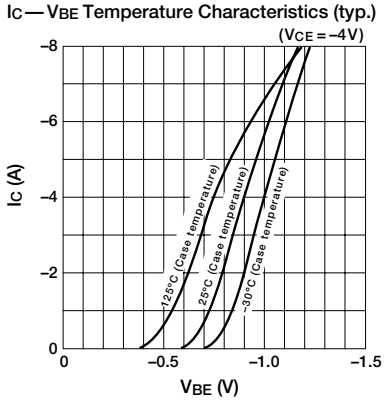
■ I_C — V_{CE} Characteristics (typ.)



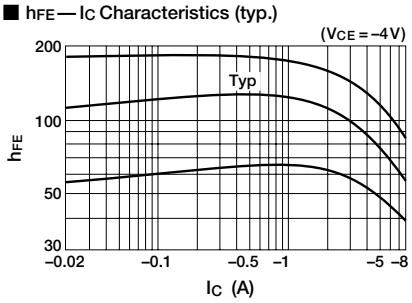
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



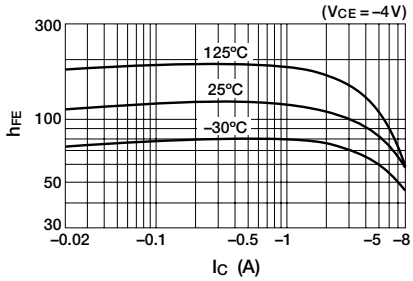
■ I_C — V_{BE} Temperature Characteristics (typ.)



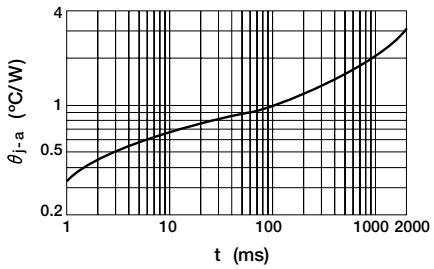
■ h_{FE} — I_C Characteristics (typ.)



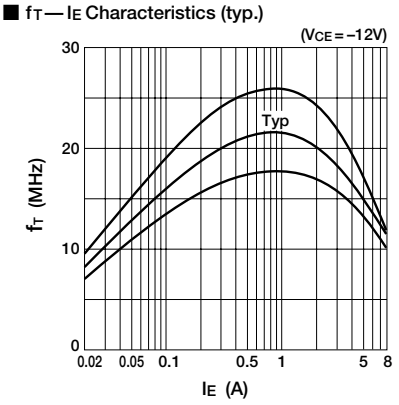
■ h_{FE} — I_C Temperature Characteristics (typ.)



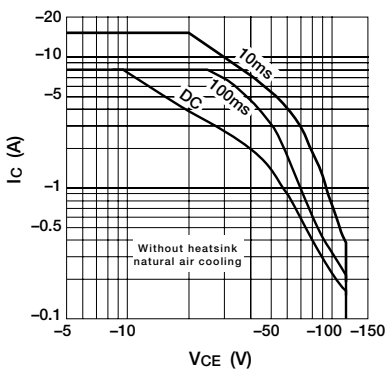
■ $\theta_{j\text{-}a}$ — t Characteristics



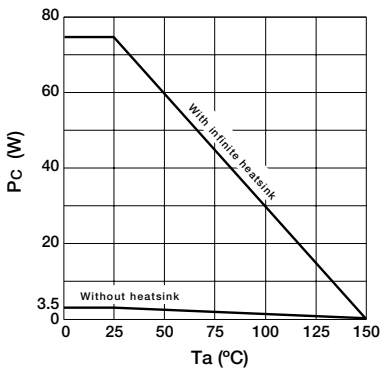
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SB1622

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	−200	V
V_{CEO}	−200	V
V_{EBO}	−5	V
I_C	−15	A
I_B	−1	A
P_C	85 (T_C=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

Electrical Characteristics (Ta=25°C)

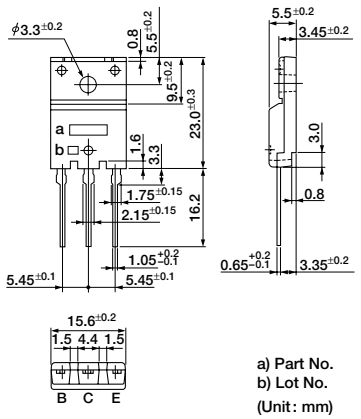
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB} = −200V			−100	μA
I_{EBO}	V_{EB} = −5V			−100	μA
V_{CEO}	I_C = −30mA	−200			V
h_{FE}*	V_{CE} = −4V, I_C = −10A	5000		30000	
$V_{CE(sat)}$	I_C = −10A, I_B = −10mA			−2.5	V
$V_{BE(sat)}$	I_C = −10A, I_B = −10mA			−3.0	V
f_T	V_{CE} = −12V, I_E = 2A		60		MHz
C_{OB}	V_{CB} = −10V, f = 1MHz		270		pF

*Rank: O(5000 to 12000), P(6500 to 20000), Y(15000 to 30000)

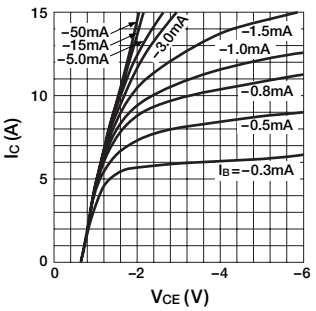
Typical Switching Characteristics

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)
−40	4	−10	−10	5	−10	10	0.4typ	3.6typ	1.0typ

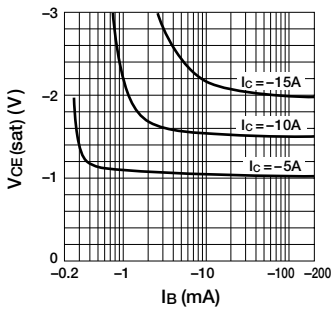
External Dimensions



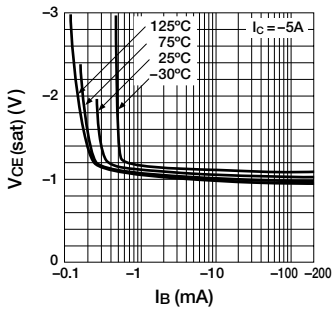
■ I_C — V_{CE} Characteristics (typ.)



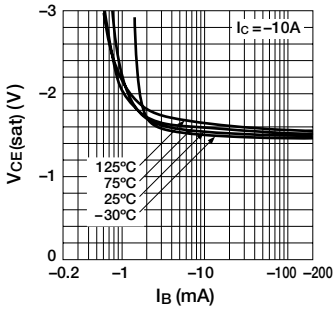
■ $V_{CE(sat)}$ — I_B Characteristics (typ.)



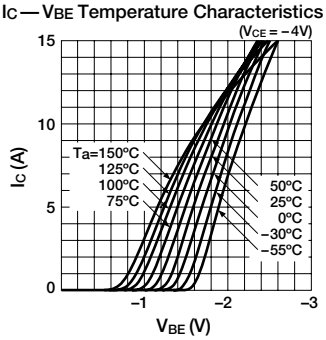
■ $V_{CE(sat)}$ — I_B Temperature Characteristics (typ.)



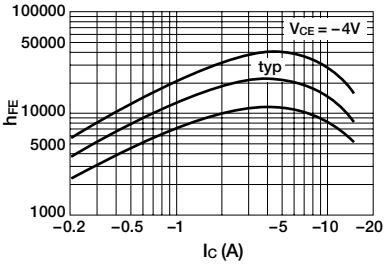
■ $V_{CE(sat)}$ — I_B Temperature Characteristics (typ.)



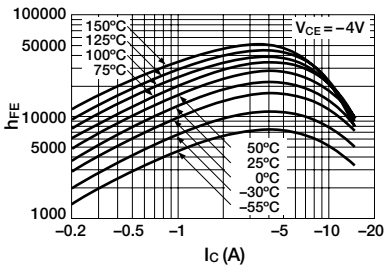
■ I_C — V_{BE} Temperature Characteristics (typ.)



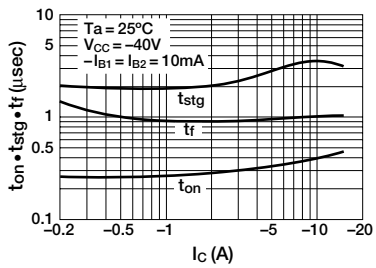
■ h_{FE} — I_C Characteristics (typ.)



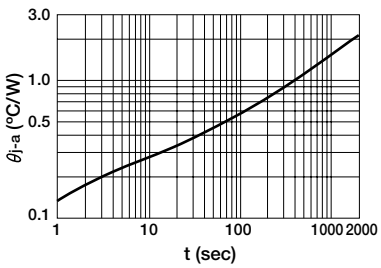
■ h_{FE} — I_C Temperature Characteristics (typ.)



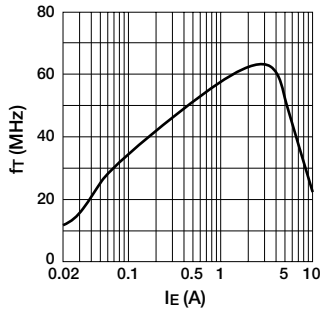
■ $t_{on} \cdot t_{stg} \cdot t_f$ — I_C Characteristics (typ.)



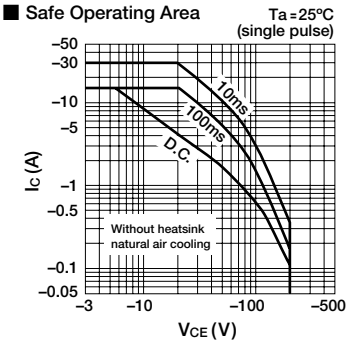
■ $\theta_{j\text{-}a}$ — t Characteristics



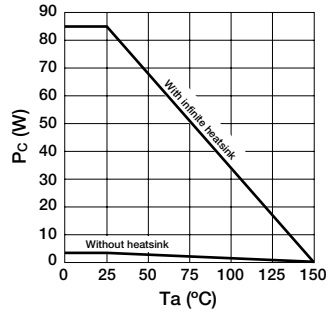
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area



■ P_C — Ta Derating



Power Transistor 2SC3852

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	80	V
V_{CEO}	60	V
V_{EBO}	6	V
I_C	3	A
I_B	1	A
P_C	25 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

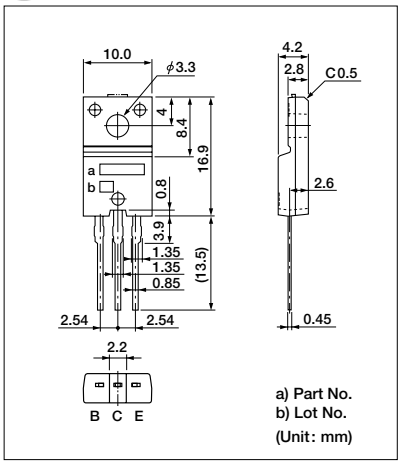
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 80V	10max	μA
I_{EBO}	V_{EB} = 6V	100max	μA
$V_{(BR)\ CEO}$	I_C = 25mA	60min	V
h_{FE}	V_{CE} = 4V, I_C = 0.5A	500min	
$V_{CE\ (sat)}$	I_C = 2A, I_B = 50mA	0.5max	V
f_T	V_{CE} = 12V, I_E = −0.2A	15typ	MHz
C_{OB}	V_{CB} = 10V, f = 1MHz	50typ	pF

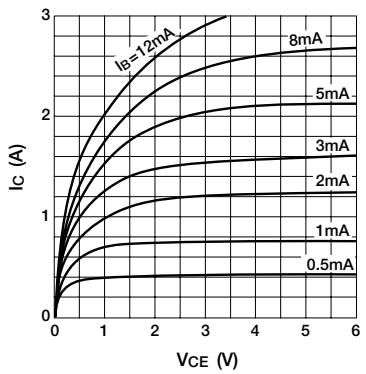
Typical Switching Characteristics (common emitter)

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)
20	20	1.0	10	−5	15	−30	0.8typ	3.0typ	1.2typ

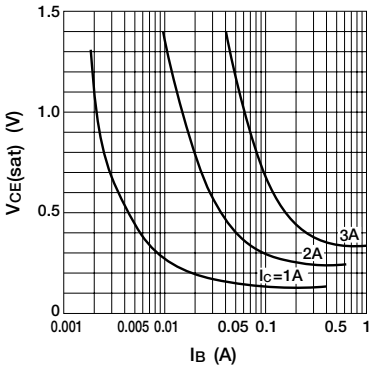
External Dimensions TO220F (full-mold)



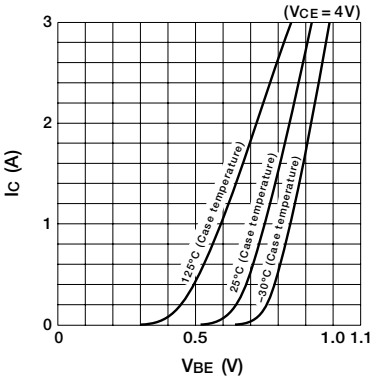
■ I_C — V_{CE} Characteristics (typ.)



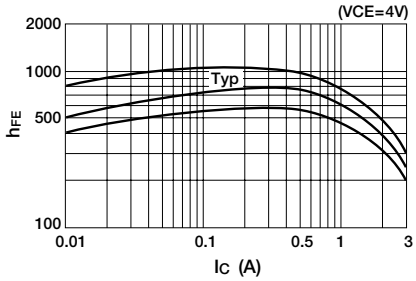
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



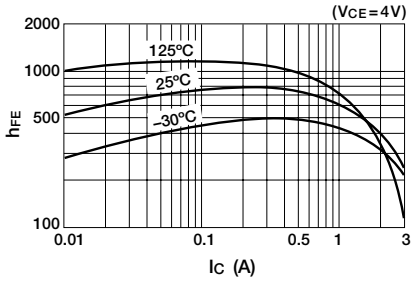
■ I_C — V_{BE} Temperature Characteristics (typ.)



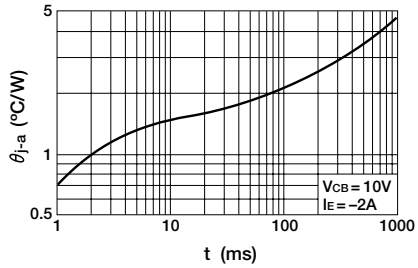
■ h_{FE} — I_C Characteristics (typ.)



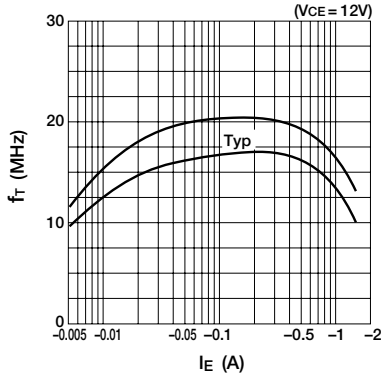
■ h_{FE} — I_C Temperature Characteristics (typ.)



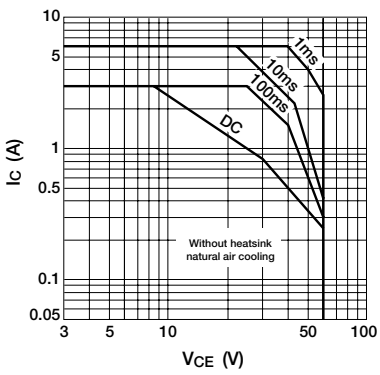
■ $\theta_{j\text{-}a}$ — t Characteristics



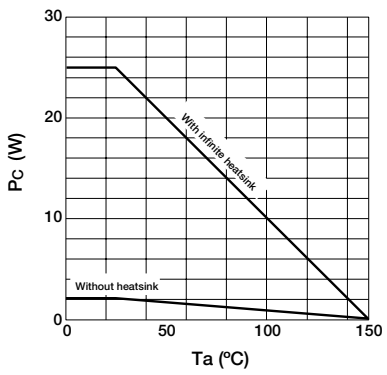
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SC4024

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	100	V
V_{CEO}	50	V
V_{EBO}	15	V
I_C	10	A
I_B	3	A
P_C	35 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

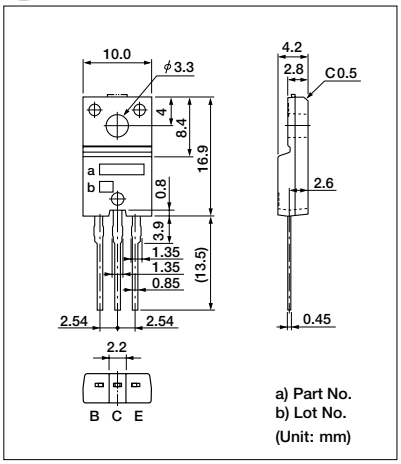
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 100V	10max	μA
I_{EBO}	V_{EB} = 15V	10max	μA
$V_{(BR)\ CEO}$	I_C = 25mA	50min	V
h_{FE}	V_{CE} = 4V, I_C = 1A	300 to 1600	
V_{CE} (sat)	I_C = 5A, I_B = 0.1A	0.5max	V
f_T	V_{CB} = 12V, I_E = −0.5A	24typ	MHz
C_{OB}	V_{CB} = 10V, f = 1MHz	150typ	pF

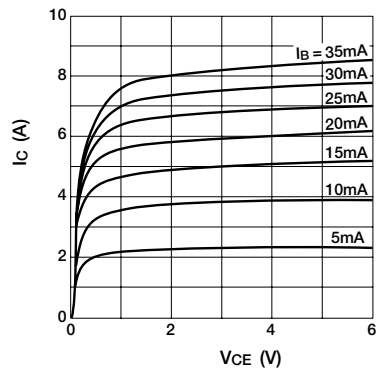
Typical Switching Characteristics (common emitter)

V_{CC} (V)	R_L (Ω)	I_C (A)	I_{B1} (A)	I_{B2} (A)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
20	4	5	0.1	−0.1	0.5typ	2.0typ	0.5typ

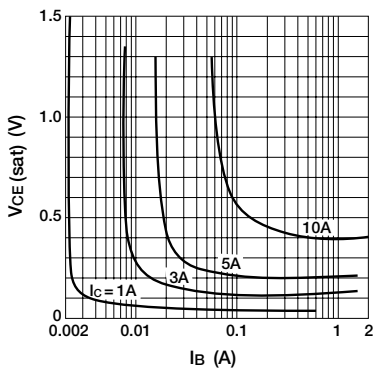
External Dimensions TO220F (full-mold)



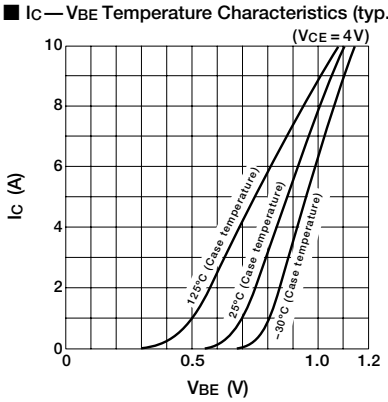
■ I_C — V_{CE} Characteristics (typ.)



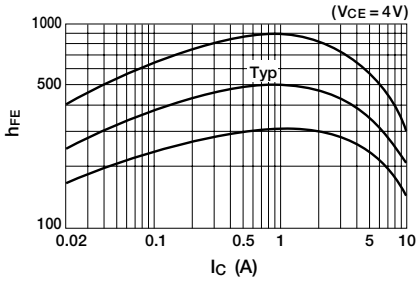
■ V_{CE} (sat) — I_B Characteristics (typ.)



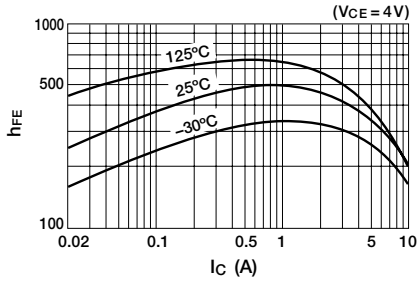
■ I_C — V_{BE} Temperature Characteristics (typ.)



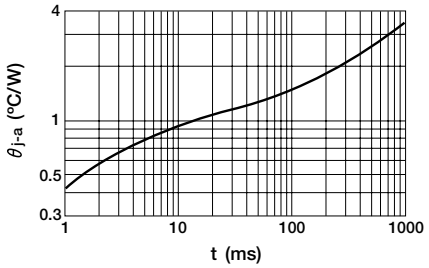
■ h_{FE} — I_C Characteristics (typ.)



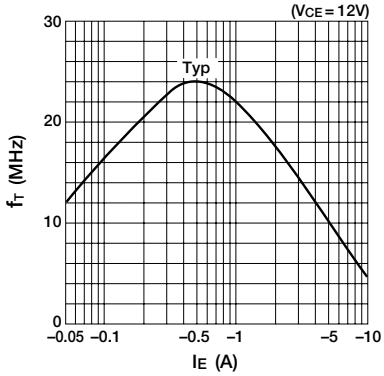
■ h_{FE} — I_C Temperature Characteristics (typ.)



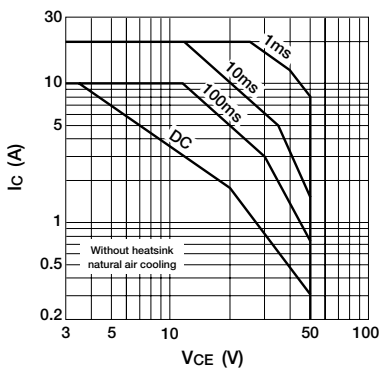
■ $\theta_{j\text{-}a}$ — t Characteristics



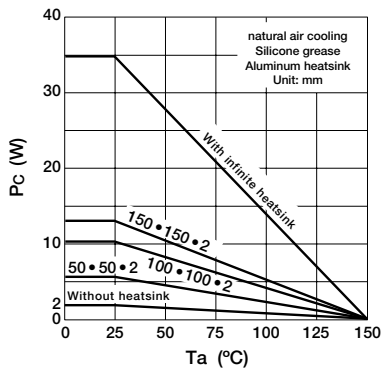
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SC4065

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	60	V
V_{CEO}	60	V
V_{EBO}	6	V
I_C	±12	A
I_B	3	A
P_C	35 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

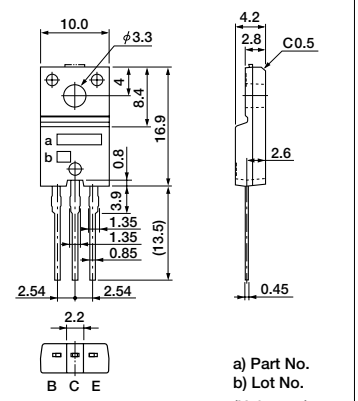
Electrical Characteristics (Ta=25°C)

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_{FEC}	V_{ECO} = 10A	2.5max	V
f_T	V_{CE} = 12V, I_E = −0.5A	24typ	MHz
C_{OB}	V_{CB} = 10V, f = 1MHz	180typ	pF

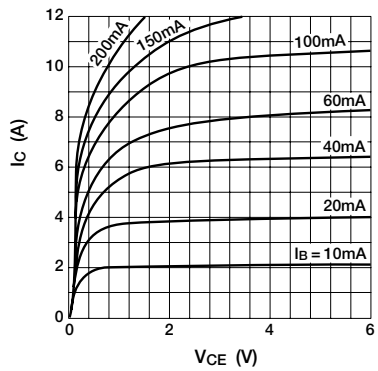
Typical Switching Characteristics (common emitter)

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

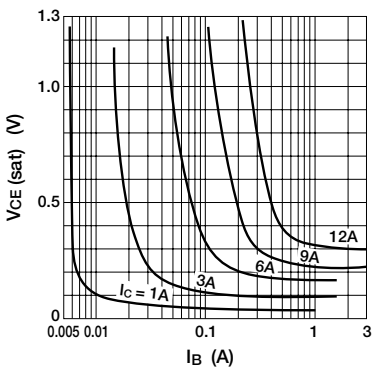
External Dimensions TO220F (full-mold)



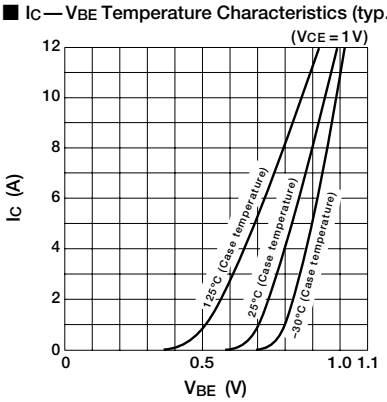
■ I_C — V_{CE} Characteristics (typ.)



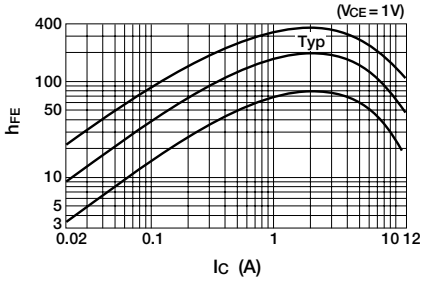
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



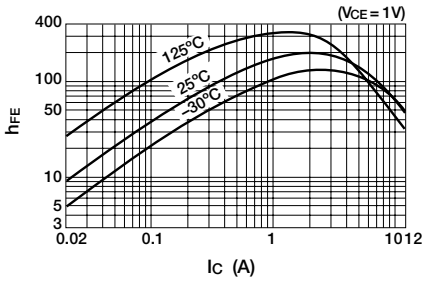
■ I_C — V_{BE} Temperature Characteristics (typp.)



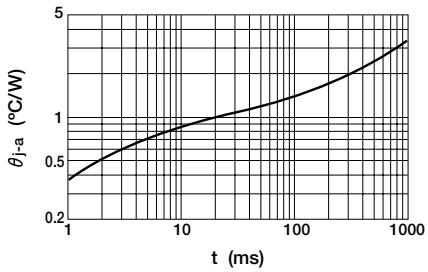
■ h_{FE} — I_C Characteristics (typ.)



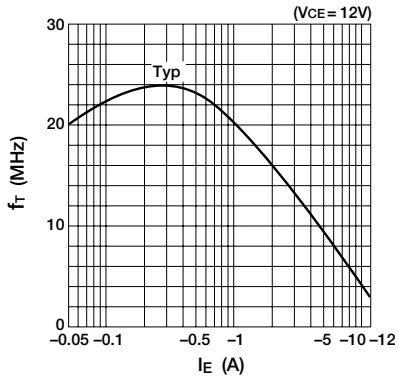
■ h_{FE} — I_C Temperature Characteristics (typ.)



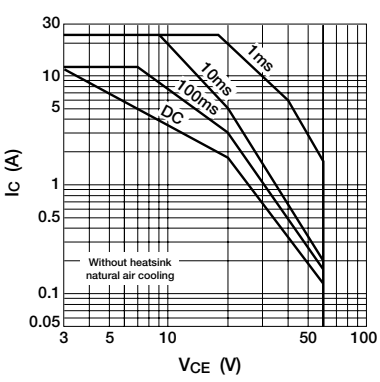
■ $\theta_{j\text{-}a}$ — t Characteristics



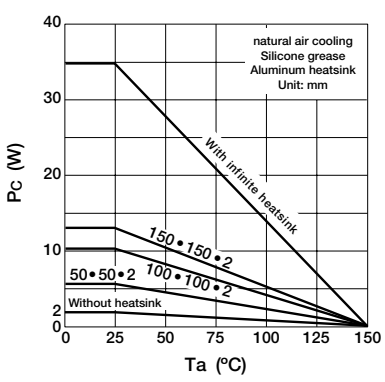
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SC4153

Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	200	V
V_{CEO}	120	V
V_{EBO}	8	V
I_C	7 (pulse 14)	A
I_B	3	A
P_C	30 (Tc=25ºC)	W
Tj	150	ºC
Tstg	−55 to +150	ºC

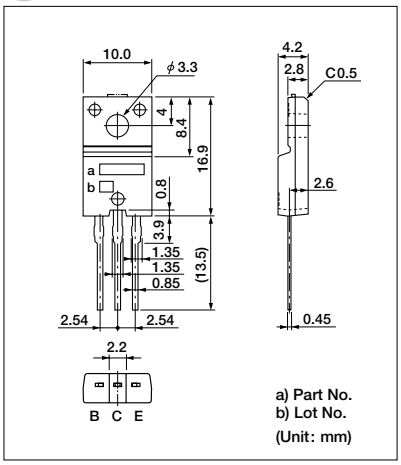
Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 200V	100max	μA
I_{EBO}	V_{EB} = 8V	100max	μA
$V_{(BR)\ CEO}$	I_C = 50mA	120min	V
h_{FE}	V_{CE} = 4V, I_C = 3A	70 to 220	
$V_{CE\ (sat)}$	I_C = 3A, I_B = 0.3A	0.5max	V
$V_{BE\ (sat)}$	I_C = 3A, I_B = 0.3A	1.2max	V
f_T	V_{CE} = 12V, I_E = −0.5A	30typ	MHz
C_{OB}	V_{CB} = 10V, f = 1MHz	110typ	pF

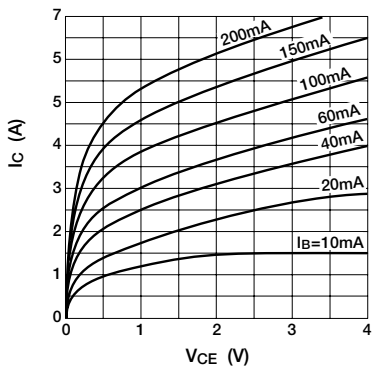
Typical Switching Characteristics (common emitter)

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)
50	16.7	3	10	−5	0.3	−0.6	0.5max	3max	0.5max

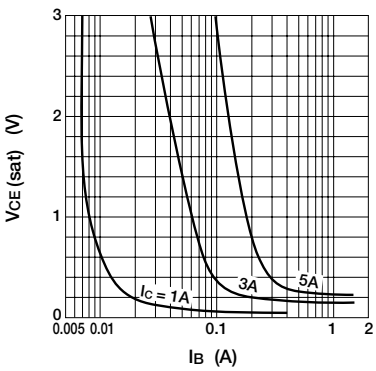
External Dimensions TO220F (full-mold)



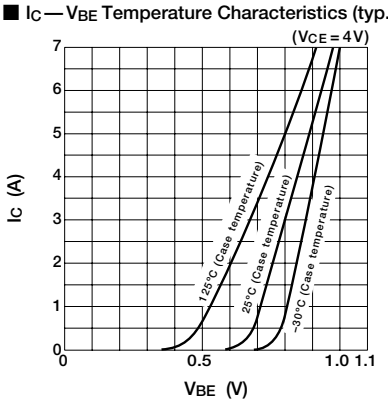
■ I_C — V_{CE} Characteristics (typ.)



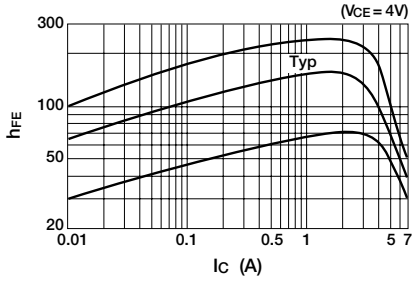
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



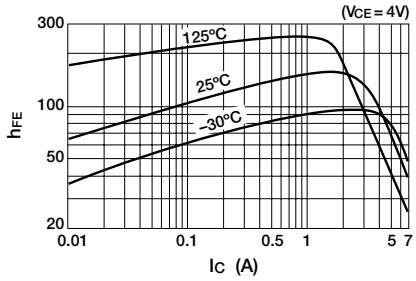
■ I_C — V_{BE} Temperature Characteristics (typ.)



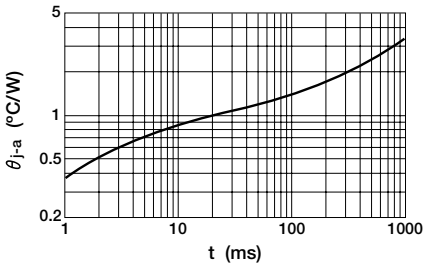
■ h_{FE} — I_C Characteristics (typ.)



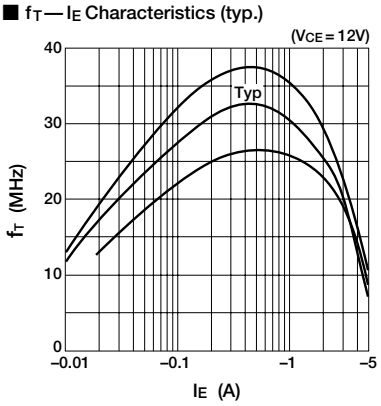
■ h_{FE} — I_C Temperature Characteristics (typ.)



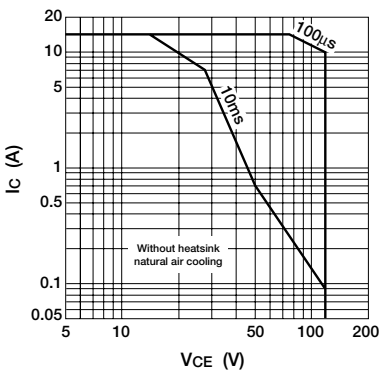
■ $\theta_{j\text{-}a}$ — t Characteristics



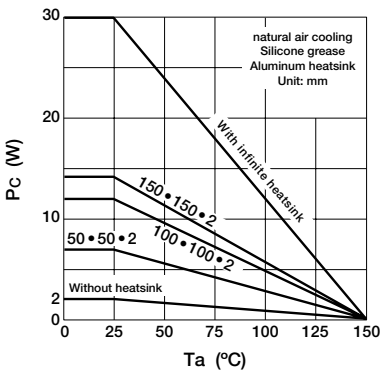
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SD2141

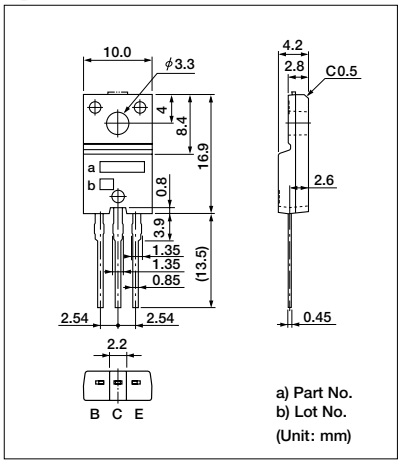
Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	380±50	V
V_{CEO}	380±50	V
V_{EBO}	6	V
I_C	6 (pulse 10)	A
I_B	1	A
P_C	35 (Tc=25ºC)	W
Tj	150	ºC
Tstg	−55 to +150	ºC

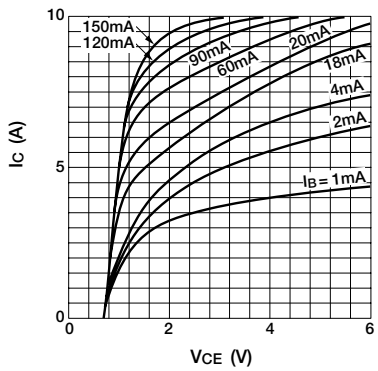
Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 330V	10max	μA
I_{EBO}	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

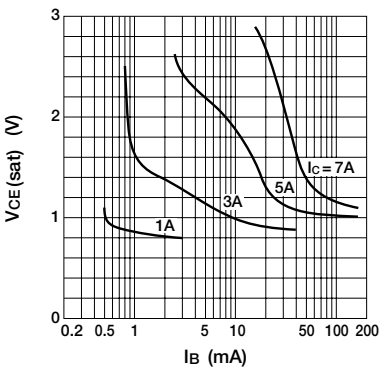
External Dimensions TO220F (full-mold)



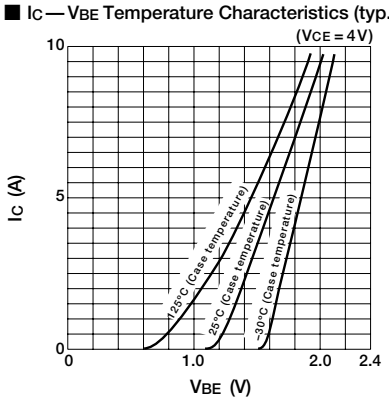
■ I_C — V_{CE} Characteristics (typ.)



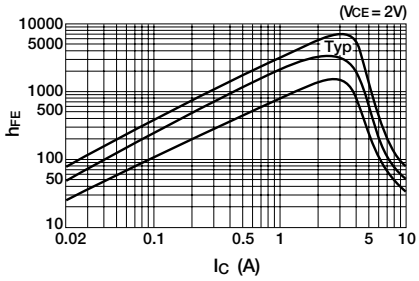
■ V_{CE} (sat) — I_B Characteristics (typ.)



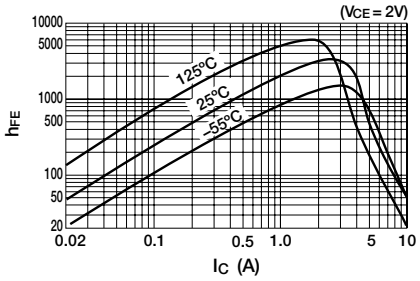
■ I_C — V_{BE} Temperature Characteristics (typp.)



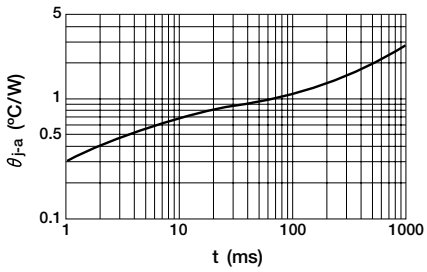
■ h_{FE} — I_C Characteristics (typ.)



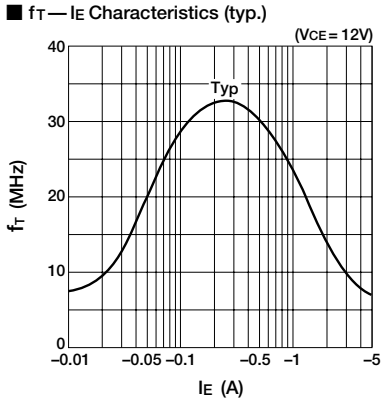
■ h_{FE} — I_C Temperature Characteristics (typ.)



