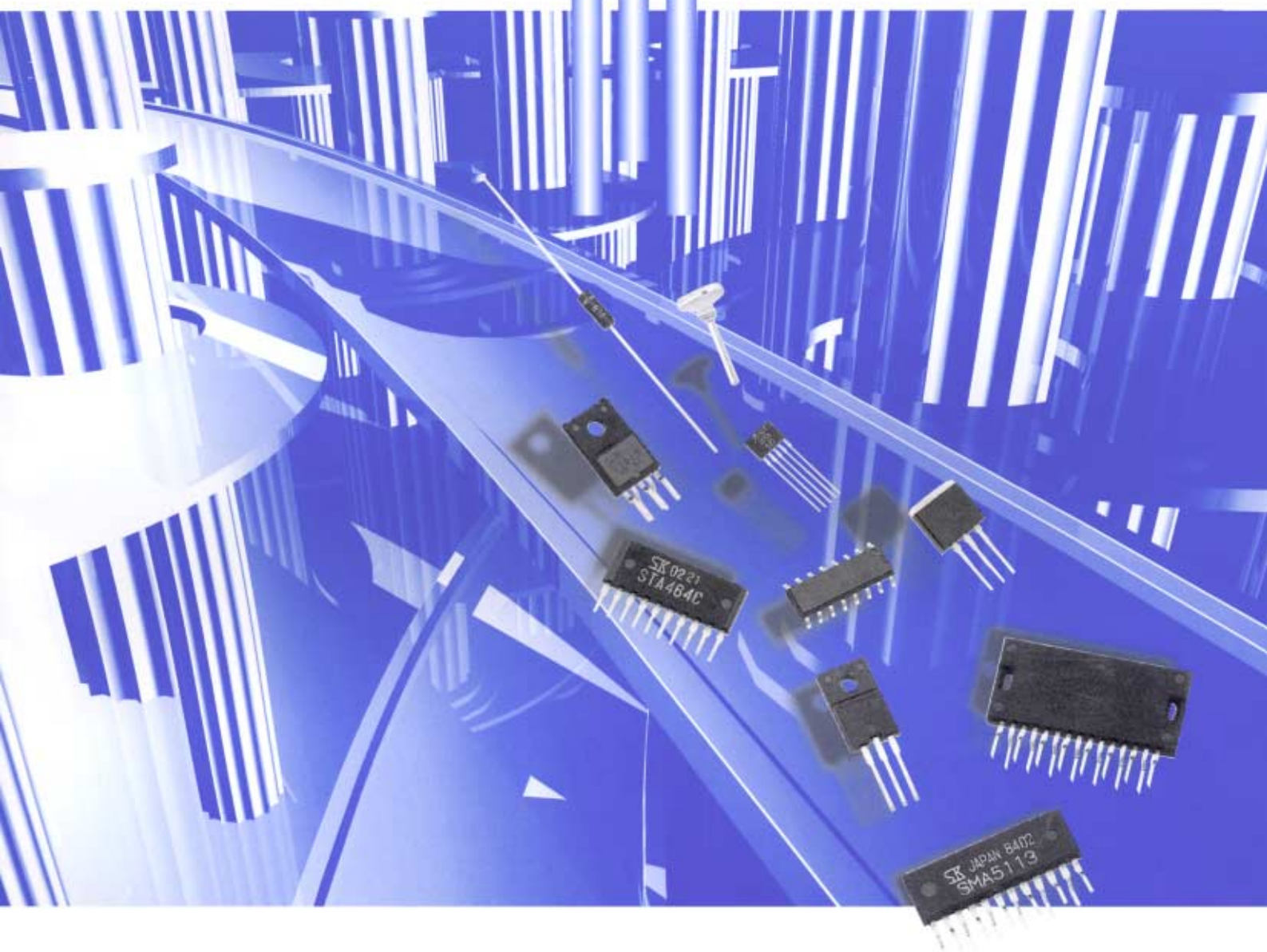


# DEVICES for AUTOMOTIVE

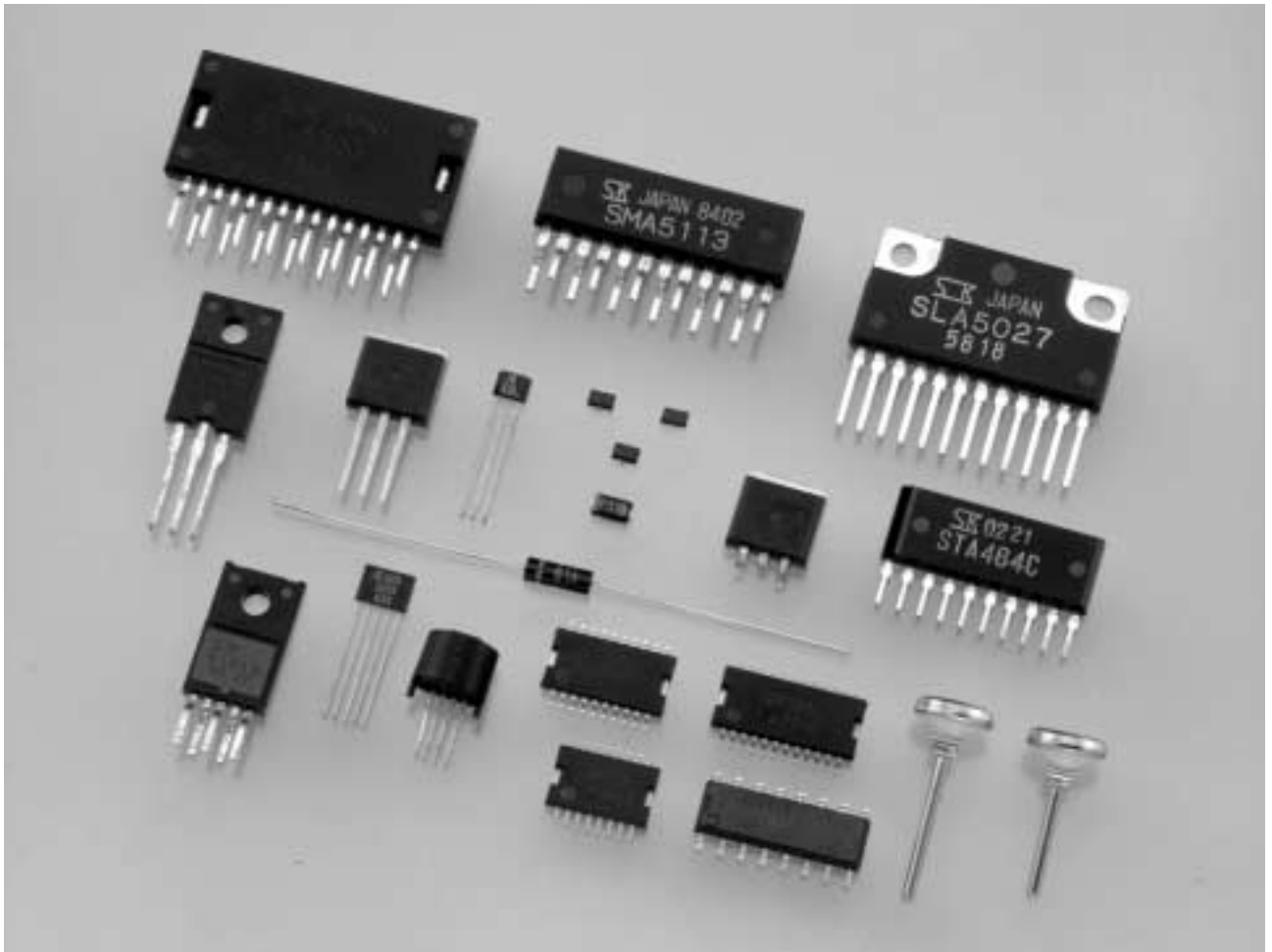


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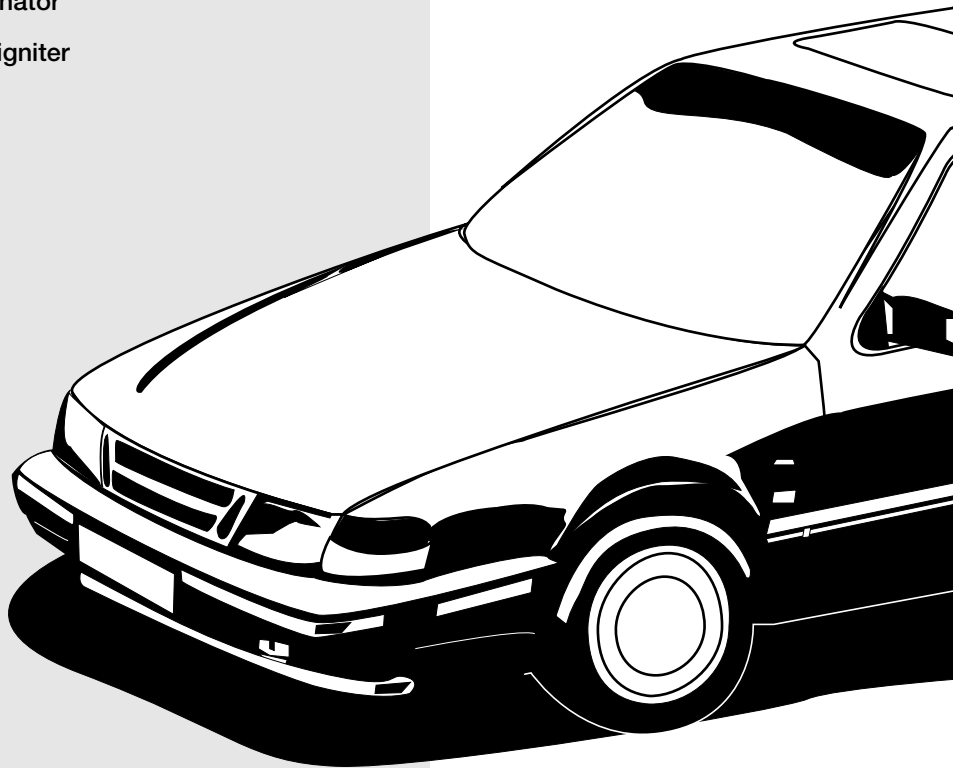
## CAUTION / WARNING

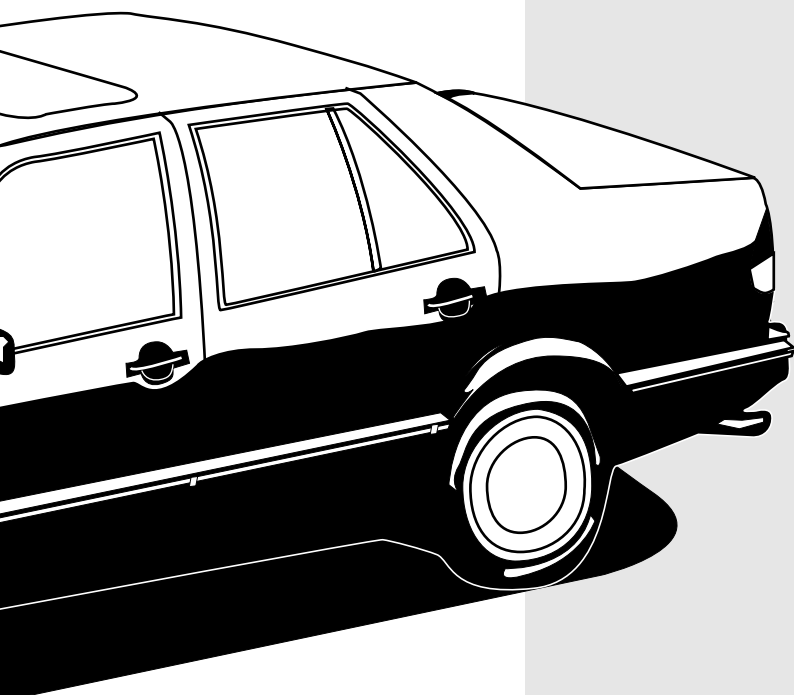
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## Product Groups

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





## Applications

### [Power Train Control]

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

- Transmission
  - Fully electronic control
  - CVT control
- Alternator

### [Carbody Control and Safety]

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

### [Compartment Equipment]

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

## Contents

|                                                               |               |          |          |         |     |
|---------------------------------------------------------------|---------------|----------|----------|---------|-----|
| ■ Application Note for Regulator ICs                          |               |          |          |         | 5   |
| ■ Dropper Type Regulator ICs                                  |               |          |          |         |     |
| • With Output ON/OFF Control                                  | SI-3001S      |          |          |         | 6   |
| • 3-terminal                                                  | SI-3003S      |          |          |         | 8   |
| • 2-output                                                    | SI-3101S      | SI-3102S |          |         | 10  |
| ■ Switching Type Regulator ICs                                | SI-3201S      |          |          |         | 14  |
| ■ High-side Power Switch ICs                                  |               |          |          |         |     |
| • With Diagnostic Function                                    | SI-5151S      | SI-5152S | SI-5155S |         | 16  |
| • With Diagnostic Function , Built-in Zener Diode             | SI-5153S      | SI-5154S |          |         | 22  |
| • Surface-mount 2-circuits                                    | SDH04         | SPF5003  | SPF5004  |         | 26  |
| • 3-circuits                                                  | SLA2501M      | SPF5007  |          |         | 32  |
| • 4-circuits                                                  | SLA2502M      |          |          |         | 36  |
| ■ Low-side Switch ICs                                         |               |          |          |         |     |
| • Surface-mount 4-circuits                                    | SPF5002A      | SPF5009  |          |         | 40  |
| • Surface-mount 4-circuits with Output Monitor                | SPF5012       |          |          |         | 44  |
| ■ Stepper-motor Driver IC                                     | SLA4708M      |          |          |         | 46  |
| ■ Full-bridge PWM Motor Driver IC                             | SI-5300       |          |          |         | 48  |
| ■ High Voltage Driver ICs for HID Lamps                       | SLA2402M      | SLA2403M |          |         | 52  |
| ■ Hall-Effect ICs                                             |               |          |          |         | 60  |
| ■ Custom IC                                                   |               |          |          |         | 62  |
| ■ Transistors and MOS FETs                                    |               |          |          |         |     |
| • Index by Application                                        |               |          |          |         | 64  |
| • Index by Load                                               |               |          |          |         | 65  |
| • Power Transistor                                            | 2SA1488/1488A | 2SA1567  | 2SA1568  | 2SC3851 | 66  |
|                                                               | 2SC3852       | 2SC4024  | 2SC4065  | 2SC4153 |     |
|                                                               | 2SD2141       | 2SD2382  | 2SD2633  | FN812   |     |
|                                                               | FP812         | MN611S   | MN638S   |         |     |
| • Power Transistor Array                                      | STA315A       | STA335A  | STA415A  | STA461C | 81  |
|                                                               | STA463C       | STA464C  | SLA8004  |         |     |
| • Surface-mount Power Transistor Array                        | SDA03         | SDA04    | SDC09    | SPF0001 | 88  |
| • MOS FET                                                     | 2SK2701       | FKV460   | FKV460S  | FKV560  | 92  |
|                                                               | FKV560S       | FKV660   | FKV660S  |         |     |
| • MOS FET Array                                               | STA508A       | STA509A  | SMA5113  | SLA5027 | 99  |
| • Surface-mount MOS FET Array                                 | SDK06         | SDK08    | SDK09    |         | 103 |
| ■ Thyristor with built-in reverse diode for HID lamp ignition |               | TFC-561D |          |         | 106 |
| ■ Rectifier Diode for Alternator                              |               |          |          |         | 107 |
| ■ High-voltage Diode for Igniter                              |               |          |          |         | 108 |
| ■ Power Zener Diode                                           |               |          |          |         | 109 |
| ■ General-purpose Diode                                       |               |          |          |         | 110 |
| ■ General-purpose Diode - External Dimensions                 |               |          |          |         | 114 |
| ■ General-purpose Diode - Taping Specifications               |               |          |          |         | 116 |
| ■ General-purpose LEDs                                        |               |          |          |         | 119 |
| ■ General-purpose LED - External Dimensions                   |               |          |          |         | 125 |
| ■ Index by Part No.                                           |               |          |          |         | 130 |

# 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<sub>D</sub>)

### 1. Dropper Type

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

### 2. Switching Type

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

Efficiency  $\eta_{\chi}$  depends on input/output conditions.

Refer to the efficiency characteristics.

$V_O$ : Output voltage       $\eta_{\chi}$ : Efficiency

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

$I_O$ : Output current

## ■ Heatsink Design

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

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

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

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

## ■ Setting DC Input Voltage

Observe the following precautions when setting the DC input voltage:

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

## ■ Screw Torque

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

## ■ Recommended silicone grease

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

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

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

## ■ Others

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

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

## Features

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

## Absolute Maximum Ratings

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

| Parameter                                  | Symbol         | Ratings     | Unit               | Conditions                   |
|--------------------------------------------|----------------|-------------|--------------------|------------------------------|
| DC Input Voltage                           | $V_{IN}$       | 35          | V                  |                              |
| Output Control Terminal Voltage            | $V_C$          | $V_{IN}$    | V                  |                              |
| Output Current                             | $I_O$          | 1.0 *1      | A                  |                              |
| Power Dissipation                          | $P_{D1}$       | 18          | W                  | With infinite heatsink       |
|                                            | $P_{D2}$       | 1.5         | W                  | Stand-alone without heatsink |
| Junction Temperature                       | $T_J$          | -40 to +125 | $^\circ\text{C}$   |                              |
| Operating Temperature                      | $T_{OP}$       | -40 to +100 | $^\circ\text{C}$   |                              |
| Storage Temperature                        | $T_{stg}$      | -40 to +125 | $^\circ\text{C}$   |                              |
| Junction to Case Thermal Resistance        | $\theta_{J-C}$ | 5.5         | $^\circ\text{C/W}$ |                              |
| Junction to Ambient-Air Thermal Resistance | $\theta_{J-a}$ | 66.7        | $^\circ\text{C/W}$ | Stand-alone without heatsink |

## Electrical Characteristics

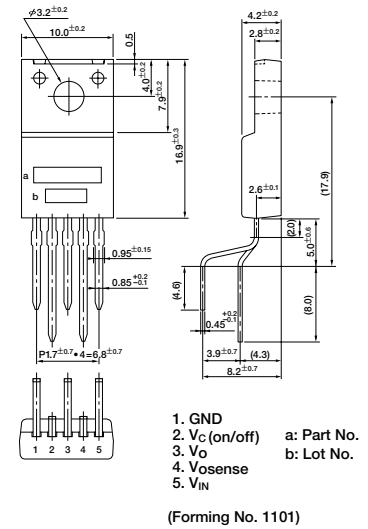
( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 14V$  unless otherwise specified)

| Parameter                               | Symbol                       | Ratings    |             |        | Unit                 | Conditions                                        |
|-----------------------------------------|------------------------------|------------|-------------|--------|----------------------|---------------------------------------------------|
|                                         |                              | min        | typ         | max    |                      |                                                   |
| Input Voltage                           | $V_{IN}$                     | 6 *2       |             | 30 *1  | V                    |                                                   |
| Output Voltage                          | $V_O$                        | 4.90       | 5.00        | 5.10   | V                    | $V_{IN} = 12$ to $16V$ , $I_O = 0.4A$             |
| Dropout Voltage                         | $V_{DIF}$                    |            |             | 0.5    | V                    | $I_O \leq 0.4A$                                   |
|                                         |                              |            |             | 1.0    | V                    | $I_O \leq 1.0A$                                   |
| Line Regulation                         | $\Delta V_O / \Delta V_{IN}$ |            |             | 30     | mV                   | $I_O = 0.4A$ , $V_{IN} = 6$ to $16V$              |
| Load Regulation                         | $\Delta V_O / \Delta I_O$    |            |             | 100    | mV                   | $I_O = 0$ to $0.4A$                               |
| Output Voltage Temperature Coefficient  | $\Delta V_O / \Delta T$      |            | $\pm 0.5$   |        | mV/ $^\circ\text{C}$ | $I_O = 5mA$ , $T_a = -10$ to $+100^\circ\text{C}$ |
| Ripple Rejection                        | $R_{REJ}$                    |            | 54          |        | dB                   | $f = 100$ to $120Hz$                              |
| Quiescent Circuit Current               | $I_Q$                        |            | 3           | 10     | mA                   | $I_O = 0A$                                        |
| Overcurrent Protection Starting Current | $I_{S1}$                     | 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                   | $\mu A$                                           |
|                                         |                              | Output OFF | $I_{C, IL}$ |        | -0.3                 | mA                                                |

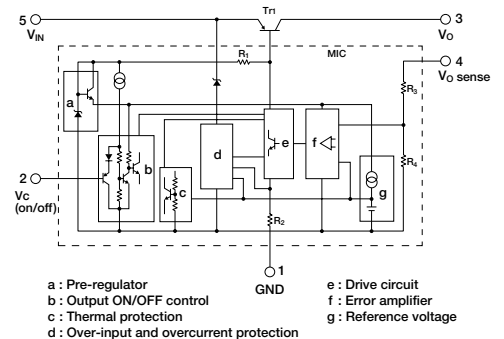
### Notes:

- \*1. Since  $P_D(\text{max}) = (V_{IN} - V_O) \cdot I_O = 18(W)$ ,  $V_{IN}(\text{max})$  and  $I_O(\text{max})$  may be limited depending on operating conditions. Refer to the  $T_a$ - $P_D$  curve to compute the corresponding values.
- \*2. Refer to the dropout voltage.
- \*3.  $I_{S1}$  rating shall be the point at which the output voltage  $V_O$  ( $V_{IN} = 14V$ ,  $I_O = 0.4A$ ) drops to -5%.
- \*4. The output control terminal  $V_C$  is pulled up inside the IC. Each input level can be directly driven with LS-TTL ICs. Thus, LS-TTL direct driving is also possible.

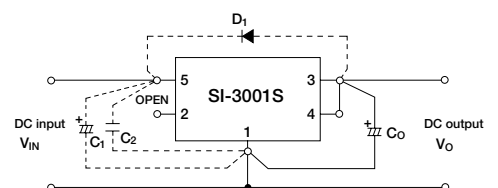
## External Dimensions (unit: mm)



## Equivalent Circuit Diagram



## Standard Circuit Diagram



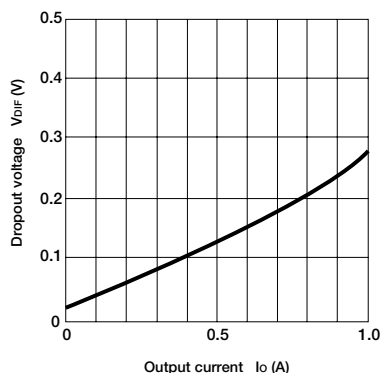
$C_O$ : Output capacitor (47 to 100 $\mu F$ , 50V)

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

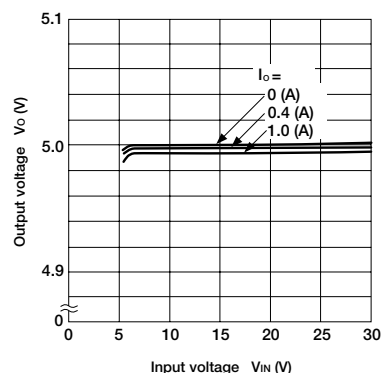
$D_1$ : Protection diode. Required as protection against reverse biasing between input and output. (Recommended diode: Sanken EU2Z.)

## Electrical Characteristics

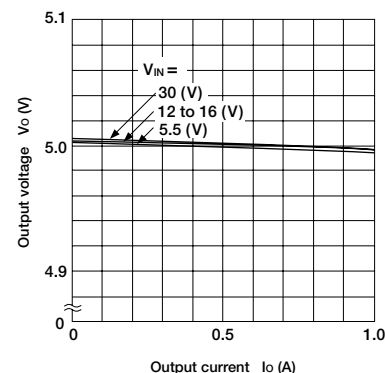
■  $I_O$  vs  $V_{DIF}$  Characteristics



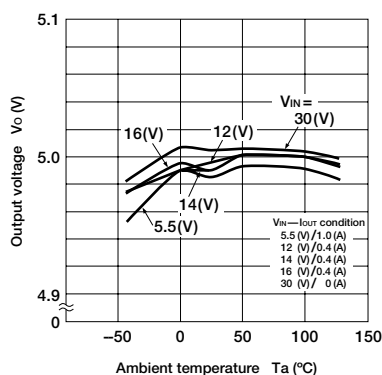
■ Line Regulation



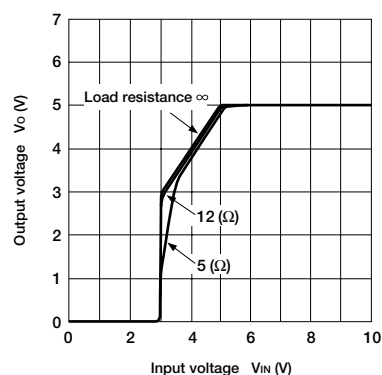
■ Load Regulation



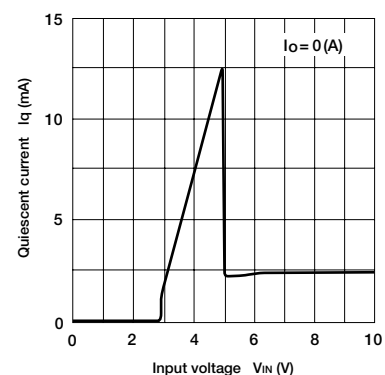
■ Output Voltage Temperature Characteristics



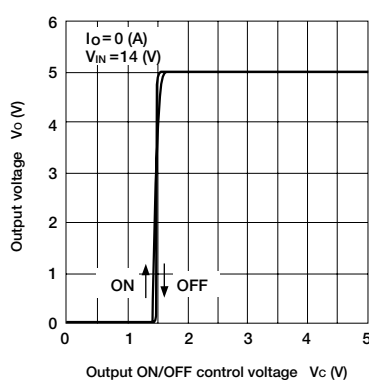
■ Rise Characteristics



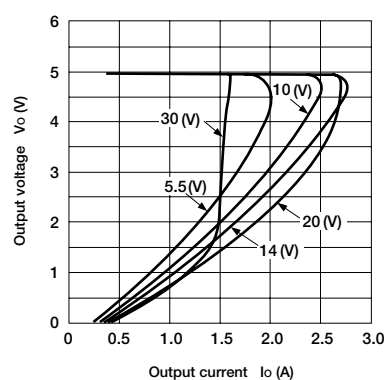
■ Quiescent Circuit Current



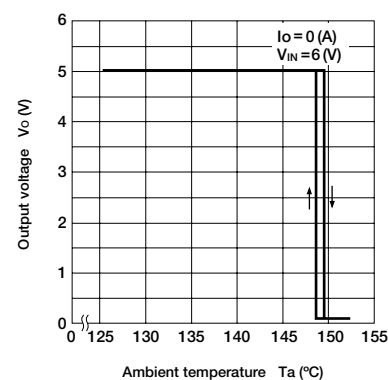
■ ON/OFF Control Characteristics



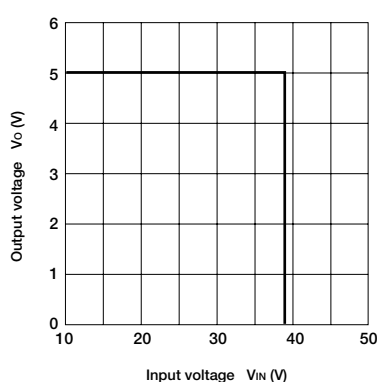
■ Overcurrent Protection Characteristics



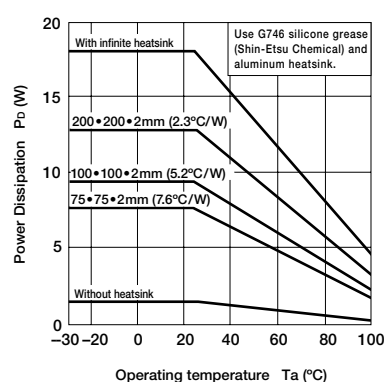
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■  $T_a$ — $P_D$  Characteristics



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

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

## Features

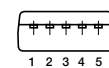
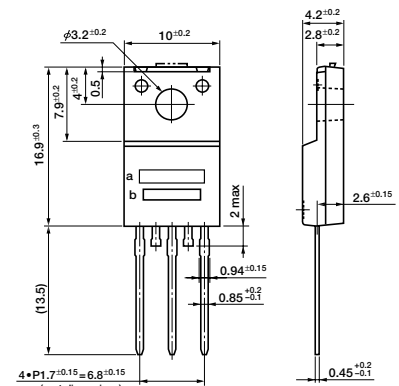
- 3-terminal IC regulator with 0.8A output current
- Voltage accuracy of  $\pm 2\%$
- Low Dropout voltage  $\leq 0.5V$  at  $I_O \leq 0.5A$ ,  $\leq 1V$  at  $I_O \leq 0.8A$
- Built-in dropping type overcurrent, overvoltage and thermal protection circuits
- TO220 equivalent full-mold package

## Absolute Maximum Ratings

( $T_a = 25^\circ C$ )

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

## External Dimensions (unit: mm)



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

## Electrical Characteristics

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

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

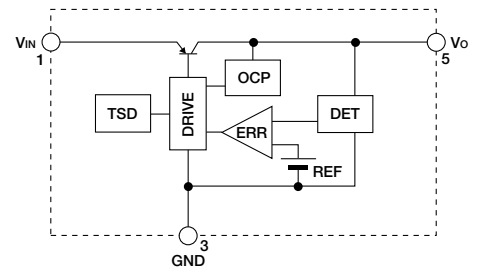
### Notes:

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

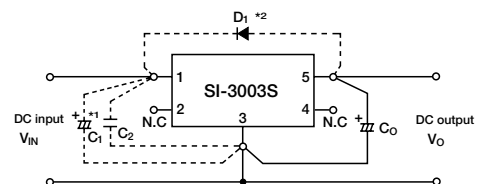
\*2. Refer to the dropout voltage.

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

## Equivalent Circuit Diagram



## Standard Circuit Diagram



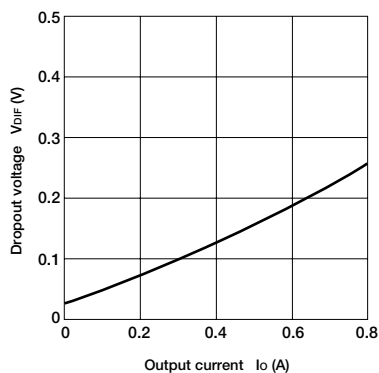
$C_O$  : Output capacitor (47 to 100 $\mu F$ , 50V)

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

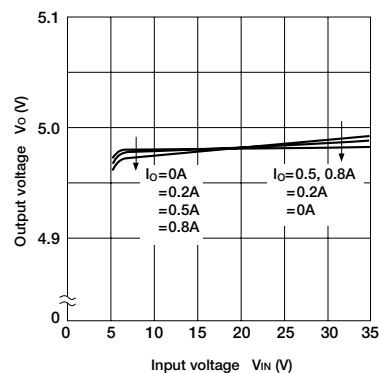
\*2  $D_1$  : Protection diode. Required as protection against reverse biasing between input and output.  
 (Recommended diode: Sanken EU2Z.)

## Electrical Characteristics

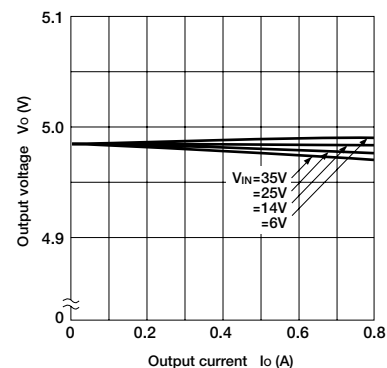
■  $I_O$  vs  $V_{DIF}$  Characteristics



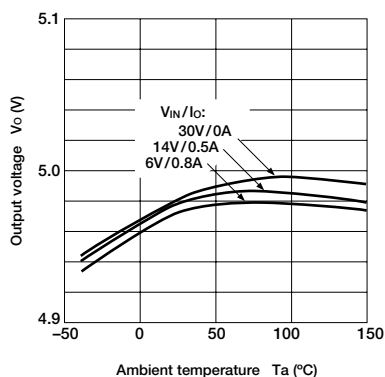
■ Line Regulation



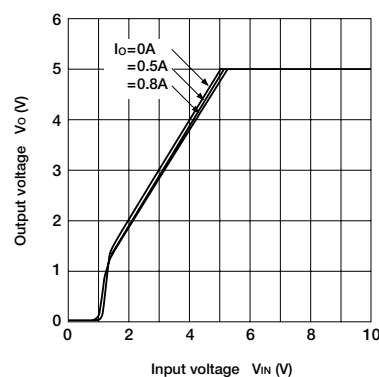
■ Load Regulation



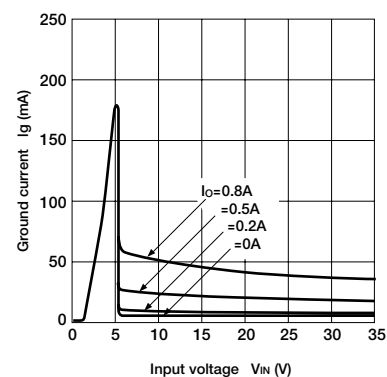
■ Output Voltage Temperature Characteristics



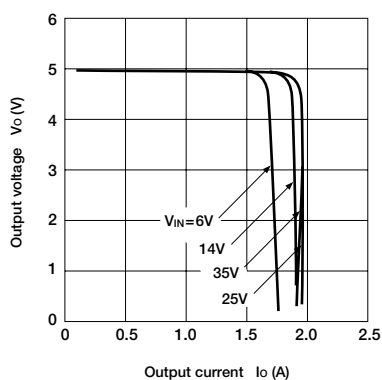
■ Rise Characteristics



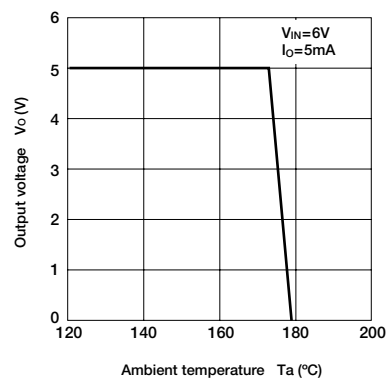
■ Circuit Current



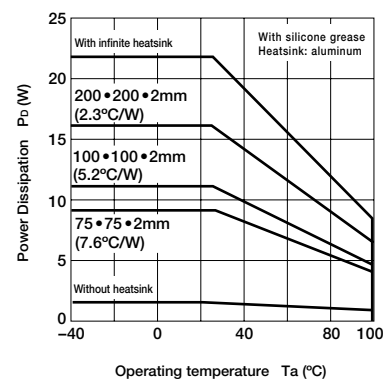
■ Overcurrent Protection Characteristics



■ Thermal Protection Characteristics



■  $T_a$ — $P_D$  Characteristics



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

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

## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

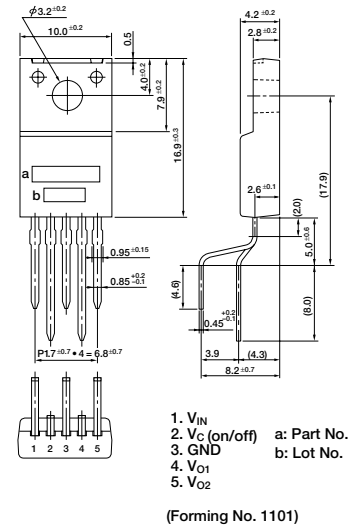
( $T_J=25^\circ\text{C}$ ,  $V_{IN}=14\text{V}$  unless otherwise specified)

| Parameter                                                                 |            | Symbol                | Ratings |      |       | Unit | Conditions                                                |
|---------------------------------------------------------------------------|------------|-----------------------|---------|------|-------|------|-----------------------------------------------------------|
|                                                                           |            |                       | min     | typ  | max   |      |                                                           |
| Input voltage                                                             |            | V <sub>IN</sub>       | 6 *2    |      | 35 *1 | V    |                                                           |
| Output voltage                                                            | CH1        | V <sub>O1</sub>       | 4.80    | 5.00 | 5.20  | V    | I <sub>O</sub> =0.05A                                     |
|                                                                           | CH2        | V <sub>O2</sub>       | 4.80    | 5.00 | 5.20  | V    | I <sub>O</sub> =0.3A                                      |
| Channel-channel voltage difference<br>(V <sub>O1</sub> —V <sub>O2</sub> ) |            | ΔV <sub>O</sub>       | −0.1    |      | 0.1   | V    | I <sub>O1</sub> =0 to 0.05A<br>I <sub>O2</sub> =0 to 0.3A |
| Dropout voltage                                                           | CH1        | V <sub>DIF1</sub>     |         |      | 1.0   | V    | I <sub>O1</sub> ≦0.05A                                    |
|                                                                           | CH2        | V <sub>DIF2</sub>     |         |      | 1.0   | V    | I <sub>O2</sub> ≦0.4A                                     |
| Line regulation                                                           | CH1        | ΔV <sub>O</sub> LINE1 |         | 10   | 30    | mV   | V <sub>IN</sub> =6 to 18V, I <sub>O</sub> =0.05A          |
|                                                                           | CH2        | ΔV <sub>O</sub> LINE2 |         | 10   | 30    | mV   | V <sub>IN</sub> =6 to 18V, I <sub>O</sub> =0.3A           |
| Load regulation                                                           | CH1        | ΔV <sub>O</sub> LOAD1 |         | 30   | 70    | mV   | I <sub>O1</sub> =0 to 0.05A                               |
|                                                                           | CH2        | ΔV <sub>O</sub> LOAD2 |         | 40   | 70    | mV   | I <sub>O2</sub> =0 to 0.3A                                |
| Ripple rejection                                                          | CH1        | R <sub>REJ1</sub>     |         | 54   |       | dB   | f=100 to 120Hz                                            |
|                                                                           | CH2        | R <sub>REJ2</sub>     |         | 54   |       | dB   | f=100 to 120Hz                                            |
| Quiescent circuit current                                                 |            | I <sub>q</sub>        |         |      | 0.8   | mA   | I <sub>O1</sub> =0A, V <sub>C</sub> =0V                   |
| Overcurrent protection<br>starting current                                | CH1        | I <sub>(S1) 1</sub>   | 0.1 *3  |      |       | A    |                                                           |
|                                                                           | CH2        | I <sub>(S1) 2</sub>   | 0.5 *3  |      |       | A    |                                                           |
| Output control voltage                                                    | Output ON  | V <sub>CH</sub>       | 4.2     | 4.5  | 4.8   | V    |                                                           |
|                                                                           | Output OFF | V <sub>CL</sub>       | 3.2     | 3.5  | 3.8   | V    |                                                           |
| Output control current                                                    | Output ON  | I <sub>CH</sub>       |         |      | 100   | μA   | V <sub>C</sub> =4.8V                                      |
|                                                                           | Output OFF | I <sub>CL</sub>       | −100    |      |       | μA   | V <sub>C</sub> =3.2V                                      |
| Overvoltage protection starting<br>voltage                                |            | V <sub>OVP</sub>      | 35 *4   |      |       | V    |                                                           |
| Thermal protection starting<br>temperature                                |            | T <sub>TSD</sub>      | 130 *5  |      |       | °C   |                                                           |

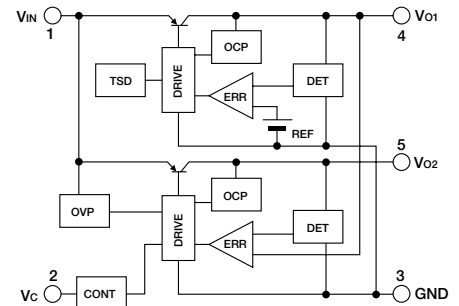
### Notes:

- \*1. Since  $P_D(\text{max}) = (V_{IN}-V_O) \cdot I_{O1} + (V_{IN}-V_{O2}) \cdot I_{O2} = 18\text{ (W)}$ ,  $V_{IN}(\text{max})$ ,  $I_{O1}(\text{max})$  and  $I_{O2}(\text{max})$  may be limited depending on operating conditions. Refer to the  $T_a-P_D$  curve to compute the corresponding values.
- \*2. Refer to the dropout voltage.
- \*3.  $I_{S1}$  rating shall be the point at which the output voltage  $V_{O1}$  or  $V_{O2}$  ( $V_{IN}=14\text{V}$ ,  $I_{O1}=0.05\text{A}$  or  $I_{O2}=0.3\text{A}$ ) drops to -5%.
- \*4. Overvoltage protection circuit is built only in CH2 ( $V_{O2}$  side).
- \*5. The indicated temperatures are junction temperatures.
- \*6. All terminals, except  $V_{IN}$  and GND, are open.

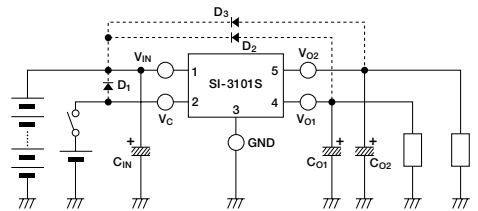
## External Dimensions (unit: mm)



## Equivalent Circuit Diagram



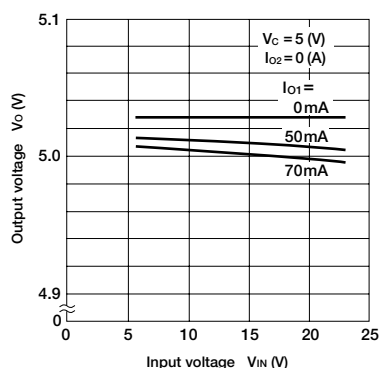
## Standard Circuit Diagram



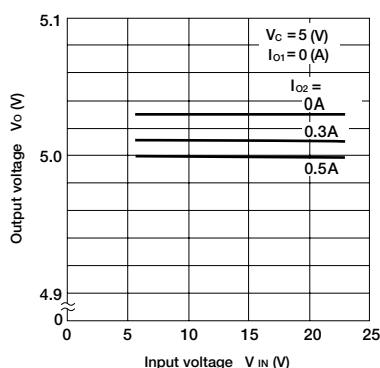
- $CO1$ : Output capacitor (47 to  $100\mu\text{F}$ , 50V)  
 $CO2$ : Output capacitor (47 to  $100\mu\text{F}$ , 50V)  
 \*1  $C_{IN}$ : Input capacitors (approx.  $47\mu\text{F}$ ).  
 Tantalum capacitors are recommended for  $CO1$ ,  $CO2$  and  $C_{IN}$ , especially at low temperatures.  
 \*2  $D1$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

## Electrical Characteristics

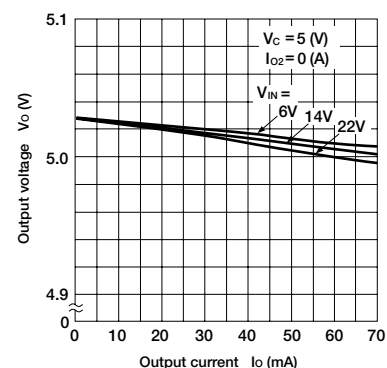
■ Line Regulation (1)



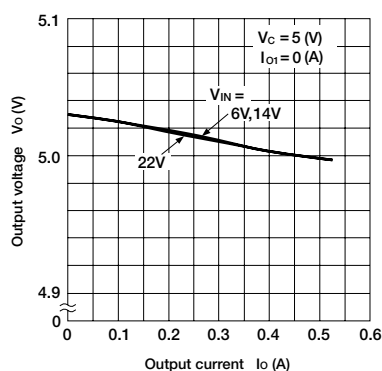
■ Line Regulation (2)



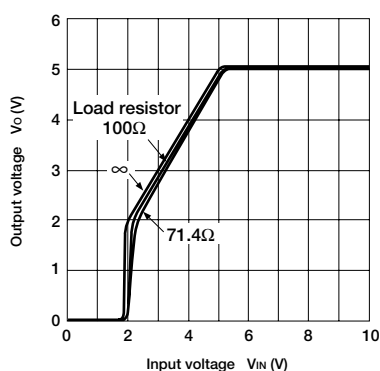
■ Load Regulation (1)



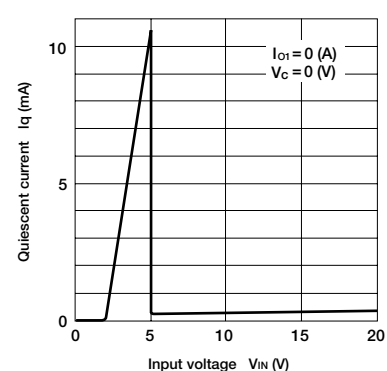
■ Load Regulation (2)



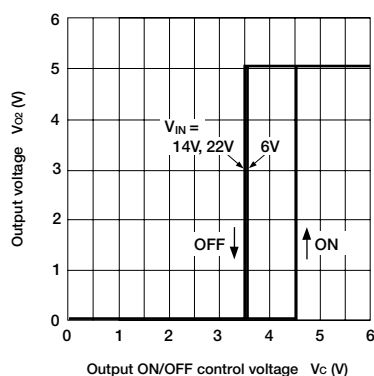
■ Rise Characteristics



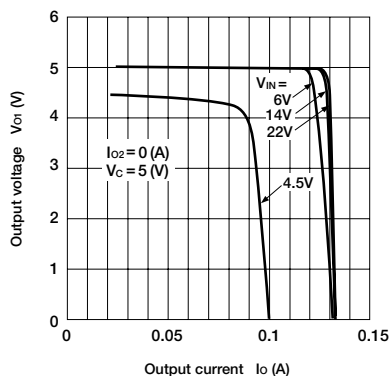
■ Quiescent Circuit Current



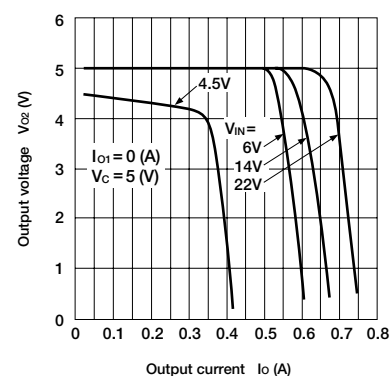
■ ON/OFF Control Characteristics



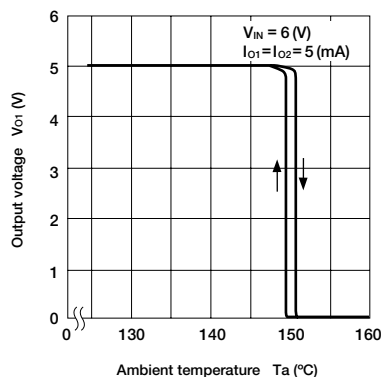
■ Overcurrent Protection Characteristics (1)



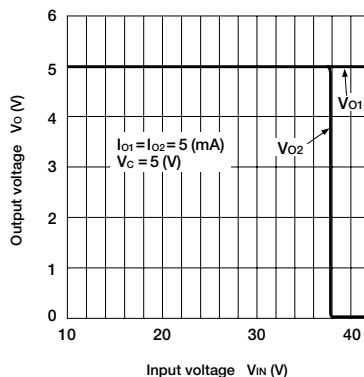
■ Overcurrent Protection Characteristics (2)



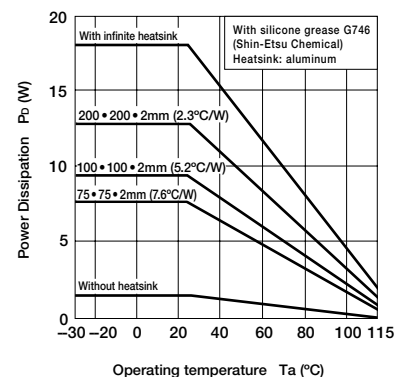
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■  $T_a$ — $P_D$  Characteristics



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

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

## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

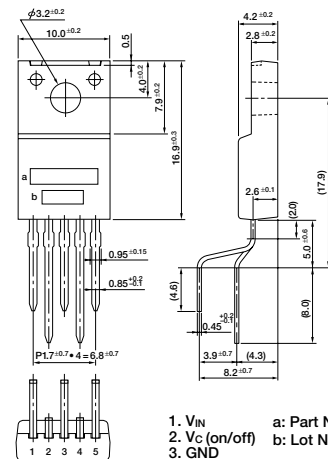
( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 14\text{V}$  unless otherwise specified)

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

### Notes:

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

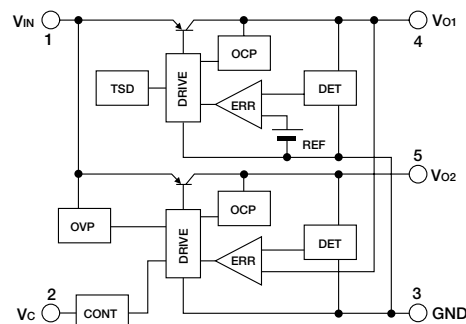
## External Dimensions (unit: mm)



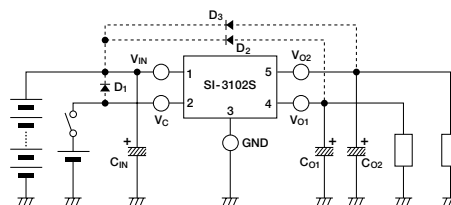
1.  $V_{IN}$
  2.  $V_C$  (on/off)
  3. GND
  4.  $V_{O1}$
  5.  $V_{O2}$
- a: Part No.  
b: Lot No.

(Forming No. 1101)

## Equivalent Circuit Diagram



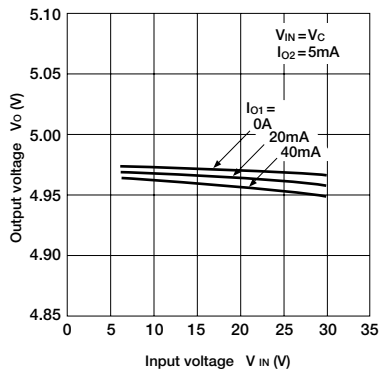
## Standard Circuit Diagram



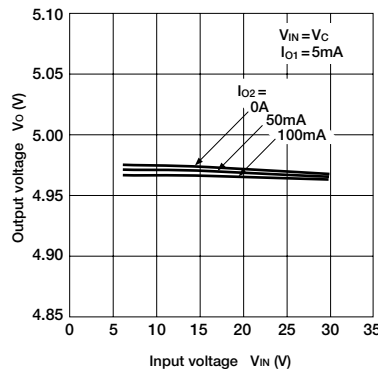
- $C_{O1}$ : Output capacitor (47 to  $100\mu\text{F}$ , 50V)  
 $C_{O2}$ : Output capacitor (47 to  $100\mu\text{F}$ , 50V)  
 \*1  $C_{IN}$ : Input capacitors (approx.  $47\mu\text{F}$ ).  
 Tantalum capacitors are recommended, for  $C_{O1}$ ,  $C_{O2}$  and  $C_{IN}$ , especially at low temperatures.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

## Electrical Characteristics

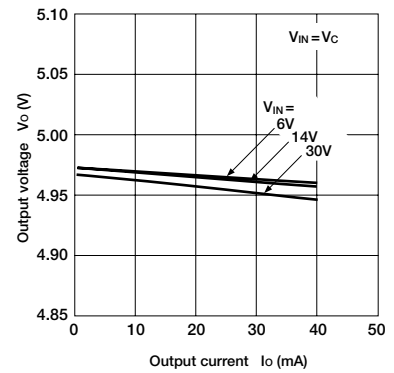
■ Line Regulation (1)



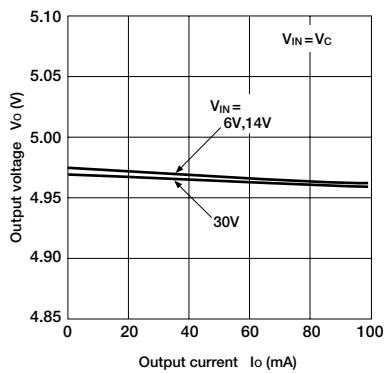
■ Line Regulation (2)



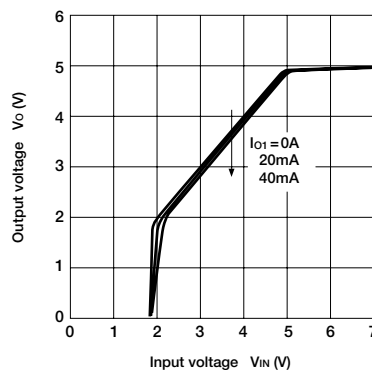
■ Load Regulation (1)



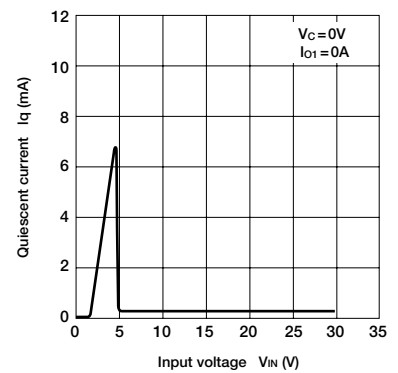
■ Load Regulation (2)



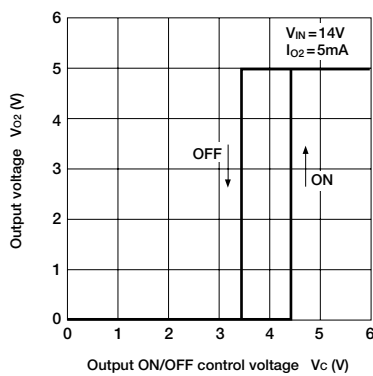
■ Rise Characteristics



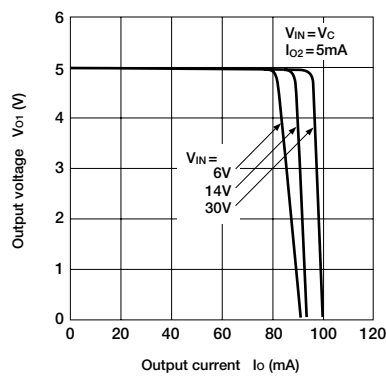
■ Quiescent Circuit Current



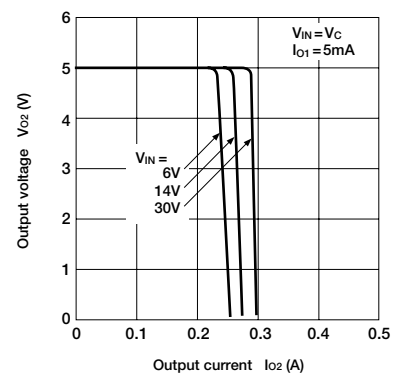
■ ON/OFF Control Characteristics



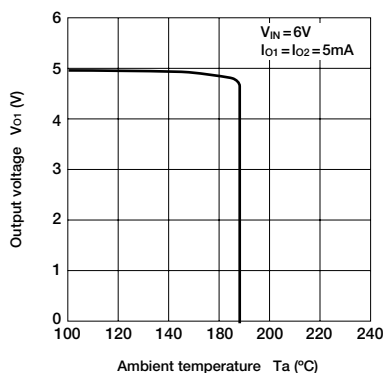
■ Overcurrent Protection Characteristics (1)



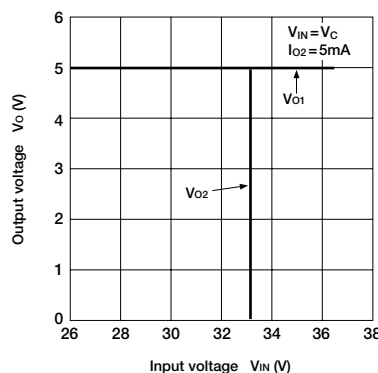
■ Overcurrent Protection Characteristics (2)



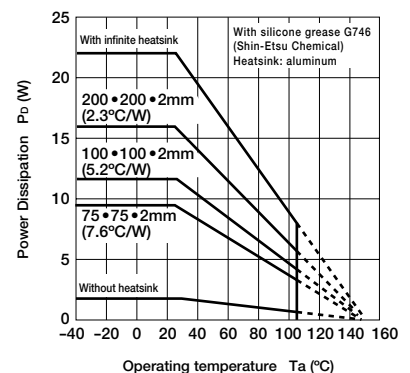
■ Thermal Protection Characteristics



■ Overvoltage Protection Characteristics



■ Ta—Pd Characteristics



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

# Switching Type Regulator ICs SI-3201S

## Features

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

## Absolute Maximum Ratings

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

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

## Recommended Operating Conditions

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

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

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

### Notes:

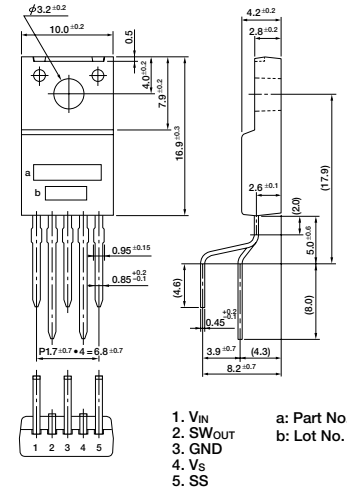
\*1. Efficiency is calculated by the following equation:

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

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

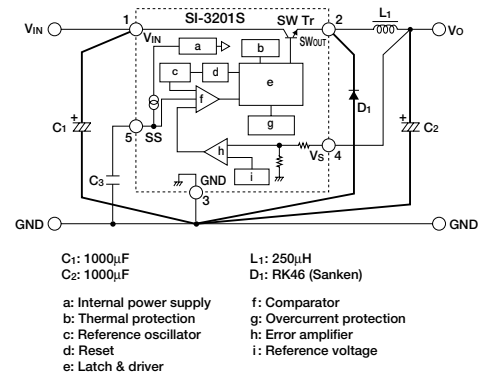
\*3. An external voltage may not be applied to the soft start terminal. As shown in the diagram to the right, use this IC in the soft start mode with a capacitor or in the open-collector drive mode with a transistor. Leave the soft start terminal open when not using it since it is already pulled up in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

## External Dimensions (unit: mm)



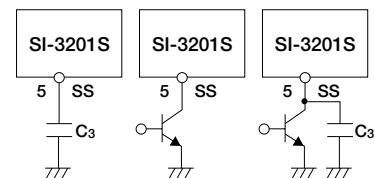
(Forming No. 1101)

## Standard Circuit Diagram



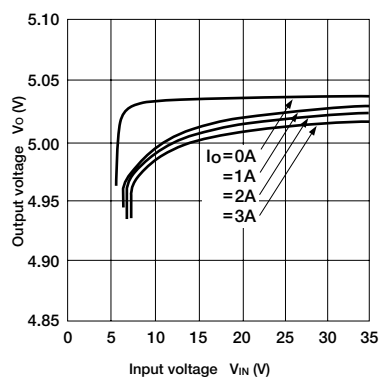
### Cautions:

- (1) A high-ripple current flows through  $C_1$  and  $C_2$ . Use high-ripple type 1000 $\mu\text{F}$  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<sub>OUT</sub> 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<sub>OUT</sub> terminal). Applying a reversed-bias voltage exceeding the maximum rating to the 2nd terminal (SW<sub>OUT</sub> 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.

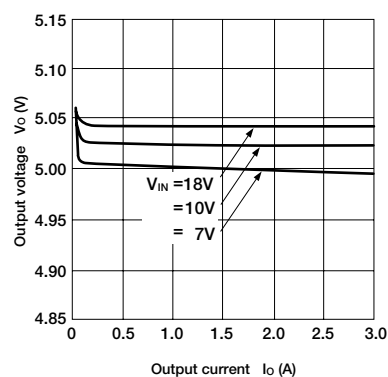


## Electrical Characteristics

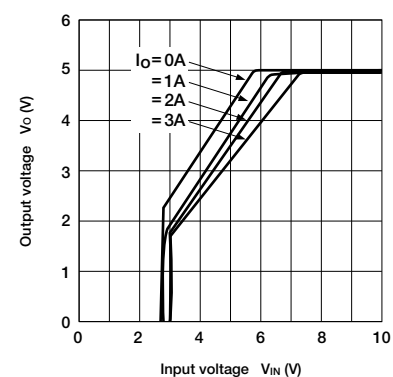
■ Line Regulation



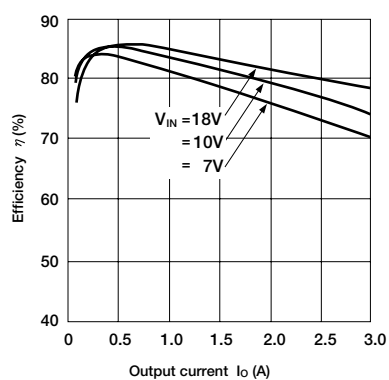
■ Load Regulation



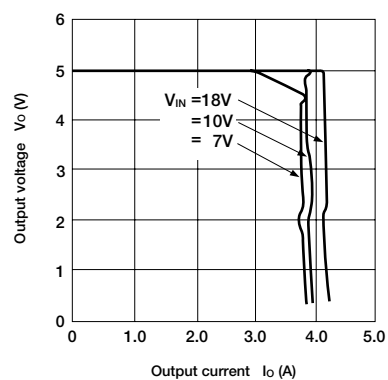
■ Rise Characteristics



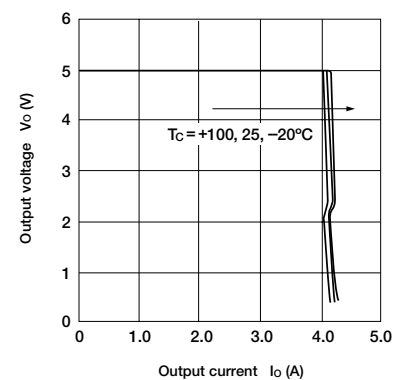
■ Efficiency Curve



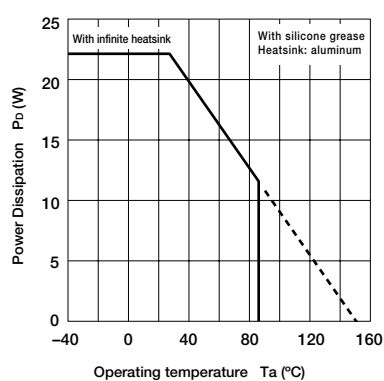
■ Overcurrent Protection Characteristics



■ Overcurrent Protection Temperature Characteristics



■ Ta—P<sub>D</sub> Characteristics



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

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

| Parameter                 | Symbol     | Ratings       | Unit | Conditions                                              |
|---------------------------|------------|---------------|------|---------------------------------------------------------|
| Power supply voltage      | $V_B$      | 40            | V    |                                                         |
| Input terminal voltage    | $V_{IN}$   | -0.3 to $V_B$ | V    |                                                         |
| DIAG terminal voltage     | $V_{DIAG}$ | 6             | V    |                                                         |
| Collector-emitter voltage | $V_{CE}$   | 40            | V    |                                                         |
| Output current            | $I_O$      | 1.8           | A    |                                                         |
| Power Dissipation         | $P_{D1}$   | 18            | W    | With infinite heatsink ( $T_C=25^\circ\text{C}$ )       |
|                           | $P_{D2}$   | 1.5           | W    | Stand-alone without heatsink ( $T_C=25^\circ\text{C}$ ) |
| Junction temperature      | $T_J$      | -40 to +125   | °C   |                                                         |
| Operating temperature     | $T_{OP}$   | -40 to +100   | °C   |                                                         |
| Storage temperature       | $T_{stg}$  | -40 to +125   | °C   |                                                         |

## Electrical Characteristics

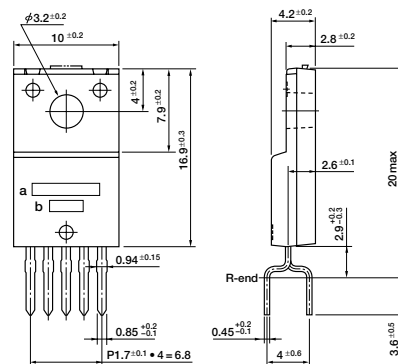
(Ta=25°C unless otherwise specified)

| Parameter                               | Symbol        | Ratings  |      |     | Unit          | Conditions                                         |
|-----------------------------------------|---------------|----------|------|-----|---------------|----------------------------------------------------|
|                                         |               | min      | typ  | max |               |                                                    |
| Operating power supply voltage          | $V_{Bopr}$    | 6.0      |      | 30  | V             |                                                    |
| Quiescent circuit current               | $I_q$         |          | 5    | 12  | mA            | $V_{Bopr}=14\text{V}$ , $V_{IN}=0\text{V}$         |
| Saturation voltage of output transistor | $V_{CE(sat)}$ |          |      | 0.5 | V             | $I_O \leq 1.0\text{A}$ , $V_{Bopr}=6$ to 16V       |
|                                         |               |          |      | 1.0 | V             | $I_O \leq 1.8\text{A}$ , $V_{Bopr}=6$ to 16V       |
| Output leak current                     | $I_{O, leak}$ |          |      | 2   | mA            | $V_{CE0}=16\text{V}$                               |
| Input voltage                           | Output ON     | $V_{IH}$ | 2.0  |     | V             | $V_{Bopr}=6$ to 16V                                |
|                                         | Output OFF    | $V_{IL}$ | -0.3 | 0.8 | V             | $V_{Bopr}=6$ to 16V                                |
| Input current                           | Output ON     | $I_{IH}$ |      | 1   | mA            | $V_{IN}=5\text{V}$                                 |
|                                         | Output OFF    | $I_{IL}$ | -0.1 |     | mA            | $V_{IN}=0\text{V}$                                 |
| Overcurrent protection starting current | $I_S$         | 1.9      |      |     | A             | $V_{Bopr}=14\text{V}$ , $V_O=V_{Bopr}-1.5\text{V}$ |
| Thermal protection starting temperature | $T_{TSD}$     | 125      | 145  |     | °C            |                                                    |
| Open load detection resistor            | $R_{open}$    |          |      | 30  | k $\Omega$    | $V_{Bopr}=6$ to 16V                                |
| Output transfer time                    | $T_{ON}$      |          | 8    | 30  | $\mu\text{s}$ | $V_{Bopr}=14\text{V}$ , $I_O=1\text{A}$            |
|                                         | $T_{OFF}$     |          | 15   | 30  | $\mu\text{s}$ | $V_{Bopr}=14\text{V}$ , $I_O=1\text{A}$            |
| DIAG output voltage                     | $V_{DH}$      | 4.5      |      | 6   | V             | $V_{CC}=6\text{V}$                                 |
|                                         | $V_{DL}$      |          |      | 0.3 | V             | $V_{CC}=6\text{V}$ , $I_{DD}=2\text{mA}$           |
| DIAG output transfer time               | $T_{PLH}$     |          |      | 30  | $\mu\text{s}$ | $V_{Bopr}=14\text{V}$ , $I_O=1\text{A}$            |
|                                         | $T_{PHL}$     |          |      | 30  | $\mu\text{s}$ | $V_{Bopr}=14\text{V}$ , $I_O=1\text{A}$            |
| Minimum load inductance                 | $L$           | 1        |      |     | mH            |                                                    |

Note:

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

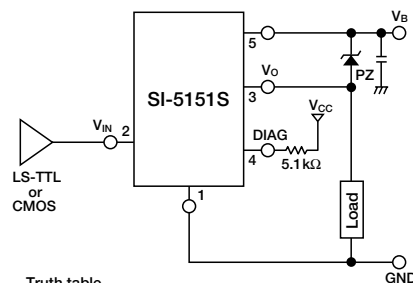
## External Dimensions (unit: mm)



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

(Forming No. 1123)

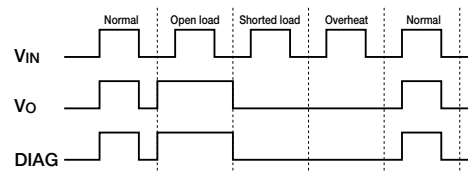
## Standard Circuit Diagram



Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | H     |
| L        | L     |

## Diagnostic Function

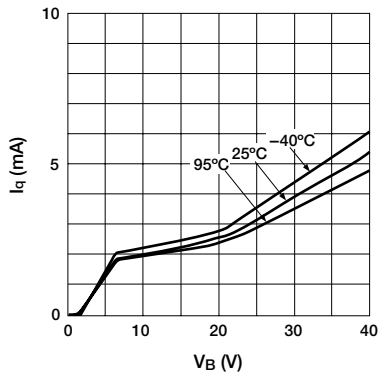


| Mode         | $V_{IN}$ | $V_O$ | DIAG |
|--------------|----------|-------|------|
| Normal       | L        | L     | L    |
| Open load    | L        | H     | H    |
| Shorted load | L        | L     | L    |
| Overheat     | L        | L     | L    |

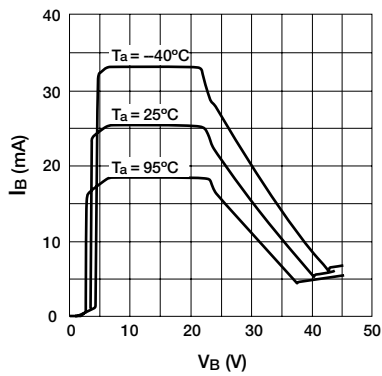
- DIAG output will be undetermined when a voltage exceeding 25V is applied to  $V_B$  terminal.

