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SEMICONDUCTORS GENERAL CATALOG

ICS

TRANSISTORS

THYRISTORS

DIODES

LEDS

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

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SANKEN SEMICONDUCTORS

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Surface-Mount Type

Series Name	Output Current	Output Voltage (V)						Variable (Reference Voltage) (V)				Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	1.8	2.5	3.3	5	9	12	1.0	1.1	1.25	1.28					
SI-3000LU	0.25	◎		◎	◎					◎		SOT89-5	○	○	Drooping	8
SI-3000LSA	1.0	◎	◎	◎	◎							SOP8	○	○	Foldback	10
SI-3000KS	1.0	◎	◎	◎							◎	SOP8	○	○	Drooping	12
SI-3000KM	1.0	◎	◎	◎	◎	◎	◎	◎			◎	TO252-5	○	○	Foldback*1	14
SI-3000KD	1.0	◎	◎	◎	◎	△	△	◎			◎	TO263-5	○	○	Foldback*2	18
SI-3000LLSL	1.5							◎				SOP8	○	○	Foldback	22
SI-3000ZD	3.0		◎	◎					◎			TO263-5	○	○	Foldback	24

△: Sample available
◎: Available
*1: Drooping for SI-3012KM/3018KM/3025KM/3033KM
*2: Drooping for SI-3012KD/3018KD/3025KD/3033KD

Thru-hole Type

Series Name	Output Current	Output Voltage (V)							Variable (Reference Voltage) (V)			Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	3.3	5	9	12	15	15.7	24	1	1.1	2.55					
SI-3000B	0.27						◎				◎	TO220F-5	–	○	Foldback	26
SI-3000F	1.0		◎	◎	◎		◎	◎			◎	TO220F-5	–	○	Foldback	28
SI-3000KFE	1.0								◎			TO220F-5	○	○	Foldback	32
SI-3000C	1.5	◎	◎	◎	◎	◎		◎				TO220F-5	–	○	Foldback*3	34
SI-3000R	1.5		◎									TO220F-5	–	○	Drooping	38
SI-3000J	2.0		◎	◎	◎	◎						TO220F-5	–	○	Foldback	40
SI-3000ZFE	3.0									◎		TO220F-5	○	○	Foldback	42

△: Sample available
◎ : Available
*3:Drooping for SI-3033C

Switching Mode Regulator ICs (built-in overcurrent, thermal protection circuits)

Surface-Mount Type

Series Name	Output Current	Output Voltage (V)						Variable (Reference Voltage) (V)			Maximum Input Voltage	Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	2.5	3.3	5	9	12	15	0.8	1.0	1.25	(V)					
SAI	0.4				◎	◎					35	PS4	–	–	Drooping	46
	0.5		◎	◎												
SI-8000W	0.6		◎	◎							35	SOP8	–	–	Drooping	48
SI-8000JD	1.5		◎	◎	◎	◎					43	TO263-5	○	○	Foldback	50
SI-8000TM	1.5							◎			43	TO252-5	○	○	Drooping	52
SI-8000SD	3.0		◎	◎							43	TO263-5	–	○	Drooping	54
SPI-8000A	3.0								◎		53	HSOP16	○	○	Foldback	56

Thru-hole Type

Series Name	Output Current	Output Voltage (V)					Variable (Reference Voltage) (V)			Maximum Input Voltage	Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	3.3	5	9	12	15	0.8	1.0	1.5	(V)					
SI-8000E	0.6		◎		◎					43	TO220F-5	–	–	Drooping	60
SI-8000JF	1.5	◎	◎	◎	◎				◎	43	TO220F-5	○	○	Foldback	62
SI-8000TFE	1.5		◎				◎			43	TO220F-5	○	○	Drooping	64
SI-8000GL	1.5							◎		53	DIP8	○	○	Foldback	66
SI-8000S	3.0	◎	◎	◎	◎	◎				43*	TO220F-5	–	○	Drooping	68
SI-8000HFE	5.5		◎				◎			43	TO220F-5	○	○	Drooping	70

*: 35V for SI-8033S

Surface-Mount, Synchronous Rectifier Type

Series Name	Oscillation Frequency	Output Voltage (V)					Variable (Reference Voltage) (V)			Maximum Input Voltage	Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(kHz)	3.3	5	9	12	15	1.0	1.1	1.25	(V)					
SI-8011NVS	250							◎		25	TSSOP24	–	○	Foldback	72
SI-8511NVS	400							◎		25	TSSOP24	–	○	Drooping	74

Flywheel Diode (Schottky-Barrier Diode) Built-in Type

Series Name	Output Current	Output Voltage (V)					Variable (Reference Voltage) (V)			Maximum Input Voltage	Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	3.3	5	6.5	12	15	1.0	1.1	2.55	(V)					
STA810M	1.5			◎						43	SIP8 (STA8Pin)	○	○	Foldback	76
STA820M	3.0		◎							31	SIP8 (STA8Pin)	–	○	Drooping	78

L-combined Type

Series Name	Output Current	Output Voltage (V)				Variable (Reference Voltage) (V)			Maximum Input Voltage	Package	Low Current Consumption During OFF	Output ON/OFF	Overcurrent Protection Characteristic	Page
	(A)	3.3	5	9	12	1.0	1.1	2.55	(V)					
SI-8400L	0.4				◎				35	Non-package type (EI-12.5 core)	–	–	Drooping	80
	0.5	◎	◎											
SI-8500L	1.0	◎	◎	◎	◎				35	Non-package type (EI-19 core)	–	○	Drooping	80

Multi Output Type Regulator ICs

2-Output Type

Series Name		Output Voltage	Output Current	Package	Regulator Type	Functions			Low Current Consumption During OFF	Remarks	Page
		(V)	(A)			Overcurrent Protection	Thermal Protection	ON/OFF Control			
STA801M	ch1	5.0	0.5	SIP10 (STA10Pin)	Step-down switching type	Drooping	○	○	–	Flywheel diode (Schottky-barrier diode)	84
	ch2	Select from 9, 11.5, 12.1 and 15.5	0.5		Step-down switching type	Drooping	○	○	–	Flywheel diode (Schottky-barrier diode)	
SPI-8001TW	ch1	Variable(1.0-16V)	1.5	HSOP16	Step-down switching type	Foldback	○	○	○		86
	ch2	Variable(1.0-16V)	1.5			Foldback	○	○			
SPI-8002TW	ch1	Variable(1.0-24V)	1.5	HSOP16	Step-down switching type	Foldback	○	○	○		86
	ch2	Variable(1.0-24V)	1.5			Foldback	○	○			
SPI-8003TW	ch1	Variable(1.0-24V)	1.5	HSOP16	Step-down switching type	Foldback	○	○	○		86
	ch2	Variable(1.0-24V)	1.5			Foldback	○	○			
SI-3002KWF	ch1	3.3	1.0	TO220F-5	Linear type	Foldback	○	○	–		90
	ch2	2.5	1.0			Foldback	○	○			
SI-3002KWM	ch1	3.3	1.0	TO252-5	Linear type	Foldback	○	○	–		92
	ch2	2.5	1.0			Foldback	○	○			
SI-3003KWF	ch1	2.5	1.0	TO220F-5	Linear type	Foldback	○	○	–		90
	ch2	1.8	1.0			Foldback	○	○			
SI-3003KWM	ch1	2.5	1.0	TO252-5	Linear type	Foldback	○	○	–		92
	ch2	1.8	1.0			Foldback	○	○			

Application Note

■ Heat dissipation and Reliability

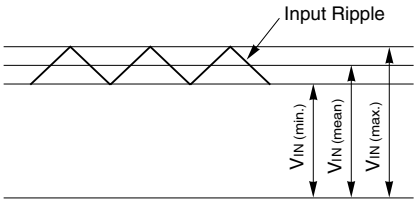
The reliability of an IC is highly dependent on its operating temperature. Please be sure to apply silicone grease to the IC and to mount it to the heatsink with a proper mounting torque.
Heatsink design should pay particular attention to ensuring sufficient heat dissipation capacity.
In addition, please take into account the air convection in operation.

■ Calculating Internal Power Dissipation(P_D)

P_D is given by the following formula:
$P_D = I_O \bullet [V_{IN(mean)} - V_O]$
Determine the size of the heatsink according to the relationship between allowable power dissipation and ambient temperature.

■ Setting DC Input Voltage

The following is the waveform of a DC input voltage.



When setting the DC input voltage, please follow the instructions below:
●Make $V_{IN(min)} \geq$ [(Output voltage) + (Minimum dropout voltage)]
●Make $V_{IN(max)} \leq$ DC input voltage shown in the "Absolute Maximum Ratings"

■ Thermal Design

The maximum junction temperature $T_{j(max)}$ given in the absolute maximum ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the maximum power dissipation $P_{D(max)}$, which varies by the conditions of use, and the maximum ambient temperature $T_{a(max)}$.
To simplify thermal design, T_a-P_D characteristic graphs are provided herein.
Please observe the following steps for heatsink design:
1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

Although the heatsink size is now obtained, in actual applications, 10-to-20% derating factor is generally introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink and case temperature in the actual operating environment.
Please refer to the T_a-P_D characteristic graphs for respective product types.

■ Mounting Torque

SI-3000B SI-3000C SI-3000F SI-3000J SI-3000KFE SI-3000R SI-3000ZFE	0.588 to 0.686 [N•m] (6.0 to 7.0 [kgf•cm])

■ Recommended Silicone Grease

• Shin-Etsu Chemical Co., Ltd.: G746
• GE Toshiba Silicones Co., Ltd.: YG-6260
• Dow Corning Toray Silicones Co., Ltd.: SC102
Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

■ Others

• Devices can not be operated in parallel connection aiming for a larger current.
• Diodes for isolation purpose are provided in between input and ground, and also in between output and ground. They may be broken down if the device is reverse biased. In this case, please clamp the device with low V_F diodes to protect them.

■ Rectifier Diodes for Power Supplies

To rectify the AC input voltage using rectifier diodes for power supplies, please use SANKEN rectifier diodes shown in the following list. (Please use a center-tap or bridge configuration in using stand-alone type diodes.)

Series Name	Diodes
SI-3000B Series	AM01Z(Axial Type, V_{RM}:200V, I_O:1.0A)
SI-3000C Series	RM2Z(Axial Type,V_{RM}:200V,I_O:1.2A) or RBV-402(Bridge Type, V_{RM}:200V,I_O:4.0A)
SI-3000F Series	
SI-3000J Series	
SI-3000ZD Series	SJPM-F2(Surface-Mount Stand-Alone Type,V_{RM}:200V,I_O:1.0A)
SI-3000KD Series	RM2Z(Axial Type,V_{RM}:200V,I_O:1.2A) or RBV-402(Bridge Type, V_{RM}:200V,I_O:4.0A)
SI-3000KFE Series	
SI-3000KM Series	
SI-3000KS Series	SJPM-F2(Surface-Mount Stand-Alone Type,V_{RM}:200V,I_O:1.0A)
SI-3000LLSL Series	
SI-3000LSA Series	
SI-3000LU Series	SJPM-D2(Surface-Mount Stand-Alone Type,V_{RM}:200V,I_O:0.9A)
SI-3000R Series	RM2Z(Axial Type,V_{RM}:200V,I_O:1.2A) or RBV-402(Bridge Type, V_{RM}:200V,Io:4.0A)
SI-3000ZFE Series	

SI-3000LU Series Surface-Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (SOT89-5)
- Output current: 250 mA
- Low current consumption Iq (OFF) ≤ 1μA (V_C = 0 V)
- Low dropout voltage: V_{DIF} ≤ 0.5 V (at I_O = 250 mA)
- 4 types of output voltages (Adj, 1.8 V, 3.3 V, 5.0 V) available
- Built-in drooping-type-overcurrent and thermal protection circuits

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	18	V
Output control terminal voltage	V_C	V_{IN}	V
DC Output Current	I_O	250	mA
Power Dissipation	P_D*1	0.75	W
Junction Temperature	T_j*2	–40 to +135	°C
Storage Temperature	T_{stg}*2	–40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$*1	146	°C/W

*1: When mounted on glass-epoxy board 40 × 40 mm (copper laminate area 2%).
*2: Thermal protection circuits may operate if the junction temperature exceeds 135°C.

■Applications

- Auxiliary power supplies for PC
- Battery-driven electronic equipment

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		min.	max.	
Input Voltage	V_{IN}	*2, *3	V_O+2*1	V
DC Output Current	I_O	0	250	mA
Operating Ambient Temperature	T_{op}	–20	85	°C

*1: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$.
Calculate these values referring to the reference data on page 11.
*2: Refer to the Dropout Voltage parameter.
*3: For the SI-3012LU, set the input voltage to Vin ≥ 2.4 V, and secure the minimum voltage as explained in "Setting DC Input Voltage" section in Linear Regulator Application Note on page 7.

■Electrical Characteristics

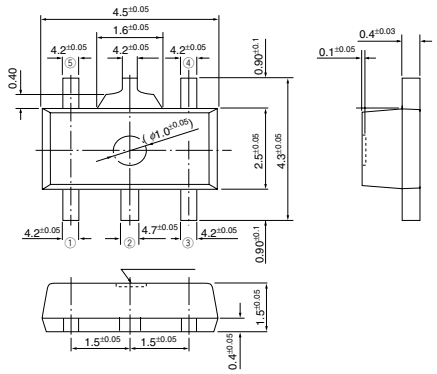
(T_a=25°C, V_C=2V unless otherwise specified)

Parameter		Symbol	Ratings												Unit
			SI-3012LU(Variable)			SI-3018LU(Under development)			SI-3033LU			SI-3050LU			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage*3		V_O(V_{ADJ})	1.210	1.250	1.290	1.764	1.800	1.836	3.234	3.300	3.366	4.900	5.000	5.100	V
		Conditions	V_{IN}=V_O+1V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			V_{IN}=6V, I_O=10mA			
Dropout Voltage		V_{DIF}			0.3			0.5			0.3			0.3	V
		Conditions	I_O=100mA(V_O=3.3V)			I_O=100mA									
					0.5			0.5			0.5			0.5	
		Conditions	I_O=250mA(V_O=3.3V)			I_O=250mA									
Line Regulation		ΔV_{LINE}			10			10			10			15	mV
		Conditions	V_{IN}=V_O+1 to V_O+5V, I_O=10mA(V_O=3.3V)			V_{IN}=2.5 to 5V, I_O=10mA			V_{IN}=4.5 to 8V, I_O=10mA			V_{IN}=6 to 10V, I_O=10mA			
Load Regulation		ΔV_{LOAD}			20			20			40			40	mV
		Conditions	V_{IN}=V_O+1V, I_O=1 to 250mA(V_O=3.3V)			V_{IN}=3.3V, I_O=1 to 250mA			V_{IN}=5V, I_O=0 to 250mA			V_{IN}=6V, I_O=0 to 250mA			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.2			±0.3			±0.3		mV/°C
		Conditions	T_j=0 to 100°C												
Ripple Rejection		R_{REJ}		55			55			55			55		dB
		Conditions	V_{IN}=V_O+1V, f=100 to 120Hz(V_O=3.3V)			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=5V, f=100 to 120Hz			V_{IN}=6V, f=100 to 120Hz			
Quiescent Circuit Current		I_q			150			150			150			150	μA
		Conditions	V_{IN}=V_O+1V, I_O=0mA V_C=2V, R2=100kΩ			V_{IN}=3.3V, I_O=0mA V_C=2V			V_{IN}=5V, I_O=0mA, V_C=2V			V_{IN}=6V, I_O=0mA, V_C=2V			
Circuit Current at Output OFF		I_q(OFF)			1			1			1			1	μA
		Conditions	V_{IN}=V_O+1V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			V_{IN}=6V, V_C=0V			
Overcurrent Protection Starting Current*1		I_{S1}	260			260			260			260			mA
		Conditions	V_{IN}=V_O+1V			V_{IN}=3.3V			V_{IN}=5V			V_{IN}=6V			
V_C Terminal	Control Voltage (Output ON)*2	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)*2	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
		Conditions	V_C=2V												
	Control Current (Output OFF)	I_C, IL		0	–5		0	–5		0	–5		0	–5	μA
		Conditions	V_C=0V												

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = 3.3 V (5 V for SI-3033LU, 6 V for SI-3050LU), and I_O = 10 mA.
*2: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*3: Reference voltage V_{ADJ} for SI-3012LU.

■External Dimensions (SOT89-5)

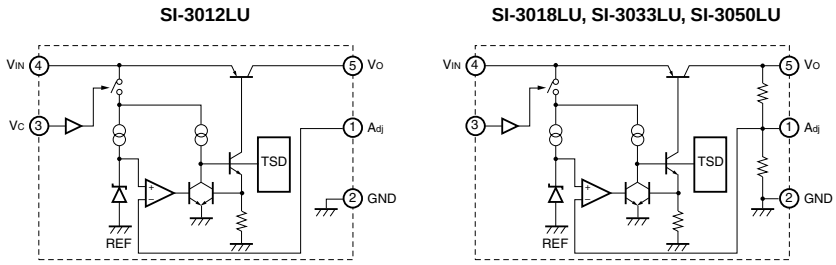
(Unit : mm)



Pin Assignment
① A_{DJ}
② GND
③ V_C
④ V_{IN}
⑤ V_O

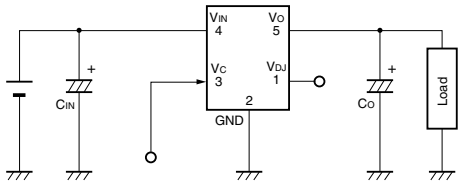
Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.05g

■Block Diagram

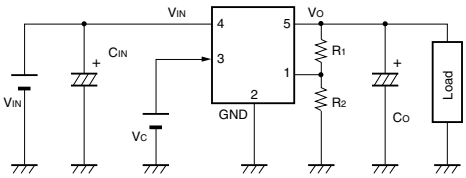


■Standard External Circuit

SI-3018LU, SI-3033LU, SI-3050LU



SI-3012LU

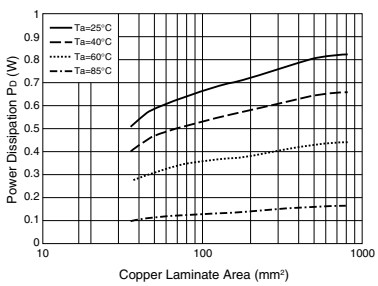


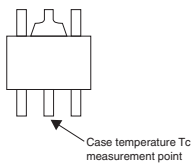
C_O: Output capacitor (10 μF or larger)
For SI-3000LU series, Co has to be a low ESR capacitor such as a ceramic capacitor.
C_{IN}: Input capacitor (10 μF approx.)

- Setting of SI-3012LU output voltage (recommended voltage: 1.5 V to 15 V)
  R1 and R2: Resistors for output setting
  The output voltage can be set by connecting R1 and R2 as shown in the diagram on the left.
  R2: 100 kΩ is recommended
  $R1=(V_O-V_{ADJ})/(V_{ADJ}/R2)$

■Reference Data

Copper Laminate Area vs Power Dissipation
T_j=100°C PCB size 40 ×40





- A monolithic ICs mounts an inner frame stage that is connected to the GND pin (pin 2). Therefore, enlarging the copper laminate area connected to the GND pin improves heat radiation effect.
- Obtaining the junction temperatureMeasure the temperature Tc at the lead part of the GND pin (pin 2) with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$$T_j=P_D\times\theta j-c+Tc \quad (\theta j-c=5°C/W)$$

SI-3000LSA Series Surface-Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (SOP8)
- Output current: 1 A
- Low circuit current at output OFF: Iq(OFF) ≤ 1 μA (V_C = 0 V)
- Low dropout voltage: V_{DIF}≤0.8 V (at I_O = 1 A)
  V_{DIF} ≤1.2 V (I_O = 1 A) for SI-3018LSA
- 4 types of output voltages (1.8 V, 2.5 V, 3.3 V, 5.0 V) available
- Output ON/OFF control terminal voltage compatible with LS-TTL
- Built-in foldback-type-overcurrent and thermal protection circuits

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	16	V
Output control terminal voltage	V_C	V_{IN}	V
DC Output Current	I_O	1	A
Power Dissipation	P_{D1}*1	1.16	W
	P_{D2}*2	1.1	W
Junction Temperature	T_j*3	–30 to +150	°C
Operating Ambient Temperature	T_{op}	–30 to +150	°C
Storage Temperature	T_{stg}	–30 to +150	°C
Thermal Resistance (Junction to Lead (pin 8))	$\theta_{j\text{-}l}$	36	°C/W
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$*2	100	°C/W

*1: When mounted on glass-epoxy board 56.5 × 56.5 mm (copper laminate area 100%).
*2: When mounted on glass-epoxy board 40 × 40 mm (copper laminate area 100%).
*3: Thermal protection circuits may be activated if the junction temperature exceeds 135°C.

■Applications

- Auxiliary power supplies for PC
- Battery-driven electronic equipment

■Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit
		SI-3018LSA	SI-3025LSA	SI-3033LSA	SI-3050LSA	
DC Input Voltage Range	V_{IN}	3.1 to 3.5*1	*2 to 3.5*1	*2 to 5.2*1	*2 to 8.0	V
DC Output Current Range	I_O	0 to 1				A
Operating Junction Temperature	T_{jop}	–20 to +125				°C
Operating Ambient Temperature	T_{aop}	–30 to +85				°C

*1: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$.
Please calculate these values referring to the reference data on page 15.
*2: Refer to the Dropout Voltage parameter.

■Electrical Characteristics

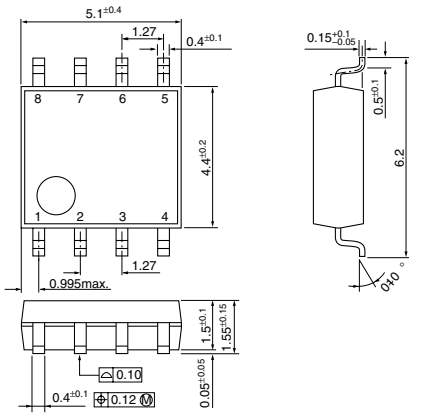
(T_a=25°C, V_C=2V unless otherwise specified)

Parameter		Symbol	Ratings												Unit
			SI-3018LSA			SI-3025LSA			SI-3033LSA			SI-3050LSA			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage		V_O	1.764	1.800	1.836	2.450	2.500	2.550	3.234	3.300	3.366	4.90	5.00	5.10	V
		Conditions	V_{IN}=3.3V, I_O=0.5A			V_{IN}=3.3V, I_O=0.5A			V_{IN}=5V, I_O=0.5A			V_{IN}=6.5V, I_O=0.5A			
Dropout Voltage		V_{DIF}		–				0.4			0.4			0.4	V
		Conditions		–		I_O≤0.5A			I_O≤0.5A			I_O≤0.5A			
				0.6	1.2			0.8			0.8			0.8	
		Conditions	I_O≤1A												
Line Regulation		ΔV_{LINE}		2	10		2	10		3	10			15	mV
		Conditions	V_{IN}=3.1 to 3.5V, I_O=0.3A			V_{IN}=3.1 to 3.5V, I_O=0.3A			V_{IN}=4.5 to 5.5V, I_O=0.3A			V_{IN}=6 to 7V, I_O=0.3A			
Load Regulation		ΔV_{OLOAD}		10	20		10	20		10	20			30	mV
		Conditions	V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=5V, I_O=0 to 1A			V_{IN}=6.5V, I_O=0 to 1A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3			±0.5		mV/°C
		Conditions	V_{IN}=3.3V, I_O=5mA, T_j=0 to 100°C			V_{IN}=3.3V, I_O=5mA, T_j=0 to 100°C			V_{IN}=5V, I_O=5mA, T_j=0 to 100°C			V_{IN}=6.5V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		60			57			55			55		dB
		Conditions	V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=5V, f=100 to 120Hz			V_{IN}=6.5V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		1.7	2.5		1.7	2.5		1.7	2.5		1.7	2.5	mA
		Conditions	V_{IN}=3.3V, I_O=0A			V_{IN}=3.3V, I_O=0A			V_{IN}=5V, I_O=0A			V_{IN}=6.5V, I_O=0A			
Circuit Current at Output OFF		I_q(OFF)			1			1			1			1	μA
		Conditions	V_{IN}=3.3V, I_O=0A, V_C=0V			V_{IN}=3.3V, I_O=0A, V_C=0V			V_{IN}=5V, I_O=0A, V_C=0V			V_{IN}=6.5V, I_O=0A, V_C=0V			
Overcurrent Protection Starting Current*1,3		I_{S1}	1.2			1.2			1.2			1.2			A
		Conditions	V_{IN}=3.3V			V_{IN}=3.3V			V_{IN}=5V			V_{IN}=6V			
V_C Terminal	Control Voltage (Output ON)*2	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)*2	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH		40	80		40	80		40	80		40	80	μA
		Conditions	V_C=2V												
	Control Current (Output OFF)	I_C, IL		0	–5		0	–5		0	–5		0	–5	μA
		Conditions	V_C=0V												

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = 3.3 V (5 V for SI-3033LSA), and I_O = 0.5 A.
*2: Output is OFF when the output control terminal VC is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*3: These products cannot be used in the following applications. Because these applications require a certain current at start-up and so the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■External Dimensions (SOP8)

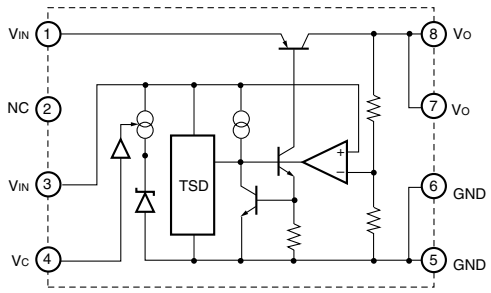
(Unit : mm)



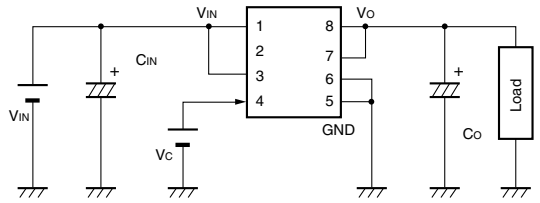
Pin Assignment
① V_{IN}
② NC (Leave open)
③ V_{IN}
④ V_C
⑤ GND
⑥ GND
⑦ V_O
⑧ V_O

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.1g

■Block Diagram



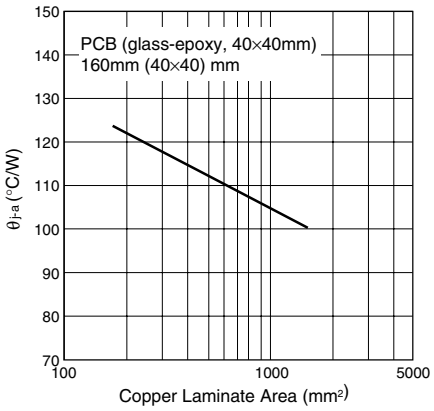
■Typical Connection Diagram



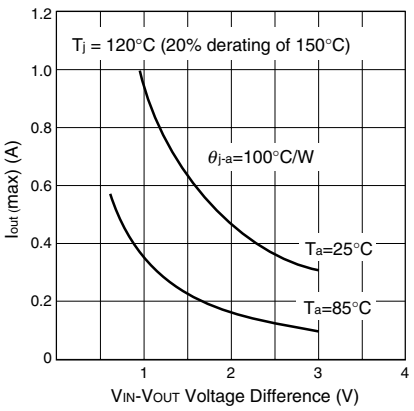
C_O: Output capacitor (22 μF or larger)
C_{IN}: Input capacitor (10 μF)
This capacitor is required in the case of an inductive input line or long wiring.
Tantalum capacitors are recommended for C_{IN} and C_O, particularly at low temperatures.
* Leave pin 2 open.

■Reference Data

PCB Copper Laminate Area vs. Junction to Ambient Air Thermal Resistance



Allowable Output Current (vs. V_{IN}-V_{OUT} Voltage Difference) V_{IN}-Io max



The inner frame stage, on which the PTr is mounted, is directly connected to the V_{OUT} pin.
Therefore, enlarging the copper laminate area around the V_{OUT} pin is really effective for a heat radiation.

SI-3000KS Series Surface-Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (SOP8)
- Output current: 1.0 A
- Compatible with low ESR capacitor
- Low circuit current at output OFF Iq ≤ 350 μA (I_O = 0 A, V_C = 2 V)
- Low current consumption Iq (OFF) ≤ 1 μA (V_C = 0 V)
- Low dropout voltage V_{DIF} ≤ 0.6 V (I_O = 1 A)
- 4 types of output voltages (1.8 V, 2.5 V, 3.3 V, and variable type) available
- Output ON/OFF control terminal voltage compatible with LS-TTL
- Built-in drooping-type-overcurrent and thermal protection circuits

■Applications

- Local power supplies
- Battery-driven electronic equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}*1	17	V
Output Control Terminal Voltage	V_C	V_{IN}	V
DC Output Current	I_O*1	1.0	A
Power Dissipation	P_D*1, *2	0.76	W
Junction Temperature	T_j	–40 to +125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$*	130	°C/W
Thermal resistance (Junction to Lead (pin 7))	$\theta_{j\text{-}l}$	22	°C/W

*1: V_{IN} (max) and I_O (max) are restricted by the relation PD = (V_{IN} - V_O) × I_O. Please calculate these values referring to the Copper laminate area vs. Power dissipation data as shown hereinafter.

*2: When mounted on a glass epoxy board of 1600 mm^2 (copper laminate area 2%).

■Electrical Characteristics

(T_a=25°C, V_C=2 V unless otherwise specified)

Parameter		Symbol	Ratings												Unit
			SI-3012KS (variable type)			SI-3018KS			SI-3025KS			SI-3033KS			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4			*1			*1			*1			V
Output Voltage (Reference voltage V_{ADJ} for SI-3012KS)		V_O (V_{ADJ})	1.24	1.28	1.32	1.764	1.800	1.836	2.45	2.50	2.55	3.234	3.300	3.366	V
	Conditions		V_{IN}=3.3V, I_O=10mA			V_{IN}=2.5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			
Dropout Voltage		V_{DIF}			0.3		–				0.4			0.4	V
	Conditions		I_O=0.5A (V_O=2.5V)				–			I_O=0.5A			I_O=0.5A		
					0.6			0.6			0.6			0.6	
	Conditions		I_O=1A (V_O=2.5V)				I_O=1A			I_O=1A			I_O=1A		
Line Regulation		ΔV_{OLINE}			10			10			10			15	mV
	Conditions		V_{IN}=3.3 to 8V, I_O=10mA (V_O=2.5V)			V_{IN}=2.5 to 6V, I_O=10mA			V_{IN}=3.3 to 8V, I_O=10mA			V_{IN}=5 to 10V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			40			40			40			50	mV
	Conditions		V_{IN}=3.3V, I_O=0 to 1A (V_O=2.5V)			V_{IN}=2.5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=5V, I_O=0 to 1A			
Quiescent Circuit Current		I_q			350			350			350			350	μA
	Conditions		V_{IN}=3.3V, I_O=0A, V_C=2V, R2=24kΩ			V_{IN}=2.5V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			V_{IN}=5V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		I_q (OFF)			1			1			1			1	μA
	Conditions		V_{IN}=3.3V, V_C=0V			V_{IN}=2.5V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3			±0.3		mV/°C
	Conditions		T_j=0 to 100°C (V_O=2.5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		55			55			55			55		dB
	Conditions		V_{IN}=3.3V, f=100 to 120Hz (V_O=2.5V)			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=5V, f=100 to 120Hz			
Overcurrent Protection Starting Current*2		I_{S1}	1.2			1.2			1.2			1.2			A
	Conditions		V_{IN}=3.3V (V_O=2.5V)			V_{IN}=2.5V			V_{IN}=3.3V			V_{IN}=5V			
V_C Terminal	Control Voltage (Output ON)*3	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
	Conditions		V_C=2V												
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		–5	0		μA
	Conditions		V_C=0V												

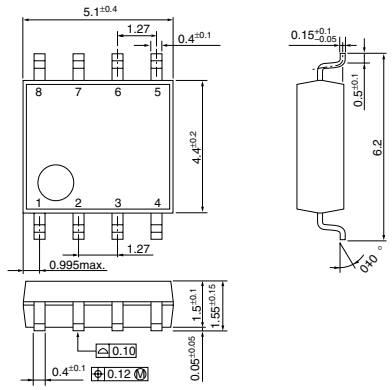
*1: Refer to the Dropout Voltage parameter.

*2: The I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = V_O + 1 V, and I_O = 10 mA.

*3: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

■External Dimensions (SOP8)

(Unit : mm)

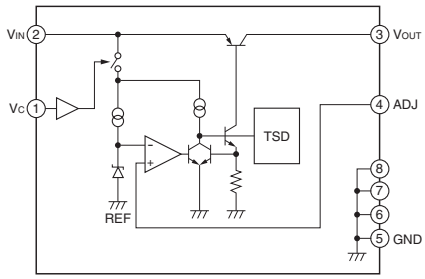


Pin Assignment
① V_C
② V_{IN}
③ V_O
④ Sence (ADJ for SI-3012KS)
⑤ GND
⑥ GND
⑦ GND
⑧ GND

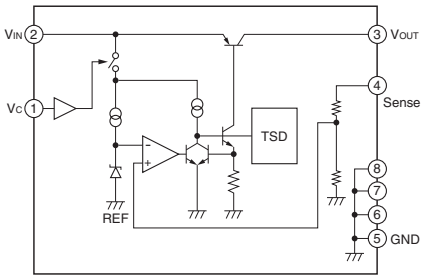
Plastic Mold Package Type
Flammability: UL 94V-0
Product Mass: Approx. 0.1 g

■Block Diagram

●SI-3012KS

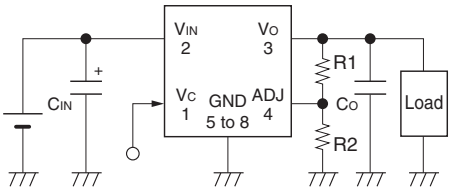


●SI-3018KS, SI-3025KS, SI-3033KS

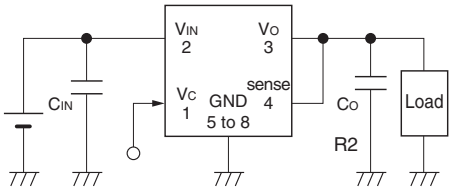


■Typical Connection Diagram

●SI-3012KS



●SI-3018KS, SI-3025KS, SI-3033KS



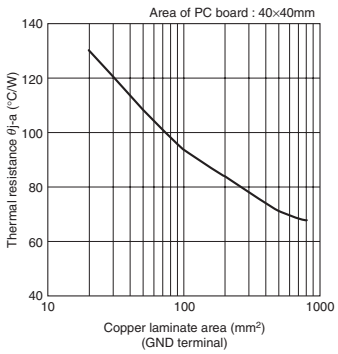
R_1, R_2: Output voltage setting resistors
The output voltage can be set by connecting R_1 and R_2 as shown above.
The recommended value of R_2 is 24 kΩ .

$R1=(V_O–V_{ADJ})÷(V_{ADJ}/R2)$

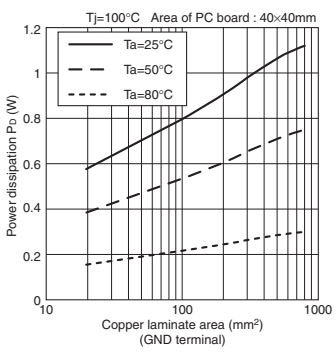
C_{IN}: Input capacitor (22 μF or larger)
C_O: Output capacitor (22 μF or larger)
For SI-3000KS series, Co has to be a low ESR capacitor.
When using the electrolytic capacitor, the SI-3000KS series may oscillate at a low temperature.

■Reference Data

Copper Laminate Area vs. Thermal Resistance



Copper Laminate Area vs. Power Dissipation



- Obtaining the junction temperature
  Measure the temperature T_L at the lead part of the GND pin (pin 7) with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

  $T_j=P_D \times \theta_{j-L} + T_L$ ($\theta_{j-L} = 22°C/W$)

SI-3000KM Series Surface Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface mount package (TO252-5)
- Output current: 1.0 A
- Low dropout voltage: $V_{DIF} \leq 0.6$ V (at I_O = 1.0 A)
- Low current consumption: $I_q \leq 350$ μA (600 μA for SI-3010KM/SI-3050KM/SI-3090KM/SI-3120KM)
- Low circuit current at output OFF: Iq (OFF) ≤ 1 μA
- Built-in overcurrent and thermal protection circuits
- Output ON/OFF control function
- Compatible with low ESR capacitors (SI-3012KM/SI-3018KM/SI-3025KM/SI-3033KM)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SI-3012KM/3018KM 3025KM/3033KM	SI-3010KM/3050KM/ 3090KM/3120KM	
DC Input Voltage	V_{IN}	17	35*1	V
Output Control Terminal Voltage	V_C	V_{IN}		V
DC Output Current	I_O	1.0		A
Power Dissipation	P_D*2	1		W
Junction Temperature	T_j	–30 to +125		°C
Storage Temperature	T_{stg}	–30 to +125		°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$*2	95		°C/W
Thermal Resistance (Junction to case)	$\theta_{j\text{-}c}$	6		°C/W

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

*2: When mounted on glass-epoxy board of 900mm^2 (copper laminate area 4.3%).

■Applications

- Secondary stabilized power supply (local power supply)

■Recommended Operating Conditions

Parameter	Symbol	Ratings								Unit
		SI-3012KM	SI-3018KM	SI-3025KM	SI-3033KM	SI-3010KM	SI-3050KM	SI-3090KM	SI-3120KM	
Input Voltage Range	V_{IN}	2.4*2 to 6.0*1	2.4*2 to 5.0*1	2.4*2 to 5*1	*2 to 6*1	2.4*2 to 15*1	2.4*2 to 27*1	*2 to 20*1	*2 to 25*1	V
Output Current Range	I_O	0 to 1.0								A
Operating Ambient Temperature	T_{op}	–30 to +85								°C
Operating Junction Temperature	T_j	–20 to +100								°C

*1: V_{IN} (max) and I_O (max) are restricted according to operating conditions due to the relation $P_D = (V_{IN}\text{-}V_O) \times I_O$. Please calculate these values referring to the Copper Laminate Area vs. Power Dissipation data as shown hereinafter.

*2: Refer to the Dropout Voltage parameter.

■Electrical Characteristics 1 (Low V_O type compatible with low ESR output capacitor)

Parameter		Symbol	Ratings												Unit
			SI-3012KM (Variable type)			SI-3018KM			SI-3025KM			SI-3033KM			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4*1			*1			*1			*1			V
Output Voltage (Reference voltage VADJ for SI-3012KM)		V_O (V_{ADJ})	1.24	1.28	1.32	1.764	1.800	1.836	2.45	2.50	2.55	3.234	3.300	3.366	V
	Conditions		V_{IN}=3.3V, I_O=10mA			V_{IN}=2.5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			15			15			15			15	mV
	Conditions		V_{IN}=3.3 to 8V, I_O=10mA (V_O=2.5V)			V_{IN}=2.5 to 6V, I_O=10mA			V_{IN}=3.3 to 8V, I_O=10mA			V_{IN}=5 to 10V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			40			40			40			50	mV
	Conditions		V_{IN}=3.3V, I_O=0 to 1A (V_O=2.5V)			V_{IN}=2.5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=5V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.4			0.6			0.4			0.4	V
	Conditions		I_O=0.5A (V_O=2.5V)			I_O=0.5A			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6			0.6	
	Conditions		I_O=1A (V_O=2.5V)			I_O=1A			I_O=1A			I_O=1A			
Quiescent Circuit Current		Iq			350			350			350			350	μA
	Conditions		V_{IN}=3.3V, I_O=0A, V_C=2V, R2=24kΩ			V_{IN}=2.5V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			V_{IN}=5V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		Iq (OFF)			1			1			1			1	μA
	Conditions		V_{IN}=3.3V, V_C=0V			V_{IN}=2.5V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3			±0.3		mV/°C
	Conditions		T_j=0 to 100°C (V_C=2.5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		55			55			55			55		dB
	Conditions		V_{IN}=3.3V, f=100 to 120Hz (V_O=2.5V)			V_{IN}=2.5V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=5V, f=100 to 120Hz			
Overcurrent Protection Starting Current*2		I_{S1}	1.1			1.1			1.1			1.1			A
	Conditions		V_{IN}=3.3V			V_{IN}=2.5V			V_{IN}=3.3V			V_{IN}=5V			
V_C Terminal	Control Voltage (Output ON)	$V_{C, IH}$	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C, IL}$			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C, IH}$			40			40			40			40	μA
	Conditions		V_C=2V			V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	$I_{C, IL}$	–5	0		–5	0		–5	0		–5	0		μA
	Conditions		V_C=0V			V_C=0V			V_C=0V			V_C=0V			

*1: Refer to the Dropout Voltage parameter.

*2: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=overcurrent protection starting current, I_O = 10 mA).

*3: Output is OFF when output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

■Electrical Characteristics 2 (High V_O type)

Parameter		Symbol	Ratings												Unit
			SI-3010KM (Variable type)			SI-3050KM			SI-3090KM			SI-3120KM			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4*1			*1			*1			*1			V
Output Voltage (Reference voltage VADJ for SI-3010KM)		V_O (V_{ADJ})	0.98	1.00	1.02	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
		Conditions	V_{IN}=7V, I_O=10mA			V_{IN}=7V, I_O=10mA			V_{IN}=11V, I_O=10mA			V_{IN}=14V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			30			30			54			72	mV
		Conditions	V_{IN}=6 to 11V, I_O=10mA (V_O=5V)			V_{IN}=6 to 11V, I_O=10mA			V_{IN}=10 to 15V, I_O=10mA			V_{IN}=13 to 18V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			75			75			135			180	mV
		Conditions	V_{IN}=7V, I_O=0 to 1A (V_O=5V)			V_{IN}=7V, I_O=0 to 1A			V_{IN}=11V, I_O=0 to 1A			V_{IN}=14V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.3			0.3			0.3			0.3	V
		Conditions	I_O=0.5A (V_O=5V)			I_O=0.5A			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6			0.6	
		Conditions	I_O=1A (V_O=5V)			I_O=1A			I_O=1A			I_O=1A			
Quiescent Circuit Current		Iq			600			600			600			600	μA
		Conditions	V_{IN}=7V, I_O=0A, V_C=2V R2=10kΩ			V_{IN}=7V, I_O=0A, V_C=2V			V_{IN}=11V, I_O=0A, V_C=2V			V_{IN}=14V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		Iq (OFF)			1			1			1			1	μA
		Conditions	V_{IN}=7V, V_C=0V			V_{IN}=7V, V_C=0V			V_{IN}=11V, V_C=0V			V_{IN}=14V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.5		mV/°C
		Conditions	T_j=0 to 100°C (V_O=5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		75			75			68			66		dB
		Conditions	V_{IN}=7V, f=100 to 120Hz(V_O=5V)			V_{IN}=7V, f=100 to 120Hz			V_{IN}=11V, f=100 to 120Hz			V_{IN}=14V, f=100 to 120Hz			
Overcurrent Protection Starting Current*2		I_{S1}	1.1			1.1			1.1			1.1			A
		Conditions	V_{IN}=7V			V_{IN}=7V			V_{IN}=11V			V_{IN}=14V			
V_C Terminal	Control Voltage (Output ON)	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
		Conditions	V_C=2V			V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		–5	0		μA
		Conditions	V_C=0V			V_C=0V			V_C=0V			V_C=0V			
Input Overvoltage Shutdown Voltage		V_{OVP}	33			26			30			33			V
		Conditions	I_O=10mA			I_O=10mA			I_O=10mA			I_O=10mA			

*1: Refer to the Dropout Voltage parameter.

*2: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=overcurrent protection starting current, I_O = 10 mA).

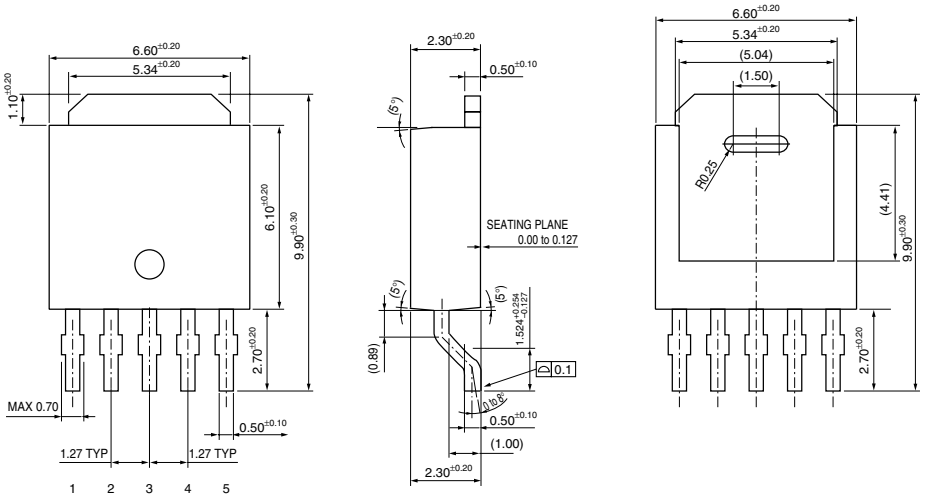
*3: Output is OFF when output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*4: SI-3010KM, SI-3050KM and SI-3090KM, SI-3120KM cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

*5: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$. Please calculate these values referring to the Copper Laminate Area vs. Power Dissipation data as shown hereinafter.

■External Dimensions (TO252-5)

(Unit : mm)

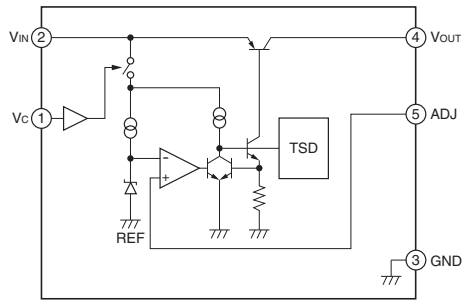


Pin Assignment
① V_C
② V_{IN}
③ GND
④ V_O
⑤ SENSE
(ADJ for SI-3010KM/SI-3120KM)

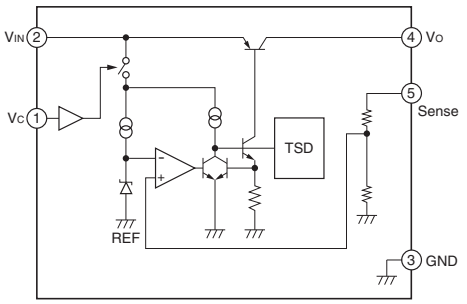
Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.33g

■Block Diagram

●SI-3010KM/SI-3012KM

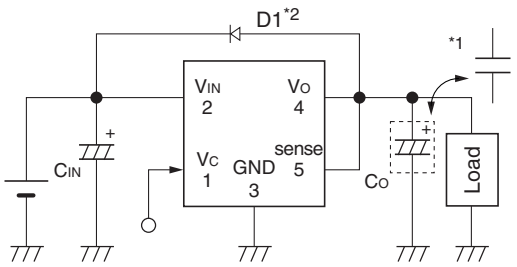


●SI-3018KM/SI-3025KM/SI-3033KM/SI-3050KM/
SI-3090KM/SI-3120KM

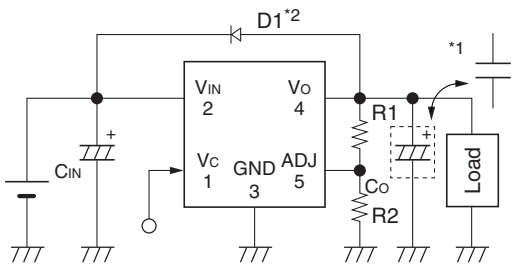


■Typical Connection Diagram

●SI-3018KM/SI-3025KM/SI-3033KM/
SI-3050KM/SI-3090KM/SI-3120KM



●SI-3010KM/SI-3012KM



CIN: Input capacitor (22 μF or larger)
CO: Output capacitor

*1: SI-3012KM/3018KM/3025KM/3033KM (22 μF or larger)
It comes with a circuit configuration that uses a low ESR capacitor for the output capacitor.
If an electrolytic capacitor is used, oscillation may occur at a low temperature.

SI-3010KM/3050KM/3090KM/3120KM (47 μF or larger)
If a low ESR capacitor is used, oscillation may occur.

*2: D1: Reverse bias protection diode
This diode is required for protection against reverse biasing between the input and output.
(Sanken SJPL-F2 is recommended.)
This diode is not required at VO ≤ 3.3 V.

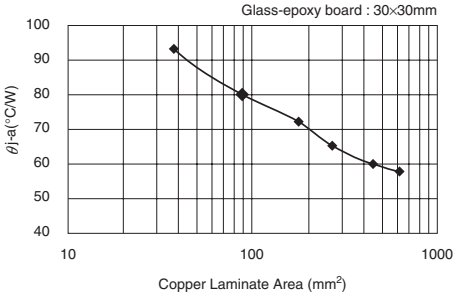
R1, R2: Output voltage setting resistors
Output voltage can be set by connecting R1 and R2 as shown above.
R2: 10 kΩ is recommended (24 kΩ for SI-3012KM).

$R1=(V_O-V_{ADJ})\div(V_{ADJ}/R2)$

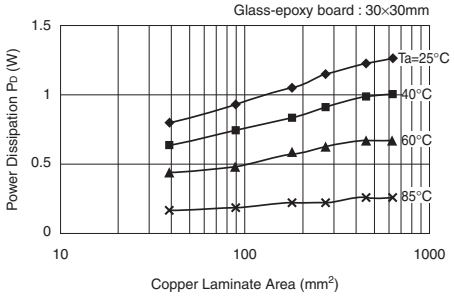
*3: For SI-3010KM, insert R3 in case of setting VO to VO ≤ 1.5V.
Recommended value for R3 is 10kΩ.

■Reference Data

Copper Laminate Area-Thermal Resistance

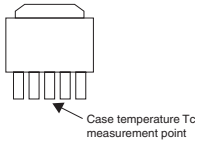


Copper Laminate Area-Power Dissipation



• Obtaining the junction temperature
Measure the temperature TC at the lead part of the GND pin with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$T_j=P_D\times\theta_{j-c}+T_C \quad (\theta_{j-c}=6°C/W)$



SI-3000KD Series — Surface-Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (TO263-5)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at $I_O = 1.0A$)
- Low circuit current consumption: $I_q \leq 350\ \mu A$ (600 μA for SI-3010KD, SI-3050KD, SI-3090KD and SI-3120KD)
- Low circuit current at output OFF: I_q (OFF) $\leq 1\ \mu A$
- Built-in overcurrent, thermal protection circuits
- Compatible with low ESR capacitors (SI-3012KD, SI-3018KD, SI-3025KD and SI-3033KD)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SI-3012KD/3018KD/3025KD/3033KD	SI-3010KD/3050KD/3090KD/3120KD	
DC Input Voltage	V_{IN}	17	35*1	V
DC Output Current	I_O	1.0		A
Power Dissipation	P_D*2	3		W
Junction Temperature	T_j	–30 to +125		°C
Storage Temperature	T_{stg}	–30 to +125		°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	33.3		°C/W
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	3		°C/W

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

*2: When mounted on glass-epoxy board of 1600m^2 (copper laminate area 100%).

■Applications

- Secondary stabilized power supply (local power supply)

■Electrical Characteristics 1 (Low V_O type compatible with low ESR output capacitor)

(T_a=25°C, V_C=2V unless otherwise specified)

Parameter		Symbol	Ratings												Unit
			SI-3012KD (Variable type)			SI-3018KD			SI-3025KD			SI-3033KD			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4*3		*4	*3		*4	*3		*4	*3		*4	V
Output Voltage (Reference Voltage for SI-3012KD)		V_O (V_{ADJ})	1.24	1.28	1.32	1.764	1.800	1.836	2.45	2.50	2.55	3.234	3.300	3.366	V
	Conditions		V_{IN}=3.3V, I_O=10mA			V_{IN}=2.5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			15			15			15			15	mV
	Conditions		V_{IN}=3.3 to 8V, I_O=10mA (V_O=2.5V)			V_{IN}=2.5 to 6V, I_O=10mA			V_{IN}=3.3 to 8V, I_O=10mA			V_{IN}=5 to 10V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			40			40			40			50	mV
	Conditions		V_{IN}=3.3V, I_O=0 to 1A (V_O=2.5V)			V_{IN}=2.5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=5V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.4			0.6			0.4			0.4	V
	Conditions		I_O=0.5A (V_O=2.5V)			I_O=0.5A			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6			0.6	
	Conditions		I_O=1A (V_O=2.5V)			I_O=1A			I_O=1A			I_O=1A			
Quiescent Circuit Current		I_q			350			350			350			350	μA
	Conditions		V_{IN}=3.3V, I_O=0A, V_C=2V, R2=2.4kΩ			V_{IN}=2.5V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			V_{IN}=5V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		I_q (OFF)			1			1			1			1	μA
	Conditions		V_{IN}=3.3V, V_C=0V			V_{IN}=2.5V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3			±0.3		mV/°C
	Conditions		T_j=0 to 100°C (V_O=2.5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		55			55			55			55		dB
	Conditions		V_{IN}=3.3V, f=100 to 120Hz, I_O=0.1A (V_O=2.5V)			V_{IN}=2.5V, f=100 to 120Hz, I_O=0.1A			V_{IN}=3.3V, f=100 to 120Hz, I_O=0.1A			V_{IN}=5V, f=100 to 120Hz, I_O=0.1A			
Overcurrent Protection Starting Current*1		I_{S1}	1.1			1.1			1.1			1.1			A
	Conditions		V_{IN}=3.3V			V_{IN}=2.5V			V_{IN}=3.3V			V_{IN}=5V			
V_C Terminal	Control Voltage (Output ON)*2	V_C, IH	2			2			2			2			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
	Conditions		V_C=2V			V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		–5	0		μA
	Conditions		V_C=0V			V_C=0V			V_C=0V			V_C=0V			

*1: I_{S1} is specified at the 5% drop point of output voltage V_O under the condition of Output Voltage parameter.

*2: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*3: Refer to the Dropout Voltage parameter.

*4: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$. Please calculate these values referring to the Copper laminate area vs. Power dissipation data.

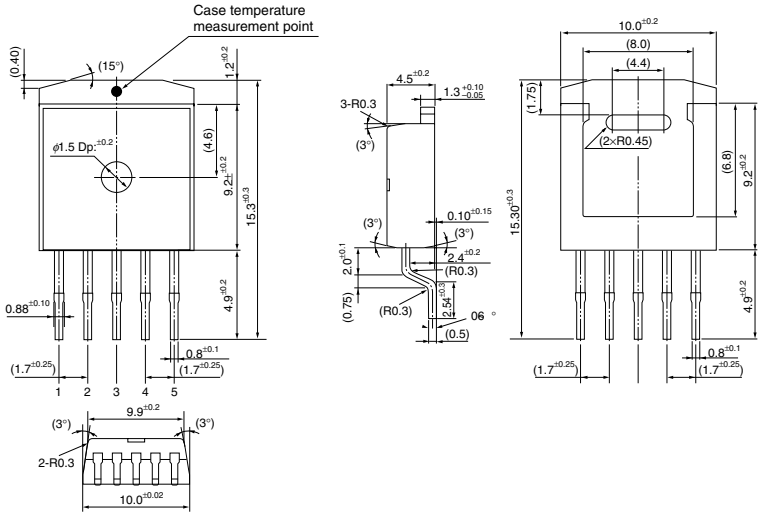
■Electrical Characteristics 2 (High V_O Type)

Parameter		Symbol	Ratings												Unit
			SI-3010KD (Variable type)			SI-3050KD			SI-3090KD			SI-3120KD			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4[*1]		27[*5]	[*1]		15[*5]	[*1]		20[*5]	[*1]		25[*5]	V
Output Voltage (Reference Voltage V_{ADJ} for SI-3010KD)		V_O (V_{ADJ})	0.98	1.00	1.02	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
		Conditions	V_{IN}=7V, I_O=10mA			V_{IN}=7V, I_O=10mA			V_{IN}=11V, I_O=10mA			V_{IN}=14V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			30			30			54			72	mV
		Conditions	V_{IN}=6 to 11V, I_O=10mA (V_O=5V)			V_{IN}=6 to 11V, I_O=10mA			V_{IN}=10 to 15V, I_O=10mA			V_{IN}=13 to 18V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			75			75			135			180	mV
		Conditions	V_{IN}=7V, I_O=0 to 1A (V_O=5V)			V_{IN}=7V, I_O=0 to 1A			V_{IN}=11V, I_O=0 to 1A			V_{IN}=14V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.3			0.3			0.3			0.3	V
		Conditions	I_O=0.5A (V_O=5V)			I_O=0.5A			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6			0.6	
		Conditions	I_O=1A (V_O=5V)			I_O=1A			I_O=1A			I_O=1A			
Quiescent Circuit Current		I_q			600			600			600			600	μA
		Conditions	V_{IN}=7V, I_O=0A, V_C=2V R2=10kΩ			V_{IN}=7V, I_O=0A, V_C=2V			V_{IN}=11V, I_O=0A, V_C=2V			V_{IN}=14V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		I_q (OFF)			1			1			1			1	μA
		Conditions	V_{IN}=7V, V_C=0V			V_{IN}=7V, V_C=0V			V_{IN}=11V, V_C=0V			V_{IN}=14V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.5		mV/°C
		Conditions	T_j=0 to 100°C (V_O=5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		75			75			68			66		dB
		Conditions	V_{IN}=7V, f=100 to 120Hz, I_O=0.1A (V_O=5V)			V_{IN}=7V, f=100 to 120Hz, I_O=0.1A			V_{IN}=11V, f=100 to 120Hz, I_O=0.1A			V_{IN}=14V, f=100 to 120Hz, I_O=0.1A			
Overcurrent Protection Starting Current[*2] [*4]		I_{S1}	1.1			1.1			1.1			1.1			A
		Conditions	V_{IN}=7V			V_{IN}=7V			V_{IN}=11V			V_{IN}=14V			
V_C Terminal	Control Voltage (Output ON)[*3]	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)[*3]	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
		Conditions	V_C=2V			V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		–5	0		μA
		Conditions	V_C=0V			V_C=0V			V_C=0V			V_C=0V			
Input Overvoltage Shutdown Voltage		V_{OVP}	33			26			30			33			V
		Conditions	I_O=10mA			I_O=10mA			I_O=10mA			I_O=10mA			

*1: Refer to the Dropout Voltage parameter.
*2: I_{S1} is specified at the 5% drop point of output voltage V_O under the condition of Output Voltage parameter.
*3: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*4: SI-3010KD, SI-3050KD, SI-3090KD and SI-3120KD cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage
*5: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$. Please calculate these values referring to the Copper laminate area vs. Power dissipation data as shown hereinafter.

■External Dimensions (TO263-5)

(unit : mm)

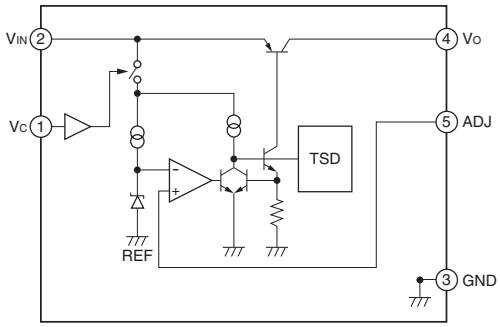


Pin Assignment
① V_C
② V_{IN}
③ GND (Common to the rear side of product)
④ V_O
⑤ Sense
(ADJ for SI-3010KD/3012KD)

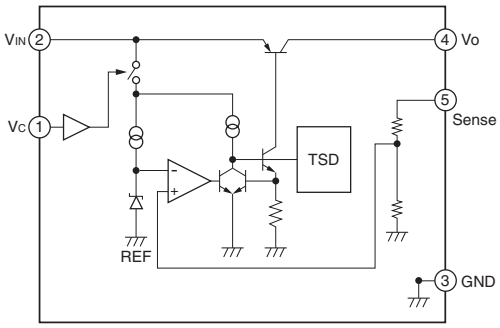
Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 1.48g

■Block Diagram

●SI-3010KD/SI-3012KD

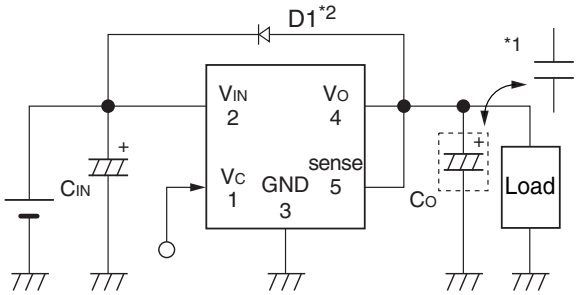


SI-3018KD/SI-3025KD/SI-3033KD/SI-3050KD/SI-3090KD/SI-3120KD

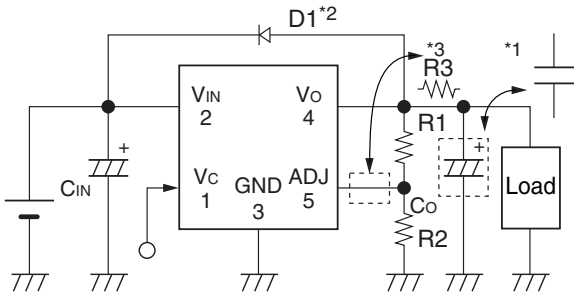


■Typical Connection Diagram

●SI-3018KD/SI-3025KD/SI-3033KD/
SI-3050KD/SI-3090KD/SI-3120KD



●SI-3010KD/SI-3012KD



CIN: Input capacitor (22 μF or larger)
CO: Output capacitor

*1: SI-3012KD/3018KD/3025KD/3033KD (22 μF or larger)
Co has to be a low ESR capacitor such as a ceramic capacitor.
When using the electrolytic capacitor, oscillation may occur at a low temperature.
SI-3010KD/3050KD/3090KD/3120KD (47 μF or larger)
If a low ESR capacitor is used, oscillation may occur.

*2: D1: Reverse bias protection diode
This diode is required for protection against reverse biasing between the input and output.
(Sanken SJPL-F2 is recommended.)
This diode is not required at VO ≤ 3.3V.

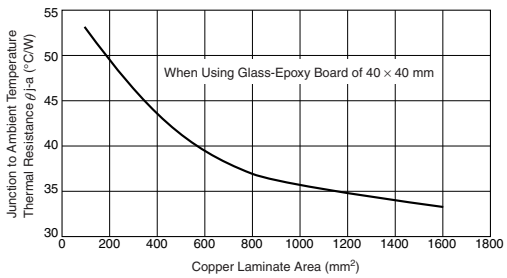
R1, R2: Output voltage setting resistors
The output voltage can be set by connecting R1 and R2 as shown above.
The recommended value for R2 is 10Ω (24kΩ for SI-3012KD).

$R1=(V_O-V_{ADJ})\div(V_{ADJ}/R2)$

*3: For SI-3010KD, insert R3 in case of setting VO to VO ≤ 1.5V.
The recommended value for R3 is 10kΩ.

■Reference Data

Copper Laminate Area (on Glass-Epoxy Board) vs.
Thermal Resistance (from Junction to Ambient Temperature) (Typical Value)



- A higher heat radiation effect can be achieved by enlarging the copper laminate area connected to the inner frame to which a monolithic ICs is mounted.
- Obtaining the junction temperature
  Measure the case temperature TC with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$T_j=P_D\times\theta_{j-C}+T_C$ ($\theta_{j-C}=3$°C/W) $P_D=(V_{IN}-V_O)\bullet I_{OUT}$

SI-3000LLSL Series Surface-Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Low input voltage (1.3V) and low output voltage (1.0V)
- Compact surface-mount package (SOP8)
- Low dropout voltage: $V_{DIF} \leq 0.3V$ (at $I_O = 1.5A$)
- Built-in overcurrent, input-overvoltage and thermal protection circuits
- Built-in ON/OFF function (OFF state circuit current: 1μA max.)
- Compatible with low ESR capacitors

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	10	V
DC Bias Voltage	V_B	10	V
Output Control Terminal Voltage	V_C	V_{IN}	V
DC Output Current	I_O	1.5	A
Power Dissipation	P_D*1	1.1	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{op}	–30 to +100	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Resistance (Junction to Lead (Pin 8))	$\theta_{(j\text{-}L)}$	36	°C/W
Thermal Resistance (Junction to Ambient Air)	$\theta_{(j\text{-}a)}$*1	100	°C/W

*1: When mounted on glass-epoxy board of 40 × 40mm (copper laminate area 100%).

■Applications

- On-board local power supply
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
		SI-3010LLSL	
Input Voltage	V_{IN}	1.4 to 3.6*1	V
Bias Voltage	V_B	3.3 to 5.5	V
Output Current	I_O	0 to 1.5*1	A
Operating Ambient Temperature	T_{op}	–20 to +85*1	°C

*1: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$.

■Electrical Characteristics

(T_a=25°C, V_C=2V, V_{IN}=1.8V, V_B=3.3V, V_O=1.5V unless otherwise specified)

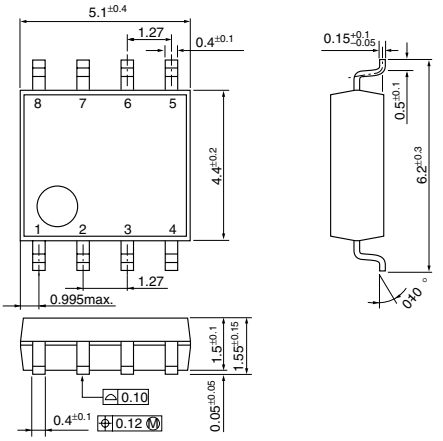
Parameter		Symbol	Ratings			Unit
			SI-3010LLSL			
			min.	typ.	max.	
Reference Voltage		V_{ADJ}	0.980	1.000	1.020	V
		Conditions	I_O=10mA			
Line Regulation		ΔV_{OLINE}			10	mV
		Conditions	V_{IN}=1.7 to 2.5V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			30	mV
		Conditions	V_{IN}=1.8V, I_O=0 to 1.5A			
Dropout Voltage		V_{DIF}			0.3	V
		Conditions	I_O=1.0A			
Quiescent Circuit Current		I_q		500	800	μA
		Conditions	I_O=0A, R_2=10kΩ			
Circuit Current at Output OFF		$I_{q\ (OFF)}$			1	μA
		Conditions	V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.2		mV/°C
		Conditions	T_j=0 to 100°C			
Overcurrent Protection Starting Current*1		I_{S1}	1.6			A
		Conditions	V_{IN}=1.8V, V_B=3.3V			
V_C Terminal	Control Voltage (Output ON)*2	V_C, IH	2			V
	Control Voltage (Output OFF)	V_C, IL			0.8	V
	Control Current (Output ON)	I_C, IH			50	μA
		Conditions	V_C=2.7V			
	Control Current (Output OFF)	I_C, IL			10	μA
		Conditions	V_C=0.4V			

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = overcurrent protection starting current, I_O = 10 mA.

*2: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

■External Dimensions (SOP8)

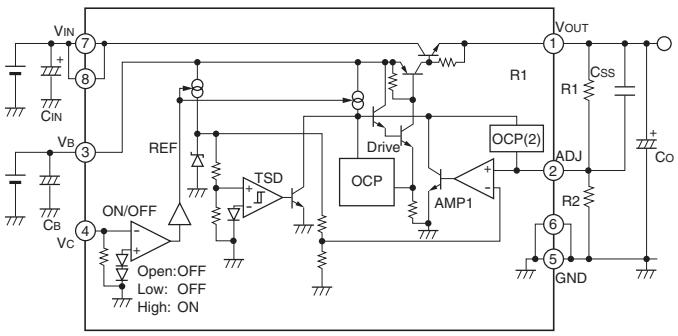
(unit : mm)



Pin Assignment
① V_O
② ADJ
③ V_B
④ V_C
⑤ GND
⑥ GND
⑦ V_{IN}
⑧ V_{IN}

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.1g

■Typical Connection Diagram/Block Diagram



C_{IN}, C_B: Input and bias capacitors (Approx. 0.1 to 10μF)
Required when the input line contains inductance or when the wiring is long.

C_O: Output capacitor (47μF or larger)
SI-3010LLSL is designed to use a low ESR capacitor (such as a ceramic capacitor) for the output capacitor. The recommended ESR value for an output capacitor is 500mΩ or less (at room temperature).

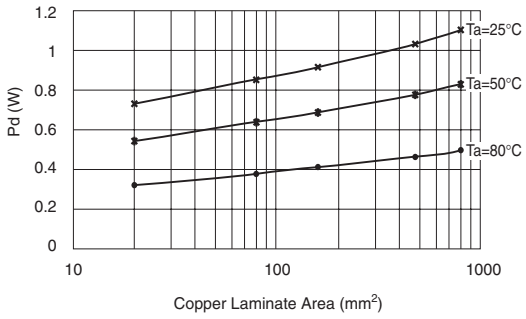
R1, R2: Output voltage setting resistors
The output voltage can be set by connecting R1 and R2 as shown at left.
The recommended value for R2 is 10kΩ.

$$R1 = (V_O - V_{ADJ}) / (V_{ADJ}/R2)$$

C_{SS}: Soft start capacitor
The rising time of the output voltage can be set by connecting C_{SS} between V_{OUT} and ADJ.

■Reference Data

Copper Laminate Area - Power Dissipation



SI-3000ZD Series Surface-Mount, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (TO263-5)
- Output current: 3.0A
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at I_O = 3.0A)
- Low circuit current at output OFF: Iq (OFF) ≤ 1μA
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}*1	10	V
Output Control Terminal Voltage	V_C	6	V
DC Output Current	I_O*1	3.0	A
Power Dissipation	P_D*3	3	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{op}	–30 to +85	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	33.3	°C/W
Thermal Resistance (Junction to Case)	θ_{j-c}	3	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit	Remarks
Input Voltage	V_{IN}	*2 to 6*1	V	
Output Current	I_O	0 to 3	A	
Operating Ambient Temperature	$T_{op\,(a)}$	–20 to +85	°C	
Operating Junction Temperature	$T_{op\,(j)}$	–20 to +100	°C	
Output Voltage Variable Range	V_{OADJ}	1.2 to 5	V	Only for SI-3011ZD. Refer to the block diagram.

*1: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$.
*2: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower (SI-3011ZD).
*3: When mounted on glass-epoxy board of 40 × 40mm (copper laminate area 100%).

■Electrical Characteristics

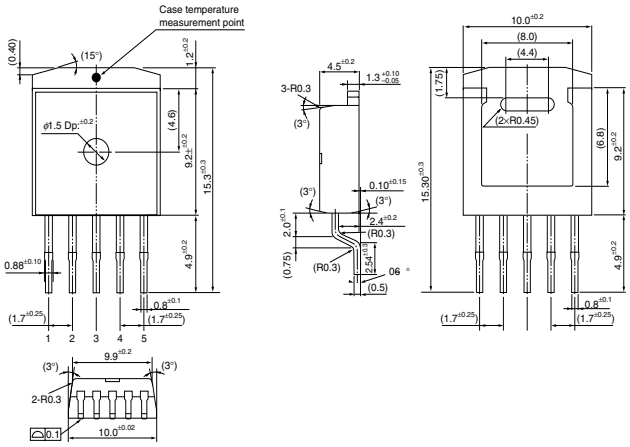
(T_a=25°C, V_C=2V unless otherwise specified)

Parameter		Symbol	Ratings									Unit
			SI-3011ZD (Variable type)			SI-3025ZD			SI-3033ZD			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage (Reference Voltage V_{ADJ} for SI-3011ZD)		V_O (V_{ADJ})	1.078	1.100	1.122	2.45	2.50	2.55	3.234	3.300	3.366	V
		Conditions	V_{IN}=V_O+1V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			10			10			10	mV
		Conditions	V_{IN}=3.3 to 5V, I_O=10mA (V_O=2.5V)			V_{IN}=3.3 to 5V, I_O=10mA			V_{IN}=4.5 to 5.5V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			40			40			40	mV
		Conditions	V_{IN}=3.3V, I_O=0 to 3A (V_O=2.5V)			V_{IN}=3.3V, I_O=0 to 3A			V_{IN}=5V, I_O=0 to 3A			
Dropout Voltage		V_{DIF}			0.6			0.6			0.6	V
		Conditions	I_O=3A (V_O=2.5V)			I_O=3A			I_O=3A			
Quiescent Circuit Current		I_q		1	1.5		1	1.5		1	1.5	mA
		Conditions	V_{IN}=V_O+1V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			V_{IN}=5V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		I_q (OFF)			1			1			1	μA
		Conditions	V_{IN}=V_O+1V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3		mV/°C
		Conditions	T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		60			60			60		dB
		Conditions	V_{IN}=V_O+1V, f=100 to 120Hz, I_O=0.1A			V_{IN}=3.3V, f=100 to 120Hz, I_O=0.1A			V_{IN}=5V, f=100 to 120Hz, I_O=0.1A			
Overcurrent Protection Starting Current*2 *4		I_{S1}	3.2			3.2			3.2			A
		Conditions	V_{IN}=V_O+1V			V_{IN}=3.3V			V_{IN}=5V			
V_C Terminal	Control Voltage (Output ON)*3	V_C, IH	2			2			2			V
	Control Voltage (Output OFF)*3	V_C, IL			0.8			0.8			0.8	
	Control Current(Output ON)	I_C, IH			100			100			100	μA
		Conditions	V_C=2.7V			V_C=2.7V			V_C=2.7V			
	Control Current(Output OFF)	I_C, IL	–5	0		–5	0		–5	0		μA
		Conditions	V_C=0V			V_C=0V			V_C=0V			

*1: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.
*2: I_{S1} is specified at the –5% drop point of output voltage V_O under the condition of Output Voltage parameter.
*3: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*4: These products cannot be used for the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■External Dimensions (TO263-5)

(Unit : mm)

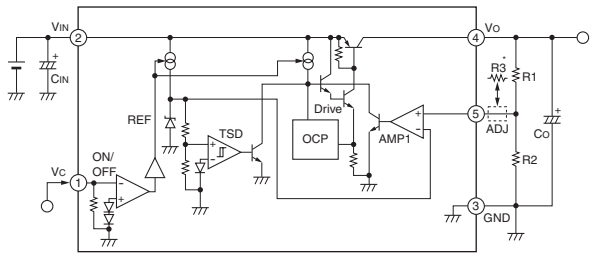


Pin Assignment
① V_C
② V_{IN}
③ GND (Common to the rear side of product)
④ V_O
⑤ Sense
(ADJ for SI-3011ZD)

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 1.48g

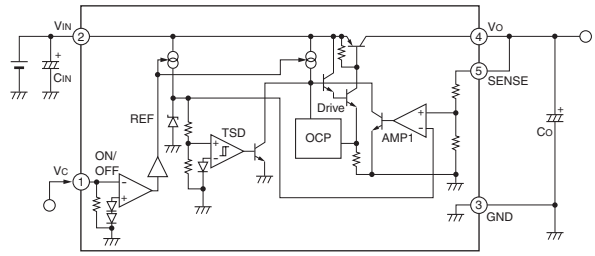
■Block Diagram

SI-3011ZD



C_{IN}: Input capacitor (Approx. 10μF)
C_O: Output capacitor (47μF or larger)
The output voltage may oscillate if a low ESR type capacitor (such as a ceramic capacitor) is used for the output capacitor in the SI-3000ZD Series.

SI-3025ZD, SI-3033ZD



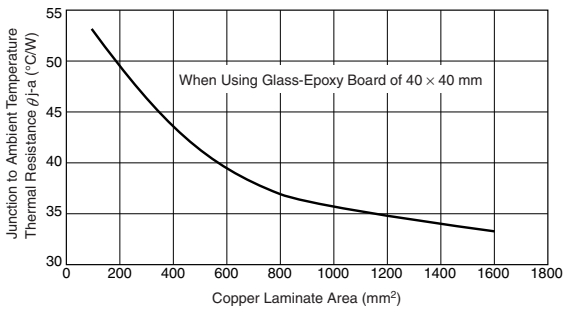
R1, R2: Output voltage setting resistors
The output voltage can be set by connecting R1 and R2 as shown at left.
The recommended value for R2 is 10kΩ or 11kΩ.

$$R1 = (V_O - V_{ADJ}) / (V_{ADJ}/R2)$$

*: Insert R3 in case of setting V_O to $V_O \leq 1.8V$. The recommended value for R3 is 10kΩ.

■Reference Data

Copper Laminate Area (on Glass-Epoxy Board) vs.
Thermal Resistance (from Junction to Ambient Temperature) (Typical Value)



- A higher heat radiation effect can be achieved by enlarging the copper laminate area connected to the inner frame to which a monolithic IC is mounted.
- Obtaining the junction temperature
  Measure GND terminal temperature T_C with a thermocouple, etc. Then substitute this value in the following formula to obtain the junction temperature.

$$T_j = P_D \times \theta_{j-C} + T_C \qquad P_D = (V_{IN} - V_O) \bullet I_{OUT}$$

SI-3000B Series 5-Terminal, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 0.27A
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at I_O=0.27A)
- Output ON/OFF control terminal is compatible with LS-TTL. (It can be driven directly by LS-TTL or standard CMOS logic.)
- Built-in foldback overcurrent and thermal protection circuits
- Accuracy of overcurrent protection starting current

  SI-3157B : 0.3 to 0.7A (V_{IN}=18V)
  SI-3025B : 0.3 to 0.7A
  (When V_{IN}=18V, at V_O=15.7V)
  0.3 to 0.75A
  (When V_{IN}=18V, at V_O=11.7V)
- Variable output voltage type (SI-3025B) also available

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbo	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Output Control Terminal Voltage	V_C	V_{IN}	V
DC Output Current	I_O	0.27*1	A
Power Dissipation	P_{D1}	14(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	–40 to +125	°C
Operating Ambient Temperature	T_{OP}	–30 to +100	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	7.0	°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)	°C/W

■Applications

- For BS and CS antenna power supplies
- Electronic equipment

■Electrical Characteristics

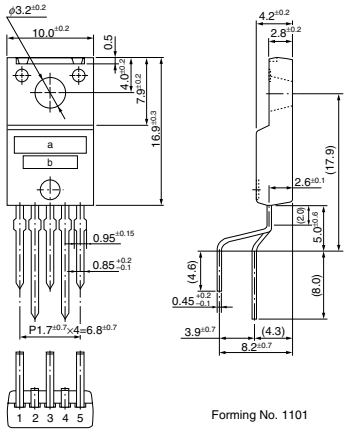
(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings						Unit
			SI-3157B			SI-3025B			
			min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	*2		27*1	6*2,6		27*1	V
Output Voltage (Reference Voltage V_{ADJ} for SI-3025B)		V_O (V_{ADJ})	14.92	15.70	16.48	2.448	2.550	2.652	V
		Conditions	V_{IN}=18V, I_O=0.2A			V_{IN}=V_O+3V, I_O=0.2A			
Dropout Voltage		V_{DIF}			0.5			0.5	V
		Conditions	I_O≤0.27A			I_O≤0.27A			
Line Regulation		ΔV_{OLINE}		30	90			10	mV (SI-3025B:mV/V)
		Conditions	V_{IN}=17 to 27V, I_O=0.2A			V_{IN}=(V_O+1) to 27V, I_O=0.27A			
Load Regulation		ΔV_{OLOAD}		120	300			10	mV (SI-3025B:mV/V)
		Conditions	V_{IN}=18V, I_O=0 to 0.27A			V_{IN}=V_O+3V, I_O=0 to 0.27A			
Temperature Coefficient of Output Voltage (SI-3025B: Temperature Coefficient of Reference Voltage)		$\Delta V_O/\Delta T_a$ ($\Delta V_{ADJ}/\Delta T_a$)		±1.5			±0.5		mV/°C
		Conditions	V_{IN}=18V, I_O=5mA, T_j=0 to 100°C			V_{IN}=V_O+3V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54		dB
		Conditions	V_{IN}=18V, f=100 to 120Hz			V_{IN}=V_O+3V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		3	10	mA
		Conditions	V_{IN}=18V, I_O=0A			V_{IN}=V_O+3V, I_O=0A			
Overcurrent Protection Starting Current*3,4		I_{S1}	0.3		0.7	0.3		0.75	A
		Conditions	V_{IN}=18V			V_{IN}=18V, at V_O=11.7V			
				———		0.3		0.7	
		Conditions				V_{IN}=18V, at V_O=15.7V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20	μA
		Conditions	V_C=2.7V			V_C=2.7V			
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3	mA
		Conditions	V_C=0.4V			V_C=0.4V			

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}$=(V_{IN}-V_O)•I_O=14(W).
*2: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)
*3: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=V_O+3V, I_O=0.2A.
*4: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage
*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*6: When setting output voltage to 5V or lower, input voltage needs to be set to 6V or higher to operate stably.

■External Dimensions (TO220F-5)

(Unit : mm)



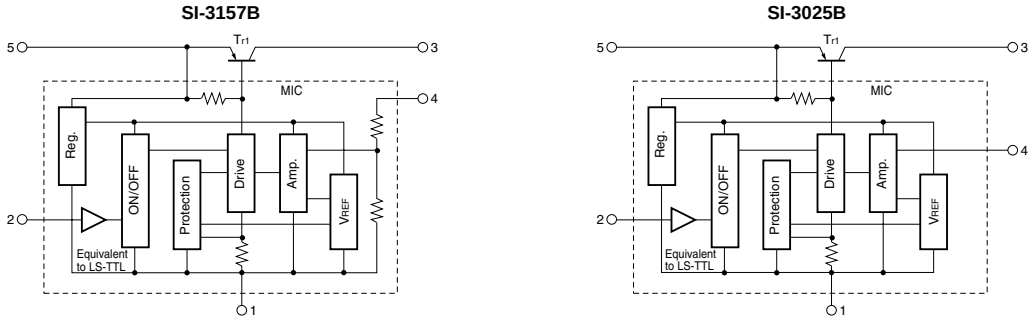
a. Part Number
b. Lot Number

Pin Assignment

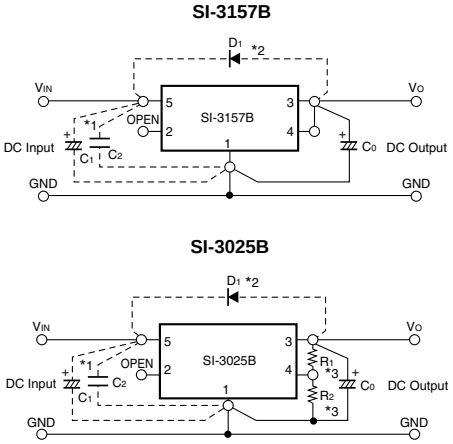
SI-3157B	SI-3025B
① GND	① GND
② VC	② VC
③ VO	③ VO
④ Sense	④ ADJ
⑤ VIN	⑤ VIN

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram



■Typical Connection Diagram

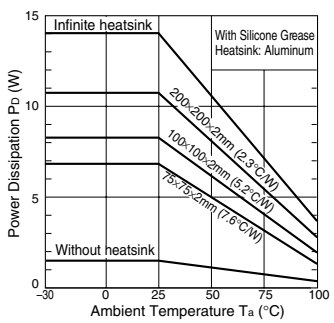


C0 : Output capacitor (47 to 100μF)
*1 C1, C2 : Oscillation prevention capacitor (Approx. C1: 47μF, C2: 0.33μF)
These capacitors are required if the input line contains inductance or the wiring is long. Especially at low temperatures, tantalum capacitors are recommended for C1 and C0.
*2 D1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.
*3 R1, R2 : External resistor for setting output voltage
The relation between output voltage VO and external resistors R1 and R2 is as follows.

$$V_O = V_{ADJ} \bullet \left(1 + \frac{R_1}{R_2}\right) \quad (V_{ADJ}=2.55V(typ.))$$

R2 must be 2.55kΩ for stable operation.

■Ta-PD Characteristics



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

SI-3000F Series 5-Terminal, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=1.0A)
- Variable output voltage (rise only) Available for remote sensing (excluding SI-3025F)
- Output ON/OFF control terminal is compatible with LS-TTL. (It can be driven directly by LS-TTL or standard CMOS logic.)
- Built-in foldback-overcurrent, input-overvoltage and thermal protection circuits
- Variable output voltage type (SI-3025F) also available

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings					Unit
		SI-3050F	SI-3090F/3120F	SI-3057F	SI-3240F	SI-3025F	
DC Input Voltage	V_{IN}	25	30	35	45	30	V
Output Control Terminal Voltage	V_C	V_{IN}					V
DC Output Current	I_O	1.0*2					A
Power Dissipation	P_{D1}	14**(With infinite heatsink)					W
	P_{D2}	1.5(Without heatsink, stand-alone operation)					W
Junction Temperature	T_j	–40 to +125					°C
Operating Ambient Temperature	T_{op}	–30 to +100					°C
Storage Temperature	T_{stg}	–40 to +125					°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	7.0***					°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)					°C/W

** SI-3240F: 18
*** SI-3240F: 5.5

■Applications

- For stabilization of the secondary-side output voltage of switching power supplies.
- Electronic equipment

■Electrical Characteristics (except SI-3025F)

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings															Unit
			SI-3050F			SI-3090F			SI-3120F			SI-3157F			SI-3240F			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	6*3		15*2	10*3		20*2	13*3		25*2	16.7*3		27*2	25*3		40*2	V
Output Voltage	SI-3000F *1	V_O	4.80	5.00	5.20	8.64	9.00	9.36	11.52	12.00	12.48	14.92	15.70	16.48	23.04	24.00	24.96	V
	SI-3000FA		4.90	5.00	5.10	8.82	9.00	9.18	———			———			———			
		Conditions	V_{IN}=8V, I_O=0.5A			V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=19V, I_O=0.5A			V_{IN}=27V, I_O=0.5A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5			0.5			0.5	V
		Conditions	I_O≤0.5A															
					1.0			1.0			1.0			1.0			1.0	
		Conditions	I_O≤1.0A															
Line Regulation		ΔV_{OLINE}		10	30		18	48		24	64		30	90		48	128	mV
		Conditions	V_{IN}=6V to 15V, I_O=0.5A			V_{IN}=10V to 20V, I_O=0.5A			V_{IN}=13V to 25V, I_O=0.5A			V_{IN}=17V to 27V, I_O=0.5A			V_{IN}=25V to 38V, I_O=0.5A			
Load Regulation		ΔV_{OLOAD}		40	100		70	180		93	240		120	300		120	300	mV
		Conditions	V_{IN}=8V, I_O=0 to 1.0A			V_{IN}=12V, I_O=0 to 1.0A			V_{IN}=15V, I_O=0 to 1.0A			V_{IN}=19V, I_O=0 to 1.0A			V_{IN}=27V, I_O=0 to 1.0A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±1.0			±1.5			±1.5			±2.5		mV/°C
		Conditions	V_{IN}=8V, I_O=5mA, T_j=0 to 100°C			V_{IN}=12V, I_O=5mA, T_j=0 to 100°C			V_{IN}=15V, I_O=5mA, T_j=0 to 100°C			V_{IN}=19V, I_O=5mA, T_j=0 to 100°C			V_{IN}=27V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54			54			54			54		dB
		Conditions	V_{IN}=8V, f=100 to 120Hz			V_{IN}=12V, f=100 to 120Hz			V_{IN}=15V, f=100 to 120Hz			V_{IN}=19V, f=100 to 120Hz			V_{IN}=27V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		3	10		3	10		3	10		5	10	mA
		Conditions	V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=19V, I_O=0A			V_{IN}=27V $_O$=0A			
Overcurrent Protection Starting Current*4,7		I_{S1}	1.2			1.2			1.2			1.2			1.2			A
		Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=19V			V_{IN}=27V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20			20			20			20	μA
		Conditions	V_C=2.7V															
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3			–0.3			–0.3	mA
		Conditions	V_C=0.4V															

*1: In some cases, "A" may be printed on the right of the marking.
*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=14W(SI-3240F: 18W).
*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)
*4: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=0.5A.
*5: Output is ON even when output control terminal VC is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*6: When setting output voltage to 5V or lower, input voltage needs to be set to 6V or higher to operate stably.
*7: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

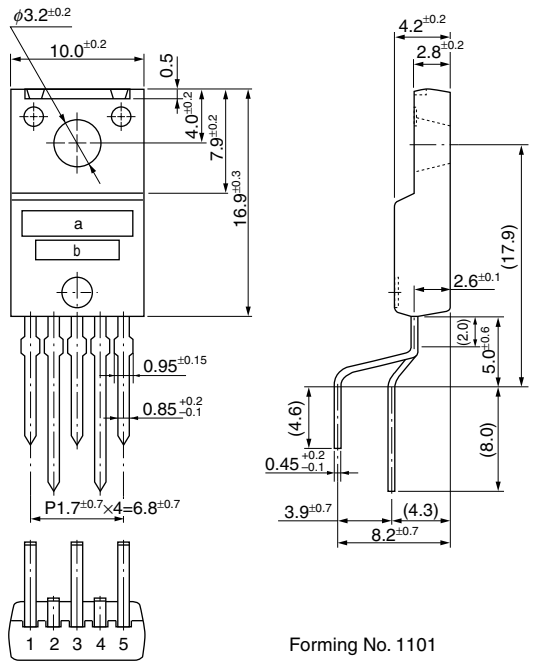
■Electrical Characteristics (SI-3025F)

(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings SI-3025F min.	typ.	max.	Unit
Input Voltage		V_{IN}	6[*6]		25[*2]	V
Output Voltage		V_O	3		24	V
Reference Voltage		V_{REF}	2.45	2.55	2.65	V
Dropout Voltage		V_{ADJ}			0.5	V
		Conditions	$I_O \leq 0.5A$			
					1.0	
		Conditions	$I_O \leq 1.0A$			
Line Regulation		ΔV_{OLINE}			10	mV/V
		Conditions	$V_{IN}=V_O+1$ to 25V, $I_O=0.5A$			
Load Regulation		ΔV_{OLOAD}			20	mV/V
		Conditions	$V_{IN}=V_O+3V$, $I_O=0$ to 1.0A			
Temperature Coefficient of Reference Voltage		$\Delta V_{REF}/\Delta T_a$		±0.5		mV/°C
		Conditions	$V_{IN}=V_O+3V$, $I_O=5mA$, $T_j=0$ to 100°C			
Ripple Rejection		R_{REJ}		54		dB
		Conditions	$V_{IN}=V_O+3V$, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10	mA
		Conditions	$V_{IN}=V_O+3V$, $I_O=0A$			
Overcurrent Protection Starting Current[*4,7]		I_{S1}	1.2			A
		Conditions	$V_{IN}=V_O+3V$			
V_C Terminal[*5]	Control Voltage (Output ON)	$V_{C.IH}$	2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20	μA
		Conditions	$V_C=2.7V$			
	Control Current (Output OFF)	$I_{C.IL}$			−0.3	mA
		Conditions	$V_C=0.4V$			

■External Dimensions (TO220F-5)

(Unit : mm)



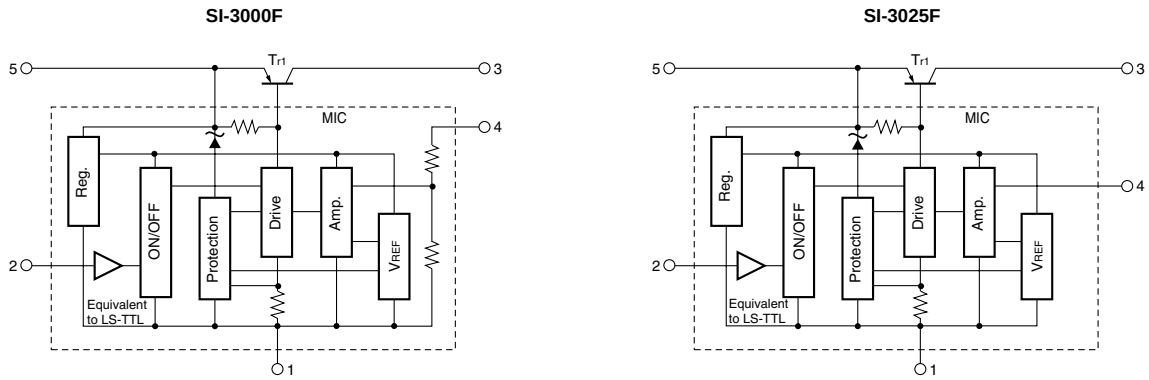
Forming No. 1101

a. Part Number
b. Lot Number

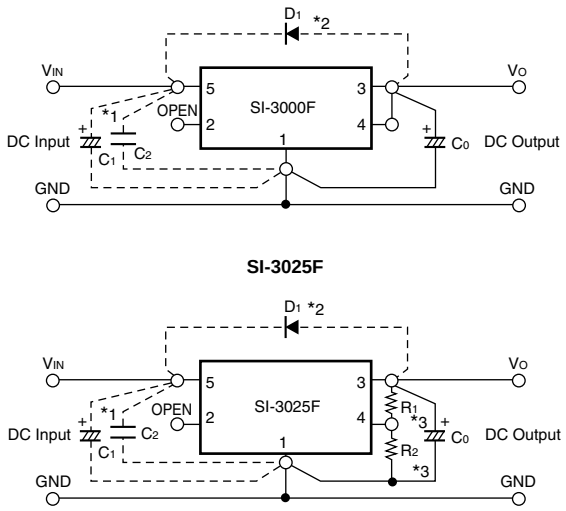
Pin Assignment	(Only for SI-3025F)
① GND	① GND
② V_C	② V_C
③ V_O	③ V_O
④ Sense	④ ADJ
⑤ V_{IN}	⑤ V_{IN}

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram



■Typical Connection Diagram



C0 : Output capacitor (47 to 100μF)

*1 C1, C2 : Oscillation prevention capacitor
(Approx. C1: 47μF, C2: 0.33μF)
These capacitors are required if the input line contains inductance or the wiring is long. Especially at low temperatures, tantalum capacitors are recommended for C1 and C0.

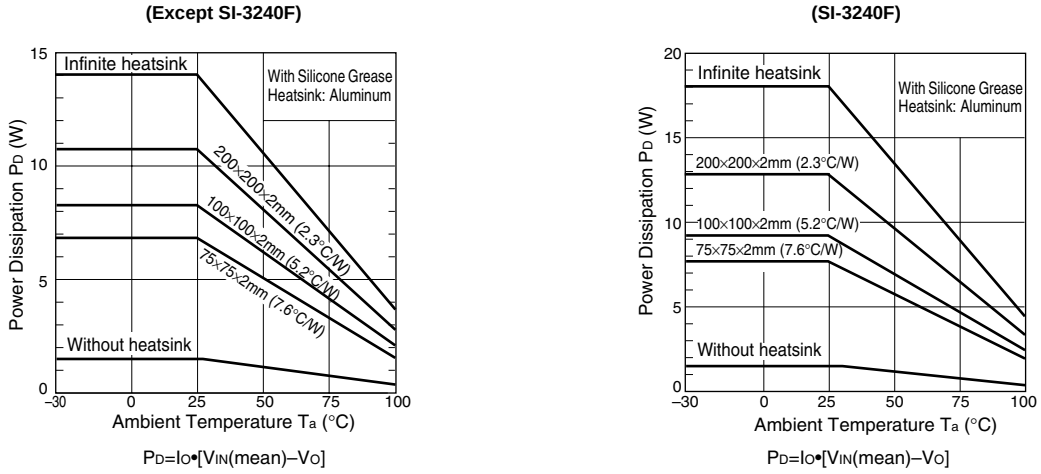
*2 D1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

*3 R1, R2 : External resistor for setting output voltage
Relationship between output voltage VO and external resistors R1 and R2 is as follows.

$$V_O = V_{ADJ} \bullet \left(1 + \frac{R_1}{R_2}\right) \quad (V_{ADJ}=2.55V(typ.))$$

R2 must be 2.55kΩ for stable operation.

■Ta-PD Characteristics



SI-3000KFE Series Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at $I_O = 1.0A$)
- High ripple rejection: 75dB
- Low circuit current at output OFF: Iq (OFF) ≤ 1μA
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit	Remarks
		SI-3010KFE		
DC Input Voltage	V_{IN}	35*1	V	
Output Control Terminal Voltage	Vc	V_{IN}	V	
DC Output Current	Io	1.0	A	
Power Dissipation	P_{D1}	16.6	W	With infinite heatsink
	P_{D2}	1.72	W	Without heatsink, stand-alone operation
Junction Temperature	Tj	–40 to +125	°C	
Storage Temperature	Tstg	–40 to +125	°C	
Operating Ambient Temperature	Top	–40 to +100	°C	
Thermal Resistance (Junction to Case)	θj-c	6.0	°C/W	
Thermal Resistance (Junction to Ambient Air)	θj-a	58	°C/W	Without heatsink, stand-alone operation

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
		SI-3010KFE	
Input Voltage Range	V_{IN}	2.4*2 to 27*1	V
Output Current Range	Io	0 to 1.0*1	A
Output Voltage Variable Range	VoADJ	1.1 to 16	V
Operating Ambient Temperature	T_{op}	–30 to +85	°C
Operating Junction Temperature	T_j	–20 to +100	°C

*1: V_{IN} (max) and I_O (max) are restricted by the relationship P_D (max) = (V_{IN} - V_O) × I_O = 16.6W.
*2: Refer to the Dropout Voltage parameter.

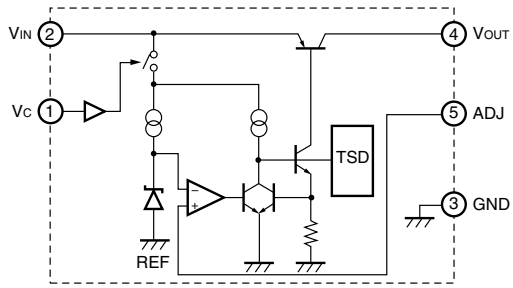
■Electrical Characteristics

Parameter		Symbol	Ratings SI-3010KFE min.	typ.	max.	Unit
Reference Voltage		V_{ADJ}	0.98	1.00	1.02	V
		Conditions	V_{IN}=7V, I_O=0.01A, V_C=2V, V_O=5A			
Line Regulation		ΔV_{OLINE}			30	mV
		Conditions	V_{IN}=6 to 15V, I_O=0.01A, V_C=2V, V_O=5A			
Load Regulation		ΔV_{OLOAD}			75	mV
		Conditions	V_{IN}=7V, I_O=0 to 1A, V_C=2V, V_O=5A			
Dropout Voltage		V_{DIF}			0.3	V
		Conditions	I_O=0.5A, V_C=2V, V_O=5V			
					0.5	
		Conditions	I_O=1.0A, V_C=2V, V_O=5V			
Quiescent Circuit Current		I_q			600	μA
		Conditions	V_{IN}=7V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		I_q (OFF)			1	μA
		Conditions	V_{IN}=7V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5		mV/°C
		Conditions	V_{IN}=7V, I_O=0.01A, V_C=2V, Tj=0 to 100°C, V_O=2.5V			
Ripple Rejection		R_{REJ}		75		dB
		Conditions	V_{IN}=7V, I_O=0.1A, V_C=2V, f=100 to 120Hz V_O=5V			
Overcurrent Protection Starting Current*3		I_{S1}	1.1			A
		Conditions	V_{IN}=7V, V_C=2V			
Vc Terminal	Control Voltage (Output ON)*4	V_C, IH	2			V
		Conditions	V_{IN}=7V			
	Control Voltage (Output OFF)	V_C, IL			0.8	V
		Conditions	V_{IN}=7V			
	Control Current (Output ON)	I_C, IH			40	μA
		Conditions	V_{IN}=7V, V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		μA
		Conditions	V_{IN}=7V, V_C=0V			
Input Overvoltage Shutdown Voltage		V_{OVP}	33			V
		Conditions	I_O=0.01A			

*3: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = overcurrent protection starting current, I_O = 10 mA.
*4: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*5: SI-3000KFE cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

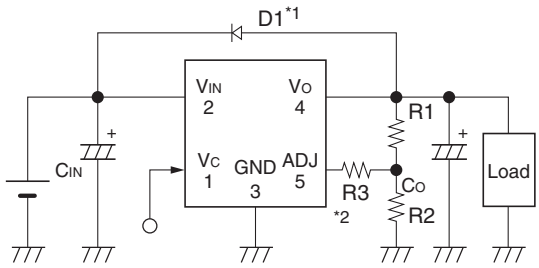
■Block Diagram

SI-3010KFE



■Typical Connection Diagram

●SI-3010KFE



CIN: Input capacitor (22μF or larger)
CO: Output capacitor (47μF or larger)
If a low ESR capacitor (such as a ceramic capacitor) is used for the output capacitor, oscillation may occur.

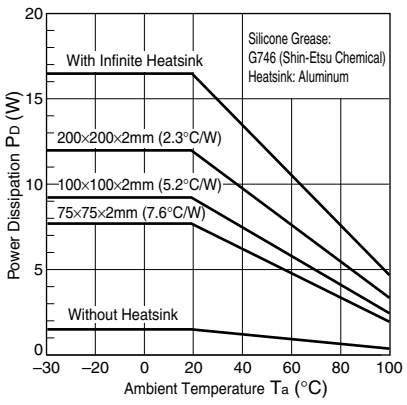
*1. D1: Reverse bias protection diode
This diode is required for protection against reverse biasing between the input and output.
(Sanken RU2Z is recommended.)

R1, R2: Output voltage setting resistors
The output voltage can be adjusted by connecting R1 and R2 as shown above.
The recommended value for R2 is 10kΩ.

$R1=(V_O-V_{ADJ})\div(V_{ADJ}/R2)$

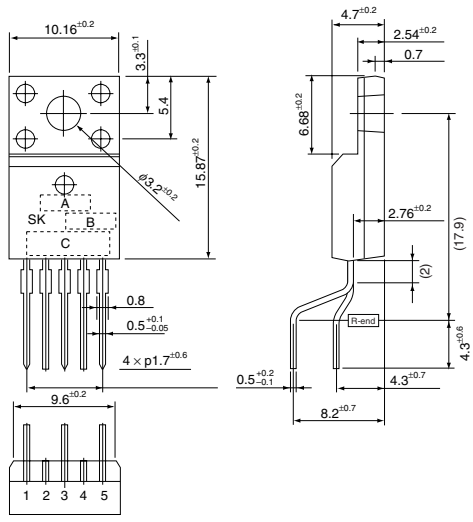
*2: For SI-3010KFE, insert R3 in case of setting VO to VO ≤ 1.5V.
The recommended value for R3 is 10kΩ.