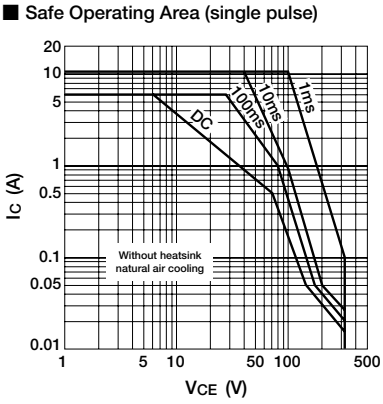
■ $\theta_{j\text{-}a}$ — t Characteristics



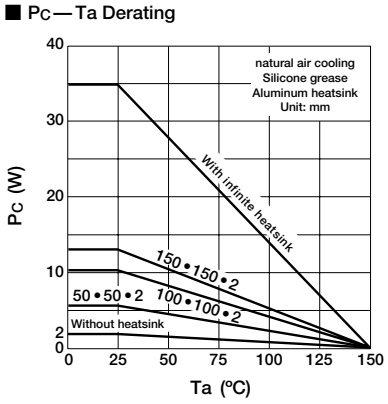
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SD2382

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	65±5	V
V_{CEO}	65±5	V
V_{EBO}	6	V
I_C	±6 (pulse ±10)	A
I_B	1	A
P_C	30 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

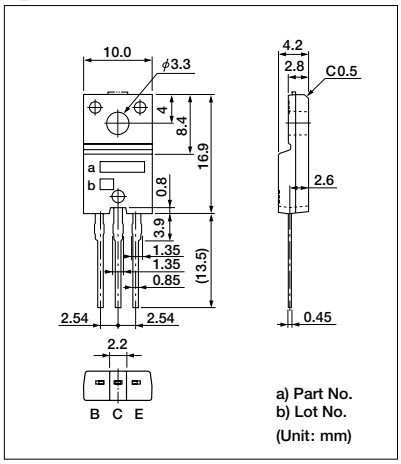
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 60V	10max	μA
I_{EBO}	V_{EB} = 6V	10max	μA
V_{CEO}	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

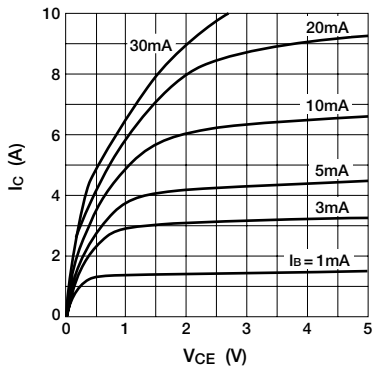
Typical Switching Characteristics

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_f (μs)
12	12	1	10	−5	30	−30	0.25	0.8	0.35

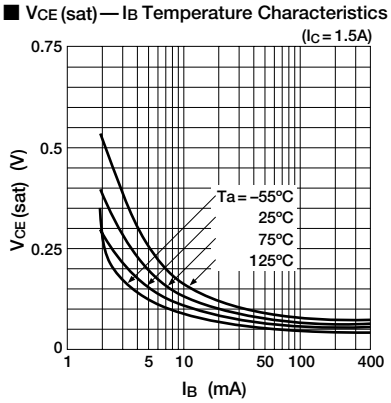
External Dimensions TO220F (full-mold)



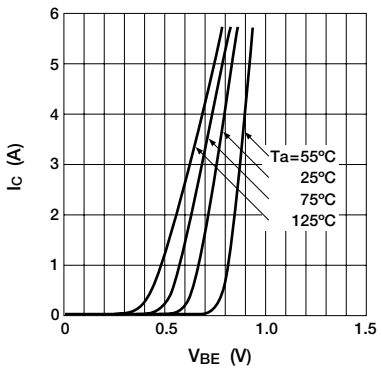
■ I_C — V_{CE} Characteristics (typ.)



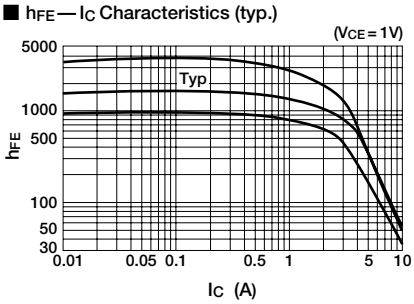
■ V_{CE} (sat) — I_B Temperature Characteristics (typ.)



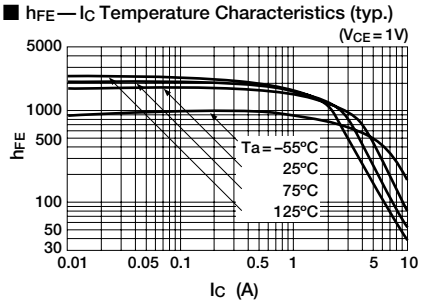
■ I_C — V_{BE} Temperature Characteristics (typ.)



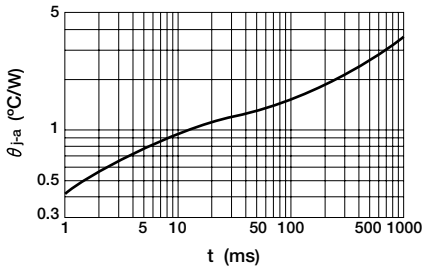
■ h_{FE} — I_C Characteristics (typ.)



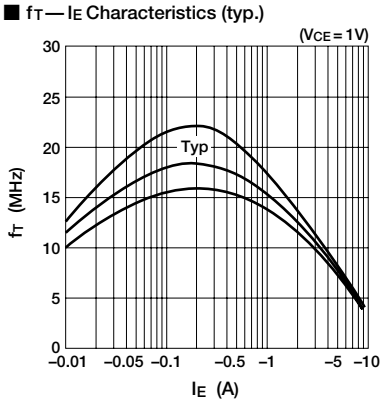
■ h_{FE} — I_C Temperature Characteristics (typ.)



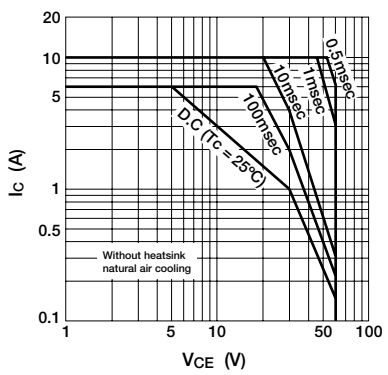
■ $\theta_{j\text{-}a}$ — t Characteristics



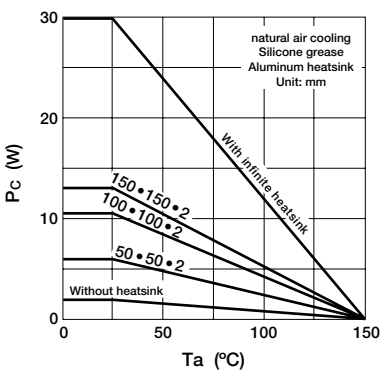
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor 2SD2633

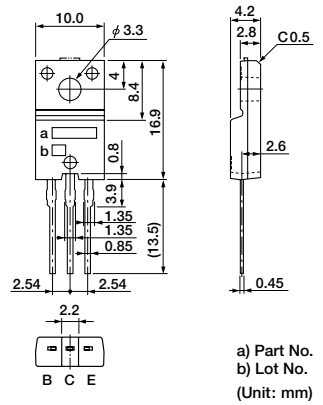
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	200	V
V_{CEO}	150	V
V_{EBO}	6	V
I_C	8	A
I_B	1	A
P_C	35 (T_C=25°C)	W
	2 (T_a=25°C, No Fin)	
Tj	150	°C
Tstg	–55 to +150	°C

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB}=200V	100max	μA
I_{EBO}	V_{EB}=6V	10max	mA
V_{CEO}	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)



a) Part No.
b) Lot No.
(Unit: mm)

Power Transistor FP812

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	–120	V
V_{CEO}	–120	V
V_{EBO}	–6	V
I_C	–8 (pulse –12)	A
I_B	–3	A
P_C	35 (Tc=25°C)	W
Tj	150	°C
Tstg	–55 to +150	°C

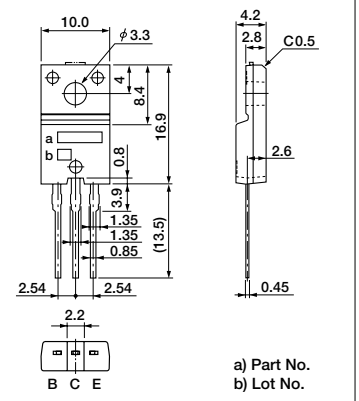
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = –120V	10max	μA
I_{EBO}	V_{EB} = –6V	10max	μA
V_{CEO}	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

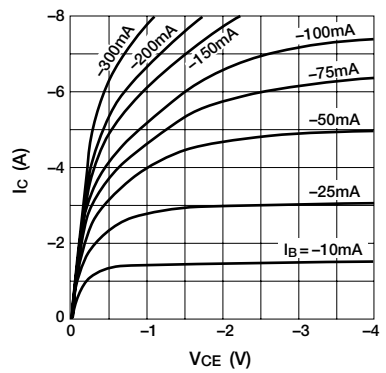
Typical Switching Characteristics

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

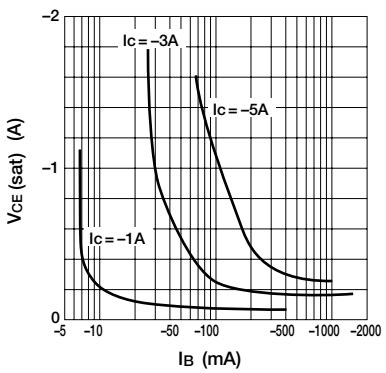
External Dimensions TO220F (full-mold)



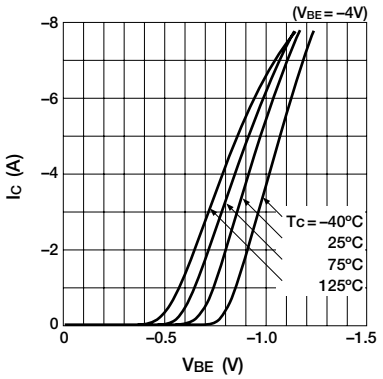
■ I_C — V_{CE} Characteristics (typ.)



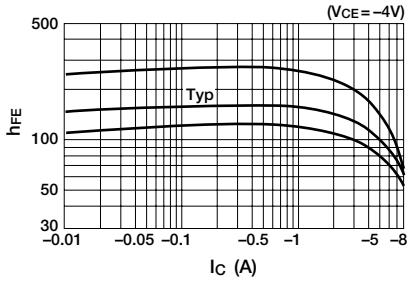
■ V_{CE} (sat) — I_B Characteristics (typ.)



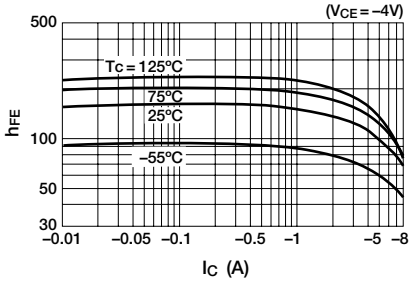
■ I_C — V_{BE} Temperature Characteristics (typ.)



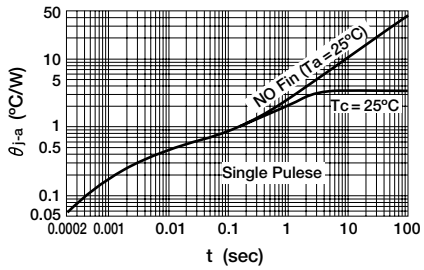
■ h_{FE} — I_C Characteristics (typ.)



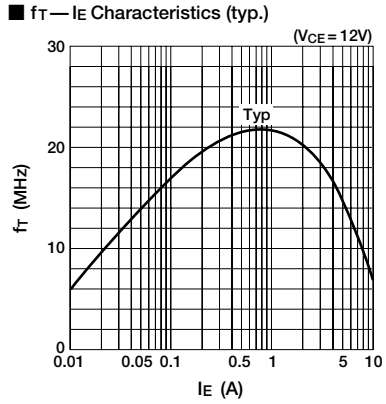
■ h_{FE} — I_C Temperature Characteristics (typ.)



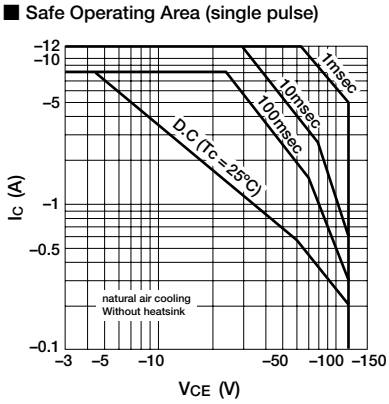
■ $\theta_{j\text{-}a}$ — t Characteristics



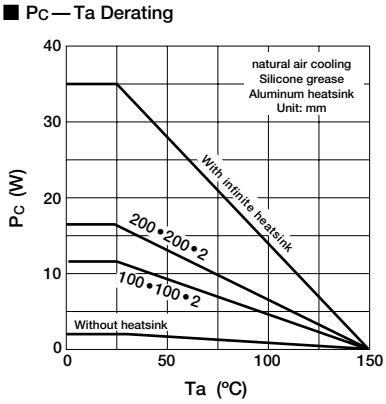
■ f_T — I_E Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_C — Ta Derating



Power Transistor MN611S

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	115±10	V
V_{CEO}	115±10	V
V_{EBO}	6	V
I_C	±6 (pulse ±10)	A
I_B	1	A
P_C	50 (Tc=25°C)	W
	1.2 (Ta=25°C, No Fin)	
Tj	150	°C
Tstg	−55 to +150	°C

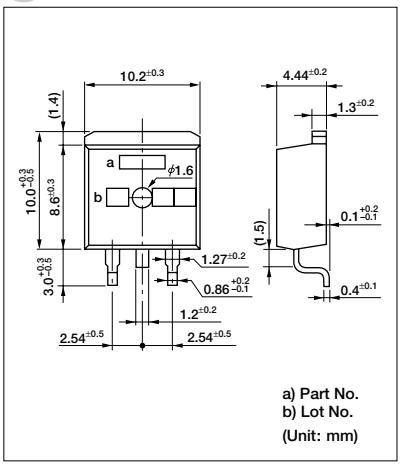
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB}=105V			10	μA
I_{EBO}	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
$E_{S/B}$	L=10mA	45			mJ

Typical Switching Characteristics

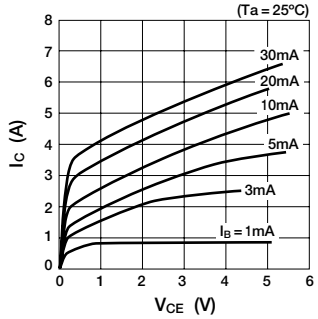
V_{CC} (V)	R_L (Ω)	V_{BB1} (V)	V_{BB2} (V)	I_C (A)	I_{B1} (mA)	I_{B2} (mA)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
12	12	10	−5	1	30	−30	0.2typ	5.7typ	0.4typ

External Dimensions TO220S

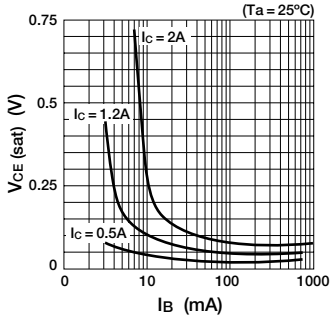


a) Part No.
b) Lot No.
(Unit: mm)

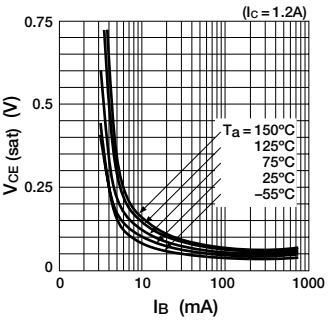
■ I_C — V_{CE} Characteristics (typ.)



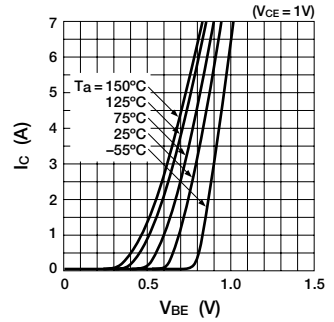
■ V_{CE} (sat) — I_B Characteristics (typ.)



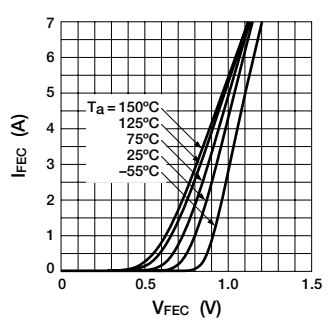
■ V_{CE} (sat) — I_B Temperature Characteristics (typ.)



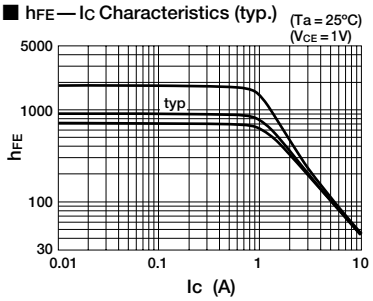
■ I_C — V_{BE} Temperature Characteristics (typ.)



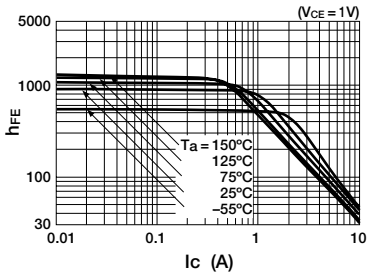
■ I_{FEC} — V_{FEC} Temperature Characteristics (typ.)



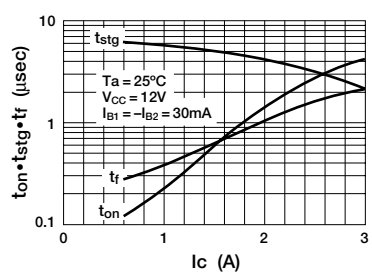
■ h_{FE} — I_C Characteristics (typ.)



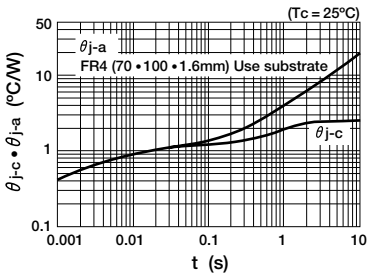
■ h_{FE} — I_C Temperature Characteristics (typ.)



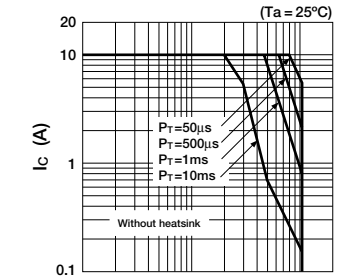
■ t_{on}•t_{stg}•t_f — I_C Characteristics (typ.)



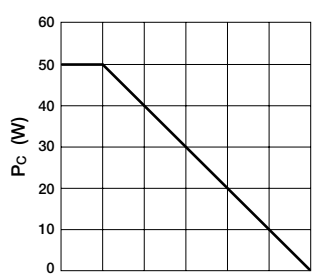
■ $\theta_{j\text{-}c}$ • $\theta_{j\text{-}a}$ — t Characteristics (Single pulse)



■ Safe Operating Area (Single pulse)



■ P_T — Ta Derating



Power Transistor MN638S

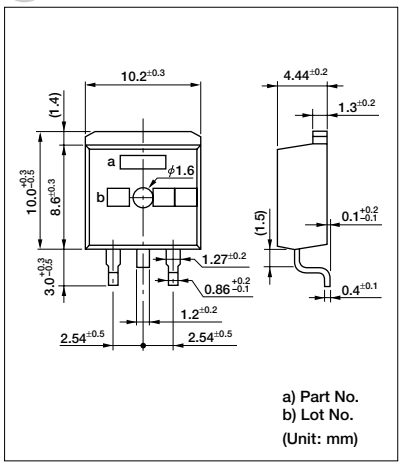
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	380±50	V
V_{CEO}	380±50	V
V_{EBO}	6	V
I_C	6 (pulse 10)	A
I_B	1	A
P_C	60 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

Electrical Characteristics (Ta=25°C)

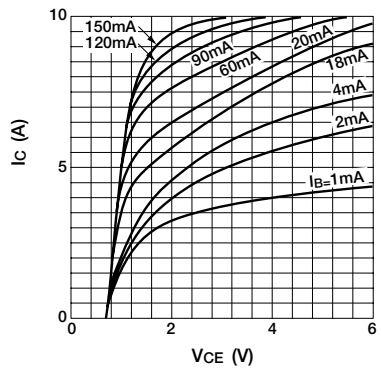
Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB}=330V	10max	μA
I_{EBO}	V_{EB}=6V	20max	mA
$V_{(BR)\ CEO}$	I_C=25mA	330 to 430	V
h_{FE}	V_{CE}=2V, I_C=3A	1500min	
$V_{CE\ (sat)}$	I_C=4A, I_B=20mA	1.5max	V

External Dimensions TO220S

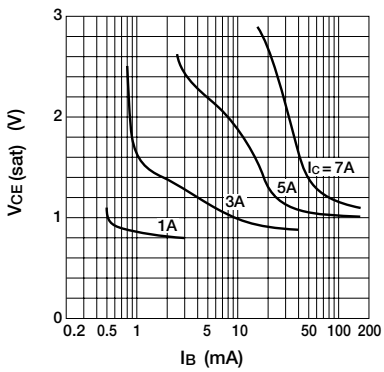


a) Part No.
b) Lot No.
(Unit: mm)

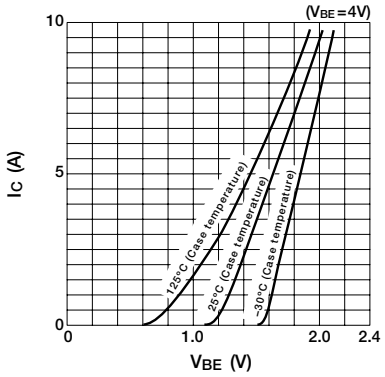
■ I_C — V_{CE} Characteristics (typ.)



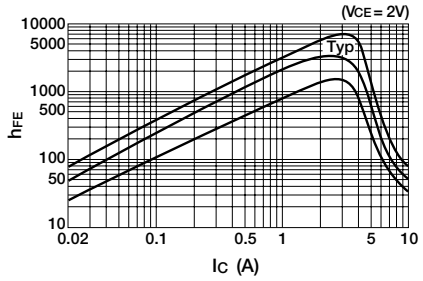
■ $V_{CE\ (sat)}$ — I_B Characteristics (typ.)



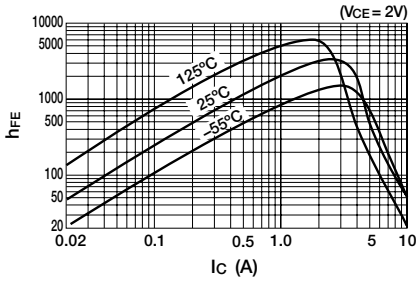
■ I_C — V_{BE} Temperature Characteristics (typ.)



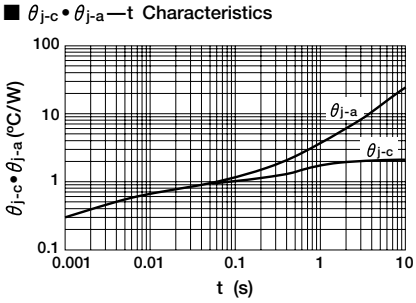
■ h_{FE} — I_C Characteristics (typ.)



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



■ $\theta_{j\text{-}c} \bullet \theta_{j\text{-}a}$ — t Characteristics



Surface-mount Power Transistor SSD103

Absolute Maximum Ratings (Ta=25°C)

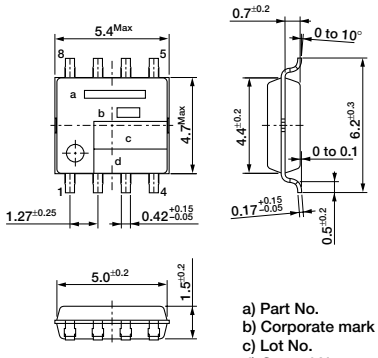
Symbol	Ratings	Unit
V_{CBO}	65±5	V
V_{CEO}	65±5	V
V_{EBO}	6	V
I_C	6	
I_C (pulse)	10 (Pw≦1mS, Duty≦25%)	A
I_B	10	A
P_C	1.5*1	W
Tj	150	°C
Tstg	−55 to +150	°C

*1: FR4 70mm•100mm•1.6mm
(drain heatsink copper foil area 25•25mm)

Electrical Characteristics (Ta=25°C)

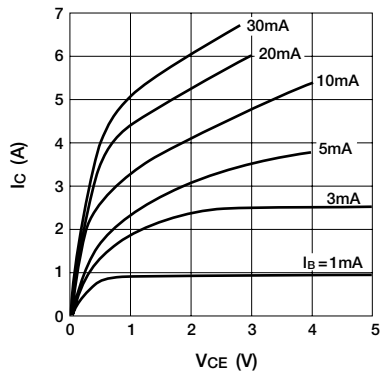
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB} = 60V, I_E = 0A			10	μA
I_{EBO}	V_{EB} = 6V, I_C = 0A			10	μA
V_{CEO}	I_C = 50mA	60	65	70	V
h_{FE}	V_{CE} = 1V, I_C = 1A	400	800	1500	
V_{CE} (sat)	I_C = 1.5A, I_B = 15mA		0.11	0.15	V
V_{FEC}	I_{FEC} = 6A		1.25	1.5	V
Es/b	L = 10mH	80			mJ

External Dimensions SOP8

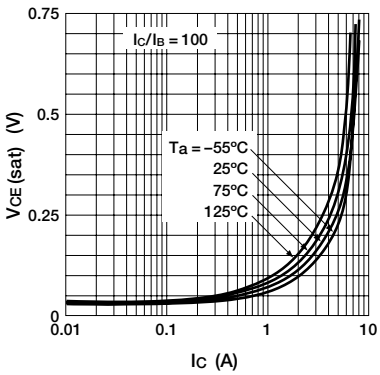


a) Part No.
b) Corporate mark
c) Lot No.
d) Control No.
(Unit: mm)

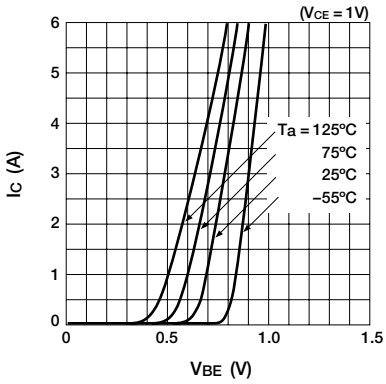
■ I_C — V_{CE} Characteristics (typ.)



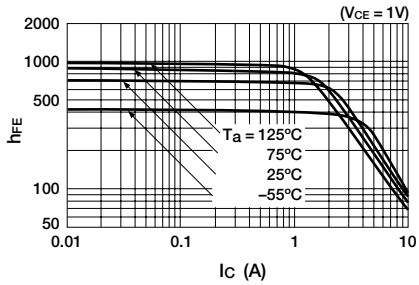
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



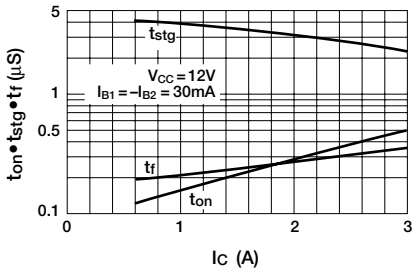
■ I_C — V_{BE} Temperature Characteristics (typ.)



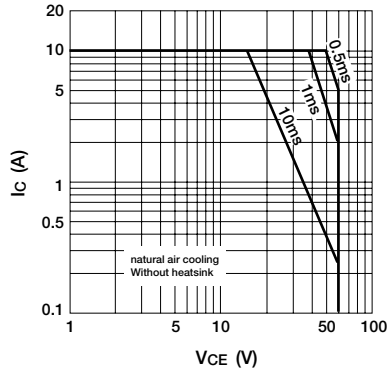
■ h_{FE} — I_C Temperature Characteristics (typ.)



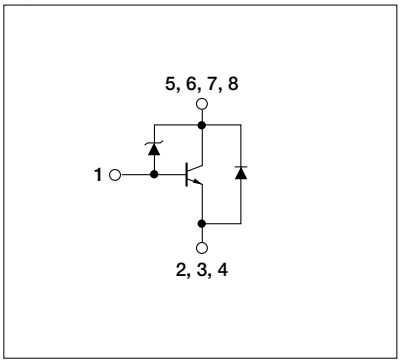
■ t_{on} • t_{stg} • t_f — I_C Characteristics (typ.)



■ Safe Operating Area (Single pulse)



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDA03

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	–60	V
V_{CEO}	–60	V
V_{EBO}	–6	V
I_C	–6 (pulse –12)	A
I_B	–1	A
P_T	3 (No Fin)	W
Tj	150	°C
Tstg	–55 to +150	°C

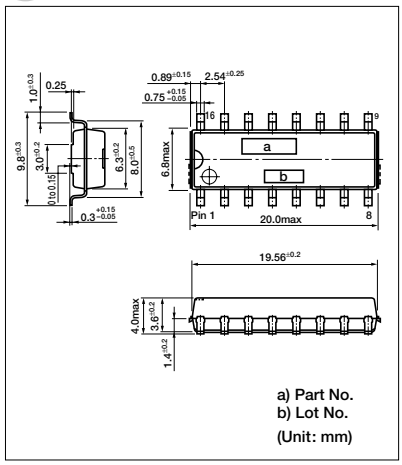
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = –60V	–10max	μA
I_{EBO}	V_{EB} = –6V	–10max	μA
V_{CEO}	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

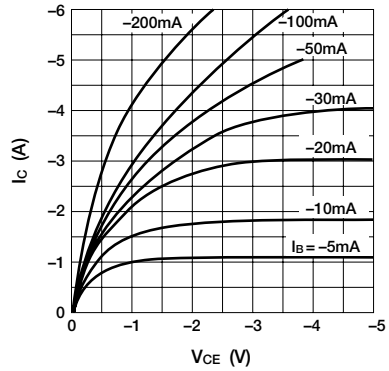
Typical Switching Characteristics

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

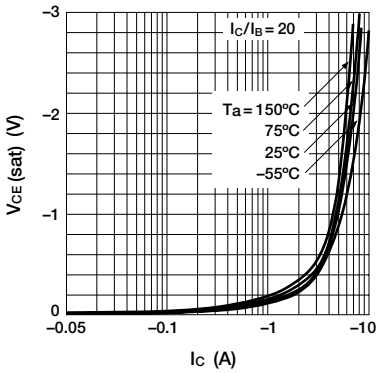
External Dimensions SMD-16A



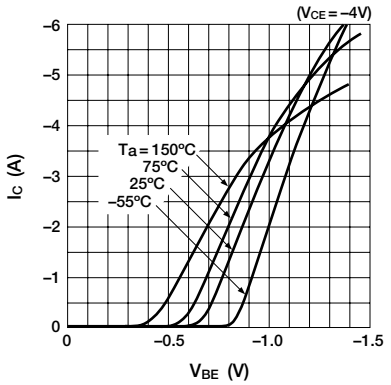
■ I_C — V_{CE} Characteristics



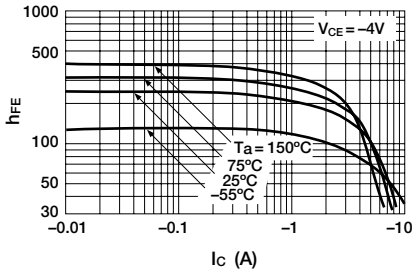
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



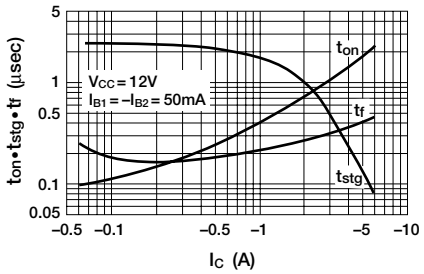
■ I_C — V_{BE} Temperature Characteristics (typ.)



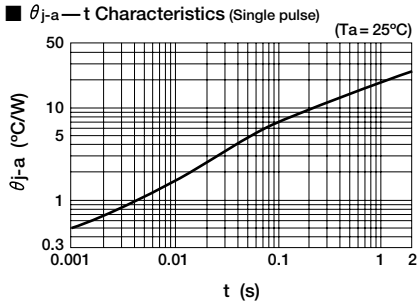
■ h_{FE} — I_C Temperature Characteristics



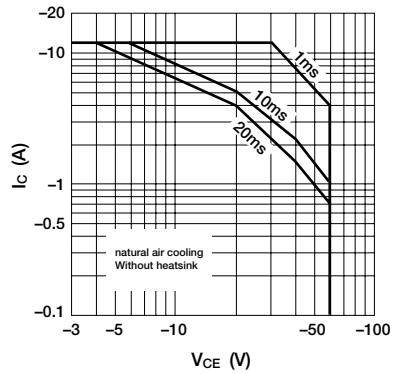
■ $t_{on} \cdot t_{stg} \cdot t_f$ — I_C Characteristics



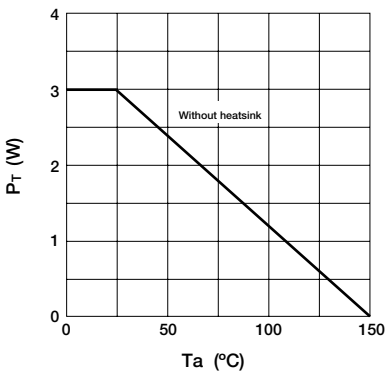
■ $\theta_{j\text{-}a}$ — t Characteristics (Single pulse)



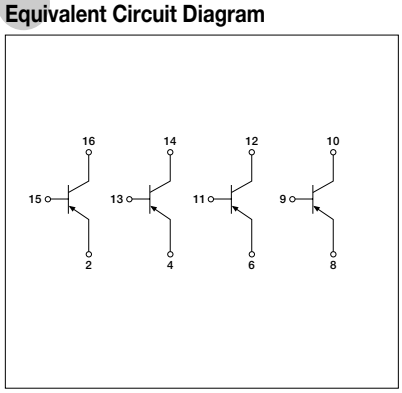
■ Safe Operating Area (Single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDA04

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	–60	V
V_{CEO}	–60	V
V_{EBO}	–6	V
I_C	–6 (pulse –12)	A
I_B	–1	A
P_T	2.5 (No Fin)	W
Tj	150	°C
Tstg	–55 to +150	°C

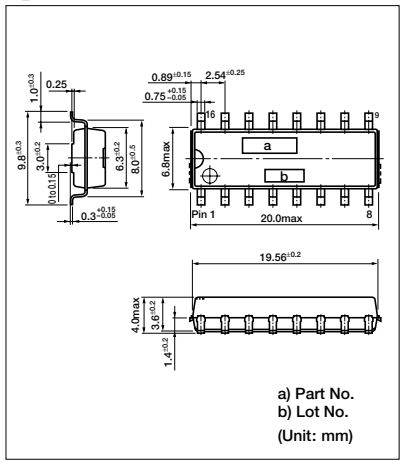
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = –60V	–10max	μA
I_{EBO}	V_{EB} = –6V	–10max	μA
V_{CEO}	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

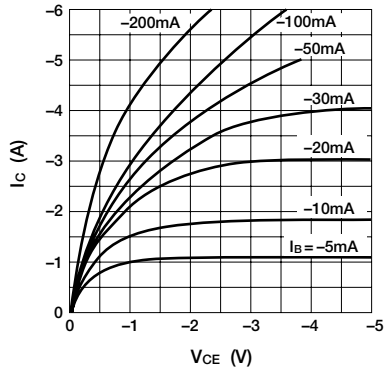
Typical Switching Characteristics

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

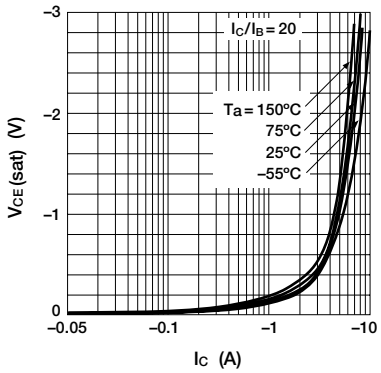
External Dimensions SMD-16A



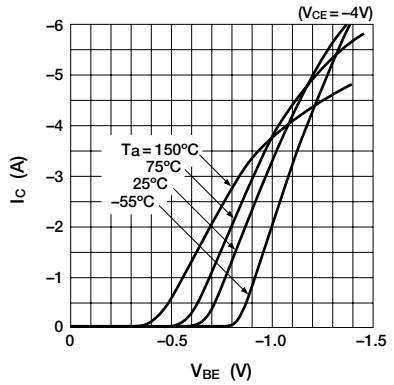
■ I_C — V_{CE} Characteristics



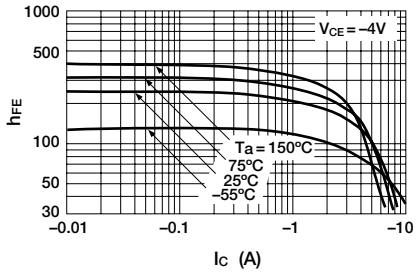
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



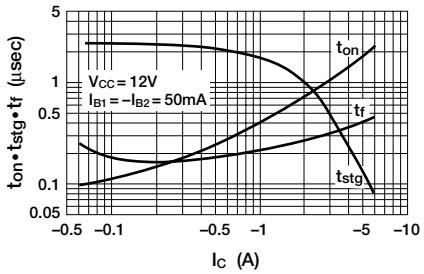
■ I_C — V_{BE} Temperature Characteristics (typ.)