## Electrical Characteristics

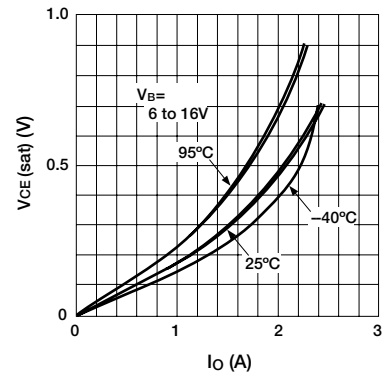
■ Quiescent Circuit Current



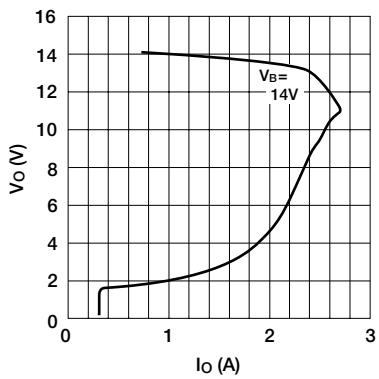
■ Circuit Current



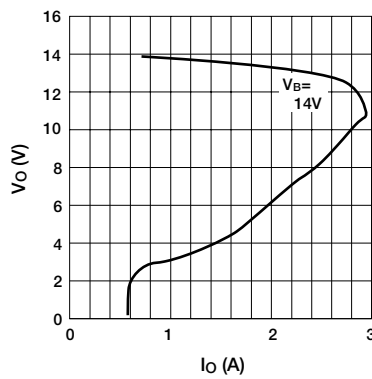
■ Saturation Voltage of Output Transistor



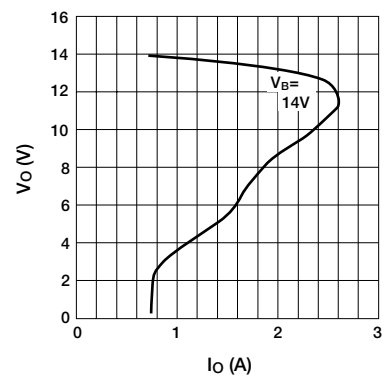
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



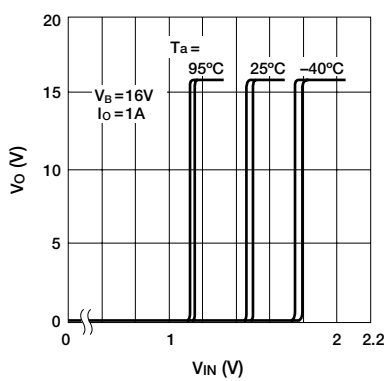
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



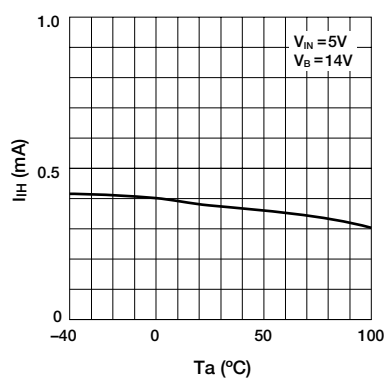
■ Overcurrent Protection Characteristics ( $T_a = 100^\circ\text{C}$ )



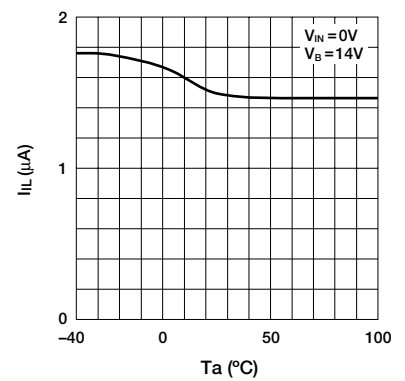
■ Threshold input voltage



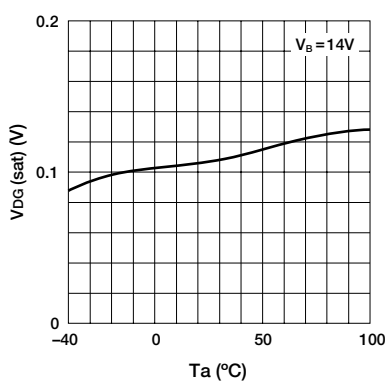
■ Input Current (Output ON)



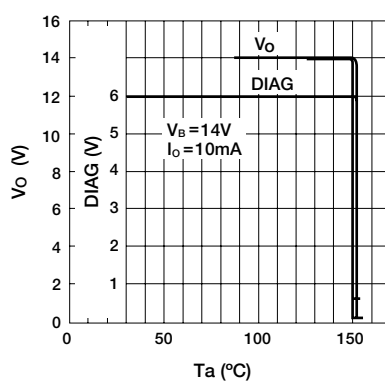
■ Input Current (Output OFF)



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



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

## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

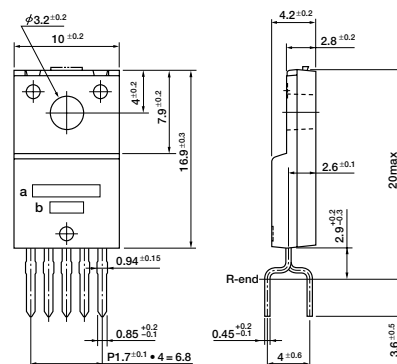
( $T_a = 25^\circ\text{C}$  unless otherwise specified)

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

Note:

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

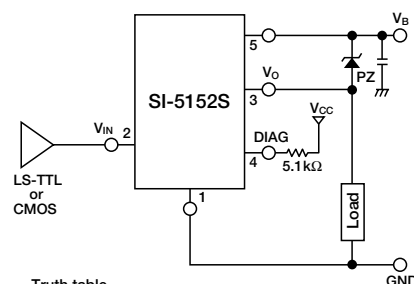
## External Dimensions (unit: mm)



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

(Forming No. 1123)

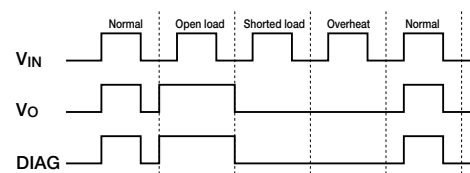
## Standard Circuit Diagram



Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | H     |
| L        | L     |

## Diagnostic Function

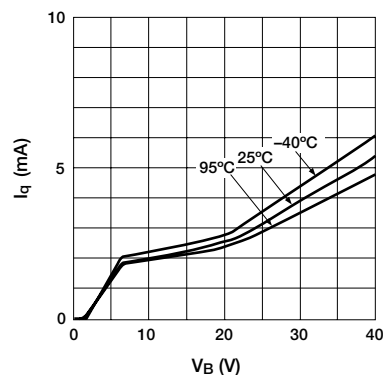


| Mode         | $V_{IN}$ | $V_O$ | DIAG |
|--------------|----------|-------|------|
| Normal       | L        | H     | L    |
| Open load    | L        | H     | H    |
| Shorted load | L        | L     | L    |
| Overheat     | L        | L     | L    |

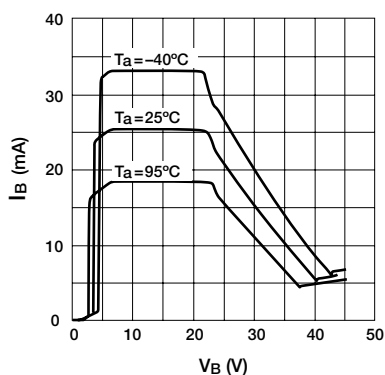
- DIAG output will be undetermined when a voltage exceeding 25V is applied to  $V_B$  terminal.

## Electrical Characteristics

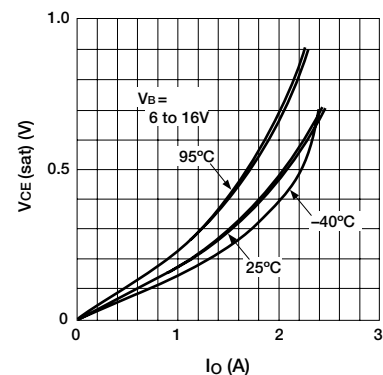
■ Quiescent Circuit Current



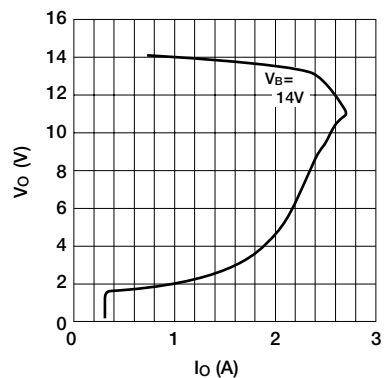
■ Circuit Current



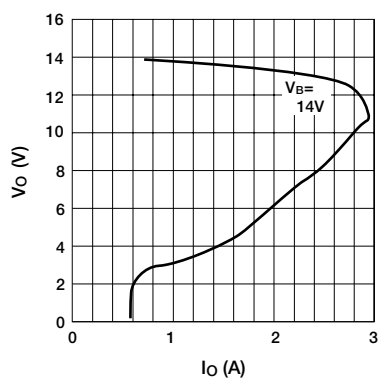
■ Saturation Voltage of Output Transistor



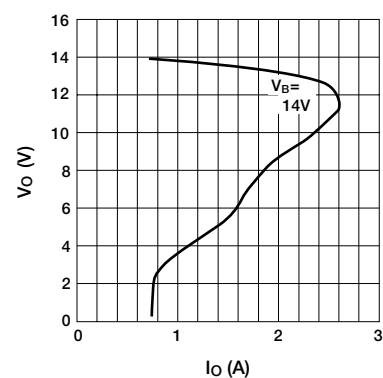
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



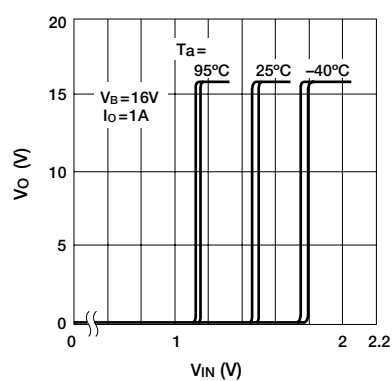
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



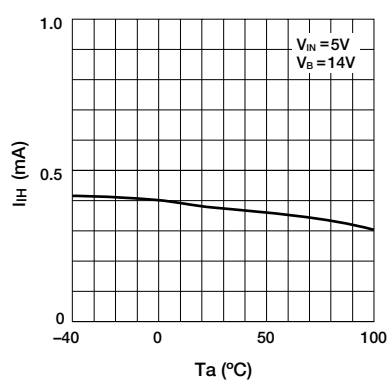
■ Overcurrent Protection Characteristics ( $T_a = 100^\circ\text{C}$ )



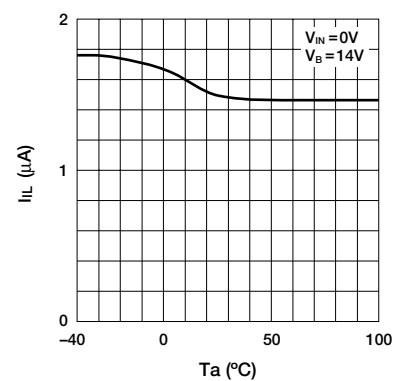
■ Threshold input voltage



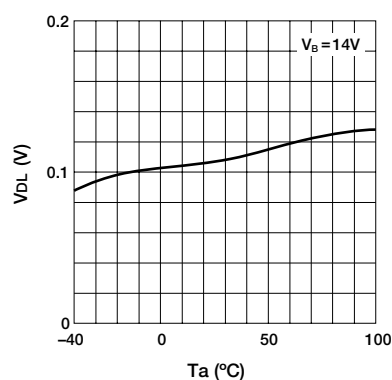
■ Input Current (Output ON)



■ Input Current (Output OFF)



■ Saturation Voltage of DIAG Output



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

## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

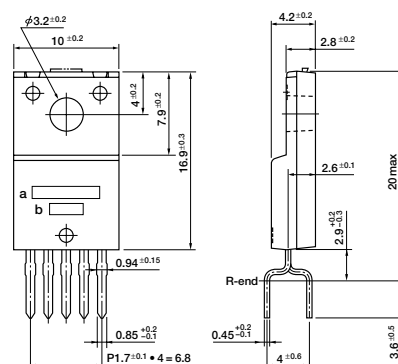
( $T_a = 25^\circ\text{C}$  unless otherwise specified)

| Parameter                               |            | Symbol                | Ratings |     |                | Unit | Conditions                                                                |
|-----------------------------------------|------------|-----------------------|---------|-----|----------------|------|---------------------------------------------------------------------------|
|                                         |            |                       | min     | typ | max            |      |                                                                           |
| Operating power supply voltage          |            | V <sub>Bopr</sub>     | 6.0     |     | 30             | V    |                                                                           |
| Quiescent circuit current               |            | I <sub>q</sub>        |         | 5   | 12             | mA   | V <sub>Bopr</sub> = 14V, V <sub>IN</sub> = 0V                             |
| Saturation voltage of output transistor |            | V <sub>CE (sat)</sub> |         |     | 0.3            | V    | I <sub>O</sub> ≅ 1.0A, V <sub>Bopr</sub> = 6 to 16V                       |
|                                         |            |                       |         |     | 0.72           | V    | I <sub>O</sub> ≅ 2.5A, V <sub>Bopr</sub> = 6 to 16V                       |
| Output leak current                     |            | I <sub>o, leak</sub>  |         |     | 2              | mA   | V <sub>CEO</sub> = 16V, V <sub>IN</sub> = 0V                              |
| Input voltage                           | Output ON  | V <sub>IH</sub>       | 2.0     |     | V <sub>B</sub> | V    | V <sub>Bopr</sub> = 6 to 16V                                              |
|                                         | Output OFF | V <sub>IL</sub>       | −0.3    |     | 0.8            | V    | V <sub>Bopr</sub> = 6 to 16V                                              |
| Input current                           | Output ON  | I <sub>IH</sub>       |         |     | 1              | mA   | V <sub>IN</sub> = 5V                                                      |
|                                         | Output OFF | I <sub>IL</sub>       | −0.1    |     |                | mA   | V <sub>IN</sub> = 0V                                                      |
| Overcurrent protection starting current |            | I <sub>S</sub>        | 2.6     |     |                | A    | V <sub>Bopr</sub> = 14V, V <sub>O</sub> = V <sub>Bopr</sub> − 1.5V        |
| Thermal protection starting temperature |            | T <sub>TSD</sub>      | 150     |     |                | °C   | V <sub>Bopr</sub> ≧ 6V                                                    |
| Open load detection resistor            |            | R <sub>open</sub>     |         |     | 30             | kΩ   | V <sub>Bopr</sub> = 6 to 16V                                              |
| Output transfer time                    |            | T <sub>ON</sub>       |         | 8   | 30             | μs   | V <sub>Bopr</sub> = 14V, I <sub>O</sub> = 1A                              |
|                                         |            | T <sub>OFF</sub>      |         | 15  | 30             | μs   | V <sub>Bopr</sub> = 14V, I <sub>O</sub> = 1A                              |
| DIAG output voltage                     |            | V <sub>DH</sub>       | 4.5     |     | 6              | V    | V <sub>CC</sub> = 6V, V <sub>Bopr</sub> = 6 to 16V                        |
|                                         |            | V <sub>DL</sub>       |         |     | 0.3            | V    | V <sub>CC</sub> = 6V, V <sub>Bopr</sub> = 6 to 16V, I <sub>DO</sub> = 2mA |
| DIAG output transfer time               |            | T <sub>PLH</sub>      |         |     | 30             | μs   | V <sub>Bopr</sub> = 14V, I <sub>O</sub> = 1A                              |
|                                         |            | T <sub>PHL</sub>      |         |     | 30             | μs   | V <sub>Bopr</sub> = 14V, I <sub>O</sub> = 1A                              |
| Minimum load inductance                 |            | L                     | 1       |     |                | mH   |                                                                           |

Note:

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

## External Dimensions (unit: mm)

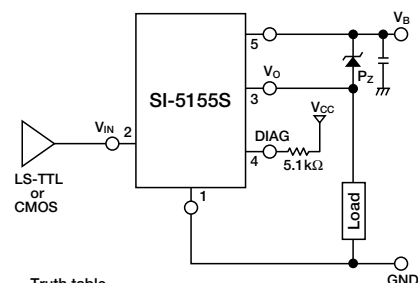


1. GND  
2.  $V_{IN}$   
3.  $V_O$   
4. DIAG  
5.  $V_B$

a: Part No.  
b: Lot No.

(Forming No. 1123)

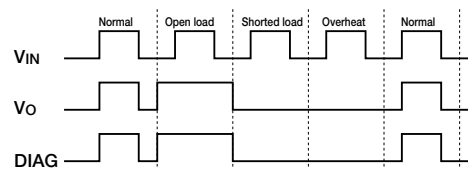
## Standard Circuit Diagram



Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | H     |
| L        | L     |

## Diagnostic Function

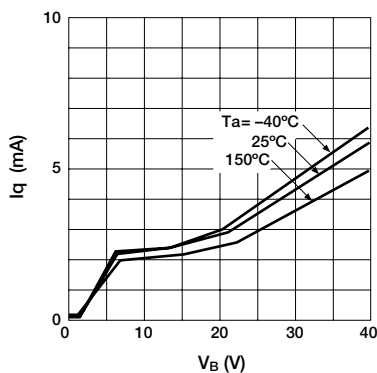


| Mode         | $V_{IN}$ | $V_O$ | DIAG |
|--------------|----------|-------|------|
| Normal       | L        | L     | L    |
|              | H        | H     | H    |
| Open load    | L        | H     | H    |
|              | H        | H     | H    |
| Shorted load | L        | L     | L    |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

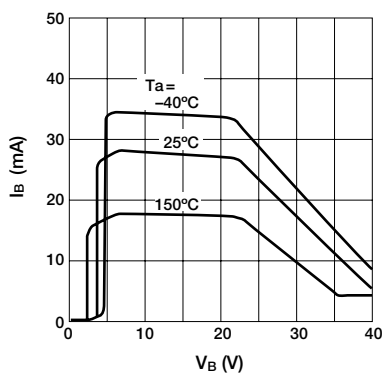
- DIAG output will be undetermined when a voltage exceeding 25V is applied to  $V_B$  terminal.

## Electrical Characteristics

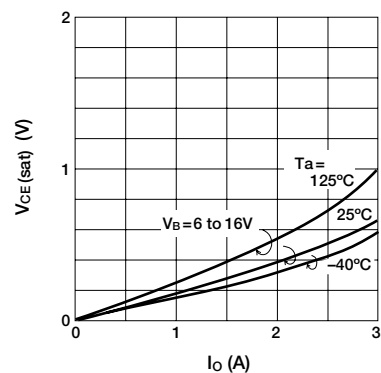
■ Quiescent Circuit Current



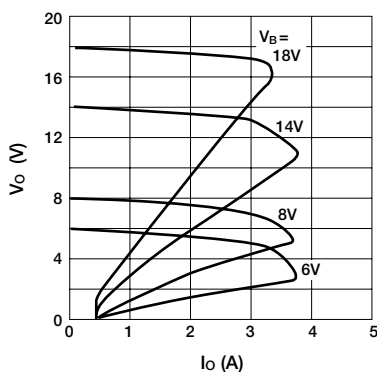
■ Circuit Current



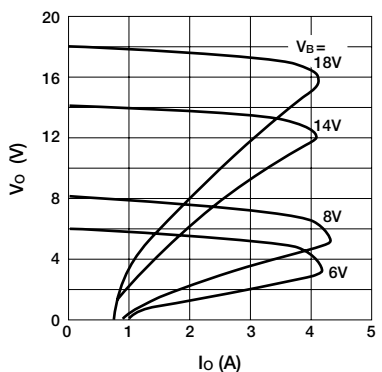
■ Saturation Voltage of Output Transistor



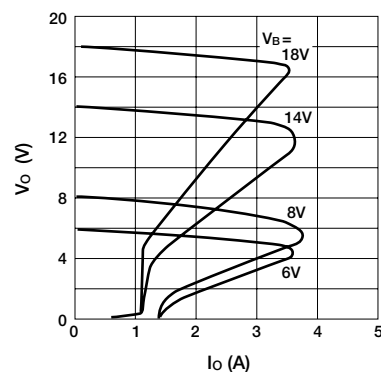
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



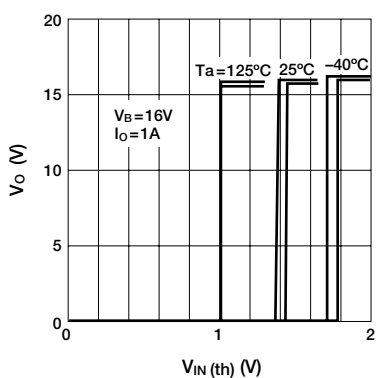
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



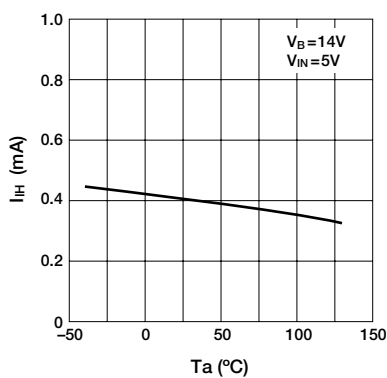
■ Overcurrent Protection Characteristics ( $T_a = 125^\circ\text{C}$ )



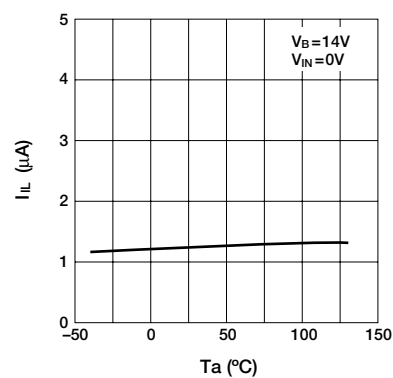
■ Threshold input voltage



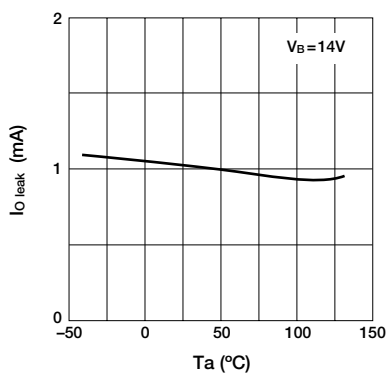
■ Input Current (Output ON)



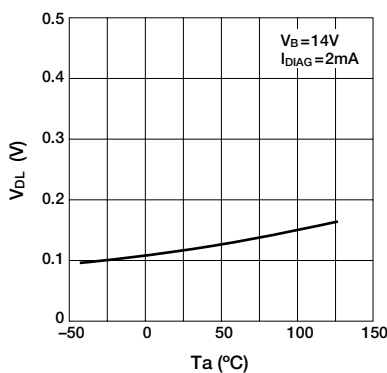
■ Input Current (Output OFF)



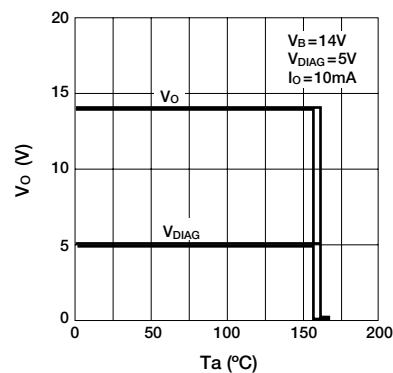
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

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

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

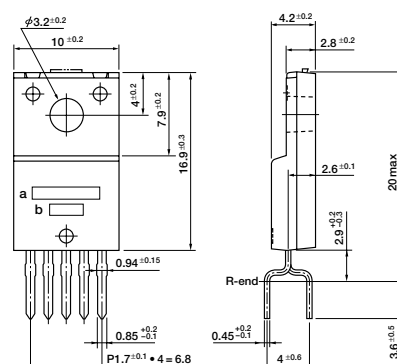
Note:

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

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

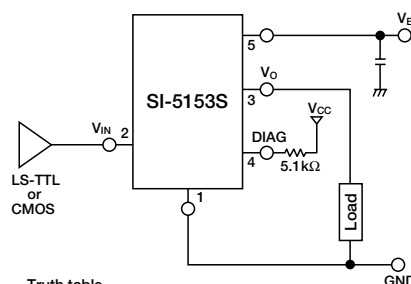
\* This driver is exclusively used for ON/OFF control.

## External Dimensions (unit: mm)



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

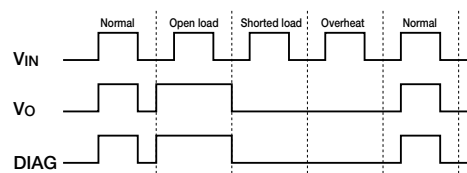
## Standard Circuit Diagram



Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | H     |
| L        | L     |

## Diagnostic Function

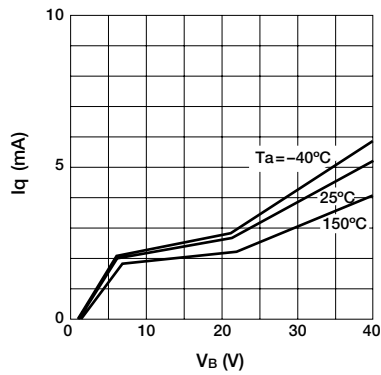


| Mode         | $V_{IN}$ | $V_O$ | DIAG |
|--------------|----------|-------|------|
| Normal       | L        | L     | L    |
| Open load    | L        | H     | H    |
| Shorted load | L        | L     | L    |
| Overheat     | L        | L     | L    |

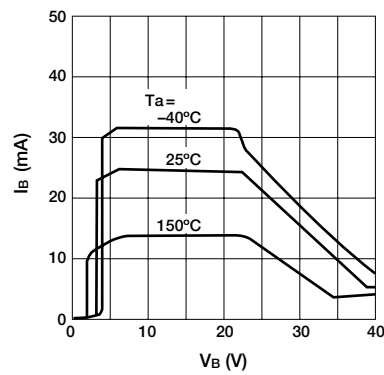
- DIAG output will be undetermined when a voltage exceeding 25V is applied to  $V_B$  terminal.

## Electrical Characteristics

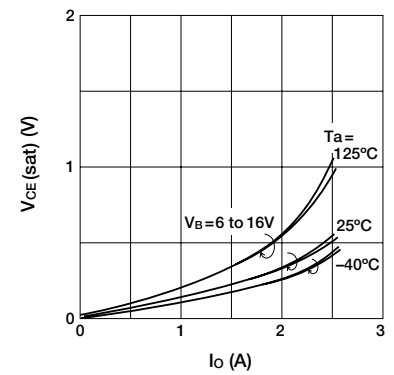
■ Quiescent Circuit Current



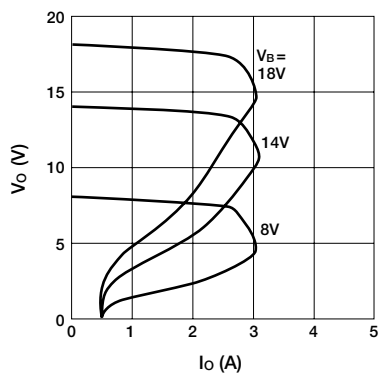
■ Circuit Current



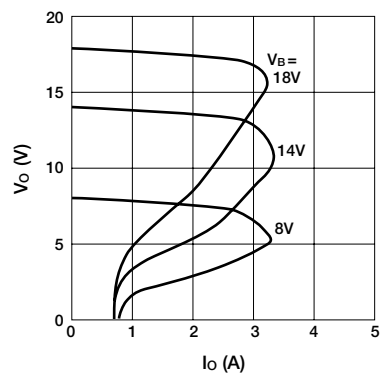
■ Saturation Voltage of Output Transistor



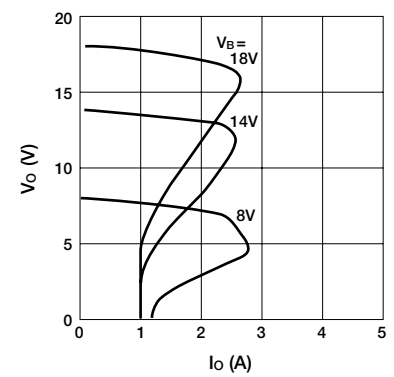
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



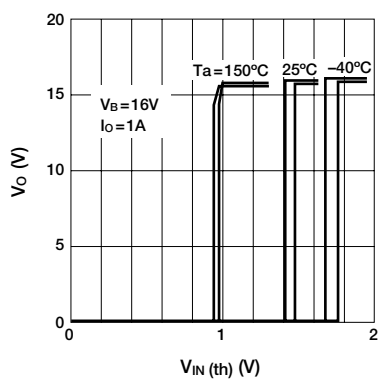
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



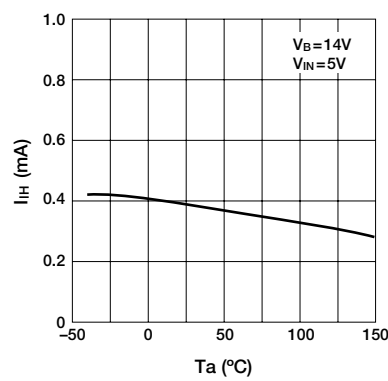
■ Overcurrent Protection Characteristics ( $T_a = 125^\circ\text{C}$ )



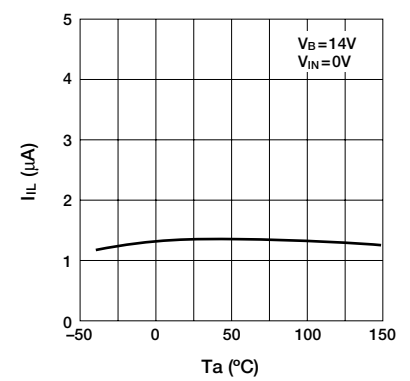
■ Threshold Characteristics of Input Voltage



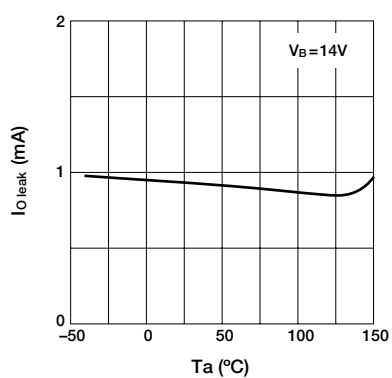
■ Input Current (Output ON)



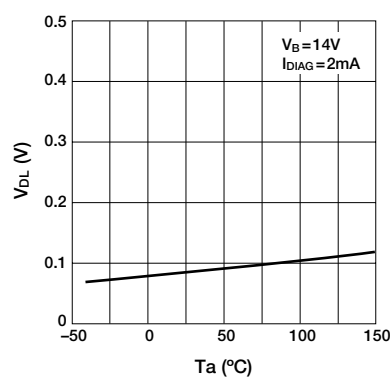
■ Input Current (Output OFF)



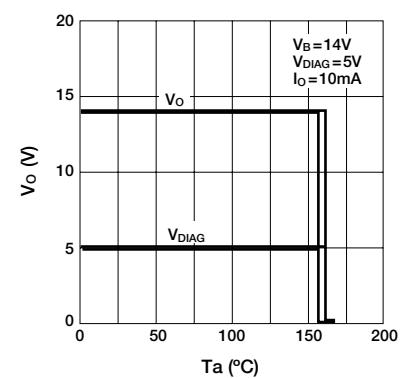
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



## Features

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

## Absolute Maximum Ratings

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

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

## Electrical Characteristics

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

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

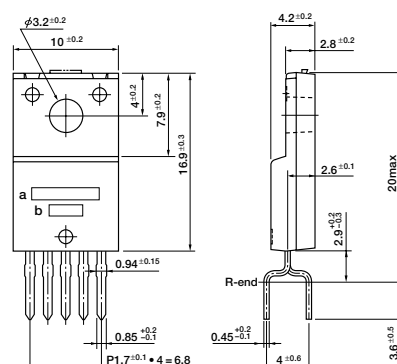
Note:

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

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

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

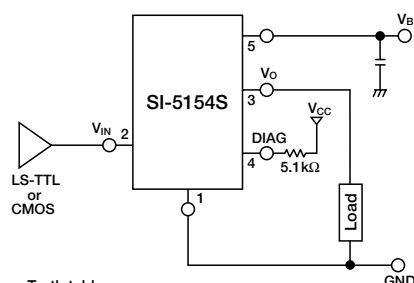
## External Dimensions (unit: mm)



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

(Forming No. 1123)

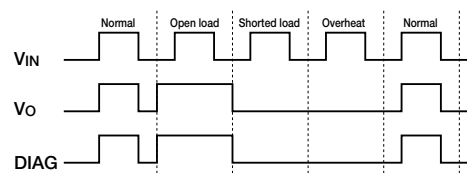
## Standard Circuit Diagram



Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | H     |
| L        | L     |

## Diagnostic Function

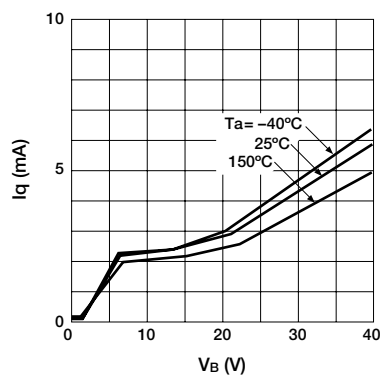


| Mode         | $V_{IN}$ | $V_O$ | DIAG |
|--------------|----------|-------|------|
| Normal       | L        | L     | L    |
| Open load    | L        | H     | H    |
| Shorted load | L        | L     | L    |
| Overheat     | L        | L     | L    |

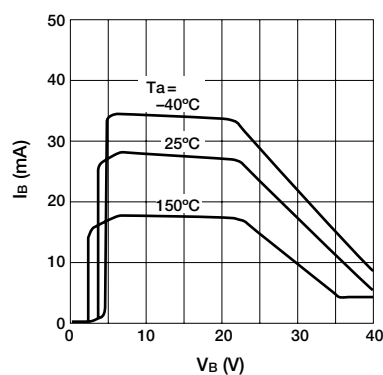
- DIAG output will be undetermined when a voltage exceeding 25V is applied to  $V_B$  terminal.

## Electrical Characteristics

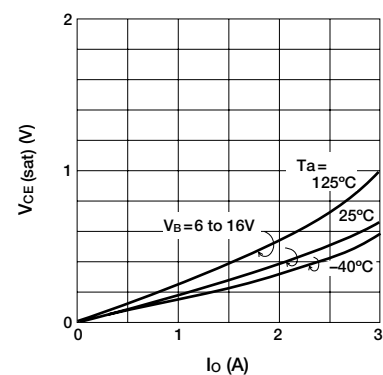
■ Quiescent Circuit Current



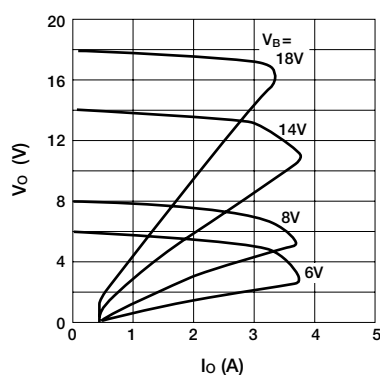
■ Circuit Current



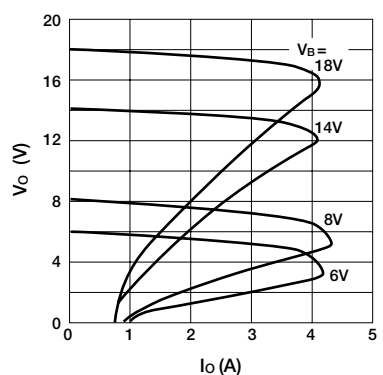
■ Saturation Voltage of Output Transistor



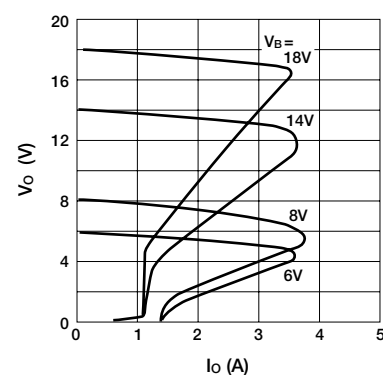
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



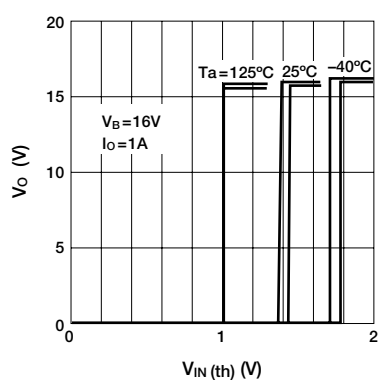
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



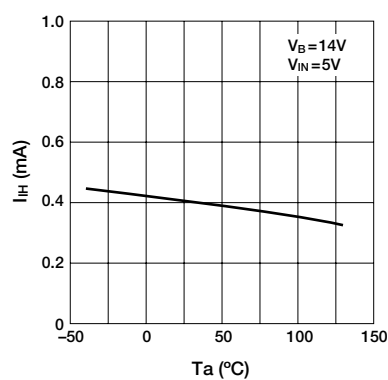
■ Overcurrent Protection Characteristics ( $T_a = 125^\circ\text{C}$ )



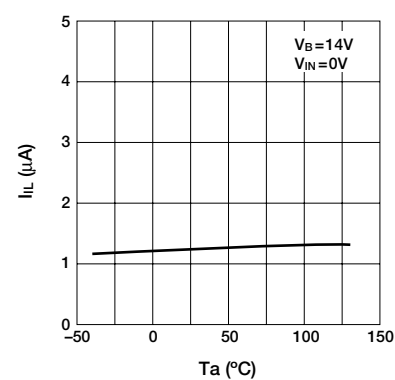
■ Threshold input voltage



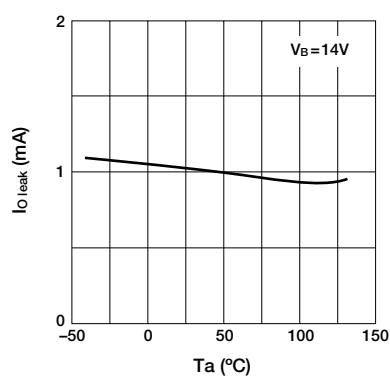
■ Input Current (Output ON)



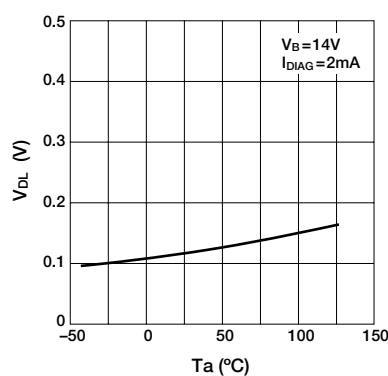
■ Input Current (Output OFF)



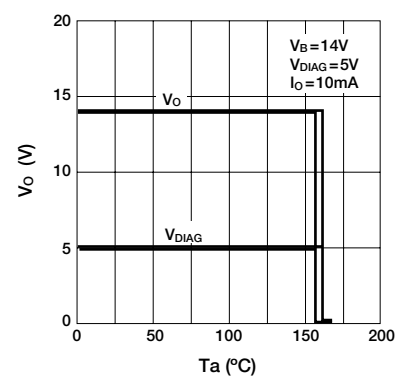
■ Output Terminal Leak Current



■ Saturation Voltage of DIAG Output



■ Thermal Protection Characteristics



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

## Features

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

## Absolute Maximum Ratings

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

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

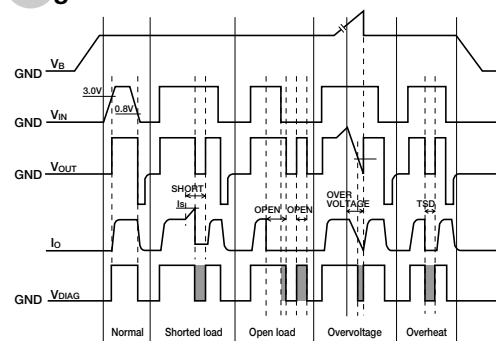
## Electrical Characteristics

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

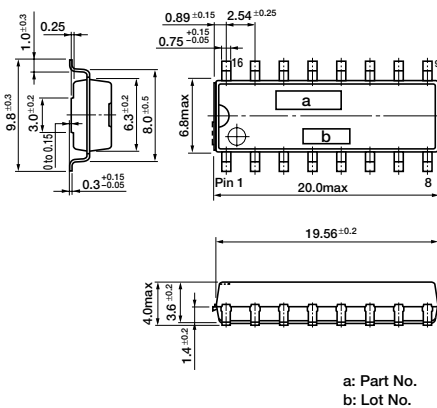
| Parameter                               | Symbol                | Ratings |     |     | Unit          | Conditions                                              |
|-----------------------------------------|-----------------------|---------|-----|-----|---------------|---------------------------------------------------------|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

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

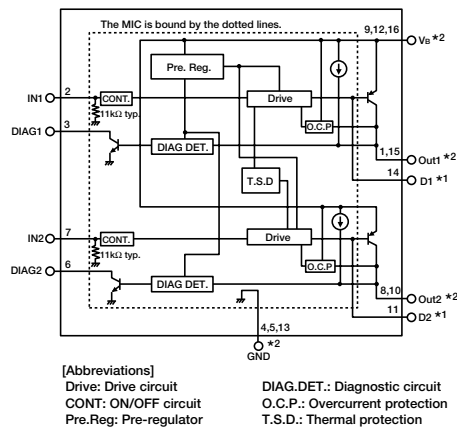
## Diagnostic Function



## External Dimensions (unit: mm) SMD-16A

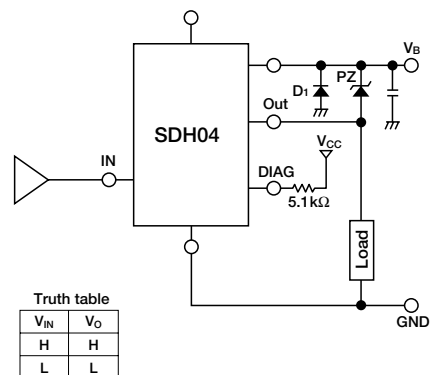


## Equivalent Circuit Diagram



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

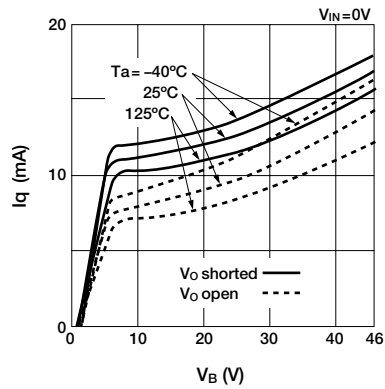
## Standard Circuit Diagram



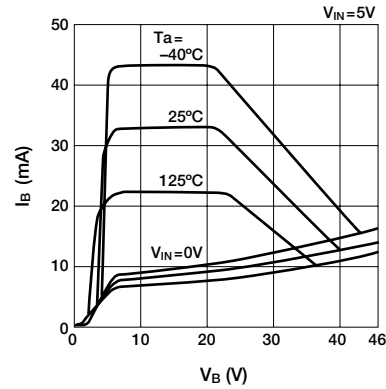
Note 1: A pull-down resistor (11 k $\Omega$  typ.) is connected to the IN terminal.  $V_{OUT}$  turns "L" when a high impedance is connected to the IN terminal in series.

## Electrical Characteristics

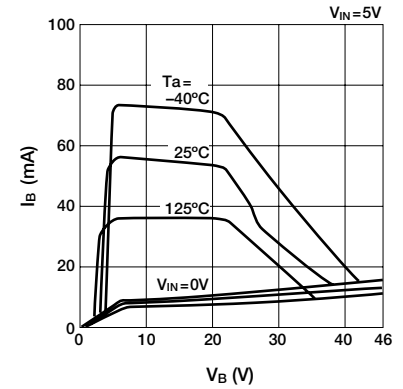
■ Quiescent Circuit Current (dual circuit)



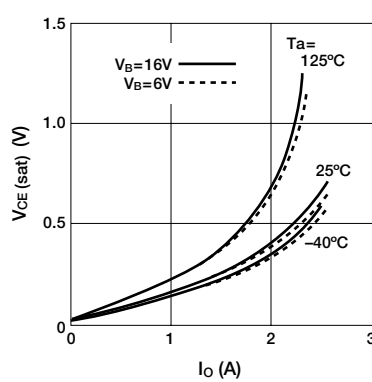
■ Circuit Current (single circuit)



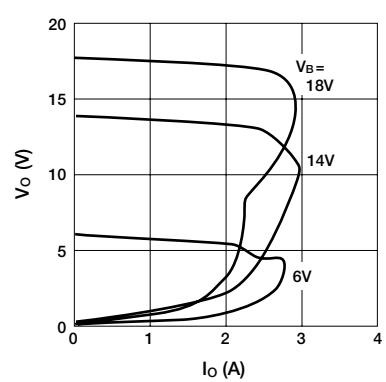
■ Circuit Current (dual circuit)



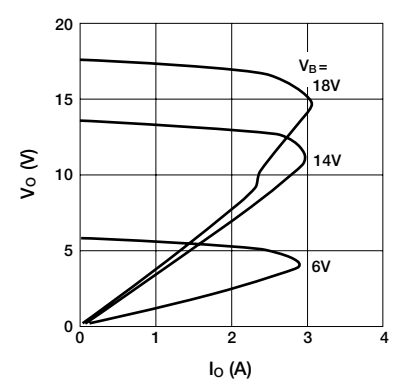
■ Saturation Voltage of Output Transistor



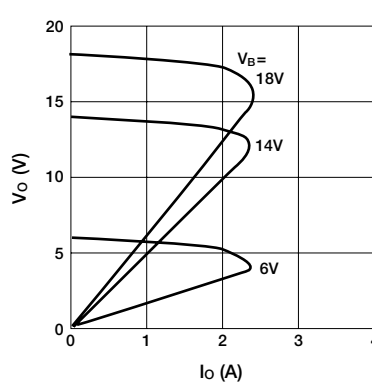
■ Overcurrent Protection Characteristics ( $T_a = -40^\circ\text{C}$ )



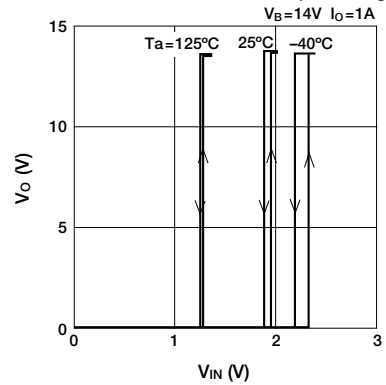
■ Overcurrent Protection Characteristics ( $T_a = 25^\circ\text{C}$ )



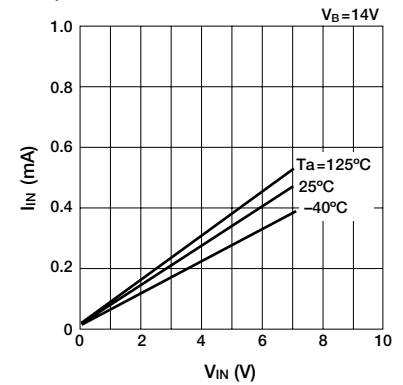
■ Overcurrent Protection Characteristics ( $T_a = 125^\circ\text{C}$ )



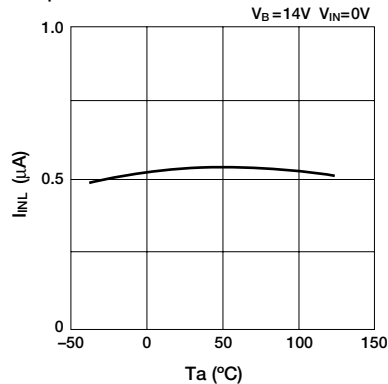
■ Threshold Characteristics of Input Voltage



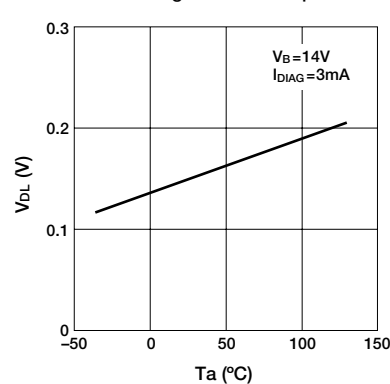
■ Input Terminal Source Current



■ Input Terminal Sink Current



■ Saturation Voltage of DIAG Output



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

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

| Parameter                          | Symbol           | Ratings            | Unit | Conditions |
|------------------------------------|------------------|--------------------|------|------------|
| Power supply voltage               | V <sub>B</sub>   | 35                 | V    |            |
| Input terminal voltage             | V <sub>IN</sub>  | -0.3 to 7          | V    |            |
| Input terminal current             | I <sub>IN</sub>  | 5                  | mA   |            |
| DG terminal voltage                | V <sub>DG</sub>  | -0.3 to 7          | V    |            |
| DG terminal current                | I <sub>DG</sub>  | 5                  | mA   |            |
| Drain to source voltage            | V <sub>DS</sub>  | V <sub>B</sub> -45 | V    |            |
| Output current                     | I <sub>O</sub>   | 1.8                | A    |            |
| Power dissipation                  | P <sub>D</sub>   | 2                  | W    | Ta=25°C    |
| Source to drain Di forward current | I <sub>F</sub>   | 0.8                | A    |            |
| Channel temperature                | T <sub>ch</sub>  | 150                | °C   |            |
| Operating temperature              | T <sub>OP</sub>  | -40 to +105        | °C   |            |
| Storage temperature                | T <sub>stg</sub> | -40 to +150        | °C   |            |

## Electrical Characteristics

(V<sub>B</sub>=14V, Ta=25°C unless otherwise specified)

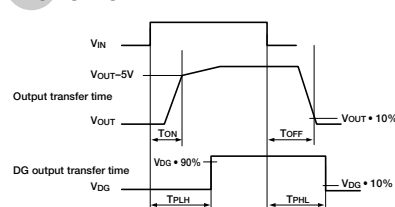
| Parameter                               |            | Symbol               | Ratings |      |     | Unit | Conditions                                |
|-----------------------------------------|------------|----------------------|---------|------|-----|------|-------------------------------------------|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

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

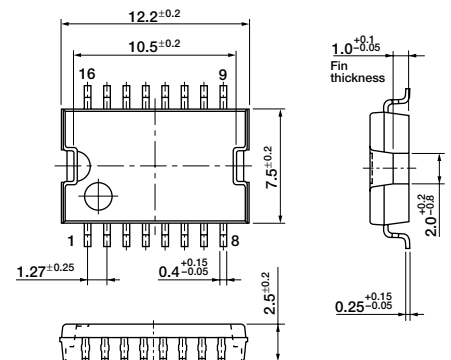
## Recommended Operating Conditions (for one channel)

| Parameter            | Ratings |     | Unit |
|----------------------|---------|-----|------|
|                      | min     | max |      |
| Power supply voltage | 5.5     | 16  | V    |
| V <sub>IH</sub>      | 4       | 5.5 | V    |
| V <sub>IL</sub>      | -0.3    | 0.9 | V    |
| I <sub>O</sub>       |         | 1   | A    |
| R <sub>IN</sub>      | 10      | 20  | kΩ   |
| R <sub>DG</sub>      | 10      | 20  | kΩ   |

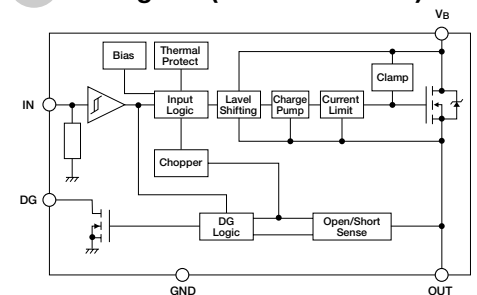
## Wave Form



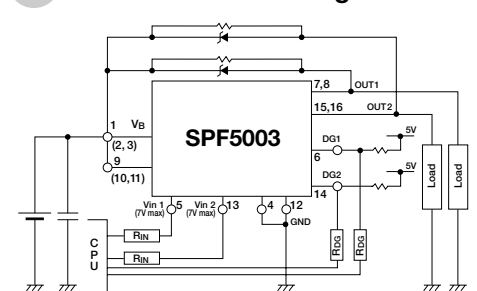
## External Dimensions (unit: mm)



## Block Diagram (for one channel)

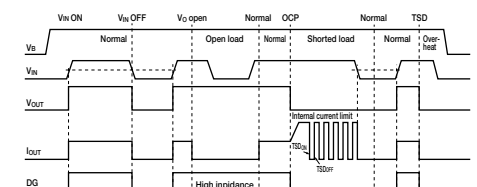


## Standard Connection Diagram



\* R<sub>IN</sub> and R<sub>DG</sub> are needed to protect CPU and SPF5003 in case of reverse connection of V<sub>B</sub> terminal.  
\* Make V<sub>B</sub> of 1Pin and 9Pin short from the fin to be plated by solder.

## Timing Chart



| Mode         | V <sub>IN</sub> | DG | V <sub>O</sub> |
|--------------|-----------------|----|----------------|
| Normal       | H               | L  | H              |
| Open load    | H               | H  | H              |
| Shorted load | H               | L  | L (Limiting)   |
| Overheat     | H               | 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                  | $T_a=25^{\circ}\text{C}$ |
| Source to drain Di forward current | $I_F$     | 0.8         | A                  |                          |
| Channel temperature                | $T_{ch}$  | 150         | $^{\circ}\text{C}$ |                          |
| Operating temperature              | $T_{OP}$  | -40 to +105 | $^{\circ}\text{C}$ |                          |
| Storage temperature                | $T_{stg}$ | -40 to +150 | $^{\circ}\text{C}$ |                          |

## Electrical Characteristics

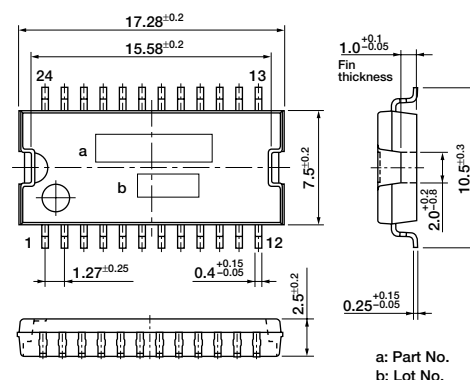
( $V_B=14V$ ,  $T_a=25^{\circ}C$  unless otherwise specified)

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

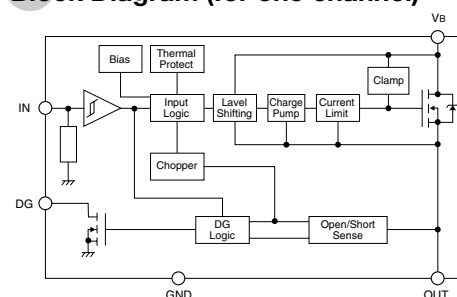
### Recommended Operating Conditions (for one channel)

| Parameter            | Ratings |      | Unit |
|----------------------|---------|------|------|
|                      | min     | max  |      |
| Power supply voltage | 5.5     | 16   | V    |
| V <sub>IH</sub>      | 4       | 5.5  | V    |
| V <sub>IL</sub>      | −0.3    | 0.9  | V    |
| I <sub>O</sub>       |         | 1.15 | A    |
| R <sub>IN</sub>      | 10      | 20   | kΩ   |
| R <sub>DG</sub>      | 10      | 20   | kΩ   |

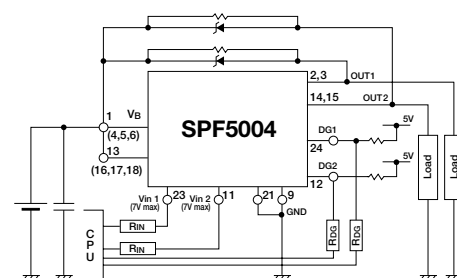
### External Dimensions (unit: mm)



### Block Diagram (for one channel)

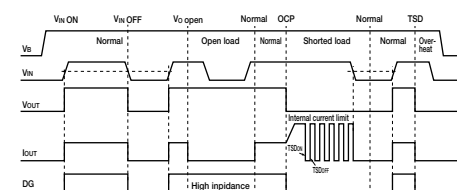


## Standard Connection Diagram



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

## Timing Chart



| Mode         | V <sub>IN</sub> | DG     | V <sub>O</sub>    |
|--------------|-----------------|--------|-------------------|
| Normal       | H<br>L          | H<br>L | H<br>L            |
| Open load    | H<br>L          | H<br>H | H<br>H            |
| Shorted load | H<br>L          | L<br>L | L (Limiting)<br>L |
| Overheat     | H<br>L          | L<br>L | L<br>L            |



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

## Features

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

## Absolute Maximum Ratings

( $T_a = 25^\circ C$ )

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

## Electrical Characteristics

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

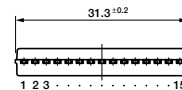
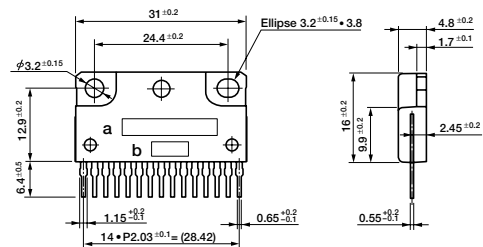
| Parameter                               | Symbol        | Ratings  |      |      | Unit       | Conditions                              |
|-----------------------------------------|---------------|----------|------|------|------------|-----------------------------------------|
|                   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

Note:

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

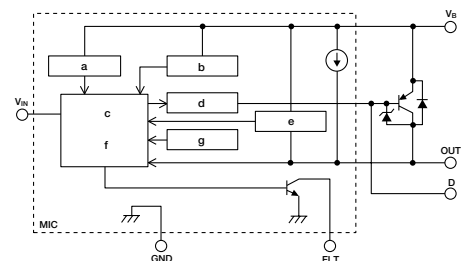
\* A start failure may occur if a short OFF signal of 10 ms or below is input in the  $V_{IN}$  terminal.

## External Dimensions (unit: mm)



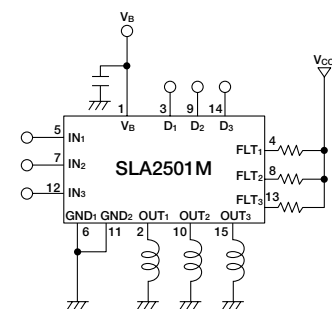
a: Part No.  
b: Lot No.

## Equivalent Circuit Diagram

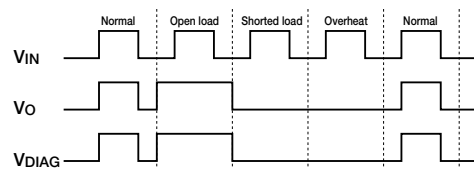


a: Pre-regulator  
b: Overvoltage protection circuit  
c: Control circuit  
d: Driver circuit  
e: Overcurrent protection circuit  
f: Diagnostic circuit  
g: Thermal protection circuit

## Standard Circuit Diagram

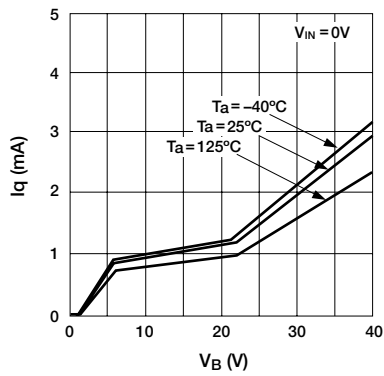


## Diagnostic Function

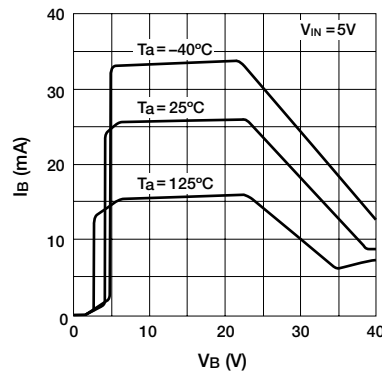


## Electrical Characteristics

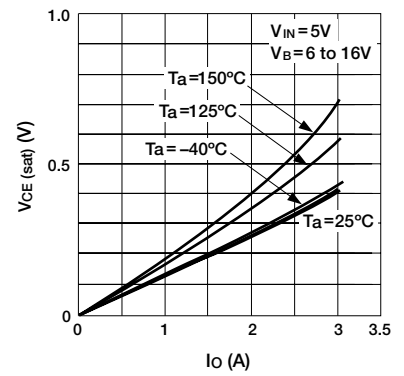
■ Quiescent Circuit Current (single circuit)



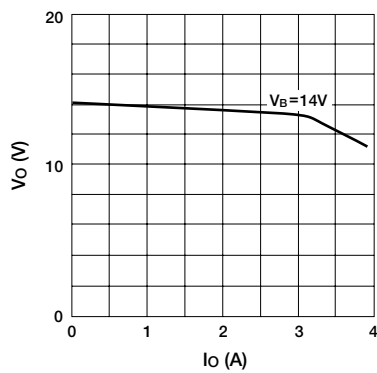
■ Circuit Current (single circuit)



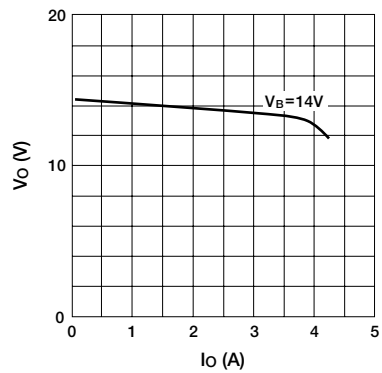
■ Saturation Voltage of Output Transistor



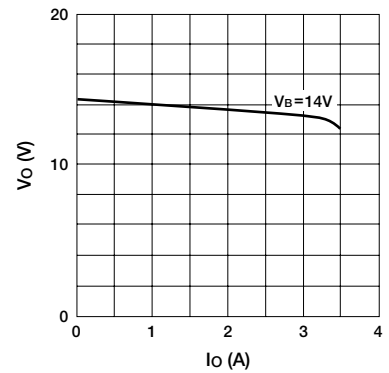
■ Overcurrent Protection Characteristics (Ta=-40°C)



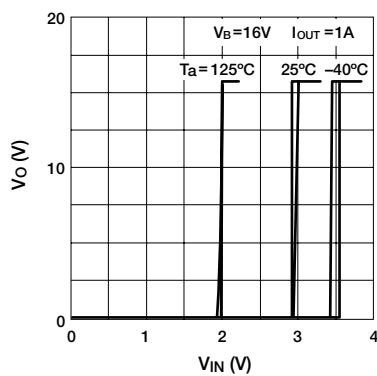
■ Overcurrent Protection Characteristics (Ta=25°C)



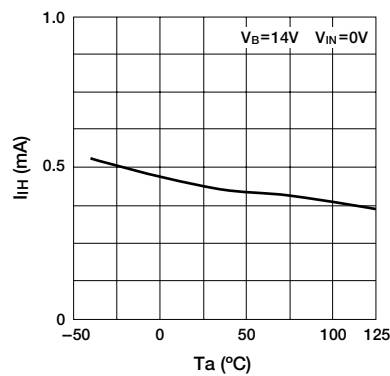
■ Overcurrent Protection Characteristics (Ta=125°C)



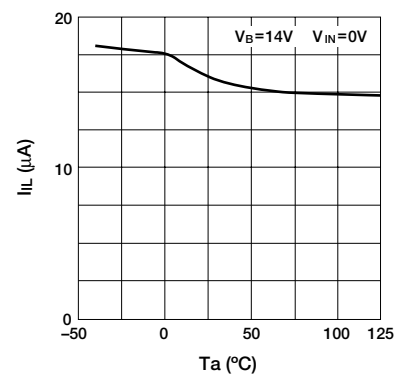
■ Threshold Input Voltage



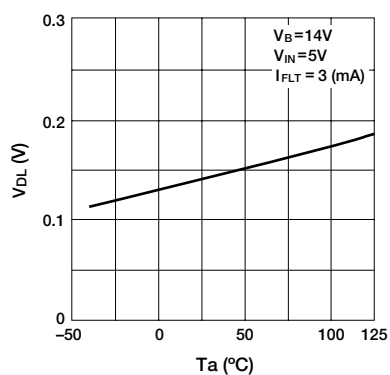
■ Input Current (Output ON)



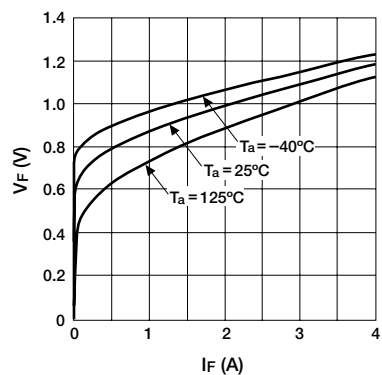
■ Input Current (Output OFF)



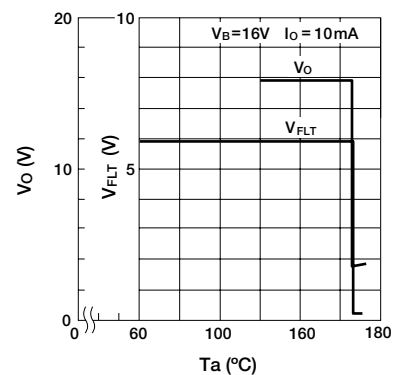
■ Saturation Voltage of DIAG Output



■ Output Reverse Current



■ Thermal Protection



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

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

| Parameter                          | Symbol           | Ratings            | Unit | Conditions                     |
|------------------------------------|------------------|--------------------|------|--------------------------------|
| Power supply voltage               | V <sub>B</sub>   | 35                 | V    |                                |
| Input terminal voltage             | V <sub>IN</sub>  | -0.3 to 7          | V    |                                |
| Input terminal current             | I <sub>IN</sub>  | 5                  | mA   |                                |
| DG terminal voltage                | V <sub>DG</sub>  | -0.3 to 7          | V    |                                |
| DG terminal current                | I <sub>DG</sub>  | 5                  | mA   |                                |
| Drain to source voltage            | V <sub>DS</sub>  | V <sub>B</sub> -45 | V    |                                |
| Output current                     | I <sub>O</sub>   | 1.8                | A    |                                |
| Power dissipation                  | P <sub>D</sub>   | 2.7                | W    | Ta=25°C, all circuit operating |
| Source to drain Di forward current | I <sub>F</sub>   | 0.8                | A    |                                |
| Channel temperature                | T <sub>ch</sub>  | 150                | °C   |                                |
| Operating temperature              | T <sub>OP</sub>  | -40 to +105        | °C   |                                |
| Storage temperature                | T <sub>stg</sub> | -40 to +150        | °C   |                                |

## Electrical Characteristics

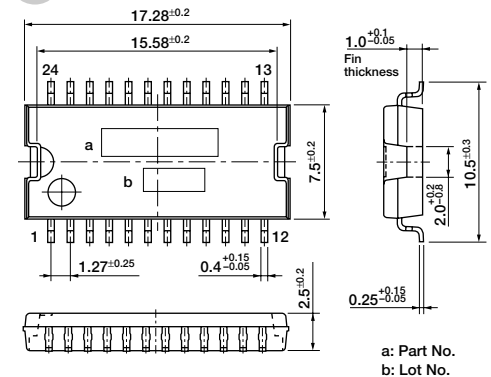
(V<sub>B</sub>=14V, Ta=25°C unless otherwise specified)

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

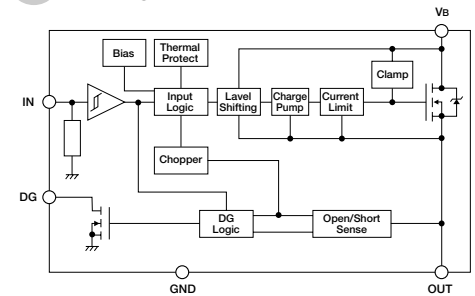
## Recommended Operating Conditions (for one channel)

| Parameter            | Ratings |     | Unit |
|----------------------|---------|-----|------|
|                      | min     | max |      |
| Power supply voltage | 5.5     | 16  | V    |
| V <sub>IH</sub>      | 4       | 5.5 | V    |
| V <sub>IL</sub>      | -0.3    | 0.9 | V    |
| I <sub>O</sub>       |         | 1   | A    |
| R <sub>IN</sub>      | 10      | 20  | kΩ   |
| R <sub>DG</sub>      | 10      | 20  | kΩ   |

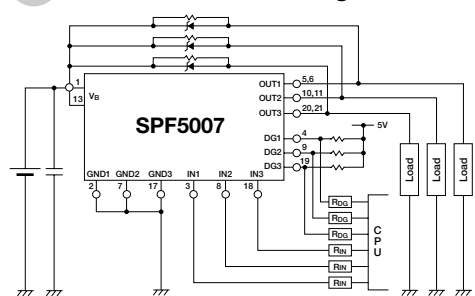
## External Dimensions (unit: mm)



## Block Diagram (for one channel)

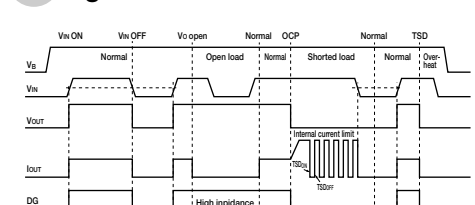


## Standard Connection Diagram



- \* R<sub>IN</sub> and R<sub>DG</sub> are needed to protect CPU and SPF5007 in case of reverse connection of V<sub>B</sub> terminal.
- \* Make V<sub>B</sub> of 1Pin and 13Pin short from the fin to be plated by solder.