■TA-PD Characteristics



■External Dimensions (TO220F-5)

(Unit : mm)



a. Part Number
b. Lot Number
c. Administer Number

Pin Assignment
① Vc
② VIN
③ GND
④ Vout
⑤ ADJ

SI-3000C Series 5-Terminal, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=1.5A)
- Variable output voltage (rise only)
  Available for remote sensing
- Output ON/OFF control terminal is compatible with LS-TTL.
  (It can be driven directly by LS-TTL or standard CMOS logic.)
- Built-in foldback overcurrent (SI-3033C: Drooping type overcurrent), input-overvoltage and thermal protection circuits

■Applications

- For stabilization of the secondary-side output voltage of switching power supplies
- Electronic equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings				Unit
		SI-3033C	SI-3050C/3090C	SI-3120C/3150C	SI-3240C	
DC Input Voltage	V_{IN}	20	35	35	45	V
Output Control Terminal Voltage	V_C	V_{IN}				V
DC Output Current	I_O	1.5*2				A
Power Dissipation	P_{D1}	18(With infinite heatsink)				W
	P_{D2}	1.5(Without heatsink, stand-alone operation)				W
Junction Temperature	T_j	–40 to +125				°C
Operating Ambient Temperature	T_{op}	–30 to +100				°C
Storage Temperature	T_{stg}	–40 to +125				°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	5.5				°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)				°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings									Unit
			SI-3033C			SI-3050C			SI-3090C			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	*3		15*2	6*3		30*2	10*3		30*2	V
Output Voltage	SI-3000C *1	V_O	3.168	3.300	3.432	4.80	5.00	5.20	8.64	9.00	9.36	V
	SI-3000CA		3.234	3.300	3.366	4.90	5.00	5.10	8.82	9.00	9.18	
		Conditions	V_{IN}=5V, I_O=1.0A			V_{IN}=8V, I_O=1.0A			V_{IN}=12V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5	V
		Conditions	I_O≤1.0A									
					1.0			1.0			1.0	
		Conditions	I_O≤1.5A									
Line Regulation		ΔV_{OLINE}		10	30		10	30		18	48	mV
		Conditions	V_{IN}=4.5 to 12V, I_O=1.0A			V_{IN}=6 to 15V, I_O=1.0A			V_{IN}=10 to 20V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		40	100		40	100		70	180	mV
		Conditions	V_{IN}=5V, I_O=0 to 1.5A			V_{IN}=8V, I_O=0 to 1.5A			V_{IN}=12V, I_O=0 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0		mV/°C
		Conditions	V_{IN}=5V, I_O=5mA, T_j=0 to 100°C			V_{IN}=8V, I_O=5mA, T_j=0 to 100°C			V_{IN}=12V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54			54		dB
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=8V, f=100 to 120Hz			V_{IN}=12V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		5	10		5	10	mA
		Conditions	V_{IN}=5V, I_O=0A			V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			
Overcurrent Protection Starting Current*4,6		I_{S1}	1.6			1.6			1.6			A
		Conditions	V_{IN}=5V			V_{IN}=8V			V_{IN}=12V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20			20	μA
		Conditions	V_C=2.7V									
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3	mA
		Conditions	V_C=0.4V									

*1: In some cases, "A" may be printed on the right of the marking.
*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=18(W).
*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)
*4: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.
*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*6: These products (except for SI-3033C) cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings									Unit
			SI-3120C			SI-3150C			SI-3240C			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	13*3		30*2	16*3		30*2	25*3		40*2	V
Output Voltage	SI-3000C *1	V_O	11.52	12.00	12.48	14.40	15.00	15.60	23.04	24.00	24.96	V
	SI-3000CA	V_O	11.76	12.00	12.24	14.70	15.00	15.30	23.52	24.00	24.48	V
		Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=18V, I_O=1.0A			V_{IN}=27V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5	V
		Conditions	I_O≤1.0A									
					1.0			1.0			1.0	
		Conditions	I_O≤1.5A									
Line Regulation		ΔV_{OLINE}		24	64		30	90		48	128	mV
		Conditions	V_{IN}=13 to 25V, I_O=1.0A			V_{IN}=16 to 25V, I_O=1.0A			V_{IN}=25 to 38V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		93	240		120	300		120	300	mV
		Conditions	V_{IN}=15V, I_O=0 to 1.5A			V_{IN}=18V, I_O=0 to 1.5A			V_{IN}=27V, I_O=0 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±1.5			±1.5			±2.5		mV/°C
		Conditions	V_{IN}=15V, I_O=5mA, T_j=0 to 100°C			V_{IN}=18V, I_O=5mA, T_j=0 to 100°C			V_{IN}=27V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54			54		dB
		Conditions	V_{IN}=15V, f=100 to 120Hz			V_{IN}=18V, f=100 to 120Hz			V_{IN}=27V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		5	10		5	10		5	10	mA
		Conditions	V_{IN}=15V, I_O=0A			V_{IN}=18V, I_O=0A			V_{IN}=27V, I_O=0A			
Overcurrent Protection Starting Current*4,6		I_{S1}	1.6			1.6			1.6			A
		Conditions	V_{IN}=15V			V_{IN}=18V			V_{IN}=27V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8	V
	Control Current (Output ON)	$I_{C.IH}$			20			20			20	μA
		Conditions	V_C=2.7V									
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3	mA
		Conditions	V_C=0.4V									

*1: In some cases, "A" may be printed on the right of the marking.

*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=18(W).

*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)

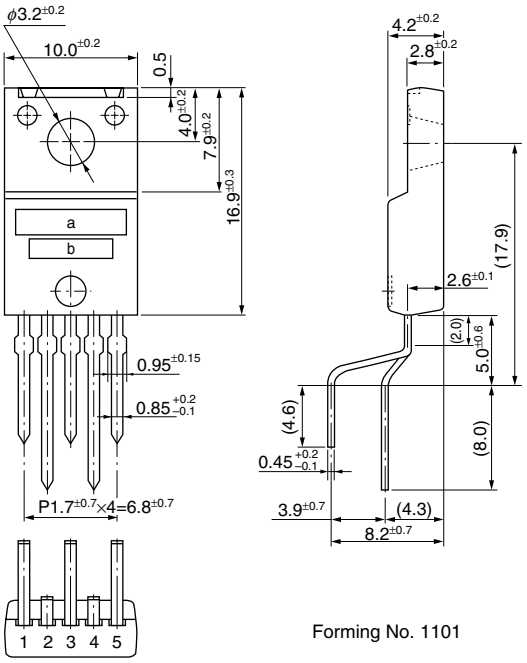
*4: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.

*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*6: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■External Dimensions (TO220F-5)

(unit : mm)



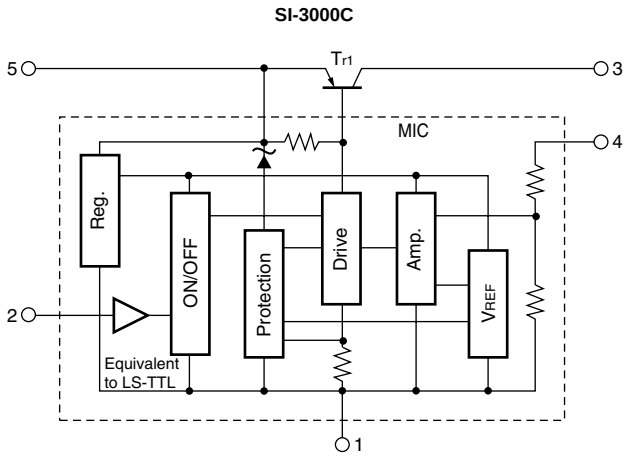
Forming No. 1101

a. Part Number
b. Lot Number

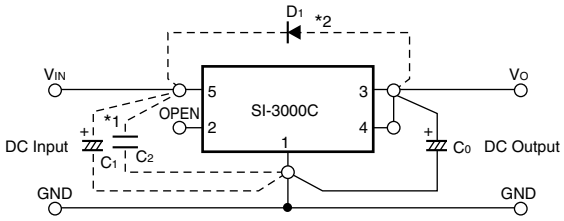
Pin Assignment
① GND
② V_C
③ V_O
④ V_{OS}
⑤ V_{IN}

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram



■Typical Connection Diagram

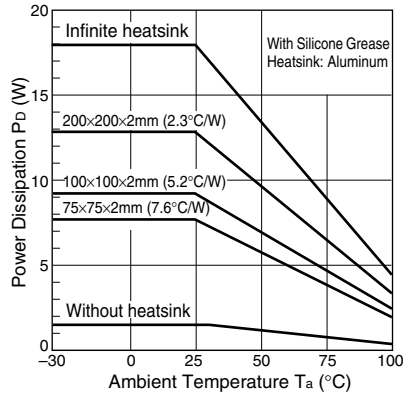


C_0 : Output capacitor (47 to 100μF)

*1 C_1, C_2 : Oscillation prevention capacitors
(Approx. C_1: 47μF, C_2: 0.33μF)
These capacitors are required if the input line contains inductance or the wiring is long. Especially at low temperatures, tantalum capacitors are recommended for C_1 and C_0.

*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

■T_a-P_D Characteristics



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

SI-3000R Series 5-Terminal, Built-in Reset Function, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■Features

- Reset signal output (When the output voltage rises, a reset signal is output to secure the normal operation of the system. When the output voltage decreases, the reset signal is also output to protect the system.)
- Reset signal detection output voltage level Voth is 92% of output voltage in the standard specification. Models with different setting values for different needs are scheduled to be added to the series.
- Delay time for reset signal can be set freely by external capacitor
- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- Low dropout voltage :$V_{DIF} \leq 1V$ (at I_O=1.5A) Applicable to battery driven equipment with built-in microcomputer.
- Built-in drooping-type-overcurrent, input-overvoltage and thermal protection circuits
- Low circuit current I_D=typ.1.5mA (I_O=0A)

■Applications

- Microcomputer-controlled equipment
- Battery-driven micro-computer-controlled equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
		SI-3050R	
DC Input Voltage	V_{IN}	35	V
Voltage of Rest Signal Output Terminal	V_{RST}	V_{IN}	V
DC Output Current	I_O	1.5*1	A
Power Dissipation	P_{D1}	18(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{OP}	–30 to +100	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	5.5	°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)	°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings			Unit
			SI-3050R			
			min.	typ.	max.	
Input Voltage		V_{IN}	6*2		30*1	V
Output Voltage		V_O	4.80	5.00	5.20	V
		Conditions	V_{IN}=8V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5	V
		Conditions	$I_O \leq 1.0A$			
					1.0	
		Conditions	$I_O \leq 1.5A$			
Line Regulation		ΔV_{OLINE}			30	mV
		Conditions	V_{IN}=6 to 15V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}			100	mV
		Conditions	V_{IN}=8V, I_O=0 to 1.5A			
Ripple Rejection		R_{REJ}		54		dB
		Conditions	V_{IN}=8V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		1.5	5.0	mA
		Conditions	V_{IN}=8V, I_O=0A			
Overcurrent Protection Starting Current (Drooping Type)		I_{S1}	1.6			A
		Conditions	V_{IN}=8V			
Current Limit at Output Short Circuit		I_{S2}	1.6			A
		Conditions	V_{IN}=8V			
DLY Terminal	Threshold	V_{DLyth}	2.7	2.9	3.1	V
	Source	I_{DLY}	25	35	45	μA
Reset Threshold Voltage Level (Voth: Threshold Output Voltage)		V_{oth}/V_O	90	92	94	%
Reset Threshold Voltage Hysteresis		ΔV_{oth}	50	100	150	mV
V_C Terminal*4	H-level Output Voltage	V_{RSTH}	V_{CC}–1			V
	L-level Output Voltage	V_{RSTL}			0.8	V
	Sink Current at H level	I_{RSTH}			–20	μA
	Source Current at L level	I_{RSTL}	–16			mA

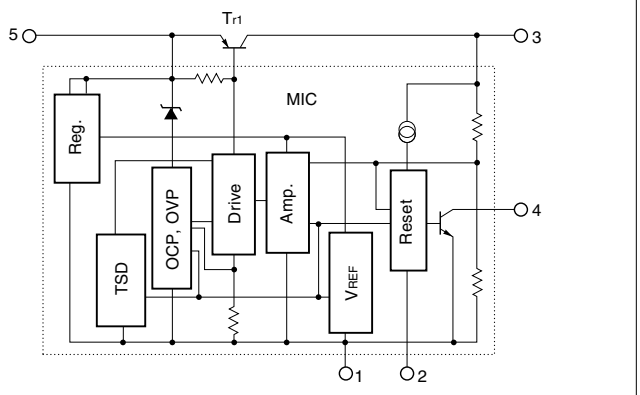
*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=18(W).

*2: Refer to the Dropout Voltage parameter. (Refer to Setting D_C Input Voltage on page 7.)

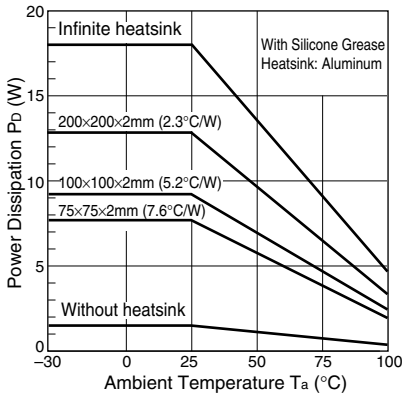
*3: Is1 is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=8V, I_O=1.0A.

*4: Reset signal output terminal V_{RST} is an open-collector output. Use a pull-up resistor when connecting it to a logic circuit.

■Block Diagram

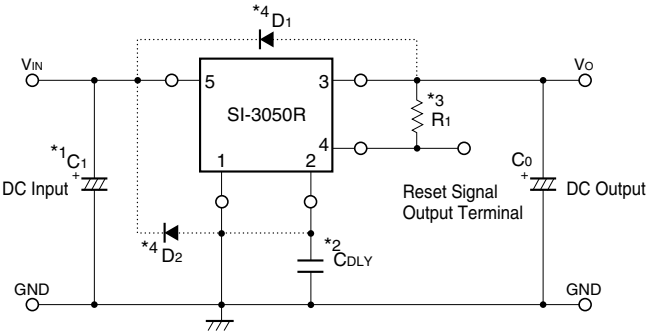


■Ta-PD Characteristics



PD=IO•[VIN(mean)–VO]

■Typical Connection Diagram



C0 : Output capacitor (Approx. 200μF)

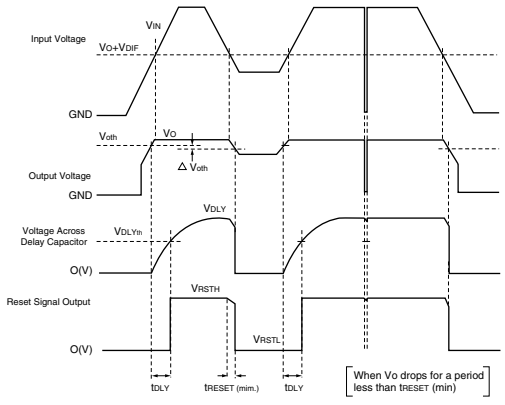
*1 C1 : Oscillation prevention capacitor (C1: Approx. 47μF)
The wiring lengths from this capacitor to terminal 5 (VIN) and terminal 1 (GND) shall be as short as possible. If the input line contains inductance or the wiring is long, a capacitor of approx. 0.33μF with superior high frequency characteristics is needed to be connected in parallel. Especially at low temperatures, tantalum capacitors are recommended for C1 and C0.

*2 CDLY : Delay capacitor (reset output)

*3 R1 : Pull-up resistor (300Ω or higher)

*4 D1, D2 : Protection diodes
These diodes are required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

■Reset Signal Output Timing Chart



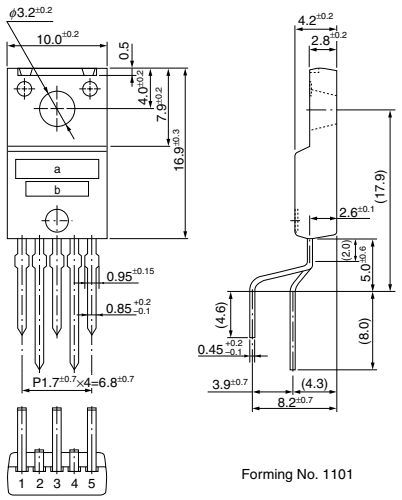
The delay time t_{DLY} of the reset signal can be calculated from the following formula:

$$t_{DLY} = \frac{V_{DLYth}}{I_{DLY}} \times C_{DLY}$$

*I_{DLY} is the current flowing from the DELAY terminal shown in the typical connection diagram.

■External Dimensions (TO220F-5)

(unit : mm)



Forming No. 1101

a. Part Number
b. Lot Number

Pin Assignment
① GND
② DELAY
③ VO
④ Rest Signal output
⑤ VIN

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

SI-3000J Series 5-Terminal, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 2.0A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=2.0A)
- Variable output voltage (rise only) Available for remote sensing used for remote sensing.
- Output ON/OFF control terminal is compatible with LS-TTL.

  (It can be driven directly by LS-TTL or standard CMOS logic.)
- Built-in foldback-overcurrent, input-overvoltage and thermal protection circuits

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Unit
		SI-3050J	SI-3090J	SI-3120J/3150J	
DC Input Voltage	V_{IN}	25	30	35	V
Output Control Terminal Voltage	V_C	V_{IN}			V
DC Output Current	I_O	2.0*1			A
Power Dissipation	P_{D1}	20(With infinite heatsink)			W
	P_{D2}	1.5(Without heatsink, stand-alone operation)			W
Junction Temperature	T_j	–40 to +125			°C
Operating Ambient Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	5.0			°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)			°C/W

■Applications

- For stabilization of the secondary-side output voltage of switching power supplies
- Electronic equipment

■Electrical Characteristics

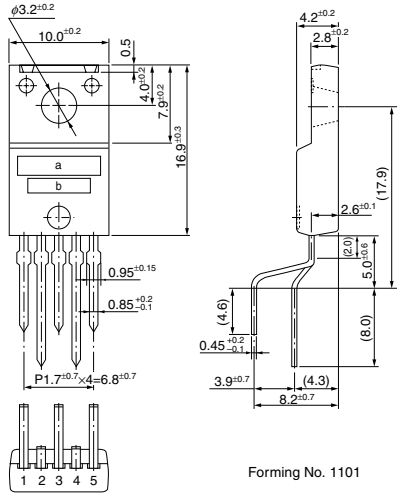
(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings												Unit
			SI-3050J			SI-3090J			SI-3120J			SI-3150J			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	6*2		15*1	10*2		25*1	13*2		27*1	16*2		27*1	V
Output Voltage		V_O	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	14.70	15.00	15.30	V
	Conditions		V_{IN}=8V, I_O=1.0A			V_{IN}=12V, I_O=1.0A			V_{IN}=15V, I_O=1.0A			V_{IN}=18V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5			0.5	V
	Conditions		I_O≤1.5A												
					1.0			1.0			1.0			1.0	
	Conditions		I_O≤2.0A												
Line Regulation		ΔV_{OLINE}		10	30		18	48		24	64		30	90	mV
	Conditions		V_{IN}=6 to 15V, I_O=1.0A			V_{IN}=10 to 20V, I_O=1.0A			V_{IN}=13 to 25V, I_O=1.0A			V_{IN}=16 to 25V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		40	100		70	180		93	240		120	300	mV
	Conditions		V_{IN}=8V, I_O=0 to 2.0A			V_{IN}=12V, I_O=0 to 2.0A			V_{IN}=15V, I_O=0 to 2.0A			V_{IN}=18V, I_O=0 to 2.0A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±1.0			±1.5			±1.5		mV/°C
	Conditions		V_{IN}=8V, I_O=5mA, T_j=0 to 100°C			V_{IN}=12V, I_O=5mA, T_j=0 to 100°C			V_{IN}=15V, I_O=5mA, T_j=0 to 100°C			V_{IN}=18V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54			54			54		dB
	Conditions		V_{IN}=8V, f=100 to 120Hz			V_{IN}=12V, f=100 to 120Hz			V_{IN}=15V, f=100 to 120Hz			V_{IN}=18V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		3	10		3	10		3	10	mA
	Conditions		V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=18V, I_O=0A			
		I_q(off)		0.5	1.0		0.5	1.0		0.5	1.0		0.5	1.0	mA
	Conditions		V_{IN}=8V, I_O=0A, V_C=0.4V			V_{IN}=12V, I_O=0A, V_C=0.4V			V_{IN}=15V, I_O=0A, V_C=0.4V			V_{IN}=18V, I_O=0A, V_C=0.4V			
Overcurrent Protection Starting Current*3,5		I_{S1}	2.1			2.1			2.1			2.1			A
	Conditions		V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			
V_C Terminal*4	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20			20			20	μA
	Conditions		V_C=2.7V												
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3			–0.3	mA
	Conditions		V_C=0.4V												

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O=20(W)$.
*2: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)
*3: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN}=V_O+3V$, I_O=1A.
*4: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, it can be driven directly by LS-TTLs.
*5: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■External Dimensions (TO220F-5)

(unit : mm)



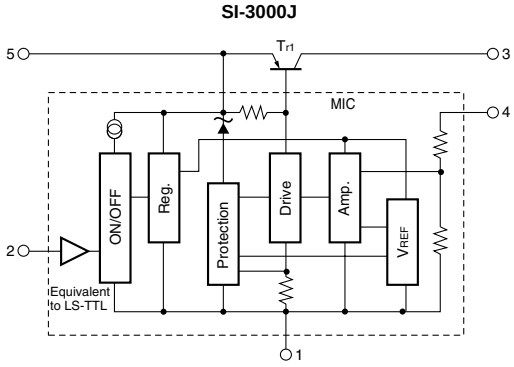
Forming No. 1101

a. Part Number
b. Lot Number

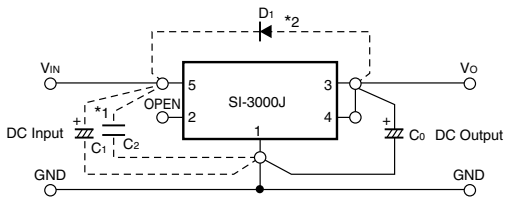
Pin Assignment
① GND
② V_C
③ V_O
④ Sense
⑤ V_{IN}

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram

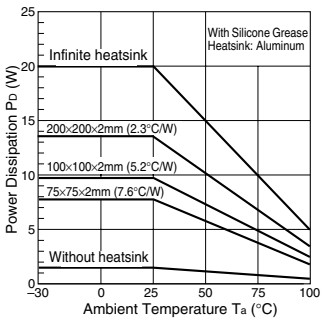


■Typical Connection Diagram



C_0 : Output capacitor (47 to 100μF)
*1 C_1, C_2 : Oscillation prevention capacitor (Approx. C_1: 47μF, C_2: 0.33μF)
These capacitors are required if the input line contains inductance or the wiring is long. Especially at low temperatures, tantalum capacitors are recommended for C_1 and C_0.
*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

■T_a-P_D Characteristics



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

SI-3000ZFE Series 5-Terminal, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 3.0A
- Low dropout voltage: $V_{DIF} \leq 0.7V$ (at $I_O = 3.0A$)
- Low circuit current at output OFF: Iq (OFF) ≤ 1μA
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

($T_a = 25°C$)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}*1	10	V
Output Control Terminal Voltage	V_C	6	V
DC Output Current	I_O*1	3.0	A
Power Dissipation	P_{D1}	20 (With infinite heatsink)	W
	P_{D2}	1.5 (Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{op}	–30 to +100	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	5.0	°C/W
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	66.7 (Without heatsink, stand-alone operation)	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Input Voltage	V_{IN}	*2 to 6*1	V
Output Current	I_O	0 to 3	A
Operating Ambient Temperature	$T_{op\,(a)}$	–20 to +85	°C
Operating Junction Temperature	$T_{op\,(j)}$	–20 to +100	°C
Output Voltage Variable Range	V_{OADJ}	1.2 to 5	V

*1: V_{IN} (max) and I_O (max) are restricted by the relationship $P_D = (V_{IN} - V_O) \times I_O$.
*2: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.

■Electrical Characteristics

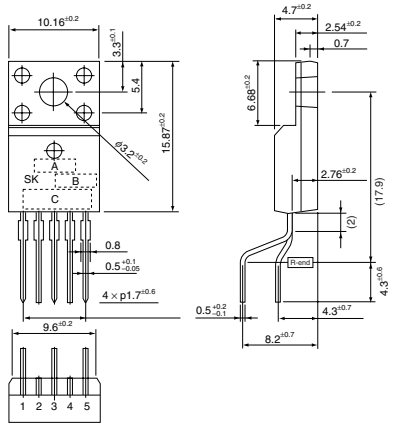
($T_a = 25°C$, $V_C = 2V$ unless otherwise specified)

Parameter		Symbol	SI-3011ZFE min.	SI-3011ZFE typ.	SI-3011ZFE max.	Unit
Reference Voltage		V_{ADJ}	1.078	1.100	1.122	V
		Conditions	$V_{IN}=V_O+1V$, $I_O=10mA$			
Line Regulation		ΔV_{OLINE}			10	mV
		Conditions	$V_{IN}=3.3$ to 5V, $I_O=10mA$ ($V_O=2.5V$)			
Load Regulation		ΔV_{OLOAD}			40	mV
		Conditions	$V_{IN}=3.3V$, $I_O=0$ to 3A ($V_O=2.5V$)			
Dropout Voltage		V_{DIF}			0.7	V
		Conditions	$I_O=3A$ ($V_O=2.5V$)			
Quiescent Circuit Current		I_q		1	1.5	mA
		Conditions	$V_{IN}=V_O+1V$, $I_O=0A$, $V_C=2V$			
Circuit Current at Output OFF		I_q (OFF)			1	μA
		Conditions	$V_{IN}=V_O+1V$, $V_C=0V$			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3		mV/°C
		Conditions	$T_j=0$ to 100°C			
Ripple Rejection		R_{REJ}		60		dB
		Conditions	$V_{IN}=V_O+1V$, f=100 to 120Hz, $I_O=0.1A$			
Overcurrent Protection Starting Current*2 *4		I_{S1}	3.2			A
		Conditions	$V_{IN}=V_O+1V$			
V_C Terminal	Control Voltage (Output ON)*3	V_C, IH	2			V
	Control Voltage (Output OFF)*3	V_C, IL			0.8	
	Control Current(Output ON)	I_C, IH			100	μA
		Conditions	$V_C=2.7V$			
	Control Current(Output OFF)	I_C, IL	–5	0		μA
		Conditions	$V_C=0V$			

*1: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.
*2: I_{S1} is specified at the 5% drop point of output voltage V_O under the Output Voltage parameter conditions.
*3: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*4: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

■External Dimensions (TO220F-5)

(unit : mm)



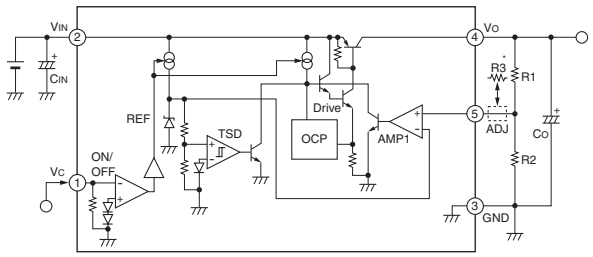
a. Part Number
b. Lot number
c. Administer number

Pin Assignment
① V_C
② V_{IN}
③ GND
④ V_O
⑤ ADJ

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Typical Connection Diagram/Block Diagram

SI-3011ZFE



C_{IN}: Input capacitor (Approx. 10μF)
This capacitor is required when the input line contains inductance or when the wiring is long.

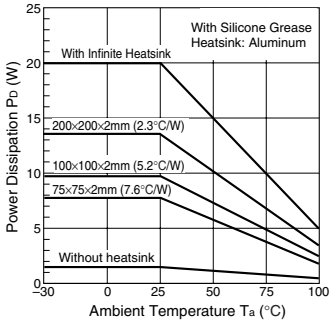
C_O: Output capacitor (47μF or higher)
The output voltage may oscillate if a low ESR type capacitor (such as a ceramic capacitor) is used for the output capacitor in SI-3000ZF.

R1, R2: Output voltage setting resistors
The output voltage can be set by connecting R1 and R2 as shown at left.
The recommended value for R2 is 10kΩ or 11kΩ.

$$R1 = (V_O - V_{ADJ}) / (V_{ADJ}/R2)$$

*: Insert R3 in case of setting V_O to $V_O \leq 1.8V$. The recommended value for R3 is 10kΩ.

■T_a-P_D Characteristics



Application Note

■ Heat Dissipation and Reliability

The reliability of an IC is highly dependent on its operating temperature. Please be sure to apply silicone grease to the IC and to mount it to the heatsink with a proper mounting torque.
Heatsink design should pay particular attention to ensuring sufficient heat dissipation capacity.
In addition, please take into account the air convection in operation.
The reliability of discrete components such as capacitors and coils is closely related to temperature. A high operating temperature may reduce the service life. Exceeding the allowable temperature may burn the coils or damage capacitors. It is important to make sure that the temperature of output smoothing coils and input/output capacitors do not exceed their allowable levels during operation. With an adequate derating for the coils, minimize heat emission as far as possible. (For discrete components, refer to the individual user manuals.)

■ Internal Power Dissipation

P_D can be obtained from the following formula.

- For the device with built-in flywheel diode:
  (SI-8000L series)

$$P_D = V_O \bullet I_O \left(\frac{100}{\eta\chi} - 1\right)$$

- For the device with external flywheel diode:
  (SAI series, SI-8000E series,SI-8000S series, SI-8000SD series, SI-8000JD series, SI-8000JF series)

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

Efficiency $\eta\chi$ depends on the input/output conditions. Please refer to the efficiency characteristics of the devices. (Posted on the Web site.)

V_O : Output voltage
V_{IN}: Input voltage
I_O : Output current
$\eta\chi$: Efficiency(%)
V_F : Diode forward voltage

■ Thermal Design

The maximum junction temperature $T_{j(max)}$ given in the Absolute Maximum Ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the maximum power dissipation $P_{D(max)}$, which varies by the conditions of use, and the maximum ambient temperature $T_{a(max)}$.
To simplify thermal design, T_a-P_D characteristic graphs are provided herein. Please observe the following steps for heatsink design:
1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

Although the heatsink size is now obtained, in actual applications, 10-to-20% derating factor is generally introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink and case temperature in the actual operating environment.
Please refer to the T_a-P_D characteristic graphs for respective product types.

■ Mounting Torque

SI-8000E
SI-8000JF
SI-8000S
SI-8000TFE
SI-8000HFE

0.588 to 0.686[N•m] (6.0 to 7.0[kgf•cm])

■ Recommended Silicone Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- GE Toshiba Silicones Co., Ltd.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

■ Others

- Devices can not be operated in parallel connection aiming for a larger current.
- Not applicable for the current boost or voltage step-up use.

■ Rectifier Diodes for Power Supplies

To rectify the AC input using rectifier diodes in power supplies, please use SANKEN rectifier diodes shown in the following list. (Please use a center-tap or bridge configuration in using stand-alone type diodes.)

Series Name	Diodes
SAI Series	SJPM-F2 (Surface-Mount Stand-Alone Type, V_{RM}=200V,Io=1.0A)
SI-8000E Series	AM01Z (Axial Type,V_{RM}=200V,Io=1.0A)
SI-8000GL Series	RM10Z (Axial Type,V_{RM}=200V,Io=1.5A)
SI-8000JD Series	
SI-8000JF Series	
SI-8000TM Series	
SI-8000TFE Series	
SI-8000S Series	RM4Z (Axial Type,V_{RM}=200V,Io=3.0A) or RBV-402 (Bridge Type, V_{RM}=200V,Io=4.0A)
SI-8000SD Series	
SI-8000W Series	AM01Z (Axial Type,V_{RM}=200V,Io=1.0A)
SI-8011NVS Series	RM4Z (Axial Type,V_{RM}=200V,Io=3.0A) or RBV-402 (Bridge Type, V_{RM}=200V,Io=4.0A)
SI-8400L Series	AM01Z (Axial Type,V_{RM}=200V,Io=1.0A)
SI-8500L Series	RM10Z (Axial Type,V_{RM}=200V,Io=1.5A)
SI-8511NVS Series	
SPI-8000A Series	RM4Z (Axial Type,V_{RM}=200V,Io=3.0A) or RBV-402 (Bridge Type, V_{RM}=200V,Io=4.0A)
STA810M Series	RM10Z (Axial Type,V_{RM}=200V,Io=1.5A)
STA820M Series	RM4Z (Axial Type,V_{RM}=200V,Io=3.0A) or RBV-402 (Bridge Type, V_{RM}=200V,Io=4.0A)
SI-8000HFE Series	RBV-1506 (Bridge Type, V_{RM}=600V,Io=15A)

SAI Series Surface-Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Surface-mount power package
- Output current: 0.4 to 0.5A
- High efficiency: 75 to 89%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Line up

Part Number	SAI01	SAI02	SAI03	SAI06
V_O(V)	5.0	3.3	12.0	9.0
I_O(A)	0.5		0.4	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Power Dissipation	P_D	0.75	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance(junction to case)	$\theta_{j\text{-}c}$	20	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit
		SAI01	SAI02	SAI03	SAI06	
DC Input Voltage Range	V_{IN}	7 to 33	5.3 to 28	15 to 33	12 to 33	V
Output Current Range	I_O	0 to 0.5		0 to 0.4		A
Operating Junction Temperature Range	T_{jop}	–30 to +125				°C

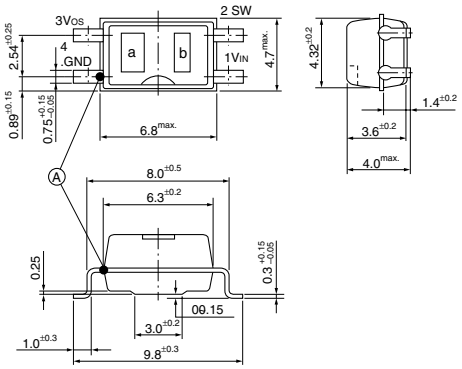
■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings												Unit
		SAI01			SAI02			SAI03			SAI06			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	3.17	3.30	3.43	11.40	12.00	12.60	8.55	9.00	9.45	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Efficiency	η		80			75			88			86		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Oscillation Frequency	f		60			60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		60	80		100	130		90	110	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=8 to 28V, I_O=0.3A			V_{IN}=18 to 30V, I_O=0.3A			V_{IN}=15 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		20	30		70	95		50	80	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=15V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			V_{IN}=21V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.5			±1.0		mV/°C
Ripple Rejection	R_{REJ}		45			45			45			45		dB
	Conditions	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current	I_{S1}	0.55			0.55			0.45			0.45			A
	Conditions	V_{IN}=10V			V_{IN}=8V			V_{IN}=18V			V_{IN}=15V			

■External Dimensions (PS4)

(unit : mm)

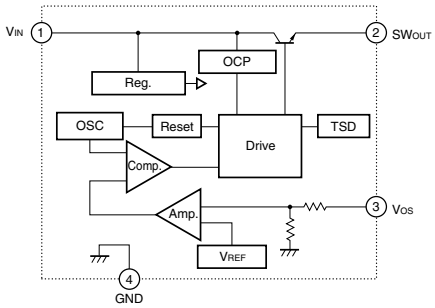


a. Part Number
b. Lot Number
Ⓐ Case Temperature Measuring Point

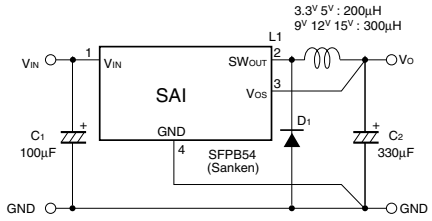
Pin Assignment
① V_{IN}
② SW_{OUT}
③ V_{OS}
④ GND

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.22g

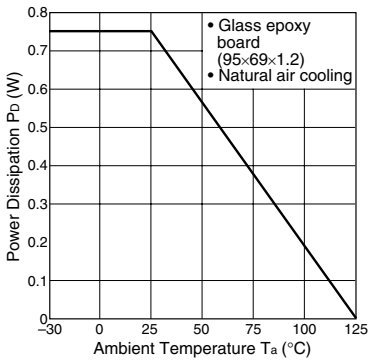
■Block Diagram



■Typical Connection Diagram



■Ta-PD Characteristics



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

The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

V_O : Output voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode D_1 forward voltage
SFPB54-0.3V

Thermal design for D_1 must be considered separately.

SI-8000W Series Surface-Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Surface-mount package (SOP8)
- Output current: 0.6A
- High efficiency: 75 to 80%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Power Dissipation	P_D	1	W
Junction Temperature	T_j	–30 to +125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to 7-Pin Lead)	$\theta_{j\text{-}L}$	22	°C/W
Thermal Resistance (Junction to Ambient Air)*1	$\theta_{j\text{-}a}$	100	°C/W

*1: Glass-epoxy board of 40 × 40mm (copper laminate area 4.3%)

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8033W	SI-8050W	
DC Input Voltage Range	V_{IN}	5.3 to 28	7 to 33	V
Output Current Range	I_O	0 to 0.6		A
Operating Junction Temperature Range	T_{jop}	–30 to +125		°C

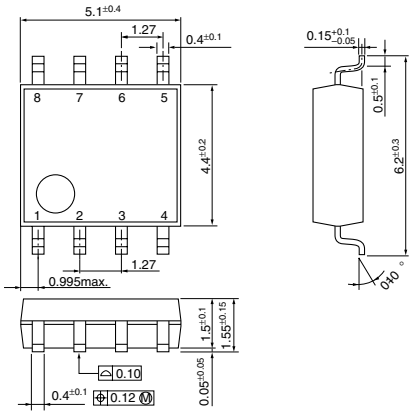
■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings						Unit
		SI-8033W			SI-8050W			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	3.17	3.30	3.43	4.80	5.00	5.20	V
	Conditions	V_{IN}=15V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
Efficiency	η		75			80		%
	Conditions	V_{IN}=15V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
Oscillation Frequency	f		60			60		kHz
	Conditions	V_{IN}=15V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		60	80		80	100	mV
	Conditions	V_{IN}=8 to 28V, I_O=0.3A			V_{IN}=10 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		20	30		30	40	mV
	Conditions	V_{IN}=15V, I_O=0.1 to 0.4A			V_{IN}=20V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±0.5		mV/°C
Ripple Rejection	R_{REJ}		45			45		dB
	Conditions	f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current	I_{S1}	0.61			0.61			A
	Conditions	V_{IN}=15V			V_{IN}=20V			

■External Dimensions (SOP8)

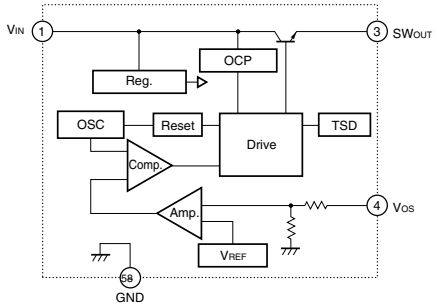
(Unit : mm)



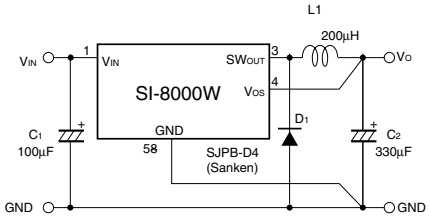
Pin Assignment
① V_{IN}
② N.C
③ SW_{OUT}
④ V_{OS}
⑤ GND
⑥ GND
⑦ GND
⑧ GND

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.1g

■Block Diagram

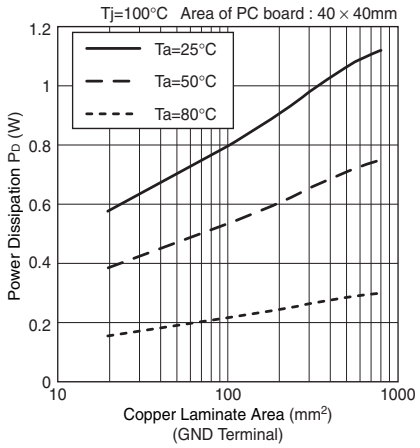


■Typical Connection Diagram

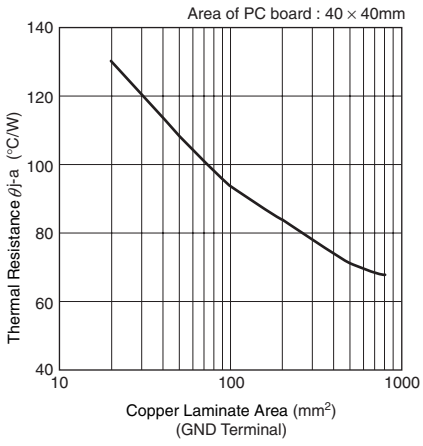


■Reference Data

Copper Laminate Area vs. Power Dissipation



Copper Laminate Area vs. Thermal Resistance $\theta_{j\text{-}a}$



SI-8000JD Series Surface-Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Surface-mount package (TO263-5)
- Output current: 1.5A
- High efficiency: 77 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Capable of downsizing a choke-coil due to IC's high switching frequency (125 kHz). (Compared with conventional Sanken devices)
- Built-in foldback-overcurrent and thermal protection circuits
- Output ON/OFF available (Circuit current at output OFF: 200μA max)
- Soft start available by ON/OFF pin Conditions

■Lineup

Part Number	SI-8033JD	SI-8050JD	SI-8090JD	SI-8120JD
V_O(V)	3.3	5.0	9.0	12.0
I_O(A)	1.5			

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Output Current	I_O	1.5	A	
Power Dissipation*	P_D	3	W	When mounted on glass-epoxy board 40 × 40 mm (copper area 100%)
Junction Temperature	T_j	+125	°C	
Storage Temperature	T_{stg}	–40 to +125	°C	
Thermal Resistance (Junction to Case)	θ_{j-c}	3	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	33.3	°C/W	When mounted on glass-epoxy board 40 × 40 mm (copper area 100%)

*: Limited by thermal protection circuit

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies, etc.

■Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit	Conditions
		SI-8033JD	SI-8050JD	SI-8090JD	SI-8120JD		
DC Input Voltage Range	V_{IN1}	5.3 to 40	7 to 40	11 to 40	14 to 40	V	I_O=0 to 1A
	V_{IN2}	6.3 to 40	8 to 40	12 to 40	15 to 40		I_O=0 to 1.5A
DC Output Current Range*	I_O	0 to 1.5				A	V_{IN}≥V_O+3V
Operating Junction Temperature Range	T_{jop}	–30 to +125				°C	
Operating Temperature Range*	T_{op}	–30 to +125				°C	

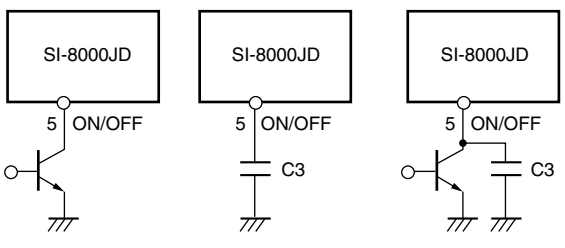
*: Limited by Ta–P_D characteristics

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	SI-8033JD			SI-8050JD			SI-8090JD			SI-8120JD			Unit
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage		V_O	3.234	3.30	3.366	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
		Conditions	V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Efficiency		η		77			82			86			88		%
		Conditions	V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Oscillation Frequency		f		125			125			125			125		kHz
		Conditions	V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Line Regulation		ΔV_{OLINE}		25	80		40	100		50	120		60	130	mV
		Conditions	V_{IN}=8 to 30V, I_O=0.5A			V_{IN}=10 to 30V, I_O=0.5A			V_{IN}=15 to 30V, I_O=0.5A			V_{IN}=18 to 30V, I_O=0.5A			
Load Regulation		ΔV_{OLOAD}		10	30		10	40		10	40		10	40	mV
		Conditions	V_{IN}=15V, I_O=0.2 to 0.8A			V_{IN}=20V, I_O=0.2 to 0.8A			V_{IN}=21V, I_O=0.2 to 0.8A			V_{IN}=24V, I_O=0.2 to 0.8A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.0		mV/°C
Overcurrent Protection Starting Current		I_{S1}	1.6			1.6			1.6			1.6			A
		Conditions	V_{IN}=15V			V_{IN}=20V			V_{IN}=21V			V_{IN}=24V			
ON/OFF* Pin	Low Level Voltage	V_{SSL}			0.5			0.5			0.5			0.5	V
	Outflow Current at Low Voltage	I_{SSL}			100			100			100			100	μA
		Conditions	V_{SSL}=0V												
Quiescent Circuit Current		I_q		7			7			7			7		mA
		Conditions	V_{IN}=15V, Io=0A			V_{IN}=20V, Io=0A			V_{IN}=21V, Io=0A			V_{IN}=24V, Io=0A			
		$I_{q(OFF)}$			200			200			200			200	μA
		Conditions	V_{IN}=15V, $V_{ON/OFF}$=0.3V			V_{IN}=20V, $V_{ON/OFF}$=0.3V			V_{IN}=21V, $V_{ON/OFF}$=0.3V			V_{IN}=24V, $V_{ON/OFF}$=0.3V			

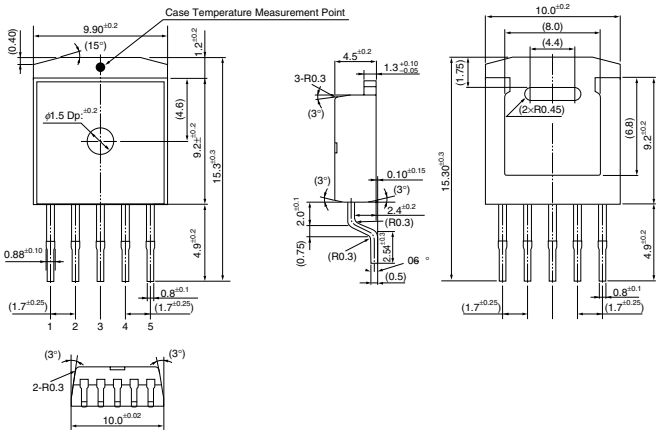
*: Pin 5 is the ON/OFF pin. Soft start at power on can be performed with a capacitor connected to this pin.
The output can also be turned ON/OFF with this pin.
The output is stopped by setting the voltage of this pin to V_{SSL} or lower.
ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor.
When using both the soft-start and ON/OFF functions together, the discharge current from C_3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large.
The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.



$V_{OUT.}$ ON/OFF　Soft Start　Soft Start +$V_{OUT.}$ ON/OFF

■External Dimensions (TO263-5)

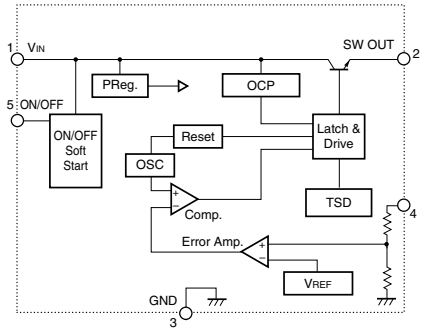
(Unit : mm)



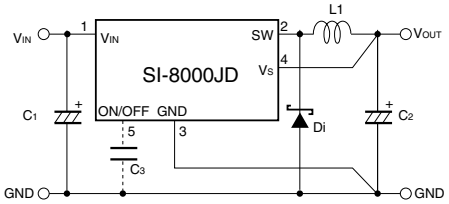
Pin Assignment
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ ON/OFF

Plastic Mold Package Type
Flammability: 94V-0
Product Mass: Approx. 1.48g

■Block Diagram



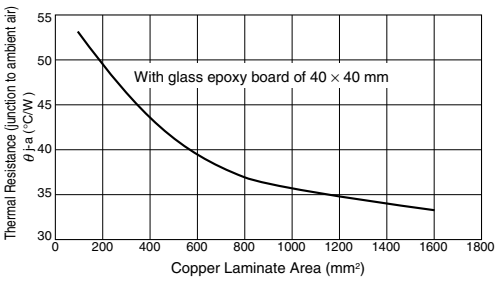
■Typical Connection Diagram



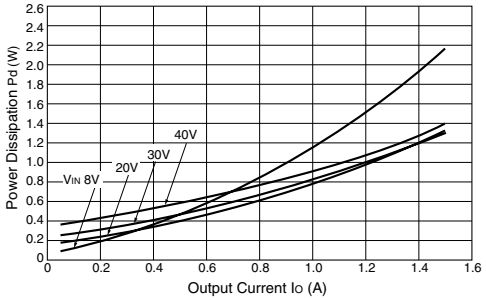
C_1 : 50V/220μF
C_2 : 25V/470μF
C_3 : 10V/0.47μF (Only when using soft-start function)
L_1 : 100μH
Di : SJPB-H6 (Sanken)

■Reference Data

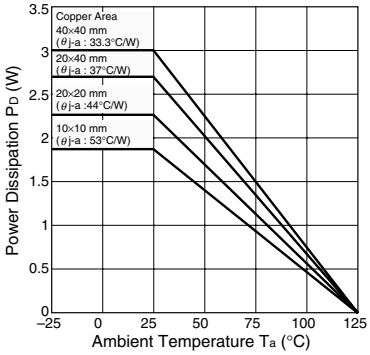
Copper Laminate Area on Glass Epoxy Board vs. Thermal Resistance (Junction to Ambient Air) (Typical Value)



Output Current vs. Power Dissipation (Typical)



■T_a-P_D Characteristics



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

The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

V_O : Output Voltage
V_{IN} : Input Voltage
I_O : Output Current
$\eta\chi$: Efficiency (%)
V_F : D_1 forward voltage
0.4V(I_O=2A)(SJPB-H6)

Thermal design for D_1 must be considered separately.

SI-8000TM Series Surface-Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact surface-mount package (TO252-5)
- Output current: 1.5 A
- High efficiency: 81% typ. (at Vo = 5 V)
- Requires only 4 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in drooping-type-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: 200 μA max)
- Soft start available by ON/OFF pin

■Applications

- Onboard local power supplies
- AV equipment
- OA equipment

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Power Dissipation	P_{D1}	1.06	W	When mounted on glass-epoxy board (900 mm^2 copper area 4.3%)
	P_{D2}	1.65		When mounted on glass-epoxy board (900 mm^2 copper area 50%)
Junction Temperature*	T_j	–30 to +150	°C	
Storage Temperature	T_{stg}	–40 to +150	°C	
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	6	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	95	°C/W	When mounted on glass-epoxy board (900 mm^2 copper area 4.3%)

*: This product has built-in thermal protection circuits that may operate when the junction temperature rises above 130°C.
The recommended design for the junction temperature during operation is below 125°C.

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
		SI-8008TM	
Input Voltage Range	V_{IN}	V_O+3*1 to 40	V
Output Voltage	V_O	0.8 to 24	V
Output Current Range	I_O	0 to 1.5	A
Operating Junction Temperature Range	T_{jop}	–20 to +125	°C
Operating Temperature Range	T_{op}	–20 to +125	°C

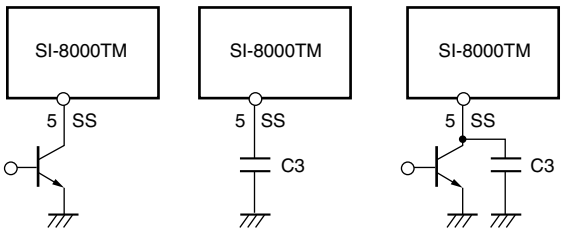
*1: The minimum value of an input voltage range is the higher of 4.5 V or V_O + 3 V.

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	Rating SI-8008TM min.	typ.	max.	Unit
Reference Voltage		V_{ADJ}	0.784	0.800	0.816	V
		Conditions	V_{IN}=15V, I_O=0.1A			
Temperature Coefficient of Reference Voltage		$\Delta V_{ADJ}/\Delta T$		±0.1		mV/°C
		Conditions	V_{IN}=15V, I_O=0.1A, T_C=0 to 100°C			
Efficiency		η		81		%
		Conditions	V_{IN}=15V, I_O=0.5A			
Oscillation Frequency		fo		300		kHz
		Conditions	V_{IN}=15V, I_O=0.5A			
Line Regulation		ΔV_{OLINE}		60	80	mV
		Conditions	V_{IN}=10 to 30V, I_O=0.5A			
Load Regulation		ΔV_{OLOAD}		10	40	mV
		Conditions	V_{IN}=15V, I_O=0.2 to 1.5A			
Overcurrent Protection Starting Current		I_S	1.6			A
		Conditions	V_{IN}=15V			
ON/OFF Pin*	Low Level Voltage	V_{SSL}			0.5	V
	Outflow Current at Low Voltage	I_{SSL}		10	40	μA
		Conditions	V_{SSL}=0V			
Quiescent Circuit Current		I_q		6		mA
		Conditions	V_{IN}=15V, I_O=0A			
		$I_{q\ (OFF)}$		200	400	μA
		Conditions	V_{IN}=15V, V_{SS}=0V			

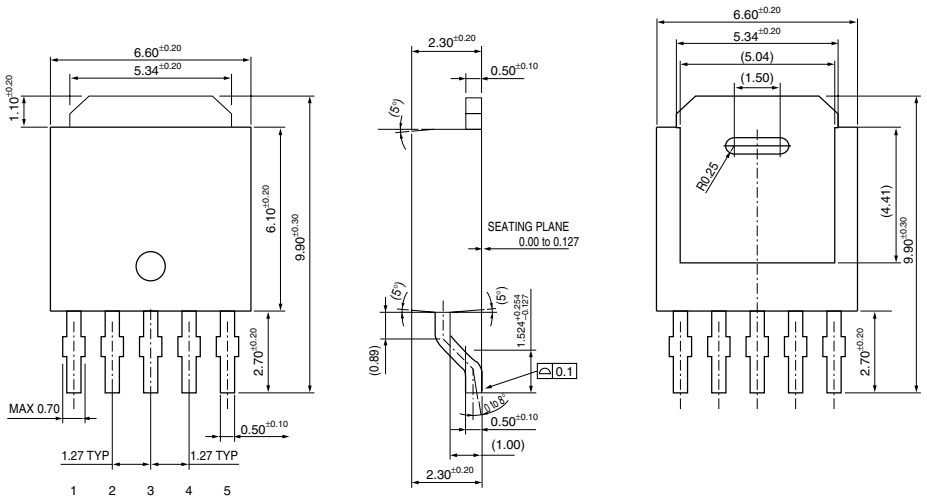
*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin.
The output is stopped by setting the voltage of this pin to VSSL or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.



Vo. ON/OFF | Soft start | Soft start +Vo. ON/OFF

■External Dimensions (TO252-5)

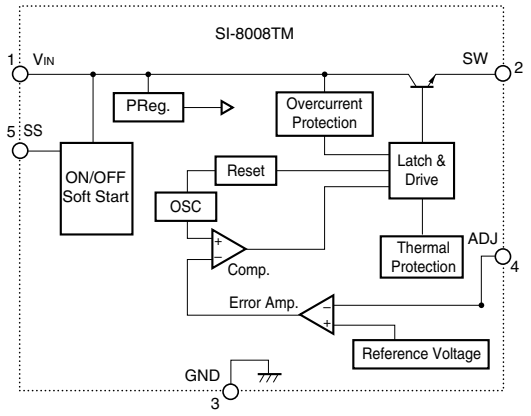
(Unit : mm)



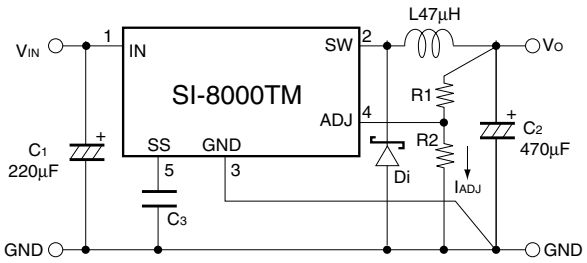
Pin Assignment
① V_{IN}
② SW
③ GND
④ ADJ
⑤ SS

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.33 g

■Block Diagram



■Typical Connection Diagram



C_1 : 220µF
C_2 : 470µF
C_3 : 1µF (Only when using soft-start function)
L_1 : 47µF
Di : SJPB-H6 (Sanken)

SI-8000SD Series Surface Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Surface-mount package (TO263-5)
- Output current: 3.0A
- High efficiency: 79% typ. (SI-8033SD), 84% typ. (SI-8050SD)
- Requires only 4 discrete external components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits
- Output ON/OFF available
- Soft start available by S.S pin

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8033SD	SI-8050SD
V_O (V)	3.3	5.0
I_O (A)	3	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43*1	V	
Power Dissipation*2	P_D	3	W	When mounted on glass-epoxy board 40 × 40 mm (copper area: 100%)
Junction Temperature	T_j	+125	°C	
Storage Temperature	T_{stg}	–40 to +125	°C	
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	3	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	33.3	°C/W	When mounted on glass-epoxy board 40 × 40 mm (copper area: 100%)

*1: 35V for SI-8033SD
*2: Limited by thermal protection circuit.

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8033SD	SI-8050SD	
DC Input Voltage Range	V_{IN1}	5.5 to 28	7 to 40	V
Output Current Range*	I_O	0 to 3.0		A
Operating Junction Temperature Range	T_{jop}	–30 to +125		°C
Operating Temperature Range*	T_{op}	–30 to +125		°C

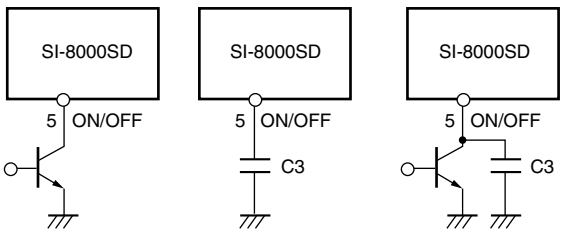
*: Limited by Ta-P_D characteristics.

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	Ratings						Unit
			SI-8033SD			SI-8050SD			
			min.	typ.	max.	min.	typ.	max.	
Output Voltage		V_O	3.17	3.3	3.43	4.8	5.0	5.2	V
		Conditions	V_{IN}=15V, I_O=1A			V_{IN}=20V, I_O=1A			
Efficiency		η		79			84		%
		Conditions	V_{IN}=15V, I_O=1A			V_{IN}=20V, I_O=1A			
Oscillation Frequency		f		60			60		kHz
		Conditions	V_{IN}=15V, I_O=1A			V_{IN}=20V, I_O=1A			
Line Regulation		ΔV_{OLINE}		25	80		40	100	mV
		Conditions	V_{IN}=8 to 28V, I_O=1A			V_{IN}=10 to 30V, I_O=1A			
Load Regulation		ΔV_{OLOAD}		10	30		10	40	mV
		Conditions	V_{IN}=15V, I_O=0.5 to 1.5A			V_{IN}=20V, I_O=0.5 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5		mV/°C
Overcurrent Protection Starting Current		I_{S1}	3.1			3.1			A
		Conditions	V_{IN}=15V			V_{IN}=20V			
Soft Start Pin*	Low-Level Voltage	V_{SSL}		0.2			0.2		V
	Outflow Current at Low Voltage	I_{SSL}	20	30	40	20	30	40	μA
		Conditions	V_{SSL}=0.2V						

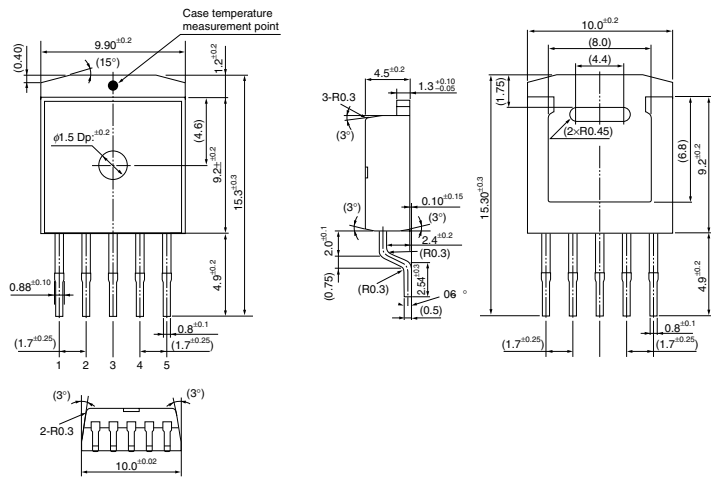
* Pin 5 is a soft start pin. Soft start at power on can be performed with a capacitor connected to this pin.
The output can also be turned ON/OFF with this pin.
The output is stopped by setting the voltage of this pin to V_{SSL} or lower.
Soft-start pin voltage can be changed with an open-collector drive circuit of a transistor.
When using both the soft-start and ON/OFF functions together, the discharge current from C_3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large.
The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.
If this pin is not used, leave it open.



$V_{OUT.}$ ON/OFF | Soft start | Soft start +$V_{OUT.}$ ON/OFF

■External Dimensions (TO263-5)

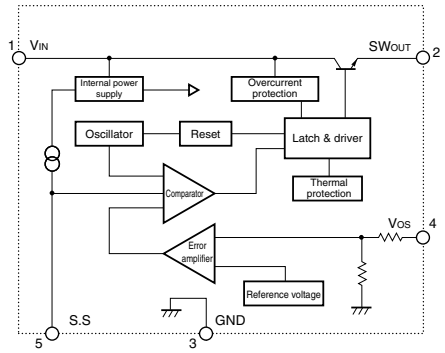
(Unit : mm)



Pin Assignment
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ S.S

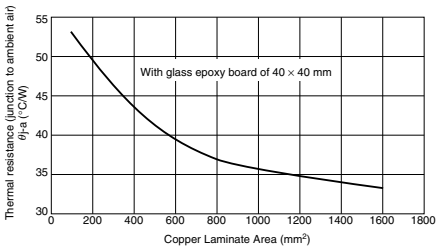
Plastic Mold Package Type
Flammability: 94V-0
Product Mass: Approx. 1.48g

■Block Diagram

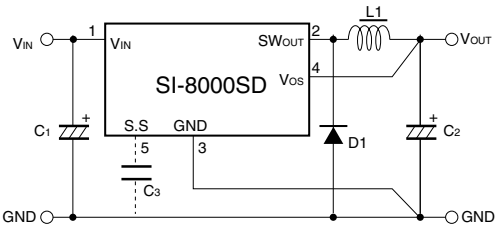


■Reference Data

Copper Laminate Area on Glass Epoxy Board vs. thermal resistance (junction to ambient air) (Typical Value)



■Typical Connection Diagram



C_1 : 50V/1000μF
C_2 : 50V/1000μF
C_3 : 0.01μF
(only when soft start function is used)
L_1 : 150μH
D_1 : SPB-G56 (Sanken)

Diode D_1

- Be sure to use Schottky-barrier diode as D_1.
  If other diodes like fast recovery diodes are used, ICs may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 3.5 A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.

Capacitors C_1, C_2, and C_3

- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures.
  For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as an OS capacitor or a tantalum capacitor, which may cause an abnormal oscillation.
- C_3 is a capacitor for soft start. Leave pin 5 open if the soft start function is not used.
  This pin is pulled up with a pull-up resistor inside the ICs.

◎To create the optimum operating conditions, place the components as close as possible to each other.

SPI-8000A Series Surface Mount, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Surface-mount 16 pin package
- Output current: 3.0A
- High efficiency: 91% (at V_{IN} = 10V, I_O = 1A, V_O = 5V)
- Capable of downsizing a choke-coil due to IC's high switching frequency (125kHz). (Compared with conventional Sanken devices)
- The output-voltage-variable type can vary its output voltage from 1V to 14V because of its low reference voltage (Vref) of 1V.
- Wide Input Voltage Range (8 to 50V)
- Output ON/OFF available
- Built-in overcurrent and thermal protection circuits

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	53	V
Power Dissipation	P_D*1, *2	2.4	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$*2	18	°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$*2	50	°C/W

*1: Limited due to thermal protection.
*2: When mounted on glass-epoxy board 700cm^2 (copper laminate area 30.8cm^2).

■Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings
		SPI-8010A
DC Input Voltage Range	V_{IN}	(V_O+3)*1 to 50
Output Voltage Range	V_O	1 to 14
Output Current Range	I_O	0.02 to 3.0
Operating Junction Temperature Range	T_{jop}	–30 to +125
Operating Temperature Range	T_{op}	–30 to +125

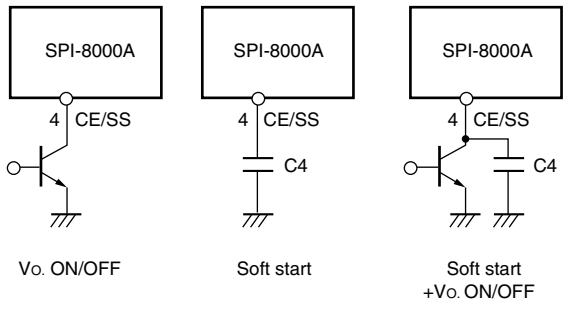
*1: The minimum value of an input voltage range is the higher of either 8V or V_O+3V.

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	Rating SPI-8010A (Variable type) min.	typ.	max.	Unit
Reference Voltage		V_{ADJ}	0.97	1.00	1.03	V
		Conditions		V_{IN}=12V, I_O=1A		
Efficiency		Eff		86		%
		Conditions		V_{IN}=20V, I_O=1A, V_O=5V		
Oscillation Frequency		F_{OSC}		250		kHz
		Conditions		V_{IN}=12V, I_O=1A		
Line Regulation		ΔV_{OLINE}		20	40	mV
		Conditions		V_{IN}=10 to 30V, I_O=1A		
Load Regulation		ΔV_{OLOAD}		10	30	mV
		Conditions		V_{IN}=12V, I_O=0.1 to 1.5A		
Temperature Coefficient of Reference Voltage		$\Delta V_{ADJ}/\Delta T_a$		±0.5		mV/°C
Overcurrent Protection Starting Current		I_S	3.1			A
		Conditions		V_{IN}=12V		
Quiescent Circuit Current		I_q		7		mA
		Conditions		V_{IN}=12V, I_O=0A		
Circuit Current at Output OFF		$I_{q(off)}$			400	μA
		Conditions		V_{IN}=12V, $V_{ON/OFF}$=0.3V		
CE/SS Terminal	Low Level Voltage	V_{SSL}			0.5	V
	Outflow Current at Low Voltage	I_{SSL}			50	μA
		Conditions		V_{SSL}=0V		

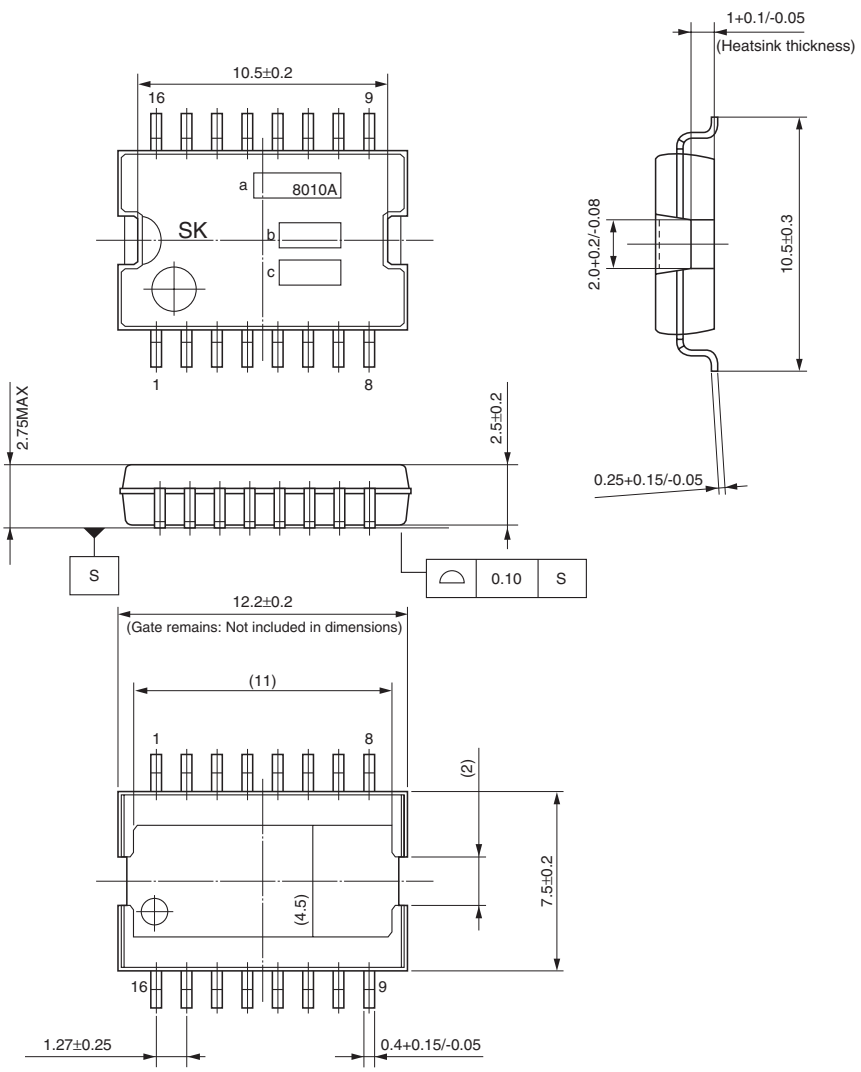
* Pin 4 is the CE/SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. CE/SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C_4 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large.
The CE/SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.



V_O. ON/OFF | Soft start | Soft start +V_O. ON/OFF

■External Dimensions (HSOP16)

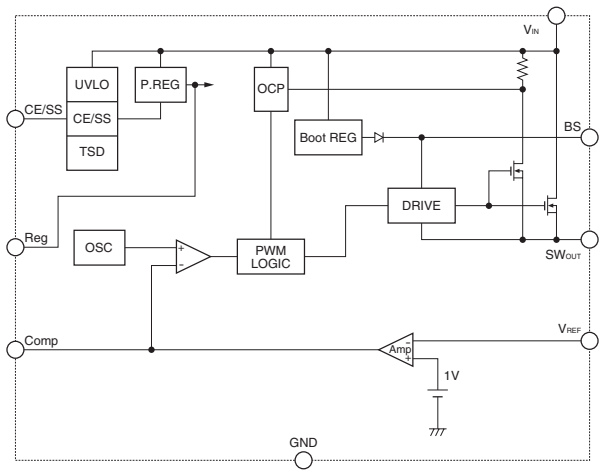
(Unit : mm)



Pin Assignment
1.AGND
2.N.C
3.DGND
4.CE/SS
5.Reg
6.N.C
7.SW_{OUT}
8.N.C
9.N.C
10.N.C
11.V_{IN}
12.B.S
13.N.C
14.C_{omp}
15.V_{REF}
16.N.C

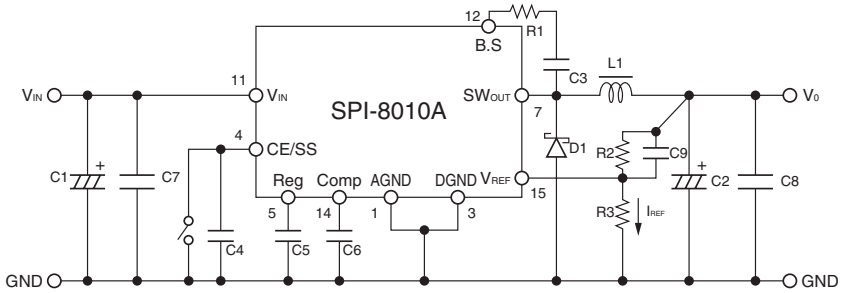
■Block Diagram

SPI-8010A



■Typical Connection Diagram

SPI-8010A



C1: 220μF/63V
C2: 470μF/25V
C3: 0.1μF
C4: 1000pF
C5: 0.1μF
C6: 0.047μF
C7: 0.1μF
C8: 0.1μF
C9: 6800pF
R1: 47Ω
L1: 47μH
D1: SPB-G56S
(Sanken)

Diode D_1

- Be sure to use a Schottky-barrier diode for D_1. If other diodes like fast recovery diodes are used, ICs may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 4.5A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.

Capacitors C_1, C_2

- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures. For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as an OS capacitor or a tantalum capacitor, which may cause an abnormal oscillation.

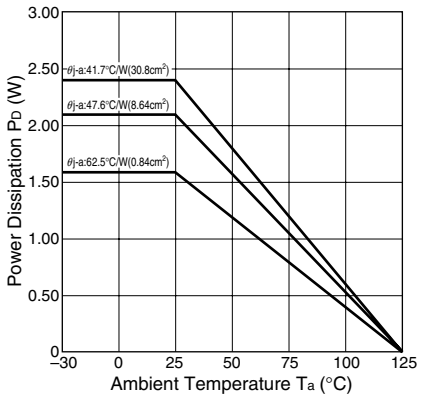
Resistors R_2, R_3

- R_2 and R_3 are the resistors to set the output voltage. Set their values so that I_{REF} becomes approx. 2mA. Obtain R_2 and R_3 values by the following formula:

$$R2=\frac{(V_{OUT}-V_{REF})}{I_{REF}}=\frac{(V_{OUT}-1)}{2\times10^{-3}}(\Omega),\ R3=\frac{V_{REF}}{I_{REF}}=\frac{1}{2\times10^{-3}}\fallingdotseq500(\Omega)$$

◎To create the optimum operating conditions, place the components as close as possible to each other.

■T_a-P_D Characteristics



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

Note 1: The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

Note 2: Thermal design for D_1 must be considered separately.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode D_1 forward voltage
SPB-G56S···0.4V(I_O=2A)

SI-8000E Series Full-Mold, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- High efficiency: 80 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8050E	SI-8120E
V_O(V)	5.0	12.0
I_O(A)	0.6	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Power Dissipation	P_{D1}	14(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance(junction to case)	$\theta_{j\text{-}c}$	7.0	°C/W
Thermal Resistance(junction to ambient air)	$\theta_{j\text{-}a}$	66.7	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8050E	SI-8120E	
DC Input Voltage Range	V_{IN}	7 to 40	14 to 40	V
Output Current Range	I_O	0 to 0.6		A
Operating Junction Temperature Range	T_{jop}	–30 to +125		°C
Operating Temperature Range	T_{op}	–30 to +125		°C

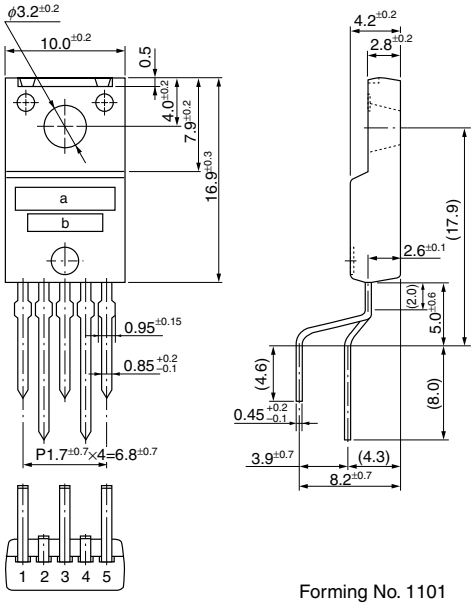
■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings						Unit
		SI-8050E			SI-8120E			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	11.52	12.00	12.48	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Efficiency	η		80			88		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Oscillation Frequency	f		60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		100	130	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=17 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		70	95	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5		mV/°C
Overcurrent Protection Starting Current	I_{S1}	0.61			0.61			A
	Conditions	V_{IN}=10V			V_{IN}=17V			

■External Dimensions (TO220F-5)

(Unit : mm)



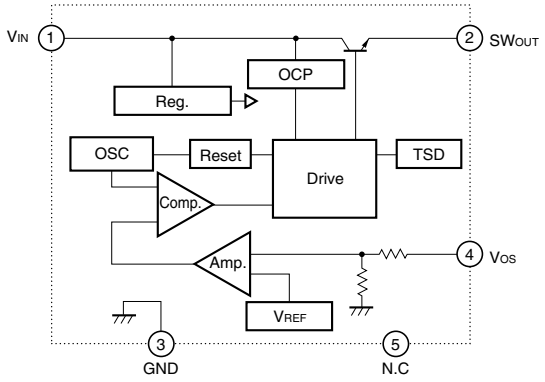
Forming No. 1101

a. Part Number
b. Lot Number

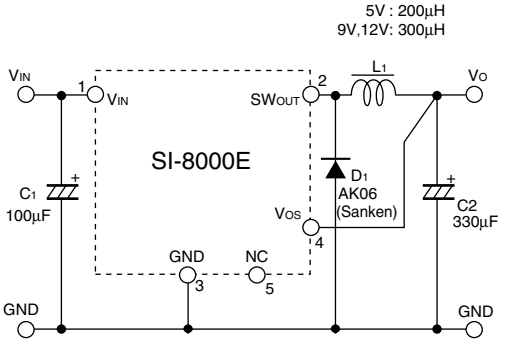
Pin Assignment
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ N.C

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

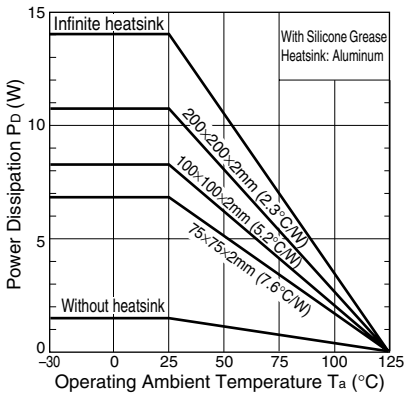
■Block Diagram



■Typical Connection Diagram



■T_a-P_D Characteristics



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

The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
ηx : Efficiency (%)
V_F : Diode D_1 forward voltage
0.4V(AK06)

Thermal design for D_1 must be considered separately.

SI-8000JF Series Full-Mold, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- High efficiency: 67 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Capable of downsize a choke-coil due to IC's high switching frequency (125kHz). (Compared with conventional Sanken devices)
- Built-in foldback-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: 200μA max.)
- Soft start available by ON/OFF pin

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8015JF	SI-8033JF	SI-8050JF	SI-8090JF	SI-8120JF
V_O (V)	1.59*	3.3	5.0	9.0	12.0
I_O (A)	1.5				

* V_{REF}(V) for SI-8015JF

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Power Dissipation	P_{D1}	16.6 (with infinite heatsink)	W
	P_{D2}	1.5 (without heatsink, standalone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	6.0	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings					Unit	Conditions
		SI-8015JF*	SI-8033JF	SI-8050JF	SI-8090JF	SI-8120JF		
DC Input Voltage Range	$V_{IN}1$	V_O+2 to 40	5.3 to 40	7 to 40	11 to 40	14 to 40	V	I_O=0 to 1A
	$V_{IN}2$	V_O+3 to 40	6.3 to 40	8 to 40	12 to 40	15 to 40	V	I_O=0 to 1.5A
Output Current Range	I_O	0 to 1.5					A	V_{IN}≥V_O+3V
Operating Junction Temperature Range	T_{jop}	–30 to +125					°C	

* SI-8015JF is a variable output voltage type. The variable output voltage range is from 2.5 V to 24 V.

■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings															Unit
		SI-8015JF			SI-8033JF			SI-8050JF			SI-8090JF			SI-8120JF			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage*1	V_O*2	1.558	1.59	1.622	3.234	3.30	3.366	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
	Conditions	V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Efficiency	η		67			77			82			86			88		%
	Conditions	V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Oscillation Frequency	f		125			125			125			125			125		kHz
	Conditions	V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=20V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			
Line Regulation	ΔV_{OLINE}		25	80		25	80		40	100		50	120		60	130	mV
	Conditions	V_{IN}=8 to 30V, I_O=0.5A			V_{IN}=8 to 30V, I_O=1.0A			V_{IN}=10 to 30V, I_O=1.0A			V_{IN}=15 to 30V, I_O=1.0A			V_{IN}=18 to 30V, I_O=1.0A			
Load Regulation	ΔV_{OLOAD}		10	30		10	30		10	40		10	40		10	40	mV
	Conditions	V_{IN}=12V, I_O=0.2 to 0.8A			V_{IN}=15V, I_O=0.5 to 1.5A			V_{IN}=20V, I_O=0.5 to 1.5A			V_{IN}=21V, I_O=0.5 to 1.5A			V_{IN}=24V, I_O=0.5 to 1.5A			
Temperature Coefficient of Output Voltage*3	$\Delta V_O/\Delta T_a$*4		±0.5			±1.0			±1.0			±1.0			±1.0		mV/°C
Overcurrent Protection Starting Current	I_{S1}	1.6			1.6			1.6			1.6			1.6			A
	Conditions	V_{IN}=12V			V_{IN}=15V			V_{IN}=20V			V_{IN}=21V			V_{IN}=24V			
ON/OFF*5 Terminal Low Level Voltage	V_{SSL}			0.5			0.5			0.5			0.5			0.5	V
ON/OFF*5 Terminal Outflow Current at Low Voltage	I_{SSL}			100			100			100			100			100	μA
	Conditions	V_{SSL}=0V			V_{SSL}=0V			V_{SSL}=0V			V_{SSL}=0V			V_{SSL}=0V			
Quiescent Circuit Current	I_q		7			7			7			7			7		mA
	Conditions	V_{IN}=12V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=20V, I_O=0A			V_{IN}=21V, I_O=0A			V_{IN}=24V, I_O=0A			
	$I_{q(OFF)}$			200			200			200			200			200	μA
	Conditions	V_{IN}=12V, $V_{ON/OFF}$=0.3V			V_{IN}=15V, $V_{ON/OFF}$=0.3V			V_{IN}=20V, $V_{ON/OFF}$=0.3V			V_{IN}=21V, $V_{ON/OFF}$=0.3V			V_{IN}=24V, $V_{ON/OFF}$=0.3V			

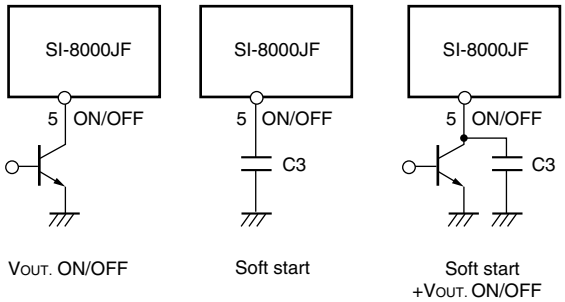
*1: Reference voltage for SI-8015JF

*2: V_{REF} for SI-8015JF

*3: Temperature Coefficient of Reference Voltage for SI-8015JF

*4: $\Delta V_{REF}/\Delta T_a$ for SI-8015JF

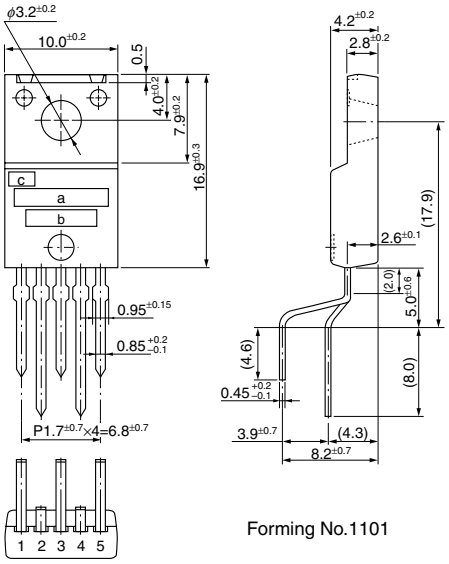
*5: Pin 5 is the ON/OFF pin. Soft start at power on can be performed with a capacitor connected to this pin.
The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C_3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large. The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.



$V_{OUT.}$ ON/OFF | Soft start | Soft start +$V_{OUT.}$ ON/OFF

■External Dimensions (TO220F-5)

(Unit : mm)



Forming No.1101

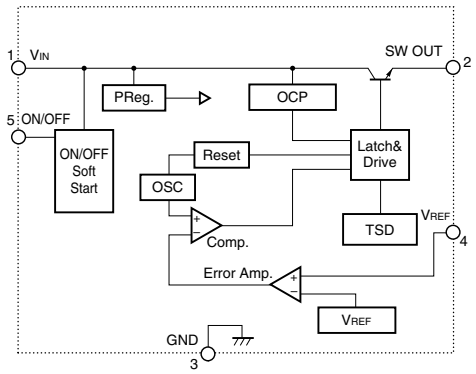
a. Part Number
b. Lot Number
c. Logo Mark

Pin Assignment
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ ON/OFF

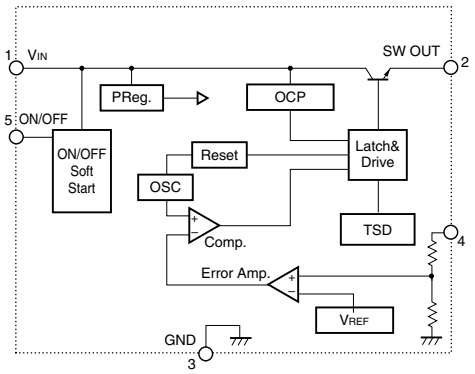
Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram

SI-8015JF

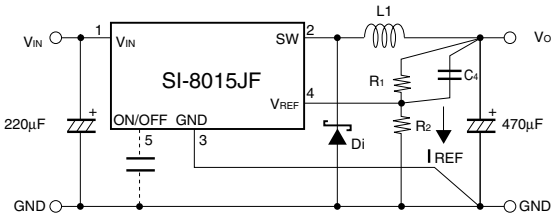


8033JF, 8050JF, 8090JF, 8120JF



■Typical Connection Diagram

SI-8015JF

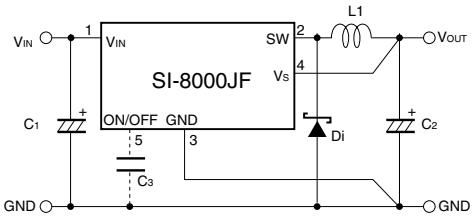


IREF shall be approx. 2mA.

C1 : 50V/220μF
C2 : 25V/470μF
C3 : 10V/0.47μF (Only when using soft-start function)
C4 : 6800pF
L1 : 100μH
Di : RK16 (Sanken)

$$V_{OUT}=\frac{V_{REF}\times(R_1+R_2)}{R_2}$$

8033JF, 8050JF, 8090JF, 8120JF



C1 : 50V/220μF
C2 : 25V/470μF
C3 : 10V/0.47μF (Only when using soft-start function)
L1 : 100μH
Di : RK16 (Sanken)

SI-8000TFE Series Full-Mold, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5 A
- High efficiency: 81% typ. (at Vo = 5 V)
- Requires only 4 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in dropping-type-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: 200μA typ.)
- Soft start available by ON/OFF pin

■Applications

- Onboard local power supplies
- AV equipment
- OA equipment

■Lineup

Part Number	SI-8008TFE	SI-8050TFE
V_O (V)	Variable (0.8 to 24)	5
I_O (A)	1.5	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Power Dissipation	$P_{D1\text{-}1}$	17.8 (with infinite heatsink)	W	Limited by thermal protection, T_{jmax}=150°C
	$P_{D1\text{-}2}$	14.2 (with infinite heatsink)		T_{jmax}=125°C
	$P_{D2\text{-}1}$	2.15 (without heat sink, standalone operation)		Limited by thermal protection, T_{jmax}=150°C
	$P_{D2\text{-}2}$	1.72 (without heatsink, standalone operation)		T_{jmax}=125°C
Junction Temperature*	T_j	−30 to +150	°C	
Storage Temperature	T_{stg}	−40 to +150	°C	
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	7	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	58	°C/W	

*: This product has built-in thermal protection circuits that may operate when the junction temperature rises above 130°C. The recommended design for the junction temperature during operation is below 125°C.

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8008TFE	SI-8050TFE	
Input Voltage Range	V_{IN}	Vo+3*1 to 40	8 to 40	V
Output Voltage Range	V_O	0.8 to 24	5.0	V
Output Current Range	I_O	0 to 1.5		A
Operating Junction Temperature Range	T_{jop}	−20 to +125		°C
Operating Temperature Range	T_{op}	−20 to +125		°C

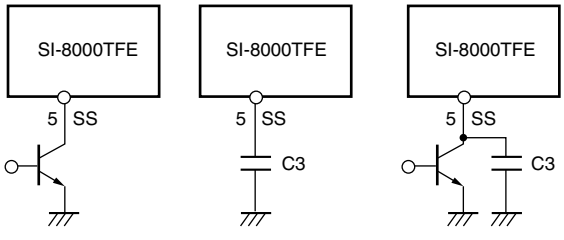
*1: The minimum value of an input voltage range is the higher of 4.5 V or V_O + 3 V.

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	Ratings SI-8008TFE min.	typ.	max.	Ratings SI-8050TFE min.	typ.	max.	Unit
Output Voltage (Reference Voltage)		Vo (V_{ADJ})				4.90	5.00	5.10	V
			0.784	0.800	0.816				
		Conditions	V_{IN}=15V, I_o=0.1A			V_{IN}=15V, I_o=0.1A			
Temperature Coefficient of Output Voltage (Temperature Coefficient of Reference Voltage)		ΔVo/ΔT ($\Delta V_{REF}/\Delta T$)					±0.5		mV/°C
				±0.1					
		Conditions	V_{IN}=15V, I_o=0.1A, T_c=0 to 100°C			V_{IN}=15V, I_o=0.1A, T_c=0 to 100°C			
Efficiency		η		81			81		%
		Conditions	V_{IN}=15V, I_o=0.5A			V_{IN}=15V, I_o=0.5A			
Oscillation Frequency		fo		300			300		kHz
		Conditions	V_{IN}=15V, I_o=0.5A			V_{IN}=15V, I_o=0.5A			
Line Regulation		ΔV_{OLINE}		60	80		60	80	mV
		Conditions	V_{IN}=10 to 30V, I_o=0.5A			V_{IN}=10 to 30V, I_o=0.5A			
Load Regulation		ΔV_{OLOAD}		10	40		10	40	mV
		Conditions	V_{IN}=15V, I_o=0.2 to 1.5A			V_{IN}=15V, I_o=0.2 to 1.5A			
Overcurrent Protection Starting Current		I_S	1.6			1.6			A
		Conditions	V_{IN}=15V			V_{IN}=15V			
ON/OFF Pin*	Low Level Voltage	V_{SSL}			0.5			0.5	V
	Outflow Current at Low Voltage	I_{SSL}		10	40		10	40	μA
		Conditions	V_{SSL}=0V			V_{SSL}=0V			
Quiescent Circuit Current		I_q		6			6		mA
		Conditions	V_{IN}=15V, I_o=0A			V_{IN}=15V, I_o=0A			
		$I_{q(OFF)}$		200	400		200	400	μA
		Conditions	V_{IN}=15V, V_{SS}=0V			V_{IN}=15V, V_{SS}=0V			

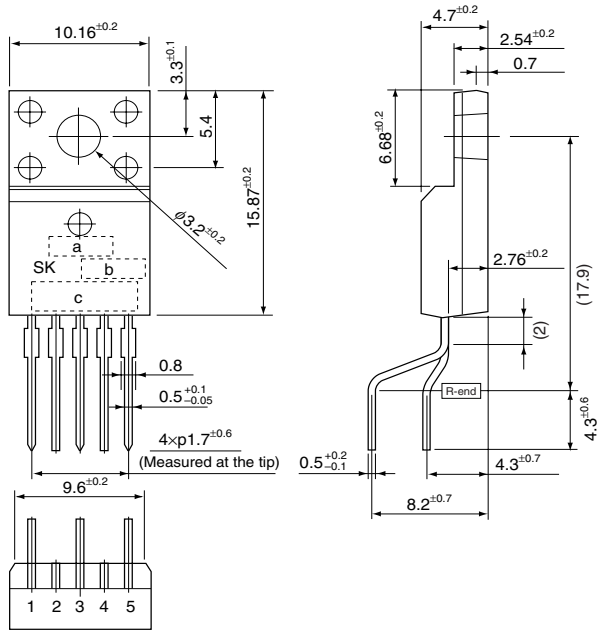
*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to VSSL or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.



Vo.ON/OFF　　Soft start　　Soft start +Vo.ON/OFF

■External Dimensions (TO220F-5)

(Unit : mm)

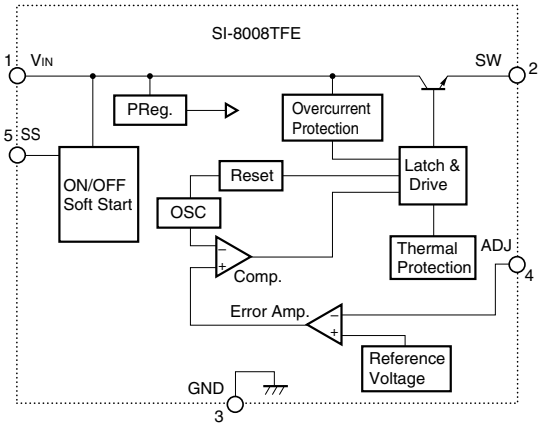


a. Part Number
b. Lot Number
c. Administer Number

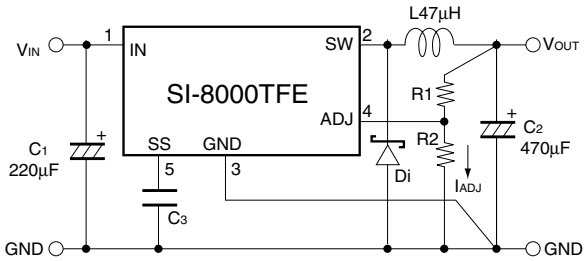
Pin Assignment
① V_{IN}
② SW
③ GND
④ ADJ
⑤ SS

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram



■Typical Connection Diagram



C_1 : 220μF
C_2 : 470μF
C_3 :1μF (Only when using soft-start function)
L_1 : 47μH
Di : SFPB-66 (Sanken)

SI-8000GL Series Compact, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- DIP 8 pin package
- Output current: 1.5A
- High efficiency: 86% (at V_{IN} = 20V, I_O = 1A, V_O = 5V)
- Capable of downsizing a choke-coil due to IC's high switching frequency (250kHz). (Compared with conventional Sanken devices)
- The output-voltage-variable type can vary its output voltage from 1V to 14V because of its low reference voltage (Vref) of 1V.
- Wide Input Voltage Range (8 to 50V)
- Output ON/OFF available
- Built-in overcurrent protection and thermal protection circuits

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	53	V
Power Dissipation	P_D*1	1	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	28	°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	100	°C/W

*1: Limited by thermal protection.

■Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings
		SI-8010GL
DC Input Voltage Range	V_{IN}	(8 or V_O+3)*1 to 50
Output Voltage Range	V_O	1 to 14
Output Current Range	I_O	0.02 to 1.5
Operating Junction Temperature Range	T_{jop}	–30 to +125
Operating Temperature Range	T_{op}	–30 to +125

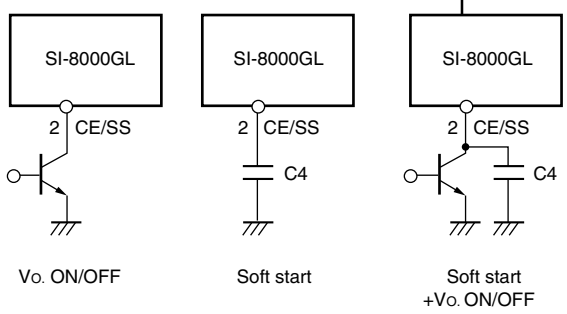
*1: The minimum value of an input voltage range is the higher of either 8V or V_O+3V.

■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings SI-8010GL (Variable type) min.	typ.	max.	Unit
Reference Voltage	V_{REF}	0.97	1.00	1.03	V
	Conditions	V_{IN}=12V, I_O=1A			
Efficiency	Eff		86		%
	Conditions	V_{IN}=20V, I_O=1A, V_O=5V			
Oscillation Frequency	F_{OSC}		250		kHz
	Conditions	V_{IN}=12V, I_O=1A			
Line Regulation	ΔV_{OLINE}		20	40	mV
	Conditions	V_{IN}=10 to 30V, I_O=1A			
Load Regulation	ΔV_{OLOAD}		10	30	mV
	Conditions	V_{IN}=12V, I_O=0.1 to 1.5A			
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T_a$		±0.5		mV/°C
Overcurrent Protection Starting Current	I_S	1.6			A
	Conditions	V_{IN}=12V			
Quiescent Circuit Current	I_q		7		mA
	Conditions	V_{IN}=12V, I_O=0A			
Circuit Current at Output OFF	$I_{q(OFF)}$			400	μA
	Conditions	V_{IN}=12V, $V_{ON/OFF}$=0.3V			
CE/SS* Terminal Low Level Voltage	V_{SSL}			0.5	V
CE/SS* Terminal Outflow Current at Low Voltage	I_{SSL}			50	μA
	Conditions	V_{SSL}=0V			

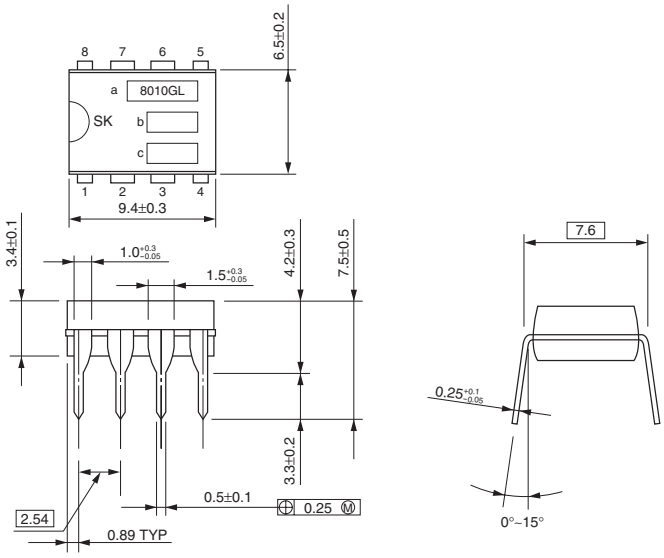
*: Pin 2 is the CE/SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. CE/SS-pin voltage can be changed with an open-collector drive circuit of a transistor.
When using both the soft-start and ON/OFF functions together, the discharge current from C_4 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large. The CE/SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.



V_O. ON/OFF | Soft start | Soft start +V_O. ON/OFF

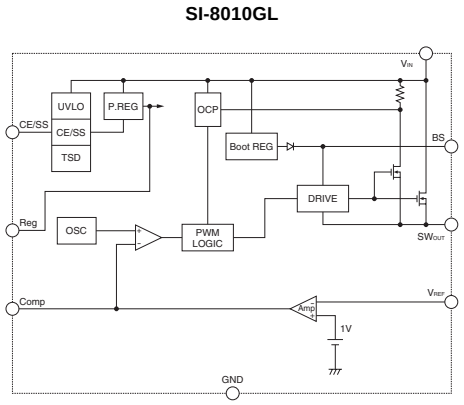
■External Dimensions (DIP8)

(Unit: mm)

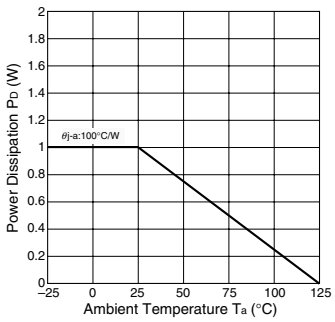


Pin Assignment
1. GND
2. CE/SS
3. Reg
4. SW_{OUT}
5. V_{IN}
6. B.S
7. C_{omp}
8. V_{REF}

■Block Diagram



■T_a-P_D Characteristics



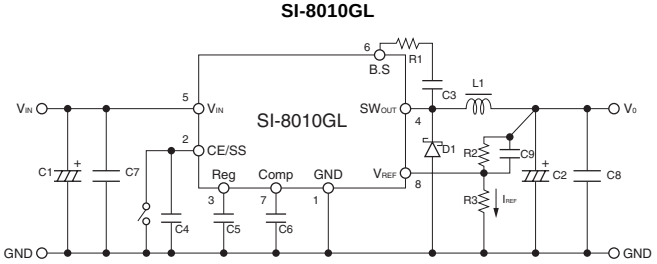
$$P_D = V_O \bullet I_O\left(\frac{100}{\eta\chi} - 1\right) - V_F \bullet I_O\left(1 - \frac{V_O}{V_{IN}}\right)$$

Note 1: The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

Note 2: Thermal design for D_1 must be considered separately.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
$\eta\chi$: Efficiency
V_F : Diode D_1 forward voltage
RK16···0.4V(I_O=1A)

■Typical Connection Diagram



C1: 220μF/63V
C2: 470μF/25V
C3: 0.1μF
C4: 1000pF
C5: 0.1μF
C6: 0.047μF
C7: 0.1μF
C8: 0.1μF
C9: 6800pF
R1: 47Ω
L1: 47μH
D1: RK16 (Sanken)

$$R2 = \frac{(V_{OUT} - V_{REF})}{I_{REF}} = \frac{(V_{OUT} - 1)}{2\times10^{-3}}\ (\Omega),\ R3 = \frac{V_{REF}}{I_{REF}} = \frac{1}{2\times10^{-3}} \fallingdotseq 500(\Omega)$$

Diode D_1

- Be sure to use a Schottky-barrier diode as D_1. If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is approx. 2.5 A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.

Capacitor C_1, C_2

- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures. For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as an OS capacitor or a tantalum capacitor, which may cause an abnormal oscillation.

Resistors R_2, R_3

- R_2 and R_3 are the resistors to set the output voltage. Set their values so that I_{REF} becomes approx. 2 mA. Obtain R_2 and R_3 values by the following formula above.

* To create the optimum operating conditions, place the components as close as possible to each other.

SI-8000S Series Full-Mold, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 3.0A
- High efficiency: 79 to 91%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8033S	SI-8050S	SI-8090S	SI-8120S	SI-8150S
V_O(V)	3.3	5.0	9.0	12.0	15.0
I_O(A)	3.0				

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43*	V
Power Dissipation	P_{D1}	18(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
SW Terminal Applied Reverse Voltage	V_{SW}	–1	V
Thermal Resistance(junction to case)	$\theta_{j\text{-}c}$	5.5	°C/W

*35V for SI-8033S

■Recommended Operating Conditions

Parameter	Symbol	Ratings					Unit
		SI-8033S	SI-8050S	SI-8090S	SI-8120S	SI-8150S	
DC Input Voltage Range	V_{IN}	5.5 to 28	7 to 40	12 to 40	15 to 40	18 to 40	V
Output Current Range	I_O	0 to 3.0					A
Operating Junction Temperature Range	T_{jop}	–30 to +125					°C

■Electrical Characteristics

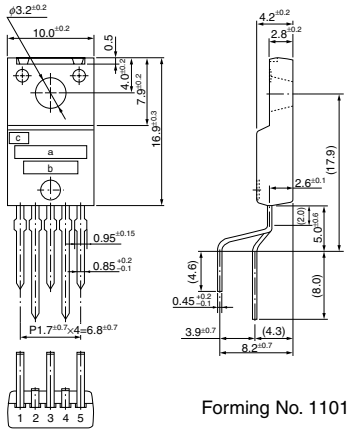
(T_a=25°C)

Parameter		Symbol	SI-8033S			SI-8050S			SI-8090S			SI-8120S			SI-8150S			Unit
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	SI-8000S*1	V_O	3.17	3.30	3.43	4.80	5.00	5.20	8.55	9.00	9.45	11.50	12.00	12.50	14.25	15.00	15.75	V
	SI-8000SS		3.234	3.30	3.366	4.90	5.00	5.10	———			———			———			
	Conditions		V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Efficiency		η		79			84			88			90			91		%
	Conditions		V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Oscillation Frequency		f		60			60			60			60			60		kHz
	Conditions		V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Line Regulation		ΔV_{OLINE}		25	80		40	100		50	120		60	130		60	130	mV
	Conditions		V_{IN}=8 to 28V, I_O=1.0A			V_{IN}=10 to 30V, I_O=1.0A			V_{IN}=15 to 30V, I_O=1.0A			V_{IN}=18 to 30V, I_O=1.0A			V_{IN}=21 to 30V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		10	30		10	40		10	40		10	40		10	40	mV
	Conditions		V_{IN}=15V, I_O=0.5 to 1.5A			V_{IN}=20V, I_O=0.5 to 1.5A			V_{IN}=21V, I_O=0.5 to 1.5A			V_{IN}=24V, I_O=0.5 to 1.5A			V_{IN}=25V, I_O=0.5 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.0			±1.0		mV/°C
Overcurrent Protection Starting Current		I_{S1}	3.1			3.1			3.1			3.1			3.1			A
	Conditions		V_{IN}=15V			V_{IN}=20V			V_{IN}=21V			V_{IN}=24V			V_{IN}=25V			

*1: “S” may be printed to the right of the marking (except SI-8090S, SI-8120S, SI-8150S).