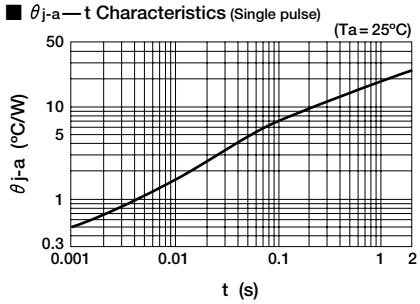
■ h_{FE} — I_C Temperature Characteristics



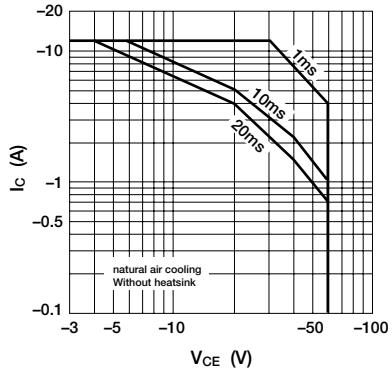
■ $t_{on} \cdot t_{stg} \cdot t_f$ — I_C Characteristics



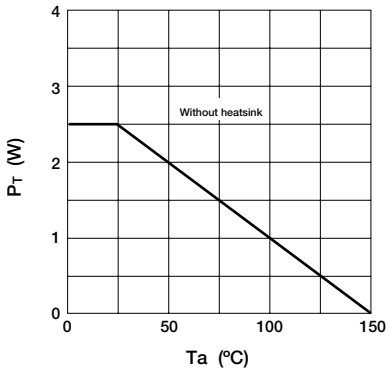
■ $\theta_{j\text{-}a}$ — t Characteristics (Single pulse)



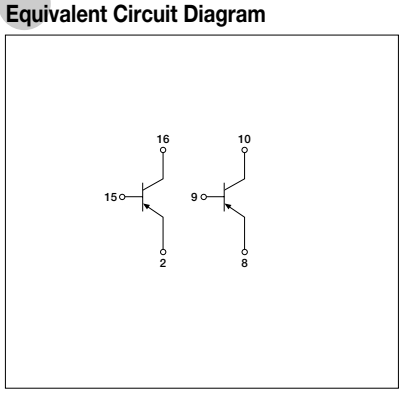
■ Safe Operating Area (Single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SDC09

Absolute Maximum Ratings (Ta=25°C)

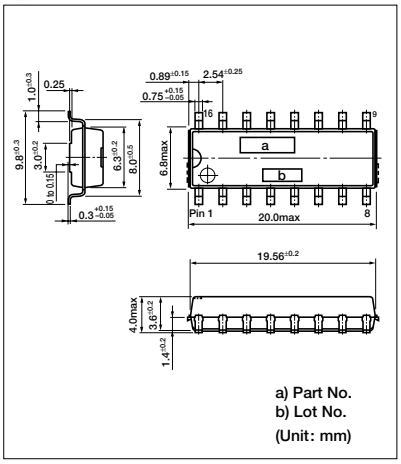
Symbol	Ratings	Unit
V_{CBO}	65±5	V
V_{CEO}	65±5	V
V_{EBO}	6	V
I_C	6 (pulse 10 *)	A
I_B	1	A
P_T	2.8	W
Tj	150	°C
Tstg	−55 to +150	°C

* $P_W \leqq 100\mu s$, Duty ≦1%

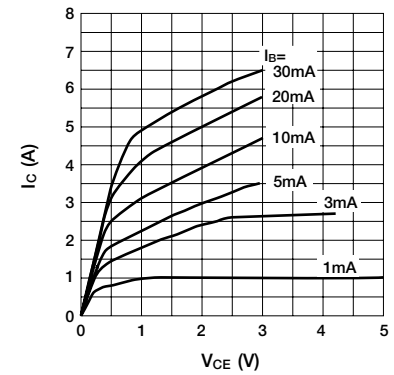
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB}=60V	10max	μA
I_{EBO}	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

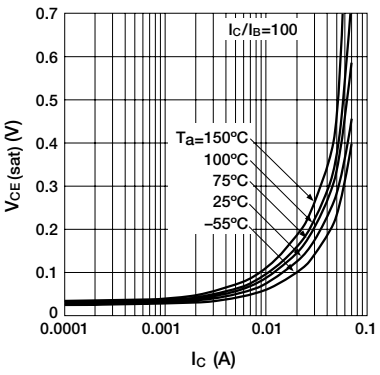
External Dimensions SMD-16A



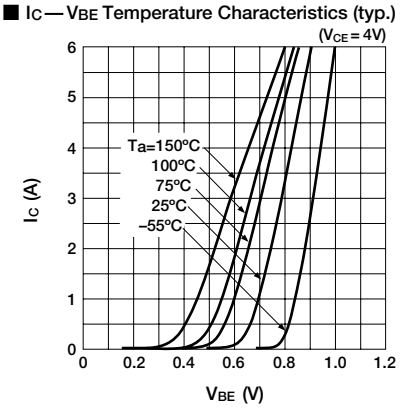
■ I_C — V_{CE} Characteristics



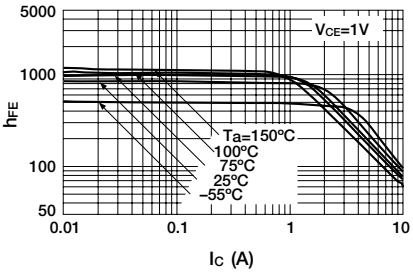
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



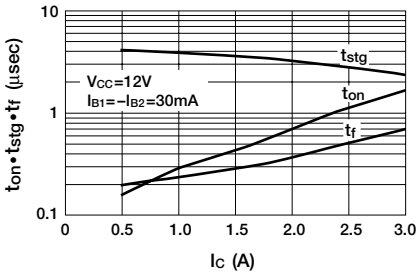
■ I_C — V_{BE} Temperature Characteristics (typ.)



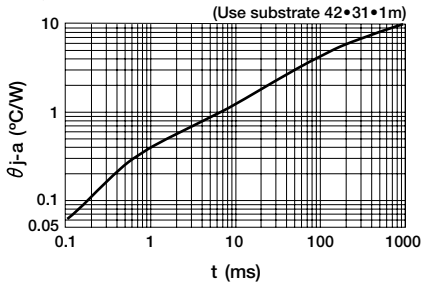
■ h_{FE} — I_C Temperature Characteristics



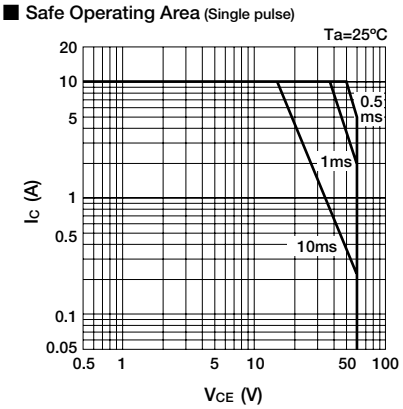
■ $t_{on} \cdot t_{stg} \cdot t_f$ — I_C Characteristics



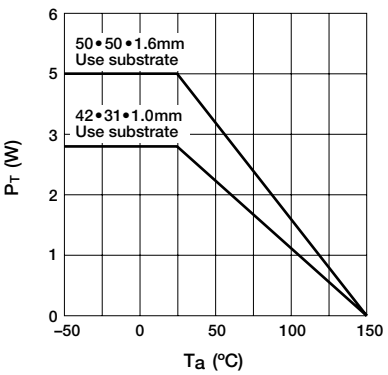
■ $\theta_{j\text{-}a}$ — t Characteristics (Single pulse)



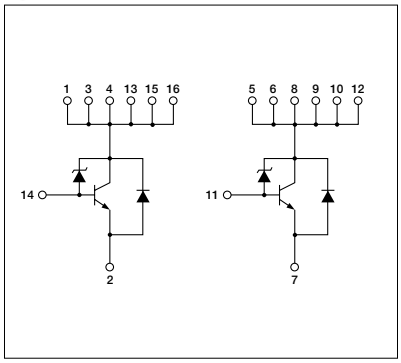
■ Safe Operating Area (Single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array SLA8004

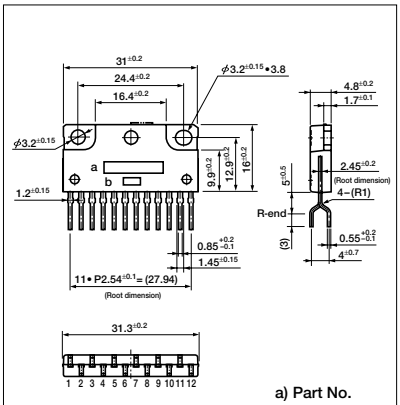
Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings		Unit
	NPN	PNP	
V_{CBO}	60	−55	V
V_{CEO}	60	−55	V
V_{EBO}	6	−6	V
I_C	12	−12	A
I_B	3	−3	A
P_T	5 (Tc=25°C, No Fin)		W
	40 (Tc=25°C)		W
Tj	150		°C
Tstg	−55 to +150		°C

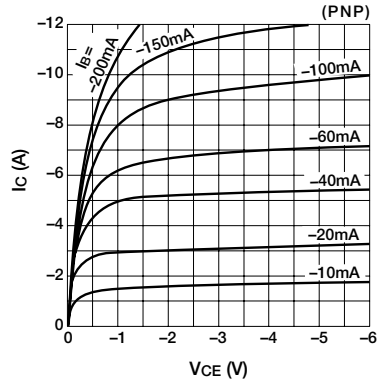
Electrical Characteristics (Ta=25°C)

Symbol	NPN		PNP		Unit
	Test Conditions	Ratings	Test Conditions	Ratings	
I_{CBO}	V_{CB} = 60V	100max	V_{CB} = −55V	−100max	μA
I_{EBO}	V_{EB} = 6V	60max	V_{EB} = −6V	−60max	mA
V_{CEO}	I_C = 25mA	60min	I_C = −25mA	−55min	V
h_{FE}	V_{CE}=1V, I_C=3A	150min	V_{CE}=−1V, I_C=−3A	80min	
V_{CE} (sat)	I_C=6A, I_B=0.3A	0.35max	I_C=−6A, I_B=−0.3A	−0.35max	V
V_{FEC}	I_{FEC} = 10A	2.5max	I_{FEC} = 10A	2.5max	V

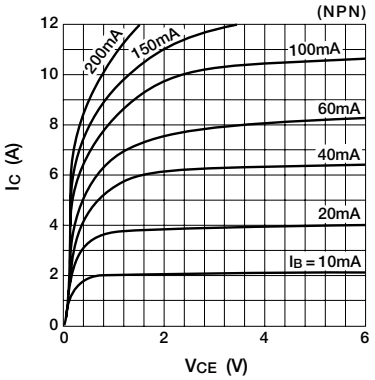
External Dimensions SLA 12pin (LF817)



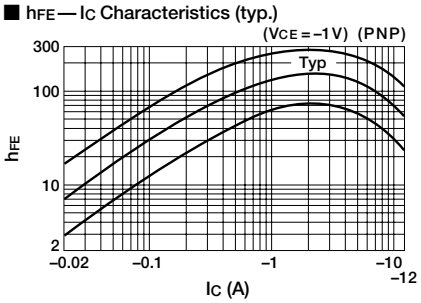
■ I_C — V_{CE} Characteristics (typ.)



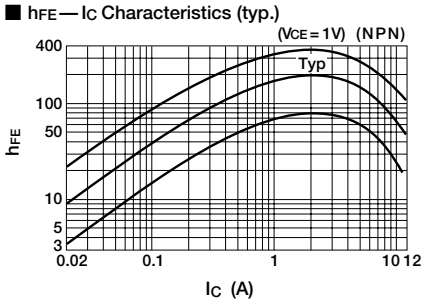
■ I_C — V_{CE} Characteristics (typ.)



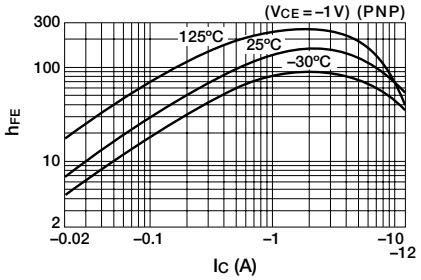
■ h_{FE} — I_C Characteristics (typ.)



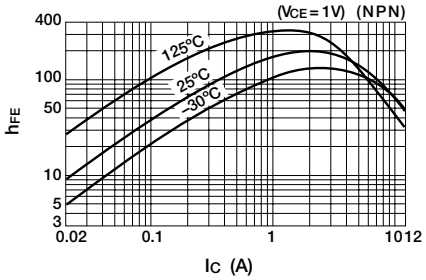
■ h_{FE} — I_C Characteristics (typ.)



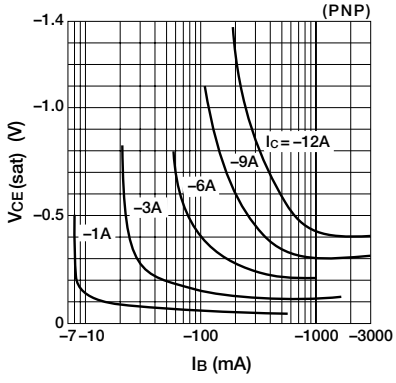
■ h_{FE} — I_C Temperature Characteristics (typ.)



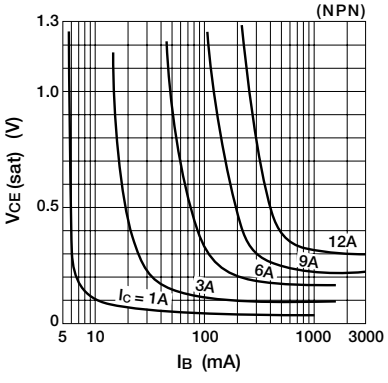
■ h_{FE} — I_C Temperature Characteristics (typ.)



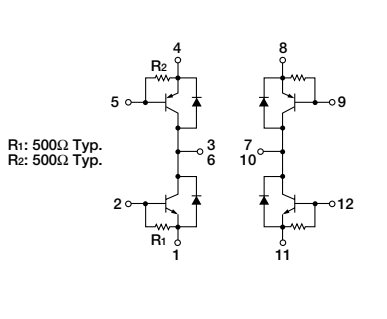
■ V_{CE} (sat) — I_B Characteristics (typ.)



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



Equivalent Circuit Diagram



Surface-mount Power Transistor Array SPF0001

Absolute Maximum Ratings (Ta=25ºC)

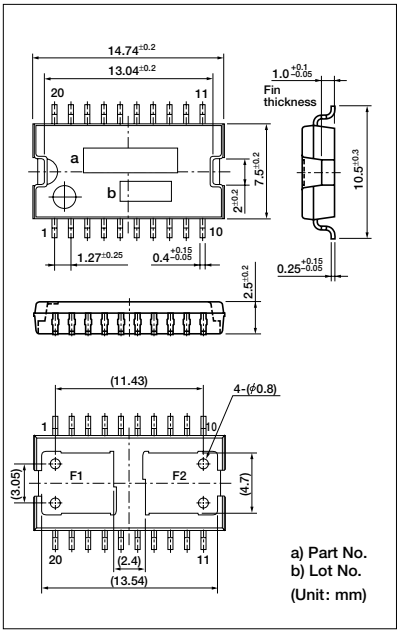
Symbol	Ratings	Unit
V_{CBO}	115±10	V
V_{CEO}	115±10	V
V_{EBO}	6	V
I_C	±6 (pulse ±10)	A
I_B	1	A
P_T *	2.5 (Ta=25ºC)	W
Tj	150	ºC
Tstg	−55 to +150	ºC

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

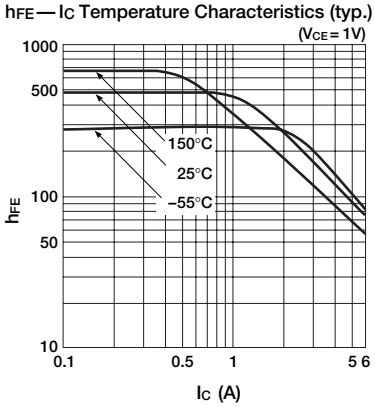
Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB}=105V			10	μA
I_{EBO}	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

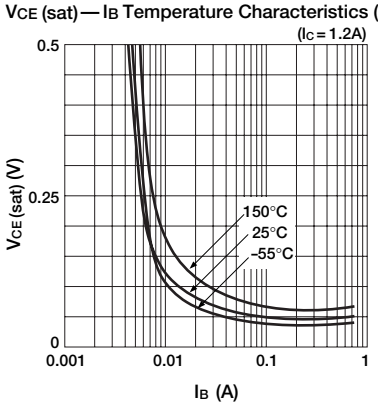
External Dimensions SPF 20pin



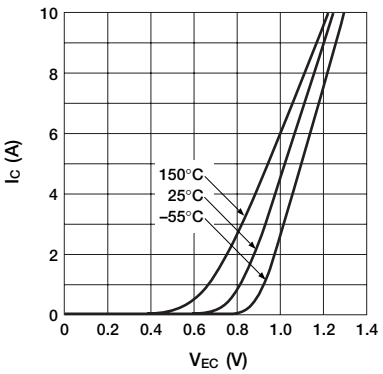
■ h_{FE} — I_C Temperature Characteristics (typ.)



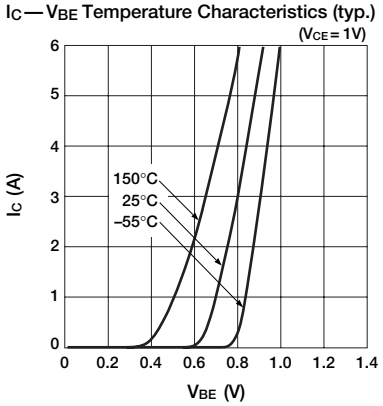
■ V_{CE} (sat) — I_B Temperature Characteristics (typ.)



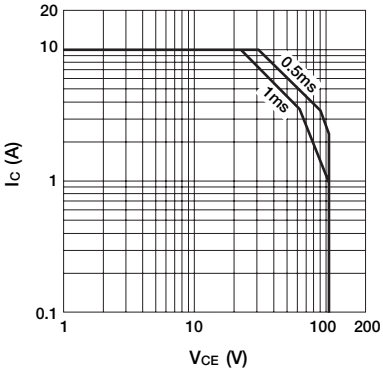
■ I_C — V_{EC} Temperature Characteristics (typ.)



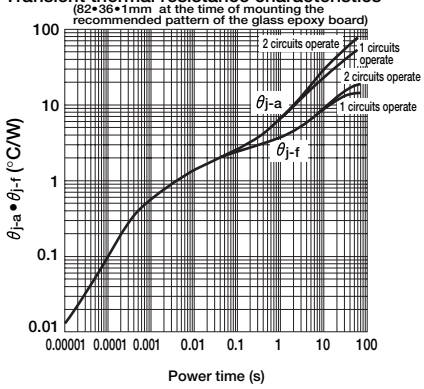
■ I_C — V_{BE} Temperature Characteristics (typ.)



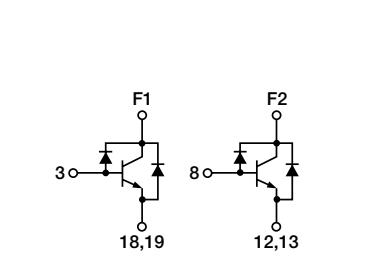
■ Safe Operating Area (single pulse)



■ Transient thermal resistance characteristics



Equivalent Circuit Diagram



Power Transistor Array STA315A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	35±5	V
V_{CEO}	36±5	V
V_{EBO}	6	V
I_C	2 (pulse 3*)	A
I_B	30	mA
P_T	3 (Ta=25°C)	W
	13.5 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

* $P_W \leqq 1$ms, Duty $\leqq$ 25%

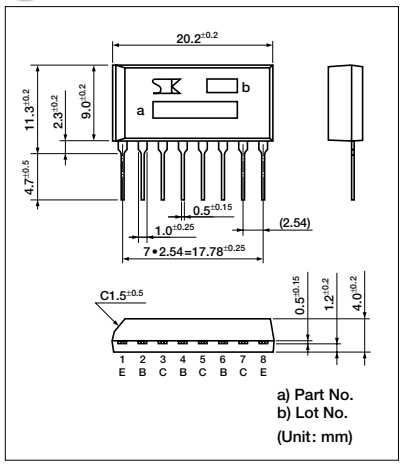
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 30V	10max	μA
I_{EBO}	V_{EB} = 6V	2.7max	mA
V_{CEO}	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

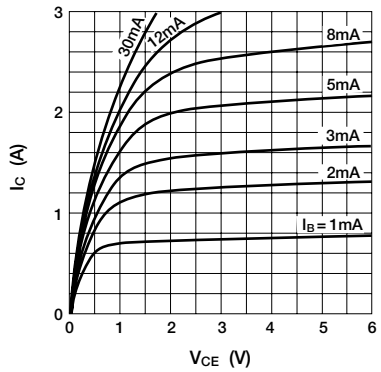
Typical Switching Characteristics

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

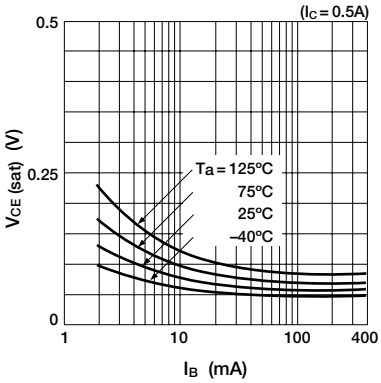
External Dimensions STA3 (LF400A)



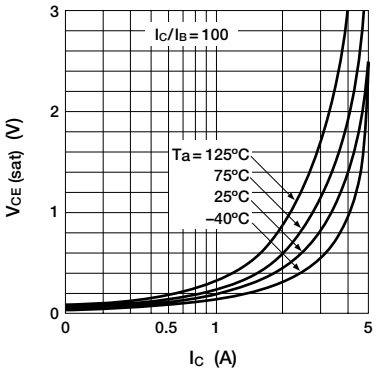
■ I_C — V_{CE} Characteristics (typ.)



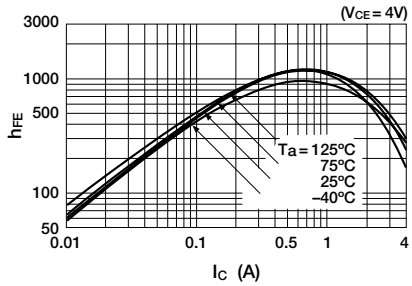
■ V_{CE} (sat) — I_B Temperature Characteristics



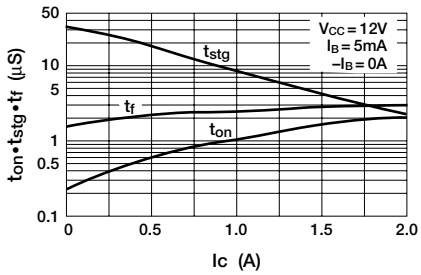
■ V_{CE} (sat) — I_C Temperature Characteristics



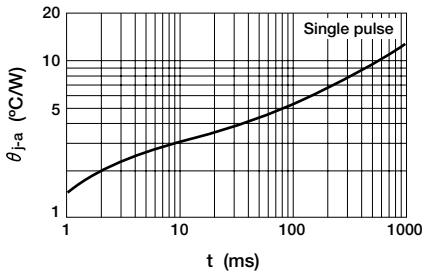
■ h_{FE} — I_C Temperature Characteristics



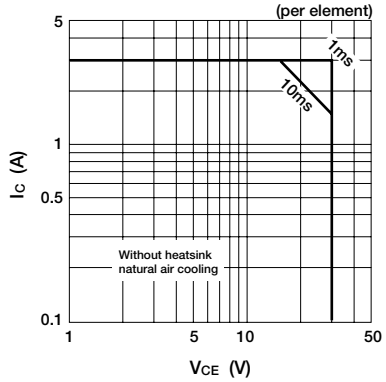
■ t_{on}•t_{stg}•t_f — I_C Characteristics (typ.)



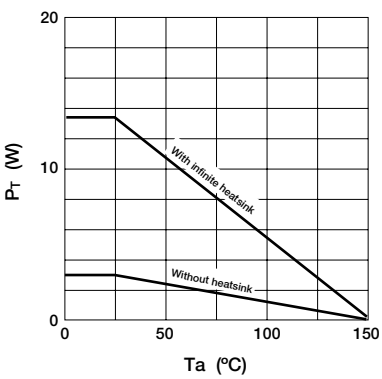
■ $\theta_{j\text{-}a}$ — t Characteristics



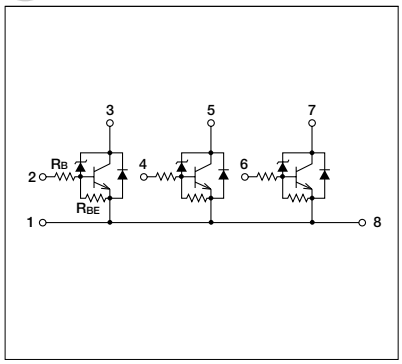
■ Safe Operating Area (single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA335A

Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	35±5	V
V_{CEO}	35±5	V
V_{EBO}	6	V
I_C	3	A
I_B	1	A
P_T	2.5 (Ta=25ºC)	W
	12 (Tc=25ºC)	W
Tj	150	ºC
Tstg	−55 to +150	ºC

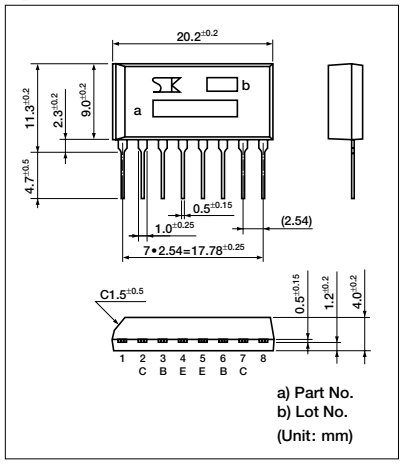
Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 30V	10max	μA
I_{EBO}	V_{EB} = 6V	10max	μA
V_{CEO}	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

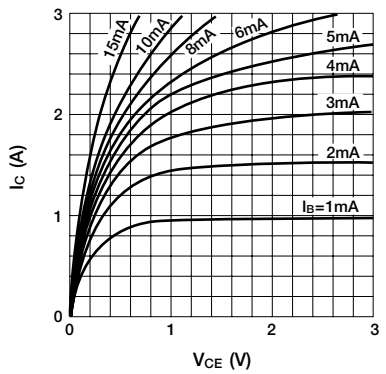
V_{CC} (V)	R_L (Ω)	I_C (A)	V_{BB1} (V)	V_{BB2} (V)	I_{B1} (mA)	I_{B2} (mA)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
12	12	1	10	−5	5	5	1.3	4.7	1.2

External Dimensions STA3 (LF400A)

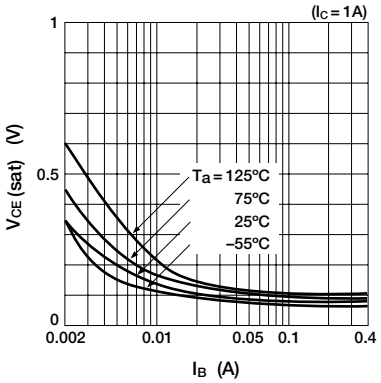


a) Part No.
b) Lot No.
(Unit: mm)

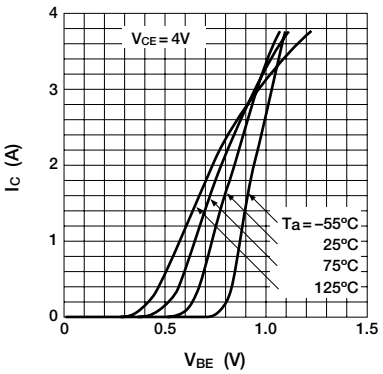
■ I_C — V_{CE} Characteristics (typ.)



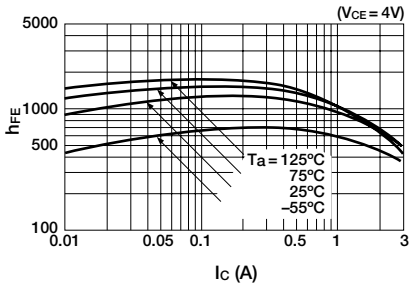
■ V_{CE} (sat) — I_B Temperature Characteristics



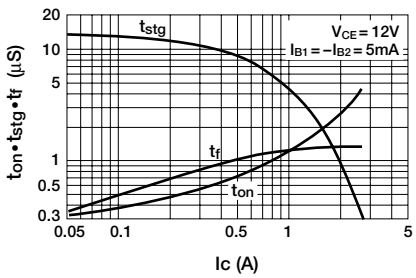
■ I_C — V_{BE} Temperature Characteristics (typ.)



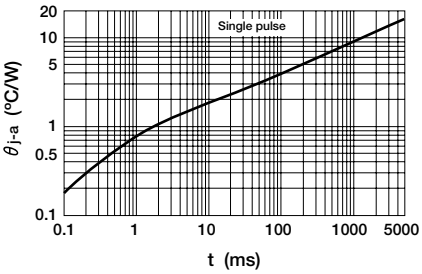
■ h_{FE} — I_C Temperature Characteristics (typ.)



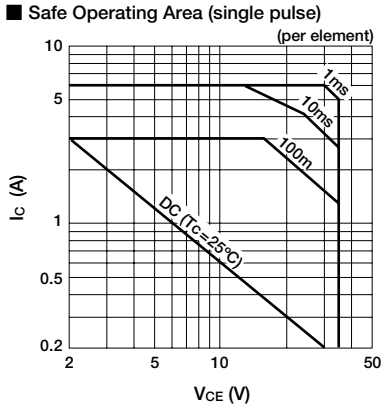
■ t_{on}•t_{stg}•t_f — I_C Characteristics (typ.)



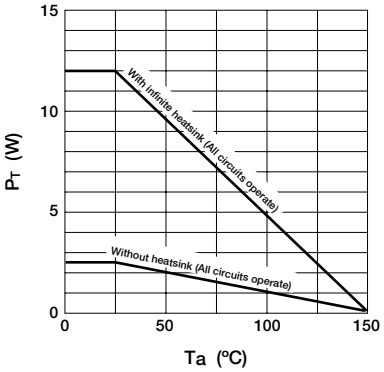
■ $\theta_{j\text{-}a}$ — t Characteristics



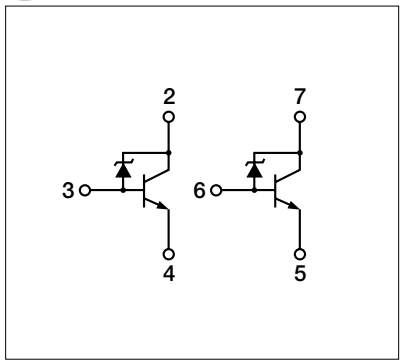
■ Safe Operating Area (single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA415A

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	35±5	V
V_{CEO}	36±5	V
V_{EBO}	6	V
I_C	2 (pulse 3*)	A
I_B	30	mA
P_T	4 (Ta = 25°C)	W
	18 (Tc = 25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

* $P_W \leqq 1$ms, Duty ≦ 25%

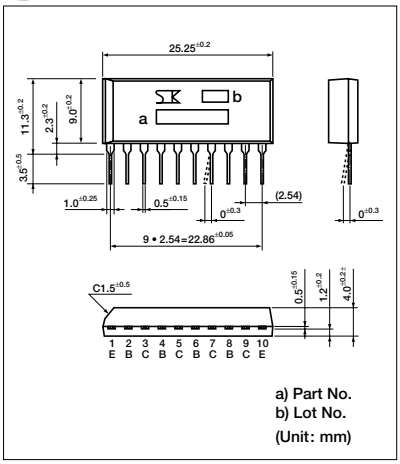
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 30V	10max	μA
I_{EBO}	V_{EB} = 6V	2.7max	mA
V_{CEO}	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

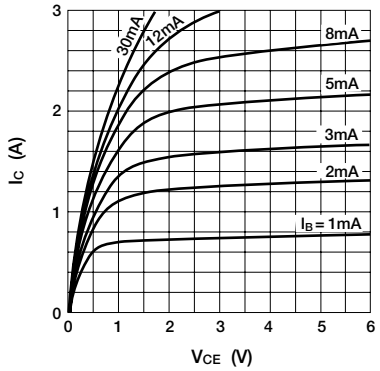
V_{CC} (V)	R_L (Ω)	I_C (A)	V_{BB1} (V)	V_{BB2} (V)	I_{B1} (mA)	I_{B2} (mA)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
12	12	1	10	−5	5	0	1.0	8.5	2.5

External Dimensions STA4 (LF412)

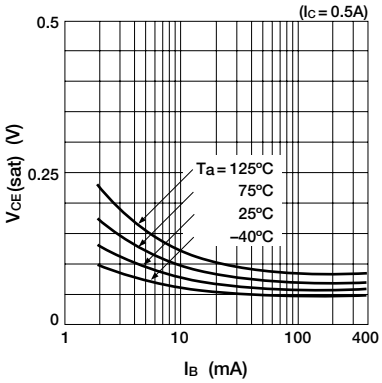


a) Part No.
b) Lot No.
(Unit: mm)

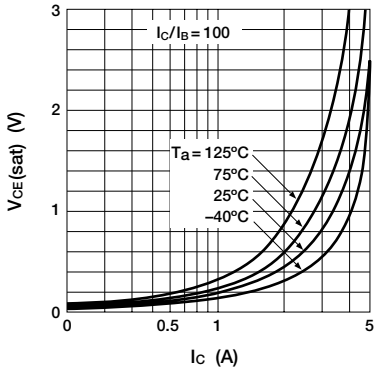
■ I_C — V_{CE} Characteristics (typ.)



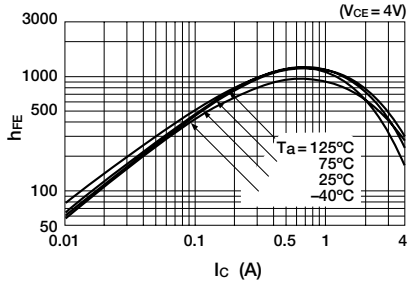
■ V_{CE} (sat) — I_B Temperature Characteristics



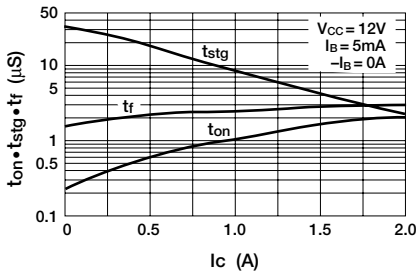
■ V_{CE} (sat) — I_C Temperature Characteristics



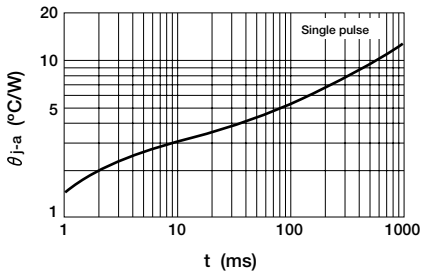
■ h_{FE} — I_C Temperature Characteristics



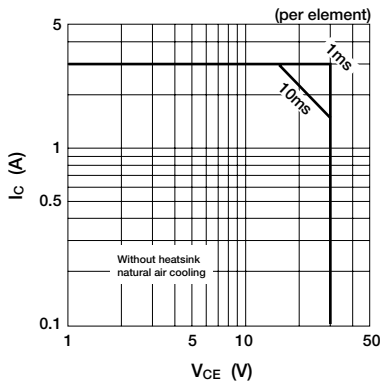
■ t_{on}•t_{stg}•t_f — I_C Characteristics (typ.)



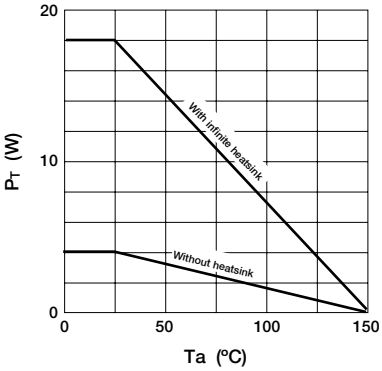
■ $\theta_{j\text{-}a}$ — t Characteristics



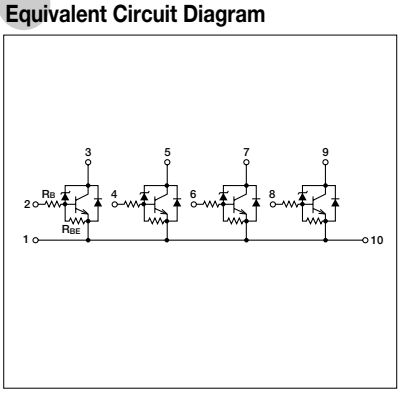
■ Safe Operating Area (single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA460C

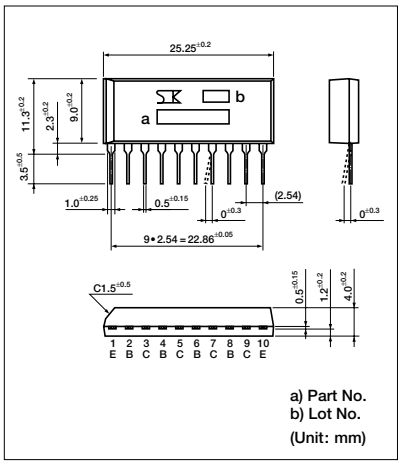
Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	60±10	V
V_{CEO}	60±10	V
V_{EBO}	6	V
I_C	±6	A
I_{CP}	±10 (Pw≦1ms, Du≦50%)	A
P_T	3.2 (Ta = 25°C)	W
	18 (Tc = 25°C)	
Tj	150	°C
Tstg	−40 to +15	°C

Electrical Characteristics (Ta=25ºC)

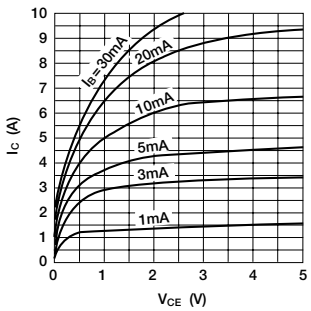
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB} = 50V			10	μA
I_{EBO}	V_{EB} = 6V			10	μA
V_{CEO}	I_C = 50mA	50	60	70	V
h_{FE}	V_{CE} = 1V, I_C = 1A	700	1500	3000	
V_{CE} (sat)	I_C = 1.5A, I_B = 15mA		0.09	0.15	V
V_{FEC}	I_{FEC} = 6A		1.25	1.5	V
Es/b	L = 10mH, single pulse	200			mJ

External Dimensions STA4 (LF412)

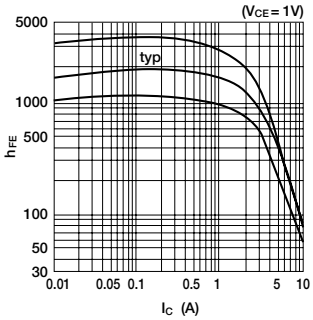


a) Part No.
b) Lot No.
(Unit: mm)

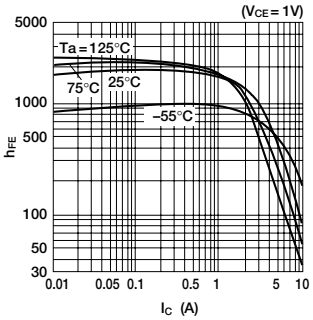
■ I_C — V_{CE} Characteristics (typ.)



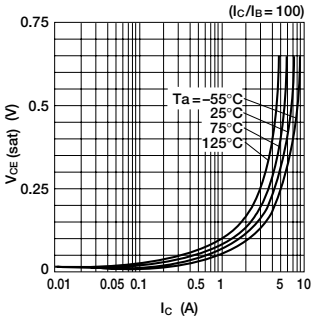
■ h_{FE} — I_C Characteristics (typ.)