## Timing Chart



| Mode         | V <sub>IN</sub> | DG | V <sub>O</sub> |
|--------------|-----------------|----|----------------|
| Normal       | H               | H  | H              |
| Open load    | L               | H  | H              |
| Shorted load | H               | L  | L (Limiting)   |
| Overheat     | H               | L  | L              |



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

## Features

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

## Absolute Maximum Ratings

( $T_a = 25^\circ C$ )

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

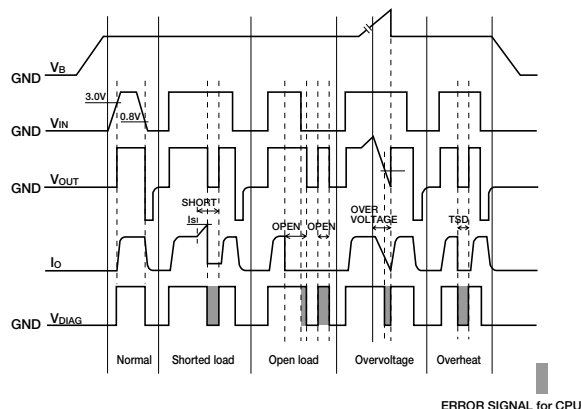
## Electrical Characteristics

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

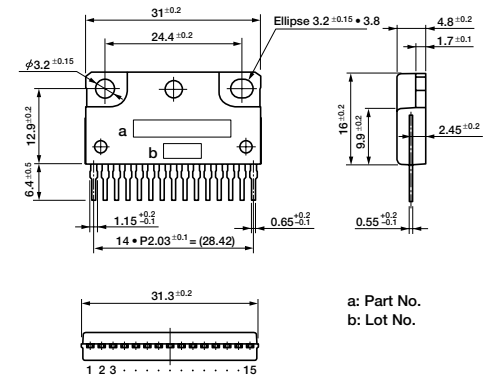
| Parameter                               | Symbol        | Ratings  |     |     | Unit       | Conditions                                |
|-----------------------------------------|---------------|----------|-----|-----|------------|-------------------------------------------|
|                   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

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

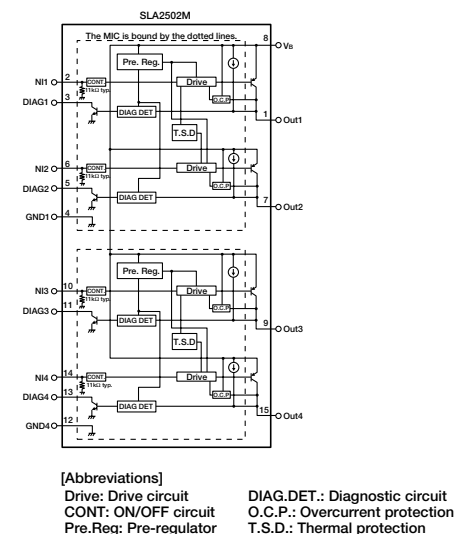
## Diagnostic Function



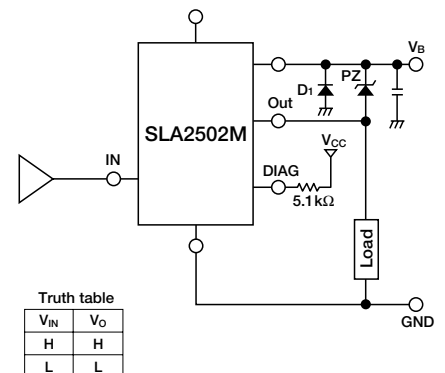
## External Dimensions (unit: mm)



## Equivalent Circuit Diagram



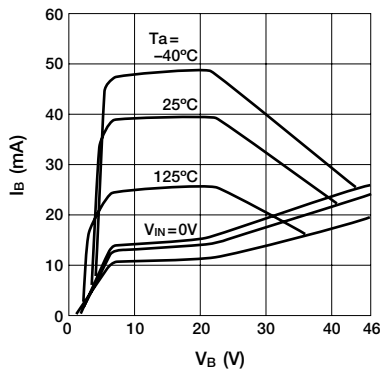
## Standard Circuit Diagram



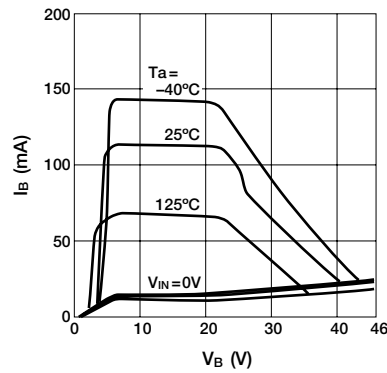
- Note 1: A pull-down resistor (11k $\Omega$  typ.) is connected to the IN terminal.  $V_{OUT}$  turns "L" when a high impedance is connected to the IN terminal in series.
- Note 2: Grounds GND1 and GND2 are not wired internally. They must be shorted at a pattern near the product.

## Electrical Characteristics

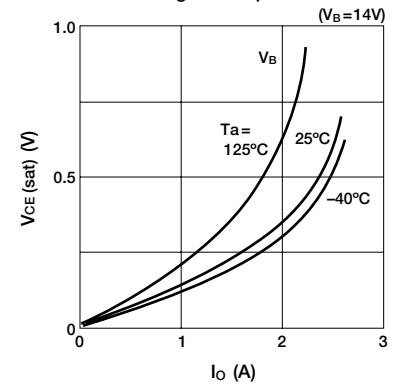
■ Circuit Current (single circuit)



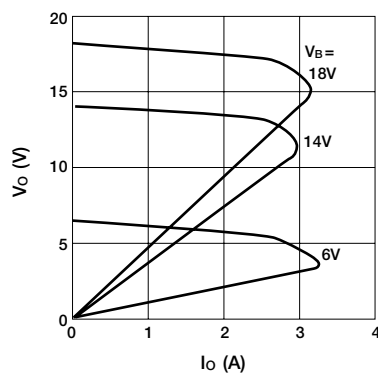
■ Circuit Current (4 circuits)



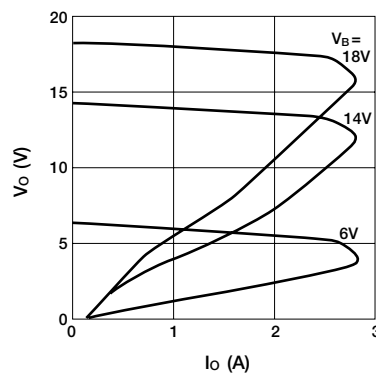
■ Saturation Voltage of Output Transistor



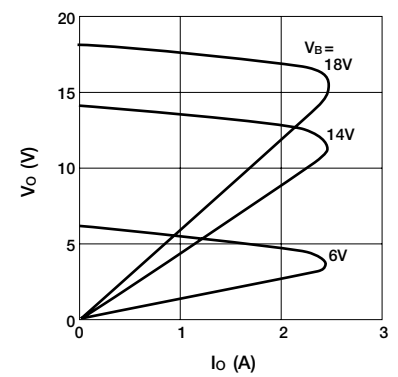
■ Overcurrent Protection Characteristics (Ta=-40°C)



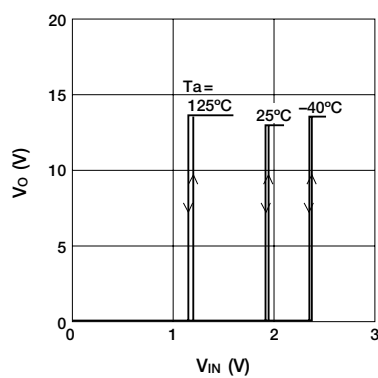
■ Overcurrent Protection Characteristics (Ta=25°C)



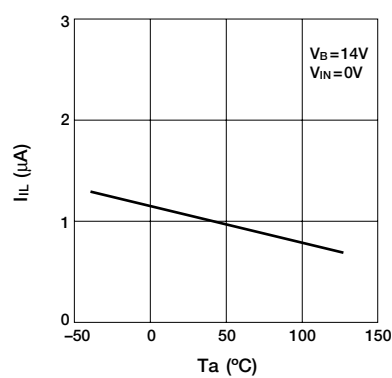
■ Overcurrent Protection Characteristics (Ta=125°C)



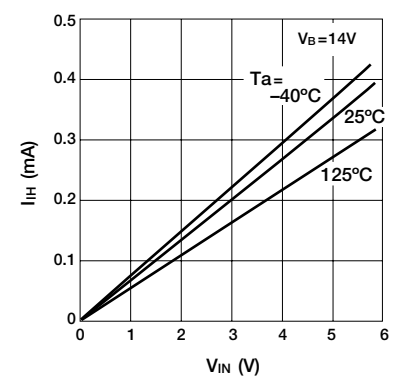
■ Threshold Input Voltage



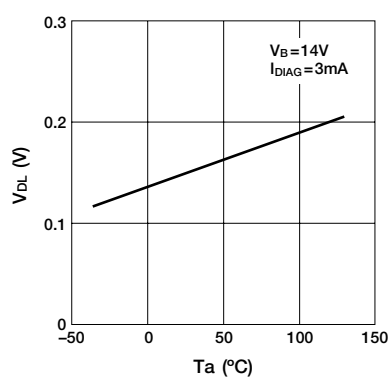
■ Input Current (Output OFF)



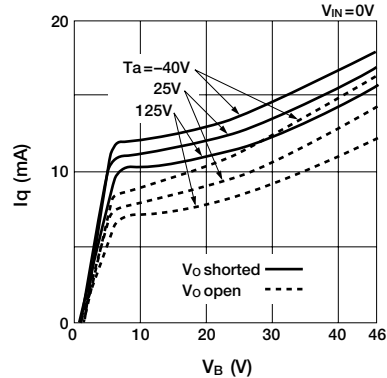
■ Input Current (Output Hi)



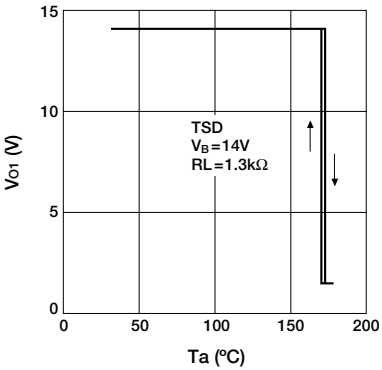
■ Saturation Voltage of DIAG Output



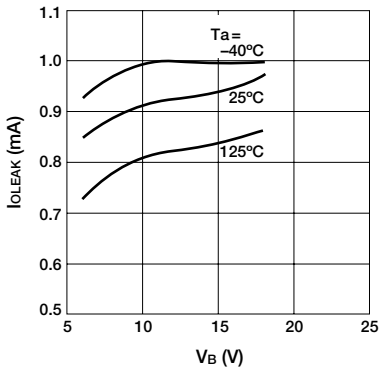
■ Quiescent Circuit Current (dual circuit)



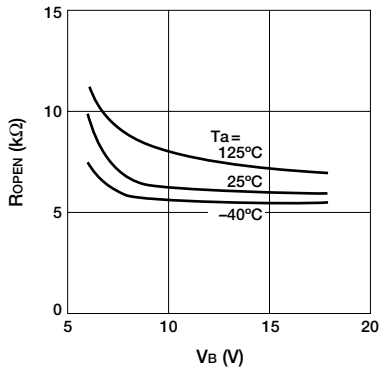
Thermal Protection Characteristics



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



Open Load Detection Resistor





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

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

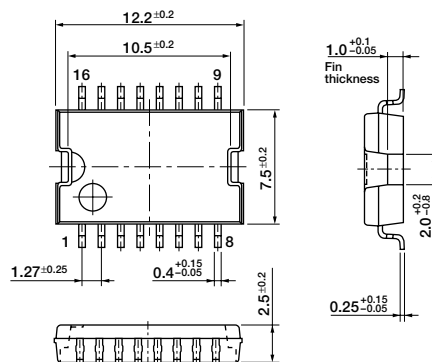
| Parameter                   | Symbol    | Ratings      | Unit | Conditions   |
|-----------------------------|-----------|--------------|------|--------------|
| Power supply voltage        | $V_B$     | 40           | V    |              |
| Output terminal voltage     | $V_{OUT}$ | 37           | V    |              |
| Input terminal voltage      | $V_{IN}$  | -0.5 to +7.5 | V    |              |
| Output current              | $I_O$     | 1.8          | A    |              |
| Power Dissipation           | $P_D$     | 2            | W    |              |
| Storage temperature         | $T_{stg}$ | -40 to +150  | °C   |              |
| Channel temperature         | $T_{ch}$  | 150          | °C   |              |
| Output avalanche capability | $E_{AV}$  | 50           | mJ   | Single pulse |

## Electrical Characteristics

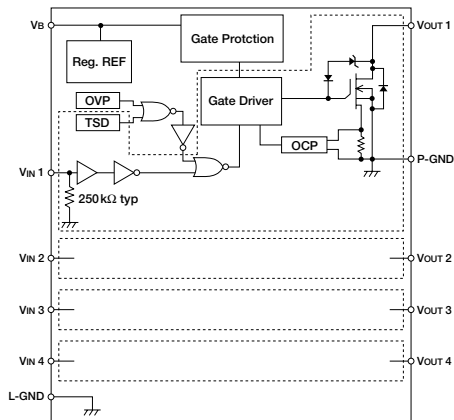
( $V_B=14V$ ,  $T_a=25^{\circ}C$  unless otherwise specified)

| Parameter                               | Symbol           | Ratings  |      |     | Unit        | Conditions               |
|-----------------------------------------|------------------|----------|------|-----|-------------|--------------------------|
|                                         |                  | min      | typ  | max |             |                          |
| Power supply voltage                    | $V_{Bopr}$       | 5.5      |      | 25  | V           |                          |
| Quiescent circuit current               | $I_q$            |          | 5    | 7   | mA          | $V_{IN}=0V$ (all inputs) |
| Operating circuit current               | $I_{CC}$         |          | 8    | 12  | mA          | $V_{IN}=5V$ (all inputs) |
| Input voltage                           | Hi output        | $V_{IN}$ | 3.5  | 5.5 | V           | $I_O=1A$                 |
|                                         | Lo output        | $V_{IN}$ | -0.5 | 1.5 | V           |                          |
| Input current                           | Hi output        | $I_{IN}$ |      | 50  | $\mu A$     | $V_{IN}=5V$              |
|                                         | Lo output        | $I_{IN}$ |      | 30  | $\mu A$     | $V_{IN}=0V$              |
| Output ON resistance                    | $R_{DS(ON)}$     |          | 0.4  | 0.6 | $\Omega$    |                          |
|                                         |                  |          | 0.5  | 0.7 | $\Omega$    | $V_B=5.5V$               |
| Output clamp voltage                    | $V_{OUT(clamp)}$ | 41       | 50   | 55  | V           | $I_O=1A$                 |
| Output leak current                     | $I_{OH}$         |          |      | 10  | $\mu A$     | $V_O=37V$                |
| 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  |     | $^{\circ}C$ |                          |
| Overcurrent protection starting current | $I_S$            | 1.1      |      |     | A           |                          |
| Output transfer time                    | $T_{ON}$         |          |      | 12  | $\mu s$     | $R_L=14\Omega, I_O=1A$   |
|                                         | $T_{OFF}$        |          |      | 8   | $\mu s$     | $R_L=14\Omega, I_O=1A$   |
| Output rise time                        | $T_r$            |          |      | 5   | $\mu s$     | $R_L=14\Omega, I_O=1A$   |
| Output fall time                        | $T_f$            |          |      | 10  | $\mu s$     | $R_L=14\Omega, I_O=1A$   |

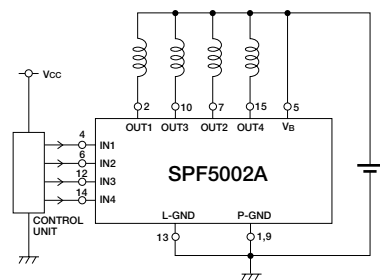
### External Dimensions (unit: mm)



### Equivalent Circuit Diagram



## Circuit Example

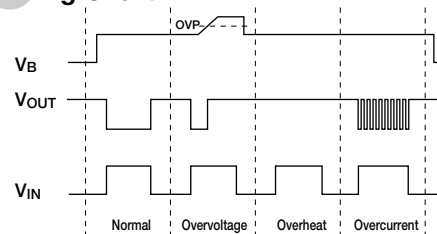


Use L-GND and P-GND being connected.

Truth table

| $V_{IN}$ | $V_O$ |
|----------|-------|
| H        | L     |
| L        | H     |

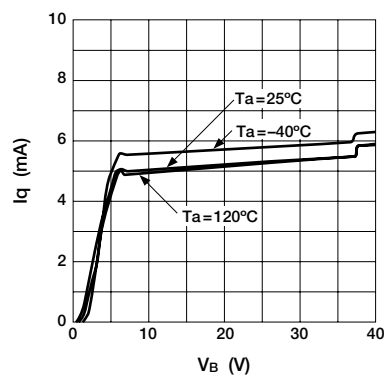
## Timing Chart



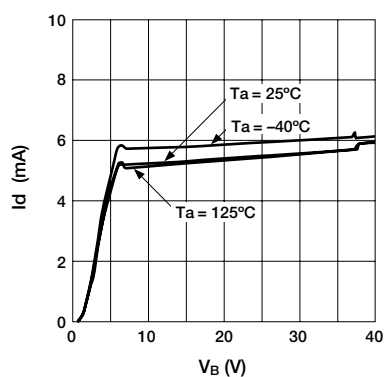
\* Self-excited frequency is used in the overcurrent protection.

## Electrical Characteristics

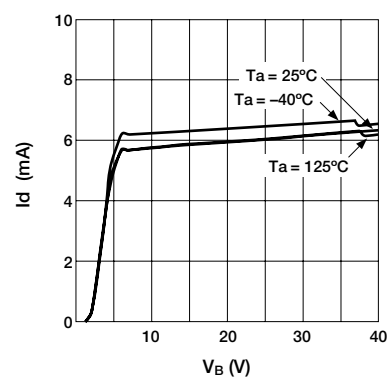
■ Quiescent Circuit Current



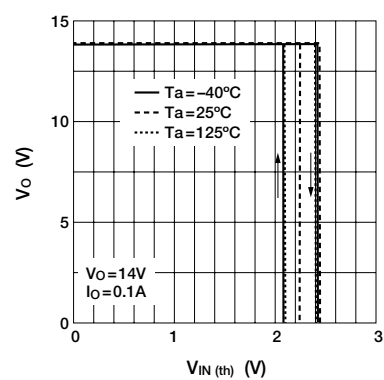
■ Circuit Current (single circuit)



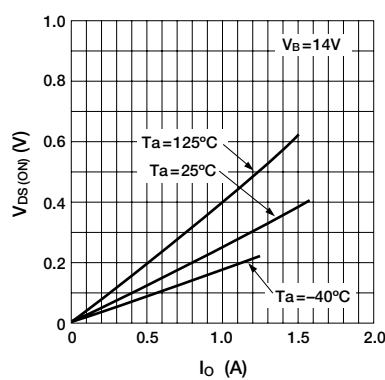
■ Circuit Current (4 circuits)



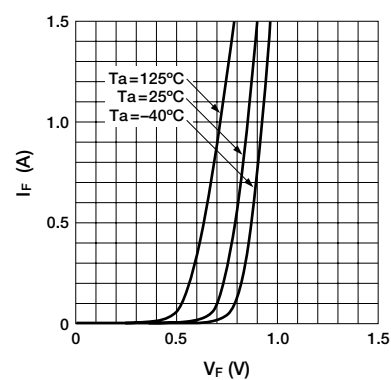
■ Threshold Input Voltage



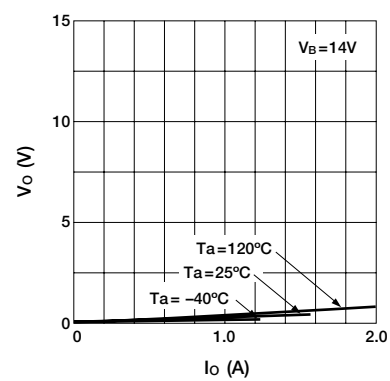
■ Output ON Voltage



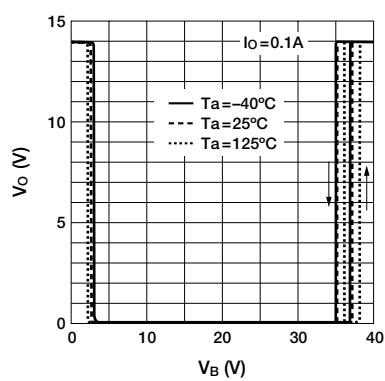
■ Forward Voltage of Output Stage Diode



■ Overcurrent Protection Characteristics



■ Overvoltage Protection Starting Voltage



## 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)

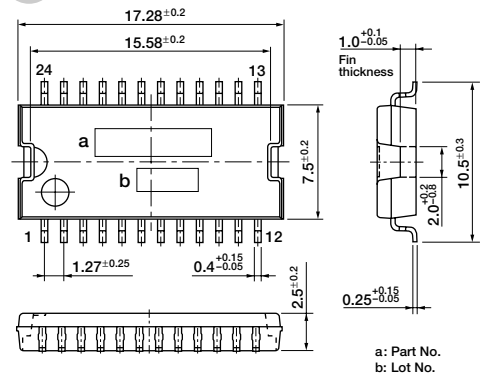
| Parameter                       | Symbol                    | Ratings                                  | Unit | Conditions   |
|---------------------------------|---------------------------|------------------------------------------|------|--------------|
| Power supply voltage            | V <sub>B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

## Electrical Characteristics

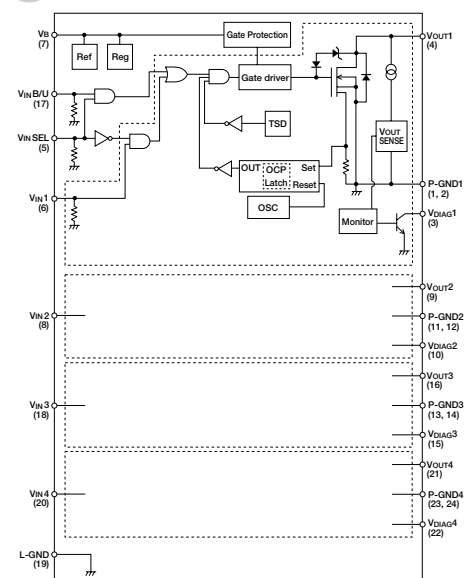
(V<sub>B</sub> = 14V, Ta = 25°C unless otherwise specified)

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

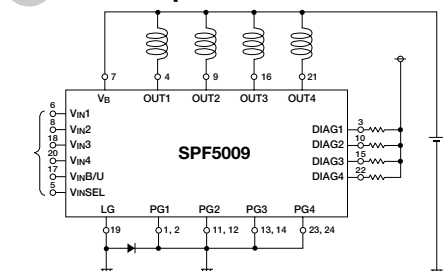
## External Dimensions (unit: mm)



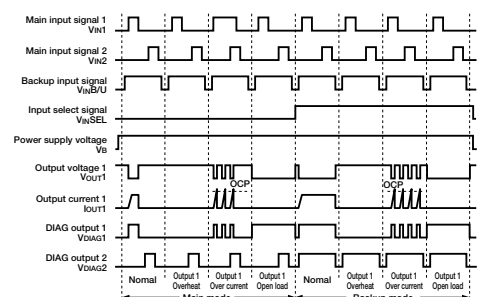
## Equivalent Circuit Diagram



## Circuit Example



## Timing Chart





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

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

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

\*1. At the clamping operation, refer to the section of V<sub>OUT (clamp)</sub> in electrical characteristics

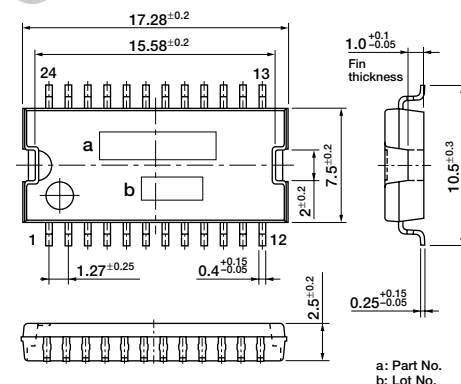
\*2. Changes by the pattern of mounted substrate

## Electrical Characteristics

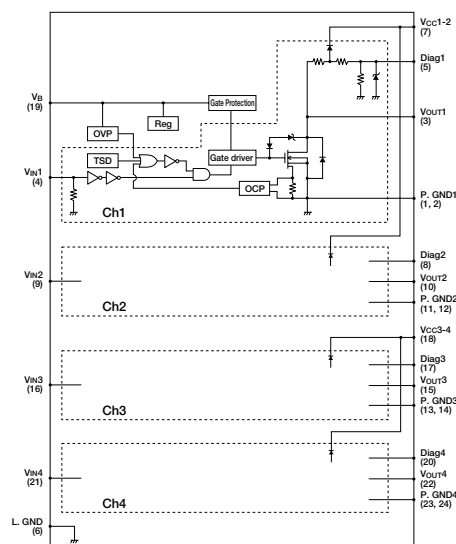
(V<sub>B</sub>=14V, Ta=25°C unless otherwise specified)

| Parameter                                 | Symbol                    | Ratings         |      |       | Unit | Conditions                                                                                  |
|-------------------------------------------|---------------------------|-----------------|------|-------|------|---------------------------------------------------------------------------------------------|
|                                           |                           | min             | typ  | max   |      |                                                                                             |
| Power supply voltage                      | V <sub>B (opr)</sub>      | 5.5             |      | 40    | V    |                                                                                             |
|                                           | V <sub>CC (opr)</sub>     | 4.5             |      | 5.5   | V    |                                                                                             |
| Quiescent circuit current                 | I <sub>q</sub>            |                 | 4    | 6     | mA   | V <sub>B</sub> =14V, V <sub>IN</sub> =0V                                                    |
| Operating circuit current                 | I <sub>d</sub>            |                 | 8    | 12    | mA   | V <sub>B</sub> =14V, V <sub>IN</sub> =5V                                                    |
| Input voltage                             | Hi output                 | V <sub>IN</sub> | 3.5  | 5.5   | V    | V <sub>B</sub> =14V, V <sub>O</sub> =1A                                                     |
|                                           | Lo output                 | V <sub>IN</sub> | -0.5 | 1.5   | V    | V <sub>B</sub> =14V                                                                         |
| Input current                             | Hi output                 | I <sub>IN</sub> |      | 50    | μA   | V <sub>B</sub> =14V, V <sub>IN</sub> =5V                                                    |
|                                           | Lo output                 | I <sub>IN</sub> |      | -30   | μA   | V <sub>B</sub> =14V, I <sub>O</sub> =1A                                                     |
| Output ON resistance                      | R <sub>DS (ON)</sub>      |                 |      | 0.3   | Ω    | V <sub>B</sub> =14V, I <sub>O</sub> =1A, Ta=125°C                                           |
|                                           |                           |                 |      | 0.2   | Ω    | V <sub>B</sub> =14V, I <sub>O</sub> =1A, Ta=25°C                                            |
| Output clamp voltage                      | V <sub>OUT (clamp)</sub>  | 45              | 50   | 55    | V    | V <sub>B</sub> =14V, I <sub>O</sub> =1A                                                     |
| Output leak current                       | I <sub>OH</sub>           |                 |      | 2.8   | mA   | V <sub>B</sub> =14V, V <sub>CC</sub> =5V, V <sub>IN</sub> =0V, V <sub>O</sub> =40V, Ta=25°C |
|                                           |                           |                 |      | 900   | μA   | V <sub>B</sub> =14V, V <sub>CC</sub> =5V, V <sub>IN</sub> =0V, V <sub>O</sub> =14V, Ta=25°C |
| Forward voltage of output stage diode     | V <sub>F</sub>            |                 |      | 1.6   | V    | I <sub>F</sub> =1A                                                                          |
| Overvoltage protection starting voltage   | V <sub>B (ovp)</sub>      | 25              |      | 40    | V    |                                                                                             |
| Overvoltage protection hysteresis voltage | V <sub>B (ovp+hys)</sub>  |                 | 8    |       | V    |                                                                                             |
| Thermal shutdown operating temperature    | T <sub>TSO</sub>          | 151             | 165  |       | °C   | V <sub>B</sub> =14V                                                                         |
| Overcurrent protection operating current  | I <sub>S</sub>            | 6               |      |       | A    | V <sub>B</sub> =14V, Ta=-40°C                                                               |
|                                           |                           | 6               |      |       | A    | V <sub>B</sub> =14V, Ta=25°C                                                                |
|                                           |                           | 5               |      |       | A    | V <sub>B</sub> =14V, Ta=125°C                                                               |
| Output transfer time                      | T <sub>ON</sub>           |                 |      | 12    | μs   | V <sub>B</sub> =14V, R <sub>L</sub> =14Ω, I <sub>O</sub> =1A                                |
|                                           | T <sub>OFF</sub>          |                 |      | 8     | μs   |                                                                                             |
| Output rise time                          | T <sub>r</sub>            |                 |      | 5     | μs   |                                                                                             |
| Output fall time                          | T <sub>f</sub>            |                 |      | 10    | μs   |                                                                                             |
| Output-diag voltage ratio                 | r <sub>a</sub> (DIAG)     | 0.195           | 0.2  | 0.205 |      | V <sub>B</sub> =14V, V <sub>O</sub> =1 to 14V, R <sub>diag</sub> =500kΩ                     |
| Diag output clamping voltage              | V <sub>DIAG (clamp)</sub> |                 |      | 4.85  | V    | V <sub>B</sub> =14V, V <sub>CC</sub> =5V, V <sub>O</sub> =40V                               |

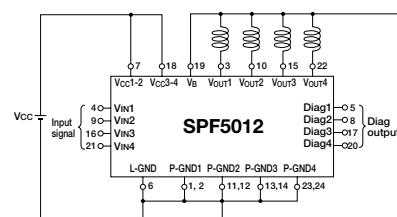
## External Dimensions (unit: mm)



## Equivalent Circuit Diagram



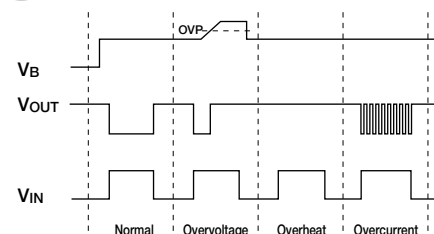
## Circuit Example



Truth table

| V <sub>IN</sub> | V <sub>O</sub> |
|-----------------|----------------|
| H               | L              |
| L               | H              |

## Timing Chart



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



# Stepper-motor Driver ICs SLA4708M

## Features

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

## Absolute Maximum Ratings

(Ta=25°C)

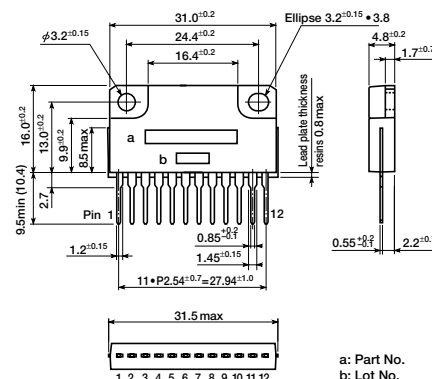
| Parameter                           | Symbol               | Ratings       | Unit | Conditions       |
|-------------------------------------|----------------------|---------------|------|------------------|
| Power supply voltage                | V <sub>S</sub>       | 35            | V    |     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

## Electrical Characteristics

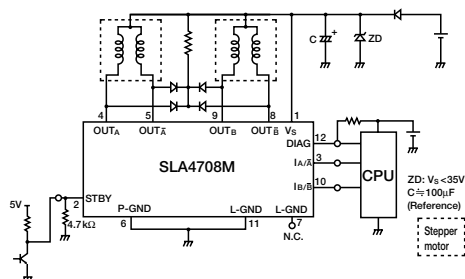
(V<sub>S</sub>=12V, Ta=25°C)

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

## External Dimensions (unit: mm)

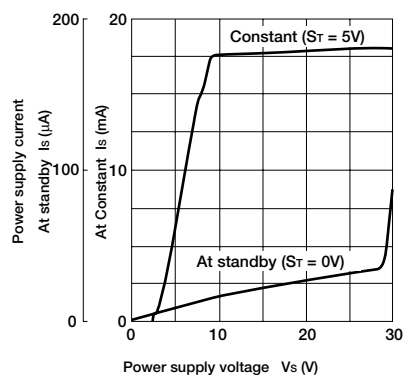


## Standard Circuit Diagram

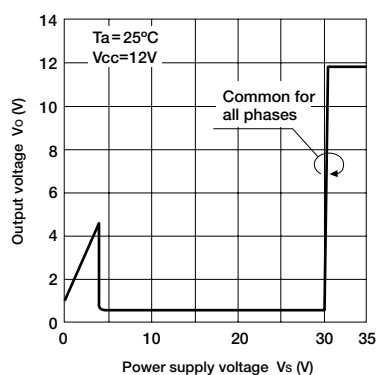


## Electrical Characteristics

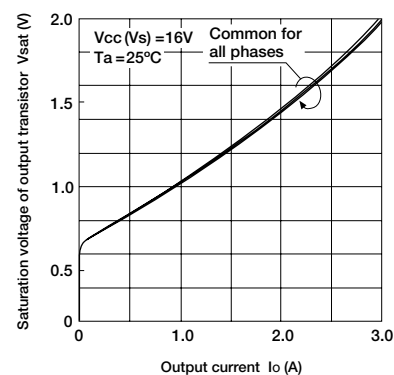
### Power Supply Current Characteristics



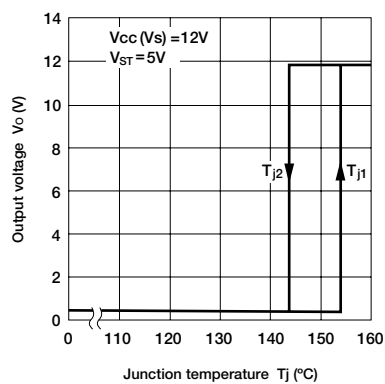
### Overvoltage Protection Characteristics



### Saturation Voltage of Output Transistor Characteristics



### Thermal Protection Characteristics



# Full Bridge PWM Control DC Motor Driver IC SI-5300

## Features

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

## Absolute Maximum Ratings

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

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

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

## Electrical Characteristics

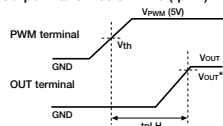
(Unless, otherwise specified,  $T_J=T_{CH}=25^{\circ}\text{C}$ ,  $V_M=14\text{V}$ ,  $I_O=3\text{A}$ )

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

Note:

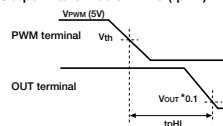
\*1: The standard value of  $I_{OCP}$  is assumed to be a value by which the output of each Power MOS FET cuts off. When the protection circuit of OCP and TSD operates, Power MOS FETs keeps cutoff. When a signal (5V: H → 0V: L) is input to the terminal PWM, the cutoff operation will be released. Moreover,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

\*2: Output transmission time (tpLH)



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

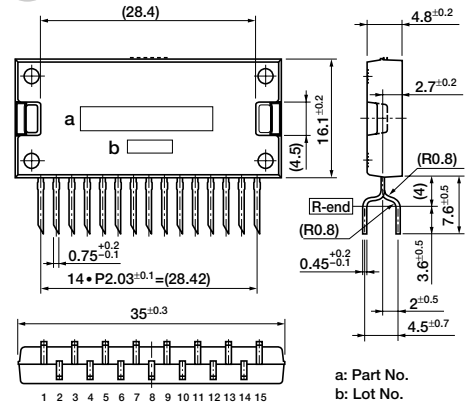
\*3: Output transmission time (tpHL)



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

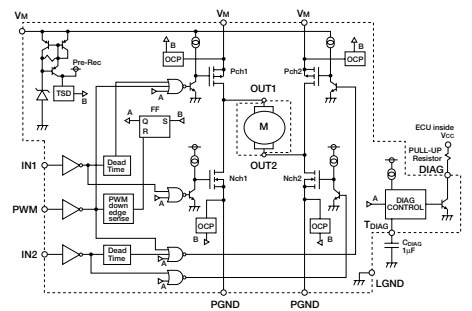
\*4: DIAG signal output terminal is an open collector output. Use a pull-up resistor when connecting it to a logic circuit.

## External Dimensions (unit: mm)

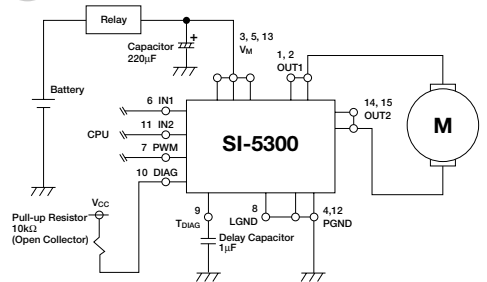


a: Part No.  
b: Lot No.

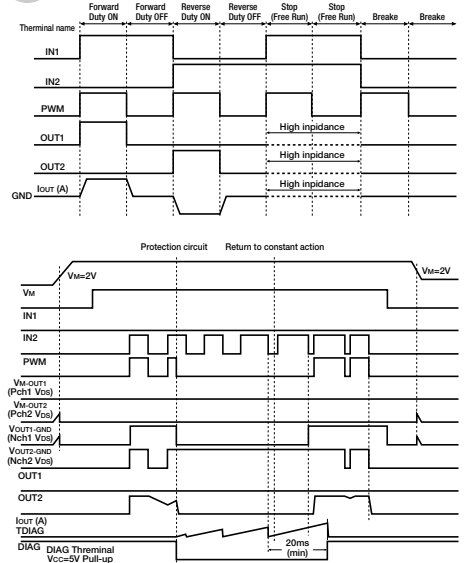
## Equivalent Circuit



## Standard Connection Diagram

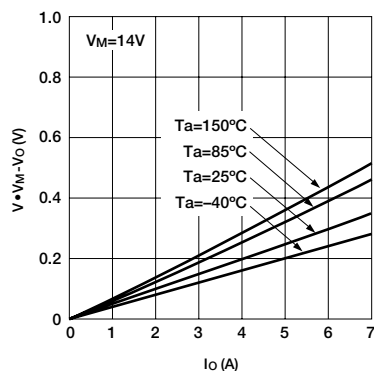


## Timing Chart

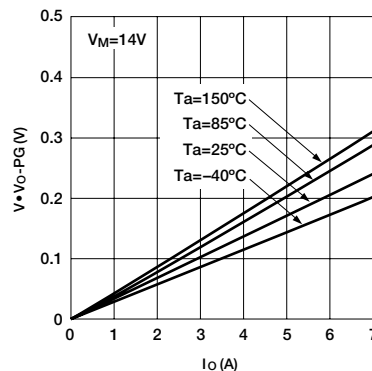


## Electrical Characteristics

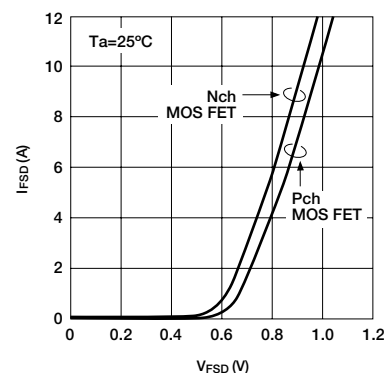
■ Output saturation voltage (Pch)



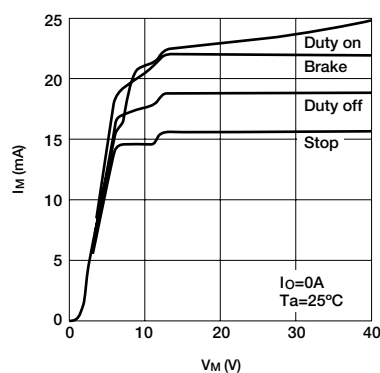
■ Output saturation voltage (Nch)



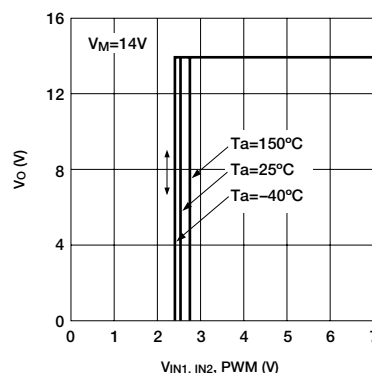
■ Forward voltage of Diode between drain and source



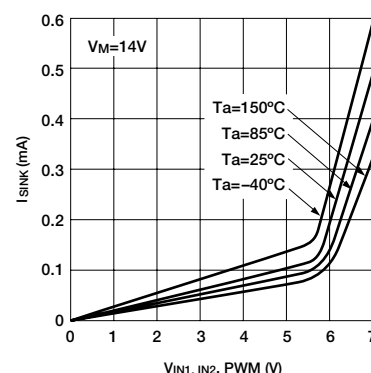
■ Quiescent circuit current



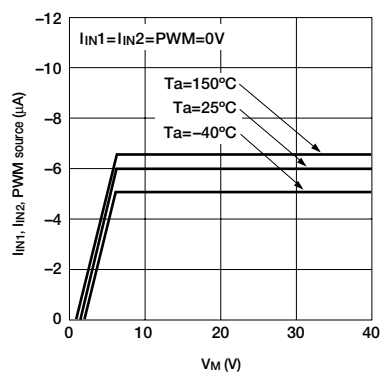
■ Voltage of input terminal (Threshold voltage)



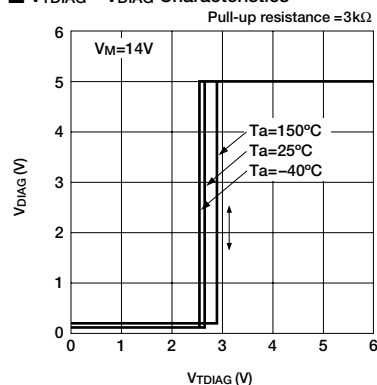
■ Current of input terminal (SINK current)



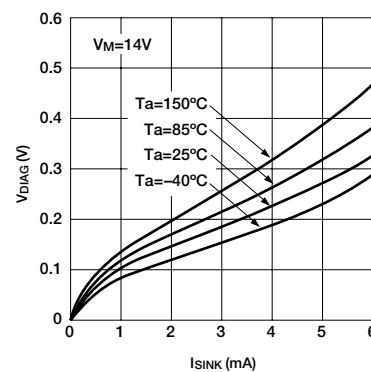
■ Current of input terminal (Source current)



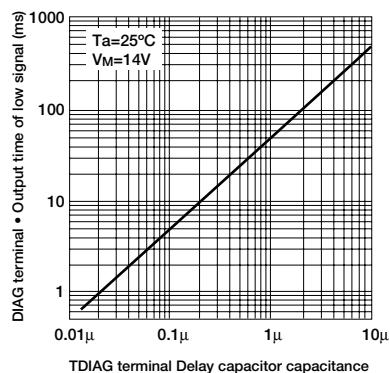
■ V\_TDIAG - V\_DIAG Characteristics



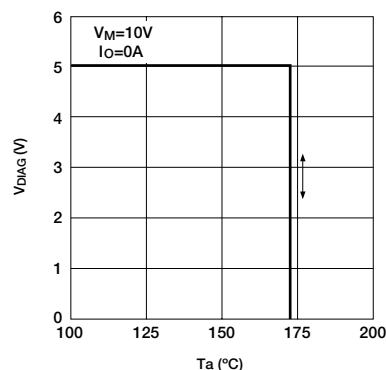
■ DIAG terminal • Saturation voltage



■ DIAG terminal • Output pulse width

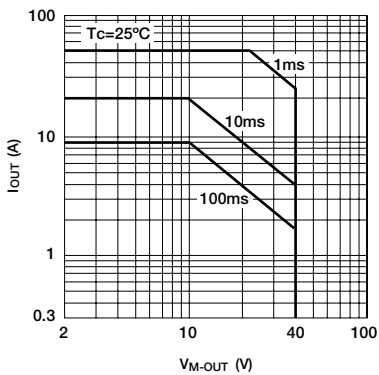


■ Thermal shut down protection

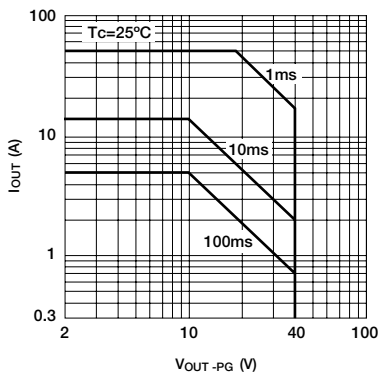


Electrical Characteristics

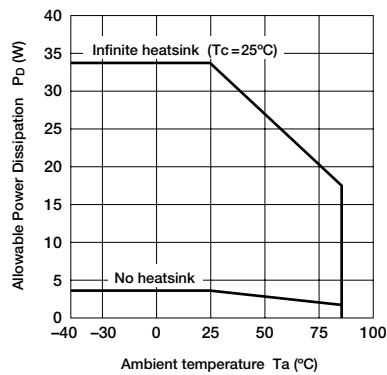
■ Pch MOS FET Safe Operating Area (SOA)



■ Nch MOS FET Safe Operating Area (SOA)



■  $P_D$ — $T_a$  Characteristics





# High Voltage Full Bridge Drive IC SLA2402M

## Features

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

## Absolute Maximum Ratings

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

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

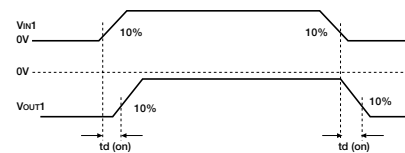
## Electrical Characteristics

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

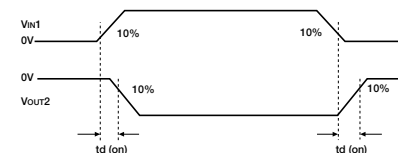
\* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

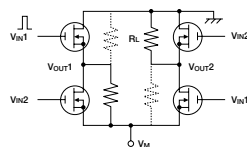


② Lowside switch turn-on, turn-off



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

Measurement Circuit



Conditions

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

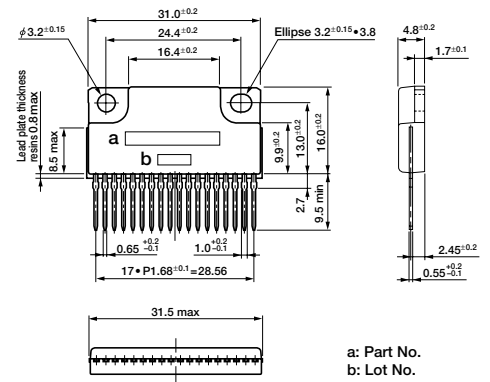
$V_M=85V$

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

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

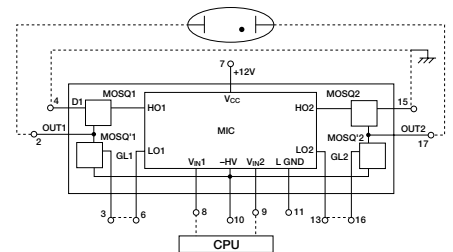
On the contrary, when pulse signal is inputted to  $V_{IN2}$ ,  $R_L$  on dotted line is ON and solid line  $R_L$  is off.

## External Dimensions (unit: mm)



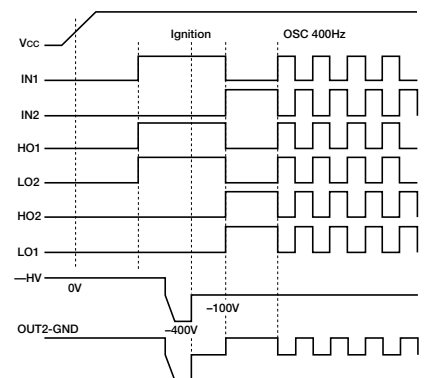
a: Part No.  
b: Lot No.

## Block Diagram



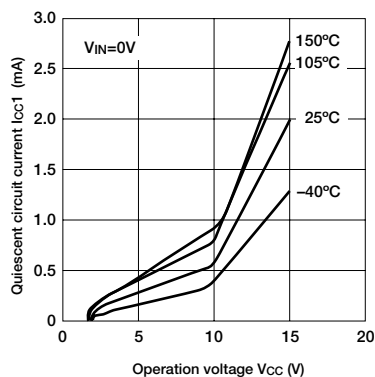
\* Dotted Line: Outside Connection

## Timing Chart

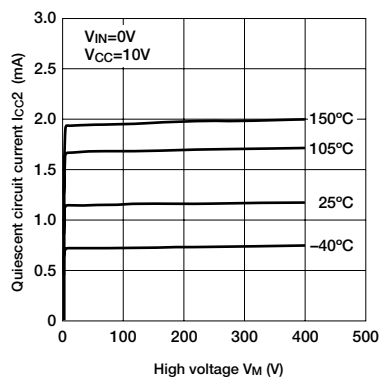


## Electrical Characteristics

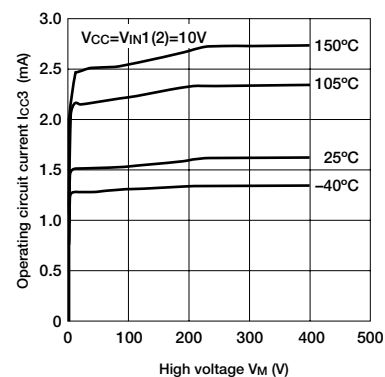
■ Quiescent circuit current



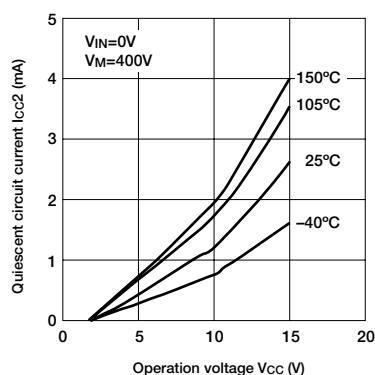
■ Quiescent circuit current supplied high voltage



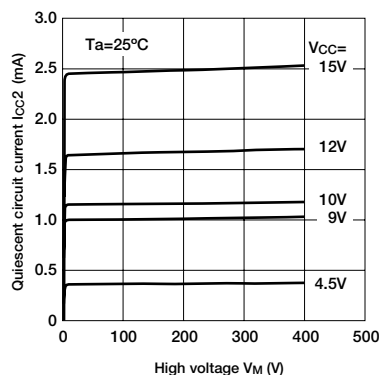
■ Operating circuit current



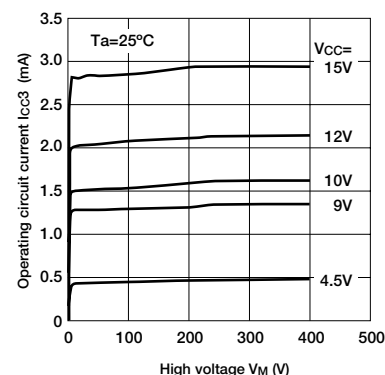
■ Quiescent circuit current supplied high voltage



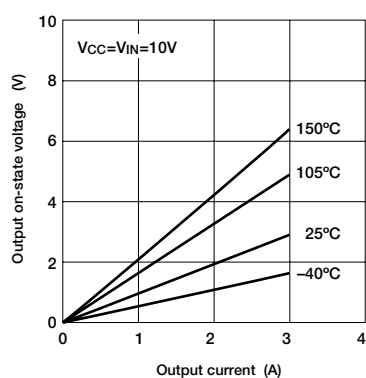
■ Quiescent circuit current



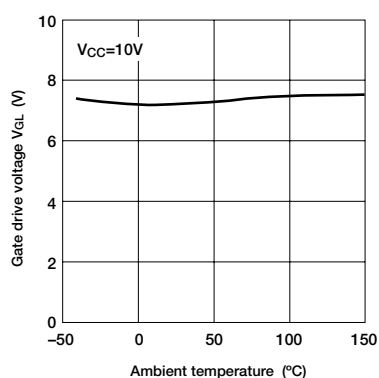
■ Operating circuit current



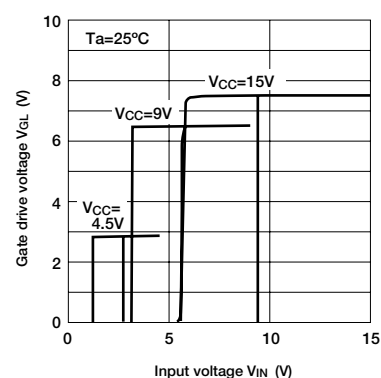
■ Output on-state voltage



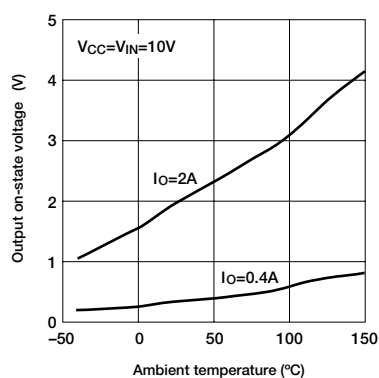
■ Gate drive voltage



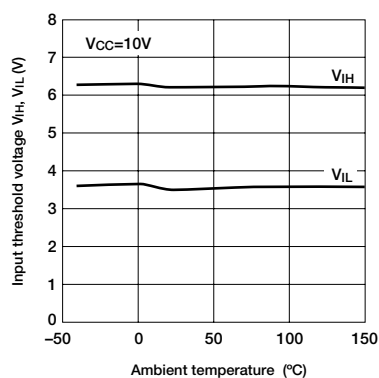
■ Gate drive voltage



■ Output on-state voltage

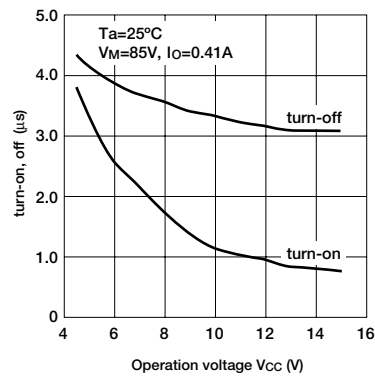


■ Input threshold voltage

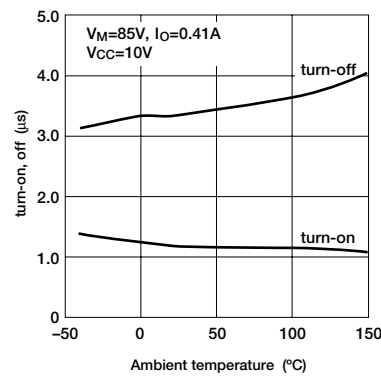


Electrical Characteristics

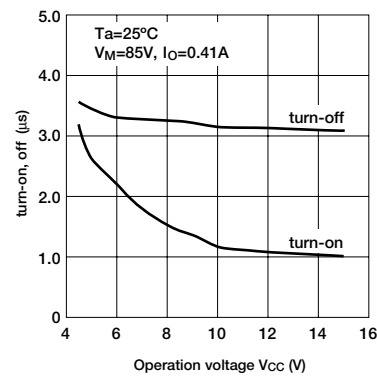
High side switch turn-on, off



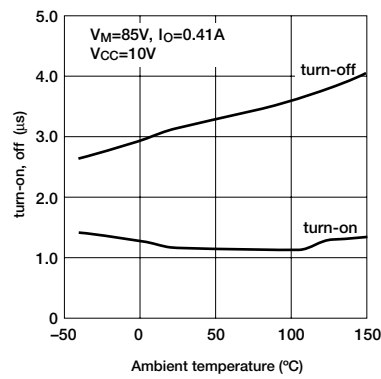
High side switch turn-on, off



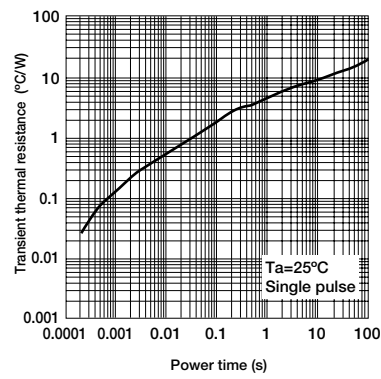
Low side switch turn-on, off



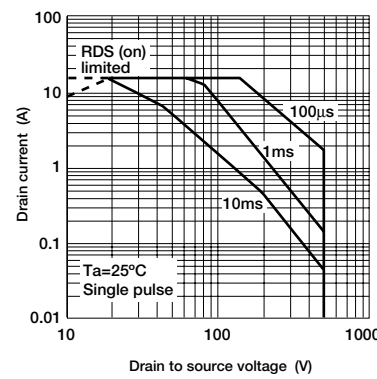
Low side switch turn-on, off



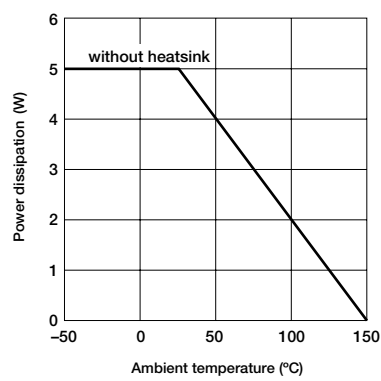
Transient thermal resistance characteristics



Safe operating area (Power MOS FET)



Power derating curve





# High Voltage Full Bridge Drive IC SLA2403M

## Features

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

## Absolute Maximum Ratings

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

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

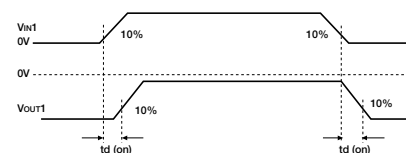
## Electrical Characteristics

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

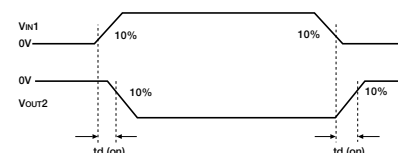
\* About delay time

Signal input waveform vs output waveform

① Highside switch turn-on, turn-off

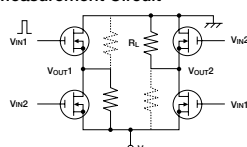


② Lowside switch turn-on, turn-off



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

Measurement Circuit



Conditions

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

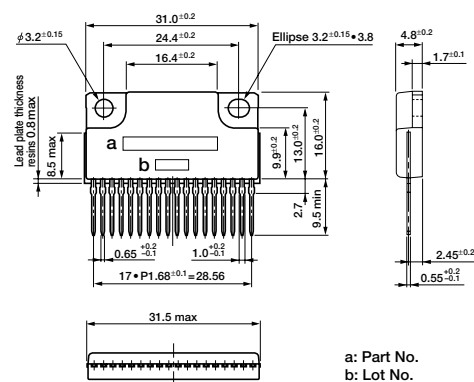
$V_M=85\text{V}$

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

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

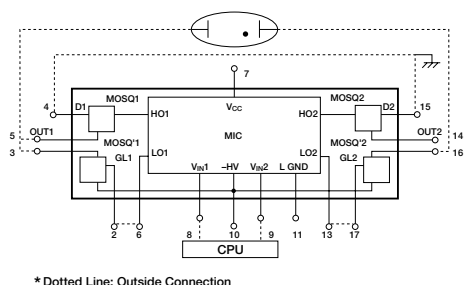
On the contrary, when pulse signal is inputted to  $V_{IN2}$ ,  $R_L$  on dotted line is ON and solid line is off.

## External Dimensions (unit: mm)



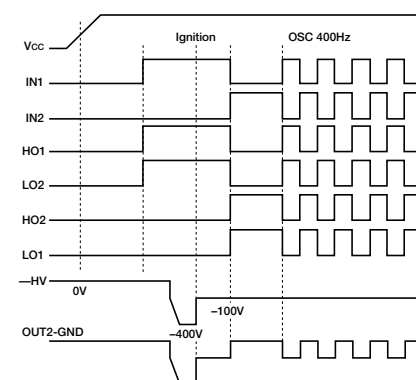
a: Part No.  
b: Lot No.

## Block Diagram



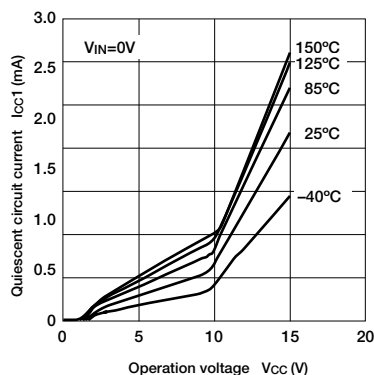
\* Dotted Line: Outside Connection

## Timing Chart

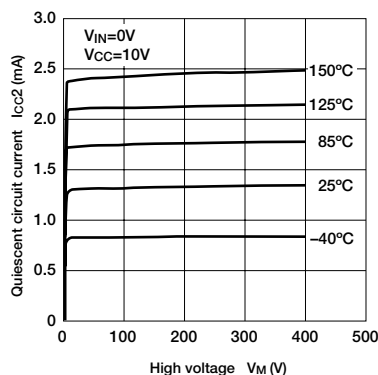


## Electrical Characteristics

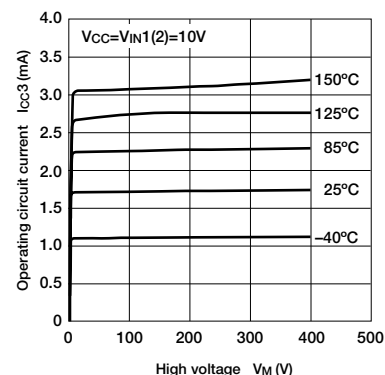
■ Quiescent circuit current



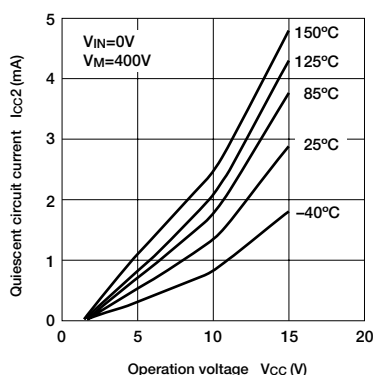
■ Quiescent circuit current supplied high voltage



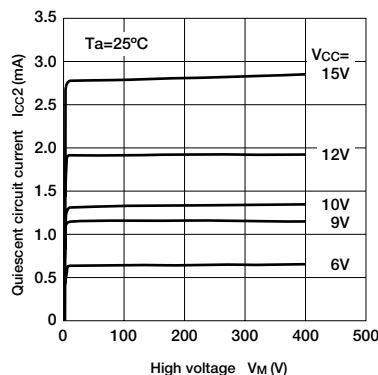
■ Operating circuit current



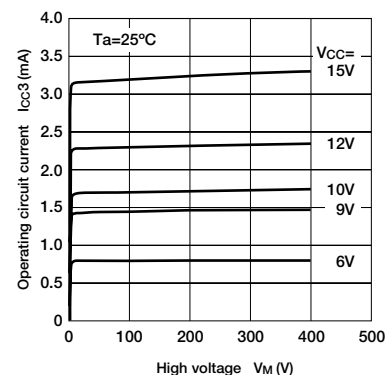
■ Quiescent circuit current supplied high voltage



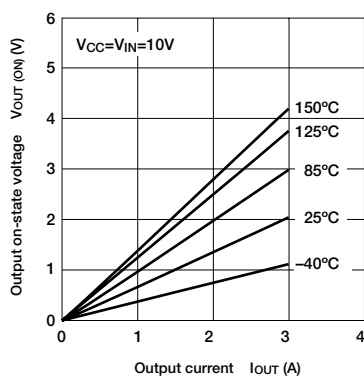
■ Quiescent circuit current supplied high voltage



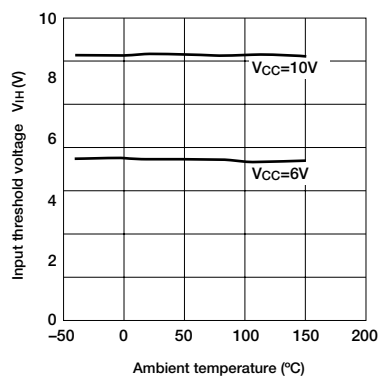
■ Operating circuit current



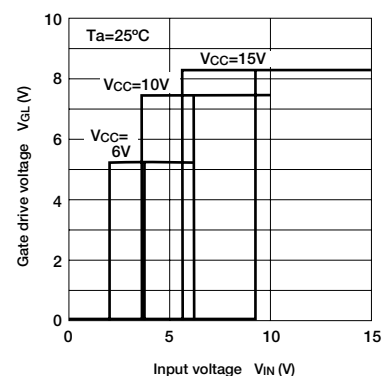
■ Output on-state voltage



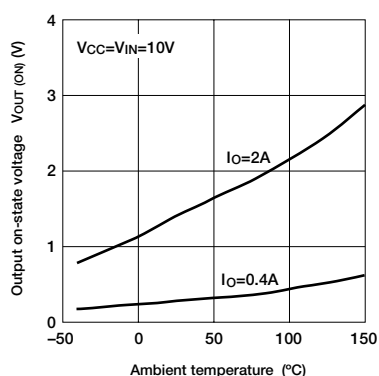
■ Input threshold voltage



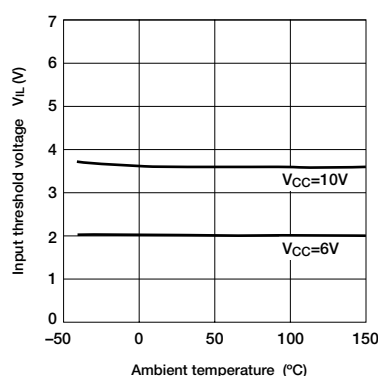
■ Gate drive voltage



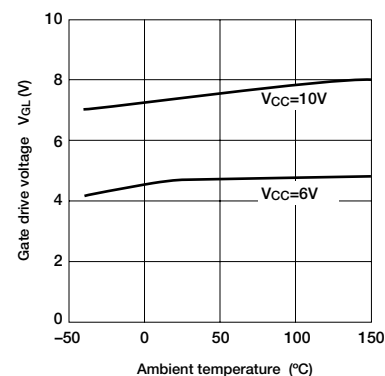
■ Output on-state voltage



■ Input threshold voltage

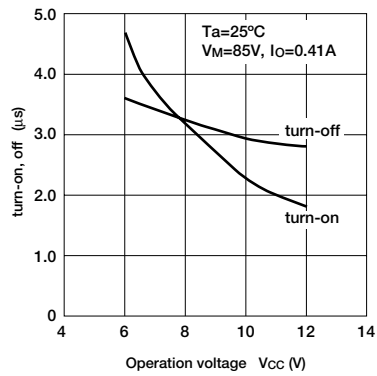


■ Gate drive voltage

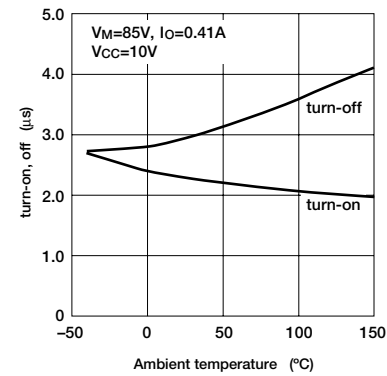


Electrical Characteristics

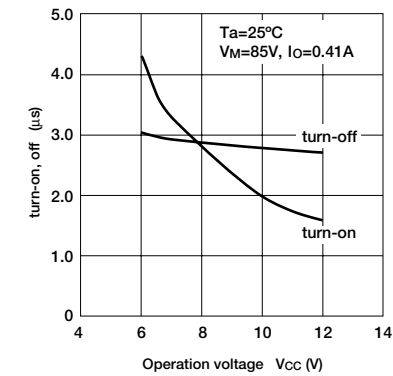
High side switch turn-on, off



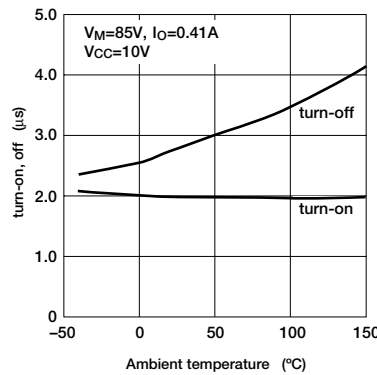
High side switch turn-on, off



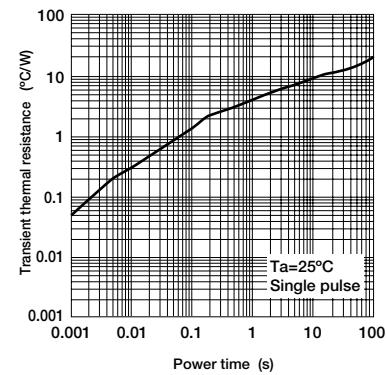
Low side switch turn-on, off



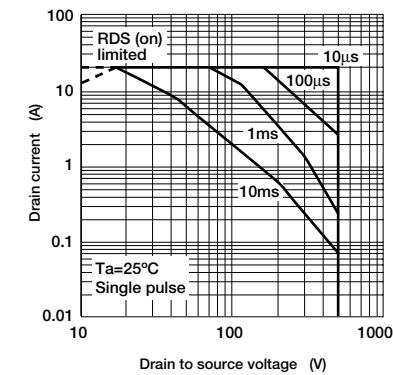
Low side switch turn-on, off



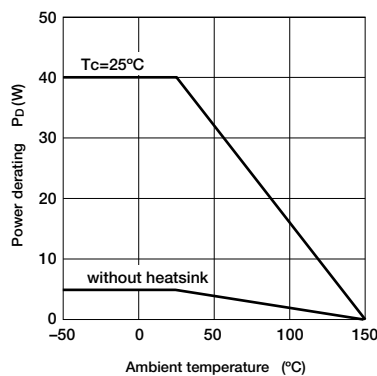
Transient thermal resistance characteristics



Safe operating area (Power MOS FET)



Power derating curve





# Hall-Effect ICs

## Unipolar Switch

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

Suffix '\*' is package option

## Bipolar Switch

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

Suffix '\*' is package option

## Bipolar Latch

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

Suffix '\*' is package option

## Gear Tooth Sensor

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

## Ratiometric, Linear Sensors

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

## Subassembly

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

# External Dimensions (unit: mm)

Figure 1 (UA)

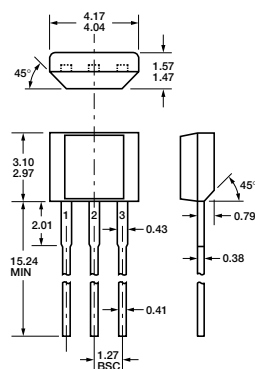


Figure 2 (LT)

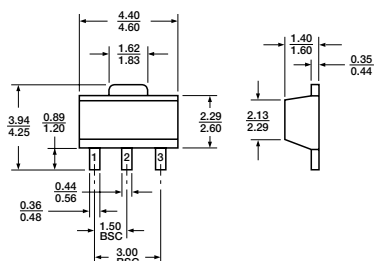


Figure 3 (LH)

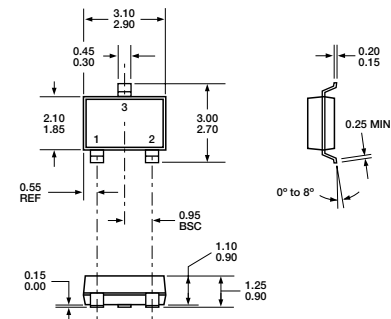


Figure 4 (KA)

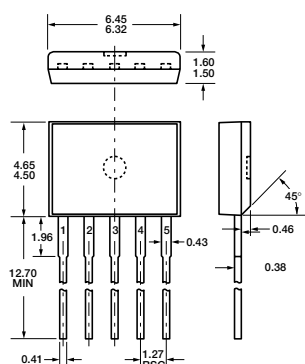


Figure 5 (SA)