■External Dimensions (TO220F-5)

(Unit : mm)

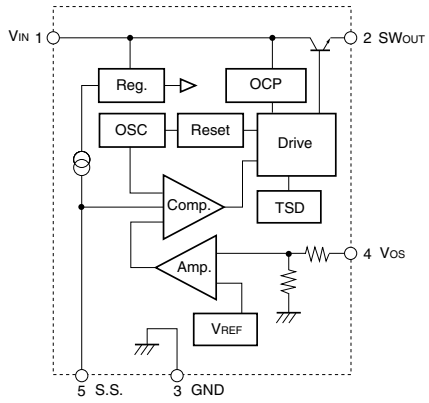


a. Part Number
b. Lot Number
c. Logo Mark

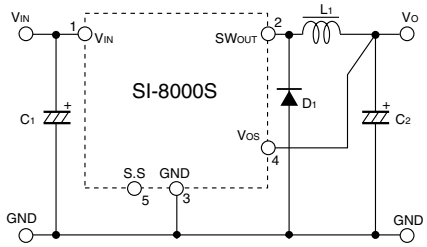
Pin Assignment
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ S.S

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram

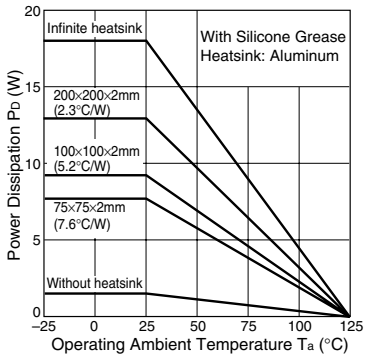


■Typical Connection Diagram



$C_{1,2}$: 1000μF
L_1 : 150μH
D_1 : RK46(Sanken)

■T_a-P_D Characteristics



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

The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
ηx : Efficiency (%)
V_F : Diode D_1 forward voltage
0.5V(RK46)

Thermal design for D_1 must be considered separately.

SI-8000HFE Series Full-Mold, Separate Excitation Step-down Switching Mode Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 5.5 A
- High efficiency: 83% typ. (at Vo = 5 V)
- Requires only 4 discrete components
- Built-in reference oscillator (150 kHz)
- Built-in drooping-type-overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)

■Applications

- Onboard local power supplies
- AV equipment

■Lineup

Part Number	SI-8008HFE	SI-8050HFE
V_O (V)	Variable (0.8 to 15)	5
I_O (A)	5.5	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Power Dissipation	$P_{D1\text{-}1}$	25 (with infinite heatsink)	W	Limited by thermal protection, T_{jmax}=150°C
	$P_{D1\text{-}2}$	20 (with infinite heatsink)		T_{jmax}=125°C
	$P_{D2\text{-}1}$	2.15 (without heat sink, standalone operation)		Limited by thermal protection, T_{jmax}=150°C
	$P_{D2\text{-}2}$	1.72 (without heatsink, standalone operation)		T_{jmax}=125°C
Junction Temperature*	T_j	+150	°C	
Storage Temperature	T_{stg}	–40 to +150	°C	
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	5	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	58	°C/W	

*: This product has built-in thermal protection circuits that may operate when the junction temperature rises above 130°C. The recommended design for the junction temperature during operation is below 125°C.

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8008HFE	SI-8050HFE	
Input Voltage Range	V_{IN}	Vo+3*1 to 40	8 to 40	V
Output Voltage Range	V_O	0.8 to 24	5.0	V
Output Current Range	I_O	0 to 5.5		A
Operating Junction Temperature Range	T_{jop}	–30 to +125		°C
Operating Temperature Range	T_{op}	–30 to +125		°C

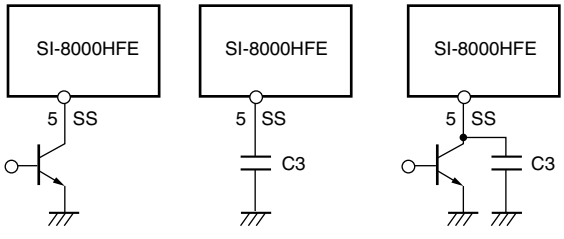
*1: The minimum value of an input voltage range is the higher of 4.5 V or V_O + 3 V.

■Electrical Characteristics

(T_a=25°C)

Parameter		Symbol	Ratings SI-8008HFE (at Vo = 5 V) min.	typ.	max.	Ratings SI-8050HFE min.	typ.	max.	Unit
Output Voltage (Reference Voltage)		Vo (V_{ADJ})	0.784	0.800	0.816	4.90	5.00	5.10	V
		Conditions	V_{IN}=15V, I_o=1A			V_{IN}=15V, I_o=1A			
Temperature Coefficient of Output Voltage (Temperature Coefficient of Reference Voltage)		ΔVo/ΔT ($\Delta V_{ADJ}/\Delta T$)		±0.1			±0.5		mV/°C
		Conditions	V_{IN}=15V, I_o=1A, T_c=0 to 100°C			V_{IN}=15V, I_o=1A, T_c=0 to 100°C			
Efficiency		η		83			83		%
		Conditions	V_{IN}=15V, I_o=3A			V_{IN}=15V, I_o=3A			
Oscillation Frequency		fo		150			150		kHz
		Conditions	V_{IN}=15V, I_o=3A			V_{IN}=15V, I_o=3A			
Line Regulation		ΔV_{OLINE}		60			60	80	mV
		Conditions	V_{IN}=10 to 30V, I_o=3A			V_{IN}=10 to 30V, I_o=3A			
Load Regulation		ΔV_{OLOAD}		20	50		20	50	mV
		Conditions	V_{IN}=15V, I_o=0.2 to 3A			V_{IN}=15V, I_o=0.2 to 3A			
Overcurrent Protection Starting Current		I_S	5.6			5.6			A
		Conditions	V_{IN}=15V			V_{IN}=15V			
ON/OFF Pin*	Low Level Voltage	V_{SSL}			0.5			0.5	V
	Outflow Current at Low Voltage	I_{SSL}		10	30		10	30	μA
		Conditions	V_{SSL}=0V			V_{SSL}=0V			
Quiescent Circuit Current		I_q		6			6		mA
		Conditions	V_{IN}=15V, I_o=0A			V_{IN}=15V, I_o=0A			
		$I_{q(OFF)}$		200	400		200	400	μA
		Conditions	V_{IN}=15V, V_{SS}=0V			V_{IN}=15V, V_{SS}=0V			

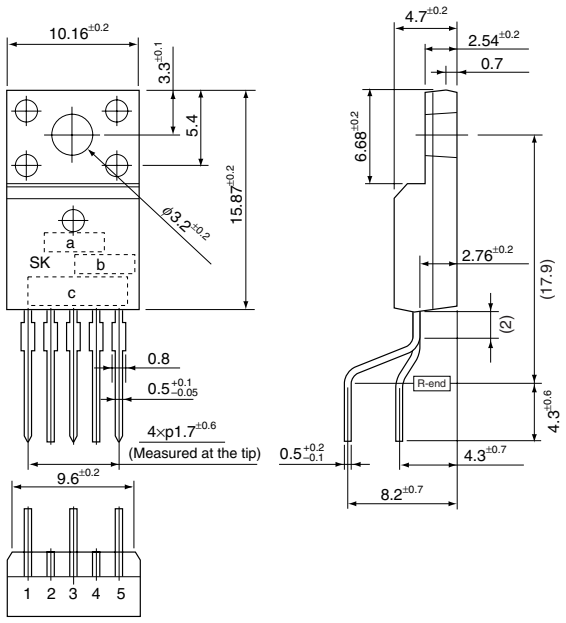
*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to VSSL or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.



$V_{OUT.}$ ON/OFF | Soft start | Soft start +$V_{OUT.}$ ON/OFF

■External Dimensions (TO220F-5)

(Unit : mm)

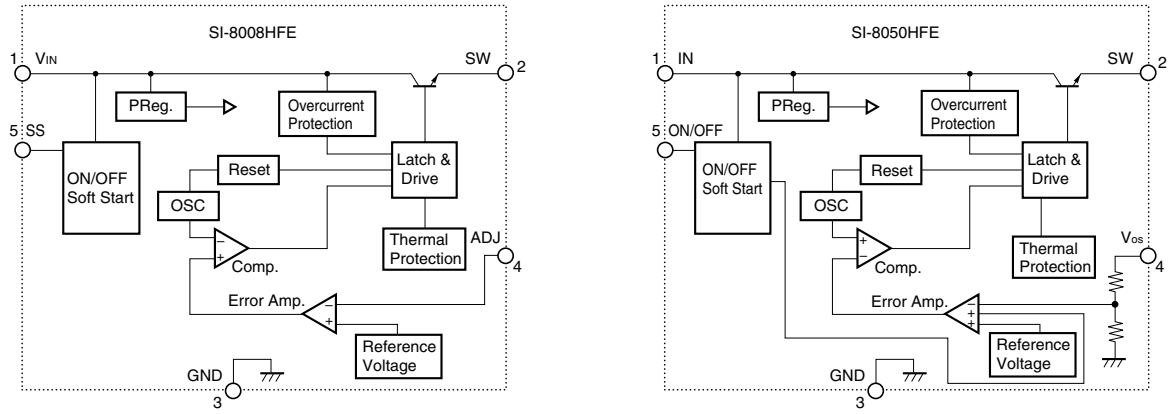


a. Part Number
b. Lot Number
c. Administer Number

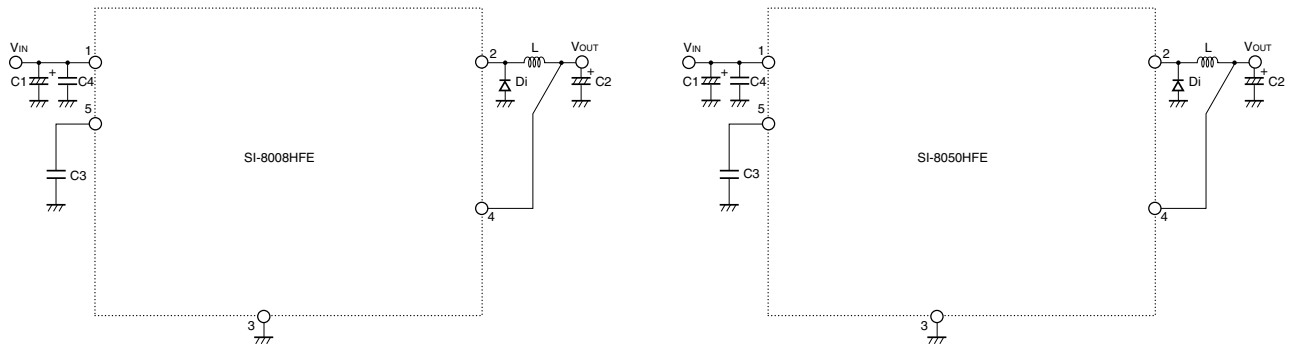
Pin Assignment
① V_{IN}
② SW
③ GND
④ ADJ (V_{OS} for SI-8050HFE)
⑤ SS

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram



■Typical Connection Diagram



C_1 : 1500μF
C_2 : 1000μF
C_3 :1μF (Only when using soft-start function)
C_4 :4.7μF (RPER11H475K5 (Murata Manufacturing) recommended)
L_1 :100μH
Di : FMB-G16L (Sanken)

SI-8011NVS Surface-Mount, Synchronous Rectifier Step-down Switching Mode Regulator Control ICs

■Features

- Surface-mount package (TSSOP24)
- High efficiency due to synchronous rectification: 93% (at V_{IN} = 5V, I_O = 1A, V_O = 2.5V)
- Capable of downsizing a choke-coil due to IC's high switching frequency (125kHz typ, On Time Control). (Compared with conventional Sanken devices)
- Low reference voltage (V_{ref}) of 1.1V. The output voltage is variable from 1.1V to 6V.
- High-speed response to a load
- Compatible with low ESR capacitors
- Soft start and output ON/OFF available
- Built-in overcurrent protection circuit
- PWRGD function to indicate the output voltage status
- High precision reference voltage: 1.1V ± 1.2%

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
Control-System DC Input Voltage	V_{CC}	7	V
DC Input Voltage	V_{IN}	25	V
Boost Block Input Voltage	V_H	30	V
EN Terminal Input Voltage	V_{EN}	V_{CC}	V
PWRGD Terminal Applied Voltage	V_{PWRGD}	7	V
Junction Temperature	T_j	+150	°C
Storage Temperature	T_{stg}	–40 to +150	°C

■Applications

- Power supplies for notebook PCs and mobile devices
- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Control System Input Voltage Range	V_{CC}	4.5 to 5.5	V
Input Voltage Range	V_{IN}	3 to 18	V
Output Voltage Range	V_O	1.1 to 6	V
Operating Temperature Range	T_{op}	–20 to +85	°C

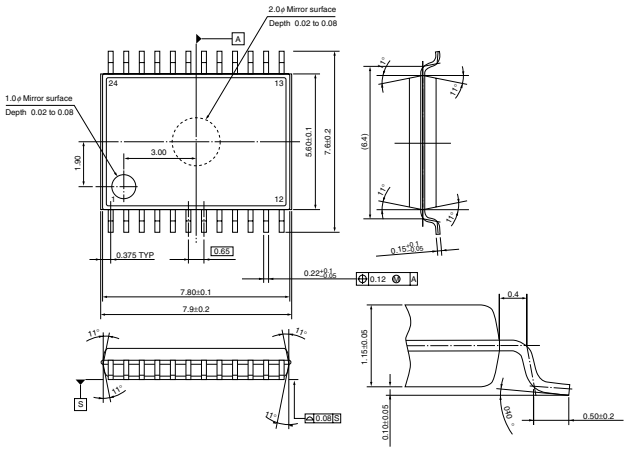
■Electrical Characteristics

(T_a = 25°C unless otherwise specified)

Parameter		Symbol	Ratings			Unit	Conditions
			min.	typ.	max.		
Dynamic Characteristics	Output Voltage	V_O	–1.2%	1.1	+1.2%	V	V_{IN}=5V, V_{CC}=5V, VSNS connected to VO, I_O=0A
	Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		±0.03		mV/°C	V_{IN}=5V, V_{CC}=5V, VSNS connected to VO, I_O=0A, T_a=0 to 85°C
Circuit Current	Circuit Current (V_{CC} Terminal)	I_{op}			6	mA	V_{CC}=5V, EN=H, FADJ:open
	Circuit Current (V_{IN} Terminal)	I_{op}			1	mA	V_{IN}=5V, EN=H
	Standby Current 1 (V_{CC} Terminal)	I_{std1}			100	μA	V_{CC}=5V, EN=L
	Standby Current 2 (V_{IN} Terminal)	I_{std2}			50	μA	V_{IN}=5V, EN=L
Undervoltage Lockout	UVLO Operating Voltage 1 (V_{CC} Terminal)	V_{uvlo1}	3.7		4.4	V	V_{IN}=5V
	UVLO Operating Voltage 2 (V_{IN} Terminal)	V_{uvlo2}	2.5		2.9	V	V_{CC}=5V
On Time Control	On Time	T_{on}		2		μS	V_{CC}=5V, V_{IN}=5V, V_O=2.5V
	Minimum Off Time	T_{off}		1		μS	V_{CC}=5V
	REF Terminal Voltage	V_{ref}	1.1	1.2	1.3	V	V_{CC}=5V
	REF Terminal Source Current	I_{ref}			100	μA	V_{CC}=5V
High Side Drive	On Resistance (high side)	RonHH		5.5		Ω	VH-VLIN=5V
	On Resistance (low side)	RonHL		5.5		Ω	VH-VLIN=5V
Low Side Drive	On Resistance (high side)	RonLH		5.5		Ω	V_{CC}=5V
	On Resistance (low side)	RonLL		5.5		Ω	V_{CC}=5V
Bootstrap	Bootstrap Voltage	VH-VLIN	4.5	5	5.5	V	
Protection System	Current for Current Limit Detection	I_{lim}	90	100	110	μA	V_{CC}=5V, V_{IN}=5V
	Soft Start Terminal Current	I_{ss}		±20		μA	V_{CC}=5V
	EN Low Level Voltage	V_{celo}	0		0.8	V	V_{CC}=5V
	EN High Level Voltage	V_{cehi}	2.4		V_{CC}	V	V_{CC}=5V
	EN Bias Level Current	ICE			5	μA	V_{CC}=5V, EN=5V
	PWRGD Good Voltage (high side)	V_{sens}		1.32		V	V_{CC}=5V
	PWRGD Good Voltage (low side)	V_{sens}		0.88		V	V_{CC}=5V
	PWRGD Low Output Voltage	V_{pwrgd}			0.4	V	V_{CC}=5V, Ipwrgd=120μA
	PWRGD Terminal Current	I_{pwrgd}			120	μA	V_{CC}=5V, Vpwrgd=0.4V
	PWRGD Leakage Current	I_{pwrgd}			5	μA	Vpwrgd=5V

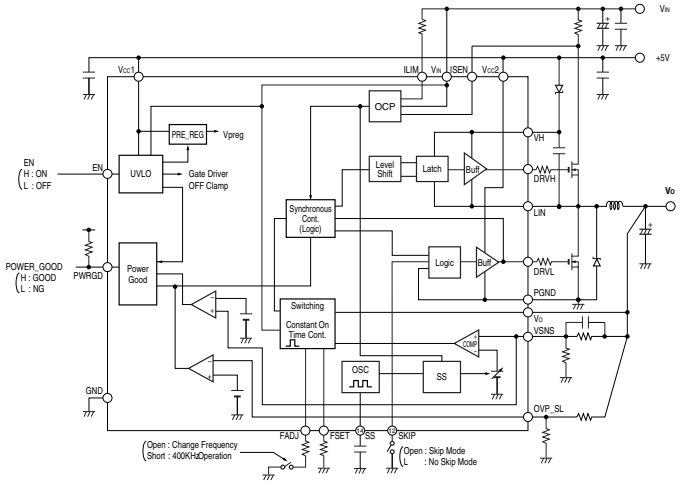
■External Dimensions (TSSOP24)

(Unit : mm)

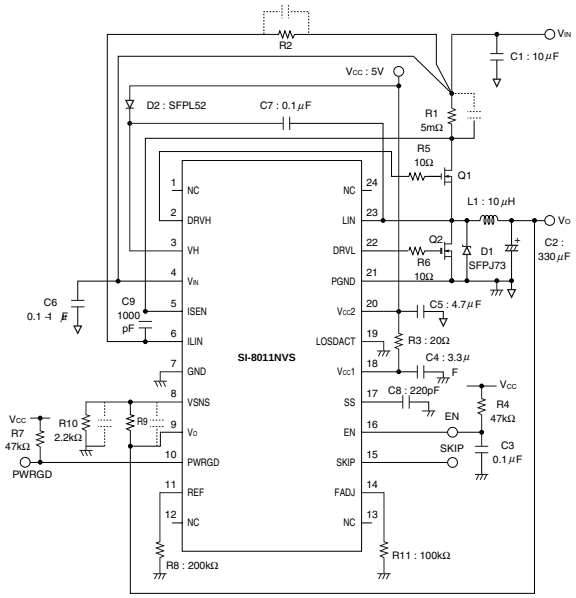


Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 1.36g

■Block Diagram (Pin Assignment)



■Typical Connection Diagram



MOS FET Q_1, Q_2

- Be sure to use logic type MOS FET as Q_1 and Q_2.
  If you use a normal power MOS FET type, the ON resistance may not drop to a satisfactory level due to a shortage of V_{GS}. This may deteriorate the efficiency and cause overheating.

Diode D_1

- Be sure to use a Schottky-barrier diode for D_1.
  If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- Take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuit load.

Capacitor C_1, C_2

- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures. For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as a ceramic capacitor, which may cause an abnormal oscillation.

* To create the optimum operating conditions, place the components as close as possible to each other.

SI-8511NVS Surface-Mount, Synchronous Rectifier Step-down Switching Mode Regulator Control ICs

■Features

- Surface-mount package (TSSOP24)
- High efficiency due to synchronous rectification: 92% (at V_{IN} = 5V, I_O = 1A, V_O = 2.5V)
- Capable of downsizing a choke-coil due to IC's high switching frequency (400kHz typ, On Time Control). (Compared with conventional Sanken devices)
- Low reference voltage (V_{ref}) of 1.1V. The output voltage is variable from 1.1V to 6V.
- High-speed response to a load
- Compatible with low ESR capacitors
- Soft start and output ON/OFF available
- Built-in overcurrent and output-overvoltage protection circuits
- PWRGD function to indicate the output voltage status
- High precision reference voltage: 1.1V ± 1.2%

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
Control-System DC Input Voltage	V_{CC}	7	V
DC Input Voltage	V_{IN}	25	V
Boost Block Input Voltage	V_H	30	V
EN Terminal Input Voltage	V_{EN}	V_{CC}	V
PWRGD Terminal Applied Voltage	V_{PWRGD}	7	V
Junction Temperature	T_j	+150	°C
Storage Temperature	T_{stg}	–40 to +150	°C

■Applications

- Power supplies for notebook PCs and mobile devices
- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Control System Input Voltage Range	V_{CC}	4.5 to 5.5	V
Input Voltage Range	V_{IN}	3 to 18	V
Output Voltage Range	V_O	1.1 to 6	V
Operating Temperature Range	T_{op}	–20 to +85	°C

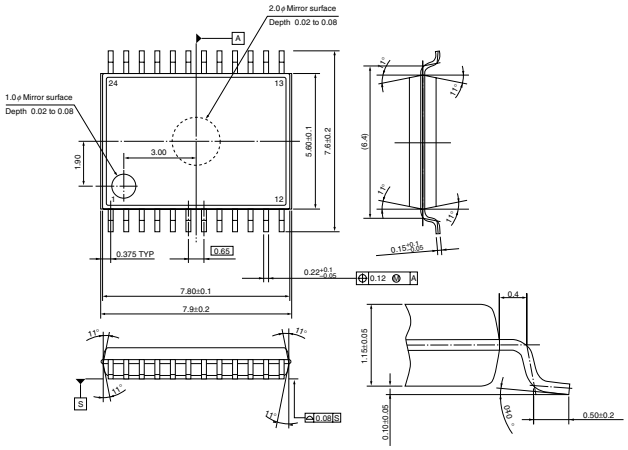
■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings			Unit	Conditions
			min.	typ.	max.		
Dynamic Characteristics	Output Voltage	V_O	–1.2%	1.1	+1.2%	V	V_{IN}=5V, V_{CC}=5V, VSNS connected to VO, I_O=0A
	Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		±0.03		mV/°C	V_{IN}=5V, V_{CC}=5V, VSNS connected to VO, I_O=0A, T_a=0 to 85°C
Circuit Current	Circuit Current (V_{CC} Terminal)	I_{op}			6	mA	V_{CC}=5V, EN=H, FADJ:open
	Circuit Current (V_{IN} Terminal)	I_{op}			1	mA	V_{IN}=5V, EN=H
	Standby Current 1 (V_{CC} Terminal)	I_{std1}			100	μA	V_{CC}=5V, EN=L
	Standby Current 2 (V_{IN} Terminal)	I_{std2}			50	μA	V_{IN}=5V, EN=L
Undervoltage Lockout	UVLO Operating Voltage 1 (V_{CC} Terminal)	V_{uvlo1}	3.7		4.45	V	V_{IN}=5V
	UVLO Operating Voltage 2 (V_{IN} Terminal)	V_{uvlo2}	2.5		2.9	V	V_{CC}=5V
On Time Control	On Time	T_{on}		1.27		μS	V_{CC}=5V, V_{IN}=5V, V_O=2.5V
	Minimum Off Time	T_{off}		0.7		μS	V_{CC}=5V
	REF Terminal Voltage	V_{ref}	1.1	1.2	1.3	V	V_{CC}=5V
	REF Terminal Source Current	I_{ref}			100	μA	V_{CC}=5V
High Side Drive	On Resistance (high side)	RonHH		5.5		Ω	VH-VLIN=5V
	On Resistance (low side)	RonHL		5.5		Ω	VH-VLIN=5V
Low Side Drive	On Resistance (high side)	RonLH		5.5		Ω	V_{CC}=5V
	On Resistance (low side)	RonLL		5.5		Ω	V_{CC}=5V
Bootstrap	Bootstrap Voltage	VH-VLIN	4.5	5	5.5	V	
Protection System	Current for Current Limit Detection	I_{lim}	90	100	110	μA	V_{CC}=5V, V_{IN}=5V
	Soft Start Terminal Current	I_{ss}		±20		μA	V_{CC}=5V
	EN Low Level Voltage	V_{celo}	0		0.8	V	V_{CC}=5V
	EN High Level Voltage	V_{cehi}	2.4		V_{CC}	V	V_{CC}=5V
	EN Bias Level Current	ICE			5	μA	V_{CC}=5V, EN=5V
	PWRGD Good Voltage (high side)	V_{sens}		1.32		V	V_{CC}=5V
	PWRGD Good Voltage (low side)	V_{sens}		0.88		V	V_{CC}=5V
	PWRGD Low Output Voltage	V_{pwrgd}			0.4	V	V_{CC}=5V, Ipwrgd=120μA
	PWRGD Terminal Current	I_{pwrgd}			120	μA	V_{CC}=5V, Vpwrgd=0.4V
	PWRGD Leakage Current	I_{pwrgd}			5	μA	Vpwrgd=5V

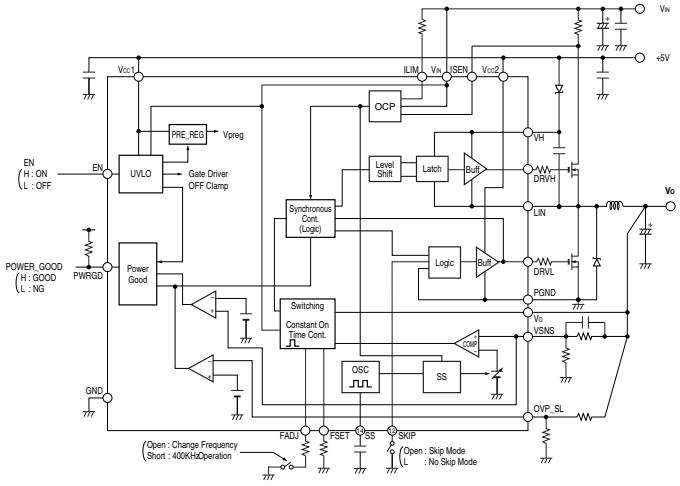
■External Dimensions (TSSOP24)

(Unit : mm)

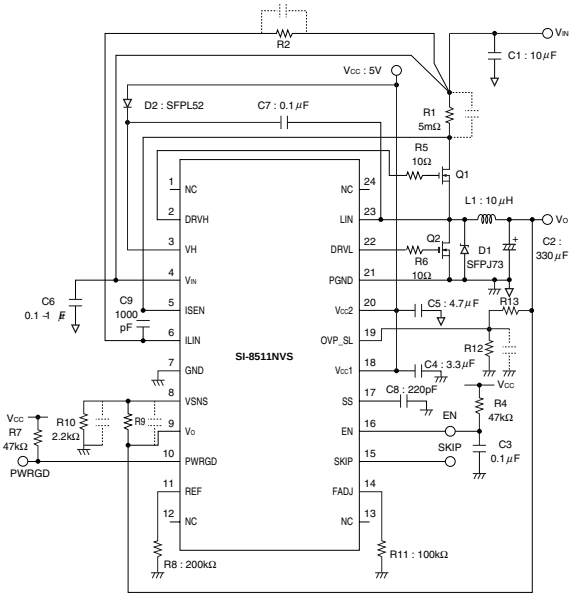


Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 1.36g

■Block Diagram (Pin Assignment)



■Typical Connection Diagram



MOS FET Q_1, Q_2

- Be sure to use logic type MOS FET as Q_1 and Q_2.
  If you use a normal power MOS FET type, the ON resistance may not drop to a satisfactory level due to a shortage of V_{GS}. This may deteriorate the efficiency and cause overheating.

Diode D_1

- Be sure to use a Schottky-barrier diode for D_1.
  If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- Take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuit load.

Capacitor C_1, C_2

- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors suitable for switching mode power supplies. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures. For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as a ceramic capacitor, which may cause an abnormal oscillation.

* To create the optimum operating conditions, place the components as close as possible to each other.

STA810M Series Separate Excitation Switching Mode Regulator ICs with Flywheel Diode

■Features

- Output current: 1.5A
- High efficiency: TYP83% (STA811M)
- Built-in flywheel diode (schottky-barrier diode)
- Requires only 3 discrete components: output coil, input and output capacitors
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (125kHz)
- Built-in foldback-overcurrent and thermal protection circuits
- Built-in ON/OFF circuit (soft start available)

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Lineup

Part Number	Output Voltage (V)
STA811M	6.5

Output voltage: 2.5V, 3.3V, 5V, 9V, 12V and adjustable types are projected.

■Absolute Maximum Ratings*1

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Output Current	I_O	1.5	A
Power Dissipation*2	P_{D1}	18.2 (With infinite heatsink)	W
	P_{D2}	2.7 (Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (junction to case)	$\theta_{j\text{-}c}$	5.5	°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	37	°C/W

*1: Absolute maximum ratings show the destructive limit. No parameter should exceed the ratings in transient or normal operations.
*2: Limited by thermal protection.

■Recommended Operating Conditions*1

Parameter	Symbol	Ratings STA811M min.	Ratings STA811M max.	Unit	Conditions
DC Input Voltage Range	V_{IN1}	8.5	9.5	V	I_O=0 to 1A
	V_{IN2}	9.5	40	V	I_O=0 to 1.5A
Output Current Range*2	I_O	0	1.5	A	$V_{IN} \geq 9.5V$
Operating Junction Temperature Range	T_{jop}	–30	+125	°C	
Operating Temperature Range*2	T_{op}	–30	+80	°C	

*1: Recommended operating conditions show operating conditions required for normal circuit function described in the electrical characteristics. These conditions must be followed in actual use.
*2: Limited by T_a-P_D characteristics.

■Electrical Characteristics

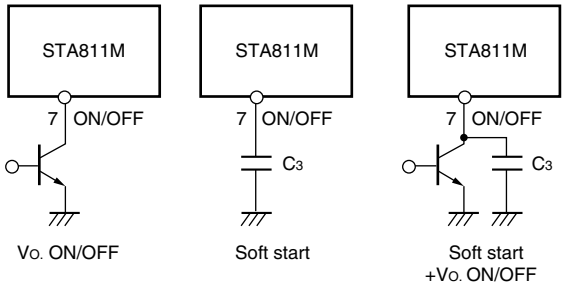
(T_a=25°C)

Parameter		Symbol	Ratings STA811M min.	Ratings STA811M typ.	Ratings STA811M max.	Unit
Output Voltage		V_O	6.37	6.5	6.63	V
		Conditions		V_{IN}=28V, I_O=1A		
Efficiency*1		η		83		%
		Conditions		V_{IN}=28V, I_O=1A		
Oscillation Frequency		f_O		125		kHz
		Conditions		V_{IN}=28V, I_O=1A		
Line Regulation		V_{Line}		40	100	mV
		Conditions		V_{IN}=10 to 30V, I_O=1A		
Load Regulation		V_{Load}		10	40	mV
		Conditions		V_{IN}=28V, I_O=0.2 to 1A		
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T$		±0.5		mV/°C
Overcurrent Protection Starting Current		I_S	1.6			A
		Conditions		V_{IN}=28V		
ON/OFF Terminal*2	Low Level Voltage	V_{SSL}			0.5	V
	Outflow Current at Low Voltage	I_{SSL}			100	μA
		Conditions		V_{SSL}=0V		
Quiescent Circuit Current 1		I_q		7		mA
		Conditions		V_{IN}=28V, I_O=0A		
Quiescent Circuit Current 2		$I_{q(OFF)}$			200	μA
		Conditions		V_{IN}=28V, $V_{ON/OFF}$=0.3A		

*1: Efficiency is calculated from the following formula.

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

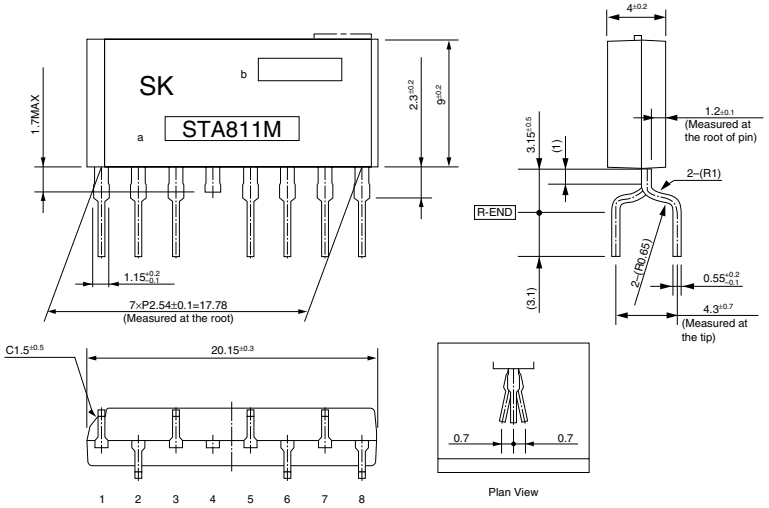
*2: Pin 7 is the ON/OFF pin. Soft start at power on can be performed by connecting a capacitor to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C_3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large. The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.



V_O. ON/OFF　　Soft start　　Soft start +V_O. ON/OFF

■External Dimensions (SIP8 [STA 8Pin])

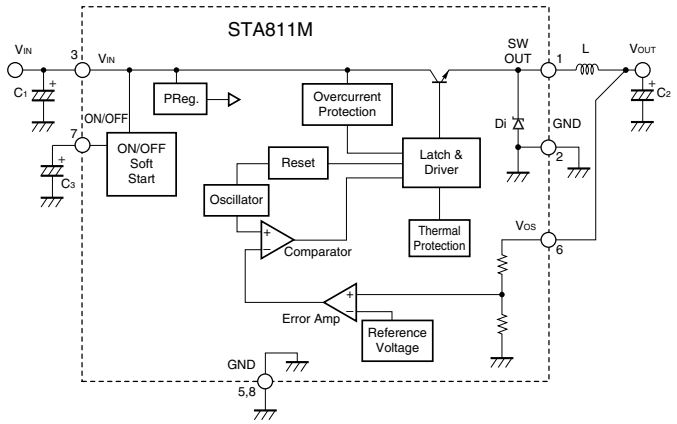
(Unit : mm)



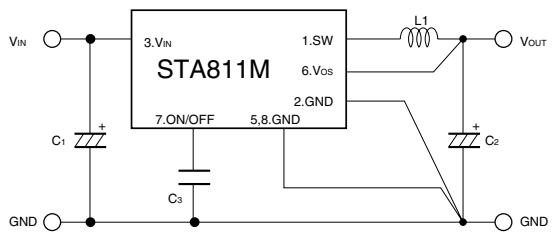
Pin Assignment

① SWOUT
② GND
③ VIN
④ N.C
⑤ GND
⑥ VOS
⑦ ON/OFF
⑧ GND

■Block Diagram

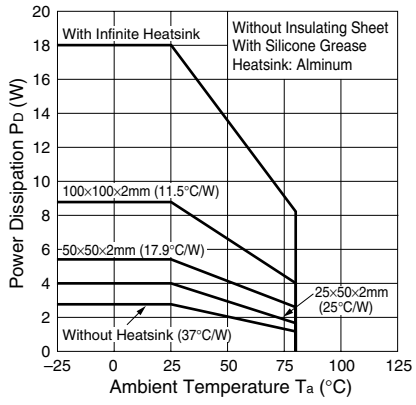


■Typical Connection Diagram



C1: 220 μF/50V
C2: 470 μF/25V
C3: 0.47 μF/10V (Only when using soft start function)
L1: 100 μH

■Thermal Derating



$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

VO : Output voltage
VIN : Input voltage
IO : Otuput current
ηχ : Efficiency (%)

STA820M Series Separate Excitation Switching Mode Regulator ICs with Flywheel Diode

■Features

- Output current: 3A
- High efficiency: TYP 83% (STA821M)
- Built-in flywheel diode (Schottky-barrier diode)
- Requires only 3 discrete components: output coil, input and output capacitors
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (110kHz)
- Built-in foldback-overcurrent and thermal protection circuits
- Built-in ON/OFF circuit (soft start available)

■Applications

- Power supplies for telecommunication equipment
- On-board local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Lineup

Part Number	Output Voltage (V)
STA821M	5

Output voltage: 3.3V, 9V, 12V; adjustable types currently being planned

■Absolute Maximum Ratings*1

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	31	V
Output Current	I_O	3	A
Power Dissipation*2	P_{D1}	18.2 (With infinite heatsink)	W
	P_{D2}	2.7 (Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Case)	$\theta_{j\text{-}c}$	5.5	°C/W
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	37	°C/W

*1: The absolute maximum ratings show the destructive limit. No parameter should exceed the ratings in transient or normal operations.
*2: Limited by thermal protection.

■Recommended Operating Conditions*1

Parameter	Symbol	Ratings STA821M min.	Ratings STA821M max.	Unit
DC Input Voltage Range	V_{IN}	7	30	V
Output Current Range*2	I_O	0	3	A
Operating Junction Temperature Range	T_{jop}	–30	+125	°C
Ambient Temperature Range*2	T_{op}	–30	+80	°C

*1: The recommended operating conditions show the operating conditions required for the normal circuit function described in the electrical characteristics. These conditions must be followed in actual use.
*2: Limited by T_a-P_D characteristics.

■Electrical Characteristics

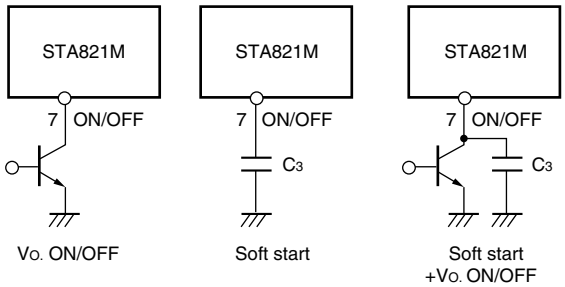
(T_a=25°C)

Parameter		Symbol	Ratings STA821M min.	Ratings STA821M typ.	Ratings STA821M max.	Unit
Output Voltage		V_O	4.8	5.0	5.2	V
		Conditions	V_{IN}=20V, I_O=1A			
Efficiency*1		η		83		%
		Conditions	V_{IN}=20V, I_O=1A			
Oscillation Frequency		f_O		110		kHz
		Conditions	V_{IN}=20V, I_O=1A			
Line Regulation		V_{Line}		40	100	mV
		Conditions	V_{IN}=10 to 30V, I_O=1A			
Load Regulation		V_{Load}		10	40	mV
		Conditions	V_{IN}=20V, I_O=0.5 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T$		±0.5		mV/°C
Overcurrent Protection Starting Current		I_S	3.1			A
		Conditions	V_{IN}=20V			
ON/OFF Terminal*2	Low Level Voltage	V_{SSL}		0.2		V
	Outflow Current at Low Voltage	I_{SSL}	15	25	35	μA
		Conditions	V_{SSL}=0.2V			
Quiescent Circuit Current		I_q		4		μA
		Conditions	V_{IN}=20V, I_O=0A			

*1: Efficiency is calculated from the following formula.

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

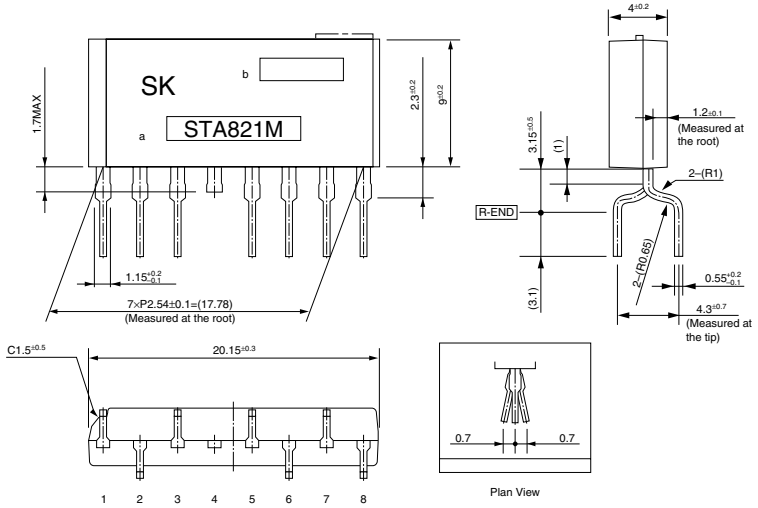
*2: Pin 7 is the ON/OFF pin. Soft start at power on can be performed by connecting a capacitor to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C_3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large. The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.



V_O. ON/OFF | Soft start | Soft start +V_O. ON/OFF

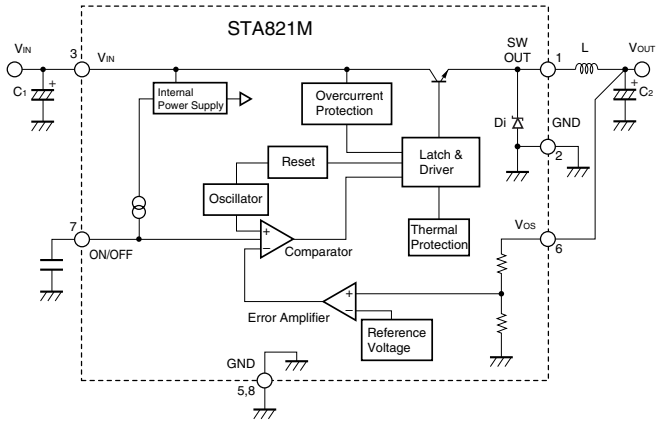
■External Dimensions (SIP8 [STA 8Pin])

(Unit : mm)

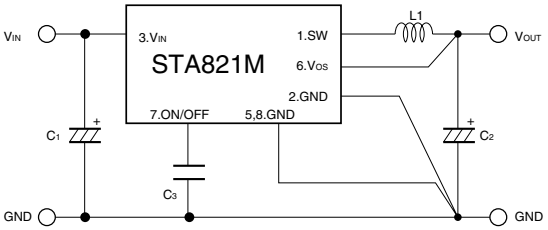


Pin Assignment
① SWOUT
② GND
③ VIN
④ N.C
⑤ GND
⑥ VOS
⑦ ON/OFF
⑧ GND

■Block Diagram

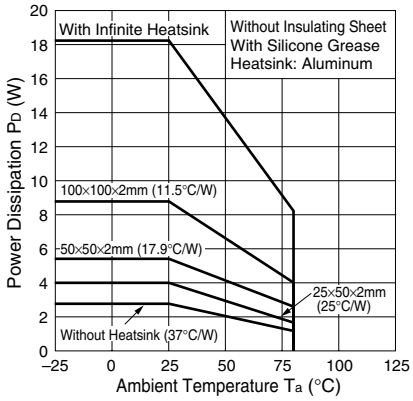


■Typical Connection Diagram



C1 : 1000μF/50V
C2 : 1000μF/25V
C3 : 0.47μF/10V(only when the soft start function is used)
L1 : 100μH

■Ta-PD Characteristics



$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

VO : Output voltage
VIN : Input voltage
IO : Output current
ηχ : Efficiency (%)

SI-8400L/8500L Series Separate Excitation Switching Mode Regulator ICs with Coil

■Features

- Switching ICs/Coil combined type
- Requires only 2 discrete components
- Low switching noise
- No heatsink required
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)...SI-8500L Series

■Applications

- Telephone power supplies
- Onboard local power supplies

■Lineup

Part Number	SI-8401L	SI-8402L	SI-8403L	SI-8501L	SI-8502L	SI-8503L	SI-8504L
V_O(V)	5.0	12.0	3.3	5.0	12.0	3.3	9.0
I_O(A)	0.5	0.4	0.5	1.0			

■Absolute Maximum Ratings

Parameter	Symbol	Ratings		Unit
		SI-8400L	SI-8500L	
DC Input Voltage	V_{IN}	35		V
Power Dissipation	P_D	1.25	3	W
Junction Temperature	T_j	+100		°C
Storage Temperature	T_{stg}	–25 to +85		°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings			Unit
		SI-8401L	SI-8402L	SI-8403L	
DC Input Voltage Range	V_{IN}	7 to 33	15 to 33	5.3 to 33	V
Output Current Range	I_O	0 to 0.5	0 to 0.4	0 to 0.5	A
Operating Temperature Range	T_{op}	–20 to +85			°C

Parameter	Symbol	Ratings				Unit
		SI-8501L	SI-8502L	SI-8503L	SI-8504L	
DC Input Voltage Range	V_{IN}	7 to 33	15 to 33	5.3 to 33	12 to 33	V
Output Current Range	I_O	0 to 1.0				A
Operating Temperature Range	T_{op}	–20 to +85				°C

■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings									Unit
		SI-8401L			SI-8402L			SI-8403L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	11.40	12.00	12.60	3.17	3.30	3.43	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			
Efficiency	η		80			88			75		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			
Oscillation Frequency	f		60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		100	130		60	80	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=18 to 30V, I_O=0.3A			V_{IN}=8 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		70	95		20	30	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			V_{IN}=15V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±0.5		mV/°C
Switching Ripple Voltage (C_2=470μF)	ΔV_r		20	40		35	70		15	30	mV_{p-p}
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			
Overcurrent Protection Starting Current	I_{S1}	0.55			0.45			0.55			A
	Conditions	V_{IN}=10V			V_{IN}=18V			V_{IN}=8V			

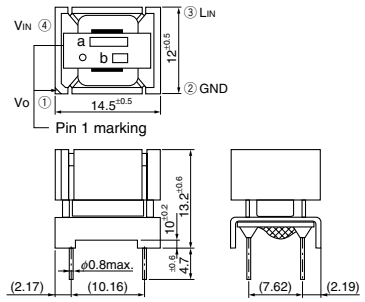
(T_a=25°C)

Parameter	Symbol	Ratings												Unit
		SI-8501L			SI-8502L			SI-8503L			SI-8504L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	11.40	12.00	12.60	3.17	3.30	3.43	8.55	9.00	9.45	V
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			
Efficiency	η		83			89			79			87		%
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			
Oscillation Frequency	f		60			60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			
Line Regulation	ΔV_{OLINE}		70	130		70	130		50	80		70	130	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.5A			V_{IN}=18 to 30V, I_O=0.5A			V_{IN}=8 to 30V, I_O=0.5A			V_{IN}=15 to 30V, I_O=0.5A			
Load Regulation	ΔV_{OLOAD}		30	55		30	55		20	45		30	55	mV
	Conditions	V_{IN}=20V, I_O=0.2 to 0.8A			V_{IN}=24V, I_O=0.2 to 0.8A			V_{IN}=15V, I_O=0.2 to 0.8A			V_{IN}=21V, I_O=0.2 to 0.8A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±0.5			±1.0		mV/°C
Switching Ripple Voltage (C_2=470μF)	ΔV_r		45			30			15			25		mV_{p-p}
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			
Overcurrent Protection Starting Current	I_{S1}	1.1			1.1			1.1			1.1			A
	Conditions	V_{IN}=18V			V_{IN}=24V			V_{IN}=12V			V_{IN}=21V			

■External Dimensions (Non-package type [EI-12.5 core/EI-19 core])

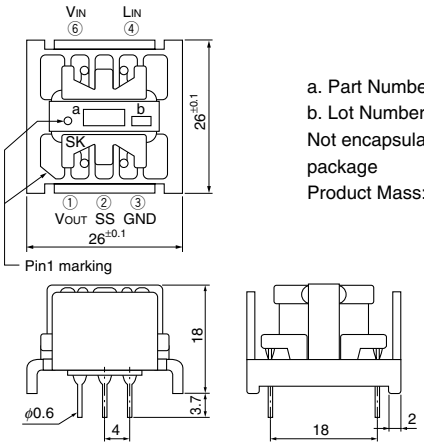
(Unit : mm)

SI-8400L



a. Part Number
b. Lot Number
Not encapsulated in a plastic package
Product Mass: Approx. 5.1g

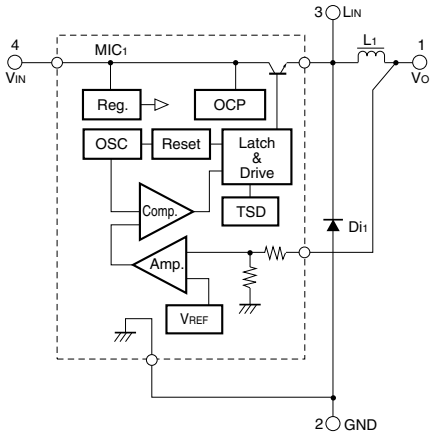
SI-8500L



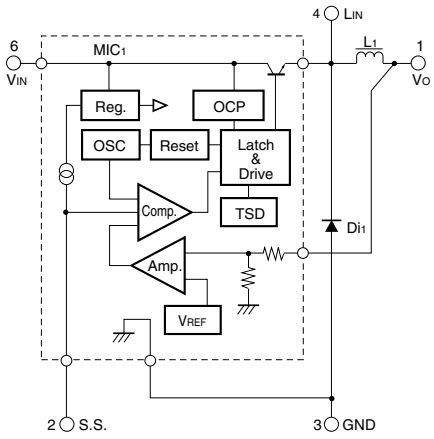
a. Part Number
b. Lot Number
Not encapsulated in a plastic package
Product Mass: Approx. 14.5g

■Block Diagram

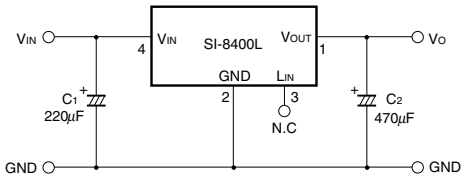
SI-8400L

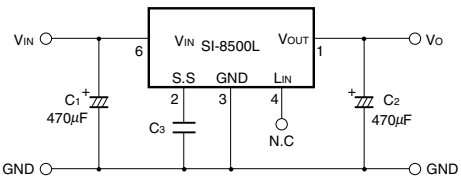


SI-8500L



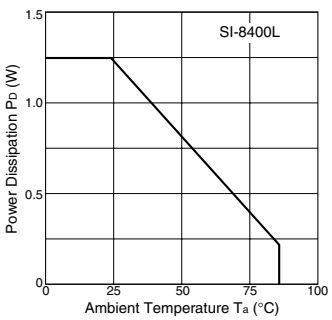
■Typical Connection Diagram

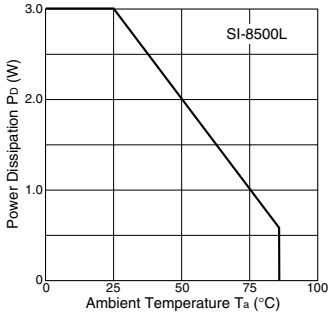




C3 is necessary only for using soft start function.

■Ta-PD Characteristics





$$P_D = V_O \bullet I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

VO : Output voltage
IO : Output current
ηχ : Efficiency (%)

The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graphs and substitute the percentage in the formula above.

Application Note

■ Heat Dissipation and Reliability

The reliability of an IC is highly dependent on its operating temperature. Please be sure to apply silicone grease to the IC and to mount it to the heatsink with a proper mounting torque.
Heatsink design should pay particular attention to ensuring sufficient heat dissipation capacity.
In addition, please take into account the air convection in operation.
The reliability of discrete components such as capacitors and coils is closely related to temperature. A high operating temperature may reduce the service life. Exceeding the allowable temperature may burn the coils or damage capacitors. It is important to make sure that the temperature of output smoothing coils and input/output capacitors do not exceed their allowable levels during operation. With an adequate derating for the coils, minimize heat emission as far as possible. (For discrete components, refer to the individual user manuals.)

■ Thermal Design

The maximum junction temperature $T_{j(max)}$ given in the Absolute Maximum Ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the maximum power dissipation $P_{D(max)}$, which varies by the conditions of use, and the maximum ambient temperature $T_{a(max)}$.
To simplify the thermal design, T_a-P_D characteristic graphs are provided herein. Please observe the following steps for heatsink design:

1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

Although the heatsink size is now obtained, in actual applications, 10-to-20% derating factor is generally introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink or case temperature in the actual operating environment.
Please refer to the T_a-P_D characteristic graphs for respective product types.

■ Mounting Torque

STA800M Series (when mounted by using a spring)
0.588 to 0.784 [N•m] (6.0 to 8.0 [kgf•cm]

■ Recommended Silicone Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- GE Toshiba Silicones Co., Ltd.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

STA801M 2-Output Separate Excitation Switching Mode Regulator ICs

■Features

- 2 regulators combined in 1 package
- Compact inline package
- Output current (0.5A × 2 outputs)
- Output voltage of Ch2 selectable from 4 levels
- Built-in flywheel diode (Schottky barrier diode)
- Requires only 7 discrete components (2 outputs)
- Internally-adjusted phase corrections and output voltages
- Built-in reference oscillator (125kHz) - Enables to downsize a choke-coil due to IC's high oscillating frequency. (Compared with conventional Sanken devices)
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuits (Output ON/OFF available)

■Lineup

Part Number	Output Voltage (V)	
	Ch1	Ch2(Select one output)
STA801M	5	9.0 / 11.5 / 12.1 / 15.5

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Power Dissipation	P_{D1}	6.7(With infinite heatsink)	W
	P_{D2}	1.6(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C

■Applications

- For BS and CS antenna power supplies
- For stabilization of the secondary stage of switching power supplies
- Electronic equipment

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		min.	max.	
DC Input Voltage Range	V_{IN}	Ch2 $V_{Omax.}$+2	40	V
Output Current Range per Channel	I_O	0	0.5	A
Operating Temperature Range	T_{jop}	–20	+125	°C

■Electrical Characteristics

(T_a=25°C)

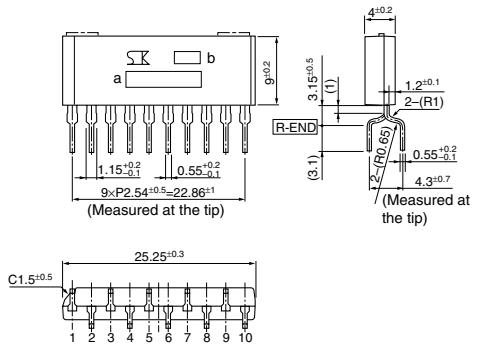
	Parameter	Symbol	Ratings STA801M min.	typ.	max.	Unit
Ch1	Output voltage 1	V_{O1}	4.80	5.00	5.20	V
		Conditions	V_{IN}=20V, I_O=0.3A			
	Efficiency *	η1		80		%
		Conditions	V_{IN}=20V, I_O=0.3A			
	Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_{a1}$		±0.5		mV/°C
	Line Regulation	ΔV_{OLINE1}		30	90	mV
		Conditions	V_{IN}=10 to 30V, I_O=0.3A			
	Load Regulation	ΔV_{OLOAD1}		10	40	mV
		Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			
Ch2 (Select one output)	Output voltage 2-1	V_{O2}-1	8.64	9.00	9.36	V
		Conditions	V_{IN}=20V, I_O=0.3A			
	Output voltage 2-2	V_{O2}-2	11.04	11.50	11.96	V
		Conditions	V_{IN}=20V, I_O=0.3A			
	Output voltage 2-3	V_{O2}-3	11.62	12.10	12.58	V
		Conditions	V_{IN}=20V, I_O=0.3A			
	Output voltage 2-4	V_{O2}-4	14.88	15.50	16.12	V
		Conditions	V_{IN}=20V, I_O=0.3A			
V_{O2}-4	Efficiency*	η		89		%
		Conditions	V_{IN}=20V, I_O=0.3A			
	Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±2.0		mV/°C
	Line Regulation	ΔV_{OLINE}		40	130	mV
		Conditions	V_{IN}=20 to 30V, I_O=0.3A			
	Load Regulation	ΔV_{OLOAD}		30	120	mV
		Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			
Common	No-load Circuit Current	I_{CC}		15		mA
	Oscillation Frequency	f		125		kHz
	Overcurrent Protection Starting Current	I_{S1}	0.51	0.7		A

* Efficiency indicates the value when only one channel is active. The value can be calculated as shown below. 7.5mA is deducted for the no-load circuit current of $\frac{I_{CC}}{2}$ at unused output.

$$\eta = \frac{V_O \bullet I_O}{V_{IN} \bullet (I_{IN} - 0.0075)} \times 100(\%)$$

■External Dimensions (SIP10 [STA 10Pin])

(Unit : mm)

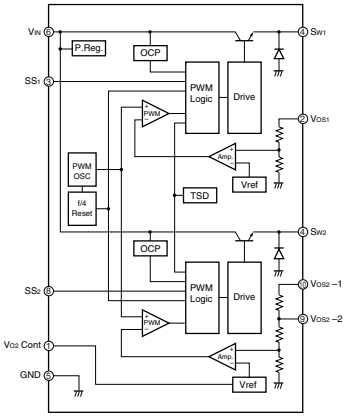


a. Part Number
b. Lot Number

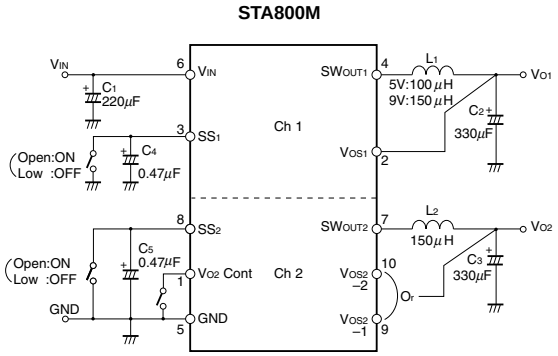
Pin Assignment

①	V_{O2} C_{ont}	⑧	SS2
②	V_{OS1}	⑨	V_{OS2}–2
③	SS1	⑩	V_{OS2}–1
④	SW_{OUT1}		
⑤	GND		Plastic Mold Package Type
⑥	V_{IN}		Flammability: UL94V-0
⑦	SW_{OUT2}		Product Mass: Approx. 2.5g

■Block Diagram

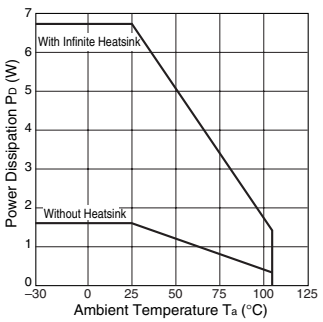


■Typical Connection Diagram



For how to connect VOS2-1 and VOS2-2 of Channel 2, refer to the output selection method on the Sanken web site.

■T_a-P_D Characteristics



SPI-8001TW/SPI-8002TW/SPI-8003TW 2-Output, Step-down Switching Mode Regulator ICs

■Features

- 2 regulators combined in one package
- Output current: 1.5A × 2 (HSOP 16 Pin Surface mount package)
- High efficiency: TYP80% (SPI-8001TW), TYP78% (SPI-8002TW)
- Variable output voltage: 1.0 to 16V (SPI-8001TW), 1.0 to 24V (SPI-8002TW)
- Built-in reference oscillator (250kHz). Enables to downsize a choke-coil
- Low circuit current consumption: ≤ 1μA (at output OFF)
- High accuracy reference voltage: ±1%
- Built-in foldback-overcurrent and thermal protection circuits
- Built-in ON/OFF circuit (soft start available) – per output

■Absolute Maximum Ratings*1

Parameter	Symbol	Ratings			Unit
		SPI-8001TW	SPI-8002TW	SPI-8003TW	
Input Voltage	V_{IN}	21	40	40	V
	V_{CC}	21	40	40	V
	$V_{C/E}$	21	40	40	V
Power Dissipation*2, *3	P_D	3.0			W
Junction Temperature	Tj	+135		+150	°C
Storage Temperature	Tstg	–40 to +135		–40 to +150	°C
Thermal Resistance (junction to case)*2	θj-c	9.0			°C/W
Thermal Resistance (junction to ambient air)*2	θj-a	35.8			°C/W

*1: Absolute maximum ratings show the destructive limit. No parameter should exceed the ratings in transient or normal operations.
*2: When mounted on glass-epoxy board 70cm^2 (copper laminate area 30.8cm^2).
*3: Limited by thermal protection.

■Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions*1

Parameter	Symbol	Ratings						Unit
		SPI-8001TW		SPI-8002TW		SPI-8003TW		
		Min	Max	Min	Max	Min	Max	
Input Voltage Range	V_{IN}	V_O+3	20	V_O+3	38	V_O+3	38	V
	V_{CC}	4.5	20	4.5	38	4.5	38	V
	$V_{C/E}$		20		38		38	V
Output Voltage Range	V_O	1	16	1	24	1	24	V
Output Current Range	I_O		1.5		1.5		1.5	A
Operating Junction Temperature Range	Tjop	–30	+135	–30	+135	–30	+125	°C
Operating Temperature Range	Top	–30	+135	–30	+135	–30	+85	°C

*1: Recommended operating conditions show the operating conditions required for the normal circuit function described in the electrical characteristics. These conditions must be followed in actual use.

■Electrical Characteristics[*1]

(T_a=25°C)

Parameter		Symbol	Ratings									Unit
			SPI-8001TW			SPI-8002TW			SPI-8003TW			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Reference Voltage		V_{REF}	0.996	1.006	1.016	0.996	1.006	1.016	0.966	1.006	1.016	V
		Conditions	V_{IN}=10V, V_O=1V, I_O=0.1A						V_{IN}=14V, I_O=0.1A			
Temperature Coefficient of Reference Voltage		$\Delta V_{REF}/\Delta T$		±0.1			±0.1			±0.1		mV/°C
		Conditions	V_{IN}=10V, V_O=1V, I_O=0.1A, Ta=–30 to +135°C						V_{IN}=14V, I_O=0.1A, Ta=–30 to +125°C			
Efficiency 1[*2]		Eff1		80			78			78		%
		Conditions	V_{IN}=V_{CC}=15V, V_O=5V, I_O=0.5A, I_{IN}: including I_{CC}						V_{IN}= V_{CC}=14V, V_O=5V, I_O=0.5A, I_{IN}: including I_{CC}			
Efficiency 2[*2]		Eff2		83			81			81		%
		Conditions	V_{IN}=15V, V_O=5V, I_O=0.5A, V_{CC}=5V, I_{IN}: excluding I_{CC}						V_{IN}=14V, V_{CC}=5V, V_O=5V, I_O=0.5A, I_{IN}: excluding I_{CC}			
Oscillation Frequency		f_{osc}		250		215	250	285	200		400	kHz
		Conditions	V_{IN}=V_{CC}=15V, V_O=5V, I_O=0.5A						V_{IN}=14V, I_O=0.1A, C_{OSC}=100pF			
Line Regulation		VLine		30	60		30	60		30	60	mV
		Conditions	V_{IN}=V_{CC}=10 to 20V, V_O=5V, I_O=1A						V_{IN}=V_{CC}=9 to 18V, V_O=5V, I_O=1A			
Load Regulation		VLoad		10	40		10	40		10	40	mV
		Conditions	V_{IN}=V_{CC}=15V, V_O=5V, I_O=0.2 to 1.5A						V_{IN}=V_{CC}=14V, V_O=5V, I_O=0.2 to 1.5A			
Overcurrent Protection Starting Current		Is	1.6			1.6			1.6			A
		Conditions	V_{IN}=V_{CC}=15V						V_{IN}=V_{CC}=14V			
Quiescent Circuit Current 1		I_{IN}		4			4			4		mA
		Conditions	V_{IN}=15V, V_{CC}=5V, I_O=0V, V_O≤12V						V_{IN}=14V, V_{CC}=5V, I_O=0A, V_O≤12V			
Quiescent Circuit Current 2		I_{CC}		8.5			8.5			8.5		mA
		Conditions	V_{CC}=15V, I_O=0A						V_{CC}=14V, I_O=0A			
Quiescent Circuit Current 3		$I_{IN\ (off)}$			1			1			1	μA
		Conditions	V_{IN}=15V, $V_{C/E}$=0V or Open						V_{IN}=14V, $V_{C/E}$=0V or Open			
Quiescent Circuit Current 4		$I_{CC\ (off)}$			1			1			1	μA
		Conditions	V_{CC}=15V, $V_{C/E}$=0V or Open						V_{IN}=14V, $V_{C/E}$=0V or Open			
Quiescent Circuit Current 5		$I_{IN\ (ssov)}$	—							4		mA
		Conditions	—						V_{IN}=14V, V_{CC}=5V, I_O=0A, SS1=SS2=0V			
Quiescent Circuit Current 6		$I_{CC\ (ssov)}$	—							8.5		mA
		Conditions	—						V_{CC}=14V, I_O=0V, SS1=SS2=0V			
C/E Terminal	High Level Voltage	$V_{C/EH}$	2			2			2			V
		Conditions	V_{IN}=V_{CC}=15V						V_{IN}=V_{CC}=14V			
	Low Level Voltage	$V_{C/EL}$			0.8			0.8			0.8	V
		Conditions	V_{IN}=V_{CC}=15V						V_{IN}=V_{CC}=14V			
	Inflow Current at High	$I_{C/EH}$		95			95			95		μA
		Conditions	$V_{C/E}$=20V						$V_{C/E}$=20V			
SS Terminal[*3]	Low Level Voltage	V_{SSL}			0.5			0.5			0.5	V
		Conditions	V_{IN}=V_{CC}=15V						V_{IN}=V_{CC}=14V			
	Inflow Current at Low	I_{SSL}		60	80		60	80		60	80	μA
		Conditions	V_{SSL}=0V, V_{IN}=V_{CC}=15V						V_{SSL}=0V, V_{IN}=V_{CC}=14V			

*1: Electrical characteristics show the characteristic ratings guaranteed when operating the ICs under the measurement conditions described in the above table.

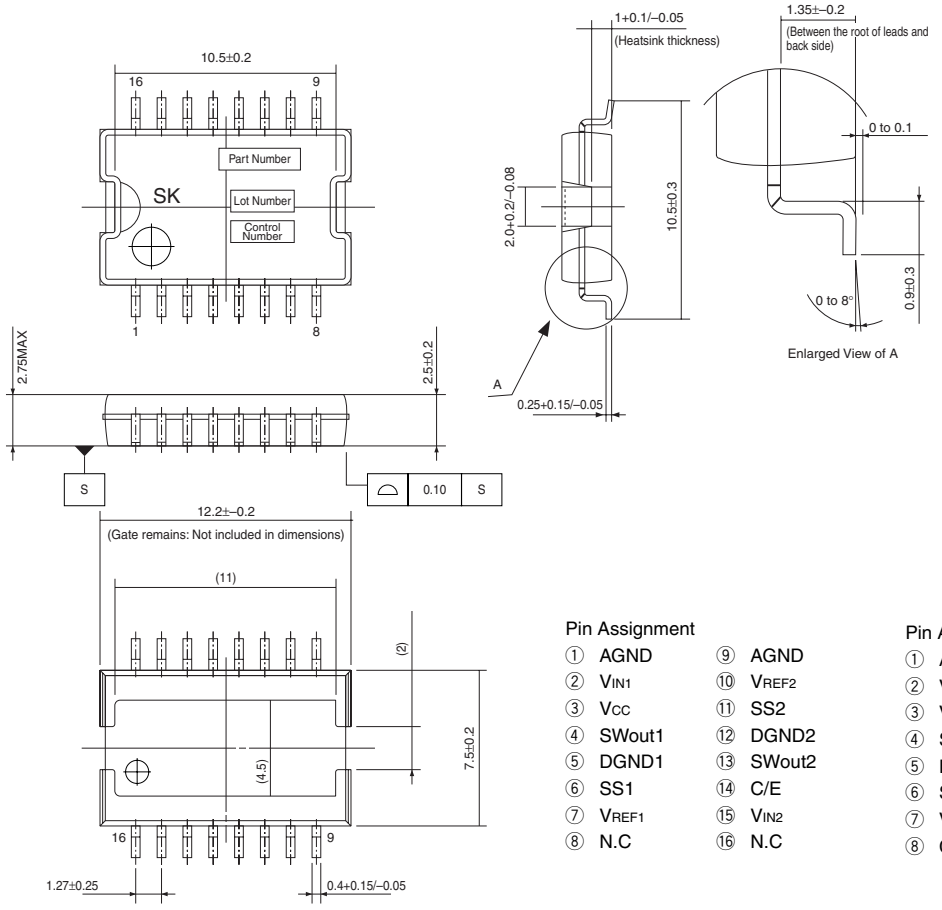
*2: Efficiency is calculated from the following formula.

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

*3: Pin 6 and pin 11 are the SS pins. Soft start at power on can be performed with capacitors connected to these pins. The outputs can also be turned ON/OFF with these pins. The outputs are stopped by setting the voltages of these pins to V_{SSL} or lower. SS-pin voltages can be changed with open-collector drive circuits of transistors.
When using both the soft-start and ON/OFF functions together, the discharge currents from C_4 and C_5 flow into the ON/OFF control transistors respectively. Therefore, limit the currents securely to protect the transistors if C_4 and C_5 capacitances are large. The SS pins are pulled up to the power supply in the ICs, so applying the external voltages are prohibited.

■External Dimensions (HSOP16)

(Unit : mm)



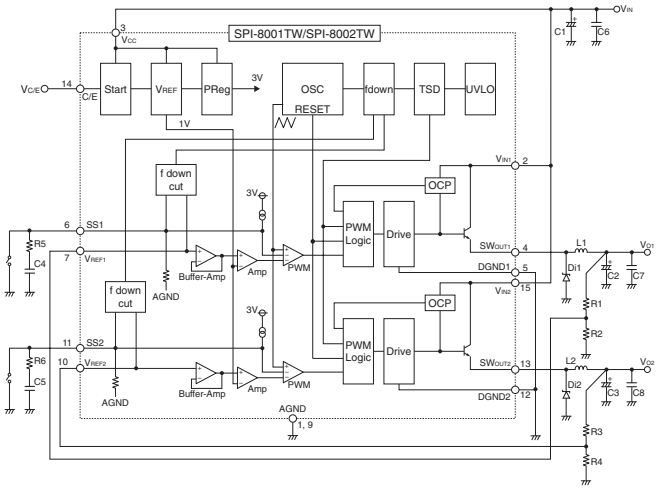
Pin Assignment

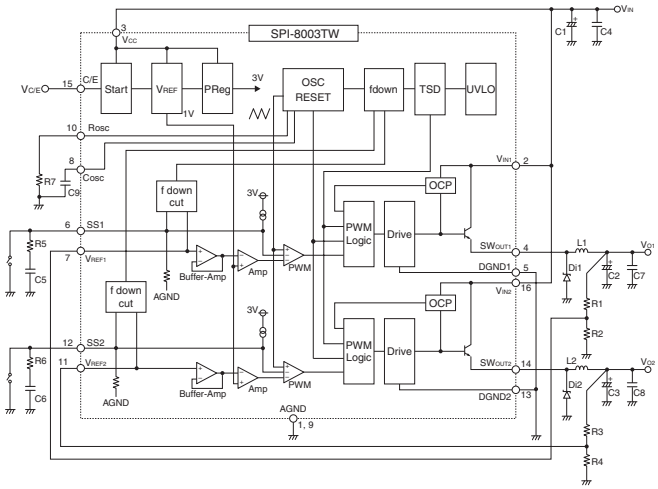
①	AGND	⑨	AGND
②	V_{IN1}	⑩	V_{REF2}
③	V_{CC}	⑪	SS2
④	SWout1	⑫	DGND2
⑤	DGND1	⑬	SWout2
⑥	SS1	⑭	C/E
⑦	V_{REF1}	⑮	V_{IN2}
⑧	N.C	⑯	N.C

Pin Assignment (SPI-8003TW)

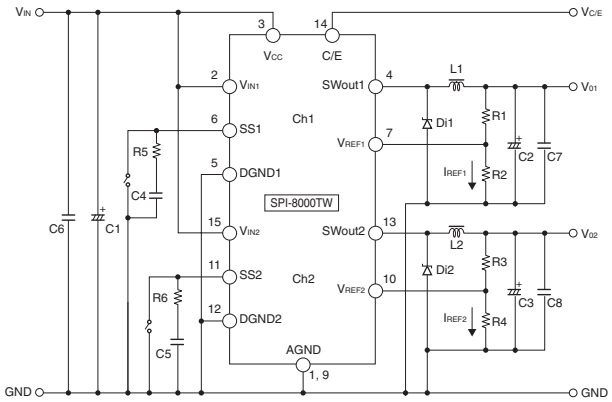
①	AGND	⑨	AGND
②	V_{IN1}	⑩	R_{OSC}
③	V_{CC}	⑪	V_{REF2}
④	SWout1	⑫	SS2
⑤	DGND1	⑬	DGND2
⑥	SS1	⑭	SWout2
⑦	V_{REF1}	⑮	C/E
⑧	C_{OSC}	⑯	V_{IN2}

■Block Diagram

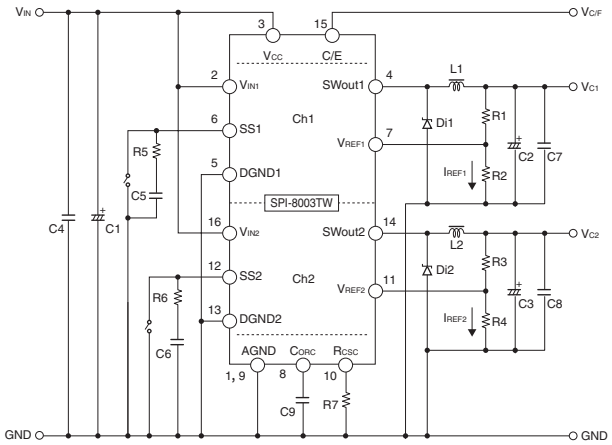




■Typical Connection Diagram



C1	: 220 μF/50V	R5, R6	: 1kΩ
C2, C3	: 470 μF/25V	L1, L2	: 47 μH
C4, C5	: 1 μF	Di1, Di2	: SJPB-H6
C6, C7, C8	: 0.1 μF	(Sanken)	



C1	: 220 μF/50V	C9	: 100pF/10V
C2, C3	: 470 μF/25V	L1, L2	: 47 μH
C4	: 1 μF/50V	R2, R4	: 1kΩ
C5, C6	: 1 μF/10V	R5, R6	: 1kΩ
C7, C8	: 0.1 μF/50V	Di1, Di2	: SJPB-H6 (Sanken)

Diodes Di1, Di2

- Be sure to use Schottky-barrier diodes for Di1 and Di2.
  If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coils L1, L2

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 2.0A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.
- Use a closed-magnetic-path coil to prevent interference between the channels $SW_{out}1$ and $SW_{out}2$.

Capacitors C1, C2, C3

- As large ripple currents flow through C1, C2 and C3, use high-frequency and low-impedance capacitors suitable for switching mode power supplies. Especially when the impedance of C2 and C3 are high, the switching waveforms may become abnormal at low temperatures. For C2 and C3, do not use capacitors with extremely low equivalent series resistance (ESR) such as OS capacitors or tantalum capacitors, which may cause abnormal oscillation.

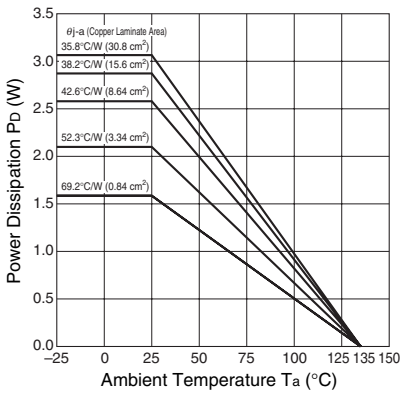
Resistors R1, R2, R3, R4

- R1, R2, R3 and R4 are resistors for setting output voltages. Set the resistors so that I_{REF} is approx. 1 mA. For example, R1 and R2 can be calculated as shown below.

$$R1=\frac{(V_{O1}-V_{REF1})}{I_{REF1}}=\frac{(V_{O1}-V)}{1\times10^{-3}}\ (\Omega),\ R2=\frac{V_{REF1}}{I_{REF1}}=\frac{1}{1\times10^{-3}}\fallingdotseq1(K\Omega)$$

◎ To create the optimum operating conditions, place the components as close as possible to each other.

■T_a-P_D Characteristics



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

V_O : Output Voltage
V_{IN} : Input Voltage
I_O : Output Current
$\eta\chi$: Efficiency (%)
V_F : D_1 Forward Voltage
SJPB-H6···0.45V (I_O=1A)

Note 1: The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.
Note 2: Thermal design for D_1 must be considered separately.

SI-3000KWF Series 2-Output, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact full-mold package (equivalent to TO220F)
- Output current: 1.0A × 2
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at I_O = 1A)
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
		SI-3002KWF/SI-3003KWF	
DC Input Voltage	V_{IN}*1	18	V
Output Control Terminal Voltage	V_C	6	V
Output Current*1	I_{O1}	1.0	A
	I_{O2}	1.0	
Power Dissipation (with two outputs ON)	P_D*2	14	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{op}	–30 to +85	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	66.7	°C/W
Thermal Resistance (Junction to Lead)	$\theta_{j\text{-}c}$	7	°C/W

*1: V_{IN} (max), I_{O1} (max) and I_{O2} (max) are restricted by the relation $P_D = (V_{IN} - V_{O1}) \times I_{O1} + (V_{IN} - V_{O2}) \times I_{O2}$.
*2: T_C = 25°C (With infinite heatsink)
Thermal protection may operate when the junction temperature exceeds 135°C.

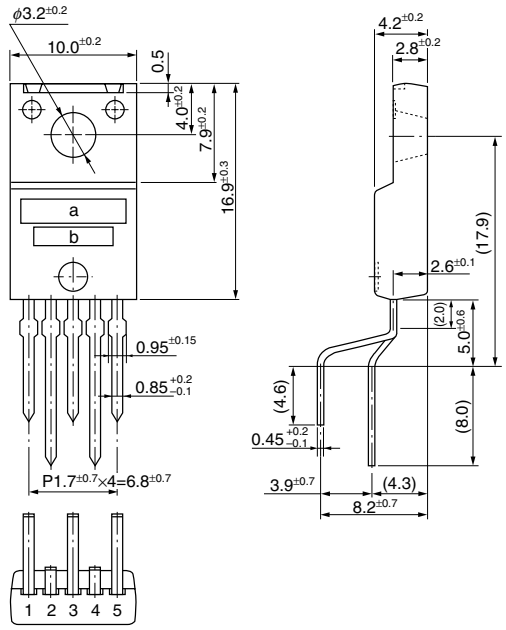
■Electrical Characteristics

Parameter		Symbol	Ratings						Unit
			SI-3002KWF			SI-3003KWF			
			min.	typ.	max.	min.	typ.	max.	
Output Voltage		V_{O1}	3.234	3.300	3.366	2.450	2.500	2.550	V
		Conditions	V_{IN}=5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			
		V_{O2}	2.450	2.500	2.550	1.764	1.800	1.836	
		Conditions	V_{IN}=5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			
Line Regulation		ΔV_{OLINE1}			20			20	mV
		Conditions	V_{IN}=4.5 to 10V, I_O=10mA			V_{IN}=3.2 to 5V, I_O=10mA			
		ΔV_{OLINE2}			20			20	
		Conditions	V_{IN}=4.5 to 10V, I_O=10mA			V_{IN}=3.2 to 5V, I_O=10mA			
Load Regulation		ΔV_{OLOAD1}			30			30	mV
		Conditions	V_{IN}=5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			
		ΔV_{OLOAD2}			30			30	
		Conditions	V_{IN}=5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			
Dropout Voltage		V_{DIF1}			0.6			0.6	V
		Conditions	I_O=1A			I_O=1A			
Temperature Coefficient of Output Voltage		$\Delta V_{O1}/\Delta T_a$		±0.3			±0.3		mV/°C
		Conditions	T_j=0 to 100°C			T_j=0 to 100°C			
		$\Delta V_{O2}/\Delta T_a$		±0.3			±0.3		
		Conditions	T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ1}		60			60		dB
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			
		R_{REJ2}		60			60		
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			
Overcurrent Protection Starting Current*1		I_{S1} 1	1.2			1.2			A
		Conditions	V_{IN}=5V			V_{IN}=3.3V			
		I_{S1} 2	1.2			1.2			
		Conditions	V_{IN}=5V			V_{IN}=3.3V			
Quiescent Circuit Current		I_q		1	1.5		1	1.5	mA
		Conditions	V_{IN}=5V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		$I_{q\ (OFF)}$			0.5			0.5	mA
		Conditions	V_{IN}=5V, V_C=0V			V_{IN}=3.3V, V_C=0V			
VC Terminal	Control Voltage (Output ON)*2	V_C, IH	2			2			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8	V
	Control Current (Output ON)	I_C, IH			5			5	μA
		Conditions	V_C=2.7V			V_C=2.7V			
	Control Current (Output OFF)	I_C, IL	–100			–100			μA
		Conditions	V_C=0.4V			V_C=0.4V			

*1: I_{S1} 1 and I_{S1} 2 are specified at the 5% drop points of output voltages V_{O1} and V_{O2} on the condition that V_{IN} = the condition of overcurrent protection starting current, I_O = 10 mA.
*2: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, the device can be driven directly by LS-TTLs.
Channels 1 and 2 are turned on or off at the same time.

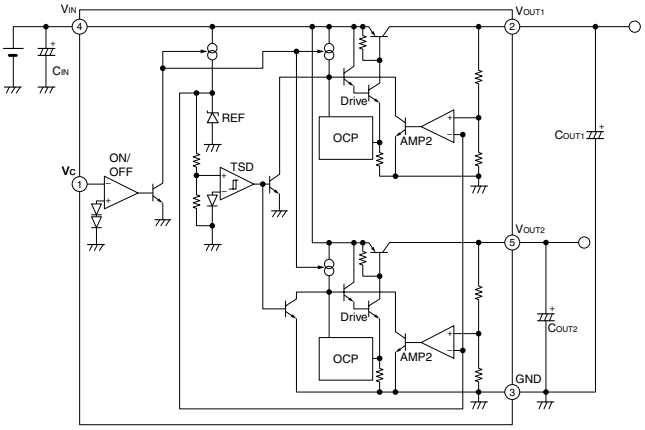
■External Dimensions (TO220F-5)

(Unit : mm)

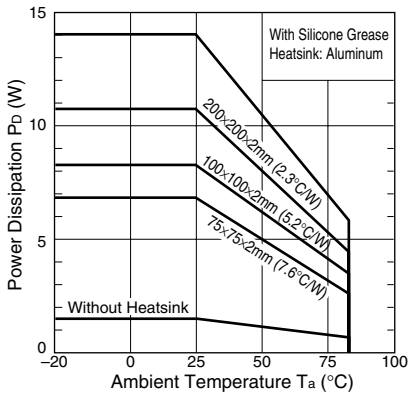


Pin Assignment
① V_C
② V_{O1}
③ GND
④ V_{IN}
⑤ V_{O2}

■Block Diagram



■T_a-P_D Characteristics



SI-3000KWM Series 2-Output, Surface-Mount, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface-mount package (TO252-5)
- Output current: 1.0A × 2
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at I_O = 1A)
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
		SI-3002KWM/SI-3003KWM	
DC Input Voltage	V_{IN}*1	18	V
Output Control Terminal Voltage	V_C	6	V
Output Current*1	I_{O1}	1.0	A
	I_{O2}	1.0	
Power Dissipation (with two outputs ON)	P_D*2	1	W
Junction Temperature	T_j	–30 to +125	°C
Operating Ambient Temperature	T_{op}	–30 to +85	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$	95	°C/W
Thermal Resistance (Junction to Lead)	$\theta_{j\text{-}c}$	6	°C/W

*1: V_{IN} (max), I_{O1} (max) and I_{O2} (max) are restricted by the relation $P_D = (V_{IN} - V_{O1}) \times I_{O1} + (V_{IN} - V_{O2}) \times I_{O2}$.
*2: When mounted on glass-epoxy board of 30 × 30mm^2 (copper laminate area 4.3%)
Thermal protection may operate when the junction temperature exceeds 135°C.

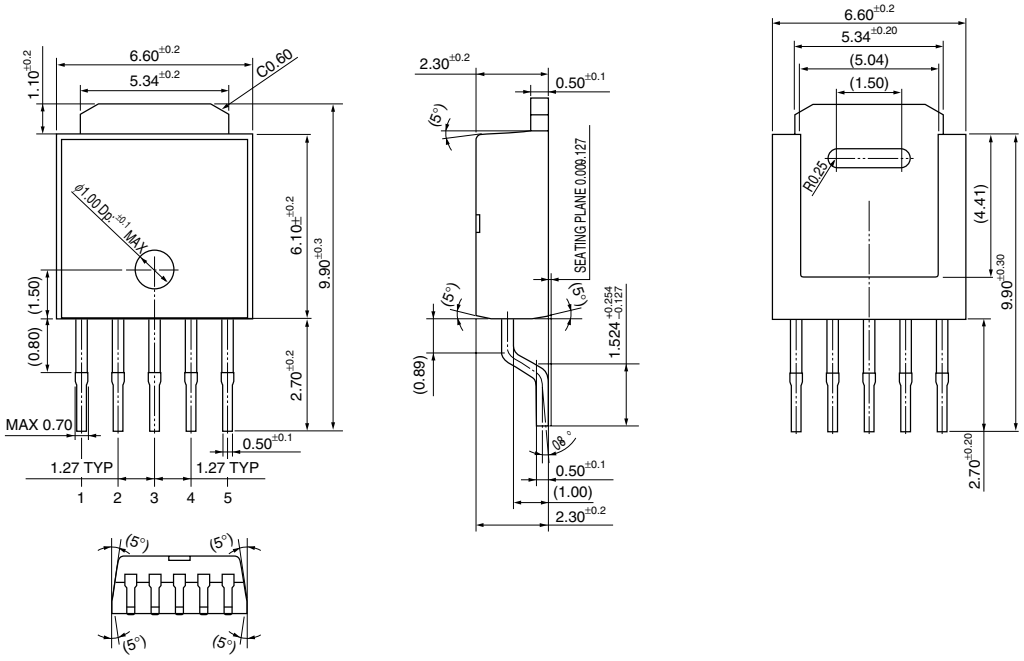
■Electrical Characteristics

Parameter		Symbol	Ratings						Unit
			SI-3002KWM			SI-3003KWM			
			min.	typ.	max.	min.	typ.	max.	
Output Voltage		V_{O1}	3.234	3.300	3.366	2.450	2.500	2.550	V
		Conditions	V_{IN}=5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			
		V_{O2}	2.450	2.500	2.550	1.764	1.800	1.836	
		Conditions	V_{IN}=5V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			
Line Regulation		ΔV_{OLINE1}			20			20	mV
		Conditions	V_{IN}=4.5 to 10V, I_O=10mA			V_{IN}=3.2 to 5V, I_O=10mA			
		ΔV_{OLINE2}			20			20	
		Conditions	V_{IN}=4.5 to 10V, I_O=10mA			V_{IN}=3.2 to 5V, I_O=10mA			
Load Regulation		ΔV_{OLOAD1}			30			30	mV
		Conditions	V_{IN}=5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			
		ΔV_{OLOAD2}			30			30	
		Conditions	V_{IN}=5V, I_O=0 to 1A			V_{IN}=3.3V, I_O=0 to 1A			
Dropout Voltage		V_{DIF1}			0.6			0.6	V
		Conditions	I_O=1A			I_O=1A			
Temperature Coefficient of Output Voltage		$\Delta V_{O1}/\Delta T_a$		±0.3			±0.3		mV/°C
		Conditions	T_j=0 to 100°C			T_j=0 to 100°C			
		$\Delta V_{O2}/\Delta T_a$		±0.3			±0.3		
		Conditions	T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ1}		60			60		dB
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			
		R_{REJ2}		60			60		
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=3.3V, f=100 to 120Hz			
Overcurrent Protection Starting Current*1		I_{S1} 1	1.2			1.2			A
		Conditions	V_{IN}=5V			V_{IN}=3.3V			
		I_{S1} 2	1.2			1.2			
		Conditions	V_{IN}=5V			V_{IN}=3.3V			
Quiescent Circuit Current		I_q		1	1.5		1	1.5	mA
		Conditions	V_{IN}=5V, I_O=0A, V_C=2V			V_{IN}=3.3V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		$I_{q\ (OFF)}$			0.5			0.5	mA
		Conditions	V_{IN}=5V, V_C=0V			V_{IN}=3.3V, V_C=0V			
VC Terminal	Control Voltage (Output ON)*2	V_C, IH	2			2			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8	V
	Control Current (Output ON)	I_C, IH			5			5	μA
		Conditions	V_C=2.7V			V_C=2.7V			
	Control Current (Output OFF)	I_C, IL	–100			–100			μA
		Conditions	V_C=0.4V			V_C=0.4V			

*1: I_{S1} 1 and I_{S1} 2 are specified at the 5% drop points of output voltages V_{O1} and V_{O2} on the condition that V_{IN} = the condition of protection starting current, I_O = 10 mA.
*2: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, the devices can be driven directly by LS-TTLs. Channels 1 and 2 are turned on or off at the same time.

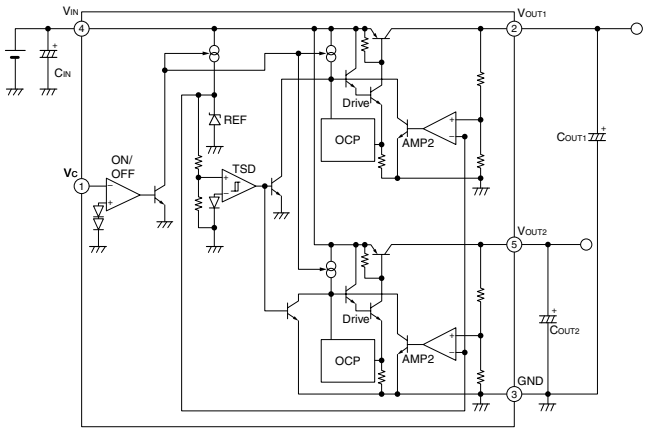
■External Dimensions (TO252-5)

(Unit : mm)



Pin Assignment
① V_C
② V_{O1}
③ GND
④ V_{IN}
⑤ V_{O2}

■Block Diagram



Selection Guide

2-Phase Stepper Motor Unipolar Driver ICs

Excitation Method	Output Current (A)					Motor Supply Voltage (V)	Package	Remarks	Page
	1.0	1.2	1.5	2.0	3.0				
2-Phase Excitation	SLA7022MU		SLA7029M			to 46	ZIP15 with Fin(SLA15Pin)		96
	SMA7022MU		SMA7029M			to 46	ZIP15(SMA15Pin)		96
			SMA7036M			to 46	ZIP15(SMA15Pin)		98
2-Phase/1-2 Phase Excitation	SDK03M					to 46	PS16(Surface-Mount)	Two ICs are used to drive a single motor.	106
	SLA7027MU		SLA7024M		SLA7026M	to 46	ZIP18 with Fin(SLA18Pin)		100
	SLA7031M		SLA7032M		SLA7033M	to 46	ZIP18 with Fin(SLA18Pin)		102
	SLA7050M			SLA7051M	SLA7052M	to 46	ZIP18 with Fin(SLA18Pin)	Built-in sequencer	104
	SLA7070MR		SLA7071MR	SLA7072MR	SLA7073MR	to 46	ZIP23 with Fin(SLA23Pin)	Built-in sequencer, Current sensing resistors	108
	SLA7070MPR		SLA7071MPR	SLA7072MPR	SLA7073MPR	to 46	ZIP23 with Fin(SLA23Pin)	Built-in sequencer, Current sensing resistors, Protection circuit	108
2W 1-2 Phase Excitation μ Step Support		SLA7042M			SLA7044M	to 46	ZIP18 with Fin(SLA18Pin)		110
	SLA7065M			SLA7066M	SLA7067M	to 46	ZIP21 with Fin(SLA21Pin)	Built-in sequencer	112
4W 1-2 Phase Excitation μ Step Support	SLA7060M			SLA7061M	SLA7062M	to 46	ZIP21 with Fin(SLA21Pin)	Built-in sequencer	114
	SLA7075MR		SLA7076MR	SLA7077MR	SLA7078MR	to 46	ZIP23 with Fin(SLA23Pin)	Built-in sequencer, Current sensing resistors	116
	SLA7075MPR		SLA7076MPR	SLA7077MPR	SLA7078MPR	to 46	ZIP23 with Fin(SLA23Pin)	Built-in sequencer, Current sensing resistors, Protection circuit	116

Serial Signal Generator for SLA704x

Part Number	Power Supply Voltage (V)	Package	Page
PG001M	4.5 to 5.5	DIP16	118

3-Phase Stepper Motor Driver ICs

Excitation Method	Part Number	Power Supply Voltage (V)	Output Current (A)	Package	Remarks	Page
2-Phase/2-3 Phase Excitation	SLA7611M	to 36	3.0	ZIP18 with Fin(SLA18Pin)		120

Application Note

■ Setup Precautions

●Recommended mounting torque
0.588 to 0.784 [N•m](6.0 to 8.0 [kgf•cm])
●Recommended silicone grease
Shin-Etsu Chemical Co., Ltd.: G746
GE Toshiba Silicones Co., Ltd.: YG-6260
Dow Corning Toray Silicone Co., Ltd.: SC102
Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

■ Handling Precautions

When using the following products that use C-MOS circuits for input terminals, observe the following.
SMA7036M/SLA7031M/SLA7032M/SLA7033M
SLA7050M/SLA7051M/SLA7052M
SLA7060M/SLA7061M/SLA7062M
SLA7065M/SLA7066M/SLA7067M
SLA7070MR/SLA7071MR/SLA7072MR/SLA7073MR
SLA7070MPR/SLA7071MPR/SLA7072MPR/SLA7073MPR
SLA7075MR/SLA7076MR/SLA7077MR/SLA7078MR
SLA7075MPR/SLA7076MPR/SLA7077MPR/SLA7078MPR
●Carefully control the humidity of the room to prevent the buildup of static electricity. Since static electricity is particularly a problem during the winter, be sure to take sufficient precautions.
Take care to make sure that static electricity is not applied to the IC during wiring and assembly. Take precautions such as shorting the terminals of the printed circuit board to ensure that they are at the same electrical potential.

SLA7022MU/SLA7029M/SMA7022MU/SMA7029M 2-Phase Excitation

■Absolute Maximum Ratings

(T_a=25°C)

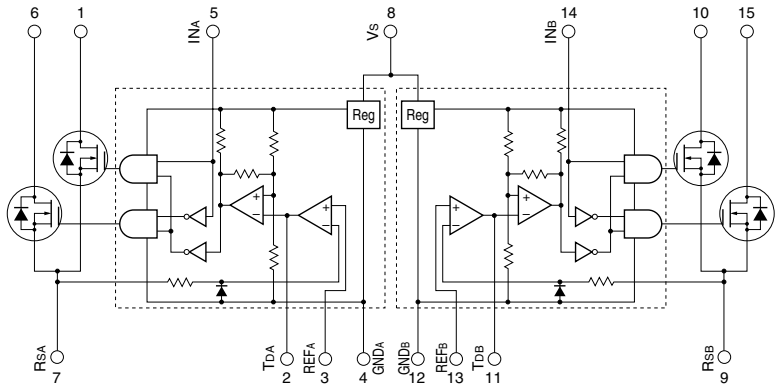
Parameter	Symbol	Ratings				Units
		SLA7022MU	SLA7029M	SMA7022MU	SMA7029M	
Motor supply voltage	V_{CC}	46				V
FET Drain-Source voltage	V_{DSS}	100				V
Control supply voltage	V_S	46				V
TTL input voltage	V_{IN}	7				V
Reference voltage	V_{REF}	2				V
Output current	I_O	1	1.5	1	1.5	A
Power dissipation	P_{D1}	4.5 (Without Heatsink)		4.0 (Without Heatsink)		W
	P_{D2}	35 (T_C=25°C)		28 (T_C=25°C)		W
Channel temperature	T_{ch}	+150				°C
Storage temperature	T_{stg}	–40 to +150				°C

■Electrical Characteristics

(T_a=25°C)

	Parameter	Symbol	Ratings												Units
			SLA7022MU			SLA7029M			SMA7022MU			SMA7029M			
			min	typ	max	min	typ	max	min	typ	max	min	typ	max	
DC characteristics	Control supply current	I_S		10	15		10	15		10	15		10	15	mA
		Condition	V_S=44V			V_S=44V			V_S=44V			V_S=44V			
	Control supply voltage	V_S	10	24	44	10	24	44	10	24	44	10	24	44	V
	FET Drain-Source voltage	V_{DSS}	100			100			100			100			V
		Condition	V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			
	FET ON voltage	V_{DS}			0.85			0.6			0.85			0.6	V
		Condition	I_D=1A, V_S=14V			I_D=1A, V_S=14V			I_D=1A, V_S=14V			I_D=1A, V_S=14V			
	FET drain leakage current	I_{DSS}			4			4			4			4	mA
		Condition	V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			
	FET diode forward voltage	V_{SD}			1.2			1.1			1.2			1.1	V
		Condition	I_D=1A			I_D=1A			I_D=1A			I_D=1A			
	TTL input current	I_{IH}			40			40		40			40		μA
		Condition	V_{IH}=2.4V, V_S=44V			V_{IH}=2.4V, V_S=44V			V_{IH}=2.4V, V_S=44V			V_{IH}=2.4V, V_S=44V			
		I_{IL}			–0.8			–0.8			–0.8			–0.8	mA
		Condition	V_{IL}=0.4V, V_S=44V			V_{IL}=0.4V, V_S=44V			V_{IL}=0.4V, V_S=44V			V_{IL}=0.4V, V_S=44V			
	TTL input voltage (Active High)	V_{IH}	2			2			2			2			V
		Condition	I_D=1A			I_D=1A			I_D=1A			I_D=1A			
		V_{IL}			0.8			0.8			0.8			0.8	
		Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
	TTL input voltage (Active Low)	V_{IH}	2			2			2			2			V
		Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
		V_{IL}			0.8			0.8			0.8			0.8	
		Condition	I_D=1A			I_D=1A			I_D=1A			I_D=1A			
AC characteristics	Switching time	T_r		0.5			0.5			0.5			0.5		μs
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			
		T_{stg}		0.7			0.7			0.7			0.7		
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			
		T_f		0.1			0.1			0.1			0.1		
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			

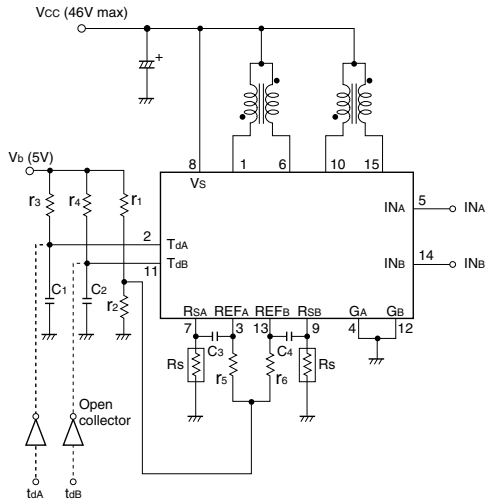
■Internal Block Diagram



1, 6, 10, 15pin
Description of pins

	Excitation input signal	
	Active H	Active L
1pin	OUT A	OUT $\bar{A}$
6pin	OUT $\bar{A}$	OUT A
10pin	OUT B	OUT $\bar{B}$
15pin	OUT $\bar{B}$	OUT B

■Typical Connection Diagram (Recommended component values)



Excitation signal time chart
2-phase excitation

clock	0	1	2	3	0	1
IN_A	H	H	L	L	H	H
IN_B	L	H	H	L	L	H

1-2 phase excitation

clock	0	1	2	3	4	5	6	7	0	1	2	3
IN_A	H	H	H	H	L	L	L	L	H	H	H	H
td_A	L	L	L	H	L	L	L	H	L	L	L	H
IN_B	L	L	H	H	H	H	L	L	L	L	H	H
td_B	L	H	L	L	L	H	L	L	L	H	L	L

●tdA and tdB are signals before the inverter stage.