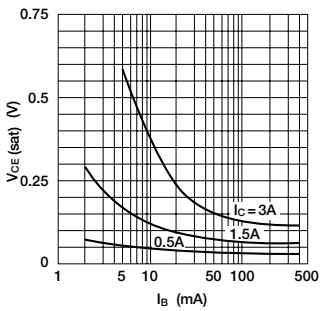
■ h_{FE} — I_C Temperature Characteristics (typ.)



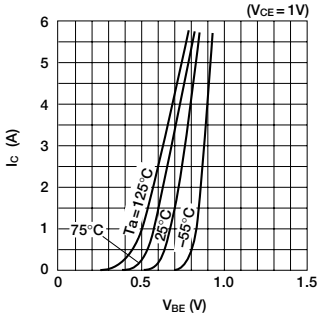
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



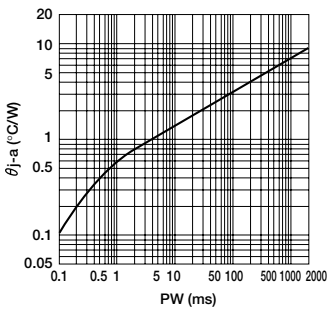
■ V_{CE} (sat) — I_B Temperature Characteristics (typ.)



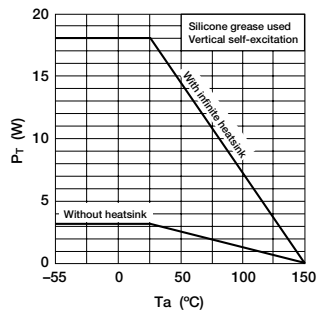
■ I_C — V_{BE} Temperature Characteristics (typ.)



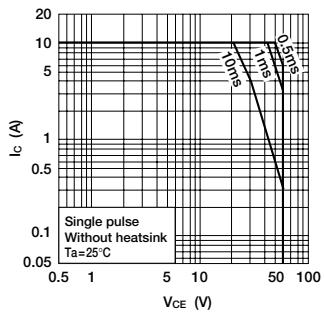
■ $\theta_{j\text{-}a}$ — PW Characteristics



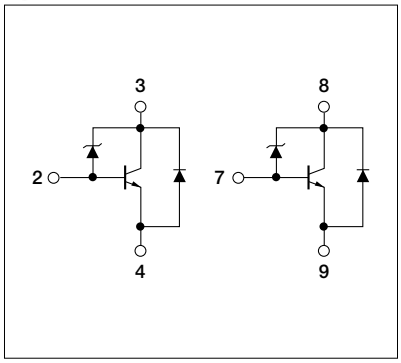
■ P_T — Ta Derating



■ Safe Operating Area



Equivalent Circuit Diagram



Power Transistor Array STA461C

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	65±5	V
V_{CEO}	65±5	V
V_{EBO}	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
Tj	150	°C
Tstg	−55 to +150	°C

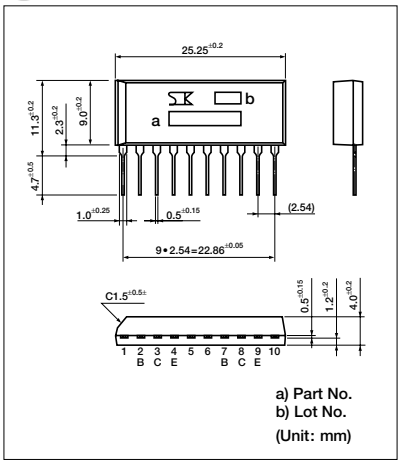
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 60V	10max	μA
I_{EBO}	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

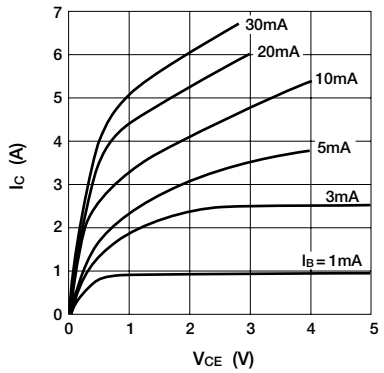
V_{CC} (V)	R_L (Ω)	I_C (A)	V_{BB1} (V)	V_{BB2} (V)	I_{B1} (mA)	I_{B2} (mA)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
12	12	1	10	−5	30	−30	0.2	3.9	0.2

External Dimensions STA4 (LF400B)

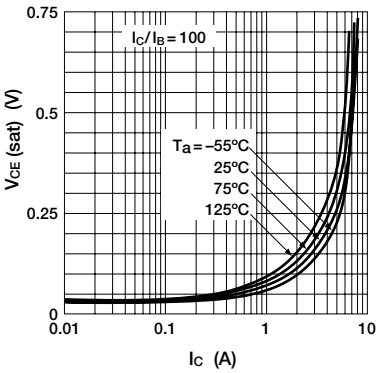


a) Part No.
b) Lot No.
(Unit: mm)

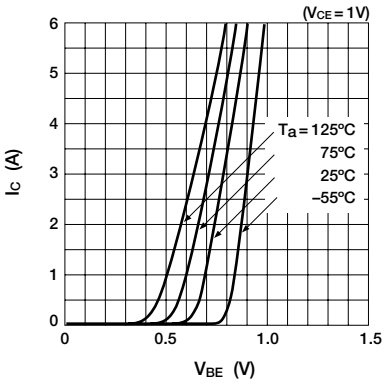
■ I_C — V_{CE} Characteristics (typ.)



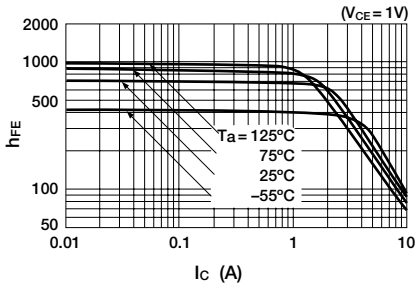
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



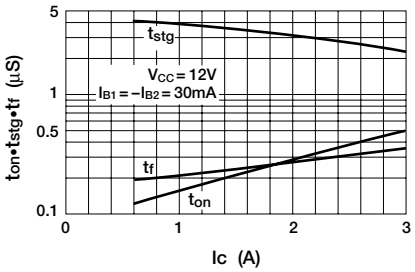
■ I_C — V_{BE} Temperature Characteristics (typ.)



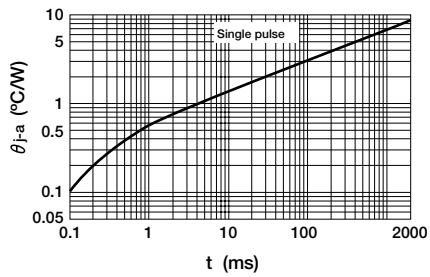
■ h_{FE} — I_C Temperature Characteristics (typ.)



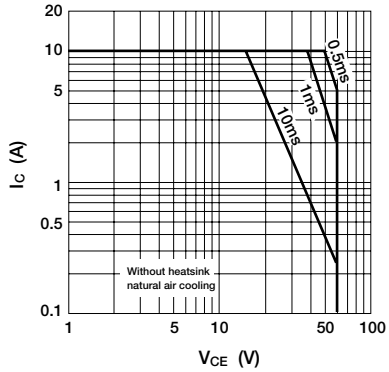
■ t_{on} • t_{stg} • t_f — I_C Characteristics



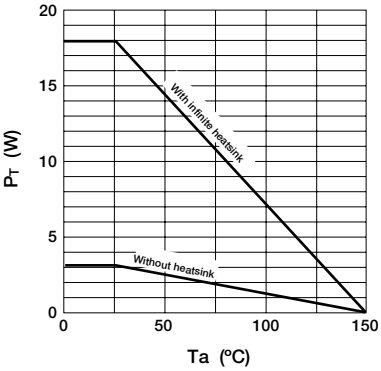
■ $\theta_{j\text{-}a}$ — t Characteristics



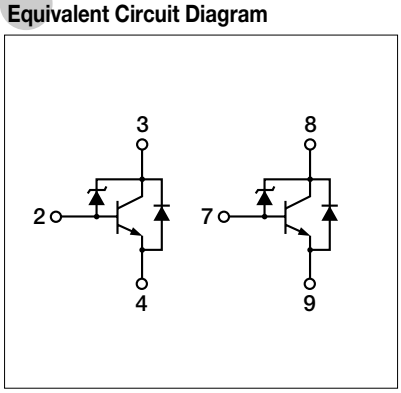
■ Safe Operating Area (single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA463C

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{CBO}	115±10	V
V_{CEO}	115±10	V
V_{EBO}	6	V
I_C	±6 (pulse ±10)	A
I_B	1	A
P_T	3.2 (Ta=250°C)	W
	18 (Tc=25°C)	W
Tj	150	°C
Tstg	−55 to +150	°C

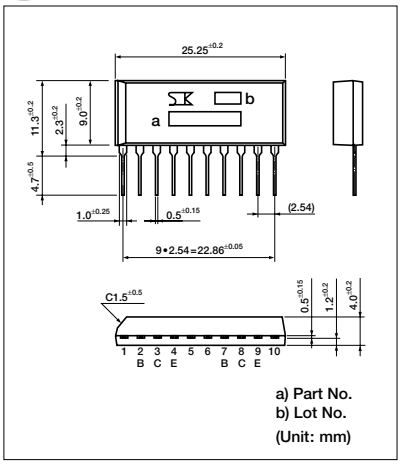
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings	Unit
I_{CBO}	V_{CB} = 105V	10max	μA
I_{EBO}	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

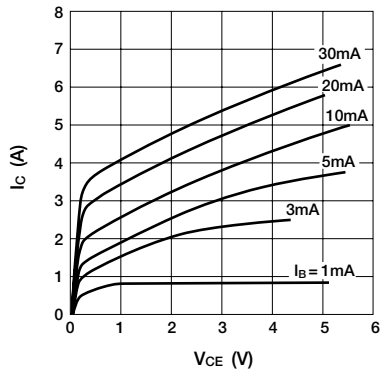
V_{CC} (V)	R_L (Ω)	I_C (A)	V_{BB1} (V)	V_{BB2} (V)	I_{B1} (mA)	I_{B2} (mA)	t_{on} (μs)	t_{stg} (μs)	t_f (μs)
12	12	1	10	−5	30	−30	0.2	5.7	0.4

External Dimensions STA4 (LF400B)

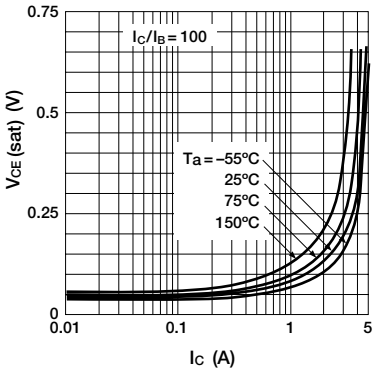


a) Part No.
b) Lot No.
(Unit: mm)

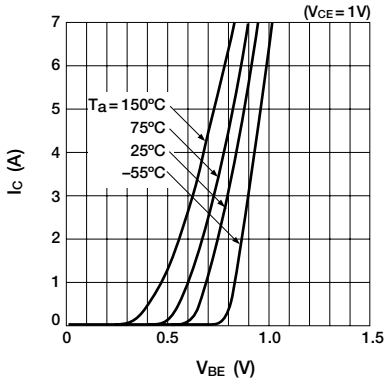
■ I_C — V_{CE} Characteristics (typ.)



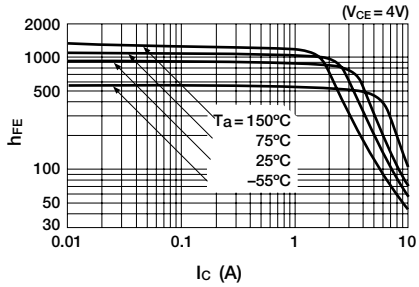
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



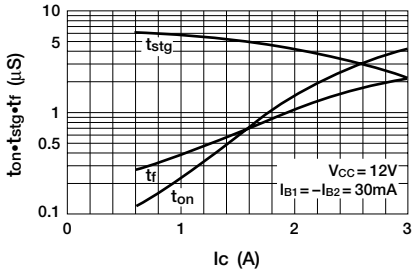
■ I_C — V_{BE} Temperature Characteristics (typ.)



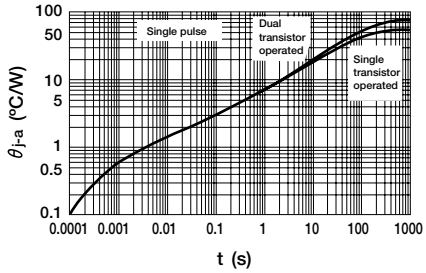
■ h_{FE} — I_C Temperature Characteristics (typ.)



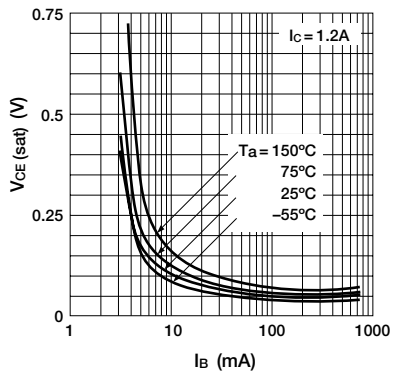
■ t_{on}•t_{stg}•t_f — I_C Characteristics



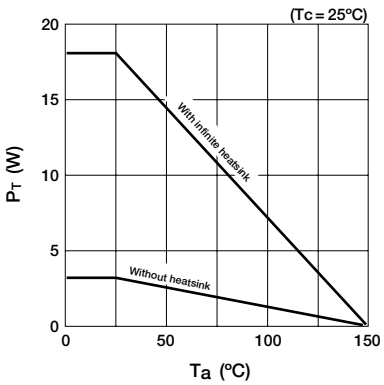
■ $\theta_{j\text{-}a}$ — t Characteristics



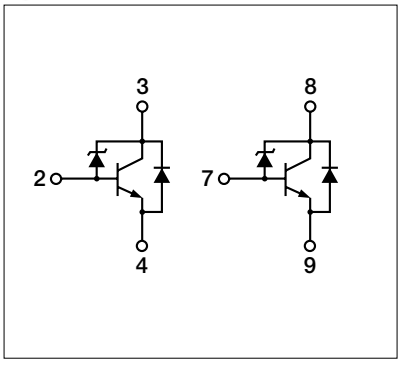
■ V_{CE} (sat) — I_B Temperature Characteristics (typ.)



■ P_T — Ta Derating



Equivalent Circuit Diagram



Power Transistor Array STA464C

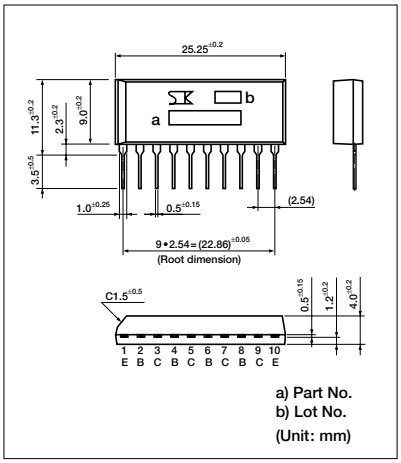
Absolute Maximum Ratings (Ta=25ºC)

Symbol	Ratings	Unit
V_{CBO}	65±5	V
V_{CEO}	65±5	V
V_{EBO}	6	V
I_C	6 (pulse 10)	A
I_B	1	A
P_C	20 (Tc=25ºC)	W
	4 (Ta=25ºC)	
Tj	150	ºC
Tstg	–55 to +150	ºC

Electrical Characteristics (Ta=25ºC)

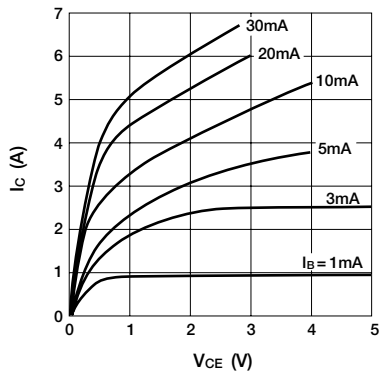
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
I_{CBO}	V_{CB}=60V			10	µA
I_{EBO}	V_{EB}=6V			10	µA
V_{CEO}	I_C=50mA	60	65	70	V
h_{FE}	V_{CE}=1V, I_C=1A	400	800	1500	
V_{CE} (sat)	I_C=1.5A, I_B=15mA		0.09	0.15	V
V_{FEC}	I_{FEC}=6A		1.25	1.5	V
Es/b	L=10mH	80			mJ

External Dimensions STA4

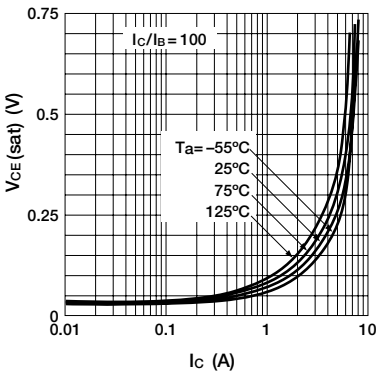


a) Part No.
b) Lot No.
(Unit: mm)

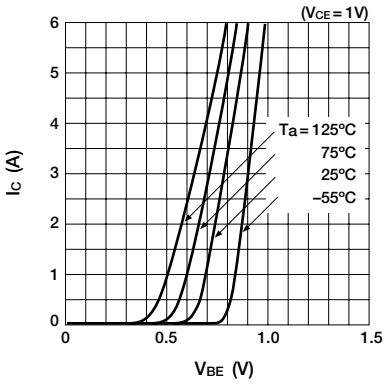
■ I_C — V_{CE} Characteristics (typ.)



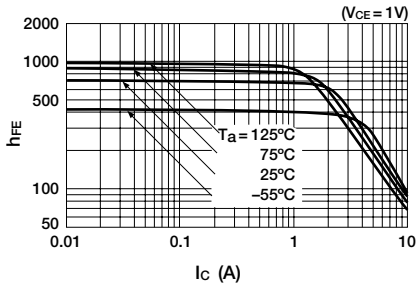
■ V_{CE} (sat) — I_C Temperature Characteristics (typ.)



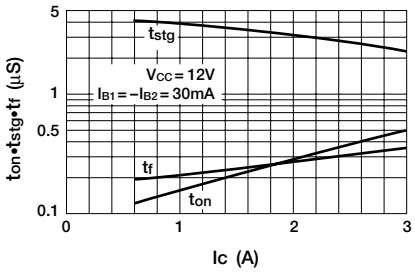
■ I_C — V_{BE} Temperature Characteristics (typ.)



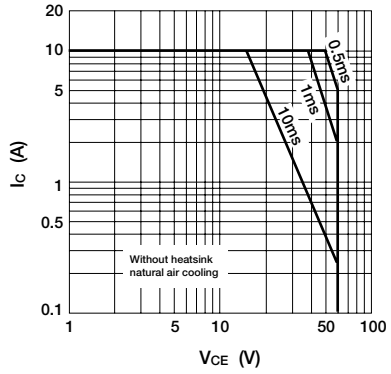
■ h_{FE} — I_C Temperature Characteristics (typ.)



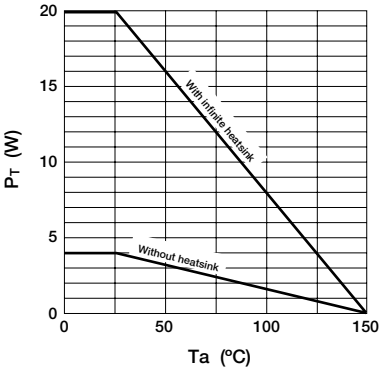
■ t_{on} • t_{stg} • t_f — I_C Characteristics



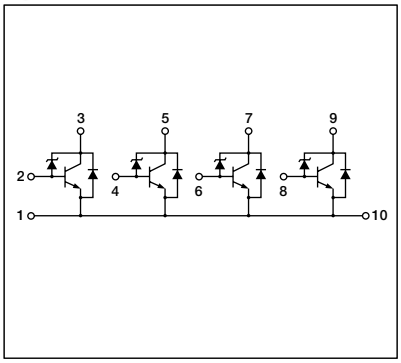
■ Safe Operating Area (single pulse)



■ P_T — Ta Derating



Equivalent Circuit Diagram



MOS FET 2SK3710 (under development)

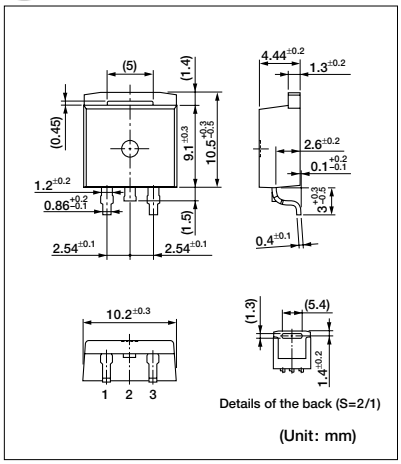
Features

- ON resistance 0.0060Ω max.
- Built-in G-S bidirectional Zener diode
- Trench MOS structure

Applications

- Power steering motor
- Various motors
- Replaces mechanical relays

External Dimensions TO220S



(Unit: mm)

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	20	V
I_D	70	A
$I_{D\ (pulse)}$	140	A
P_D	130	W
EAS	400	mJ
T_{ch}	150	°C
Tstg	–55 to +150	°C

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
$V_{(BR)\ DSS}$	I_D = 100μA	60			V
I_{GSS}	V_{GS} = ±20V			±10	μA
I_{DSS}	V_{DS} = 60V, V_{GS} = 0V			100	μA
V_{TH}	V_{DS} = 10V, I_D = 250μA	2		4	V
$R_{DS\ (ON)}$	V_{GS} = 10V, I_D = 35A		5.0	6.0	mΩ
V_{SD}	I_{SD} = 50A		0.9	1.5	V
t_{rr}	I_{SD} = 25A, di/dt = 50A/μs		110		ns
Ciss	V_{DS} = 10V		9400		pF
Coss	V_{GS} = 10V		1400		pF
Crss	f = 1.0MHz		1100		pF

MOS FET 2SK3711

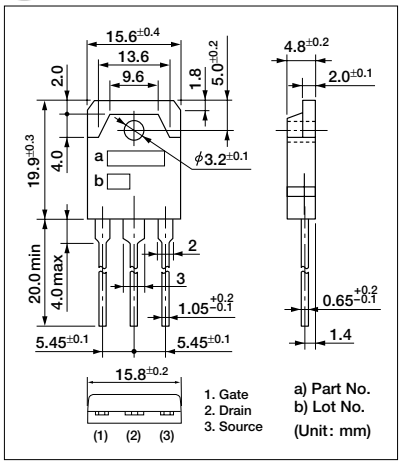
Features

- ON resistance 0.006Ω max.
- Built-in G-S bidirectional Zener diode
- Trench MOS structure

Applications

- Power steering motor
- Various motors
- Replaces mechanical relays

External Dimensions TO-3P



Absolute Maximum Ratings (Ta=25°C)

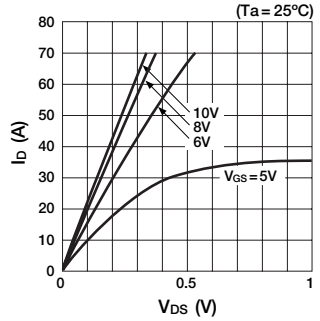
Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	20	V
I_D	70	A
$I_{D\ (pulse)}$	140	A
P_D	130	W
EAS	To be defined	mJ
Tch	150	°C
Tstg	−55 to +150	°C

* 1: $P_W \leqq 100\mu s$, duty cycle ≦1%
* 2: V_{DD}=20V, L=1mH, I_L=20A, unclamped, R_G=50Ω
* Contact your sales rep for the details of warranty at Tch=175°C

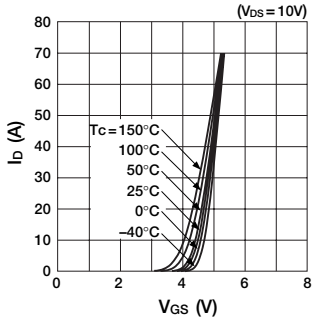
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100μA	60			V
I_{GSS}	V_{GS}=+20V			±10	μA
I_{DSS}	V_{DS}=60V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=250μA	2		4	V
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=35A		5.0	6.0	mΩ
V_{SD}	I_{SD}=50A		0.9	1.2	V
t_{rr}	I_{SD}=25A, di/dt=50A/μs		70		ns
Ciss	V_{DS}=10V		7800		pF
Coss	V_{GS}=10V		1250		pF
Crss	f=1.0MHz		990		pF

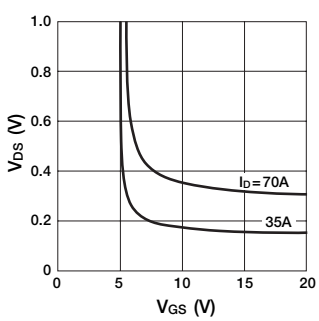
■ I_D — V_{DS} Characteristics (typ.)



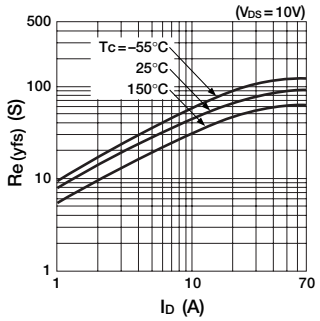
■ I_D — V_{GS} Characteristics (typ.)



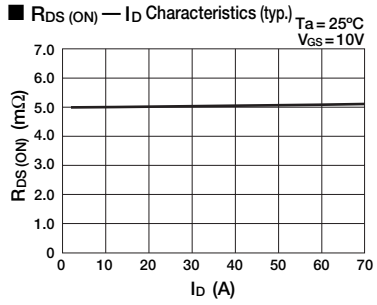
■ V_{DS} — V_{GS} Characteristics (typ.)



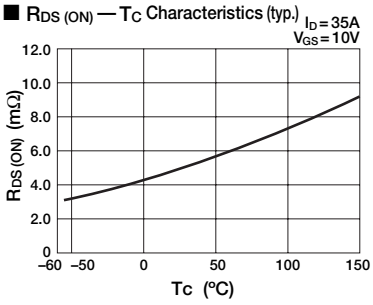
■ Re (yfs) — I_D Characteristics (typ.)



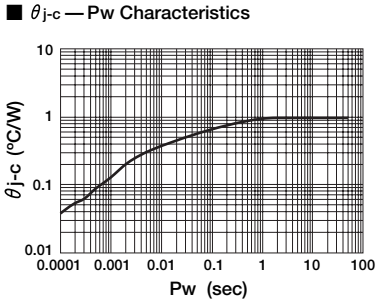
■ $R_{DS\ (ON)}$ — I_D Characteristics (typ.)



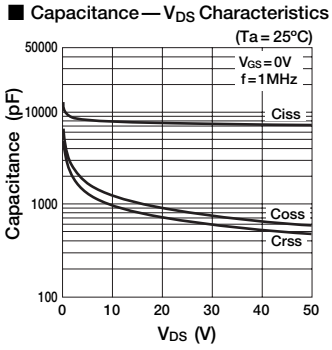
■ $R_{DS\ (ON)}$ — T_C Characteristics (typ.)



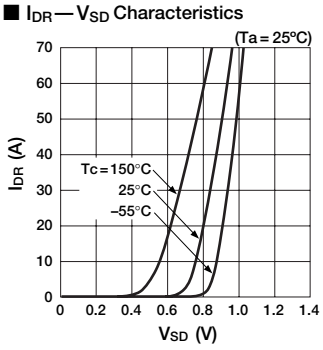
■ $\theta_{j\text{-}c}$ — Pw Characteristics



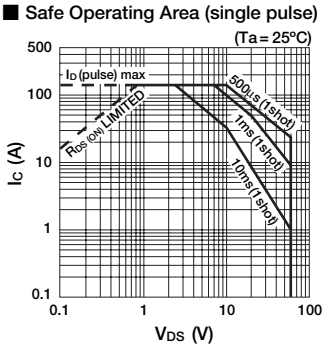
■ Capacitance — V_{DS} Characteristics



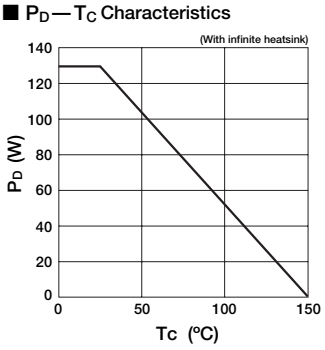
■ I_{DR} — V_{SD} Characteristics



■ Safe Operating Area (single pulse)



■ P_D — T_C Characteristics



MOS FET 2SK3724 (under development)

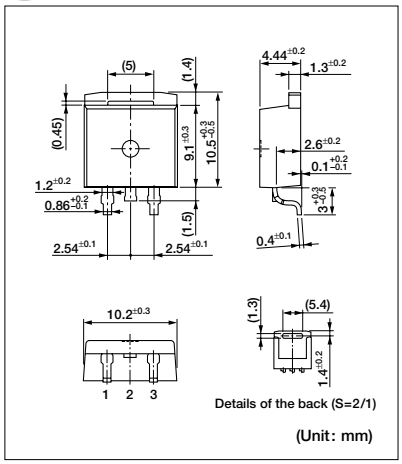
Features

- ON resistance 0.005Ω max.
- Built-in G-S bidirectional Zener diode
- Trench MOS structure

Applications

- Power steering motor
- Various motors
- Replaces mechanical relays

External Dimensions TO220S



(Unit: mm)

Absolute Maximum Ratings (Ta=25°C)

Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	20	V
I_D	80	A
$I_{D\ (pulse)}$	160	A
P_D	60	W
EAS	To be defined	mJ
Tch*	150	°C
Tstg	−55 to +150	°C

* Contact your sales rep for the details of warranty at Tch=175°C

Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings			Unit
		min	typ	max	
$V_{(BR)\ DSS}$	I_D=100μA	60			V
I_{GSS}	V_{GS}=±20V			±10	μA
I_{DSS}	V_{DS}=60V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=1mA	1		2	V
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=40A		4.0	5.0	mΩ
V_{SD}	I_{SD}=50A		0.9	1.5	V
t_{rr}	I_{SD}=25A, di/dt=50A/μs		To be defined		ns
Ciss	V_{DS}=10V		10600		pF
Coss	V_{GS}=10V		1600		pF
Crss	f=1.0MHz		1300		pF

MOS FET 2SK3800

Absolute Maximum Ratings (Ta=25°C)

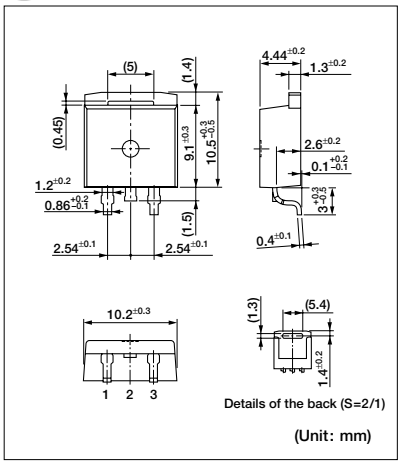
Symbol	Ratings	Unit
V_{DSS}	40	V
V_{GSS}	±20	V
I_D	±70	A
$I_{D\ (pulse)}$*1	±140	A
P_D	80 (Tc=25°C)	W
EAS*2	400	mJ
Tch	150	°C
Tstg	–40 to +150	°C

* 1: $P_W \leqq 100\mu s$, duty cycle ≦1%
* 2: V_{DD}=20V, L=1mH, I_L=20A, unclamped, R_G=50Ω

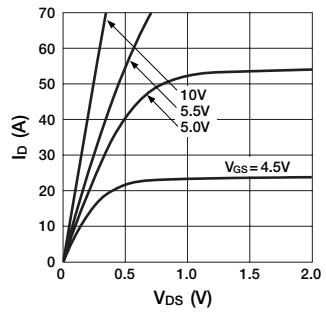
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100μA, V_{GS}=0V	40			V
I_{GSS}	V_{GS}=±15V			±10	μA
I_{DSS}	V_{DS}=40V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=1mA	2.0	3.0	4.0	V
$R_{e\ (yfs)}$	V_{DS}=10V, I_D=35A	30	50		S
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=35A		5.0	6.0	mΩ
Ciss	V_{DS}=10V, f=1.0MHz, V_{GS}=0V		5100		pF
Coss			1200		pF
Crss			860		pF
$t_{d\ (on)}$	I_D=35A, V_{DD}=20V, R_G=22Ω, R_L=0.57Ω, V_{GS}=10V		100		ns
t_r			100		ns
$t_{d\ (off)}$			300		ns
t_f			130		ns
V_{SD}	I_{SD}=50A, V_{GS}=0V		0.9	1.2	V
t_{rr}	I_{SD}=25A, di/dt=50A/μs		110		ns
$R_{th\ (ch-c)}$				1.56	°C/W
$R_{th\ (ch-a)}$				62.5	°C/W

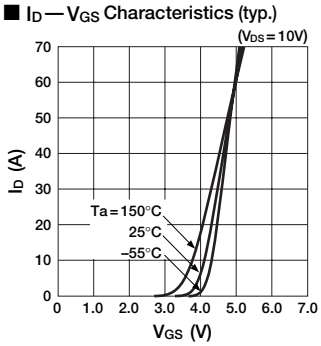
External Dimensions TO220S



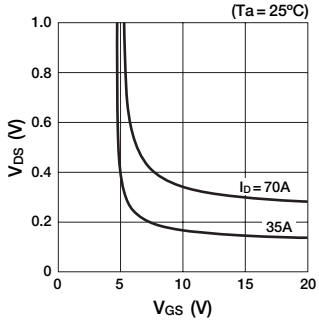
■ I_D — V_{DS} Characteristics (typ.)



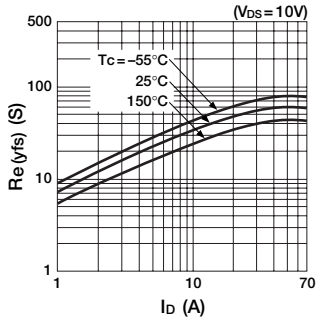
■ I_D — V_{GS} Characteristics (typ.)



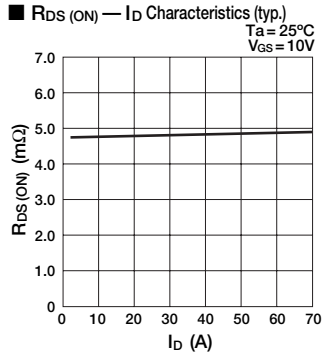
■ V_{DS} — V_{GS} Characteristics (typ.)



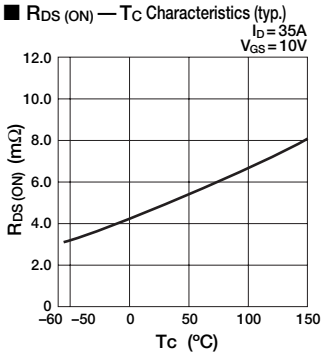
■ R_e (yfs) — I_D Characteristics (typ.)



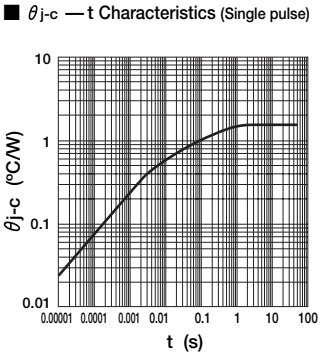
■ $R_{DS\ (ON)}$ — I_D Characteristics (typ.)



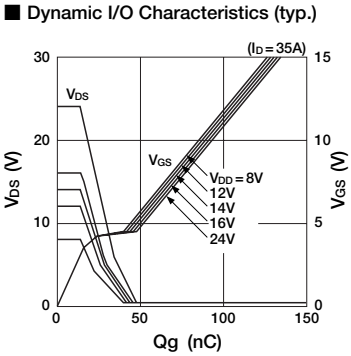
■ $R_{DS\ (ON)}$ — T_C Characteristics (typ.)



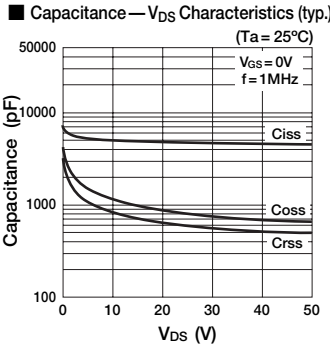
■ $\theta_{j\text{-}c}$ — t Characteristics (Single pulse)



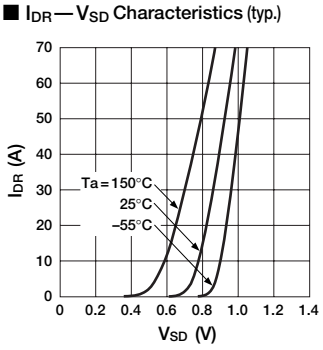
■ Dynamic I/O Characteristics (typ.)



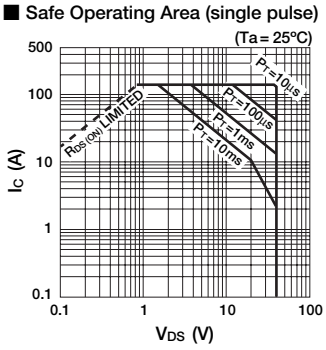
■ Capacitance — V_{DS} Characteristics (typ.)