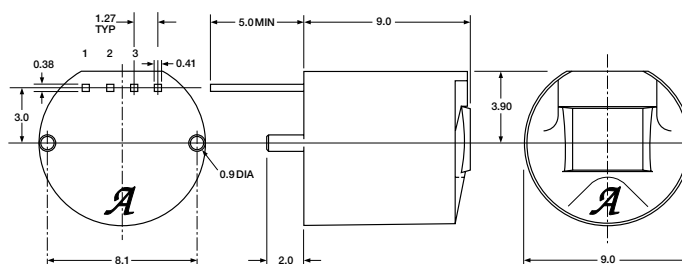
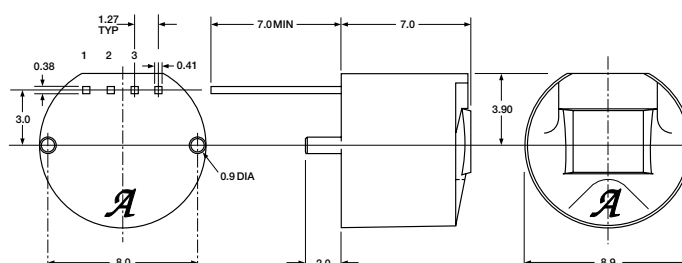


Figure 6 (SB)



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

## Features

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

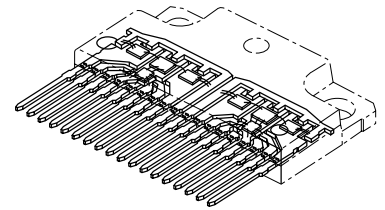
## Examples of Custom Hybrid IC Products

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

## Examples of Sanken Automotive Hybrid ICs

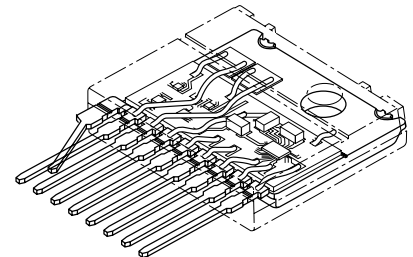
Lead frame type  
multi-chip power IC

- One-chip power IC

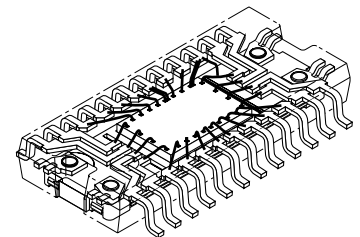


Lead frame type  
power hybrid IC with  
ceramic substrate

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

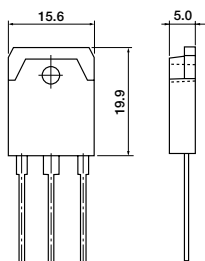


Surface-mount  
power IC

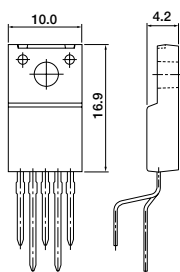


# External Dimensions (unit: mm)

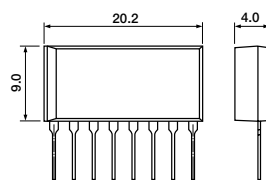
MT-100



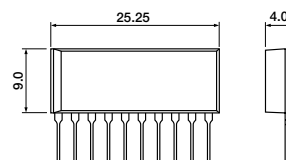
FM205



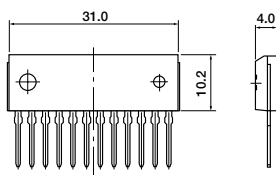
STA 8pin



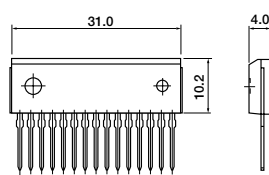
STA 10pin



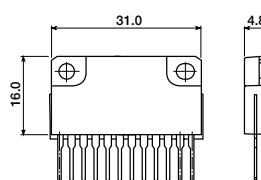
SMA12pin



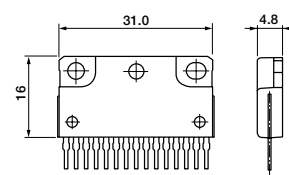
SMA15pin



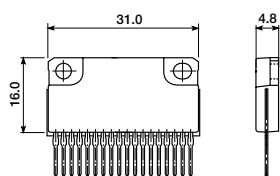
SLA12pin



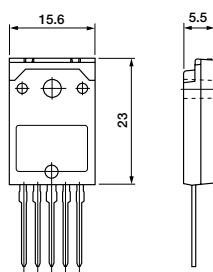
SLA15pin



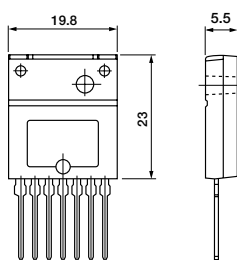
SLA18pin



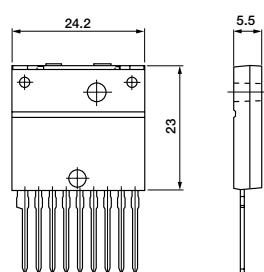
3GR-F



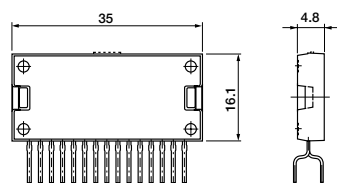
3GR-M



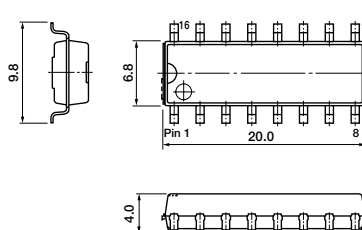
STR-S



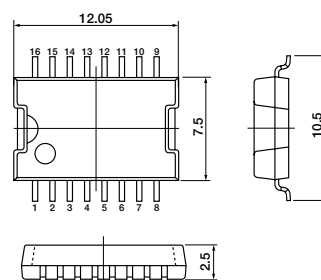
SPM



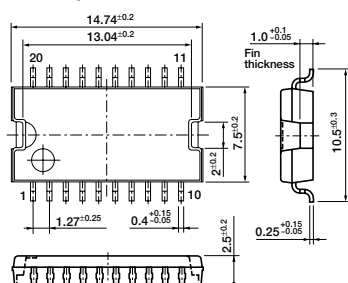
SMD16pin



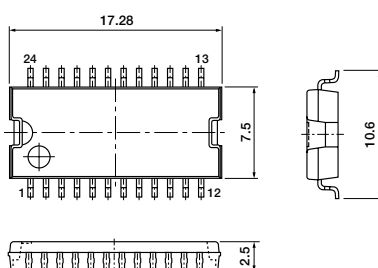
SPF16pin



SPF20pin



SPF24pin



# Transistors and MOS FETs

## Index by Application

| Application                                 | Part No. | Page |
|---------------------------------------------|----------|------|
| Igniters                                    | 2SD2141  | 74   |
|                                             | MN638S   | 80   |
| Injectors                                   | 2SC4153  | 73   |
|                                             | 2SD2382  | 75   |
|                                             | MN611S   | 79   |
|                                             | STA461C  | 84   |
|                                             | STA463C  | 85   |
|                                             | STA464C  | 86   |
|                                             | STA508A  | 99   |
|                                             | SDC09    | 90   |
|                                             | SDK09    | 105  |
|                                             | SPF0001  | 91   |
| AT (Automatic Transmissions)                | 2SA1488  | 66   |
|                                             | 2SA1488A | 66   |
| Cruise controls                             | 2SA1568  | 68   |
|                                             | 2SC4065  | 72   |
|                                             | SLA8004  | 87   |
| Airbag systems                              | 2SA1567  | 67   |
|                                             | SDA03    | 88   |
|                                             | SDA04    | 89   |
| Boosters for power supply of microcomputers | 2SA1488  | 66   |
|                                             | FP812    | 78   |
| Power steering                              | FKV460   | 93   |
|                                             | FKV460S  | 94   |
|                                             | FKV560   | 95   |
|                                             | FKV560S  | 96   |
|                                             | FKV660   | 97   |
|                                             | FKV660S  | 98   |
| ABS                                         | SLA5027  | 102  |
|                                             | SDK08    | 104  |
| Electronic meters                           | 2SC3852  | 70   |
| Solenoid drivers                            | STA315A  | 81   |
|                                             | STA335A  | 82   |
|                                             | STA415A  | 83   |
|                                             | STA509A  | 100  |
|                                             | SDK06    | 103  |
|                                             | SDK08    | 104  |
| Clutch controls                             | 2SC4024  | 71   |
| Lamp controls                               | 2SK2701  | 92   |
|                                             | SMA5113  | 101  |
| Others                                      | 2SC3851  | 69   |
|                                             | FN812    | 77   |
|                                             | 2SD2633  | 76   |

## Index by Load

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

# Power Transistor 2SA1488/1488A

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                    |          | Unit |
|------------------|----------------------------|----------|------|
|                  | 2SA1488                    | 2SA1488A |      |
| V <sub>CB0</sub> | -60                        | -80      | V    |
| V <sub>CE0</sub> | -60                        | -80      | V    |
| V <sub>EB0</sub> | -6                         |          | V    |
| I <sub>C</sub>   | -4                         |          | A    |
| I <sub>B</sub>   | -1                         |          | A    |
| P <sub>C</sub>   | 25 (T <sub>C</sub> = 25°C) |          | W    |
| T <sub>J</sub>   | 150                        |          | °C   |
| T <sub>stg</sub> | -55 to +150                |          | °C   |

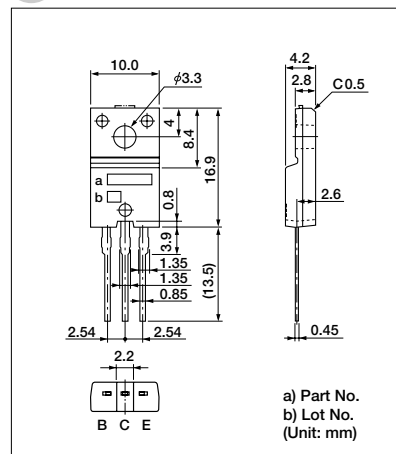
## Electrical Characteristics (Ta = 25°C)

| Symbol                | Test Conditions                                | Ratings |          | Unit |
|-----------------------|------------------------------------------------|---------|----------|------|
|                       |                                                | 2SA1488 | 2SA1488A |      |
| I <sub>CB0</sub>      | V <sub>CB</sub> =                              | -100max | -100max  | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> = -6V                          | -100max | -80      | μA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> = -25mA                         | -60min  | -80min   | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> = -4V, I <sub>C</sub> = -1A    | 40min   |          |      |
| V <sub>CE</sub> (sat) | I <sub>C</sub> = -2A, I <sub>B</sub> = -0.2A   | -0.5max |          | V    |
| f <sub>T</sub>        | V <sub>CE</sub> = -12V, I <sub>E</sub> = -0.2A | 15typ   |          | MHz  |
| C <sub>OB</sub>       | V <sub>CB</sub> = -10V, f = 1MHz               | 90typ   |          | pF   |

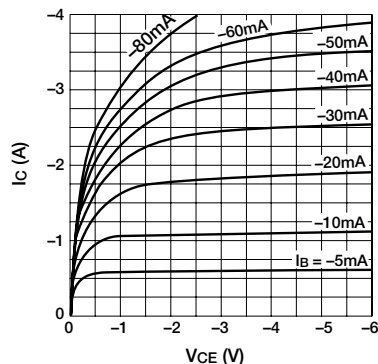
## Typical Switching Characteristics (common emitter)

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| -12                 | 6                  | -2                 | -10                  | 5                    | -200                 | 200                  | 0.25typ              | 0.75typ               | 0.25typ             |

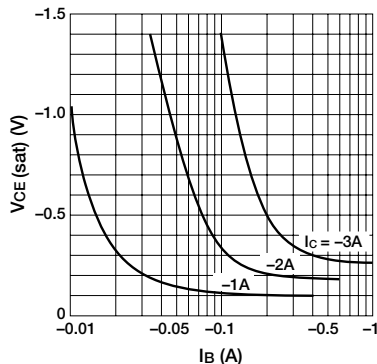
## External Dimensions TO220F (full-mold)



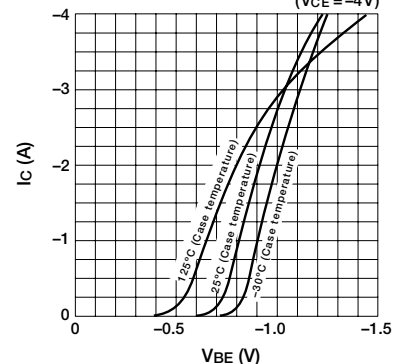
■ I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



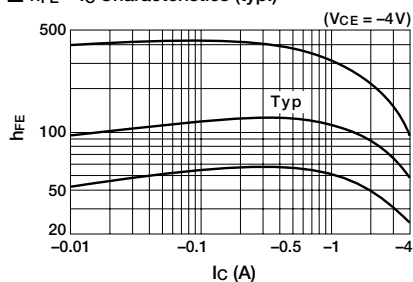
■ V<sub>CE</sub> (sat)—I<sub>B</sub> Characteristics (typ.)



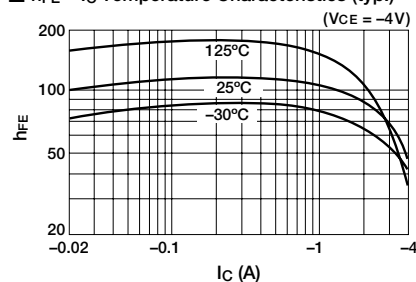
■ I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



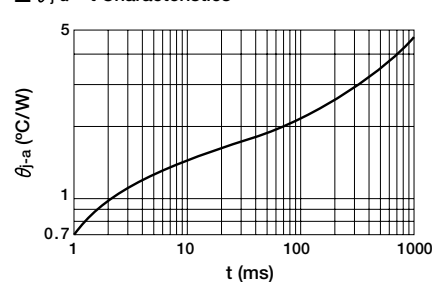
■ h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



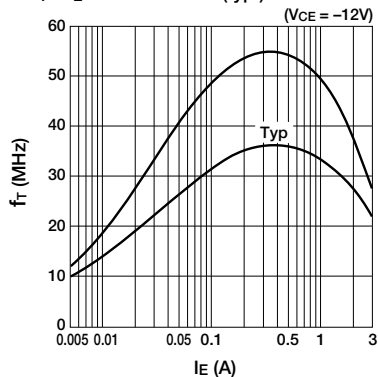
■ h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



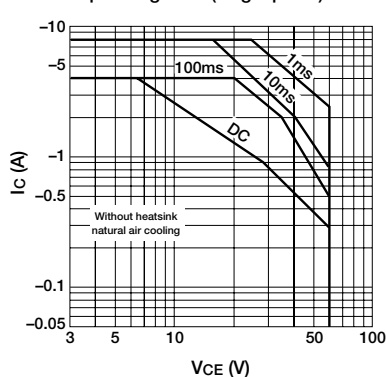
■ θ<sub>JA</sub>—t Characteristics



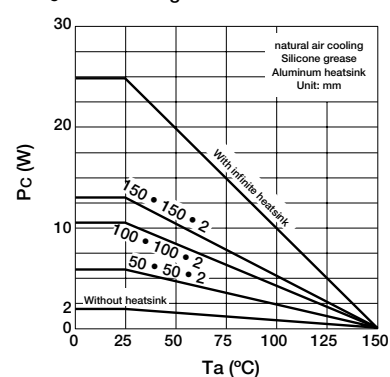
■ f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P<sub>C</sub>—T<sub>a</sub> Derating



# Power Transistor 2SA1567

## Absolute Maximum Ratings (Ta = 25°C)

| Symbol           | Ratings                    | Unit |
|------------------|----------------------------|------|
| V <sub>CB0</sub> | -50                        | V    |
| V <sub>CE0</sub> | -50                        | V    |
| V <sub>EB0</sub> | -6                         | V    |
| I <sub>C</sub>   | -12                        | A    |
| I <sub>B</sub>   | -3                         | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> = 25°C) | W    |
| T <sub>J</sub>   | 150                        | °C   |
| Tstg             | -55 to +150                | °C   |

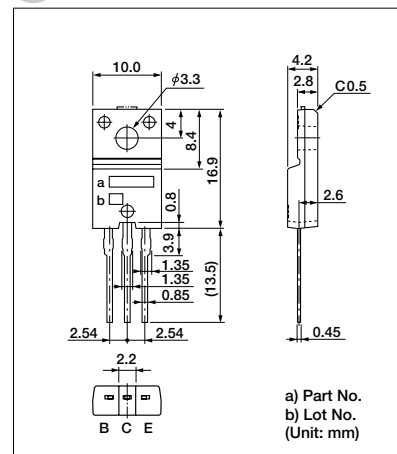
## Electrical Characteristics (Ta = 25°C)

| Symbol                | Test Conditions                                | Ratings  | Unit |
|-----------------------|------------------------------------------------|----------|------|
| I <sub>CB0</sub>      | V <sub>CB</sub> = -50V                         | -100max  | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> = -6V                          | -100max  | μA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> = -25 mA                        | -50min   | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> = -1V, I <sub>C</sub> = -6A    | 50min    |      |
| V <sub>CE(sat)</sub>  | I <sub>C</sub> = -6A, I <sub>B</sub> = -0.3A   | -0.35max | V    |
| f <sub>T</sub>        | V <sub>CE</sub> = -12V, I <sub>E</sub> = -0.5A | 40typ    | MHz  |
| C <sub>OB</sub>       | V <sub>CB</sub> = -10V, f = 1MHz               | 330typ   | pF   |

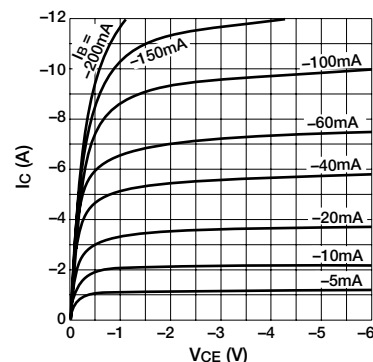
## Typical Switching Characteristics (common emitter)

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| -24                 | 4                  | -6                 | -10                  | 5                    | -120                 | 120                  | 0.4typ               | 0.4typ                | 0.2typ              |

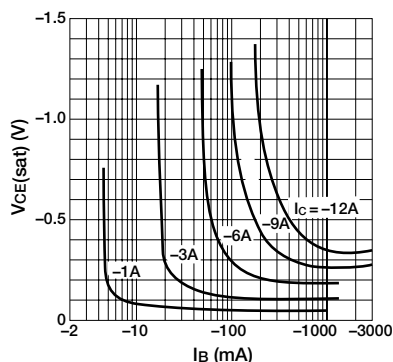
## External Dimensions TO220F (full-mold)



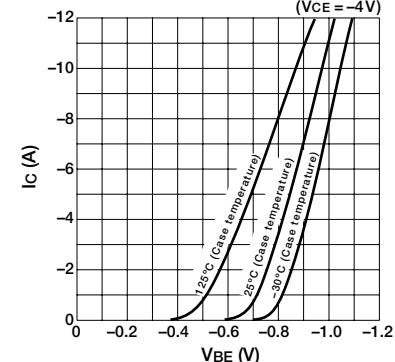
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



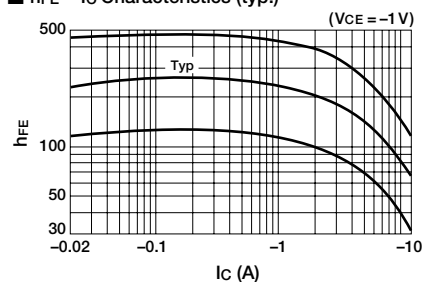
### V<sub>CE(sat)</sub>—I<sub>B</sub> Characteristics (typ.)



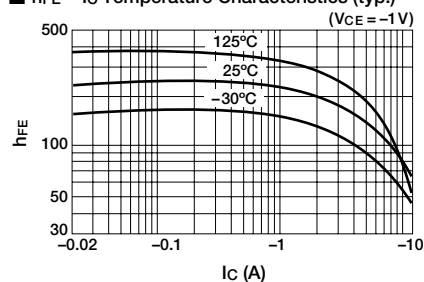
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



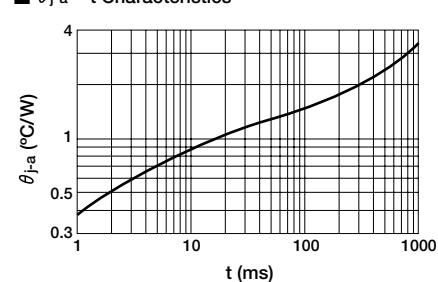
### h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



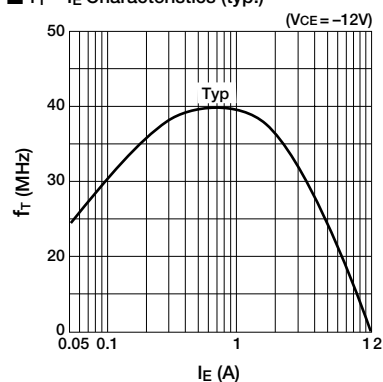
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



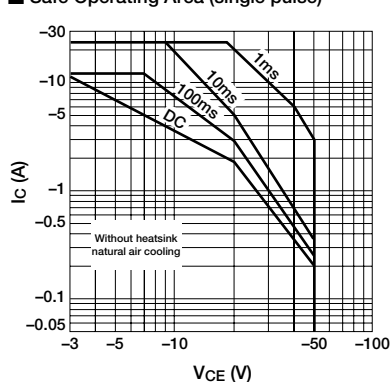
### θ<sub>JA</sub>—t Characteristics



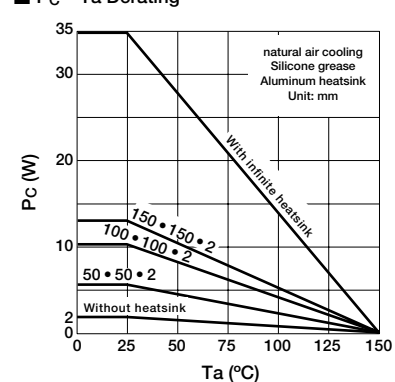
### f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



### Safe Operating Area (single pulse)



### P<sub>C</sub>—Ta Derating



# Power Transistor 2SA1568

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | -60                       | V    |
| V <sub>CE0</sub> | -60                       | V    |
| V <sub>EB0</sub> | -6                        | V    |
| I <sub>C</sub>   | ±12                       | A    |
| I <sub>B</sub>   | -3                        | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

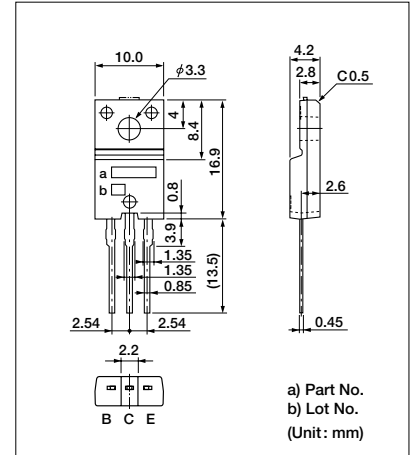
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings  | Unit |
|-----------------------|-----------------------------------------------|----------|------|
| I <sub>CB0</sub>      | V <sub>CB</sub> = -60V                        | -100max  | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> = -6V                         | -60max   | mA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> = -25mA                        | -60min   | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> = -1V, I <sub>C</sub> = -6A   | 50min    |      |
| V <sub>CE (sat)</sub> | I <sub>C</sub> = -6A, I <sub>B</sub> = -0.3A  | -0.35max | V    |
| V <sub>FEC</sub>      | I <sub>ECO</sub> = -10A                       | -2.5max  | V    |
| f <sub>T</sub>        | V <sub>CE</sub> = -12V, I <sub>E</sub> = 0.5A | 40typ    | MHz  |
| C <sub>OB</sub>       | V <sub>CB</sub> = -10V, f = 1MHz              | 330typ   | pF   |

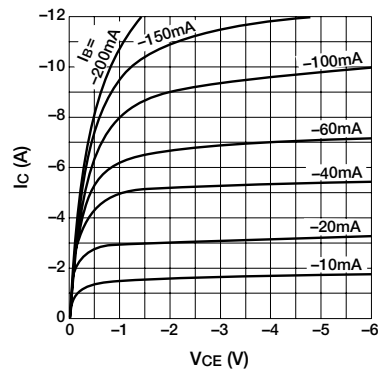
## Typical Switching Characteristics (common emitter)

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| -24                 | 4                  | -6                 | -10                  | 5                    | -120                 | 120                  | 0.4typ               | 0.4typ                | 0.2typ              |

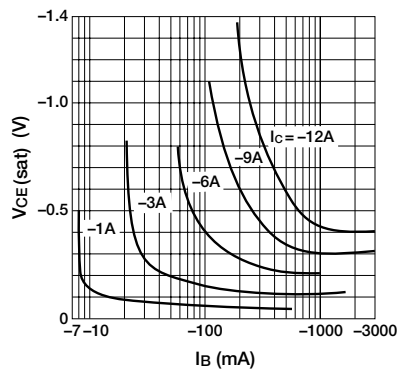
## External Dimensions TO220F (full-mold)



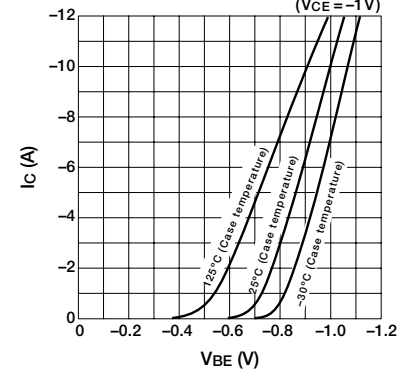
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



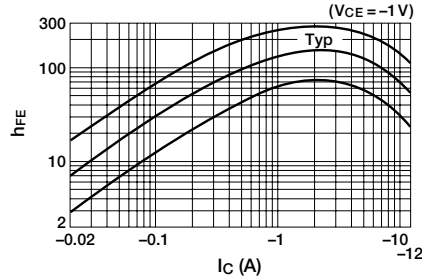
### V<sub>CE (sat)</sub>—I<sub>B</sub> Characteristics (typ.)



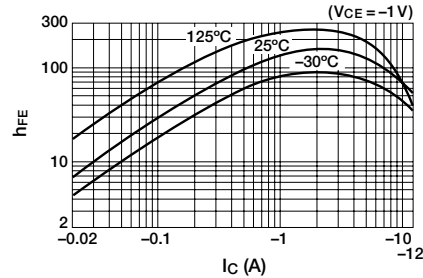
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



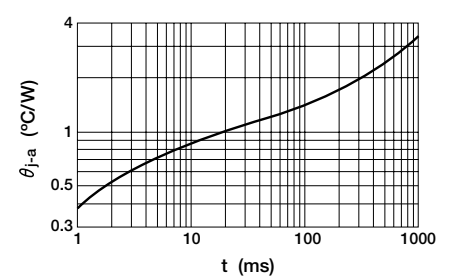
### h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



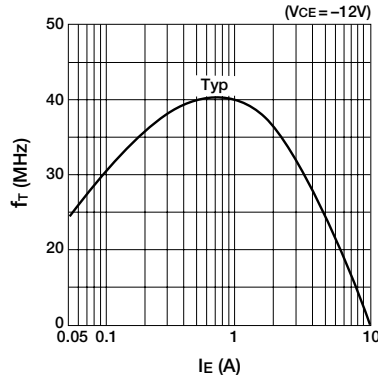
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



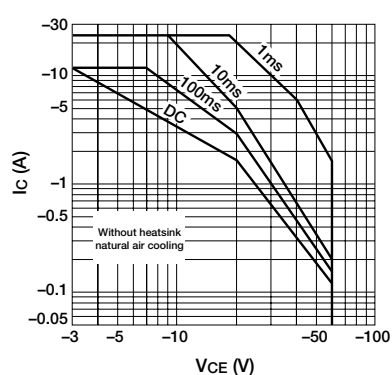
### θ<sub>J-A</sub>—t Characteristics



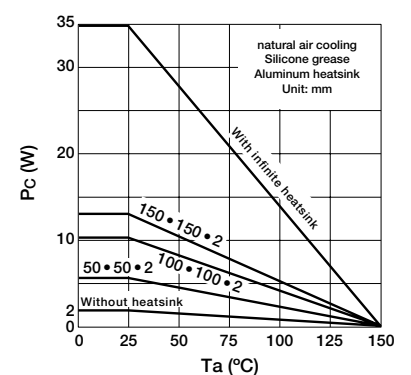
### f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



### Safe Operating Area (single pulse)



### P<sub>C</sub>—T<sub>a</sub> Derating



# Power Transistor 2SC3851

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | 80                        | V    |
| V <sub>CE0</sub> | 60                        | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | 4                         | A    |
| I <sub>B</sub>   | 1                         | A    |
| P <sub>C</sub>   | 25 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

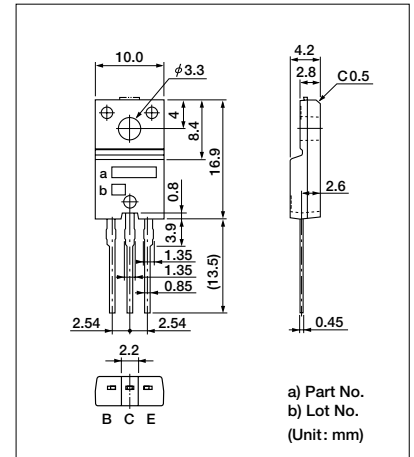
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings   | Unit |
|-----------------------|-----------------------------------------------|-----------|------|
| I <sub>CB0</sub>      | V <sub>CB</sub> = 80V                         | 100max    | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> = 6V                          | 100max    | μA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> = 25mA                         | 60min     | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> = 4V, I <sub>C</sub> = 1A     | 40 to 320 |      |
| V <sub>CE(sat)</sub>  | I <sub>C</sub> = 2A, I <sub>B</sub> = 0.2A    | 0.5max    | V    |
| f <sub>T</sub>        | V <sub>CE</sub> = 12V, I <sub>E</sub> = -0.2A | 15typ     | MHz  |
| C <sub>OB</sub>       | V <sub>CB</sub> = 10V, f = 1MHz               | 60typ     | pF   |

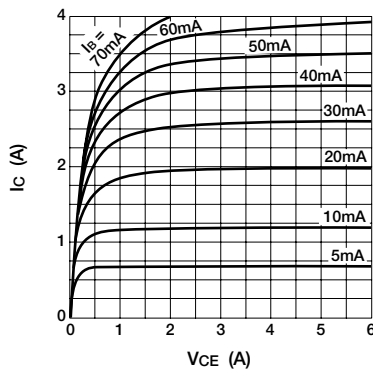
## Typical Switching Characteristics (common emitter)

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 6                  | 2                  | 10                   | -5                   | 200                  | -200                 | 0.2typ               | 1typ                  | 0.3typ              |

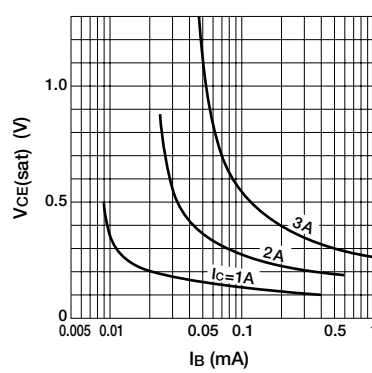
## External Dimensions TO220F (full-mold)



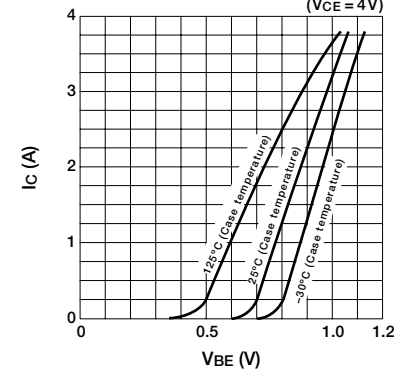
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



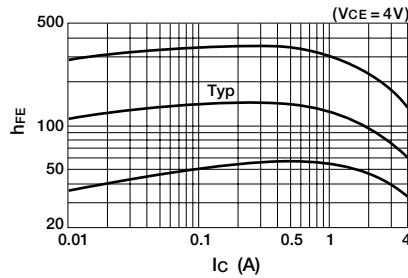
### V<sub>CE(sat)</sub>—I<sub>B</sub> Characteristics (typ.)



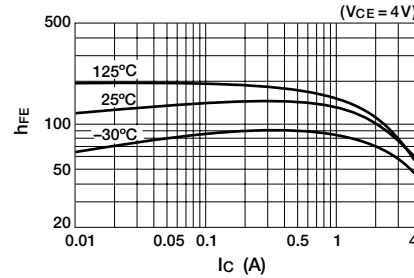
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



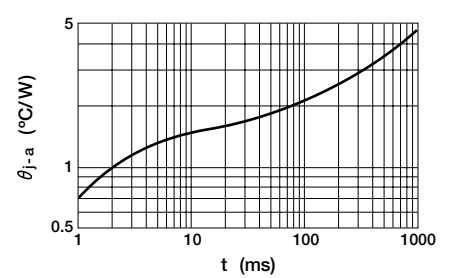
### h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



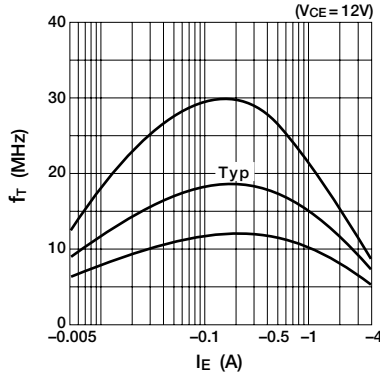
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



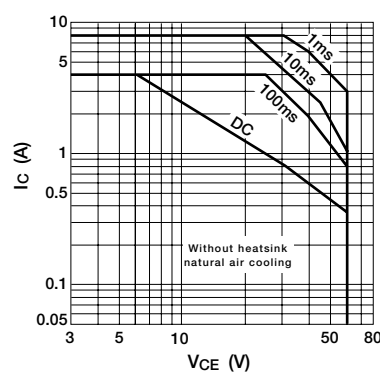
### θ<sub>J-a</sub>—t Characteristics



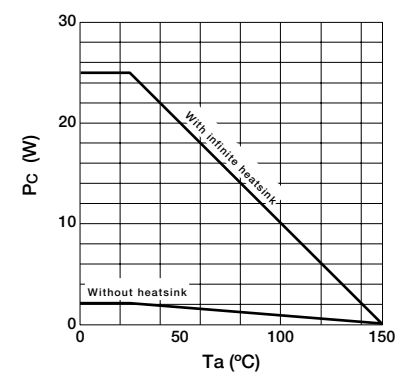
### f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



### Safe Operating Area (single pulse)



### P<sub>C</sub>—T<sub>a</sub> Derating



# Power Transistor 2SC3852

## Absolute Maximum Ratings (Ta=25°C)

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

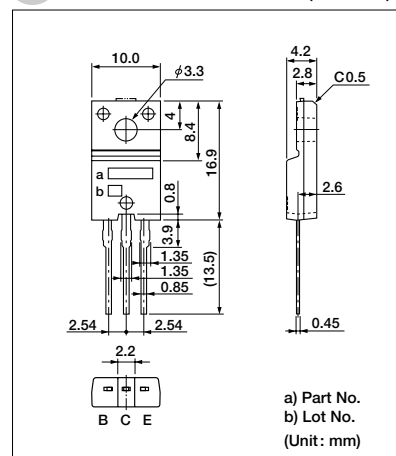
## Electrical Characteristics (Ta=25°C)

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

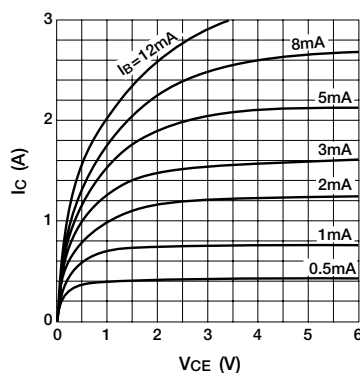
## Typical Switching Characteristics (common emitter)

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

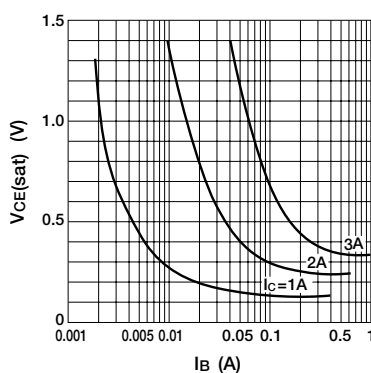
## External Dimensions TO220F (full-mold)



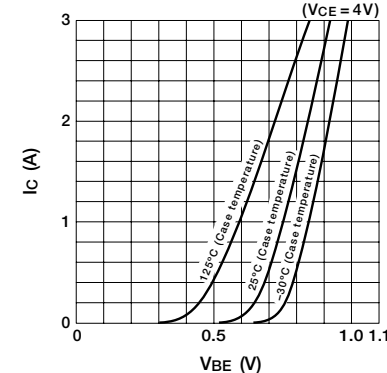
■ IC—VCE Characteristics (typ.)



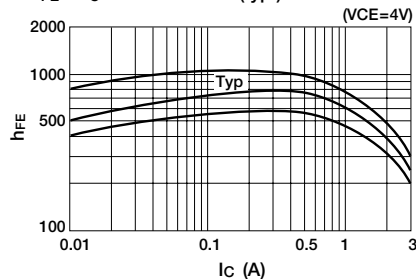
■ VCE(sat)—IB Characteristics (typ.)



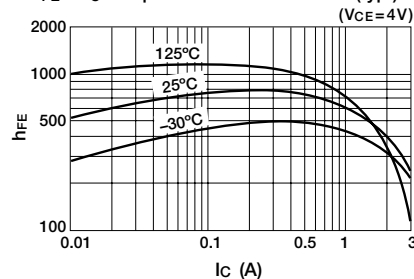
■ IC—VBE Temperature Characteristics (typ.)



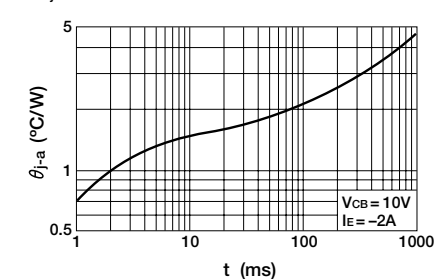
■ hFE—IC Characteristics (typ.)



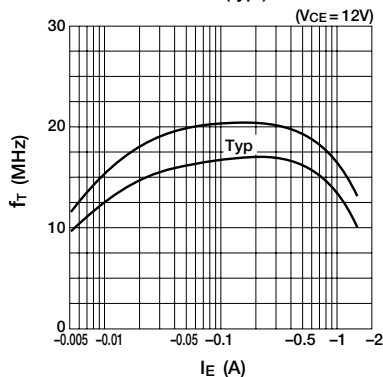
■ hFE—IC Temperature Characteristics (typ.)



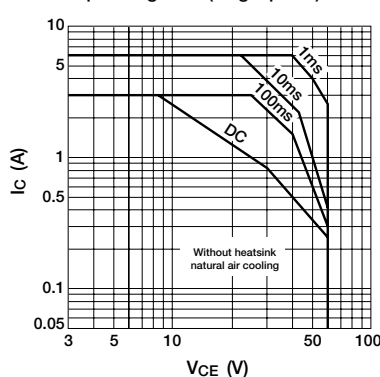
■ θJA—t Characteristics



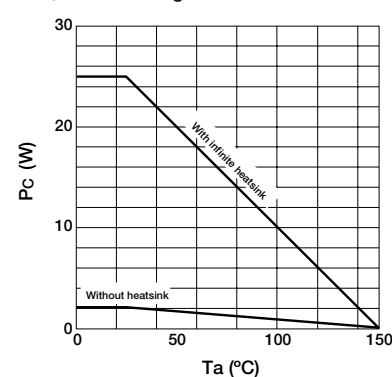
■ fT—IE Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ PC—Ta Derating



# Power Transistor 2SC4024

## Absolute Maximum Ratings (Ta=25°C)

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

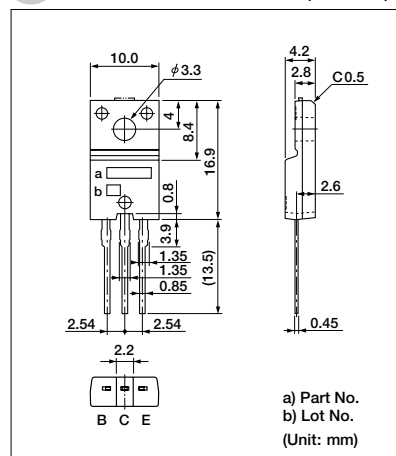
## Electrical Characteristics (Ta=25°C)

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

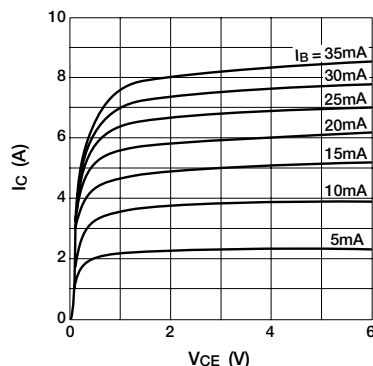
## Typical Switching Characteristics (common emitter)

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

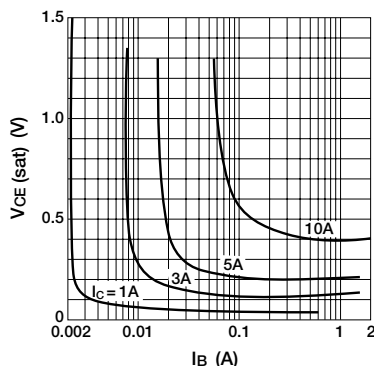
## External Dimensions TO220F (full-mold)



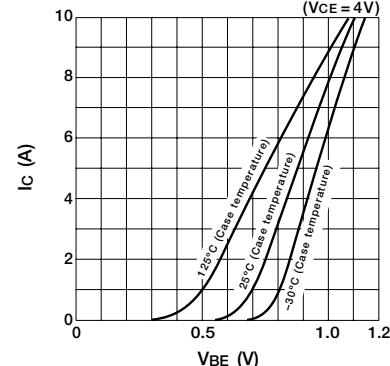
■ IC—VCE Characteristics (typ.)



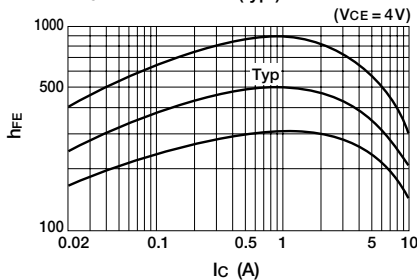
■ VCE (sat)—IB Characteristics (typ.)



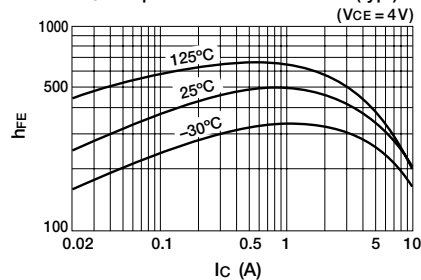
■ IC—VBE Temperature Characteristics (typ.)



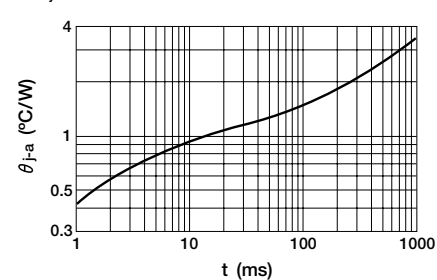
■ hFE—IC Characteristics (typ.)



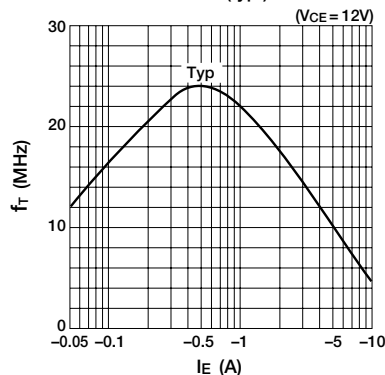
■ hFE—IC Temperature Characteristics (typ.)



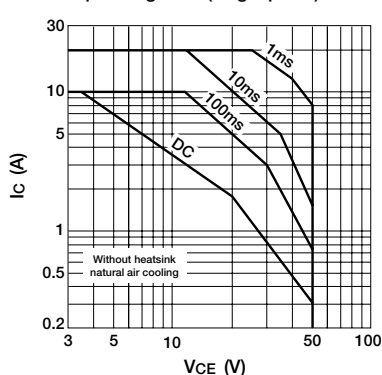
■ θJA—t Characteristics



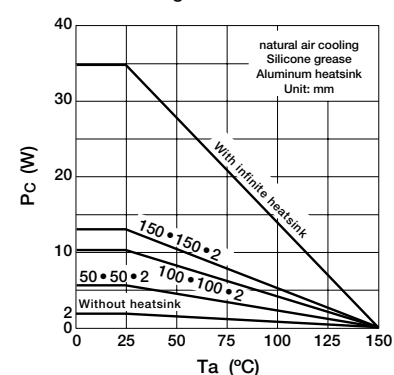
■ fT—IE Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ PC—Ta Derating



# Power Transistor 2SC4065

### Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CBO</sub> | 60                        | V    |
| V <sub>CEO</sub> | 60                        | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | ±12                       | A    |
| I <sub>B</sub>   | 3                         | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

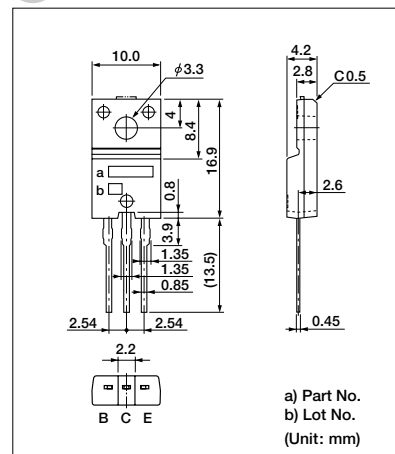
## Electrical Characteristics

| Symbol         | Test Conditions             | Ratings | Unit    |
|----------------|-----------------------------|---------|---------|
| $I_{CBO}$      | $V_{CB} = 60V$              | 100max  | $\mu A$ |
| $I_{EBO}$      | $V_{EB} = 6V$               | 60max   | mA      |
| $V_{(BR) CEO}$ | $I_C = 25mA$                | 60min   | V       |
| hFE            | $V_{CE} = 1V, I_C = 6A$     | 50min   |         |
| $V_{CE(sat)}$  | $I_C = 6A, I_B = 1.3A$      | 0.35max | V       |
| $V_{FEC}$      | $V_{ECO} = 10A$             | 2.5max  | V       |
| fT             | $V_{CE} = 12V, I_E = -0.5A$ | 24typ   | MHz     |
| COB            | $V_{CB} = 10V, f = 1MHz$    | 180typ  | pF      |

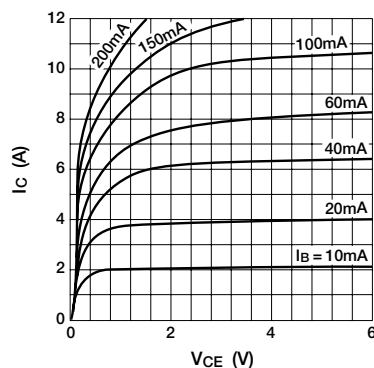
### Typical Switching Characteristics (common emitter)

| V <sub>CC</sub><br>(V) | R <sub>L</sub><br>(Ω) | I <sub>C</sub><br>(A) | V <sub>BB1</sub><br>(V) | V <sub>BB2</sub><br>(V) | I <sub>B1</sub><br>(A) | I <sub>B2</sub><br>(A) | t <sub>on</sub><br>(μs) | t <sub>stg</sub><br>(μs) | t <sub>f</sub><br>(μs) |
|------------------------|-----------------------|-----------------------|-------------------------|-------------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|
| 24                     | 4                     | 6                     | 10                      | -5                      | 0.12                   | -0.12                  | 0.6typ                  | 1.4typ                   | 0.4typ                 |

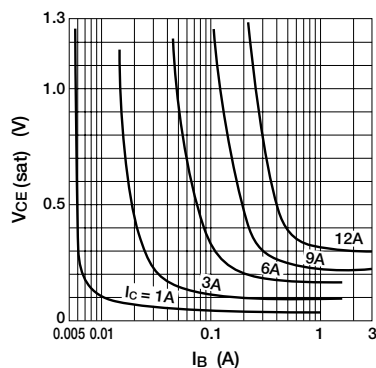
### External Dimensions TO220F (full-mold)



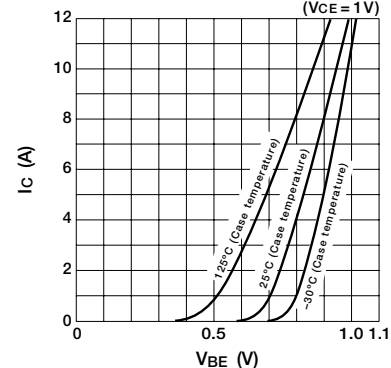
■  $I_C$ — $V_{CE}$  Characteristics (typ.)



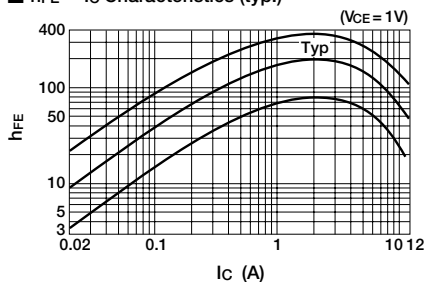
■  $V_{CE}(\text{sat}) - I_B$  Characteristics (typ.)



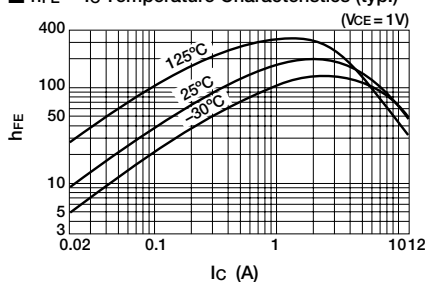
■  $I_C$ — $V_{BE}$  Temperature Characteristics (typ.)



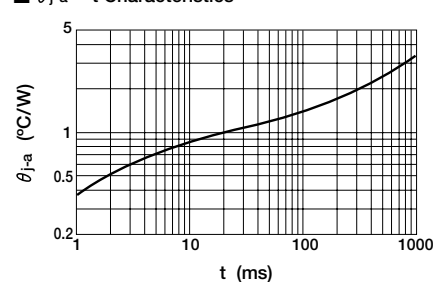
### ■ $h_{FE}$ — $I_C$ Characteristics (typ.)



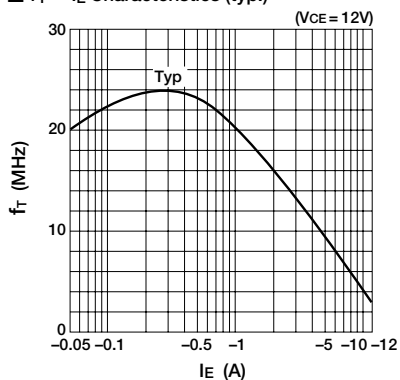
### ■ $h_{FE}$ — $I_C$ Temperature Characteristics (typ.)



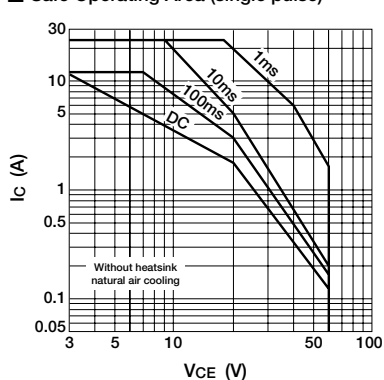
### ■ $\theta_{j-a-t}$ Characteristics



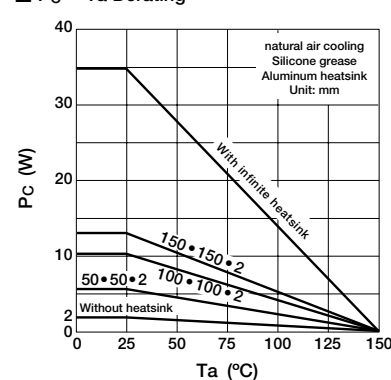
■  $f_T$ — $I_E$  Characteristics (typ.)



■ Safe Operating Area (single pulse)



### ■ P<sub>C</sub>—Ta Derating



# Power Transistor 2SC4153

## Absolute Maximum Ratings (Ta=25°C)

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

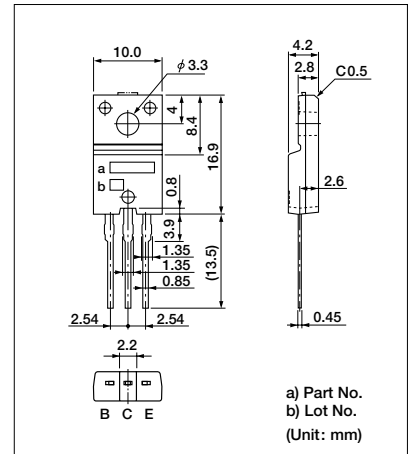
## Electrical Characteristics (Ta=25°C)

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

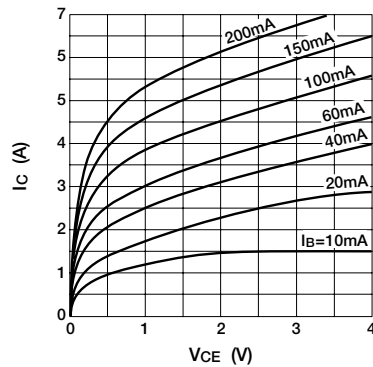
## Typical Switching Characteristics (common emitter)

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

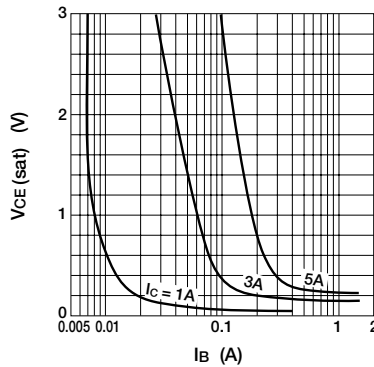
## External Dimensions TO220F (full-mold)



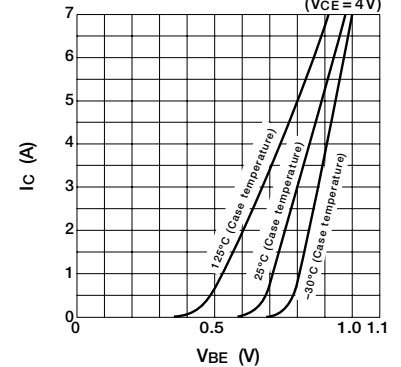
### IC—VCE Characteristics (typ.)



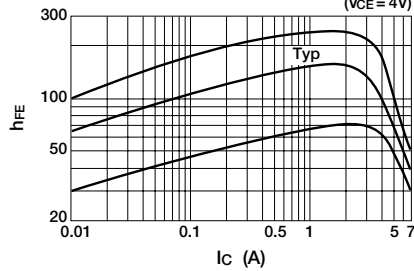
### VCE (sat)—IB Characteristics (typ.)



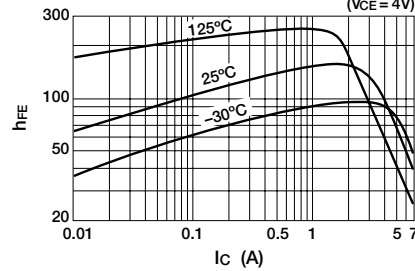
### IC—VBE Temperature Characteristics (typ.)



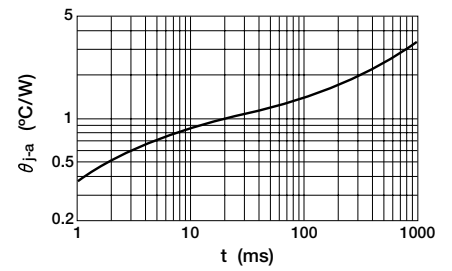
### hFE—IC Characteristics (typ.)



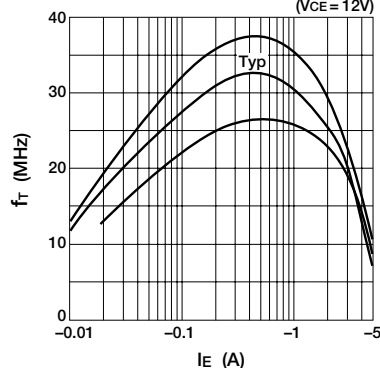
### hFE—IC Temperature Characteristics (typ.)



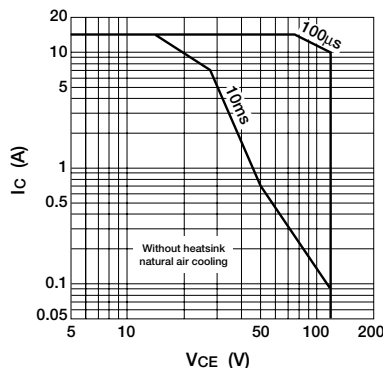
### θJA—t Characteristics



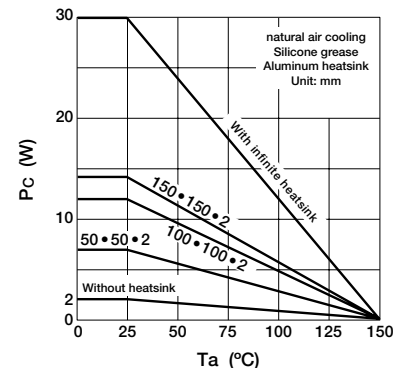
### fT—IE Characteristics (typ.)



### Safe Operating Area (single pulse)



### PC—Ta Derating



# Power Transistor 2SD2141

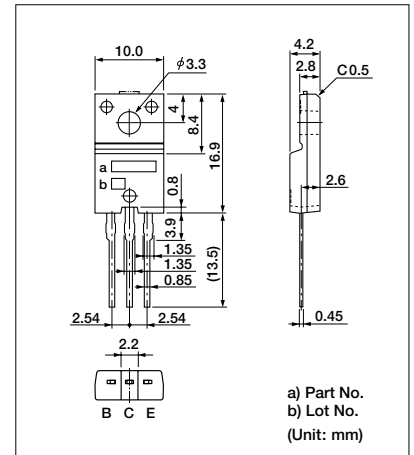
## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | 380±50                    | V    |
| V <sub>CE0</sub> | 380±50                    | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | 6 (pulse 10)              | A    |
| I <sub>B</sub>   | 1                         | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

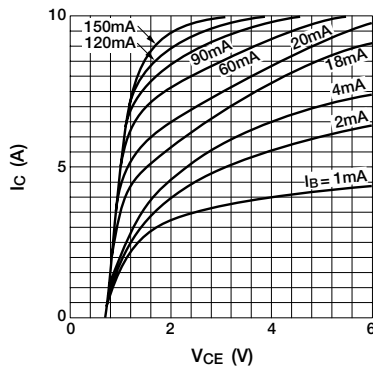
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                            | Ratings    | Unit |
|-----------------------|--------------------------------------------|------------|------|
| I <sub>CB0</sub>      | V <sub>CB</sub> = 330V                     | 10max      | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> = 6V                       | 20max      | μA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> = 25mA                      | 330 to 430 | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> = 2V, I <sub>C</sub> = 3A  | 1500min    |      |
| V <sub>CE(sat)</sub>  | I <sub>C</sub> = 4A, I <sub>B</sub> = 20mA | 1.5max     | V    |

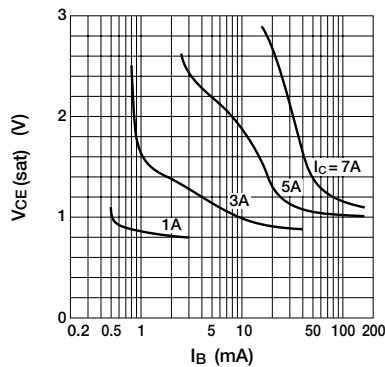
## External Dimensions TO220F (full-mold)



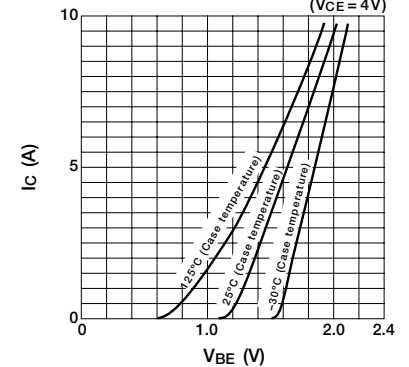
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



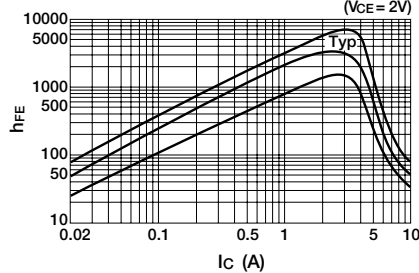
### V<sub>CE(sat)</sub>—I<sub>B</sub> Characteristics (typ.)



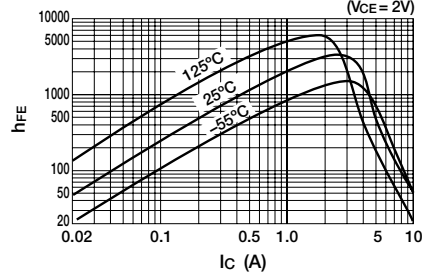
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



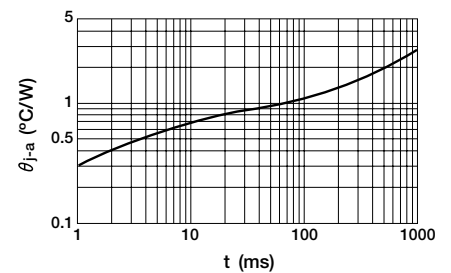
### h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



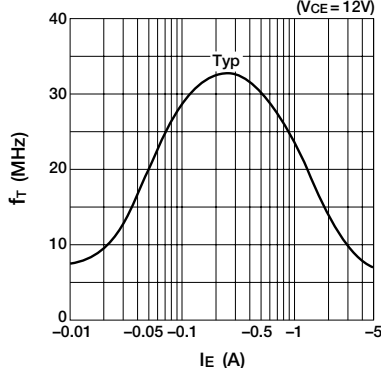
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



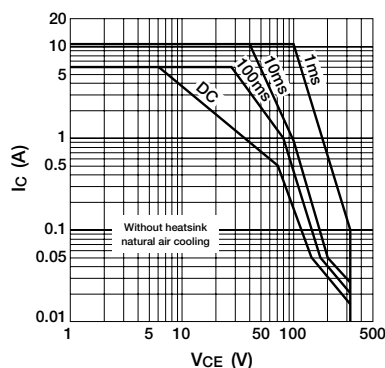
### θ<sub>J-a</sub>—t Characteristics



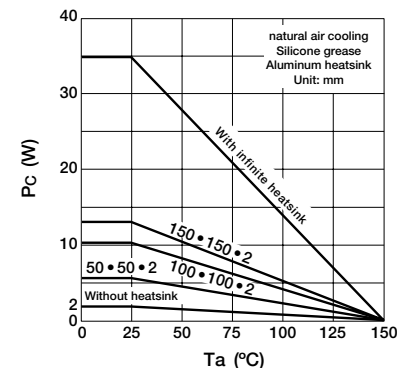
### f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



### Safe Operating Area (single pulse)



### P<sub>C</sub>—T<sub>a</sub> Derating



# Power Transistor 2SD2382

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | 65±5                      | V    |
| V <sub>CE0</sub> | 65±5                      | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | ±6 (pulse ±10)            | A    |
| I <sub>B</sub>   | 1                         | A    |
| P <sub>C</sub>   | 30 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

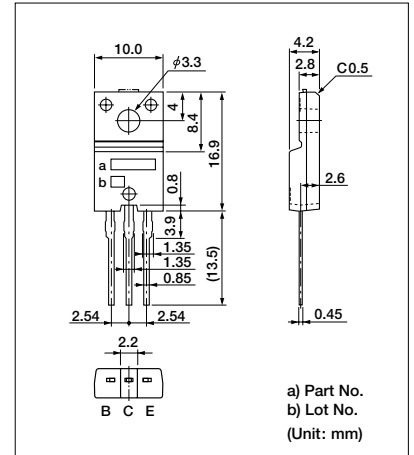
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings     | Unit |
|----------------------|----------------------------------------------|-------------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 60V                        | 10max       | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                         | 10max       | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = 50mA                        | 60 to 70    | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 1V, I <sub>C</sub> = 1A    | 700 to 3000 |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 1.5A, I <sub>B</sub> = 15mA | 0.15max     | V    |
| V <sub>FEC</sub>     | I <sub>FEC</sub> = 6A                        | 1.5max      | V    |
| Es/b                 | L = 10mH, single pulse                       | 200min      | mJ   |

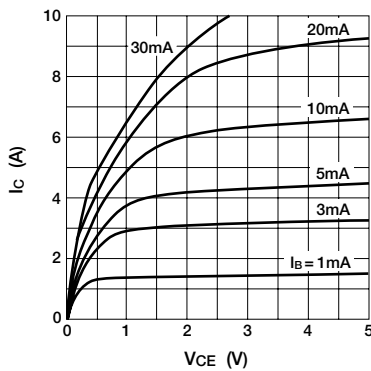
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>r</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 12                 | 1                  | 10                   | -5                   | 30                   | -30                  | 0.25                 | 0.8                   | 0.35                |

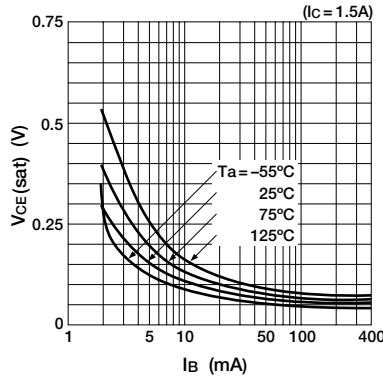
## External Dimensions TO220F (full-mold)



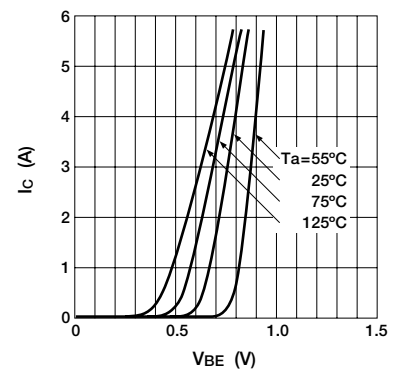
■ I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



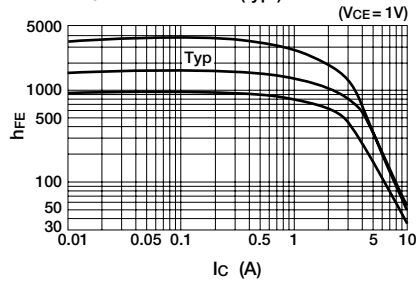
■ V<sub>CE(sat)</sub>—I<sub>B</sub> Temperature Characteristics (typ.)