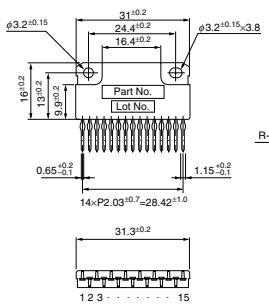
r1 : 510Ω
r2 : 100Ω (VR)
r3 : 47kΩ
r4 : 47kΩ
r5 : 2.4kΩ
r6 : 2.4kΩ

C1 : 330 to 500pF
C2 : 330 to 500pF
C3 : 2200pF
C4 : 2200pF
Rs : 1.8Ω typ (7022MU) (12W)
1Ω typ (7029M)

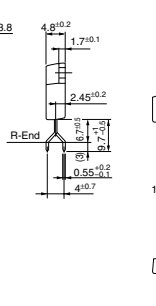
■External Dimensions (ZIP15 with Fin [SLA15Pin] /ZIP15[SMA15Pin])

(Unit:mm)

SLA7022MU/SLA7029M

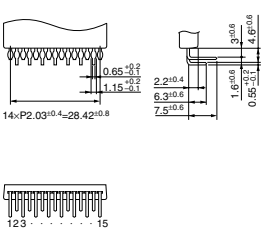


Forming No. No.853

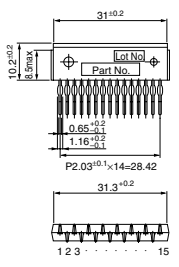


Forming No. No.855

Epoxy resin package

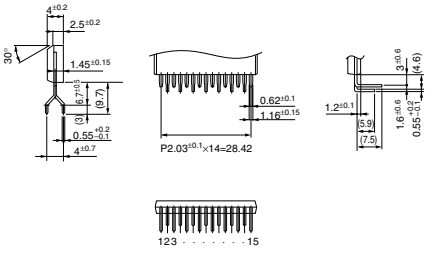


SMA7022MU/SMA7029MA



Forming No. No.1054

Epoxy resin package



Forming No. No.1055

SMA7036M 2-Phase Excitation

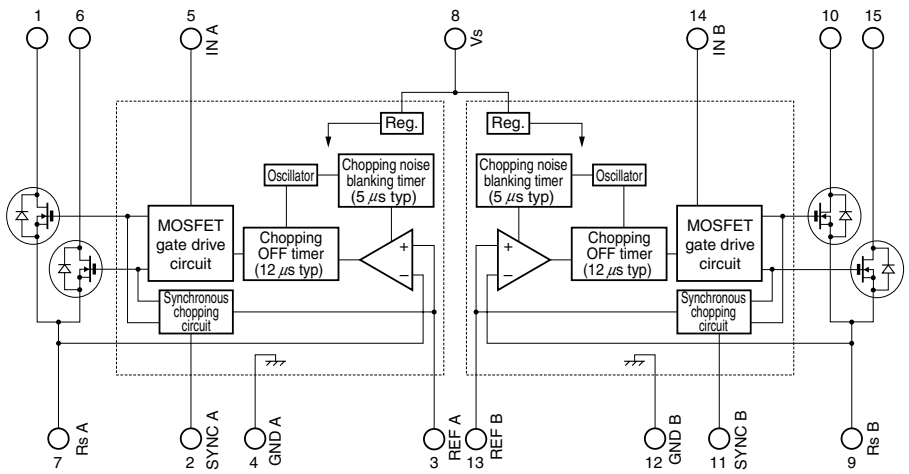
■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Motor supply voltage	V_{CC}	46	V
Control supply voltage	V_S	46	V
FET Drain-Source voltage	V_{DSS}	100	V
TTL input voltage	V_{IN}	–0.3 to +7	V
SYNC terminal voltage	V_{SYNC}	–0.3 to +7	V
Reference voltage	V_{REF}	–0.3 to +7	V
Sense voltage	V_{RS}	–5 to +7	V
Output current	I_O	1.5	A
Power dissipation	P_{D1}	4.0 (T_a=25°C)	W
	P_{D2}	28 (T_c=25°C)	W
Channel temperature	T_{ch}	150	°C
Storage temperature	T_{stg}	–40 to +150	°C
Operating ambient temperature	T_a	–20 to +85	°C

■Electrical Characteristics

	Parameter		Symbol	Ratings min	Ratings typ	Ratings max	Units
DC characteristics	Control supply current		I_S		10	15	mA
			Condition	V_S=44V			
	Control supply voltage		V_S	10	24	44	V
	FET Drain-Source voltage		V_{DSS}	100			V
			Condition	V_S=44V, I_{DSS}=250μA			
	FET ON voltage		V_{DS}			0.6	V
			Condition	I_D=1A, V_S=10V			
	FET diode forward voltage		V_{SD}			1.1	V
			Condition	I_{SD}=1A			
	FET drain leakage current		I_{DSS}			250	μA
			Condition	V_{DSS}=100V, V_S=44V			
	IN terminal	Active H	V_{IH}	2			V
			Condition	I_D=1A			
			V_{IL}			0.8	
			Condition	V_{DSS}=100V			
		Active L	V_{IH}	2			V
			Condition	V_{DSS}=100V			
			V_{IL}			0.8	
			Condition	I_D=1A			
		Input current	I_I			±1	μA
			Condition	V_S=44V, V_I=0 or 5V			
	SYNC terminal	Input voltage	$V_{SYNC}H$	4.0			V
			Condition	Synchronous chopping mode			
			$V_{SYNC}L$			0.8	
			Condition	Asynchronous chopping mode			
		Input current	$I_{SYNC}H$			0.1	mA
			Condition	V_S=44V, V_{YS}=5V			
			$I_{SYNC}L$			–0.1	
			Condition	V_S=44V, V_{YS}=0V			
	REF terminal	Input voltage	V_{REF}	0		2.0	V
			Condition	Reference voltage input			
			V_{REF}	4.0		5.5	
			Condition	Output FET OFF			
		Input current	I_{REF}			±1	μA
			Condition	No synchronous trigger			
		Internal resistance	R_{REF}		40		Ω
			Condition	Resistance between GND and REF terminal at synchronous trigger			
AC characteristics	Switching time		T_{on}		1.5		μs
			Condition	V_S=24V, I_D=1A			
			T_r		0.5		
			Condition	V_S=24V, I_D=1A			
			T_{stg}		0.9		
			Condition	V_S=24V, I_D=1A			
			T_f		0.1		
			Condition	V_S=24V, I_D=1A			
	Chopping OFF time		T_{OFF}		12		μs
			Condition	V_S=24V			

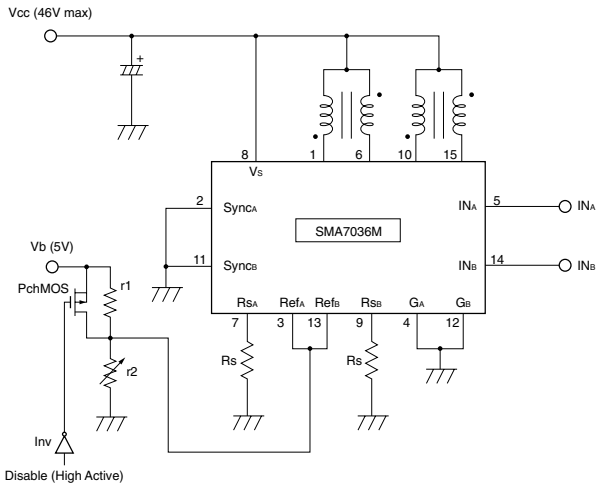
■Internal Block Diagram



1, 6, 10, 15pin
Description of pins

	Excitation input signal	
	Active H	Active L
1pin	OUT A	OUT $\bar{A}$
6pin	OUT $\bar{A}$	OUT A
10pin	OUT B	OUT $\bar{B}$
15pin	OUT $\bar{B}$	OUT B

■Typical Connection Diagram (Recommended component values)



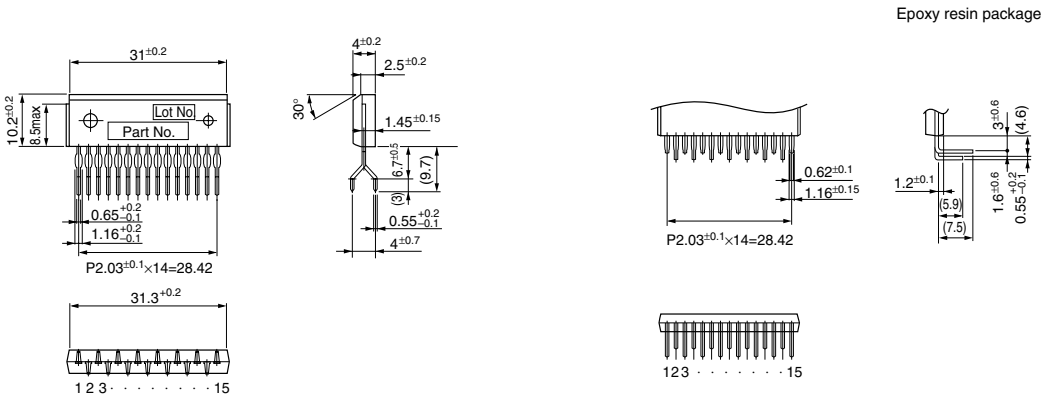
Excitation signal time chart
2-phase excitation

clock	0	1	2	3	0	1
IN_A	H	H	L	L	H	H
IN_B	L	H	H	L	L	H

r_1 : 8kΩ
r_2 : 2kΩ (VR)
R_S (1 to 2W) : 1Ω typ
PchMOS : HN1J02FU (Toshiba)
Inv : 7404

■External Dimensions (ZIP15 [SMA15Pin])

(Unit : mm)



Forming No. No.1054

Forming No. No.1055

SLA7027MU/SLA7024M/SLA7026M 2-Phase/1-2 Phase Excitation

■Absolute Maximum Ratings

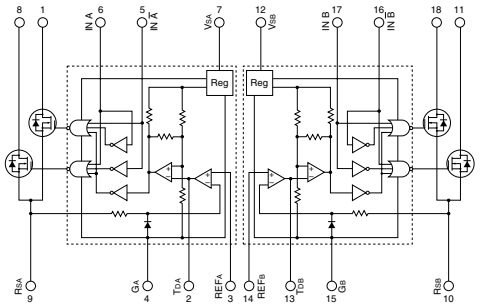
(T_a=25°C)

Parameter	Symbol	Ratings			Units
		SLA7027MU	SLA7024M	SLA7026M	
Motor supply voltage	V_{CC}	46			V
FET Drain-Source voltage	V_{DSS}	100			V
Control supply voltage	V_S	46			V
Input voltage	V_{IN}	7			V
Reference voltage	V_{REF}	2			V
Output current	I_O	1	1.5	3	A
Power dissipation	P_{D1}	4.5 (Without Heatsink)			W
	P_{D2}	35 (T_C=25°C)			W
Channel temperature	T_{ch}	+150			°C
Storage temperature	T_{stg}	–40 to +150			°C

■Electrical Characteristics

	Parameter	Symbol	Ratings									Units
			SLA7027MU			SLA7024M			SLA7026M			
			min	typ	max	min	typ	max	min	typ	max	
DC characteristics	Control supply current	I_S		10	15		10	15		10	15	mA
		Condition	V_S=44V			V_S=44V			V_S=44V			
	Control supply voltage	V_S	10	24	44	10	24	44	10	24	44	V
	FET Drain-Source voltage	V_{DSS}	100			100			100			V
		Condition	V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			
	FET ON voltage	V_{DS}			0.85			0.6			0.85	V
		Condition	I_D=1A, V_S=14V			I_D=1A, V_S=14V			I_D=3A, V_S=14V			
	FET drain leakage current	I_{DSS}			4			4			4	mA
		Condition	V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			
	FET diode forward voltage	V_{SD}			1.2			1.1			2.3	V
		Condition	I_D=1A			I_D=1A			I_D=3A			
	TTL input current	I_{IH}			40			40			40	μA
		Condition	V_{IH}=2.4V, V_S=44V			V_{IH}=2.4V, V_S=44V			V_{IH}=2.4V, V_S=44V			
		I_{IL}			–0.8			–0.8			–0.8	mA
		Condition	V_{IL}=0.4V, V_S=44V			V_{IL}=0.4V, V_S=44V			V_{IL}=0.4V, V_S=44V			
	TTL input voltage (Active High)	V_{IH}	2			2			2			V
		Condition	I_D=1A			I_D=1A			I_D=3A			
		V_{IL}			0.8			0.8			0.8	
		Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
	TTL input voltage (Active Low)	V_{IH}	2			2			2			V
		Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
		V_{IL}			0.8			0.8			0.8	
		Condition	I_D=1A			I_D=1A			I_D=3A			
AC characteristics	Switching time	T_r		0.5			0.5			0.5		μs
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=1A			
		T_{stg}		0.7			0.7			0.7		
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=1A			
		T_f		0.1			0.1			0.1		
		Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=1A			

■Internal Block Diagram

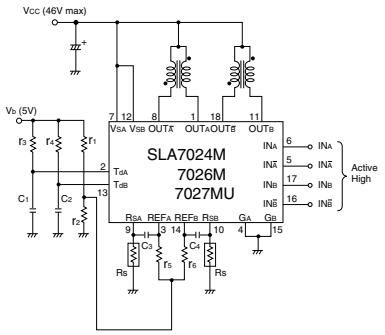


1, 8, 11, 18pin
Description of pins

	Excitation input signal	
	Active H	Active L
Pin 1	OUT_A	$OUT_{\overline{A}}$
Pin 8	$OUT_{\overline{A}}$	OUT_A
Pin 11	OUT_B	$OUT_{\overline{B}}$
Pin 18	$OUT_{\overline{B}}$	OUT_B

■Typical Connection Diagram (Recommended component values)

Active High



Excitation signal time chart
2-phase excitation

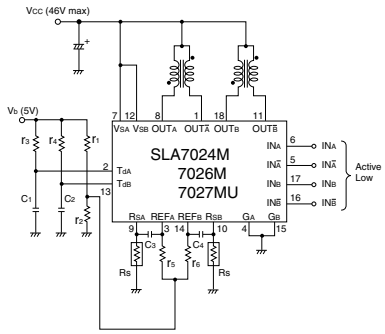
clock	0	1	2	3	0	1
IN_A	H	L	L	H	H	L
$IN_{\overline{A}}$	L	H	H	L	L	H
IN_B	H	H	L	L	H	H
$IN_{\overline{B}}$	L	L	H	H	L	L

1-2 phase excitation

clock	0	1	2	3	4	5	6	7	0	1	2	3
IN_A	H	H	L	L	L	L	L	H	H	H	L	L
$IN_{\overline{A}}$	L	L	L	H	H	H	L	L	L	L	L	H
IN_B	L	H	H	H	L	L	L	L	L	H	H	H
$IN_{\overline{B}}$	L	L	L	L	L	H	H	H	L	L	L	L

r_1 : 510Ω
r_2 : 100Ω (VR)
r_3 : 47kΩ
r_4 : 47kΩ
r_5 : 2.4kΩ
r_6 : 2.4kΩ
C_1 : 470pF
C_2 : 470pF
C_3 : 2200pF
C_4 : 2200pF
R_S : 1Ω typ (7024M)
(1 to 2W) 0.68Ω typ (7026M)
1.8Ω typ (7027MU)

Active Low



Excitation signal time chart
2-phase excitation

clock	0	1	2	3	0	1
IN_A	L	H	H	L	L	H
$IN_{\overline{A}}$	H	L	L	H	H	L
IN_B	L	L	H	H	L	L
$IN_{\overline{B}}$	H	H	L	L	H	H

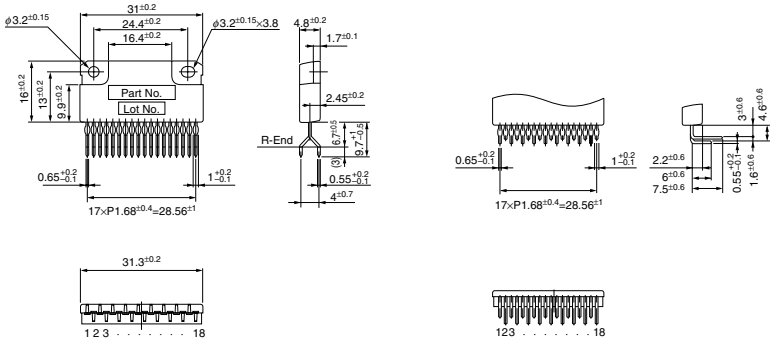
1-2 phase excitation

clock	0	1	2	3	4	5	6	7	0	1	2	3
IN_A	L	L	H	H	H	H	H	L	L	L	H	H
$IN_{\overline{A}}$	H	H	H	L	L	L	H	H	H	H	H	L
IN_B	H	L	L	L	H	H	H	H	H	L	L	L
$IN_{\overline{B}}$	H	H	H	H	H	L	L	L	H	H	H	H

r_1 : 510Ω
r_2 : 100Ω (VR)
r_3 : 47kΩ
r_4 : 47kΩ
r_5 : 2.4kΩ
r_6 : 2.4kΩ
C_1 : 470pF
C_2 : 470pF
C_3 : 2200pF
C_4 : 2200pF
R_S : 1Ω typ (7024M)
(1 to 2W) 0.68Ω typ (7026M)
1.8Ω typ (7027MU)

■External Dimensions (ZIP18 with Fin [SLA18Pin])

(Unit : mm)



Forming No. No.871

Forming No. No.872

SLA7031M/SLA7032M/SLA7033M 2-Phase/1-2 Phase Excitation

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Units
		SLA7031M	SLA7032M	SLA7033M	
Motor supply voltage	V_{CC}	46			V
Control supply voltage	V_S	46			V
FET Drain-Source voltage	V_{DSS}	100			V
Input voltage	V_{IN}	−0.3 to +7			V
	V_{SYNC}	−0.3 to +7			
Reference voltage	V_{REF}	−0.3 to +7			V
Sense voltage	V_{RS}	−5 to +7			V
Output current	I_O	1	1.5	3	A
Power dissipation	P_{D1}	4.5(Without Heatsink)			W
	P_{D2}	35(T_c=25°C)			W
Channel temperature	T_{ch}	+150			°C
Operating ambient temperature	T_a	−20 to+85			°C
Storage temperature	T_{stg}	−40 to +150			°C

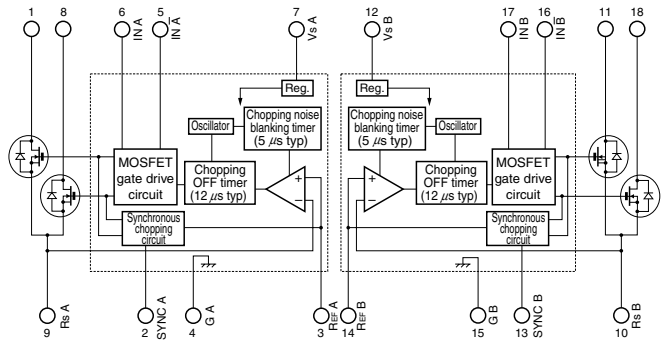
■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit	Remarks
		min	max		
Motor Supply Voltage	V_M		44	V	
Control Supply Voltage	V_S	10	44	V	
REF Input Voltage	V_{REF}	0.1	1.0	V	The control current precision is degraded at 0.1V or lower.
	$V_{REF(dis)}$	4.0	5.5	V	Output MOS FET OFF
Case Temperature	T_C		100	°C	Temperature of 4(15)-Pin Lead(without heatsink)

■Electrical Characteristics

	Parameter		Symbol	Ratings									Units
				SLA7031M			SLA7032M			SLA7033M			
				min	typ	max	min	typ	max	min	typ	max	
DC characteristics	Control supply current		I_S		10	15		10	15		10	15	mA
			Condition	V_S=44V			V_S=44V			V_S=44V			
	Control supply voltage		V_S	10	24	44	10	24	44	10	24	44	V
	FET Drain-Source voltage		V_{DSS}	100			100			100			V
			Condition	V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			V_S=44V, I_{DSS}=250μA			
	FET ON voltage		V_{DS}			0.85			0.6			0.85	V
			Condition	I_D=1A, V_S=10V			I_D=1A, V_S=14V			I_D=3A, V_S=14V			
	FET diode forward voltage		V_{SD}			1.2			1.1			2.3	V
			Condition	I_{SD}=1A			I_{SD}=1A			I_{SD}=3A			
	FET drain leakage current		I_{DSS}			250			250			250	μA
			Condition	V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			V_{DSS}=100V, V_S=44V			
	IN terminal	Input voltage (Active High)	V_{IH}	2.0			2.0			2.0			V
			Condition	I_D=1A			I_D=1A			I_D=3A			
			V_{IL}			0.8			0.8			0.8	
			Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
		Input voltage (Active Low)	V_{IH}	2.0			2.0			2.0			V
			Condition	V_{DSS}=100V			V_{DSS}=100V			V_{DSS}=100V			
			V_{IL}			0.8			0.8			0.8	
			Condition	I_D=1A			I_D=1A			I_D=3A			
		Input current	I_I			±1			±1			±1	μA
			Condition	V_S=44V, V_I=0 or 5V			V_S=44V, V_I=0 or 5V			V_S=44V, V_I=0 or 5V			
	SYNC terminal	Input voltage	V_{SYNC}	4.0			4.0			4.0			V
			Condition	Synchronous chopping mode			Synchronous chopping mode			Synchronous chopping mode			
			V_{SYNC}			0.8			0.8			0.8	
			Condition	Asynchronous chopping mode			Asynchronous chopping mode			Asynchronous chopping mode			
		Input current	I_{SYNC}			0.1			0.1			0.1	mA
			Condition	V_S=44V, V_{SYNC}=5V			V_S=44V, V_{SYNC}=5V			V_S=44V, V_{SYNC}=5V			
			I_{SYNC}			−0.1			−0.1			−0.1	
			Condition	V_S=44V, V_{SYNC}=0V			V_S=44V, V_{SYNC}=0V			V_S=44V, V_{SYNC}=0V			
	REF terminal	Input current	V_{REF}	0		2.0	0		2.0	0		2.0	V
			Condition	Reference voltage input			Reference voltage input			Reference voltage input			
			V_{REF}	4.0		5.5	4.0		5.5	4.0		5.5	
			Condition	Output FET OFF			Output FET OFF			Output FET OFF			
		Input current	I_{REF}			±1			±1			±1	μA
			Condition	No synchronous trigger			No synchronous trigger			No synchronous trigger			
		Internal resistance	R_{REF}		40			40			40		Ω
			Condition	Resistance between GND and REF terminal at synchronous trigger			Resistance between GND and REF terminal at synchronous trigger			Resistance between GND and REF terminal at synchronous trigger			
	Sense Voltage		VR_S		V_{REF}			V_{REF}			V_{REF}		V
AC characteristics	Switching time		T_r		0.5			0.5			0.5		μs
			T_{stg}		0.7			0.7			0.7		
			T_f		0.1			0.1			0.1		
			Condition	V_S=24V, I_D=0.8A			V_S=24V, I_D=1A			V_S=24V, I_D=1A			
	Chopping OFF time		T_{OFF}		12			12			12		μs
			Condition	V_S=24V			V_S=24V			V_S=24V			

■Internal Block Diagram

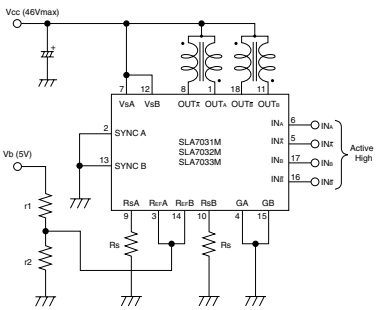


1,8,11,18pin
Description of pins

	Excitation input signal	
	Active H	Active L
1pin	OUT A	OUT $\bar{A}$
8pin	OUT $\bar{A}$	OUT A
11pin	OUT B	OUT $\bar{B}$
18pin	OUT $\bar{B}$	OUT B

■Typical Connection Diagram (Recommended component values)

Active High



Excitation signal time chart
2-phase excitation

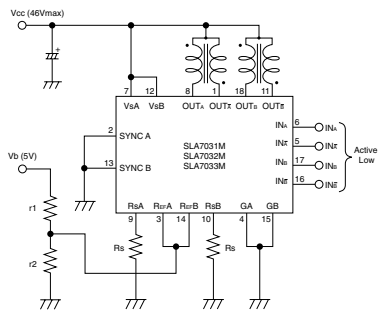
clock	0	1	2	3	0	1
IN_A	H	L	L	H	H	L
$IN_{\bar{A}}$	L	H	H	L	L	H
IN_B	H	H	L	L	H	H
$IN_{\bar{B}}$	L	L	H	H	L	L

1-2 phase excitation

clock	0	1	2	3	4	5	6	7	0	1	2	3
IN_A	H	H	L	L	L	L	L	H	H	H	L	L
$IN_{\bar{A}}$	L	L	L	H	H	H	L	L	L	L	L	H
IN_B	L	H	H	H	L	L	L	L	L	H	H	H
$IN_{\bar{B}}$	L	L	L	L	L	H	H	H	L	L	L	L

r_1 : 4kW
r_2 : 1kW (VR)
R_S : 1W typ (7031M/7032M)
(1 to 2W) 0.68W typ (7033M)

Active Low



Excitation signal time chart
2-phase excitation

clock	0	1	2	3	0	1
IN_A	L	H	H	L	L	H
$IN_{\bar{A}}$	H	L	L	H	H	L
IN_B	L	L	H	H	L	L
$IN_{\bar{B}}$	H	H	L	L	H	H

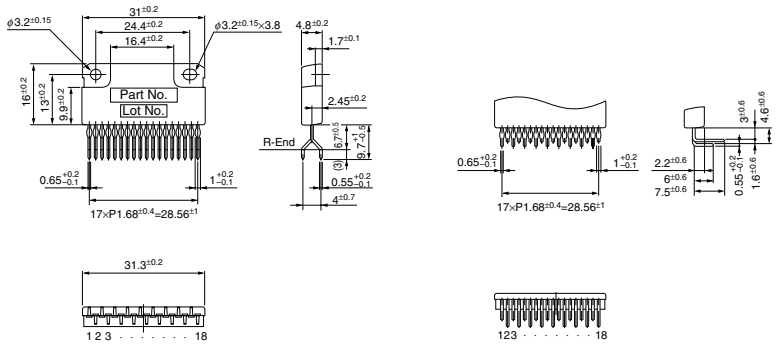
1-2 phase excitation

clock	0	1	2	3	4	5	6	7	0	1	2	3
IN_A	L	L	H	H	H	H	H	L	L	L	H	H
$IN_{\bar{A}}$	H	H	H	L	L	L	H	H	H	H	H	L
IN_B	H	L	L	L	H	H	H	H	H	L	L	L
$IN_{\bar{B}}$	H	H	H	H	H	L	L	L	H	H	H	H

r_1 : 4kW
r_2 : 1kW (VR)
R_S : 1W typ (7031M/7032M)
(1 to 2W) 0.68W typ (7033M)

■External Dimensions (ZIP18 with Fin [SLA18Pin])

(Unit : mm)



Forming No. No.871

Forming No. No.872

SLA7050M/SLA7051M/SLA7052M 2-Phase/1-2 Phase Excitation, Built-in Sequencer

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Unit
		SLA7050M	SLA7051M	SLA7052M	
Motor Supply Voltage	V_M	46			V
Load Supply Voltage	V_S	46			V
Logic Supply Voltage	V_{CC}	7			V
Output Current	I_O	1	2	3	A
Logic Input Voltage	V_{IN}	–0.3 to V_{CC}+0.3			V
REF Input Voltage	V_{REF}	–0.3 to V_{CC}+0.3			V
Sense Voltage	V_{RS}	–2 to +2			V
Power Dissipation	P_{D1}	4 (Without Heatsink)			W
	P_{D2}	20 (T_C=25°C)			W
Junction Temperature	T_j	+150			°C
Operating Ambient Temperature	T_a	–20 to +85			°C
Storage Temperature	T_{stg}	–30 to +150			°C

■Recommended Operating Conditions

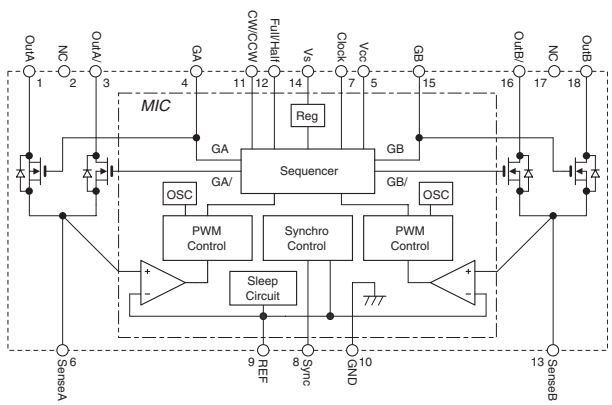
Parameter	Symbol	Ratings		Unit	Remarks
		min.	max.		
Motor Supply Voltage	V_M		44	V	
Load Supply Voltage	V_S	10	44	V	
Logic Supply Voltage	V_{CC}	3.0	5.5	V	The V_{CC} surge voltage should be 0.5V or lower.
REF Input Voltage	V_{REF}	0.1	1.0	V	The control current precision is degraded at 0.1V or lower.
Case Temperature	T_C		100	°C	Temperature at pin-10 Lead (Without heatsink)

■Electrical Characteristics

(V_{CC} = 5V, V_S = 24V, T_a = 25°C, unless otherwise specified)

Parameter	Symbol	Ratings									Unit
		SLA7050M			SLA7051M			SLA7052M			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Main Supply Current	I_{SS}			15			15			15	mA
	Conditions	Normal operation			Normal operation			Normal operation			
	I_S			100			100			100	μA
	Conditions	Sleep mode			Sleep mode			Sleep mode			
Logic Supply Current	I_{CC}			3			3			3	mA
Output MOSFET Breakdown Voltage	V_{DSS}	100			100			100			V
	Conditions	V_S=44V, I_{DSS}=1mA			V_S=44V, I_{DSS}=1mA			V_S=44V, I_{DSS}=1mA			
Output MOSFET ON Resistance	$R_{DS\ (ON)}$			0.85			0.5			0.27	Ω
	Conditions	I_D=1A			I_D=1A			I_D=3A			
Output MOSFET Diode Forward Voltage	V_{SD}			1.2			1.1			2.3	V
	Conditions	I_{SD}=1A			I_{SD}=1A			I_{SD}=3A			
Maximum Clock Frequency	F_{clock}			100			100			100	kHz
Logic Input Voltage	V_{IL}			V_{CC}·0.25			V_{CC}·0.25			V_{CC}·0.25	V
	V_{IH}	V_{CC}·0.75			V_{CC}·0.75			V_{CC}·0.75			
Logic Input Current	I_{IL}		±1			±1			±1		μA
	I_{IH}		±1			±1			±1		
REF Input Voltage	V_{REF}	0		1.5	0		1.5	0		1.5	V
	Conditions	Normal-operation current control			Normal-operation current control			Normal-operation current control			
	V_{REFS}	2		V_{CC}	2		V_{CC}	2		V_{CC}	
	Conditions	Output OFF (sleep)			Output OFF (sleep)			Output OFF (sleep)			
REF Input Current	I_{REF}		±10			±10			±10		μA
Sense Voltage	V_{RS}		V_{REF}			V_{REF}			V_{REF}		V
PWM OFF Time	T_{OFF}		12			12			12		μS
PWM Minimum ON Time	$T_{ON\ (min)}$		5			5			5		μS
Sleep - Enable Recovery Time	T_{SE}	100			100			100			
	Conditions	V_{REF} : 2.0→1.5V, I_O : 0.75A			V_{REF} : 2.0→1.5V, I_O : 1.5A			V_{REF} : 2.0→1.5V, I_O : 2.0A			μS
Switching Time	T_{ONC}		2.5			2.5			2.5		μS
	Conditions	Clock→Out			Clock→Out			Clock→Out			
	T_{OFFC}		2.0			2.0			2.0		
	Conditions	Clock→Out			Clock→Out			Clock→Out			

■Internal Block Diagram and Pin Assignment



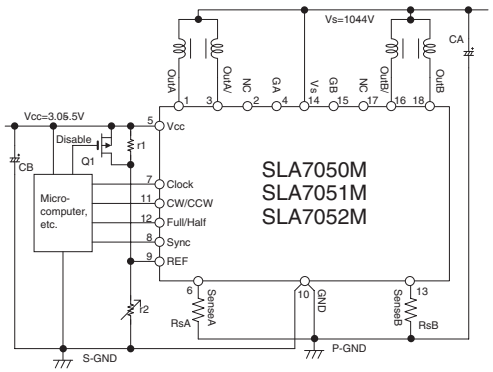
Pin No.	Symbol	Function
1	OutA	Phase A output
2	NC	No Connection
3	Out$\overline{A}$	Phase $\overline{A}$ output
4	GA	No Connection
5	V_{CC}	Logic supply
6	SenseA	Phase A current sense
7	Clock	Step Clock input
8	Sync	Synchronous PWM control signal input
9	Ref	Control current setting & output OFF
10	GND	Device GND
11	CW/CCW	Normal/reverse control input
12	Full/Half	Full/Half Step control input
13	SenseB	Phase B current sense
14	V_S	Load supply (motor supply)
15	GB	No Connection
16	Out$\overline{B}$	Phase $\overline{B}$ output
17	NC	No Connection
18	OutB	Phase B output

Truth Table

	L	H
CW/CCW	CW	CCW
Full/Half	Full	Half
REF	Enable	Disable
Sync	Asynchronous	Synchronous
Clock		▲

* REF terminal turns into normal operation at VREF < 1.5V.
The output is disabled (Output OFF) at VREF > 2V.

■Typical Connection Diagram

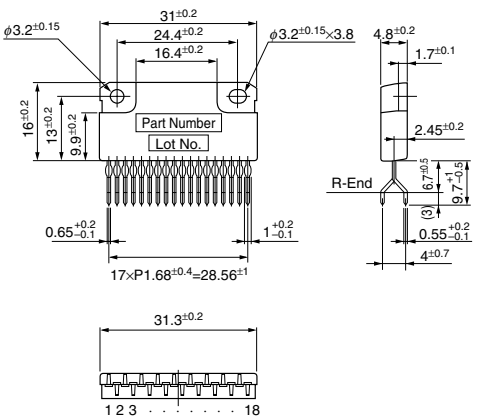


Rs=0.1 to 2Ω (Power dissipation should be: P≒Io^2 × Rs)
R1=10kΩ CA=100μF/50V
R2=5.1kΩ (VR) CB=10μF/10V
Q1:T.B.D

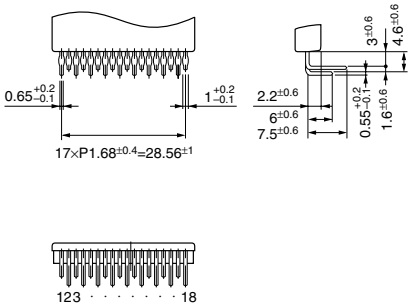
* V_{CC} line noise precaution:
The device may malfunction if the V_{CC} line noise exceeds 0.5V.
* Be sure to connect the unused logic input terminals (CW/CCW, F/H, Sync) to V_{CC} or GND. If they are open, the device will malfunction.
* GND pattern precaution:
Separating the V_{CC} system GND (S-GND) and V_S system GND (P-GND) from the device GND (10-Pin) helps to reduce noise.

■External Dimensions (ZIP18 with Fin [SLA18Pin])

(Unit : mm)



Forming No. No.871



Forming No. No.872

SDK03M 2-Phase/1-2 Phase Excitation

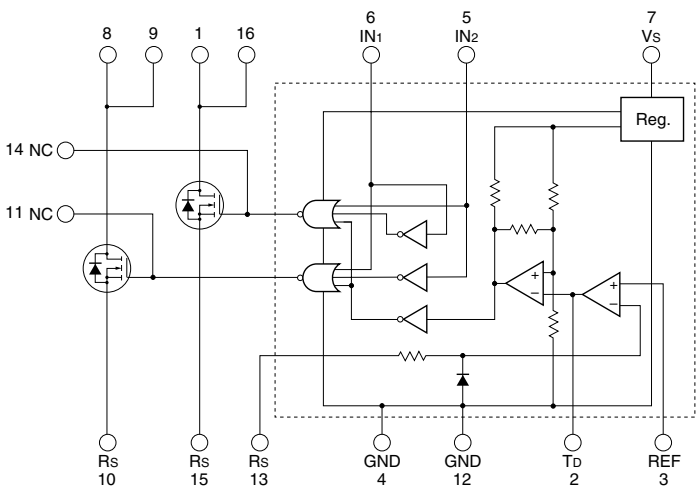
■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Motor supply voltage	V_{CC}	46	V
FET Drain-Source voltage	V_{DSS}	100	V
Control supply voltage	V_S	46	V
TTL input voltage	V_{IN}	7	V
Reference voltage	V_{REF}	2	V
Output current	I_O	1	A
Power dissipation	P_D	2.5 (Without Heatsink)	W
Channel temperature	T_{ch}	+150	°C
Storage temperature	T_{stg}	–40 to +150	°C

■Electrical Characteristics

	Parameter	Symbol	Ratings min	Ratings typ	Ratings max	Units
DC characteristics	Control supply current	I_S		5	7.5	mA
		Condition		V_S=44V		
	Control supply voltage	V_S	10	24	44	V
	FET Drain-Source voltage	V_{DSS}	100			V
		Condition		V_S=44V, I_{DSS}=250μA		
	FET ON voltage	V_{DS}			0.85	V
		Condition		I_D=1A, V_S=14V		
	FET drain leakage current	I_{DSS}			4	mA
		Condition		V_{DSS}=100V, V_S=44V		
	FET diode forward voltage	V_{SD}			1.2	V
		Condition		I_D=1A		
	TTL input current	I_{IH}			40	μA
		Condition		V_{IH}=2.4V, V_S=44V		
		I_{IL}			–0.8	mA
		Condition		V_{IL}=0.4V, V_S=44V		
	TTL input voltage (Active High)	V_{IH}	2			V
		Condition		I_D=1A		
		V_{IL}			0.8	
		Condition		V_{DSS}=100V		
	TTL input voltage (Active Low)	V_{IH}	2			V
		Condition		V_{DSS}=100V		
		V_{IL}			0.8	
		Condition		I_D=1A		
AC characteristics	Switching time	T_r		0.5		μs
		Condition		V_S=24V, I_D=0.8A		
		T_{stg}		0.7		
		Condition		V_S=24V, I_D=0.8A		
		T_f		0.1		
		Condition		V_S=24V, I_D=0.8A		

■Internal Block Diagram

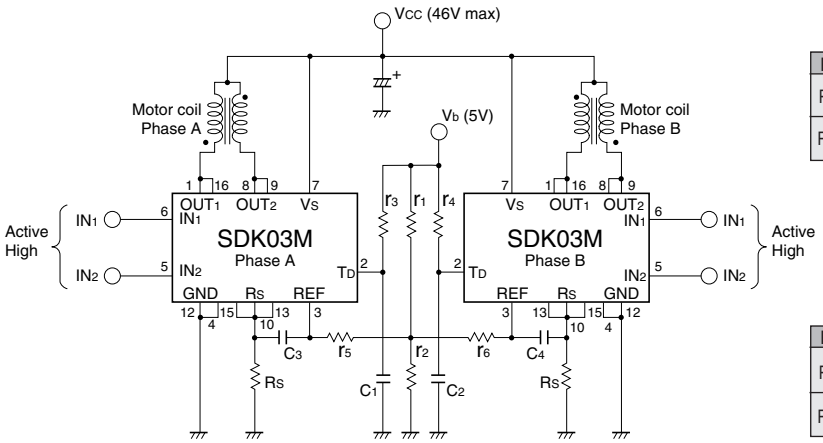


1,8,9,16pin Description of pins

	Excitation input signal	
	Active H	Active L
Pin 1	OUT_1	OUT_2
Pin 16		
Pin 8	OUT_2	OUT_1
Pin 9		

■Typical Connection Diagram (Recommended component values)

Active High



Excitation signal time chart
2-phase excitation

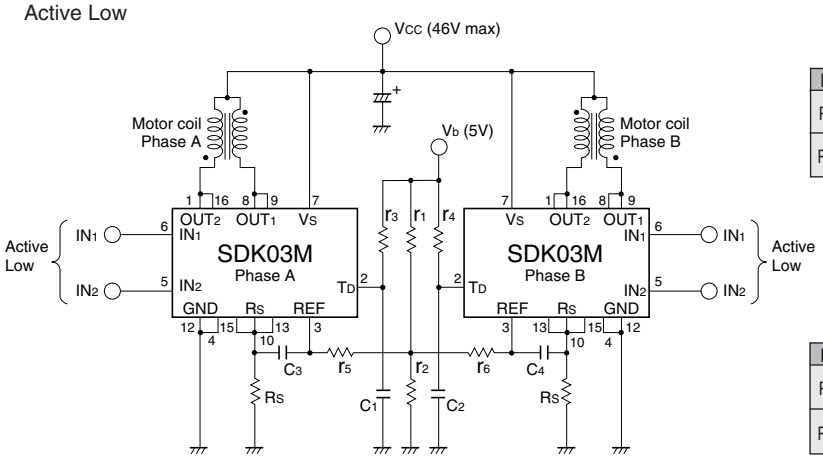
Phase	clock	0	1	2	3	0	1
Phase A	IN_1	H	L	L	H	H	L
	IN_2	L	H	H	L	L	H
Phase B	IN_1	H	H	L	L	H	H
	IN_2	L	L	H	H	L	L

1-2-phase excitation

Phase	clock	0	1	2	3	4	5	6	7	0	1	2	3
Phase A	IN_1	H	H	L	L	L	L	L	H	H	H	L	L
	IN_2	L	L	L	H	H	H	L	L	L	L	L	H
Phase B	IN_1	L	H	H	H	L	L	L	L	L	H	H	H
	IN_2	L	L	L	L	L	H	H	H	L	L	L	L

r_1 : 510Ω
r_2 : 100Ω (VR)
r_3 : 47kΩ
r_4 : 47kΩ
r_5 : 2.4kΩ
r_6 : 2.4kΩ
C_1 : 470pF
C_2 : 470pF
C_3 : 2200pF
C_4 : 2200pF
R_S : 1.8Ω typ
(1 to 2W)

Active Low



Excitation signal time chart
2-phase excitation

Phase	clock	0	1	2	3	0	1
Phase A	IN_1	L	H	H	L	L	H
	IN_2	H	L	L	H	H	L
Phase B	IN_1	L	L	H	H	L	L
	IN_2	H	H	L	L	H	H

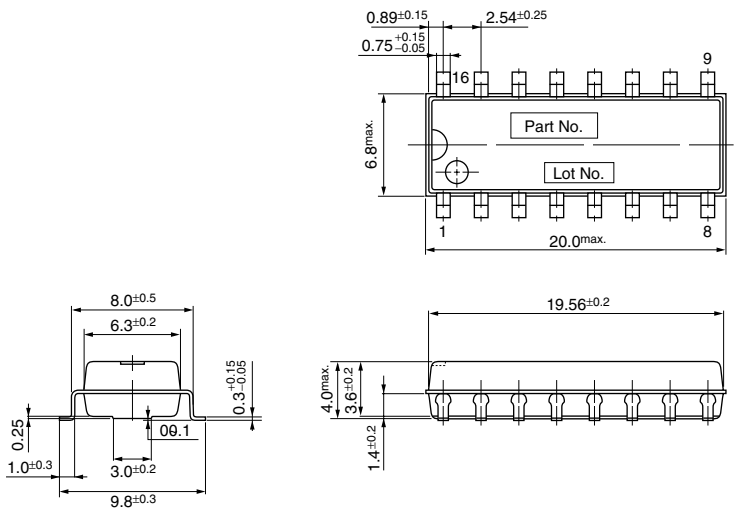
1-2-phase excitation

Phase	clock	0	1	2	3	4	5	6	7	0	1	2	3
Phase A	IN_1	L	L	H	H	H	H	H	L	L	L	H	H
	IN_2	H	H	H	L	L	L	H	H	H	H	H	L
Phase B	IN_1	H	L	L	L	H	H	H	H	H	L	L	L
	IN_2	H	H	H	H	H	L	L	L	H	H	H	H

r_1 : 510Ω
r_2 : 100Ω (VR)
r_3 : 47kΩ
r_4 : 47kΩ
r_5 : 2.4kΩ
r_6 : 2.4kΩ
C_1 : 470pF
C_2 : 470pF
C_3 : 2200pF
C_4 : 2200pF
R_S : 1.8Ω typ
(1 to 2W)

■External Dimensions (PS16)

(Unit : mm)



SLA7070MR, MPR/7071MR, MPR/7072MR, MPR/7073MR, MPR 2-Phase/1-2 Phase Excitation Support, Built-in Sequencer

■Features

- Lineup of built-in current sense resistor and built-in protection circuit-type
- Power supply voltages, V_{BB}: 46 V (max), 10 to 44 V normal operating range
- Logic supply voltages, V_{DD}: 3.0 to 5.5 V
- Maximum output currents: 1 A, 1.5 A, 2 A, and 3 A
- Built-in sequencer
- Self-excitation PWM current control with fixed off-time
- Synchronous PWM chopping function prevents motor noise in Hold mode
- Sleep mode for reducing the IC input current in stand-by state
- ZIP type 23-pin molded package (SLA package)

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Remarks
Motor Supply Voltage	V_M	46	V	
Driver Supply Voltage	V_{BB}	46	V	
Logic Supply Voltage	V_{DD}	6	V	
Output Current	Io	*1	A	Mode F
Logic Input Voltage	V_{IN}	–0.3 to V_{DD}+0.3	V	
REF Input Voltage	V_{REF}	–0.3 to V_{DD}+0.3	V	
Sense Voltage	V_{RS}	±2	V	Excluding tw<1µs
Power Dissipation	PD	4.7	W	When T_a = 25°C
		17		When T_c = 25°C
Junction Temperature	T_j	+150	°C	
Operating Ambient Temperature	T_a	–20 to +85	°C	
Storage Temperature	T_{stg}	–30 to +150	°C	

*1: Output current value may be limited for the SLA7070MR, MPR (1.0 A), SLA7071MR, MPR (1.5 A), SLA7072MR, MPR (2.0 A), and SA7073MR, MPR (3.0 A), depending on the duty ratio, ambient temperature, and heating conditions. Be sure that junction temperature of T_j is not exceeded under any circumstances.

■Recommended Operating Conditions

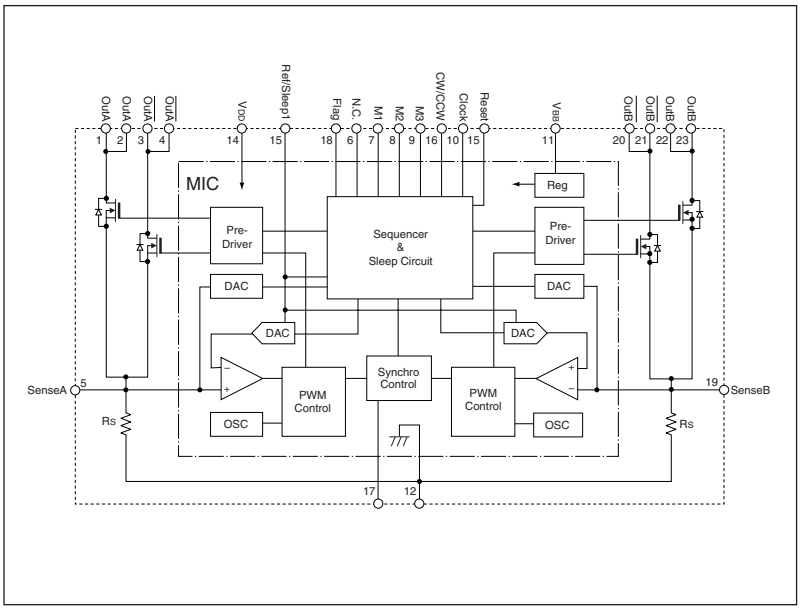
Parameter	Symbol	Rating		Unit	Remarks
		min.	max.		
Motor Supply Voltage	V_M		44	V	
Driver Supply Voltage	V_S	10	44	V	
Logic Supply Voltage	V_{CC}	3.0	5.5	V	The V_{CC} surge voltage should be 0.5 V or lower
Case Temperature	T_C		90	°C	Temperature at Pin-12 Lead (without heatsink)

■Electrical Characteristics

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Main Supply Current	I_{BB}			15	mA	In operation
	I_{BBS}			100	µA	Sleep 1 and Sleep 2 modes
Logic Supply Current	Icc			5	mA	
Output MOSFET Breakdown Voltage	$V_{(BR)DSS}$	100			V	VBB=44V, ID=1mA
Output MOSFET ON Resistance	$R_{DS(ON)}$		0.7	0.85	Ω	SLA7070M, ID=1.0A
			0.45	0.6		SLA7071M, ID=1.5A
			0.25	0.4		SLA7072M, ID=2.0A
			0.18	0.24		SLA7073M, ID=3.0A
Output MOSFET Diode Forward Voltage	V_F		0.85	1.1	V	SLA7070M, ID=1.0A
			1.0	1.25		SLA7071M, ID=1.5A
			0.95	1.2		SLA7072M, ID=2.0A
			0.95	2.1		SLA7073M, ID=3.0A
Maximum Clock Frequency	Fclock	250			kHz	When Clock Duty = 50%
Logic Input Voltage	V_{IL}			0.25VDD	V	
	V_{IH}	0.75VDD				
Logic Input Current	I_{IL}		±1		µA	
	I_{IH}		±1			
REF Input Voltage	V_{REF}	0.04		0.3	V	SLA7070MR/7070MPR, within the current setting range
		0.04		0.45		SLA7071MR/7071MPR, within the current setting range
		0.04		0.4		SLA7072MR/7072MPR, within the current setting range
		0.04		0.45		SLA7073MR/7073MPR, within the current setting range
	V_{REFS}	2		VDD		Output (OFF) Sleep 1
REF Input Current	I_{REF}		±10		µA	
Sense Voltage	V_{SENSE}		VREF		V	When step reference current ratio is 100%
Sleep-Enable Recovery Time	T_{SE}	100			µS	Sleep1&Sleep2
Switching Time	t_{con}		2.0		µS	Clock → Out ON
	t_{coff}		1.5		µS	Clock → Out OFF
Sense Resistance	R_S	0.296	0.305	0.314	Ω	SLA7070MR/7070MPR , when motor coil shorts out
		0.296	0.305	0.314		SLA7071MR/7071MPR, tolerance of ±3%
		0.199	0.205	0.211		SLA7072MR/7072MPR, tolerance of ±3%
		0.150	0.155	0.160		SLA7073MR/7073MPR, tolerance of ±3%
Overcurrent sense voltage	Vocp	0.65	0.7	0.75	V	SLA7070MPR/7071MPR/7072MPR/7073MPR, when motor coil shorts out
Overcurrent sense current	Iocp		2.3		A	SLA7070MPR/7071MPR
			3.5			SLA7072MPR
			4.6			SLA7073MPR
Flag Output Voltage	V_{FlagL}			1.25	V	SLA7070MPR/7071MPR/7072MPR/7073MPR, IFlagL=1.25mA
	V_{FlagH}	1.25VDD				SLA7070MPR/7071MPR/7072MPR/7073MPR, IFlagH=–1.25mA
Flag Output Current	I_{FlagL}			1.25	mA	SLA7070MPR/7071MPR/7072MPR/7073MPR
	I_{FlagH}	–1.25				
Step Reference Current Ratio	ModeF		100		%	
	Mode8		70.7		%	
PWM Minimum ON Time	ton(min)		3		µs	
PWM OFF Time	toff		12		µs	

The direction in which current flows out of the device is regarded as negative.

■Internal Block Diagram



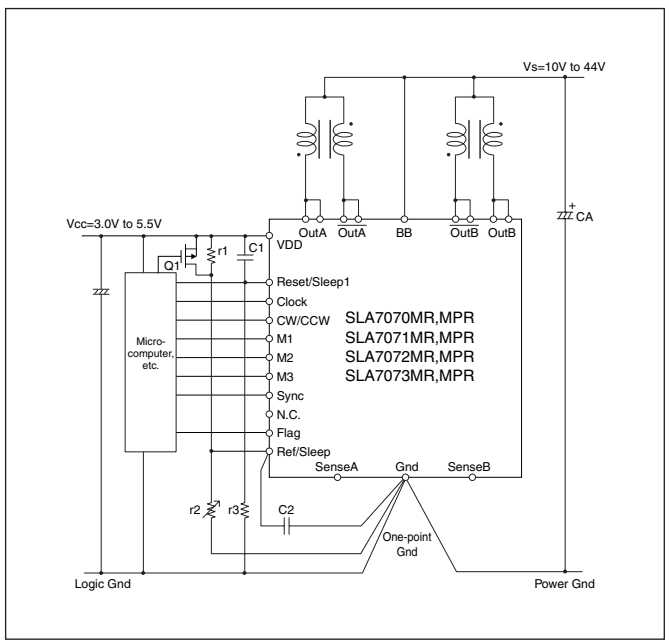
The protect circuit is deleted and the flag pin is N.C. for SLA7070MR, 7071MR, 7072MR, and 7073MR.

■Pin Assignment

Pin No.	Symbol	Function
1	OutA	Phase A output
2		
3	OutA/	Phase $\overline{A}$ output
4		
5	SenseA	Phase A current sense
6	N.C.	N.C.
7	M1	Excitation mode/Sleep 2 setting input
8	M2	
9	M3	
10	Clock	Step Clock input
11	V_{BB}	Driver supply (motor supply)
12	Gnd	Device GND
13	Ref/Sleep1	Control current mode/Sleep 1 setting input
14	V_{DD}	Logic supply
15	Reset	Internal logic reset input
16	CW/CCW	Normal/reverse control input
17	Sync	PWM control signal input
18	Flag	Protection circuit monitor output*1
19	SenseB	Phase B current sense
20	OutB/	Phase $\overline{B}$ current output
21		
22	OutB	Phase B current output
23		

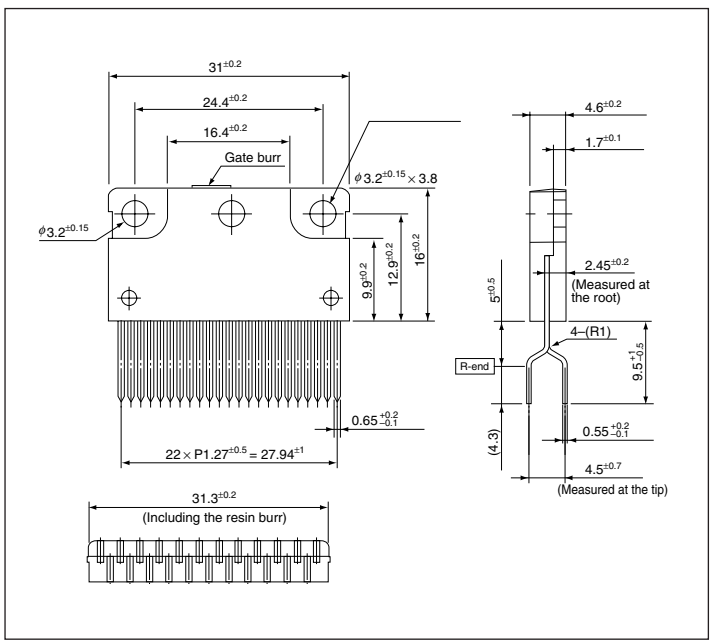
*1: N.C. pin for SLA7070MR, 7071MR, 7072MR, and 7073MR.

■Typical Connection Diagram



* There is no Flag pin (Pin-18) for SLA7070MR, 7071MR, 7072MR, and 7073MR.

■External Dimensions (ZIP23 with Fin[SLA23Pin])



SLA7042M/SLA7044M 2W1-2 Phase Excitation/Micro-step Support

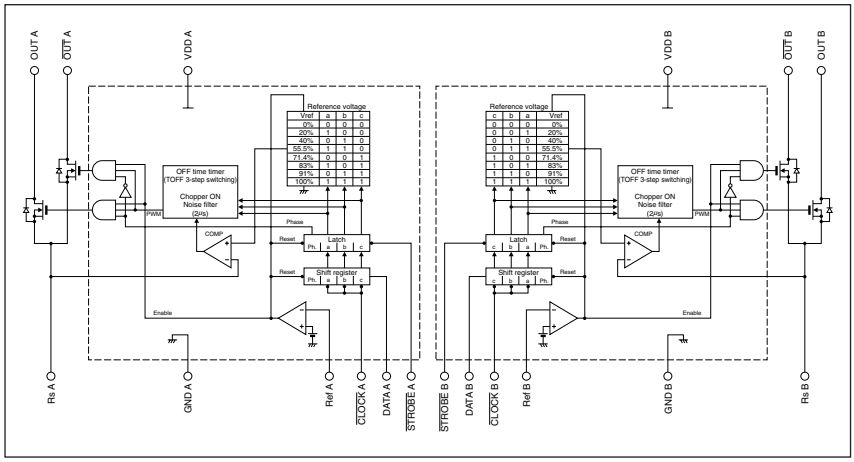
■Absolute Maximum Ratings

Parameter	Symbol	Ratings		Units
		SLA7042M	SLA7044M	
Motor supply voltage	V_{CC}	46		V
FET Drain-Source voltage	V_{DSS}	100		V
Control supply voltage	V_{DD}	7		V
Input voltage	V_{IN}	–0.5 to V_{DD}+0.5		V
Output current	I_O	1.2	3.0	A
Power dissipation	P_D	4.5 (Without Heatsink)		W
Channel temperature	T_{ch}	+150		°C
Storage temperature	T_{stg}	–40 to +150		°C

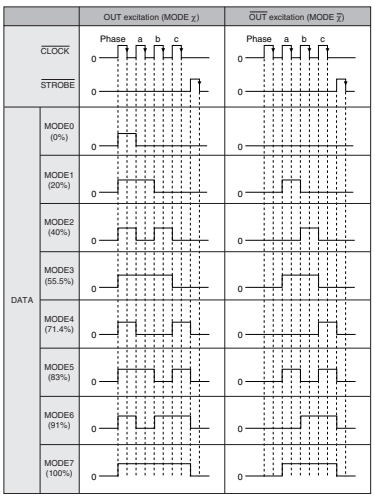
■Electrical Characteristics

Parameter			Symbol	Ratings						Units
				SLA7042M			SLA7044M			
				min	typ	max	min	typ	max	
DC characteristics	Control supply current		I_{DD}			7			7	mA
			Conditions	V_{DD}=5.5V			V_{DD}=5.5V			
	Control supply voltage		V_{DD}	4.5	5	5.5	4.5	5	5.5	V
	Terminals DATA, CLOCK and STROBE	Input voltage	V_{IH}	3.5		5	3.5		5	V
			Conditions	V_{DD}=5V			V_{DD}=5V			
			V_{IL}	0		1.5	0		1.5	
			Conditions	V_{DD}=5V			V_{DD}=5V			
		Input hysteresis voltage	V_H		1			1		V
			Conditions	V_{DD}=5V			V_{DD}=5V			
		Input current	I_I			±1			±1	μA
			Conditions	V_{DD}=5V, V_I=0 or 5V			V_{DD}=5V, V_I=0 or 5V			
	REF terminal	Input voltage	V_{REF}	0.4		2.5	0.4		2.5	V
			Conditions	V_{DD}=5V			V_{DD}=5V			
			$V_{DISABLE}$	V_{DD}–1		V_{DD}	V_{DD}–1		V_{DD}	
			Conditions	V_{DD}=5V			V_{DD}=5V			
		Input current	I_{REF}			±1			±1	μA
			Conditions	V_{DD}=5V, V_I=0 or 5V			V_{DD}=5V, V_I=0 or 5V			
	Step reference current ratio		V_{ref}	0			0			%
			Conditions	MODE 0			MODE 0			
			V_{ref}	20			20			
			Conditions	MODE 1			MODE 1			
			V_{ref}	40			40			
			Conditions	MODE 2			MODE 2			
			V_{ref}	55.5			55.5			
			Conditions	MODE 3			MODE 3			
			V_{ref}	71.4			71.4			
			Conditions	MODE 4			MODE 4			
			V_{ref}	83			83			
			Conditions	MODE 5			MODE 5			
			V_{ref}	91			91			
			Conditions	MODE 6			MODE 6			
			V_{ref}	100			100			
			Conditions	MODE 7			MODE 7			
	FET ON voltage		V_{DS}			0.8			1.4	V
			Conditions	I_D=1.2A, V_{DD}=4.75V			I_D=3.0A, V_{DD}=4.75V			
	FET Drain-Source voltage		V_{DSS}	100			100			V
			Conditions	I_{DSS}=4mA, V_{DD}=5V			I_{DSS}=4mA, V_{DD}=5V			
	FET drain leakage current		I_{DSS}			4			4	mA
			Conditions	V_{DSS}=100V, V_{DD}=5V			V_{DSS}=100V, V_{DD}=5V			
	FET diode forward voltage		V_{SD}			1.2			2.3	V
			Conditions	I_D=1.2A			I_D=3A			
AC characteristics	Chopper off time		T_{OFF}		7			7		μs
			Conditions	MODE 1, 2			MODE 1, 2			
			T_{OFF}		9			9		
			Conditions	MODE 3, 4, 5			MODE 3, 4, 5			
			T_{OFF}		11			11		
			Conditions	MODE 6, 7			MODE 6, 7			
	Switching time		T_r		0.5			0.5		μs
			Conditions	V_{DD}=5V, I_D=1A			V_{DD}=5V, I_D=1A			
			T_{stg}		0.7			0.7		
			Conditions	V_{DD}=5V, I_D=1A			V_{DD}=5V, I_D=1A			
			T_f		0.1			0.1		
			Conditions	V_{DD}=5V, I_D=1A			V_{DD}=5V, I_D=1A			
	Data setup time "A"		t_{sl}DAT	75			75			ns
			Conditions	Data active time before clock ↓			Data active time before clock ↓			
	Data hold time "B"		t_{hl}DAT	75			75			
			Conditions	Data active time before clock ↓			Data active time before clock ↓			
	Data pulse time "C"		t_{wl}DAT	150			150			
			Conditions							
	Clock pulse width "D"		t_{wh}CLK	100			100			
			Conditions							
	Strobe stability time "E"		t_{ps}STB	100			100			
			Conditions	Time from clock ↓ to Strobe ↓			Time from clock ↓ to Strobe ↓			
	Strobe pulse H width "F"		t_{wh}STB	100			100			
			Conditions							

■Internal Block Diagram

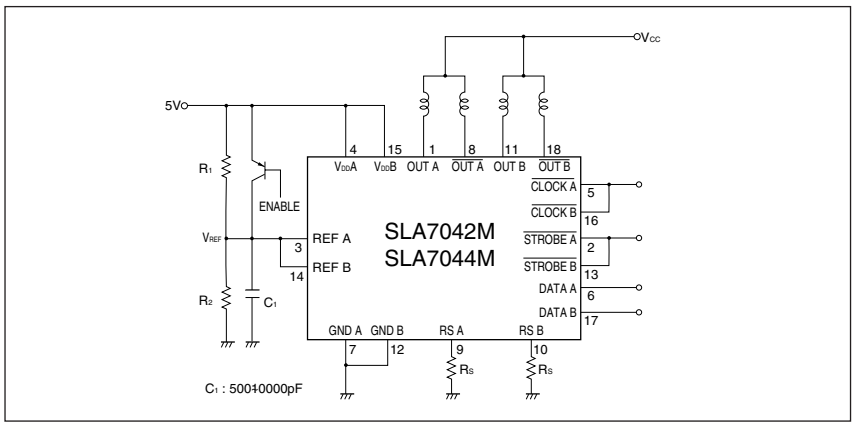


■Serial Data Pattern



Successively output this serial data and set any current. Then, determine the step time of the reference voltage Vref with $\overline{\text{STROBE}}$ signal intervals.

■Diagram of Standard External Circuit



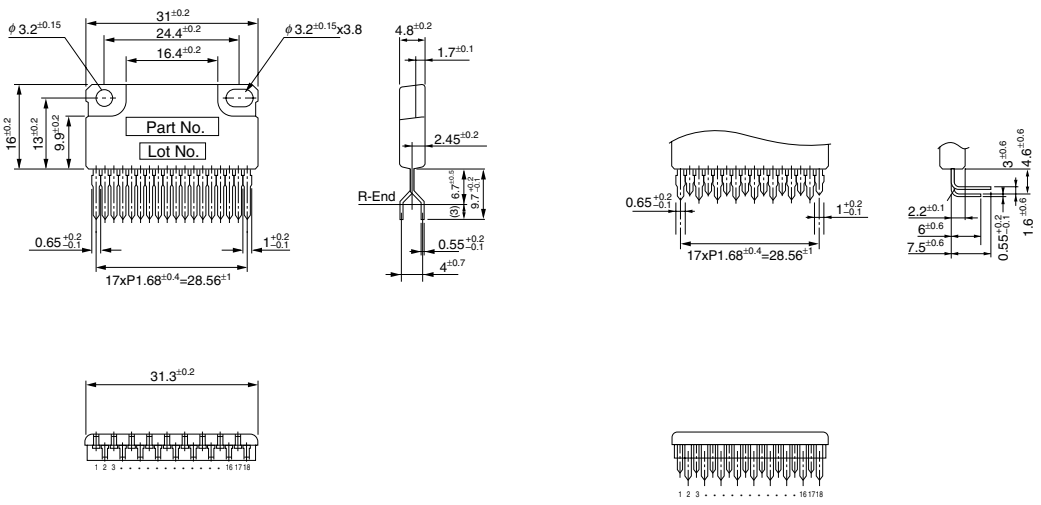
■Output Current Formula

$$I_O = \frac{K}{3} \cdot \frac{V_{REF}}{R_S}$$

K:Reference voltage setting ratio by serial signal (See the internal block diagram)

■External Dimensions (ZIP18 with Fin [SLA18Pin])

(Unit : mm)



Forming No. No.871

Forming No. No.872

SLA7065M/SLA7066M/SLA7067M 2-Phase to 2W 1-2 Phase Excitation Support, Built-in Sequencer

■Features

- Main supply voltage VBB: 46V (max), 10 to 44V recommended
- Logic supply voltage V_{DD}: 3.0 to 5.5V support
- Lineup of output current I_O: 1A, 2A, 3A (maximum set current)
- Supporting the clock-input-method micro-step drive (built-in sequencer)
- 2-phase excitation to 2W 1-2 phase excitation support
- Self-excitation PWM current control method
- Built-in synchronous chopping function to prevent the audible motor noise in the hold state
- ZIP type 21-Pin mold package (SLA package)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Unit
		SLA7065M	SLA7066M	SLA7067M	
Motor Supply Voltage	V_M	46			V
Driver Supply Voltage	V_{BB}	46			V
Logic Supply Voltage	V_{DD}	7			V
Output Current	I_O	1.0	2.0	3.0	A
Logic Input Voltage	V_{IN}	–0.3 to V_{DD}+0.3			V
REF Input Voltage	V_{REF}	–0.3 to V_{DD}+0.3			V
Sense Voltage	V_{RS}	–2 to +2 (tw >1μs)			V
Power Dissipation	P_D	3.5 (Without Heatsink)			W
Junction Temperature	T_j	+150			°C
Operating Ambient Temperature	T_a	–20 to +85			°C
Storage Temperature	T_{stg}	–30 to +150			°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit	Remarks
		min	max		
Motor Supply Voltage	V_M		44	V	
Driver Supply Voltage	V_{BB}	10	44	V	
Logic Supply Voltage	V_{DD}	3.0	5.5	V	The V_{DD} surge voltage should be 0.5V or lower.
REF Input Voltage	V_{REF}	0.1	1.0	V	The control current precision is degraded at 0.1V or lower.
Case Temperature	T_C		90	°C	Temperature at pin-11 Lead (Without heatsink)

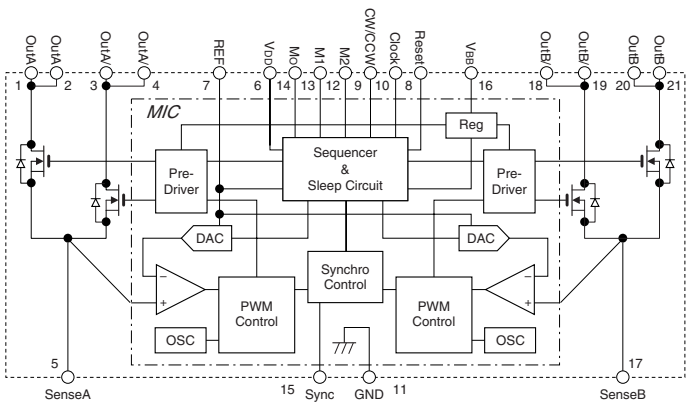
■Electrical Characteristics

(V_{DD}=5V, V_{BB}=24V, T_a=25°C, unless otherwise specified)

Parameter	Symbol	Ratings									Unit
		SLA7065M			SLA7066M			SLA7067M			
		min	typ	max	min	typ	max	min	typ	max	
Main Supply Current	I_{BB}			15			15			15	mA
	Conditions	In operation			In operation			In operation			
	I_{BBS}			100			100			100	μA
	Conditions	Sleep mode			Sleep mode			Sleep mode			
Logic Supply Current	I_{DD}			4			4			4	mA
Output MOSFET Breakdown Voltage	$V_{(BR)\ DS}$	100			100			100			V
	Conditions	V_{BB}=44V, I_D=1mA			V_{BB}=44V, I_D=1mA			V_{BB}=44V, I_D=1mA			
Output MOSFET ON Resistance	$R_{DS\ (ON)}$		0.7			0.25			0.18		Ω
	Conditions	I_D=1A			I_D=2A			I_D=3A			
Output MOSFET Diode Forward Voltage	V_F		0.85			0.95			0.95		V
	Conditions	I_F=1A			I_F=2A			I_F=3A			
Maximum Clock Frequency	f_{clk}	250			250			250			kHz
	Conditions	When Clock Duty = 50%			When Clock Duty = 50%			When Clock Duty = 50%			
Logic Input Voltage	V_{IL}			V_{DD}·0.25			V_{DD}·0.25			V_{DD}·0.25	V
	V_{IH}	V_{DD}·0.75			V_{DD}·0.75			V_{DD}·0.75			
Logic Input Current	I_{IL}		±1			±1			±1		μA
	I_{IH}		±1			±1			±1		
	Conditions	Clock, Reset, CW/CCW, Sync			Clock, Reset, CW/CCW, Sync			Clock, Reset, CW/CCW, Sync			
	I_{ILM}		–50			–50			–50		
	I_{IH}		±1			±1			±1		
	Conditions	M1, M2			M1, M2			M1, M2			
REF Input Voltage	V_{REF}	0		1.5	0		1.5	0		1.5	V
	Conditions	Normal-operation current control			Normal-operation current control			Normal-operation current control			
	V_{REFS}	2		V_{DD}	2		V_{DD}	2		V_{DD}	
	Conditions	Output OFF (sleep)			Output OFF (sleep)			Output OFF (sleep)			
REF Input Current	I_{REF}		±10			±10			±10		μA
Mo Output Voltage	V_{MoL}			1.25			1.25			1.25	V
	Conditions	I_{MOL}=1.5mA			I_{MOL}=1.5mA			I_{MOL}=1.5mA			
	V_{MoH}	V_{DD}–1.25			V_{DD}–1.25			V_{DD}–1.25			
	Conditions	I_{MOH}=–1.5mA			I_{MOH}=–1.5mA			I_{MOH}=–1.5mA			
Mo Output Current	I_{MoL}			3			3			3	mA
	I_{MoH}	–3			–3			–3			
Sense Terminal Inflow Current	I_{SENSE}		±10			±10			±10		μA
Sense Voltage	V_{SENSE}	0.95	1.00	1.05	0.95	1.00	1.05	0.95	1.00	1.05	V
	Conditions	When V_{REF} = 1V in Mode F			When V_{REF} = 1V in Mode F			When V_{REF} = 1V in Mode F			
Step Reference Current Ratio	Mode F		100			100			100		%
	Mode E		98.1			98.1			98.1		
	Mode C		92.4			92.4			92.4		
	Mode A		83.1			83.1			83.1		
	Mode 8		70.7			70.7			70.7		
	Mode 6		55.5			55.5			55.5		
	Mode 4		38.2			38.2			38.2		
	Mode 2		19.5			19.5			19.5		
	Conditions	V_{REF}÷V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			V_{REF}÷V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			V_{REF}÷V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			
Switching Time	T_{ONC}		2.0			2.0			2.0		μs
	Conditions	Clock→OutON			Clock→OutON			Clock→OutON			
	T_{OFFC}		1.5			1.5			1.5		
	Conditions	Clock→OutOFF			Clock→OutOFF			Clock→OutOFF			
PWM Minimum ON Time	$T_{ON\ (min)}$		1.8			1.8			1.8		μs
	Conditions	Mode 2 to F			Mode 2 to F			Mode 2 to F			
	t_{OFF1}		12			12			12		μs
	Conditions	Mode 8 to F			Mode 8 to F			Mode 8 to F			
Chopping OFF Time	t_{OFF2}		9			9			9		μs
	Conditions	Mode 4 to 6			Mode 4 to 6			Mode 4 to 6			
	t_{OFF3}		7			7			7		
	Conditions	Mode 2			Mode 2			Mode 2			

The direction in which current flows out of the device is regarded as negative.

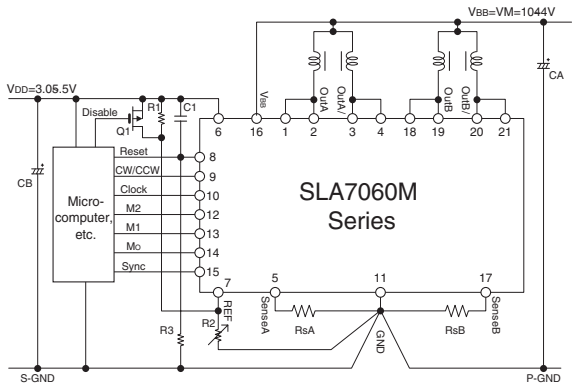
■Internal Block Diagram



■Pin Assignment

Pin No.	Symbol	Function
1	OutA	Phase A output
2		
3	$\overline{\text{OutA}}$	Phase $\overline{\text{A}}$ output
4		
5	SenseA	Phase A current sense
6	V_{DD}	Logic supply
7	REF	Control current setting & output OFF control input
8	Reset	Internal logic reset input
9	CW/CCW	Normal/reverse control input
10	Clock	Step Clock input
11	GND	Device GND
12	M2	Excitation mode setting input
13	M1	
14	M_O	2-phase excitation state monitor output
15	Sync	PWM control signal input
16	V_{BB}	Driver supply (motor supply)
17	SenseB	Phase B current sense
18	$\overline{\text{OutB}}$	Phase $\overline{\text{B}}$ output
19		
20	OutB	Phase B output
21		

■Typical Connection Diagram



Component Values (Typical)
Rs=0.1 to 2Ω (Power dissipation should be: $P \fallingdotseq I_O^2 \times Rs$)
R1=10kWΩ CA=100μF/50V
R2=5.1kΩ (VR) CB=10μF/10V
R3=10kΩ C1=0.1μF

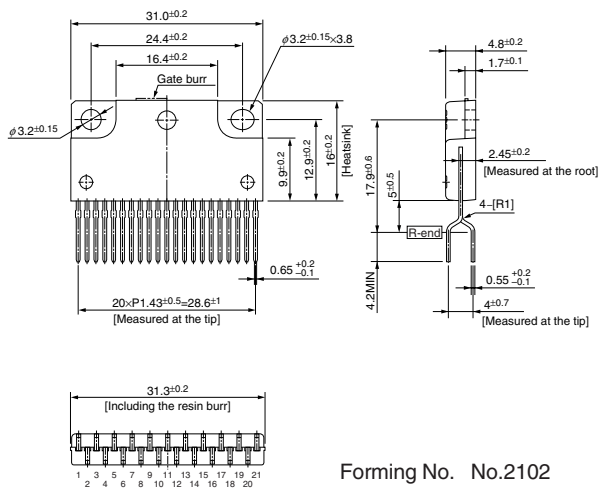
* V_{DD} line noise precaution:
The device may malfunction if the V_{DD} line noise exceeds 0.5V.
As a countermeasure, separating the V_{DD} system GND (S-GND) and V_{BB} system GND (P-GND) from the device GND (Pin-11) helps to reduce noise.

* Be sure to connect the unused logic input terminals (CW/CCW, M1, M2, Reset, Sync) to V_{DD} or GND.
Otherwise, the device will malfunction.

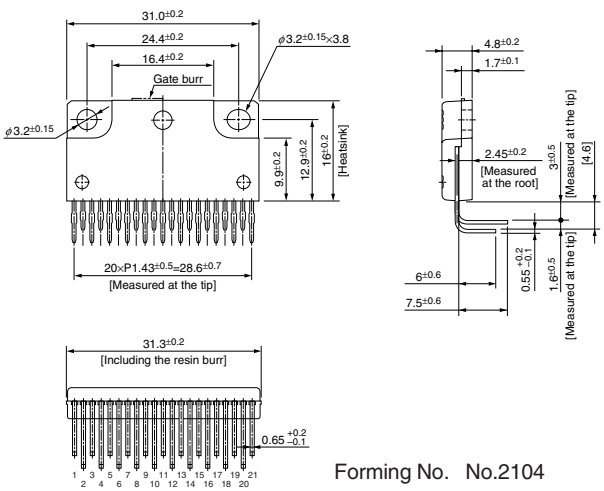
* Be sure to open the unused logic output terminal Mo.

■External Dimensions (ZIP21 with Fin [SLA21Pin])

(Unit : mm)



Forming No. No.2102



Forming No. No.2104

SLA7060M/SLA7061M/SLA7062M 1-2 Phase to 4W 1-2 Phase Excitation Support, Built-in Sequencer

■Features

- Main supply voltage V_{BB}: 46V (max), 10 to 44V recommended
- Logic supply voltage V_{DD}: 3.0 to 5.5V support
- Lineup of output current I_O: 1A, 2A, 3A (maximum set current)
- Supporting the clock-input-method micro-step drive (built-in sequencer)
- 1-2 phase excitation to 4W 1-2 phase excitation support
- Self-excitation PWM current control method
- Built-in synchronous chopping function to prevent the audible motor noise in the hold state
- ZIP type 21-Pin mold package (SLA package)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Unit
		SLA7060M	SLA7061M	SLA7062M	
Motor Supply Voltage	V_M	46			V
Driver Supply Voltage	V_{BB}	46			V
Logic Supply Voltage	V_{DD}	7			V
Output Current	I_O	1.0	2.0	3.0	A
Logic Input Voltage	V_{IN}	–0.3 to V_{DD}+0.3			V
REF Input Voltage	V_{REF}	–0.3 to V_{DD}+0.3			V
Sense Voltage	V_{RS}	–2 to +2 (tw > 1μs)			V
Power Dissipation	P_D	3.5 (Without Heatsink)			W
Junction Temperature	T_j	+150			°C
Operating Ambient Temperature	T_a	–20 to +85			°C
Storage Temperature	T_{stg}	–30 to +150			°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit	Remarks
		min	max		
Motor Supply Voltage	V_M		44	V	
Driver Supply Voltage	V_{BB}	10	44	V	
Logic Supply Voltage	V_{DD}	3.0	5.5	V	The V_{DD} surge voltage should be 0.5V or lower.
REF Input Voltage	V_{REF}	0.1	1.0	V	The control current precision is degraded at 0.1V or lower.
Case Temperature	T_C		90	°C	Temperature at Pin-11 Lead (Without heatsink)

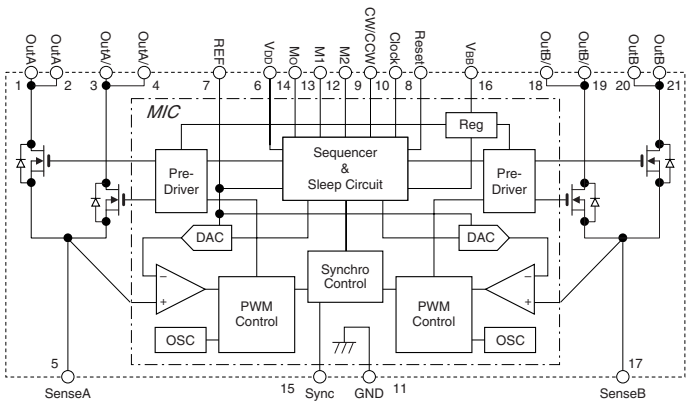
■Electrical Characteristics

(V_{DD}=5V, V_{BB}=24V, T_a=25°C, unless otherwise specified)

Parameter	Symbol	SLA7060M			SLA7061M			SLA7062M			Unit
		min	typ	max	min	typ	max	min	typ	max	
Main Supply Current	I_{BB}			15			15			15	mA
	Conditions		In operation			In operation			In operation		
	I_{BBS}			100			100			100	μA
	Conditions		Sleep mode			Sleep mode			Sleep mode		
Logic Supply Current	I_{DD}			4			4			4	mA
Output MOSFET Breakdown Voltage	$V_{(BR)DS}$	100			100			100			V
	Conditions	V_{BB}=44V, I_D=1mA			V_{BB}=44V, I_D=1mA			V_{BB}=44V, I_D=1mA			
Output MOSFET ON Resistance	$R_{DS(ON)}$		0.7			0.25			0.18		Ω
	Conditions	I_D=1A			I_D=2A			I_D=3A			
Output MOSFET Diode Forward Voltage	V_F		0.85			0.95			0.95		V
	Conditions	I_F=1A			I_F=2A			I_F=3A			
Maximum Clock Frequency	f_{clk}	250			250			250			kHz
	Conditions	When Clock Duty = 50%			When Clock Duty = 50%			When Clock Duty = 50%			
Logic Input Voltage	V_{IL}			V_{DD}·0.25			V_{DD}·0.25			V_{DD}·0.25	V
	V_{IH}	V_{DD}·0.75			V_{DD}·0.75			V_{DD}·0.75			
Logic Input Current	I_{IL}		+1			+1			+1		μA
	I_{IH}		+1			+1			+1		
	Conditions	Clock, Reset, CW/CCW, Sync			Clock, Reset, CW/CCW, Sync			Clock, Reset, CW/CCW, Sync			
	I_{ILM}		–50			–50			–50		
	I_{IH}		+1			+1			+1		
	Conditions	M1, M2			M1, M2			M1, M2			
REF Input Voltage	V_{REF}	0		1.5	0		1.5	0		1.5	V
	Conditions	Normal-operation current control			Normal-operation current control			Normal-operation current control			
	V_{REFS}	2		V_{DD}	2		V_{DD}	2		V_{DD}	
	Conditions	Output OFF (sleep)			Output OFF (sleep)			Output OFF (sleep)			
REF Input Current	I_{REF}		+10			+10			+10		μA
Mo Output Voltage	V_{MoL}			1.25			1.25			1.25	V
	Conditions	I_{MOL}=1.5mA			I_{MOL}=1.5mA			I_{MOL}=1.5mA			
	V_{MoH}	V_{DD}–1.25			V_{DD}–1.25			V_{DD}–1.25			
	Conditions	I_{MOH}=–1.5mA			I_{MOH}=–1.5mA			I_{MOH}=–1.5mA			
Mo Output Current	I_{MoL}			3			3			3	mA
	I_{MoH}	–3			–3			–3			
Sense Terminal Inflow Current	I_{SENSE}		+10			+10			+10		μA
Sense Voltage	V_{SENSE}	0.95	1.00	1.05	0.95	1.00	1.05	0.95	1.00	1.05	V
	Conditions	When V_{REF} = 1V in Mode F			When V_{REF} = 1V in Mode F			When V_{REF} = 1V in Mode F			
Step Reference Current Ratio	Mode F		100			100			100		%
	Mode E		98.1			98.1			98.1		
	Mode D		95.7			95.7			95.7		
	Mode C		92.4			92.4			92.4		
	Mode B		88.2			88.2			88.2		
	Mode A		83.1			83.1			83.1		
	Mode 9		77.3			77.3			77.3		
	Mode 8		70.7			70.7			70.7		
	Mode 7		63.4			63.4			63.4		
	Mode 6		55.5			55.5			55.5		
	Mode 5		47.1			47.1			47.1		
	Mode 4		38.2			38.2			38.2		
	Mode 3		29			29			29		
	Mode 2		19.5			19.5			19.5		
	Mode 1		9.8			9.8			9.8		
	Conditions	V_{REF}≒V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			V_{REF}≒V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			V_{REF}≒V_{SENSE}=100%, V_{REF}=0.1 to 1.0V			
Switching Time	T_{ONC}		2.0			2.0			2.0		μs
	Conditions	Clock→OutON			Clock→OutON			Clock→OutON			
	T_{OFFC}		1.5			1.5			1.5		
	Conditions	Clock→OutOFF			Clock→OutOFF			Clock→OutOFF			
PWM Minimum ON Time	$T_{ON(min)}$		1.8			1.8			1.8		μs
	Conditions	Mode 1 to F			Mode 1 to F			Mode 1 to F			
Chopping OFF Time	t_{OFF1}		12			12			12		μs
	Conditions	Mode 8 to F			Mode 8 to F			Mode 8 to F			
	t_{OFF2}		9			9			9		μs
	Conditions	Mode 4 to 7			Mode 4 to 7			Mode 4 to 7			
	t_{OFF3}		7			7			7		
	Conditions	Mode 1 to 3			Mode 1 to 3			Mode 1 to 3			

The direction in which current flows out of the product is regarded as negative.

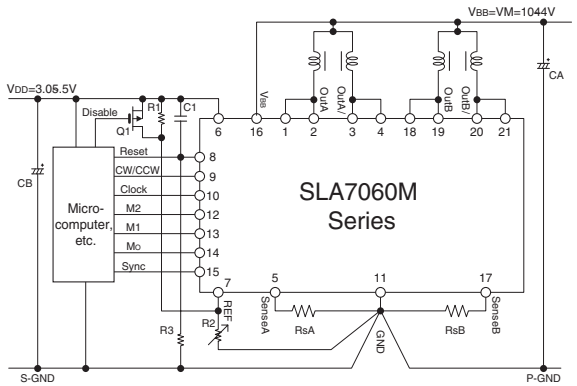
■Internal Block Diagram



■Pin Assignment

Pin No.	Symbol	Function
1	OutA	Phase A output
2		
3	$\overline{\text{OutA}}$	Phase $\overline{\text{A}}$ output
4		
5	SenseA	Phase A current sense
6	V_{DD}	Logic supply
7	REF	Control current setting & output OFF control input
8	Reset	Internal logic reset input
9	CW/CCW	Normal/reverse control input
10	Clock	Step Clock input
11	GND	Device GND
12	M2	Excitation mode setting input
13	M1	
14	M_O	2-phase excitation state monitor output
15	Sync	PWM control signal input
16	V_{BB}	Driver supply (motor supply)
17	SenseB	Phase B current sense
18	$\overline{\text{OutB}}$	Phase $\overline{\text{B}}$ output
19		
20	OutB	Phase B output
21		

■Typical Connection Diagram



Component Values (Typical)
Rs=0.1 to 2Ω (Power dissipation should be: P≒I_O^2×Rs)
R1=10kWΩ CA=100μF/50V
R2=5.1kΩ (VR) CB=10μF/10V
R3=10kΩ C1=0.1μF

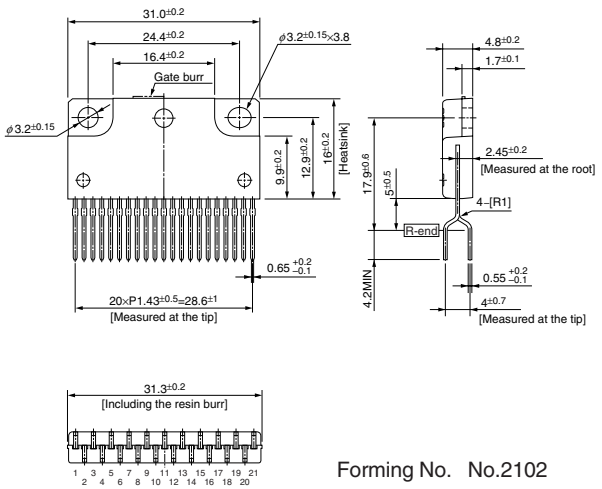
* V_{DD} line noise precaution:
The device may malfunction if the V_{DD} line noise exceeds 0.5V. As a countermeasure, separating the V_{DD} system GND (S-GND) and V_{BB} system GND (P-GND) from the device GND (Pin-11) helps to reduce noise.

* Be sure to connect the unused logic input terminals (CW/CCW, M1, M2, Reset, Sync) to V_{DD} or GND.
Otherwise, the device will malfunction.

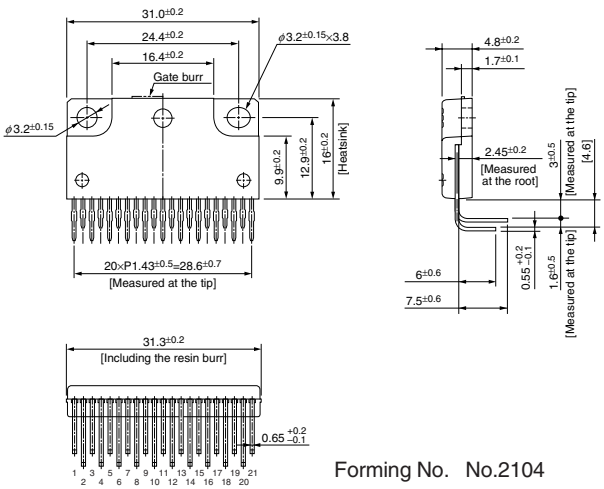
* Be sure to open the unused logic output terminal Mo.

■External Dimensions (ZIP21 with Fin [SLA21Pin])

(Unit : mm)



Forming No. No.2102



Forming No. No.2104

SLA7075MR, MPR/7076MR, MPR/7077MR, MPR/7078MR, MPR 2-Phase/4 W1-2 Phase Excitation Support, Built-in Sequencer

■Features

- Lineup of built-in current sense resistor and built-in protection circuit-type
- Power supply voltages, V_{BB}: 46 V (max), 10 to 44 V normal operating range
- Logic supply voltages, V_{DD}: 3.0 to 5.5 V
- Maximum output currents: 1 A, 1.5 A, 2 A, and 3 A
- Built-in sequencer
- Self-excitation PWM current control with fixed off-time
- Synchronous PWM chopping function prevents motor noise in Hold mode
- Sleep mode for reducing the IC input current in stand-by state
- ZIP type 23-pin molded package (SLA package)

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Remarks
Motor Supply Voltage	V_M	46	V	
Driver Supply Voltage	V_{BB}	46	V	
Logic Supply Voltage	V_{DD}	6	V	
Output Current	Io	*1	A	Vref=0.4V, Mode F
Logic Input Voltage	V_{IN}	–0.3 to V_{DD}+0.3	V	
REF Input Voltage	V_{REF}	–0.3 to V_{DD}+0.3	V	
Sense Voltage	V_{RS}	±2	V	Excluding tw<1µs
Power Dissipation	PD	4.7	W	When T_a = 25°C
		17		When T_c = 25°C
Junction Temperature	T_j	+150	°C	
Operating Ambient Temperature	T_a	–20 to +85	°C	
Storage Temperature	T_{stg}	–30 to +150	°C	

*1: Output current value may be limited for the SLA7075MR, MPR (1.0 A), SLA7076MR, MPR (1.5 A), SLA7077MR, MPR (2.0 A), and SA7078MR, MPR (3.0 A), depending on the duty ratio, ambient temperature, and heating conditions. Do not exceed junction temperature of T_j under any circumstances.

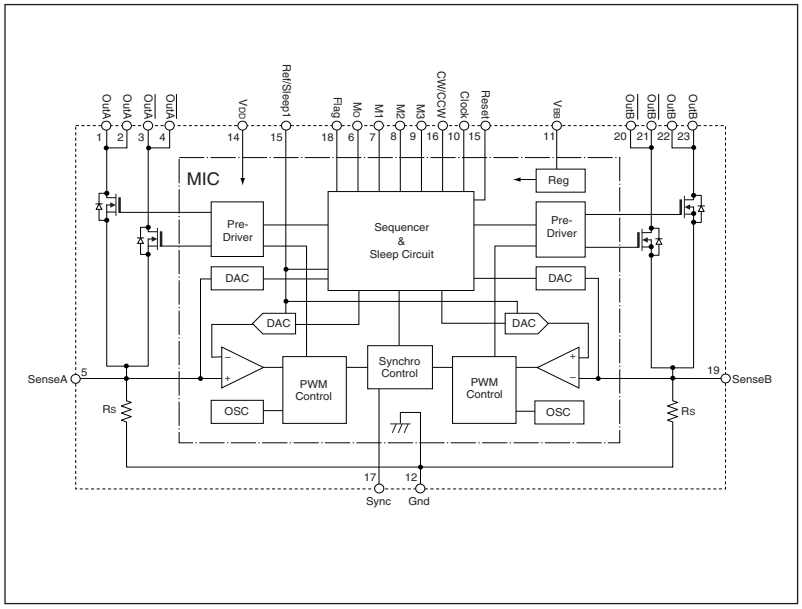
■Recommended Operating Conditions

Parameter	Symbol	Rating		Unit	Remarks
		min.	max.		
Motor Supply Voltage	V_M		44	V	
Driver Supply Voltage	V_S	10	44	V	
Logic Supply Voltage	V_{DD}	3.0	5.5	V	The V_{CC} surge voltage should be 0.5 V or lower
REF Input Voltage	V_{REF}	0.0	0.4	V	When operating current control
Case Temperature	T_C		90	°C	Temperature at Pin-12 Lead (without heatsink)

■Electrical Characteristics

Parameter	Symbol	Ratings			Unit	Conditions
		min	typ	max		
Main Supply Current	I_{BB}			15	mA	In operation
	I_{BBS}			100	µA	Sleep 1 and Sleep 2 modes
Logic Supply Current	Icc			5	mA	
Output MOSFET Breakdown Voltage	$V_{(BR)DSS}$	100			V	VBB=44V, ID=1mA
Output MOSFET ON Resistance	$R_{DS(ON)}$		0.7	0.85	Ω	SLA7075M, ID=1.0A
			0.45	0.6		SLA7076M, ID=1.5A
			0.25	0.4		SLA7077M, ID=2.0A
			0.18	0.24		SLA7078M, ID=3.0A
Output MOSFET Diode Forward Voltage	V_F		0.85	1.1	V	SLA7075M, ID=1.0A
			1.0	1.25		SLA7076M, ID=1.5A
			0.95	1.2		SLA7077M, ID=2.0A
			0.95	2.1		SLA7078M, ID=3.0A
Maximum Clock Frequency	Fclock	250			kHz	When Clock Duty = 50%
Logic Input Voltage	V_{IL}			0.25V_{DD}	V	
	V_{IH}	0.75V_{DD}				
Logic Input Current	I_{IL}		±1		µA	
	I_{IH}		±1			
REF Input Voltage	V_{REF}	0.04		0.3	V	SLA7075MR/7075MPR, within the specified current limit
		0.04		0.45		SLA7077MR/7076MPR, within the specified current limit
		0.04		0.4		SLA7077MR/7077MPR, within the specified current limit
		0.04		0.45		SLA7078MR/7078MPR, within the specified current limit
	V_{REFS}	2		V_{DD}		Output (OFF) Sleep 1
REF Input Current	I_{REF}		±10		µA	
SENSE Sense Voltage	V_{SENSE}		V_{REF}		V	When step reference current ratio is 100%
Sleep-Enable Recovery Time	T_{SE}	100			µS	Sleep1&Sleep2
Switching Time	t_{con}		2.0		µS	Clock → Out ON
	t_{coff}		1.5		µS	Clock → Out OFF
Sense Resistance	R_S	0.296	0.305	0.314	Ω	SLA7075MR/7075MPR, tolerance of ±3%
		0.296	0.305	0.314		SLA7076MR/7076MPR, tolerance of ±3%
		0.199	0.205	0.211		SLA7077MR/7077MPR, tolerance of ±3%
		0.150	0.155	0.160		SLA7078MR/7078MPR, tolerance of ±3%
Overcurrent sense voltage	Vocp	0.65	0.7	0.75	V	SLA7075MPR/7076MPR/7077MPR/7078MPR, when motor coil shorts out
Overcurrent sense current	Iocp		2.3		A	SLA7075MPR/7076MPR
			3.5			SLA7077MPR
			4.6			SLA7078MPR
Flag Output Voltage	V_{FlagL}			1.25	V	SLA70750MPR/7076MPR/7077MPR/7078MPR, IFlagL=1.25mA
	V_{FlagH}	1.25V_{DD}				SLA7075MPR/7076MPR/7077MPR/7078MPR, IFlagH=-1.25mA
Flag Output Current	I_{FlagL}			1.25	mA	SLA7075MPR/7076MPR/7077MPR/7078MPR
	I_{FlagH}	–1.25				
Step Reference Current Ratio	ModeF		100		%	
	ModeE		98.1		%	
	ModeD		95.7		%	
	ModeC		92.4		%	
	ModeB		88.2		%	
	ModeA		83.1		%	
	Mode9		77.3		%	
	Mode8		70.7		%	
	Mode7		63.4		%	
	Mode6		55.5		%	
	Mode5		47.1		%	
	Mode4		38.2		%	
	Mode3		29.0		%	
	Mode2		19.5		%	
	Mode1		9.8		%	
PWM Minimum ON Time	ton(min)		1.7		µS	
PWM OFF Time	toff1		12		µS	Mode 8 to F
	toff2		9		µS	Mode 4 to 7
	toff3		7		µS	Mode 1 to 3

■Internal Block Diagram



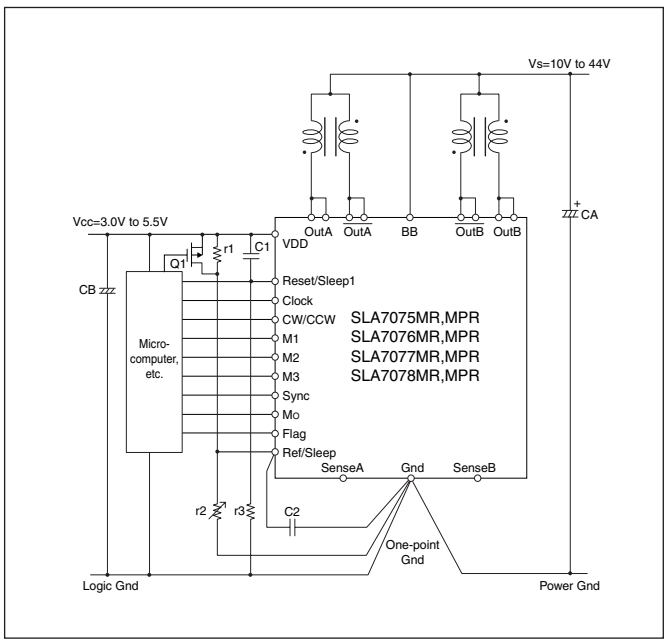
The protect circuit is deleted and the flag pin is N.C. for SLA7075MR, 7076MR, 7077MR, and 7078MR.

■Pin Assignment

Pin No.	Symbol	Function
1	OutA	Phase A output
2		
3	OutA/	Phase $\overline{A}$ output
4		
5	SenseA	Phase A current sense
6	M_O	2 phase excitation state output monitor output
7	M1	Excitation mode/Sleep 2 setting input
8	M2	
9	M3	
10	Clock	Step Clock input
11	V_{SS}	Driver supply (motor supply)
12	Gnd	Device GND
13	Ref/Sleep1	Control current mode/Sleep 1 setting input
14	V_{DD}	Logic supply
15	Reset	Internal logic reset input
16	CW/CCW	Normal/reverse control input
17	Sync	PWM control signal input
18	Flag*1	Protection circuit monitor output*1
19	SenseB	Phase B current sense
20	OutB/	Phase $\overline{B}$ current output
21		
22	OutB	Phase B current output
23		

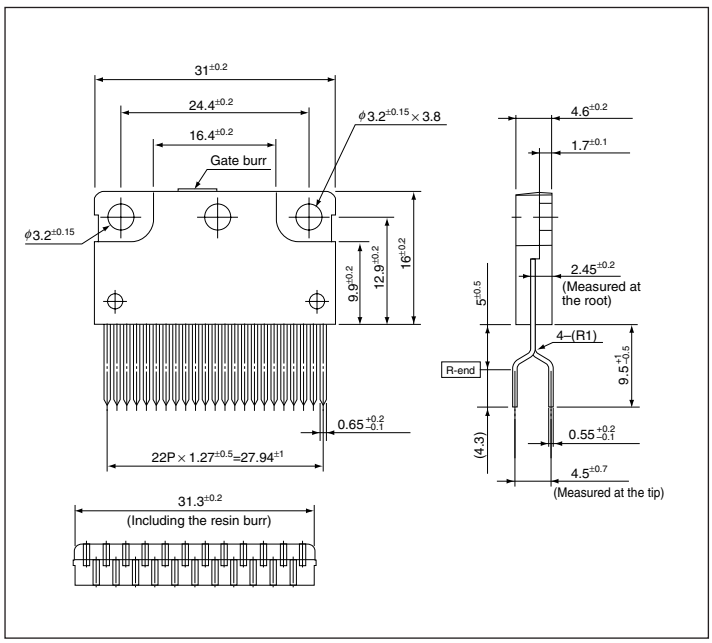
*1: N.C. pin for SLA7075MR, 7076MR, 7077MR, and 7078MR.

■Typical Connection Diagram



* There is no Flag pin (pin 18) for SLA7075MR, 7076MR, 7077MR, and 7078MR.

■External Dimensions (ZIP23 with Fin [SLA23Pin])



PG001M Serial Signal Generator ICs for SLA7042M and SLA7044M

■Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{DD}	–0.5 to 7	V
Input voltage	V_I	–0.5 to V_{DD}+0.5	V
Input current	I_I	±10	mA
Output voltage	V_O	–0.5 to V_{DD}+0.5	V
Output current	I_O	±15	mA
Power dissipation	P_D	200	mW
Operating temperature	T_{OP}	–20 to +85	°C
Storage temperature	T_{stg}	–40 to +150	°C

■Electrical Characteristics

(Ta=25°C)

	Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Units
DC characteristics	Supply voltage	V_{DD}		4.5		5.5	V
	Supply current	I_{DD}	V_{DD}=5.5V		0.35	0.45	mA
	Output voltage	V_{OH}	V_{DD}=5V, I_O=±3mA	4.5			V
		V_{OL}				0.4	
	Input current	I_I	V_{DD}=5V, V_I=0 or 5V			±1	μA
	Input voltage	V_{IH}	V_{DD}=5V	3.5		5	V
		V_{IL}		–0.3		1.5	
	Input hysteresis voltage	V_H	V_{DD}=5V		1		V
	Input capacity	C_I	V_{DD}=5V		5	10	pF
AC characteristics	Internal oscillation frequency	F	V_{DD}=5V See Fig.1.		1.5		MHz
	Propagation delay time	T_{CS}			50	100	ns
		T_{CC}			430	550	
	Output voltage Rise and fall time	T_r	V_{DD}=5V, C_L=15pF See Fig.2.		20		ns
		T_f			20		
	CLOCK IN terminal Input clock time	V_{CIH}	H level time, V_{DD}=5V	4.5			μs
		V_{CIL}	L level time, V_{DD}=5V	0.5			
	Reset setting time (A)	$_{ts}R$	From/To CLOCK_IN ↑ See Fig.3.	100			ns
	Stabilization time after reset input (B)	$_{tps}R$					
	Signal setting time (C)	$_{ts}S$	From/To CLOCK_IN ↑ See Fig.3.	100			ns
	Stabilization time after signal input (D)	$_{tps}S$					

Fig. 1

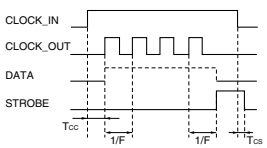


Fig.2

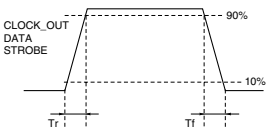
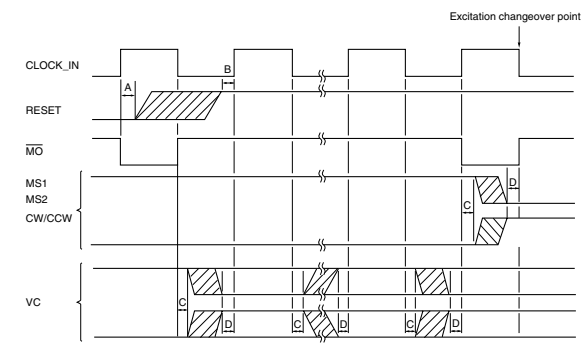
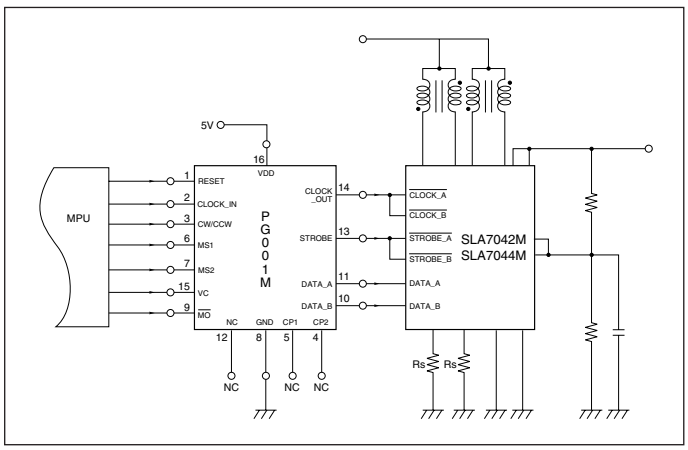


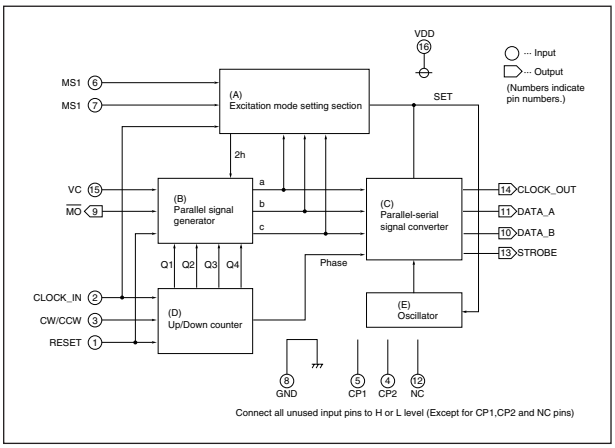
Fig. 3 Timing conditions



■Typical Connection Diagram



■Internal Block Diagram



■Input and Output Function Correlation Table

Input				Input Output				
Mode	CLOCK_IN	CW/CCW	RESET	$\overline{MO}$	CLOCK_OUT	STROBE	DATA-A	DATA-B
CW	⎍	L	H	⎍	⎍⎍⎍	⎍	CW	CW
	⎍	L	H	⎍	—	⎍		
CCW	⎍	H	H	⎍	⎍⎍⎍	⎍	CCW	CCW
	⎍	H	H	⎍	—	⎍		
RESET	⎍	×	L	⎍	⎍⎍⎍	⎍	Output Mode 4 or 7 Output Mode	Input Mode 4 or 7 Output Mode
	⎍	×	L	⎍	—	⎍		

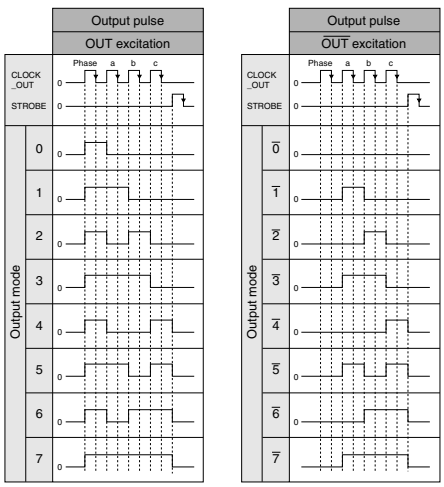
×:Immaterial

*:$\overline{MO}$ outputs L level while CLOCK_IN is H level when output mode is 4:4 (7:7), $\overline{4}$:4 ($\overline{7}$:7), 4:$\overline{4}$ (7:$\overline{7}$), or $\overline{4}$:$\overline{4}$ ($\overline{7}$:$\overline{7}$).
Modes in brackets ( ) are for 2-2 phase VC:H.