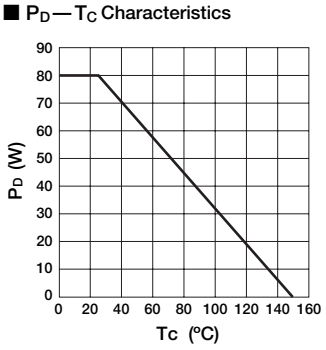
■ I_{DR} — V_{SD} Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_D — T_C Characteristics



MOS FET 2SK3801

Absolute Maximum Ratings (Ta=25°C)

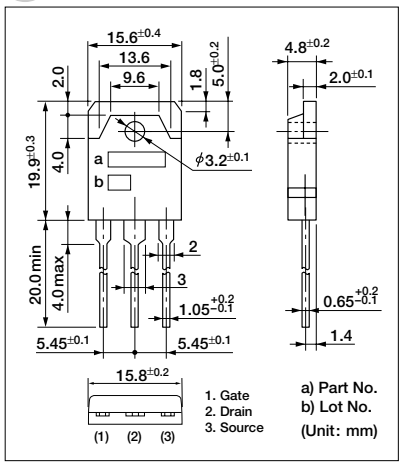
Symbol	Ratings	Unit
V_{DSS}	40	V
V_{GSS}	±20	V
I_D	±70	A
$I_{D\ (pulse)}$*1	±140	A
P_D	100 (Tc=25°C)	W
EAS*1	400	mJ
Tch	150	°C
Tstg	−40 to +150	°C

* 1: $P_W \leqq 100\mu s$, duty cycle ≦1%
* 2: V_{DD}=20V, L=1mH, I_L=20A, unclamped, R_G=50Ω

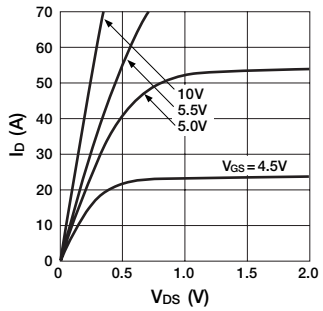
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100μA, V_{GS}=0V	40			V
I_{GSS}	V_{GS}=±15V			±10	μA
I_{DSS}	V_{DS}=40V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=1mA	2.0	3.0	4.0	V
$R_{e\ (yfs)}$	V_{DS}=10V, I_D=35A	30	50		S
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=35A		5.0	6.0	mΩ
Ciss	V_{DS}=10V, f=1.0MHz, V_{GS}=0V		5100		pF
Coss			1200		pF
Crss			860		pF
$t_{d\ (on)}$	I_D=35A, V_{DD}=20V, R_G=22Ω, R_L=0.57Ω, V_{GS}=10V		100		ns
t_r			100		ns
$t_{d\ (off)}$			300		ns
t_f			130		ns
V_{SD}	I_{SD}=50A, V_{GS}=0V		0.9	1.5	V
t_{rr}	I_{SD}=25A, di/dt=50A/μs		100		ns
$R_{th\ (ch-c)}$				1.25	°C/W
$R_{th\ (ch-a)}$				35.71	°C/W

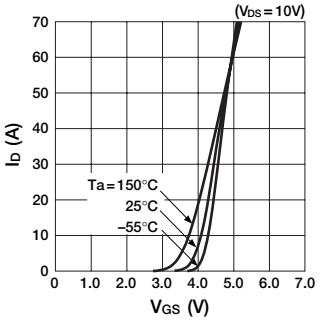
External Dimensions TO-3P



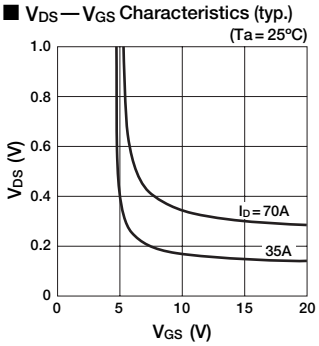
■ I_D — V_{DS} Characteristics (typ.)



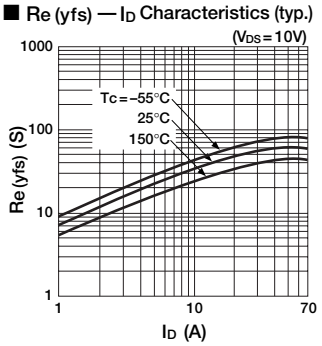
■ I_D — V_{GS} Characteristics (typ.)



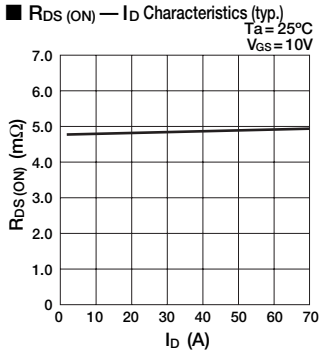
■ V_{DS} — V_{GS} Characteristics (typ.)



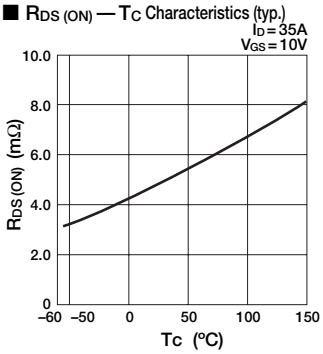
■ R_e (yfs) — I_D Characteristics (typ.)



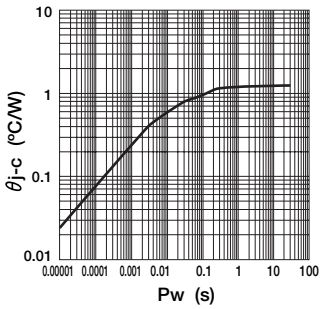
■ $R_{DS\ (ON)}$ — I_D Characteristics (typ.)



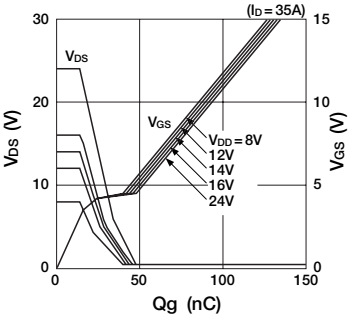
■ $R_{DS\ (ON)}$ — T_C Characteristics (typ.)



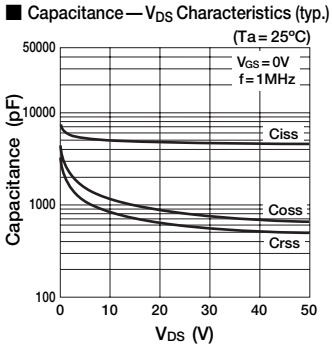
■ $\theta_{j\text{-}c}$ — Pw Characteristics (Single pulse)



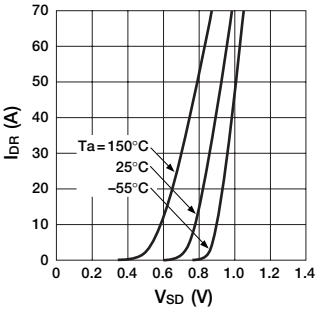
■ Dynamic I/O Characteristics (typ.)



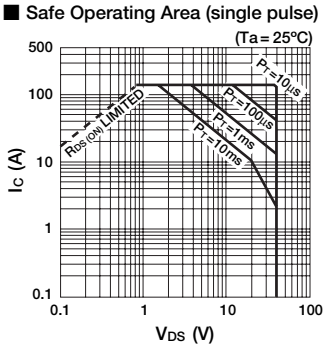
■ Capacitance — V_{DS} Characteristics (typ.)



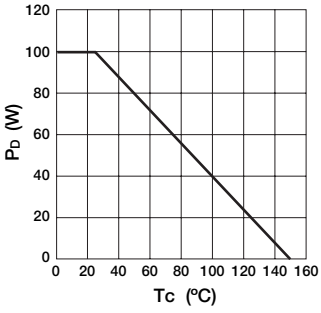
■ I_{DR} — V_{SD} Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P_D — T_C Characteristics



MOS FET 2SK3803 (under development)

Absolute Maximum Ratings (Ta=25ºC)

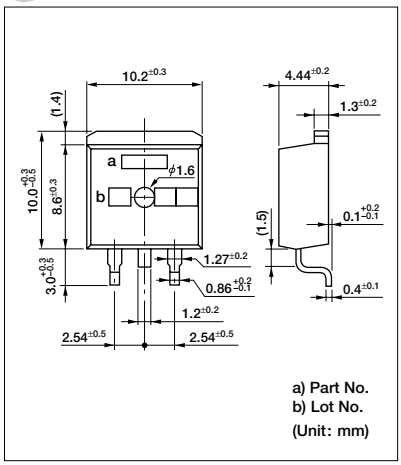
Symbol	Ratings	Unit
V_{DSS}	40	V
V_{GSS}	±20	V
I_D	±85	A
$I_{D\ (pulse)}$*1	±170	A
P_D	100 (Tc=25ºC)	W
EAS*2	730	mJ
Tch	150	ºC
Tstg	–55 to +150	ºC

* 1: $P_W \leqq 100\mu s$, duty cycle ≦1%
* 2: V_{DD} = 20V, L = 1mH, I_L = 20A, unclamped, $R_G = 50\Omega$

Electrical Characteristics (Ta=25ºC)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D = 100μA, V_{GS} = 0V	40			V
I_{GSS}	V_{GS} = ±15V			±10	μA
I_{DSS}	V_{DS} = 40V, V_{GS} = 0V			100	μA
V_{TH}	V_{DS} = 10V, I_D = 1mA	2.0		4.0	V
$Re_{(yfs)}$	V_{DS} = 10V, I_D = 42A	50			S
$R_{DS\ (ON)}$	V_{GS} = 10V, I_D = 42A		2.1	3.0	mΩ
Ciss	V_{DS} = 10V, f = 1.0MHz, V_{GS} = 0V		10500		pF
Coss			2400		pF
Crss			1900		pF
$t_{d\ (on)}$	I_D = 42A, V_{DD} = 20V, $R_G = 22\Omega$, V_{GS} = 10V		90		ns
t_r			230		ns
$t_{d\ (off)}$			490		ns
t_f			760		ns
V_{SD}	I_{SD} = 50A, V_{GS} = 0V		0.85	1.2	V
t_{rr}	I_{SD} = 25A, di/dt = 50A/μs		90		ns

External Dimensions TO220S



a) Part No.
b) Lot No.
(Unit: mm)

MOS FET 2SK3851

Absolute Maximum Ratings (Ta=25°C)

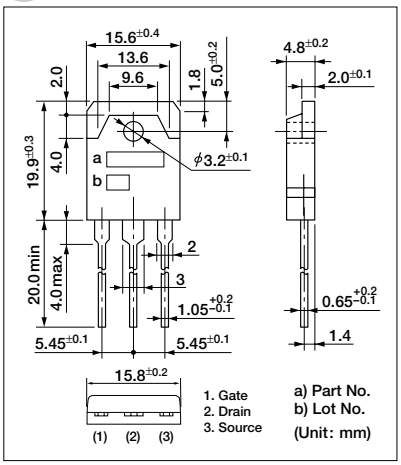
Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	±20	V
I_D	±85	A
$I_{D\ (pulse)}$*1	±280	A
P_D	150	W
EAS*2	280	mJ
T_{ch}	150	°C
Tstg	−55 to +150	°C

* 1: $P_W \leqq 100\mu s$, duty cycle $\leqq 1\%$
* 2: V_{DD} = 20V, L = 1mH, I_L = 20A, unclamped

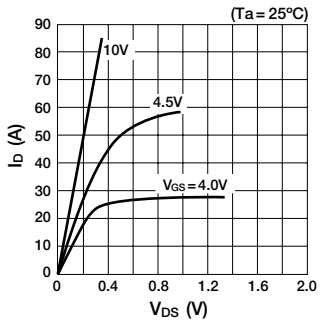
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D = 100μA, V_{GS} = 0V	60			V
I_{GSS}	V_{GS} = ±20V			±10	μA
I_{DSS}	V_{DS} = 60V, V_{GS} = 0V			100	μA
V_{TH}	V_{DS} = 10V, I_D = 1mA	2.0	2.5	3.0	V
$R_{e\ (yfs)}$	V_{DS} = 10V, I_D = 42A	30			S
$R_{DS\ (ON)}$	V_{GS} = 10V, I_D = 42A		4.0	4.7	mΩ
Ciss	V_{DS} = 10V, f = 1.0MHz, V_{GS} = 0V		11500		pF
Coss			1500		pF
Crss			1100		pF
$t_{d\ (on)}$	I_D = 42A, $V_{DD} \fallingdotseq$ 16V, R_G = 22Ω, V_{GS} = 10V		60		ns
t_r			25		ns
$t_{d\ (off)}$			370		ns
t_f			65		ns
V_{SD}	I_{SD} = 50A, V_{GS} = 0V		0.87	1.5	V
t_{rr}	I_{SD} = 50A, di/dt = 100A/μS		70		ns

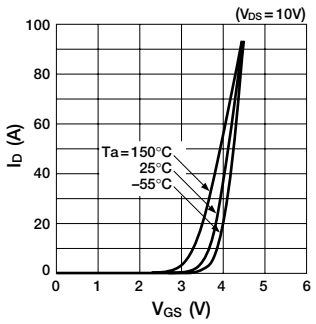
External Dimensions TO-3P



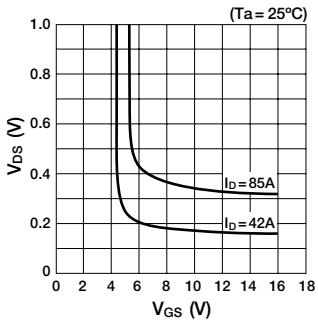
■ I_D — V_{DS} Characteristics



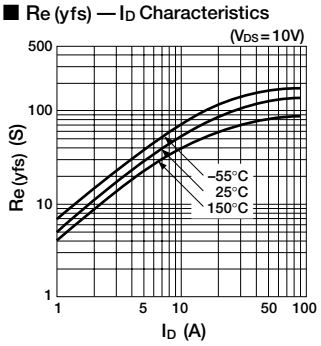
■ I_D — V_{GS} Characteristics



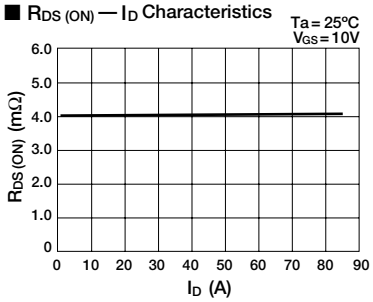
■ V_{DS} — V_{GS} Characteristics



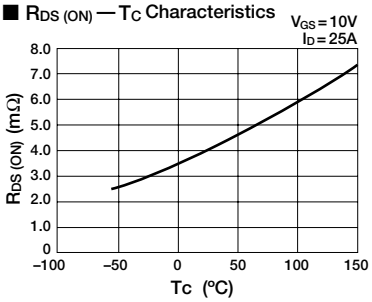
■ Re (yfs) — I_D Characteristics



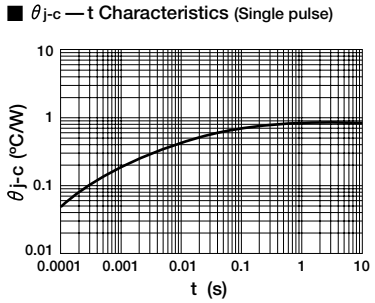
■ $R_{DS\ (ON)}$ — I_D Characteristics



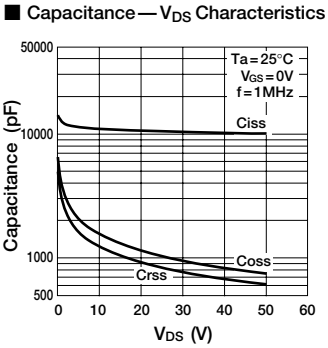
■ $R_{DS\ (ON)}$ — T_C Characteristics



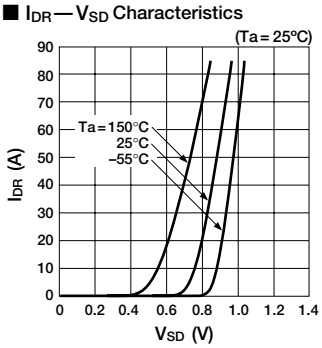
■ $\theta_{j\text{-}c}$ — t Characteristics (Single pulse)



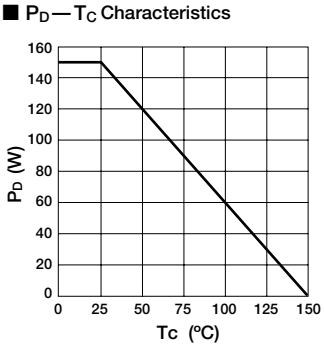
■ Capacitance — V_{DS} Characteristics



■ I_{DR} — V_{SD} Characteristics



■ P_D — T_C Characteristics



MOS FET FKV460S

Absolute Maximum Ratings (Ta=25°C)

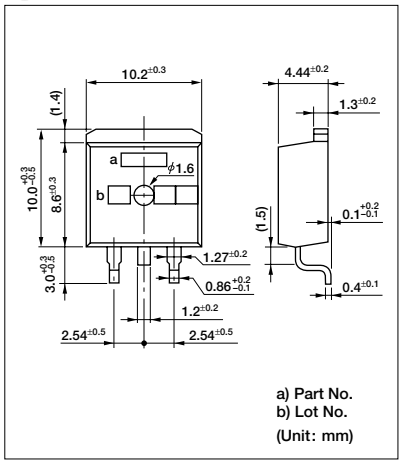
Symbol	Ratings	Unit
V_{DSS}	40	V
V_{GSS}	+20, –10	V
I_D	±60	A
$I_{D\ (pulse)}$*	±180	A
P_D	60 (Tc=25°C)	W
Tch	150	°C
Tstg	–55 to +150	°C

* $P_W \leqq 100\mu s$, duty ≦1%

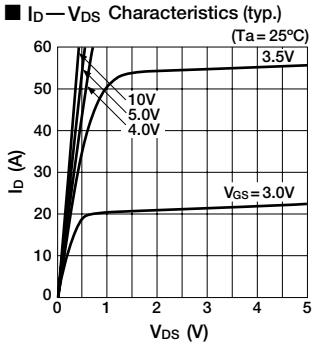
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100μA, V_{GS}=0V	40			V
I_{GSS}	V_{GS}=+20V			+10	μA
	V_{GS}=–10V			–5	
I_{DSS}	V_{DS}=40V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=250μA	1.3		2.3	V
$Re_{(yfs)}$	V_{DS}=10V, I_D=25A	20.0			S
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=25A		7	9	mΩ
Ciss	V_{DS}=10V		2800		pF
Coss	f=1.0MHz		1400		pF
Crss	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

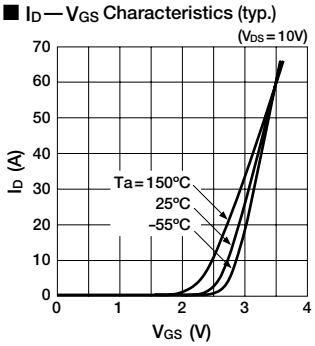
External Dimensions TO220S



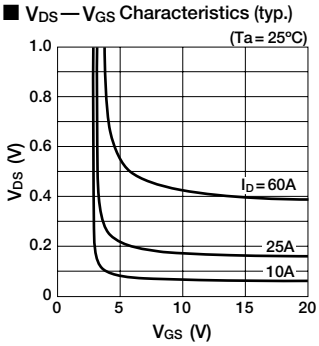
■ I_D — V_{DS} Characteristics (typ.)



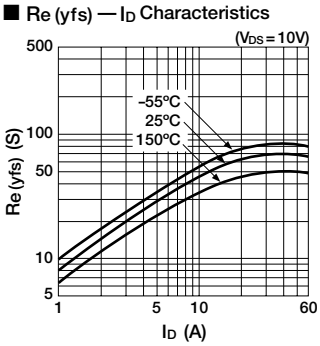
■ I_D — V_{GS} Characteristics (typ.)



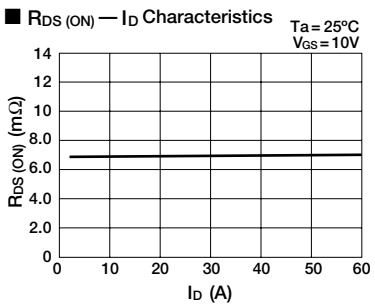
■ V_{DS} — V_{GS} Characteristics (typ.)



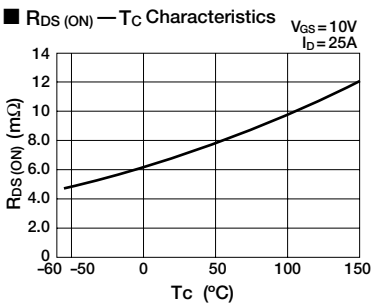
■ Re (yfs) — I_D Characteristics



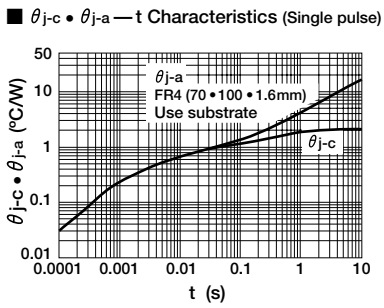
■ $R_{DS\ (ON)}$ — I_D Characteristics



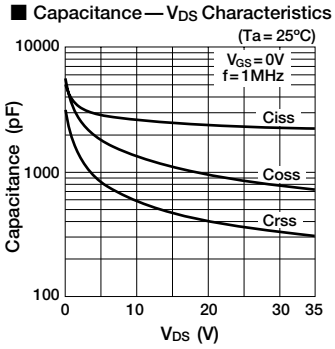
■ $R_{DS\ (ON)}$ — T_C Characteristics



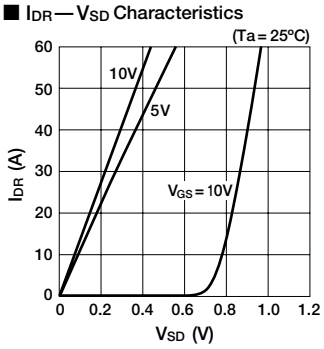
■ $\theta_{j\text{-}c} \bullet \theta_{j\text{-}a}$ — t Characteristics (Single pulse)



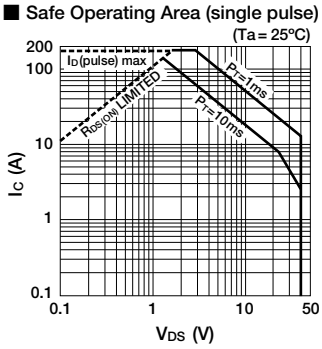
■ Capacitance — V_{DS} Characteristics



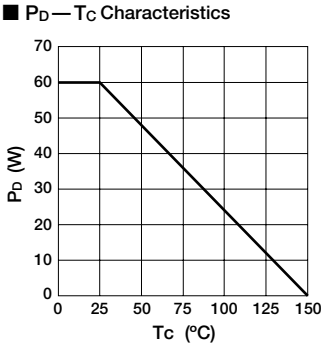
■ I_{DR} — V_{SD} Characteristics



■ Safe Operating Area (single pulse)



■ P_D — T_C Characteristics



MOS FET FKV660S

Absolute Maximum Ratings (Ta=25°C)

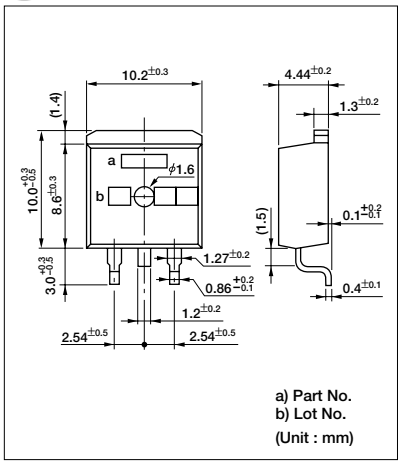
Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	+20, −10	V
I_D	±60	A
$I_{D(pulse)}$ ※	±180	A
P_D	60(Tc=25°C)	W
Tch	150	°C
Tstg	−40 to +150	°C

※P_W ≦100μs, duty≦1%

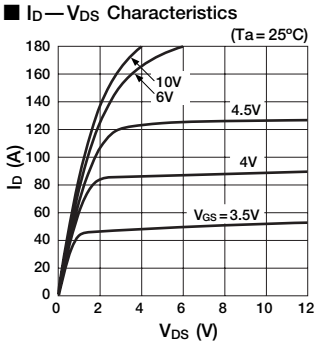
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)DSS}$	I_D=100μA, V_{GS}=0V	60			V
I_{GSS}	V_{GS}=+20V			+10	μA
	V_{GS}=−10V			−5	
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
Ciss	V_{DS}=10V		2500		pF
Coss	f=1.0MHz		900		pF
Crss	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

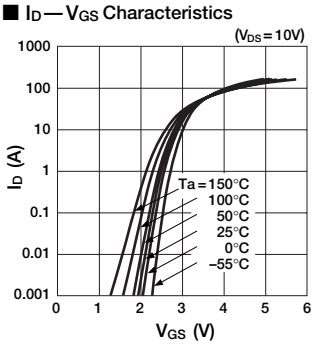
External Dimensions TO220S



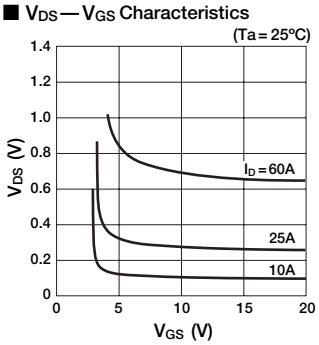
■ I_D — V_{DS} Characteristics



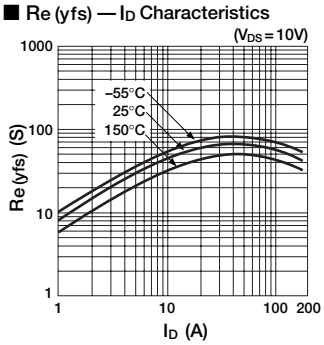
■ I_D — V_{GS} Characteristics



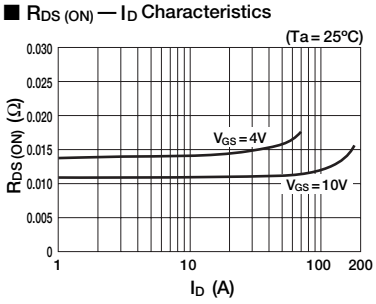
■ V_{DS} — V_{GS} Characteristics



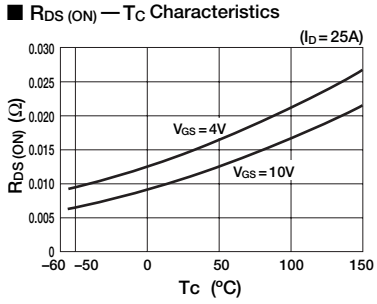
■ Re (yfs) — I_D Characteristics



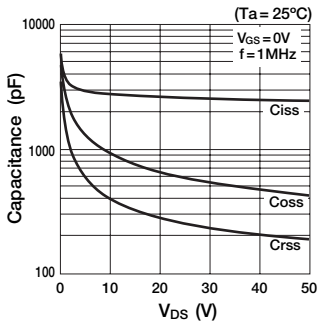
■ $R_{DS(ON)}$ — I_D Characteristics



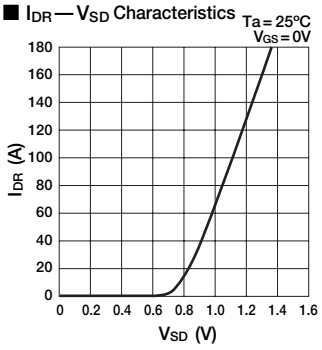
■ $R_{DS(ON)}$ — T_C Characteristics



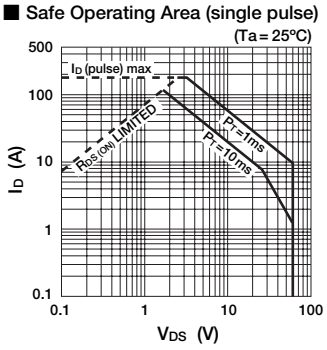
■ Capacitance — V_{DS} Characteristics



■ I_{DR} — V_{SD} Characteristics



■ Safe Operating Area (single pulse)



Surface-mount MOS FET Array SDK06

Absolute Maximum Ratings (Ta=25°C)

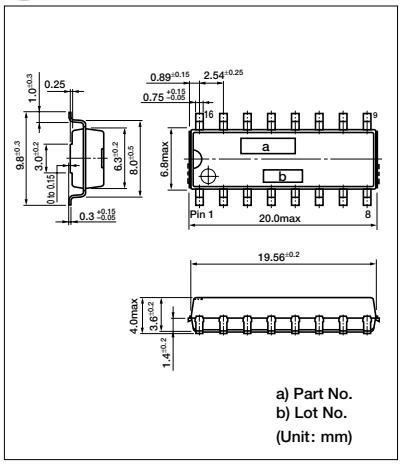
Symbol	Ratings	Unit
V_{DSS}	52±5	V
V_{GSS}	±20	V
I_D	±3	A
$I_{D\ (pulse)}$ *1	±6	A
P_T	3 (Tc=25°C, 4 circuits operate)	W
E_{AS} *2	40	mJ
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 100\mu s$, duty $\leqq 1\%$
*2 $V_{DD}=12V$, L=10mH, unclamped, $R_G=10\Omega$

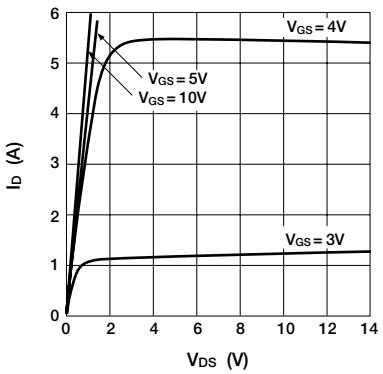
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	$I_D=1mA$, $V_{GS}=0V$	47	52	57	V
I_{GSS}	$V_{GS}=\pm 20V$			±1.0	μA
I_{DSS}	$V_{DS}=40V$, $V_{GS}=0V$			100	μA
V_{TH}	$V_{DS}=10V$, $I_D=250\mu A$	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
$t_{d\ (on)}$	$I_D=1A$		2.0		μs
t_r	$V_{DD} \fallingdotseq 12V$		7.4		μs
$t_{d\ (off)}$	$R_L=12\Omega$		3.3		μs
t_f	$V_{GS}=5V$		4.2		μs
V_{SD}	$R_{G1}=50\Omega$, $R_{G2}=10k\Omega$		1.0	1.5	V
	$I_{SD}=1A$, $V_{GS}=0V$				

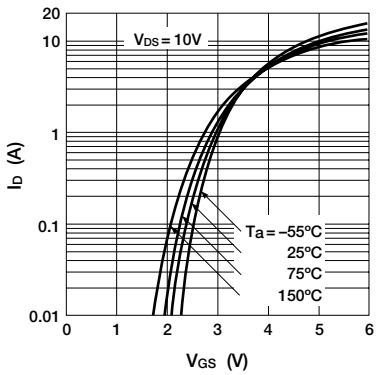
External Dimensions SMD-16A



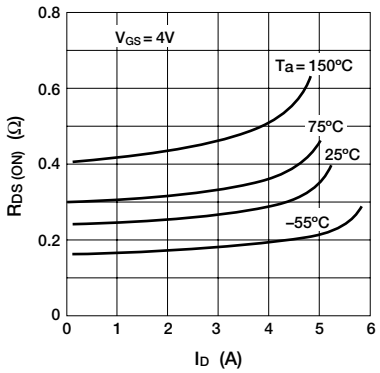
■ I_D — V_{DS} Characteristics



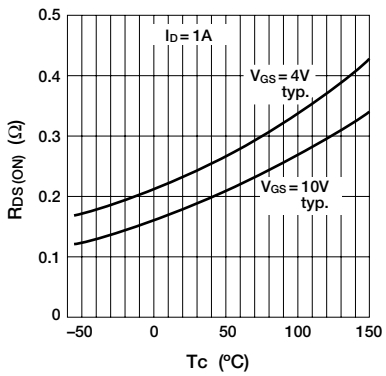
■ I_D — V_{GS} Characteristics



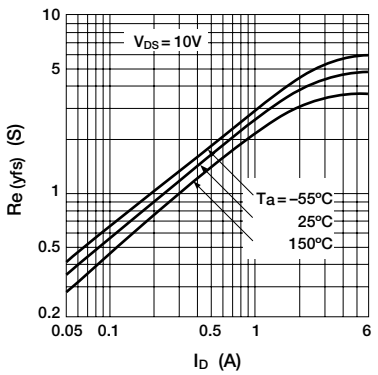
■ $R_{DS\ (ON)}$ — I_D Characteristics



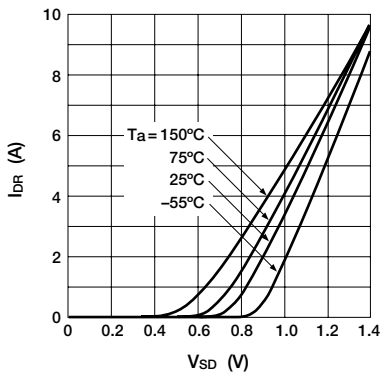
■ $R_{DS\ (ON)}$ — T_C Characteristics



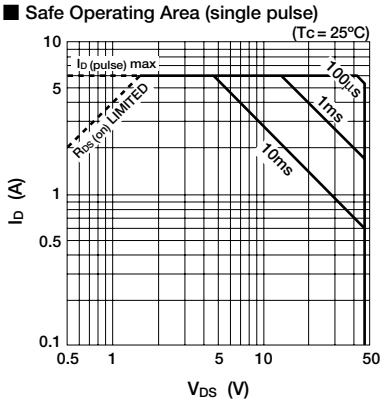
■ $Re\ (yfs)$ — I_D Characteristics



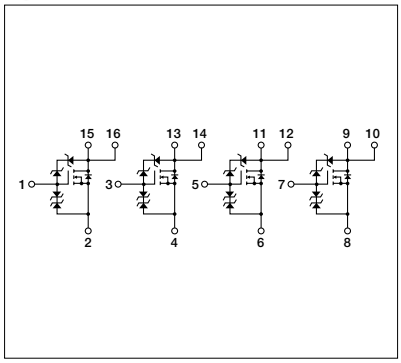
■ I_{DR} — V_{SD} Characteristics



■ Safe Operating Area (single pulse)



Equivalent Circuit Diagram



Surface-mount MOS FET Array SDK08

Absolute Maximum Ratings (Ta=25°C)

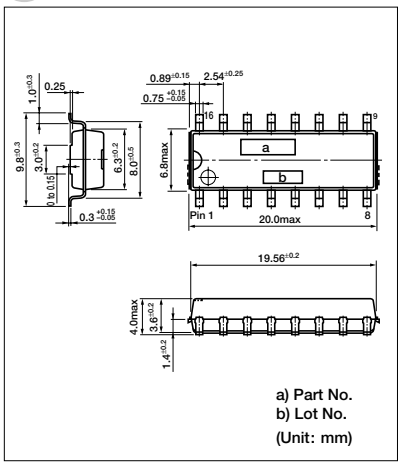
Symbol	Ratings	Unit
V_{DSS}	50	V
V_{GSS}	±20	V
I_D	±4.5	A
$I_{D\ (pulse)}$ *1	±9	A
P_T	4 (Tc=25°C, 4 circuits operate)	W
E_{AS} *2	80	mJ
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 100\mu s$, duty ≦1%
*2 $V_{DD}=12V$, L=10mH, unclamped, $R_G=50\Omega$

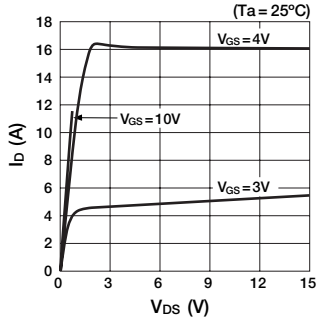
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	$I_D=100\mu A$, $V_{GS}=0V$	50			V
I_{GSS}	$V_{GS}=\pm 20V$			±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
$R_{e\ (yfs)}$	$V_{DS}=10V$, $I_D=4.0A$	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
Ciss	$V_{DS}=10V$		700		pF
Coss	f=1.0MHz		300		pF
Crss	$V_{GS}=0V$		90		pF
$t_{d\ (on)}$	$I_D=4A$		50		ns
t_r	$V_{DD}\fallingdotseq 12V$		80		ns
$t_{d\ (off)}$	$R_L=3\Omega$		60		ns
t_f	$V_{GS}=5V$		40		ns
	$R_G=50\Omega$		40		ns
V_{SD}	$I_{SD}=6A$, $V_{GS}=0V$		1.0	1.5	V

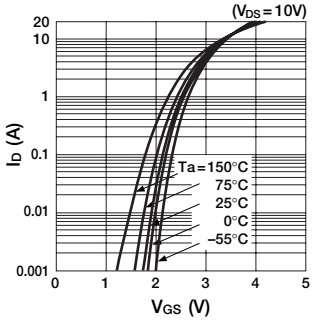
External Dimensions SMD-16A



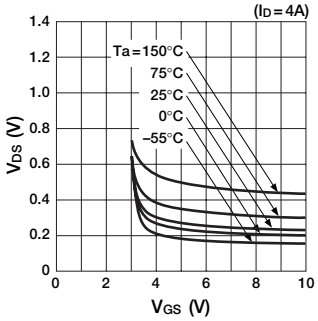
■ I_D — V_{DS} Characteristics (typ.)



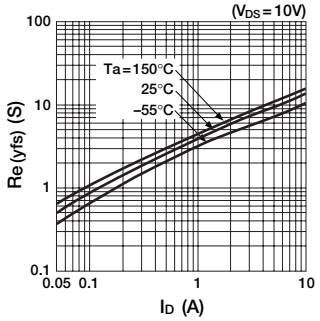
■ I_D — V_{GS} Characteristics



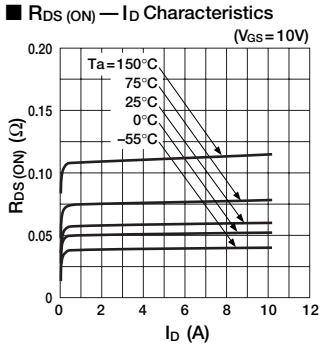
■ V_{DS} — V_{GS} Characteristics (typ.)



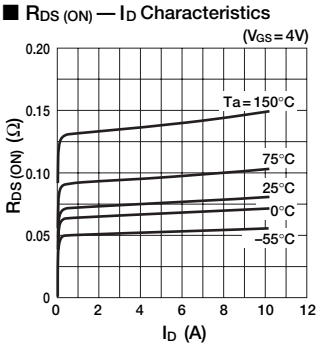
■ R_e (yfs) — I_D Characteristics



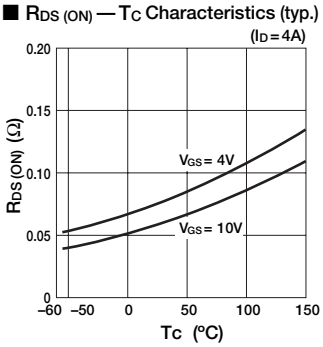
■ $R_{DS\ (ON)}$ — I_D Characteristics



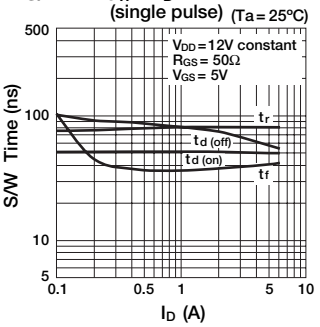
■ $R_{DS\ (ON)}$ — I_D Characteristics



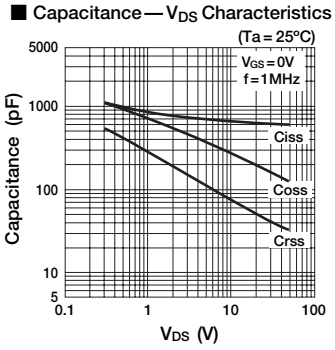
■ $R_{DS\ (ON)}$ — T_C Characteristics (typ.)