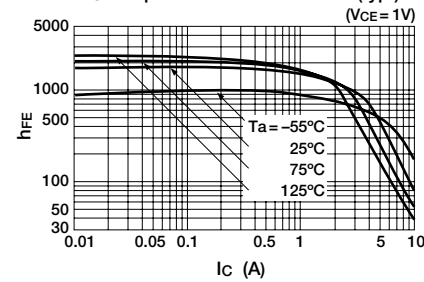
■ I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



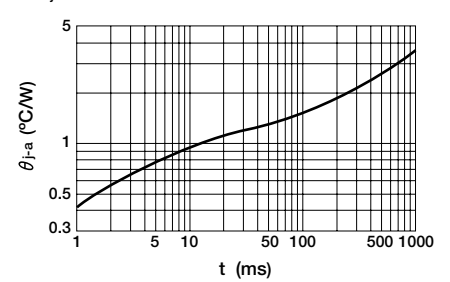
■ h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



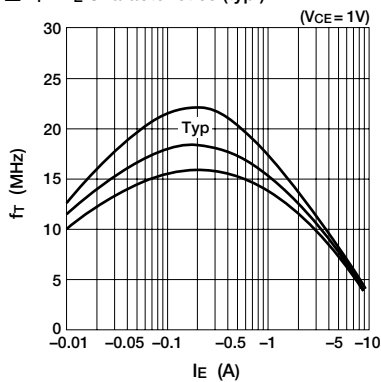
■ h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



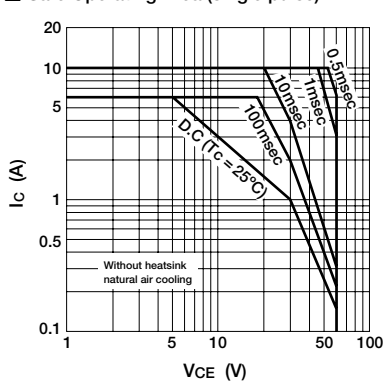
■ θ<sub>J-a</sub>—t Characteristics



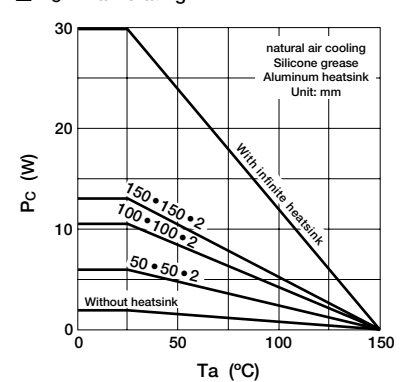
■ f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



■ Safe Operating Area (single pulse)



■ P<sub>C</sub>—Ta Derating



# Power Transistor 2SD2633

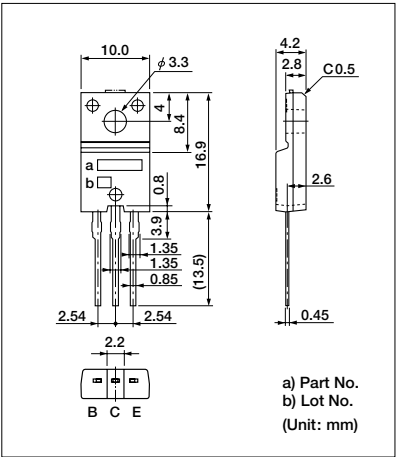
## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                                                       | Unit |
|------------------|---------------------------------------------------------------|------|
| V <sub>CB0</sub> | 200                                                           | V    |
| V <sub>CE0</sub> | 150                                                           | V    |
| V <sub>EB0</sub> | 6                                                             | V    |
| I <sub>C</sub>   | 8                                                             | A    |
| I <sub>B</sub>   | 1                                                             | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C)<br>2 (T <sub>a</sub> =25°C, No Fin) | W    |
| T <sub>J</sub>   | 150                                                           | °C   |
| T <sub>stg</sub> | -55 to +150                                                   | °C   |

## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                         | Ratings | Unit |
|-----------------------|-----------------------------------------|---------|------|
| I <sub>CBO</sub>      | V <sub>CB</sub> =200V                   | 100max  | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> =6V                     | 10max   | mA   |
| V <sub>CE0</sub>      | I <sub>C</sub> =50mA                    | 150min  | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> =2V, I <sub>C</sub> =6A | 2000min |      |
| V <sub>CE</sub> (sat) | I <sub>C</sub> =6A, I <sub>B</sub> =6mA | 1.5max  | V    |
| V <sub>BE</sub> (sat) | I <sub>C</sub> =6A, I <sub>B</sub> =6mA | 2.0max  | V    |

## External Dimensions TO220F (full-mold)



# Power Transistor FN812

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | 120                       | V    |
| V <sub>CEO</sub> | 100                       | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | 8 (pulse 12)              | A    |
| I <sub>B</sub>   | 3                         | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

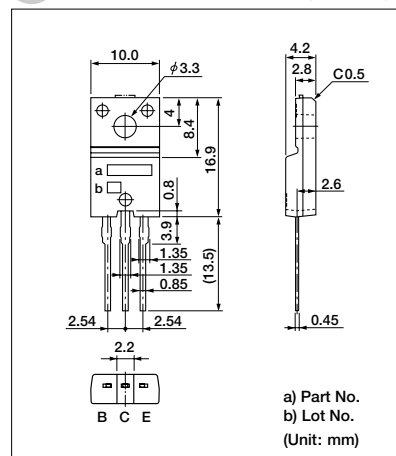
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                            | Ratings | Unit |
|----------------------|--------------------------------------------|---------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 120V                     | 10max   | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                       | 10max   | μA   |
| V <sub>CEO</sub>     | I <sub>C</sub> = 50mA                      | 100min  | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 4V, I <sub>C</sub> = 3A  | 70min   |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 4A, I <sub>B</sub> = 0.4A | 0.3max  | V    |

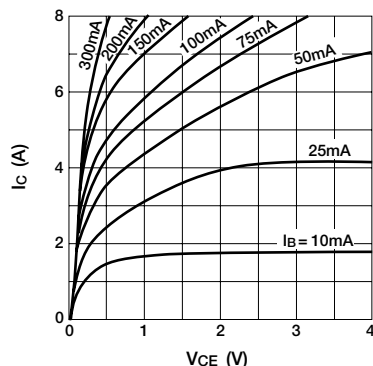
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 4                  | 3                  | 10                   | -5                   | 30                   | -30                  | 1.0                  | 2.0                   | 0.5                 |

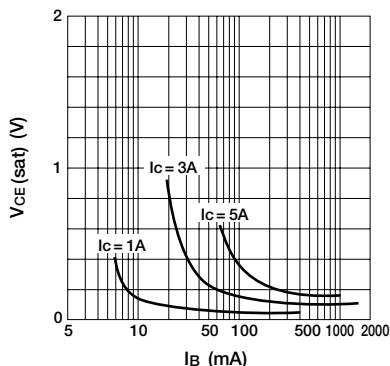
## External Dimensions TO220F (full-mold)



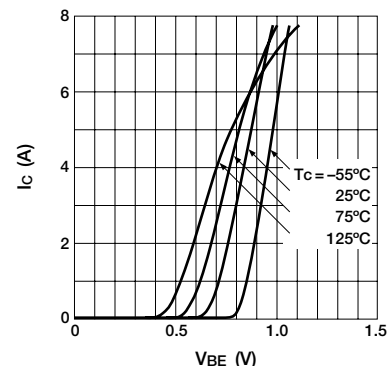
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



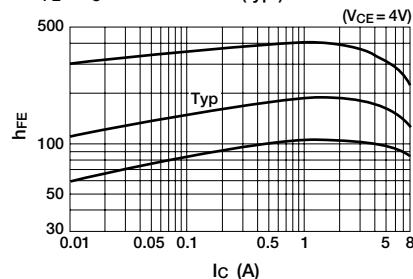
### V<sub>CE(sat)</sub>—I<sub>B</sub> Characteristics (typ.)



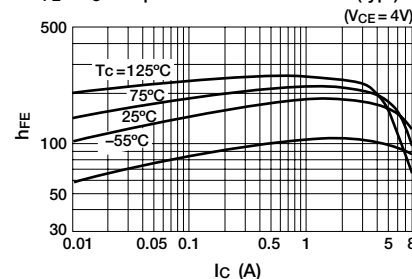
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



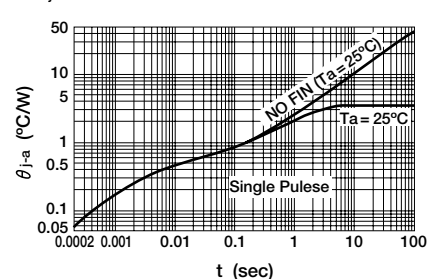
### h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



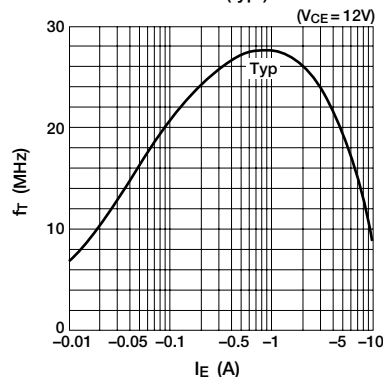
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



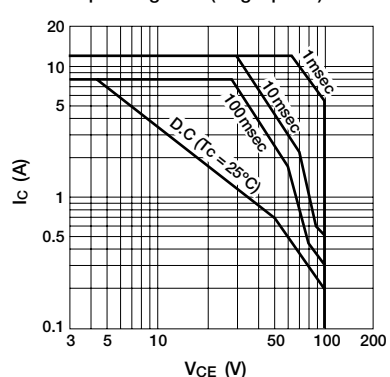
### θ<sub>J-a</sub>—t Characteristics



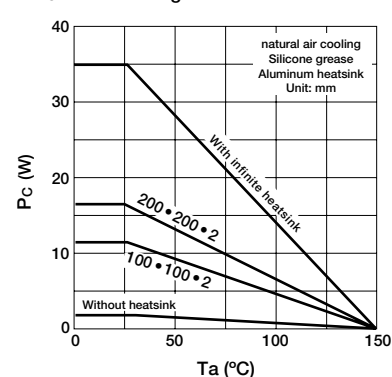
### f<sub>T</sub>—I<sub>E</sub> Characteristics (typ.)



### Safe Operating Area (single pulse)



### P<sub>C</sub>—T<sub>a</sub> Derating



# Power Transistor FP812

### Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CBO</sub> | -120                      | V    |
| V <sub>CEO</sub> | -120                      | V    |
| V <sub>EBO</sub> | -6                        | V    |
| I <sub>C</sub>   | -8 (pulse -12)            | A    |
| I <sub>B</sub>   | -3                        | A    |
| P <sub>C</sub>   | 35 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

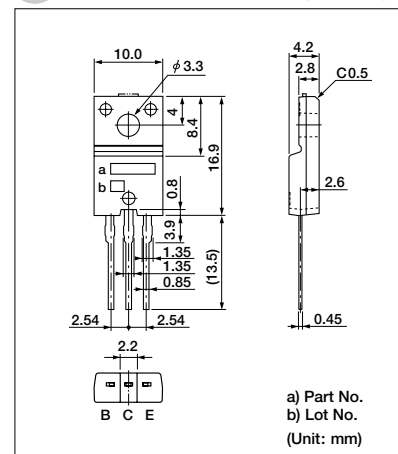
## Electrical Characteristics

| Symbol               | Test Conditions                              | Ratings | Unit |
|----------------------|----------------------------------------------|---------|------|
| ICBO                 | V <sub>CB</sub> = -120V                      | 10max   | μA   |
| IEBO                 | V <sub>EB</sub> = -6V                        | 10max   | μA   |
| V <sub>CEO</sub>     | I <sub>C</sub> = -50mA                       | -120min | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = -4V, I <sub>C</sub> = -3A  | 70min   |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = -3A, I <sub>B</sub> = -0.3A | -0.3max | V    |

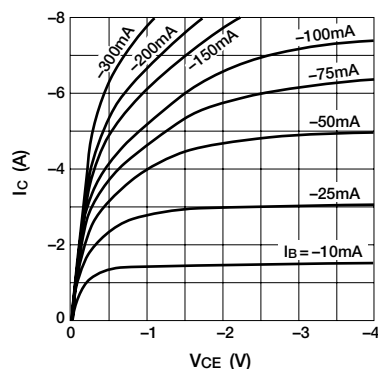
## Typical Switching Characteristics

| V <sub>CC</sub><br>(V) | R <sub>L</sub><br>(Ω) | I <sub>C</sub><br>(A) | V <sub>BB1</sub><br>(V) | V <sub>BB2</sub><br>(V) | I <sub>B1</sub><br>(mA) | I <sub>B2</sub><br>(mA) | t <sub>on</sub><br>(μs) | t <sub>stg</sub><br>(μs) | t <sub>f</sub><br>(μs) |
|------------------------|-----------------------|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|------------------------|
| -12                    | 4                     | -3                    | -10                     | 5                       | -30                     | 30                      | 2.5                     | 0.4                      | 0.6                    |

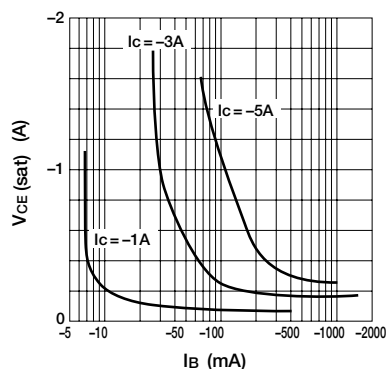
### External Dimensions TO220F (full-mold)



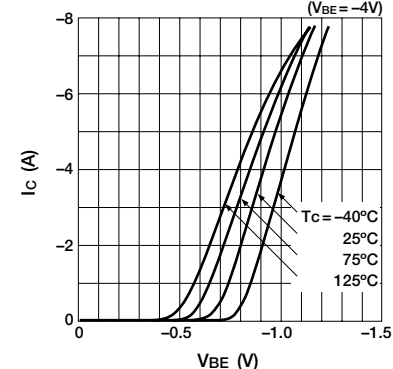
■  $I_C$ — $V_{CE}$  Characteristics (typ.)



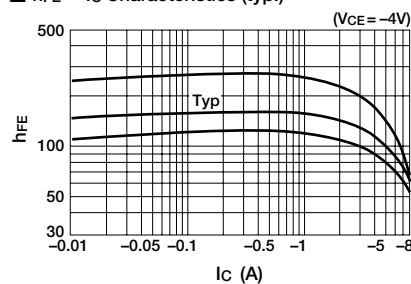
■  $V_{CE}(\text{sat})$ — $I_B$  Characteristics (typ.)



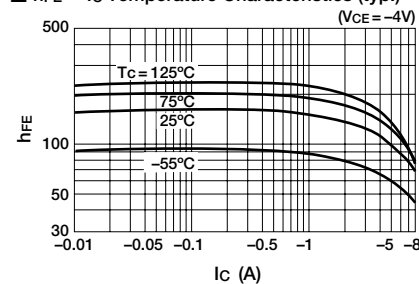
■  $I_C$ — $V_{BE}$  Temperature Characteristics (typ.)



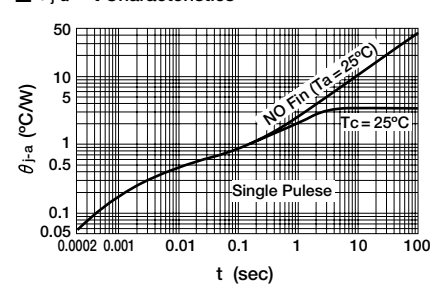
### ■ $h_{FE}$ — $I_C$ Characteristics (typ.)



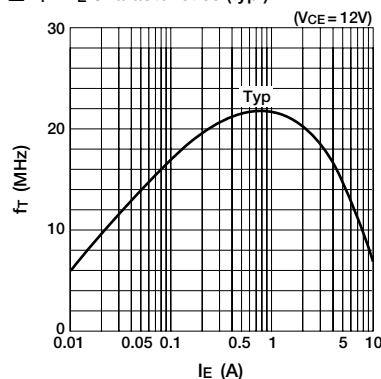
### ■ $h_{FE}$ — $I_C$ Temperature Characteristics (typ.)



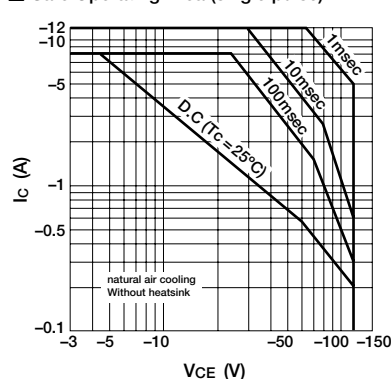
### ■ $\theta_{j-a-t}$ Characteristics



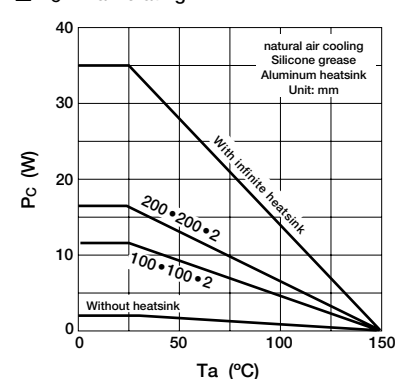
■  $f_T$ — $I_E$  Characteristics (typ.)



■ Safe Operating Area (single pulse)



### ■ $P_C$ —Ta Derating



# Power Transistor MN611S

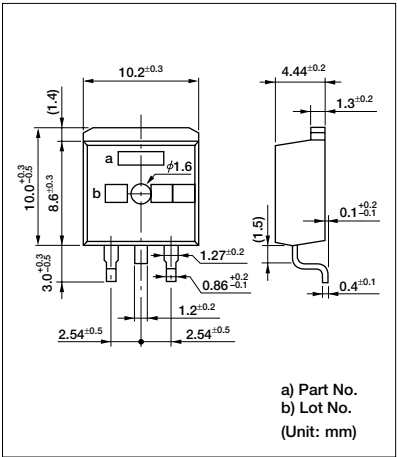
## Absolute Maximum Ratings (Ta=25°C)

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

## Electrical Characteristics (Ta=25°C)

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

## External Dimensions TO220S



# Power Transistor MN638S

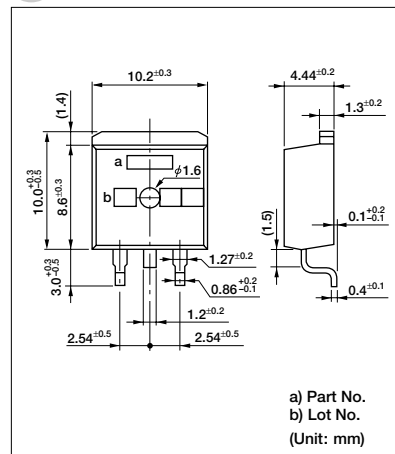
## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                   | Unit |
|------------------|---------------------------|------|
| V <sub>CB0</sub> | 380±50                    | V    |
| V <sub>CEO</sub> | 380±50                    | V    |
| V <sub>EB0</sub> | 6                         | V    |
| I <sub>C</sub>   | 6 (pulse 10)              | A    |
| I <sub>B</sub>   | 1                         | A    |
| P <sub>C</sub>   | 60 (T <sub>C</sub> =25°C) | W    |
| T <sub>J</sub>   | 150                       | °C   |
| T <sub>stg</sub> | -55 to +150               | °C   |

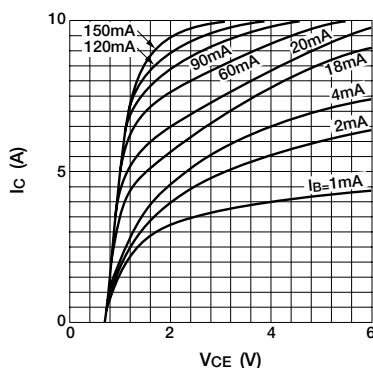
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                          | Ratings    | Unit |
|-----------------------|------------------------------------------|------------|------|
| I <sub>CBO</sub>      | V <sub>CB</sub> =330V                    | 10max      | μA   |
| I <sub>EB0</sub>      | V <sub>EB</sub> =6V                      | 20max      | mA   |
| V <sub>(BR) CEO</sub> | I <sub>C</sub> =25mA                     | 330 to 430 | V    |
| h <sub>FE</sub>       | V <sub>CE</sub> =2V, I <sub>C</sub> =3A  | 1500min    |      |
| V <sub>CE(sat)</sub>  | I <sub>C</sub> =4A, I <sub>B</sub> =20mA | 1.5max     | V    |

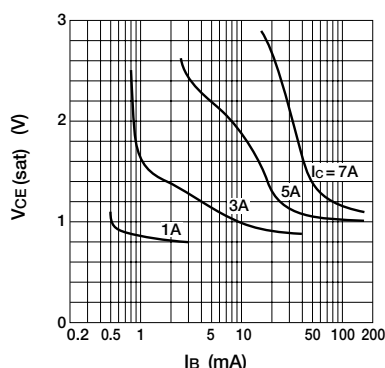
## External Dimensions TO220S



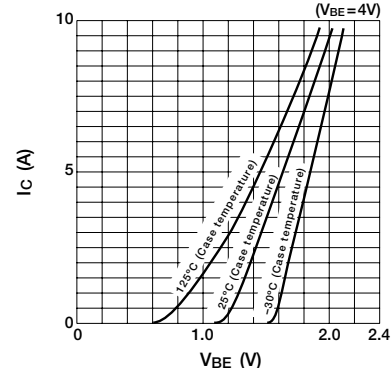
■ I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



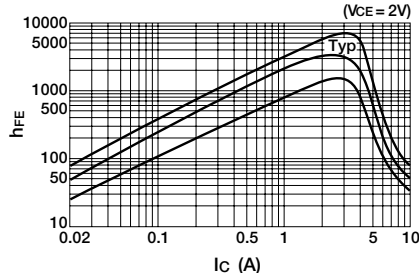
■ V<sub>CE(sat)</sub>—I<sub>B</sub> Characteristics (typ.)



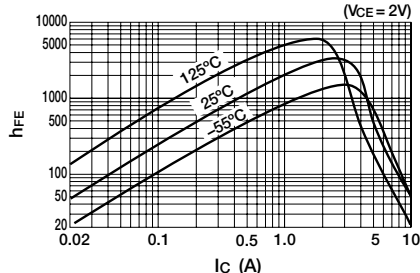
■ I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



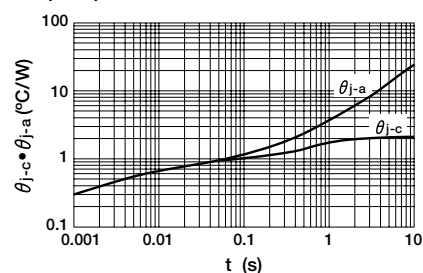
■ h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



■ h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



■ θ<sub>J-C</sub>•θ<sub>J-A</sub>—t Characteristics



# Power Transistor Array STA315A

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                       | Unit |
|------------------|-------------------------------|------|
| V <sub>CB0</sub> | 35±5                          | V    |
| V <sub>CE0</sub> | 36±5                          | V    |
| V <sub>EB0</sub> | 6                             | V    |
| I <sub>C</sub>   | 2 (pulse 3*)                  | A    |
| I <sub>B</sub>   | 30                            | mA   |
| P <sub>T</sub>   | 3 (Ta=25°C)<br>13.5 (Tc=25°C) | W    |
| T <sub>J</sub>   | 150                           | °C   |
| T <sub>stg</sub> | -55 to +150                   | °C   |

\* P<sub>W</sub> ≤ 1ms, Duty ≤ 25%

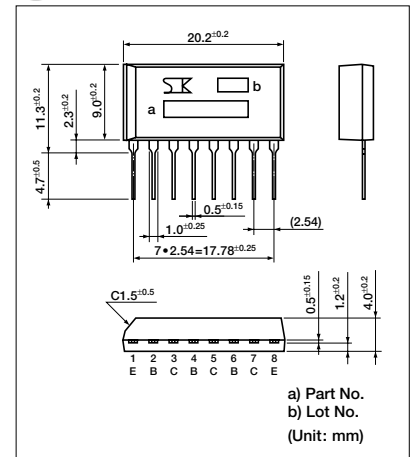
## Electrical Characteristics (Ta=25°C)

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

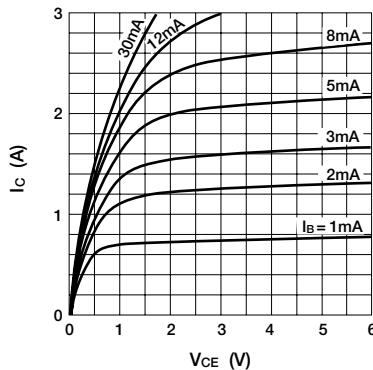
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 12                 | 1                  | 10                   | -5                   | 5                    | 0                    | 1.0                  | 8.5                   | 2.5                 |

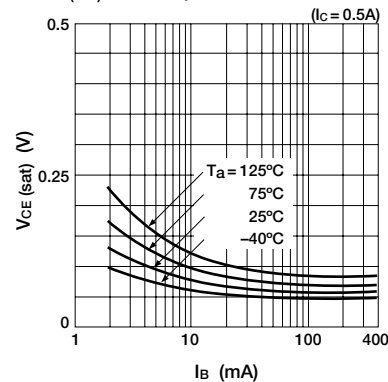
## External Dimensions STA3 (LF400A)



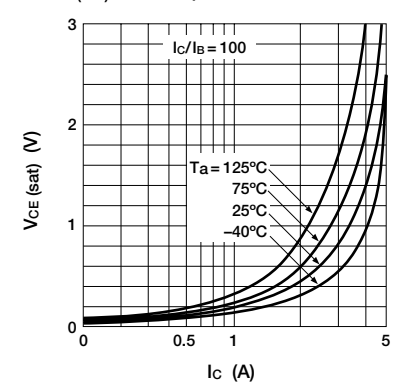
### I<sub>C</sub> — V<sub>CE</sub> Characteristics (typ.)



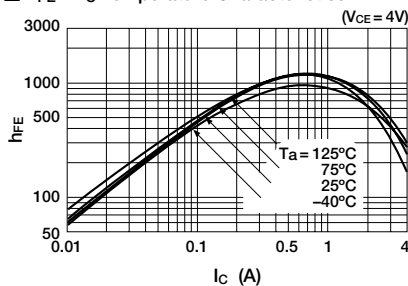
### V<sub>CE</sub> (sat) — I<sub>B</sub> Temperature Characteristics



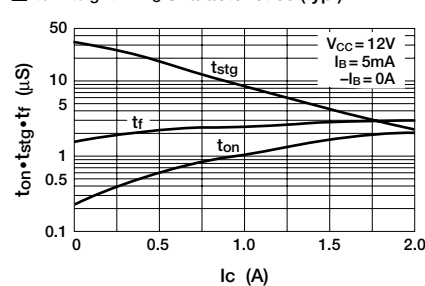
### V<sub>CE</sub> (sat) — I<sub>C</sub> Temperature Characteristics



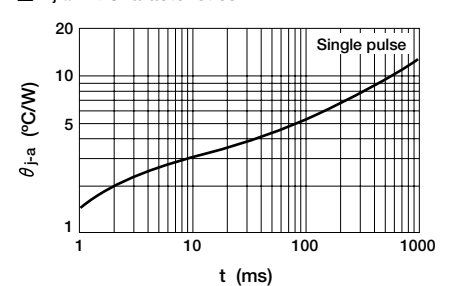
### h<sub>FE</sub> — I<sub>C</sub> Temperature Characteristics



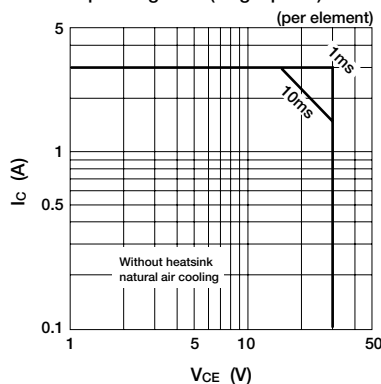
### t<sub>on</sub>•t<sub>stg</sub>•t<sub>f</sub> — I<sub>C</sub> Characteristics (typ.)



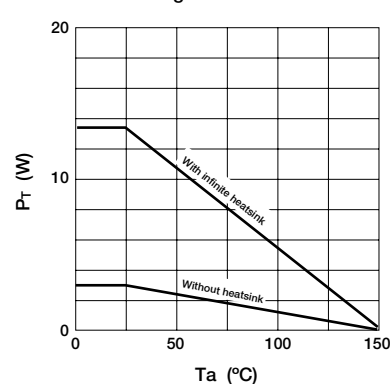
### θ<sub>J-a</sub> — t Characteristics



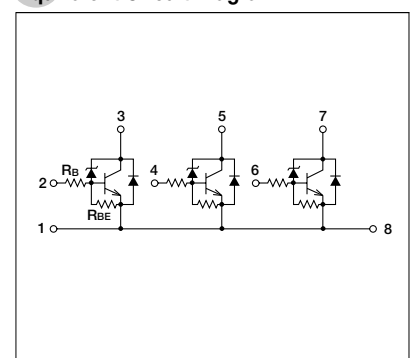
### Safe Operating Area (single pulse)



### P<sub>T</sub> — T<sub>a</sub> Derating



## Equivalent Circuit Diagram



# Power Transistor Array STA335A

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                       | Unit |
|------------------|-------------------------------|------|
| V <sub>CB0</sub> | 35±5                          | V    |
| V <sub>CE0</sub> | 35±5                          | V    |
| V <sub>EB0</sub> | 6                             | V    |
| I <sub>C</sub>   | 3                             | A    |
| I <sub>B</sub>   | 1                             | A    |
| P <sub>T</sub>   | 2.5 (Ta=25°C)<br>12 (Tc=25°C) | W    |
| T <sub>J</sub>   | 150                           | °C   |
| T <sub>stg</sub> | -55 to +150                   | °C   |

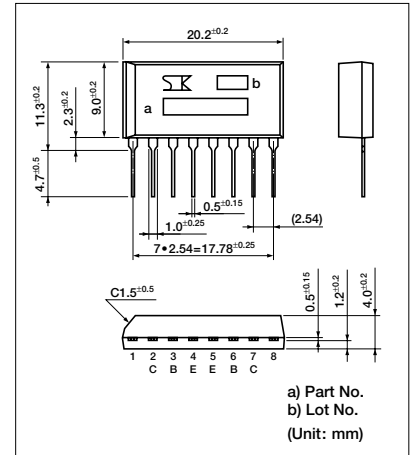
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                             | Ratings | Unit |
|----------------------|---------------------------------------------|---------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 30V                       | 10max   | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                        | 10max   | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = 25mA                       | 35±5    | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 4V, I <sub>C</sub> = 0.5A | 500min  |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 1A, I <sub>B</sub> = 5mA   | 0.5max  | V    |
| Es/b                 | L = 10mH, single pulse                      | 150min  | mJ   |

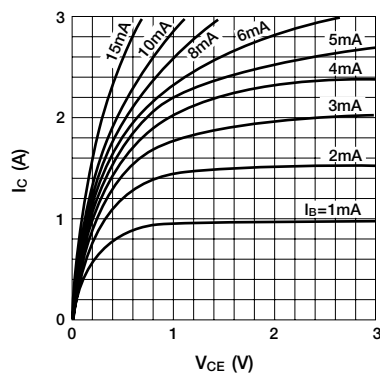
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 12                 | 1                  | 10                   | -5                   | 5                    | 5                    | 1.3                  | 4.7                   | 1.2                 |

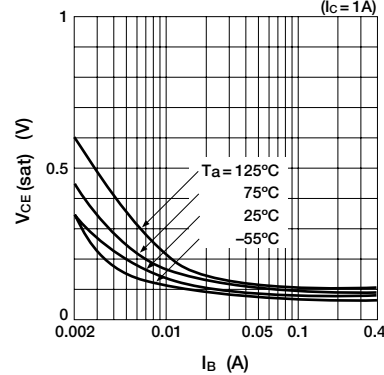
## External Dimensions STA3 (LF400A)



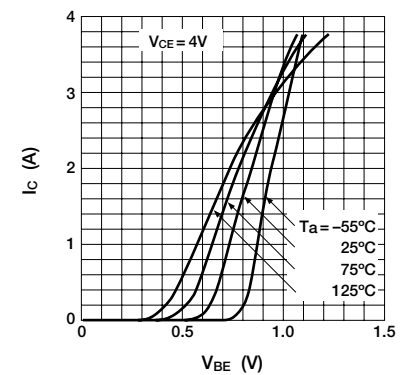
### I<sub>C</sub> — V<sub>CE</sub> Characteristics (typ.)



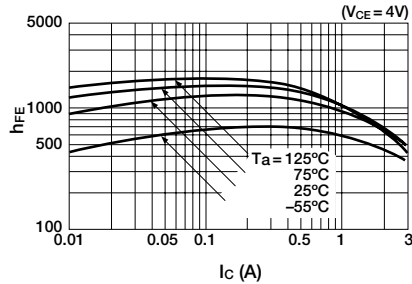
### V<sub>CE(sat)</sub> — I<sub>B</sub> Temperature Characteristics



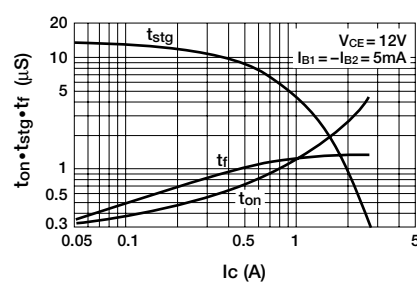
### I<sub>C</sub> — V<sub>BE</sub> Temperature Characteristics (typ.)



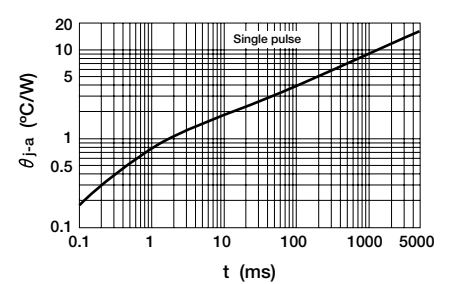
### h<sub>FE</sub> — I<sub>C</sub> Temperature Characteristics (typ.)



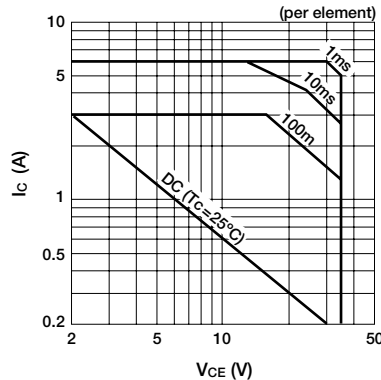
### t<sub>on</sub>•t<sub>stg</sub>•t<sub>f</sub> — I<sub>C</sub> Characteristics (typ.)



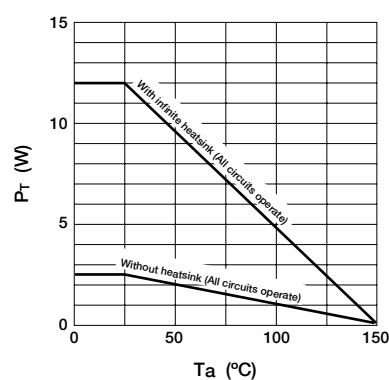
### θ<sub>J-a</sub> — t Characteristics



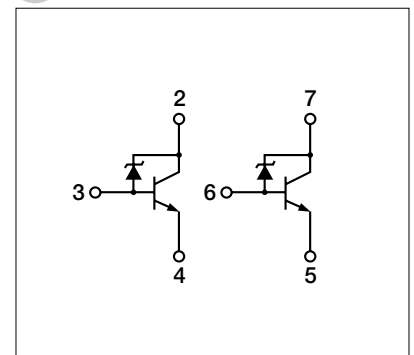
### Safe Operating Area (single pulse)



### P<sub>T</sub> — Ta Derating



## Equivalent Circuit Diagram



# Power Transistor Array STA415A

## Absolute Maximum Ratings (Ta=25°C)

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

\* PW ≤ 1ms, Duty ≤ 25%

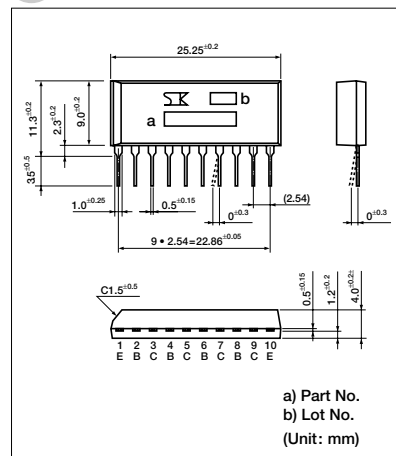
## Electrical Characteristics (Ta=25°C)

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

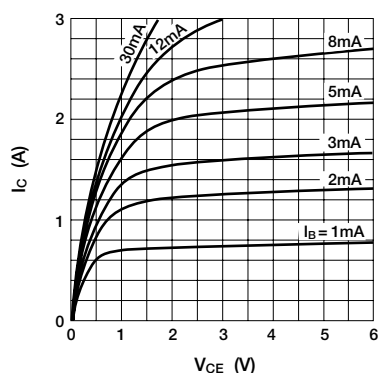
## Typical Switching Characteristics

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

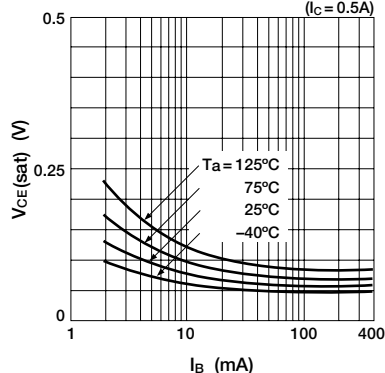
## External Dimensions STA4 (LF412)



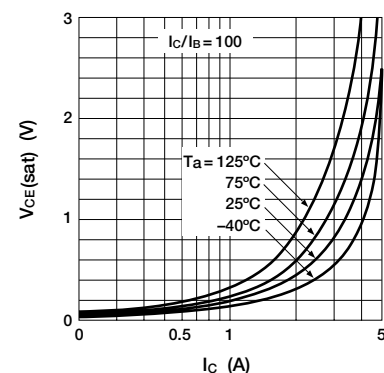
### IC — VCE Characteristics (typ.)



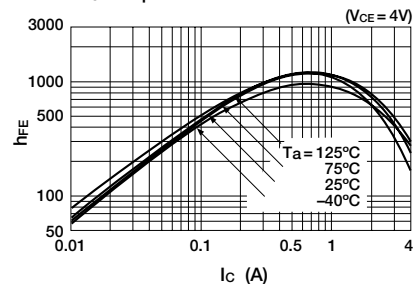
### VCE(sat) — IB Temperature Characteristics (IC = 0.5A)



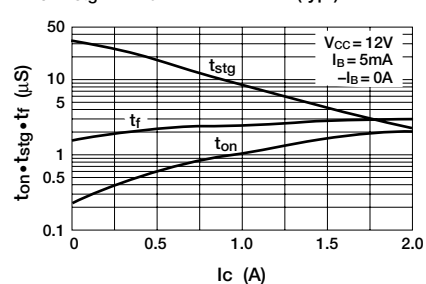
### VCE(sat) — IC Temperature Characteristics (IC/IB = 100)



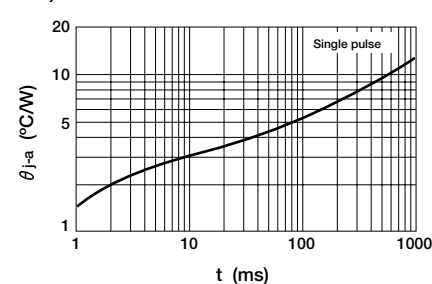
### hFE — IC Temperature Characteristics (VCE = 4V)



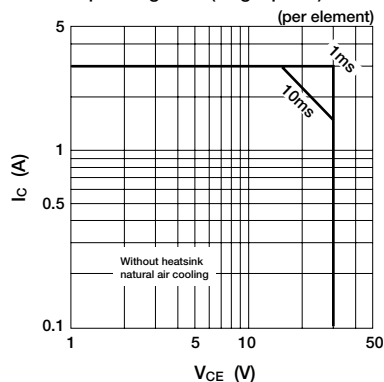
### ton • tstg • tr — IC Characteristics (typ.)



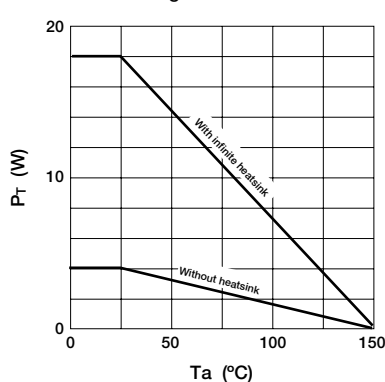
### θJA — t Characteristics



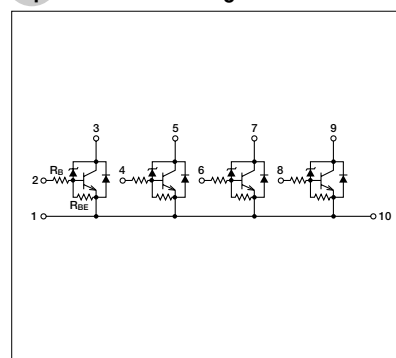
### Safe Operating Area (single pulse)



### PT — Ta Derating



## Equivalent Circuit Diagram



# Power Transistor Array STA461C

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings         | Unit |
|------------------|-----------------|------|
| V <sub>CB0</sub> | 65±5            | V    |
| V <sub>CEO</sub> | 65±5            | V    |
| V <sub>EB0</sub> | 6               | V    |
| I <sub>C</sub>   | ±6 (pulse ±10)  | A    |
| I <sub>B</sub>   | 1               | A    |
| P <sub>T</sub>   | 3.2 (Ta = 25°C) | W    |
|                  | 18 (Tc = 25°C)  | W    |
| T <sub>J</sub>   | 150             | °C   |
| T <sub>stg</sub> | -55 to +150     | °C   |

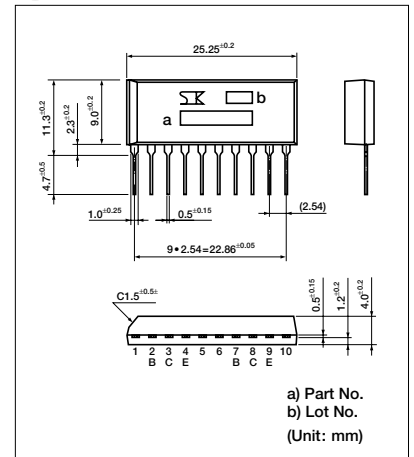
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings     | Unit |
|----------------------|----------------------------------------------|-------------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 60V                        | 10max       | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                         | 10max       | μA   |
| V <sub>CEO</sub>     | I <sub>C</sub> = 50mA                        | 60 to 70    | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 1V, I <sub>C</sub> = 1A    | 400 to 1500 |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 1.5A, I <sub>B</sub> = 15mA | 0.15max     | V    |
| V <sub>FEC</sub>     | I <sub>FEC</sub> = 6A                        | 1.5max      | V    |
| Es/b                 | L = 10mH, single pulse                       | 80min       | mJ   |

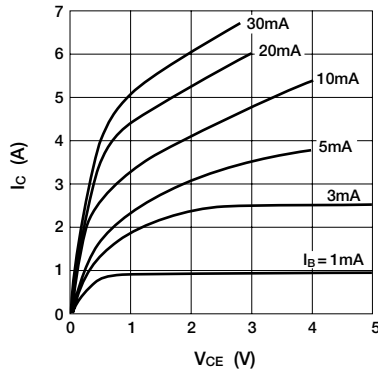
## Typical Switching Characteristics

| V <sub>CC</sub><br>(V) | R <sub>L</sub><br>(Ω) | I <sub>C</sub><br>(A) | V <sub>BB1</sub><br>(V) | V <sub>BB2</sub><br>(V) | I <sub>B1</sub><br>(mA) | I <sub>B2</sub><br>(mA) | t <sub>on</sub><br>(μs) | t <sub>stg</sub><br>(μs) | t <sub>f</sub><br>(μs) |
|------------------------|-----------------------|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|------------------------|
| 12                     | 12                    | 1                     | 10                      | -5                      | 30                      | -30                     | 0.2                     | 3.9                      | 0.2                    |

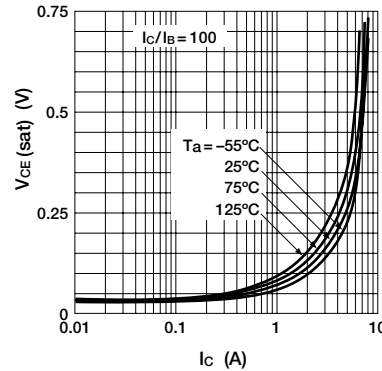
## External Dimensions STA4 (LF400B)



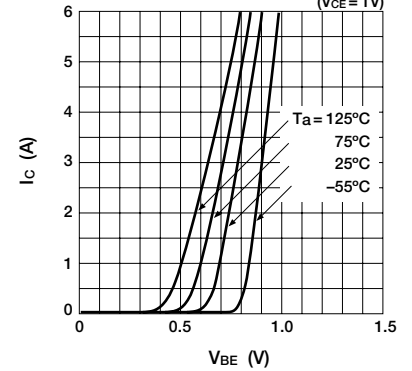
### I<sub>C</sub>—V<sub>CE</sub> Characteristics (typ.)



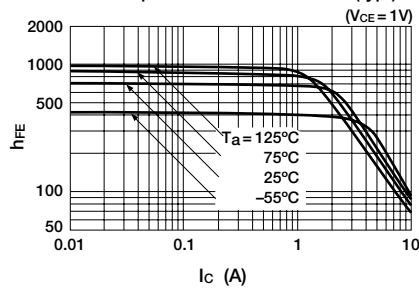
### V<sub>CE(sat)</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



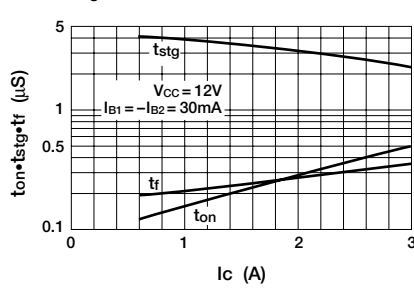
### I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



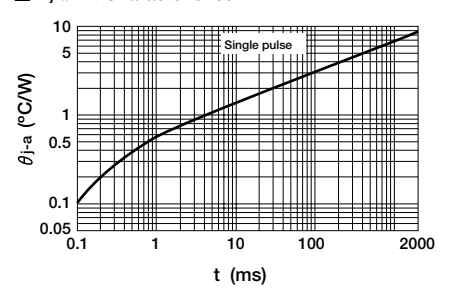
### h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



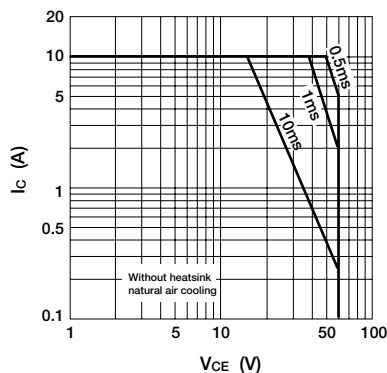
### t<sub>on</sub>•t<sub>stg</sub>•t<sub>f</sub>—I<sub>C</sub> Characteristics



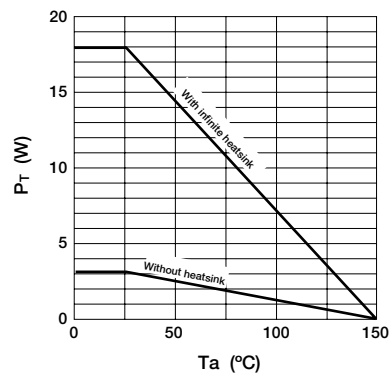
### θ<sub>J-a</sub>—t Characteristics



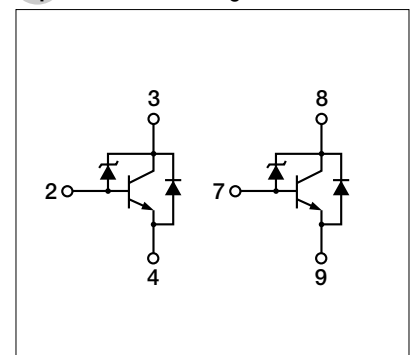
### Safe Operating Area (single pulse)



### P<sub>T</sub>—Ta Derating



## Equivalent Circuit Diagram



# Power Transistor Array STA463C

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                        | Unit |
|------------------|--------------------------------|------|
| V <sub>CB0</sub> | 115±10                         | V    |
| V <sub>CE0</sub> | 115±10                         | V    |
| V <sub>EB0</sub> | 6                              | V    |
| I <sub>C</sub>   | ±6 (pulse ±10)                 | A    |
| I <sub>B</sub>   | 1                              | A    |
| P <sub>T</sub>   | 3.2 (Ta=250°C)<br>18 (Tc=25°C) | W    |
| T <sub>J</sub>   | 150                            | °C   |
| T <sub>stg</sub> | -55 to +150                    | °C   |

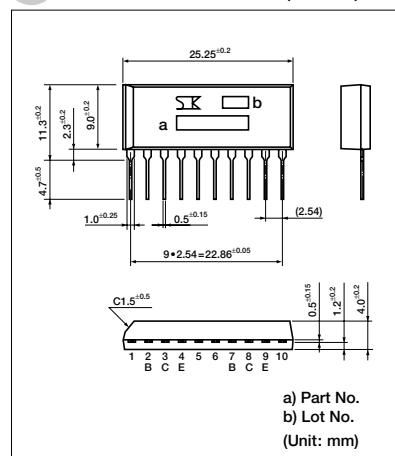
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings     | Unit |
|----------------------|----------------------------------------------|-------------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 105V                       | 10max       | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                         | 10max       | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = 50mA                        | 105 to 125  | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 1V, I <sub>C</sub> = 1A    | 400 to 1500 |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 1.2A, I <sub>B</sub> = 12mA | 0.12max     | V    |
| V <sub>FEC</sub>     | I <sub>FEC</sub> = 6A                        | 1.5max      | V    |
| Es/b                 | L = 10mH, single pulse                       | 45min       | mJ   |

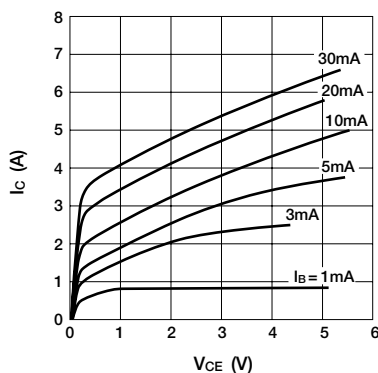
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 12                  | 12                 | 1                  | 10                   | -5                   | 30                   | -30                  | 0.2                  | 5.7                   | 0.4                 |

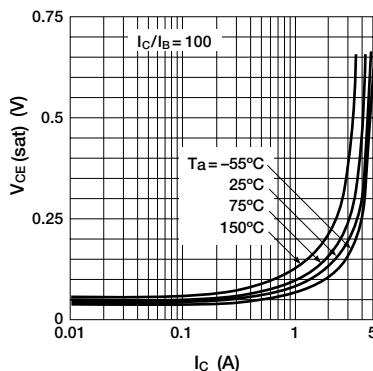
## External Dimensions STA4 (LF400B)



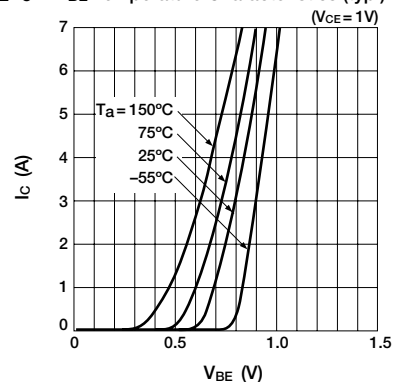
## I<sub>C</sub> — V<sub>CE</sub> Characteristics (typ.)



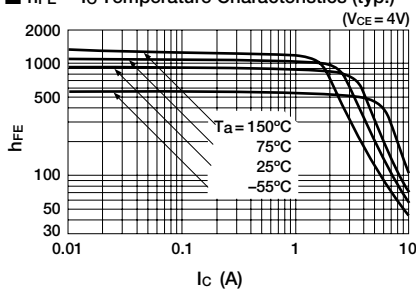
## V<sub>CE(sat)</sub> — I<sub>C</sub> Temperature Characteristics (typ.)



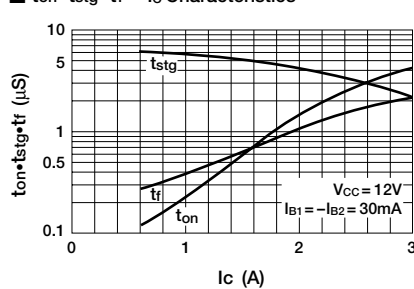
## I<sub>C</sub> — V<sub>BE</sub> Temperature Characteristics (typ.)



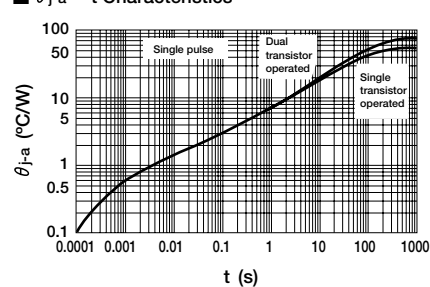
## h<sub>FE</sub> — I<sub>C</sub> Temperature Characteristics (typ.)



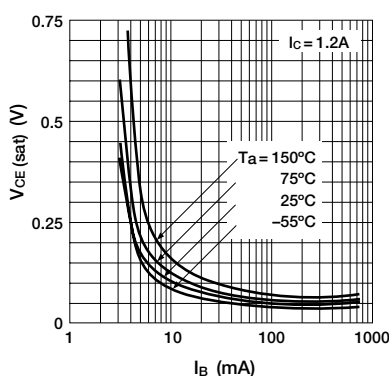
## t<sub>on</sub> • t<sub>stg</sub> • t<sub>f</sub> — I<sub>C</sub> Characteristics



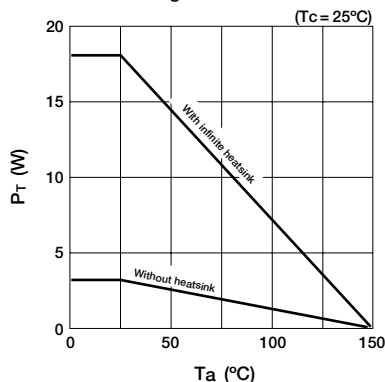
## θ<sub>J-a</sub> — t Characteristics



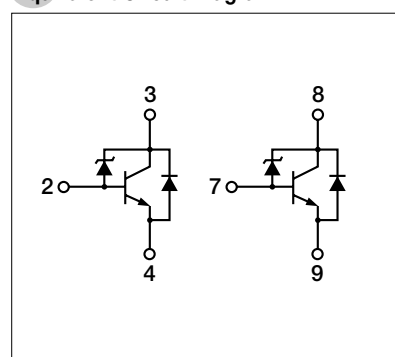
## V<sub>CE(sat)</sub> — I<sub>B</sub> Temperature Characteristics (typ.)



## P<sub>T</sub> — Ta Derating



## Equivalent Circuit Diagram



# Power Transistor Array STA464C

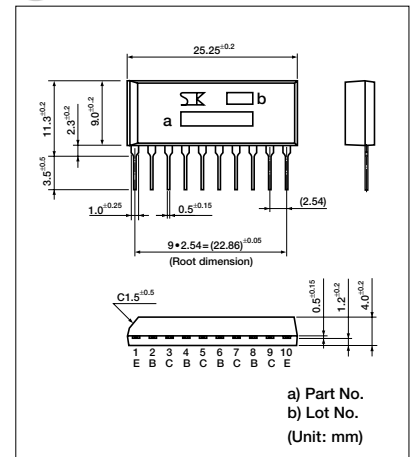
## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                     | Unit |
|------------------|-----------------------------|------|
| V <sub>CB0</sub> | 65±5                        | V    |
| V <sub>CEO</sub> | 65±5                        | V    |
| V <sub>EB0</sub> | 6                           | V    |
| I <sub>C</sub>   | 6 (pulse 10)                | A    |
| I <sub>B</sub>   | 1                           | A    |
| P <sub>C</sub>   | 20 (Tc=25°C)<br>4 (Ta=25°C) | W    |
| T <sub>J</sub>   | 150                         | °C   |
| T <sub>stg</sub> | -55 to +150                 | °C   |

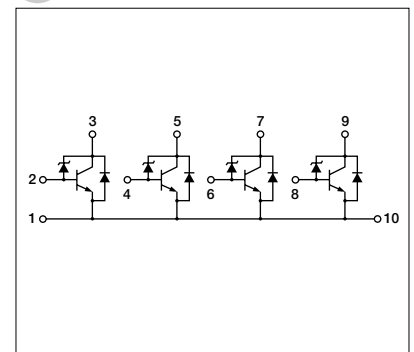
## Electrical Characteristics (Ta=25°C)

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

## External Dimensions STA4



## Equivalent Circuit Diagram



# Power Transistor Array SLA8004

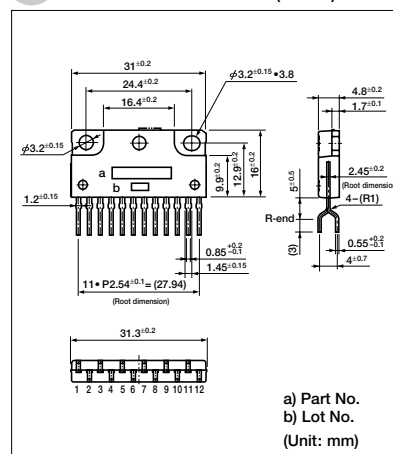
### Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings                          |     | Unit |
|------------------|----------------------------------|-----|------|
|                  | NPN                              | PNP |      |
| V <sub>CB0</sub> | 60                               | -55 | V    |
| V <sub>CE0</sub> | 60                               | -55 | V    |
| V <sub>EB0</sub> | 6                                | -6  | V    |
| I <sub>C</sub>   | 12                               | -12 | A    |
| I <sub>B</sub>   | 3                                | -3  | A    |
| P <sub>T</sub>   | 5 (T <sub>C</sub> =25°C, No Fin) |     | W    |
|                  | 40 (T <sub>C</sub> =25°C)        |     | W    |
| T <sub>J</sub>   | 150                              |     | °C   |
| T <sub>sta</sub> | -55 to +150                      |     | °C   |

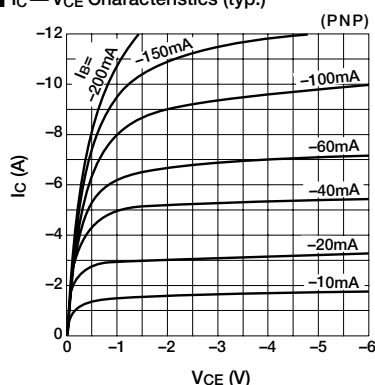
## Electrical Characteristics

| Symbol               | NPN                                        |         | PNP                                          |          | Unit |
|----------------------|--------------------------------------------|---------|----------------------------------------------|----------|------|
|                      | Test Conditions                            | Ratings | Test Conditions                              | Ratings  |      |
| ICBO                 | V <sub>CB</sub> = 60V                      | 100max  | V <sub>CB</sub> = -55V                       | -100max  | μA   |
| IEBO                 | V <sub>EB</sub> = 6V                       | 60max   | V <sub>EB</sub> = -6V                        | -60max   | mA   |
| V <sub>CEO</sub>     | I <sub>C</sub> = 25mA                      | 60min   | I <sub>C</sub> = -25mA                       | -55min   | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 1V, I <sub>C</sub> = 3A  | 150min  | V <sub>CE</sub> = -1V, I <sub>C</sub> = -3A  | 80min    |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 6A, I <sub>B</sub> = 0.3A | 0.35max | I <sub>C</sub> = -6A, I <sub>B</sub> = -0.3A | -0.35max | V    |
| V <sub>FE</sub>      | I <sub>FE</sub> = 10A                      | 2.5max  | I <sub>FE</sub> = 10A                        | 2.5max   | V    |

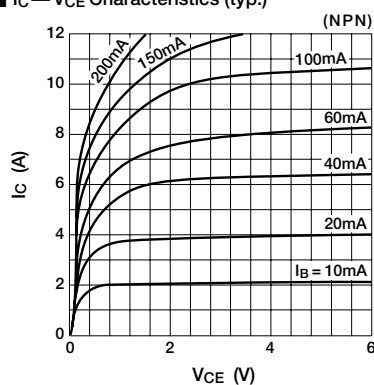
## External Dimensions SLA (LF817)



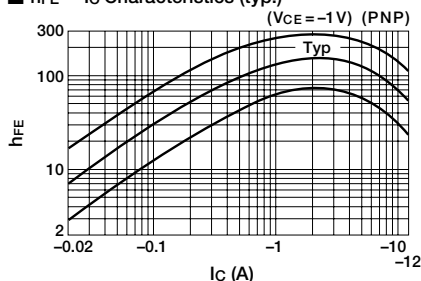
■  $I_C$ — $V_{CE}$  Characteristics (typ.)



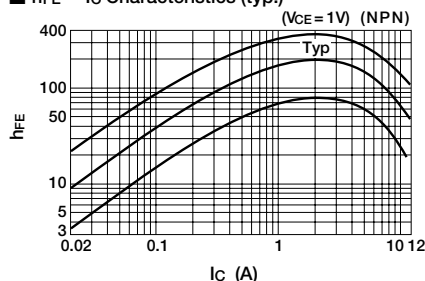
■  $I_C$ — $V_{CE}$  Characteristics (typ.)



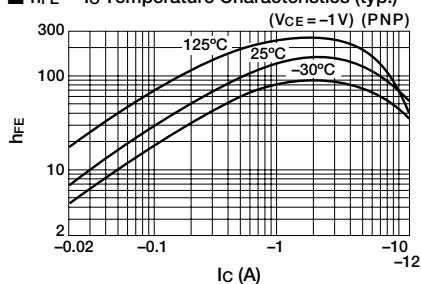
### ■ h<sub>FE</sub>—I<sub>C</sub> Characteristics (typ.)



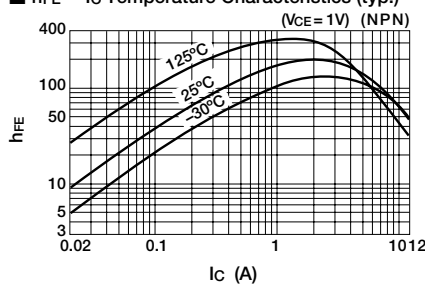
### ■ $h_{FE}$ — $I_C$ Characteristics (typ.)



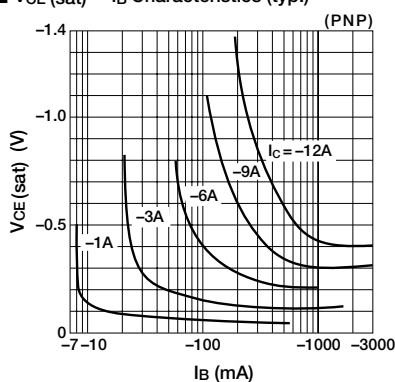
### ■ $h_{FE}$ — $I_C$ Temperature Characteristics (typ.)



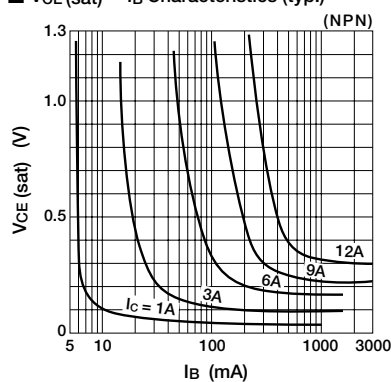
### ■ $h_{FE}$ — $I_C$ Temperature Characteristics (typ.)



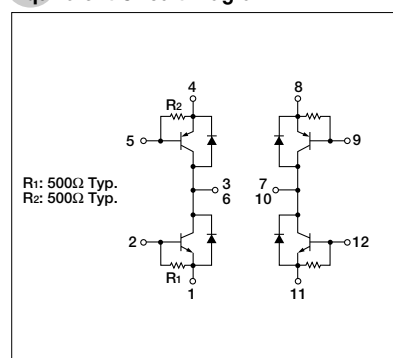
■  $V_{CE}(\text{sat}) - I_B$  Characteristics (typ.)



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



### Equivalent Circuit Diagram



# Surface-mount Power Transistor Array SDA03

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings        | Unit |
|------------------|----------------|------|
| V <sub>CB0</sub> | -60            | V    |
| V <sub>CE0</sub> | -60            | V    |
| V <sub>EB0</sub> | -6             | V    |
| I <sub>C</sub>   | -6 (pulse -12) | A    |
| I <sub>B</sub>   | -1             | A    |
| P <sub>T</sub>   | 3 (No Fin)     | W    |
| T <sub>J</sub>   | 150            | °C   |
| T <sub>stg</sub> | -55 to +150    | °C   |

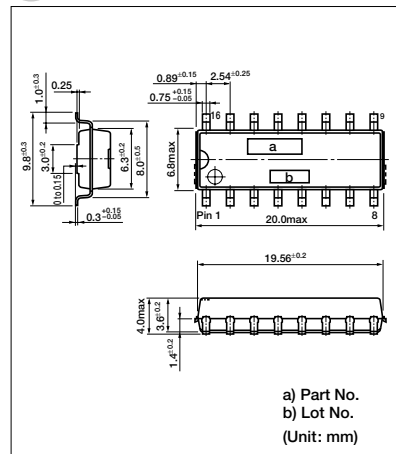
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings | Unit |
|----------------------|----------------------------------------------|---------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = -60V                       | -10max  | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = -6V                        | -10max  | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = -25mA                       | -60min  | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = -4V, I <sub>C</sub> = -2A  | 100min  |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = -2A, I <sub>B</sub> = -0.1A | -0.4max | V    |

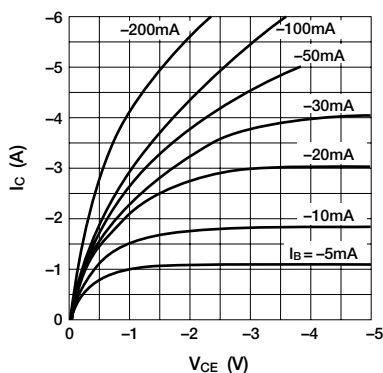
## Typical Switching Characteristics

| V <sub>CC</sub> (V) | R <sub>L</sub> (Ω) | I <sub>C</sub> (A) | V <sub>BB1</sub> (V) | V <sub>BB2</sub> (V) | I <sub>B1</sub> (mA) | I <sub>B2</sub> (mA) | t <sub>on</sub> (μs) | t <sub>stg</sub> (μs) | t <sub>f</sub> (μs) |
|---------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| -12                 | 12                 | -1                 | -10                  | 5                    | -50                  | 50                   | 0.4                  | 1.75                  | 0.22                |

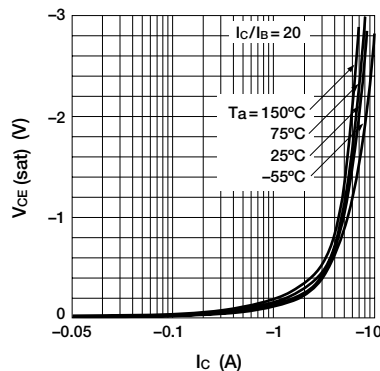
## External Dimensions SMD-16A



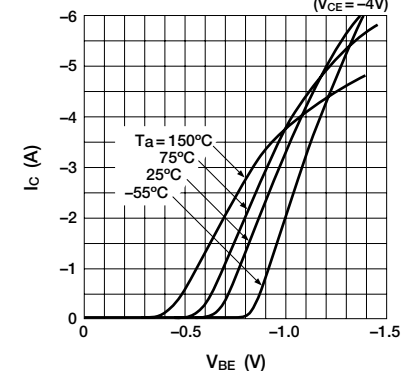
### I<sub>C</sub> — V<sub>CE</sub> Characteristics



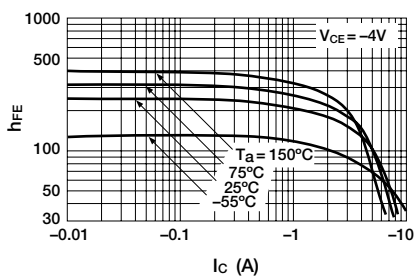
### V<sub>CE(sat)</sub> — I<sub>C</sub> Temperature Characteristics (typ.)



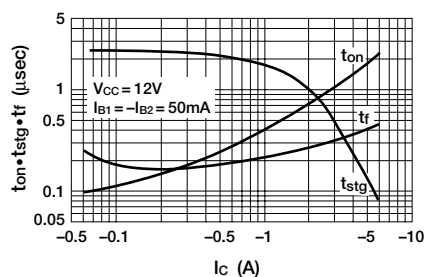
### I<sub>C</sub> — V<sub>BE</sub> Temperature Characteristics (typ.)



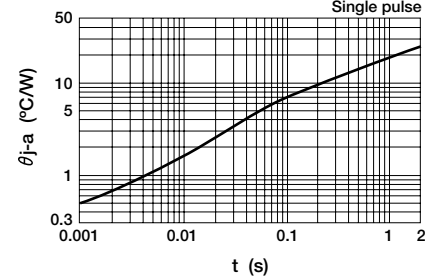
### h<sub>FE</sub> — I<sub>C</sub> Temperature Characteristics



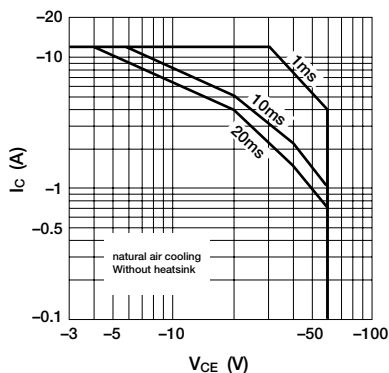
### t<sub>on</sub> • t<sub>stg</sub> • t<sub>f</sub> — I<sub>C</sub> Characteristics



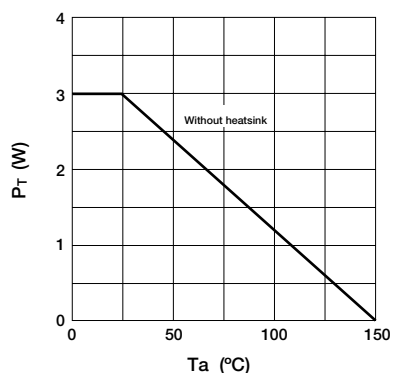
### θ<sub>J-A</sub> — t Characteristics



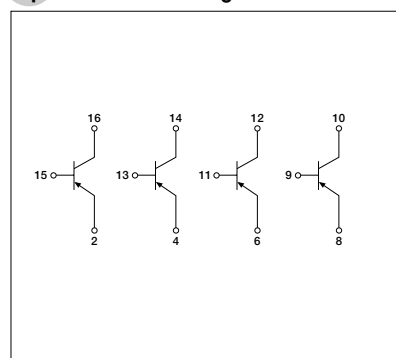
### Safe Operating Area (single pulse)



### P<sub>T</sub> — Ta Derating



## Equivalent Circuit Diagram



# Surface-mount Power Transistor Array SDA04

## Absolute Maximum Ratings (Ta=25°C)

| Symbol           | Ratings        | Unit |
|------------------|----------------|------|
| V <sub>CB0</sub> | -60            | V    |
| V <sub>CE0</sub> | -60            | V    |
| V <sub>EB0</sub> | -6             | V    |
| I <sub>C</sub>   | -6 (pulse -12) | A    |
| I <sub>B</sub>   | -1             | A    |
| P <sub>T</sub>   | 2.5 (No Fin)   | W    |
| T <sub>J</sub>   | 150            | °C   |
| T <sub>stg</sub> | -55 to +150    | °C   |

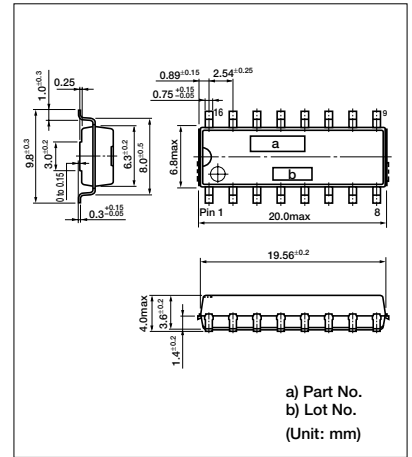
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings | Unit |
|----------------------|----------------------------------------------|---------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = -60V                       | -10max  | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = -6V                        | -10max  | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = -25mA                       | -60min  | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = -4V, I <sub>C</sub> = -2A  | 100min  |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = -2A, I <sub>B</sub> = -0.1A | -0.4max | V    |

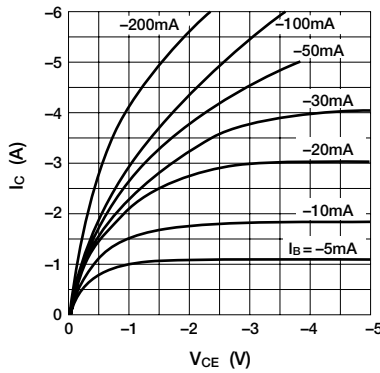
## Typical Switching Characteristics

| V <sub>CC</sub><br>(V) | R <sub>L</sub><br>(Ω) | I <sub>C</sub><br>(A) | V <sub>BB1</sub><br>(V) | V <sub>BB2</sub><br>(V) | I <sub>B1</sub><br>(mA) | I <sub>B2</sub><br>(mA) | t <sub>on</sub><br>(μs) | t <sub>stg</sub><br>(μs) | t <sub>f</sub><br>(μs) |
|------------------------|-----------------------|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|------------------------|
| -12                    | 12                    | -1                    | -10                     | 5                       | -50                     | 50                      | 0.4                     | 1.75                     | 0.22                   |

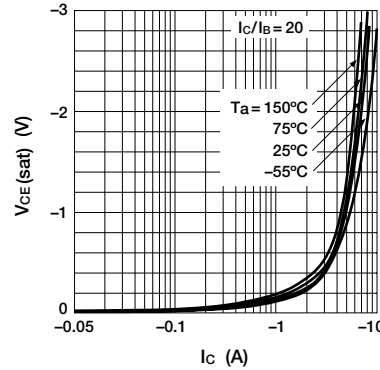
## External Dimensions SMD-16A



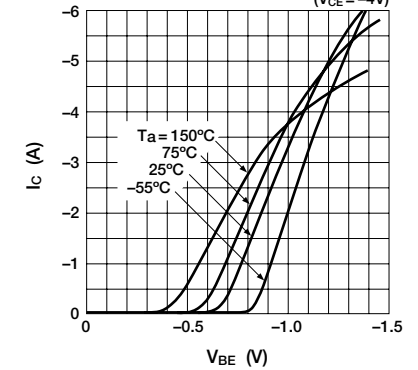
### I<sub>C</sub> — V<sub>CE</sub> Characteristics



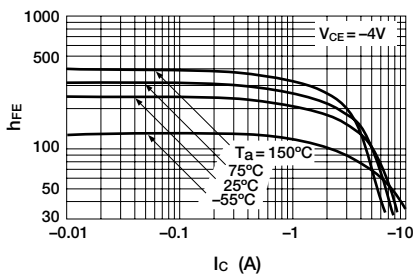
### V<sub>CE(sat)</sub> — I<sub>C</sub> Temperature Characteristics (typ.)