■Excitation Selection Table

Excitation method	Input			Output current mode of SLA7042M/7044M								
	Excitation mode selection			0	1	2	3	4	5	6	7	Torque vector
	VC	MS1	MS2	0%	20%	40%	55.5%	71.4%	83%	91%	100%	
2-2 Phase Full Step	H	L	L	–	–	–	–	–	–	–	○	141%
	L	L	L	–	–	–	–	○	–	–	–	100%
1-2 Phase Half Step	×	H	L	○	–	–	–	○	–	–	○	100%
W1-2 Phase 1/4 Step	×	L	H	○	–	○	–	○	–	○	○	100%
2W1-2 Phase 1/8 Step	×	H	H	○	○	○	○	○	○	○	○	100%

■Output Mode Vs Output Pulse



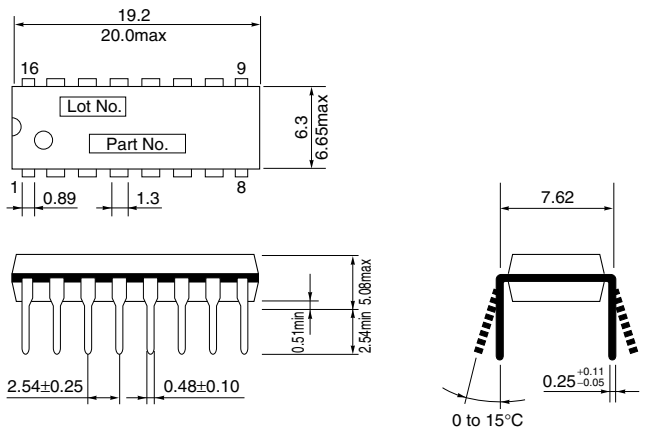
■Output Mode Sequence

Excitation method	CW/CCW	CLOCK	RESET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		$\overline{MO}$	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	L
2-2 Phase Full Step (1) (VC:H)	CW	DATA_A	7	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	7	=	=	=	=	=	=	=	7
		DATA_B	7	=	=	=	=	=	=	7	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	7
	CCW	DATA_A	7	=	=	=	=	=	=	7	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	7
		DATA_B	7	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	$\overline{7}$	=	=	=	=	=	=	=	7	=	=	=	=	=	=	=	7
2-2 Phase Full Step (2) (VC:L)	CW	DATA_A	4	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	4	=	=	=	=	=	=	=	4
		DATA_B	4	=	=	=	=	=	=	4	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	4
	CCW	DATA_A	4	=	=	=	=	=	=	4	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	4
		DATA_B	4	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	$\overline{4}$	=	=	=	=	=	=	=	4	=	=	=	=	=	=	=	4
1-2 Phase Half Step	CW	DATA_A	4	=	=	=	$\overline{0}$	=	=	$\overline{4}$	=	=	=	$\overline{7}$	=	=	=	$\overline{4}$	=	=	=	0	=	=	=	4	=	=	=	7	=	=	=	4
		DATA_B	4	=	=	=	7	=	=	4	=	=	=	$\overline{0}$	=	=	=	$\overline{4}$	=	=	=	$\overline{7}$	=	=	=	$\overline{4}$	=	=	=	0	=	=	=	4
	CCW	DATA_A	4	=	=	=	7	=	=	4	=	=	=	0	=	=	=	$\overline{4}$	=	=	=	$\overline{7}$	=	=	=	$\overline{4}$	=	=	=	$\overline{0}$	=	=	=	4
		DATA_B	4	=	=	=	0	=	=	$\overline{4}$	=	=	=	$\overline{7}$	=	=	=	$\overline{4}$	=	=	=	$\overline{0}$	=	=	=	4	=	=	=	7	=	=	=	4
W1-2 Phase 1/4 Step	CW	DATA_A	4	=	2	=	$\overline{0}$	=	$\overline{2}$	=	$\overline{4}$	=	$\overline{6}$	=	$\overline{7}$	=	$\overline{6}$	=	$\overline{4}$	=	$\overline{2}$	=	0	=	2	=	4	=	6	=	7	=	6	=	4
		DATA_B	4	=	6	=	7	=	6	=	4	=	2	=	$\overline{0}$	=	$\overline{2}$	=	$\overline{4}$	=	$\overline{6}$	=	$\overline{7}$	=	$\overline{6}$	=	$\overline{4}$	=	$\overline{2}$	=	0	=	2	=	4
	CCW	DATA_A	4	=	6	=	7	=	6	=	4	=	2	=	0	=	$\overline{2}$	=	$\overline{4}$	=	$\overline{6}$	=	$\overline{7}$	=	$\overline{6}$	=	$\overline{4}$	=	$\overline{2}$	=	$\overline{0}$	=	2	=	4
		DATA_B	4	=	2	=	0	=	$\overline{2}$	=	$\overline{4}$	=	$\overline{6}$	=	$\overline{7}$	=	$\overline{6}$	=	$\overline{4}$	=	$\overline{2}$	=	$\overline{0}$	=	2	=	4	=	6	=	7	=	6	=	4
2W1-2 Phase 1/8 Step	CW	DATA_A	4	3	2	1	0	$\overline{1}$	$\overline{2}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\overline{6}$	$\overline{7}$	$\overline{7}$	$\overline{7}$	$\overline{6}$	$\overline{5}$	$\overline{4}$	$\overline{3}$	$\overline{2}$	$\overline{1}$	0	1	2	3	4	5	6	7	7	6	5	4
		DATA_B	4	5	6	7	7	7	6	5	4	3	2	1	0	$\overline{1}$	$\overline{2}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\overline{6}$	$\overline{7}$	$\overline{7}$	$\overline{7}$	$\overline{6}$	$\overline{5}$	$\overline{4}$	$\overline{3}$	$\overline{2}$	$\overline{1}$	0	1	2	3	4
	CCW	DATA_A	4	5	6	7	7	7	6	5	4	3	2	1	0	$\overline{1}$	$\overline{2}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\overline{6}$	$\overline{7}$	$\overline{7}$	$\overline{7}$	$\overline{6}$	$\overline{5}$	$\overline{4}$	$\overline{3}$	$\overline{2}$	$\overline{1}$	$\overline{0}$	1	2	3	4
		DATA_B	4	3	2	1	0	$\overline{1}$	$\overline{2}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\overline{6}$	$\overline{7}$	$\overline{7}$	$\overline{7}$	$\overline{6}$	$\overline{5}$	$\overline{4}$	$\overline{3}$	$\overline{2}$	$\overline{1}$	$\overline{0}$	1	2	3	4	5	6	7	7	7	6	5	4

=:No output

■External Dimensions (DIP16)

(Unit : mm)



SLA7611M Star Connection/Delta Connection

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit	Remarks
Main Supply Voltage	V_{BB}	36	V	
Logic Supply Voltage	V_{CC}	7	V	
Output Current	$I_{O\ (Ave)}$	3	A	
	$I_{O\ (Peak)}$	6	A	tw < 1ms
Logic Input Voltage	V_{IN}	–0.3 to V_{CC}+0.3	V	
REF Input Voltage	V_{REF}	–0.3 to V_{CC}+0.3	V	
PFD Input Voltage	V_{PFD}	–0.3 to V_{CC}+0.3	V	
Sense Voltage	V_{Rs}	–2 to 2	V	
Power Dissipation	P_D	4	W	Without heatsink
Junction Temperature	T_j	150	°C	
Operating Ambient Temperature	T_a	–20 to 85	°C	
Storage Temperature	T_{stg}	–30 to 150	°C	

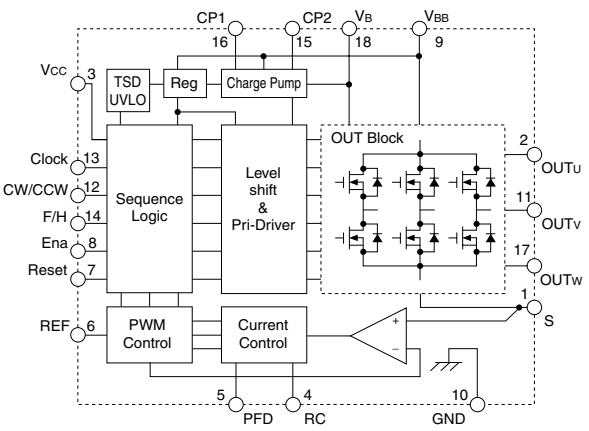
■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit	Remarks
Main Supply Voltage	V_{BB}	10 to 30	V	
Logic Supply Voltage	V_{CC}	3 to 5.5	V	The VCC surge voltage should be 0.5V or lower.
REF Input Voltage	V_{REF}	0.2 to V_{CC}	V	The control current precision is degraded at 0.2V or lower.
Case Temperature	T_C	110max	°C	Temperature at Pin-10 Lead (without heatsink)

■Electrical Characteristics (T_a = 25°C, V_{BB} = 24V, V_{CC} = 5V, unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Remarks
		min	typ	max		
Main Supply Current	I_{BB}			20	mA	
Logic Supply Current	I_{cc}			10	mA	
Charge Pump Voltage	V_B		V_{BB}+5		V	
Output Withstand Voltage	V_O	36			V	
Output MOS FET ON Resistance (total of the upper and lower values)	$R_{DS\ (on)}$			0.8	Ω	I_{DS}=3A
Output MOS FET Diode Forward Voltage	V_{SD}			1.5	V	I_{SD}=3A
Logic Input Voltage	V_{IL}			V_{CC}×0.25	V	
	V_{IH}	V_{CC}×0.75			V	
Logic Input Current	I_{IL}		±1		μA	Excluding E_{na}
	I_{IH}		±1		μA	
Maximum Clock Frequency	F_{clock}			100	kHz	
PFD Input Current	I_{PFD}		±10		μA	
RC Terminal Inflow Current	I_{RC}		200		μA	
PFD Input Voltage	V_{PFDS}	1.7		V_{CC}	V	Slow Decay
	V_{PFDM}	0.7		1.3	V	Mixed Decay
	V_{PFDF}			0.3	V	Fast Decay
Sense Voltage	V_{Rs}		V_{REF}×0.2		V	Steady-state
REF Input Voltage	V_{REF}	0		V_{CC}	V	
REF Input Current	I_{REF}		±10		μA	
PWM OFF Time	T_{OFF}		1.1×R_t×C_t		μs	
Thermal Protection Circuit Activation Temperature	T_j		150		°C	
Hysteresis of Thermal Protection Circuit Activation Temperature	ΔT_j		10		°C	
Switching Time	T_{ONC}		2.5		μs	Clock→Out
	T_{OFFC}		2		μs	Clock→Out

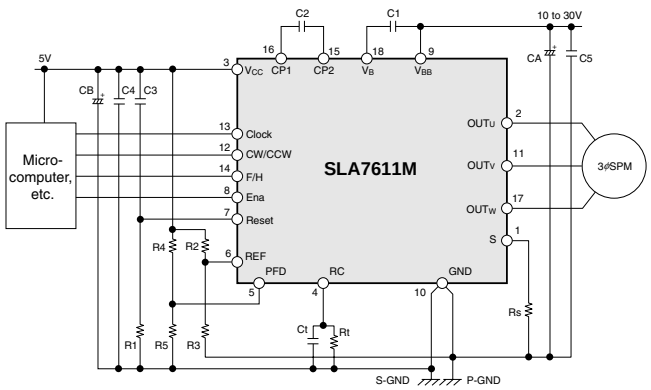
■Internal Block Diagram



■Pin Assignment (Function Table)

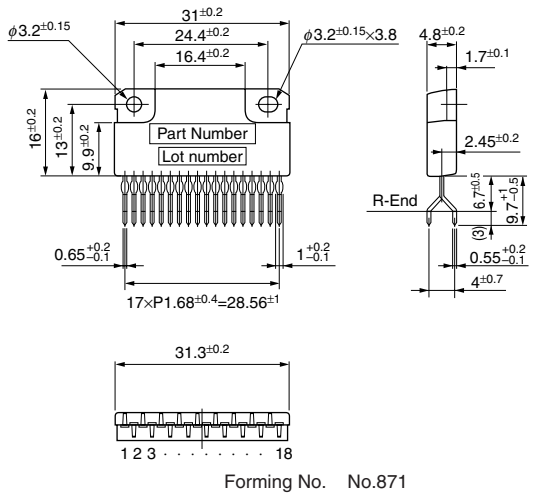
Pin No.	Symbol	Function
1	Sense	Current sense
2	Out U	Phase U output
3	V_{CC}	Logic supply
4	RC	PWM OFF time setting
5	PFD	Mixed Decay ratio setting
6	REF	Control current setting
7	Reset	Internal logic reset
8	Ena	Output Enable/Disable control
9	V_{BB}	Main supply (motor supply)
10	GND	Device GND
11	Out V	Phase V output
12	CW/CCW	Forward/reverse control
13	Clock	Step Clock
14	Full/Half	Full/half step control
15	CP2	Charge pump capacitor 2
16	CP1	Charge pump capacitor 1
17	Out W	Phase W output
18	V_B	Boost charge pump

■Typical Connection Diagram



■External Dimensions (ZIP18 with Fin [SLA18Pin])

(Unit : mm)

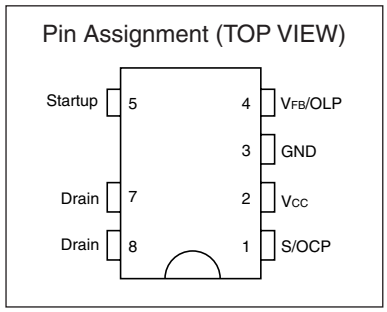


Forming No. No.871

Other lead forming shapes are also available.
For details, contact our sales representative.

STR-A6100 Series

■Features



- **PRC [Pulse Ratio Control]: (8μs fixed off-time, variable on-time)**
  Low-EMI noise operation thanks to the quasi-jittering operation that varies the switching frequency within a range from about 63kHz to 120kHz according to load variations.
- **Auto burst standby: (Power consumption at no load <100mW at AC264V)**
  Enables very low power consumption at no load.
  Typical results of a 5W universal input power supply: Pin= 35mW at AC110V
  Pin=43mW at AC220V
- **Auto bias function**
  This function stabilizes operation during Auto Burst Standby mode, by controlling stably the hiccup mode caused by UVLO. The Auto Bias function forces the IC to turn on before the V_{CC} voltage drops down to V_{CC}(OFF), thereby stabilizing the entire power supply operation.
- **Startup circuit**
  600V BCD process allows direct connection of the STARTUP pin to the rectified high voltage rail. This reduces component count and improves overall efficiency.
- **Current mode control**
- **Leading edge blanking**
  Requires no external Low-pass filter circuit preventing the malfunction due to the surge current at turn-on.
- **Built-in Power MOSFET guaranteeing avalanche energy capability**
  Thus, surge absorber circuit can be simplified and also no VDSS derating is required.
- **Versatile protecting functions**
  - Over current protection ---------- Pulse by pulse
  - Over voltage protection ---------- With latch
  - Overload protection ---------- Auto restart
  - Thermal shutdown ---------- With latch

■Applications

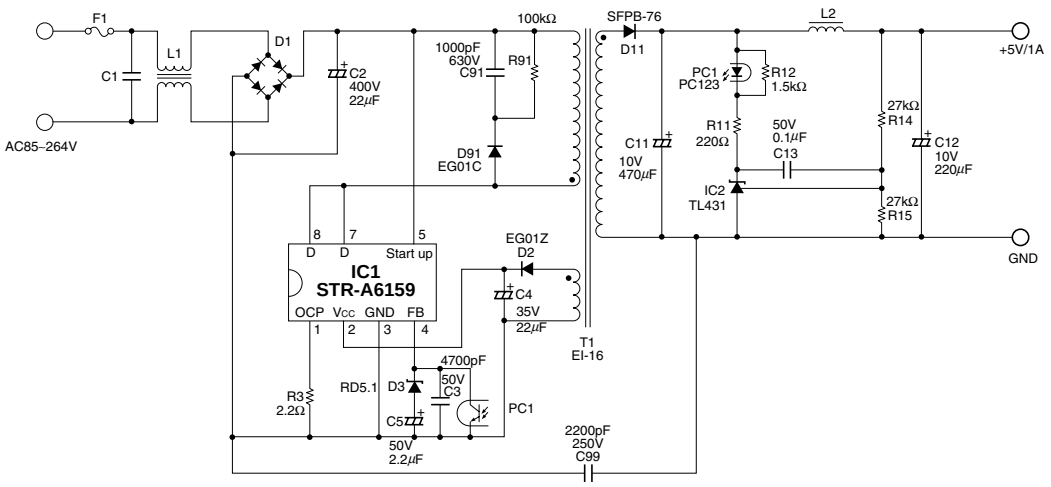
- Battery Charger ---------- Cell Phone, Digital Still Camera, Camcorder, Shaver, Emergency light, Guidance light, etc.
- Standby Power Supply ---------- CRT TV, Projection TV, LCD TV, PDP TV, Desktop PC, LBP, Audio system, etc.
- Compact SMPS ---------- Inkjet printer, DVD Player/Recorder, VCR, Set Top Box, etc. (SMPS: Switching Mode Power Supply)
- Auxiliary Power Supply for Controller -- Air conditioner, Refrigerator, Washer, Dish Washer, etc.

■Lineup

Part Number	V_{DSS}	$R_{DS(ON)}$	$V_{IN(AC)}$	Pout
STR-A6131	500V	3.95Ω	100V/120V	12W
STR-A6132		2.62Ω	100V/120V	16W
STR-A6153E	650V	1.90Ω	230V/85V to 264V	24W/20W
STR-A6151		3.95Ω	230V/85V to 264V	16W/12W
STR-A6159		6.00Ω	230V/85V to 264V	13W/12W
STR-A6169	800V	19.20Ω	230V/85V to 264V	8W/5W

■Typical Connection Diagram (STR-A6159)

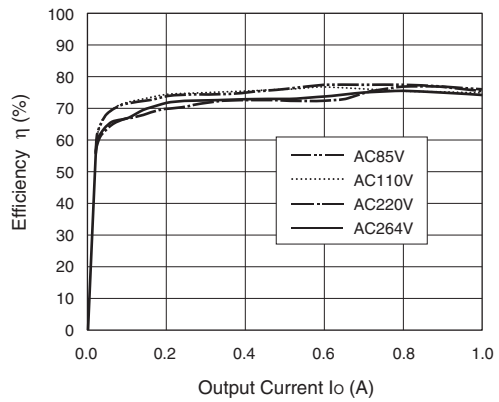
(5W Universal input, single output power supply)



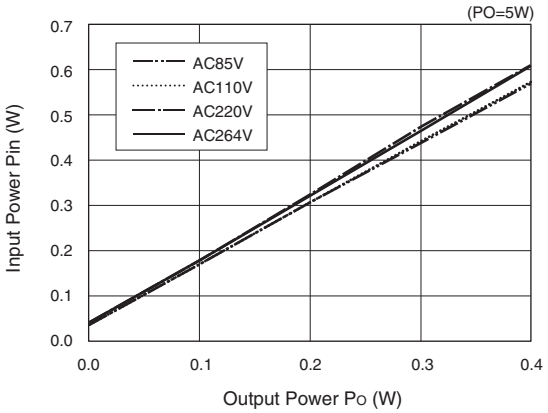
■Electrical Characteristics (STR-A6159)

(Power supply characteristics at input of 85VAC to 264VAC and 5V 1A output)

Efficiency η vs Output Current Io

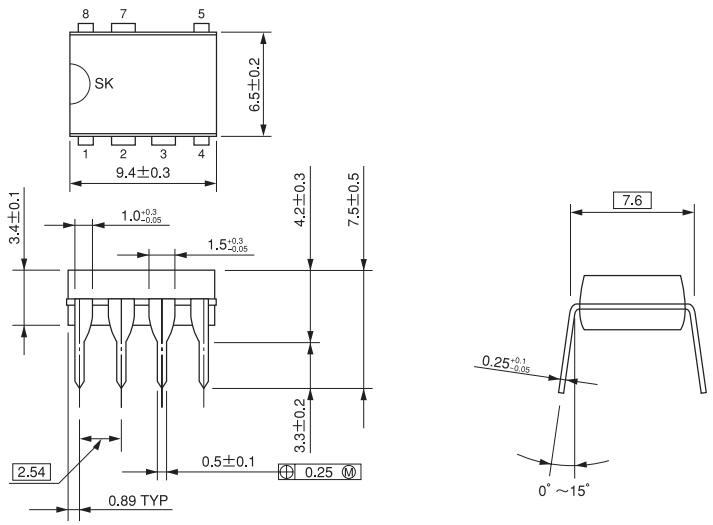


Input Power Pin vs Output Power Po



■External Dimensions (DIP8)

(Unit : mm)



2

Transistors

Application Note

Since reliability can be affected adversely by improper storage environment or handling methods during Characteristic tests, please observe the following cautions.

■ Cautions for Storage

- ●Ensure that storage conditions comply with the normal temperature (5 to 35°C) and the normal relative humidity (around 40 to 75%), and avoid storage locations that experience high temperature and humidity, or extreme changes in temperature or humidity.
- ●Avoid locations where dust or harmful gases are present, and avoid direct sunlight.
- ●Reinspect the devices for rust in leads and solderability after stored for a long time.

■ Cautions for Characteristic Tests and Handling

On characteristics test at incoming inspection, etc, take good care to avoid the surge voltages from the test equipment, the short circuit at terminals, or the wrong connection.

■ Silicone Grease

When using a heatsink, please coat thinly and evenly the back surface of the device and both surfaces of the insulating plate with silicone grease to lower the thermal resistance between the device and the heatsink.
Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.
Recommended Silicone Grease
- G-746 (Shin-Etsu Chemical)
- YG6260 (GE Toshiba Silicones)
- SC102 (Dow Corning Toray Silicone)

■ Mounting Torque

When mounting torque is insufficient, thermal resistance increases, and so heat radiation effect is decreased. When the torque is excessive, the screw may be broken, the heatsink may be deformed, and the device frame may be distorted, resulting in the device damage. Recommended mounting torque per package is as follows:

● Mounting Torque Table

Package	Screw Torque
TO-220 (MT-25)	0.490 to 0.686 N•m (5 to 7kgf•cm)
TO-220F (FM20)	
TO-3P (MT-100)	0.686 to 0.882 N•m (7 to 9kgf•cm)
TO-3PF(FM100)	
MT-200 (fixed at two points)	
SIP with Fin (SLA)	0.588 to 0.784 N•m (6 to 8kgf•cm)

* When the surface of a heatsink where Full Mold package is to be mounted is not flat due to the burred metal bracket for screwing around the mounting hole of the heatsink, the resin of the package might be cracked even if the torque is lower than the recommended value.

* When a screw is fastened with an air driver for the Full Mold package, a large impact is generated at the time of stop, and the resin may crack even if the torque is lower than the recommended value. An electric driver, therefore, should be used instead of an air driver.

■ Heatsink

A larger contact area between the device and the heatsink is required for more effective heat radiation. To ensure a larger contact area, minimize mounting holes. And select a heatsink with a surface smooth enough and free from burrs and slivers.

■ Soldering Temperature

In general, the device mounted on a printed circuit board is subjected to high temperatures from flow solder in a solder bath, or, from a soldering iron at hand soldering.
The testing method and test conditions (JIS-C-7021 standards) for a device's heat resistance to soldering are:
At a distance of 1.5mm from the device's main body, apply 260°C for 10 seconds, and 350°C for 3 seconds.
Please observe these limits and finish soldering in as short a time as possible.

■ Antistatic measure for power MOS FET Arrays

- ●When handling the device, body grounding is necessary. Wear a wrist strap with a 1 MΩ resistor close to the body in the wrist strap to prevent electric shock.
- ●Use a conductive tablemat and a floor mat at the device-handling workbench and ground them properly.
- ●When using a curve tracer or other measuring equipment, ground them as well.
- ●In soldering, ground the soldering iron tip and the solder bath to prevent a leakage voltage from damaging the device.
- ●As an antistatic measure for device containers, use Sanken shipping containers or a conductive containers, or use aluminum foils.
  Since reliability can be affected adversely by improper storage environment or handling methods during Characteristic tests, please observe the following cautions.

Selection Guide

V_{CEO}-I_C

Collector–Emitter Voltage V_{CEO}(V)

800		C3678 C4020 C4304 C4445		C3679 C4300		C3680 C4301									
600										C4706 C5924					
550				C4518 C4518A C5287 C5586				C3927 C4557							
450							C5830								
400				C5130		C3832 C4546		C4138	C3833 C4297 C5071		C4139 C4298 C4434			C4140	
380					D2141										
300	C2023 C5333														
250					D2017										
230											A1294 C3263 A2151A C6011A		A1295 C3264		
200	A1668 C4382	D2016		D2557 D2558							A1493 C3857 A2151 C6011		A1494 C3858		
180	A1859A C4883A										A1386A A1492 A1673 C3519A C3856 C4388		A1216 C2922		
160											A1215 A1386 C2921 C3519				
150	A1667 A1859 C4381 C4883						B1559 B1587 D2389 D2438	A1186 B1560 B1588 C2837 D2390 D2439	B1570 D2401	A1303 A1860 C3284 C4886	B1647 B1649 D2560 D2562		B1648 D2561		
140								A1695 A1909 C4468 C5101							
120			D2015		D1769 D1785 D2045	C3834 C3835 C4153	A1694 A1908 C4467 C5100	B1259 D2081				B1382 B1420 D2082			B1383 D2083
110					B1685 B1686 B1687 D2641 D2642 D2643										
100					B1258										
80		C3852A	A1488A C3851A D2014		A1693 A1725 A1726 A1907 C4466 C4511 C4512 C5099										
60		C3852	A1262 A1488 B1257 C3179 C3851 D1796						A1568 B1351						
50		C4495						C4024	A1567 A1746 C4064		C4131				
	2	3	4	5	6	7	8	10	12	14	15	16	17	18	25

Collector Current Ic(A)

Audio Transistors

■Output Transistors

Pc (W)	Ic (A)	VCEO (V)	Chip						Package
			Single Transistors				Darlington		
			General		LAPT				
30	6	80	2SA1725	2SC4511					TO-220F (FM20)
	6	110					2SB1686	2SD2642	TO-220F (FM20)
50	6	80	2SA1726	2SC4512					TO-220 (MT-25)
60	6	80	2SA1693	2SC4466					TO-3P (MT-100)
	6	80	2SA1907	2SC5099					TO-3PF (FM100)
	6	110					2SB1685	2SD2641	TO-3P (MT-100)
	6	110					2SB1687	2SD2643	TO-3PF (FM100)
75	8	120	2SA1908	2SC5100					TO-3PF (FM100)
	8	150					2SB1587	2SD2438	TO-3PF (FM100)
80	8	120	2SA1694	2SC4467					TO-3P (MT-100)
	10	140	2SA1909	2SC5101					TO-3PF (FM100)
	8	150					2SB1559	2SD2389	TO-3P (MT-100)
	10	150					2SB1588	2SD2439	TO-3PF (FM100)
	14	150			2SA1860	2SC4886			TO-3PF (FM100)
85	15	150					2SB1649	2SD2562	TO-3PF (FM100)
	15	180	2SA1673	2SC4388					TO-3PF (FM100)
100	10	140	2SA1695	2SC4468					TO-3P (MT-100)
	10	150			2SA1186	2SC2837			TO-3P (MT-100)
	10	150					2SB1560	2SD2390	TO-3P (MT-100)
125	14	150			2SA1303	2SC3284			TO-3P (MT-100)
130	15	150					2SB1647	2SD2560	TO-3P (MT-100)
	15	160			2SA1386	2SC3519			TO-3P (MT-100)
	15	180	2SA1492	2SC3856					TO-3P (MT-100)
	15	180			2SA1386A	2SC3519A			TO-3P (MT-100)
	15	230			2SA1294	2SC3263			TO-3P (MT-100)
150	12	150					2SB1570	2SD2401	MT-200 (fixed at two points)
	15	160			2SA1215	2SC2921			MT-200 (fixed at two points)
	15	200	2SA1493	2SC3857					MT-200 (fixed at two points)
160	15	200	2SA2151	2SC6011					TO-3P (MT-100)
	15	230	2SA2151A	2SC6011A					TO-3P (MT-100)
200	17	150					2SB1648	2SD2561	MT-200 (fixed at two points)
	17	180			2SA1216	2SC2922			MT-200 (fixed at two points)
	17	200	2SA1494	2SC3858					MT-200 (fixed at two points)
	17	230			2SA1295	2SC3264			MT-200 (fixed at two points)

LAPT: Multi-Emitter for High Frequency

■Output Transistors with Temperature Compensating Function (Refer to our Web site for applications)

Part Number		Pc (W)	Ic (A)	VCEO (V)	Package
STD03P	STD03N	160	15	160	TO3P-5pin

■Driver and Temperature Compensating Transistors

Part Number		Pc (W)	VCEO (V)	Ic (A)	hFE (min)	fT (MHz)	Package	Remarks
2SC4495		25	50	3	500	40	TO-220F (FM20)	For temperature compensation
2SA1859	2SC4883	20	150	2	60	60/120	TO-220F (FM20)	Driver
2SA1859A	2SC4883A	20	180	2	60	60/120	TO-220F (FM20)	Driver
2SA1667	2SC4381	25	150	2	60	20/15	TO-220F (FM20)	Driver
2SA1668	2SC4382	25	200	2	60	20/15	TO-220F (FM20)	Driver

Refer to our Web site for the hFE ranks.

Switching Transistors

■DC-DC Converter

Part Number	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_C (W)	Package
2SC4024	100	50	10	35	TO-220F (FM20)
2SC4131			15	60	TO-3PF (FM100)
2SC4153	200	120	7	30	TO-220F (FM20)
2SC3834				50	TO-220 (MT-25)
2SC3835				70	TO-3P (MT-100)

■For AC100V Input

Part Number	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_C (W)	Package
2SC3832	500	400	7	50	TO-220 (MT-25)
2SC4138			10	80	TO-3P (MT-100)
2SC4297			12	75	TO-3PF (FM100)
2SC3833				100	TO-3PF (FM100)
2SC5071				100	TO-3P (MT-100)
2SC4298			15	80	TO-3P (MT-100)
2SC4139				120	TO-3P (MT-100)
2SC4434				120	TO-3P (MT-100)
2SC4140			18	130	TO-3P (MT-100)
2SC5130	600	400	5	30	TO-220F (FM20)
2SC4546			7	30	TO-220F (FM20)

■For AC200V Input

Part Number	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_C (W)	Package
2SC4518	900	550	5	35	TO-220F (FM20)
2SC5287				80	TO-3P (MT-100)
2SC4557			10	80	TO-3PF (FM100)
2SC3927				120	TO-3P (MT-100)
2SC5586		600	5	70	TO-3PF (FM100)
2SC4706			14	130	TO-3P (MT-100)
2SC5924				90	TO-3PF (FM100)
2SC4304		800	3	35	TO-220F (FM20)
2SC4020				50	TO-220 (MT-25)
2SC4445				60	TO-3PF (FM100)
2SC3678				80	TO-3P (MT-100)
2SC4300			5	75	TO-3PF (FM100)
2SC3679				100	TO-3P (MT-100)
2SC4301			7	80	TO-3PF (FM100)
2SC3680				120	TO-3P (MT-100)
2SC4518A	1000	550	5	35	TO-220F (FM20)

Specifications List by Part Number

Part Number	Applications	Absolute Maximum Ratings				I_{CBO}		h_{FE}			
		V_{CBO}	V_{CEO}	I_C	P_C		Conditions V_{CB}			Conditions V_{CE}	I_C
		(V)	(V)	(A)	(W)	(μA)	(V)	min	max	(V)	(A)
2SA1186	Audio, general-purpose	–150	–150	–10	100	–100	–150	50	180	–4	–3
2SA1215	Audio, general-purpose	–160	–160	–15	150	–100	–160	50	180	–4	–5
2SA1216	Audio, general-purpose	–180	–180	–17	200	–100	–180	30	180	–4	–8
2SA1262	Audio, general-purpose	–60	–60	–4	30	–100	–60	40		–4	–1
2SA1294	Audio, general-purpose	–230	–230	–15	130	–100	–230	50	140	–4	–5
2SA1295	Audio, general-purpose	–230	–230	–17	200	–100	–230	50	140	–4	–5
2SA1303	Audio, general-purpose	–150	–150	–14	125	–100	–150	50	180	–4	–5
2SA1386	Audio, general-purpose	–160	–160	–15	130	–100	–160	50	180	–4	–5
2SA1386A	Audio, general-purpose	–180	–180	–15	130	–100	–180	50	180	–4	–5
2SA1488	Audio, general-purpose	–60	–60	–4	25	–100	–60	40		–4	–1
2SA1488A	Audio, general-purpose	–80	–80	–4	25	–100	–80	40		–4	–1
2SA1492	Audio, general-purpose	–180	–180	–15	130	–100	–180	50	180	–4	–3
2SA1493	Audio, general-purpose	–200	–200	–15	150	–100	–200	50	180	–4	–5
2SA1494	Audio, general-purpose	–200	–200	–17	200	–100	–200	50	180	–4	–8
2SA1567	DC motor driver, chopper regulator, general-purpose	–50	–50	–12	35	–100	–50	50		–1	–6
2SA1568	DC motor driver, chopper regulator, general-purpose	–60	–60	±12	35	–100	–60	50		–1	–6
2SA1667	TV vertical output, audio output driver, general-purpose	–150	–150	–2	25	–10	–150	60		–10	–0.7
2SA1668	TV vertical output, audio output driver, general-purpose	–200	–200	–2	25	–10	–200	60		–10	–0.7
2SA1673	Audio, general-purpose	–180	–180	–15	85	–10	–180	50	180	–4	–3
2SA1693	Audio, general-purpose	–80	–80	–6	60	–10	–80	50	180	–4	–2
2SA1694	Audio, general-purpose	–120	–120	–8	80	–10	–120	50	180	–4	–3
2SA1695	Audio, general-purpose	–140	–140	–10	100	–10	–140	50	180	–4	–3
2SA1725	Audio, general-purpose	–80	–80	–6	30	–10	–80	50	180	–4	–2
2SA1726	Audio, general-purpose	–80	–80	–6	50	–10	–80	50	180	–4	–2
2SA1746	Chopper regulator, switch, general-purpose	–70	–50	–12 (Pulse –20)	60	–10	–70	50		–1	–5
2SA1859	Audio output driver, TV velocity modulation	–150	–150	–2	20	–10	–150	60	240	–10	–0.7
2SA1859A	Audio output driver, TV velocity modulation	–180	–180	–2	20	–10	–180	60	240	–10	–0.7
2SA1860	Audio, general-purpose	–150	–150	–14	80	–100	–150	50	180	–4	–5
2SA1907	Audio, general-purpose	–80	–80	–6	60	–10	–80	50	180	–4	–2
2SA1908	Audio, general-purpose	–120	–120	–8	75	–10	–120	50	180	–4	–3
2SA1909	Audio, general-purpose	–140	–140	–10	80	–10	–140	50	180	–4	–3
2SA2151	Audio, general-purpose	–200	–200	–15	160	–10	–200	50	180	–4	–3
2SA2151A	Audio, general-purpose	–230	–230	–15	160	–10	–230	50	180	–4	–3
2SB1257	Solenoid/relay/motor driver, general-purpose	–60	–60	–4 (Pulse –6)	25	–10	–60	2000		–4	–3
2SB1258	Solenoid/relay/motor driver, general-purpose	–100	–100	–6 (Pulse –10)	30	–10	–100	1000		–2	–3
2SB1259	Solenoid/relay/motor driver, general-purpose	–120	–120	–10 (Pulse –15)	30	–10	–120	2000		–4	–5
2SB1351	Printer head/solenoid/relay/motor driver, general-purpose	–60	–60	–12 (Pulse –20)	30	–10	–60	2000		–4	–10
2SB1382	Chopper regulator, DC motor driver, general-purpose	–120	–120	–16 (Pulse –26)	75	–10	–120	2000		–4	–8
2SB1383	Chopper regulator, DC motor driver, general-purpose	–120	–120	–25 (Pulse –40)	120	–10	–120	2000		–4	–12
2SB1420	Chopper regulator, DC motor driver, general-purpose	–120	–120	–16 (Pulse –26)	80	–10	–120	2000		–4	–8
2SB1559	Audio, series regulator, general-purpose	–160	–150	–8	80	–100	–160	5000	30000	–4	–6
2SB1560	Audio, series regulator, general-purpose	–160	–150	–10	100	–100	–160	5000	30000	–4	–7
2SB1570	Audio, series regulator, general-purpose	–160	–150	–12	150	–100	–160	5000	30000	–4	–7
2SB1587	Audio, series regulator, general-purpose	–160	–150	–8	75	–100	–160	5000	30000	–4	–6
2SB1588	Audio, series regulator, general-purpose	–160	–150	–10	80	–100	–160	5000	30000	–4	–7
2SB1647	Audio, series regulator, general-purpose	–150	–150	–15	130	–100	–150	5000	30000	–4	–10
2SB1648	Audio, series regulator, general-purpose	–150	–150	–17	200	–100	–150	5000	30000	–4	–10
2SB1649	Audio, series regulator, general-purpose	–150	–150	–15	85	–100	–150	5000	30000	–4	–10
2SB1685	Audio, series regulator, general-purpose	–110	–110	–6	60	–100	–110	5000	30000	–4	–5
2SB1686	Audio, series regulator, general-purpose	–110	–110	–6	30	–100	–110	5000	30000	–4	–5
2SB1687	Audio, series regulator, general-purpose	–110	–110	–6	60	–100	–110	5000	30000	–4	–5

Electrical Characteristics												Complementary	Package
	$V_{CE(sat)}$	$V_{BE(sat)}$	Conditions		fT	Conditions		Switching Time			Cob		
								t_{on}	t_{stg}	t_f			
	(V)	(V)	I_C	I_B	MHz	V_{CE}	I_E	(μS)	(μS)	(μS)	(pF)		
	max	max	(A)	(A)		(V)	(A)						
	–2.0		–5	–0.5	60	–12	1	0.25typ	0.8typ	0.2typ	110typ	2SC2837	TO-3P (MT-100)
	–2.0		–5	–0.5	50	–12	2	0.25typ	0.85typ	0.2typ	400typ	2SC2921	MT-200
	–2.0		–8	–0.8	40	–12	2	0.3typ	0.7typ	0.2typ	500typ	2SC2922	MT-200
	–0.6		–2	–0.2	15	–12	0.2	0.25typ	0.75typ	0.25typ	90typ	2SC3179	TO-220 (MT-25)
	–2.0		–5	–0.5	35	–12	2	0.35typ	1.5typ	0.3typ	500typ	2SC3263	TO-3P (MT-100)
	–2.0		–5	–0.5	35	–12	2	0.35typ	1.5typ	0.3typ	500typ	2SC3264	MT-200
	–2.0		–5	–0.5	50	–12	2	0.25typ	0.85typ	0.2typ	400typ	2SC3284	TO-3P (MT-100)
	–2.0		–5	–0.5	40	–12	2	0.3typ	0.7typ	0.2typ	500typ	2SC3519	TO-3P (MT-100)
	–2.0		–5	–0.5	40	–12	2	0.3typ	0.7typ	0.2typ	500typ	2SC3519A	TO-3P (MT-100)
	–0.5		–2	–0.2	15	–12	0.2	0.25typ	0.75typ	0.25typ	90typ	2SC3851	TO-220F (FM20)
	–0.5		–2	–0.2	15	–12	0.2	0.25typ	0.75typ	0.25typ	90typ	2SC3851A	TO-220F (FM20)
	–2.0		–5	–0.5	20	–12	0.5	0.6typ	0.9typ	0.2typ	500typ	2SC3856	TO-3P (MT-100)
	–3.0		–10	–1	20	–12	0.5	0.3typ	0.9typ	0.2typ	400typ	2SC3857	MT-200
	–2.5		–10	–1	20	–12	1	0.6typ	0.9typ	0.2typ	500typ	2SC3858	MT-200
	–0.35		–6	–0.3	40	–12	0.5	0.4typ	0.4typ	0.2typ	330typ	2SC4064	TO-220F (FM20)
	–0.35		–6	–0.3	40	–12	0.5	0.4typ	0.4typ	0.2typ	330typ		TO-220F (FM20)
	–1.0		–0.7	–0.07	20	–12	0.2	0.4typ	1.5typ	0.5typ	60typ	2SC4381	TO-220F (FM20)
	–1.0		–0.7	–0.07	20	–12	0.2	0.4typ	1.5typ	0.5typ	60typ	2SC4382	TO-220F (FM20)
	–2.0		–5	–0.5	20	–12	0.5	0.6typ	0.9typ	0.2typ	500typ	2SC4388	TO-3PF (FM100)
	–1.5		–2	–0.2	20	–12	0.5	0.18typ	1.1typ	0.21typ	150typ	2SC4466	TO-3P (MT-100)
	–1.5		–3	–0.3	20	–12	0.5	0.14typ	1.4typ	0.21typ	300typ	2SC4467	TO-3P (MT-100)
	–0.5		–5	–0.5	20	–12	0.5	0.17typ	1.86typ	0.27typ	400typ	2SC4468	TO-3P (MT-100)
	–0.5		–2	–0.2	20	–12	0.5	0.18typ	1.1typ	0.21typ	150typ	2SC4511	TO-220F (FM20)
	–0.5		–2	–0.2	20	–12	0.5	0.18typ	1.1typ	0.21typ	150typ	2SC4512	TO-220 (MT-25)
	–0.5	–1.2	–5	–0.08	25	–12	1	0.5typ	0.6typ	0.3typ	400typ		TO-3PF (FM100)
	–1.0		–0.7	–0.07	60	–12	0.7	0.5typ	1typ	0.5typ	30typ	2SC4883	TO-220F (FM20)
	–1.0		–0.7	–0.07	60	–12	0.7	0.5typ	1typ	0.5typ	30typ	2SC4883A	TO-220F (FM20)
	–2.0		–5	–0.5	50	–12	2	0.25typ	0.85typ	0.2typ	400typ	2SC4886	TO-3PF (FM100)
	–0.5		–12	–0.2	20	–12	0.5	0.18typ	1.1typ	0.21typ	150typ	2SC5099	TO-3PF (FM100)
	–0.5		–3	–0.3	20	–12	0.5	0.14typ	1.4typ	0.21typ	300typ	2SC5100	TO-3PF (FM100)
	–0.5		–5	–0.5	20	–12	0.5	0.17typ	1.86typ	0.27typ	400typ	2SC5101	TO-3PF (FM100)
	–0.5		–5	–0.5	20	–12	–0.5	–	–	–	450typ	2SC6011	TO-3P (MT-100)
	–0.5		–5	–0.5	20	–12	–0.5	–	–	–	450typ	2SC6011A	TO-3P (MT-100)
	–1.5	–2.0	–3	–0.006	200	–12	0.2	0.4typ	0.8typ	0.6typ	75typ	2SD2014	TO-220F (FM20)
	–1.5	–2.0	–3	–0.006	100	–12	0.2	0.6typ	1.6typ	0.5typ	100typ	2SD1785	TO-220F (FM20)
	–1.5	–2.0	–5	–0.01	100	–12	0.2	0.6typ	1.6typ	0.5typ	145typ	2SD2081	TO-220F (FM20)
	–1.5	–2.0	–10	–0.02	130	–12	1	0.7typ	1.5typ	0.6typ	170typ		TO-220F (FM20)
	–1.5	–2.5	–8	–0.016	50	–12	1	0.8typ	1.8typ	1typ	350typ	2SD2082	TO-3PF (FM100)
	–1.8	–2.5	–12	–0.024	50	–12	1	1typ	3typ	1typ	230typ	2SD2083	TO-3P (MT-100)
	–1.5	–2.5	–8	–0.016	50	–12	1	1typ	3typ	1typ	350typ		TO-3P (MT-100)
	–2.5	–3.0	–6	–0.006	65	–12	1	0.7typ	3.6typ	0.9typ	160typ	2SD2389	TO-3P (MT-100)
	–2.5	–3.0	–7	–0.007	50	–12	2	0.8typ	3typ	1.2typ	230typ	2SD2390	TO-3P (MT-100)
	–2.5	–3.0	–7	–0.007	50	–12	2	0.8typ	3typ	1.2typ	230typ	2SD2401	MT-200
	–2.5	–3.0	–6	–0.006	65	–12	1	0.7typ	3.6typ	0.9typ	160typ	2SD2438	TO-3PF (FM100)
	–2.5	–3.0	–7	–0.007	50	–12	2	0.8typ	3typ	1.2typ	230typ	2SD2439	TO-3PF (FM100)
	–2.5	–3.0	–10	–0.01	45	–12	2	0.7typ	1.6typ	1.1typ	320typ	2SD2560	TO-3P (MT-100)
	–2.5	–3.0	–10	–0.01	45	–12	2	0.7typ	1.6typ	1.1typ	320typ	2SD2561	MT-200
	–2.5	–3.0	–10	–0.01	45	–12	2	0.7typ	1.6typ	1.1typ	320typ	2SD2562	TO-3PF (FM100)
	–2.5	–3.0	–5	–0.005	100	–12	0.5	1.1typ	3.2typ	1.1typ	110typ	2SD2641	TO-3P (MT-100)
	–2.5	–3.0	–5	–0.005	100	–12	0.5	1.1typ	3.2typ	1.1typ	110typ	2SD2642	TO-220F (FM20)
	–2.5	–3.0	–5	–0.005	100	–12	0.5	1.1typ	3.2typ	1.1typ	110typ	2SD2643	TO-3PF (FM100)

Part Number	Applications	Absolute Maximum Ratings				I_{CBO}		h_{FE}			
		V_{CBO}	V_{CEO}	Ic	Pc		Conditions V_{CB}			Conditions V_{CE}	Ic
		(V)	(V)	(A)	(W)	(μA)	(V)	min	max	(V)	(A)
2SC2023	Series regulator, switch, general-purpose	300	300	2	40	1mA	300	30		4	0.5
2SC2837	Audio, general-purpose	150	150	10	100	100	150	50	180	4	3
2SC2921	Audio, general-purpose	160	160	15	150	100	160	50	180	4	5
2SC2922	Audio, general-purpose	180	180	17	200	100	180	30	180	4	8
2SC3179	Audio, general-purpose	80	60	4	30	100	80	40		4	1
2SC3263	Audio, general-purpose	230	230	15	130	100	230	50	140	4	5
2SC3264	Audio, general-purpose	230	230	17	200	100	230	50	140	4	5
2SC3284	Audio, general-purpose	150	150	14	125	100	150	50	180	4	5
2SC3519	Audio, general-purpose	160	160	15	130	100	160	50	180	4	5
2SC3519A	Audio, general-purpose	180	180	15	130	100	180	50	180	4	5
2SC3678	Switching regulator, general-purpose	900	800	3 (Pulse 6)	80	100	800	10	30	4	1
2SC3679	Switching regulator, general-purpose	900	800	5 (Pulse 10)	100	100	800	10	30	4	2
2SC3680	Switching regulator, general-purpose	900	800	7 (Pulse 14)	120	100	800	10	30	4	3
2SC3832	Switching regulator, general-purpose	500	400	7 (Pulse 14)	50	100	500	10	30	4	3
2SC3833	Switching regulator, general-purpose	500	400	12 (Pulse 24)	100	100	500	10	30	4	7
2SC3834	Humidifier, DC-DC converter, general-purpose	200	120	7 (Pulse 14)	50	100	200	70	220	4	3
2SC3835	Humidifier, DC-DC converter, general-purpose	200	120	7 (Pulse 14)	70	100	200	70	220	4	3
2SC3851	Audio, PPC high voltage power supply, general-purpose	80	60	4	25	100	80	40	320	4	1
2SC3851A	Audio, PPC high voltage power supply, general-purpose	100	80	4	25	100	100	40	320	4	1
2SC3852	Solenoid/motor driver/series regulator, general-purpose	80	60	3	25	10	80	500		4	0.5
2SC3852A	Solenoid/motor driver/series regulator, general-purpose	100	80	3	25	10	100	500		4	0.5
2SC3856	Audio, general-purpose	200	180	15	130	100	200	80	180	4	3
2SC3857	Audio, general-purpose	200	200	15	150	100	200	50	180	4	5
2SC3858	Audio, general-purpose	200	200	17	200	100	200	50	180	4	8
2SC3927	Switching regulator, general-purpose	900	550	10 (Pulse 15)	120	100	800	10	28	4	5
2SC4020	Switching regulator, general-purpose	900	800	3 (Pulse 6)	50	100	800	10	30	4	0.7
2SC4024	DC-DC converter, emergency lamp inverter, general-purpose	100	50	10	35	100	100	300	1600	4	1
2SC4064	DC motor driver, general-purpose	50	50	12	35	100	50	50		1	6
2SC4131	DC-DC converter, emergency lamp inverter, general-purpose	100	50	15 (Pulse 20)	60	10	100	60	360	1	5
2SC4138	Switching regulator, general-purpose	500	400	10 (Pulse 20)	80	100	500	10	30	4	6
2SC4139	Switching regulator, general-purpose	500	400	15 (Pulse 30)	120	100	500	10	30	4	8
2SC4140	Switching regulator, general-purpose	500	400	18 (Pulse 36)	130	100	500	10	30	4	10
2SC4153	Humidifier, DC-DC converter, general-purpose	200	120	7 (Pulse 14)	30	100	200	70	220	4	3
2SC4297	Switching regulator, general-purpose	500	400	12 (Pulse 24)	75	100	500	10	30	4	7
2SC4298	Switching regulator, general-purpose	500	400	15 (Pulse 30)	80	100	500	10	30	4	8
2SC4300	Switching regulator, general-purpose	900	800	5 (Pulse 10)	75	100	800	10	30	4	2
2SC4301	Switching regulator, lighting inverter, general-purpose	900	800	7 (Pulse 14)	80	100	800	10	30	4	3
2SC4304	Switching regulator, general-purpose	900	800	3 (Pulse 6)	35	100	800	10	30	4	0.7
2SC4381	TV vertical output, audio output driver, general-purpose	150	150	2	25	10	150	60		10	0.7
2SC4382	TV vertical output, audio output driver, general-purpose	200	200	2	25	10	200	60		10	0.7
2SC4388	Audio, general-purpose	200	180	15	85	10	200	50	180	4	3
2SC4434	Switching regulator, lighting inverter, general-purpose	500	400	15 (Pulse 30)	120	100	500	10	25	4	8
2SC4445	Switching regulator, general-purpose	900	800	3 (Pulse 6)	60	100	800	10	30	4	0.7
2SC4466	Audio, general-purpose	120	80	6	60	10	120	50	180	4	2
2SC4467	Audio, general-purpose	160	120	8	80	10	160	50	180	4	3
2SC4468	Audio, general-purpose	200	140	10	100	10	200	50	180	4	3
2SC4495	For audio temperature compensation, general-purpose	80	50	3	25	10	80	500		4	0.5
2SC4511	Audio, general-purpose	120	80	6	30	10	120	50	180	4	2
2SC4512	Audio, general-purpose	120	80	6	50	10	120	50	180	4	2
2SC4518	Switching regulator, lighting inverter, general-purpose	900	550	5 (Pulse 10)	35	100	800	10	25	4	1.8
2SC4518A	Switching regulator, lighting inverter, general-purpose	1000	550	5 (Pulse 10)	35	100	800	10	25	4	1.8

Electrical Characteristics												Complementary	Package
	$V_{CE(sat)}$	$V_{BE(sat)}$	Conditions		fT	Conditions		t_{on}	t_{stg}	t_f	Cob		
	(V)	(V)	I_C	I_B	MHz	V_{CE}	I_E	(μS)	(μS)	(μS)	(pF)		
	max	max	(A)	(A)		(V)	(A)						
	1.0		1	0.2	10	12	–0.2	0.3typ	4typ	1typ	75typ		TO-220 (MT-25)
	2.0		5	0.5	70	12	–1	0.2typ	1.4typ	0.35typ	60typ	2SA1186	TO-3P (MT-100)
	2.0		5	0.5	60	12	–2	0.2typ	1.5typ	0.35typ	200typ	2SA1215	MT-200
	2.0		8	0.8	50	12	–2	0.2typ	1.3typ	0.45typ	250typ	2SA1216	MT-200
	0.6		2	0.2	15	12	–0.2	0.2typ	1.9typ	0.29typ	60typ	2SA1262	TO-220 (MT-25)
	2.0		5	0.5	60	12	–2	0.3typ	2.4typ	0.5typ	250typ	2SA1294	TO-3P (MT-100)
	2.0		5	0.5	60	12	–2	0.3typ	2.4typ	0.5typ	250typ	2SA1295	MT-200
	2.0		5	0.5	60	12	–2	0.2typ	1.5typ	0.35typ	200typ	2SA1303	TO-3P (MT-100)
	2.0		5	0.5	50	12	–2	0.2typ	1.3typ	0.45typ	250typ	2SA1386	TO-3P (MT-100)
	2.0		5	0.5	50	12	–2	0.2typ	1.3typ	0.45typ	250typ	2SA1386A	TO-3P (MT-100)
	0.5	1.2	1	0.2	6	12	–0.3	1max	5max	1max	50typ		TO-3P (MT-100)
	0.5	1.2	2	0.4	6	12	–0.5	1max	5max	1max	75typ		TO-3P (MT-100)
	0.5	1.2	3	0.6	6	12	–2	1max	5max	1max	105typ		TO-3P (MT-100)
	0.5	1.3	3	0.6	10	12	–0.5	1max	3max	0.5max	50typ		TO-220 (MT-25)
	0.5	1.3	7	1.4	10	12	–1	1max	3max	0.5max	105typ		TO-3P (MT-100)
	0.5	1.2	3	0.3	30	12	–0.5	0.5max	3max	0.5max	110typ		TO-220 (MT-25)
	0.5	1.2	3	0.3	30	12	–0.5	0.5max	3max	0.5max	110typ		TO-3P (MT-100)
	0.5		2	0.2	15	12	–0.2	0.2typ	1typ	0.3typ	60typ	2SA1488	TO-220F (FM20)
	0.5		2	0.2	15	12	–0.2	0.2typ	1typ	0.3typ	60typ	2SA1488A	TO-220F (FM20)
	0.5		2	0.05	15	12	–0.2	0.8typ	3typ	1.2typ	50typ		TO-220F (FM20)
	0.5		2	0.05	15	12	–0.2	0.8typ	3typ	1.2typ	50typ		TO-220F (FM20)
	2.0		5	0.5	20	12	–0.5	0.5typ	1.8typ	0.6typ	300typ	2SA1492	TO-3P (MT-100)
	3.0		10	1	20	12	–0.5	0.3typ	2.4typ	0.4typ	250typ	2SA1493	MT-200
	2.5		10	1	20	12	–1	0.5typ	1.8typ	0.6typ	300typ	2SA1494	MT-200
	0.5	1.2	5	1	6	12	–1	1max	5max	0.5max	105typ		TO-3P (MT-100)
	0.5	1.2	0.7	0.14	6	12	–0.3	1max	5max	1max	40typ		TO-220 (MT-25)
	0.5		5	0.1	24	12	–0.5	0.5typ	2typ	0.5typ	150typ		TO-220F (FM20)
	0.35		6	0.3	40	12	–0.5	0.6typ	1.4typ	0.4typ	180typ	2SA1567	TO-220F (FM20)
	0.5	1.2	5	0.08	18	12	–1	0.5typ	2typ	0.4typ	210typ		TO-3PF (FM100)
	0.5	1.3	6	1.2	10	12	–0.7	1max	3max	0.5max	85typ		TO-3P (MT-100)
	0.5		8	1.6	10	12	–1.5	1max	3max	0.5max	85typ		TO-3P (MT-100)
	0.5	1.3	10	2	10	12	–2.0	1max	3max	0.5max	165typ		TO-3P (MT-100)
	0.5	1.2	3	0.3	30	12	–0.5	0.5max	3max	0.5max	110typ		TO-220F (FM20)
	0.5	1.3	7	1.4	10	12	–1	1max	3max	0.5max	105typ		TO-3PF (FM100)
	0.5	1.3	8	1.6	10	12	–1.5	1max	3max	0.5max	85typ		TO-3PF (FM100)
	0.5	1.2	2	0.4	6	12	–0.5	1max	5max	1max	75typ		TO-3PF (FM100)
	0.5	1.2	3	0.6	6	12	–1	1max	5max	1max	105typ		TO-3PF (FM100)
	0.5	1.2	7	0.14	15	12	–0.3	0.7max	4max	0.7max	50typ		TO-220F (FM20)
	1.0		7	0.07	15	12	–0.2	1typ	3typ	1.5typ	35	2SA1667	TO-220F (FM20)
	1.0		7	0.07	15	12	–0.2	1typ	3typ	1.5typ	35	2SA1668	TO-220F (FM20)
	2.0		5	0.5	20	12	–0.5	0.5max	1.8max	0.6max	300	2SA1673	TO-3PF (FM100)
	0.7	1.3	8	1.6	10	12	–1.5	0.5typ	2typ	0.15typ	135		TO-3P (MT-100)
	0.5	1.2	0.7	0.14	15	12	–0.3	0.7max	4max	0.7max	50		TO-3PF (FM100)
	1.5		2	0.2	20	12	–0.5	0.16typ	2.6typ	0.34typ	110	2SA1693	TO-3P (MT-100)
	1.5		3	0.3	20	12	–0.5	0.13typ	3.5typ	0.32typ	200	2SA1694	TO-3P (MT-100)
	0.5		5	0.5	20	12	–0.5	0.24typ	4.32typ	0.4typ	250	2SA1695	TO-3P (MT-100)
	0.5		4	0.02	40	12	–0.1	0.45typ	1.6typ	0.85typ	30		TO-220F (FM20)
	0.5		2	0.2	20	12	–0.5	0.16typ	2.6typ	0.34typ	110	2SA1725	TO-220F (FM20)
	0.5		5	0.2	20	12	–0.5	0.16typ	2.6typ	0.34typ	110	2SA1726	TO-220 (MT-25)
	0.5	1.2	1.8	0.36	6	12	–0.35	0.7max	4max	0.5max	50		TO-220F (FM20)
	0.5	1.2	1.8	0.36	6	12	–0.35	0.7max	4max	0.5max	50		TO-220F (FM20)

Part Number	Applications	Absolute Maximum Ratings				I_{CBO}		h_{FE}			
		V_{CBO}	V_{CEO}	Ic	Pc		Conditions V_{CB}			Conditions V_{CE}	Ic
		(V)	(V)	(A)	(W)	(μA)	(V)	min	max	(V)	(A)
2SC4546	Switching regulator, lighting inverter, general-purpose	600	400	7 (Pulse 14)	30	100	600	10	25	4	3
2SC4557	Switching regulator, general-purpose	900	550	10 (Pulse 20)	80	100	800	10	28	4	5
2SC4706	Switching regulator, general-purpose	900	600	14 (Pulse 28)	130	100	800	10	25	4	7
2SC4883	Audio output driver, TV velocity modulation	150	150	2	20	10	150	60	240	10	0.7
2SC4883A	Audio output driver, TV velocity modulation	180	180	2	20	10	180	60	240	10	0.7
2SC4886	Audio, general-purpose	150	150	14	80	100	150	50	180	4	5
2SC5071	Switching regulator, general-purpose	500	400	12 (Pulse 24)	100	100	500	10	30	4	7
2SC5099	Audio, general-purpose	120	80	6	60	10	120	50	180	4	2
2SC5100	Audio, general-purpose	160	120	8	75	10	160	50	180	4	3
2SC5101	Audio, general-purpose	200	140	10	80	10	200	50	180	4	3
2SC5130	Switching regulator, general-purpose	600	400	5 (Pulse 10)	30	100	500	10	30	4	1.5
2SC5287	Switching regulator, general-purpose	900	550	5 (Pulse 10)	80	100	800	10	25	4	1.8
2SC5333	Series regulator, switch, general-purpose	300	300	2	35	1	300	30		4	0.5
2SC5586	Switching regulator, general-purpose	900	550	5 (Pulse 10)	70	100	800	10	25	4	1.8
2SC5830	Switching regulator, lighting inverter, general-purpose	1000	450	8 (Pulse 16)	35	1000	1000	10	30	5	4
2SC5924	Switching regulator, general-purpose	900	600	14 (Pulse 28)	90	100	800	10	25	4	7
2SC6011	Audio, general-purpose	200	200	15	160	10	200	50	180	4	3
2SC6011A	Audio, general-purpose	230	230	15	160	10	230	50	180	4	3
2SD1769	Solenoid/relay/motor driver/series regulator, general-purpose	120	120	6 (Pulse 10)	50	10	120	2000		2	3
2SD1785	Solenoid/relay/motor driver/series regulator, general-purpose	120	120	6 (Pulse 10)	30	10	120	2000		2	3
2SD1796	Solenoid/relay/motor driver, general-purpose	60±10	60±10	4	25	10	50	2000		4	3
2SD2014	Solenoid/relay/motor driver/series regulator, general-purpose	120	80	4	25	10	120	2000		2	3
2SD2015	Solenoid/relay/motor driver, general-purpose	150	120	4	25	10	150	2000		2	2
2SD2016	Igniter, relay, general-purpose	200	200	3	25	10	200	1000	15000	4	1
2SD2017	Solenoid/relay/motor driver, general-purpose	300	250	6	35	100	300	2000		2	2
2SD2045	Solenoid/motor driver, general-purpose	120	120	6 (Pulse 10)	50	10	120	2000		2	3
2SD2081	Solenoid/motor driver, general-purpose	120	120	10 (Pulse 15)	30	10	120	2000		4	5
2SD2082	Solenoid/motor driver, general-purpose	120	120	16 (Pulse 26)	75	10	120	2000		4	8
2SD2083	Solenoid/motor driver, general-purpose	120	120	25 (Pulse 40)	120	10	120	2000		4	12
2SD2141	Igniter, solenoid, motor driver, general-purpose	380±50	380±50	6 (Pulse 10)	35	10	330	1500		2	3
2SD2389	Audio, series regulator, general-purpose	160	150	8	80	100	160	5000	30000	4	6
2SD2390	Audio, series regulator, general-purpose	160	150	10	100	100	160	5000	30000	4	7
2SD2401	Audio, series regulator, general-purpose	160	150	12	150	100	160	5000	30000	4	7
2SD2438	Audio, series regulator, general-purpose	160	150	8	75	100	160	5000	30000	4	6
2SD2439	Audio, series regulator, general-purpose	160	150	10	80	100	160	5000	30000	4	7
2SD2557	Series regulator, general-purpose	200	200	5	70	100	200	1500	6500	5	1
2SD2558	Series regulator, general-purpose	200	200	5	60	100	200	1500	6500	5	1
2SD2560	Audio, series regulator, general-purpose	150	150	15	130	100	150	5000	30000	4	10
2SD2561	Audio, series regulator, general-purpose	150	150	17	200	100	150	5000	30000	4	10
2SD2562	Audio, series regulator, general-purpose	150	150	15	85	100	150	5000	30000	4	10
2SD2641	Audio, series regulator, general-purpose	110	110	6	60	100	110	5000	30000	4	5
2SD2642	Audio, series regulator, general-purpose	110	110	6	30	100	110	5000	30000	4	5
2SD2643	Audio, series regulator, general-purpose	110	110	6	60	100	110	5000	30000	4	5
STD03N	Audio	160	160	15	160	100	160	5000	20000	4	10
STD03P	Audio	–160	–160	–15	160	–100	–160	5000	20000	–4	–10

Electrical Characteristics												Complementary	Package
	$V_{CE\ (sat)}$	$V_{BE\ (sat)}$			fT			Switching Time			Cob		
			Conditions			Conditions		t_{on}	t_{stg}	t_f			
	(V)	(V)	I_C	I_B	MHz	V_{CE}	I_E	(μS)	(μS)	(μS)	(pF)		
	max	max	(A)	(A)		(V)	(A)						
	0.7	1.3	3	0.6	10	12	–0.5	0.5max	2max	0.15max	55		TO-220F (FM20)
	0.5	1.2	5	1	6	12	–1	1max	5max	0.5max	105		TO-3PF (FM100)
	0.5	1.2	7	1.4	6	12	–1.5	1max	5max	0.7max	160		TO-3P (MT-100)
	1.0		0.7	0.07	120	12	–0.7	0.5typ	1.5typ	0.5typ	30	2SA1859	TO-220F (FM20)
	1.0		0.7	0.07	120	12	–0.7	0.5typ	1.5typ	0.5typ	30	2SA1859A	TO-220F (FM20)
	2.0		5	0.5	60	12	–2	0.26typ	1.5typ	0.35typ	200	2SA1860	TO-3PF (FM100)
	0.5	1.3	7	1.4	10	12	–1	1max	3max	0.5max	105		TO-3P (MT-100)
	0.5		2	0.2	20	12	–0.5	0.16typ	2.6typ	0.34typ	110	2SA1907	TO-3PF (FM100)
	0.5		3	0.3	20	12	–0.5	0.13typ	3.5typ	0.32typ	200	2SA1908	TO-3PF (FM100)
	0.5		5	0.5	20	12	–0.5	0.24typ	4.32typ	0.4typ	250	2SA1909	TO-3PF (FM100)
	0.5	1.3	1.5	0.3	20	12	–0.3	1max	2max	0.3max	30		TO-220F (FM20)
	0.5	1.2	1.8	0.36	6	12	–0.35	0.7max	4max	0.5max	50		TO-3P (MT-100)
	1.0		1	0.2	10	12	–0.2	0.3typ	4typ	1typ	75		TO-220F (FM20)
	0.5	1.2	1.8	0.36	6	12	–0.35	0.7max	4max	0.5max	50		TO-3PF (FM100)
	0.5	1.2	4	0.8	4	12	–0.25	1max	4max	0.4max	95		TO-220F (FM20)
	0.5	1.2	7	1.4	6	12	–1.5	1max	5max	0.7max	160		TO-3PF (FM100)
	0.5		5	0.5	20	12	–0.5	–	–	–	270	2SA2151	TO-3P (MT-100)
	0.5		5	0.5	20	12	–0.5	–	–	–	270	2SA2151A	TO-3P (MT-100)
	1.5	2.0	3	3mA	100	12	–0.2	0.5typ	5.5typ	1.5typ			TO-220 (MT-25)
	1.5		2	3mA	100	12	–0.1	0.5typ	5.5typ	1.5typ	70	2SB1258	TO-220F (FM20)
	1.5		3	10mA	60	12	–0.2	1typ	4typ	1.5typ	45		TO-220F (FM20)
	1.5	2.0	3	3mA	75	12	–0.1	1typ	4typ	1.5typ	45	2SB1257	TO-220F (FM20)
	1.5	2.0	2	2mA	40	12	–0.1	0.6typ	5typ	2typ	40		TO-220F (FM20)
	1.5	2.0	1	1.5mA	90	12	–0.1				40		TO-220F (FM20)
	1.5	2.0	2	2mA	20	12	–1	0.6typ	16typ	3typ	65		TO-220F (FM20)
	1.5	2.0	3	3mA	50	12	–1	0.5typ	5.5typ	1.5typ	70		TO-3PF (FM100)
	1.5	2.0	5	5mA	60	12	–0.5				95	2SB1259	TO-220F (FM20)
	1.5	2.5	8	16mA	20	12	–1	0.6typ	7typ	1.5typ	210	2SB1382	TO-3PF (FM100)
	1.8	2.5	12	24mA	20	12	–1	1typ	6typ	1typ	340	2SB1383	TO-3P (MT-100)
	1.5		4	20mA	20	12	–0.5				95		TO-220F (FM20)
	2.5	3.0	6	6mA	80	12	–1	0.6typ	10typ	0.9typ	85	2SB1559	TO-3P (MT-100)
	2.5	3.0	7	7mA	55	12	–2	0.5typ	10typ	1.1typ	95	2SB1560	TO-3P (MT-100)
	2.5	3.0	7	7mA	55	12	–2	0.5typ	10typ	1.1typ	95	2SB1570	MT-200
	2.5	3.0	6	6mA	80	12	–1	0.6typ	10typ	0.9typ	85	2SB1587	TO-3PF (FM100)
	2.5	3.0	7	7mA	55	12	–2	0.5typ	10typ	1.1typ	95	2SB1588	TO-3PF (FM100)
	1.5		1	5mA	15	10	–0.5				110		TO-3P (MT-100)
	1.5		1	5mA	15	10	–0.5				110		TO-3PF (FM100)
	2.5	3.0	10	10mA	70	12	–2	0.8typ	4typ	1.2typ	120	2SB1647	TO-3P (MT-100)
	2.5	3.0	10	10mA	70	12	–2	0.8typ	4typ	1.2typ	120	2SB1648	MT-200
	2.5	3.0	10	10mA	70	12	–2	0.8typ	4typ	1.2typ	120	2SB1649	TO-3PF (FM100)
	2.5	3.0	5	5mA	60	12	–2	0.8typ	6.2typ	1.1typ	55	2SB1624	TO-3P (MT-100)
	2.5	3.0	5	5mA	60	12	–0.5	0.8typ	6.2typ	1.1typ	55	2SB1626	TO-220F (FM20)
	2.5	3.0	5	5mA	60	12	–0.5	0.8typ	6.2typ	1.1typ	55	2SB1625	TO-3PF (FM100)
	2.0	2.5	10	10mA								STD03P	TO-3P-5pin
	–2.0	–2.5	–10	–10mA								STD03N	TO-3P-5pin

Selection Guide

By V_{DSS}

V_{DSS} (V)	R_{DS} (ON) (Ω) max	I_D (A)	P_D (W)	Part Number	Package Type
40	6.0m	±70	80	2SK3800	TO-220S (Surface-mount)
	6.0m	±70	100	2SK3801	TO-3P (MT100)
	9m	±60	60	FKV460S	TO-220S (Surface-mount)
50	13m	±50	35	FKV550T	TO-220F (FM20)
	15m	±50	35	FKV550N	TO-220F (FM20)
	15m	±50	85	EKV550	TO-220 (MT25)
60	4.7m	±85	150	2SK3851*	TO-3P (MT100)
	5.0m	±80	80	2SK3724*	TO-220S (Surface-mount)
	6.0m	±70	90	2SK3710*	TO-220S (Surface-mount)
	6.0m	±70	130	2SK3711	TO-3P (MT100)
	14m	±60	60	FKV660S	TO-220S (Surface-mount)
	28m	±30	40	2SK2420	TO-220F (FM20)
	37m	±25	35	2SK2419	TO-220F (FM20)
	0.2	±10	25	2SK1188	TO-220F (FM20)
100	80m	±20	35	2SK2779	TO-220F (FM20)
	0.175	±12	30	2SK2778	TO-220F (FM20)
200	53m	±45	40	FKP202	TO-220F (FM20)
	53m	±45	95	SKP202	TO-263(Surface-mount)
	0.175	±18	35	2SK3003	TO-220F (FM20)
	0.35	±8	30	2SK3002*	TO-220F (FM20)
	1.5	±3	25	2SK1183	TO-220F (FM20)
250	43m	±50	85	FKP250A	TO-3PF(FM100)
	75m	±25	40	FKP252	TO-220F(FM20)
	95m	±20	40	FKP253	TO-220F(FM20)
	95m	±20	40	SKP253	TO-263(Surface-mount)
	0.25	±18	35	2SK3004	TO-220F (FM20)
280	53m	±40	85	FKP280A	TO-3PF(FM100)
300	65m	±30	85	FKP300A	TO-3PF(FM100)
450	0.38	±15	80	2SK2805*	TO-3PF (FM100)
	0.57	±13	40	2SK2704	TO-220F (FM20)
	0.80	±10	35	2SK2702*	TO-220F (FM20)
	1.1	±7	35	2SK2701	TO-220F (FM20)
	2.8	±3	30	2SK2803	TO-220F (FM20)
500	0.85	±8.5	85	2SK1179	TO-220F (FM20)
	1.5	±5	30	2SK3199	TO-220F (FM20)
600	0.55	±12	85	2SK2710A	TO-3PF (FM100)
	0.85	±8.5	85	2SK2709*	TO-3PF (FM100)
	1.85	±4.5	35	2SK2707*	TO-220F (FM20)
	3.8	±2	30	2SK2848	TO-220F (FM20)
900	3.0	±5	35	2SK2945	TO-220F (FM20)
	5.0	±3	30	2SK2943	TO-220F (FM20)

*Under development

Specifications List by Part Number

Part Number	Absolute Maximum Ratings						I_{GSS}		I_{DSS}			V_{TH}			
	V_{DSS}	V_{GSS}	I_D	$I_{D\ (pulse)}$	P_D	E_{AS}		Conditions			Conditions			Conditions	
	(V)	(V)	(A)	(A)	(W)	(mJ)	(nA)	V_{GS}	(μA)		V_{DS}	(V)		V_{DS}	I_D
							max	(V)	min	max	(V)	min	max	(V)	(μA)
2SK1179	500	±20	±8.5	±34	85	400	±500	±20		250	500	2.0	4.0	10	250
2SK1183	200	±20	±3	±12	25	30	±500	±20		250	200	2.0	4.0	10	250
2SK1188	60	±20	±10	±40	25	2.1	±500	±20		250	60	2.0	4.0	10	250
2SK2419	60	±20	±25	±100	35	26	±100	±20		100	60	2.0	4.0	10	250
2SK2420	60	±20	±30	±120	40	38	±100	±20		100	60	2.0	4.0	10	250
2SK2701	450	±30	±7	±28	35	130	±100	±30		100	450	2.0	4.0	10	1m
2SK2702*	450	±30	±10	±40	35	300	±100	±30		100	450	2.0	4.0	10	1m
2SK2704	450	±30	±13	±52	40	400	±100	±30		100	450	2.0	4.0	10	1m
2SK2707*	600	±30	±4.5	±18	35	50	±100	±30		100	600	2.0	4.0	10	1m
2SK2709*	600	±30	±8.5	±34	85	300	±100	±30		100	600	2.0	4.0	10	1m
2SK2710A	600	±30	±12	±48	85	400	±100	±30		100	600	2.0	4.0	10	1m
2SK2778	100	±20	±12	±48	30	70	±100	±20		100	100	1.0	2.0	10	250
2SK2779	100	±20	±20	±80	35	200	±100	±20		100	100	1.0	2.0	10	250
2SK2803	450	±30	±3	±12	30	30	±100	±30		100	450	2.0	4.0	10	1m
2SK2805*	450	±30	±15	±60	80	550	±100	±30		100	450	2.0	4.0	10	1m
2SK2848	600	±30	±2	±8	30	10	±100	±30		100	600	2.0	4.0	10	250
2SK2943	900	±30	±3	±12	30	60	±100	±30		100	900	2.0	4.0	10	1m
2SK2945	900	±30	±5	±20	35	120	±100	±30		100	900	2.0	4.0	10	1m
2SK3002*	200	±20	±8	±32	30	55	±100	±20		100	200	2.0	4.0	10	1m
2SK3003	200	±20	±18	±72	35	120	±100	±20		100	200	2.0	4.0	10	1m
2SK3004	250	±20	±18	±72	35	120	±100	±20		100	250	2.0	4.0	10	1m
2SK3199	500	±30	±5	±20	30	35	±100	±30		100	500	2.0	4.0	10	1m
2SK3710*	60	±20	±70	±140	90	468	±10μ	±15		100	60	2.0	4.0	10	1m
2SK3711	60	±20	±70	±140	130		±10μ	±15		100	60	2.0	4.0	10	1m
2SK3724*	60	±20	±80	±160	80	400	±10μ	±20		100	60	1.0	2.0	10	1m
2SK3800	40	±20	±70	±140	80	400	±10	±15		100	40	2.0	4.0	10	1m
2SK3801	40	±20	±70	±140	100	400	±10	±15		100	40	2.0	4.0	10	1m
2SK3851*	60	±20	±85	±280	150	280	±10μ	±20		100	60	2.0	3.0	10	1m
EKV550	50	±20	±50	±150	85	150	±10μ	±20		100	50	3.0	4.2	10	250
FKP202	250	±30	±45	±180	40	200	±100	±30		100	200	3.0	4.5	10	1m
FKP250A	250	±30	±50	±200	85	400	±100	±30		100	250	3.0	4.5	10	1m
FKP252	250	±30	±25	±100	40	200	±100	±30		100	250	3.0	4.5	10	1m
FKP253	250	±30	±20	±80	40	160	±100	±30		100	250	3.0	4.5	10	1m
FKP280A	280	±30	±40	±160	85	400	±100	±30		100	280	3.0	4.5	10	1m
FKP300A	300	±30	±30	±120	85	400	±100	±30		100	300	3.0	4.5	10	1m
FKV460S	40	+20, –10	±60	±180	60		+10, –5μ	+20, –10		100	40	1.0	2.5	10	250
FKV550T	50	±20	±50	±150	35	150	±10μ	±20		100	50	1.0	2.5	10	250
FKV550N	50	±20	±50	±150	35	150	±10μ	±20		100	50	3.0	4.2	10	250
FKV660S	60	+20, –10	±60	±180	60		+10, –5μ	+20, –10		100	60	1.0	2.5	10	250
SKP202	200	±30	±45	±180	95	200	±100	±30		100	200	3.0	4.5	10	1m
SKP253	250	±30	±20	±80	40	160	±100	±30		100	250	3.0	4.5	10	1m

*Under development

Electrical Characteristics																	Package
$R_{e\ (yfs)}$				C_{iss}	C_{rss}			$R_{DS\ (ON)}$									
		Conditions				Conditions				Conditions				Conditions			
(S)		V_{DS}	I_D	(pF)	(pF)	V_{GS}	V_{DS}	(Ω)		V_{GS}	I_D	(Ω)		V_{GS}	I_D		
min	typ	(V)	(A)	typ	typ	(V)	(V)	typ	max	(V)	(A)	typ	max	(V)	(A)		
5.1	7.7	10	4.5	1300		0	25	0.7	0.85	10	4.5					TO-220F (FM20)	
0.8	1.2	10	1.5	140		0	25	1.2	1.5	10	1.5					TO-220F (FM20)	
2.2	3.3	10	5	300		0	25	0.15	0.2	10	5					TO-220F (FM20)	
10	15	10	12	1300	200	0	25	31m	37m	10	12					TO-220F (FM20)	
13	20	10	15	2200		0	25	21m	28m	10	15					TO-220F (FM20)	
3.5	5	20	3.5	720	62	0	10	0.84	1.1	10	3.5					TO-220F (FM20)	
5	7	20	5	1000	95	0	10	0.66	0.8	10	5					TO-220F (FM20)	
6.0	9.0	20	6.5	1300	130	0	10	0.48	0.57	10	6.5					TO-220F (FM20)	
2.4	3.5	20	2	560	65	0	10	1.45	1.85	10	2					TO-220F (FM20)	
5.0	7.0	20	4	1200	150	0	10	0.65	0.85	10	4					TO-3PF (FM100)	
7.5	11	20	6	1900	240	0	10	0.42	0.55	10	6					TO-3PF (FM100)	
7	11	10	6	740	75	0	10	105m	175m	10	6	130m	220m	4	6	TO-220F (FM20)	
12	20	10	10	1630	180	0	10	60m	80m	10	10	75m	95m	4	10	TO-220F (FM20)	
1.5	2.1	20	1.5	340	26	0	10	2.1	2.8	10	1.5					TO-220F (FM20)	
8.0	11.5	20	7.5	2100	210	0	10	0.30	0.38	10	7.5					TO-3PF (FM100)	
1.2	1.7	20	1	290	30	0	10	3	3.8	10	1					TO-220F (FM20)	
1.8	2.8	20	1.5	600	40	0	10	4	5	10	1.5					TO-220F (FM20)	
2.0	4.5	20	2.5	880	70	0	10	2.3	3	10	2.5					TO-220F (FM20)	
2.5	5.5	10	4	450	120	0	10	0.27	0.35	10	4					TO-220F (FM20)	
7	11	10	9	850	250	0	10	130m	175m	10	9					TO-220F (FM20)	
7	11	10	9	850	250	0	10	0.2	0.25	10	9					TO-220F (FM20)	
3.5	5.2	20	2.5	650	110	0	10	1.2	1.5	10	2.5					TO-220F (FM20)	
30	80	10	35	8000	1000	0	10	5m	6m	10	35					TO-220S (Surface-mount)	
30	80	10	35	8000	1000	0	10	5m	6m	10	35					TO-3P (MT100)	
				10600	1300	0	10	4m	5m	10	40					TO-220S (Surface-mount)	
30	50	10	35	5100	860	0	10	5.0	6.0	10	35					TO-220S (Surface-mount)	
30	50	10	35	5100	860	0	10	5.0	6.0	10	35					TO-3P (MT100)	
30		10	42	11500	1100	0	10	4m	4.7m	10	42					TO-3P (MT100)	
17		10	25	2000	500	0	10	12m	15m	10	25					TO-220 (MT25)	
18	28	10	22	2000	80	0	25	45m	53m	10	22					TO-220F (FM20)	
30	42	10	25	3800	210	0	25	37m	43m	10	25					TO-3PF (FM100)	
13	21	10	12	2000	70	0	25	68m	75m	10	12					TO-220F (FM20)	
8	17	10	10	1600	50	0	25	86m	95m	10	10					TO-220F (FM20)	
25	38	10	20	3800	190	0	25	46m	53m	10	20					TO-3PF (FM100)	
20	33	10	15	3800	180	0	25	57m	65m	10	15					TO-3PF (FM100)	
20		10	25	2800	600	0	10	7m	9m	10	25					TO-220S (Surface-mount)	
20		10	25	2700	500	0	10	10m	13m	10	25					TO-220F (FM20)	
17		10	25	2000	500	0	10	12m	15m	10	25					TO-220F (FM20)	
20		10	25	2500	150	0	10	11m	14m	10	25					TO-220S (Surface-mount)	
18	28	10	22	2000	80	0	25	45m	53m	10	22					TO-263 (Surface-mount)	
8	17	10	10	1600	50	0	25	88m	95m	10	10					TO-263 (Surface-mount)	

Specifications List by Part Number

Part Number	Category	Circuit Count	V_{CEO} · V_{DSS} (V)	IC · ID (A)	hFE (min)	$R_{DS(ON)}$ max(Ω)	Package
SDA01	For source driver	4	–60	–1.5	2000		PS16 (Surface-Mount)
SDA05	For 3-phase motor driver	3	–60	–4	2000		PS16 (Surface-Mount)
SDC03	For sink driver	4	60±10	1.5	2000		PS16 (Surface-Mount)
SDC04	For sink driver	4	100±15	1.5	2000		PS16 (Surface-Mount)
SDC06	For sink driver	4	30 to 45	2	400		PS16 (Surface-Mount)
SDC07	For 3-phase motor driver	3	60	4	2000		PS16 (Surface-Mount)
SDH02	For sink driver	4	100	1.5	2000		PS16 (Surface-Mount)
SDH03	H bridge	4	+100/–60	±1.5	2000		PS16 (Surface-Mount)
SDK04	For sink driver	4	100	2		0.8	PS16 (Surface-Mount)
SLA4010	For sink driver	4	60±10	4	2000		SIP12 with Fin (SLA12Pin)
SLA4030	For sink driver	4	100	4	2000		SIP12 with Fin (SLA12Pin)
SLA4031	For sink driver	4	120	4	2000		SIP12 with Fin (SLA12Pin)
SLA4041	For sink driver	4	200	3	1000		SIP12 with Fin (SLA12Pin)
SLA4051	For sink driver	9	120	2	2000		SIP21 with Fin (SLA21Pin)
SLA4052	For sink driver	9	120	3	2000		SIP21 with Fin (SLA21Pin)
SLA4060	For sink driver	4	120	5	2000		SIP12 with Fin (SLA12Pin)
SLA4061	For sink driver	4	120	5	2000		SIP12 with Fin (SLA12Pin)
SLA4070	For source driver	4	–100	–5	1000		SIP12 with Fin (SLA12Pin)
SLA4071	For source driver	4	–100	–5	2000		SIP12 with Fin (SLA12Pin)
SLA4310	H bridge	4	±60	±4	80		SIP12 with Fin (SLA12Pin)
SLA4340	H bridge	4	±60	±4	2000		SIP12 with Fin (SLA12Pin)
SLA4390	H bridge	4	±100	±5	2000		SIP12 with Fin (SLA12Pin)
SLA4391	H bridge	4	±100	±5	1000		SIP12 with Fin (SLA12Pin)
SLA5001	For sink driver	4	100	5		0.3	SIP12 with Fin (SLA12Pin)
SLA5002	For sink driver	4	100	5		0.3	SIP12 with Fin (SLA12Pin)
SLA5007	H bridge	4	±60	+5/–4		0.22/0.55	SIP12 with Fin (SLA12Pin)
SLA5011	For sink driver	5	60	5		0.22	SIP12 with Fin (SLA12Pin)
SLA5012	For source driver	5	–60	–5		0.3	SIP12 with Fin (SLA12Pin)
SLA5013	H bridge	4	±100	±5		0.3/0.7	SIP12 with Fin (SLA12Pin)
SLA5015	For source driver	5	–60	–4		0.55	SIP12 with Fin (SLA12Pin)
SLA5017	For 3-phase motor driver	6	±60	+5/–4		0.22/0.55	SIP12 with Fin (SLA12Pin)
SLA5022	For 3-phase motor driver	6	±60	±6	2000	0.22	SIP12 with Fin (SLA12Pin)
SLA5023	For 3-phase motor driver	6	±100	±6	2000	0.55	SIP12 with Fin (SLA12Pin)
SLA5024	For source driver	4	–60	–4		0.55	SIP12 with Fin (SLA12Pin)
SLA5037	For sink driver	4	100	10		0.08	SIP12 with Fin (SLA12Pin)
SLA5040	For sink driver	4	100	4		0.6	SIP12 with Fin (SLA12Pin)
SLA5041	For sink driver	4	200	10		0.175	SIP12 with Fin (SLA12Pin)
SLA5044	For sink driver	4	250	10		0.25	SIP12 with Fin (SLA12Pin)
SLA5049	For sink driver	5	250	7		0.5	SIP12 with Fin (SLA12Pin)
SLA5058	For sink driver	5	150	±7		0.2	SIP12 with Fin (SLA12Pin)
SLA5059	For 3-phase motor driver	6	±60	±4		0.55	SIP12 with Fin (SLA12Pin)
SLA5060	For 3-phase motor driver	6	±60	±6		0.22	SIP12 with Fin (SLA12Pin)
SLA5061	For 3-phase motor driver	6	±60	±10		0.14	SIP12 with Fin (SLA12Pin)
SLA5064	For 3-phase motor driver	6	±60	±10		0.14	SIP12 with Fin (SLA12Pin)
SLA5065	For 5-phase motor driver	4	60	7		0.1	SIP15 with Fin (SLA15Pin)
SLA5068	For 5-phase motor driver	6	60	7		0.1	SIP15 with Fin (SLA15Pin)
SLA5072	For 3-phase motor driver	6	250	7		0.5	SIP15 with Fin (SLA15Pin)
SLA5073	For 5-phase motor driver	6	60	5		0.3	SIP15 with Fin (SLA15Pin)
SLA5074	For 5-phase motor driver	4	60	5		0.3	SIP15 with Fin (SLA15Pin)
SLA5075	For 3-phase motor driver	6	500	±5		1.4	SIP15 with Fin (SLA15Pin)
SLA5077	For sink driver	4	150	±10		0.2	SIP12 with Fin (SLA12Pin)
SLA5085	For sink driver	5	60	5		0.22	SIP12 with Fin (SLA12Pin)
SLA5086	For source driver	5	–60	–5		0.22	SIP12 with Fin (SLA12Pin)
SLA5094	For sink driver	5	200	7		0.35	SIP12 with Fin (SLA12Pin)
SLA5096	For 3-phase motor driver	6	55	8		0.08	SIP15 with Fin (SLA15Pin)

Part Number	Category	Circuit Count	V_{CEO} · V_{DSS} (V)	IC · ID (A)	hFE (min)	$R_{DS\ (ON)}$ max(Ω)	Package
SLA5201	For 3-phase motor driver	6	600	7		1.85typ	SIP15 with Fin (SLA15Pin)
SLA6012	For 3-phase motor driver	6	±60	±4	2000		SIP12 with Fin (SLA12Pin)
SLA6020	For 3-phase motor driver	6	±100	±5	2000		SIP12 with Fin (SLA12Pin)
SLA6022	For 3-phase motor driver	6	±80	±5	2000		SIP12 with Fin (SLA12Pin)
SLA6023	For 3-phase motor driver	6	±60	±6	2000		SIP12 with Fin (SLA12Pin)
SLA6024	For 3-phase motor driver	6	±60	±8	2000		SIP12 with Fin (SLA12Pin)
SLA6026	For 3-phase motor driver	6	±60	±10	2000		SIP12 with Fin (SLA12Pin)
SLA8001	H bridge	4	±60	±12	50		SIP12 with Fin (SLA12Pin)
SMA4020	For source driver	4	–60	–4	2000		SIP12 (SMA12Pin)
SMA4021	For source driver	4	–60	–3	2000		SIP12 (SMA12Pin)
SMA4030	For sink driver	4	100	3	2000		SIP12 (SMA12Pin)
SMA4032	For sink driver	4	100	3	2000		SIP12 (SMA12Pin)
SMA4033	For sink driver	4	100	2	2000		SIP12 (SMA12Pin)
SMA4036	For sink driver	6	120	2	2000		SIP15 (SMA15Pin)
SMA5101	For sink driver	4	100	4		0.6	SIP12 (SMA12Pin)
SMA5102	For sink driver	4	100	4		0.6	SIP12 (SMA12Pin)
SMA5103	H bridge	4	±60	+5/–4		0.22/0.55	SIP12 (SMA12Pin)
SMA5106	For sink driver	4	100	4		0.55	SIP12 (SMA12Pin)
SMA5112	For 3-phase motor driver	6	250	7		0.5	SIP12 (SMA12Pin)
SMA5117	For 3-phase motor driver	6	250	7		0.25	SIP12 (SMA12Pin)
SMA5118	For 3-phase motor driver	6	500	±5		1.4	SIP12 (SMA12Pin)
SMA5125	For 3-phase motor driver	6	±60	±10		0.14	SIP12 (SMA12Pin)
SMA5127	For 3-phase motor driver	6	±60	±4		0.55	SIP12 (SMA12Pin)
SMA5130	For 3-phase motor driver	6	250	2.5	2000	0.9	SIP15 (SMA15Pin)
SMA5131	For 3-phase motor driver	6	250	2		1.8	SIP12 (SMA12Pin)
SMA5132	For 3-phase motor driver	6	500	1.5		4	SIP12 (SMA12Pin)
SMA5133	For 3-phase motor driver	6	500	2.5		2	SIP12 (SMA12Pin)
SMA6010	For 3-phase motor driver	6	±60	±4	2000		SIP12 (SMA12Pin)
SMA6014	For 3-phase motor driver	6	±60	±2	1500/2000		SIP12 (SMA12Pin)
SMA6080	For 3-phase motor driver	6	±60	±2	2000		SIP12 (SMA12Pin)
SMA6511	For driving stepping motor with two supplies	5	100±15/–60	1.5/–3	2000		SIP12 (SMA12Pin)
SMA6512	For driving stepping motor with two supplies	5	60±10/–60	1.5/–3	2000		SIP12 (SMA12Pin)
STA301A	For sink driver	3	60±10	4	1000		SIP8 (STA8Pin)
STA302A	For source driver/3-phase motor driver	3	–50	–4	1000		SIP8 (STA8Pin)
STA303A	For sink driver/3-phase motor driver	3	100	4	1000		SIP8 (STA8Pin)
STA308A	For source driver/3-phase motor driver	3	–120	–4	2000		SIP8 (STA8Pin)
STA309A	For source driver/3-phase motor driver	3	–250	–2.5	1000		SIP8 (STA8Pin)
STA312A	For sink driver	3	60	3	300		SIP8 (STA8Pin)
STA322A	For source driver	3	–50	–3	100		SIP8 (STA8Pin)
STA351A	For sink driver/3-phase motor driver	3	100	5	1000		SIP8 (STA8Pin)
STA352A	For source driver/3-phase motor driver	3	–100	–5	1000		SIP8 (STA8Pin)
STA371A	For sink driver	3	60±10	2	2000		SIP8 (STA8Pin)
STA401A	For sink driver	4	60±10	4	1000		SIP10 (STA10Pin)
STA402A	For source driver	4	–50	–4	1000		SIP10 (STA10Pin)
STA403A	For sink driver	4	100	4	1000		SIP10 (STA10Pin)
STA404A	For sink driver	4	200	3	1000		SIP10 (STA10Pin)
STA406A	For sink driver	4	60±10	6	2000		SIP10 (STA10Pin)
STA408A	For source driver	4	–120	–4	2000		SIP10 (STA10Pin)
STA412A	For sink driver	4	60	3	300		SIP10 (STA10Pin)
STA413A	For sink driver	4	35±5	3	500		SIP10 (STA10Pin)
STA421A	For source driver	4	–60	–3	40		SIP10 (STA10Pin)
STA431A	H bridge	4	±60	±3	40		SIP10 (STA10Pin)
STA434A	H bridge	4	±60	±4	1000		SIP10 (STA10Pin)
STA435A	For sink driver	4	65±15	4	1000		SIP10 (STA10Pin)
STA457C	H bridge	4	±60	±4	2000		SIP10 (STA10Pin)

Part Number	Category	Circuit Count	V_{CEO} · V_{DSS} (V)	IC · ID (A)	hFE (min)	$R_{DS\ (ON)}$ max(Ω)	Package
STA458C	H bridge	4	±30	±5	40		SIP10 (STA10Pin)
STA460C	For sink driver	2	60±10	6	700		SIP10 (STA10Pin)
STA471A	For sink driver	4	60±10	2	2000		SIP10 (STA10Pin)
STA472A	For source driver	4	–60	–2	2000		SIP10 (STA10Pin)
STA473A	For sink driver	4	100	2	2000		SIP10 (STA10Pin)
STA475A	For sink driver	4	100±15	2	2000		SIP10 (STA10Pin)
STA481A	For sink driver	4	60±10	1	2000		SIP10 (STA10Pin)
STA485A	For sink driver	4	100±15	1	2000		SIP10 (STA10Pin)
STA491A	H bridge	4	±20	±7	80		SIP10 (STA10Pin)
STA492A	Half bridge	2	±20	±7	80		SIP10 (STA10Pin)
STA513A	For sink driver/3-phase motor driver	3	250	3.5		0.9	SIP10 (STA10Pin)
STA517A	For sink driver/3-phase motor driver	3	305	3		1.8	SIP10 (STA10Pin)
STA521A	For sink driver	4	200	±7		0.35	SIP10 (STA10Pin)
STA524A	For sink driver	3	200	±7		0.35	SIP10 (STA10Pin)

Specifications List by Application — Sink Driver Arrays

●Built-in Avalanche Diodes, between Collector and Base

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
STA460C	2	60±10	6	700		1	SIP10 (STA10Pin)
STA371A	3	60±10	2	2000		2	SIP8 (STA8Pin)
STA301A	3	60±10	4	1000		2	SIP8 (STA8Pin)
SDC06	4	30 to 45	2	400		3	PS16 (Surface-Mount)
STA413A	4	35±5	3	500		4	SIP10 (STA10Pin)
STA481A	4	60±10	1	2000		5	SIP10 (STA10Pin)
SDC03	4	60±10	1.5	2000		6	PS16 (Surface-Mount)
STA471A	4	60±10	2	2000		5	SIP10 (STA10Pin)
STA401A	4	60±10	4	1000		5	SIP10 (STA10Pin)
SLA4010	4	60±10	4	2000		6	SIP12 with Fin (SLA12Pin)
STA406A	4	60±10	6	2000		5	SIP10 (STA10Pin)
STA435A	4	65±15	4	1000		7	SIP10 (STA10Pin)
STA485A	4	100±15	1	2000		5	SIP10 (STA10Pin)
SDC04	4	100±15	1.5	2000		6	PS16 (Surface-Mount)
STA475A	4	100±15	2	2000		5	SIP10 (STA10Pin)

●Built-in Flywheel Diodes

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SDH02	4	100	1.5	2000		9	PS16 (Surface-Mount)
SMA4033	4	100	2	2000		10	SIP12 (SMA12Pin)
SMA4032	4	100	3	2000		10	SIP12 (SMA12Pin)
SLA5040	4	100	4		0.6	8	SIP12 with Fin (SLA12Pin)
SMA5102	4	100	4		0.6	8	SIP12 (SMA12Pin)
SMA5106	4	100	4		0.55	8	SIP12 (SMA12Pin)
SLA5002	4	100	5		0.3	8	SIP12 with Fin (SLA12Pin)
SLA4031	4	120	4	2000		10	SIP12 with Fin (SLA12Pin)
SLA4061	4	120	5	2000		10	SIP12 with Fin (SLA12Pin)
SLA4041	4	200	3	1000		10	SIP12 with Fin (SLA12Pin)
SMA4036	6	120	2	2000		11	SIP15 (SMA15Pin)
SLA4051	9	120	2	2000		12	SIP12 with Fin (SLA12Pin)
SLA4052	9	120	3	2000		12	SIP12 with Fin (SLA12Pin)

●**Equivalent Circuit (for Sink Driver)**

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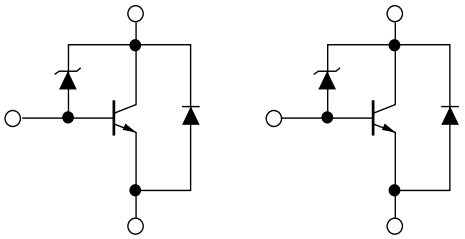

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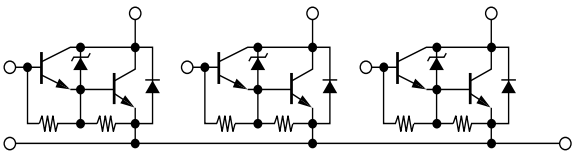

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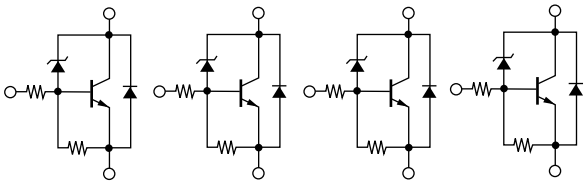

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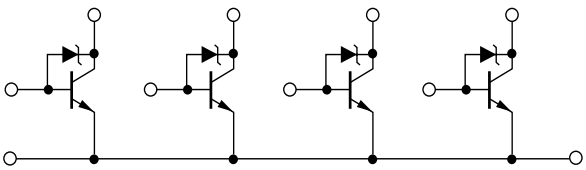

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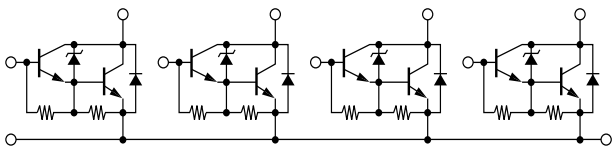

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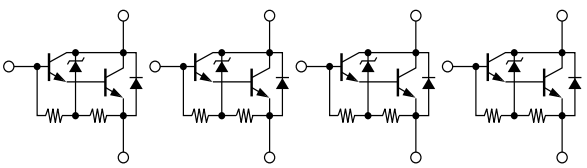

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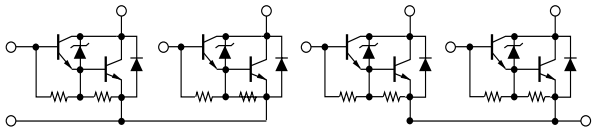

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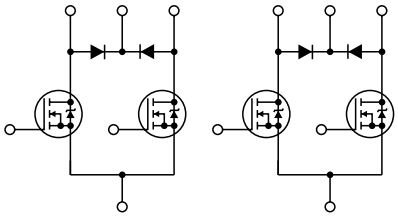

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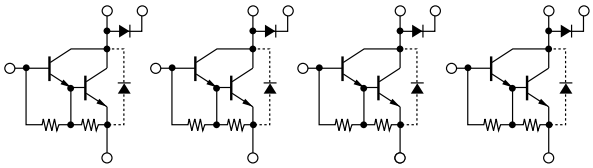

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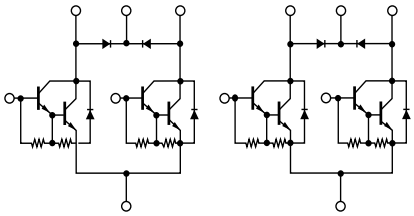

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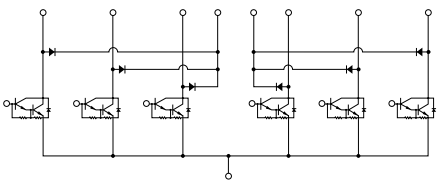

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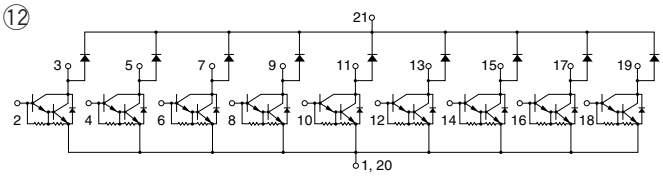