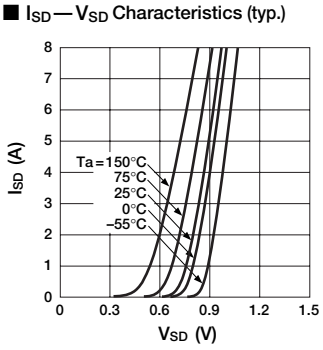
■ S/W Time$_W$ — I_D Characteristics (single pulse) (Ta=25°C)



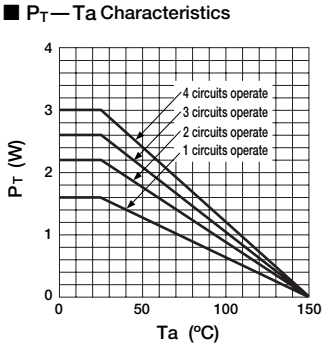
■ Capacitance — V_{DS} Characteristics



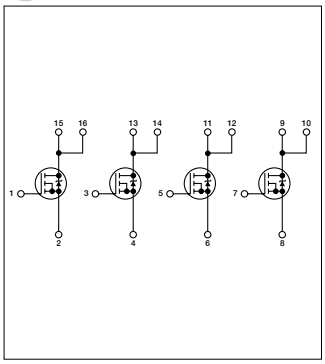
■ I_{SD} — V_{SD} Characteristics (typ.)



■ P_T — Ta Characteristics



Equivalent Circuit Diagram



Surface-mount MOS FET Array SDK09

Absolute Maximum Ratings (Ta=25°C)

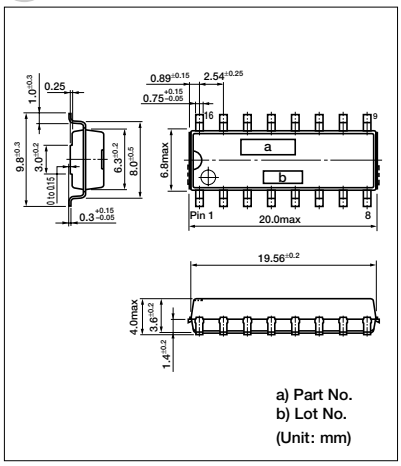
Symbol	Ratings	Unit
V_{DSS}	120	V
V_{GSS}	±20	V
I_D	±6	A
$I_{D\ (pulse)}$ *1	±10	A
P_T	3 (Tc=25°C, 4 circuits operate)	W
E_{AS} *2	80	mJ
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 100\mu s$, duty ≦1%
*2 $V_{DD}=12V$, L=10mH, unclamped, $R_G=50\Omega$

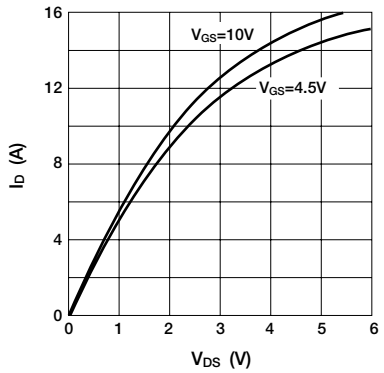
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	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
Re (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	
Ciss	V_{DS}=10V		400		pF
Coss	f=1.0MHz		130		pF
Crss	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=3Ω		250		ns
t_f	V_{GS}=5V, R_G=50Ω		200		ns
V_{SD}	I_{SD}=6A, V_{GS}=0V		1.0	1.5	V

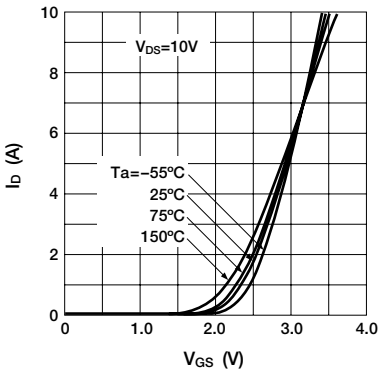
External Dimensions SMD-16A



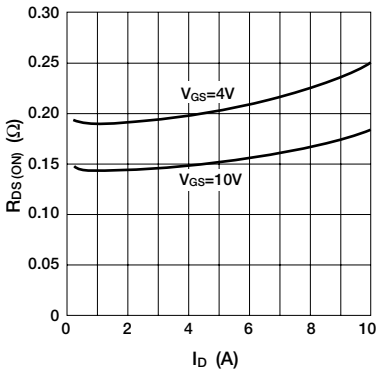
■ I_D — V_{DS} Characteristics



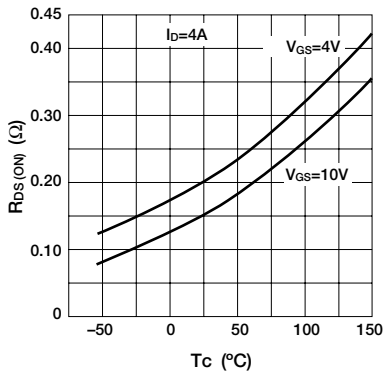
■ I_D — V_{GS} Characteristics



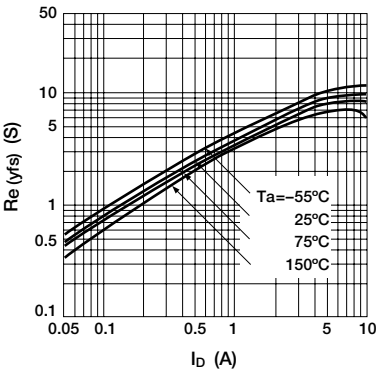
■ $R_{DS\ (ON)}$ — I_D Characteristics



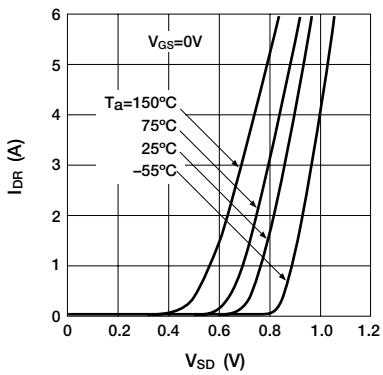
■ $R_{DS\ (ON)}$ — T_C Characteristics



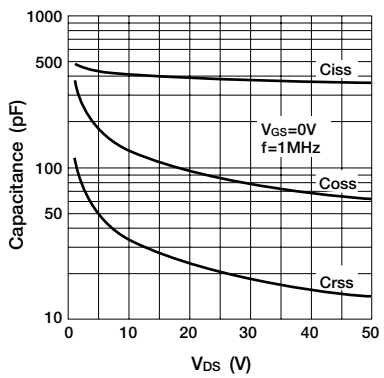
■ Re (yfs) — I_D Characteristics



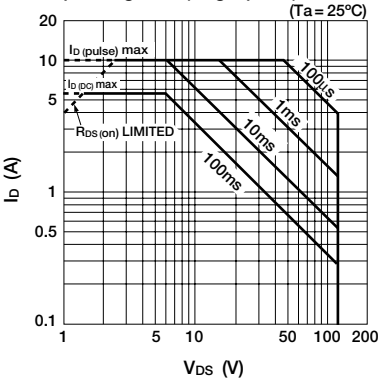
■ I_{DR} — V_{SD} Characteristics



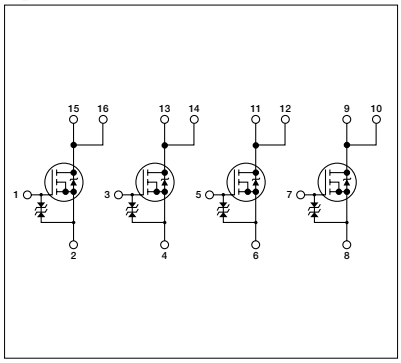
■ Capacitance — V_{DS} Characteristics



■ Safe Operating Area (single pulse)



Equivalent Circuit Diagram



MOS FET Array SLA5027

Absolute Maximum Ratings (Ta=25°C)

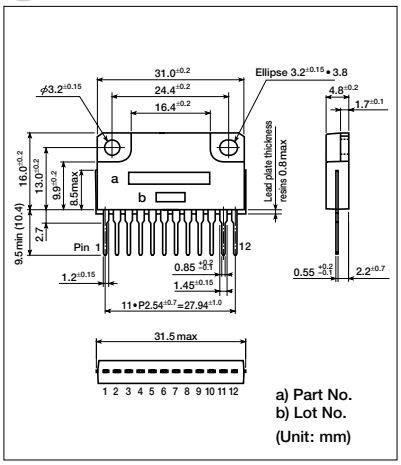
Symbol	Ratings	Unit
V_{DSS}	60	V
V_{GSS}	±20	V
I_D	±12	A
$I_{D\ (pulse)}$*1	±48	A
P_T	5 (Ta=25°C, 4 circuits operate)	W
	60 (Tc=25°C,4 circuits operate)	W
E_{AS}*2	250	mJ
θj-c	2.08	°C/W
V_{ISO}	(Fin to lead terminal) AC1000	Vrms
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 250\mu s$, duty ≦1%
*2 V_{DD}=30V, L=10mH, unclamped, $R_G=50\Omega$

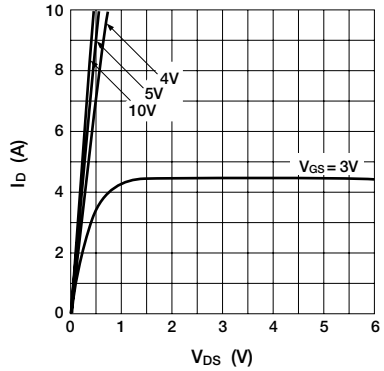
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	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
Ciss	V_{DS}=10V, f=1.0MHz, V_{GS}=0V		1100		pF
Coss			500		pF
Crss			170		pF
$t_{d\ (on)}$	I_D=8A, $V_{DD}\fallingdotseq$30V, R_L=3.75Ω, V_{GS}=5V, R_G=50Ω		50		ns
t_r			250		ns
$t_{d\ (off)}$			250		ns
t_f			180		ns
V_{SD}	I_{SD}=10A, V_{GS}=0V		1.0	1.5	V

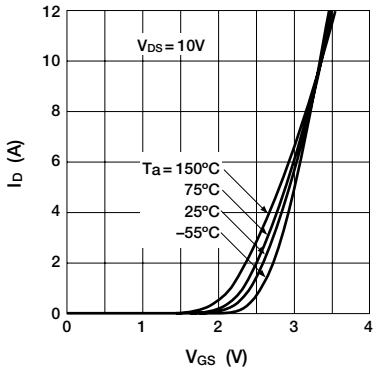
External Dimensions SLA 12pin (LF800)



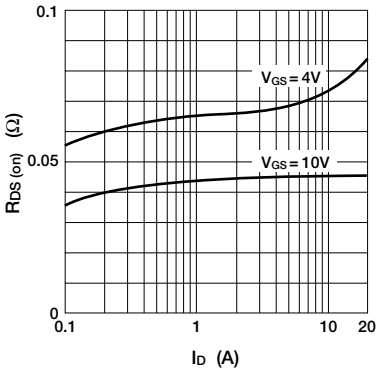
■ I_D — V_{DS} Characteristics



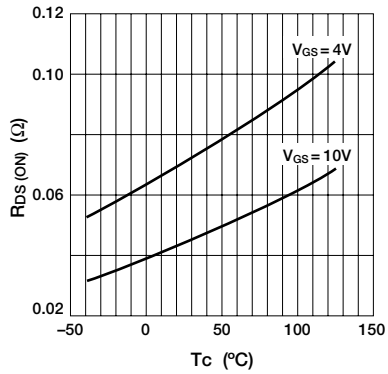
■ I_D — V_{GS} Characteristics



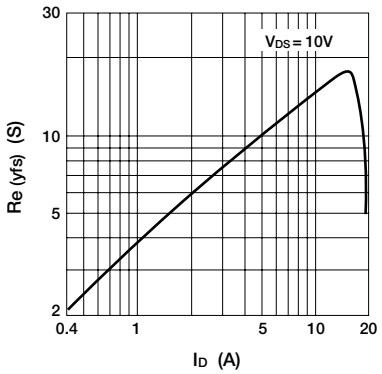
■ $R_{DS\ (ON)}$ — I_D Characteristics



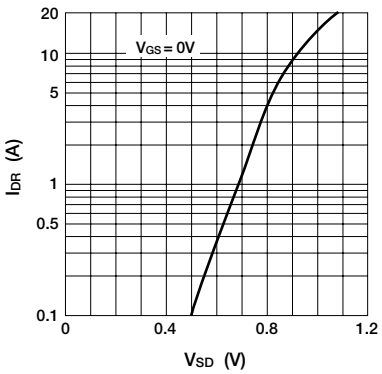
■ $R_{DS\ (ON)}$ — T_C Characteristics



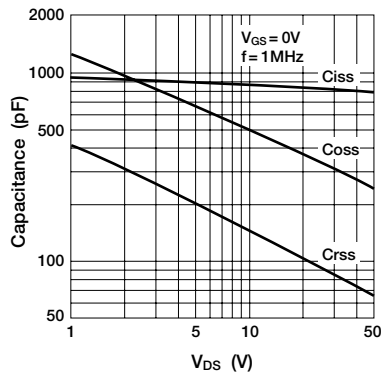
■ R_e (yfs) — I_D Characteristics



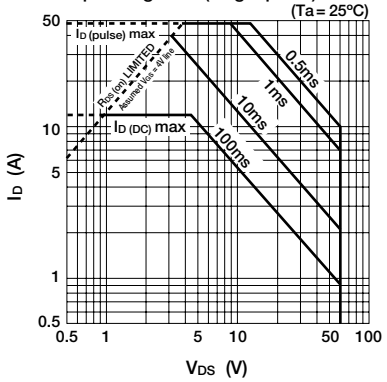
■ I_{DR} — V_{SD} Characteristics



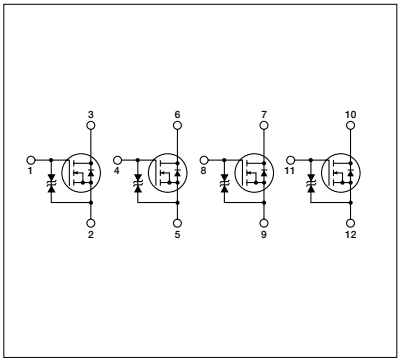
■ Capacitance — V_{DS} Characteristics



■ Safe Operating Area (single pulse) (Ta = 25°C)



Equivalent Circuit Diagram



MOS FET Array SLA5098 (under development)

Absolute Maximum Ratings (Ta=25°C)

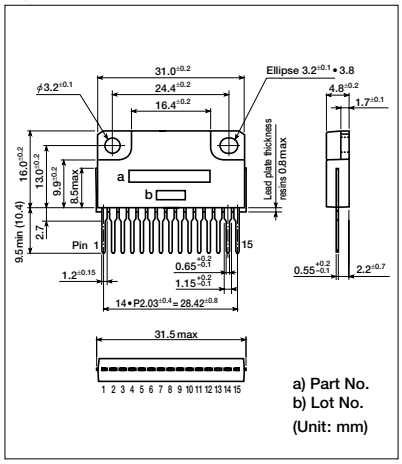
Symbol	Ratings	Unit
V_{DSS}	40	V
V_{GSS}	±20	V
I_D	20	A
$I_{D\ (pulse)}$*	40	A
E_{AS}	To be defined	mJ
I_{AS}	To be defined	A
P_T	5 (Without heatsink, Ta=25°C, All circuits operate)	W
	90 (Tc=25°C, All circuits operate)	W
Tch	150	°C
Tstg	−55 to +150	°C

* $P_W \leqq 100\mu s$, duty ≦ 1%

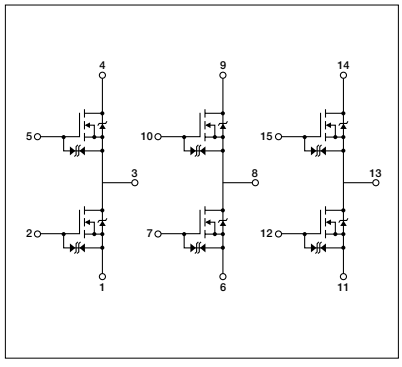
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	$I_D = 100\mu A$, $V_{GS} = 0V$	40			V
I_{GSS}	$V_{GS} = \pm 15V$			±10	μA
I_{DSS}	$V_{DS} = 40V$, $V_{GS} = 0V$			100	μA
V_{TH}	$V_{DS} = 10V$, $I_D = 250\mu A$	1.5		2.5	V
$Re_{(yfs)}$	$V_{DS} = 10V$, $I_D = 10A$	10			S
$R_{DS\ (ON)}$	$V_{GS} = 10V$, $I_D = 10A$			17	mΩ
Ciss	$V_{DS} = 10V$		1450		pF
Coss	f = 1.0MHz		420		pF
Crss	$V_{GS} = 0V$		260		pF
$t_{d\ (on)}$	$I_D = 10A$		40		ns
t_r	$V_{DD} = 14V$		40		ns
$t_{d\ (off)}$	$R_L = 1.4\Omega$		200		ns
t_f	$V_{GS} = 10V$		100		ns
V_{SD}	$R_G = 50\Omega$		0.85	1.2	V
t_{rr}	$I_{SD} = 10A$, $V_{GS} = 0V$, di/dt = 100A/μs		45		ns

External Dimensions STA4 (LF412)



Equivalent Circuit Diagram



MOS FET Array SMA5113

Absolute Maximum Ratings (Ta=25°C)

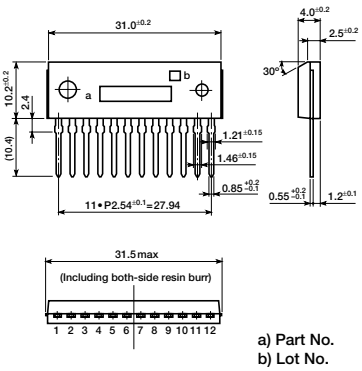
Symbol	Ratings	Unit
V_{DSS}	450	V
V_{GSS}	±30	V
I_D	±7	A
$I_{D\ (pulse)}$ *1	±28	A
P_T	4 (Ta=25°C, All circuits operate, No Fin)	W
	35 (Tc=25°C, All circuits operate, ∞ Fin)	W
E_{AS} *2	130	mJ
I_{AS}	7	A
θj-a	31.2 (Junction - Ambientare, Ta=25°C, All circuits operate)	°C/W
θj-c	3.57 (Junction - Case, Ta=25°C, All circuits operate)	°C/W
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 100\mu s$, duty ≦1%
*2 V_{DD}=30V, L=5mH, I_L=7A, unclamped, R_G=50Ω

Electrical Characteristics (Ta=25°C)

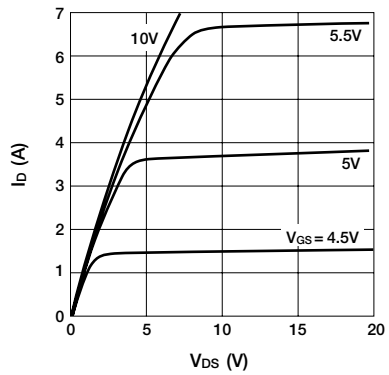
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100μA, V_{GS}=0V	450			V
I_{GSS}	V_{GS}=±30V			±100	nA
I_{DSS}	V_{DS}=450V, V_{GS}=0V			100	μA
V_{TH}	V_{DS}=10V, I_D=1mA	2.0		4.0	V
$R_{e\ (yfs)}$	V_{DS}=20V, I_D=3.5A	3.5	5.0		S
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=3.5A		0.84	1.1	Ω
Ciss	V_{DS}=10V		720		pF
Coss	f=1.0MHz		150		pF
Crss	V_{GS}=0V		65		pF
$t_{d\ (on)}$	I_D=3.5A		25		ns
t_r	V_{DD}≒200V		40		ns
$t_{d\ (off)}$	R_L=57Ω		70		ns
t_f	V_{GS}=10V, R_G=50Ω		50		ns
V_{SD}	I_{SD}=7A, V_{GS}=0V		1.0	1.5	V

External Dimensions SMA (LF1000)

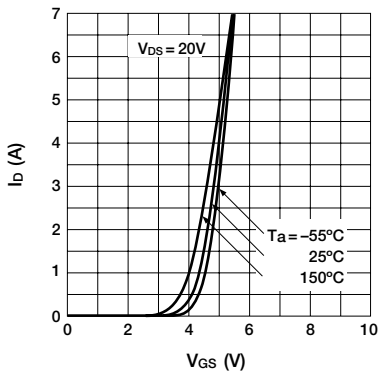


a) Part No.
b) Lot No.
(Unit: mm)

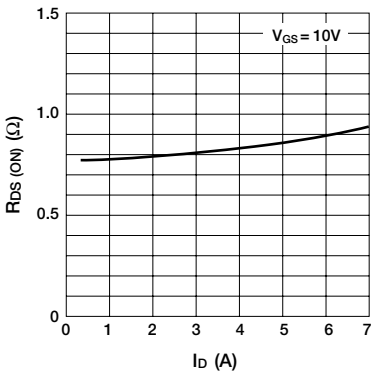
■ I_D — V_{DS} Characteristics



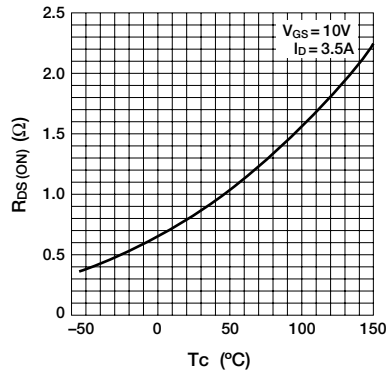
■ I_D — V_{GS} Characteristics



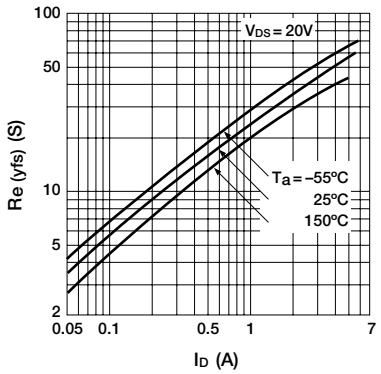
■ $R_{DS\ (ON)}$ — I_D Characteristics



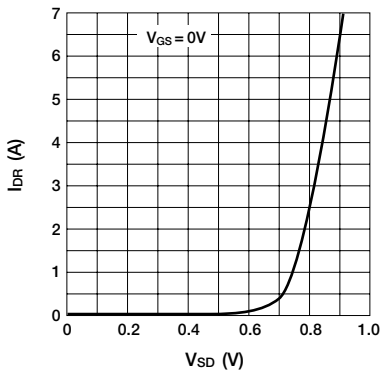
■ $R_{DS\ (ON)}$ — T_C Characteristics



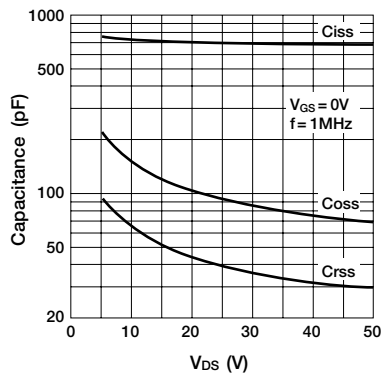
■ R_e (yfs) — I_D Characteristics



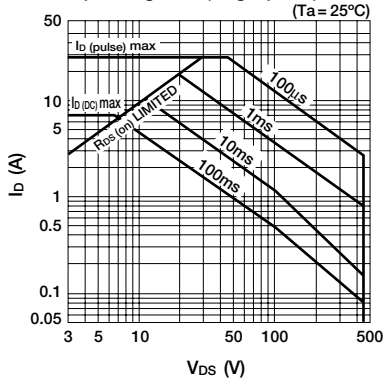
■ I_{DR} — V_{SD} Characteristics



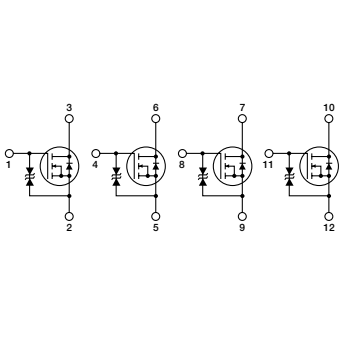
■ Capacitance — V_{DS} Characteristics



■ Safe Operating Area (single pulse) (Ta=25°C)



Equivalent Circuit Diagram



MOS FET Array STA508A

Absolute Maximum Ratings (Ta=25ºC)

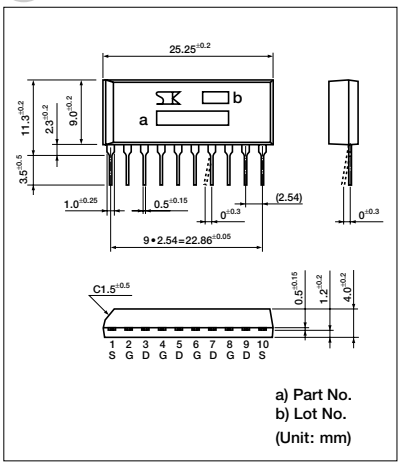
Symbol	Ratings	Unit
V_{DSS}	120	V
V_{GSS}	±20	V
I_D	±6	A
$I_{D\ (pulse)}$*1	±10	A
P_T	4 (Ta=25ºC)	W
	20 (Tc=25ºC)	W
E_{AS} *2	80	mJ
Tch	150	ºC
Tstg	−55 to +150	ºC

*1 $P_W \leqq 100\mu s$, duty ≦ 1%
*2 V_{DD}=12V, L=10mH, unclamped, $R_G=50\Omega$

Electrical Characteristics (Ta=25ºC)

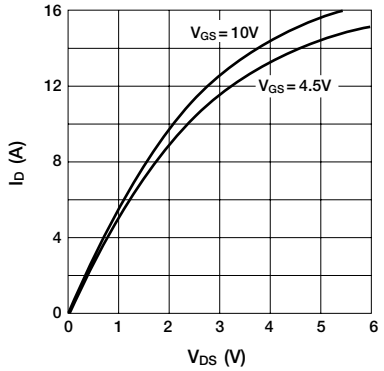
Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	I_D=100µA, V_{GS}=0V	120			V
I_{GSS}	V_{GS}=±20V			±5	µA
I_{DSS}	V_{DS}=120V, V_{GS}=0V			100	µA
V_{TH}	V_{DS}=10V, I_D=250µA	1.0		2.0	V
$R_{e\ (yfs)}$	V_{DS}=10V, I_D=4.0A	5.0			S
$R_{DS\ (ON)}$	V_{GS}=10V, I_D=4.0A		0.15	0.2	Ω
	V_{GS}=4V, I_D=4.0A		0.2	0.25	Ω
Ciss	V_{DS}=10V		400		pF
Coss	f=1.0MHz		130		pF
Crss	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=3Ω		250		ns
t_f	V_{GS}=5V		200		ns
V_{SD}	R_G=50Ω		1.0	1.5	V
	I_{SD}=6A, V_{GS}=0V				

External Dimensions STA4 (LF412)

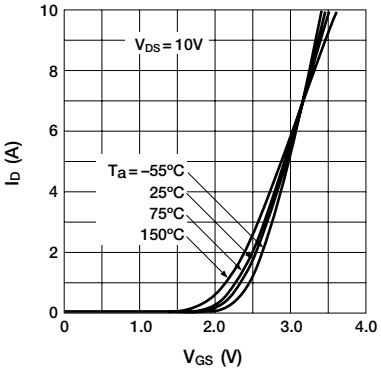


a) Part No.
b) Lot No.
(Unit: mm)

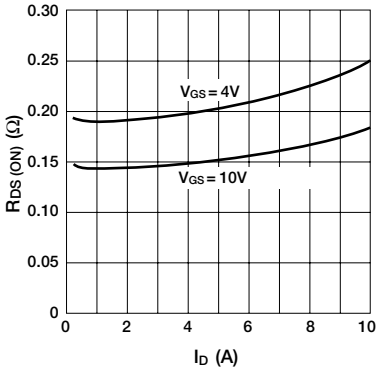
■ I_D — V_{DS} Characteristics



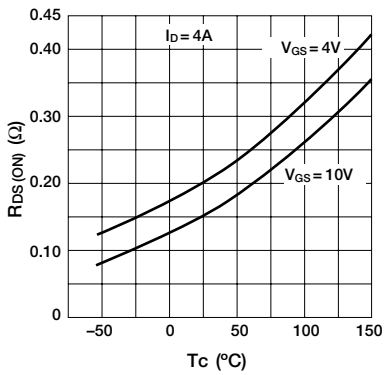
■ I_D — V_{GS} Characteristics



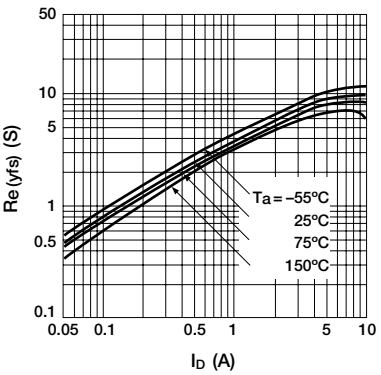
■ $R_{DS\ (ON)}$ — I_D Characteristics



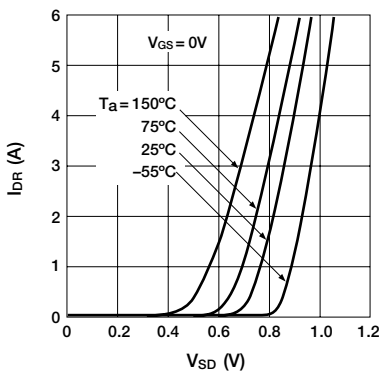
■ $R_{DS\ (ON)}$ — T_C Characteristics



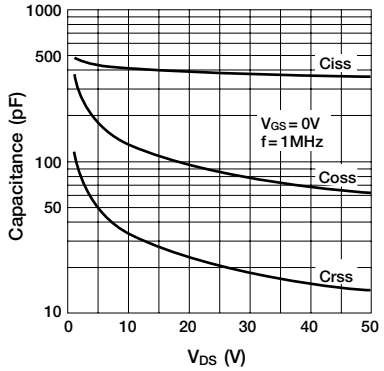
■ R_e (yfs) — I_D Characteristics



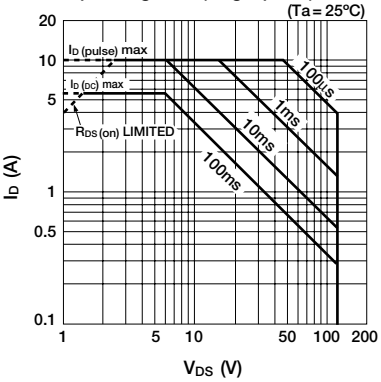
■ I_{DR} — V_{SD} Characteristics



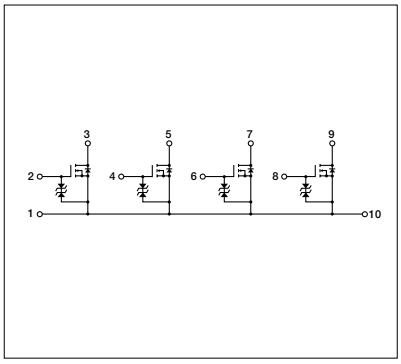
■ Capacitance — V_{DS} Characteristics



■ Safe Operating Area (single pulse)



Equivalent Circuit Diagram



MOS FET Array STA509A

Absolute Maximum Ratings (Ta=25°C)

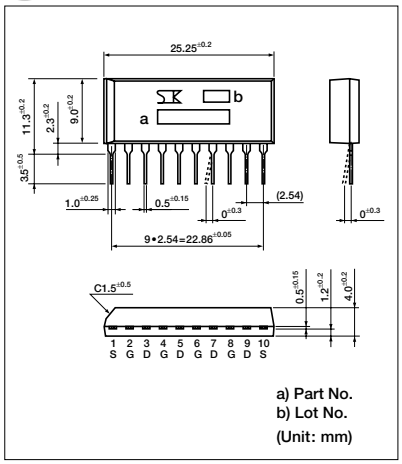
Symbol	Ratings	Unit
V_{DSS}	52±5	V
V_{GSS}	±20	V
I_D	±3	A
$I_{D\ (pulse)}$ *1	±6	A
P_T	4 (Ta=25°C)	W
	20 (Tc=25°C)	W
E_{AS} *2	40	mJ
Tch	150	°C
Tstg	−55 to +150	°C

*1 $P_W \leqq 100\mu s$, duty ≦1%
*2 $V_{DD}=12V$, L=10mH, unclamped, $R_G=10\Omega$

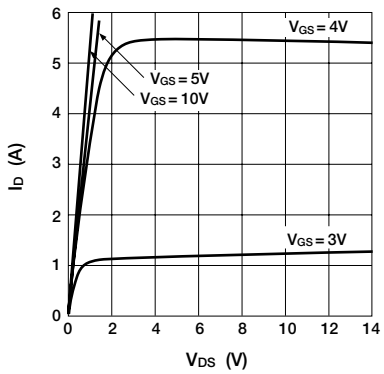
Electrical Characteristics (Ta=25°C)

Symbol	Test Conditions	Ratings min	Ratings typ	Ratings max	Unit
$V_{(BR)\ DSS}$	$I_D=1mA$, $V_{GS}=0V$	47	52	57	V
I_{GSS}	$V_{GS}=\pm20V$			±1.0	μA
I_{DSS}	$V_{DS}=40V$, $V_{GS}=0V$			100	μA
V_{TH}	$V_{DS}=10V$, $I_D=250\mu A$	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
Ciss	$V_{DS}=10V$		200		pF
Coss	f=1.0MHz		120		pF
Crss	$V_{GS}=0V$		20		pF
$t_{d\ (on)}$	$I_D=1A$		2.0		μs
t_r	$V_{DD}\fallingdotseq12V$		7.4		μs
$t_{d\ (off)}$	$R_L=12\Omega$		3.3		μs
t_f	$V_{GS}=5V$		4.2		μs
V_{SD}	$R_{G1}=50\Omega$, $R_{G2}=10\Omega$		1.0	1.5	V
	$I_{SD}=6A$, $V_{GS}=0V$				

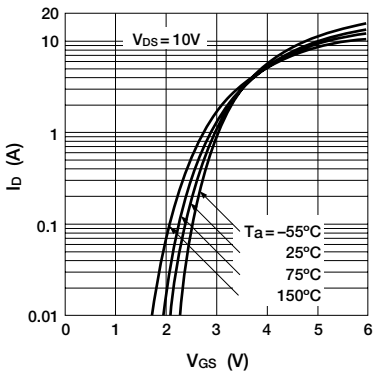
External Dimensions STA



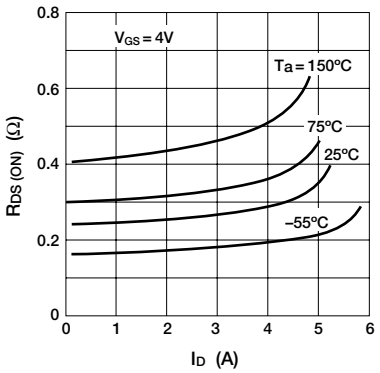
■ I_D — V_{DS} Characteristics



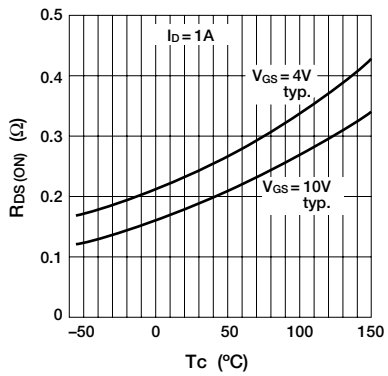
■ I_D — V_{GS} Characteristics



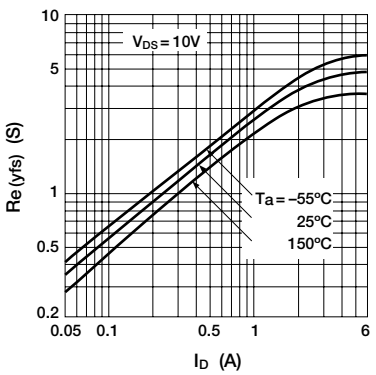
■ $R_{DS\ (ON)}$ — I_D Characteristics



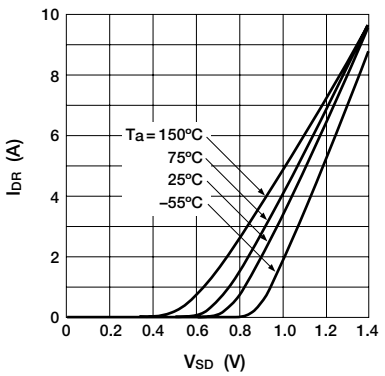
■ $R_{DS\ (ON)}$ — T_C Characteristics



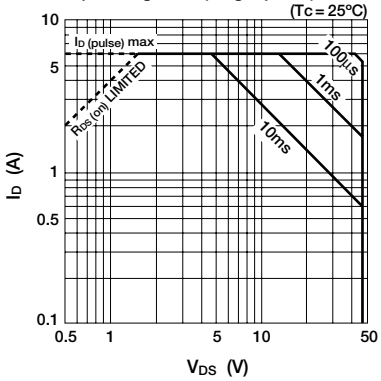
■ R_e (yfs) — I_D Characteristics



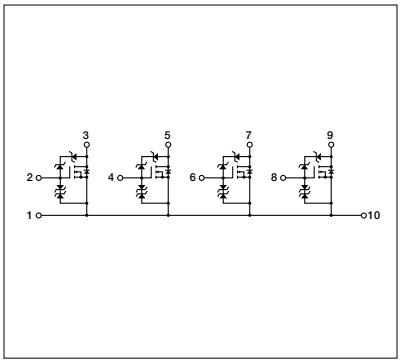
■ I_{DR} — V_{SD} Characteristics



■ Safe Operating Area (single pulse)



Equivalent Circuit Diagram



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/μs
- 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	Tj=–40 to +125°C, R_{GK}=1kΩ
Repetitive surge peak on-state current	I_{TRM}	430	A	V_D≦430V, 100kcycle, * Wp=1.3μs, Ta=125°C
Critical rate-of-rise of on-state current	di/dt	1200	A/μs	*
Peak forward gate current	I_{FGM}	2.0	A	f≧50Hz, duty≦10%
Peak gate power loss	P_{GM}	5.0	W	f≧50Hz, duty≦10%
Average gate power loss	$P_{G(AV)}$	0.5	W	
Peak reverse gate voltage	V_{RGM}	5	V	f≧50Hz
Diode repetitive peak surge forward current	I_{FRM}	240	A	V_D≦430V, 100kcycle, * Wp=1.3μs, Ta=125°C
Junction temperature	Tj	–40 to +125	°C	
Storage temperature	Tstg	–40 to +125	°C	

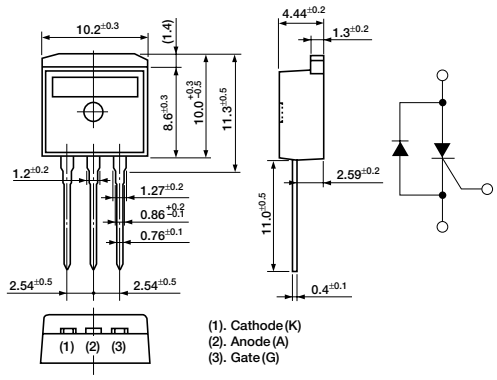
* The surge current for T=10ms /cycle shall be applied 50 cycles successively, and an interval time shall follow to cool down the junction temperature of the device to 125°C. This process shall be repeated up to 100K cycles.