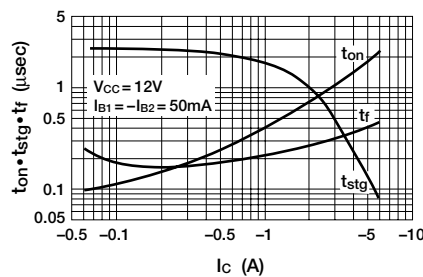
### I<sub>C</sub> — V<sub>BE</sub> Temperature Characteristics (typ.)



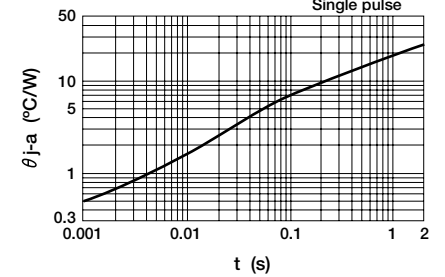
### h<sub>FE</sub> — I<sub>C</sub> Temperature Characteristics



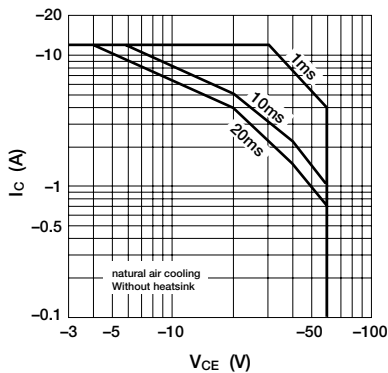
### t<sub>on</sub>•t<sub>stg</sub>•t<sub>f</sub> — I<sub>C</sub> Characteristics



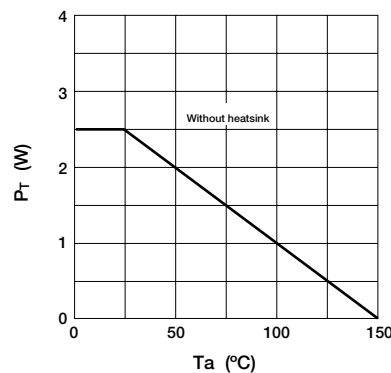
### θ<sub>J-A</sub> — t Characteristics



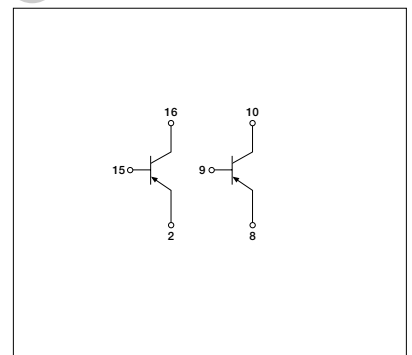
### Safe Operating Area (single pulse)



### P<sub>T</sub> — Ta Derating



## Equivalent Circuit Diagram



# Surface-mount Power Transistor Array SDC09

## Absolute Maximum Ratings (Ta=25°C)

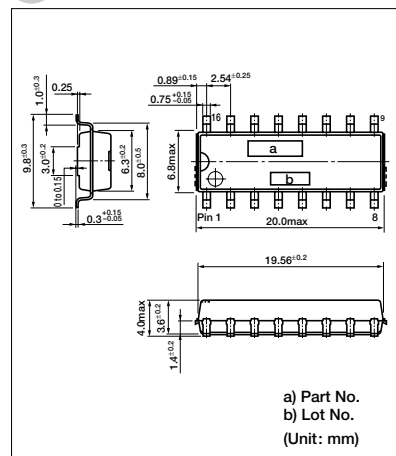
| Symbol           | Ratings       | Unit |
|------------------|---------------|------|
| V <sub>CB0</sub> | 65±5          | V    |
| V <sub>CE0</sub> | 65±5          | V    |
| V <sub>EB0</sub> | 6             | V    |
| I <sub>C</sub>   | 6 (pulse 10*) | A    |
| I <sub>B</sub>   | 1             | A    |
| P <sub>T</sub>   | 2.8           | W    |
| T <sub>J</sub>   | 150           | °C   |
| T <sub>stg</sub> | -55 to +150   | °C   |

\* P<sub>W</sub> ≤ 100μs, Duty ≤ 1%

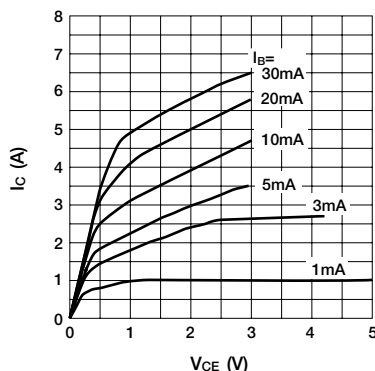
## Electrical Characteristics (Ta=25°C)

| Symbol               | Test Conditions                              | Ratings     | Unit |
|----------------------|----------------------------------------------|-------------|------|
| I <sub>CB0</sub>     | V <sub>CB</sub> = 60V                        | 10max       | μA   |
| I <sub>EB0</sub>     | V <sub>EB</sub> = 6V                         | 10max       | μA   |
| V <sub>CE0</sub>     | I <sub>C</sub> = 50mA                        | 60 to 70    | V    |
| h <sub>FE</sub>      | V <sub>CE</sub> = 1V, I <sub>C</sub> = 1A    | 400 to 1500 |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 1.5A, I <sub>B</sub> = 15mA | 0.15max     | V    |
| V <sub>FEC</sub>     | I <sub>FEC</sub> = 6A                        | 1.5max      | V    |
| Es/b                 | L = 10mH, single pulse                       | 80min       | mJ   |

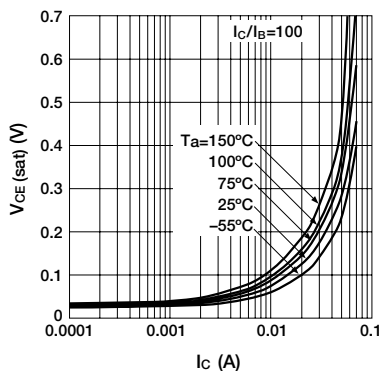
## External Dimensions SMD-16A



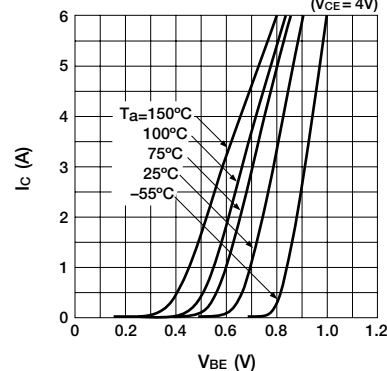
## I<sub>C</sub>—V<sub>CE</sub> Characteristics



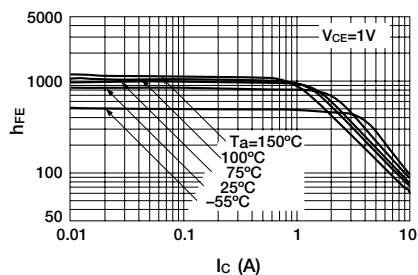
## V<sub>CE(sat)</sub>—I<sub>C</sub> Temperature Characteristics (typ.)



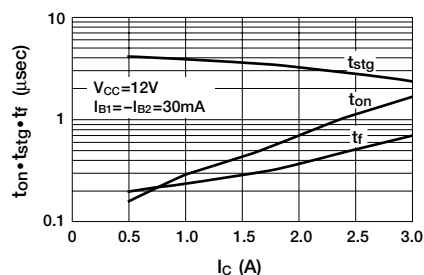
## I<sub>C</sub>—V<sub>BE</sub> Temperature Characteristics (typ.)



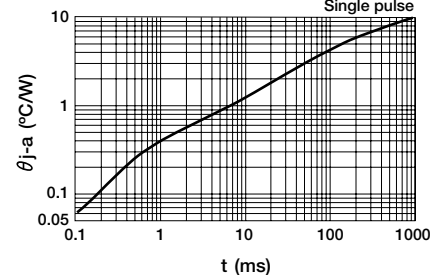
## h<sub>FE</sub>—I<sub>C</sub> Temperature Characteristics



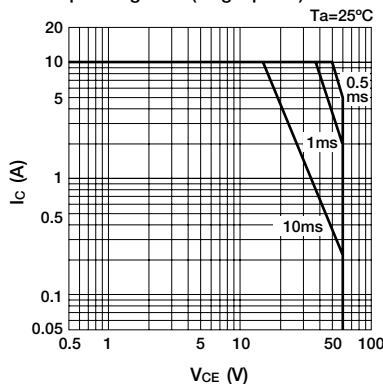
## ton·tstg·tr—I<sub>C</sub> Characteristics



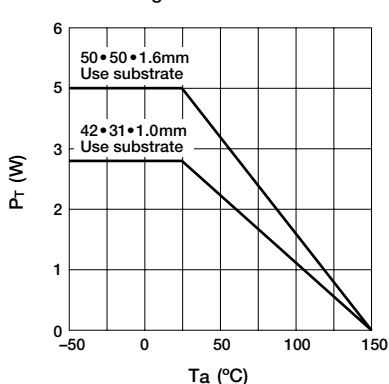
## θ<sub>j-a</sub>—t Characteristics



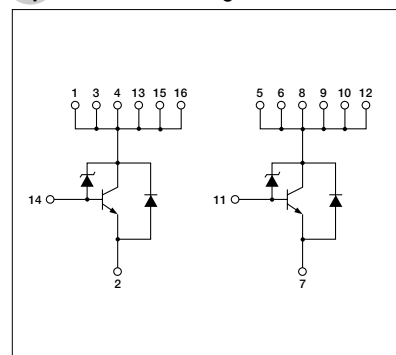
## Safe Operating Area (single pulse)



## P<sub>T</sub>—Ta Derating



## Equivalent Circuit Diagram



# Surface-mount Power Transistor Array SPF0001

## Absolute Maximum Ratings (Ta=25°C)

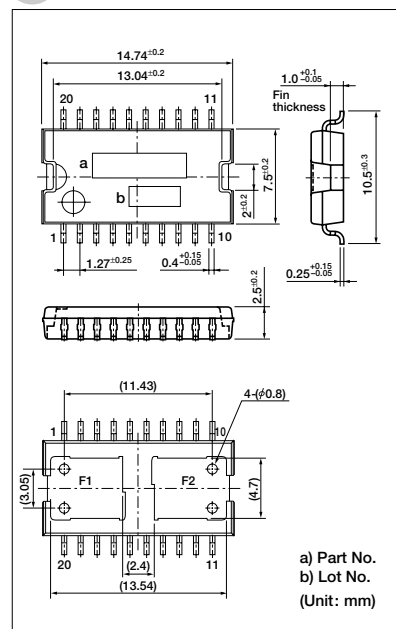
| Symbol           | Ratings        | Unit |
|------------------|----------------|------|
| V <sub>CB0</sub> | 115±10         | V    |
| V <sub>CEO</sub> | 115±10         | V    |
| V <sub>EB0</sub> | 6              | V    |
| I <sub>C</sub>   | ±6 (pulse ±10) | A    |
| I <sub>B</sub>   | 1              | A    |
| P <sub>T</sub> * | 2.5 (Ta=25°C)  | W    |
| T <sub>J</sub>   | 150            | °C   |
| Tstg             | -55 to +150    | °C   |

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

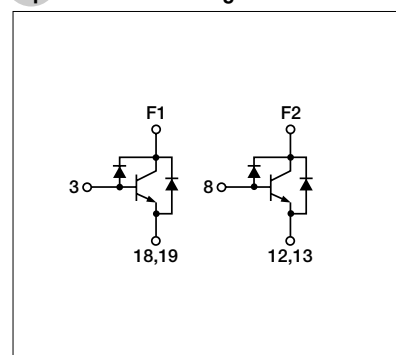
## Electrical Characteristics (Ta=25°C)

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

## External Dimensions SMD-16A



## Equivalent Circuit Diagram



# MOS FET 2SK2701

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                   | Ratings      | Unit |
|--------------------------|--------------|------|
| V <sub>DSS</sub>         | 450          | V    |
| V <sub>GSS</sub>         | ±30          | V    |
| I <sub>D</sub>           | ±7           | A    |
| I <sub>D</sub> (pulse)*1 | ±28          | A    |
| P <sub>T</sub>           | 35 (Tc=25°C) | W    |
| EAS*2                    | 130          | mJ   |
| IAS                      | 7            | A    |
| T <sub>ch</sub>          | 150          | °C   |
| T <sub>stg</sub>         | -55 to +150  | °C   |

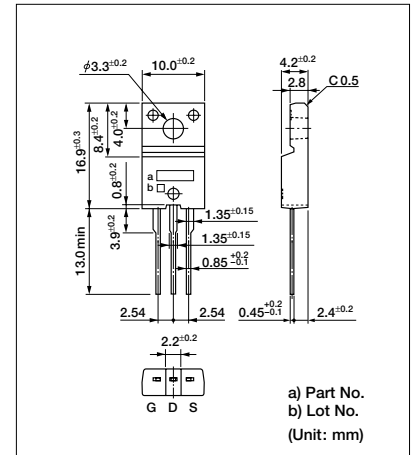
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 30V, L = 5mH, I<sub>L</sub> = 7A, unclamped, R<sub>G</sub> = 50Ω

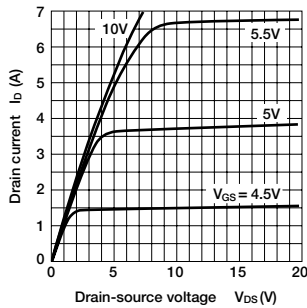
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                                | Ratings |      |      | Unit |
|-----------------------|------------------------------------------------|---------|------|------|------|
|                       |                                                | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V   | 450     |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±30V                         |         |      | ±100 | nA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 450V, V <sub>GS</sub> = 0V   |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA    | 2.0     | 3.0  | 4.0  | V    |
| Re (yfs)              | V <sub>DS</sub> = 20V, I <sub>D</sub> = 3.5A   | 3.5     | 5    |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 3.5A   |         | 0.84 | 1.10 | Ω    |
| Ciss                  | V <sub>D</sub> = 10V<br>f = 1.0MHz             |         | 720  |      | pF   |
| Coss                  | V <sub>GS</sub> = 0V                           |         | 150  |      | pF   |
| Crss                  | V <sub>GS</sub> = 0V                           |         | 65   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 3.5A                          |         | 25   |      | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 200V<br>R <sub>L</sub> = 57Ω |         | 40   |      | ns   |
| t <sub>d</sub> (off)  | V <sub>GS</sub> = 10V                          |         | 70   |      | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 10V                          |         | 50   |      | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 7A, V <sub>GS</sub> = 0V     |         | 1.0  | 1.5  | V    |

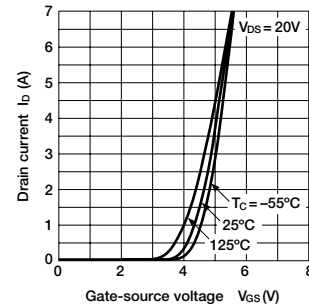
## External Dimensions FM20 (full-mold)



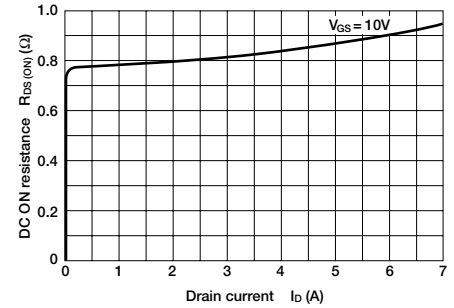
### I<sub>D</sub>—V<sub>DS</sub> Characteristics



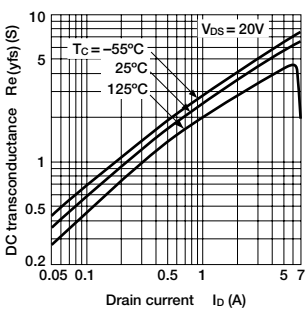
### I<sub>D</sub>—V<sub>GS</sub> Characteristics



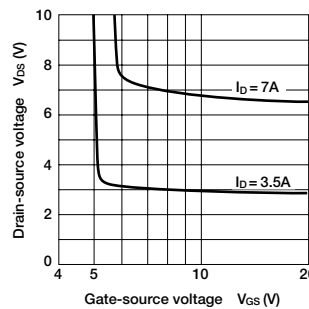
### R<sub>DS</sub> (ON)—I<sub>D</sub> Characteristics



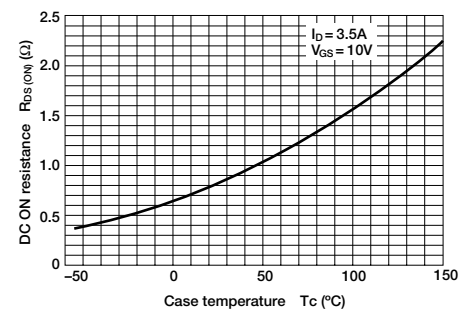
### Re (yfs)—I<sub>D</sub> Characteristics



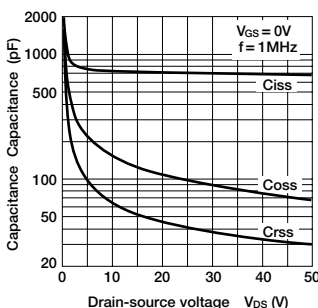
### V<sub>DS</sub>—V<sub>GS</sub> Characteristics



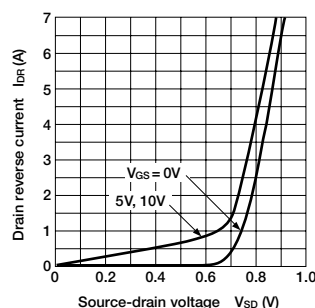
### R<sub>DS</sub> (ON)—T<sub>C</sub> Characteristics



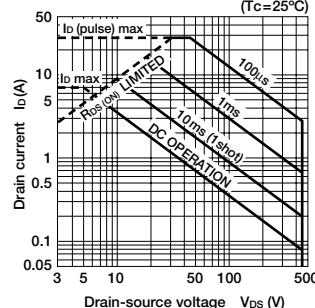
### Capacitance—V<sub>DS</sub> Characteristics



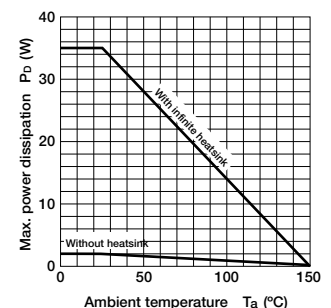
### I<sub>DR</sub>—V<sub>SD</sub> Characteristics



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



### P<sub>D</sub>—T<sub>a</sub> Derating



# MOS FET FKV460 (under development)

## Absolute Maximum Ratings (Ta=25°C)

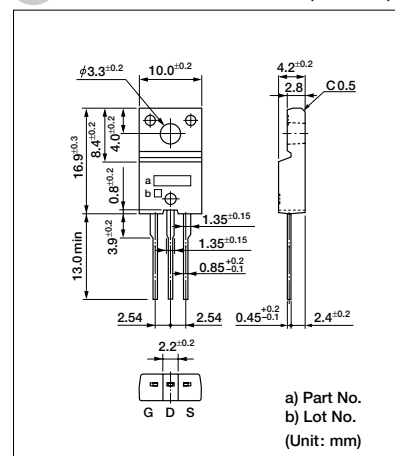
| Symbol                  | Ratings      | Unit |
|-------------------------|--------------|------|
| V <sub>DSS</sub>        | 40           | V    |
| V <sub>GSS</sub>        | +20, -10     | V    |
| I <sub>D</sub>          | ±60          | A    |
| I <sub>D</sub> (pulse)* | ±180         | A    |
| P <sub>D</sub>          | 40 (Tc=25°C) | W    |
| T <sub>ch</sub>         | 150          | °C   |
| T <sub>stg</sub>        | -55 to +150  | °C   |

\* P<sub>W</sub> ≤ 100μs, duty ≤ 1%

## Electrical Characteristics (Ta=25°C)

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

## External Dimensions TO220F (full-mold)



# MOS FET    FKV460S

## Absolute Maximum Ratings (Ta=25°C)

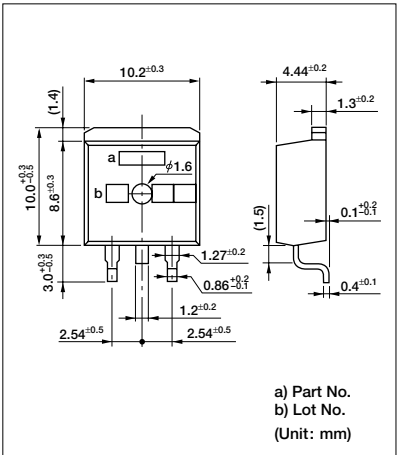
| Symbol                  | Ratings      | Unit |
|-------------------------|--------------|------|
| V <sub>DSS</sub>        | 40           | V    |
| V <sub>GSS</sub>        | +20, -10     | V    |
| I <sub>D</sub>          | ±60          | A    |
| I <sub>D</sub> (pulse)* | ±180         | A    |
| P <sub>D</sub>          | 60 (Tc=25°C) | W    |
| T <sub>ch</sub>         | 150          | °C   |
| T <sub>stg</sub>        | -55 to +150  | °C   |

\* P<sub>W</sub> ≤ 100μs, duty ≤ 1%

## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |     | Unit |
|-----------------------|-----------------------------------------------|---------|------|-----|------|
|                       |                                               | min     | typ  | max |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V  | 40      |      |     | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = +20V                        |         |      | +10 | μA   |
|                       | V <sub>GS</sub> = -10V                        |         |      | -5  | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V   |         |      | 100 | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.3     |      | 2.3 | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 25A   | 20.0    |      |     | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 25A   |         | 7    | 9   | mΩ   |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 2800 |     | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 1400 |     | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 600  |     | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 25A                          |         | 20   |     | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 12V                         |         | 600  |     | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 0.48Ω                        |         | 250  |     | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 10V                         |         | 100  |     | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 50A, V <sub>GS</sub> = 0V   |         | 1.0  | 1.5 | V    |

## External Dimensions TO220S



# MOS FET FKV560

## Absolute Maximum Ratings (Ta=25°C)

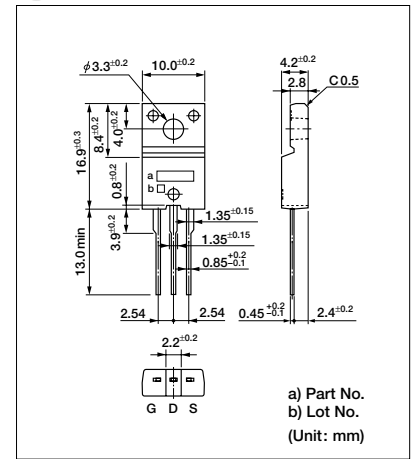
| Symbol                  | Ratings      | Unit |
|-------------------------|--------------|------|
| V <sub>DSS</sub>        | 50           | V    |
| V <sub>GSS</sub>        | +20, -10     | V    |
| I <sub>D</sub>          | ±60          | A    |
| I <sub>D</sub> (pulse)* | ±180         | A    |
| P <sub>D</sub>          | 35 (Tc=25°C) | W    |
| T <sub>ch</sub>         | 150          | °C   |
| T <sub>stg</sub>        | -55 to +150  | °C   |

\* P<sub>W</sub> ≤ 100μs, duty ≤ 1%

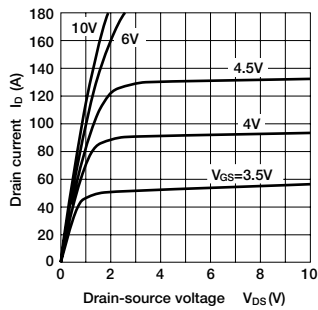
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |     | Unit |
|-----------------------|-----------------------------------------------|---------|------|-----|------|
|                       |                                               | min     | typ  | max |      |
| V <sub>(BR) DSS</sub> | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V  | 50      |      |     | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = +20V                        |         |      | +10 | μA   |
|                       | V <sub>GS</sub> = -10V                        |         |      | -5  | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 50V, V <sub>GS</sub> = 0V   |         |      | 100 | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     |      | 2.5 | V    |
| Re (yfs)              | V <sub>DS</sub> = 10V, I <sub>D</sub> = 25A   | 20      |      |     | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 25A   |         | 9    | 11  | mΩ   |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 2700 |     | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 1100 |     | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 500  |     | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 25A                          |         | 20   |     | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 12V                         |         | 600  |     | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 0.48Ω                        |         | 300  |     | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 10V                         |         | 100  |     | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 50A, V <sub>GS</sub> = 0V   | 1.0     |      | 1.5 | V    |
| Di, t <sub>rr</sub>   | I <sub>F</sub> = 25A, di/dt = 100A/μs         | 110     |      |     | ns   |

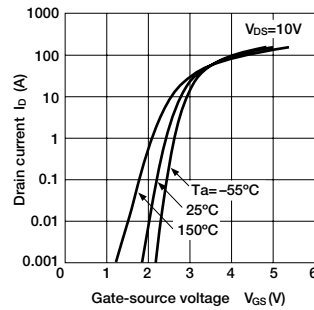
## External Dimensions TO220F (full-mold)



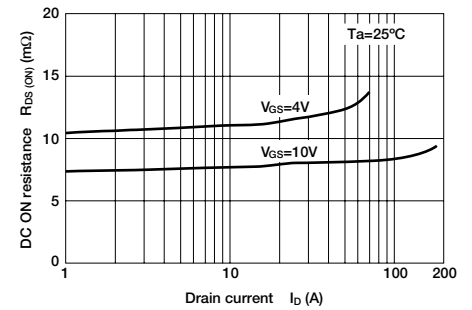
## I<sub>D</sub> — V<sub>DS</sub> Characteristics



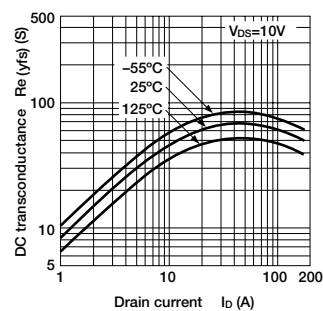
## I<sub>D</sub> — V<sub>GS</sub> Characteristics



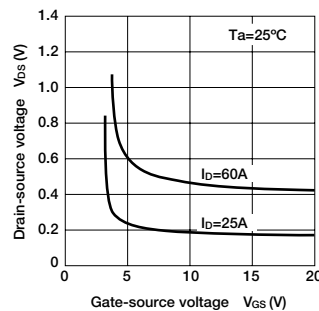
## R<sub>DS</sub> (ON) — I<sub>D</sub> Characteristics



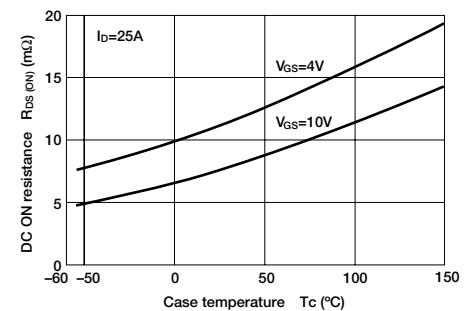
## Re (yfs) — I<sub>D</sub> Characteristics



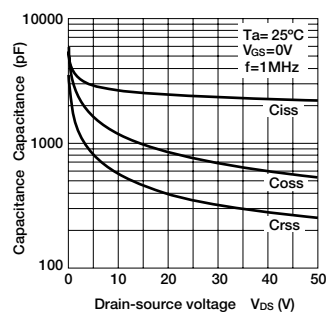
## V<sub>DS</sub> — V<sub>GS</sub> Characteristics



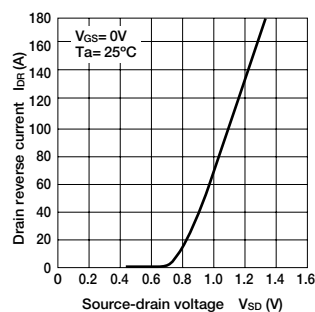
## R<sub>DS</sub> (ON) — T<sub>C</sub> Characteristics



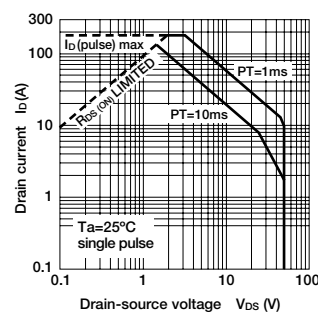
## Capacitance — V<sub>DS</sub> Characteristics



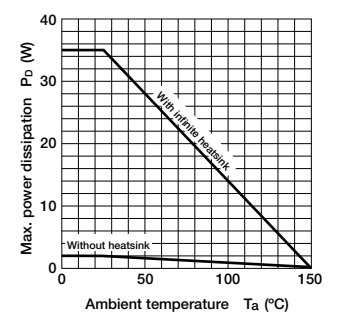
## I<sub>DR</sub> — V<sub>SD</sub> Characteristics



## Safe Operating Area



## P<sub>D</sub> — T<sub>a</sub> Derating



# MOS FET FKV560S

### Absolute Maximum Ratings (Ta=25°C)

| Symbol                  | Ratings                   | Unit |
|-------------------------|---------------------------|------|
| V <sub>DSS</sub>        | 50                        | V    |
| V <sub>GSS</sub>        | ±20                       | V    |
| I <sub>D</sub>          | ±45                       | A    |
| I <sub>D</sub> (pulse)* | ±135                      | A    |
| P <sub>D</sub>          | 60 (T <sub>c</sub> =25°C) | W    |
| T <sub>ch</sub>         | 150                       | °C   |
| T <sub>stg</sub>        | -55 to +150               | °C   |

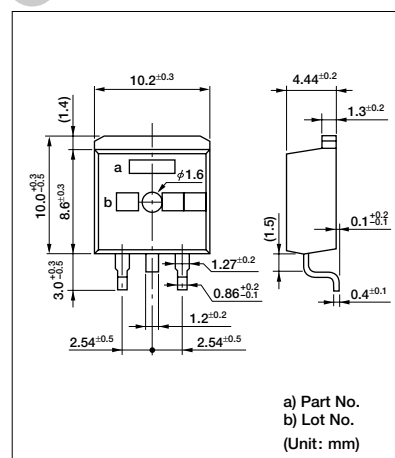
\*  $P_W \leq 100\mu s$ , duty  $\leq 1\%$

## Electrical Characteristics

(Ta=25°C)

| Symbol         | Test Conditions                | Ratings |               |     | Unit       |
|----------------|--------------------------------|---------|---------------|-----|------------|
|                |                                | min     | typ           | max |            |
| $V_{(BR)} DSS$ | $I_D = 100\mu A, V_{GS} = 0V$  | 50      |               |     | V          |
| $I_{GSS}$      | $V_{GS} = +20V$                |         |               | +10 | $\mu A$    |
|                | $V_{GS} = -20V$                |         |               | -5  |            |
| $I_{DSS}$      | $V_{DS} = 50V, V_{GS} = 0V$    |         |               | 100 | $\mu A$    |
| $V_{TH}$       | $V_{DS} = 10V, I_D = 250\mu A$ | 1.0     |               | 2.0 | V          |
| $Re (y_{fs})$  | $V_{DS} = 10V, I_D = 25A$      | 20.0    |               |     | S          |
| $R_{DS (ON)}$  | $V_{GS} = 10V, I_D = 25A$      |         | 9             | 11  | m $\Omega$ |
| $C_{iss}$      | $V_{DS} = 10V$                 |         | 2000          |     | pF         |
| $C_{oss}$      | $f = 1.0MHz$                   |         | 1000          |     | pF         |
| $C_{rss}$      | $V_{GS} = 0V$                  |         | 150           |     | pF         |
| $t_d (on)$     | $I_D = 25A$                    |         | To be defined |     | ns         |
| $t_r$          | $V_{DD} \div 12V$              |         |               |     | ns         |
| $t_d (off)$    | $R_L = 0.48\Omega$             |         |               |     | ns         |
| $t_f$          | $V_{GS} = 10V$                 |         |               |     | ns         |
| $V_{SD}$       | $I_{SD} = 50A, V_{GS} = 0V$    |         | 1.0           | 1.5 | V          |

## External Dimensions T0220S



# MOS FET FKV660 (under development)

## Absolute Maximum Ratings (Ta=25°C)

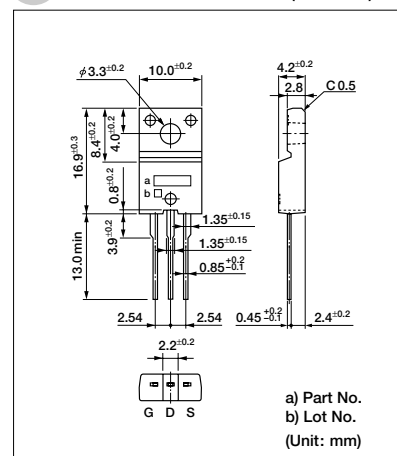
| Symbol                  | Ratings      | Unit |
|-------------------------|--------------|------|
| V <sub>DSS</sub>        | 60           | V    |
| V <sub>GSS</sub>        | ±20          | V    |
| I <sub>D</sub>          | ±50          | A    |
| I <sub>D</sub> (pulse)* | ±150         | A    |
| P <sub>D</sub>          | 40 (Tc=25°C) | W    |
| T <sub>ch</sub>         | 150          | °C   |
| T <sub>stg</sub>        | -55 to +150  | °C   |

\* P<sub>W</sub> ≤ 100μs, duty ≤ 1%

## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |               |     | Unit |
|-----------------------|-----------------------------------------------|---------|---------------|-----|------|
|                       |                                               | min     | typ           | max |      |
| V <sub>(BR) DSS</sub> | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V  | 60      |               |     | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = +20V                        |         |               | +10 | μA   |
|                       | V <sub>GS</sub> = -20V                        |         |               | -5  | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 60V, V <sub>GS</sub> = 0V   |         |               | 100 | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     |               | 2.0 | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 25A   | 20.0    |               |     | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 25A   |         | 11            | 14  | mΩ   |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 2000          |     | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 900           |     | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 100           |     | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 25A                          |         |               |     | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 12V                         |         | To be defined |     | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 0.48Ω                        |         |               |     | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 10V                         |         |               |     | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 50A, V <sub>GS</sub> = 0V   | 1.0     | 1.5           |     | V    |

## External Dimensions FM20 (full-mold)



# MOS FET FKV660S

### Absolute Maximum Ratings (Ta=25°C)

| Symbol                               | Ratings                   | Unit |
|--------------------------------------|---------------------------|------|
| V <sub>DSS</sub>                     | 60                        | V    |
| V <sub>GSS</sub>                     | +20, -10                  | V    |
| I <sub>D</sub>                       | ±60                       | A    |
| I <sub>D(pulse)</sub> <sup>(*)</sup> | ±180                      | A    |
| P <sub>D</sub>                       | 60 (T <sub>c</sub> =25°C) | W    |
| T <sub>ch</sub>                      | 150                       | °C   |
| T <sub>stg</sub>                     | -40 to +150               | °C   |

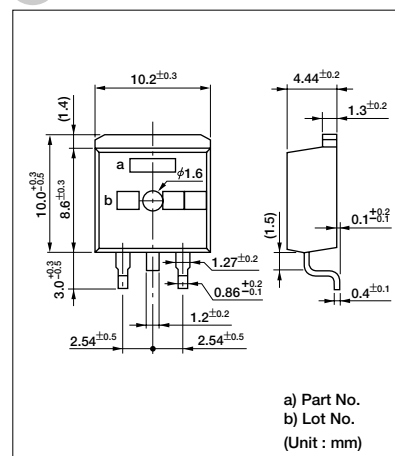
\* $P_w \leq 100 \mu s$ , duty  $\leq 1\%$

## Electrical Characteristics

(Ta=25°C)

| Symbol        | Test Conditions            | Ratings |      |     | Unit      |
|---------------|----------------------------|---------|------|-----|-----------|
|               |                            | min     | typ  | max |           |
| $V_{(BR)DSS}$ | $I_D=100\mu A, V_{GS}=0V$  | 60      |      |     | V         |
| $I_{GSS}$     | $V_{GS}=+20V$              |         |      | +10 | $\mu A$   |
|               | $V_{GS}=-10V$              |         |      | -5  |           |
| $I_{DSS}$     | $V_{DS}=60V, V_{GS}=0V$    |         |      | 100 | $\mu A$   |
| $V_{TH}$      | $V_{DS}=10V, I_D=250\mu A$ | 1.0     |      | 2.5 | V         |
| $Re(y_{fs})$  | $V_{DS}=10V, I_D=25A$      | 20      |      |     | S         |
| $R_{DS(ON)}$  | $V_{GS}=10V, I_D=25A$      |         | 11   | 14  | $m\Omega$ |
| $C_{iss}$     | $V_{DS}=10V$               |         | 2500 |     | pF        |
| $C_{oss}$     | $f=1.0MHz$                 |         | 900  |     | pF        |
| $C_{rss}$     | $V_{GS}=0V$                |         | 150  |     | pF        |
| $t_{d(on)}$   | $I_D=25A$                  |         | 50   |     | ns        |
| $t_r$         | $V_{DD}=12V$               |         | 400  |     | ns        |
| $t_{d(off)}$  | $R_L=0.48\Omega$           |         | 400  |     | ns        |
| $t_f$         | $V_{GS}=10V$               |         | 300  |     | ns        |
| $V_{SN}$      | $I_{SN}=50A, V_{GS}=0V$    |         | 1.0  | 1.5 | V         |

## External Dimensions



# MOS FET Array STA508A

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                   | Ratings      | Unit |
|--------------------------|--------------|------|
| V <sub>DSS</sub>         | 120          | V    |
| V <sub>GSS</sub>         | ±20          | V    |
| I <sub>D</sub>           | ±6           | A    |
| I <sub>D</sub> (pulse)*1 | ±10          | A    |
| P <sub>T</sub>           | 4 (Ta=25°C)  | W    |
|                          | 20 (Tc=25°C) | W    |
| E <sub>AS</sub> *2       | 80           | mJ   |
| T <sub>ch</sub>          | 150          | °C   |
| T <sub>stg</sub>         | -55 to +150  | °C   |

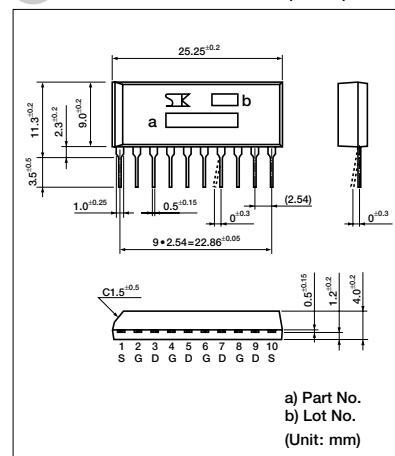
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 12V, L = 10mH, unclamped, R<sub>G</sub> = 50Ω

## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |      | Unit |
|-----------------------|-----------------------------------------------|---------|------|------|------|
|                       |                                               | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V  | 120     |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                        |         |      | ±5   | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 120V, V <sub>GS</sub> = 0V  |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     |      | 2.0  | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 4.0A  | 5.0     |      |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 4.0A  |         | 0.15 | 0.2  | Ω    |
|                       | V <sub>GS</sub> = 4V, I <sub>D</sub> = 4.0A   |         | 0.2  | 0.25 | Ω    |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 400  |      | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 130  |      | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 30   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 4A                           |         | 100  |      | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 12V                         |         | 300  |      | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 3Ω                           |         | 250  |      | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 5V                          |         | 200  |      | ns   |
|                       | R <sub>G</sub> = 50Ω                          |         |      |      |      |
| V <sub>SD</sub>       | I <sub>SD</sub> = 6A, V <sub>GS</sub> = 0V    | 1.0     | 1.5  |      | V    |

## External Dimensions STA4 (LF412)



# MOS FET Array STA509A

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                    | Ratings                     | Unit |
|---------------------------|-----------------------------|------|
| V <sub>DSS</sub>          | 52±5                        | V    |
| V <sub>GSS</sub>          | ±20                         | V    |
| I <sub>D</sub>            | ±3                          | A    |
| I <sub>D</sub> (pulse) *1 | ±6                          | A    |
| P <sub>T</sub>            | 4 (Ta=25°C)<br>20 (Tc=25°C) | W    |
| E <sub>AS</sub> *2        | 40                          | mJ   |
| T <sub>ch</sub>           | 150                         | °C   |
| T <sub>stg</sub>          | -55 to +150                 | °C   |

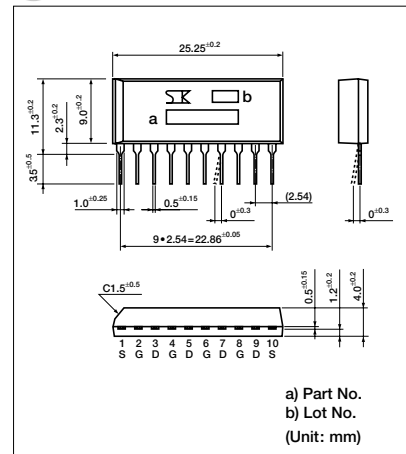
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 12V, L = 10mH, unclamped, R<sub>G</sub> = 10Ω

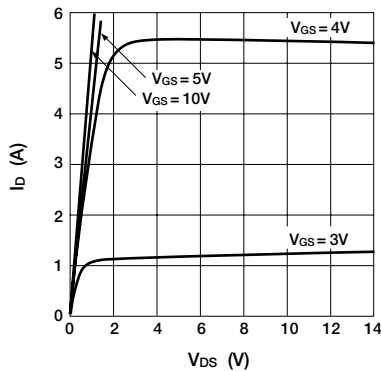
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |      | Unit |
|-----------------------|-----------------------------------------------|---------|------|------|------|
|                       |                                               | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 1mA, V <sub>GS</sub> = 0V    | 47      | 52   | 57   | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                        |         |      | ±1.0 | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V   |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     |      | 2.5  | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1.0A  | 1.0     |      |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 1.0A  |         | 0.2  | 0.25 | Ω    |
|                       | V <sub>GS</sub> = 4V, I <sub>D</sub> = 1.0A   |         | 0.25 | 0.3  | Ω    |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 200  |      | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 120  |      | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 20   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 1A<br>V <sub>DD</sub> = 12V  |         | 2.0  |      | μs   |
| t <sub>r</sub>        | R <sub>L</sub> = 12Ω                          |         | 7.4  |      | μs   |
| t <sub>d</sub> (off)  | V <sub>GS</sub> = 5V                          |         | 3.3  |      | μs   |
| t <sub>f</sub>        | R <sub>G1</sub> = 50Ω, R <sub>G2</sub> = 10Ω  |         | 4.2  |      | μs   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 6A, V <sub>GS</sub> = 0V    | 1.0     | 1.5  |      | V    |

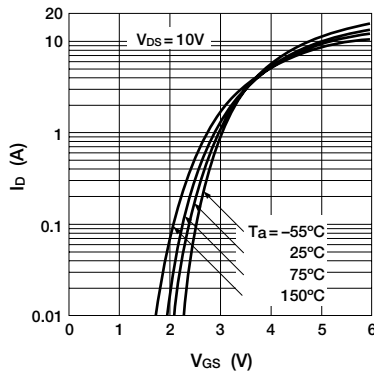
## External Dimensions STA



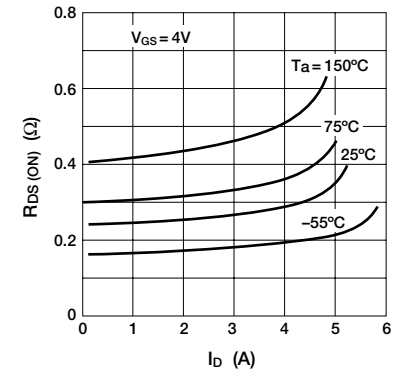
### ■ I<sub>D</sub>—V<sub>DS</sub> Characteristics



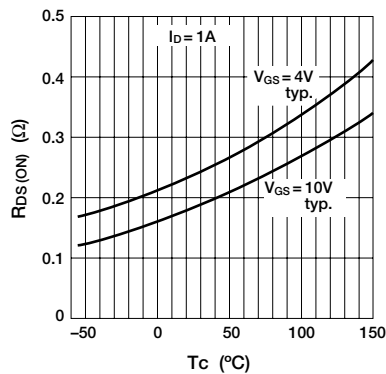
### ■ I<sub>D</sub>—V<sub>GS</sub> Characteristics



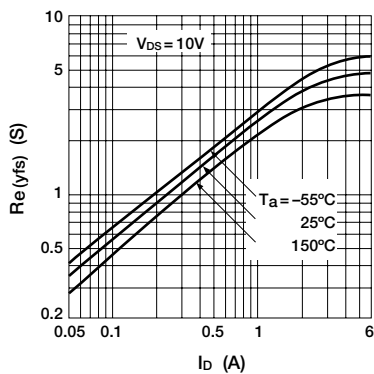
### ■ R<sub>DS</sub> (ON)—I<sub>D</sub> Characteristics



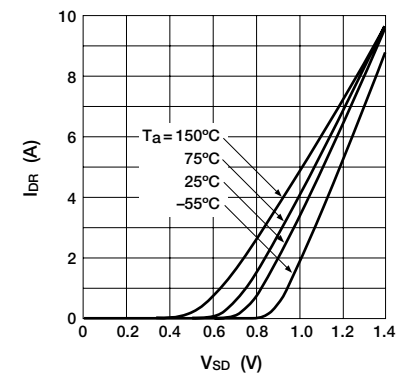
### ■ R<sub>DS</sub> (ON)—T<sub>C</sub> Characteristics



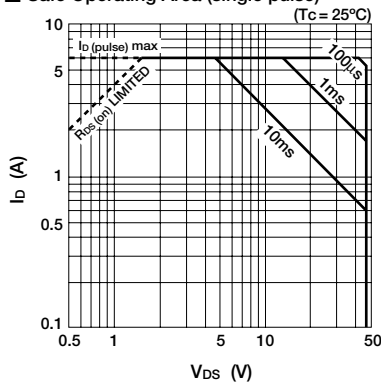
### ■ R<sub>e</sub> (yfs)—I<sub>D</sub> Characteristics



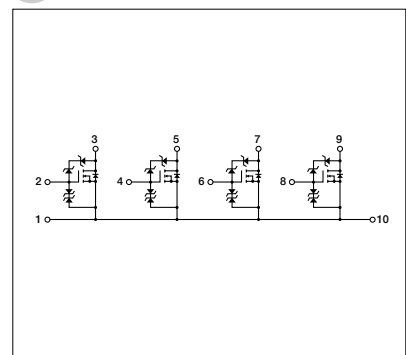
### ■ I<sub>DR</sub>—V<sub>SD</sub> Characteristics



### ■ Safe Operating Area (single pulse)



## Equivalent Circuit Diagram



# MOS FET Array SMA5113

## Absolute Maximum Ratings (Ta=25°C)

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

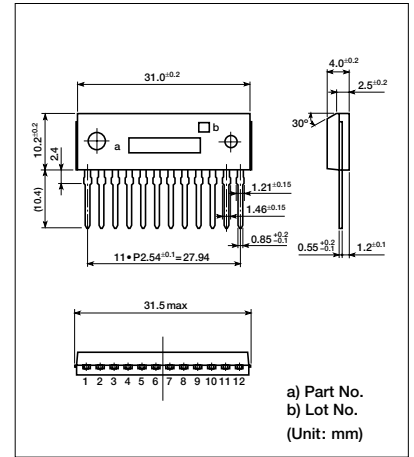
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 30V, L = 5mH, I<sub>L</sub> = 7A, unclamped, R<sub>G</sub> = 50Ω

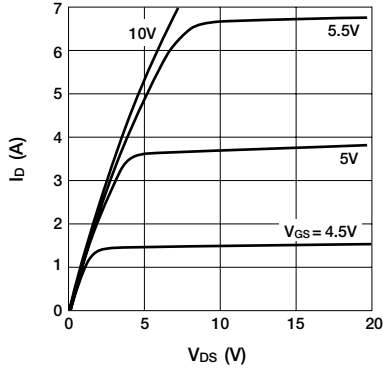
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                                                         | Ratings |      |      | Unit |
|-----------------------|-------------------------------------------------------------------------|---------|------|------|------|
|                       |                                                                         | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V                            | 450     |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±30V                                                  |         |      | ±100 | nA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 450V, V <sub>GS</sub> = 0V                            |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA                             | 2.0     |      | 4.0  | V    |
| Re (yfs)              | V <sub>DS</sub> = 20V, I <sub>D</sub> = 3.5A                            | 3.5     | 5.0  |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 3.5A                            |         | 0.84 | 1.1  | Ω    |
| Ciss                  | V <sub>DS</sub> = 10V<br>f = 1.0MHz                                     |         | 720  |      | pF   |
| Coss                  | V <sub>GS</sub> = 0V                                                    |         | 150  |      | pF   |
| Crss                  | V <sub>GS</sub> = 0V                                                    |         | 65   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 3.5A<br>V <sub>DD</sub> = 200V<br>R <sub>L</sub> = 57Ω |         | 25   |      | ns   |
| t <sub>r</sub>        | V <sub>GS</sub> = 10V                                                   |         | 40   |      | ns   |
| t <sub>d</sub> (off)  | V <sub>GS</sub> = 10V                                                   |         | 70   |      | ns   |
| t <sub>f</sub>        | R <sub>G</sub> = 50Ω                                                    |         | 50   |      | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 7A, V <sub>GS</sub> = 0V                              |         | 1.0  | 1.5  | V    |

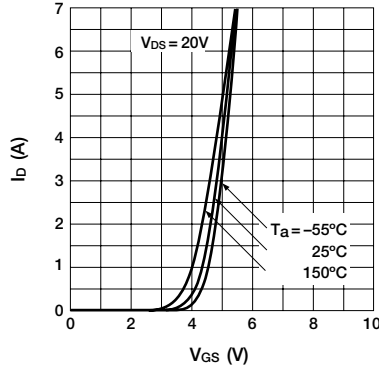
## External Dimensions SMA (LF1000)



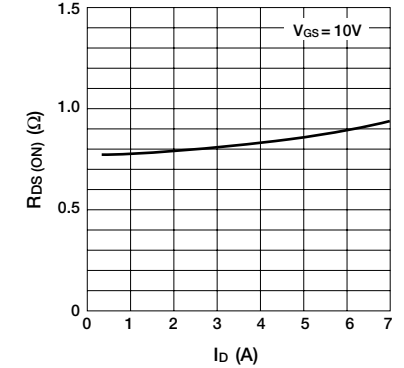
### I<sub>D</sub> — V<sub>DS</sub> Characteristics



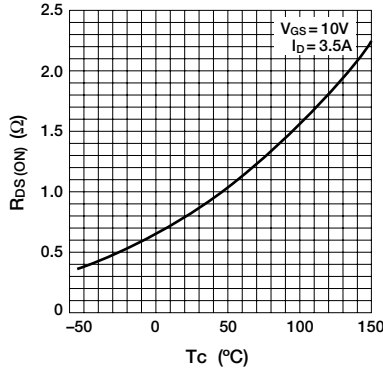
### I<sub>D</sub> — V<sub>GS</sub> Characteristics



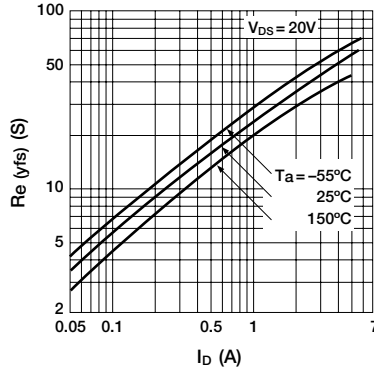
### R<sub>DS</sub> (ON) — I<sub>D</sub> Characteristics



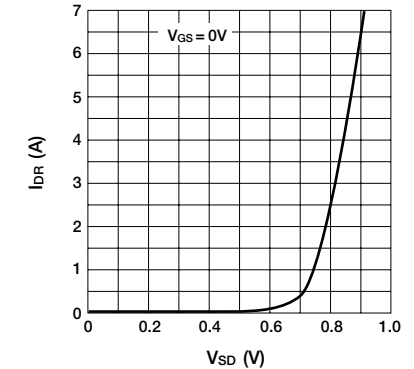
### R<sub>DS</sub> (ON) — T<sub>C</sub> Characteristics



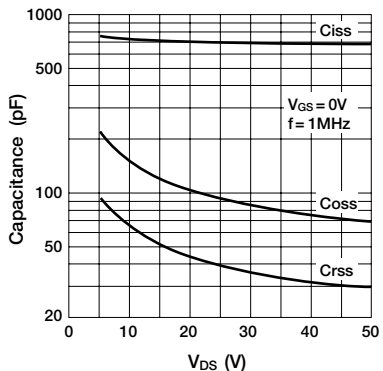
### Re (yfs) — I<sub>D</sub> Characteristics



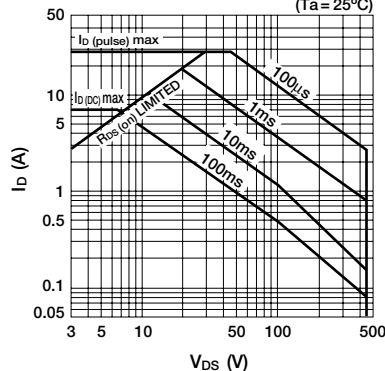
### I<sub>DR</sub> — V<sub>SD</sub> Characteristics



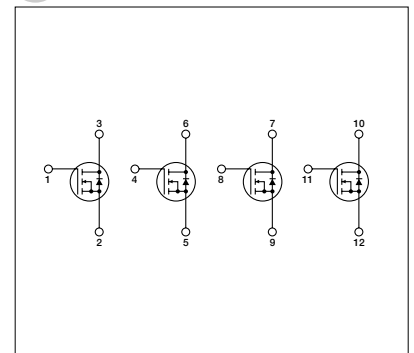
### Capacitance — V<sub>DS</sub> Characteristics



### Safe Operating Area (single pulse)



## Equivalent Circuit Diagram



# MOS FET Array SLA5027

## Absolute Maximum Ratings (Ta=25°C)

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

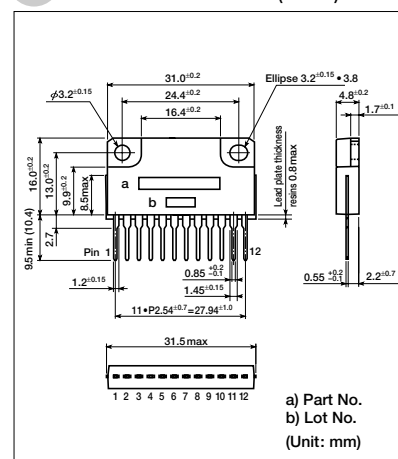
\*1 P<sub>W</sub> ≤ 250μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 30V, L = 10mH, unclamped, R<sub>G</sub> = 50Ω

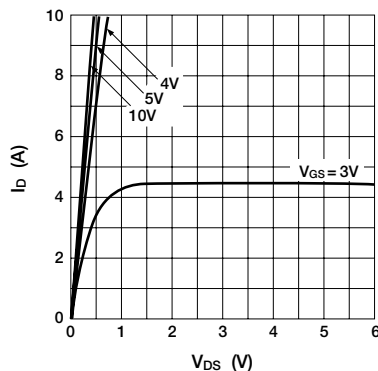
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                              | Ratings |      |      | Unit |
|-----------------------|----------------------------------------------|---------|------|------|------|
|                       |                                              | min     | typ  | max  |      |
| V <sub>(BR) DSS</sub> | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V | 60      |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                       |         |      | ±100 | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 60V, V <sub>GS</sub> = 0V  |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA  | 1.0     | 1.5  | 2.0  | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 8A   | 6.0     | 12.0 |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 4V, I <sub>D</sub> = 8A    |         | 0.07 | 0.08 | Ω    |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                        |         | 1100 |      | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                   |         | 500  |      | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                         |         | 170  |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 8A<br>V <sub>DD</sub> = 30V |         | 50   |      | ns   |
| t <sub>r</sub>        | R <sub>L</sub> = 3.75Ω                       |         | 250  |      | ns   |
| t <sub>d</sub> (off)  | V <sub>GS</sub> = 5V                         |         | 250  |      | ns   |
| t <sub>f</sub>        | R <sub>G</sub> = 50Ω                         |         | 180  |      | ns   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 10A, V <sub>GS</sub> = 0V  | 1.0     | 1.5  |      | V    |

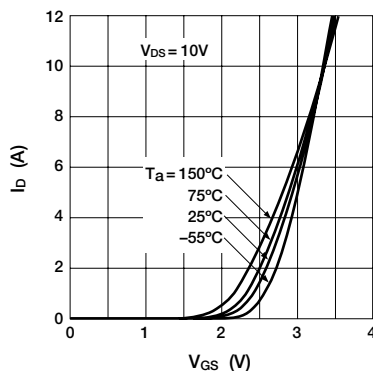
## External Dimensions SLA (LF800)



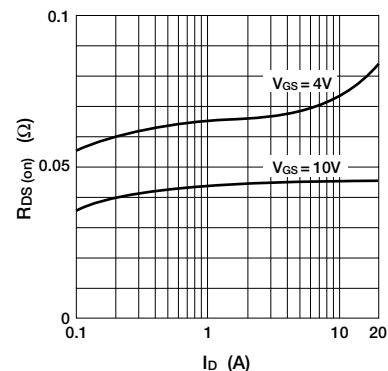
### I<sub>D</sub>—V<sub>DS</sub> Characteristics



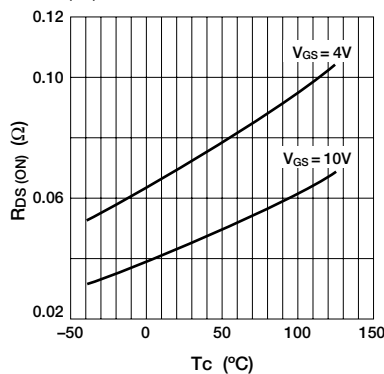
### I<sub>D</sub>—V<sub>GS</sub> Characteristics



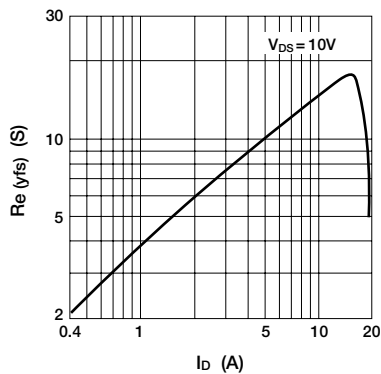
### R<sub>DS</sub> (ON)—I<sub>D</sub> Characteristics



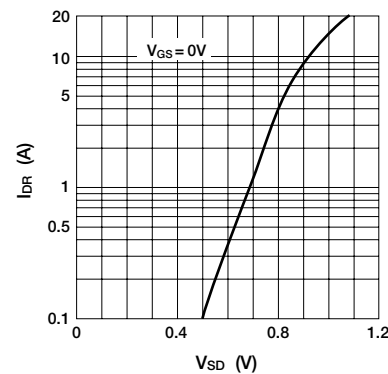
### R<sub>DS</sub> (ON)—T<sub>C</sub> Characteristics



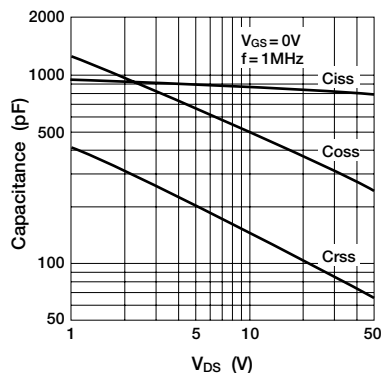
### R<sub>e</sub> (yfs)—I<sub>D</sub> Characteristics



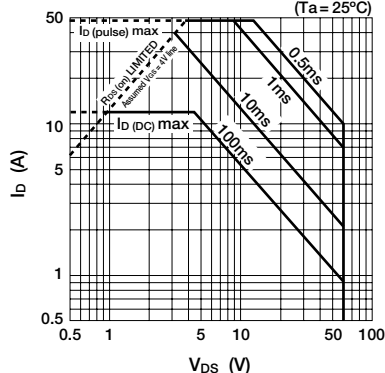
### I<sub>DR</sub>—V<sub>SD</sub> Characteristics



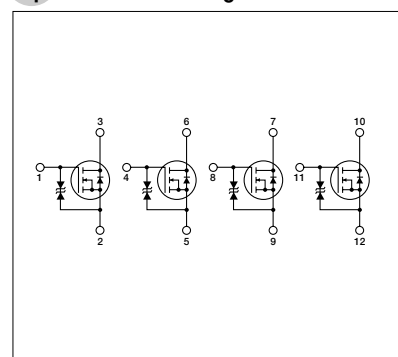
### Capacitance—V<sub>DS</sub> Characteristics



### Safe Operating Area (single pulse)



## Equivalent Circuit Diagram



# Surface-mount MOS FET Array SDK06

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                    | Ratings                         | Unit |
|---------------------------|---------------------------------|------|
| V <sub>DSS</sub>          | 52±5                            | V    |
| V <sub>GSS</sub>          | ±20                             | V    |
| I <sub>D</sub>            | ±3                              | A    |
| I <sub>D</sub> (pulse) *1 | ±6                              | A    |
| P <sub>T</sub>            | 3 (Tc=25°C, 4 circuits operate) | W    |
| E <sub>AS</sub> *2        | 40                              | mJ   |
| T <sub>ch</sub>           | 150                             | °C   |
| T <sub>stg</sub>          | -55 to +150                     | °C   |

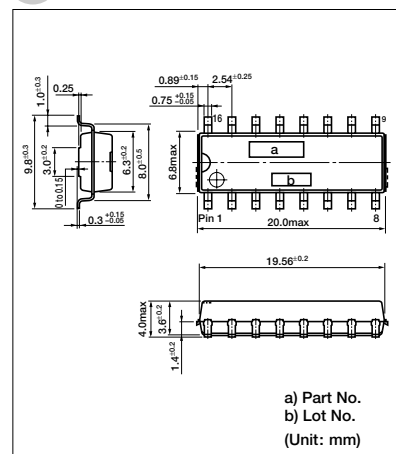
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 12V, L = 10mH, unclamped, R<sub>G</sub> = 10Ω

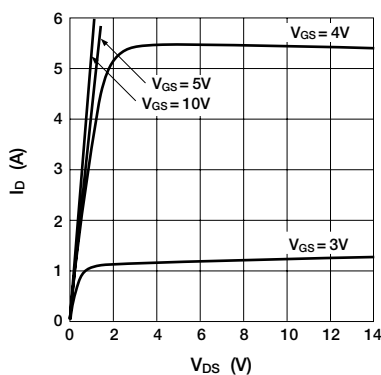
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |      | Unit |
|-----------------------|-----------------------------------------------|---------|------|------|------|
|                       |                                               | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 1mA, V <sub>GS</sub> = 0V    | 47      | 52   | 57   | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                        |         |      | ±1.0 | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V   |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     | 1.8  | 2.5  | V    |
| Re (yfs)              | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1.0A  | 1.0     |      |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 1.0A  |         | 0.2  | 0.25 | Ω    |
|                       | V <sub>GS</sub> = 4V, I <sub>D</sub> = 1.0A   |         | 0.25 | 0.3  | Ω    |
| Ciss                  | V <sub>DS</sub> = 10V                         |         | 200  |      | pF   |
| Coss                  | f = 1.0MHz                                    |         | 120  |      | pF   |
| Crss                  | V <sub>GS</sub> = 0V                          |         | 20   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 1A<br>V <sub>DD</sub> = 12V  |         | 2.0  |      | μs   |
| t <sub>r</sub>        | R <sub>L</sub> = 12Ω                          |         | 7.4  |      | μs   |
| t <sub>d</sub> (off)  | V <sub>GS</sub> = 5V                          |         | 3.3  |      | μs   |
| t <sub>f</sub>        | R <sub>G1</sub> = 50Ω, R <sub>G2</sub> = 10kΩ |         | 4.2  |      | μs   |
| V <sub>SD</sub>       | I <sub>SD</sub> = 1A, V <sub>GS</sub> = 0V    | 1.0     | 1.5  |      | V    |

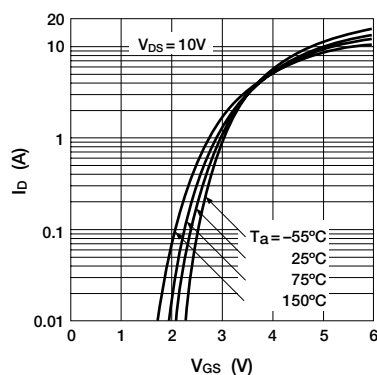
## External Dimensions SMD-16A



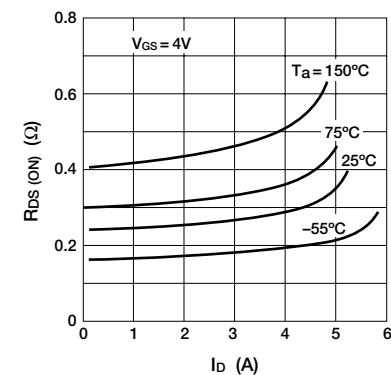
### I<sub>D</sub>—V<sub>DS</sub> Characteristics



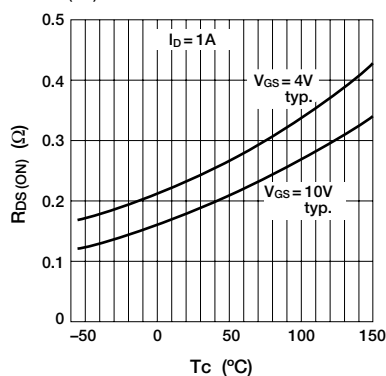
### I<sub>D</sub>—V<sub>GS</sub> Characteristics



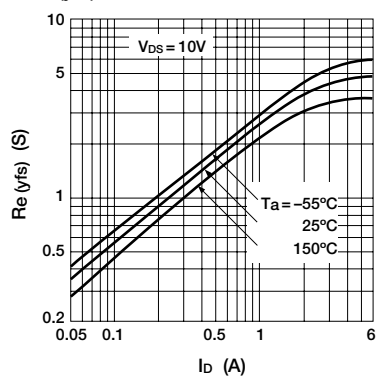
### R<sub>DS</sub> (ON)—I<sub>D</sub> Characteristics



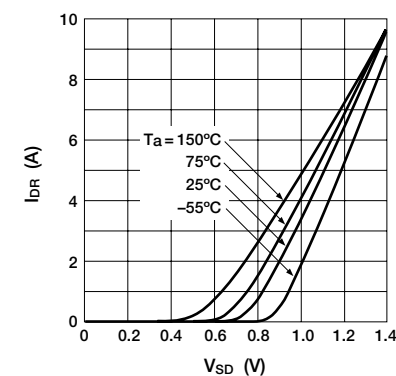
### R<sub>DS</sub> (ON)—T<sub>C</sub> Characteristics



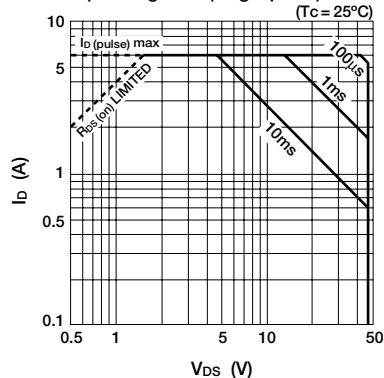
### Re (yfs)—I<sub>D</sub> Characteristics