●General-Purpose

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
STA312A	3	60	3	300		13	SIP8 (STA8Pin)
STA303A	3	100	4	100		14	SIP8 (STA8Pin)
STA524A	3	200	7		0.35	21	SIP10 (STA10Pin)
STA412A	4	60	3	300		15	SIP10 (STA10Pin)
STA473A	4	100	2	2000		16	SIP10 (STA10Pin)
SDK04	4	100	2		0.8	17	PS16 (Surface-Mount)
SMA4030	4	100	3	2000		18	SIP12 (SMA12Pin)
STA403A	4	100	4	1000		16	SIP10 (STA10Pin)
SLA4030	4	100	4	2000		18	SIP12 with Fin (SLA12Pin)
SMA5101	4	100	4		0.6	17	SIP12 (SMA12PIN)
SLA5001	4	100	5		0.3	17	SIP12 with Fin (SLA12Pin)
SLA5037	4	100	10		0.08	17	SIP12 with Fin (SLA12Pin)
SLA4060	4	120	5	2000		18	SIP12 with Fin (SLA12Pin)
SLA5077	4	150	±10		0.2	17	SIP12 with Fin (SLA12Pin)
STA404A	4	200	3	1000		16	SIP10 (STA10Pin)
STA521A	4	200	7		0.35	20	SIP10 (STA10Pin)
SLA5041	4	200	10		0.175	17	SIP10 (STA10Pin)
SLA5044	4	250	10		0.25	17	SIP12 with Fin (SLA12Pin)
SLA5011	5	60	5		0.22	19	SIP12 with Fin (SLA12Pin)
SLA5085	5	60	5		0.22	19	SIP12 with Fin (SLA12Pin)
SLA5058	5	150	±7		0.2	19	SIP12 with Fin (SLA12Pin)
SLA5094	5	200	7		0.35	19	SIP12 with Fin (SLA12Pin)
SLA5049	5	250	±7		0.5	19	SIP12 with Fin (SLA12Pin)

●**Equivalent Circuit (for Sink Driver)**

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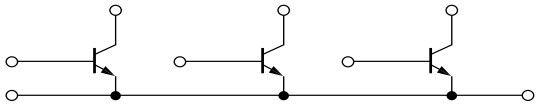

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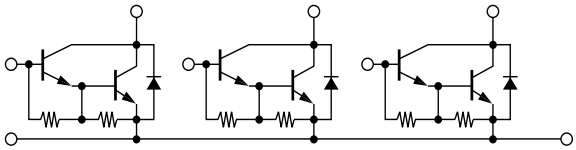

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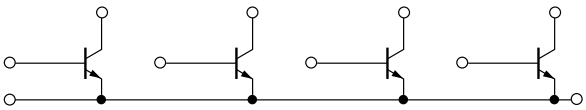

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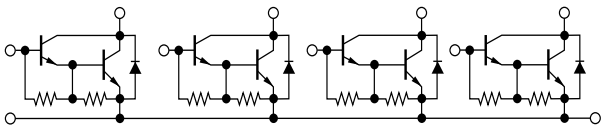

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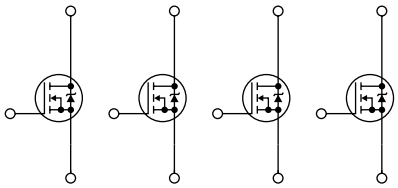

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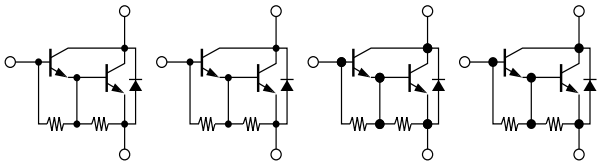

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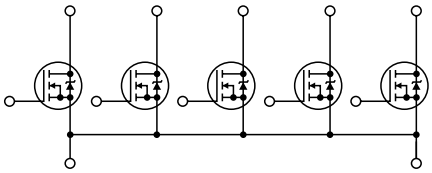

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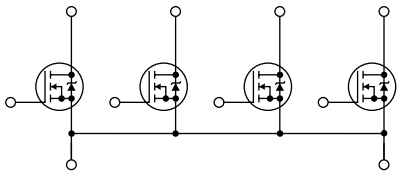

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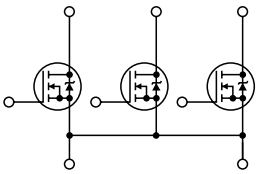


Specifications List by Application — Source Driver Arrays

●Built-in Flywheel Diodes

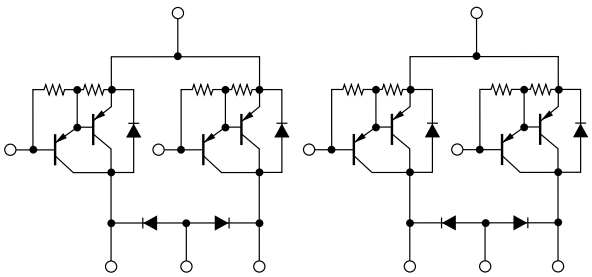
Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SMA4021	4	–60	–3	2000		1	SIP12 (SMA12Pin)
SLA4071	4	–100	–5	2000		1	SIP12 with Fin (SLA12Pin)

●General-Purpose

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
STA322A	3	–50	–3	100		3	SIP8 (STA8Pin)
STA302A	3	–50	–4	1000		4	SIP8 (STA8Pin)
STA308A	3	–120	–4	2000		4	SIP8 (STA8Pin)
STA402A	4	–50	–4	1000		5	SIP10 (STA10Pin)
SDA01	4	–60	–1.5	2000		6	PS16 (Surface-Mount)
STA472A	4	–60	–2	2000		5	SIP10 (STA10Pin)
STA421A	4	–60	–3	40		7	SIP10 (STA10Pin)
SMA4020	4	–60	–4	2000		6	SIP12 (SMA12Pin)
SLA5024	4	–60	–4		0.55	8	SIP12 with Fin (SLA12Pin)
SLA4070	4	–100	–5	1000		6	SIP12 with Fin (SLA12Pin)
STA408A	4	–120	–4	2000		9	SIP10 (STA10Pin)
SLA5015	5	–60	–4		0.55	10	SIP12 with Fin (SLA12Pin)
SLA5012	5	–60	–5		0.3	10	SIP12 with Fin (SLA12Pin)
SLA5086	5	–60	–5		0.22	10	SIP12 with Fin (SLA12Pin)

●**Equivalent Circuit (for Source Driver)**

①



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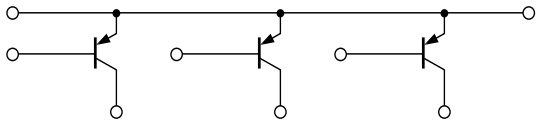

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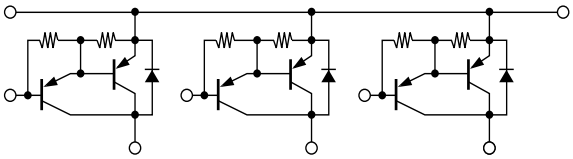

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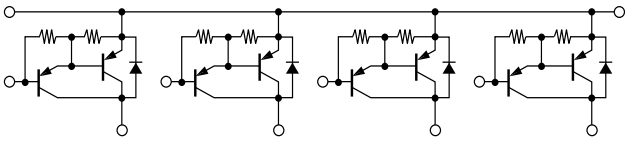

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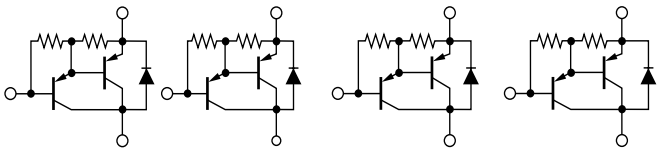

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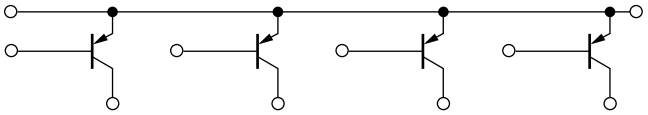

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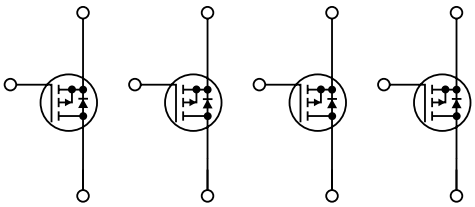

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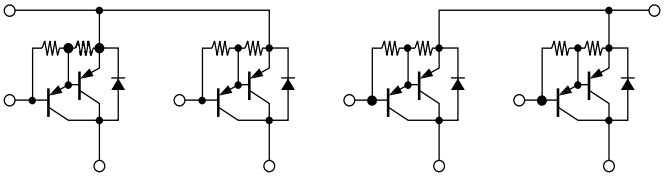

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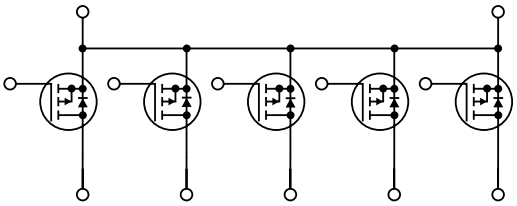


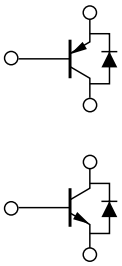
Specifications List by Application Motor Driver Arrays

●H Bridge

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
STA492A	2	±20	±7	45		1	SIP10 (STA10Pin)
STA458C	4	±30	±5	40		2	SIP10 (STA10Pin)
STA431A	4	±60	±3	40		3	SIP10 (STA10Pin)
STA434A	4	±60	±4	1000		4	SIP10 (STA10Pin)
STA457C	4	±60	±4	2000		5	SIP10 (STA10Pin)
SLA4310	4	±60	±4	80		6	SIP12 with Fin (SLA12Pin)
SLA4340	4	±60	±4	2000		4	SIP12 with Fin (SLA12Pin)
SLA5007	4	±60	+5/–4		0.22/0.55	7	SIP12 with Fin (SLA12Pin)
SMA5103	4	±60	+5/–4		0.22/0.55	7	SIP12 (SMA12Pin)
SLA8001	4	±60	±12	50		2	SIP12 with Fin (SLA12Pin)
SDH03	4	+100/–60	±1.5	2000		8	PS16 (Surface-Mount)
SLA4390	4	±100	±5	2000		4	SIP12 with Fin (SLA12Pin)
SLA4391	4	±100	±5	1000		9	SIP12 with Fin (SLA12Pin)
SLA5013	4	±100	±5		0.3/0.7	7	SIP12 with Fin (SLA12Pin)
STA491A	4	±20	±7	45		10	SIP10 (STA10Pin)

●Equivalent Circuit (for Motor Driver)

①



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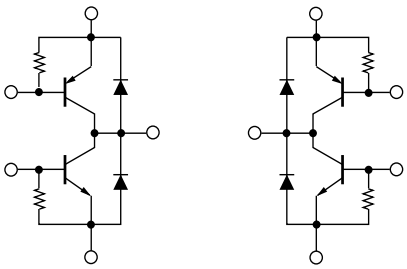

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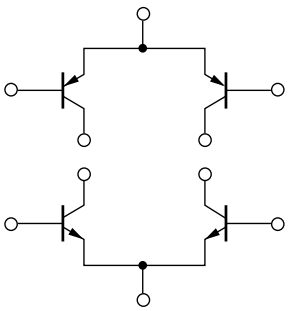

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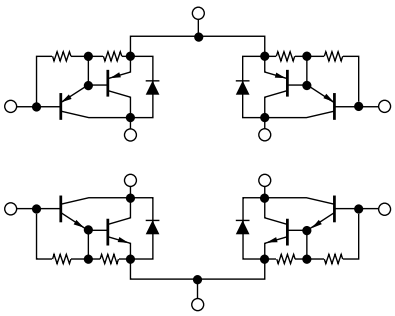

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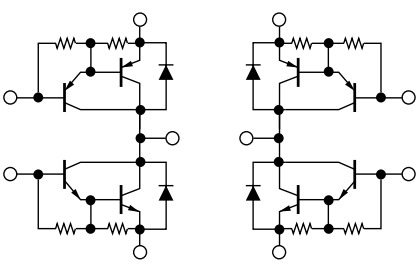

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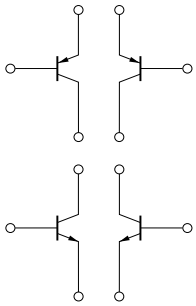

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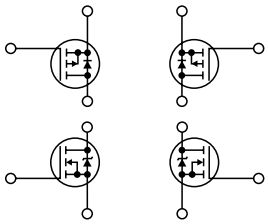

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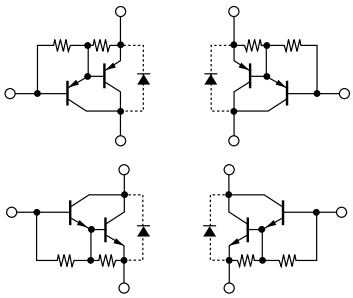

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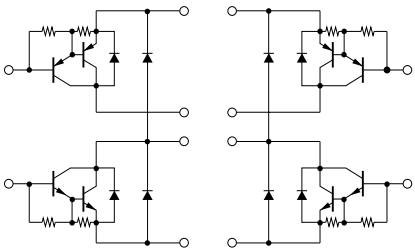

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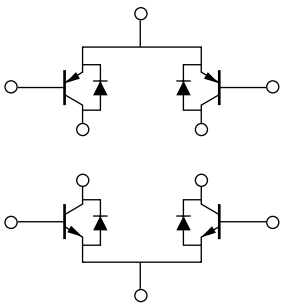
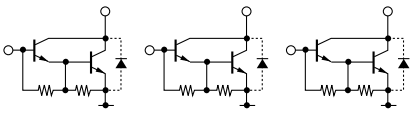


●For 3-Phase Motor Drivers

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)/ V_{CES} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SDC07	3	60	4	2000		11	PS16 (Surface-Mount)
STA303A	3	100	4	1000		12	SIP8 (STA8Pin)
STA351A	3	100	5	1000		12	SIP8 (STA8Pin)
STA513A	3	250	3.5		0.9	13	SIP10 (STA10Pin)
STA517A	3	305	3		1.8	13	SIP10 (STA10Pin)
STA302A	3	–50	–4	1000		14	SIP8 (STA8Pin)
SDA05	3	–60	–4	2000		15	PS16 (Surface-Mount)
STA352A	3	–100	–5	1000		14	SIP8 (STA8Pin)
STA309A	3	–250	–2.5	1000		14	SIP8 (STA8Pin)
SLA5096	6	55	±8		80m	24	SIP15 with Fin (SLA15Pin)
SLA5059	6	60	±4		0.55	16	SIP12 with Fin (SLA12Pin)
SLA5060	6	60	±6		0.22	16	SIP12 with Fin (SLA12Pin)
SLA5061	6	60	±10		0.14	16	SIP12 with Fin (SLA12Pin)
SLA5064	6	60	±10		0.14	17	SIP12 with Fin (SLA12Pin)
SMA6014	6	±60	±2	1500/2000		18	SIP12 (SMA12Pin)
SMA6080	6	±60	±2	2000		19	SIP12 (SMA12Pin)
SMA6010	6	±60	±4	2000		19	SIP12 (SMA12Pin)
SLA6012	6	±60	±4	2000		18	SIP12 with Fin (SLA12Pin)
SMA5127	6	±60	±4		0.55	16	SIP12 (SMA12Pin)
SLA5017	6	±60	+5/–4		0.22/0.55	20	SIP12 with Fin (SLA12Pin)
SLA5022	6	±60	±6	2000	0.22	21	SIP12 with Fin (SLA12Pin)
SLA6023	6	±60	±6	2000		18	SIP12 with Fin (SLA12Pin)
SLA6024	6	±60	±8	2000		18	SIP12 with Fin (SLA12Pin)
SLA6026	6	±60	±10	2000		18	SIP12 with Fin (SLA12Pin)
SMA5125	6	±60	±10		0.14	17	SIP12 (SMA12Pin)
SLA6022	6	±80	±5	2000		18	SIP12 with Fin (SLA12Pin)
SLA6020	6	±100	±5	2000		19	SIP12 with Fin (SLA12Pin)
SLA5023	6	±100	±6	2000	0.55	21	SIP12 with Fin (SLA12Pin)
SMA5130	6	±250	±2.5	2000	0.9	26	SIP15 (SMA15Pin)
SMA5131	6	250	2		1.8	23	SIP12 (SMA12Pin)
SLA5072	6	250	7		0.5	22	SIP15 with Fin (SLA15Pin)
SMA5112	6	250	7		0.5	23	SIP12 (SMA12Pin)
SMA5117	6	250	7		0.25	23	SIP12 (SMA12Pin)
SMA5132	6	500	1.5		4	23	SIP12 (SMA12Pin)
SMA5133	6	500	2.5		2	23	SIP12 (SMA12Pin)
SLA5075	6	500	±5		1.4	22	SIP15 with Fin (SLA15Pin)
SMA5118	6	500	±5		1.4	23	SIP12 (SMA12Pin)
SLA5201	6	600	7			25	SIP15 with Fin (SLA15Pin)

●Equivalent Circuit (for Motor Driver)

⑪



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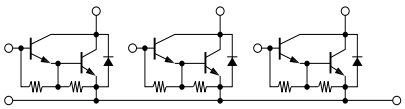

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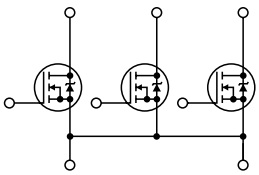

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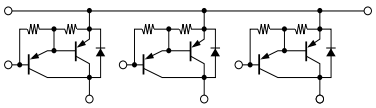

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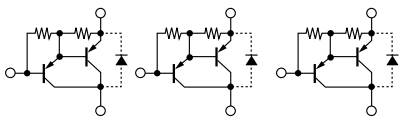

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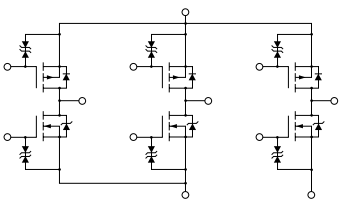

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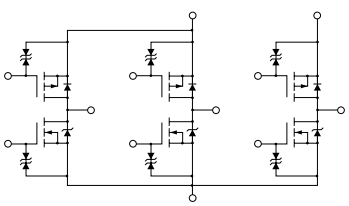

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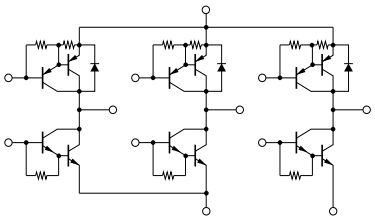

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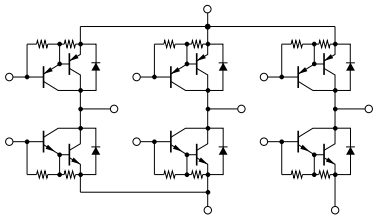

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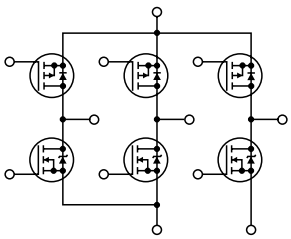

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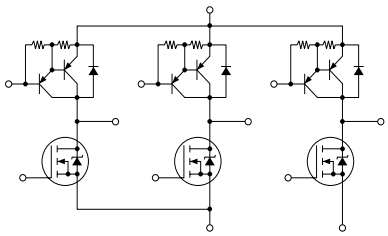

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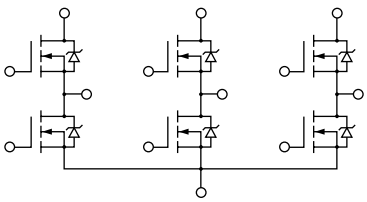

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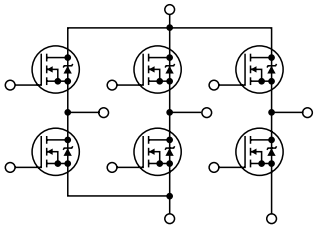

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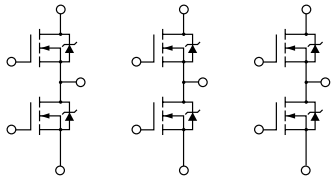

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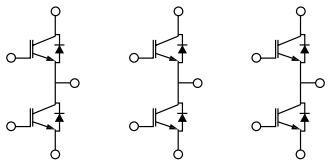

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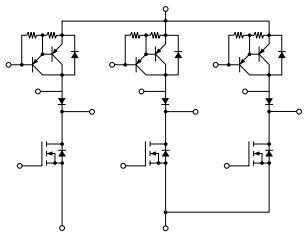

●For Driving Stepping Motor with Two Supplies

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SMA6511	5	100±15/–60	1.5/–3	2000		27	SIP12 (SMA12Pin)
SMA6512	5	60—10/–60	1.5/–3	2000		27	SIP12 (SMA12Pin)

●For 5-Phase Motor Drive

Part Number	Circuit Count	V_{CEO} (V)/ V_{DSS} (V)	I_C (A)/ I_D (A)	h_{FE} (min)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SLA5074	4	60	5		0.3	28	SIP15 with Fin (SLA15Pin)
SLA5065	4	60	7		0.1	28	SIP15 with Fin (SLA15Pin)
SLA5073	6	60	5		0.3	24	SIP15 with Fin (SLA15Pin)
SLA5068	6	60	7		0.1	22	SIP15 with Fin (SLA15Pin)

●Equivalent Circuit (for Motor Driver)

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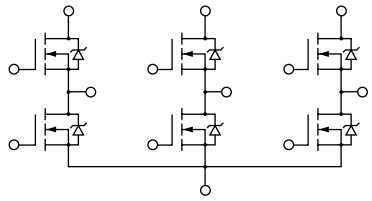

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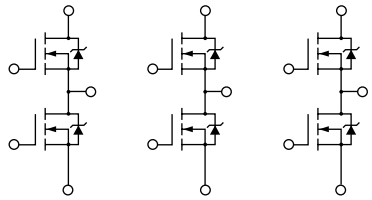

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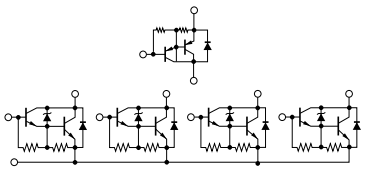

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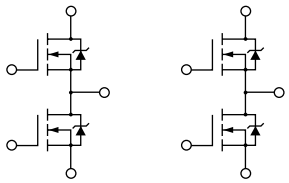
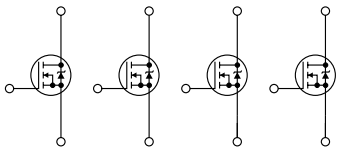


Specifications List by Application — Arrays for CRT Monitor S-Distortion Correction Circuit

Part Number	V_{DSS}	Circuit Count	I_D (A)	$R_{DS(ON)}$max (Ω)	Equivalent Circuit	Package
SLA5037	100	4	10	0.08	1	SIP12 with Fin (SLA12Pin)
SLA5047	150	4	10	0.085	1	SIP12 with Fin (SLA12Pin)
SLA5052		4	10	0.115	1	SIP12 with Fin (SLA12Pin)
SLA5077		4	±10	0.2	1	SIP12 with Fin (SLA12Pin)
SLA5058		5	±7	0.2	2	SIP12 with Fin (SLA12Pin)
STA524A	200	3	±7	0.35	3	SIP10 (STA10Pin)
STA521A		4	±7	0.35	4	SIP10 (STA10Pin)
SLA5041		4	10	0.175	1	SIP12 with Fin (SLA12Pin)
SLA5089		4	10	0.12	1	SIP12 with Fin (SLA12Pin)
SLA5046		5	7	0.35	2	SIP12 with Fin (SLA12Pin)
SLA5094		5	7	0.35	2	SIP12 with Fin (SLA12Pin)
SLA5044	250	4	10	0.25	1	SIP12 with Fin (SLA12Pin)
SLA5049		5	7	0.5	2	SIP12 with Fin (SLA12Pin)

●Equivalent Circuit (for CRT Monitor S-Distortion Correction)

①



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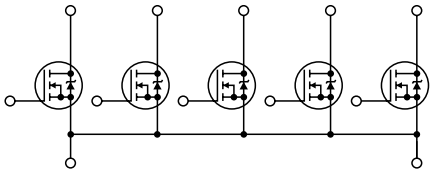
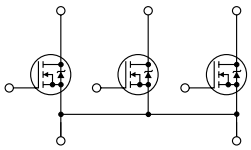
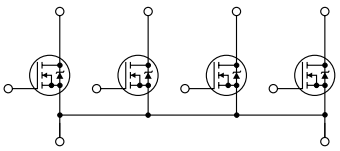


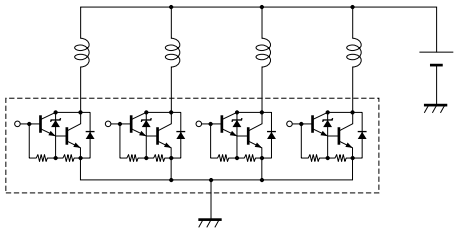
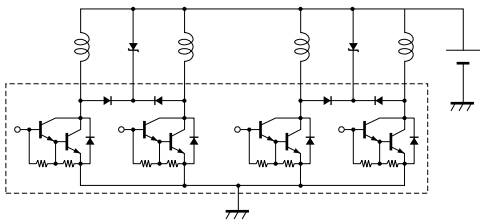
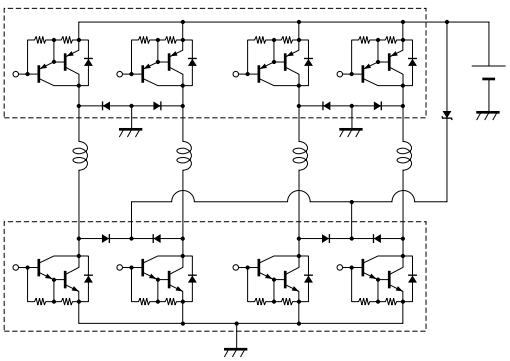
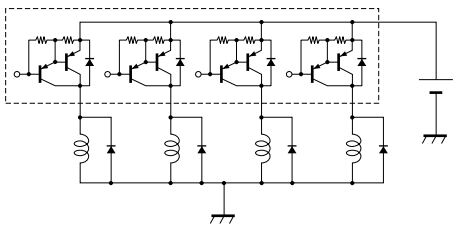
③

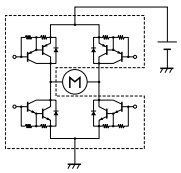
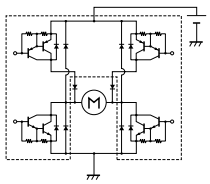
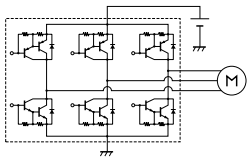
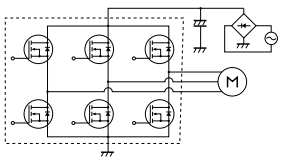
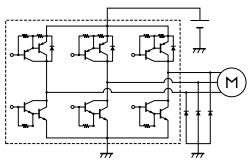
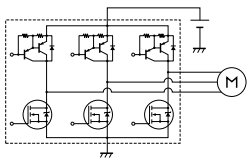
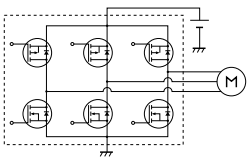


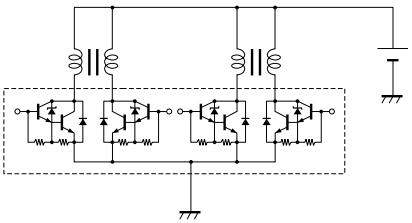
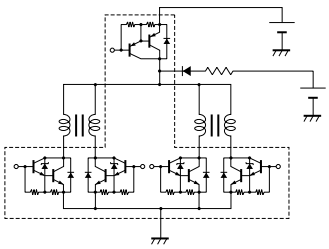
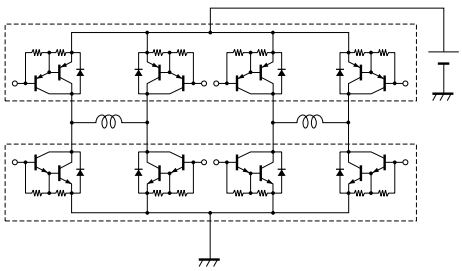
④

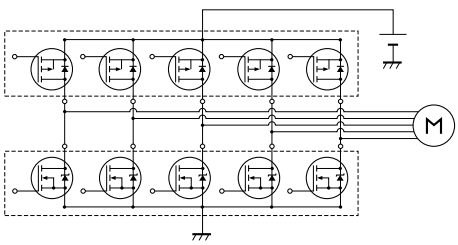


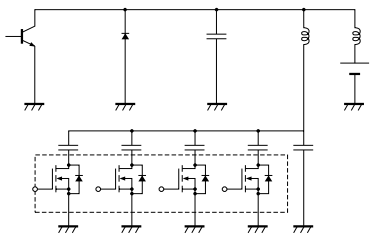
Specifications List by Application

Applications	Typical Connection Diagram	Part Number		
		Transistors		MOS FETs
		Darlington	Single	
●Solenoid ●Relay		STA301A STA371A STA401A STA406A STA435A STA471A STA475A STA481A STA485A STA4010 SDC04 SDC03	STA460C STA413A SDC06	
		SLA4031 SLA4041 SLA4060 SMA4032 SMA4033 SMA4036 SDH02		SLA5002 SLA5040 SMA5102 SMA5106 SDK02
		SLA4071 SMA4021		SLA5006
		STA302A STA308A STA402A STA408A STA472A SLA4070 SMA4020 SDA01	STA322A STA421A	SLA5004 SLA5024

Applications		Typical Connection Diagram	Part Number		
			Transistors		MOS FETs
			Darlington	Single	
●DC Motor	Normal/Reverse Rotation Control		STA434A STA457C SLA4340 STA4390 SDH03	STA431A STA458C STA474A SLA4310 SLA8001	
	PWM Control		SLA4391		SLA5007 SLA5013 SLA5018 SMA5103
●3-Phase DC Brushless Motor			STA302A+STA303A SMA6010 SLA6020 SDA05+SDC07 SMA6080 STA351A+STA352A		
	AC100V Direct Driver AC200V Direct Driver				SLA5072 SLA5075 SMA5112 SMA5117 SMA5118 SMA5131 SMA5132 SMA5133
	PWM Control		SLA6012 SLA6022 SLA6023 SLA6024 SLA6026 SMA6014		
			SLA5022 SLA5023 SMA5130 STA309A STA309A	 + +	 STA513A STA517A
					SLA5010 SLA5017 SLA5059 SLA5060 SLA5061 SLA5064 SMA5125 SMA5127

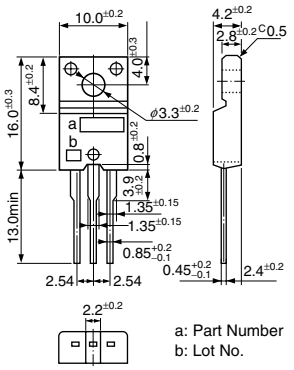
Applications		Typical Connection Diagram	Part Number		
			Transistors		MOS FETs
			Darlington	Single	
●Stepping Motor	Constant Voltage Driver		STA401A STA406A STA435A STA471A STA475A STA481A STA485A SLA4010 SDC04 SDC03	STA460C STA413A SDC06	
	Two Supplies Driver		SMA6511 SMA6512		
	Bipolar Driver		STA473A STA472A STA408A STA404A STA403A STA402A SMA4030 SMA4020 SLA4070 SLA4060 SLA4030 SDA01	STA421A STA412A SDC01	SMA5101 SLA5024 SLA5005 SLA5004 SLA5001

Applications	Typical Connection Diagram	Part Number	
		N-CH	P-CH
●5-Phase Motor		SLA5011 SLA5029 SLA5065+SLA5068 SLA5073+SLA5074 SLA5085	SLA5012 SLA5015 SLA5086

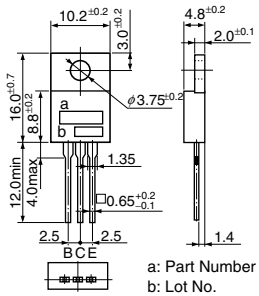
Applications	Typical Connection Diagram	Part Number			
		100V	150V	200V	250V
●S-Distortion Correction		SLA5037 SLA5042	SLA5058 SLA5077	SLA5041 SLA5094 STA521A STA524A	SLA5044 SLA5049

■Package Type (Dimensions)

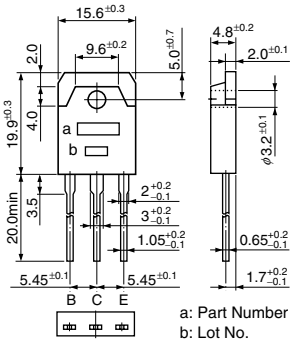
• TO-220F (FM20)



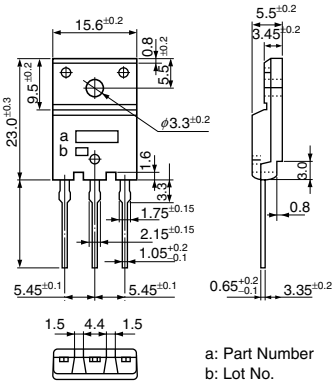
• TO-220 (MT-25)



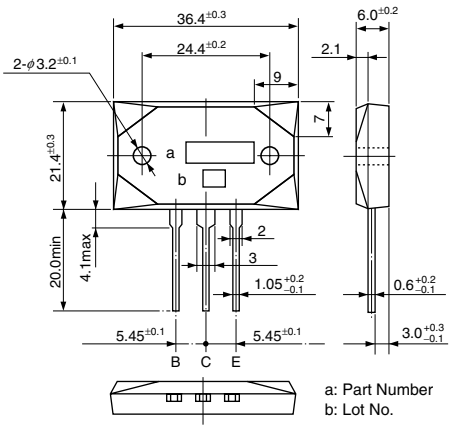
• TO-3P (MT-100)



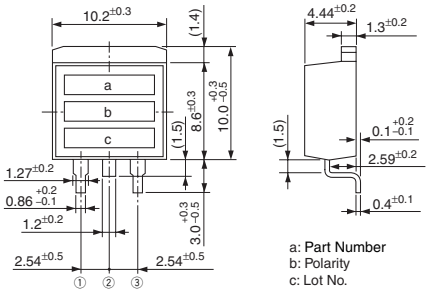
• TO-3PF (FM100)



• MT-200

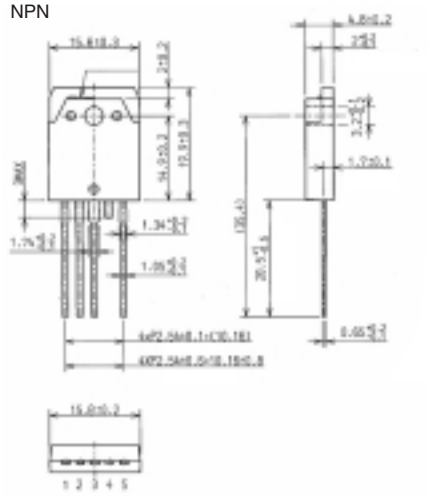


• TO-220S

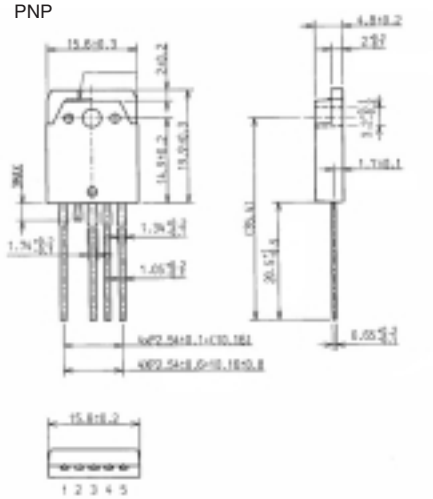


• TO3P-5Pin

NPN

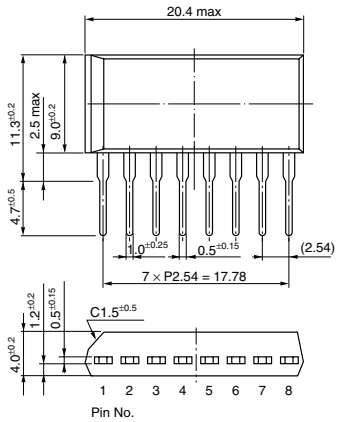


PNP

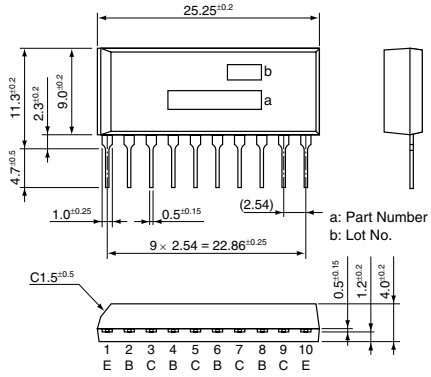


(Unit:mm)

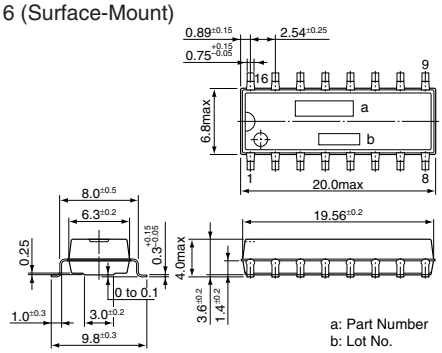
• SIP 8 (STA8Pin)



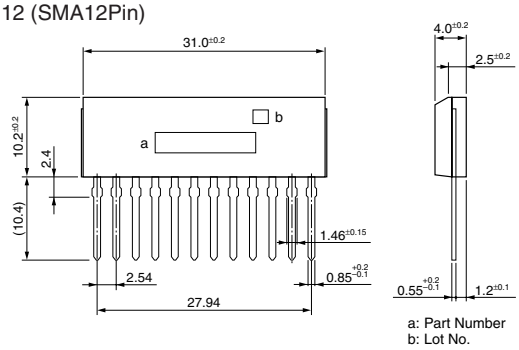
• SIP 10 (STA10Pin)



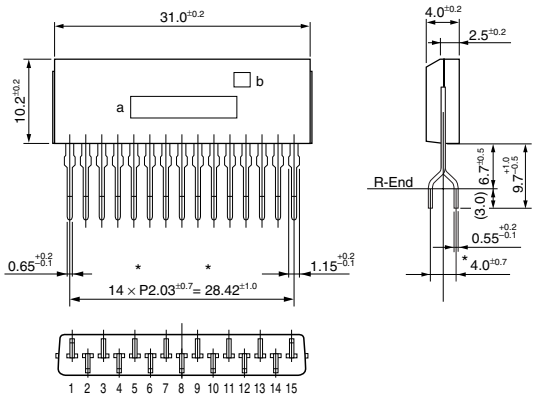
• PS 16 (Surface-Mount)



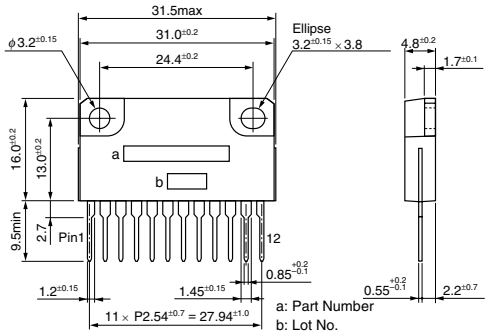
• SIP 12 (SMA12Pin)



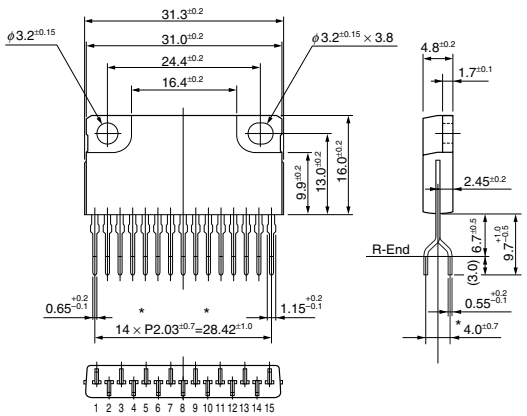
• SIP 15 (SMA15Pin)



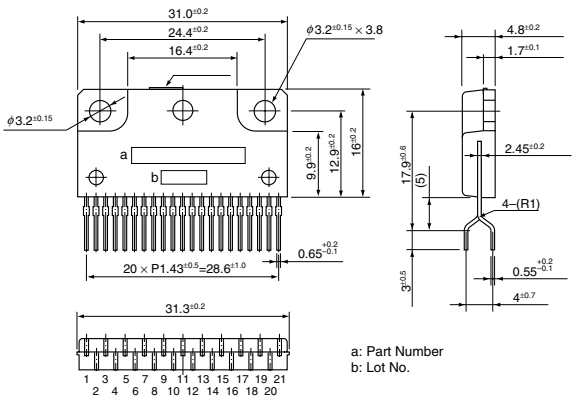
• SIP 12 with Fin (SLA12Pin)



• SIP 15 with Fin (SLA15Pin)



• SIP 21 with Fin (SLA21Pin)



(Unit:mm)

3

Thyristors

Application Note

Since reliability can be affected adversely by improper storage environment or handling methods during Characteristic tests, please observe the following cautions.

■ Cautions for Storage

- ●Ensure that storage conditions comply with the normal temperature (5 to 35°C) and the normal relative humidity (around 40 to 75%), and avoid storage locations that experience high temperature and humidity, or extreme changes in temperature or humidity.
- ●Avoid locations where dust or harmful gases are present, and avoid direct sunlight.
- ●Reinspect the devices for rust in leads and solderability after stored for a long time.

■ Cautions for Characteristic Tests and Handling

On characteristics test at incoming inspection, etc, take good care to avoid the surge voltages from the test equipment, the short circuit at terminals, or the wrong connection.

■ Silicone Grease

When using a heatsink, please coat thinly and evenly the back surface of the device and both surfaces of the insulating plate with silicone grease to lower the thermal resistance between the device and the heatsink.
Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.
Recommended Silicone Grease
- G-746 (Shin-Etsu Chemical)
- YG6260 (GE Toshiba Silicones)
- SC102 (Dow Corning Toray Silicone)

■ Mounting Torque

When mounting torque is insufficient, thermal resistance increases, and so heat radiation effect is decreased. When the torque is excessive, the screw may be broken, the heatsink may be deformed, and the device frame may be distorted, resulting in the device damage. Recommended mounting torque per package is as follows:

● Mounting Torque Table

Package	Screw Torque
TO-220 (MT-25)	0.490 to 0.686 N•m (5 to 7kgf•cm)
TO-220F (FM20)	
TO-3P (MT-100)	0.686 to 0.882 N•m (7 to 9kgf•cm)
TO-3PF (FM100)	
SIP with Fin (SLA)	0.588 to 0.784 N•m (6 to 8kgf•cm)

* When the surface of a heatsink where Full Mold package is to be mounted is not flat due to the burred metal bracket for screwing around the mounting hole of the heatsink, the resin of the package might be cracked even if the torque is lower than the recommended value.
* When a screw is fastened with an air driver for the Full Mold package, a large impact is generated at the time of stop, and the resin may crack even if the torque is lower than the recommended value. An electric driver, therefore, should be used instead of an air driver.

■ Heatsink

A larger contact area between the device and the heatsink is required for more effective heat radiation. To ensure a larger contact area, minimize mounting holes. And select a heatsink with a surface smooth enough and free from burrs and slivers.

■ Soldering Temperature

In general, the device mounted on a printed circuit board is subjected to high temperatures from flow solder in a solder bath, or, from a soldering iron at hand soldering.
The testing method and test conditions (JIS-C-7021 standards) for a device's heat resistance to soldering are:
At a distance of 1.5mm from the device's main body, apply 260°C for 10 seconds, and 350°C for 3 seconds.
Please observe these limits and finish soldering in as short a time as possible.
Since reliability can be affected adversely by improper storage environment or handling methods during Characteristic tests, please observe the following cautions.

Thyristors

Part Number	Absolute Maximum Ratings														
	V_{RSM} V_{DSM} (V)	V_{RRM} V_{DRM} (V)	$I_{T(AV)}$ (A)	Conditions Tc (°C)	$I_{T(RMS)}$ (50Hz) (A)	I_{TSM} 50Hz Single Half Sine Wave, Default T_j=125°C (A)	P_{GM} (W)	$P_{G(AV)}$ (W)	V_{RGM} (V)	I_{FGM} (A)	T_j (°C)	T_{stg} (°C)	I_{RRM} I_{DRM} (mA) max	Conditions T_j (°C)	
TF321M-A	300	200	3.0	87	4.7	60	5.0	0.5	5.0	2.0	–40 to +110	–40 to +125	1.0	110	
TF321S	300	200	3.0	93	4.7	60	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF521M	300	200	5.0	96	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF821M	300	200	8.0	83	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF821S	300	200	8.0	74	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF341M	500	400	3.0	102	4.7	60	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF341M-A	500	400	3.0	87	4.7	60	5.0	0.5	5.0	2.0	–40 to +110	–40 to +125	1.0	110	
TF341S	500	400	3.0	93	4.7	60	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF541M	500	400	5.0	96	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF541S	500	400	5.0	87	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF541S-A	500	400	5.0	88	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF841M	500	400	8.0	83	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF841S	500	400	8.0	74	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
SLA0201	650	600	5 × 4		7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF361M	700	600	3.0	102	4.7	60	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF361M-A	700	600	3.0	87	4.7	60	5.0	0.5	5.0	2.0	–40 to +110	–40 to +125	1.0	110	
TF361S	700	600	3.0	93	4.7	60	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF561M	700	600	5.0	96	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF561S	700	600	5.0	87	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF561S-A	700	600	5.0	88	7.8	80	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF861M	700	600	8.0	83	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	
TF861S	700	600	8.0	74	12.6	120	5.0	0.5	5.0	2.0	–40 to +125		2.0	125	

3-Pin Reverse Conducting Thyristors for HID Lamp Ignition

Part Number	Absolute Maximum Ratings										I_{DRM}		V_{TM}		
	V_{DRM} (V)	I_{TRM} (50Hz) (A)	di/dt (A/μs)	P_{GM} (W)	$P_{G(AV)}$ (W)	V_{RGM} (V)	I_{FGM} (A)	I_{FRM}* (A)	T_j (°C)	T_{stg} (°C)	(mA) max	Conditions T_j (°C)	(V) max	Conditions T_c (°C)	Conditions I_{TM} (A)
TFC561D	600	430	1200	5.0	0.5	5.0	2.0	240	–40 to +125		1.0	125	1.4		10

*: V_D≤430V, 100kcycle, W_p=1.3*m*s, T_a=125°C

Electrical Characteristics																	Package
	V_{TM}	Conditions		V_{GT}		I_{GT}		Conditions	V_{GD}			dv/dt			I_H	R_{th}	
	(V) max	T_c (°C)	I_{TM} (A)	(V) typ	(V) max	(mA) typ	(mA) max	T_c (°C)	(V) min	T_j (°C)	Conditions V_D (V)	(V/μs) t_{yp}	Conditions T_j (°C)	V_D (V)	(mA) typ	(°C/W) max	
	1.4	25	5		1.0		0.1	25	0.1	110	1/2V_{DRM}	20	110	1/2V_{DRM}	1.0	3.0	TO-220
	1.4	25	5	0.7	1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	5.0	5.0	TO-220F
	1.4	25	10		1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.0	TO-220
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	2.7	TO-220
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.6	TO-220F
	1.4	25	5		1.5	2.0	10	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.0	TO-220
	1.4	25	5		1.0		0.1	25	0.1	110	1/2V_{DRM}	20	110	1/2V_{DRM}	1.0	3.0	TO-220
	1.4	25	5	0.7	1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	5.0	5.0	TO-220F
	1.4	25	10		1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.0	TO-220
	1.4	25	10		1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	4.0	TO-220F
	1.4	25	10		1.5	0.03	0.2	25	0.1	125	1/2V_{DRM}	20	125	1/2V_{DRM}	4.0	4.0	TO-220F
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	2.7	TO-220
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.6	TO-220F
	1.4	25	10	0.7	1.5	5.0	10	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0		SIP12 with Fin (SLA12Pin)
	1.4	25	5		1.5	2.0	10	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.0	TO-220
	1.4	25	5		1.0		0.1	25	0.1	110	1/2V_{DRM}	20	110	1/2V_{DRM}	1.0	3.0	TO-220
	1.4	25	5	0.7	1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	5.0	5.0	TO-220F
	1.4	25	10		1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.0	TO-220
	1.4	25	10		1.5	3.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	4.0	TO-220F
	1.4	25	10		1.5	0.03	0.2	25	0.1	125	1/2V_{DRM}	20	125	1/2V_{DRM}	4.0	4.0	TO-220F
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	2.7	TO-220
	1.4	25	15		1.5	5.0	15	25	0.1	125	1/2V_{DRM}	50	125	1/2V_{DRM}	4.0	3.6	TO-220F

Electrical Characteristics														Package
	V_{GT}		I_{GT}		Conditions	V_{GD}			I_H	Rth	V_F			
	(V) typ	(V) max	(mA) typ	(mA) max	Tc (°C)	(V) min	Conditions Tj (°C)	V_D (V)	(mA) typ	(°C/W) max	(V) max	Conditions IF (A)		
		1.5		20		0.1	125	480	10	4.0	1.4	10.0		TO-220S (Straight)

Triacs

Part Number	Absolute Maximum Ratings																
	V_{DRM} (V)	$I_{T\ (RMS)}$ (A)	Conditions T_C (°C)	I_{TSM} (A)	Conditions	P_{GM} (W)	$P_{G\ (AV)}$ (W)	I_{GM} (A)	T_j (°C)	T_{stg} (°C)	I_{DRM1} (mA) max	Conditions	I_{DRM2} (mA) max	Conditions	V_{TM} (V) max	Conditions I_{TM} (A)	
TMA34M-L*1	400	3		30		3	0.3	0.5	–40 to +125		0.1		2		1.5	4.5	
TMA34S-L	400	3	109	30		3	0.3	0.5	–40 to +125		0.1		2		1.5	4.5	
TM341S-R	400	3	109	30		3	0.3	0.5	–40 to +125		0.1		2		1.6	5	
TMA54M-L*1	400	5		50		5	0.5	2	–40 to +125		0.1		2		1.5	7	
TMA54S-L	400	5	102	50		5	0.5	2	–40 to +125		0.1		2		1.5	7	
TM541S-R	400	5	104	50		5	0.5	2	–40 to +125		0.1		2		1.6	7	
TMA84M-L*1	400	8		80		5	0.5	2	–40 to +125		0.1		2		1.5	12	
TMA84S-L	400	8	92	80		5	0.5	2	–40 to +125		0.1		2		1.5	12	
TMA104S-L	400	10	85	100		5	0.5	2	–40 to +125		0.1		2		1.5	14	
TM1041S-R	400	10	90	80		5	0.5	2	–40 to +125		0.1		2		1.6	14	
TMA124S-L	400	12	77	120		5	0.5	2	–40 to +125		0.1		2		1.5	17	
TM1241S-R	400	12	84	110		5	0.5	2	–40 to +125		0.1		2		1.6	16	
TMA164S-L	400	16	66	160		5	0.5	2	–40 to +125		0.1		2		1.45	20	
TMA164P-L	400	16	108	160		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TMA164B-L	400	16	98	160		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TMA204S-L	400	20	53	190		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TM2541B-L	400	25	84	240		5	0.5	2	–40 to +125		0.1		2		1.3	20	
STA221A	400	1.0 × 4	97	10	125°C	1	0.1	0.5	–40 to +125		0.1		1		1.6	1.6	
STA203A	400	1.2 × 3	97	10	50Hz	1.2	0.1	0.5	–40 to +125		0.1	25°C	1	125°C	1.6	1.6	
TMA36M-L*1	600	3		30	1shot	3	0.3	0.5	–40 to +125		0.1	V_D=V_{DRM}	2	V_D=V_{DRM}	1.5	4.5	
TMA36S-L	600	3	109	30		3	0.3	0.5	–40 to +125		0.1		2		1.5	4.5	
TM361S-R	600	3	109	30		3	0.3	0.5	–40 to +125		0.1		2		1.6	5	
TMA56M-L*1	600	5		50		5	0.5	2	–40 to +125		0.1		2		1.5	7	
TMA56S-L	600	5	102	50		5	0.5	2	–40 to +125		0.1		2		1.5	7	
TM561S-R	600	5	104	50		5	0.5	2	–40 to +125		0.1		2		1.6	7	
TMA86M-L*1	600	8		80		5	0.5	2	–40 to +125		0.1		2		1.5	12	
TMA86S-L	600	8	92	80		5	0.5	2	–40 to +125		0.1		2		1.5	12	
TMA106S-L	600	10	85	100		5	0.5	2	–40 to +125		0.1		2		1.5	14	
TM1061S-R	600	10	90	90		5	0.5	2	–40 to +125		0.1		2		1.6	14	
TMA126S-L	600	12	77	120		5	0.5	2	–40 to +125		0.1		2		1.5	17	
TM1261S-R	600	12	84	110		5	0.5	2	–40 to +125		0.1		2		1.6	16	
TMA166S-L	600	16	66	160		5	0.5	2	–40 to +125		0.1		2		1.45	20	
TMA166P-L	600	16	108	160		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TMA166B-L	600	16	98	160		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TMB166S-L	600	16	94	160		5	0.5	2	–40 to +150		0.2		2		1.45	20	
TMA206S-L	600	20	53	190		5	0.5	2	–40 to +125		0.1		2		1.4	20	
TMB206S-L	600	20	85	200		5	0.5	2	–40 to +150		0.1		2		1.4	20	
TM2561B-L	600	25	84	240		5	0.5	2	–40 to +125		0.1		2		1.3	20	
TM583S-L	800	5	101	45		5	0.5	2	–40 to +125		0.1		2		1.6	7	
TM883S-L	800	8	91	80		5	0.5	2	–40 to +125		0.1		2		1.6	10	

*1: Under development

Electrical Characteristics (T_j = 25°C, unless otherwise specified)

V_{GT}					I_{GT}					V_{GD}			(dv/dt) c			$R_{th\ (j-c)}$	
			Conditions					Conditions			Conditions			Conditions			
Mode I (T2+, G+) (V) max	Mode II (T2+, G–) (V) max	Mode III (T2–, G–) (V) max	V_D (V)	R_L (W)	Mode I (T2+, G+) (mA) max	Mode II (T2+, G–) (mA) max	Mode III (T2–, G–) (mA) max	V_D (V)	R_L (Ω)		T_j (°C)	V_O (V)	(V/us) min	(dv/dt) c (–A/ms)	T_j (°C)	(°C/W) max	Package
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	1.5	125	-	TO-220
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	1.5	125	4.5	TO-220F
1.8	1.2	1.2	20	40	12	12	12	20	40	0.1	125	1/2V_{DRM}	-			5	TO-220F
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	2.5	125	-	TO-220
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	2.5	125	4	TO-220F
1.8	1.2	1.2	20	40	12	12	12	20	40	0.1	125	1/2V_{DRM}	-			4	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	4	125	-	TO-220
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	4	125	3.7	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	5	125	3.6	TO-220F
2	1.2	1.2	20	40	7	7	7	20	40	0.1	125	1/2V_{DRM}	-			3.3	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	6	125	3.5	TO-220F
1.8	1.2	1.2	20	40	8	8	8	20	40	0.1	125	1/2V_{DRM}	-			3	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	8	125	3.3	TO-220F
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	8	125	1.2	TO-3P
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	8	125	1.8	TO-3PF
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	10	125	3.2	TO-220F
2	2	2	6	10	30	30	30	6	10	0.2	125	1/2V_{DRM}	10	4	125	1.5	TO-3PF
3.5	1.2	1.2	6	10	3	3	3	6	10	0.2	125	1/2V_{DRM}	1		125	20	SIP10 (STA10Pin)
3.5	1.2	1.2	6	10	3	3	3	6	10	0.2	125	1/2V_{DRM}	1		125	20	SIP8 (STA8Pin)
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	1.5	125	-	TO-220
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	1.5	125	4.5	TO-220F
1.8	1.2	1.2	20	40	12	12	12	20	40	0.1	125	1/2V_{DRM}	-			5	TO-220F
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	2.5	125	-	TO-220
1.5	1.5	1.5	12	20	15/20	15/20	15/20	12	20	0.2	125	1/2V_{DRM}	5	2.5	125	4	TO-220F
1.8	1.2	1.2	20	40	12	12	12	20	40	0.1	125	1/2V_{DRM}	-			4	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	4	125	-	TO-220
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	4	125	3.7	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	5	125	3.6	TO-220F
2	1.2	1.2	20	40	7	7	7	20	40	0.1	125	1/2V_{DRM}	-			3.3	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	6	125	3.5	TO-220F
1.8	1.2	1.2	20	40	8	8	8	20	40	0.1	125	1/2V_{DRM}	-			3	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	8	125	3.3	TO-220F
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	8	125	1.2	TO-3P
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	8	125	1.8	TO-3PF
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	10	125	3.0	TO-220F
1.5	1.5	1.5	12	20	20/30	20/30	20/30	12	20	0.2	125	1/2V_{DRM}	10	10	125	3.2	TO-220F
1.5	1.5	1.5	12	20	30	30	30	12	20	0.2	125	1/2V_{DRM}	10	10	125	2.7	TO-220F
2	2	2	6	10	30	30	30	6	10	0.2	125	1/2V_{DRM}	10	4	125	1.5	TO-3PF
2	2	2	6	10	20	20	20	6	10	0.2	125	1/2V_{DRM}	5	2	125	4	TO-220F
2	2	2	6	10	30	30	30	6	10	0.2	125	1/2V_{DRM}	10	4	125	3.6	TO-220F

3-3 PNPN Switch Elements

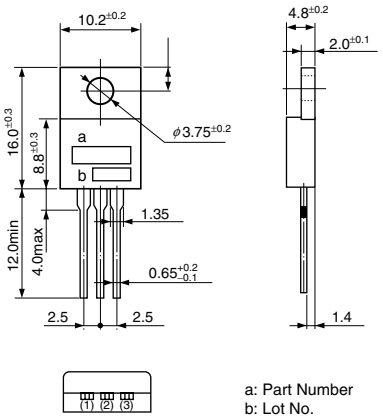
PNPN Switch Elements List

Part Number	Absolute Maximum Ratings								
	V_{DRM} (V)	$I_{T\ (RMS)}$ (A)	Conditions T_l (°C)	I_{TSM} (A)	Conditions T_a/Wp/f (°C)/(μs)/(Hz)	di_T/dt (A/μs)	T_j (°C)	T_{stg} (°C)	
ET013	90	0.6	≤112	80	25/10/50	30	–40 to +125		
ET015	115	0.6	≤112	80		30	–40 to +125		
ET020	170	0.6	≤112	80		30	–40 to +125		
ET0141	115	0.6	≤112	80		30	–40 to +125		

	Electrical Characteristics								Package (Body Diameter/Lead Diameter)
	V_{BO}			I_{BO}	I_{DRM}		VT		
	(V) min	typ	max	(μA) max	(μA) max	Conditions V_D (V)	(V) max	Conditions I_T (A)	
	120		138	150			±2.5	±10	Axial (ϕ2.7/ϕ0.6)
	142		157	100			±2.5	±10	Axial (ϕ2.7/ϕ0.6)
	190		210	100			±2.5	±10	Axial (ϕ2.7/ϕ0.6)
	134		146	100	10	V_{DRM}	±2.5	±10	Axial (ϕ2.7/ϕ0.6)

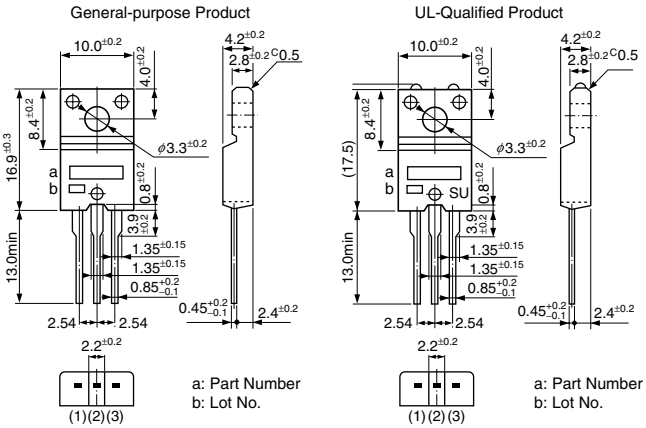
Package Type (Dimensions)

• TO-220



a: Part Number
b: Lot No.

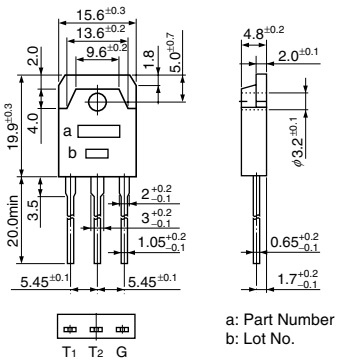
• TO-220F



a: Part Number
b: Lot No.

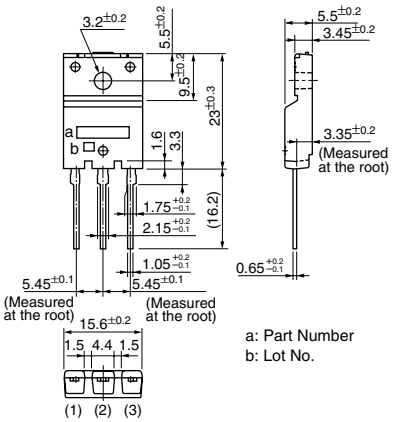
Pin No.	
(1)	Cathode (K)
(2)	Anode (A)
(3)	Gate (G)

• TO-3P



a: Part Number
b: Lot No.

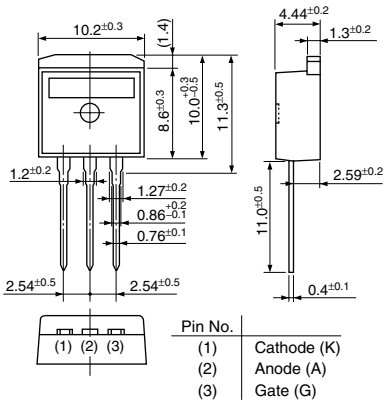
• TO-3PF



a: Part Number
b: Lot No.

(1) Terminal 1 (T_1)
(2) Terminal 2 (T_2)
(3) Gate (G)

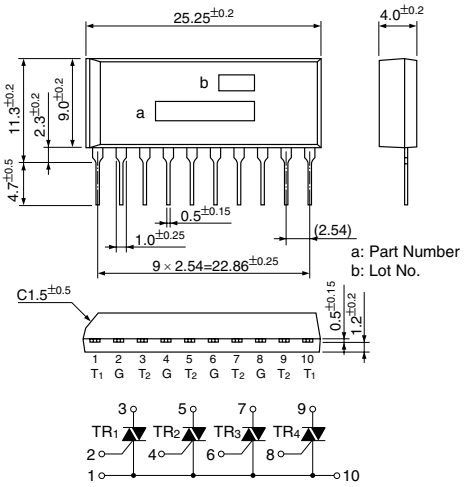
• TO-220S Straight



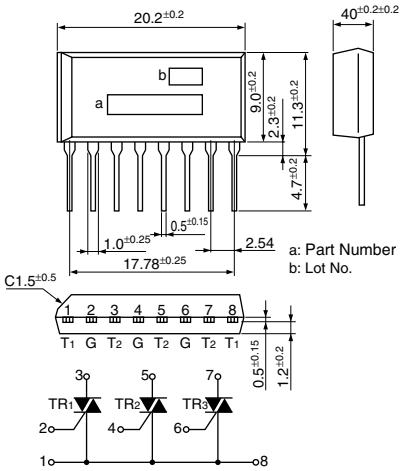
Pin No.	
(1)	Cathode (K)
(2)	Anode (A)
(3)	Gate (G)

(Unit: mm)

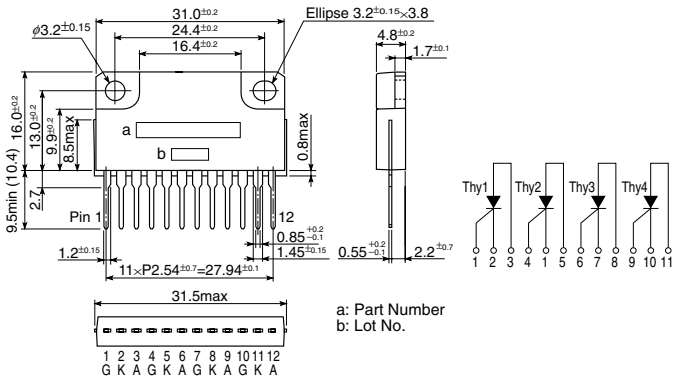
• SIP 10 (STA10Pin)



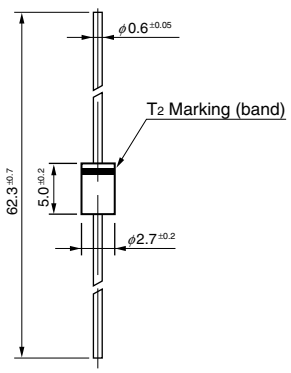
• SIP 8 (STA8Pin)



• SIP 12 with Fin (SLA12Pin)



• Axial (φ2.7/φ0.6)

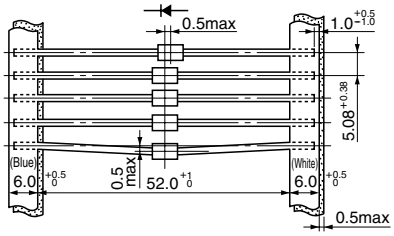
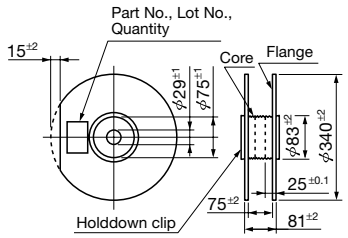
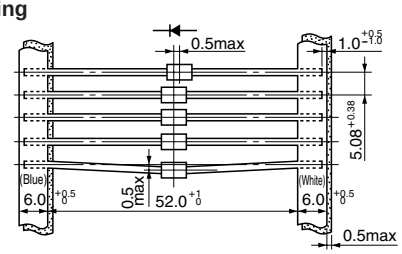
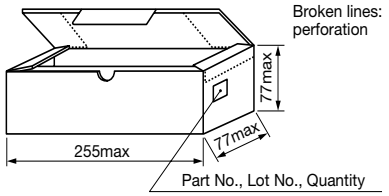
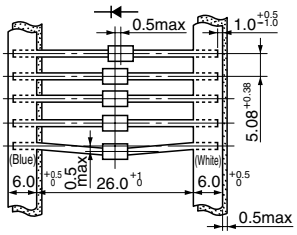
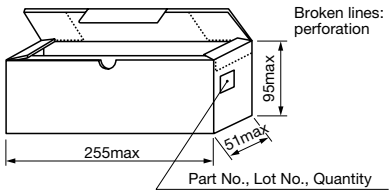
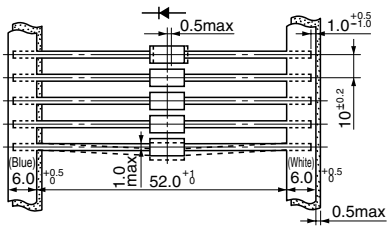
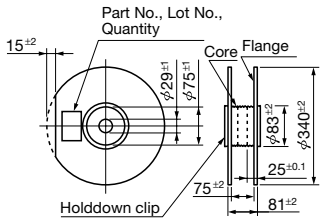
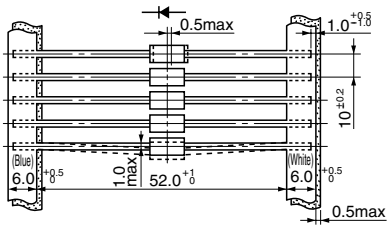
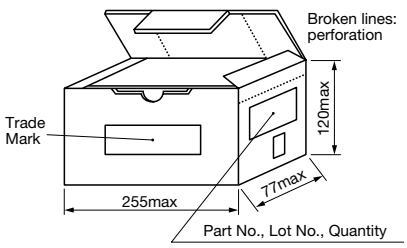


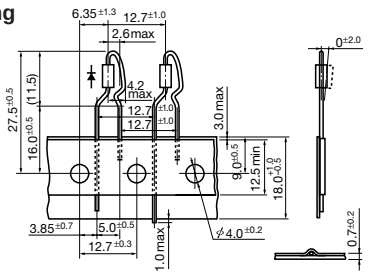
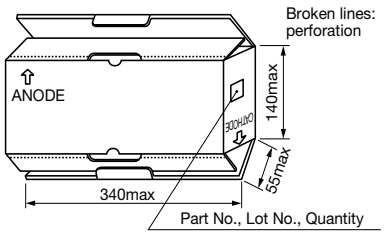
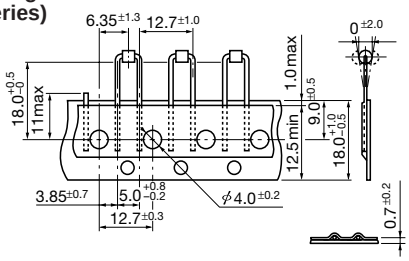
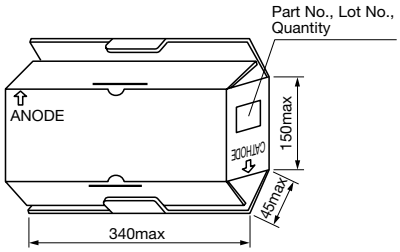
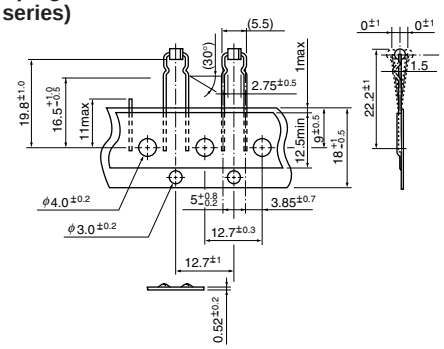
(Unit: mm)

4

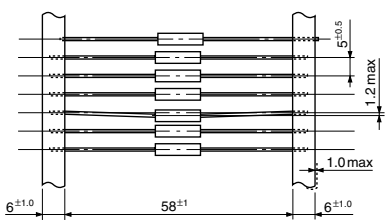
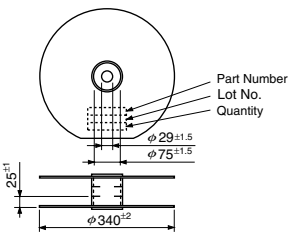
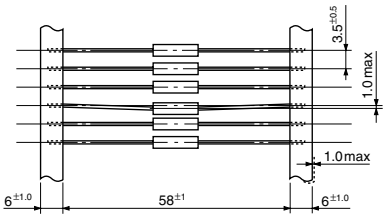
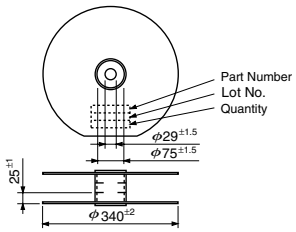
Diodes

Taping Specifications

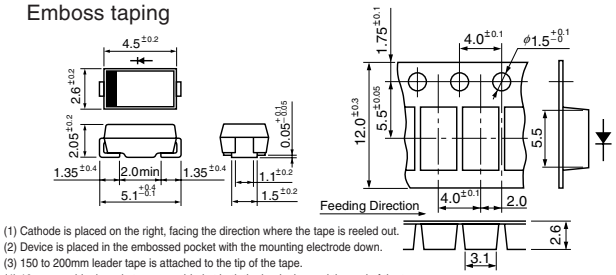
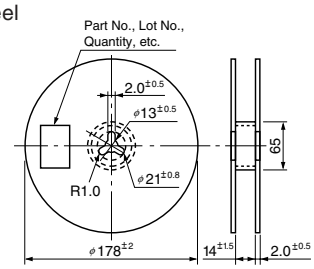
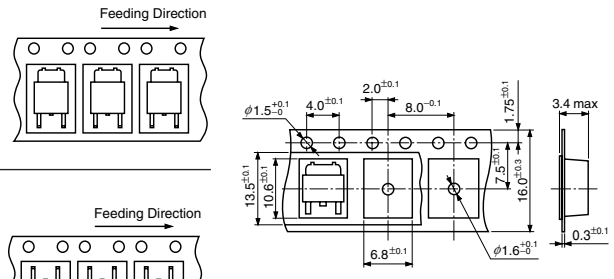
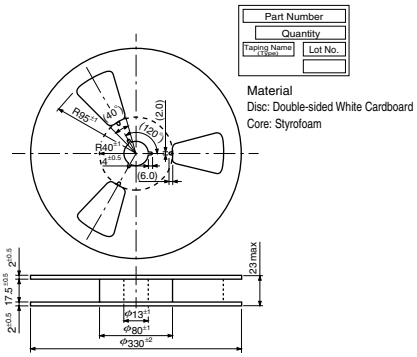
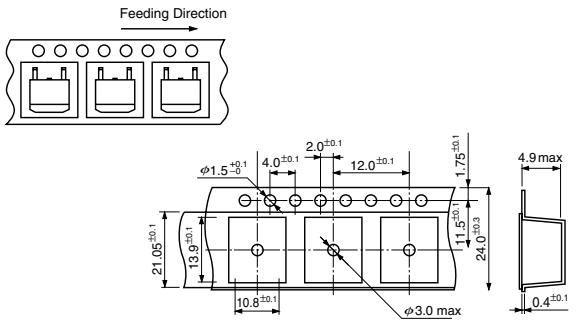
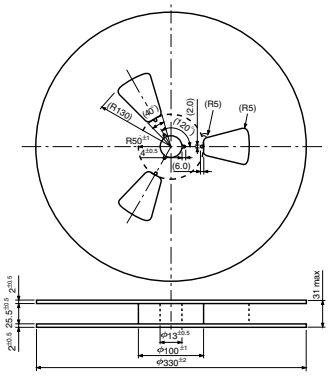
Taping name	Taping Type, Dimensions (mm)	Packing Dimensions (mm) and Packing Note	Quantity
V To specify the taping type, add a suffix [V]	**Axial taping** 	**Reel** 	5,000 pcs/reel (2.7φ body 2.4φ body) 3,000 pcs/reel (4φ body)
V1 To specify the taping type, add a suffix [V1]	**Axial taping** 	**Ammunition (Ammo) pack** 	2,000 pcs/box (2.7φ body) 3,000 pcs/box (2.4φ body) 1,000 pcs/box (4φ body)
V0 To specify the taping type, add a suffix [V0]	**Axial taping** 	**Ammunition (Ammo) pack** 	2,000 pcs/box (2.7φ body) 3,000 pcs/box (2.4φ body)
V3 To specify the taping type, add a suffix [V3]	**Axial taping** 	**Reel** 	1,500 pcs/reel (5.2φ body)
V4 To specify the taping type, add a suffix [V4]	**Axial taping** 	**Ammunition (Ammo) pack** 	1,000 pcs/box (5.2φ body)

Taping name	Taping Type, Dimensions (mm)	Packing Dimensions (mm) and Packing Note	Quantity
W To specify the taping type, add a suffix [W]	**Radial taping** 	**Ammunition (Ammo) pack** 	4,000 pcs/box 2.7ϕ body 0.6ϕ lead only
WS To specify the taping type, add a suffix [WS]	**Radial taping (for A0 series)** 	**Ammunition (Ammo) pack** 	2,500 pcs/box (2.4ϕ body)
WK To specify the taping type, add a suffix [WK]	**Radial taping (for A0 series)** 		

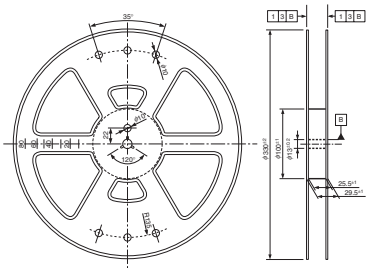
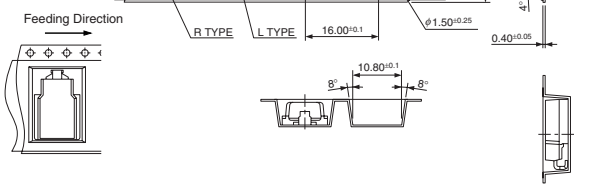
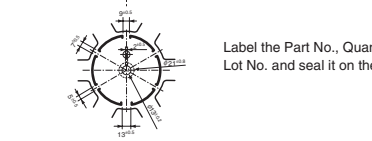
High Voltage Rectifier Diodes Taping Specifications

Taping Name	Taping Type, Dimensions (mm)	Packing Dimensions (mm) and Packing Note	Quantity
V1 To specify the taping type, add a suffix [V1]	Axial taping 		5000 pcs/reel
VD To specify the taping type, add a suffix [VD]	Axial taping 		8000 pcs/reel

Surface-Mount Taping Specifications

Taping Name	Taping Type, Dimensions (mm)	Packing Dimensions (mm) and Packing Note	Quantity
SFP/SJP **V** **(VR for SJP)** To specify the taping type, add a suffix [V]	Emboss taping  (1) Cathode is placed on the right, facing the direction where the tape is reeled out. (2) Device is placed in the embossed pocket with the mounting electrode down. (3) 150 to 200mm leader tape is attached to the tip of the tape. (4) 10 or more blank pockets are provided at both the beginning and the end of the tape. (5) It is possible to apply taping with the diode polarity reversed on demand (taping name VL).	Reel 	1800 pcs/reel
D Pack **VL** To specify the taping type, add a suffix [VL]		 Material Disc: Double-sided White Cardboard Core: Styrofoam	3000 pcs/reel
VR To specify the taping type, add a suffix [VR]			3000 pcs/reel
TO-220S **VR** To specify the taping type, add a suffix [VR]			1000 pcs/reel

Power Zener Surface-Mount Taping Specifications

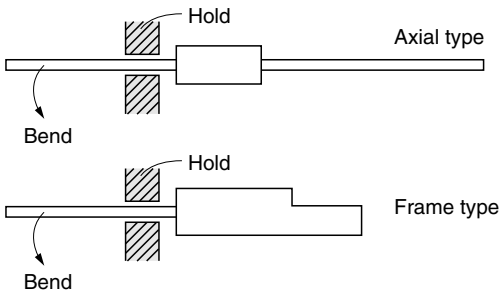
Taping Name	Taping Type, Dimensions (mm)	Packing Dimensions (mm) and Packing Note	Quantity
VL To specify the taping type, add a suffix [VL]			750 pcs/reel
VR To specify the taping type, add a suffix [VR]		 Label the Part No., Quantity, Lot No. and seal it on the reel	750 pcs/reel

Application Note

■ General Description

(1) Lead Forming

When forming leads, hold the lead wire on the main body's side so as to prevent stress from being applied to the main body.



(2) Mounting

To mount a frame-type diode on a heatsink, use its screw hole. Do not fix its resin body as the silicon chip may get broken.

(3) Temperature Measurement

For an axial type diode, measure the temperature of the lead wire on the main body side. The thermocouple to be used must be as thin as possible (approximately ϕ0.125mm).

(4) Temperature Rise Consideration

A diode's temperature increases due to losses from forward current, reverse current and reverse recovery time.

In normal use, losses are mainly attributable to forward current and voltage. However, in high frequency circuits such as switching power supplies, losses due to reverse recovery time also occurs. Moreover, in diodes having large reverse currents like Schottky barrier diode losses due to reverse current cannot be disregarded.

Forward loss tends to decrease at high temperatures. However, reverse loss tends to increase at high temperatures. Therefore, it is necessary to consider the ambient temperature when verifying operation.

(5) Inrush current

In a capacitor-input type rectifier circuit, inrush current flows when the power supply is switched on. The peak value of this inrush current shall be set less than peak forward surge current I_{FSM} (I^2t can also be obtained but set the minimum pulse width to 1 msec). The value of IFSM is guaranteed for a single shot only. If the inrush current is repeated within a short period of time, the derating has to be taken into account.

(6) Peak value current

Considering normal use, limit of the peak value current must be set to 10 times of the average current IF (AV). If the peak value increases. the diode's forward loss also increases. In this case, check the temperature rise.

● Carefully study the mounting method when the usage environment is prone to creeping discharge.

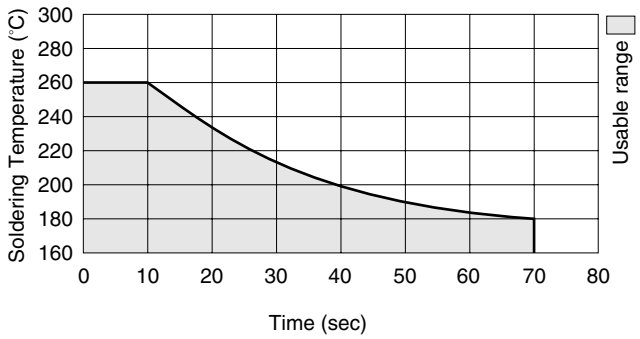
■ Surface-Mount Diodes

(Part Number Type: SFP/SJP)

Soldering (common to flow and reflow)

i) Use rosin based flux. Never use acidic fluxes.

ii) To prevent a large thermal stress, preheat within 1 to 2 minutes at 150°C and solder within the usable range shown below.



iii) When using a soldering iron, make use of the following references:

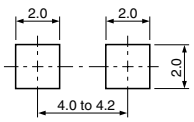
Temperature of soldering Iron Tip:

Lower than 300ºC
(Power of the soldering iron: 30W or lower)
The soldering tip must be as thin as possible.

Soldering time: Less than 10 seconds

Reference Copper Laminate Pattern when Mounting SFP/SJP Series

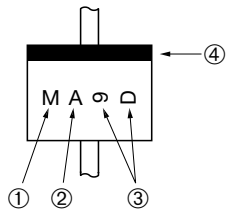
(Unit : mm)



Contact us if there is any unclear point.

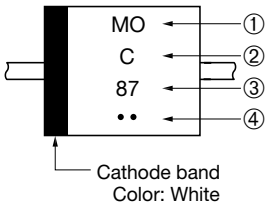
Marking Guide

1 Axial (A0)



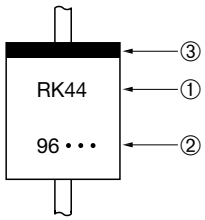
①Part Number (abbreviation)
The AM01 is indicated as "M."
②Class
Z: 200V None: 400V A: 600V
B: 800V C: 1000V
③Manufacturing date
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
④Cathode band: Continuous band
Color of the band: White(Yellow for AU02 series)

2 Axial (E0, E1)



①Part Number (abbreviation)
EM01, EM2, EM1 are indicated as MO, M2 and M1, respectively.
②Class
Z: 200V None: 400V A: 600V
B: 800V C: 1000V F: 1500V
But EU02A is indicated as A2 and EU2YX as Y.
③Manufacturing date
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
④Manufacturing period
• First 10 days of month
•• Middle 10 days of month
••• Last 10 days of month

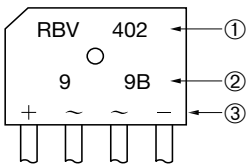
3 Axial (R1, R2, R3, R4)



①Part Number: 2 set marking
②Manufacturing date and period: 2 set marking
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
• First 10 days of month
•• Middle 10 days of month
••• Last 10 days of month
③Cathode band

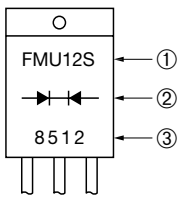
Color of the band:
White: For Power Supply and SBD
Yellow: For Medium speed
Red: For Fast and ultrafast

4 RBV



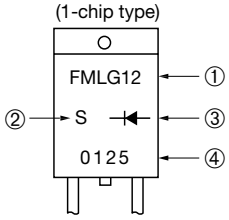
①Part Number
②Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
Third letter: A—First 10 days of month
B—Middle 10 days of month
C—Last 10 days of month
③Input/output marking
Laser marking or White ink marking

5 TO-220F type



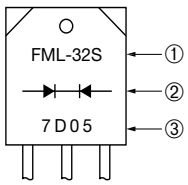
①Part Number
FMU-12S is indicated as "FMU12S."
②Polarity: Rectifier Symbol
③Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
Third and fourth letters: Day
Laser marking or White ink marking

(1-chip type)



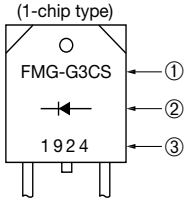
①Part Number: Excluding last letter
FML-G12S is indicated as "FML-G12."
②Last letter of Part Number
③Polarity: Rectifier Symbol
④Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
Third and fourth letters: Day
Laser marking or White ink marking

6 TO-3PF, FM100 type

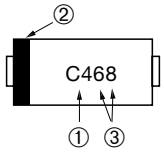


①Part Number: Full name
②Polarity: Rectifier Symbol
③Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)
Third and fourth letters: Day
Laser marking or White ink marking

(1-chip type)

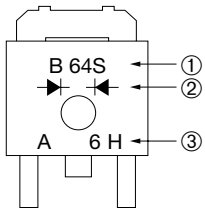


7 Surface-Mount (SFP)



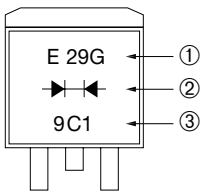
①Part Number: abbreviation
SFPB-64 is indicated as "C4"
②Cathode band
③Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, D)

8 Surface-Mount (D pack)



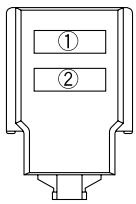
①Part Number
②Polarity: Rectifier Symbol
③Lot No.
First letter: Lot code
Second letter: Year (Last digit of year)
Third letter: Month (A to M except I)

9 Surface-Mount (TO-220S)



①Part Number
②Polarity: Rectifier Symbol
③Lot No.
First letter: Year (Last digit of year)
Second letter: Month (A to M except I)
Third letter: Week

10 SZ-10 Series

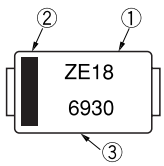


①Part Number
②Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, and D)
Third letter: Day

11 Silicon Varistors

Refer to P222

12 Surface-Mount (SJP)



①Part Number
②Polarity: Rectifier Symbol
③Lot No.
First letter: Year (Last digit of year)
Second letter: Month (1 to 9, O, N, and D)
Third and fourth letters: Day

4-1 Rectifier Diodes

●Surface-Mount

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	$I_{R(H)}$ (μA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
200	0.9	Surface-Mount (SFP)	SFPM-52	30	-40 to +150		1.00	1.0	10	50	100	20	0.072
	1.0	Surface-Mount (SFP)	SFPM-62	45	-40 to +150		0.98	1.0	10	50	100	20	0.072
	1.0	Surface-Mount (SJP)	SJPM-D2*	30	-40 to +150		1.00	1.0	10	50	100	20	0.072
	1.5	Surface-Mount (SJP)	SJPM-F2*	45	-40 to +150		1.00	1.5	10	50	100	20	0.072
400	0.9	Surface-Mount (SFP)	SFPM-54	30	-40 to +150		1.00	1.0	10	50	100	20	0.072
	1.0	Surface-Mount (SFP)	SFPM-64	45	-40 to +150		0.98	1.0	10	50	100	20	0.072
	1.0	Surface-Mount (SJP)	SJPM-D4*	30	-40 to +150		1.00	1.0	10	50	100	20	0.072
	2.0	Surface-Mount (SJP)	SJPM-H4	45	-40 to +150		1.05	2.0	10	50	100	20	0.072

*: Under Development

●Thru-hole

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	$I_{R(H)}$ (μA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
100	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1Y	45	-40 to +150		0.97	1.0	10	50	100	17	0.3
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4Y	200	-40 to +150		0.95	3.0	10	50	100	8	1.2
200	1.0	Axial(ϕ2.4/ϕ0.6)	AM01Z	35	-40 to +150		0.98	1.0	10	50	100	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EM01Z	45	-40 to +150		0.97	1.0	10	50	100	20	0.2
	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1Z	45	-40 to +150		0.97	1.0	10	50	100	17	0.3
	1.0	Axial(ϕ4.0/ϕ0.78)	RM 1Z	50	-40 to +150		0.95	1.0	5	50	100	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RO 2Z	80	-40 to +150		0.92	1.5	10	50	100	12	0.61
	1.2	Axial(ϕ4.0/ϕ0.98)	RM 2Z	100	-40 to +150		0.91	1.5	10	50	100	12	0.6
	1.5	Axial(ϕ4.0/ϕ0.78)	RM 10Z	120	-40 to +150		0.91	1.5	10	50	100	15	0.4
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4Z	200	-40 to +150		0.95	3.0	10	50	100	8	1.2
	10	TO-220F(Center-tap)	FMM-22S, R	100	-40 to +150		1.10	5.0	10	100	100	4.0	2.1
400	1.0	Axial(ϕ2.4/ϕ0.6)	AM01	35	-40 to +150		0.98	1.0	10	50	100	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EM01	45	-40 to +150		0.97	1.0	10	50	100	20	0.2
	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1	45	-40 to +150		0.97	1.0	10	50	100	17	0.3
	1.0	Axial(ϕ4.0/ϕ0.78)	RM 1	50	-40 to +150		0.95	1.0	5	50	100	15	0.4
	1.2	Axial(ϕ2.7/ϕ0.78)	EM 2	80	-40 to +150		0.92	1.2	10	50	100	17	0.3
	1.2	Axial(ϕ4.0/ϕ0.98)	RO 2	80	-40 to +150		0.92	1.5	10	50	100	12	0.61
	1.2	Axial(ϕ4.0/ϕ0.98)	RM 2	100	-40 to +150		0.91	1.5	10	50	100	12	0.6
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 10	150	-40 to +150		0.91	1.5	10	50	100	15	0.4
	2.5	Axial(ϕ5.2/ϕ1.2)	RM 3	150	-40 to +150		0.95	2.5	10	100	150	10	1.0
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4	200	-40 to +150		0.95	3.0	10	50	100	8	1.2
	10	TO-220F(Center-tap)	FMM-24S, R	100	-40 to +150		1.10	5.0	10	100	100	4.0	2.1
600	1.0	Axial(ϕ2.4/ϕ0.6)	AM01A	35	-40 to +150		0.98	1.0	10	50	100	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EM01A	45	-40 to +150		0.97	1.0	10	50	100	20	0.2
	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1A	45	-40 to +150		0.97	1.0	10	50	100	17	0.3
	1.0	Axial(ϕ4.0/ϕ0.78)	RM 1A	50	-40 to +150		0.95	1.0	5	50	100	15	0.4
	1.2	Axial(ϕ2.7/ϕ0.78)	EM 2A	80	-40 to +150		0.92	1.2	10	50	100	17	0.3
	1.2	Axial(ϕ4.0/ϕ0.98)	RO 2A	80	-40 to +150		0.92	1.5	10	50	100	12	0.61
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 11A	100	-40 to +150		0.92	1.5	10	50	100	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RM 2A	100	-40 to +150		0.91	1.5	10	50	100	12	0.6
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 10A	150	-40 to +150		0.91	1.5	10	50	100	15	0.4
	2.5	Axial(ϕ5.2/ϕ1.2)	RM 3A	150	-40 to +150		0.95	2.5	10	100	100	10	1.0
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4A	200	-40 to +150		0.95	3.0	10	50	100	8	1.2
	1.8(3.2)	Axial(ϕ6.5/ϕ1.4)	RM 4AM	350	-40 to +150		0.92	3.5	10	50	100	8	1.2
	10	TO-220F(Center-tap)	FMM-26S, R	100	-40 to +150		1.10	5.0	10	100	100	4.0	2.1
800	0.8	Axial(ϕ4.0/ϕ0.78)	RM 1B	40	-40 to +150		1.2	1.0	5	50	100	15	0.4
	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1B	35	-40 to +150		0.97	1.0	20	100	100	17	0.3
	1.2	Axial(ϕ2.7/ϕ0.78)	EM 2B	80	-40 to +150		0.92	1.2	10	50	100	17	0.3
	1.2	Axial(ϕ4.0/ϕ0.98)	RO 2B	80	-40 to +150		0.92	1.5	10	50	100	12	0.61
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 11B	100	-40 to +150		0.92	1.5	10	50	100	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RM 2B	100	-40 to +150		0.91	1.5	10	50	100	12	0.6
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 10B	150	-40 to +150		0.91	1.5	10	50	100	15	0.4
	2.5	Axial(ϕ5.2/ϕ1.2)	RM 3B	150	-40 to +150		0.95	2.5	10	100	150	10	1.0
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4B	150	-40 to +150		0.95	3.0	10	50	100	8	1.2

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	$I_{R(H)}$ (μA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1000	0.8	Axial(ϕ4.0/ϕ0.78)	RM 1C	40	-40 to +150		1.2	1.0	5	50	100	15	0.4
	1.0	Axial(ϕ2.7/ϕ0.78)	EM 1C	35	-40 to +150		0.97	1.0	20	100	100	17	0.3
	1.2	Axial(ϕ4.0/ϕ0.98)	RO 2C	80	-40 to +150		0.92	1.5	10	50	100	12	0.61
	1.2	Axial(ϕ4.0/ϕ0.78)	RM 11C	100	-40 to +150		0.92	1.5	10	50	100	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RM 2C	100	-40 to +150		0.91	1.5	10	50	100	12	0.6
	2.0	Axial(ϕ5.2/ϕ1.2)	RM 3C	150	-40 to +150		0.95	2.5	10	100	150	10	1.0
	1.7(3.0)	Axial(ϕ6.5/ϕ1.4)	RM 4C	150	-40 to +150		0.95	3.0	10	50	100	8	1.2

●Bridge

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	$I_{R(H)}$ (μA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
60	4.0	RBV-40	RBV-406B*1	40	-40 to +150		0.62	2.0	2	55	150	5	4.25
100	4.0	RBV-40	RBV-401	80	-40 to +150		1.05	2.0	10	100	100	5.0	4.05
	6.0	RBV-60	RBV-601	120	-40 to +150		1.00	3.0	10	100	100	3.0	6.45
200	4.0	RBV-40	RBV-402	80	-40 to +150		1.05	2.0	10	100	100	5.0	4.05
	4.0	RBV-40	RBV-402L*2	80	-40 to +150		0.98	2.0	50	100	100	5.0	4.05
	6.0	RBV-60	RBV-602L*3	100	-40 to +150		1.0	3.0	250	1000	100	3.0	6.45
	6.0	RBV-60	RBV-602	120	-40 to +150		1.00	3.0	10	100	100	3.0	6.45
	10	RBV-40	RBV-4102	80	-40 to +150		1.1	5.0	10	100	150(Tj)	2.0	4.05
400	4.0	RBV-40	RBV-404	80	-40 to +150		1.10	2.0	10	100	100	5.0	4.05
	6.0	RBV-60	RBV-604	120	-40 to +150		1.05	3.0	10	100	100	3.0	6.45
600	4.0	RBV-40	RBV-406	80	-40 to +150		1.10	2.0	10	100	100	5.0	4.05
	4.0	RBV-40	RBV-406H	120	-40 to +150		0.92	2.0	10	100	100	5.0	4.05
	4.0	RBV-40	RBV-406M	120	-40 to +150		1.00	2.0	10	100	100	5.0	4.05
	6.0	RBV-60	RBV-606	120	-40 to +150		1.05	3.0	10	100	100	3.0	6.45
	6.0	RBV-60	RBV-606H	140	-40 to +150		1.05	3.0	10	200	100	3.0	6.45
	10	RBV-40	RBV-4106M	120	-40 to +150		1.00	5.0	10	100	100	2.0	4.05
	13	RBV-60	RBV-1306	80	-40 to +150		1.20	6.5	10	100	100	1.5	6.45
	15	RBV-60	RBV-1506S	150	-40 to +150		1.10	7.5	10	200	100	1.5	6.45
	15	RBV-60	RBV-1506J	150	-40 to +150		1.10	7.5	10	200	150(Tj)	1.5	6.45
	15	RBV-60	RBV-1506	200	-40 to +150		1.05	7.5	50	200	100	1.5	6.45
	25	RBV-60	RBV-2506	350	-40 to +150		1.05	12.5	50	200	100	1.5	6.45
800	4.0	RBV-40	RBV-408	100	-40 to +150		1.00	2.0	10	50	100	5.0	4.05
	6.0	RBV-60	RBV-608	170	-40 to +150		0.95	3.0	10	100	100	3.0	6.45
1000	4.0	RBV-40	RBV-40C	100	-40 to +150		1.00	2.0	10	50	100	5.0	4.05
	15	RBV-60	RBV-150C	200	-40 to +150		1.05	7.5	50	200	100(Tj)	1.5	6.45

*1: Schottky barrier diode
*2: Ultrafast recovery diode (trr=40ns)
*3: Ultrafast recovery diode (trr=50ns)

4-2 Fast Recovery Diodes

●Thru-hole

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (μA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
100	1.2	Axial(ϕ2.7/ϕ0.78)	EU 2YX	25	-40 to +150		0.9	1.2	10	300	100	0.2	10/10	0.08	10/20	17	0.3
	1.5	Axial(ϕ4.0/ϕ0.78)	RU 2YX	30	-40 to +150		0.95	1.5	10	300	100	0.2	10/10	0.08	10/20	15	0.4
	2.0	Axial(ϕ4.0/ϕ0.98)	RU 3YX	50	-40 to +150		0.95	2.0	10	300	100	0.2	10/10	0.08	10/20	12	0.6
	1.5(3.5)	Axial(ϕ5.2/ϕ1.2)	RU 30Y	80	-40 to +150		0.97	3.5	10	300	100	0.4	10/10	0.18	10/20	10	1.0
	2.0(3.5)	Axial(ϕ6.5/ϕ1.4)	RU 4Y	70	-40 to +150		1.3	3.5	10	300	100	0.4	10/10	0.18	10/20	8	1.2
	2.2(4.0)	Axial(ϕ6.5/ϕ1.4)	RU 4YX	70	-40 to +150		1.3	3.5	10	300	100	0.4	100/100	0.18	100/200	8	1.2
	10	TO-220F(Center-tap)	FMU-21S, R	40	-40 to +150		1.5	5.0	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	10	TO-220F-2Pin	FMU-G2YXS	100	-40 to +150		1.0	10	50	500	100	0.2	100/100	0.08	100/200	4.2	2.1
200	0.25	Axial(ϕ2.7/ϕ0.6)	EU01Z	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	20	0.2
	0.25	Axial(ϕ2.7/ϕ0.78)	EU 1Z	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	17	0.3
	0.5	Axial(ϕ2.4/ϕ0.6)	AU01Z	15	-40 to +150		1.7	0.5	10	150	100	0.4	10/10	0.18	10/20	22	0.13
	0.6	Axial(ϕ2.7/ϕ0.78)	EH 1Z	30	-40 to +150		1.35	0.6	10	200	150	4	10/10	1.3	10/20	17	0.3
	0.6	Axial(ϕ4.0/ϕ0.78)	RH 1Z	35	-40 to +150		1.3	0.6	5	70	150	4	10/10	1.3	10/20	15	0.4
	0.7	Axial(ϕ2.7/ϕ0.78)	ES 1Z	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	17	0.3
	0.7	Axial(ϕ2.7/ϕ0.6)	ES01Z	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.8	Axial(ϕ2.4/ϕ0.6)	AU02Z	25	-40 to +150		1.3	0.8	10	250	100	0.4	10/10	0.18	10/20	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EU02Z	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	20	0.2
	1.0	Axial(ϕ2.7/ϕ0.78)	EU 2Z	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	17	0.3
	1.0	Axial(ϕ4.0/ϕ0.78)	RU 2Z	20	-40 to +150		1.5	1.0	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.5(3.5)	Axial(ϕ5.2/ϕ1.2)	RU 30Z	80	-40 to +150		0.97	3.5	10	300	100	0.4	10/10	0.18	10/20	10	1.0
	2.0(3.5)	Axial(ϕ6.5/ϕ1.4)	RU 4Z	70	-40 to +150		1.3	3.5	10	300	100	0.4	10/10	0.18	10/20	8	1.2
	5.0	TO-220F(Center-tap)	FMU-12S, R	30	-40 to +150		1.5	2.5	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	10	TO-220F(Center-tap)	FMU-22S, R	40	-40 to +150		1.5	5.0	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
400	0.25	Axial(ϕ2.7/ϕ0.6)	EU01	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	20	0.2
	0.25	Axial(ϕ2.7/ϕ0.78)	EU 1	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	17	0.3
	0.25	Axial(ϕ4.0/ϕ0.78)	RU 1	15	-40 to +150		2.5	0.25	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.5	Axial(ϕ2.4/ϕ0.6)	AU01	15	-40 to +150		1.7	0.5	10	150	100	0.4	10/10	0.18	10/20	22	0.13
	0.6	Axial(ϕ2.4/ϕ0.6)	AS01	20	-40 to +150		1.5	0.6	10	50	100	1.5	10/10	0.6	10/20	22	0.13
	0.6	Axial(ϕ2.7/ϕ0.78)	EH 1	30	-40 to +150		1.35	0.6	10	200	150	4	10/10	1.3	10/20	17	0.3
	0.7	Axial(ϕ2.7/ϕ0.78)	ES 1	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.7	Axial(ϕ2.7/ϕ0.6)	ES01	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.8	Axial(ϕ2.4/ϕ0.6)	AU02	25	-40 to +150		1.3	0.8	10	250	100	0.4	10/10	0.18	10/20	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EU02	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	20	0.2
	1.0	Axial(ϕ2.7/ϕ0.78)	EU 2	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	17	0.3
	1.1	Axial(ϕ4.0/ϕ0.78)	RU 2M	20	-40 to +150		1.2	1.1	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.5	Axial(ϕ4.0/ϕ0.98)	RU 3	20	-40 to +150		1.5	1.5	10	400	100	0.4	10/10	0.18	10/20	12	0.6
	1.5	Axial(ϕ4.0/ϕ0.98)	RU 3M	50	-40 to +150		1.1	1.5	10	350	100	0.4	10/10	0.18	10/20	12	0.6
	2.0	Axial(ϕ5.2/ϕ1.2)	RU 30	200	-40 to +150		0.95	2.0	10	300	100	0.4	100/100	0.18	100/200	10	1.0
	3.0	Axial(ϕ5.2/ϕ1.2)	RU 31	150	-40 to +150		1.2	3.0	50	500	100		100/100	0.18	100/200	10	1.0
	1.5(3.0)	Axial(ϕ6.5/ϕ1.4)	RU 4	50	-40 to +150		1.5	3.0	10	300	100	0.4	10/10	0.18	10/20	8	1.2
	2.0(3.5)	Axial(ϕ6.5/ϕ1.4)	RU 4M	70	-40 to +150		1.3	3.5	10	300	100	0.4	100/100	0.18	100/200	8	1.2
	5.0	TO-220F(Center-tap)	FMU-14S, R	30	-40 to +150		1.5	2.5	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	10	TO-220F(Center-tap)	FMU-24S, R	40	-40 to +150		1.5	5.0	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
600	0.25	Axial(ϕ2.7/ϕ0.6)	EU01A	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	20	0.2
	0.25	Axial(ϕ2.7/ϕ0.78)	EU 1A	15	-40 to +150		2.5	0.25	10	150	100	0.4	10/10	0.18	10/20	17	0.3
	0.25	Axial(ϕ4.0/ϕ0.78)	RU 1A	15	-40 to +150		2.5	0.25	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.5	Axial(ϕ2.4/ϕ0.6)	AU01A	15	-40 to +150		1.7	0.5	10	150	100	0.4	10/10	0.18	10/20	22	0.13
	0.6	Axial(ϕ4.0/ϕ0.78)	RF 1A	15	-40 to +150		2.0	0.6	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.6	Axial(ϕ2.4/ϕ0.6)	AS01A	20	-40 to +150		1.5	0.6	10	50	100	1.5	10/10	0.6	10/20	22	0.13
	0.6	Axial(ϕ2.7/ϕ0.78)	EH 1A	30	-40 to +150		1.35	0.6	10	200	150	4	10/10	1.3	10/20	17	0.3
	0.6	Axial(ϕ4.0/ϕ0.78)	RH 1A	35	-40 to +150		1.3	0.6	5	70	150	4	10/10	1.3	10/20	15	0.4
	0.7	Axial(ϕ2.7/ϕ0.78)	ES 1A	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.7	Axial(ϕ2.7/ϕ0.6)	ES01A	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.7	Axial(ϕ4.0/ϕ0.78)	RS 1A	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.4