Electrical Characteristics

(Tj=25°C)

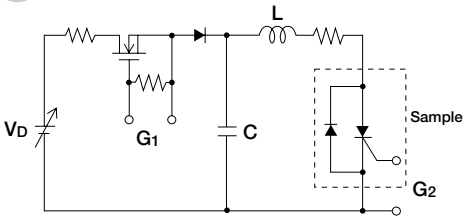
Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
On-state voltage	V_{TM}			1.4	V	I_T=10A
Gate trigger voltage	V_{GT}			1.5	V	V_D=6V, R_L=10Ω
Gate trigger current	I_{GT}			20	mA	V_D=6V, R_L=10Ω
Gate non-trigger voltage	V_{GD}	0.1			V	V_D=480V, Tj=125°C
Holding current	I_H	2	10.0		mA	R_{G-K}=1kΩ,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

External Dimensions (unit: mm)

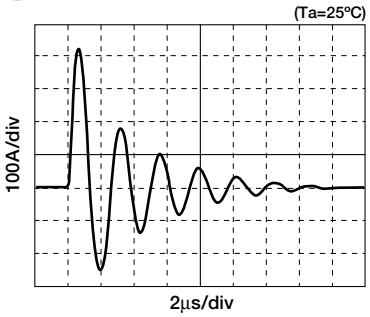


Weight: Approx. 1.5g

Measurement circuit



Current waveform (1cycle)



Thyristor with built-in reverse diode for HID lamp ignition TFC562D

Features

- Repetitive peak off-state voltage: V_{DRM}=600V
- Repetitive peak surge on-state current: I_{TRM}=600A
- Critical rate-of-rise of on-state current: di/dt=1600A/μs
- 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	Tj=–40 to +125°C, R_{GK}=1kΩ
Repetitive surge peak on-state current	I_{TRM}	600	A	Ta=100°C, V_D≦430V, W_P=1.05μs, I_G=70mA, dig/dt=0.5A/μs, 100kcycle*, See the examples of current waveforms
Critical rate-of-rise of on-state current	di/dt	1600	A/μs	
Peak forward gate current	I_{FGM}	2	A	f≧50Hz, duty≦10%
Peak gate power loss	P_{GM}	5	W	f≧50Hz, duty≦10%
Average gate power loss	$P_{G(AV)}$	0.5	W	
Peak reverse gate voltage	V_{RGM}	5	V	f≧50Hz
Diode repetitive peak surge forward current	I_{FRM}	460	A	Ta=100°C, V_D≦430V, W_P=1.05μs, 100kcycle*, See the examples of current waveforms
Junction temperature	Tj	–40 to +125	°C	
Storage temperature	Tstg	–40 to +125	°C	

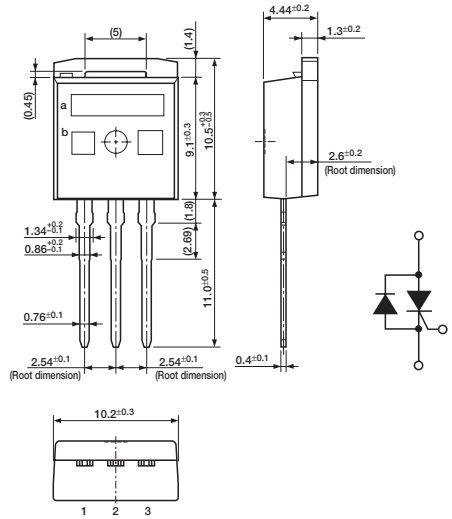
* The surge current for T=10ms /cycle shall be applied 50 cycles successively, and an interval time shall follow to cool down the junction temperature of the device to 125°C. This process shall be repeated up to 100K cycles.

Electrical Characteristics

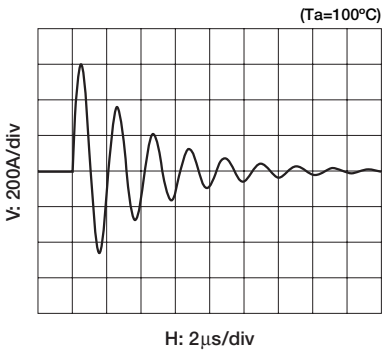
(Tj=25°C)

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=10Ω
Gate trigger current	I_{GT} (1)			20	mA	V_D=6V, R_L=10Ω
Gate non-trigger voltage	V_{GD}	0.1			V	V_D=480V, Tj=125°C
Holding current	I_H	2	5		mA	R_{G-K}=1kΩ, Tj=25°C
Off-state current (1)	I_{DRM} (1)			10	μA	V_D=V_{DRM}, R_{G-K}=1kΩ, Tj=25°C
Off-state current (2)	I_{DRM} (2)			1	mA	V_D=V_{DRM}, R_{G-K}=1kΩ, Tj=125°C
Thermal resistance	Rth			4.0	°C/W	Junction to case, With infinite heatsink
Diode forward voltage	V_F			1.4	V	I_F=10A

External Dimensions (unit: mm)



Current waveform (1cycle)



* A single cycle operation consists of a continuous impression of 50 rounds with period T = 10ms followed by a rest time for the junction temperature of the element to cool down to 100°C (= Ta). Repeat this cycle operation.

■ Normal 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	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	30	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	—	—	
SG-9LLCNR											
SG-10LS	200	30	300	–40 to +150		1.2	100	0.25	—	—	3
SG-10LR											
SG-10LXS	150	35	350	–40 to +150		1.05	100	0.25	—	—	
SG-10LXR											
SG-10LLS	200	40	400	–40 to +150		1.05	100	0.25	—	—	
SG-10LLR											
SG-10LLXS	150	45	450	–40 to +150		1.0	100	0.25	—	—	
SG-10LLXR											

■ Zener 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	Condition I_F (A)	I_R (mA) max	V_Z (V)	Condition I_Z (mA)	
SG-9CZS	17	20	200	–40 to +200		1.10	20	0.05	23±3	10	1
SG-9CZR											
SG-9LLCZS	17	35	350	–40 to +200		1.10	35	0.05	23±3	10	2
SG-9LLCZR											
SG-10LZ23S	17	30	300	–40 to +150		1.2	100	0.05	23±3	10	3
SG-10LZ23R											
SG-10LLZ23S	17	40	400	–40 to +150		1.05	100	0.05	23±3	10	
SG-10LLZ23R											
SG-14LXZS	16	35	350	–40 to +200		1.15	100	0.05	22±3	100	4
SG-14LXZR											

External Dimensions (unit: mm)

Fig. 1

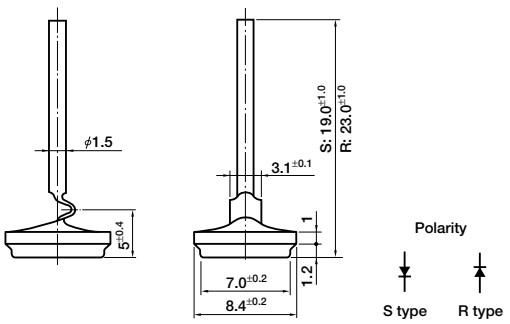


Fig. 2

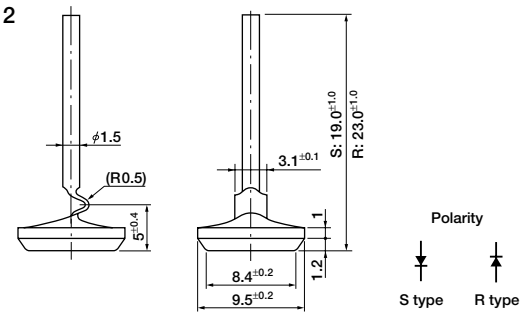


Fig. 3

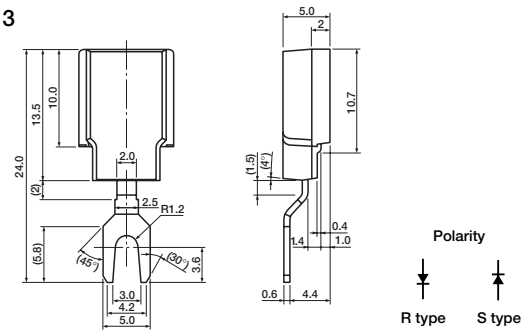
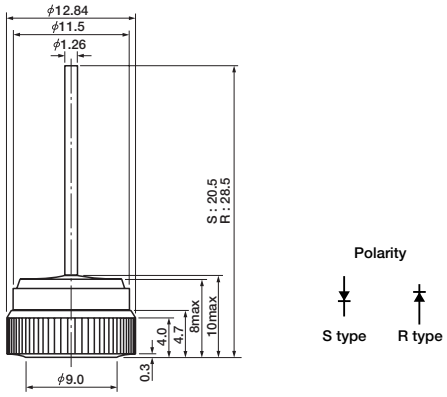


Fig. 4



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 (°C)	T_{stg} (°C)	V_F (V) max	Condition I_F (mA)	I_R (μA) $V_R=V_{RM}$ max	V_Z (kV) I_R=100μA	
SHV-01JN	0.5	30	30	3	−40 to +150		1	10	10	0.55 to 1.0	2
SHV-05J	2.5	30	30	3			5			2.6 to 5.0	1
SHV-06JN	3.0	30	10	3			6			3.2 to 6.0	2

External Dimensions (unit: mm)

Fig. 1 (SHV-05J)

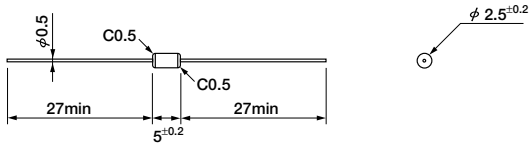
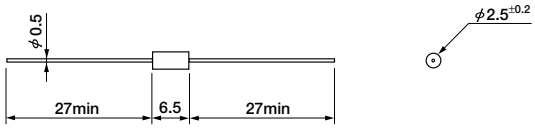


Fig. 2 (SHV-06JN)



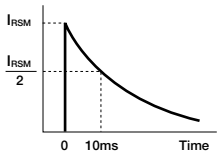
Power Zener Diode

(Ta=25°C)

Part No.	Absolute Maximum Ratings						Electrical Characteristics			Fig. No.	Remarks
	P (W)	P_R (W)	V_{DC} (V)	I_{ZSM} (A)	Tj (°C)	Tstg (°C)	V_Z (V) 1mA instantaneous current	Condition I_Z (mA)	I_R $V_R=V_{DC}$ (μA) max		
SFPZ-68	1	50 (5ms)	20	2	−40 to +150		25.0 to 31.0	1	10	1	Surface-mount type
SJPZ-K28*	1		20	2	−55 to +150		25.0 to 31.0	1	10	2	
SJPZ-E18*	1	85 (500μs)	13	—	−55 to +150		16.8 to 19.1	1	10	2	
SJPZ-E27*	1		20	—	−55 to +150		25.1 to 28.9	1	10	2	
SJPZ-E33*	1		25	—	−55 to +150		31.0 to 35.0	1	10	2	
SJPZ-E36*	1		27	—	−55 to +150		34.0 to 38.0	1	10	2	
PZ628	5	1500 (5ms)	20	65*1	−40 to +150		25.0 to 31.0	10	50	3	Axial type
SZ-10N27	5	—	22	70*1	−55 to +175		24 to 30	10	10	4	Surface-mount type
SZ-10N40*	5	—	22	40*1	−55 to +175		36 to 40	10	10	4	
SZ-10NN27	6	—	22	90*1	−55 to +175		24 to 30	10	10	4	
SZ-10NN40*	6	—	22	55*1	−55 to +175		36 to 40	10	10	4	

* under development

*1: I_{ZSM} conditions



External Dimensions (unit: mm)

Fig. 1

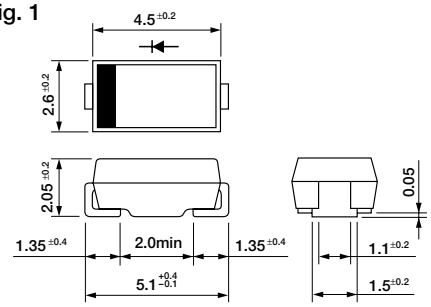


Fig. 2

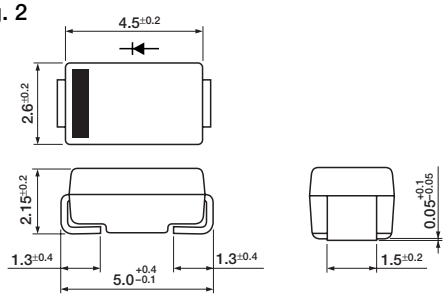


Fig. 3

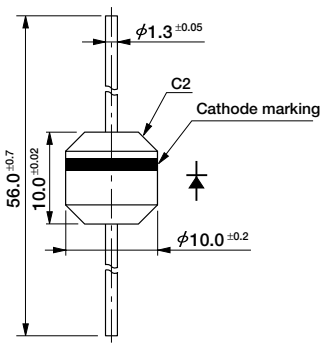
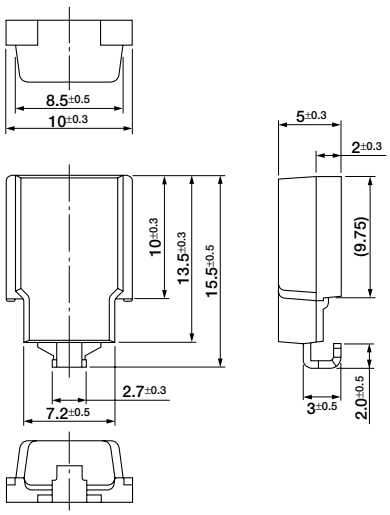


Fig. 3



Rectifier Diodes

■ Surface-mount

Part No.	V_{RM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A) Peak value of 50 Hz half-wave signal	Tj (°C)	Tstg (°C)	V_F (V) max	Condition I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R (H) (mA) $V_R=V_{RM}$ max	Condition Ta (°C)	$Rth_{(j-l)}$ (°C/W)	Package	Weight (g)
SFPM-52	200	0.9	30	–40 to +150		1.0	1.0	10	50	100	20	1	0.072
SFPM-62		1.0	45			0.98	1.0	10	50	100	20	1	0.072
SFPM-54	400	0.9	30			1.0	1.0	10	50	100	20	1	0.072
SFPM-64		1.0	45			0.98	1.0	10	50	100	20	1	0.072

Ultra Fast Recovery Rectifier Diodes

■ Surface-mount

Part No.	V_{RM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A) Peak value of 50 Hz half-wave signal	Tj (°C)	Tstg (°C)	V_F (V) max	Condition I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R (H) (mA) $V_R=V_{RM}$ max	Condition Ta (°C)	t_{rr} ① (ns)	Condition I_F/I_{RP} (mA)	t_{rr} ② (ns)	Condition I_F/I_{RP} (mA)	$Rth_{(j-l)}$ (°C/W)	Package	Weight (g)
SFPL-52	200	0.9	25	–40 to +150		0.98	1.0	10	1	150 (Tj)	50	100/100	35	100/200	20	1	0.072
SFPL-62		1.0	25			0.98	2.0	10	1	150 (Tj)	50	100/100	35	100/200	20	1	0.072
MPL-102S		10.0	65			0.98	5.0	100	0.2	150	40	100/100	30	100/200	2.5	2	1.4
MP2-202S		20.0	110			0.98	10.0	200	0.4	150	50	100/100	35	100/200	2.5	2	1.4
SFPL-64	400	1.0	25			1.3	1.0	10	0.05	150	50	100/100	30	100/200	20	1	0.072

Schottky Barrier Diodes

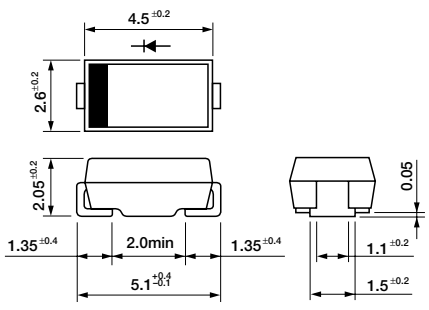
■ Surface-mount

Part No.	V_{RM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A) Peak value of 50 Hz half-wave signal	Tj (°C)	Tstg (°C)	V_F (V) max	Condition I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R (H) (mA) $V_R=V_{RM}$ max	Condition Ta (°C)	$Rth_{(j-l)}$ (°C/W)	Package	Weight (g)
SFPJ-53*	30	1.0	30	–40 to +150		0.45	1.0	1.0	35	150	20	1	0.072
SFPJ-63	30	2.0	40			0.45	2.0	2.0	70	150	20	1	0.072
SFPJ-73	30	3.0	50			0.45	3.0	3.0	100	150	20	1	0.072
SFPB-54	40	1.0	30			0.55	1.0	1	35	150	20	1	0.072
SFPB-64	40	2.0	60			0.55	2.0	5	70	150	20	1	0.072
SFPE-64	40	2.0	40			0.6	2.0	0.2	70	150	20	1	0.072
SFPB-74	40	3.0	60			0.5	2.0	5	100	150	20	1	0.072
SFPB-56	60	0.7	10			0.62	0.7	1	30	150	20	1	0.072
SFPW-56	60	1.5	25			0.7	1.5	1	70	150	20	1	0.072
SFPB-66	60	2.0	25			0.69	2.0	1	55	150	20	1	0.072
SFPB-76	60	2.0	40			0.62	2.0	2	70	150	20	1	0.072
SFPB-59	90	0.7	10			0.81	0.7	1	30	150	20	1	0.072
SFPB-69	90	1.5	40			0.81	1.5	2	55	150	20	1	0.072

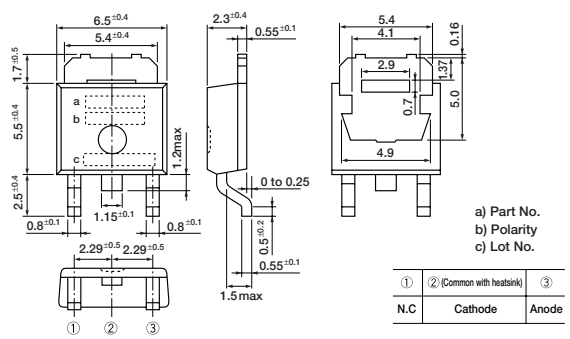
* under development

External Dimensions (unit: mm)

1: (Surface-mount SFP)



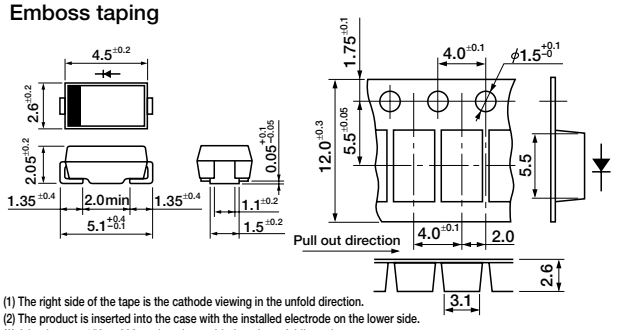
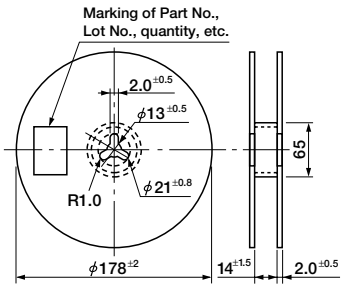
2: (TO-220S)



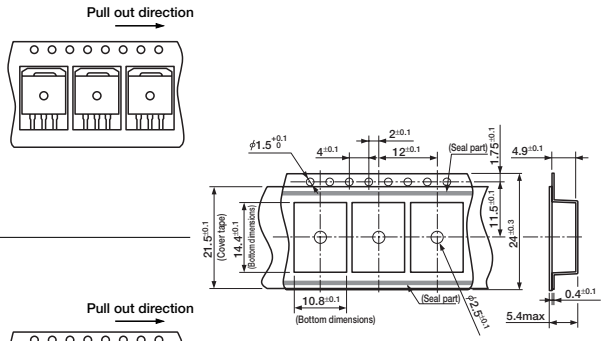
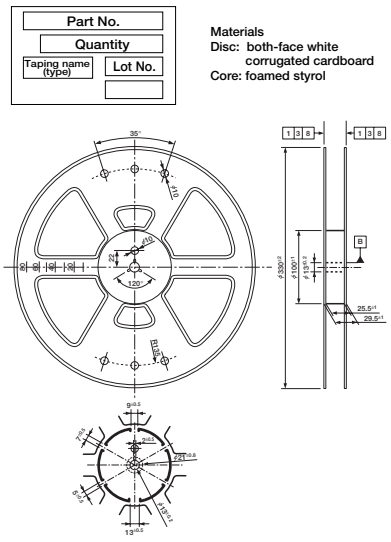
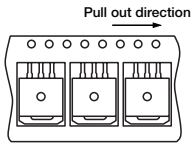
①	② (Common with heatsink)	③
N.C	Cathode	Anode

General-purpose Diodes - Taping Specifications

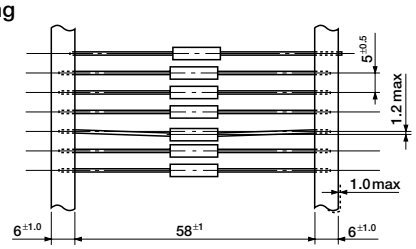
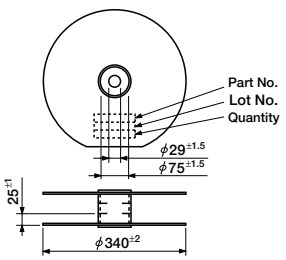
Taping Specifications

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 right side of the tape is the cathode viewing in the unfold direction. (2) The product is inserted into the case with the installed electrode on the lower side. (3) A leader tape 150 to 200mm long is provided on the unfolding edge. (4) A space of at least 10 pitches equivalent is provided on either end of the tape. (5) Taping with reversed diode polarity is available on request (taping name VL).	Reel 	1,800 pcs. per reel

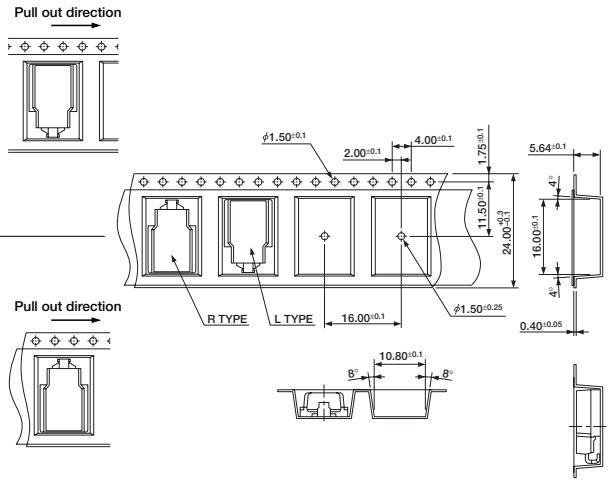
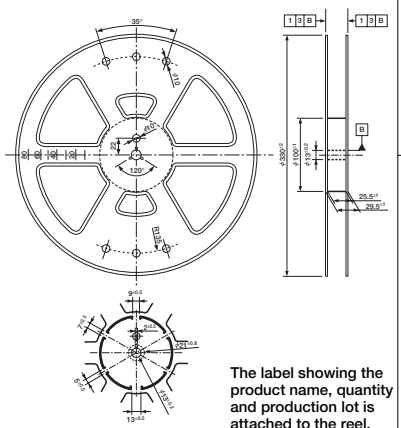
Power Surface-mount - Taping Specifications

Taping Name	Taping Dimensions (mm)	Packaging Dimensions (mm) and Markings	Packaging Quantity
VL A suffix "VL" is added to Part No. for tape packaging.			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 for ignition - 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

Power Zener 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.		 The label showing the product name, quantity and production lot is attached to the reel.	750 pcs. per reel
VR A suffix "VR" is added to Part No. for tape packaging.			750 pcs. per reel

3 LEDs

Uni-Color LED Lamps

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings						Conditions
		GaP	GaAsP	GaAℓAs	AℓGaInP	InGaN	GaN	
P_D	mW	75				120		
I_F	mA	30						
ΔI_F	mA/°C	−0.45						Above 25°C
I_{FP}	mA	100					70	f=1kHz, tw=100μs
V_R	V	3				5		
Top	°C	−30 to +85					−30 to +80	
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)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material		
				typ	max	typ		typ	typ			
5φ Round	Deep red	SEL1110R	Diffused red	2.0	2.5	2.8	5	700	625	GaP	×	1
		SEL1110W	Diffused white			2.8					×	
		SEL1110S	Tinted red			4.5					×	
	High-intensity red	SEL1610W	Diffused white	1.75	2.2	250	20	660	642	GaAℓAs	×	
		SEL1610C	Clear			300					×	
	Red	SEL1210R	Diffused red	1.9	2.5	26	20	630	620	GaAsP	×	
		SEL1210S	Tinted red			75					×	
	Amber	SEL1810D	Diffused orange	1.9	2.5	18	10	610	605	GaAsP	×	
		SEL1810A	Tinted orange			37					×	
	Orange	SEL1910D	Diffused orange	1.9	2.5	14	10	587	590	GaAsP	×	
		SEL1910A	Tinted orange			25					×	
	Yellow	SEL1710Y	Diffused yellow	2.0	2.5	22	10	570	571	GaP	×	
		SEL1710K	Tinted yellow			65					×	
	Green	SEL1410G	Diffused green	2.0	2.5	32	20	560	567	GaP	×	
		SEL1410E	Tinted green			84					×	
	Pure green	SEL1510C	Clear	2.0	2.5	50	20	555	559	GaP	×	
	Red	SEL1210RM	Diffused red	1.9	2.5	36	20	630	620	GaAsP	×	2
		SEL1210SM	Tinted red			75					×	
	Amber	SEL1810DM	Diffused orange	1.9	2.5	18	10	610	605	GaAsP	×	
		SEL1810AM	Tinted orange			37					×	
	Orange	SEL1910DM	Diffused orange	1.9	2.5	19	10	587	590	GaAsP	×	
		SEL1910AM	Tinted orange			34					×	
	Yellow	SEL1710KM	Tinted yellow	2.0	2.5	65	10	570	571	GaP	×	
	Green	SEL1410GM	Diffused green	2.0	2.5	30	20	560	567	GaP	×	
		SEL1410EM	Tinted green			84					×	
	Pure green	SEL1510CM	Clear	2.0	2.5	50	20	555	559	GaP	×	
	Ultra high-intensity red	SELU1210CXM	Clear	2.0	2.5	280	20	635	625	AℓGaInP	×	3
	Ultra high-intensity orange	SELU1910CXM-S	Clear	2.0	2.5	450	20	591	589	AℓGaInP	×	
	Ultra high-intensity pure green	SELU1D10CXM	Clear	3.3	4.0	2000	20	525	530	InGaN	×	
	Ultra high-intensity blue	SELU1E10CXM	Clear	3.3	4.0	600	20	468	470	InGaN	×	
	Ultra high-intensity blue	SELS1E10CXM-M	Clear	3.7	4.2	1000	20	468	470	InGaN	×	
	Ultra high-intensity red	SELU1250CM	Clear	2.0	2.5	900	20	635	625	AℓGaInP	○	4
	Red	SEL1250SM	Tinted red	1.9	2.5	75	20	630	620	GaAsP	○	
		SEL1250RM	Diffused red			48					○	
	Amber	SEL1850AM	Tinted orange	1.9	2.5	90	20	610	605	GaAsP	○	
		SEL1850DM	Diffused orange			60					○	
	Orange	SEL1950KM	Tinted orange	1.9	2.5	96	20	587	590	GaAsP	○	
	Green	SEL1450EKM	Tinted green	2.0	2.5	190	20	560	567	GaP	○	
		SEL1450GM-YG	Diffused green			120					○	
	Pure green	SEL1550CM	Clear	2.0	2.5	72	20	555	559	GaP	○	
	Ultra high-intensity pure green	SELU1D50CM	Clear	3.3	4.0	6000	20	525	530	InGaN	×	
	Ultra high-intensity blue	SELU1E50CM	Clear	3.3	4.0	1850	20	468	470	InGaN	×	
	High-intensity red	SEL1615C	Clear	1.75	2.2	170	20	660	642	GaAℓAs	×	5
4.6×5.6φ Egg-shaped	Ultra high-intensity red	SELU1253CMKT	Clear	2.0	2.5	200	20	635	625	AℓGaInP	×	6
	Green	SEL1453CEMKT	Tinted green	2.0	2.5	140	20	560	567	GaP	×	
4φ Round	Deep red	SEL4110S	Tinted red	2.0	2.5	2.4	5	700	625	GaP	×	7
		SEL4110R	Diffused red			1.7					×	
	Red	SEL4210S	Tinted red	1.9	2.5	30	20	630	620	GaAsP	×	
		SEL4210R	Diffused red			17					×	
	Amber	SEL4810A	Tinted orange	1.9	2.5	20	10	610	605	GaAsP	×	
		SEL4810D	Diffused orange			15					×	
	Orange	SEL4910A	Tinted orange	1.9	2.5	26	10	587	590	GaAsP	×	
		SEL4910D	Diffused orange			16					×	
	Yellow	SEL4710K	Tinted yellow	2.0	2.5	36	10	570	571	GaP	×	
		SEL4710Y	Diffused yellow			14					×	

Uni-Color LED Lamps

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)							Contact mount	Fig. No.
				V_F (V)		Iv (mcd)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material		
				typ	max	typ		typ	typ			
4ϕ Round	Green	SEL4410E	Tinted green	2.0	2.5	87	20	560	567	GaP	×	7
		SEL4410G	Diffused green			34					×	
	Ultra high-intensity green	SELU4410CKT-S	Clear	2.1	2.5	170	20	560	562	AℓGaInP	×	
	Pure green	SEL4510C	Clear	2.0	2.5	45	20	555	559	GaP	×	
	Deep red	SEL4114S	Tinted red	2.0	2.5	3.8	10	700	625	GaP	○	8
		SEL4114R	Diffused red			2.8					○	
	Red	SEL4214S	Tinted red	1.9	2.5	40	20	630	620	GaAsP	○	
		SEL4214R	Diffused red			24					○	
	Amber	SEL4814A	Tinted orange	1.9	2.5	20	10	610	605	GaAsP	○	
		SEL4814D	Diffused orange			15					○	
	Orange	SEL4914A	Tinted orange	1.9	2.5	26	10	587	590	GaAsP	○	
		SEL4914D	Diffused orange			11					○	
	Yellow	SEL4714K	Tinted yellow	2.0	2.5	38	10	570	571	GaP	○	
		SEL4714Y	Diffused yellow			27					○	
	Green	SEL4414E	Tinted green	2.0	2.5	69	20	560	567	GaP	○	
		SEL4414G	Diffused green			48					○	
	Pure green	SEL4514C	Clear	2.0	2.5	26	20	555	559	GaP	○	
3ϕ Round	Deep red	SEL6110S	Tinted red	2.0	2.5	3.9	10	700	625	GaP	○	9
		SEL6110R	Diffused red			2.6					○	
	Red	SEL6210S	Tinted red	1.9	2.5	41	20	630	620	GaAsP	○	
		SEL6210R	Diffused red			18					○	
	Amber	SEL6810A	Tinted orange	1.9	2.5	22	10	610	605	GaAsP	○	
		SEL6810D	Diffused orange			9.6					○	
	Ultra high-intensity orange	SELU6910C-S	Clear	2.0	2.5	550	20	591	589	AℓGaInP	○	
	Orange	SEL6910A	Tinted orange	1.9	2.5	22	10	587	590	GaAsP	○	
		SEL6910D	Diffused orange			11					○	
	Yellow	SEL6710K	Tinted yellow	2.0	2.5	37	10	570	571	GaP	○	
		SEL6710Y	Diffused yellow			11					○	
	Green	SEL6410E	Tinted green	2.0	2.5	90	20	560	567	GaP	○	
		SEL6410G	Diffused green			30					○	
	Pure green	SEL6510C	Clear	2.0	2.5	42	20	555	559	GaP	○	
		SEL6510G	Diffused green			9.6					○	
	Blue	SEL6E10C	Clear	4.0	4.8	60	20	430	466	GaN	○	
	Ultra high-intensity deep red	SELU6614C-S	Clear	2.0	2.5	150	20	650	639	AℓGaInP	○	10
		SELU6614W-S	Diffused white			90					○	
	Ultra high-intensity red	SELU6214C	Clear	2.0	2.5	180	20	635	625	AℓGaInP	○	
	Red	SEL6214S	Tinted red	1.9	2.5	18	20	630	620	GaAsP	○	
	Amber	SEL6814A	Tinted orange	1.9	2.5	9.0	10	610	605	GaAsP	○	
	Ultra high-intensity light amber	SELS6B14C	Clear	2.	2.5	120	20	600	596	AℓGaInP	○	
	Ultra high-intensity orange	SELU6914C-S	Clear	2.0	2.5	180	20	591	589	AℓGaInP	○	
	Orange	SEL6914A	Tinted orange	1.9	2.5	8.0	10	587	590	GaAsP	○	
		SEL6914W	Diffused white			5.0					○	
	Ultra high-intensity yellow	SELU6714C	Clear	2.1	2.5	60	20	572	571	AℓGaInP	○	
	Yellow	SEL6714K	Tinted yellow	2.0	2.5	66	20	570	571	GaP	○	
		SEL6714W	Diffused white			30					○	
	Green	SEL6414E	Tinted green	2.0	2.5	42	20	560	567	GaP	○	
	Ultra high-intensity green	SELU6414G-S	Diffused green	2.1	2.5	30	20	560	562	AℓGaInP	○	
	Deep green	SEL6414E-TG	Tinted green	2.0	2.5	18	20	558	564	GaP	○	
	Pure green	SEL6514C	Clear	2.0	2.5	12	20	555	559	GaP	○	
	Ultra high-intensity pure green	SELS6D14C	Clear	3.3	4.0	300	20	518	525	InGaN	○	
	Ultra high-intensity blue	SELS6E14C-M	Clear	3.7	4.2	70	20	468	470	InGaN	○	
	Red	SEL6215S	Tinted red	1.9	2.5	45	20	630	620	GaAsP	○	11
	Orange	SEL6915A	Tinted orange	1.9	2.5	60	20	587	590	GaAsP	○	
	Yellow	SEL6715C	Clear	2.0	2.5	90	20	570	571	GaP	○	
	Green	SEL6415E	Tinted green	2.0	2.5	81	20	560	567	GaP	○	
	Pure green	SEL6515C	Clear	2.0	2.5	44	20	555	559	GaP	○	
	Deep red	SEL2110S	Tinted red	2.0	2.5	4	10	700	625	GaP	×	12
		SEL2110R	Diffused red			1.8					×	
		SEL2110W	Diffused white			1.8					×	
	High-intensity red	SEL2610C	Clear	1.75	2.2	60	20	660	642	GaAℓAs	×	
	Ultra high-intensity deep red	SELU2610C-S	Clear	2.0	2.5	300	20	650	639	AℓGaInP	×	
	Red	SEL2210S	Tinted red	1.9	2.5	40	20	630	620	GaAsP	×	
		SEL2210R	Diffused red			15					×	
		SEL2210W	Diffused white			15					×	
	Amber	SEL2810A	Tinted orange	1.9	2.5	22	10	610	605	GaAsP	×	
		SEL2810D	Diffused orange			9.0					×	
	Ultra high-intensity light amber	SELU2B10A-S	Tinted orange	2.0	2.5	300	20	598	595	AℓGaInP	×	