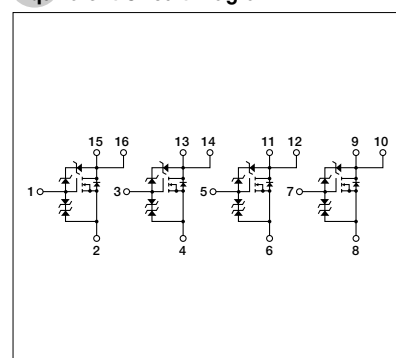
### I<sub>DR</sub>—V<sub>SD</sub> Characteristics



### Safe Operating Area (single pulse)



### Equivalent Circuit Diagram



# Surface-mount MOS FET Array    SDK08

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                    | Ratings                         | Unit |
|---------------------------|---------------------------------|------|
| V <sub>DSS</sub>          | 50                              | V    |
| V <sub>GSS</sub>          | ±20                             | V    |
| I <sub>D</sub>            | ±4.5                            | A    |
| I <sub>D</sub> (pulse) *1 | ±9                              | A    |
| P <sub>T</sub>            | 4 (Tc=25°C, 4 circuits operate) | W    |
| E <sub>AS</sub> *2        | 80                              | mJ   |
| T <sub>ch</sub>           | 150                             | °C   |
| T <sub>stg</sub>          | -55 to +150                     | °C   |

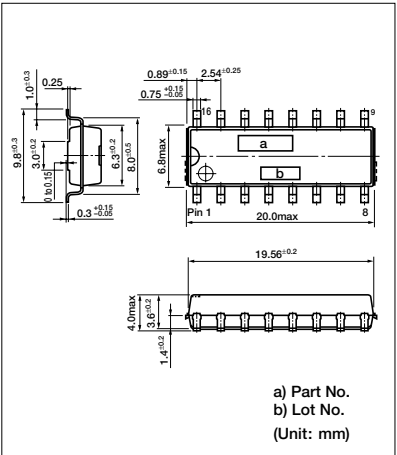
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DD</sub> = 12V, L = 10mH, unclamped, R<sub>G</sub> = 50Ω

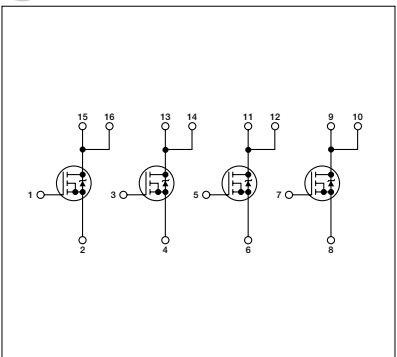
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                              | Ratings |      |      | Unit |
|-----------------------|----------------------------------------------|---------|------|------|------|
|                       |                                              | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V | 50      |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                       |         |      | ±100 | nA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 50V, V <sub>GS</sub> = 0V  |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA  | 1.3     | 1.8  | 2.3  | V    |
| R <sub>e</sub> (y/s)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 4.0A | 5.0     | 9.0  | 13.0 | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 4.0A |         | 0.07 | 0.08 | Ω    |
|                       | V <sub>GS</sub> = 4V, I <sub>D</sub> = 4.0A  |         | 0.09 | 0.1  | Ω    |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                        |         | 700  |      | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                   |         | 300  |      | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                         |         | 90   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 4A                          |         | 50   |      | ns   |
| t <sub>r</sub>        | V <sub>DD</sub> = 12V                        |         | 80   |      | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 3Ω                          |         | 60   |      | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 5V                         |         | 40   |      | ns   |
|                       | R <sub>G</sub> = 50Ω                         |         |      |      |      |
| V <sub>SD</sub>       | I <sub>SD</sub> = 6A, V <sub>GS</sub> = 0V   | 1.0     | 1.5  |      | V    |

## External Dimensions SMD-16A



## Equivalent Circuit Diagram



# Surface-mount MOS FET Array SDK09 (under development)

## Absolute Maximum Ratings (Ta=25°C)

| Symbol                   | Ratings                         | Unit |
|--------------------------|---------------------------------|------|
| V <sub>DS</sub>          | 120                             | V    |
| V <sub>GS</sub>          | ±20                             | V    |
| I <sub>D</sub>           | ±6                              | A    |
| I <sub>D</sub> (pulse)*1 | ±10                             | A    |
| P <sub>T</sub>           | 3 (Tc=25°C, 4 circuits operate) | W    |
| E <sub>AS</sub> *2       | 80                              | mJ   |
| T <sub>ch</sub>          | 150                             | °C   |
| T <sub>stg</sub>         | -55 to +150                     | °C   |

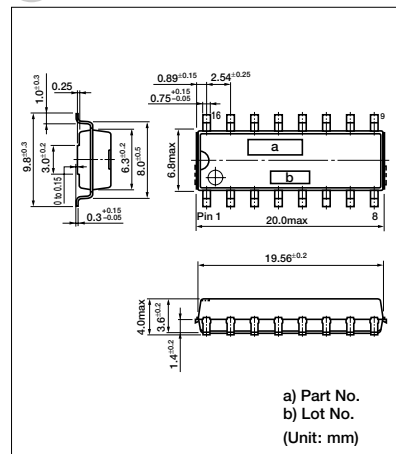
\*1 P<sub>W</sub> ≤ 100μs, duty ≤ 1%

\*2 V<sub>DS</sub> = 12V, L = 10mH, unclamped, R<sub>G</sub> = 50Ω

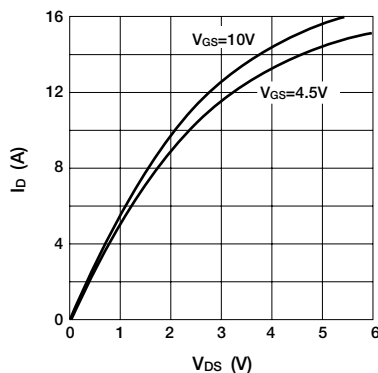
## Electrical Characteristics (Ta=25°C)

| Symbol                | Test Conditions                               | Ratings |      |      | Unit |
|-----------------------|-----------------------------------------------|---------|------|------|------|
|                       |                                               | min     | typ  | max  |      |
| V <sub>(BR)</sub> DSS | I <sub>D</sub> = 100μA, V <sub>GS</sub> = 0V  | 120     |      |      | V    |
| I <sub>GSS</sub>      | V <sub>GS</sub> = ±20V                        |         |      | ±5   | μA   |
| I <sub>DSS</sub>      | V <sub>DS</sub> = 120V, V <sub>GS</sub> = 0V  |         |      | 100  | μA   |
| V <sub>TH</sub>       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA | 1.0     |      | 2.0  | V    |
| R <sub>e</sub> (yfs)  | V <sub>DS</sub> = 10V, I <sub>D</sub> = 4A    | 5.0     |      |      | S    |
| R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 4A    |         | 0.15 | 0.2  | Ω    |
|                       | V <sub>GS</sub> = 4V, I <sub>D</sub> = 4A     |         | 0.2  | 0.25 |      |
| C <sub>iss</sub>      | V <sub>DS</sub> = 10V                         |         | 400  |      | pF   |
| C <sub>oss</sub>      | f = 1.0MHz                                    |         | 130  |      | pF   |
| C <sub>rss</sub>      | V <sub>GS</sub> = 0V                          |         | 30   |      | pF   |
| t <sub>d</sub> (on)   | I <sub>D</sub> = 4A                           |         | 100  |      | ns   |
| t <sub>r</sub>        | V <sub>DS</sub> = 12V                         |         | 300  |      | ns   |
| t <sub>d</sub> (off)  | R <sub>L</sub> = 3Ω                           |         | 250  |      | ns   |
| t <sub>f</sub>        | V <sub>GS</sub> = 5V                          |         | 200  |      | ns   |
|                       | R <sub>G</sub> = 50Ω                          |         |      |      |      |
| V <sub>SD</sub>       | I <sub>SD</sub> = 6A, V <sub>GS</sub> = 0V    | 1.0     | 1.5  |      | V    |

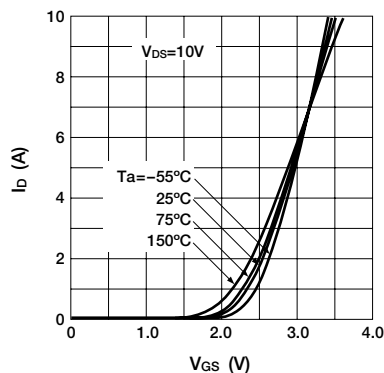
## External Dimensions SMD-16A



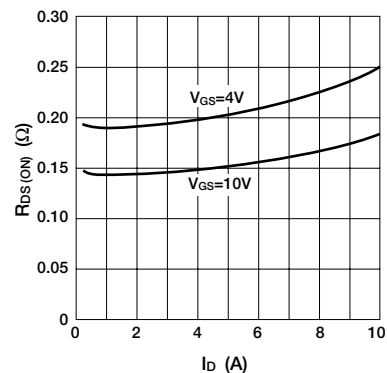
### I<sub>D</sub> — V<sub>DS</sub> Characteristics



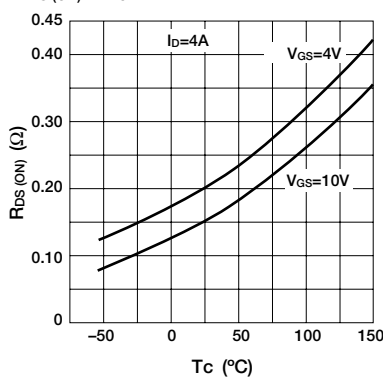
### I<sub>D</sub> — V<sub>GS</sub> Characteristics



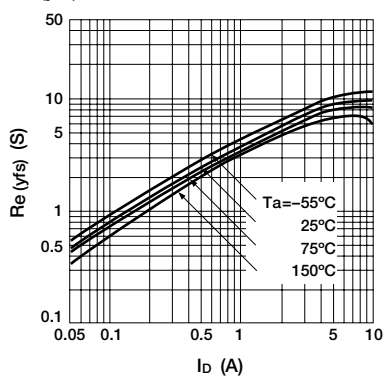
### R<sub>DS</sub> (ON) — I<sub>D</sub> Characteristics



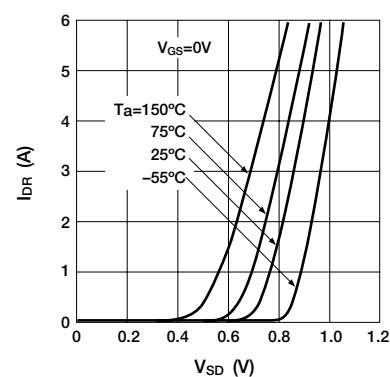
### R<sub>DS</sub> (ON) — T<sub>C</sub> Characteristics



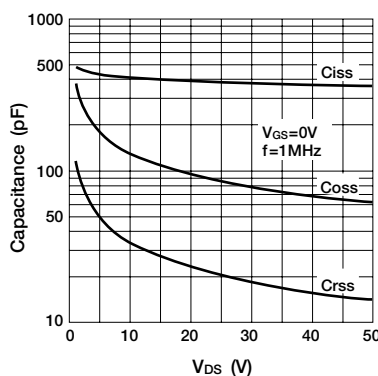
### R<sub>e</sub> (yfs) — I<sub>D</sub> Characteristics



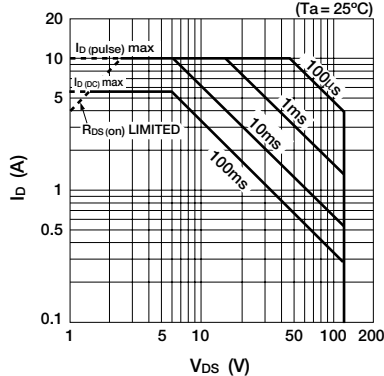
### I<sub>DR</sub> — V<sub>SD</sub> Characteristics



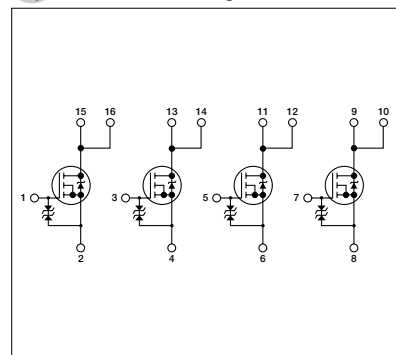
### Capacitance — V<sub>DS</sub> Characteristics



### Safe Operating Area (single pulse)



## Equivalent Circuit Diagram



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

## Features

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

## Absolute Maximum Ratings

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

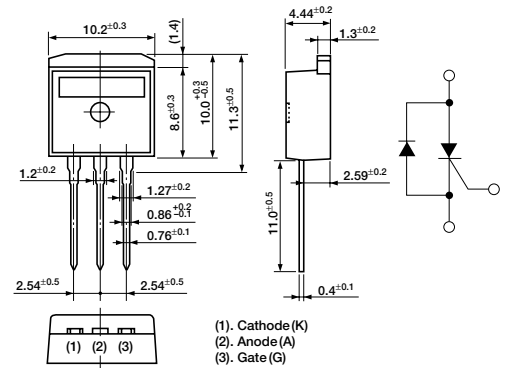
\* The surge current for  $T=10ms$ /cycle shall be applied 50 cycles successively, and an interval time shall follow to cool down the junction temperature of the device to  $125^\circ C$ . This process shall be repeated up to 100K cycles.

## Electrical Characteristics

( $T_J=25^\circ C$ )

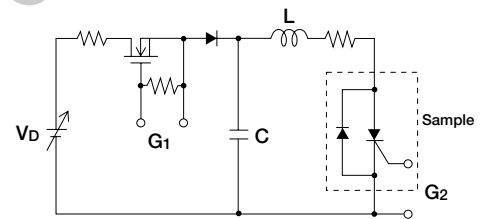
| Parameter                | Symbol        | Ratings |      |     | Unit         | Conditions                                             |
|--------------------------|---------------|---------|------|-----|--------------|--------------------------------------------------------|
|                   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

## External Dimensions (unit: mm)



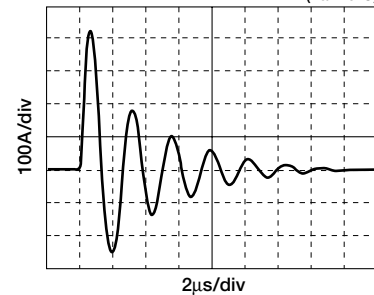
Weight: Approx. 1.5g

## Measurement circuit



## Current waveform (1cycle)

( $T_a=25^\circ C$ )



# Rectifier Diodes for Alternators

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

## External Dimensions (unit: mm)

Fig. 1

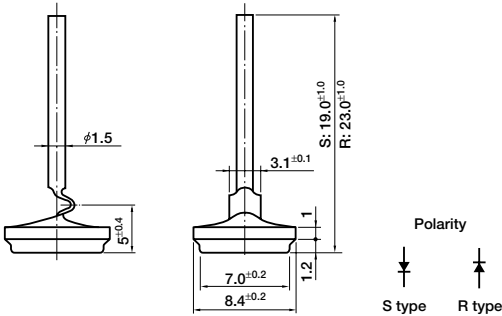
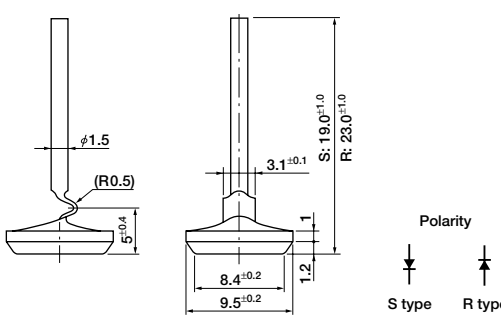


Fig. 2



# High-voltage Diodes for Igniters

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

## External Dimensions (unit: mm)

Fig. 1 (SHV-05JS)

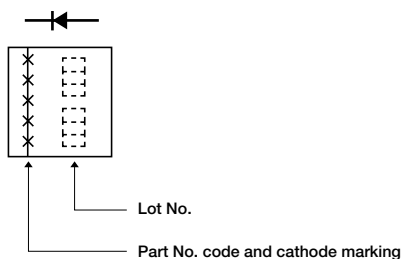
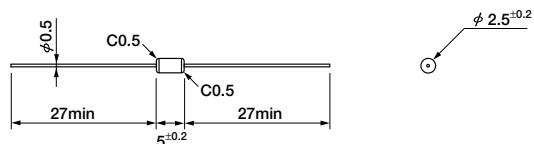


Fig. 2 (SHV-08J)

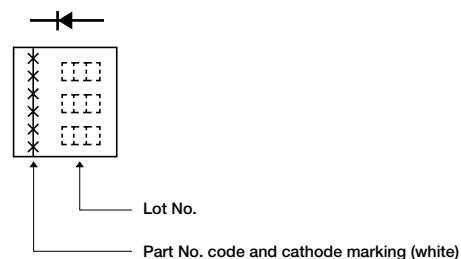
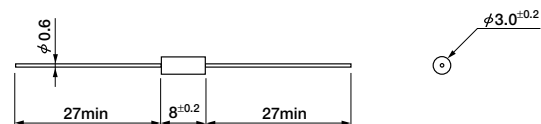
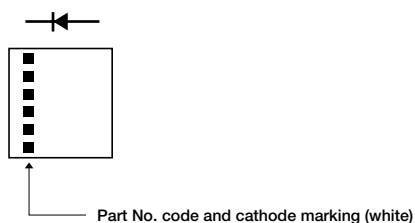
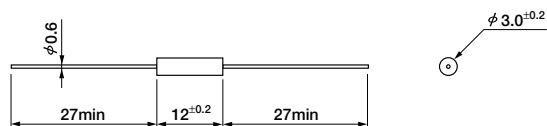


Fig. 3 (SHV-30J)



# Power Zener Diode

(Ta=25°C)

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

## External Dimensions (unit: mm)

Fig. 1

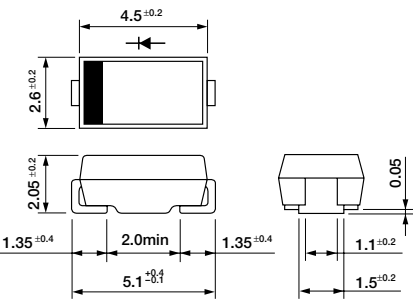


Fig. 2

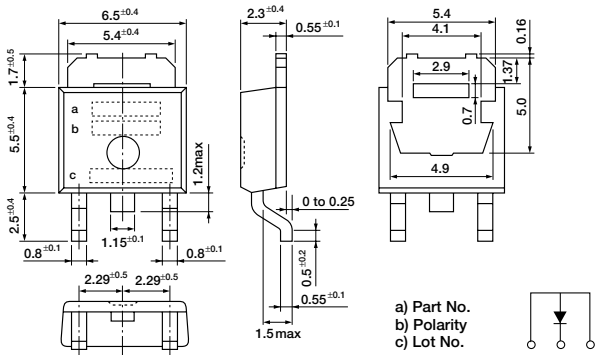
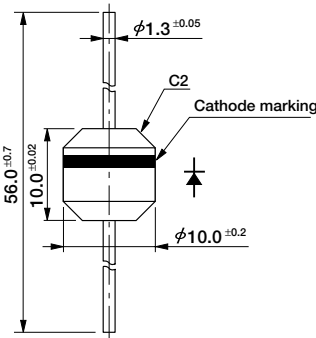


Fig. 3



# General-purpose Diodes

## Rectifier Diodes

### ■ Surface-mount Type

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

### ■ Axial Type

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

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

### ■ Center-tap Type

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

# Fast Recovery Rectifier Diodes

## ■ Axial Type

● trr1=I<sub>F</sub>/I<sub>RP</sub>=1:1, trr2=I<sub>F</sub>/I<sub>RP</sub>=1:2

| Part No. | Absolute Maximum Ratings |                            |                         |                |                  | Electrical Characteristics   |                               |                     |                     | Fig. No. |
|----------|--------------------------|----------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|---------------------|---------------------|----------|
|          | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(μA)<br>max | trr1<br>(μs)<br>max | trr2<br>(μs)<br>max |          |
|          |                          |                            |                         | °C             |                  |                              |                               |                     |                     |          |
| EU 2YX   | 100                      | 1.2                        | 25                      | -40 to +150    |                  | 0.9                          | 10                            | 0.2                 | 0.08                | 4        |
| RU 2YX   |                          | 1.5                        | 30                      | -40 to +150    |                  | 0.95                         | 10                            | 0.2                 | 0.08                | 5        |
| RU 3YX   |                          | 2.0                        | 50                      | -40 to +150    |                  | 0.95                         | 10                            | 0.2                 | 0.08                | 6        |
| RU 4Y    |                          | 3.5                        | 70                      | -40 to +150    |                  | 1.3                          | 10                            | 0.4                 | 0.18                | 8        |
| RU 30Y   |                          |                            | 80                      | -40 to +150    |                  | 0.97                         | 10                            | 0.4                 | 0.18                | 7        |
| RU 4YX   |                          | 4.0                        | 70                      | -40 to +150    |                  | 1.3                          | 10                            | 0.4                 | 0.18                | 8        |
| EU01Z    | 200                      | 0.25                       | 15                      | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 1Z    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 4        |
| AU01Z    |                          | 0.5                        | 15                      | -40 to +150    |                  | 1.7                          | 10                            | 0.4                 | 0.18                | 2        |
| RF 1Z    |                          |                            |                         | -40 to +150    |                  | 2.0                          | 10                            | 0.4                 | 0.18                | 5        |
| AS01Z    |                          | 0.6                        | 20                      | -40 to +150    |                  | 1.5                          | 10                            | 1.5                 | 0.6                 | 2        |
| EH 1Z    |                          |                            |                         | -40 to +150    |                  | 1.35                         | 10                            | 4.0                 | 1.3                 | 4        |
| RH 1Z    |                          |                            |                         | -40 to +150    |                  | 1.3                          | 5                             | 4.0                 | 1.3                 | 5        |
| ES01Z    |                          | 0.7                        | 30                      | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 3        |
| ES 1Z    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 4        |
| AU02Z    |                          | 0.8                        | 25                      | -40 to +150    |                  | 1.3                          | 10                            | 0.4                 | 0.18                | 2        |
| EU02Z    |                          |                            |                         | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 2Z    |                          | 1.0                        | 15                      | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 4        |
| RU 2Z    |                          |                            |                         | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 5        |
| RU 4Z    |                          | 3.5                        | 70                      | -40 to +150    |                  | 1.3                          | 10                            | 0.4                 | 0.18                | 8        |
| RU 30Z   |                          |                            |                         | -40 to +150    |                  | 0.97                         | 10                            | 0.4                 | 0.18                | 7        |
| RU 1     | 400                      | 0.25                       | 15                      | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 5        |
| EU01     |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 1     |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 4        |
| AU01     |                          | 0.5                        | 15                      | -40 to +150    |                  | 1.7                          | 10                            | 0.4                 | 0.18                | 2        |
| RF 1     |                          |                            |                         | -40 to +150    |                  | 2.0                          | 10                            | 0.4                 | 0.18                | 5        |
| AS01     |                          |                            |                         | -40 to +150    |                  | 1.5                          | 10                            | 1.5                 | 0.6                 | 2        |
| EH 1     |                          | 0.6                        | 20                      | -40 to +150    |                  | 1.35                         | 10                            | 4.0                 | 1.3                 | 4        |
| RH 1     |                          |                            |                         | -40 to +150    |                  | 1.3                          | 5                             | 4.0                 | 1.3                 | 5        |
| ES01     |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 4        |
| ES 1     |                          | -40 to +150                |                         | 2.5            | 10               | 1.5                          | 0.6                           |                     |                     |          |
| AU02     |                          | 0.8                        | 25                      | -40 to +150    |                  | 1.3                          | 10                            | 0.4                 | 0.18                | 2        |
| EU02     |                          |                            |                         | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 2     |                          | 1.0                        | 15                      | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 4        |
| RU 2M    |                          |                            |                         | -40 to +150    |                  | 1.2                          | 10                            | 0.4                 | 0.18                | 5        |
| RU 3     |                          | 1.5                        | 20                      | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 6        |
| RU 3M    |                          |                            |                         | -40 to +150    |                  | 1.1                          | 10                            | 0.4                 | 0.18                |          |
| RU 30    |                          | 2.0                        | 200                     | -40 to +150    |                  | 0.95                         | 10                            | 0.4                 | 0.18                | 7        |
| RU 4     |                          |                            |                         | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 8        |
| RU 31    |                          | 3.0                        | 50                      | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 7        |
| RU 31    |                          |                            |                         | -40 to +150    |                  | 1.2                          | 50                            | 0.4                 | 0.18                |          |
| RU 4M    | 3.5                      | 70                         | -40 to +150             |                | 1.3              | 10                           | 0.4                           | 0.18                | 8                   |          |
| RU 1A    | 600                      | 0.25                       | 15                      | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 5        |
| EU01A    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 1A    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 4        |
| RF 1A    |                          | 0.6                        | 15                      | -40 to +150    |                  | 2.0                          | 10                            | 0.4                 | 0.18                | 5        |
| AS01A    |                          |                            |                         | -40 to +150    |                  | 1.5                          | 10                            | 1.5                 | 0.6                 | 2        |
| EH 1A    |                          |                            |                         | -40 to +150    |                  | 1.35                         | 10                            | 4.0                 | 1.3                 | 4        |
| RH 1A    |                          | 0.7                        | 35                      | -40 to +150    |                  | 1.3                          | 5                             | 4.0                 | 1.3                 | 5        |
| ES01A    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 3        |
| ES 1A    |                          | 0.7                        | 30                      | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 4        |
| RS 1A    |                          |                            |                         | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 | 5        |

| Part No. | Absolute Maximum Ratings |                            |                         |                |                  | Electrical Characteristics   |                               |                     |                     | Fig. No. |
|----------|--------------------------|----------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|---------------------|---------------------|----------|
|          | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(μA)<br>max | trr1<br>(μs)<br>max | trr2<br>(μs)<br>max |          |
|          |                          |                            |                         | (°C)           |                  |                              |                               |                     |                     |          |
| EU02A    | 600                      | 1.0                        | 15                      | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 3        |
| EU 2A    |                          |                            |                         | -40 to +150    |                  | 1.4                          | 10                            | 0.4                 | 0.18                | 4        |
| RU 2     |                          | 2.0                        | 20                      | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 5        |
| RU 2AM   |                          |                            |                         | -40 to +150    |                  | 1.2                          | 10                            | 0.4                 | 0.18                |          |
| RU 3A    |                          | 1.1                        | 20                      | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 6        |
| RU 20A   |                          |                            |                         | -40 to +150    |                  | 1.1                          | 10                            | 0.4                 | 0.18                | 5        |
| RU 3AM   |                          | 1.5                        | 50                      | -40 to +150    |                  | 1.1                          | 10                            | 0.4                 | 0.18                | 6        |
| RU 30A   |                          |                            |                         | -40 to +150    |                  | 0.95                         | 10                            | 0.4                 | 0.18                | 7        |
| RU 4A    |                          | 3.0                        | 200                     | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 8        |
| RU 31A   |                          |                            |                         | -40 to +150    |                  | 1.2                          | 50                            | 0.4                 | 0.18                | 7        |
| RU 4AM   | 3.5                      | 70                         | -40 to +150             |                | 1.3              | 10                           | 0.4                           | 0.18                | 8                   |          |
| RU 1B    | 800                      | 0.25                       | 15                      | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 5        |
| RF 1B    |                          | 0.6                        | 15                      | -40 to +150    |                  | 2.0                          | 10                            | 0.4                 | 0.18                |          |
| RH 1B    |                          |                            | 35                      | -40 to +150    |                  | 1.3                          | 5                             | 4.0                 | 1.3                 |          |
| RS 1B    |                          | 0.7                        | 30                      | -40 to +150    |                  | 2.5                          | 10                            | 1.5                 | 0.6                 |          |
| RU 2B    |                          |                            | 1.0                     | 20             | -40 to +150      |                              | 1.5                           | 10                  | 0.4                 |          |
| RU 3B    |                          | 1.1                        | 20                      | -40 to +150    |                  | 1.5                          | 10                            | 0.4                 | 0.18                | 6        |
| RU 4B    |                          |                            |                         | 3.0            | 50               | -40 to +150                  |                               | 1.6                 | 10                  |          |
| RU 1C    | 1000                     | 0.2                        | 15                      | -40 to +150    |                  | 3.0                          | 10                            | 0.4                 | 0.18                | 5        |
| RH 1C    |                          | 0.6                        | 35                      | -40 to +150    |                  | 1.3                          | 5                             | 4.0                 | 1.3                 |          |
| RU 2C    |                          |                            | 0.8                     | 20             | -40 to +150      |                              | 1.5                           | 10                  | 0.4                 |          |
| RU 3C    |                          | 1.5                        | 20                      | -40 to +150    |                  | 2.5                          | 10                            | 0.4                 | 0.18                | 6        |
| RU 4C    |                          |                            |                         | 2.5            | 50               | -40 to +150                  |                               | 1.6                 | 50                  |          |
| ES01F    | 1500                     | 0.5                        | 20                      | -40 to +150    |                  | 2.0                          | 10                            | 1.5                 | 0.6                 | 3        |
| ES 1F    |                          |                            |                         | -40 to +150    |                  | 2.0                          | 10                            | 1.5                 | 0.6                 | 4        |
| RC 2     | 2000                     | 0.2                        | 20                      | -40 to +150    |                  | 2.0                          | 10                            | 4.0                 | 1.3                 | 5        |

## ■ Frame 2-pin Type

| Part No.  | Absolute Maximum Ratings |                            |                         |                |      | Electrical Characteristics   |                               |                     |                     | Fig. No. |
|-----------|--------------------------|----------------------------|-------------------------|----------------|------|------------------------------|-------------------------------|---------------------|---------------------|----------|
|           | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | Tstg | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(μA)<br>max | trr1<br>(μs)<br>max | trr2<br>(μs)<br>max |          |
|           |                          |                            |                         | (°C)           |      |                              |                               |                     |                     |          |
| FMU-G2YXS | 100                      | 10.0                       | 100                     | -40 to +150    |      | 1.0                          | 50                            | 0.2                 | 0.08                | 11       |

## ■ Center-tap Type

| Part No.  | Absolute Maximum Ratings |                           |                         |                |                  | Electrical Characteristics   |                               |                     |                     | Fig. No. |
|-----------|--------------------------|---------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|---------------------|---------------------|----------|
|           | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (A)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(μA)<br>max | trr1<br>(μs)<br>max | trr2<br>(μs)<br>max |          |
|           |                          |                           |                         | (°C)           |                  |                              |                               |                     |                     |          |
| FMU-21S,R | 100                      | 10.0                      | 40                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                | 9        |
| FMU-12S,R | 200                      | 5.0                       | 30                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                | 9        |
| FMU-22S,R |                          | 10.0                      | 40                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                |          |
| FMU-32S,R |                          | 20.0                      | 80                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                | 10       |
| FMU-14S,R | 400                      | 5.0                       | 30                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                | 9        |
| FMU-24S,R |                          | 10.0                      | 40                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                |          |
| FMU-34S,R |                          | 20.0                      | 80                      | -40 to +150    |                  | 1.5                          | 50                            | 0.4                 | 0.18                | 10       |

# Ultra Fast Recovery Rectifier Diodes

## ■ Surface-mount Type

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

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

## ■ Axial Type

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

## ■ Frame 2-pin Type

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

## ■ Center-tap Type

| Part No.  | Absolute Maximum Ratings |                   |                  |               |                   | Electrical Characteristics |                            |                              |                              | Fig. No. |
|-----------|--------------------------|-------------------|------------------|---------------|-------------------|----------------------------|----------------------------|------------------------------|------------------------------|----------|
|           | $V_{RM}$<br>(V)          | $I_F$ (AV)<br>(A) | $I_{FSM}$<br>(A) | $T_J$<br>(°C) | $T_{stg}$<br>(°C) | $V_F$<br>(V)<br>max        | $I_R$<br>( $\mu$ A)<br>max | $\text{trr1}$<br>(ns)<br>max | $\text{trr2}$<br>(ns)<br>max |          |
| FMG-12S,R | 200                      | 5.0               | 35               | -40 to +150   |                   | 1.8                        | 500                        | 100                          | 50                           | 9        |
| FML-12S   |                          |                   |                  | -40 to +150   |                   | 0.98                       | 150                        | 40                           | 30                           |          |
| FMG-22S,R |                          | 10.0              | 65               | -40 to +150   |                   | 1.8                        | 500                        | 100                          | 50                           |          |
| FML-22S   |                          |                   |                  | -40 to +150   |                   | 0.98                       | 250                        | 40                           | 30                           |          |
| FMG-32S,R |                          | 20.0              | 150              | -40 to +150   |                   | 1.8                        | 1000                       | 100                          | 50                           |          |
| FML-32S   |                          |                   |                  | -40 to +150   |                   | 0.98                       | 600                        | 40                           | 30                           |          |
| FMG-13S,R | 300                      | 5.0               | 35               | -40 to +150   |                   | 1.8                        | 500                        | 100                          | 50                           | 9        |
| FML-13S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 50                         | 50                           | 35                           |          |
| FMG-23S,R |                          | 10.0              | 65               | -40 to +150   |                   | 1.8                        | 500                        | 100                          | 50                           |          |
| FML-23S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 100                        | 50                           | 35                           |          |
| FMG-33S,R |                          | 20.0              | 150              | -40 to +150   |                   | 1.8                        | 1000                       | 100                          | 50                           |          |
| FML-33S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 200                        | 50                           | 35                           |          |
| FMG-14S,R | 400                      | 5.0               | 35               | -40 to +150   |                   | 2.0                        | 500                        | 100                          | 50                           | 9        |
| FML-14S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 50                         | 50                           | 35                           |          |
| FMG-24S,R |                          | 8.0               | 65               | -40 to +150   |                   | 2.0                        | 500                        | 100                          | 50                           |          |
| FML-24S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 100                        | 50                           | 35                           |          |
| FMG-34S,R |                          | 16.0              | 100              | -40 to +150   |                   | 2.0                        | 1000                       | 100                          | 50                           |          |
| FML-34S   |                          |                   |                  | -40 to +150   |                   | 1.3                        | 200                        | 50                           | 35                           |          |
| FMG-26S,R | 600                      | 6.0               | 50               | -40 to +150   |                   | 2.2                        | 500                        | 100                          | 50                           | 9        |
| FMG-36S,R |                          | 15.0              | 80               | -40 to +150   |                   | 2.2                        | 1000                       | 100                          | 50                           | 10       |
| FML-36S   |                          | 20.0              | 100              | -40 to +150   |                   | 1.7                        | 100                        | 65                           | 35                           |          |

## ■ Bridge Type

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

# Schottky Barrier Diodes

## ■ Surface-mount Type

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

## ■ Axial Type

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

## ■ Frame 2-pin Type

| Part No. | Absolute Maximum Ratings |                            |                         |                |                  | Electrical Characteristics   |                               |                                                          | Fig. No. |
|----------|--------------------------|----------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|----------------------------------------------------------|----------|
|          | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(mA)<br>max | H•I <sub>R</sub><br>(mA)<br>T <sub>a</sub> =100°C<br>max |          |
|          |                          |                            |                         | (°C)           |                  |                              |                               |                                                          |          |
| FMB-G14  | 40                       | 3.0                        | 60                      | -40 to +150    |                  | 0.55                         | 5                             | 100                                                      | 11       |
| FMB-G14L |                          | 5.0                        | 60                      | -40 to +150    |                  | 0.55                         | 5                             | 100                                                      |          |
| FMB-G24H |                          | 10.0                       | 150                     | -40 to +150    |                  | 0.55                         | 10                            | 65                                                       |          |
| FMB-G16L | 60                       | 6.0                        | 50                      | -40 to +150    |                  | 0.62                         | 5                             | 50                                                       | 11       |
| FMB-G19L | 90                       | 4.0                        | 60                      | -40 to +150    |                  | 0.81                         | 5                             | 35                                                       | 11       |

## ■ Center-tap Type

| Part No. | Absolute Maximum Ratings |                            |                         |                |                  | Electrical Characteristics   |                               |                                                          | Fig. No. |
|----------|--------------------------|----------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|----------------------------------------------------------|----------|
|          | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(mA)<br>max | H•I <sub>R</sub><br>(mA)<br>T <sub>a</sub> =100°C<br>max |          |
|          |                          |                            |                         | (°C)           |                  |                              |                               |                                                          |          |
| FMB-24   | 40                       | 4.0                        | 50                      | -40 to +150    |                  | 0.55                         | 5                             | 35                                                       | 9        |
| FMB-24M  |                          | 6.0                        | 60                      | -40 to +150    |                  | 0.55                         | 5                             | 35                                                       |          |
| FMB-24L  |                          | 10                         | 60                      | -40 to +150    |                  | 0.55                         | 5                             | 35                                                       |          |
| FME-24L  |                          |                            | 80                      | -40 to +150    |                  | 0.6                          | 0.5                           | 30                                                       |          |
| FMB-34S  |                          | 12                         | 75                      | -40 to +150    |                  | 0.58                         | 5                             | 35                                                       | 10       |
| FMB-24H  |                          | 15                         | 100                     | -40 to +150    |                  | 0.55                         | 7.5                           | 50                                                       | 9        |
| FME-24H  |                          |                            |                         | -40 to +150    |                  | 0.6                          | 0.75                          | 50                                                       |          |
| MPE-24H  |                          |                            |                         | -40 to +150    |                  | 0.6                          | 0.75                          | 50<br>(T <sub>J</sub> =150°C)                            |          |
| FMB-34   |                          | 30                         | 150                     | -40 to +150    |                  | 0.55                         | 10                            | 65                                                       | 10       |
| FMB-34M  |                          |                            | 300                     | -40 to +150    |                  | 0.55                         | 20                            | 100                                                      |          |
| FMB-26   | 60                       | 4.0                        | 40                      | -40 to +150    |                  | 0.62                         | 1                             | 20                                                       | 9        |
| FMB-26L  |                          | 10                         | 50                      | -40 to +150    |                  | 0.62                         | 2.5                           | 50                                                       |          |
| FMB-36   |                          | 15                         | 100                     | -40 to +150    |                  | 0.62                         | 5                             | 75                                                       |          |
| FMB-36M  |                          | 30                         | 150                     | -40 to +150    |                  | 0.62                         | 10                            | 150                                                      |          |
| FMB-29   | 90                       | 4.0                        | 50                      | -40 to +150    |                  | 0.81                         | 3                             | 15                                                       | 9        |
| FMB-29L  |                          | 8.0                        | 60                      | -40 to +150    |                  | 0.81                         | 5                             | 35                                                       |          |
| FMB-39   |                          | 15                         | 60                      | -40 to +150    |                  | 0.81                         | 10                            | 50                                                       |          |
| FMB-39M  |                          | 20                         | 150                     | -40 to +150    |                  | 0.81                         | 15                            | 60                                                       |          |

## ■ Bridge Type

| Part No. | Absolute Maximum Ratings |                            |                         |                |                  | Electrical Characteristics   |                               |                                             | Fig. No. |
|----------|--------------------------|----------------------------|-------------------------|----------------|------------------|------------------------------|-------------------------------|---------------------------------------------|----------|
|          | V <sub>RM</sub><br>(V)   | I <sub>F</sub> (AV)<br>(A) | I <sub>FSM</sub><br>(A) | T <sub>J</sub> | T <sub>stg</sub> | V <sub>F</sub><br>(V)<br>max | I <sub>R</sub><br>(mA)<br>max | H•I <sub>R</sub><br>(mA)<br>Ta=100°C<br>max |          |
|          |                          |                            |                         | (°C)           |                  |                              |                               |                                             |          |
| RBV-406B | 60                       | 4.0                        | 40                      | -40 to +150    |                  | 0.62                         | 2                             | 20                                          | 13       |

(Unit: mm)

Technical drawings of the 10000mAh battery pack showing top, front, and side views with dimensions:

- Top View:**
  - Overall width:  $4.5^{+0.2}$
  - Overall height:  $2.6^{+0.2}$
  - Internal width (excluding terminals):  $2.0^{min}$
- Front View:**
  - Overall width:  $5.1^{+0.4}_{-0.1}$
  - Overall height:  $2.05^{+0.2}$
  - Terminal width (left):  $1.35^{+0.4}$
  - Terminal width (right):  $1.35^{+0.4}$
- Side View:**
  - Overall height:  $0.05$
  - Terminal height:  $1.1^{+0.2}$
  - Terminal width:  $1.5^{+0.2}$

[illegible]

Technical drawing of a cathode marking on a wire. The drawing shows a vertical wire with a central rectangular marking. Dimensions are given: total length  $62.3 \pm 0.7$ , marking height  $5.0 \pm 0.2$ , marking width  $2.7 \pm 0.2$ , and wire diameter  $\phi 0.6 \pm 0.05$ . A label "Cathode marking" points to the central rectangle. A right-pointing arrow is also shown.

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

(Unit: mm)

Fig. 11 Full-mold

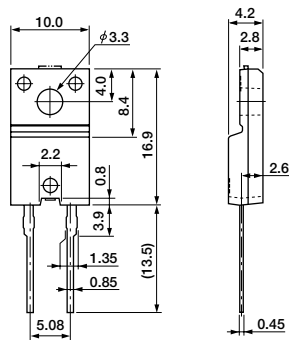
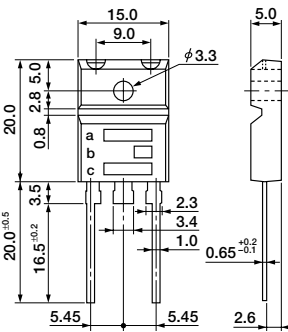
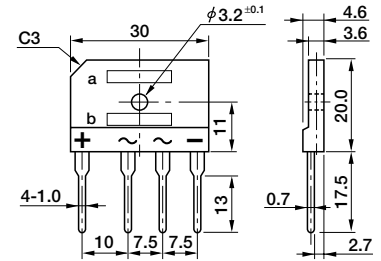


Fig. 12 Full-mold



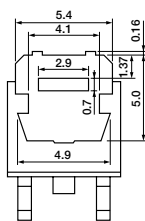
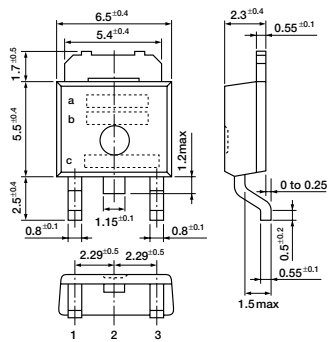
a) Part No.  
b) Polarity  
c) Lot No.

Fig. 13



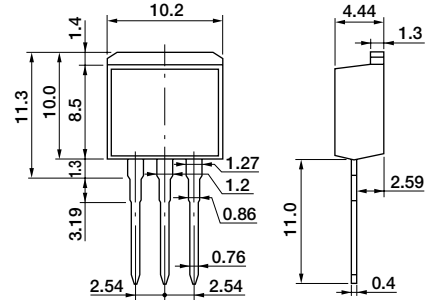
a) Part No.  
b) Lot No.

Fig. 14



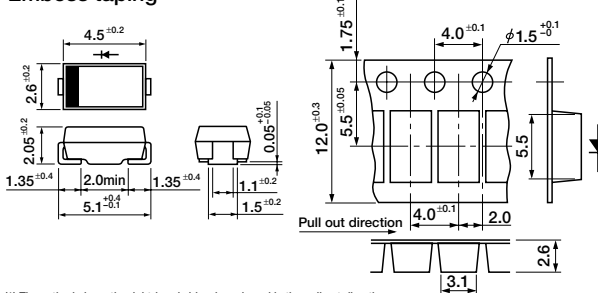
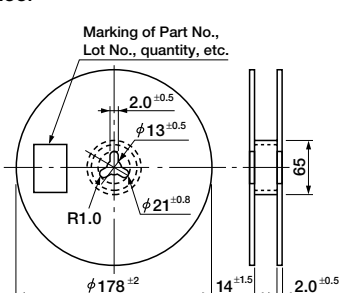
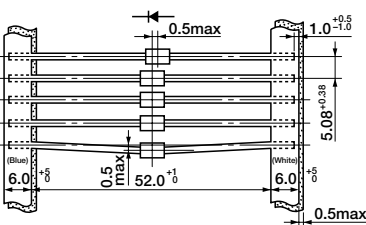
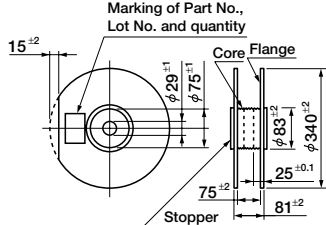
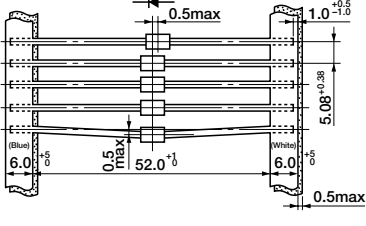
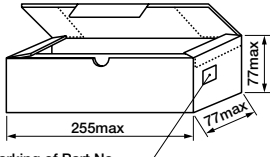
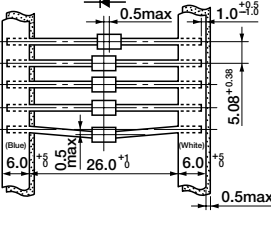
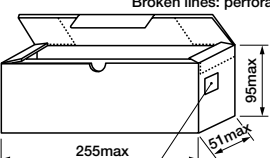
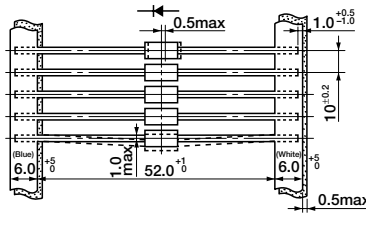
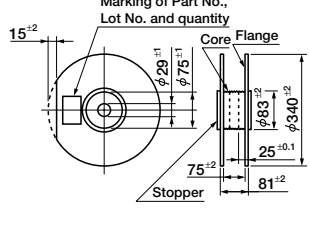
a) Part No.  
b) Polarity  
c) Lot No.

Fig. 15



# General-purpose Diodes - Taping Specifications

## Taping Specifications

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

### Taping Specifications

| Taping Name                                                             | Taping Dimensions (mm) | Packaging Dimensions (mm) and Markings | Packaging Quantity                                      |
|-------------------------------------------------------------------------|------------------------|----------------------------------------|---------------------------------------------------------|
| <b>V4</b><br><br>A suffix "V4" is added to Part No. for tape packaging. |                        |                                        | 1,000 pcs.<br>per box<br>(5.2φ body)                    |
| <b>W</b><br><br>A suffix "W" is added to Part No. for tape packaging.   |                        |                                        | 4,000 pcs.<br>per box<br>(2.7φ body<br>0.6φ leads only) |
| <b>WS</b><br><br>A suffix "WS" is added to Part No. for tape packaging. |                        |                                        | 2,500 pcs.<br>per box<br>(2.4φ body)                    |
| <b>WK</b><br><br>A suffix "WK" is added to Part No. for tape packaging. |                        |                                        |                                                         |

## High-voltage Diodes - Taping Specifications

118

# General-purpose LEDs

## Uni-Color LED Lamp

### Absolute Maximum Ratings

(Ta=25°C)

| Parameter       | Unit  | Ratings     |       |        |         |            |     | Ratings                       |
|-----------------|-------|-------------|-------|--------|---------|------------|-----|-------------------------------|
|                 |       | GaP         | GaAsP | GaAlAs | AlGaInP | InGaIn     | GaN |                               |
| I <sub>F</sub>  | mA    | 30          |       |        |         |            |     |                               |
| ΔI <sub>F</sub> | mA/°C | -0.45       |       |        |         |            |     | Above 25°C                    |
| I <sub>FP</sub> | mA    | 100         |       |        |         |            | 70  | f=1kHz, t <sub>w</sub> =100μs |
| V <sub>R</sub>  | V     | 3           |       |        | 4       | 5          |     |                               |
| Top             | °C    | -30 to +85  |       |        |         | -25 to +85 |     |                               |
| Tstg            | °C    | -30 to +100 |       |        |         |            |     |                               |

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

| Outline                   | Emitting color                  | Part No.        | Lens color      | Electro-optical characteristics (Ta=25°C) |      |                      |                               |                     |               | Contact mount | Fig. No. |   |
|---------------------------|---------------------------------|-----------------|-----------------|-------------------------------------------|------|----------------------|-------------------------------|---------------------|---------------|---------------|----------|---|
|                           |                                 |                 |                 | V <sub>F</sub> (V)                        |      | I <sub>V</sub> (mcd) |                               | λ <sub>p</sub> (nm) | Chip material |               |          |   |
|                           |                                 |                 |                 | typ                                       | max  | typ                  | Condition I <sub>F</sub> (mA) |                     |               |               |          |   |
| 5 φ Round                 | Ultra high-intensity red        | SELU1250CM      | Clear           | 2.0                                       | 2.5  | 900                  | 20                            | 635                 | AlGaInP       | ○             | 4        |   |
|                           | Red                             | SEL1250SM       | Tinted red      | 1.9                                       | 2.5  | 75                   | 20                            | 630                 | GaAsP         | ○             |          |   |
|                           |                                 | SEL1250RM       | Diffused red    |                                           |      | 48                   |                               |                     |               | ○             |          |   |
|                           | Amber                           | SEL1850AM       | Tinted orange   | 1.9                                       | 2.5  | 90                   | 20                            | 610                 | GaAsP         | ○             |          |   |
|                           |                                 | SEL1850DM       | Diffused orange |                                           |      | 60                   |                               |                     |               | ○             |          |   |
|                           | Orange                          | SEL1950KM       | Tinted orange   | 1.9                                       | 2.5  | 96                   | 20                            | 587                 | GaAsP         | ○             |          |   |
|                           | Green                           | SEL1450EKM      | Tinted green    | 2.0                                       | 2.5  | 190                  | 20                            | 560                 | GaP           | ○             |          |   |
|                           |                                 | SEL1450GM-YG    | Diffused green  |                                           |      | 120                  |                               |                     |               | ○             |          |   |
|                           | Pure green                      | SEL1550CM       | Clear           | 2.0                                       | 2.5  | 72                   | 20                            | 555                 | GaP           | ○             |          |   |
|                           | Ultra high-intensity pure green | SELU1D50CM      | Clear           | 3.3                                       | 4.0  | 6000                 | 20                            | 525                 | InGaIn        | ×             |          |   |
| Ultra high-intensity blue | SELU1E50CM                      | Clear           | 3.3             | 4.0                                       | 1850 | 20                   | 470                           | InGaIn              | ×             |               |          |   |
| High-intensity red        | SEL1615C                        | Clear           | 1.75            | 2.2                                       | 700  | 20                   | 660                           | GaAlAs              | ×             | 5             |          |   |
| 5 φ Cylindrical           | Deep red                        | SEL1111R        | Diffused red    | 2.0                                       | 2.5  | 1.4                  | 10                            | 700                 | GaP           | ×             | 6        |   |
|                           | Red                             | SEL1211R        | Diffused red    | 1.9                                       | 2.5  | 12                   | 20                            | 630                 | GaAsP         | ×             |          |   |
|                           | Amber                           | SEL1811D        | Diffused orange | 1.9                                       | 2.5  | 8.0                  | 10                            | 610                 | GaAsP         | ×             |          |   |
|                           | Orange                          | SEL1911D        | Diffused orange | 1.9                                       | 2.5  | 8.0                  | 10                            | 587                 | GaAsP         | ×             |          |   |
|                           | Yellow                          | SEL1711Y        | Diffused yellow | 2.0                                       | 2.5  | 13                   | 10                            | 570                 | GaP           | ×             |          |   |
|                           | Green                           | SEL1411G        | Diffused green  | 2.0                                       | 2.5  | 30                   | 20                            | 560                 | GaP           | ×             |          |   |
| 4.6x5.6φ Egg-shaped       | Ultra high-intensity red        | SELU1253CMKT    | Clear           | 2.0                                       | 2.5  | 200                  | 20                            | 635                 | AlGaInP       | ×             | 7        |   |
|                           | Ultra high-intensity amber      | SELU1853CMKT    | Clear           | 2.0                                       | 2.5  | 450                  | 20                            | 615                 | AlGaInP       | ×             |          |   |
|                           | Green                           | SEL1453CEMKT    | Tinted green    | 2.0                                       | 2.5  | 140                  | 20                            | 560                 | GaP           | ×             |          |   |
| 4 φ Round                 | Deep red                        | SEL4110S        | Tinted red      | 2.0                                       | 2.5  | 2.4                  | 5                             | 700                 | GaP           | ×             | 8        |   |
|                           |                                 | SEL4110R        | Diffused red    |                                           |      | 1.7                  |                               |                     |               | ×             |          |   |
|                           | Red                             | SEL4210S        | Tinted red      | 1.9                                       | 2.5  | 30                   | 20                            | 630                 | GaAsP         | ×             |          |   |
|                           |                                 | SEL4210R        | Diffused red    |                                           |      | 17                   |                               |                     |               | ×             |          |   |
|                           | Amber                           | SEL4810A        | Tinted orange   | 1.9                                       | 2.5  | 20                   | 10                            | 610                 | GaAsP         | ×             |          |   |
|                           |                                 | SEL4810D        | Diffused orange |                                           |      | 15                   |                               |                     |               | ×             |          |   |
|                           | Orange                          | SEL4910A        | Tinted orange   | 1.9                                       | 2.5  | 26                   | 10                            | 587                 | GaAsP         | ×             |          |   |
|                           |                                 | SEL4910D        | Diffused orange |                                           |      | 16                   |                               |                     |               | ×             |          |   |
|                           | Yellow                          | SEL4710K        | Tinted yellow   | 2.0                                       | 2.5  | 36                   | 10                            | 570                 | GaP           | ×             |          |   |
|                           |                                 | SEL4710Y        | Diffused yellow |                                           |      | 14                   |                               |                     |               | ×             |          |   |
|                           | Green                           | SEL4410E        | Tinted green    | 2.0                                       | 2.5  | 87                   | 20                            | 560                 | GaP           | ×             |          |   |
|                           |                                 | SEL4410G        | Diffused green  |                                           |      | 34                   |                               |                     |               | ×             |          |   |
|                           | Pure green                      | SEL4510C        | Clear           | 2.0                                       | 2.5  | 45                   | 20                            | 555                 | GaP           | ×             |          |   |
|                           | Deep red                        | SEL4114S        | Tinted red      | 2.0                                       | 2.5  | 3.8                  | 10                            | 700                 | GaP           | ○             |          | 9 |
|                           |                                 | SEL4114R        | Diffused red    |                                           |      | 2.8                  |                               |                     |               | ○             |          |   |
|                           | Red                             | SEL4214S        | Tinted red      | 1.9                                       | 2.5  | 40                   | 20                            | 630                 | GaAsP         | ○             |          |   |
|                           |                                 | SEL4214R        | Diffused red    |                                           |      | 24                   |                               |                     |               | ○             |          |   |
|                           | Amber                           | SEL4814A        | Tinted orange   | 1.9                                       | 2.5  | 20                   | 10                            | 610                 | GaAsP         | ○             |          |   |
|                           |                                 | SEL4814D        | Diffused orange |                                           |      | 15                   |                               |                     |               | ○             |          |   |
|                           | Orange                          | SEL4914A        | Tinted orange   | 1.9                                       | 2.5  | 26                   | 10                            | 587                 | GaAsP         | ○             |          |   |
| SEL4914D                  |                                 | Diffused orange | 11              |                                           |      | ○                    |                               |                     |               |               |          |   |
| Yellow                    | SEL4714K                        | Tinted yellow   | 2.0             | 2.5                                       | 38   | 10                   | 570                           | GaP                 | ○             |               |          |   |
|                           | SEL4714Y                        | Diffused yellow |                 |                                           | 27   |                      |                               |                     | ○             |               |          |   |
| Green                     | SEL4414E                        | Tinted green    | 2.0             | 2.5                                       | 69   | 20                   | 560                           | GaP                 | ○             |               |          |   |
|                           | SEL4414G                        | Diffused green  |                 |                                           | 48   |                      |                               |                     | ○             |               |          |   |
| Pure green                | SEL4514C                        | Clear           | 2.0             | 2.5                                       | 26   | 20                   | 555                           | GaP                 | ○             |               |          |   |

## Uni-Color LED Lamp

| Outline                                    | Emitting color                   | Part No.                  | Lens color          | Electro-optical characteristics (Ta=25°C) |     |                      |                               |                     |               | Contact mount | Fig. No. |
|--------------------------------------------|----------------------------------|---------------------------|---------------------|-------------------------------------------|-----|----------------------|-------------------------------|---------------------|---------------|---------------|----------|
|                                            |                                  |                           |                     | V <sub>F</sub> (V)                        |     | I <sub>V</sub> (mcd) |                               | λ <sub>p</sub> (nm) | Chip material |               |          |
|                                            |                                  |                           |                     | typ                                       | max | typ                  | Condition I <sub>F</sub> (mA) |                     |               |               |          |
| 3φ Round                                   | Deep red                         | SEL6110S                  | Tinted red          | 2.0                                       | 2.5 | 3.9                  | 10                            | 700                 | GaP           | ○             | 10       |
|                                            |                                  | SEL6110R                  | Diffused red        |                                           |     | 2.6                  |                               |                     |               | ○             |          |
|                                            | Red                              | SEL6210S                  | Tinted red          | 1.9                                       | 2.5 | 41                   | 20                            | 630                 | GaAsP         | ○             |          |
|                                            |                                  | SEL6210R                  | Diffused red        |                                           |     | 18                   |                               |                     |               | ○             |          |
|                                            | Amber                            | SEL6810A                  | Tinted orange       | 1.9                                       | 2.5 | 22                   | 10                            | 610                 | GaAsP         | ○             |          |
|                                            |                                  | SEL6810D                  | Diffused orange     |                                           |     | 9.6                  |                               |                     |               | ○             |          |
|                                            | Orange                           | SEL6910A                  | Tinted orange       | 1.9                                       | 2.5 | 22                   | 10                            | 587                 | GaAsP         | ○             |          |
|                                            |                                  | SEL6910D                  | Diffused orange     |                                           |     | 11                   |                               |                     |               | ○             |          |
|                                            | Yellow                           | SEL6710K                  | Tinted yellow       | 2.0                                       | 2.5 | 37                   | 10                            | 570                 | GaP           | ○             |          |
|                                            |                                  | SEL6710Y                  | Diffused yellow     |                                           |     | 11                   |                               |                     |               | ○             |          |
|                                            | Green                            | SEL6410E                  | Tinted green        | 2.0                                       | 2.5 | 90                   | 20                            | 560                 | GaP           | ○             |          |
|                                            |                                  | SEL6410G                  | Diffused green      |                                           |     | 30                   |                               |                     |               | ○             |          |
|                                            | Pure green                       | SEL6510C                  | Clear               | 2.0                                       | 2.5 | 42                   | 20                            | 555                 | GaP           | ○             |          |
|                                            |                                  | SEL6510G                  | Diffused green      |                                           |     | 9.6                  |                               |                     |               | ○             |          |
|                                            | Red                              | SEL6214S                  | Tinted red          | 1.9                                       | 2.5 | 18                   | 20                            | 630                 | GaAsP         | ○             |          |
|                                            | Amber                            | SEL6814A                  | Tinted orange       | 1.9                                       | 2.5 | 9.0                  | 10                            | 610                 | GaAsP         | ○             |          |
|                                            | Ultra-high-intensity light amber | SELS6B14C                 | Clear               | 2.0                                       | 2.5 | 120                  | 20                            | 600                 | AlGaInP       | ○             |          |
|                                            |                                  | Orange                    | SEL6914A            | Tinted orange                             | 1.9 | 2.5                  | 8.0                           | 10                  | 587           | GaAsP         | ○        |
|                                            | SEL6914W                         |                           | Diffused white      | 5.0                                       |     |                      | ○                             |                     |               |               |          |
|                                            | Yellow                           | SEL6714K                  | Tinted yellow       | 2.0                                       | 2.5 | 66                   | 20                            | 570                 | GaP           | ○             |          |
|                                            |                                  | SEL6714W                  | Diffused white      |                                           |     | 30                   |                               |                     |               | ○             |          |
|                                            | Green                            | SEL6414E                  | Tinted green        | 2.0                                       | 2.5 | 42                   | 20                            | 560                 | GaP           | ○             |          |
|                                            | Deep green                       | SEL6414E-TG               | Tinted green        |                                           |     | 18                   |                               |                     |               | 558           | ○        |
|                                            | Pure green                       | SEL6514C                  | Clear               | 2.0                                       | 2.5 | 12                   | 20                            | 555                 | GaP           | ○             |          |
|                                            | Red                              | SEL6215S                  | Tinted red          | 1.9                                       | 2.5 | 45                   | 20                            | 630                 | GaAsP         | ○             |          |
|                                            | Orange                           | SEL6915A                  | Tinted orange       | 1.9                                       | 2.5 | 60                   | 20                            | 587                 | GaAsP         | ○             |          |
|                                            | Yellow                           | SEL6715C                  | Clear               | 2.0                                       | 2.5 | 90                   | 20                            | 570                 | GaP           | ○             |          |
|                                            | Green                            | SEL6415E                  | Tinted green        | 2.0                                       | 2.5 | 81                   | 20                            | 560                 | GaP           | ○             |          |
|                                            | Pure green                       | SEL6515C                  | Clear               | 2.0                                       | 2.5 | 44                   | 20                            | 555                 | GaP           | ○             |          |
|                                            | Deep red                         | SEL2110S                  | Tinted red          | 2.0                                       | 2.5 | 4                    | 10                            | 700                 | GaP           | ×             |          |
| SEL2110R                                   |                                  | Diffused red              | 1.8                 |                                           |     | ×                    |                               |                     |               |               |          |
| SEL2110W                                   |                                  | Diffused white            | 1.8                 |                                           |     | ×                    |                               |                     |               |               |          |
| High-intensity red                         | SEL2610C                         | Clear                     | 1.75                | 2.2                                       | 350 | 20                   | 660                           | GaAlAs              | ×             |               |          |
|                                            | Red                              | SEL2210S                  | Tinted red          | 1.9                                       | 2.5 | 40                   | 20                            | 630                 | GaAsP         | ×             |          |
|                                            |                                  | SEL2210R                  | Diffused red        |                                           |     | 15                   |                               |                     |               | ×             |          |
|                                            |                                  | SEL2210W                  | Diffused white      |                                           |     | 15                   |                               |                     |               | ×             |          |
| Amber                                      | SEL2810A                         | Tinted orange             | 1.9                 | 2.5                                       | 22  | 10                   | 610                           | GaAsP               | ×             |               |          |
|                                            | SEL2810D                         | Diffused orange           |                     |                                           | 9.0 |                      |                               |                     | ×             |               |          |
| Orange                                     | SEL2910A                         | Tinted orange             | 1.9                 | 2.5                                       | 16  | 10                   | 587                           | GaAsP               | ×             |               |          |
|                                            | SEL2910D                         | Diffused orange           |                     |                                           | 8.0 |                      |                               |                     | ×             |               |          |
| Ultra high-intensity yellow                | SELU2710C                        | Clear                     | 2.0                 | 2.5                                       | 270 | 20                   | 572                           | AlGaInP             | ×             |               |          |
| Yellow                                     | SEL2710K                         | Tinted yellow             | 2.0                 | 2.5                                       | 40  | 10                   | 570                           | GaP                 | ×             |               |          |
|                                            | SEL2710Y                         | Diffused yellow           |                     |                                           | 14  |                      |                               |                     | ×             |               |          |
| Green                                      | SEL2410E                         | Tinted green              | 2.0                 | 2.5                                       | 77  | 20                   | 560                           | GaP                 | ×             |               |          |
|                                            | SEL2410G                         | Diffused green            |                     |                                           | 20  |                      |                               |                     | ×             |               |          |
| 3φ Cylindrical                             | Pure green                       | SEL2510C                  | Clear               | 2.0                                       | 2.5 | 43                   | 20                            | 555                 | GaP           | ×             |          |
|                                            |                                  | SEL2510G                  | Diffused green      |                                           |     | 8.2                  |                               |                     |               | ×             |          |
|                                            | Ultra high-intensity pure green  | SEL2U2D10C                | Clear               | 3.3                                       | 4.0 | 1200                 | 20                            | 525                 | InGaIn        | ×             |          |
|                                            |                                  | Ultra high-intensity blue | SEL2U2E10C          | Clear                                     | 3.3 | 4.0                  | 400                           | 20                  | 470           | InGaIn        | ×        |
|                                            | Blue                             | SEL2E10C                  | Clear               | 3.8                                       | 4.8 | 60                   | 20                            | 430                 | GaN           | ×             |          |
|                                            | Red                              | SEL2215S                  | Tinted red          | 1.9                                       | 2.5 | 45                   | 20                            | 630                 | GaAsP         | ×             |          |
|                                            |                                  | SEL2215R                  | Diffused red        |                                           |     | 38                   |                               |                     |               | ×             |          |
|                                            | Amber                            | SEL2815A                  | Tinted orange       | 1.9                                       | 2.5 | 80                   | 10                            | 610                 | GaAsP         | ×             |          |
|                                            |                                  | SEL2815D                  | Diffused orange     |                                           |     | 60                   |                               |                     |               | ×             |          |
|                                            | Orange                           | SEL2915A                  | Tinted orange       | 1.9                                       | 2.5 | 81                   | 10                            | 587                 | GaAsP         | ×             |          |
|                                            |                                  | SEL2915D                  | Diffused orange     |                                           |     | 53                   |                               |                     |               | ×             |          |
|                                            | Yellow                           | SEL2715K                  | Tinted yellow       | 2.0                                       | 2.5 | 130                  | 10                            | 570                 | GaP           | ×             |          |
|                                            |                                  | SEL2715Y                  | Diffused yellow     |                                           |     | 110                  |                               |                     |               | ×             |          |
|                                            | Green                            | SEL2415E                  | Tinted green        | 2.0                                       | 2.5 | 110                  | 20                            | 560                 | GaP           | ×             |          |
|                                            |                                  | SEL2415G                  | Diffused green      |                                           |     | 72                   |                               |                     |               | ×             |          |
| Pure green                                 | SEL2515C                         | Clear                     | 2.0                 | 2.5                                       | 52  | 20                   | 555                           | GaP                 | ×             |               |          |
| 2φ Round                                   | Deep red                         | SEL2111R                  | Diffused red        | 2.0                                       | 2.5 | 0.7                  | 10                            | 700                 | GaP           | ×             |          |
|                                            | Orange                           | SEL2911D                  | Diffused orange     | 1.9                                       | 2.5 | 3.3                  | 10                            | 587                 | GaAsP         | ×             |          |
|                                            | Green                            | SEL2411G                  | Diffused green      | 2.0                                       | 2.5 | 18                   | 20                            | 560                 | GaP           | ×             |          |
| Inverted-cone typ for surface illumination | Deep red                         | SEL4117R                  | Diffused red        | 2.0                                       | 2.5 | 1.1                  | 10                            | 700                 | GaP           | ×             |          |
|                                            | Amber                            | SEL4817D                  | Diffused orange     | 1.9                                       | 2.5 | 7.5                  | 10                            | 610                 | GaAsP         | ×             |          |
|                                            | Orange                           | SEL4917D                  | Diffused orange     | 1.9                                       | 2.5 | 7.5                  | 10                            | 587                 | GaAsP         | ×             |          |
|                                            | Yellow                           | SEL4717Y                  | Diffused yellow     | 2.0                                       | 2.5 | 14                   | 20                            | 570                 | GaP           | ×             |          |
|                                            | Green                            | SEL4417G                  | Diffused green      | 2.0                                       | 2.5 | 16                   | 20                            | 560                 | GaP           | ×             |          |
|                                            | Red                              | SEL1213C                  | Tinted red          | 1.9                                       | 2.5 | 7.0                  | 20                            | 630                 | GaAsP         | ×             |          |
| 3x5 Rectangular                            | Amber                            | SEL1813A                  | Tinted orange       | 1.9                                       | 2.5 | 8.0                  | 20                            | 610                 | GaAsP         | ×             |          |
|                                            | Orange                           | SEL1913K                  | Tinted light orange | 1.9                                       | 2.5 | 8.0                  | 20                            | 587                 | GaAsP         | ×             |          |
|                                            | Yellow                           | SEL1713K                  | Tinted yellow       | 2.0                                       | 2.5 | 15                   | 20                            | 570                 | GaP           | ×             |          |
|                                            | Green                            | SEL1413E                  | Tinted green        | 2.0                                       | 2.5 | 12                   | 20                            | 560                 | GaP           | ×             |          |
|                                            | Pure green                       | SEL1513E                  | Tinted light green  | 2.0                                       | 2.5 | 5.0                  | 20                            | 555                 | GaP           | ×             |          |
|                                            | Green                            | SEL6413E                  | Tinted green        | 2.0                                       | 2.5 | 14                   | 20                            | 560                 | GaP           | ○             |          |
|                                            | Pure green                       | SEL6513C                  | Clear               | 2.0                                       | 2.5 | 5.0                  | 20                            | 555                 | GaP           | ○             |          |
|                                            | High-intensity red               | SEL2613CS-S               | Tinted light red    | 1.7                                       | 2.5 | 80                   | 20                            | 660                 | GaAlAs        | ×             |          |
|                                            | Red                              | SEL2213C                  | Clear               | 1.9                                       | 2.5 | 7.0                  | 20                            | 630                 | GaAsP         | ×             |          |
|                                            | Amber                            | SEL2813A                  | Tinted orange       | 1.9                                       | 2.5 | 8.0                  | 20                            | 610                 | GaAsP         | ×             |          |
|                                            | Orange                           | SEL2913K                  | Tinted light orange | 1.9                                       | 2.5 | 8.0                  | 20                            | 587                 | GaAsP         | ×             |          |
|                                            | Yellow                           | SEL2713K                  | Tinted yellow       | 2.0                                       | 2.5 | 17                   | 20                            | 570                 | GaP           | ×             |          |
|                                            | Green                            | SEL2413E                  | Tinted green        | 2.0                                       | 2.5 | 14                   | 20                            | 560                 | GaP           | ×             |          |
|                                            |                                  | SEL2413G                  | Diffused green      |                                           |     | 12                   |                               |                     |               | ×             |          |
|                                            | Pure green                       | SEL2513E                  | Tinted green        | 2.0                                       | 2.5 | 5.0                  | 20                            | 555                 | GaP           | ×             |          |
| 3x5 Rectangular                            | Deep red                         | SEL1121R                  | Diffused red        | 2.0                                       | 2.5 | 0.9                  | 10                            | 700                 | GaP           | ×             |          |
|                                            | Amber                            | SEL1821D                  | Diffused orange     | 1.9                                       | 2.5 | 3.0                  | 10                            | 610                 | GaAsP         | ×             |          |
|                                            | Orange                           | SEL1921D                  | Diffused orange     | 1.9                                       | 2.5 | 3.8                  | 10                            | 587                 | GaAsP         | ×             |          |
|                                            | Yellow                           | SEL1721Y                  | Diffused yellow     | 2.0                                       | 2.5 | 7.0                  | 10                            | 570                 | GaP           | ×             |          |
|                                            | Green                            | SEL1421G                  | Diffused green      | 2.0                                       | 2.5 | 12                   | 20                            | 560                 | GaP           | ×             |          |