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (μA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
600	0.8	Axial(φ2.4/φ0.6)	AU02A	25	-40 to +150		1.3	0.8	10	250	100	0.4	10/10	0.18	10/20	22	0.13
	1.0	Axial(φ2.7/φ0.6)	EU02A	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	20	0.2
	1.0	Axial(φ2.7/φ0.78)	EU 2A	15	-40 to +150		1.4	1.0	10	300	100	0.4	10/10	0.18	10/20	17	0.3
	1.0	Axial(φ4.0/φ0.78)	RU 2	20	-40 to +150		1.5	1.0	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.1	Axial(φ4.0/φ0.78)	RU 2AM	20	-40 to +150		1.2	1.1	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.5	Axial(φ4.0/φ0.98)	RU 3A	20	-40 to +150		1.5	1.5	10	400	100	0.4	10/10	0.18	10/20	12	0.6
	1.5	Axial(φ4.0/φ0.78)	RU 20A	50	-40 to +150		1.1	1.5	10	350	100	0.4	10/10	0.18	10/20	15	0.4
	1.5	Axial(φ4.0/φ0.98)	RU 3AM	50	-40 to +150		1.1	1.5	10	350	100	0.4	10/10	0.18	10/20	12	0.6
	2.0	Axial(φ5.2/φ1.2)	RU 30A	200	-40 to +150		0.95	2.0	10	300	100	0.4	100/100	0.18	100/200	10	1.0
	3.0	Axial(φ5.2/φ1.2)	RU 31A	150	-40 to +150		1.2	3.0	50	500	100	0.4	100/100	0.18	100/200	10	1.0
	1.5(3.0)	Axial(φ6.5/φ1.4)	RU 4A	50	-40 to +150		1.5	3.0	10	300	100	0.4	10/10	0.18	10/20	8	1.2
	2.0(3.5)	Axial(φ6.5/φ1.4)	RU 4AM	70	-40 to +150		1.3	3.5	10	300	100	0.4	100/100	0.18	100/200	8	1.2
	5.0	TO-220F2Pin	FMU-G16S	30	-40 to +150		1.25	5.0	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	5.0	TO-220F(Center-tap)	FMU-16S, R	30	-40 to +150		1.5	2.5	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	10	TO-220F(Center-tap)	FMU-26S, R	40	-40 to +150		1.5	5.0	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
	10	TO-220F2Pin	FMU-G26S	40	-40 to +150		1.35	10	50	500	100	0.4	100/100	0.18	100/200	4.0	2.1
800	0.25	Axial(φ4.0/φ0.78)	RU 1B	15	-40 to +150		2.5	0.25	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.6	Axial(φ4.0/φ0.78)	RF 1B	15	-40 to +150		2.0	0.6	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.6	Axial(φ4.0/φ0.78)	RH 1B	35	-40 to +150		1.3	0.6	5	70	150	4	10/10	1.3	10/20	15	0.4
	0.7	Axial(φ4.0/φ0.78)	RS 1B	30	-40 to +150		2.5	0.8	10	200	100	1.5	10/10	0.6	10/20	20	0.4
	1.0	Axial(φ4.0/φ0.78)	RU 2B	20	-40 to +150		1.5	1.0	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.1	Axial(φ4.0/φ0.98)	RU 3B	20	-40 to +150		1.5	1.0	10	400	100	0.4	10/10	0.18	10/20	12	0.6
	1.5(3.0)	Axial(φ6.5/φ1.4)	RU 4B	50	-40 to +150		1.6	3.0	10	500	100	0.4	10/10	0.18	10/20	8	1.2
1000	0.2	Axial(φ4.0/φ0.78)	RU 1C	15	-40 to +150		3.0	0.25	10	200	100	0.4	10/10	0.18	10/20	15	0.4
	0.6	Axial(φ4.0/φ0.78)	RH 1C	35	-40 to +150		1.3	0.6	5	70	150	4	10/10	1.3	10/20	15	0.4
	0.8	Axial(φ4.0/φ0.78)	RU 2C	20	-40 to +150		1.5	1.0	10	300	100	0.4	10/10	0.18	10/20	15	0.4
	1.5	Axial(φ4.0/φ0.98)	RU 3C	20	-40 to +150		2.5	1.5	10	400	100	0.4	10/10	0.18	10/20	12	0.6
	1.5(2.5)	Axial(φ6.5/φ1.4)	RU 4C	50	-40 to +150		1.6	3.0	50	500	100	0.4	100/100	0.18	100/200	8	1.2
1300	1.0	Axial(φ4.0/φ0.98)	RH 2D	60	-40 to +150		1.0	1.0	10	500	100	4	10/10	1.3	100/200	12	0.6
	1.2(1.5)	Axial(φ6.5/φ1.4)	RU 4D	50	-40 to +150		1.8	1.5	50	500	100	0.4	500/500	0.18	500/1000	8	1.2
	1.5(2.5)	Axial(φ6.5/φ1.4)	RU 4DS	50	-40 to +150		1.8	3.0	50	500	100	0.4	500/500	0.18	500/1000	8	1.2
1500	0.5	Axial(φ2.7/φ0.6)	ES01F	20	-40 to +150		2.0	0.5	10	200	100	1.5	10/10	0.6	10/20	20	0.2
	0.5	Axial(φ2.7/φ0.78)	ES 1F	20	-40 to +150		2.0	0.5	10	200	100	1.5	10/10	0.6	10/20	17	0.3
	0.8	Axial(φ4.0/φ0.78)	RH 10F	60	-40 to +150		1.0	1.0	10	500	100	4	10/10	1.3	100/200	15	0.4
	1.0	Axial(φ4.0/φ0.98)	RH 2F	60	-40 to +150		1.0	1.0	10	500	100	4	10/10	1.3	100/200	12	0.6
	2.0	Axial(φ5.2/φ1.2)	RS 3FS	50	-40 to +150		1.1	3.0	50	500	100	2	100/100	0.8	100/200	10	1.0
	2.0	Axial(φ5.2/φ1.2)	RP 3F	50	-40 to +150		1.7	2.0	50	500	100	0.7	500/500	0.3	500/1000	10	1.0
	2.5	Axial(φ5.2/φ1.2)	RH 3F	50	-40 to +150		1.3	2.5	50	500	100	4	100/100	1.3	100/200	10	1.0
	1.5(2.5)	Axial(φ6.5/φ1.4)	RS 4FS	50	-40 to +150		1.5	3.0	50	500	100	1	100/100	0.4	100/200	8	1.2
	2.5	Axial(φ6.5/φ1.4)	RH 4F	50	-40 to +150		1.5	2.5	10	350	100	4	100/100	1.3	100/200	8	1.2
	5.0	TO-220F2Pin	FMQ-G1FS	50	-40 to +150		5.0	5.0	50	500	150	0.7	500/500	0.3	500/1000	4.0	2.1
	10	TO-220F2Pin	FMQ-G2FS	50	-40 to +150		2.8	10	50	500	150(Tj)	0.5	500/500	0.2	500/1000	4.0	2.1
	10	TO-220F2Pin	FMU-G2FS	50	-40 to +150		1.6	10	50	6000	150(Tj)	0.6	500/500	0.25	500/1000	4.0	2.1
	10	TO-220F2Pin	FMQ-G2FLS	50	-40 to +150		1.8	10	50	500	150(Tj)	1.2	500/500	0.4	500/1000	4.0	2.1
	10	TO-220F2Pin	FMQ-G2FMS	50	-40 to +150		2.4	10	50	500	150	0.5	500/500	0.25	500/1000	4.0	2.1
	10	TO-3PF2Pin	FMQ-G5FMS	50	-40 to +150		2.4	10	50	500	100	0.5	500/500	0.2	500/1000	2	6.5
1600	2.5	Axial(φ5.2/φ1.2)	RH 3G	50	-40 to +150		1.3	2.5	50	500	100	4	100/100	1.3	100/200	10	1.0
1700	10	TO-3PF2Pin	FMQ-G5GS	50	-40 to +150		2.7	10	100	500	100	0.5	500/500	0.2	500/1000	2	6.5
1800	8.0	TO-3PF2Pin	FMP-G5HS	50	-40 to +150		2.0	8	25	250	100	1.0	500/500	0.4	500/1000	2	6.5
	10	TO-3PF2Pin	FMR-G5HS	50	-40 to +150		1.6	10	20	200	100	1.8	500/500	0.7	500/1000	2	6.5
2000	0.2	Axial(φ4.0/φ0.78)	RC 2	20	-40 to +150		2.0	0.2	10	300	100	4.0	10/10	1.3	10/20	15	0.4

4-3 Ultrafast Recovery Diodes

●Surface-Mount

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (ns)	I_F/I_{RP} (mA)	trr② (ns)	I_F/I_{RP} (mA)	Rth(j-l) (°C/W)	Mass (g)
200	0.9	Surface-Mount (SFP)	SFPL-52	25	-40 to +150		0.98	1.0	10	1	150(Tj)	50	100/100	35	100/200	20	0.072
	1.0	Surface-Mount (SFP)	SFPL-62	25	-40 to +150		0.98	2.0	10	1	150(Tj)	50	100/100	35	100/200	20	0.072
	1.0	Surface-Mount (SJP)	SJPL-D2*	25	-40 to +150		0.98	2.0	10	1	150	50	100/100	35	100/200	20	0.072
	2.0	Surface-Mount (SFP)	SJPL-H2	25	-40 to +150		0.98	2.0	50	0.2	150	50	100/100	35	100/200	20	0.072
	1.5	Surface-Mount (SJP)	SFPX-62	30	-40 to +150		0.98	1.5	10	2	150(Tj)	30	100/100	25	100/200	20	0.072
	1.5	Surface-Mount (SJP)	SJPX-F2	30	-40 to +150		0.98	1.5	10	2	150	30	100/100	25	100/200	20	0.072
	3.0	Surface-Mount (D pack)	SPX-G32S	50	-40 to +150		0.98	3.0	50	10	100	30	100/100	25	100/200	5.0	0.41
	6.0	Surface-Mount (D pack)Center-tap	SPX-62S	80	-40 to +150		0.98	3.0	50	10	100	30	100/100	25	100/200	5.0	0.41
	10.0	Surface-Mount (TO220S)	MPL-102S	65	-40 to +150		0.98	5.0	100	0.2	150	40	100/100	30	100/200	2.5	1.4
	20.0	Surface-Mount (TO220S)Center-tap	MP2-202S	110	-40 to +150		0.98	10.0	200	0.4	150	50	100/100	35	100/200	2.5	1.4
300	2.0	Surface-Mount (SFP)	SFPX-63	20	-40 to +150		1.3	2	50	3	150	30	100/100	25	100/200	20	0.072
	2.0	Surface-Mount (SJP)	SJPX-H3	20	-40 to +150		1.3	2	50	3	150	30	100/100	25	100/200	20	0.072
	10.0	Surface-Mount (TO220S)Center-tap	MPX-2103	65	-40 to +150		1.3	5.0	50	15	150(Tj)	30	100/100	25	100/200	2.5	1.4
400	1.0	Surface-Mount(SFP)	SFPL-64	25	-40 to +150		1.3	1.0	10	0.05	150	50	100/100	30	100/200	20	0.072
	1.5	Surface-Mount(SJP)	SJPL-F4	25	-40 to +150		1.3	1.0	10	0.05	150	50	100/100	30	100/200	20	0.072
	10.0	Surface-Mount(TO263)	MPXA-1104S	100	-40 to +150		1.5	10.0	100	30	150(Tj)	25	500/500	–	–	2.5	1.04
600	1.0	Surface-Mount(SFP)	SFPX-66	20	-40 to +150		1.35	1.0	10	3	150(Tj)	30	100/100	20	100/200	20	0.072
	2.0	Surface-Mount (SJP)	SJPX-H6	20	-40 to +150		1.5	2.0	10	3	150	30	100/100	20	100/200	20	0.072
	3.0	Surface-Mount (TO263)	MPL-1036S	50	-40 to +150		1.75	3.0	50	0.1	150(Tj)	50	100/100	–	–	2.5	1.04
	10.0	Surface-Mount (TO263)	MPXA-1106S	100	-40 to +150		1.98	10.0	100	30	150(Tj)	28	500/500	–	–	2.5	1.04
	30.0	Surface-Mount(TO220S)	MP3-306	180	-40 to +150		1.7	30.0	100	0.5	150(Tj)	150	500/500	70	500/1000	2.0	1.4

*: Under Development

●Thru-hole

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (ns)	I_F/I_{RP} (mA)	trr② (ns)	I_F/I_{RP} (mA)	Rth(j-l) (°C/W)	Mass (g)
70	1.0	Axial(ϕ2.4/ϕ0.6)	AG01Y	25	-40 to +150		1.2	1.0	100	0.5	100	100	100/100	50	100/200	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EG01Y	30	-40 to +150		1.2	1.0	100	0.5	100	100	100/100	50	100/200	20	0.2
	1.1	Axial(ϕ2.7/ϕ0.78)	EG 1Y	30	-40 to +150		1.2	1.1	100	0.5	100	100	100/100	50	100/200	17	0.3
	1.5	Axial(ϕ4.0/ϕ0.78)	RG 10Y	50	-40 to +150		1.1	1.5	500	2.5	100	100	100/100	50	100/200	15	0.4
	1.5	Axial(ϕ4.0/ϕ0.98)	RG 2Y	50	-40 to +150		1.1	1.5	500	2.5	100	100	100/100	50	100/200	12	0.6
	2.0(3.5)	Axial(ϕ6.5/ϕ1.4)	RG 4Y	100	-40 to +150		1.3	3.5	1000	5	100	100	100/100	50	100/200	8	1.2
200	0.7	Axial(ϕ2.4/ϕ0.6)	AG01Z	15	-40 to +150		1.8	0.7	100	0.5	100	100	100/100	50	100/200	22	0.13
	0.7	Axial(ϕ2.7/ϕ0.6)	EG01Z	15	-40 to +150		1.9	0.7	50	0.3	100	100	100/100	50	100/200	20	0.2
	0.8	Axial(ϕ2.7/ϕ0.78)	EG 1Z	15	-40 to +150		1.7	0.8	50	0.3	100	100	100/100	50	100/200	17	0.3
	1.0	Axial(ϕ2.4/ϕ0.6)	AL01Z	25	-40 to +150		0.98	1.0	100	0.5	100	50	100/100	35	100/200	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EN 01Z	50	-40 to +150		0.92	1.0	10	2	150(Tj)	100	100/100	50	100/200	20	0.2
	1.2	Axial(ϕ4.0/ϕ0.78)	RG 10Z	50	-40 to +150		1.5	1.2	500	2.5	100	100	100/100	50	100/200	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RG 2Z	50	-40 to +150		1.5	1.5	500	2.5	100	100	100/100	50	100/200	12	0.6
	1.5	Axial(ϕ2.7/ϕ0.78)	EL 1Z	20	-40 to +150		0.98	1.5	100	0.5	100	100	100/100	50	100/200	17	0.3
	1.5	Axial(ϕ2.7/ϕ0.6)	EL02Z	25	-40 to +150		0.98	1.5	50	0.1	100	40	100/100	30	100/200	20	0.2
	1.5	Axial(ϕ4.0/ϕ0.78)	RN 1Z	60	-40 to +150		0.92	1.5	20	3	150(Tj)	100	100/100	50	100/200	15	0.4
	2.0	Axial(ϕ4.0/ϕ0.78)	RX 10Z	30	-40 to +150		0.98	2.0	50	3	150(Tj)	30	100/100	25	100/200	15	0.4
	2.0	Axial(ϕ4.0/ϕ0.78)	RL 10Z	30	-40 to +150		0.98	2.0	50	0.1	100	50	100/100	35	100/200	15	0.4
	2.0	Axial(ϕ4.0/ϕ0.98)	RL 2Z	30	-40 to +150		0.98	2.0	100	0.5	100	50	100/100	35	100/200	12	0.6
	2.0	Axial(ϕ4.0/ϕ0.98)	RN 2Z	70	-40 to +150		0.92	2.0	50	4	150(Tj)	100	100/100	50	100/200	12	0.6
	3.0	Axial(ϕ5.2/ϕ1.2)	RX 3Z	80	-40 to +150		0.98	3.0	50	10	100	30	100/100	25	100/200	10	1.0
	3.0	Axial(ϕ5.2/ϕ1.2)	RN 3Z	80	-40 to +150		0.92	3.0	50	6	150(Tj)	100	100/100	50	100/200	10	0.6
	1.0(3.0)	Axial(ϕ6.5/ϕ1.4)	RG 4ZS	80	-40 to +150		1.7	3.0	1000	5	100	100	100/100	50	100/200	8	1.2
	3.5	Axial(ϕ5.2/ϕ1.2)	RL 3Z	80	-40 to +150		0.95	3.5	50	0.2	100	50	100/100	35	100/200	10	1.0
	3.5	Axial(ϕ6.5/ϕ1.4)	RL 4Z	80	-40 to +150		0.95	3.5	150	0.5	100	50	100/100	35	100/200	8	1.2
	3.5	Axial(ϕ6.5/ϕ1.4)	RN 4Z	120	-40 to +150		0.92	3.5	50	6	150(Tj)	100	100/100	50	100/200	8	1.2
	5.0	TO-220F(Center-tap)	FML-12S	35	-40 to +150		0.98	2.5	150	0.5	100	40	100/100	30	100/200	4.0	2.1
	5.0	TO-220F(Center-tap)	FMG-12S, R	35	-40 to +150		1.8	2.5	500	1.5	100	100	100/100	50	100/200	4.0	2.1
	5.0	TO-220F(Center-tap)	FMX-12S	35	-40 to +150		0.98	2.5	50	10	100	30	100/100	25	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMP-G12S	65	-40 to +150		1.15	5.0	50	0.5	100	150	100/100	70	100/200	4.0	2.1
	5.0	TO-220F2Pin	FML-G12S	65	-40 to +150		0.98	5.0	250	1	100	40	100/100	30	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMX-G12S	65	-40 to +150		0.98	5.0	100	20	100	30	100/100	25	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMN-G12S	100	-40 to +150		0.92	5.0	100	10	150	100	100/100	50	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FMXA-2102ST	100	-40 to +150		1.2	5.0	100	20	150(Tj)	25	500/500	—	—	4.0	2.1

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (ns)	I_F/I_{RP} (mA)	trr② (ns)	I_F/I_{RP} (mA)	Rth(j-l) (°C/W)	Mass (g)
200	10.0	TO-220F(Center-tap)	FMXB-2102	150	-40 to +150		0.98	10.0	200	50	150(Tj)	30	500/500	25	500/1000	4.0	2.1
	10.0	TO-220F(Center-tap)	FML-22S	65	-40 to +150		0.98	5.0	250	1	100	40	100/100	30	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FMG-22S, R	65	-40 to +150		1.8	5.0	500	1.5	100	100	100/100	50	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FMX-22S	65	-40 to +150		0.98	5.0	100	20	100	30	100/100	25	100/200	4.0	2.1
	10.0	TO-220F2Pin	FML-G22S	150	-40 to +150		0.98	10.0	500	2	100	40	500/500	30	500/1000	4.0	2.1
	10.0	TO-220F2Pin	FMX-G22S	150	-40 to +150		0.98	10.0	200	50	100	30	500/500	25	500/1000	4.0	2.1
	15.0	TO-220F(Center-tap)	FMX-22SL	100	-40 to +150		0.98	7.5	150	30	100	30	500/500	25	500/1000	4.0	2.1
	20.0	TO-220F2Pin	FM2-2202	110	-40 to +150		0.98	10.0	200	400	150(Tj)	50	100/100	35	100/200	4.0	2.1
	20.0	TO-220F2Pin	FMXA-2202S	100	-40 to +150		1.2	10.0	100	30	150	25	500/500	—	—	4.0	2.1
300	5.0	TO-220F(Center-tap)	FMG-13S, R	35	-40 to +150		1.8	2.5	500	1.5	100	100	100/100	50	100/200	4.0	2.1
	5.0	TO-220F(Center-tap)	FML-13S	40	-40 to +150		1.3	2.5	50	0.1	100	50	100/100	35	100/200	4.0	2.1
	5.0	TO-220F2Pin	FML-G13S	70	-40 to +150		1.3	5.0	100	0.2	100	50	100/100	35	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FMG-23S, R	65	-40 to +150		1.8	5.0	500	1.5	100	100	100/100	50	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FML-23S	70	-40 to +150		1.3	5.0	100	0.5	100	50	100/100	35	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FMX-23S	65	-40 to +150		1.3	5.0	50	15	150	30	100/100	25	100/200	4.0	2.1
	15.0	TO-220F(Center-tap)	FMXA-2153S	75	-40 to +150		1.3	7.5	75	23	150(Tj)	25	500/500	—	—	4.0	2.1
	20.0	TO-220F(Center-tap)	FMX-2203	100	-40 to +150		1.3	10.0	100	30	150	30	500/500	25	500/1000	4.0	2.1
	20.0	TO-220F(Center-tap)	FMXA-2203S	100	-40 to +150		1.3	10.0	100	30	150	25	500/500	—	—	4.0	2.1
	20.0	TO-3PF(Center-tap)	FMXA-4203S	100	-40 to +150		1.3	10.0	100	30	150(Tj)	25	500/500	—	—	2.0	6.5
400	0.7	Axial(ϕ2.4/ϕ0.6)	AG01	15	-40 to +150		1.8	0.7	100	0.5	100	100	100/100	50	100/200	22	0.13
	0.7	Axial(ϕ2.7/ϕ0.6)	EG01	15	-40 to +150		2.0	0.7	50	0.3	100	100	100/100	50	100/200	20	0.2
	0.8	Axial(ϕ2.7/ϕ0.78)	EG 1	15	-40 to +150		1.8	0.8	50	0.3	100	100	100/100	50	100/200	17	0.3
	1.0	Axial(ϕ2.4/ϕ0.6)	AL01	20	-40 to +150		1.4	1.0	10	0.5	150(Tj)	50	100/100	35	100/200	22	0.13
	1.2	Axial(ϕ4.0/ϕ0.78)	RG 10	50	-40 to +150		1.8	1.5	500	2.5	100	100	100/100	50	100/200	15	0.4
	1.2	Axial(ϕ4.0/ϕ0.98)	RG 2	50	-40 to +150		1.8	1.5	500	2.5	100	100	100/100	50	100/200	12	0.6
	1.5	Axial(ϕ2.7/ϕ0.78)	EL 1	20	-40 to +150		1.3	1.5	10	0.05	100	100	100/100	50	100/200	17	0.3
	2.0	Axial(ϕ4.0/ϕ0.98)	RL 2	40	-40 to +150		1.3	2.0	10	0.1	150(Tj)	50	100/100	35	100/200	12	0.6
	1.0(3.0)	Axial(ϕ6.5/ϕ1.4)	RG 4S	80	-40 to +150		1.8	3.0	500	2.5	100	100	100/100	50	100/200	8	1.2
	3.5	Axial(ϕ5.2/ϕ1.2)	RL 3	80	-40 to +150		1.3	3.5	100	0.2	150(Tj)	50	100/100	35	100/200	10	1.0
	5.0	TO-220F(Center-tap)	FMG-14S, R	35	-40 to +150		2.0	2.5	500	1.5	100	100	100/100	50	100/200	4.0	2.1
	5.0	TO-220F(Center-tap)	FML-14S	40	-40 to +150		1.3	2.5	50	0.1	100	50	100/100	35	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMXA-1054S	50	-40 to +150		1.5	5.0	50	15	150	20	500/500	—	—	4.0	2.1
	5.0	TO-220F2Pin	FMX-G14S	70	-40 to +150		1.3	5.0	50	15	150	30	100/100	25	100/200	4.0	2.1
	5.0	TO-220F2Pin	FML-G14S	70	-40 to +150		1.3	5.0	100	0.2	100	50	100/100	35	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMN-G14S	70	-40 to +150		1.0	5.0	50	10	150(Tj)	100	100/100	50	100/200	4.0	2.1
	8.0	TO-220F(Center-tap)	FMG-24S, R	65	-40 to +150		2.0	5.0	500	2.5	100	100	100/100	50	100/200	4.0	2.1
	10.0	TO-220F(Center-tap)	FML-24S	70	-40 to +150		1.3	5.0	100	0.2	100	50	100/100	35	100/200	4.0	2.1
	10.0	TO-220F2Pin	FMXA-1104S	100	-40 to +150		1.5	10.0	100	30	150(Tj)	25	500/500	—	—	4.0	2.1
	16.0	TO-220F(Center-tap)	FMXJ-2146S	100	-40 to +150		1.4	8.0	100	20	150(Tj)	18	500/500	—	—	4.0	2.1
600	0.5	Axial(ϕ2.7/ϕ0.6)	EG01A	10	-40 to +150		2.0	0.5	100	0.5	100	100	100/100	50	100/200	20	0.2
	0.5	Axial(ϕ2.4/ϕ0.6)	AG01A	15	-40 to +150		1.8	0.5	100	0.5	100	100	100/100	50	100/200	22	0.13
	0.6	Axial(ϕ2.7/ϕ0.78)	EG 1A	10	-40 to +150		2.0	0.6	100	0.5	100	100	100/100	50	100/200	17	0.3
	1.0	Axial(ϕ4.0/ϕ0.78)	RG 10A	50	-40 to +150		2.0	1.0	500	2.5	100	100	100/100	50	100/200	15	0.4
	1.0	Axial(ϕ4.0/ϕ0.98)	RG 2A	50	-40 to +150		2.0	1.0	500	2.5	100	100	100/100	50	100/200	12	0.6
	1.2	Axial(ϕ4.0/ϕ0.98)	RD 2A	30	-40 to +150		1.55	1.2	50	0.1	150(Tj)	50	100/100	35	100/200	12	0.6
	2.0	Axial(ϕ5.2/ϕ1.2)	RL 3A	60	-40 to +150		1.7	3.0	50	0.2	150(Tj)	50	100/100	35	100/200	10	1.0
	3.0	TO-220F(Two elements)	FMC-26U	50	-40 to +150		2.0	3.0	500	3	150(Tj)	70	500/500	35	500/1000	4.0	2.1
	3.0	Axial(ϕ6.5/ϕ1.4)	RL 4A	80	-40 to +150		1.5	3.0	50	0.1	150(Tj)	50	500/500	35	500/1000	8	1.2
	4.0	TO-220F2Pin	FMG-G26S	50	-40 to +150		2.5	4.0	500	3	100	100	100/100	50	100/200	4.0	2.1
	5.0	TO-220F2Pin	FMX-G16S	50	-40 to +150		1.5	5.0	50	15	150	30	100/100	25	100/200	4.0	2.1
	5.0	TO-220F2Pin	FML-G16S	50	-40 to +150		1.5	5.0	100	0.5	100	50	500/500	35	500/1000	4.0	2.1
	5.0	TO-220F2Pin	FMN-G16S	50	-40 to +150		1.2	5.0	50	10	150(Tj)	100	100/100	50	100/200	4.0	2.1
	6.0	TO-220F(Center-tap)	FMG-26S, R	50	-40 to +150		2.2	3.0	500	3	100	100	100/100	50	100/200	4.0	2.1

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (ns)	I_F/I_{RP} (mA)	trr② (ns)	I_F/I_{RP} (mA)	Rth(j-l) (°C/W)	Mass (g)
600	10.0	TO-220F2Pin	FMX-G26S	100	-40 to +150		1.5	10.0	100	20	150	30	100/100	25	100/200	4.0	2.1
	10.0	TO-220F2Pin	FMD-G26S	100	-40 to +150		1.7	10.0	100	0.3	100	50	500/500	30	500/1000	4.0	2.1
	10.0	TO-220F2Pin	FMXA-1106S	100	-40 to +150		1.98	10.0	100	30	150(Tj)	28	500/500	—	—	4.0	2.1
	1.0(2.0)	Axial(ϕ6.5/ϕ1.4)	RG 4AS	50	-40 to +150		2.0	2.0	500	2.5	100	100	100/100	50	100/200	8	1.2
800	6.0	TO-220F(Two elements)	FMC-28U	50	-40 to +150		3.0	3.0	100	0.5	150(Tj)	70	500/500	35	500/1000	4.0	2.1
	6.0	TO-220F2Pin	FMC-G28S	50	-40 to +150		3.0	3.0	100	1	150(Tj)	70	500/500	35	500/1000	4.0	2.1
	5.0	TO-220F2Pin	FMC-G28SL	60	-40 to +150		3.0	3.0	200	2	150(Tj)	70	500/500	35	500/1000	4.0	2.1
1000	0.2	Axial(ϕ2.4/ϕ0.6)	AP01C	5	-40 to +150		4.0	4.0	100	0.5	100	200	100/100	80	100/200	22	0.13
	0.2	Axial(ϕ2.7/ϕ0.6)	EP01C	5	-40 to +150		4.0	4.0	5	0.05	100	200	100/100	80	100/200	20	0.2
	0.4	Axial(ϕ2.7/ϕ0.6)	RU 1P	10	-40 to +150		4.0	4.0	5	0.05	100	100	100/100	50	100/200	15	0.4
	0.5	Axial(ϕ4.0/ϕ0.78)	EG01C	10	-40 to +150		3.3	3.3	50	0.5	100	100	100/100	50	100/200	20	0.2
	0.7	Axial(ϕ4.0/ϕ0.78)	RG 1C	10	-40 to +150		3.3	3.3	20	0.25	100	100	100/100	50	100/200	15	0.4
	4.0	TO-220F2Pin	FMG-G2CS	30	-40 to +150		4.0	4.0	50	0.3	100	100	500/500	50	500/1000	4.0	2.1
	1.0(2.0)	Axial(ϕ6.5/ϕ1.4)	RG 4C	60	-40 to +150		3.0	3.0	500	2.5	100	100	500/500	50	500/1000	8	1.2
1200	3.0	TO-220F2Pin(Two elements)	FMC-26UA	50	-40 to +150		4.0	4.0	500	3	150(Tj)	70	500/500	35	500/1000	4.0	2.1
1600	3.0	TO-220F2Pin(Two elements)	FMC-28UA	50	-40 to +150		6.0	6.0	100	0.5	150(Tj)	70	500/500	35	500/1000	4.0	2.1
2000	0.1	Axial(ϕ4.0/ϕ0.78)	RP 1H	5	-40 to +150		7.0	7.0	20	0.01	100	100	10/10	50	10/20	15	0.4

4-4 Schottky Barrier Diodes

Standard

●Surface-Mount

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
40	1.0	Surface-Mount (SFP)	SFPB-54	30	-40 to +150		0.55	1.0	1	35	150	20	0.072
	1.0	Surface-Mount (SJP)	SJPB-D4	30	-40 to +150		0.55	1.0	0.1	35	150	20	0.072
	2.0	Surface-Mount (SFP)	SFPB-64	60	-40 to +150		0.55	2.0	5	70	150	20	0.072
	2.0	Surface-Mount (SJP)	SJPB-H4	50	-40 to +150		0.55	2.0	0.2	70	150	20	0.072
	3.0	Surface-Mount (SFP)	SFPB-74	60	-40 to +150		0.5	2.0	5	100	150	20	0.072
	3.0	Surface-Mount (SJP)	SJPB-L4	60	-40 to +150		0.55	3.0	0.3	100	150	20	0.072
	3.0	Surface-Mount (D pack)	SPB-G34S	50	-40 to +150		0.55	3.0	3.5	100	150	5	0.29
	5.0	Surface-Mount (D pack)	SPB-G54S	60	-40 to +150		0.55	5.0	5	175	150	5	0.29
	6.0	Surface-Mount (D pack)Center-tap	SPB-64S	50	-40 to +150		0.55	3.0	3.5	100	150	5	0.29
60	0.7	Surface-Mount(SFP)	SFPB-56	10	-40 to +150		0.62	0.7	1	30	150	20	0.072
	1.0	Surface-Mount (SJP)	SJPB-D6*	20	-40 to +150		0.70	1.0	0.1	30	150	20	0.072
	1.5	Surface-Mount (SFP)	SFPW-56	25	-40 to +150		0.7	1.5	1	70	150	20	0.072
	1.5	Surface-Mount (SJP)	SJPW-F6*	25	-40 to +150		0.70	1.5	1.0	70	150	20	0.072
	2.0	Surface-Mount(SFP)	SFPB-66	25	-40 to +150		0.69	2.0	1	55	150	20	0.072
	2.0	Surface-Mount(SFP)	SFPB-76	40	-40 to +150		0.62	2.0	2	70	150	20	0.072
	2.0	Surface-Mount (SJP)	SJPB-H6*	40	-40 to +150		0.69	2.0	0.2	55	150	20	0.072
	3.0	Surface-Mount (SJP)	SJPB-L6	50	-40 to +150		0.70	3.0	0.3	70	150	20	0.072
	5.0	Surface-Mount (D pack)	SPB-G56S	60	-40 to +150		0.7	5.0	3	125	150	5	0.29
90	0.7	Surface-Mount (SFP)	SFPB-59	10	-40 to +150		0.81	0.7	1	30	150	20	0.072
	1.0	Surface-Mount (SJP)	SJPB-D9*	20	-40 to +150		0.85	1.0	0.1	30	150	20	0.072
	1.5	Surface-Mount (SFP)	SFPB-69	40	-40 to +150		0.81	1.5	2	55	150	20	0.072
	2.0	Surface-Mount (SJP)	SJPB-H9*	40	-40 to +150		0.85	2.0	0.2	56	150	20	0.072
100	20	Surface-Mount (TO220S)Center-tap	MPE-220A	120	-40 to +150		0.85	10.0	1	100	150	2.5	1.04

*: Under development

●Thru-hole

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
30	1.0	Axial(ϕ2.4/ϕ0.6)	AK 03	25	-40 to +150		0.55	1.0	1.0	35	150	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EK 03	40	-40 to +150		0.55	1.0	5.0	35	150	20	0.3
	1.7	Axial(ϕ4.0/ϕ0.78)	RK 13	60	-40 to +150		0.55	2.0	5	70	150	15	0.45
	2.5	Axial(ϕ4.0/ϕ0.98)	RK 33	50	-40 to +150		0.55	2.5	5	100	150	12	0.6
	3.0	Axial(ϕ6.5/ϕ1.4)	RK 43	80	-40 to +150		0.55	3.0	5	100	150	8	1.2
40	1.0	Axial(ϕ2.4/ϕ0.6)	AK 04	25	-40 to +150		0.55	1.0	1	35	150	22	0.13
	1.0	Axial(ϕ2.7/ϕ0.6)	EK 04	40	-40 to +150		0.55	1.0	5	35	150	20	0.3
	1.5	Axial(ϕ2.7/ϕ0.78)	EK 14	40	-40 to +150		0.55	2.0	5	70	150	17	0.3
	1.7	Axial(ϕ4.0/ϕ0.78)	RK 14	60	-40 to +150		0.55	2.0	5	70	150	15	0.45
	2.5	Axial(ϕ4.0/ϕ0.98)	RK 34	50	-40 to +150		0.55	2.5	5	100	150	12	0.6
	3.0	TO-220F2Pin	FMB-G14	60	-40 to +150		0.55	3.0	5	100	150	4	2.1
	3.0	Axial(ϕ6.5/ϕ1.4)	RK 44	80	-40 to +150		0.55	3.0	5	100	150	8	1.2
	4.0	TO-220F(Center-tap)	FMB-24	50	-40 to +150		0.55	2.0	5	250	150	4	2.1
	5.0	Axial(ϕ6.5/ϕ1.4)	RW54	120	-40 to +150		0.55	5.0	1	150	150(Tj)	8	1.2
	5.0	TO-220F2Pin	FMB-G14L	60	-40 to +150		0.55	5.0	5	175	150	4	2.1
	6.0	TO-220F(Center-tap)	FMB-24M	60	-40 to +150		0.55	3.0	5	100	150	4	2.1
	10	TO-220F(Center-tap)	FMB-24L	60	-40 to +150		0.55	5.0	5	175	150	4	2.1
	10	TO-220F(Center-tap)	FMW-24L	100	-40 to +150		0.55	5.0	5	175	150	4	2.1
	10	TO-220F2Pin	FMB-G24H	150	-40 to +150		0.55	10.0	10	350	150	4	2.1
	15	TO-220F(Center-tap)	FMB-24H	100	-40 to +150		0.55	7.5	7.5	250	150	4	2.1
	15	TO-220F(Center-tap)	FMW-24H	120	-40 to +150		0.55	7.5	7.5	250	150	4	2.1
	20	TO-220F(Center-tap)	FMB-2204	150	-40 to +150		0.55	10	10	350	150	4	2.1
	20	TO-220F(Center-tap)	FMW-2204	150	-40 to +150		0.55	10.0	10	350	150	4	2.1
	30	TO-220F(Center-tap)	FMB-2304	150	-40 to +150		0.55	15	15	500	150	4	2.1

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
60	0.7	Axial(ϕ2.4/ϕ0.6)	AK 06	10	-40 to +150		0.62	0.7	1	30	150	20	0.13
	0.7	Axial(ϕ2.7/ϕ0.6)	EK 06	10	-40 to +150		0.62	0.7	1	30	150	20	0.3
	1.5	Axial(ϕ2.7/ϕ0.78)	EK 16	25	-40 to +150		0.62	1.5	1	55	150	17	0.3
	1.5	Axial(ϕ4.0/ϕ0.78)	RK 16	25	-40 to +150		0.62	1.5	1	55	150	15	0.45
	2.0	Axial(ϕ4.0/ϕ0.98)	RK 36	40	-40 to +150		0.62	2.0	2	70	150	12	0.6
	3.5	Axial(ϕ6.5/ϕ1.4)	RK 46	70	-40 to +150		0.62	3.5	3	125	150	8	1.2
	4.0	TO-220F(Center-tap)	FMB-26	40	-40 to +150		0.62	2.0	1	55	150	4	2.1
	6.0	TO-220F2Pin	FMB-G16L	50	-40 to +150		0.62	0.62	5	175	150	150	2.1
	10	TO-220F(Center-tap)	FMB-26L	50	-40 to +150		0.62	0.62	2.5	175	150	150	2.1
	20	TO-220F(Center-tap)	FMB-2206	150	-40 to +150		0.7	0.7	8	275	150	150	2.1
	30	TO-220F(Center-tap)	FMB-2306	150	-40 to +150		0.7	0.7	8	400	150	150	2.1
	15	TO-220F(Center-tap)	FMW-2156	100	-40 to +150		0.7	0.7	5	175	150	150	2.1
90	0.7	Axial(ϕ2.4/ϕ0.6)	AK 09	10	-40 to +150		0.81	0.81	1	30	150	150	0.13
	0.7	Axial(ϕ2.7/ϕ0.6)	EK 09	10	-40 to +150		0.81	0.7	1	30	150	20	0.3
	1.5	Axial(ϕ2.7/ϕ0.78)	EK 19	40	-40 to +150		0.81	1.5	2	55	150	17	0.3
	1.5	Axial(ϕ4.0/ϕ0.78)	RK 19	40	-40 to +150		0.81	1.5	2	55	150	15	0.45
	2.0	Axial(ϕ4.0/ϕ0.98)	RK 39	50	-40 to +150		0.81	2.0	3	70	150	12	0.6
	3.5	Axial(ϕ6.5/ϕ1.4)	RK 49	60	-40 to +150		0.81	3.5	5	125	150	8	1.2
	4.0	TO-220F(Center-tap)	FMB-29	50	-40 to +150		0.81	2.0	3	70	150	4	2.1
	4.0	TO-220F2Pin	FMB-G19L	60	-40 to +150		0.81	4.0	5	125	150	4	2.1
	8.0	TO-220F(Center-tap)	FMB-29L	60	-40 to +150		0.81	4.0	5	125	150	4	2.1

Low VF "A Series"

●Surface-Mount

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
30	1.0	Surface-Mount (SFP)	SFPA-53	30	-40 to +125		0.36	1.0	1.5	70	100	20	0.072
	1.0	Surface-Mount (SJP)	SJPA-D3*	30	-40 to +125		0.36	1.0	1.5	70	100	20	0.072
	2.0	Surface-Mount (SFP)	SFPA-63	40	-40 to +125		0.36	2.0	3.0	140	100	20	0.072
	2.0	Surface-Mount (SJP)	SJPA-H3*	40	-40 to +125		0.36	2.0	3.0	140	100	20	0.072
	3.0	Surface-Mount (SFP)	SFPA-73	50	-40 to +125		0.36	3.0	4.5	210	100	20	0.072
	3.0	Surface-Mount (SJP)	SJPA-L3	50	-40 to +125		0.36	3.0	4.5	210	100	20	0.072

*Under development

●Thru-hole

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
30	2.0	Axial(ϕ4.0/ϕ0.78)	RA 13	40	-40 to +125		0.36	2.0	3.0	140	100	15	0.45

Low IR "E Series"

●Surface-Mount

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
40	2.0	Surface-Mount (SFP)	SFPE-64	40	-40 to +150		0.6	2.0	0.2	70	150	20	0.072
	2.0	Surface-Mount (SJP)	SJPE-H4*	40	-40 to +150		0.6	2.0	0.2	70	150	20	0.072

*Under development

●Thru-hole

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
40	10	TO-220F(Center-tap)	FME-2104	80	-40 to +150		0.6	5.0	0.5	50	150	4	2.1
	15	TO-220F(Center-tap)	FME-24H	100	-40 to +150		0.6	7.5	0.75	75	150	4	2.1
60	10	TO-220F(Center-tap)	FME-2106	60	-40 to +150		0.72	5.0	1	35	150	4	2.1
100	10	TO-220F(Center-tap)	FMEN-210A	100	-40 to +150		0.85	5.0	0.1	50	150(Tj)	4	2.1
	15	TO-220F(Center-tap)	FMEN-215A*	100	-40 to +150		0.85	7.5	0.15	75	150(Tj)	4	2.1
	20	TO-220F(Center-tap)	FME-220A	120	-40 to +150		0.85	10	1	100	150	4	2.1
	20	TO-220F(Center-tap)	FMEN-220A	120	-40 to +150		0.85	10	0.2	100	150(Tj)	4	2.1
	30	TO-220F(Center-tap)	FME-230A	150	-40 to +150		0.85	15	1.5	150	150	4	2.1
	30	TO-220F(Center-tap)	FMEN-230A	150	-40 to +150		0.85	15	0.3	150	150(Tj)	4	2.1
	30	TO-262(Center-tap)	MPEN-230AF	150	-40 to +150		0.90	15	0.25	125	150(Tj)	1.5	1.55
150	10	TO-220F(Center-tap)	FME-210B	100	-40 to +150		0.9	5	0.5	25	150	4	2.1
	20	TO-220F(Center-tap)	FME-220B	120	-40 to +150		0.9	10	1.0	50	150	4	2.1
	30	TO-220F(Center-tap)	FME-230B	150	-40 to +150		0.9	15	1.5	75	150	4	2.1

*Under development

Low VF/Low IR Balance "J Series"

●Surface-Mount

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
30	1.0	Surface-Mount (compact)	MI1A3	12	-40 to +150		0.47	1.0	1.0	70	150(Tj)	70	0.011
	1.0	Surface-Mount (SJP)	SJPJ-D3*	30	-40 to +150		0.45	1.0	0.1	35	150	20	0.072
	2.0	Surface-Mount (SFP)	SFPJ-63	40	-40 to +150		0.45	2.0	2.0	70	150	20	0.072
	2.0	Surface-Mount (SJP)	SJPJ-H3*	40	-40 to +150		0.45	2.0	0.2	70	150	20	0.072
	3.0	Surface-Mount (SFP)	SFPJ-73	50	-40 to +150		0.45	3.0	3.0	100	150	20	0.072
	3.0	Surface-Mount (SJP)	SJPJ-L3	60	-40 to +150		0.45	3.0	0.3	150	150	20	0.072
	6.0	Surface-Mount (D pack)Center-tap	SPJ-63S*	50	-40 to +150		0.45	3.0	3.0	100	150	5	0.29

*Under development

●Thru-hole

V_{RM} (V)	I_F (AV) (A)	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (mA) $V_R=V_{RM}$ max	$I_{R(H)}$ (mA) $V_R=V_{RM}$ max	T_a (°C)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
30	3.0	Axial(ϕ6.5/ϕ1.4)	RJ 43	50	-40 to +150		0.45	3.0	3	100	150	8	1.2
	10	TO-220F(Center-tap)	FMJ-23L	100	-40 to +150		0.45	5.0	5	175	150	4	2.1
	20	TO-220F(Center-tap)	FMJ-2203*	150	-40 to +150		0.47	10.0	10	350	150	4	2.1
	30	TO-220F(Center-tap)	FMJ-2303	150	-40 to +150		0.48	15.0	15	500	150	4	2.1

*Under development

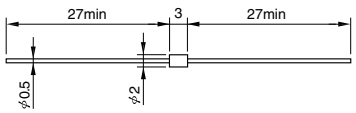
4-5 High Voltage Rectifier Diodes

Category	V_{RM} (kV)	Part Nubmer	$I_{F(AV)}$ (mA)	I_{FSM} (A) 50Hz Single Half Sine Wave	T_c (°C)	T_{stg} (°C)	V_F (V) max	I_F (mA)	I_R (μA) $V_R=V_{RM}$ max	$I_R(H)$ (μA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	Ta=100°C	I_F/I_{RP} (mA)	Mass (g)	Package Type No.
General-purpose	2	SHV-02	2.0	0.3	100	-40 to +120	16	10	1	3	100	0.18	—	10/10	0.13	1
	3	SHV-03S	2.0	0.3	100	-40 to +120	16	10	1	3	100	0.18	—	10/10	0.13	
	3	SHV-03	2.0	0.5	100	-40 to +120	16	10	1	3	100	0.18	—	10/10	0.16	2
For high frequency multilayer FBT	6	SHV-06EN	2.0	0.5	100	-40 to +120	24	10	1	3	100	0.15	0.20	10/10	0.17	3
	8	SHV-08EN	2.0	0.5	100	-40 to +120	30	10	1	3	100	0.15	0.20	10/10	0.17	
For ultra-high frequency multilayer FBT	8	SHV-08DN	2.0	0.5	100	-40 to +120	30	10	1	3	100	0.15	0.20	10/10	0.17	3

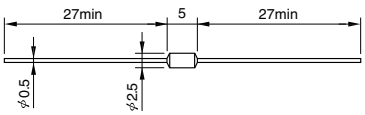
- The SHV series is being packaged in a highly compact case based on the premise of overmolding with epoxy or similar materials. Handling procedures for prevention of discharge through creepage or environmental effects such as humidity must be used.
- Taping specifications for the SHV series differ from those for general diodes (refer to page 177).

Package Type (Dimensions)

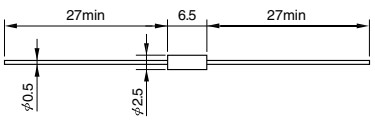
• No. 1 High Voltage Rectifier Diodes



• No. 2 High Voltage Rectifier Diodes



• No. 3 High Voltage Rectifier Diodes



4-6 Damper Diodes

Damper Diodes

●For TV

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1300	1.0	Axial(φ4.0/φ0.98)	RH 2D	60	-40 to +150		1.0	1.0	10	0.5	100	4.0	10/10	1.3	100/200	12	0.6
1500	0.8	Axial(φ4.0/φ0.78)	RH 10F	60	-40 to +150		1.0	1.0	10	0.5	100	4.0	10/10	1.3	100/200	15	0.44
	1.0	Axial(φ4.0/φ0.98)	RH 2F	60	-40 to +150		1.0	1.0	10	0.5	100	4.0	10/10	1.3	100/200	12	0.6
	2.0	Axial(φ5.2/φ1.2)	RS 3FS	50	-40 to +150		1.1	3.0	50	0.5	100	2.0	100/100	0.8	100/200	10	1.0
	2.5	Axial(φ5.2/φ1.2)	RH 3F	50	-40 to +150		1.3	2.5	50	0.5	100	4.0	100/100	1.3	100/200	10	1.0
	1.5(2.5)	Axial(φ6.5/φ1.4)	RS 4FS	50	-40 to +150		1.5	3.0	50	0.5	100	1.0	100/100	0.4	100/200	8	1.2
	2.5	Axial(φ6.5/φ1.4)	RH 4F	50	-40 to +150		1.5	2.5	10	0.35	100	4.0	100/100	1.3	100/200	8	1.2
1600	2.5	Axial(φ5.2/φ1.2)	RH 3G	50	-40 to +150		1.3	2.5	50	0.5	100	4.0	100/100	1.3	100/200	10	1.0
1700	6.0	TO-220F2Pin	FMV-G2GS	50	-40 to +150		1.5	6.0	50	3	150(Tj)	2.0	500/500	0.8	500/1000	4	2.1
1800	10	TO-3PF2Pin	FMR-G5HS	50	-40 to +150		1.6	10	20	0.2	100	1.8	500/500	0.7	500/1000	2	6.5

●For CRT Monitor

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1300	1.2(1.5)	Axial(φ6.5/φ1.4)	RU 4D	50	-40 to +150		1.8	1.5	50	0.5	100	0.4	500/500	0.18	500/1000	8	1.2
	1.5(2.5)	Axial(φ6.5/φ1.4)	RU 4DS	50	-40 to +150		1.8	3.0	50	0.5	100	0.4	500/500	0.18	500/1000	8	1.2
1500	2.0	Axial(φ5.2/φ1.2)	RP 3F	50	-40 to +150		1.7	2.0	50	0.5	100	0.7	500/500	0.3	500/1000	10	1.0
	5.0	TO-220F2Pin	FMQ-G1FS	50	-40 to +150		2.0	5.0	50	0.5	150	0.7	500/500	0.3	500/1000	4	2.1
	5.0	TO-220F2Pin	FMP-G2FS	50	-40 to +150		2.0	5.0	50	0.5	100	0.7	500/500	0.3	500/1000	4	2.1
	10	TO-220F2Pin	FMQ-G2FLS	50	-40 to +150		1.8	10.0	50	0.5	150(Tj)	1.2	500/500	0.4	500/1000	4	2.1
	10	TO-220F2Pin	FMU-G2FS	50	-40 to +150		1.6	10	50	6	150(Tj)	0.6	500/500	0.25	500/1000	4	2.1
	10	TO-220F2Pin	FMQ-G2FS	50	-40 to +150		2.8	10	50	0.5	150(Tj)	0.5	500/500	0.2	500/1000	4	2.1
	10	TO-220F2Pin	FMQ-G2FMS	50	-40 to +150		2.4	10	50	0.5	150	0.5	500/500	0.25	500/1000	4	2.1
	10	TO-3PF2Pin	FMQ-G5FMS	50	-40 to +150		2.4	10	50	0.5	100	0.5	500/500	0.2	500/1000	2	6.5
1700	10	TO-3PF2Pin	FMQ-G5GS	50	-40 to +150		2.7	10	100	0.5	100	0.5	500/500	0.2	500/1000	2	6.5
1800	8.0	TO-3PF2Pin	FMP-G5HS	50	-40 to +150		2.0	8.0	25	0.25	100	1.0	500/500	0.4	500/1000	2	6.5
	10	TO-3PF2Pin	FMR-G5HS	50	-40 to +150		1.6	10	20	0.2	100	1.8	500/500	0.7	500/1000	2	6.5

●For CRT Monitor Correction

V_{RM} (V)	I_F (AV) (A) Values in parentheses are for the products with heatsinks	Package Axial (Body Diameter/Lead Diameter)	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{FP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1300	0.5	Axial(φ4.0/φ0.98)	RG 2A2	5	-40 to +150		3.5	0.5	100	0.5	100	0.1	100/100	0.05	100/200	12	0.6
1600	1.0	Axial(φ5.2/φ1.2)	RC 3B2	20	-40 to +150		3.6	1.0	100	0.5	100	0.07	500/500	0.035	500/1000	10	1.0

DM Damper Diodes

●For TV

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (mA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1500	5.0	TO-3PF	FMV-3FU	50	-40 to +150		1.4	5.0	50	0.5	100	4.0	500/500	1.3	500/1000	2.0	6.5
600							1.3	5.0	50	0.5	100	0.4	500/500	0.18	500/1000		
1700	5.0	TO-3PF	FMV-3GU	50	-40 to +150		1.5	5.0	50	0.5	100	2.0	500/500	0.8	500/1000	2.0	6.5
600							1.3	5.0	50	0.5	100	0.4	500/500	0.18	500/1000		
1800	5.0	TO-3PF	FMV-3HU	50	-40 to +150		1.5	5.0	50	3	150	2.0	500/500	0.8	500/1000	2.0	6.5
600							1.3	5.0	50	3	150	0.4	500/500	0.18	500/1000		

●For CRT Monitor

V_{RM} (V)	I_F (AV) (A)	Package	Part Number	I_{FSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	V_F (V) max	I_F (A)	I_R (μA) $V_R=V_{RM}$ max	I_R(H) (μA) $V_R=V_{RM}$ max	T_a (°C)	trr① (μs)	I_F/I_{RP} (mA)	trr② (μs)	I_F/I_{RP} (mA)	Rth(j-l) Rth(j-c) (°C/W)	Mass (g)
1500	5.0	TO-220F	FMP-2FUR	50	-40 to +150		2.0	5.0	50	3	150(Tj)	0.7	500/500	0.3	500/1000	4.0	2.1
600							2.5	5.0	50	3	150(Tj)	0.1	500/500	0.05	500/1000		
1500	5.0	TO-220F	FMQ-2FUR	50	-40 to +150		1.4	5.0	50	2	150	2	500/500	0.8	500/1000	4.0	2.1
600							1.65	5.0	50	0.5	150	0.15	500/500	0.07	500/1000		
1500	5.0	TO-3PF	FMP-3FU	50	-40 to +150		2.0	5.0	50	0.5	100	0.7	500/500	0.3	500/1000	1.8	6.5
600							2.5	5.0	50	0.5	100	0.1	500/500	0.05	500/1000		
1700	5.0	TO-3PF	FMQ-3GU	50	-40 to +150		2.0	5.0	500	1	100	0.7	500/500	0.3	500/1000	1.8	6.5
800							4.0	5.0	100	0.5	100	0.07	500/500	0.04	500/1000		

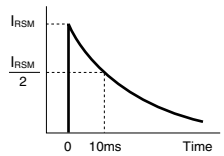
4-7 Power Zener Diodes

P (W)	VZ 1mA (V)	PR (W)	Package	Part Number	VDC (V)	IZSM (A)	Conditions	Tj Tstg (°C)	IR (μA) max	Mass(g)
1	28±3	50 (5ms)	Surface-Mount (SFP)	SFPZ-68	20	2	5 mA rectangular wave	-40 to +150	10	0.07
1	28±3		Surface-Mount (SJP)	SJPZ-K28*	20	–	–	-55 to +150	10	0.07
1	16.8 to 19.1	85 (500 μs)	Surface-Mount (SJP)	SJPZ-E18*	13	–	–	-55 to +150	10	0.07
1	25.1 to 28.9		Surface-Mount (SJP)	SJPZ-E27*	20	–	–	-55 to +150	10	0.07
1	31.0 to 35.0		Surface-Mount (SJP)	SJPZ-E33*	25	–	–	-55 to +150	10	0.07
1	34.0 to 38.0		Surface-Mount (SJP)	SJPZ-E36*	27	–	–	-55 to +150	10	0.07
5	28±3	1500 (5ms)	Axial (φ10.0/φ1.3)	PZ628	20	65	–	-40 to +150	50	2.6
5	24 to 30	–	Surface-Mount (SZ-10)	SZ-10N27	22	70	Fig.1	-55 to +175	10	2.55
5	36 to 40	–	Surface-Mount (SZ-10)	SZ-10N40*	22	45	Fig.1	-55 to +175	10	2.55
6	24 to 30	–	Surface-Mount (SZ-10)	SZ-10NN27	22	90	Fig.1	-55 to +175	10	2.55
6	36 to 40	–	Surface-Mount (SZ-10)	SZ-10NN40	22	70	Fig.1	-55 to +175	10	2.55

* : Under Development

Figure1

SZ-10 IZSM Condition



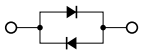
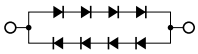
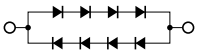
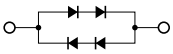
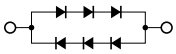
4-8 Silicon Varistors

●Symmetrical

V_F (V)	I_F (mA)	Part Number	I_F (μA) max	V_F (V)	I_{TSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	Rth(j-l) (°C/W)	Mass (g)	Package
1.5max	1000	VR-60SS	20	0.2	15	-40 to +100		20	0.3	Axial(ϕ2.7/ϕ0.6)
2.3±0.25	1	VR-61SS			7.5	-40 to +100		20	0.3	Axial(ϕ2.7/ϕ0.6)
2.75±0.25	10									
3.1±0.25	70									
4.0max	100	SV-2SS	50	1.2		-40 to +100		20	0.3	Axial(ϕ2.7/ϕ0.6)
2.0max	100	SV-3SS	50	0.6		-40 to +100		20	0.3	Axial(ϕ2.7/ϕ0.6)
1.8±0.2	1	SV-4SS	50	0.9		-40 to +100		20	0.3	Axial(ϕ2.7/ϕ0.6)
2.15±0.2	10									
2.4±0.25	30									

●Asymmetrical

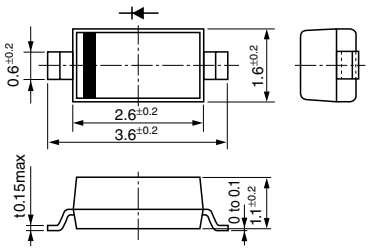
V_F (V)	I_F (mA)	Part Number	I_F (μA) max	I_{TSM} (A) 50Hz Single Half Sine Wave	T_j (°C)	T_{stg} (°C)	I_R (μA)	V_R (V)	Rth(j-l) (°C/W)	Mass (g)	Package
1.2±0.2	1	SV 02YS	200	30	-40 to +130		10	100	20	0.3	Axial(ϕ2.7/ϕ0.6)
1.5±0.25	70										
1.8±0.2	1	SV 03YS	150	16	-40 to +130		10	100	20	0.3	Axial(ϕ2.7/ϕ0.6)
2.3±0.25	70										
2.35±0.2	1	SV 04YS	100	12	-40 to +130		10	100	20	0.3	Axial(ϕ2.7/ϕ0.6)
3.0±0.3	70										
3.0±0.3	1	SV 05YS	80	10	-40 to +130		10	100	20	0.3	Axial(ϕ2.7/ϕ0.6)
3.8±0.4	70										
3.5±0.4	1	SV 06YS	70	8	-40 to +130		10	100	20	0.3	Axial(ϕ2.7/ϕ0.6)
4.5±0.45	70										

Part Number	VR-60SS	VR-61SS	SV-2SS	SV-3SS	SV-4SS
Display Color					
Internal Connection					

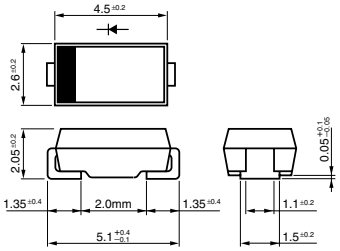
Part Number	SV 02YS	SV 03YS	SV 04YS	SV 05YS	SV 06YS
Internal Connection					

Package Type (Dimensions)

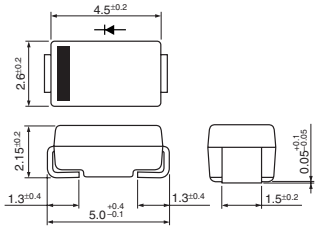
• No. 1 Surface-Mount (Compact)



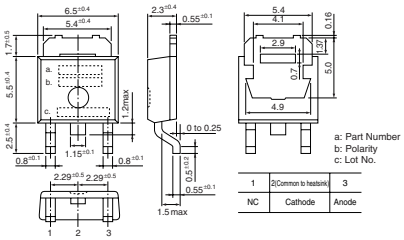
• No. 2 Surface-Mount (SFP)



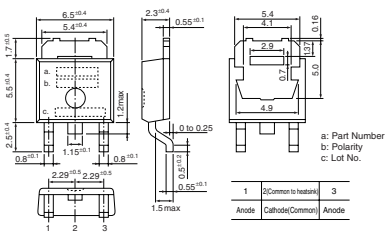
• No. 3 Surface-Mount (SJP)



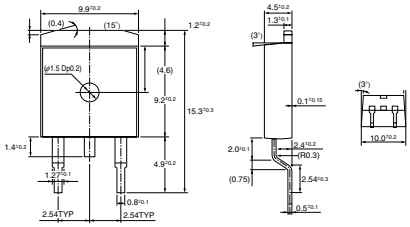
• No. 4 Surface-Mount (D pack)



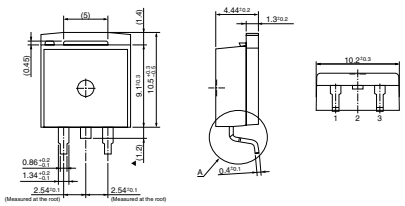
• No. 5 Surface-Mount (D pack) Center-tap



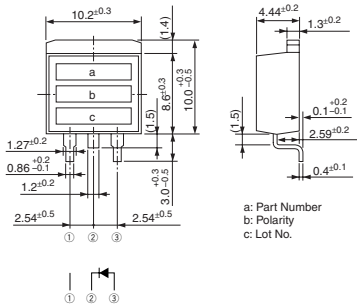
• No. 6 Surface-Mount (TO263)



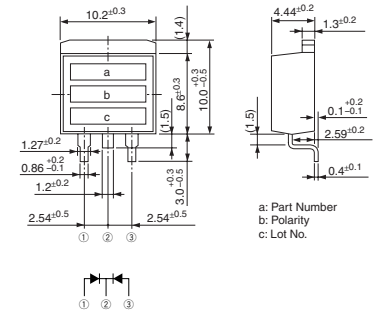
• No. 7 Surface-Mount (TO220S)
MPL-102S, MP2-202S



• No. 8 Surface-Mount (TO220S)

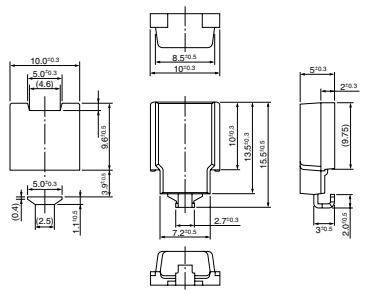


• No. 9 Surface-Mount (TO220S) Center-tap

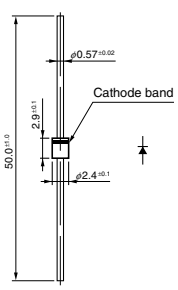


*② is common to the frame.

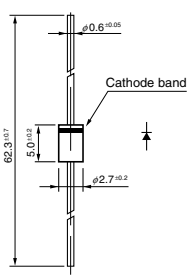
• No. 10 Surface-Mount (SZ-10)



• No. 11 Axial (ϕ2.4/ϕ0.6)

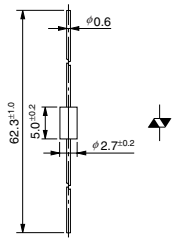


• No. 12 Axial (ϕ2.7/ϕ0.6)

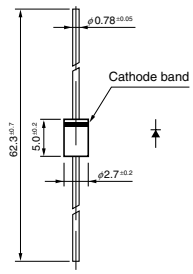


• No. 13 Axial (ϕ2.7/ϕ0.6)

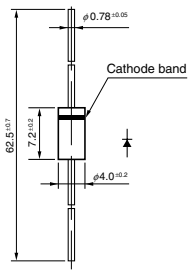
Silicon Varistors (Symmetrical)



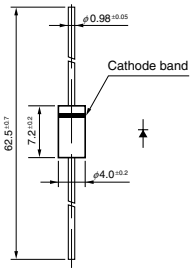
• No. 14 Axial (ϕ2.7/ϕ0.78)



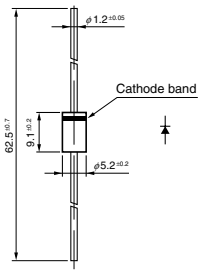
• No. 15 Axial (ϕ4.0/ϕ0.78)



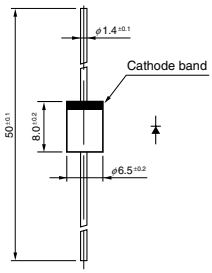
• No. 16 Axial (ϕ4.0/ϕ0.98)



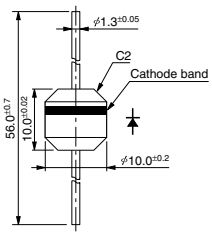
• No. 17 Axial (ϕ5.2/ϕ1.2)



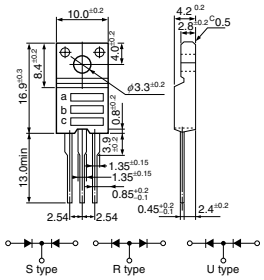
• No. 18 Axial (ϕ6.5/ϕ1.4)



• No. 19 Axial (ϕ10.0/ϕ1.3)

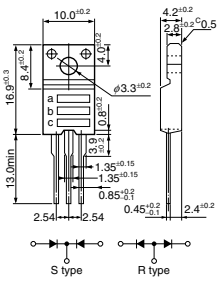


• No. 20 TO-220F (Two Elements)



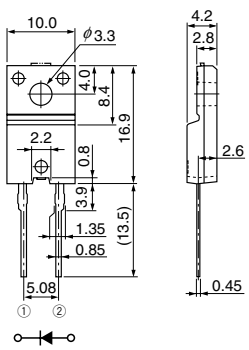
a: Part Number
b: Polarity
c: Lot No.

• No. 21 TO-220F (Center-tap)

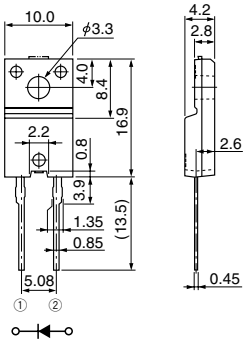


a: Part Number
b: Polarity
c: Lot No.

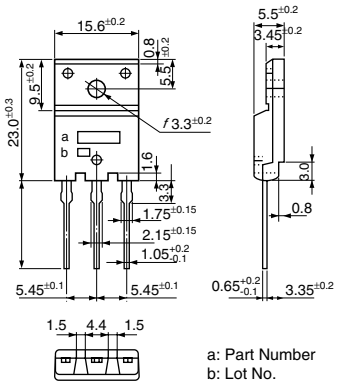
• No. 22 TO-220F2Pin



• No. 23 TO-220F2Pin (Two Elements)

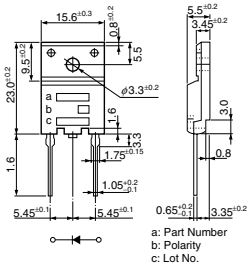


• No. 24 TO-3PF

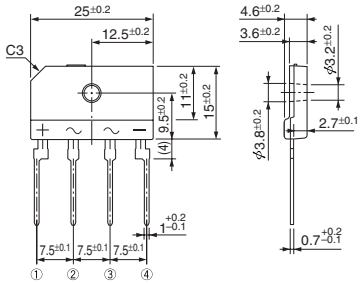


a: Part Number
b: Lot No.

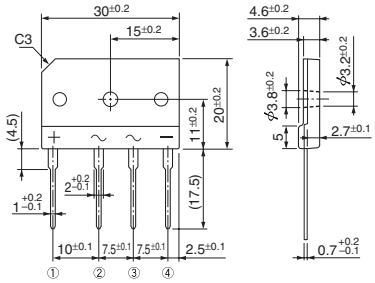
• No. 25 TO-3PF2Pin



• No. 26 RBV-40



• No. 27 RBV-60



5

LEDs

Application Note

Sanken Electric's light emitting diodes (LEDs) are all molded in resin molds. When using Sanken's LEDs, observe the following cautions:

■ Heat resistance of mold resin

Since an LED must emit internally generated light with high efficiency, a highly transparent resin is used for molding. To ensure high transparency, the molding material must be free from the additives (silica, glass fiber, and others) that are used to improve the heat and moisture resistance of other semiconductor components (such as transistors).
Since the resin used for LEDs generally has a low heat resistance, the following cautions must be fully considered.
Never apply an external force, stress, or excess vibration to the terminals (leads) at high temperature. The glass transition point of the epoxy resin used in LEDs is about 120 to 130°C. Beyond this temperature range, the coefficient of linear thermal expansion becomes more than double that at room temperature, and the resin softens as well.
Under this condition, an external force or stress may budge the terminals, and may result in disconnection of the internal wire. Figure 1 shows reference data for the disconnection temperature and terminal load for the SEL1010 Series.

●Do not apply heat beyond the absolute maximum rating of the storage temperature (100°C for ordinary LEDs, 90°C for surface-mount LEDs). (For soldering, see the soldering conditions.)

■ Mechanical strength

If an excessive mechanical force is applied between the lens resin and the terminals, the lens resin or internal connections may be damaged.
Figure 2 shows the fracture strength of the SEL1000 Series according to the direction of the force applied to the terminals. When aligning or forming the terminals after soldering, do not bend or twist them with a force beyond the limits shown in Figure 2.

Figure 1 Disconnection temperature - Terminal load

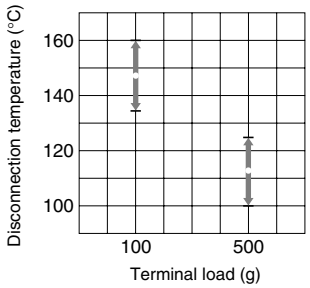
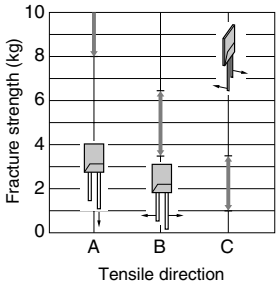
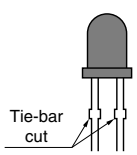


Figure 2 Fracture strength



■ Forming

1. Be sure to form terminals before soldering.
2. When forming the terminals, hold tightly them at a point closer to the lens resin than the forming position to prevent stress from being applied between the lens resin and the terminals.
3. Form the terminals only below the tie-bar cuts (protruding part of the terminals).
4. Make the forming pitch equal to the board hole pitch.



■ Overcurrent

Since an overcurrent may burn the LED, connect a protective resistor in series to prevent a current over 100 mA in the case of a single-pulse overcurrent (excluding infrared LEDs).

■ Moisture-proof packaging of Surface Mount LEDs

1. Influence of moisture absorption on resin of surface-mount LEDs

- If the resin is unusually damp, solder dipping may cause interfacial peeling. This phenomenon, generally called "popcorn phenomenon", occurs when a drastic temperature change causes moisture in the resin to vaporize and to expand.
- Due to this peeling, the efficiency of light emission might worsen and the luminosity could lower.

2. Moisture-proof packaging

- Surface Mount LEDs are protected by a moisture-proof packaging (baked by Sanken) to minimize moisture absorption by the resin before use.
- Aluminum laminates with high moisture resistance are used for packaging.
- Silica gel packs are enclosed in each package to further improve moisture proof efficiency.

3. Storage after opening

- Once the package has been opened, solder dipping should be carried out within seven days.
  (Pb-free devices should be reflowed within 48 hours after opening the package.)

4. Handling of Remaining Surface Mount LEDs

- If some Surface Mount LEDs have not been used, put them back into the moisture-proof packaging, seal the package completely and store it in a dry place.

■ Chemical resistance

For washing after soldering, the following chemicals are recommended:

- Isopropyl alcohol
- Ethyl alcohol

In addition, keep the dip time within five minutes and work at room temperature.

- Freon-substitute cleaning liquid

Depending on the constituents, the chemicals may discolor the resin. Make sure that there will be no problems before use.

■ Mounting method

Do not mount the LED in such a way that there is a residual stress between the terminal and lens resin.

■ Electrostatic discharge (ESD) precaution

The devices with GaN / InGaN as die ingredients ara electrostatic-sensitive, so be careful in handling them. Especially when the voltage exceeding the absolute maximum ratings are applied to the devices, they may be damaged. Therefore, take complete measure against ESD and surge voltages.

■ Mounting

1. Mounting holes

- Please use the printed circuit board with the same mounting hole spacing as the LED lead pitch.
  The recommended PCB hole diameters are as follows:

Lead diameter	PCB hole diameter
0.4×0.45mm	ϕ0.9 to 1.0
□ 0.5mm	ϕ1.0 to 1.1
□ 0.6mm	ϕ1.0 to 1.2

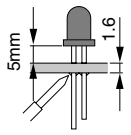
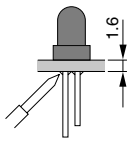
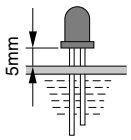
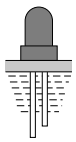
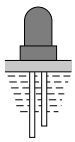
2. Direct mount type

(a) Printed circuit board
Single-sided board is recommended. When using a double-sided board, do not use thru-holes. If the direct mount type LEDs and the surface mount devices are on the same surface of the board, insert the LEDs after the adhesives of the surface mount devices are cured.

(b) Insertion condition
Make an insertion pressure lower but enough to insert properly. For cut and clinch, T pattern of Panasert is recommended. When using N pattern, make the clinching angle of the anode lead looser, but enough to hold the LED. Standard Manual insertion of direct-mount type Automatic insertion of direct-mount type.

■ Soldering conditions

●Thru-hole type

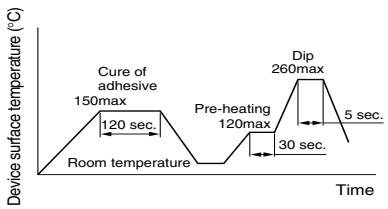
		Standard	Manual contact mount insertion	Automatic contact mount insertion
Soldering iron	Temperature	Iron bit: 350°C or lower	Iron bit: 350°C or lower	–
	Time	3 sec. or shorter	3 sec. or shorter	–
	Position			–
Flow dip soldering	Preheat	90°C, 120 sec or shorter	90°C, 120 sec or shorter	90°C, 120 sec or shorter
	Temperature	Soldering Bath: 250°C or lower	Soldering Bath: 250°C or lower	Soldering Bath: 250°C or lower
	Time	5 sec. or shorter	3 sec. or shorter	3 sec. or shorter
	Position			

- The heat resistance of the mold-resin of the direct mount type is almost equal to that of the standard type. Be careful not to apply a load when the LED is heated.
- When thermally curing the adhesive of surface-mount components on the same board after LED mounting, keep the temperature of the curing oven below 120°C and the curing time to less than 60 seconds. (For soldering a Surface Mount LED, see the soldering conditions.)
- When the direct-mount-type LED is mounted by the automatic inserter, note that open circuit may occur depending on the conditions of insertion even under the above conditions.

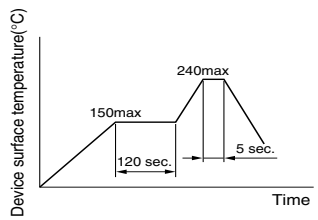
●Surface Mount LED (Please contact out sales office for SEC1005 and 1007.)

Soldering iron Iron bit temperature: 300°C max, 3 sec max

Dip



Reflow



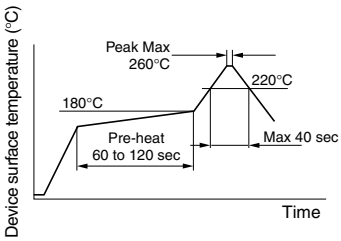
●Surface Mount Type (Pb-free device)

Soldering iron Iron bit temperature: 350±10°C, 3 sec max
Soldering has to be only once per one place.

Dip: Unavailable

Preheat: 150 to 180°C, 60 to 120 sec
Reflow: The period for 220°C or higher should be 40 sec or shorter.
Reflow peak temperature should be 260°C or lower.

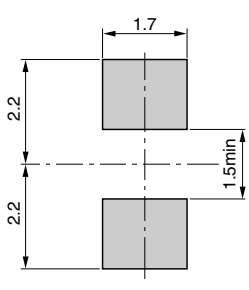
Reflow



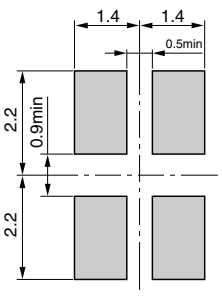
■ Reference mounting pattern for Surface Mount LEDs

(Unit: mm)

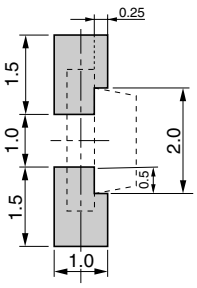
Unicolor SEC1001/1003 Series



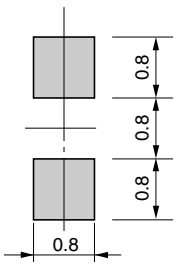
Bicolor SEC2002/2004 Series



SEC4001/4003
Side-view type

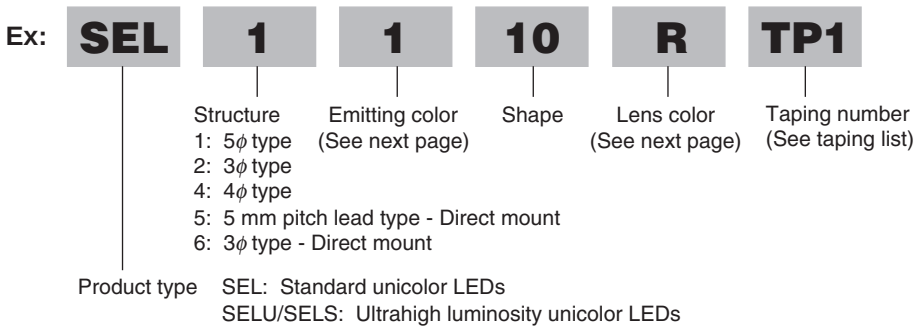


SEC1005/1007

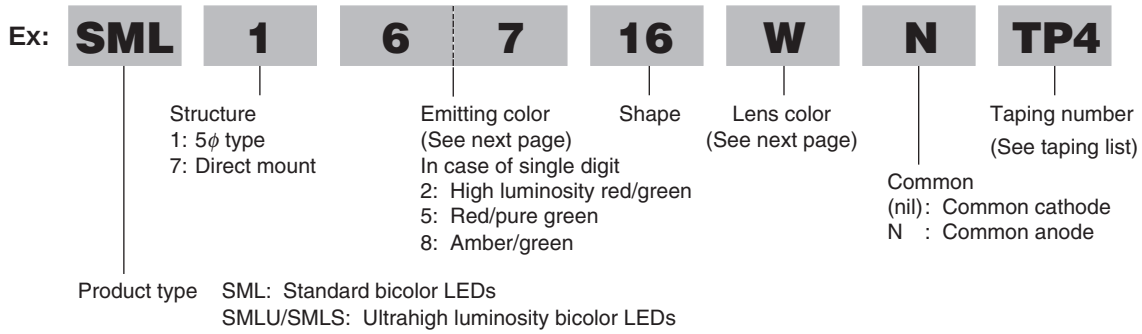


Part Numbering Guide

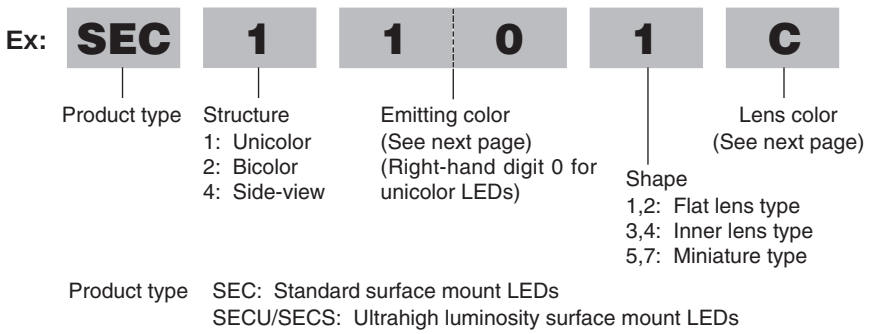
Unicolor LEDs



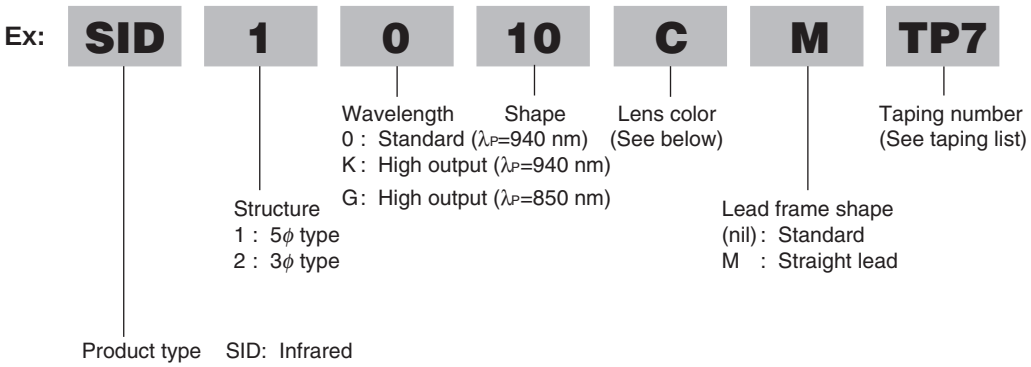
Bicolor LEDs



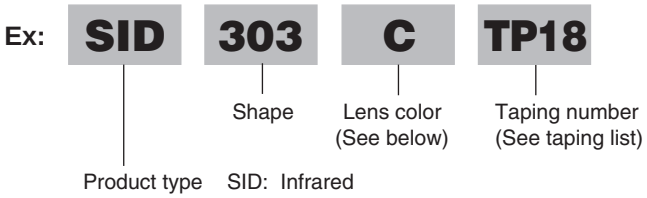
Surface Mount LEDs



Infrared LEDs (1)



Infrared LEDs (2)



●Emitting color

	Color code	Emitting color	Chip material	Dominant wavelength (nm)	Peak wavelength (nm)	Spectrum Half Bandwidth (nm)
Standard type	6	High luminosity	GaAlAs	642	660	30
	1	Deep red	GaP	625	700	100
	2	Red	GaAsP	620	630	35
	8	Amber	GaAsP	605	610	33
	9	Orange	GaAsP	590	587	35
	7	Yellow	GaP	571	570	30
	4	Deep green/Green	GaP	564/567	558/560	20/20
	5	Pure green	GaP	559	555	20
	E	Blue	GaN	466	430	65
Ultrahigh luminosity type	6	Deep red	AlGaInP	639	650	20
	2	Red	AlGaInP	624/625	632/635	20/15
	8	Amber	AlGaInP	605/607	611/615	17/15
	B	Light Amber	AlGaInP	595/596	598/600	16/15
	9	Orange	AlGaInP	590/589	590/591	15/15
	7	Yellow	AlGaInP	571	572	15
	4	Green	AlGaInP	563	560	15
	D	Pure green	InGaN	530	525	35
	J	Blue green	InGaN	503/505	500/502	35/30
	L	Aqua Blue	InGaN	495	492	35
	E	Blue	InGaN	470	468	25

●Lens color

Lens color			
R	Diffused red	K	Transparent yellow
W	Diffused white	G	Diffused green
S	Transparent red	E	Transparent green
C	Water clear	B	Transparent blue
D	Diffused orange	BR	Transparent deep blue
A	Transparent orange	BP	Transparent violet
Y	Diffused yellow	BQ	Transparent light deep blue

Selection Guide

Unicolor LEDs/Unicolor surface mount LEDs

Shape	Lens diameter	Feature	Direct mount	Series	Emitting color and dominant wavelength																			Page
					Standard luminosity type									Ultrahigh luminosity type										
					High luminosity red	Deep red	Red	Amber	Orange	Yellow	Deep green/Green	Pure green	Blue	Ultrahigh luminosity deep red	Ultrahigh luminosity red	Ultrahigh luminosity amber	Ultrahigh luminosity light amber	Ultrahigh luminosity orange	Ultrahigh luminosity yellow	Ultrahigh luminosity green	Ultrahigh luminosity pure green	Ultrahigh luminosity blue green	Ultrahigh luminosity aqua blue	Ultrahigh luminosity blue	
				Color code⇒	6	1	2	8	9	7	4	5	E	6	2	8	B	9	7	4	D	J	L	E	
				Dominant wavelength [nm]⇒	642	625	620	605	590	571	564/567	559	466	639	624/625	605/607	595/596	590/589	571	563	530	503/505	495	470	
Round	5ϕ	Standard	N	SEL1010	○	○	○	○	○	○	○	○													209
			N	SEL1010M			○	○	○	○	○	○													209
		Wide viewing angle	N	SEL1010XM										△	○	○	△	○	△	△	○	△	△	○	209
		Narrow viewing angle	Y	SEL1050M		○		○	○		○	○			○						○*			○*	210
	5.6×4.6ϕ	Egg-shaped	N	SEL1053M							○				○	○									210
	4ϕ	Standard	N	SEL4010		○	○	○	○	○	○	○													210
		Wide viewing angle	Y	SEL4014		○	○	○	○	○	○	○													210
	3ϕ	Standard	Y	SEL6010		○	○	○	○	○	○	○	○												211
		Wide viewing angle	Y	SEL6014			○	○	○	○	○	○		○	○	○	○	○	○	○	○			△	211
		Narrow viewing angle	Y	SEL6015			○		○	○	○	○													211
		Standard	N	SEL2010	○	○	○	○	○	○	○	○	○	○	○	○		△	○	△	○	△	○	○	212
		Narrow viewing angle	N	SEL2015			○	○	○	○	○	○			○										212
Inverted cone	5ϕ	For lighting	N	SEL1013			○	○	○	○	○	○													213
	3ϕ		Y	SEL6013							○	○					○								213
	3ϕ		N	SEL2013	○		○	○	○	○	○	○													213
Bow shaped	4ϕ		N	SEL4027			○				○														214
	3.1ϕ		N	SEL4028	○		○	○	○	○	○	○													214
	3.1ϕ		Y	SEL4029			○	○	○	○	○														214
	4ϕ		Y	SEL6027			○		○		○														214
5mm pich lead	Rectangular		Y	SEL5020	○		○	○	○		○	○	○	○	△	○	△	○	○	○	○			○	215
	3ϕ	Narrow viewing angle	Y	SEL5021			○	○	○	○	○	○													215
	Bow shaped	Wide viewing angle	Y	SEL5023			○	○	○	○	○	○	○		○	○	○	○	○		△			○	215
	5.6×4.6ϕ		Y	SEL5055			○		○	○															215
Surface mount	Flat lens			SEC1001	○	○	○	○	○	○	○	○	○								○			○	219
	Inner lens			SEC1003	○		○	○	○	○	○	○			○	○		○							219
	1608 type	0.55t		SEC1005										○	○	○		○			○		○	○	218
	1608 type	0.7t		SEC1007													○		△						218
	Side view Flat lens			SEC4001			△	○	△	△	○	○	△								△			○	218
	Side view inner lens			SEC4003			△	△	△	△	△	△	△								△			△	218

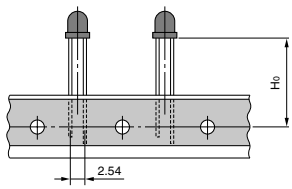
Y ···Available ○ ···Available
N ···Unavailable △ ···In preparation for mass production
* ···Not for direct mount

Taping Specifications

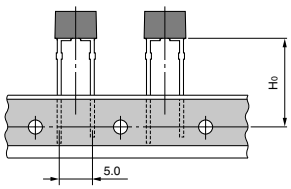
Lamp Types

1.Straight lead type

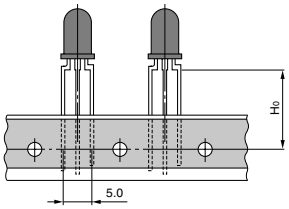
2. Forming (5 mm pitch) type



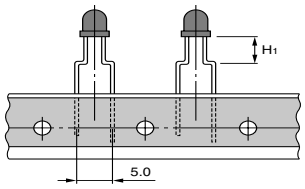
Straight standard shape



Straight standard shape
(5 mm pitch lead)



Bicolor straight standard shape



Forming standard shape

Taping shape (unit: mm)

Taping availability

Series name	Forming (5 mm pitch) type							Straight type						With holder*			Quantity/ package	Page
	TP1	TP2	TP3	TP6	TP7	TP8	TP19	TP4	TP5	TP15	TP16	TP17	TP18	TH8F	TH10D	TH12E		
	4.5	7.5	6.0	3.5	5.0	9.0	7.4	17.0	20.5	20.5	19.0	23.5	25.0					
SEL1010		○	○		○	○											2500	209
SEL1010M	○	○	○	○	○	○											2500	209
SEL1010XM	○	○	○	○	○	○											2500	209
SEL1050M	○	○	○	○	○	○			○								2500	210
SEL1053M									○								2500	210
SEL4010		○	○		○	○											3000	210
SEL4014	○	○	○	○	○	○			○								3000	210
SEL6010			Use SEL2010						○						○	○	4000	211
SEL6014									○								4000	211
SEL6015			Use SEL2015						○								4000	211
SEL2010	○	○	○	○	○	○											4000	212
SEL2015	○	○	○	○	○	○											4000	212
SEL1013		○	○		○	○											2500	213
SEL6013			Use SEL2013						○								4000	213
SEL2013	○	○	○	○	○	○											4000	213
SEL4027		○				○											6000	214
SEL4028		○				○											6000	214
SEL4029		○				○											6000	214
SEL6027			Use SEL4027						○								6000	214
SEL5020										○				○			4000	215
SEL5021										○							4000	215
SEL5023										○							4000	215
SEL5055										○							4000	215
SML1016/10016								○									2500	216
SML10051								○									2500	216
SML70023										○							4000	217
SML70055										○							3000	217
SID1010M	○	○	○	○	○	○											2500	222
SID1010XM	○	○	○	○	○	○											2500	222
SID1050M	○	○	○	○	○	○			○								2500	222
SID300/1003									○		○	○	○				2000	222
SID2010																	3000	222

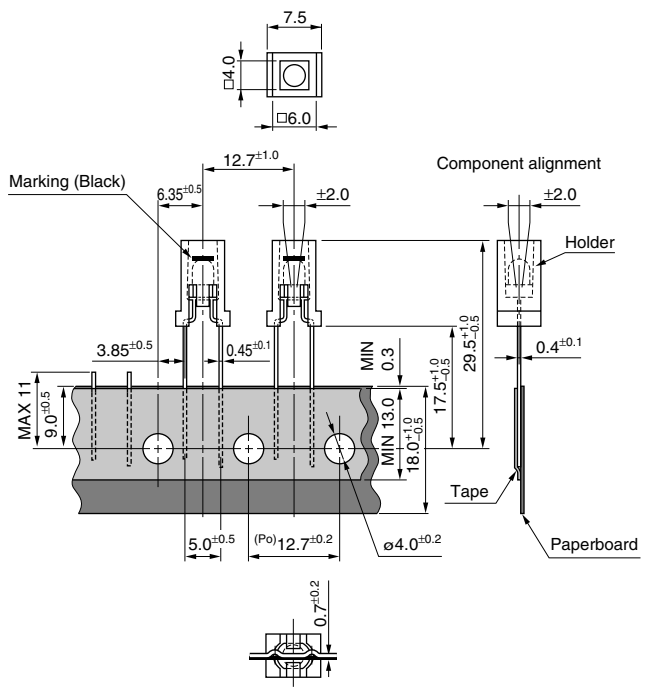
* The quantity per package for taping with holder are 1200.

Taping with holder

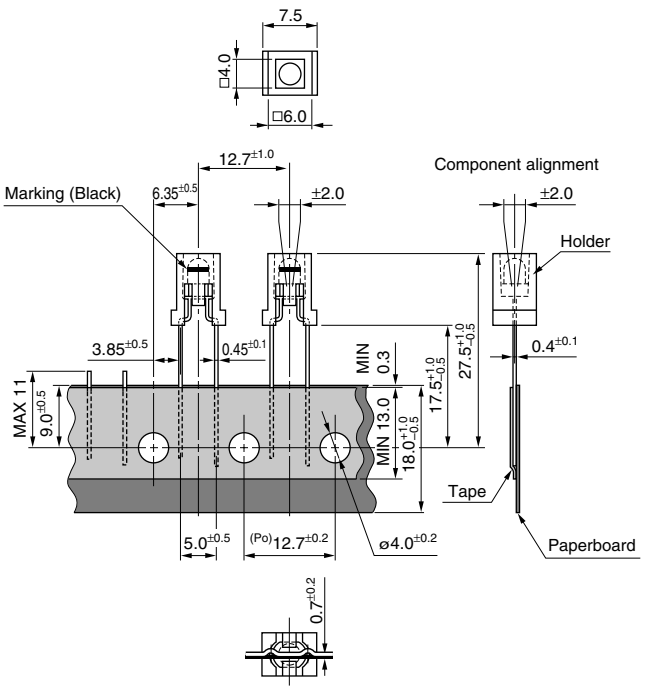
Features

- Free from the trouble of attaching LEDs to holders.
- Radial taping of 5 mm-pitch lead: Available for any inserters.

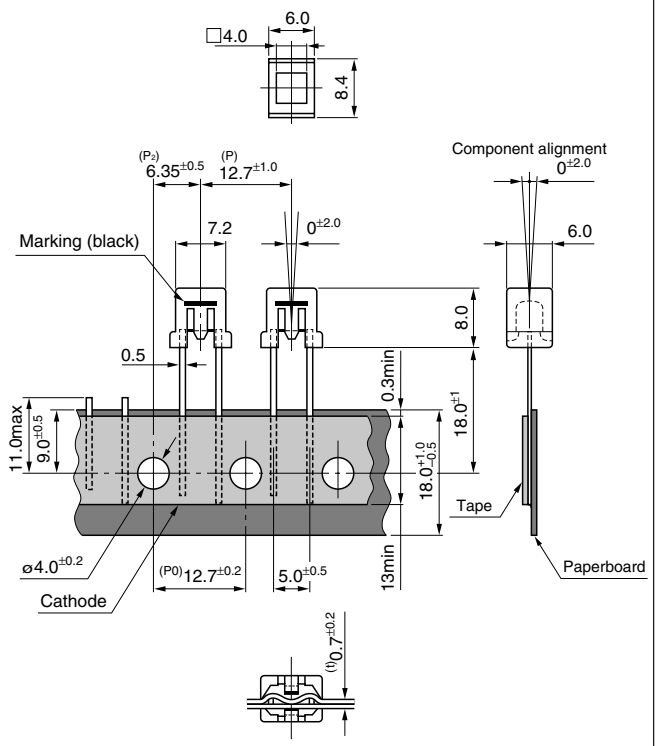
TH12E



TH10D



TH8F

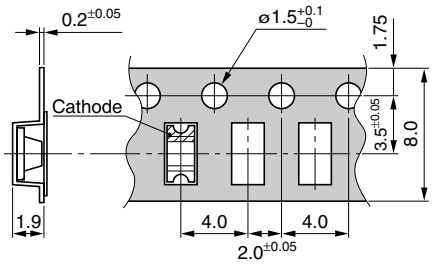


Po: The cumulative pitch error is ±1.0 mm per 20 pitches.
Dimensional tolerance: ±0.3
Unit: mm

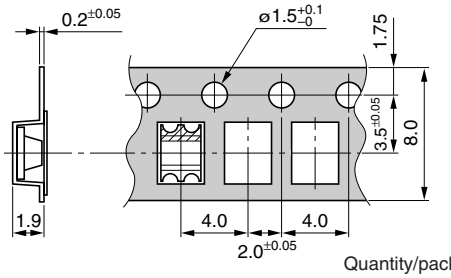
See the previous page for the part number and quantity per standard package.