Uni-Color LED Lamps

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25ºC)							Contact mount	Fig. No.
				V_F (V)		I_V (mcd)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material		
				typ	max	typ		typ	typ			
3φ Round	Orange	SEL2910A	Tinted orange	1.9	2.5	16	10	587	590	GaAsP	×	12
		SEL2910D	Diffused orange			8.0					×	
	Ultra high-intensity yellow	SELU2710C	Clear	2.1	2.5	270	20	572	571	AℓGaInP	×	
	Yellow	SEL2710K	Tinted yellow	2.0	2.5	40	10	570	571	GaP	×	
		SEL2710Y	Diffused yellow			14					×	
	Green	SEL2410E	Tinted green	2.0	2.5	77	20	560	567	GaP	×	
		SEL2410G	Diffused green			20					×	
	Pure green	SEL2510C	Clear	2.0	2.5	43	20	555	559	GaP	×	
		SEL2510G	Diffused green			8.2					×	
	Ultra high-intensity pure green	SELU2D10C	Clear	3.3	4.0	1200	20	525	530	InGaN	×	
	Ultra high-intensity blue	SELU2E10C	Clear	3.3	4.0	400	20	468	470	InGaN	×	
	Blue	SEL2E10C	Clear	4.0	4.8	60	20	430	466	GaN	×	
	Ultra high-intensity red	SELU2215R-S	Diffused red	2.0	2.5	380	20	632	624	AℓGaInP	×	13
	Red	SEL2215S	Tinted red	1.9	2.5	45	20	630	620	GaAsP	×	
		SEL2215R	Diffused red			38					×	
	Amber	SEL2815A	Tinted orange	1.9	2.5	80	10	610	605	GaAsP	×	
		SEL2815D	Diffused orange			60					×	
	Orange	SEL2915A	Tinted orange	1.9	2.5	81	10	587	590	GaAsP	×	
		SEL2915D	Diffused orange			53					×	
	Yellow	SEL2715K	Tinted yellow	2.0	2.5	130	10	570	571	GaP	×	
		SEL2715Y	Diffused yellow			110					×	
	Green	SEL2415E	Tinted green	2.0	2.5	110	20	560	567	GaP	×	
		SEL2415G	Diffused green			72					×	
	Pure green	SEL2515C	Clear	2.0	2.5	52	20	555	559	GaP	×	
Inverted-cone typ for surface illumination	Red	SEL1213C	Tinted red	1.9	2.5	7.0	20	630	620	GaAsP	×	14
	Amber	SEL1813A	Tinted orange	1.9	2.5	8.0	20	610	605	GaAsP	×	
	Orange	SEL1913K	Tinted light orange	1.9	2.5	8.0	20	587	590	GaAsP	×	
	Yellow	SEL1713K	Tinted yellow	2.0	2.5	15	20	570	571	GaP	×	
	Green	SEL1413E	Tinted green	2.0	2.5	12	20	560	567	GaP	×	
	Pure green	SEL1513E	Tinted light green	2.0	2.5	5.0	20	555	559	GaP	×	
	Ultra high-intensity red	SELU6213C-S	Clear	2.0	2.5	30	20	632	624	AℓGaInP	○	15
	Ultra high-intensity light amber	SELS6B13W	Diffused white	2.0	2.5	60	20	600	596	AℓGaInP	○	
	Green	SEL6413E	Tinted green	2.0	2.5	14	20	560	567	GaP	○	
	Deep green	SEL6413E-TG	Tinted green	2.0	2.5	6	20	558	564	GaP	○	
	Pure green	SEL6513C	Clear	2.0	2.5	5.0	20	555	559	GaP	○	
	High-intensity red	SEL2613CS-S	Tinted light red	1.75	2.2	20	20	660	642	GaAℓAs	×	16
	Red	SEL2213C	Tinted red	1.9	2.5	7.0	20	630	620	GaAsP	×	
	Amber	SEL2813A	Tinted orange	1.9	2.5	8.0	20	610	605	GaAsP	×	
	Orange	SEL2913K	Tinted orange	1.9	2.5	8.0	20	587	590	GaAsP	×	
	Yellow	SEL2713K	Tinted yellow	2.0	2.5	17	20	570	571	GaP	×	
	Green	SEL2413E	Tinted green	2.0	2.5	14	20	560	567	GaP	×	
		SEL2413G	Diffused green			12					×	
	Pure green	SEL2513E	Tinted green	2.0	2.5	5.0	20	555	559	GaP	×	
5mm Pitch lead rectangular	High-intensity red	SEL5620C	Clear	1.75	2.2	100	20	660	642	GaAℓAs	○	17
	Ultra high-intensity deep red	SELU5620S-S	Tinted red	2.0	2.5	100	20	650	639	AℓGaInP	○	
	Ultra high-intensity red	SELU5220C-S	Clear	2.0	2.5	120	20	632	624	AℓGaInP	○	
	Red	SEL5220S	Tinted red	1.9	2.5	20	20	630	620	GaAsP	○	
	Ultra high-intensity amber	SELU5820C-S	Clear	2.0	2.5	150	20	611	605	AℓGaInP	○	
	Amber	SEL5820A	Tinted orange	1.9	2.5	12	20	610	605	GaAsP	○	
	Ultra high-intensity light amber	SELU5B20C	Clear	2.0	2.5	120	20	600	596	AℓGaInP	○	
	Orange	SEL5920A	Tinted orange	1.9	2.5	12	20	587	590	GaAsP	○	
	Ultra high-intensity yellow	SELU5720C	Clear	2.1	2.5	50	20	572	571	AℓGaInP	○	
	Green	SEL5420E	Tinted green	2.0	2.5	20	20	560	567	GaP	○	
	Pure green	SEL5520C	Clear	2.0	2.5	6.0	20	555	559	GaP	○	
	Blue	SEL5E20C	Clear	4.0	4.8	10	20	430	466	GaN	○	
5mm Pitch lead bow-shaped	Ultra high-intensity red	SELS5223C	Clear	2.0	2.5	100	20	635	625	AℓGaInP	○	18
	Red	SEL5223S	Tinted red	1.9	2.5	25	20	630	620	GaAsP	○	
	Amber	SEL5823A	Tinted orange	1.9	2.5	35	20	610	605	GaAsP	○	
	Ultra high-intensity light amber	SELS5B23C	Clear	2.0	2.5	135	20	600	596	AℓGaInP	○	
	Ultra high-intensity orange	SELS5923C	Clear	2.0	2.5	145	20	591	589	AℓGaInP	○	
	Orange	SEL5923A	Tinted orange	1.9	2.5	35	20	587	590	GaAsP	○	
	Ultra high-intensity yellow	SELU5723C	Clear	2.1	2.5	155	20	572	571	AℓGaInP	○	
	Yellow	SEL5723C	Clear	2.0	2.5	60	20	570	571	GaP	○	
	Green	SEL5423E	Tinted green	2.0	2.5	40	20	560	567	GaP	○	
	Pure green	SEL5523C	Clear	2.0	2.5	13	20	555	559	GaP	○	
	Ultra high-intensity blue	SELU5E23C	Clear	3.3	4.0	180	20	468	470	InGaN	○	
	Blue	SEL5E23C	Clear	4.0	4.8	20	20	430	466	GaN	○	

Bi-Color LED Lamps

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings					Conditions
		GaP	GaAsP	GaAℓAs	AℓGaInP	InGaN	
P_D	mW	75				120	Also applies to simultaneous lighting
I_F	mA	30					
ΔI_F	mA/°C	–0.45					Above 25°C
I_{FP}	mA	100					f=1kHz, tw=100μs
V_R	V	3			5		
Top	°C	–30 to +85					
Tstg	°C	–30 to +100					

Outline	Part No.	Emitting color	Lens color	Electro-optical characteristics (Ta=25°C)							Common	Contact mount	Fig. No.
				V_F (V)		I_V (mcd)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material			
				typ	max	typ		typ	typ				
5ϕ Round	SML11516C	Deep red	Clear	2.0	2.5	15	20	700	625	GaP	Cathode	×	19
		Pure green		2.0	2.5	50	20	555	559	GaP			
	SML1516W	Deep red	Diffused white	2.0	2.5	6.0	20	700	625	GaP	Cathode	×	
		Pure green		2.0	2.5	20	20	555	559	GaP			
	SML1216C	Red	Clear	1.9	2.5	65	20	630	620	GaAsP	Cathode	×	
		Green		2.0	2.5	90	20	560	567	GaP			
	SML1216W	Red	Diffused white	1.9	2.5	60	20	630	620	GaAsP	Cathode	×	
		Green		2.0	2.5	60	20	560	567	GaP			
	SML1816W	Amber	Diffused white	1.9	2.5	50	20	610	605	GaAsP	Cathode	×	
		Green		2.0	2.5	60	20	560	567	GaP			
	SML19416W	Orange	Diffused white	1.9	2.5	45	20	587	590	GaAsP	Cathode	×	
		Green		2.0	2.5	60	20	560	567	GaP			
	SMLU12E16C	Ultra high-intensity red	Clear	2.0	2.5	500	20	632	624	AℓGaInP	Cathode	×	
		Ultra high-intensity blue		3.3	4.0	400	20	468	470	InGaN			
	SMLU12E16W	Ultra high-intensity red	Diffused white	2.0	2.5	250	20	632	624	AℓGaInP	Cathode	×	
		Ultra high-intensity blue		3.3	4.0	150	20	468	470	InGaN			
	SMLU12D16W	Ultra high-intensity red	Diffused white	2.0	2.5	250	20	632	624	AℓGaInP	Cathode	×	
		Ultra high-intensity pure green		3.3	4.0	700	20	525	530	InGaN			
	SMLU18D16C	Ultra high-intensity amber	Clear	2.0	2.5	800	20	611	605	AℓGaInP	Cathode	×	
		Ultra high-intensity pure green		3.3	4.0	2000	20	525	530	InGaN			
	SMLU18D16W-S	Ultra high-intensity amber	Diffused white	2.0	2.5	300	20	611	605	AℓGaInP	Cathode	×	
		Ultra high-intensity pure green		3.3	4.0	500	20	525	530	InGaN			
3.3×6 Rectangular	SML72420C	Red	Clear	1.9	2.5	15	20	630	620	AGaAsP	Cathode	○	20
		Green		2.0	2.5	20	20	560	567	GaP			
	SML78420C	Amber	Clear	1.9	2.5	10	20	610	605	GaAsP	Cathode	○	
		Green		2.0	2.5	20	20	560	567	GaP			
	SML79420C	Orange	Clear	1.9	2.5	10	20	587	590	GaAsP	Cathode	○	
		Green		2.0	2.5	20	20	560	567	GaP			
3.3×6 Bow-shaped	SML72423C	Red	Clear	1.9	2.5	25	20	630	620	GaAsP	Cathode	○	21
		Green		2.0	2.5	35	20	560	567	GaP			
	SML72923C	Red	Clear	1.9	2.5	25	20	630	620	GaAsP	Cathode	○	
		Orange		1.9	2.5	25	20	587	590	GaAsP			
	SML78423C	Amber	Clear	1.9	2.5	25	20	610	605	GaAsP	Cathode	○	
		Green		2.0	2.5	35	20	560	567	GaP			
	SML79423C	Orange	Clear	1.9	2.5	25	20	587	590	GaAsP	Cathode	○	
		Green		2.0	2.5	35	20	560	657	GaP			
	SMLS79723C	Ultra high-intensity orange	Clear	2.0	2.5	150	20	590	590	AℓGaInP	Cathode	○	
		Yellow		2.0	2.5	40	20	570	571	GaP			
	SMLU72423C-S	Ultra high-intensity red	Clear	2.0	2.5	120	20	635	625	AℓGaInP	Cathode	○	
		Ultra high-intensity green		2.2	2.5	30	20	560	567	AℓGaInP			
	SMLU79423C-S	Ultra high-intensity orange	Clear	2.0	2.5	150	20	590	590	AℓGaInP	Cathode	○	
		Ultra high-intensity green		2.2	2.5	30	20	560	567	AℓGaInP			

Surface Mount LEDs

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						

Uni-Color Surface Mount LEDs

Outline	Emitting color	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)							Fig. No.
				V_F (V)		I_V (mcd)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material	
				typ	max	typ		typ	typ		
Side view (flat lens type)	Red	SEC4201C	Clear	1.9	2.5	10	20	630	620	GaAsP	22
	Amber	SEC4801C	Clear	1.9	2.5	16	20	610	605	GaAsP	
	Orange	SEC4901C	Clear	1.9	2.5	13	20	587	590	GaAsP	
	Yellow	SEC4701C	Clear	2.0	2.5	25	20	570	571	GaP	
	Green	SEC4401C	Clear	2.0	2.5	22	20	560	567	GaP	
	Deep green	SEC4401E-TG	Tinted green	2.0	2.5	11	20	558	564	GaP	
	Pure green	SEC4501C	Clear	2.0	2.5	8.0	20	555	559	GaP	
	Ultra high-intensity blue	SECU4E01C	Clear	3.3	4.0	50	20	468	470	InGaN	
Side view (inner lens type)	Red	SEC4203C	Clear	1.9	2.5	15	20	630	620	GaAsP	23
	Amber	SEC4803C	Clear	1.9	2.5	20	20	610	605	GaAsP	
	Orange	SEC4903C	Clear	1.9	2.5	15	20	587	590	GaAsP	
	Yellow	SEC4703C	Clear	2.0	2.5	35	20	570	571	GaP	
	Green	SEC4403C	Clear	2.0	2.5	33	20	560	567	GaP	
	Deep green	SEC4403E-TG	Tinted green	2.0	2.5	15	20	558	564	GaP	
	Pure green	SEC4503C	Clear	2.0	2.5	10	20	555	559	GaP	
3×1.5 (flat lens type)	Deep red	SEC1101C	Clear	2.0	2.5	1.5	20	700	625	GaP	24
	High-intensity red	SEC1601C	Clear	1.7	2.2	25	20	660	642	GaAℓAs	
	Red	SEC1201C	Clear	1.9	2.5	10	20	630	620	GaAsP	
	Amber	SEC1801C	Clear	1.9	2.5	16	20	610	605	GaAsP	
	Orange	SEC1901C	Clear	1.9	2.5	13	20	587	590	GaAsP	
	Yellow	SEC1701C-YG	Clear	2.0	2.5	25	20	570	571	GaP	
	Green	SEC1401C	Clear	2.0	2.5	22	20	560	567	GaP	
	Deep green	SEC1401E-TG	Tinted green	2.0	2.5	11	20	558	564	GaP	
	Pure green	SEC1501C	Clear	2.0	2.5	8.0	20	555	559	GaP	
	Ultra high-intensity pure green	SECU1D01C	Clear	3.3	4.0	150	20	525	525	InGaN	
	Ultra high-intensity blue	SECU1E01C	Clear	3.3	4.0	50	20	470	468	InGaN	
	Blue	SEC1E01C	Clear	3.9	4.8	6.0	20	430	466	GaN	
3×1.5 (inner lens type)	High-intensity red	SEC1603C	Clear	1.7	2.2	35	20	660	642	GaAℓAs	25
	Ultra high-intensity red	SECS1203C	Clear	1.9	2.5	100	20	635	625	AℓGaInP	
	Red	SEC1203C	Clear	1.9	2.5	15	20	630	620	GaAsP	
	Ultra high-intensity amber	SECS1803C	Clear	1.9	2.5	10	3	615	607	AℓGaInP	
	Amber	SEC1803C	Clear	1.9	2.5	20	20	610	605	GaAsP	
	Ultra high-intensity orange	SECS1903C	Clear	1.9	2.5	70	20	590	590	AℓGaInP	
	Orange	SEC1903C	Clear	1.9	2.5	15	20	587	590	GaAsP	
	Yellow	SEC1703C	Clear	2.0	2.5	35	20	570	571	GaP	
	Green	SEC1403C	Clear	2.0	2.5	33	20	560	567	GaP	
	Deep green	SEC1403E-TG	Tinted green	2.0	2.5	15	20	558	564	GaP	
	Pure green	SEC1503C	Clear	2.0	2.5	10	20	555	559	GaP	

Surface Mount LEDs

Uni-color / Bi-color Surface Mount LEDs with two elements

Outline	Part No.	Emitting color	Lens color	Electro-optical characteristics (Ta=25°C)							Fig. No.
				V_F (V)		Iv (mcd)	Condition I_F (mA)	Peak wavelength λp (nm)	Dominant wavelength λp (nm)	Chip material	
				typ	max	typ		typ	typ		
3×2.5 (flat lens type)	SEC2422C	Red	Clear	1.9	2.5	10	20	630	620	GaAsP	26
		Green		2.0	2.5	20	20	560	567	GaP	
	SEC2442C	Green	Clear	2.0	2.5	20	20	560	567	GaP	
		Green		2.0	2.5	20	20	560	567	GaP	
	SEC2462C	High-intensity red	Clear	1.7	2.2	20	20	660	642	GaAℓAs	
		Green		2.0	2.5	20	20	560	567	GaP	
	SEC2492C	Orange	Clear	1.9	2.5	10	20	587	590	GaAsP	
		Green		2.0	2.5	20	20	560	567	GaP	
	SEC2552C	Pure green	Clear	2.0	2.5	5.0	20	555	559	GaP	
		Pure green		2.0	2.5	5.0	20	555	559	GaP	
	SEC2592C	Orange	Clear	1.9	2.5	10	20	587	590	GaAsP	
		Pure green		2.0	2.5	5.0	20	555	559	GaP	
	SEC2762C-YG	High-intensity red	Clear	1.7	2.2	20	20	660	642	GaAℓAs	
		Yellow		2.0	2.5	20	20	570	571	GaP	
3×2.5 (inner lens type)	SEC2484C	Amber	Clear	1.9	2.5	20	20	610	605	GaAsP	27
		Green		2.0	2.5	30	20	560	567	GaP	
	SEC2554C	Pure green	Clear	2.0	2.5	10	20	555	559	GaP	
		Pure green		2.0	2.5	10	20	555	559	GaP	
	SEC2494C	Orange	Clear	1.9	2.5	20	20	587	590	GaAsP	
		Green		2.0	2.5	30	20	560	567	GaP	
	SEC2764C	High-intensity red	Clear	1.7	2.2	50	20	660	642	GaAℓAs	
		Yellow		2.0	2.5	50	20	570	571	GaP	
	SEC2774C	Yellow	Clear	2.0	2.5	50	20	570	571	GaP	
		Yellow		2.0	2.5	50	20	570	571	GaP	

Infrared LEDs

Absolute Maximum Ratings

(Ta=25°C)

Parameter	Unit	Ratings	Conditions
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	

Infrared LEDs

Outline	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)						Contact mount	Fig. No.
			V_F (V)		Radiant intensity Ie (mW/sr)	Condition	Peak wavelength λp (nm)	Chip material		
			typ	max	typ		typ			
5φ Round	SID1010CM	Clear	1.3	1.5	130	(Constant voltage) Vcc=3V, R=2.2Ω	940	GaAs	×	28
	SID1K10CM	Clear	1.3	1.5	200		940	GaAs	×	
	SID1010CXM	Clear	1.3	1.5	80		940	GaAs	×	
	SID1K10CXM	Clear	1.3	1.5	110		940	GaAs	×	
	SID1050CM	Clear	1.3	1.5	250		940	GaAs	○	29
	SID303C	Clear	1.3	1.5	80		940	GaAs	×	30
	SID313BP	Transparent light purple	1.3	1.5	130		940	GaAs	×	
	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	×	
	SID1G313C	Clear	1.5	1.8	50		850	GaAs	×	
3φ Round	SID2010C	Clear	1.3	1.5	7		940	GaAs	×	31
	SID2K10C	Clear	1.3	1.5	14		940	GaAs	×	
3×1.5 (inner lens type) chip	SEC1G03C	Clear	1.5	1.8	3		850	GaAℓAs	—	25

Ultraviolet LEDs

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=10μs
I_R	mA	100	Max. rating of built-in Zener diode
Top	°C	–30 to +85	
Tstg	°C	–30 to +100	

Ultraviolet Surface Mount LEDs

Outline	Part No.	Lens color	Electro-optical characteristics (Ta=25°C)								Fig. No.
			V_F (V)		Iv (mcd)	Condition I_F(mA)	Peak wavelength λp (nm)	Electrostatic withstand voltage (V)	Condition	Chip material	
			typ	max	typ		typ	typ			
2.8×3.5	SECU1V0AC	Clear	3.7	4.0	2.2	20	385	4000	100pF, 1.5kΩ	InGaN	32

Multi-chip LED Module (under development)

Absolute Maximum Ratings

(Per element Ta=25°C)

Parameter	Unit	Ratings	Conditions
I_F	mA	40	With an infinite heatsink mounted
ΔI_F	mA/°C	–0.25	
I_{FP}	mA	100	f=1kHz, tw=10μs
V_R	V	5	
Topr	°C	–30 to +85	
Tstg	°C	–30 to +100	

Part No.	Colors compliant with JIS-Z9112	Color temperature [°K] 20mA	Total flux [lm] 20mA	Chromaticity x, y 20mA	Fig. No.
SEP8WD4001	Cool white	6400	30	0.32, 0.33	33
SEP8WN4001	Natural white	5000	30	0.34, 0.35	
SEP8WE4001	White	4200	30	0.37, 0.37	
SEP8WW4001	Warm white	3450	25	0.41, 0.38	
SEP8WL4001	Light bulb	2875	25	0.44, 0.41	

General-purpose LEDs - External Dimensions

(Unit: mm)

Fig.1

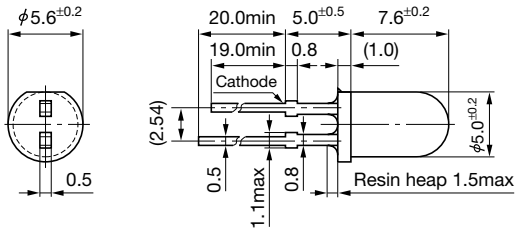


Fig.2

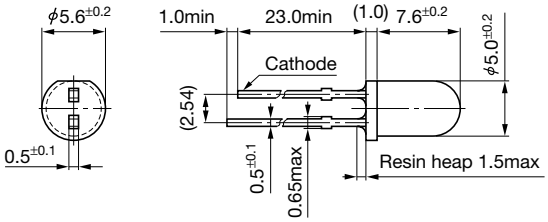


Fig.3

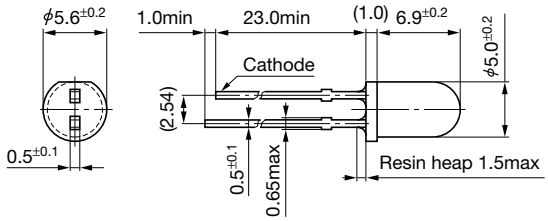


Fig.4

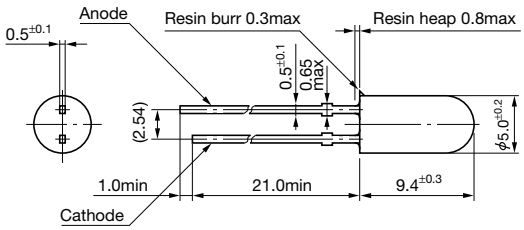


Fig.5

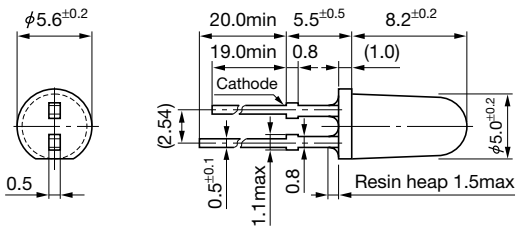


Fig.6

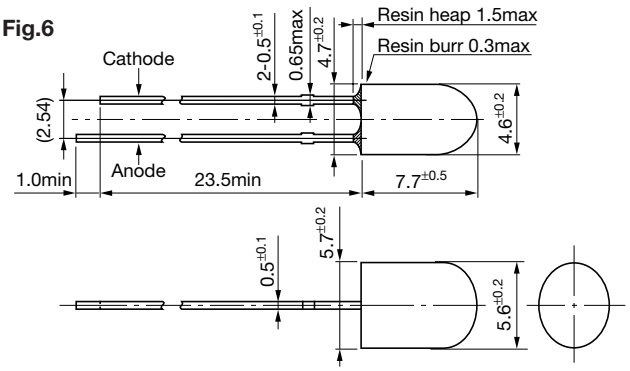


Fig.7

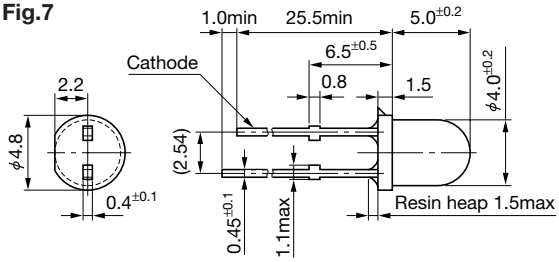


Fig.8

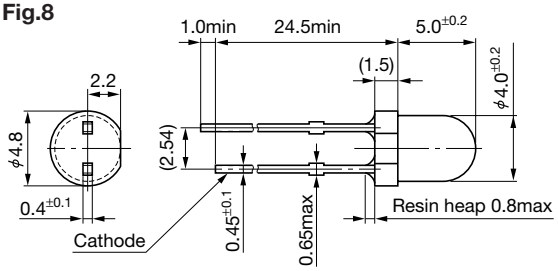


Fig.9

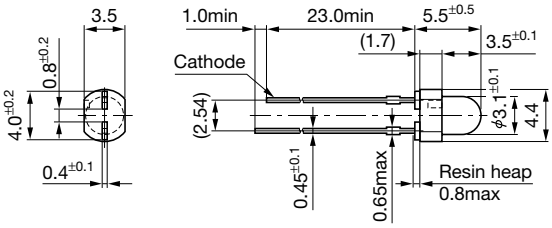
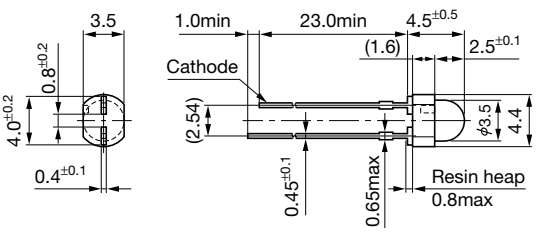


Fig.10



(Unit: mm)

Fig.11

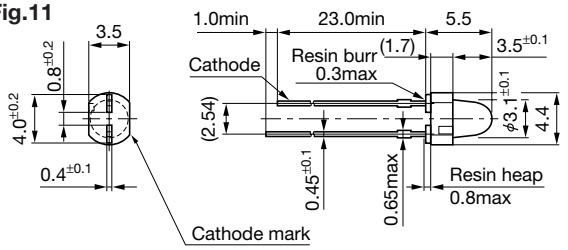


Fig.12

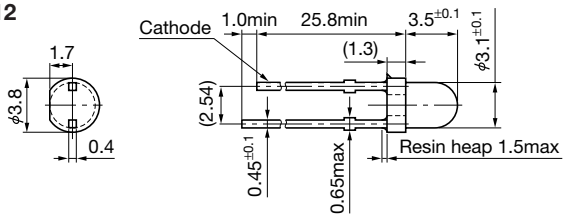


Fig.13

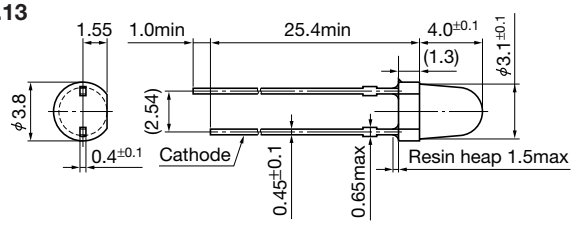


Fig.14

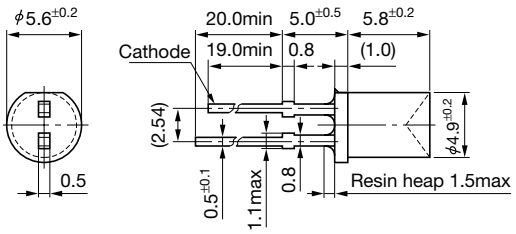


Fig.15

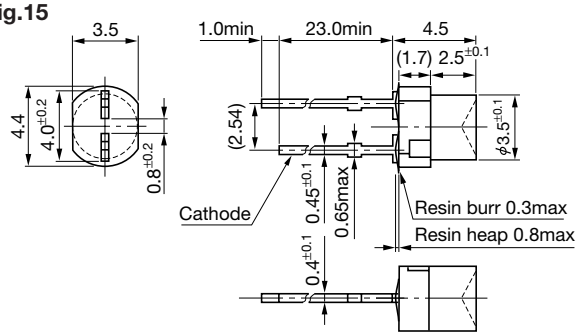


Fig.16

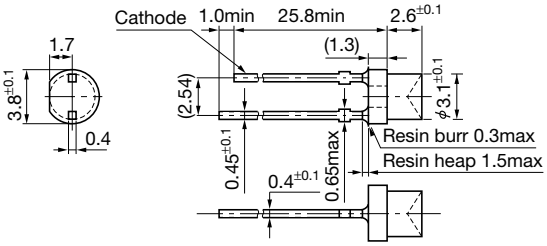


Fig.17

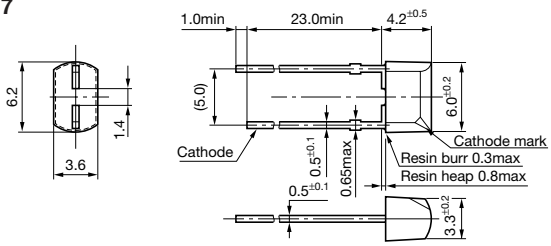


Fig.18

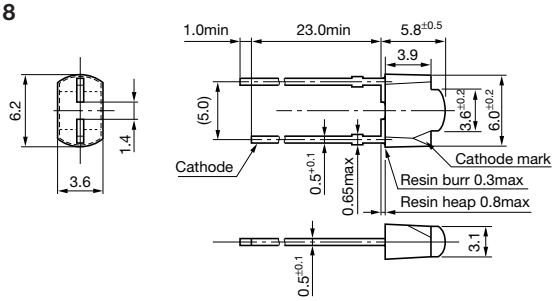


Fig.19

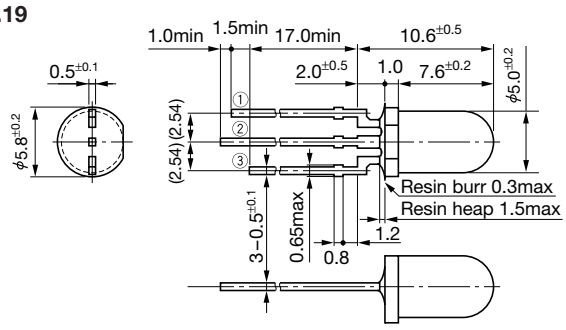
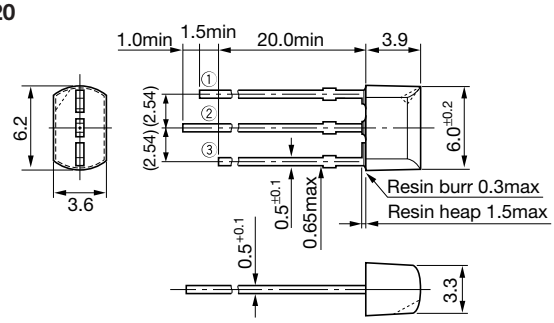


Fig.20



(Unit: mm)

Fig.21

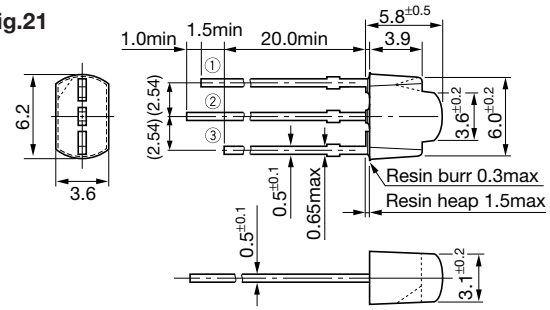


Fig.22 SEC4001

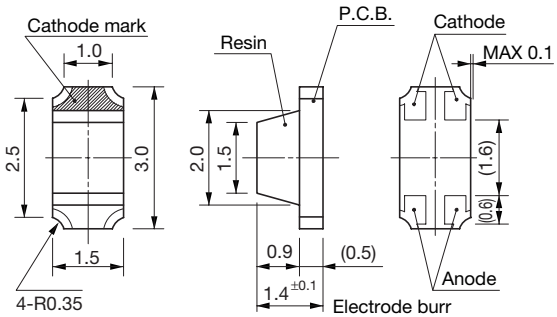


Fig.23 SEC4003

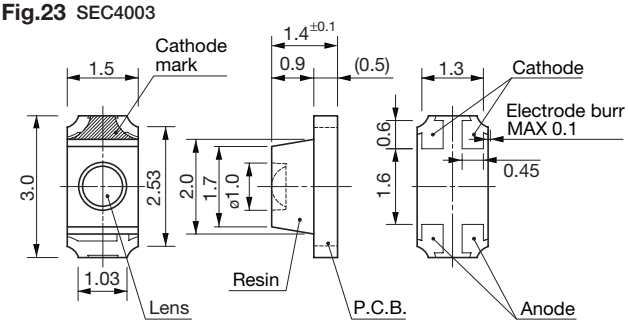


Fig.24

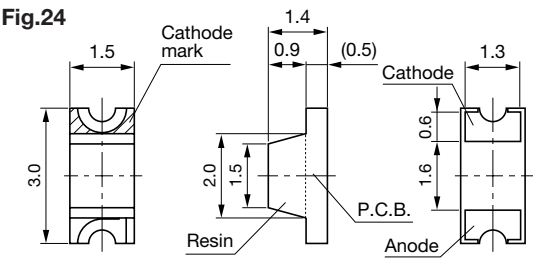


Fig.25

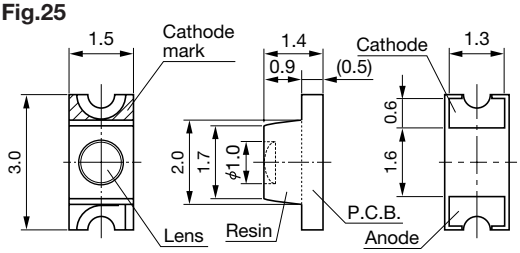


Fig.26

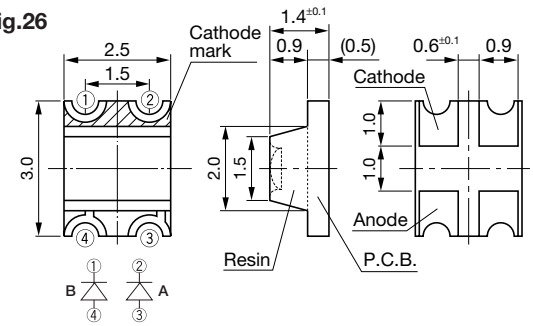


Fig.27

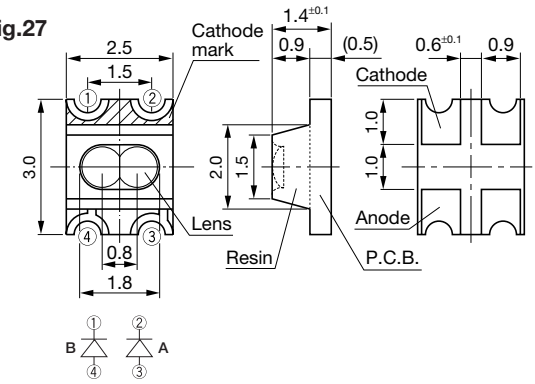
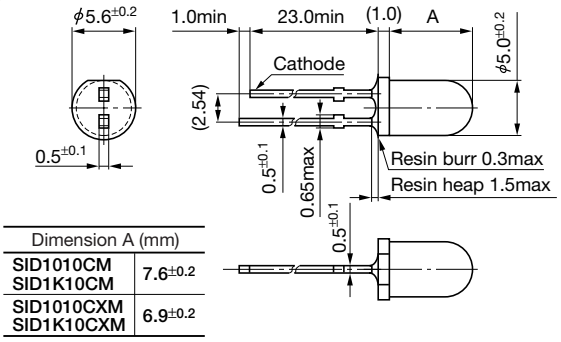
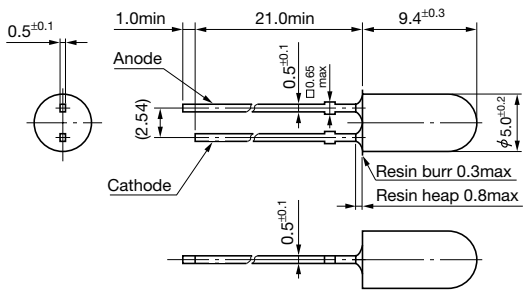


Fig.28



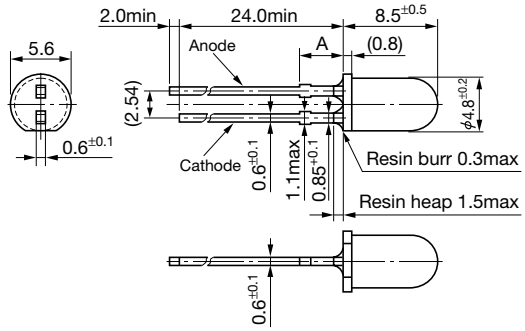
Dimension A (mm)	
SID1010CM SID1K10CM	7.6±0.2
SID1010CXM SID1K10CXM	6.9±0.2

Fig.29



(Unit: mm)

Fig.30



Dimension A (mm)	
SID303C	$3.0^{\pm0.5}$
SID313BP SID1003BQ	$3.6^{\pm0.5}$
SID307BR SID1G307C	$4.2^{\pm0.5}$

Fig.31

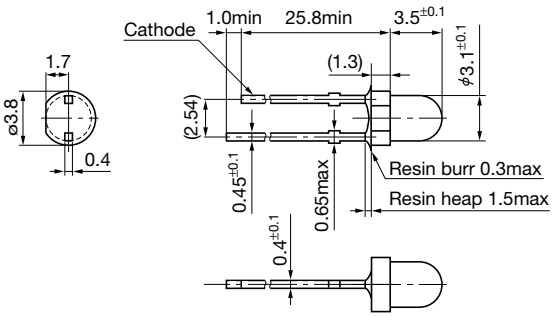


Fig.32

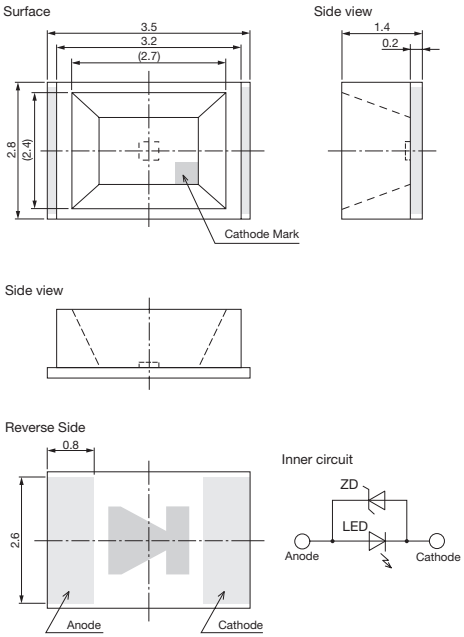
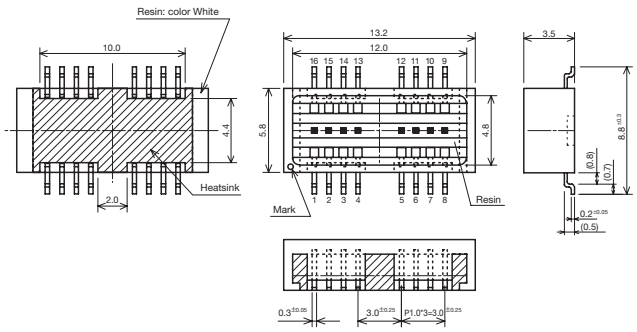


Fig.33



Part Number Index in Alphanumeric Order

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