## Uni-Color LED Lamp

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

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

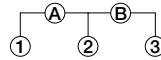
## Bi-Color LED Lamp

## Absolute Maximum Ratings

(Ta=25°C)

| Parameter       | Unit  | Ratings     | Conditions       |
|-----------------|-------|-------------|------------------|
| I <sub>F</sub>  | mA    | 30          |                  |
| ΔI <sub>F</sub> | mA/°C | -0.45       | Above 25°C       |
| I <sub>FP</sub> | mA    | 100         | f=1kHz, tw=100μs |
| V <sub>R</sub>  | V     | 4           |                  |
| Top             | °C    | -30 to +85  |                  |
| Tstg            | °C    | -30 to +100 |                  |

## Internal wiring diagram



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

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

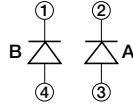
# Surface Mount LED

## Absolute Maximum Ratings

(Ta=25°C)

| Parameter       | Unit  | Ratings     |       |        |         |            |     | Conditions       |
|-----------------|-------|-------------|-------|--------|---------|------------|-----|------------------|
|                 |       | GaP         | GaAsP | GaAlAs | AlGaInP | InGaN      | GaN |                  |
| I <sub>F</sub>  | mA    | 30          |       |        |         |            |     |                  |
| ΔI <sub>F</sub> | mA/°C | -0.45       |       |        |         |            |     | Above 25°C       |
| I <sub>FP</sub> | mA    | 70          |       |        |         |            |     | f=1kHz, tw=100μs |
| V <sub>R</sub>  | V     | 4           |       |        |         | 5          |     |                  |
| Top             | °C    | -30 to +85  |       |        |         | -25 to +85 |     |                  |
| Tstg            | °C    | -30 to +100 |       |        |         |            |     |                  |

## Internal wiring diagram



## Uni-Color

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

## Bi-Color

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

## Infrared LED

## Absolute Maximum Ratings

(Ta=25°C)

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

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

# General-purpose LEDs - External Dimensions

(Unit: mm)

Fig. 1

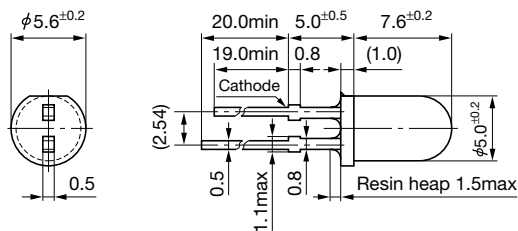


Fig. 2

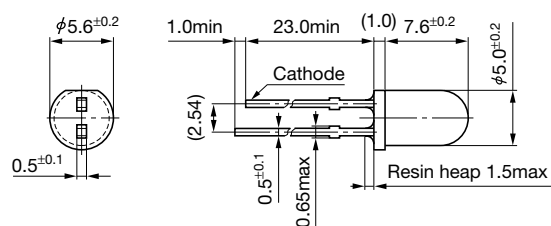


Fig. 3

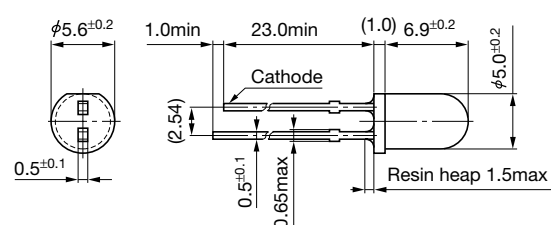


Fig. 4

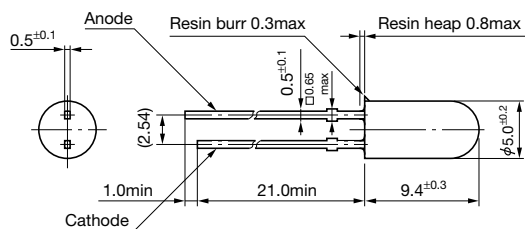


Fig. 5

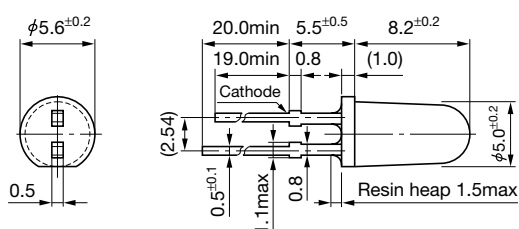


Fig. 6

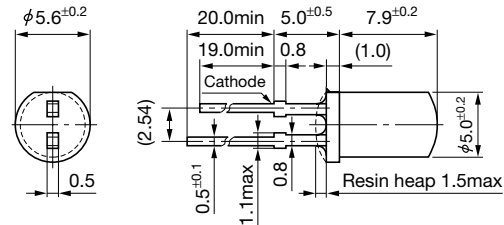


Fig. 7

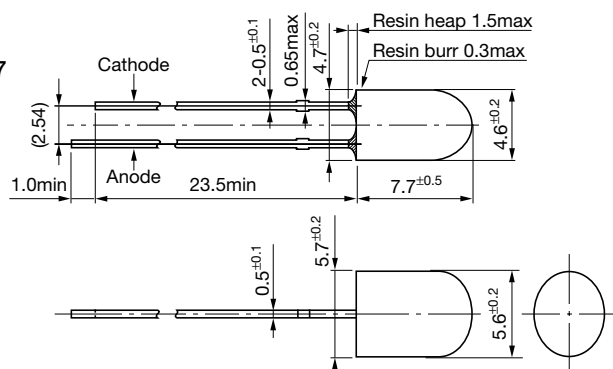


Fig. 8

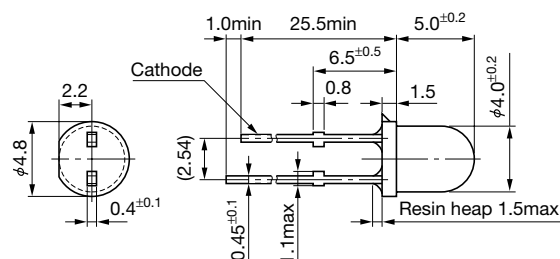


Fig. 9

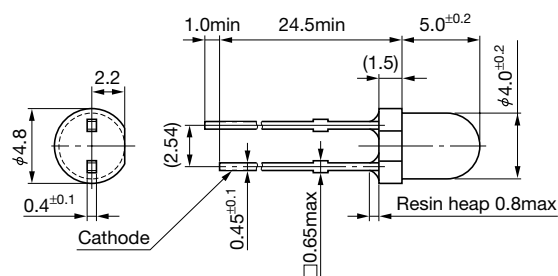
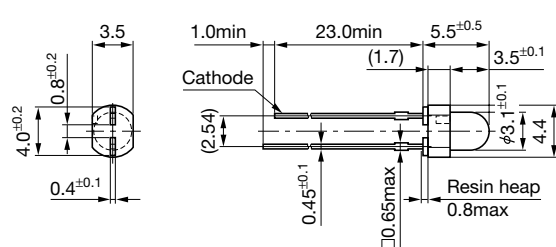


Fig. 10



(Unit: mm)

Fig. 11

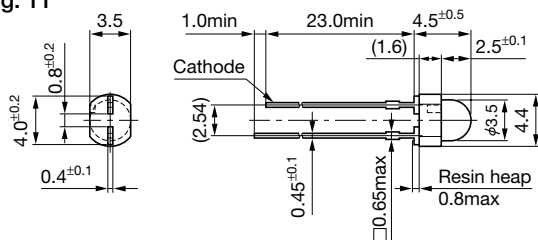


Fig. 12

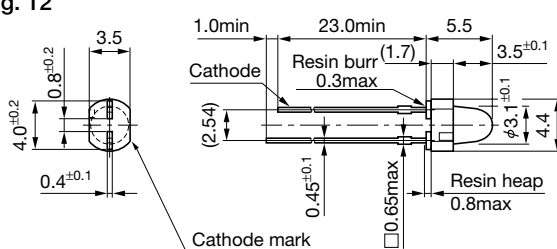


Fig. 13

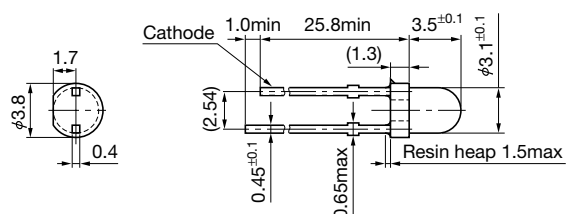


Fig. 14

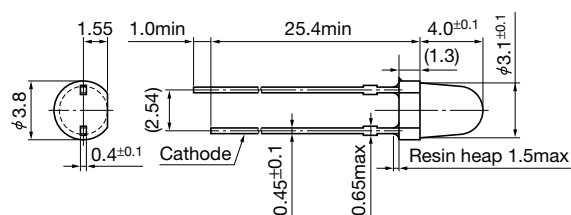


Fig. 15

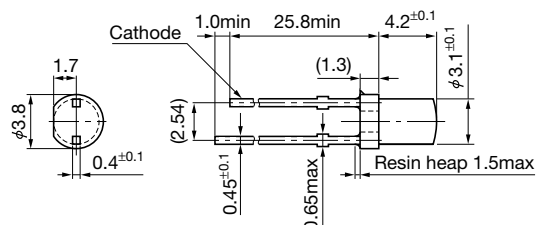


Fig. 16

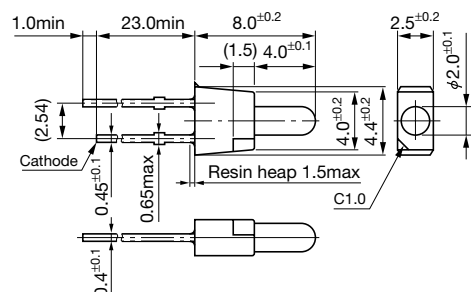


Fig. 17

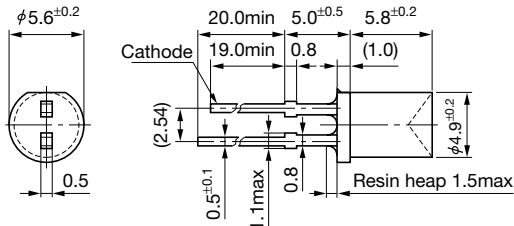


Fig. 18

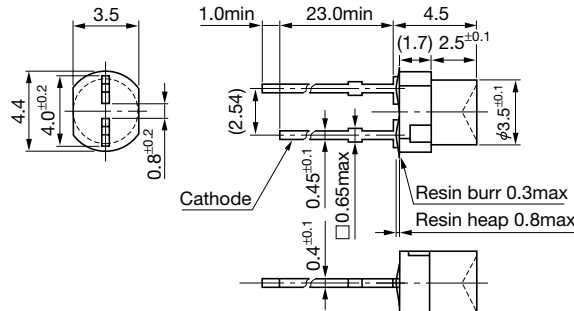


Fig. 19

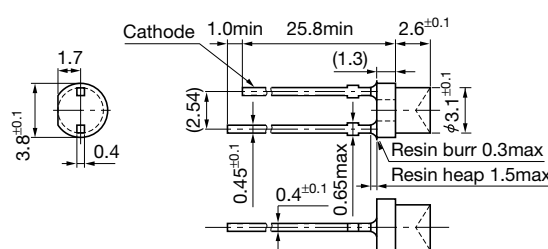
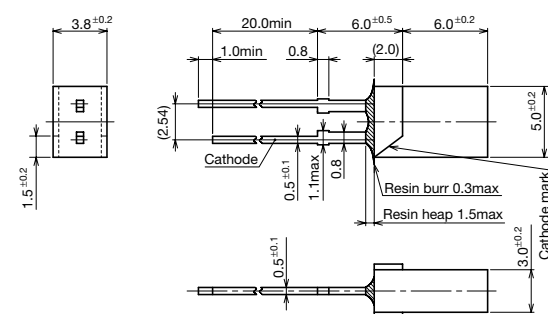


Fig. 20



(Unit: mm)

Fig. 21

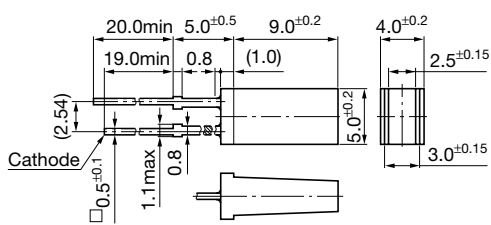


Fig. 26

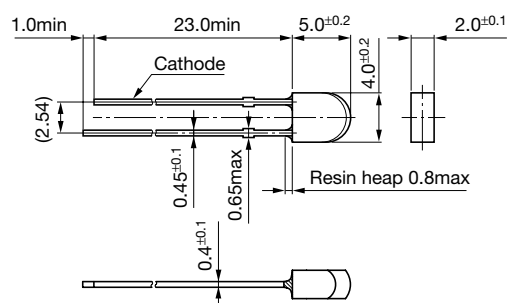


Fig. 22

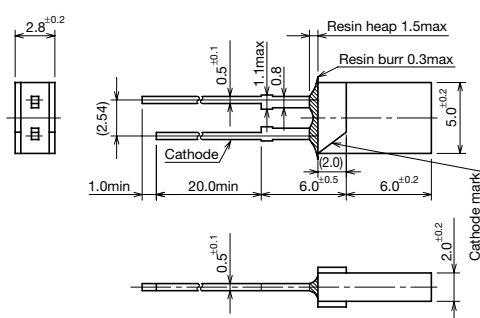


Fig. 27

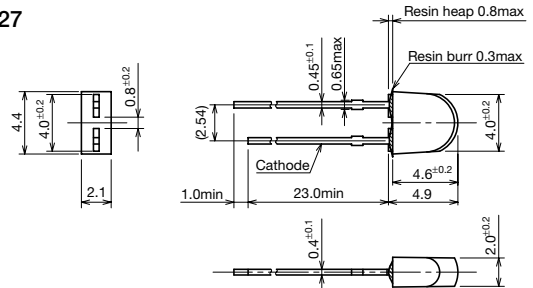


Fig. 23

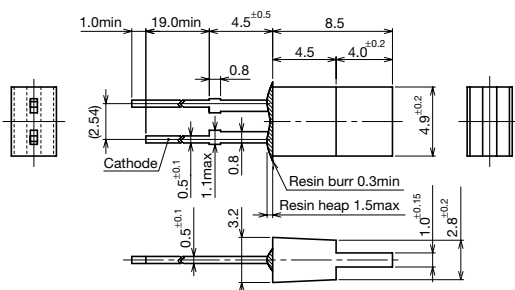


Fig. 28

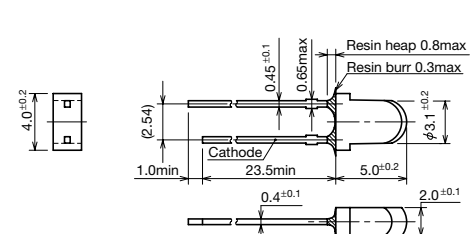


Fig. 24

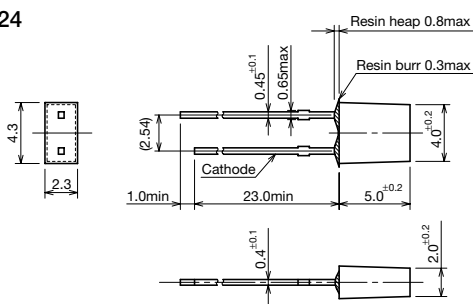


Fig. 29

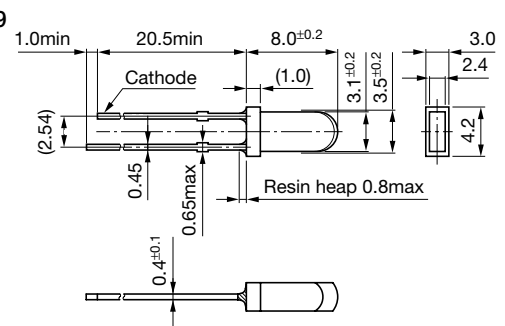


Fig. 25

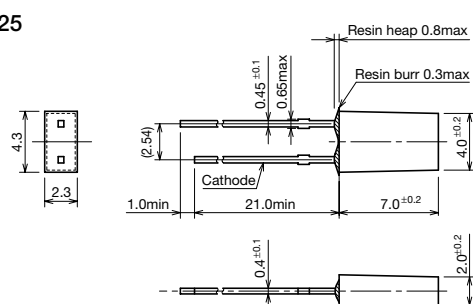
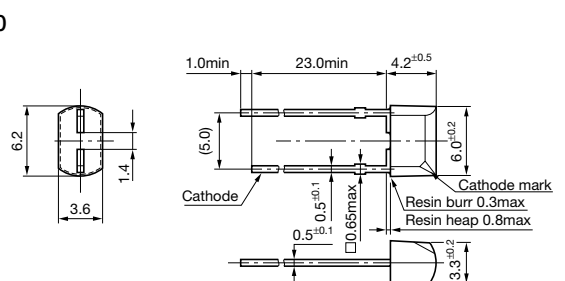


Fig. 30



# General-purpose LEDs - External Dimensions

(Unit: mm)

Fig. 31

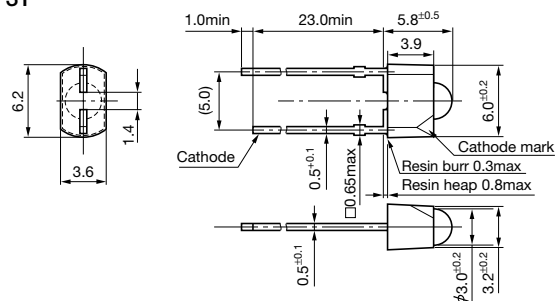


Fig. 32

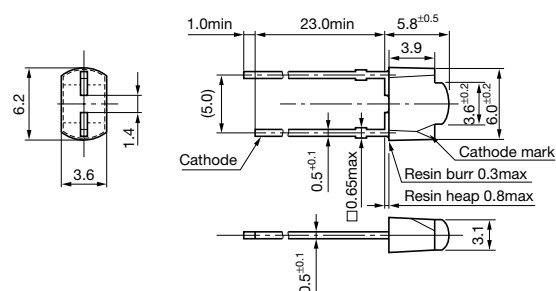


Fig. 33

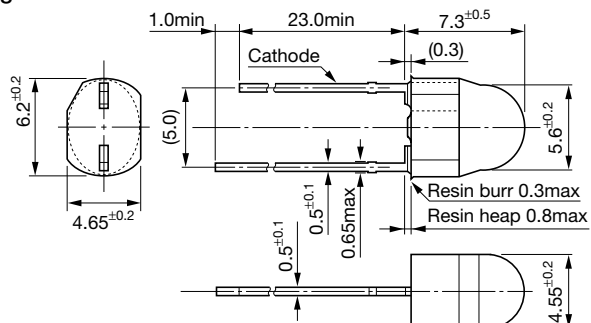


Fig. 34

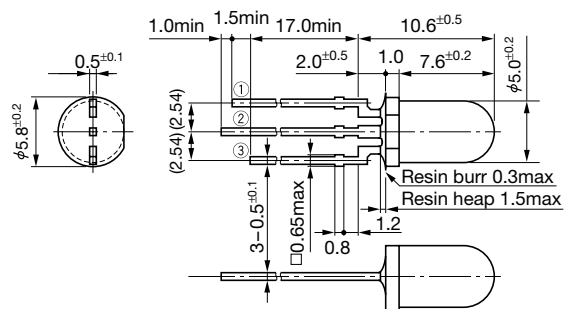


Fig. 35

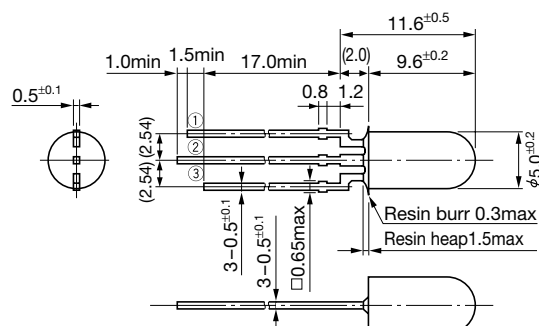


Fig. 36

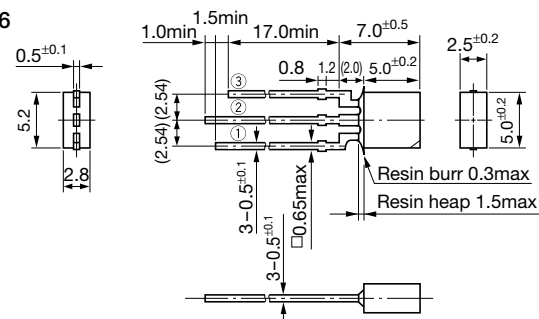


Fig. 37

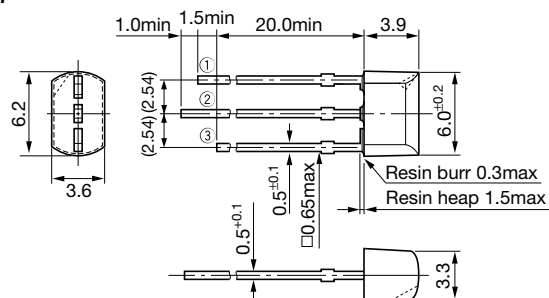


Fig. 38

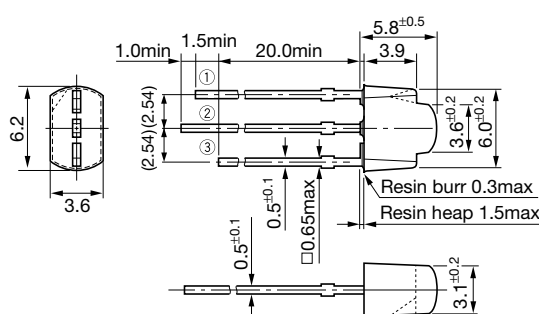


Fig. 39

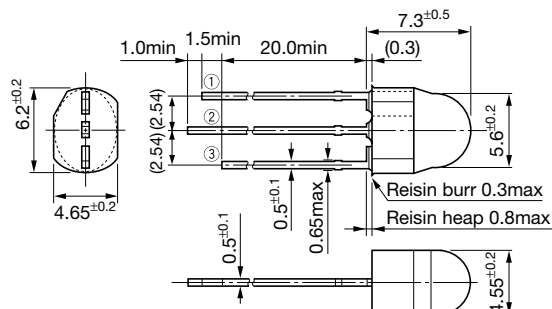
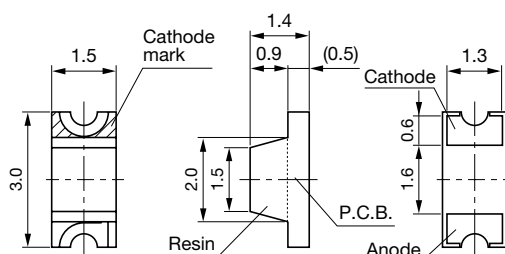


Fig. 40



(Unit: mm)

Fig. 41

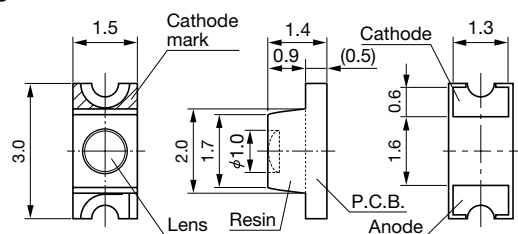


Fig. 45

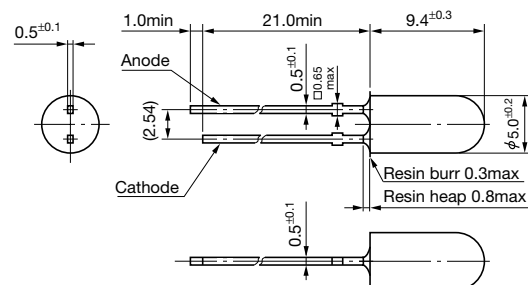
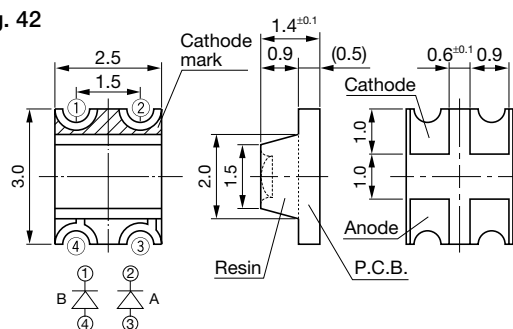


Fig. 42



**Fig. 46**

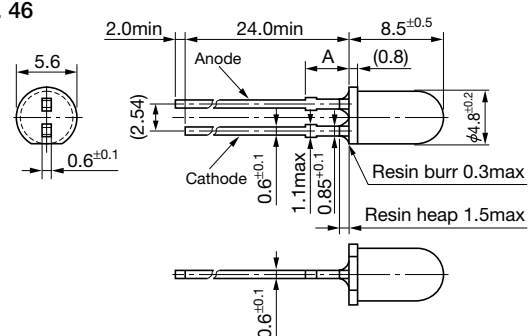


Fig. 43

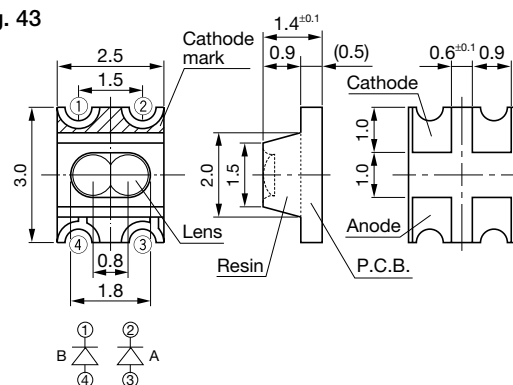


Fig. 47

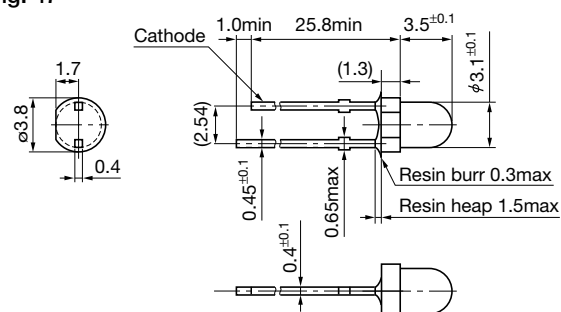
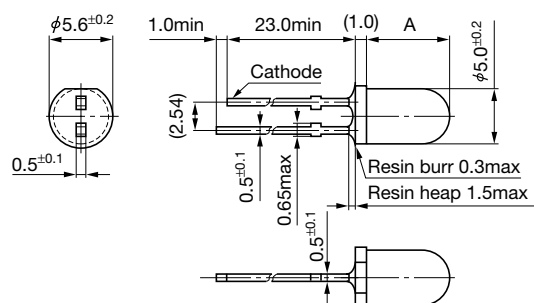


Fig. 44



| Dimension A (mm)      |         |
|-----------------------|---------|
| SID303C               | 3.0±0.5 |
| SID313BP<br>SID1003BQ | 3.6±0.5 |
| SID307BR<br>SID1G307C | 4.2±0.5 |

# Index by Part No.

| Part No.  | Classification                              | Page |
|-----------|---------------------------------------------|------|
| 2SA1488   | Power transistor                            | 66   |
| 2SA1488A  | Power transistor                            | 66   |
| 2SA1567   | Power transistor                            | 67   |
| 2SA1568   | Power transistor                            | 68   |
| 2SC3851   | Power transistor                            | 69   |
| 2SC3852   | Power transistor                            | 70   |
| 2SC4024   | Power transistor                            | 71   |
| 2SC4065   | Power transistor                            | 72   |
| 2SC4153   | Power transistor                            | 73   |
| 2SD2141   | Power transistor                            | 74   |
| 2SD2382   | Power transistor                            | 75   |
| 2SD2633   | Power transistor                            | 76   |
| 2SK2701   | MOS FET                                     | 92   |
| A3121L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3122L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3123L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3134L*   | Hall-Effect IC (Bipolar Switch)             | 60   |
| A3141L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3142L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3143L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3144L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3185L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3187L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3188L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3189L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3240L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3250L*   | Hall-Effect IC (Unipolar Switch)            | 60   |
| A3280L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3281L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3283L*   | Hall-Effect IC (Bipolar Latch)              | 60   |
| A3515LUA  | Hall-Effect IC (Linear Sensor)              | 60   |
| A3516LUA  | Hall-Effect IC (Linear Sensor)              | 60   |
| AG01      | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AG01A     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AG01Y     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AG01Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AK 03     | Schottky barrier Diode (Axial)              | 113  |
| AK 04     | Schottky barrier Diode (Axial)              | 113  |
| AK 06     | Schottky barrier Diode (Axial)              | 113  |
| AK 09     | Schottky barrier Diode (Axial)              | 113  |
| AL01Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AM01      | Rectifier Diode (Axial)                     | 110  |
| AM01A     | Rectifier Diode (Axial)                     | 110  |
| AM01Z     | Rectifier Diode (Axial)                     | 110  |
| AP01C     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| AS01      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| AS01A     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| AS01Z     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ATS610LSA | Hall-Effect IC (Subassembly)                | 60   |

| Part No.  | Classification                              | Page |
|-----------|---------------------------------------------|------|
| ATS611LSB | Hall-Effect IC (Subassembly)                | 60   |
| ATS612LSB | Hall-Effect IC (Subassembly)                | 60   |
| AU01      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| AU01Z     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| AU02      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| AU02Z     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| EG 1      | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG 1A     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG 1Y     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG 1Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG01      | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG01A     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG01C     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG01Y     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EG01Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EH 1      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| EH 1A     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| EH 1Z     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| EK 03     | Schottky barrier Diode (Axial)              | 113  |
| EK 04     | Schottky barrier Diode (Axial)              | 113  |
| EK 06     | Schottky barrier Diode (Axial)              | 113  |
| EK 09     | Schottky barrier Diode (Axial)              | 113  |
| EK 13     | Schottky barrier Diode (Axial)              | 113  |
| EK 14     | Schottky barrier Diode (Axial)              | 113  |
| EK 16     | Schottky barrier Diode (Axial)              | 113  |
| EK 19     | Schottky barrier Diode (Axial)              | 113  |
| EL 1      | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EL 1Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EL02Z     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EM 1      | Rectifier Diode (Axial)                     | 110  |
| EM 1A     | Rectifier Diode (Axial)                     | 110  |
| EM 1B     | Rectifier Diode (Axial)                     | 110  |
| EM 1C     | Rectifier Diode (Axial)                     | 110  |
| EM 1Y     | Rectifier Diode (Axial)                     | 110  |
| EM 1Z     | Rectifier Diode (Axial)                     | 110  |
| EM 2      | Rectifier Diode (Axial)                     | 110  |
| EM 2A     | Rectifier Diode (Axial)                     | 110  |
| EM 2B     | Rectifier Diode (Axial)                     | 110  |
| EM01      | Rectifier Diode (Axial)                     | 110  |
| EM01A     | Rectifier Diode (Axial)                     | 110  |
| EM01Z     | Rectifier Diode (Axial)                     | 110  |
| EN 01Z    | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| EP01C     | Ultra-Fast-Recovery Rectifier Diode (Axial) | 112  |
| ES 1      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ES 1A     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ES 1F     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ES 1Z     | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ES01      | Fast-Recovery Rectifier Diode (Axial)       | 111  |
| ES01A     | Fast-Recovery Rectifier Diode (Axial)       | 111  |

| Part No.  | Classification                                    | Page |
|-----------|---------------------------------------------------|------|
| ES01F     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| ES01Z     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 1      | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 1A     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 1Z     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 2      | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 2A     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 2YX    | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU 2Z     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU01      | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU01A     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU01Z     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU02      | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU02A     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| EU02Z     | Fast-Recovery Rectifier Diode (Axial)             | 111  |
| FKV460    | MOS FET                                           | 93   |
| FKV460S   | MOS FET                                           | 94   |
| FKV560    | MOS FET                                           | 95   |
| FKV560S   | MOS FET                                           | 96   |
| FKV660    | MOS FET                                           | 97   |
| FKV660S   | MOS FET                                           | 98   |
| FMB-24    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-24H   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-24L   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-24M   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-26    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-26L   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-29    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-29L   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-34    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-34M   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-34S   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-36    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-36M   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-39    | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-39M   | Schottky barrier Diode (Center-tap)               | 113  |
| FMB-G14   | Schottky barrier Diode (Frame 2-pin)              | 113  |
| FMB-G14L  | Schottky barrier Diode (Frame 2-pin)              | 113  |
| FMB-G16L  | Schottky barrier Diode (Frame 2-pin)              | 113  |
| FMB-G19L  | Schottky barrier Diode (Frame 2-pin)              | 113  |
| FMB-G24H  | Schottky barrier Diode (Frame 2-pin)              | 113  |
| FMD-G26S  | Ultra-Fast-Recovery Rectifier Diode (Frame 2-pin) | 112  |
| FME-24H   | Schottky barrier Diode (Center-tap)               | 113  |
| FME-24L   | Schottky barrier Diode (Center-tap)               | 113  |
| FMG-12S,R | Ultra-Fast-Recovery Rectifier Diode (Center-tap)  | 112  |
| FMG-13S,R | Ultra-Fast-Recovery Rectifier Diode (Center-tap)  | 112  |
| FMG-14S,R | Ultra-Fast-Recovery Rectifier Diode (Center-tap)  | 112  |
| FMG-22S,R | Ultra-Fast-Recovery Rectifier Diode (Center-tap)  | 112  |
| FMG-23S,R | Ultra-Fast-Recovery Rectifier Diode (Center-tap)  | 112  |



## Index by Part No.

| Part No.    | Classification                                       | Page |
|-------------|------------------------------------------------------|------|
| RU 2B       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 2C       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 2M       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 2YX      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 2Z       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3        | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 30       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 30A      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 30Y      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 30Z      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 31       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 31A      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3A       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3AM      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3B       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3C       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3M       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 3YX      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4        | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4A       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4AM      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4B       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4C       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4M       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4Y       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4YX      | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| RU 4Z       | Fast-Recovery Rectifier Diode (Axial)                | 111  |
| SDA03       | Power transistor Array (Surface Mount)               | 88   |
| SDA04       | Power transistor Array (Surface Mount)               | 89   |
| SDC09       | Power transistor Array (Surface Mount)               | 90   |
| SDH04       | High-side Power Switch IC (Surface Mount 2-circuits) | 26   |
| SDK06       | MOS FET Array (Surface mount)                        | 103  |
| SDK08       | MOS FET Array (Surface mount)                        | 104  |
| SDK09       | MOS FET Array (Surface mount)                        | 105  |
| SEC1101C    | Flat Lens Deep Red Chip LED                          | 123  |
| SEC1201C    | Flat Lens Red Chip LED                               | 123  |
| SEC1203C    | Inner Lens Red Chip LED                              | 123  |
| SEC1401C    | Flat Lens Green Chip LED                             | 123  |
| SEC1401E-TG | Flat Lens Deep Green Chip LED                        | 123  |
| SEC1403C    | Inner Lens Green Chip LED                            | 123  |
| SEC1403E-TG | Inner Lens Deep Green Chip LED                       | 123  |
| SEC1501C    | Flat Lens Pure Green Chip LED                        | 123  |
| SEC1503C    | Inner Lens Pure Green Chip LED                       | 123  |
| SEC1601C    | Flat Lens GaAlAs Red Chip LED                        | 123  |
| SEC1603C    | Inner Lens GaAlAs Red Chip LED                       | 123  |
| SEC1701C-YG | Flat Lens Yellow Chip LED                            | 123  |
| SEC1703C    | Inner Lens Yellow Chip LED                           | 123  |
| SEC1801C    | Flat Lens Amber Chip LED                             | 123  |
| SEC1803C    | Inner Lens Amber Chip LED                            | 123  |

| Part No.     | Classification                                  | Page |
|--------------|-------------------------------------------------|------|
| SEC1901C     | Flat Lens Orange Chip LED                       | 123  |
| SEC1903C     | Inner Lens Orange Chip LED                      | 123  |
| SEC1E01C     | Flat Lens GaN Blue Chip LED                     | 123  |
| SEC2422C     | Flat Lens Green / Red Bicolor Chip LED          | 123  |
| SEC2442C     | Inner Lens Green / Red Bicolor Chip LED         | 123  |
| SEC2462C     | Flat Lens Green / GaAlAs Red Bicolor Chip LED   | 123  |
| SEC2484C     | Inner Lens Green / Amber Bicolor Chip LED       | 123  |
| SEC2492C     | Flat Lens Green / Orange Bicolor Chip LED       | 123  |
| SEC2494C     | Inner Lens Green / Orange Bicolor Chip LED      | 123  |
| SEC2552C     | Flat Lens Green / Green Chip LED                | 123  |
| SEC2554C     | Inner Lens Green / Green Chip LED               | 123  |
| SEC2592C     | Flat Lens Pure Green / Orange Bicolor Chip LED  | 123  |
| SEC2762C-YG  | Flat Lens Yellow / GaAlAs Red Bicolor Chip LED  | 123  |
| SEC2764C     | Inner Lens Yellow / GaAlAs Red Bicolor Chip LED | 123  |
| SEC2774C     | Inner Lens Yellow / Yellow Chip LED             | 123  |
| SECS1203C    | Flat Lens AlGaInP Red Chip LED                  | 123  |
| SECU1D01C    | Flat Lens InGaN Pure Green Chip LED             | 123  |
| SECU1E01C    | Flat Lens InGaN Blue Chip LED                   | 123  |
| SEL1110R     | 5ø Round Deep Red LED Lamp                      | 119  |
| SEL1110S     | 5ø Round Deep Red LED Lamp                      | 119  |
| SEL1110W     | 5ø Round Deep Red LED Lamp                      | 119  |
| SEL1111R     | 5ø Round Cylindrical Deep Red LED Lamp          | 119  |
| SEL1120R     | 2X5 Rectangular Deep Red LED Lamp               | 121  |
| SEL1121R     | 3X5 Rectangular Deep Red LED Lamp               | 120  |
| SEL1124R     | 1X5 Rectangular Deep Red LED Lamp               | 121  |
| SEL1210R     | 5ø Round Red LED Lamp                           | 119  |
| SEL1210RM    | 5ø Round Red LED Lamp                           | 119  |
| SEL1210S     | 5ø Round Red LED Lamp                           | 119  |
| SEL1210SM    | 5ø Round Red LED Lamp                           | 119  |
| SEL1211R     | 5ø Round Cylindrical Red LED Lamp               | 119  |
| SEL1213C     | For Surface Illumination Red LED Lamp           | 120  |
| SEL1220R     | 2X5 Rectangular Red LED Lamp                    | 121  |
| SEL1222R     | 2.5X5 Rectangular Red LED Lamp                  | 121  |
| SEL1250RM    | 5ø Round Red LED Lamp                           | 119  |
| SEL1250SM    | 5ø Round Red LED Lamp                           | 119  |
| SEL1410E     | 5ø Round Green LED Lamp                         | 119  |
| SEL1410EM    | 5ø Round Green LED Lamp                         | 119  |
| SEL1410G     | 5ø Round Green LED Lamp                         | 119  |
| SEL1410GM    | 5ø Round Green LED Lamp                         | 119  |
| SEL1411G     | 5ø Round Cylindrical Green LED Lamp             | 119  |
| SEL1413E     | For Surface Illumination Green LED Lamp         | 120  |
| SEL1420G     | 2X5 Rectangular Green LED Lamp                  | 121  |
| SEL1421G     | 3X5 Rectangular Green LED Lamp                  | 120  |
| SEL1422G     | 2.5X5 Rectangular Green LED Lamp                | 121  |
| SEL1424G     | 1X5 Rectangular Green LED Lamp                  | 121  |
| SEL1450EKM   | 5ø Round Green LED Lamp                         | 119  |
| SEL1450GM-YG | 5ø Round Green LED Lamp                         | 119  |
| SEL1453CEMKT | 4.6X5.6ø Egg-shaped Green LED Lamp              | 119  |
| SEL1510C     | 5ø Round Pure Green LED Lamp                    | 119  |

| Part No.  | Classification                               | Page |
|-----------|----------------------------------------------|------|
| SEL1510CM | 5ø Round Pure Green LED Lamp                 | 119  |
| SEL1513E  | For Surface Illumination Pure Green LED Lamp | 120  |
| SEL1550CM | 5ø Round Pure Green LED Lamp                 | 119  |
| SEL1610C  | 5ø Round GaAlAs Red LED Lamp                 | 119  |
| SEL1610W  | 5ø Round GaAlAs Red LED Lamp                 | 119  |
| SEL1615C  | 5ø Round GaAlAs Red LED Lamp                 | 119  |
| SEL1710K  | 5ø Round Yellow LED Lamp                     | 119  |
| SEL1710KM | 5ø Round Yellow LED Lamp                     | 119  |
| SEL1710Y  | 5ø Round Yellow LED Lamp                     | 119  |
| SEL1711Y  | 5ø Round Cylindrical Yellow LED Lamp         | 119  |
| SEL1713K  | For Surface Illumination Yellow LED Lamp     | 120  |
| SEL1720Y  | 2X5 Rectangular Yellow LED Lamp              | 121  |
| SEL1721Y  | 3X5 Rectangular Yellow LED Lamp              | 120  |
| SEL1722K  | 2.5X5 Rectangular Yellow LED Lamp            | 121  |
| SEL1722Y  | 2.5X5 Rectangular Yellow LED Lamp            | 121  |
| SEL1724Y  | 1X5 Rectangular Yellow LED Lamp              | 121  |
| SEL1810A  | 5ø Round Amber LED Lamp                      | 119  |
| SEL1810AM | 5ø Round Amber LED Lamp                      | 119  |
| SEL1810D  | 5ø Round Amber LED Lamp                      | 119  |
| SEL1810DM | 5ø Round Amber LED Lamp                      | 119  |
| SEL1811D  | 5ø Round Cylindrical Amber LED Lamp          | 119  |
| SEL1813A  | For Surface Illumination Amber LED Lamp      | 120  |
| SEL1820D  | 2X5 Rectangular Amber LED Lamp               | 121  |
| SEL1821D  | 3X5 Rectangular Amber LED Lamp               | 120  |
| SEL1822D  | 2.5X5 Rectangular Amber LED Lamp             | 121  |
| SEL1824D  | 1X5 Rectangular Amber LED Lamp               | 121  |
| SEL1850AM | 5ø Round Amber LED Lamp                      | 119  |
| SEL1850DM | 5ø Round Amber LED Lamp                      | 119  |
| SEL1910A  | 5ø Round Orange LED Lamp                     | 119  |
| SEL1910AM | 5ø Round Orange LED Lamp                     | 119  |
| SEL1910D  | 5ø Round Orange LED Lamp                     | 119  |
| SEL1910DM | 5ø Round Orange LED Lamp                     | 119  |
| SEL1911D  | 5ø Round Cylindrical Orange LED Lamp         | 119  |
| SEL1913K  | For Surface Illumination Orange LED Lamp     | 120  |
| SEL1920D  | 2X5 Rectangular Orange LED Lamp              | 121  |
| SEL1921D  | 3X5 Rectangular Orange LED Lamp              | 120  |
| SEL1922D  | 2.5X5 Rectangular Orange LED Lamp            | 121  |
| SEL1924D  | 1X5 Rectangular Orange LED Lamp              | 121  |
| SEL1950KM | 5ø Round Orange LED Lamp                     | 119  |
| SEL2110R  | 3ø Round Deep Red LED Lamp                   | 120  |
| SEL2110S  | 3ø Round Deep Red LED Lamp                   | 120  |
| SEL2110W  | 3ø Round Deep Red LED Lamp                   | 120  |
| SEL2111R  | 3ø Round Cylindrical Deep Red LED Lamp       | 120  |
| SEL2210R  | 3ø Round Red LED Lamp                        | 120  |
| SEL2210S  | 3ø Round Red LED Lamp                        | 120  |
| SEL2210W  | 3ø Round Red LED Lamp                        | 120  |
| SEL2213C  | For Surface Illumination Red LED Lamp        | 120  |
| SEL2215R  | 3ø Round Red LED Lamp                        | 120  |
| SEL2215S  | 3ø Round Red LED Lamp                        | 120  |

| Part No.    | Classification                               | Page |
|-------------|----------------------------------------------|------|
| SEL2410E    | 3ø Round Green LED Lamp                      | 120  |
| SEL2410G    | 3ø Round Green LED Lamp                      | 120  |
| SEL2411G    | 3ø Round Cylindrical Green LED Lamp          | 120  |
| SEL2413E    | For Surface Illumination Green LED Lamp      | 120  |
| SEL2413G    | For Surface Illumination Green LED Lamp      | 120  |
| SEL2415E    | 3ø Round Green LED Lamp                      | 120  |
| SEL2415G    | 3ø Round Green LED Lamp                      | 120  |
| SEL2510C    | 3ø Round Pure Green LED Lamp                 | 120  |
| SEL2510G    | 3ø Round Pure Green LED Lamp                 | 120  |
| SEL2513E    | For Surface Illumination Pure Green LED Lamp | 120  |
| SEL2515C    | 3ø Round Pure Green LED Lamp                 | 120  |
| SEL2610C    | 3ø Round GaAlAs Red LED Lamp                 | 120  |
| SEL2613CS-S | For Surface Illumination GaAlAs Red LED Lamp | 120  |
| SEL2710K    | 3ø Round Yellow LED Lamp                     | 120  |
| SEL2710Y    | 3ø Round Yellow LED Lamp                     | 120  |
| SEL2713K    | For Surface Illumination Yellow LED Lamp     | 120  |
| SEL2715K    | 3ø Round Yellow LED Lamp                     | 120  |
| SEL2715Y    | 3ø Round Yellow LED Lamp                     | 120  |
| SEL2810A    | 3ø Round Amber LED Lamp                      | 120  |
| SEL2810D    | 3ø Round Amber LED Lamp                      | 120  |
| SEL2813A    | For Surface Illumination Amber LED Lamp      | 120  |
| SEL2815A    | 3ø Round Amber LED Lamp                      | 120  |
| SEL2815D    | 3ø Round Amber LED Lamp                      | 120  |
| SEL2910A    | 3ø Round Orange LED Lamp                     | 120  |
| SEL2910D    | 3ø Round Orange LED Lamp                     | 120  |
| SEL2911D    | 3ø Round Cylindrical Orange LED Lamp         | 120  |
| SEL2913K    | For Surface Illumination Orange LED Lamp     | 120  |
| SEL2915A    | 3ø Round Orange LED Lamp                     | 120  |
| SEL2915D    | 3ø Round Orange LED Lamp                     | 120  |
| SEL2E10C    | 3ø Round GaN Blue LED Lamp                   | 120  |
| SEL4110R    | 4ø Round Deep Red LED Lamp                   | 119  |
| SEL4110S    | 4ø Round Deep Red LED Lamp                   | 119  |
| SEL4114R    | 4ø Round Deep Red LED Lamp                   | 119  |
| SEL4114S    | 4ø Round Deep Red LED Lamp                   | 119  |
| SEL4117R    | 2ø Round Deep Red LED Lamp                   | 120  |
| SEL4210R    | 4ø Round Red LED Lamp                        | 119  |
| SEL4210S    | 4ø Round Red LED Lamp                        | 119  |
| SEL4214R    | 4ø Round Red LED Lamp                        | 119  |
| SEL4214S    | 4ø Round Red LED Lamp                        | 119  |
| SEL4225C    | 2X4 Rectangular Red LED Lamp                 | 121  |
| SEL4225R    | 2X4 Rectangular Red LED Lamp                 | 121  |
| SEL4226C    | 2X4 Rectangular Red LED Lamp                 | 121  |
| SEL4226R    | 2X4 Rectangular Red LED Lamp                 | 121  |
| SEL4227C    | 4ø Bow-shaped Red LED Lamp                   | 121  |
| SEL4228C    | 3.1ø Bow-shaped Red LED Lamp                 | 121  |
| SEL4229R    | 3.1ø Bow-shaped Red LED Lamp                 | 121  |
| SEL4410E    | 4ø Round Green LED Lamp                      | 119  |
| SEL4410G    | 4ø Round Green LED Lamp                      | 119  |
| SEL4414E    | 4ø Round Green LED Lamp                      | 119  |

| Part No.    | Classification                          | Page |
|-------------|-----------------------------------------|------|
| SEL4414G    | 4ø Round Green LED Lamp                 | 119  |
| SEL4417G    | 2ø Round Green LED Lamp                 | 120  |
| SEL4425E    | 2X4 Rectangular Green LED Lamp          | 121  |
| SEL4425G    | 2X4 Rectangular Green LED Lamp          | 121  |
| SEL4426E    | 2X4 Rectangular Green LED Lamp          | 121  |
| SEL4426G    | 2X4 Rectangular Green LED Lamp          | 121  |
| SEL4427EP   | 4ø Bow-shaped Green LED Lamp            | 121  |
| SEL4428B-TG | 3.1ø Bow-shaped Deep Green LED Lamp     | 121  |
| SEL4428E    | 3.1ø Bow-shaped Green LED Lamp          | 121  |
| SEL4429E    | 3.1ø Bow-shaped Green LED Lamp          | 121  |
| SEL4510C    | 4ø Round Pure Green LED Lamp            | 119  |
| SEL4514C    | 4ø Round Pure Green LED Lamp            | 119  |
| SEL4525C    | 2X4 Rectangular Pure Green LED Lamp     | 121  |
| SEL4528C    | 3.1ø Bow-shaped Pure Green LED Lamp     | 121  |
| SEL4628C-S  | 3.1ø Bow-shaped GaAlAs Red LED Lamp     | 121  |
| SEL4710K    | 4ø Round Yellow LED Lamp                | 119  |
| SEL4710Y    | 4ø Round Yellow LED Lamp                | 119  |
| SEL4714K    | 4ø Round Yellow LED Lamp                | 119  |
| SEL4714Y    | 4ø Round Yellow LED Lamp                | 119  |
| SEL4717Y    | 2ø Round Yellow LED Lamp                | 120  |
| SEL4725K    | 2X4 Rectangular Yellow LED Lamp         | 121  |
| SEL4725Y    | 2X4 Rectangular Yellow LED Lamp         | 121  |
| SEL4726K    | 2X4 Rectangular Yellow LED Lamp         | 121  |
| SEL4726Y    | 2X4 Rectangular Yellow LED Lamp         | 121  |
| SEL4728K    | 3.1ø Bow-shaped Yellow LED Lamp         | 121  |
| SEL4729KH   | 3.1ø Bow-shaped Yellow LED Lamp         | 121  |
| SEL4810A    | 4ø Round amber LED Lamp                 | 119  |
| SEL4810D    | 4ø Round amber LED Lamp                 | 119  |
| SEL4814A    | 4ø Round amber LED Lamp                 | 119  |
| SEL4814D    | 4ø Round amber LED Lamp                 | 119  |
| SEL4817D    | 2ø Round Amber LED Lamp                 | 120  |
| SEL4825A    | 2X4 Rectangular Amber LED Lamp          | 121  |
| SEL4825D    | 2X4 Rectangular Amber LED Lamp          | 121  |
| SEL4826A    | 2X4 Rectangular Amber LED Lamp          | 121  |
| SEL4826D    | 2X4 Rectangular Amber LED Lamp          | 121  |
| SEL4828A    | 3.1ø Bow-shaped Amber LED Lamp          | 121  |
| SEL4829A    | 3.1ø Bow-shaped Amber LED Lamp          | 121  |
| SEL4910A    | 4ø Round Orange LED Lamp                | 119  |
| SEL4910D    | 4ø Round Orange LED Lamp                | 119  |
| SEL4914A    | 4ø Round Orange LED Lamp                | 119  |
| SEL4914D    | 4ø Round Orange LED Lamp                | 119  |
| SEL4917D    | 2ø Round Orange LED Lamp                | 120  |
| SEL4925A    | 2X4 Rectangular Orange LED Lamp         | 121  |
| SEL4925D    | 2X4 Rectangular Orange LED Lamp         | 121  |
| SEL4926A    | 2X4 Rectangular Orange LED Lamp         | 121  |
| SEL4926D    | 2X4 Rectangular Orange LED Lamp         | 121  |
| SEL4928A    | 3.1ø Bow-shaped Orange LED Lamp         | 121  |
| SEL4929A    | 3.1ø Bow-shaped Orange LED Lamp         | 121  |
| SEL5220S    | 5mm Pitch Lead Rectangular Red LED Lamp | 121  |

| Part No.    | Classification                                  | Page |
|-------------|-------------------------------------------------|------|
| SEL5221S    | 5mm Pitch Lead 3ø Lens-type Red LED Lamp        | 121  |
| SEL5223S    | 5mm Pitch Lead Bow-shaped Red LED Lamp          | 121  |
| SEL5255S    | 5mm Pitch Lead Egg-shaped Red LED Lamp          | 121  |
| SEL5420E    | 5mm Pitch Lead Rectangular Orange LED Lamp      | 121  |
| SEL5421E    | 5mm Pitch Lead 3ø Lens-type Green LED Lamp      | 121  |
| SEL5423E    | 5mm Pitch Lead Bow-shaped Green LED Lamp        | 121  |
| SEL5520C    | 5mm Pitch Lead Rectangular Pure Green LED Lamp  | 121  |
| SEL5521C    | 5mm Pitch Lead 3ø Lens-type Pure Green LED Lamp | 121  |
| SEL5523C    | 5mm Pitch Lead Bow-shaped Pure Green LED Lamp   | 121  |
| SEL5620C    | 5mm Pitch Lead Rectangular GaAlAs Red LED Lamp  | 121  |
| SEL5721C    | 5mm Pitch Lead 3ø Lens-type Yellow LED Lamp     | 121  |
| SEL5723C    | 5mm Pitch Lead Bow-shaped Yellow LED Lamp       | 121  |
| SEL5755C    | 5mm Pitch Lead Egg-shaped Yellow LED Lamp       | 121  |
| SEL5820A    | 5mm Pitch Lead Rectangular Amber LED Lamp       | 121  |
| SEL5821A    | 5mm Pitch Lead 3ø Lens-type Amber LED Lamp      | 121  |
| SEL5823A    | 5mm Pitch Lead Bow-shaped Amber LED Lamp        | 121  |
| SEL5920A    | 5mm Pitch Lead Rectangular Orange LED Lamp      | 121  |
| SEL5921A    | 5mm Pitch Lead 3ø Lens-type Orange LED Lamp     | 121  |
| SEL5923A    | 5mm Pitch Lead Bow-shaped Orange LED Lamp       | 121  |
| SEL5955A    | 5mm Pitch Lead Egg-shaped Orange LED Lamp       | 121  |
| SEL5E23C    | 5mm Pitch Lead Bow-shaped GaN Blue LED Lamp     | 121  |
| SEL6110R    | 3ø Round Deep Red LED Lamp                      | 120  |
| SEL6110S    | 3ø Round Deep Red LED Lamp                      | 120  |
| SEL6210R    | 3ø Round Red LED Lamp                           | 120  |
| SEL6210S    | 3ø Round Red LED Lamp                           | 120  |
| SEL6214S    | 3ø Round Red LED Lamp                           | 120  |
| SEL6215S    | 3ø Round Red LED Lamp                           | 120  |
| SEL6227S    | 4ø Bow-shaped Red LED Lamp                      | 121  |
| SEL6410E    | 3ø Round Green LED Lamp                         | 120  |
| SEL6410G    | 3ø Round Green LED Lamp                         | 120  |
| SEL6413E    | For Surface Illumination Green LED Lamp         | 120  |
| SEL6414E    | 3ø Round Green LED Lamp                         | 120  |
| SEL6414E-TG | 3ø Round Green LED Lamp                         | 120  |
| SEL6415E    | 3ø Round Green LED Lamp                         | 120  |
| SEL6427EP   | 4ø Bow-shaped Green LED Lamp                    | 121  |
| SEL6510C    | 3ø Round Pure Green LED Lamp                    | 120  |
| SEL6510G    | 4ø Round Pure Green LED Lamp                    | 120  |
| SEL6513C    | For Surface Illumination GaAlAs Red LED Lamp    | 120  |
| SEL6514C    | 3ø Round Pure Green LED Lamp                    | 120  |
| SEL6515C    | 3ø Round Pure Green LED Lamp                    | 120  |
| SEL6710K    | 3ø Round Yellow LED Lamp                        | 120  |
| SEL6710Y    | 3ø Round Yellow LED Lamp                        | 120  |
| SEL6714K    | 3ø Round Yellow LED Lamp                        | 120  |
| SEL6714W    | 3ø Round Yellow LED Lamp                        | 120  |
| SEL6715C    | 3ø Round Yellow LED Lamp                        | 120  |
| SEL6810A    | 3ø Round Amber LED Lamp                         | 120  |
| SEL6810D    | 3ø Round Amber LED Lamp                         | 120  |
| SEL6814A    | 3ø Round Amber LED Lamp                         | 120  |
| SEL6910A    | 3ø Round Orange LED Lamp                        | 120  |

## Index by Part No.

| Part No.     | Classification                                         | Page |
|--------------|--------------------------------------------------------|------|
| SEL6910D     | 3ø Round Orange LED Lamp                               | 120  |
| SEL6914A     | 3ø Round Orange LED Lamp                               | 120  |
| SEL6914W     | 3ø Round Orange LED Lamp                               | 120  |
| SEL6915A     | 3ø Round Orange LED Lamp                               | 120  |
| SEL6927A     | 4ø Bow-shaped Orange LED Lamp                          | 121  |
| SELS1803C    | Inner Lens AlGaInP Amber Chip LED                      | 123  |
| SELS1903C    | Inner Lens AlGaInP Orange Chip LED                     | 123  |
| SELS5223C    | 5mm Pitch Lead Bow-shaped AlGaInP Red LED Lamp         | 121  |
| SELS5823C    | 5mm Pitch Lead Bow-shaped AlGaInP Amber LED Lamp       | 121  |
| SELS5923C    | 5mm Pitch Lead Bow-shaped AlGaInP Orange LED Lamp      | 121  |
| SELS5B23C    | 5mm Pitch Lead Bow-shaped AlGaInP Light Amber LED Lamp | 121  |
| SELS6B14C    | 3ø Round AlGaInP Light Amber LED Lamp                  | 120  |
| SELU1210CXM  | 5ø Round AlGaInP Red LED Lamp                          | 119  |
| SELU1250CM   | 5ø Round AlGaInP Red LED Lamp                          | 119  |
| SELU1253CMKT | 4.6X5.6ø Egg-shaped AlGaInP Red LED Lamp               | 119  |
| SELU1810CXM  | 5ø Round AlGaInP Amber LED Lamp                        | 119  |
| SELU1853CMKT | 4.6X5.6ø Egg-shaped AlGaInP Amber LED Lamp             | 119  |
| SELU1D10CXM  | 5ø Round InGaN Pure Green LED Lamp                     | 119  |
| SELU1D50CM   | 5ø Round InGaN Pure Green LED Lamp                     | 119  |
| SELU1E10CXM  | 5ø Round InGaN Blue LED Lamp                           | 119  |
| SELU1E50CM   | 5ø Round InGaN Blue LED Lamp                           | 119  |
| SELU2710C    | 3ø Round AlGaInP Yellow LED Lamp                       | 120  |
| SELU2D10C    | 3ø Round InGaN Pure green LED Lamp                     | 120  |
| SELU2E10C    | 3ø Round InGaN Blue LED Lamp                           | 120  |
| SELU5723C    | 5mm Pitch Lead Bow-shaped AlGaInP Yellow LED Lamp      | 121  |
| SELU5823C    | 5mm Pitch Lead Bow-shaped AlGaInP Amber LED Lamp       | 121  |
| SELU5E20C    | 5mm Pitch Lead Rectangular InGaN Pure Green LED Lamp   | 121  |
| SELU5E23C    | 5mm Pitch Lead Bow-shaped InGaN Blue LED Lamp          | 121  |
| SFPB-54      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-56      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-59      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-64      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-66      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-69      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-74      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPB-76      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPE-63      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPE-64      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPJ-53      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPJ-63      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPJ-73      | Schottky barrier Diode (Surface Mount)                 | 113  |
| SFPL-52      | Ultra-Fast-Recovery Rectifier Diode (Surface Mount)    | 112  |
| SFPL-62      | Ultra-Fast-Recovery Rectifier Diode (Surface Mount)    | 112  |
| SFPM-52      | Rectifier Diode (Surface Mount)                        | 110  |
| SFPM-54      | Rectifier Diode (Surface Mount)                        | 110  |
| SFPM-62      | Rectifier Diode (Surface Mount)                        | 110  |
| SFPM-64      | Rectifier Diode (Surface Mount)                        | 110  |
| SFPZ-68      | Power Zener Diode (Surface Mount)                      | 109  |
| SG-9CNR      | Rectifier Diode for Alternator                         | 107  |

| Part No.   | Classification                                                              | Page |
|------------|-----------------------------------------------------------------------------|------|
| SG-9CNS    | Rectifier Diode for Alternator                                              | 107  |
| SG-9LCNR   | Rectifier Diode for Alternator                                              | 107  |
| SG-9LCNS   | Rectifier Diode for Alternator                                              | 107  |
| SG-9LLCNR  | Rectifier Diode for Alternator                                              | 107  |
| SG-9LLCNS  | Rectifier Diode for Alternator                                              | 107  |
| SHV-05JS   | High-Voltage Rectifier Diode for Ignition Coil                              | 108  |
| SHV-08J    | High-Voltage Rectifier Diode for Ignition Coil                              | 108  |
| SHV-30J    | High-Voltage Rectifier Diode for Ignition Coil                              | 108  |
| SI-3001S   | Dropper Type Regulator IC with ON / OFF Control                             | 6    |
| SI-3003S   | Dropper Type Regulator IC (3-terminal)                                      | 8    |
| SI-3101S   | Dropper Type Regulator IC (2-output)                                        | 10   |
| SI-3102S   | Dropper Type Regulator IC (2-output)                                        | 12   |
| SI-3201S   | Switching Type Regulator IC                                                 | 14   |
| SI-5151S   | High-side Power Switch IC with Diagnostic Function                          | 16   |
| SI-5152S   | High-side Power Switch IC with Diagnostic Function                          | 18   |
| SI-5153S   | High-side Power Switch IC with Diagnostic Function and built-in Zener Diode | 22   |
| SI-5154S   | High-side Power Switch IC with Diagnostic Function and built-in Zener Diode | 24   |
| SI-5155S   | High-side Power Switch IC with Diagnostic Function                          | 20   |
| SI-5300    | Full-bridge PWM Motor Driver IC                                             | 48   |
| SID1003BQ  | 5ø Round Infrared LED                                                       | 124  |
| SID1010CM  | 5ø Round Infrared LED                                                       | 124  |
| SID1010CXM | 5ø Round Infrared LED                                                       | 124  |
| SID1050CM  | 5ø Round Infrared LED                                                       | 124  |
| SID1G307C  | 5ø Round Infrared LED                                                       | 124  |
| SID1K10CM  | 5ø Round Infrared LED                                                       | 124  |
| SID1K10CXM | 5ø Round Infrared LED                                                       | 124  |
| SID2010C   | 3ø Round Infrared LED                                                       | 124  |
| SID2K10C   | 3ø Round Infrared LED                                                       | 124  |
| SID303C    | 5ø Round Infrared LED                                                       | 124  |
| SID307BR   | 5ø Round Infrared LED                                                       | 124  |
| SID313BP   | 5ø Round Infrared LED                                                       | 124  |
| SLA2402M   | High Voltage Driver IC for HID Lamps                                        | 52   |
| SLA2403M   | High Voltage Driver IC for HID Lamps                                        | 56   |
| SLA2501M   | High-side Power Switch IC (3-circuits)                                      | 32   |
| SLA2502M   | High-side Power Switch IC (4-circuits)                                      | 36   |
| SLA4708M   | Stepper-motor Driver IC                                                     | 46   |
| SLA5027    | MOS FET Array                                                               | 102  |
| SLA8004    | Power transistor Array                                                      | 87   |
| SMA5113    | MOS FET Array                                                               | 101  |
| SML11516C  | 5ø Round Deep Red / Pure Green Bicolor LED Lamp                             | 122  |
| SML1216C   | 5ø Round Red / Green Bicolor LED Lamp                                       | 122  |
| SML1216W   | 5ø Round Red / Green Bicolor LED Lamp                                       | 122  |
| SML12451W  | 5ø Round Red / Green Bicolor LED Lamp                                       | 122  |
| SML12460C  | 2.5X5 Rectangular Red / Green Bicolor LED Lamp                              | 122  |
| SML1516W   | 5ø Round Deep Red / Pure Green Bicolor LED Lamp                             | 122  |
| SML16716CN | 5ø Round GaAlAs Red / Yellow Bicolor LED Lamp                               | 122  |
| SML16716WN | 5ø Round GaAlAs Red / Yellow Bicolor LED Lamp                               | 122  |
| SML16751WN | 5ø Round GaAlAs Red / Yellow Bicolor LED Lamp                               | 122  |
| SML16760CN | 2.5X5 Rectangular GaAlAs Red / Yellow Bicolor LED Lamp                      | 122  |

| Part No.   | Classification                                                   | Page |
|------------|------------------------------------------------------------------|------|
| SML1816W   | 5ø Round Amber / Green Bicolor LED Lamp                          | 122  |
| SML19416W  | 5ø Round Orange / Green Bicolor LED Lamp                         | 122  |
| SML19460C  | 2.5X5 Rectangular Orange / Green Bicolor LED Lamp                | 122  |
| SML72420C  | 3.3X6 Rectangular Red / Green Bicolor LED Lamp                   | 122  |
| SML72423C  | Bow Lens Red / Green Bicolor LED Lamp                            | 122  |
| SML72755C  | Egg Shape Red / Yellow Bicolor LED Lamp                          | 122  |
| SML72923C  | Bow Lens Red / Orange Bicolor LED Lamp                           | 122  |
| SML76755WN | Egg Shape Red / Yellow Bicolor LED Lamp                          | 122  |
| SML78420C  | 3.3X6 Rectangular Amber / Green Bicolor LED Lamp                 | 122  |
| SML78423C  | Bow Lens Amber/Green Bicolor LED Lamp                            | 122  |
| SML79255C  | Egg Shape Orange / Red Bicolor LED Lamp                          | 122  |
| SML79420C  | 3.3X6 Rectangular Orange / Green Bicolor LED Lamp                | 122  |
| SML79423C  | Bow Lens Orange/Green Bicolor LED Lamp                           | 122  |
| SML79455C  | Egg Shape Orange / Green Bicolor LED Lamp                        | 122  |
| SMLS79723C | Bow Lens AlGaInP Orange / Yellow Bicolor LED Lamp                | 122  |
| SMLU72755C | Egg Shape AlGaInP Red / AlGaInP Yellow Bicolor LED Lamp          | 122  |
| SMLU78755C | Egg Shape AlGaInP Amber / AlGaInP Yellow Bicolor LED Lamp        | 122  |
| SPB-64S    | Schottky barrier Diode (Surface Mount)                           | 113  |
| SPB-G34S   | Schottky barrier Diode (Surface Mount)                           | 113  |
| SPB-G54S   | Schottky barrier Diode (Surface Mount)                           | 113  |
| SPB-G56S   | Schottky barrier Diode (Surface Mount)                           | 113  |
| SPF0001    | Power transistor Array (Surface Mount)                           | 91   |
| SPF5002A   | Low-side Switch IC (Surface Mount 4-circuit)                     | 40   |
| SPF5003    | High-side Power Switch IC (Surface Mount 2-circuits)             | 28   |
| SPF5004    | High-side Power Switch IC (Surface Mount 2-circuits)             | 30   |
| SPF5007    | High-side Power Switch IC (Surface Mount 3-circuits)             | 34   |
| SPF5009    | Low-side Switch IC (Surface Mount 4-circuit)                     | 42   |
| SPF5012    | Low-side Switch IC (Surface Mount 4-circuit with Output Monitor) | 44   |
| SPJ-63S    | Schottky barrier Diode (Surface Mount)                           | 113  |
| SPZ-G36    | Power Zener Diode (Surface Mount)                                | 109  |
| STA315A    | Power transistor Array                                           | 81   |
| STA335A    | Power transistor Array                                           | 82   |
| STA415A    | Power transistor Array                                           | 83   |
| STA461C    | Power transistor Array                                           | 84   |
| STA463C    | Power transistor Array                                           | 85   |
| STA464C    | Power transistor Array                                           | 86   |
| STA508A    | MOS FET Array                                                    | 99   |
| STA509A    | MOS FET Array                                                    | 100  |
| TFC561D    | Thyristor for HID Lamp Ignition with built-in Reverse Diode      | 106  |
| UGS3059KA  | Hall-Effect IC (Gear-Tooth Sensor)                               | 60   |
| UGS3060KA  | Hall-Effect IC (Gear-Tooth Sensor)                               | 60   |
| UGS3132*   | Hall-Effect IC (Bipolar Switch)                                  | 60   |
| UGS3133*   | Hall-Effect IC (Bipolar Switch)                                  | 60   |



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