Surface Mount Types

Unicolor SEC1001/1003 Series

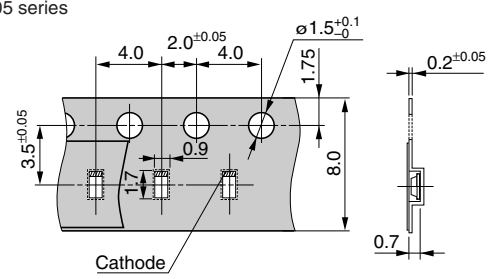


Bicolor SEC2002/2004 Series

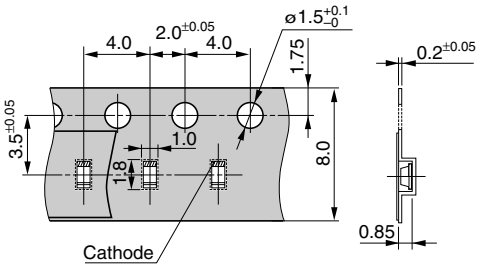


Quantity/package: 3000

SEC1005 series

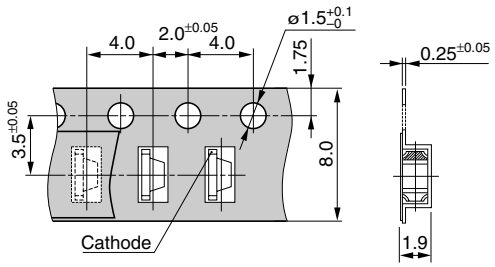


SEC1007 series



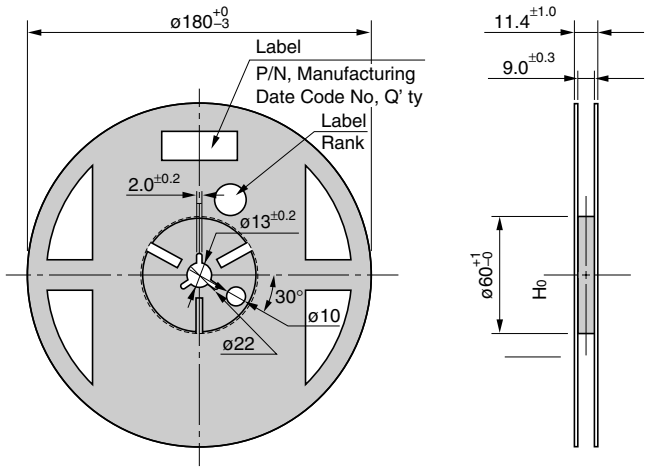
Quantity/package: 4000

SEC4001/SEC4003 series



Quantity/package: 3000

Reel specifications



General tolerance: ±0.2

Absolute Maximum Ratings

●Visible Light Unicolor Lamp

Parameter	Unit	Ratings						Conditions
		GaP	GaAsP	GaAlAs	AlGaInP	InGaN	GaN	
PD	mW	75				120		
IF	mA	30						
ΔIF	mA/°C	−0.45						25°C or higher
IFP	mA	100					70	f=1kHztw ≤100μs
VR	V	3			5			
Top	°C	−30 to +85					−30 to +80	
Tstg	°C	−30 to +100						

●Visible Light Bicolor Lamp

Parameter	Unit	Ratings					Conditions
		GaP	GaAsP	GaAlAs	AlGaInP	InGaN	
PD	mW	75				120	Same conditions for simultaneous lighting
IF	mA	30					
ΔIF	mA/°C	−0.45					25°C or higher
IFP	mA	100					f=1kHztw ≤100μs
VR	V	4			5		
Top	°C	−30 to +85					
Tstg	°C	−30 to +100					

●Visible Light Unicolor Surface Mount LEDs

Parameter	Unit	Ratings						Conditions
		GaP	GaAsP	GaAlAs	AlGaInP	InGaN	GaN	
IF	mA	30				20		
ΔIF	mA/°C	−0.45				−0.27		25°C or higher
IFP	mA	100*1				70*2		f=1kHztw ≤100μs
VR	V	3			5			
Top	°C	−30 to +85				−30 to +80		
Tstg	°C	−30 to +100						

*1: 70mA for SEC1005/1007 Series
*2: 50mA for SEC1005/1007 Series

●Visible Light Bicolor Surface Mount LEDs

Parameter	Unit	Ratings	Conditions
		SEC2002/2004	
PD	mW	75	
		(Same conditions for simultaneous lighting)	
IF	mA	30	
ΔIF	mA/°C	−0.45	25°C or higher
IFP	mA	70	f=1kHztw ≤100μs
VR	V	4	
Top	°C	−30 to +85	
Tstg	°C	−30 to +100	

●Visible Light Three Element Surface Mount LEDs

Parameter	Unit	Ratings		Conditions
		SECU3M02C		
		Red	Green/Blue	
PD	mW	75	120	When one chip lights up (same as green/blue for simultaneous lighting)
IF	mA	30		
ΔIF	mA/°C	−0.45		25°C or higher
IFP	mA	70	50	f=1kHztw ≤100μs
VR	V	5		
Top	°C	−30 to +80		
Tstg	°C	−30 to +100		

■5ϕ Round Standard LEDs (with Stopper) - External Dimensions 1

SEL1010 Series (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL1110R	Deep red	Diffused red	2.0	2.5	10	2.8	5	700	10	625	10	100	10	GaP
SEL1110S	Deep red	Transparent red	2.0	2.5	10	4.5	5	700	10	625	10	100	10	GaP
SEL1110W	Deep red	Diffused white	2.0	2.5	10	2.8	5	700	10	625	10	100	10	GaP
SEL1610C	High-luminosity red	Water clear	1.75	2.2	10	300	20	660	10	642	10	30	10	GaAlAs
SEL1610W	High-luminosity red	Diffused white	1.75	2.2	10	250	20	660	10	642	10	30	10	GaAlAs
SEL1210R	Red	Diffused red	1.9	2.5	10	26	20	630	10	620	10	35	10	GaAsP
SEL1210S	Red	Transparent red	1.9	2.5	10	75	20	630	10	620	10	35	10	GaAsP
SEL1810A	Amber	Transparent orange	1.9	2.5	10	37	10	610	10	605	10	35	10	GaAsP
SEL1810D	Amber	Diffused orange	1.9	2.5	10	18	10	610	10	605	10	35	10	GaAsP
SEL1910A	Orange	Transparent orange	1.9	2.5	10	25	10	587	10	590	10	33	10	GaAsP
SEL1910D	Orange	Diffused orange	1.9	2.5	10	14	10	587	10	590	10	33	10	GaAsP
SEL1710K	Yellow	Transparent yellow	2.0	2.5	10	65	10	570	10	571	10	30	10	GaP
SEL1710Y	Yellow	Diffused yellow	2.0	2.5	10	22	10	570	10	571	10	30	10	GaP
SEL1410E	Green	Transparent green	2.0	2.5	10	84	20	560	10	567	10	20	10	GaP
SEL1410G	Green	Diffused green	2.0	2.5	10	32	20	560	10	567	10	20	10	GaP
SEL1510C	Pure green	Water clear	2.0	2.5	10	50	20	555	10	559	10	20	10	GaP

■5ϕ Round Standard LEDs - External Dimensions 2

SEL1010M Series (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL1210RM	Red	Diffused red	1.9	2.5	10	36	20	630	10	620	10	35	10	GaAsP
SEL1210SM	Red	Transparent red	1.9	2.5	10	75	20	630	10	620	10	35	10	GaAsP
SEL1810AM	Amber	Transparent orange	1.9	2.5	10	37	10	610	10	605	10	35	10	GaAsP
SEL1810DM	Amber	Diffused orange	1.9	2.5	10	18	10	610	10	605	10	35	10	GaAsP
SEL1910AM	Orange	Transparent orange	1.9	2.5	10	34	10	587	10	590	10	33	10	GaAsP
SEL1910DM	Orange	Diffused orange	1.9	2.5	10	19	10	587	10	590	10	33	10	GaAsP
SEL1710KM	Yellow	Transparent yellow	2.0	2.5	10	65	10	570	10	571	10	30	10	GaP
SEL1410EM	Green	Transparent green	2.0	2.5	10	84	20	560	10	567	10	20	10	GaP
SEL1410GM	Green	Diffused green	2.0	2.5	10	30	20	560	10	567	10	20	10	GaP
SEL1510CM	Pure green	Water clear	2.0	2.5	10	50	20	555	10	559	10	20	10	GaP

■5ϕ Round Wide Viewing LEDs - External Dimensions 3

SEL1010XM Series (Viewing angle 2θ 1/2 - AlGaInP: 60° typ, InGaN: 30° typ)

	Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
					VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
*	SELU1610CXM-S	Ultrahigh luminosity	Deep red	Water clear	2.0	2.5	20	350	20	650	20	639	20	20	20	AlGaInP
	SELU1210CXM		Red	Water clear	2.0	2.5	20	280	20	635	20	625	20	15	20	AlGaInP
	SELU1810CXM		Amber	Water clear	2.0	2.5	20	570	20	615	20	607	20	15	20	AlGaInP
*	SELU1B10CXM-S		Light amber	Water clear	2.0	2.5	20	350	20	598	20	595	20	16	20	AlGaInP
	SELU1910CXM		Orange	Water clear	2.0	2.5	20	450	20	591	20	589	20	15	20	AlGaInP
*	SELU1710CXM		Yellow	Water clear	2.1	2.5	20	300	20	572	20	571	20	15	20	AlGaInP
*	SELU1410CXM-S		Green	Water clear	2.1	2.5	20	150	20	560	20	562	20	12	20	AlGaInP
	SELT1D10CXM-S		Pure green	Water clear	3.3	4.0	20	3200	20	512	20	520	20	35	20	InGaN
*	SELU1J10CXM		Blue green	Water clear	3.3	4.0	20	1150	20	502	20	505	20	35	20	InGaN
*	SELU1L10CXM		Aqua blue	Water clear	3.3	4.0	20	750	20	492	20	495	20	35	20	InGaN
	SELS1E10CXM-M		Blue	Water clear	3.7	4.2	20	1000	20	468	20	470	20	25	20	InGaN
	SELT1E10CXM-S		Blue	Water clear	3.3	4.0	20	1000	20	458	20	465	20	25	20	InGaN
	SELT1E10WXM-S		Blue	Diffused white	3.3	4.0	20	255	20	458	20	465	20	25	20	InGaN
	SELK1E10CXM-D	High luminosity	Blue	Water clear	3.6	4.0	20	200	20	468	20	470	20	30	20	GaN on Si

* Mass production in preparation

■5ϕ Round Narrow Viewing Angle LEDs - External Dimensions 4

SEL 1050M Series (available as Direct Mount) (Viewing angle 2θ 1/2 - Diffused lens: 30° typ, Transparent lens: 30° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL1250RM	Red		Diffused red	1.9	2.5	10	48	20	630	10	620	10	35	10	GaAsP
SEL1250SM	Red		Transparent red	1.9	2.5	10	75	20	630	10	620	10	35	10	GaAsP
SEL1850AM	Amber		Transparent orange	1.9	2.5	10	90	20	610	10	605	10	35	10	GaAsP
SEL1850DM	Amber		Diffused orange	1.9	2.5	10	60	20	610	10	605	10	35	10	GaAsP
SEL1950KM	Orange		Transparent orange	1.9	2.5	10	96	20	587	10	590	10	33	10	GaAsP
SEL1450EKM	Green		Diffused green	2.0	2.5	10	190	20	560	10	567	10	20	10	GaP
SEL1450GM-YG	Green		Diffused green	2.0	2.5	10	120	20	560	10	567	10	20	10	GaP
SEL1550CM	Pure green		Water clear	2.0	2.5	10	72	20	555	10	559	10	20	10	GaP
SEL1E50CM-S	Blue		Water clear	4.0	4.6	10	80	10	430	10	466	10	65	10	GaN
SELU1250CM	Ultrahigh luminosity	Red	Water clear	2.0	2.5	20	900	20	635	20	625	20	15	20	AlGaInP
SELT1D50CM-S		Pure green	Water clear	3.3	4.0	20	6500	20	512	20	520	20	35	20	InGaN
SELT1E50CM-S		Blue	Water clear	3.3	4.0	20	2000	20	458	20	465	20	25	20	InGaN

■4.6 × 5.6ϕ Egg-Shaped LEDs - External Dimensions 5

SEL 1053M Series (Viewing angle 2θ 1/2 - A1GaInP: 30° typ/80° typ, GaP: 30° typ/80° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL1453CEMKT	Green		Transparent green	2.0	2.5	10	140	20	560	10	567	10	20	10	GaP
SELU1253CMKT	Ultrahigh luminosity	Red	Water clear	2.0	2.5	20	200	20	635	20	625	20	15	20	AlGaInP
SELU1853CM-S		Amber	Water clear	2.0	2.5	20	550	20	611	20	605	20	17	20	AlGaInP

■4ϕ Round Standard LEDs - External Dimensions 6

SEL 4010 Series (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL4110R	Deep red	Diffused red	2.0	2.5	10	1.7	5	700	10	625	10	100	10	GaP
SEL4110S	Deep red	Transparent red	2.0	2.5	10	2.4	5	700	10	625	10	100	10	GaP
SEL4210R	Red	Diffused red	1.9	2.5	10	17	20	630	10	620	10	35	10	GaAsP
SEL4210S	Red	Transparent red	1.9	2.5	10	30	20	630	10	620	10	35	10	GaAsP
SEL4810A	Amber	Transparent orange	1.9	2.5	10	20	10	610	10	605	10	35	10	GaAsP
SEL4810D	Amber	Diffused orange	1.9	2.5	10	15	10	610	10	605	10	35	10	GaAsP
SEL4910A	Orange	Transparent orange	1.9	2.5	10	26	10	587	10	590	10	33	10	GaAsP
SEL4910D	Orange	Diffused orange	1.9	2.5	10	16	10	587	10	590	10	33	10	GaAsP
SEL4710K	Yellow	Transparent yellow	2.0	2.5	10	36	10	570	10	571	10	30	10	GaP
SEL4710Y	Yellow	Diffused yellow	2.0	2.5	10	14	10	570	10	571	10	30	10	GaP
SEL4410E	Green	Transparent green	2.0	2.5	10	87	20	560	10	567	10	20	10	GaP
SEL4410G	Green	Diffused green	2.0	2.5	10	34	20	560	10	567	10	20	10	GaP
SEL4510C	Pure green	Water clear	2.0	2.5	10	45	20	555	10	559	10	20	10	GaP
SELU4410CKT-S	Ultrahigh luminosity Green	Water clear	2.1	2.5	20	170	20	560	20	562	20	12	20	AlGaInP

■4ϕ Round Wide Vieiwng Angle LEDs - External Dimensions 7

SEL 4014 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Dominant Wavelength Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL4114R	Deep red	Diffused red	2.0	2.5	10	2.8	10	700	10	625	10	100	10	GaP
SEL4114S	Deep red	Transparent red	2.0	2.5	10	3.8	10	700	10	625	10	100	10	GaP
SEL4214R	Red	Diffused red	1.9	2.5	10	24	20	630	10	620	10	35	10	GaAsP
SEL4214S	Red	Transparent red	1.9	2.5	10	40	20	630	10	620	10	35	10	GaAsP
SEL4814A	Amber	Transparent orange	1.9	2.5	10	20	10	610	10	605	10	35	10	GaAsP
SEL4814D	Amber	Diffused orange	1.9	2.5	10	15	10	610	10	605	10	35	10	GaAsP
SEL4914A	Orange	Transparent orange	1.9	2.5	10	26	10	587	10	590	10	33	10	GaAsP
SEL4914D	Orange	Diffused orange	1.9	2.5	10	11	10	587	10	590	10	33	10	GaAsP
SEL4714K	Yellow	Transparent yellow	2.0	2.5	10	38	10	570	10	571	10	30	10	GaP
SEL4714Y	Yellow	Diffused yellow	2.0	2.5	10	27	10	570	10	571	10	30	10	GaP
SEL4414E	Green	Transparent green	2.0	2.5	10	69	20	560	10	567	10	20	10	GaP
SEL4414G	Green	Diffused green	2.0	2.5	10	48	20	560	10	567	10	20	10	GaP
SEL4514C	Pure green	Water clear	2.0	2.5	10	26	20	555	10	559	10	20	10	GaP

■3ϕ Round LEDs - External Dimensions 8

SEL 6010 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL6110R	Deep red		Diffused red	2.0	2.5	10	2.6	10	700	10	625	10	100	10	GaP
SEL6110S	Deep red		Transparent red	2.0	2.5	10	3.9	10	700	10	625	10	100	10	GaP
SEL6210R	Red		Diffused red	1.9	2.5	10	18	20	630	10	620	10	35	10	GaAsP
SEL6210S	Red		Transparent red	1.9	2.5	10	41	20	630	10	620	10	35	10	GaAsP
SEL6810A	Amber		Transparent orange	1.9	2.5	10	22	10	610	10	605	10	35	10	GaAsP
SEL6810D	Amber		Diffused orange	1.9	2.5	10	9.6	10	610	10	605	10	35	10	GaAsP
SEL6910A	Orange		Transparent orange	1.9	2.5	10	22	10	587	10	590	10	33	10	GaAsP
SEL6910D	Orange		Diffused orange	1.9	2.5	10	11	10	587	10	590	10	33	10	GaAsP
SEL6710K	Yellow		Transparent yellow	2.0	2.5	10	37	10	570	10	571	10	30	10	GaP
SEL6710Y	Yellow		Diffused yellow	2.0	2.5	10	11	10	570	10	571	10	30	10	GaP
SEL6410E	Green		Transparent green	2.0	2.5	10	90	20	560	10	567	10	20	10	GaP
SEL6410G	Green		Diffused green	2.0	2.5	10	30	20	560	10	567	10	20	10	GaP
SEL6510C	Pure green		Water clear	2.0	2.5	10	42	20	555	10	559	10	20	10	GaP
SEL6510G	Pure green		Diffused green	2.0	2.5	10	9.6	20	555	10	559	10	20	10	GaP
SEL6E10C	Blue		Water clear	4.0	4.8	20	60	20	430	20	466	20	65	20	GaN
SELK6E10C	High luminosity	Blue	Water clear	3.6	4.0	20	100	20	468	20	470	20	30	20	GaN on Si
SELU6910C-S	Ultrahigh luminosity	Orange	Water clear	2.0	2.5	20	550	20	591	20	589	20	15	20	AlGaInP

■3ϕ Round Wide Viewing Angle LEDs - External Dimensions 9

SEL 6014 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - Transparent lens: 140° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL6214S	Red		Transparent red	1.9	2.5	10	18	20	630	10	620	10	35	10	GaAsP
SEL6814A	Amber		Transparent orange	1.9	2.5	10	9.0	10	610	10	605	10	35	10	GaAsP
SEL6914A	Orange		Transparent orange	1.9	2.5	10	8.0	10	587	10	590	10	33	10	GaAsP
SEL6914W	Orange		Diffused white	1.9	2.5	10	5.0	10	587	10	590	10	33	10	GaAsP
SEL6714K	Yellow		Transparent yellow	2.0	2.5	10	66	20	570	10	571	10	30	10	GaP
SEL6714W	Yellow		Diffused white	2.0	2.5	10	30	20	570	10	571	10	30	10	GaP
SEL6414E	Green		Transparent green	2.0	2.5	10	42	20	560	10	567	10	20	10	GaP
SEL6414E-TG	Deep green		Transparent green	2.0	2.5	10	18	20	558	10	564	10	20	10	GaP
SEL6514C	Pure green		Water clear	2.0	2.5	10	12	20	555	10	559	10	20	10	GaP
SELK6D14C-D	High luminosity	Green	Water clear	3.7	4.0	20	120	20	514	20	520	20	40	20	GaN on Si
SELK6E14C-D		Blue	Water clear	3.6	4.0	20	40	20	468	20	470	20	30	20	GaN on Si
SELU6614C-S	Ultrahigh luminosity	Deep red	Water clear	2.0	2.5	20	150	20	650	20	639	20	20	20	AlGaInP
SELU6614W-S		Deep red	Diffused white	2.0	2.5	20	90	20	650	20	639	20	20	20	AlGaInP
SELU6214C		Red	Water clear	2.0	2.5	20	180	20	635	20	625	20	15	20	AlGaInP
SELU6814C-S		Amber	Water clear	2.0	2.5	20	230	20	615	20	607	20	15	20	AlGaInP
SELS6B14C		Light amber	Water clear	2.0	2.5	20	120	20	600	20	596	20	15	20	AlGaInP
SELU6914C-S		Orange	Water clear	2.0	2.5	20	180	20	591	20	589	20	15	20	AlGaInP
SELU6714C		Yellow	Water clear	2.1	2.5	20	60	20	572	20	571	20	15	20	AlGaInP
SELU6414G-S		Green	Water clear	2.1	2.5	20	30	20	560	20	562	20	12	20	AlGaInP
SELS6D14C		Pure green	Water clear	3.3	4.0	20	300	20	518	20	525	20	35	20	InGaN
SELS6E14C-M		Blue	Water clear	3.7	4.2	20	70	20	468	20	470	20	25	20	InGaN

■3ϕ Round Narrow Viewing Angle LEDs - External Dimensions 10

SEL 6015 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - Transparent lens: 30° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL6215S	Red	Transparent red	1.9	2.5	10	45	20	630	10	620	10	35	10	GaAsP
SEL6915A	Orange	Transparent orange	1.9	2.5	10	60	20	587	10	590	10	33	10	GaAsP
SEL6715C	Yellow	Water clear	2.0	2.5	10	90	20	570	10	571	10	30	10	GaP
SEL6415E	Green	Transparent green	2.0	2.5	10	81	20	560	10	567	10	20	10	GaP
SEL6515C	Pure green	Water clear	2.0	2.5	10	44	20	555	10	559	10	20	10	GaP

■3ϕ Round Standard LEDs - External Dimensions 11

SEL 2010 Series (Viewing angle 2θ 1/2 - Diffused lens: 60° typ, Transparent lens: 40° typ)

	Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
	SEL2110R	Deep red		Diffused red	2.0	2.5	10	1.8	10	700	10	625	10	100	10	GaP
	SEL2110S	Deep red		Transparent red	2.0	2.5	10	4.0	10	700	10	625	10	100	10	GaP
	SEL2110W	Deep red		Diffused white	2.0	2.5	10	1.8	10	700	10	625	10	100	10	GaP
	SEL2610C	High luminosity red		Water clear	1.75	2.2	10	60	20	660	10	642	10	30	10	GaAlAs
	SEL2210R	Red		Diffused red	1.9	2.5	10	15	20	630	10	620	10	35	10	GaAsP
	SEL2210S	Red		Transparent red	1.9	2.5	10	40	20	630	10	620	10	35	10	GaAsP
	SEL2210W	Red		Diffused white	1.9	2.5	10	15	20	630	10	620	10	35	10	GaAsP
	SEL2810A	Amber		Transparent orange	1.9	2.5	10	22	10	610	10	605	10	35	10	GaAsP
	SEL2810D	Amber		Diffused orange	1.9	2.5	10	9.0	10	610	10	605	10	35	10	GaAsP
	SEL2910A	Orange		Transparent orange	1.9	2.5	10	16	10	587	10	590	10	33	10	GaAsP
	SEL2910D	Orange		Diffused orange	1.9	2.5	10	8.0	10	587	10	590	10	33	10	GaAsP
	SEL2710K	Yellow		Transparent yellow	2.0	2.5	10	40	10	570	10	571	10	30	10	GaP
	SEL2710Y	Yellow		Diffused yellow	2.0	2.5	10	14	10	570	10	571	10	30	10	GaP
	SEL2410E	Green		Transparent green	2.0	2.5	10	77	20	560	10	567	10	20	10	GaP
	SEL2410G	Green		Diffused green	2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
	SEL2510C	Pure green		Water clear	2.0	2.5	10	43	20	555	10	559	10	20	10	GaP
	SEL2510G	Pure green		Diffused green	2.0	2.5	10	8.2	20	555	10	559	10	20	10	GaP
	SEL2E10C	Blue		Water clear	4.0	4.8	20	60	20	430	10	466	20	65	10	GaN
	SELU2610C-S	Ultrahigh luminosity	Deep red	Water clear	2.0	2.5	20	300	20	650	20	639	20	20	20	AlGaInP
	SELU2210C-S		Red	Water clear	2.0	2.5	20	350	20	632	20	624	20	20	20	AlGaInP
*	SELU2810C-S		Amber	Water clear	2.0	2.5	20	400	20	611	20	605	20	17	20	AlGaInP
	SELU2B10A-S		Light amber	Water clear	2.0	2.5	20	300	20	598	20	595	20	16	20	AlGaInP
*	SELU2910C-S		Orange	Water clear	2.0	2.5	20	350	20	591	20	589	20	15	20	AlGaInP
	SELU2910D-S		Orange	Diffused orange	2.0	2.5	20	300	20	590	20	592	20	15	20	AlGaInP
	SELU2710C		Yellow	Water clear	2.1	2.5	20	270	20	572	20	571	20	15	20	AlGaInP
*	SELU2410C-S		Green	Water clear	2.1	2.5	20	100	20	560	20	562	20	12	20	AlGaInP
	SELT2D10C-S		Pure green	Water clear	3.3	4.0	20	1800	20	512	20	520	20	35	20	InGaN
*	SELU2J10C		Blue green	Water clear	3.3	4.0	20	800	20	502	20	505	20	35	20	InGaN
	SELU2L10C		Aqua blue	Water clear	3.3	4.0	20	600	20	492	20	495	20	35	20	InGaN
	SELS2E10C		Blue	Water clear	3.7	4.3	20	300	20	468	20	470	20	26	20	InGaN
	SELT2E10C-S		Blue	Water clear	3.3	4.0	20	550	20	458	20	465	20	25	20	InGaN

* Mass production in preparation

■3ϕ Round Narrow Viewing Angle LEDs - External Dimensions 12

SEL 2015 Series (Viewing angle 2θ 1/2 - Diffused lens: 50° typ, Transparent lens: 30° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL2215R	Red		Diffused red	1.9	2.5	10	38	20	630	10	620	10	35	10	GaAsP
SEL2215S	Red		Transparent red	1.9	2.5	10	45	20	630	10	620	10	35	10	GaAsP
SEL2815A	Amber		Transparent orange	1.9	2.5	10	80	20	610	10	605	10	35	10	GaAsP
SEL2815D	Amber		Diffused orange	1.9	2.5	10	60	20	610	10	605	10	35	10	GaAsP
SEL2915A	Orange		Transparent orange	1.9	2.5	10	81	20	587	10	590	10	33	10	GaAsP
SEL2915D	Orange		Diffused orange	1.9	2.5	10	53	20	587	10	590	10	33	10	GaAsP
SEL2715K	Yellow		Transparent yellow	2.0	2.5	10	130	20	570	10	571	10	30	10	GaP
SEL2715Y	Yellow		Diffused yellow	2.0	2.5	10	110	20	570	10	571	10	30	10	GaP
SEL2415E	Green		Transparent green	2.0	2.5	10	110	20	560	10	567	10	20	10	GaP
SEL2415G	Green		Diffused green	2.0	2.5	10	72	20	560	10	567	10	20	10	GaP
SEL2515C	Pure green		Water clear	2.0	2.5	10	52	20	555	10	559	10	20	10	GaP
SELU2215R-S	Ultrahigh luminosity	Red	Diffused red	2.0	2.5	20	380	20	632	20	624	20	20	20	AlGaInP

■5ϕ Inverted-Cone Lighting-Panel LEDs - External Dimensions 13

SEL 1013 Series

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL1213C	Red	Water clear	1.9	2.5	10	7.0	20	630	10	620	10	35	10	GaAsP
SEL1813A	Amber	Transparent orange	1.9	2.5	10	8.0	20	610	10	605	10	35	10	GaAsP
SEL1913K	Orange	Transparent light orange	1.9	2.5	10	8.0	20	587	10	590	10	33	10	GaAsP
SEL1713K	Yellow	Transparent yellow	2.0	2.5	10	15	20	570	10	571	10	30	10	GaP
SEL1413E	Green	Transparent green	2.0	2.5	10	12	20	560	10	567	10	20	10	GaP
SEL1513E	Pure green	Transparent light green	2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP

■3ϕ Inverted-Cone Lighting-Panel LEDs - External Dimensions 14

SEL 6013 Series (available as Direct Mount)

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL6413E	Green		Transparent green	2.0	2.5	10	14	20	560	10	567	10	20	10	GaP
SEL6413E-TG	Deep green		Transparent green	2.0	2.5	10	6.0	20	558	10	564	10	20	10	GaP
SEL6513C	Pure green		Water clear	2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP
SELU6213C-S	Ultrahigh luminosity	Red	Water clear	2.0	2.5	20	30	20	632	20	624	20	20	20	AlGaInP
SELS6B13W		Light amber	Diffused white	2.0	2.5	20	60	20	600	20	596	20	15	20	AlGaInP

■3ϕ Inverted-Cone Lighting-Panel LEDs - External Dimensions 15

SEL 2013 Series

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL2613CS-S	High luminosity red	Transparent light red	1.75	2.2	10	20	20	660	10	642	10	30	10	GaAlAs
SEL2213C	Red	Water clear	1.9	2.5	10	7.0	20	630	10	620	10	35	10	GaAsP
SEL2813A	Amber	Transparent orange	1.9	2.5	10	8.0	20	610	10	605	10	35	10	GaAsP
SEL2913K	Orange	Transparent light orange	1.9	2.5	10	8.0	20	587	10	590	10	33	10	GaAsP
SEL2713K	Yellow	Transparent yellow	2.0	2.5	10	17	20	570	10	571	10	30	10	GaP
SEL2413E	Green	Transparent green	2.0	2.5	10	14	20	560	10	567	10	20	10	GaP
SEL2413G	Green	Diffused green	2.0	2.5	10	12	20	560	10	567	10	20	10	GaP
SEL2513E	Pure green	Transparent green	2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP

■4ϕ Bow Shaped LEDs - External Dimensions 16

SEL4027 Series (Viewing angle 2θ 1/2 - 60° typ/110° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL4227C	Red	Water clear	1.9	2.5	10	15	20	630	10	620	10	35	10	GaAsP
SEL4427EP	Green	Transparent green	2.0	2.5	10	19	20	560	10	567	10	20	10	GaP

■4ϕ Bow Shaped LEDs - External Dimensions 17

SEL6027 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - 40° typ/50° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL6227S	Red	Transparent red	1.9	2.5	10	14	20	630	10	620	10	35	10	GaAsP
SEL6927A	Orange	Transparent orange	1.9	2.5	10	10	10	587	10	590	10	33	10	GaAsP
SEL6427EP	Green	Transparent green	2.0	2.5	10	26	20	560	10	567	10	20	10	GaP

■3.1ϕ Bow Shaped LEDs - External Dimensions 18

SEL4028 Series (Viewing angle 2θ 1/2 - 40° typ/50° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL4628C-S	High luminosity red	Water clear	1.75	2.2	10	50	20	660	10	642	10	30	10	GaAlAs
SEL4228C	Red	Water clear	1.9	2.5	10	27	20	630	10	620	10	35	10	GaAsP
SEL4828A	Amber	Transparent orange	1.9	2.5	10	14	10	610	10	605	10	35	10	GaAsP
SEL4928A	Orange	Transparent orange	1.9	2.5	10	14	10	587	10	590	10	33	10	GaAsP
SEL4728K	Yellow	Transparent yellow	2.0	2.5	10	30	10	570	10	571	10	30	10	GaP
SEL4428E	Green	Transparent green	2.0	2.5	10	63	20	560	10	567	10	20	10	GaP
SEL4428B-TG	Deep green	Transparent blue	2.0	2.5	10	18	20	558	10	564	10	20	10	GaP
SEL4528C	Pure green	Water clear	2.0	2.5	10	30	20	555	10	559	10	20	10	GaP

■3.1ϕ Bow Shaped LEDs - External Dimensions 19

SEL4029 Series (available as Direct Mount) (Viewing angle 2θ 1/2 - 60° typ/110° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEL4229R	Red	Diffused red	1.9	2.5	10	21	20	630	10	620	10	35	10	GaAsP
SEL4829A	Amber	Transparent orange	1.9	2.5	10	18	10	610	10	605	10	35	10	GaAsP
SEL4929A	Orange	Transparent orange	1.9	2.5	10	18	10	587	10	590	10	33	10	GaAsP
SEL4729KH	Yellow	Transparent yellow	2.0	2.5	10	60	10	570	10	571	10	30	10	GaP
SEL4429E	Green	Transparent green	2.0	2.5	10	60	20	560	10	567	10	20	10	GaP

■5mm Pitch Lead Rectangular LEDs- External Dimensions 20

SEL 5020 Series (available as Direct Mount) (Viewing angle 2θ1/2 - 120° typ/160° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL5620C	High luminosity red		Water clear	1.75	2.2	10	25	10	660	10	642	10	30	10	GaAlAs
SEL5220S	Red		Transparent red	1.9	2.5	10	20	20	630	10	620	10	35	10	GaAsP
SEL5820A	Amber		Transparent orange	1.9	2.5	10	12	20	610	10	605	10	35	10	GaAsP
SEL5920A	Orange		Transparent orange	1.9	2.5	10	12	20	587	10	590	10	33	10	GaAsP
SEL5420E	Green		Transparent green	2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
SEL5520C	Pure green		Water clear	2.0	2.5	10	6.0	20	555	10	559	10	20	10	GaP
SEL5E20C	Blue		Water clear	4.0	4.8	20	10	20	430	20	466	20	65	20	GaN
SELK5E20C-D	High luminosity	Blue	Water clear	3.6	4.0	20	40	20	468	20	470	20	30	20	GaN on Si
SELU5620S-S	Ultrahigh luminosity	Deep red	Transparent red	2.0	2.5	20	75	20	650	20	639	20	20	20	AlGaInP
* SELU5220C-S		Red	Water clear	2.0	2.5	20	120	20	632	20	624	20	20	20	AlGaInP
SELU5820C-S		Amber	Water clear	2.0	2.5	20	150	20	611	20	605	20	17	20	AlGaInP
* SELU5B20C		Light amber	Water clear	2.0	2.5	20	120	20	600	20	596	20	15	20	AlGaInP
SELU5920A-S		Orange	Transparent orange	2.0	2.5	20	130	20	591	20	589	20	15	20	AlGaInP
SELU5720C		Yellow	Water clear	2.1	2.5	20	50	20	572	20	571	20	15	20	AlGaInP
SELU5420E-S		Green	Transparent green	2.1	2.5	20	18	20	562	20	562	20	12	20	AlGaInP
SELT5D20C-S		Pure green	Water clear	3.3	4.0	20	300	20	512	20	520	20	35	20	InGaN
SELT5E20C-S		Blue	Water clear	3.3	4.0	20	90	20	458	20	465	20	25	20	InGaN

* Mass production in preparation

■5mm Pitch Lead 3φ Lens LEDs - External Dimensions 21

SEL 5021 Series (available as Direct Mount) (Viewing angle 2θ1/2 - 40° typ/30° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL5221S	Red	Transparent red	1.9	2.5	10	35	20	630	10	620	10	35	10	GaAsP
SEL5821A	Amber	Transparent orange	1.9	2.5	10	60	20	610	10	605	10	35	10	GaAsP
SEL5921A	Orange	Transparent orange	1.9	2.5	10	60	20	587	10	590	10	33	10	GaAsP
SEL5721C	Yellow	Water clear	2.0	2.5	10	90	20	570	10	571	10	30	10	GaP
SEL5421E	Green	Transparent green	2.0	2.5	10	95	20	560	10	567	10	20	10	GaP
SEL5521C	Pure green	Water clear	2.0	2.5	10	35	20	555	10	559	10	20	10	GaP

■5mm Pitch Lead Bow Shaped LEDs - External Dimensions 22

SEL 5023 Series (available as Direct Mount) (Viewing angle 2θ1/2 - 60° typ/60° typ)

Part Number	Emitting Color		Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL5223S	Red		Transparent red	1.9	2.5	10	25	20	630	10	620	10	35	10	GaAsP
SEL5823A	Amber		Transparent orange	1.9	2.5	10	35	20	610	10	605	10	35	10	GaAsP
SEL5923A	Orange		Transparent orange	1.9	2.5	10	35	20	587	10	590	10	33	10	GaAsP
SEL5723C	Yellow		Water clear	2.0	2.5	10	60	20	570	10	571	10	30	10	GaP
SEL5423E	Green		Transparent green	2.0	2.5	10	40	20	560	10	567	10	20	10	GaP
SEL5523C	Pure green		Water clear	2.0	2.5	10	13	20	555	10	559	10	20	10	GaP
SEL5E23C	Blue		Water clear	4.0	4.8	20	20	20	430	20	466	20	65	20	GaN
SELK5E23C-D	High luminosity	Blue	Water clear	3.6	4.0	20	60	20	468	20	470	20	30	20	GaN on Si
SELU5223C-S	Ultrahigh luminosity	Red	Water clear	2.0	2.5	20	100	20	635	20	625	20	15	20	AlGaInP
SELU5823A-S		Amber	Transparent orange	2.0	2.5	20	200	20	614	20	605	20	17	20	AlGaInP
SELS5B23C		Light amber	Water clear	2.0	2.5	20	135	20	600	20	596	20	15	20	AlGaInP
SELU5923C-S		Orange	Water clear	2.0	2.5	20	145	20	591	20	589	20	15	20	AlGaInP
SELU5723C		Yellow	Water clear	2.0	2.5	20	155	20	572	20	571	20	15	20	AlGaInP
* SELT5D23C-S		Pure green	Water clear	3.3	4.0	20	400	20	512	20	520	20	35	20	InGaN
SELT5E23C-S		Blue	Water clear	3.3	4.0	20	130	20	458	20	465	20	25	20	InGaN

* Mass production in preparation

■5mm Pitch Lead Egg-Shaped LEDs - External Dimensions 23

SEL 5055 Series (available as Direct Mount) (Viewing angle 2θ1/2 - 80° typ/40° typ)

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material
SEL5255S	Red	Transparent red	1.9	2.5	10	35	20	630	10	620	10	35	10	GaAsP
SEL5955A	Orange	Transparent orange	1.9	2.5	10	25	20	587	10	590	10	33	10	GaAsP
SEL5755C	Yellow	Water clear	2.0	2.5	10	140	20	570	10	571	10	30	10	GaP

■5ϕ Round Standard Bicolor LEDs - External Dimensions 24

SML 1016/10016 Series

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark
SML11516C	A: Deep red	Water clear	2.0	2.5	10	15	20	700	10	625	10	100	10	GaP	Cathode common
	B: Pure green		2.0	2.5	10	50	20	555	10	559	10	20	10	GaP	
SML1516W	A: Deep red	Diffused white	2.0	2.5	10	6.0	20	700	10	625	10	100	10	GaP	Cathode common
	B: Pure green		2.0	2.5	10	20	20	555	10	559	10	20	10	GaP	
SML1216C	A: Red	Water clear	1.9	2.5	10	65	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Green		2.0	2.5	10	90	20	560	10	567	10	20	10	GaP	
SML1216W	A: Red	Diffused white	1.9	2.5	10	60	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Green		2.0	2.5	10	60	20	560	10	567	10	20	10	GaP	
SML1816W	A: Amber	Diffused white	1.9	2.5	10	50	20	610	10	605	10	35	10	GaAsP	Cathode common
	B: Green		2.0	2.5	10	60	20	560	10	567	10	20	10	GaP	
SML19416W	A: Orange	Diffused white	1.9	2.5	10	45	20	587	10	590	10	33	10	GaAsP	Cathode common
	B: Green		2.0	2.5	10	60	20	560	10	567	10	20	10	GaP	
SMLT12E16C-S	Ultrahigh luminosity A: Red	Water clear	2.0	2.5	20	250	20	632	20	624	20	20	20	AlGaInP	Cathode common
	B: Blue		3.3	4.0	20	700	20	458	20	465	20	25	20	InGaN	
SMLT12E16W-S	A: Red	Diffused white	2.0	2.5	20	250	20	632	20	624	20	20	20	AlGaInP	Cathode common
	B: Blue		3.3	4.0	20	223	20	458	20	465	20	25	20	InGaN	
SMLT12D16W-S	A: Red	Diffused white	2.0	2.5	20	250	20	632	20	624	20	20	20	AlGaInP	Cathode common
	B: Pure green		3.3	4.0	20	2000	20	512	20	520	20	35	20	InGaN	
SMLT18D16C-S	A: Amber	Water clear	2.0	2.5	20	800	20	611	20	605	20	17	20	AlGaInP	Cathode common
	B: Pure green		3.3	4.0	20	2000	20	512	20	520	20	35	20	InGaN	
* SMLT18D16W-S	A: Amber	Diffused white	2.0	2.5	20	300	20	611	20	605	20	17	20	AlGaInP	Cathode common
	B: Pure green		3.3	4.0	20	580	20	512	20	520	20	35	20	InGaN	
* SMLT18E16C-S	A: Amber	Water clear	2.0	2.5	20	800	20	611	20	605	20	17	20	AlGaInP	Cathode common
	B: Blue		3.3	4.0	20	465	20	458	20	465	20	25	20	InGaN	

*Mass production in preparation

■5ϕ Round Bicolor LEDs - External Dimensions 25

SML 10051 Series

Part Number	Emitting Color	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Luminous Intensity Iv (mcd) TYP	Conditions IF (mA)	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Dominant Wavelength λd (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark
SML12451W	A: Red	Diffused white	1.9	2.5	10	40	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Green		2.0	2.5	10	60	20	560	10	567	10	20	10	GaP	

■3.3 × 6 Bow Shaped Bicolor LEDs - External Dimensions 26

SML 70023 Series (available as Direct Mount)

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material	Remark
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)		
SML72423C	A: Red		Water clear	1.9	2.5	10	25	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Green			2.0	2.5	10	35	20	560	10	567	10	20	10	GaP	
SML72923C	A: Red		Water clear	1.9	2.5	10	25	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Orange			1.9	2.5	10	25	20	587	10	590	10	33	10	GaAsP	
SML78423C	A: Amber		Water clear	1.9	2.5	10	25	20	610	10	605	10	35	10	GaAsP	Cathode common
	B: Green			2.0	2.5	10	35	20	560	10	567	10	20	10	GaP	
SML79423C	A: Orange		Water clear	1.9	2.5	10	25	20	587	10	590	10	33	10	GaAsP	Cathode common
	B: Green			2.0	2.5	10	35	20	560	10	567	10	20	10	GaP	
SMLS79723C	A: Ultrahigh luminosity orange		Water clear	2.0	2.5	10	150	20	590	10	590	10	15	10	AlGaInP	Cathode common
	B: Yellow			2.0	2.5	10	40	20	570	10	571	10	30	10	GaP	
SMLU76423C-S	A: Ultrahigh luminosity red		Water clear	2.0	2.5	20	26	3	650	20	639	20	20	20	AlGaInP	Cathode common
	B: Green			2.0	2.5	20	3.8	3	560	20	567	20	20	20	GaP	
SMLU72423C-S	Ultrahigh luminosity	A: Red	Water clear	2.0	2.5	10	120	20	635	20	625	20	15	20	AlGaInP	Cathode common
		B: Green		2.2	2.5	10	30	20	560	20	567	10	15	20	AlGaInP	
SMLU79423C-S		A: Orange	Water clear	2.0	2.5	10	150	20	590	20	590	10	15	20	AlGaInP	Cathode common
		B: Green		2.2	2.5	10	30	20	560	20	567	10	15	20	AlGaInP	

*Mass production in preparation

■Egg-Shaped Bicolor LEDs - External Dimensions 27

SML 70055 Series (available as Direct Mount)

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material	Remark
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)		
SML72755C	A: Red		Water clear	1.9	2.5	10	45	20	630	10	620	10	35	10	GaAsP	Cathode common
	B: Yellow			2.0	2.5	10	75	20	570	10	571	10	30	10	GaP	
SML79255C	A: Orange		Water clear	1.9	2.5	10	40	20	587	10	590	10	33	10	GaAsP	Cathode common
	B: Red			2.0	2.5	10	45	20	630	10	620	10	35	10	GaAsP	
SML79455C	A: Orange		Water clear	1.9	2.5	10	45	20	587	10	590	10	33	10	GaAsP	Cathode common
	B: Green			2.0	2.5	10	75	20	560	10	567	10	20	10	GaP	
SMLU72755C	Ultrahigh luminosity	A: Red	Water clear	2.0	2.5	10	160	20	635	10	625	20	15	10	AlGaInP	Cathode common
		B: Yellow		2.0	2.5	10	170	20	572	10	571	20	15	10	AlGaInP	
SMLU78755C		A: Amber	Water clear	2.0	2.5	10	280	20	615	10	607	20	15	10	AlGaInP	Cathode common
		B: Yellow		2.0	2.5	10	170	20	572	10	571	20	15	10	AlGaInP	

■1.6 × 0.8 Miniature Surface Mount LEDs - External Dimensions 28

SEC 1005 Series

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SECU1605C-S	Deep red	Water clear	1.9	2.5	10	25	10	650	10	639	10	20	10	AlGaInP
SECU1205C-S	Red	Water clear	1.9	2.5	10	45	10	635	10	625	10	20	10	AlGaInP
SECU1805C-S	Amber	Water clear	1.9	2.5	10	50	10	615	10	607	10	17	10	AlGaInP
SECU1905C-S	Orange	Water clear	1.9	2.5	10	40	10	591	10	589	10	15	10	AlGaInP
SECT1D05C-S	Pure green	Water clear	3.3	3.8	10	180	10	515	10	523	10	35	10	InGaN
SECS1L05C-S	Blue green	Water clear	3.1	3.6	10	50	10	486	10	490	10	45	10	InGaN
SECT1E05C-S	Blue	Water clear	3.3	3.8	10	28	10	460	10	466	10	25	10	InGaN

■1.6 × 0.8 Miniature Surface Mount LEDs - External Dimensions 29

SEC 1007 Series

	Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
	SECS1B07C	Light amber	Water clear	1.9	2.5	10	45	10	600	10	596	10	15	10	AlGaInP
*	SECU1707C	Yellow	Water clear	2.2	2.5	10	15	10	572	10	571	10	15	10	AlGaInP

*Mass production in preparation

■Side View Surface Mount LEDs - External Dimensions 30

SEC 4001 Series

	Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
*	SEC4201C	Red	Water clear	1.9	2.5	10	10	20	630	10	620	10	35	10	GaAsP
	SEC4801C	Amber	Water clear	1.9	2.5	10	16	20	610	10	605	10	35	10	GaAsP
*	SEC4901C	Orange	Water clear	1.9	2.5	10	13	20	587	10	590	10	33	10	GaAsP
*	SEC4701C	Yellow	Water clear	2.0	2.5	10	25	20	570	10	571	10	30	10	GaP
*	SEC4401C	Green	Water clear	2.0	2.5	10	22	20	560	10	567	10	20	10	GaP
	SEC4401E-TG	Deep green	Transparent green	2.0	2.5	10	11	20	558	10	564	10	20	10	GaP
*	SEC4501C	Pure green	Water clear	2.0	2.5	10	8	20	555	10	559	10	20	10	GaP
*	SECT4D01C-S	Ultrahigh luminosity Pure green	Water clear	3.3	4.0	20	180	20	512	20	520	20	35	20	InGaN
	SECT4E01C-S	Ultrahigh luminosity Blue	Water clear	3.3	4.0	20	50	20	458	20	465	20	25	20	InGaN

*Mass production in preparation

■Side View Surface Mount LEDs (Inner Lens Type) - External Dimensions 31

SEC 4003 Series

	Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
*	SEC4203C	Red	Water clear	1.9	2.5	10	15	20	630	10	620	10	35	10	GaAsP
*	SEC4803C	Amber	Water clear	1.9	2.5	10	20	20	610	10	605	10	35	10	GaAsP
*	SEC4903C	Orange	Water clear	1.9	2.5	10	15	20	587	10	590	10	33	10	GaAsP
*	SEC4703C	Yellow	Water clear	2.0	2.5	10	35	20	570	10	571	10	30	10	GaP
*	SEC4403C	Green	Water clear	2.0	2.5	10	33	20	560	10	567	10	20	10	GaP
*	SEC4403E-TG	Deep green	Transparent green	2.0	2.5	10	15	20	558	10	564	10	20	10	GaP
	SEC4503C	Pure green	Water clear	2.0	2.5	10	10	20	555	10	559	10	20	10	GaP
*	SECU4D03C	Ultrahigh luminosity Pure green	Water clear	3.3	4.0	20	300	20	525	20	530	20	35	20	InGaN
*	SECU4E03C	Ultrahigh luminosity Blue	Water clear	3.3	4.0	20	100	20	468	20	470	20	25	20	InGaN

*Mass production in preparation

■3.0 × 1.5 Surface Mount LEDs (Flat Lens Type) - External Dimensions 32

SEC 1001 Series

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEC1101C	Deep red		Water clear	2.0	2.5	10	1.5	20	700	10	625	10	100	10	GaP
SEC1601C	High luminosity red		Water clear	1.7	2.2	10	25	20	660	10	642	10	30	10	GaAlAs
SEC1201C	Red		Water clear	1.9	2.5	10	10	20	630	10	620	10	35	10	GaAsP
SEC1801C	Amber		Water clear	1.9	2.5	10	16	20	610	10	605	10	35	10	GaAsP
SEC1901C	Orange		Water clear	1.9	2.5	10	13	20	587	10	590	10	33	10	GaAsP
SEC1701C-YG	Yellow		Water clear	2.0	2.5	10	25	20	570	10	571	10	30	10	GaP
SEC1401C	Green		Water clear	2.0	2.5	10	22	20	560	10	567	10	20	10	GaP
SEC1401E-TG	Deep green		Transparent green	2.0	2.5	10	11	20	558	10	564	10	20	10	GaP
SEC1501C	Pure green		Water clear	2.0	2.5	10	8.0	20	555	10	559	10	20	10	GaP
SEC1E01C	Blue		Water clear	3.9	4.8	20	6.0	20	430	20	466	20	65	20	GaN
SECU1701C	High luminosity	Yellow	Water clear	2.1	2.5	20	50	20	572	20	571	20	15	20	AlGaInP
SECU1401C-S		Green	Water clear	2.1	2.5	20	13	20	562	20	562	20	120	20	AlGaInP
SECU1401C-TG		Green	Water clear	2.1	2.5	20	25	20	564	20	564	20	12	20	AlGaInP
SECU1901C-S	Ultrahigh luminosity	Orange	Water clear	2.0	2.5	10	30	10	590	10	590	10	15	10	AlGaInP
SECT1D01C-S		Pure green	Water clear	3.3	4.0	20	180	20	512	20	520	20	35	20	InGaN
SECT1E01C-S		Blue	Water clear	3.3	4.0	20	50	20	458	20	465	20	25	20	InGaN

■3.0 × 1.5 Surface Mount LEDs (Inner Lens Type) - External Dimensions 33

SEC 1003 Series

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
				VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEC1603C	High luminosity red		Water clear	1.7	2.2	10	35	20	660	10	642	10	30	10	GaAlAs
SEC1203C	Red		Water clear	1.9	2.5	10	15	20	630	10	620	10	35	10	GaAsP
SEC1803C	Amber		Water clear	1.9	2.5	10	20	20	610	10	605	10	35	10	GaAsP
SEC1903C	Orange		Water clear	1.9	2.5	10	15	20	587	10	590	10	33	10	GaAsP
SEC1703C	Yellow		Water clear	2.0	2.5	10	35	20	570	10	571	10	30	10	GaP
SEC1403C	Green		Water clear	2.0	2.5	10	33	20	560	10	567	10	20	10	GaP
SEC1403E-TG	Deep green		Transparent green	2.0	2.5	10	15	20	558	10	564	10	20	10	GaP
SEC1503C	Pure green		Water clear	2.0	2.5	10	10	20	555	10	559	10	20	10	GaP
SECU1703C	High luminosity	Yellow	Water clear	2.1	2.5	20	70	20	572	20	571	20	15	20	AlGaInP
SECU1403C-S		Green	Water clear	2.1	2.5	20	40	20	562	20	562	20	12	20	AlGaInP
SECU1403C-TG		Green	Water clear	2.1	2.5	20	75	20	564	20	564	20	12	20	AlGaInP
SECS1203C	Ultrahigh luminosity	Red	Water clear	1.9	2.5	20	100	20	635	20	625	20	15	20	AlGaInP
SECS1803C		Amber	Water clear	1.9	2.5	3	10	3	615	3	607	20	15	3	AlGaInP
SECS1903C		Orange	Water clear	1.9	2.5	20	70	20	590	20	590	20	15	20	AlGaInP

■3.0 × 2.5 Surface Mount LEDs with Two Elements (Flat Lens Type) - External Dimensions 34

SEC 2002 Series

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEC2762C-YG	A: High luminosity red	Water clear	1.7	2.2	10	20	20	660	10	642	10	30	10	GaAlAs
	B: Yellow		2.0	2.5	10	20	20	570	10	571	10	30	10	GaP
SEC2462C	A: High luminosity red	Water clear	1.7	2.2	10	20	20	660	10	642	10	30	10	GaAlAs
	B: Green		2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
SEC2422C	A: Red	Water clear	1.9	2.5	10	10	20	630	10	620	10	35	10	GaAsP
	B: Green		2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
SEC2492C	A: Orange	Water clear	1.9	2.5	10	10	20	587	10	590	10	33	10	GaAsP
	B: Green		2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
SEC2592C	A: Orange	Water clear	1.9	2.5	10	10	20	587	10	590	10	33	10	GaAsP
	B: Pure green		2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP
SEC2442C	A: Green	Water clear	2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
	B: Green		2.0	2.5	10	20	20	560	10	567	10	20	10	GaP
SEC2552C	A: Pure green	Water clear	2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP
	B: Pure green		2.0	2.5	10	5.0	20	555	10	559	10	20	10	GaP

■3.0 × 2.5 Surface Mount LEDs with Two Elements (Inner Lens Type) - External Dimensions 35

SEC 2004 Series

Part Number	Emitting Color	Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material
			VF (V) TYP	MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)	
SEC2764C	A: High luminosity red	Water clear	1.7	2.2	10	50	20	660	10	642	10	30	10	GaAlAs
	B: Yellow		2.0	2.5	10	50	20	570	10	571	10	30	10	GaP
SEC2484C	A: Amber	Water clear	1.9	2.5	10	20	20	610	10	605	10	35	10	GaAsP
	B: Green		2.0	2.5	10	30	20	560	10	567	10	20	10	GaP
SEC2494C	A: Orange	Water clear	1.9	2.5	10	20	20	587	10	590	10	33	10	GaAsP
	B: Green		2.0	2.5	10	30	20	560	10	567	10	20	10	GaP
SEC2774C	A: Yellow	Water clear	2.0	2.5	10	50	20	570	10	571	10	30	10	GaP
	B: Yellow		2.0	2.5	10	50	20	570	10	571	10	30	10	GaP
SEC2554C	A: Pure green	Water clear	2.0	2.5	10	10	20	555	10	559	10	20	10	GaP
	B: Pure green		2.0	2.5	10	10	20	555	10	559	10	20	10	GaP

■Surface Mount LEDs with Three Elements - External Dimensions 36

SEC3M00 Series

Part Number	Emitting Color		Lens Color	Forward Voltage			Luminous Intensity		Peak Wavelength		Dominant Wavelength		Spectrum Half Bandwidth		Chip Material	Remark
				VF (V) TYP	VF (V) MAX	Conditions IF (mA)	Iv (mcd) TYP	Conditions IF (mA)	λP (nm) TYP	Conditions IF (mA)	λd (nm) TYP	Conditions IF (mA)	Δλ (nm) TYP	Conditions IF (mA)		
SECT3M02C-S	Ultrahigh luminosity	A: Blue	Water clear	3.3	4.0	20	70	20	458	20	465	20	25	20	InGaN	Anode common
		B: Red		1.9	2.5	20	150	20	635	20	625	20	15	20	AlGaInP	
		C: Green		3.2	4.0	20	230	20	512	20	520	20	35	20	InGaN	

Absolute Maximum Ratings

Parameter	Unit	Ratings	Conditions
IF	mA	100	
ΔIF	mA/°C	–1.33	25°C or higher
IFP	mA	1000	f=1kHztw ≤10μs
VR	V	5	
Top	°C	–30 to +85	
Tstg	°C	–30 to +100	

■5φ Round Infrared LEDs - External Dimensions 37

SID1010M Series

Part Number	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Radiant Intensity Ie (mW/sr) TYP	Conditions	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark (Dimension A)
SID1010CM	Water clear	1.3	1.5	50	130	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	7.6±0.2
SID1K10CM	Water clear	1.3	1.5	50	200	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	7.6±0.2
SID1010CXM	Water clear	1.3	1.5	50	80	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	6.9±0.2
SID1K10CXM	Water clear	1.3	1.5	50	110	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	6.9±0.2

■5φ Round Infrared LEDs - External Dimensions 38

SID1050M Series (available as Direct Mount)

Part Number	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Radiant Intensity Ie (mW/sr) TYP	Conditions	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark
SID1050CM	Water clear	1.3	1.5	50	250	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	–

■5φ Round Infrared LEDs - External Dimensions 39

SID300/1003 Series

Part Number	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Radiant Intensity Ie (mW/sr) TYP	Conditions	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark (Dimension A)
SID303C	Water clear	1.3	1.5	50	80	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	3.0±0.5
SID313BP	Transparent light violet	1.3	1.5	50	130	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	3.6±0.5
SID1003BQ	Transparent light deep blue	1.3	1.5	50	180	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	3.6±0.5
SID307BR	Transparent deep blue	1.3	1.5	50	200	(Constant voltage) Vcc=3V, R=2.2Ω	940	50	50	50	GaAs	4.2±0.5
SID1G307C	Water clear	1.5	1.8	50	50	IF=50mA	850	50	40	50	GaAlAs	4.2±0.5
SID1G313C	Water clear	1.5	1.8	50	30	IF=50mA	850	50	40	50	GaAlAs	3.6±0.5

■5φ Round Infrared LEDs - External Dimensions 40

SID 2010 Series

Part Number	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Radiant Intensity Ie (mW/sr) TYP	Conditions	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark
SID2010C	Water clear	1.3	1.5	50	7	IF=50mA	940	50	50	50	GaAs	–
SID2K10C	Water clear	1.3	1.5	50	14	IF=50mA	940	50	50	50	GaAs	–

■3 × 1.5 Surface Mount Infrared LEDs (Inner Lens Type) - External Dimensions 41

SEC 1003C Series

Part Number	Lens Color	Forward Voltage VF (V) TYP	MAX	Conditions IF (mA)	Radiant Intensity Ie (mW/sr) TYP	Conditions	Peak Wavelength λP (nm) TYP	Conditions IF (mA)	Spectrum Half Bandwidth Δλ (nm) TYP	Conditions IF (mA)	Chip Material	Remark
SEC1G03C	Water clear	1.5	1.8	50	3	IF=50mA	850	50	40	40	GaAlAs	–

■External Dimensions List

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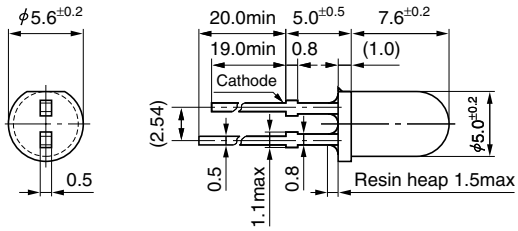

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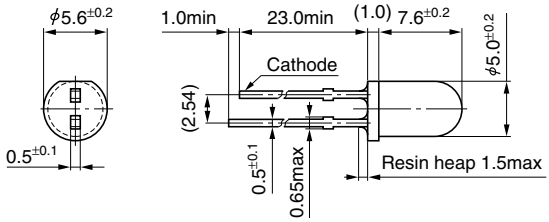

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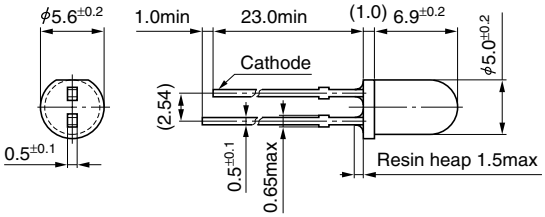

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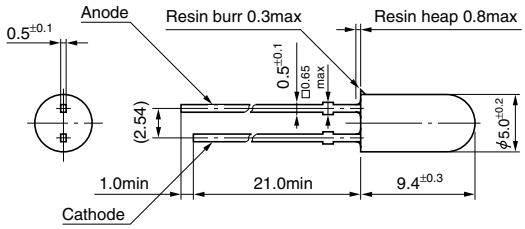

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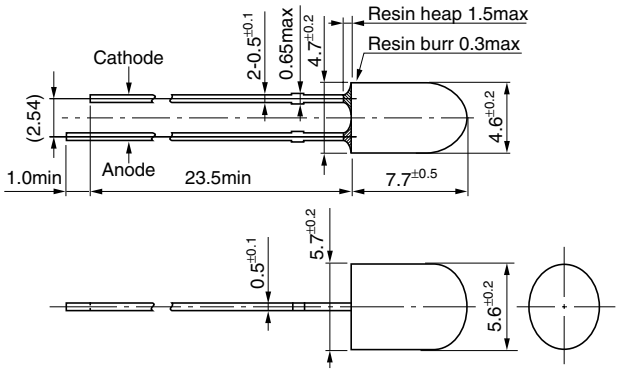

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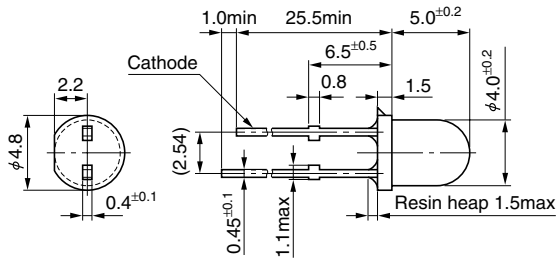

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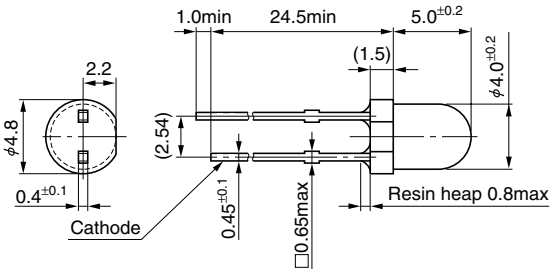

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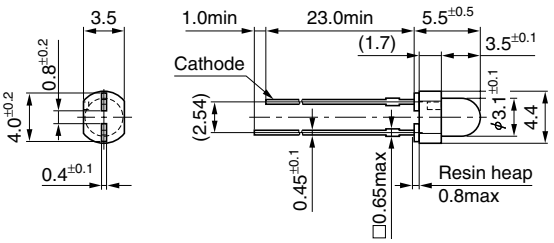

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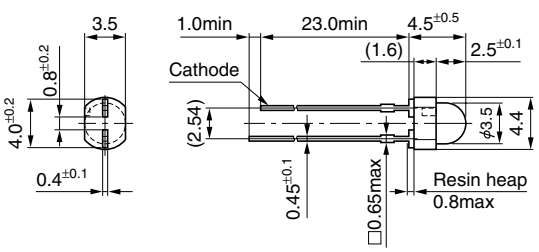

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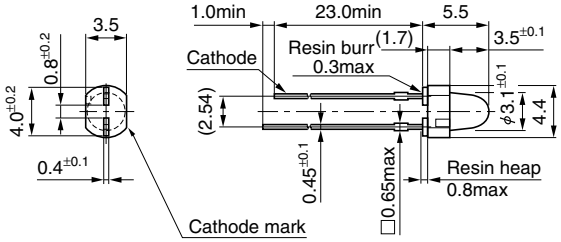

(Unit: mm) (General tolerance: ±0.3)

■External Dimensions List

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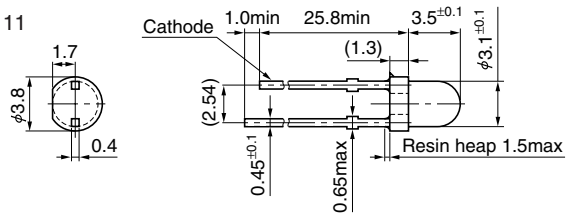

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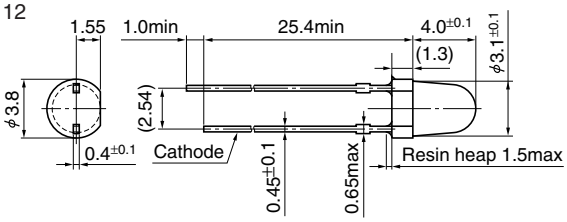

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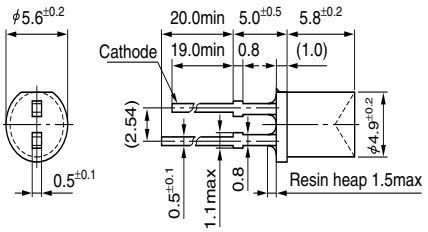

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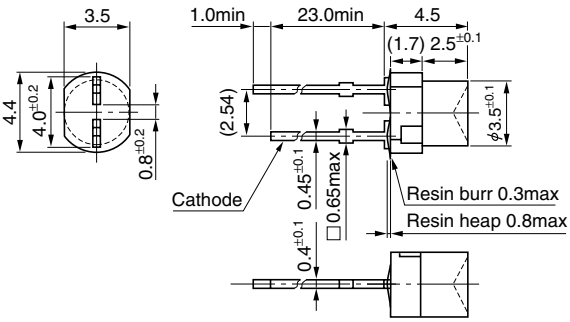

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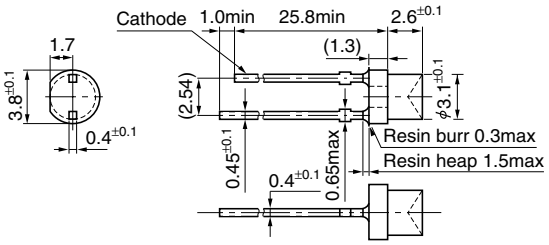

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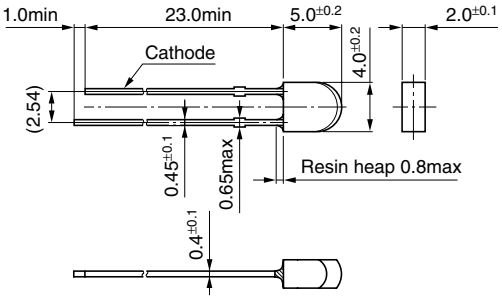

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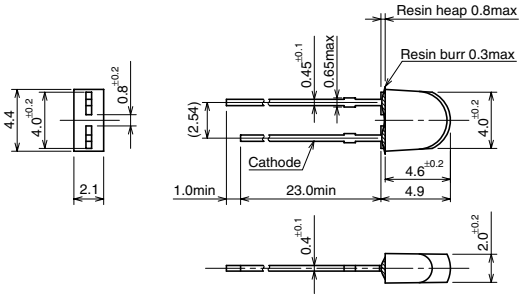

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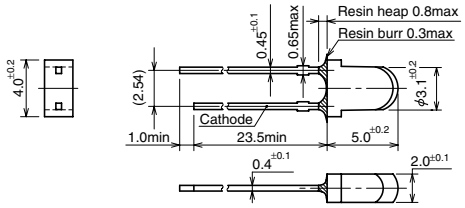

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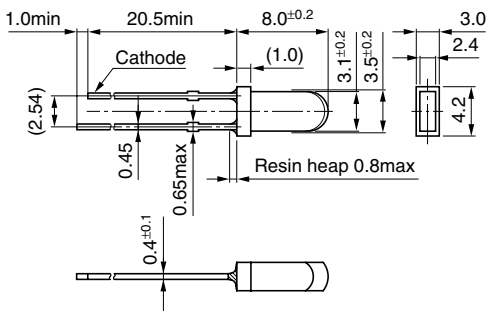

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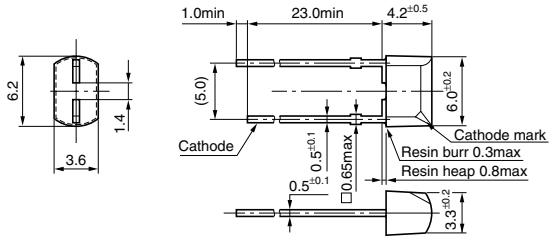

(Unit: mm) (General tolerance: ±0.3)

■External Dimensions List

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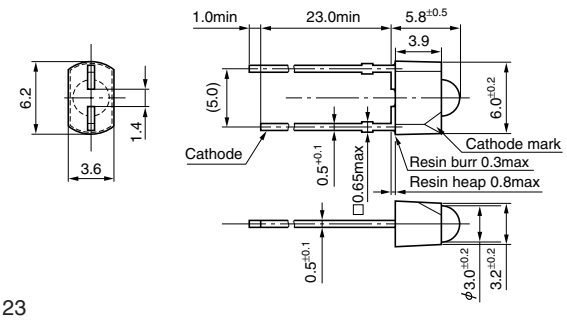

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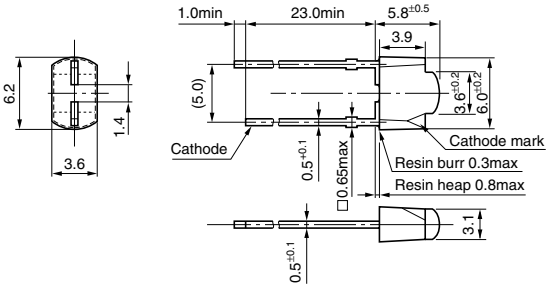

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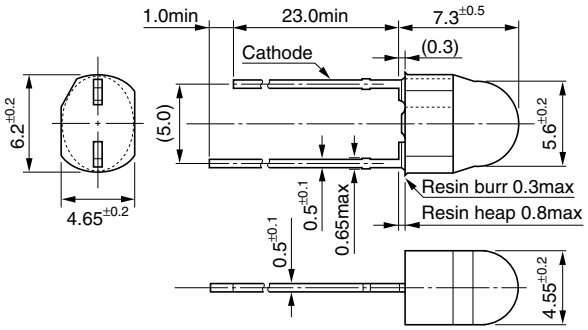

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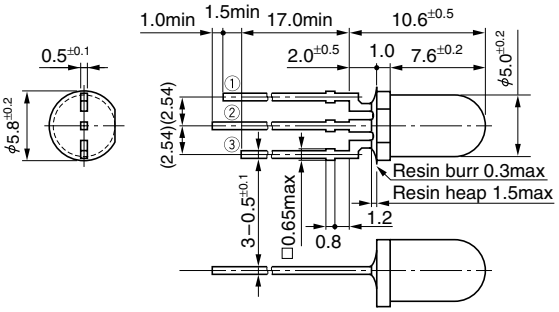

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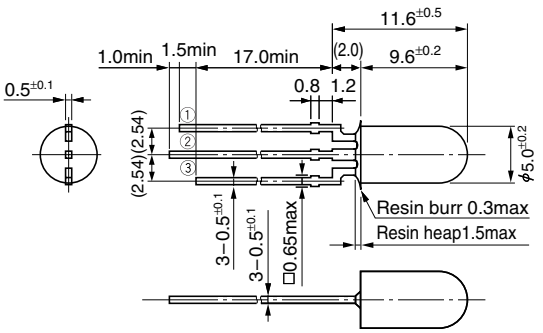

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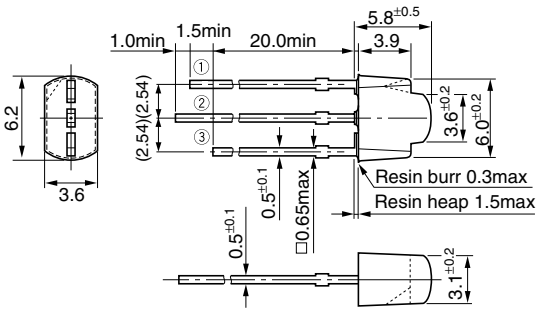

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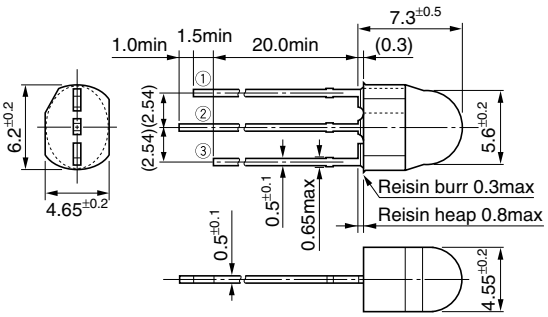

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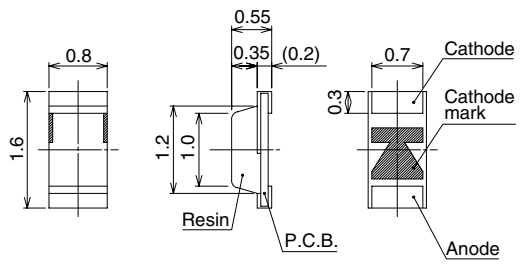

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■External Dimensions List

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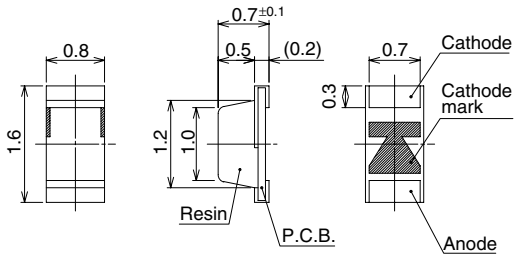

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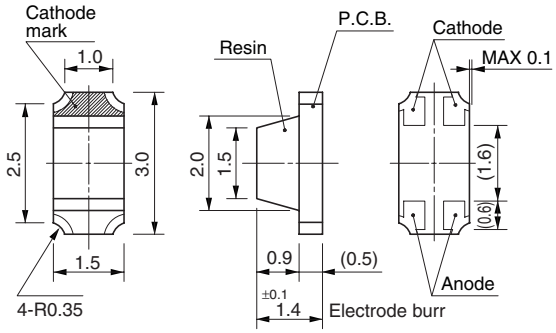

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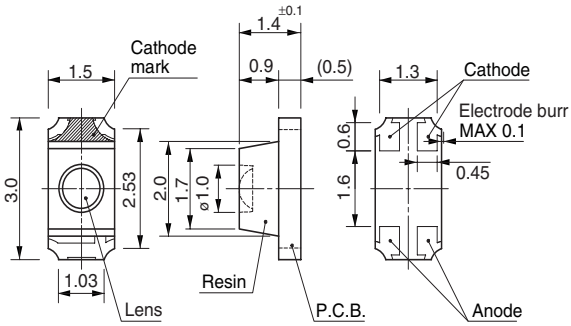

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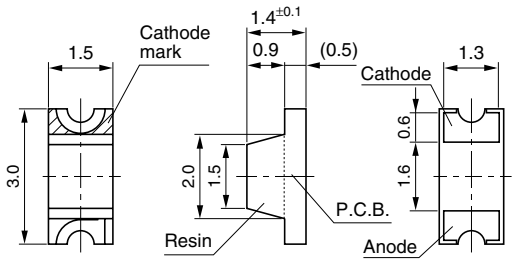

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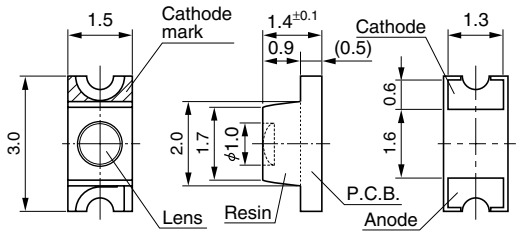

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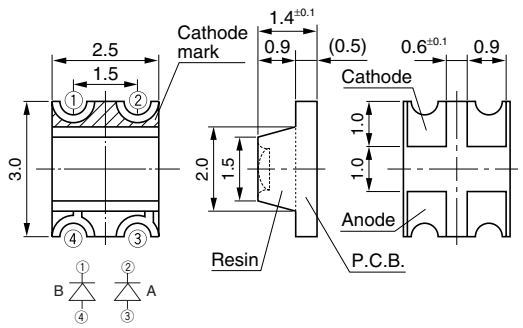

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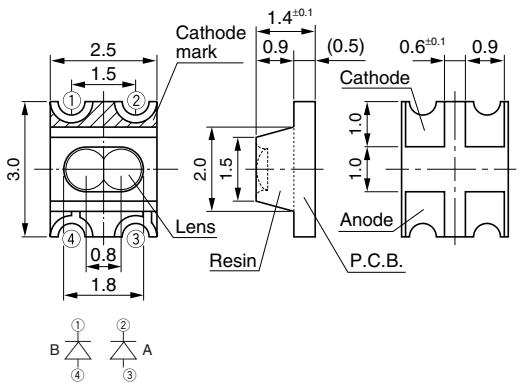

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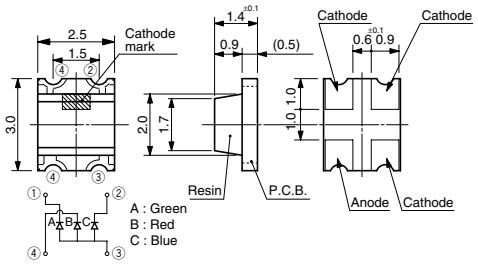

(Unit: mm) (General tolerance: ±0.3)

■External Dimensions List

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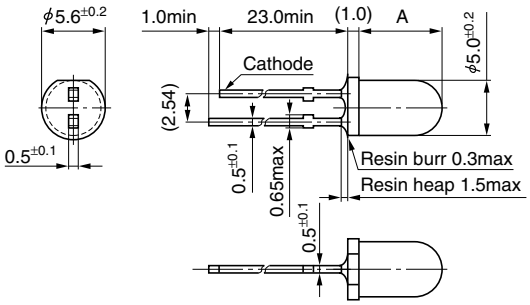

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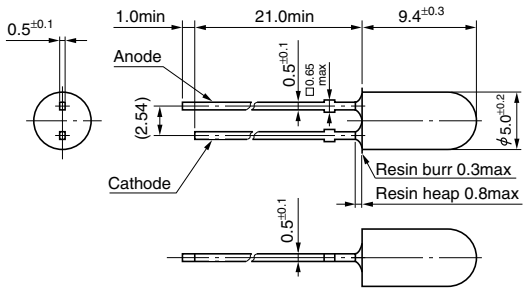

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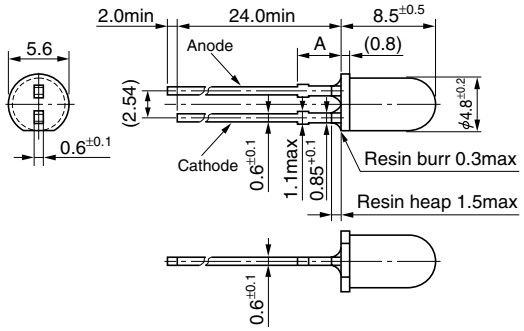

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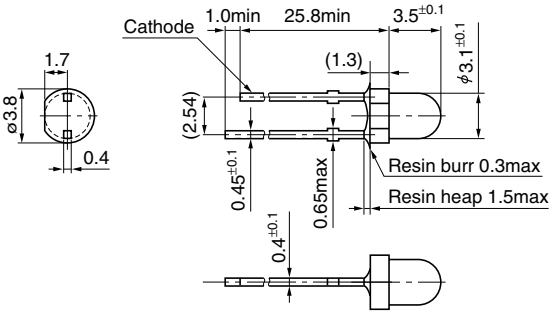

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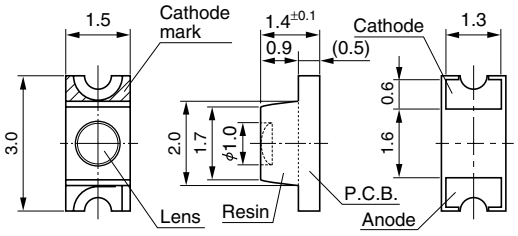

(Unit: mm) (General tolerance: ±0.3)

Ordering Information

Please place orders by integer multiples of the standard minimum package unit.

Series Name	Standard Minimum Package Unit					
	Bulk	Taping (Suffix and Quantity)				
DIP8	100 pcs (2 sticks)					
DIP16	100 pcs (4 sticks)					
SOP8	–	-TL: 1000 pcs				
SOT89-5	–	-TL: 1000 pcs				
TSSOP-24	–	-TL: 2800 pcs				
HSOP16	–	-TL: 1400 pcs				
PS16 (SMD16Pin)	–	V1: 1200 pcs				
PS4 (SMD4Pin)	–	V1: 2000 pcs				
TO252-5	–	-TL: 3000 pcs				
TO263-5	–	-TL: 800 pcs				
TO220F-5 (FM205)	100 pcs/600 pcs*					
EI–12.5/19 core (SI-8400/8500)	100 pcs					
ZIP15/18/21/23 (SLA)	108pcs (6 sticks)					
SIP12/15/21 (SLA)	108pcs (6 sticks)					
ZIP15 (SMA)	144pcs (8 sticks)					
SIP12/15 (SMA)	144pcs (8 sticks)					
SIP 8/10 (STA)	100 pcs					
TO220S (Straight)	100 pcs (2 sticks)					
TO-220S (Surface-Mount)	–	VR: 1000 pcs	VL: 1000 pcs			
TO-220 (MT-25)	100 pcs					
TO-220F (FM20)	100 pcs					
TO220F-2Pin	100 pcs					
TO-3P (MT100)	100 pcs					
TO-3PF (FM100)	100 pcs					
TO3PF-2Pin	100 pcs					
MT-200	100 pcs					
Diode (ϕ10 body/ϕ1.5 lead)	100 pcs					
Diode (ϕ2.4 body/ϕ0.6 lead)	100 pcs	V: 5000 pcs	V1: 3000 pcs	V0: 3000 pcs	WS: 2500 pcs	WK: 2500 pcs
Diode (ϕ2.7 body/ϕ0.6 lead)	100 pcs	V: 5000 pcs	V1: 2000 pcs	V0: 2000 pcs	W: 4000 pcs	
Diode (ϕ2.7 body/ϕ0.78 lead)	100 pcs	V: 5000 pcs	V1: 2000 pcs	V0: 2000 pcs		
Diode (ϕ4.0 body/ϕ0.78 lead)	100 pcs	V: 3000 pcs	V1: 1000 pcs			
Diode (ϕ4.0 body/ϕ0.98 lead)	100 pcs	V: 3000 pcs	V1: 1000 pcs			
Diode (ϕ5.2 body/ϕ1.2 lead)	100 pcs	V3: 1500 pcs	V4: 1000 pcs			
Diode (ϕ6.5 body/ϕ1.4 lead)	100 pcs					
Diode (Compact-Surface-Mount)	–	VL: 3000 pcs	VR: 3000pcs			
Diode (SFP/SJP-Surface-Mount)	–	V/VR: 1800 pcs				
Diode (RBV-40)	100 pcs					
Diode (RBV-60)	100 pcs					
SZ-10 (Surface Mount)	–	VL: 750 pcs	VR: 750 pcs			
High voltage rectifier diode	–	V1: 5000 pcs	VD: 8000 pcs			
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LED Chip	–	Refer to Page 207 for Taping Qty				
LED Bullet	100 pcs (Plastic bag)	Refer to Page 205 for Taping Qty				

*: Contact your local sales representative for order quantity.

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Discontinued Products and Service Parts (NND)

The shapes and electrical characteristics of the following products may be changed. When using them, check if they can installed properly and also evaluate them.

■Discontinued products

Part No.	Alternative	Category
2SA744	2SA1694	Transistors
2SA745	2SA1695	Transistors
2SA746	2SA1695	Transistors
2SA747	2SA1695	Transistors
2SA764	2SA1725	Transistors
2SA765	2SA1726	Transistors
2SA768	2SA1262,1488,1488A	Transistors
2SA769	2SA1262,1488,1488A	Transistors
2SA770	2SA1725,1726	Transistors
2SA771	2SA1725,1726	Transistors
2SA807	2SA1693	Transistors
2SA808	2SA1694	Transistors
2SA878	–	Transistors
2SA892	2SB1351	Transistors
2SA907	2SA1215	Transistors
2SA908	2SA1216	Transistors
2SA909	2SA1295	Transistors
2SA957	2SA1667	Transistors
2SA958	2SA1668	Transistors
2SA971	–	Transistors
2SA980	2SA1694	Transistors
2SA981	2SA1694	Transistors
2SA982	2SA1694	Transistors
2SA1067	–	Transistors
2SA1068	–	Transistors
2SA1102	2SA1693	Transistors
2SA1103	2SA1694	Transistors
2SA1104	2SA1694	Transistors
2SA1105	2SA1695	Transistors
2SA1106	2SA1695	Transistors
2SA1116	2SA1493	Transistors
2SA1117	2SA1494	Transistors
2SA1135	2SA1693	Transistors
2SA1169	2SA1493	Transistors
2SA1170	2SA1494	Transistors
2SA1187	–	Transistors
2SA1205	2SA1746	Transistors
2SA1355	2SA1262,1488	Transistors
2SA1489	2SA1693	Transistors
2SA1490	2SA1694	Transistors
2SA1670	2SA1907	Transistors
2SA1671	2SA1908	Transistors
2SA1901	2SA1488	Transistors
2SA2003	–	Transistors
2SA2042	–	Transistors
2SB622	–	Transistors
2SB711	2SB1259,1351	Transistors
2SB712	2SB1259,1351	Transistors
2SB1005	2SB1257	Transistors
2SB1352	–	Transistors
2SB1476	2SB1685	Transistors
2SB1586	2SB1687	Transistors
2SB1620	–	Transistors
2SB1621	–	Transistors
2SB1624	2SB1685	Transistors
2SB1625	2SB1687	Transistors
2SB1659	2SB1686	Transistors
2SB1677	–	Transistors
2SB1692	–	Transistors
2SC1107	2SC3179,3851	Transistors
2SC1108	2SC3851A	Transistors

Part No.	Alternative	Category
2SC1109	2SC3179,3851	Transistors
2SC1110	2SC3851A	Transistors
2SC1111	2SC4467,4468	Transistors
2SC1112	2SC4467,4468	Transistors
2SC1113	2SC4511,4512	Transistors
2SC1114	–	Transistors
2SC1115	2SC4468	Transistors
2SC1116	2SC4468	Transistors
2SC1402	2SC4467,4468	Transistors
2SC1403	2SC4467,4468	Transistors
2SC1436	–	Transistors
2SC1437	–	Transistors
2SC1440	–	Transistors
2SC1441	–	Transistors
2SC1442	–	Transistors
2SC1443	–	Transistors
2SC1444	2SC4511,4512	Transistors
2SC1445	2SC4511,4512	Transistors
2SC1454	–	Transistors
2SC1477	–	Transistors
2SC1504	2SC2023	Transistors
2SC1577	2SC3833	Transistors
2SC1578	2SC3833	Transistors
2SC1579	2SC4706	Transistors
2SC1580	2SC4706	Transistors
2SC1584	2SC2921- 2922,3264	Transistors
2SC1585	2SC2921- 2922,3264	Transistors
2SC1586	2SC3264	Transistors
2SC1618	2SC4466,4467	Transistors
2SC1619	2SC4466,4467	Transistors
2SC1629	2SD2045	Transistors
2SC1664	2SD2642	Transistors
2SC1768	–	Transistors
2SC1777	–	Transistors
2SC1783	–	Transistors
2SC1786	–	Transistors
2SC1826	2SC3179,3851,3851A	Transistors
2SC1827	2SC3179,3851,3851A	Transistors
2SC1828	2SC3832,3830	Transistors
2SC1829	–	Transistors
2SC1830	2SD2082,2083	Transistors
2SC1831	–	Transistors
2SC1832	–	Transistors
2SC1888	2SC3852,3852A	Transistors
2SC1889	2SC3852,3852A	Transistors
2SC2022	2SC2023	Transistors
2SC2147	–	Transistors
2SC2198	2SC4024	Transistors
2SC2199	2SC4131	Transistors
2SC2256	–	Transistors
2SC2260	2SC4467	Transistors
2SC2261	2SC4467	Transistors
2SC2262	2SC4467	Transistors
2SC2302	2SC3832	Transistors
2SC2303	2SC3833	Transistors
2SC2304	2SC3833	Transistors
2SC2305	–	Transistors
2SC2306	2SC4140	Transistors
2SC2307	2SC3833	Transistors
2SC2317	2SD2016	Transistors
2SC2354	2SC2023	Transistors

Part No.	Alternative	Category
2SC2364	–	Transistors
2SC2365	2SC3927	Transistors
2SC2491	2SC4024	Transistors
2SC2492	–	Transistors
2SC2493	–	Transistors
2SC2577	2SC4466	Transistors
2SC2578	2SC4467	Transistors
2SC2579	2SC4467	Transistors
2SC2580	2SC4468	Transistors
2SC2581	2SC4468	Transistors
2SC2607	2SC3857	Transistors
2SC2608	2SC3858	Transistors
2SC2665	2SC4466	Transistors
2SC2723	2SC4140	Transistors
2SC2761	–	Transistors
2SC2773	2SC3857	Transistors
2SC2774	2SC3858	Transistors
2SC2809	–	Transistors
2SC2810A	2SC4518	Transistors
2SC2825	2SD2045	Transistors
2SC2838	–	Transistors
2SC2900	–	Transistors
2SC3409	2SC3679	Transistors
2SC3520	2SC4140	Transistors
2SC3706	–	Transistors
2SC3830	2SC4518	Transistors
2SC3831	2SC3927	Transistors
2SC3853	2SC4466	Transistors
2SC3890	2SC4546	Transistors
2SC3909	2SC3680	Transistors
2SC4023	2SC4301	Transistors
2SC4065	–	Transistors
2SC4073	2SC5130	Transistors
2SC4130	2SC4546	Transistors
2SC4199	2SC4301	Transistors
2SC4199A	2SC4301	Transistors
2SC4296	2SC4138	Transistors
2SC4299	2SC3678	Transistors
2SC4302	2SC4301	Transistors
2SC4303	2SC4301	Transistors
2SC4303A	2SC4301	Transistors
2SC4327	–	Transistors
2SC4385	2SC5099	Transistors
2SC4387	2SC5101	Transistors
2SC4418	2SC5130	Transistors
2SC4494	2SC4495	Transistors
2SC4517	2SC4518	Transistors
2SC4662	2SC5130	Transistors
2SC4756	2SC4301	Transistors
2SC4820	2SC4518	Transistors
2SC4907	2SC4518	Transistors
2SC4908	2SC4304	Transistors
2SC5002	2SC4301	Transistors
2SC5003	2SC4301	Transistors
2SC5124	2SC4301	Transistors
2SC5239	2SC4518	Transistors
2SC5249	2SC4518	Transistors
2SC5271	–	Transistors
2SC5370	–	Transistors
2SC5487	–	Transistors
2SD15	2SC4468	Transistors
2SD16	2SC4468	Transistors
2SD17	2SC4468	Transistors
2SD18	2SC4468	Transistors
2SD80	2SC4466,4467	Transistors

Part No.	Alternative	Category
2SD81	2SC4466,4467	Transistors
2SD82	2SC4466,4467	Transistors
2SD83	2SC4466,4467	Transistors
2SD84	2SC4466,4467	Transistors
2SD90	2SC3179,3851,3851A	Transistors
2SD91	2SC3179,3851,3851A	Transistors
2SD92	2SC3179,3851,3851A	Transistors
2SD93	2SC3179,3851,3851A	Transistors
2SD94	2SC3179,3851,3851A	Transistors
2SD163	2SC4468	Transistors
2SD164	2SC4468	Transistors
2SD165	2SC4468	Transistors
2SD166	2SC4468	Transistors
2SD201	2SC4466,4467	Transistors
2SD202	2SC4466,4467	Transistors
2SD203	2SC4466,4467	Transistors
2SD211	2SC4468	Transistors
2SD212	2SC4468	Transistors
2SD213	2SC4468	Transistors
2SD214	2SC4468	Transistors
2SD219	2SC3179,3851,3851A	Transistors
2SD219F	2SC3179,3851,3851A	Transistors
2SD220	2SC3179,3851,3851A	Transistors
2SD220F	2SC3179,3851,3851A	Transistors
2SD221	2SC3179,3851,3851A	Transistors
2SD221F	2SC3179,3851,3851A	Transistors
2SD222	2SC3179,3851,3851A	Transistors
2SD223	2SC3179,3851,3851A	Transistors
2SD224	2SC3179,3851,3851A	Transistors
2SD236	2SC3179,3851,3851A	Transistors
2SD237	2SC3179,3851,3851A	Transistors
2SD238	2SC3179,3851,3851A	Transistors
2SD241	2SC3179,3851,3851A	Transistors
2SD242	2SC3179,3851,3851A	Transistors
2SD243	2SC3179,3851,3851A	Transistors
2SD244	2SC3179,3851,3851A	Transistors
2SD256	2SC3179,3851,3851A	Transistors
2SD257	2SC3179,3851,3851A	Transistors
2SD258	2SC3179,3851,3851A	Transistors
2SD259	2SC3179,3851,3851A	Transistors
2SD419	2SD1769,1785	Transistors
2SD420	2SD1769,1785	Transistors
2SD421	2SD1769,1785	Transistors
2SD556	2SC4468	Transistors
2SD557	2SC4468	Transistors
2SD593	2SC4020	Transistors
2SD594	2SC4020	Transistors
2SD605	–	Transistors
2SD606	–	Transistors
2SD614	2SD1769,1785	Transistors
2SD615	2SD1769,1785	Transistors
2SD617	2SD2082	Transistors
2SD721	2SD2081	Transistors
2SD722	2SD2081	Transistors
2SD807	2SC3679	Transistors
2SD810	2SC4024	Transistors
2SD971	–	Transistors
2SD972	2SD1796	Transistors
2SD1031	2SD1769,1785	Transistors
2SD1170	2SD2045	Transistors
2SD1532	2SD2015	Transistors
2SD2231	2SD2641	Transistors
2SD2437	2SD2643	Transistors
2SD2488	–	Transistors
2SD2489	–	Transistors

Part No.	Alternative	Category
2SD2619	–	Transistors
2SJ425	–	MOS FETs
2SJ426	–	MOS FETs
2SK979	–	MOS FETs
2SK1180	–	MOS FETs
2SK1181	–	MOS FETs
2SK1184	–	MOS FETs
2SK1185	–	MOS FETs
2SK1186	–	MOS FETs
2SK1187	–	MOS FETs
2SK1189	–	MOS FETs
2SK1190	–	MOS FETs
2SK1193	–	MOS FETs
2SK1343	–	MOS FETs
2SK1367	2SK3199	MOS FETs
2SK1368	2SK2701	MOS FETs
2SK1369	2SK2704	MOS FETs
2SK1370	–	MOS FETs
2SK1711	2SK2778	MOS FETs
2SK1712	–	MOS FETs
2SK1713	–	MOS FETs
2SK1714	–	MOS FETs
2SK1715	–	MOS FETs
2SK2156A	–	MOS FETs
2SK2207	2SK2943	MOS FETs
2SK2208	2SK2945	MOS FETs
2SK2238	2SK2803	MOS FETs
2SK2239	2SK3199	MOS FETs
2SK2240	2SK3199	MOS FETs
2SK2241	2SK2702	MOS FETs
2SK2242	2SK2702	MOS FETs
2SK2243	2SK2702	MOS FETs
2SK2244	2SK2704	MOS FETs
2SK2245	–	MOS FETs
2SK2421	–	MOS FETs
2SK2706	–	MOS FETs
2SK2708	–	MOS FETs
2SK2804	2SK3199	MOS FETs
2SK3200	–	MOS FETs
2SK3332	–	MOS FETs
2SK3460	–	MOS FETs
CTB-23L	FMB-24L	Diodes
CTB-24	FMB-24	Diodes
CTB-24L	FMB-24L	Diodes
CTB-3154	–	Diodes
CTB-3204	–	Diodes
CTB-33	–	Diodes
CTB-33S	–	Diodes
CTB-34	–	Diodes
CTB-34D	–	Diodes
CTB-34M	–	Diodes
CTB-34S	–	Diodes
CTB-34T	–	Diodes
CTG-12S	FMG-12S	Diodes
CTG-14R	FMG-14R	Diodes
CTG-14S	FMG-14S	Diodes
CTG-21R	FMG-22R	Diodes
CTG-21S	FMG-22S	Diodes
CTG-22R	FMG-22R	Diodes
CTG-22S	FMG-22S	Diodes
CTG-23R	FMG-23R	Diodes
CTG-23S	FMG-23S	Diodes
CTG-24R	FMG-24R	Diodes
CTG-24S	FMG-24S	Diodes
CTG-24U	FMG-24U	Diodes

Part No.	Alternative	Category
CTG-26S	FMG-26S	Diodes
CTG-2TR	FMG-22S	Diodes
CTG-2TS	FMG-24U	Diodes
CTG-31R	–	Diodes
CTG-31S	–	Diodes
CTG-32R	–	Diodes
CTG-32S	–	Diodes
CTG-32U	–	Diodes
CTG-33R	–	Diodes
CTG-33S	–	Diodes
CTG-34R	–	Diodes
CTG-34S	–	Diodes
CTG-34U	–	Diodes
CTG-3TS	–	Diodes
CTG-G12S	FML-G12S	Diodes
CTL-12S	FML-12S	Diodes
CTL-21S	FML-21S	Diodes
CTL-22S	FML-22S	Diodes
CTL-32S	–	Diodes
CTL-33S	–	Diodes
CTL-34S	–	Diodes
CTL-G12S	FML-G12S	Diodes
CTM-21R	FMM-22R	Diodes
CTM-21S	FMM-22S	Diodes
CTM-22R	FMM-22R	Diodes
CTM-22S	FMM-22S	Diodes
CTM-22U	FMM-24U	Diodes
CTM-24R	FMM-24R	Diodes
CTM-24S	FMM-24S	Diodes
CTM-26R	FMM-26R	Diodes
CTM-26S	FMM-26S	Diodes
CTM-26U	–	Diodes
CTM-31R	–	Diodes
CTM-31S	–	Diodes
CTM-32R	–	Diodes
CTM-32S	–	Diodes
CTM-34R	–	Diodes
CTM-34S	–	Diodes
CTM-36R	–	Diodes
CTM-36S	–	Diodes
CTP-G2FR	FMP-G2FS	Diodes
CTS-3FU	FMP-3FU	Diodes
CTS-G3FR	FMQ-G5FMS	Diodes
CTU-12R	FMU-12R	Diodes
CTU-12S	FMU-12S	Diodes
CTU-21R	FMU-21R	Diodes
CTU-21S	FMU-21S	Diodes
CTU-22R	FMU-22R	Diodes
CTU-22S	FMU-22S	Diodes
CTU-24R	FMU-24R	Diodes
CTU-24S	FMU-24S	Diodes
CTU-26R	FMU-26R	Diodes
CTU-26S	FMU-26S	Diodes
CTU-31R	–	Diodes
CTU-31S	–	Diodes
CTU-32R	–	Diodes
CTU-32S	–	Diodes
CTU-34R	–	Diodes
CTU-34S	–	Diodes
CTU-36R	–	Diodes
CTU-36S	–	Diodes
CTU-38R	–	Diodes
CTU-38S	–	Diodes
CTU-G26R	FMU-G26S	Diodes
CTU-G2DR	FMU-G2FS	Diodes

Part No.	Alternative	Category
CTU-G3DR	–	Diodes
CTX-12SL	FMX-12SL	Diodes
EK 02	–	Diodes
EK 12	–	Diodes
EK 13	EK 14	Diodes
EP01Z	–	Diodes
ET014	ET0141	PNPN switch elements
FKV560	–	MOS FETs
FMB-22H	–	Diodes
FMB-22L	–	Diodes
FMB-23L	–	Diodes
FMB-32	–	Diodes
FMB-32M	–	Diodes
FMB-G12L	–	Diodes
FMB-G22H	–	Diodes
FMS-3FUM	–	Diodes
HVR-1X-40B	–	Diodes
PZ 127	–	Diodes
RB-150	–	Diodes
RB-151	–	Diodes
RB-152	–	Diodes
RB-154	–	Diodes
RB-156	–	Diodes
RB-158	–	Diodes
RB-401	–	Diodes
RB-402	–	Diodes
RB-402U	–	Diodes
RB-404	–	Diodes
RB-406	–	Diodes
RB-40C	–	Diodes
RB-601	–	Diodes
RB-601F	–	Diodes
RB-602	–	Diodes
RB-602F	–	Diodes
RB-604	–	Diodes
RB-606	–	Diodes
RBA-1002	RBV-4102	Diodes
RBA-1004B	–	Diodes
RBA-401	RBV-401	Diodes
RBA-402	RBV-402	Diodes
RBA-402L	RBV-402L	Diodes
RBA-404B	RBV-404B	Diodes
RBA-406B	RBV-406B	Diodes
SAP09N	–	Transistors
SAP09P	–	Transistors
SDC01	SDC03	Transistors
SDK01M	SDK03M	ICs (Motor Driver)
SE005A	–	ICs (Error Amplifier)
SE005B	–	ICs (Error Amplifier)
SE013E	–	ICs (Error Amplifier)
SE034N	–	ICs (Error Amplifier)
SE040N	–	ICs (Error Amplifier)
SE070N	–	ICs (Error Amplifier)
SE075N	–	ICs (Error Amplifier)
SE080N	–	ICs (Error Amplifier)
SE095N	–	ICs (Error Amplifier)
SE103N	–	ICs (Error Amplifier)
SE105N	–	ICs (Error Amplifier)
SE113N	–	ICs (Error Amplifier)
SE117N	–	ICs (Error Amplifier)
SECU1D01C	SECT1D01C-S	LEDs
SECU1D05C-S	SECT1D05C-S	LEDs
SECU1E01C	SECT1E01C-S	LEDs
SECU1E05C-SE	SECT1E05C-S	LEDs
SECU4D01C	SECT4D01C-S	LEDs
SECU4E01C	SECT4E01C-S	LEDs
SEL1112R	–	LEDs
SEL1121R	–	LEDs
SEL1123R	SEL1124R	LEDs
SEL1131R	–	LEDs
SEL1132R	–	LEDs
SEL1134R	–	LEDs
SEL1142R	–	LEDs
SEL1211R	–	LEDs
SEL1213CM	SEL1213C	LEDs
SEL1215R	–	LEDs
SEL1222R	–	LEDs
SEL1310E	SEL1410E	LEDs
SEL1310G	SEL1410G	LEDs
SEL1311G	–	LEDs
SEL1312G	–	LEDs
SEL1320G	–	LEDs
SEL1321G	–	LEDs
SEL1323G	–	LEDs
SEL1324G	–	LEDs
SEL1331G	–	LEDs
SEL1332G	–	LEDs
SEL1334G	–	LEDs
SEL1342G	–	LEDs
SEL1411G	–	LEDs
SEL1420GW	–	LEDs
SEL1421G	–	LEDs
SEL1422G	–	LEDs
SEL1650CM	–	LEDs
SEL1722K	–	LEDs
SEL1723Y	–	LEDs
SEL1731Y	–	LEDs
SEL1742Y	–	LEDs
SEL1820W	–	LEDs
SEL1821D	–	LEDs
SEL1823D	–	LEDs
SEL1842D	–	LEDs
SEL1915C	–	LEDs
SEL1922D	–	LEDs
SEL1923D	–	LEDs
SEL1942D	–	LEDs
SEL1E10CM	SELU1E10CXM/SELU1E50CM	LEDs
SEL2111R	–	LEDs
SEL2111W	–	LEDs
SEL2215RM	SEL2215R	LEDs
SEL2310E	SEL2410E	LEDs
SEL2310G	SEL2410G	LEDs
SEL2311G	–	LEDs
SEL2411G	–	LEDs
SEL2710E	–	LEDs
SEL2915DM	SEL2915D	LEDs
SEL3110R	SEL2110R/SEL6210R	LEDs
SEL3110S	SEL2110S/SEL6210S	LEDs
SEL3210R	SEL2210R/SEL6210R	LEDs
SEL3210S	SEL2210S/SEL6210S	LEDs
SEL3213C	SEL2213C	LEDs
SEL3410E	SEL2410E/SEL6410E	LEDs
SEL3410G	SEL2410G	LEDs
SEL3413E	SEL2413E	LEDs
SEL3510C	SEL2510C/SEL6510C	LEDs
SEL3510G	SEL2510G/SEL6510G	LEDs
SEL3710K	SEL2710K/SEL6710K	LEDs
SEL3710Y	SEL2710Y/SEL6710Y	LEDs
SEL3713K	SEL2713K	LEDs
SEL3810A	SEL2910A/SEL6810A	LEDs

Part No.	Alternative	Category
SEL3810D	SEL2910D/SEL6810D	LEDs
SEL3813A	SEL2813A	LEDs
SEL3910A	SEL2910A/SEL6910A	LEDs
SEL3910D	SEL2910D/SEL6910D	LEDs
SEL3913K	SEL2913K	LEDs
SEL3E10C	SELU2E10C	LEDs
SEL4110W	–	LEDs
SEL4117R	–	LEDs
SEL4225R	–	LEDs
SEL4225RM	–	LEDs
SEL4310E	SEL4410E	LEDs
SEL4310G	SEL4410G	LEDs
SEL4417G	–	LEDs
SEL4425G	–	LEDs
SEL4425GM	–	LEDs
SEL4427E	SEL4427EP	LEDs
SEL4525C	–	LEDs
SEL4725CM	–	LEDs
SEL4725Y	–	LEDs
SEL4814W	–	LEDs
SEL4817D	–	LEDs
SEL4825D	–	LEDs
SEL4917D	–	LEDs
SEL4925D	–	LEDs
SEL550ST	–	LEDs
SEL650ST	–	LEDs
SEL8301A	–	LEDs
SEL8302A	–	LEDs
SEL8701Y	–	LEDs
SEL8701YB	–	LEDs
SELU1D10CXM	SELT1D10CXM-S	LEDs
SELU1D50CM	SELT1D50CM-S	LEDs
SELU1E10CXM-S	SELT1E10CXM-S	LEDs
SELU1E50CM	SELT1E50CM-S	LEDs
SELU2D10C	SELT2D10C-S	LEDs
SELU2E10C	SELT2E10C-S	LEDs
SELU5D20C-S	SELT5D20C-S	LEDs
SELU5D23C	SELT5D23C-S	LEDs
SELU5E20C-S	SELT5E20C-S	LEDs
SELU5E23C	SELT5E23C-S	LEDs
SE-M140	–	ICs (Error Amplifier)
SI-18751	–	ICs (Audio Amplifier)
SI-3018KF	SI-3010KFE	ICs (Regulator)
SI-3018LS	SI-3018LSA	ICs (Regulator)
SI-3025LS	SI-3025LSA	ICs (Regulator)
SI-3025ZF	SI-3011ZFE	ICs (Regulator)
SI-3025ZF	SI-3011ZFE	ICs (Regulator)
SI-3033KF	SI-3010KFE	ICs (Regulator)
SI-3033LS	SI-3033LSA	ICs (Regulator)
SI-3050KF	SI-3010KFE	ICs (Regulator)
SI-3050N	SI-3010KFE	ICs (Regulator)
SI-3052P	SI-3050J	ICs (Regulator)
SI-3052V	SI-3050J	ICs (Regulator)
SI-3062V	SI-3050Jを**Vo可変**	ICs (Regulator)
SI-3082V	SI-3050Jを**Vo可変**	ICs (Regulator)
SI-3102V	SI-3090Jを**Vo可変**	ICs (Regulator)
SI-3120N	SI-3010KFE	ICs (Regulator)
SI-3122P	SI-3120J	ICs (Regulator)
SI-3122V	SI-3120J	ICs (Regulator)
SI-3132V	SI-3120Jを**Vo可変**	ICs (Regulator)
SI-3150F	SI-3010KFE	ICs (Regulator)
SI-3150N	SI-3010KFE	ICs (Regulator)
SI-3151N	SI-3150C	ICs (Regulator)
SI-3152P	SI-3150J	ICs (Regulator)
SI-3152V	SI-3150J	ICs (Regulator)

Part No.	Alternative	Category
SI-3182V	SI-3150Jを**Vo可変**	ICs (Regulator)
SI-3202V	SI-3150Jを**Vo可変**	ICs (Regulator)
SI-3242P	–	ICs (Regulator)
SI-3522V	SI-3050Jを**Vo可変**	ICs (Regulator)
SI-3922V	SI-3090Jを**Vo可変**	ICs (Regulator)
SI-7115B	SLA7032M	ICs (Motor Driver)
SI-7200E	–	ICs (Motor Driver)
SI-7200M	–	ICs (Motor Driver)
SI-7201A	–	ICs (Motor Driver)
SI-7202A	–	ICs (Motor Driver)
SI-7230E	–	ICs (Motor Driver)
SI-7230M	–	ICs (Motor Driver)
SI-7235E	–	ICs (Motor Driver)
SI-7300A	SLA7032M	ICs (Motor Driver)
SI-7330A	SLA7033M	ICs (Motor Driver)
SI-7500A	–	ICs (Motor Driver)
SI-7600	–	ICs (Motor Driver)
SI-7600D	–	ICs (Motor Driver)
SI-8011	–	ICs (Regulator)
SI-8012	–	ICs (Regulator)
SI-8013	–	ICs (Regulator)
SI-8014	–	ICs (Regulator)
SI-8020	–	ICs (Regulator)
SI-8021	–	ICs (Regulator)
SI-8022	–	ICs (Regulator)
SI-8023	–	ICs (Regulator)
SI-8025JF	SI-8008TFE	ICs (Regulator)
SI-8090K	SI-8008TFE	ICs (Regulator)
SI-8100D	–	ICs (Regulator)
SI-8202L	–	ICs (Regulator)
SI-8211L	–	ICs (Regulator)
SI-8213L	–	ICs (Regulator)
SI-8811L	–	ICs (Regulator)
SI-8911L	–	ICs (Regulator)
SID1010BXM	–	LEDs
SID1010CM2	–	LEDs
SID1H10CXM	–	LEDs
SID1K10CM2	–	LEDs
SLA3001M	–	ICs (Regulator)
SLA4300	–	Transistors (Array)
SLA5003	–	Transistors (Array)
SLA5005	–	Transistors (Array)
SLA5009	SLA5060	Transistors (Array)
SLA5027	–	Transistors (Array)
SLA5031	SLA5040	Transistors (Array)
SLA5046	SLA5094	Transistors (Array)
SLA5047	SLA5041	Transistors (Array)
SLA5052	SLA5041	Transistors (Array)
SLA5054	–	Transistors (Array)
SLA5057	–	Transistors (Array)
SLA5070	–	Transistors (Array)
SLA5089	SLA5044	Transistors (Array)
SLA7022M	SLA7022MU	ICs (Motor Driver)
SLA7027M	SLA7027MU	ICs (Motor Driver)
SLH30	–	LEDs
SLH50	–	LEDs
SLS34	–	LEDs
SLS36	–	LEDs
SLS54	–	LEDs
SMA4392	–	Transistors (Array)
SMA5104	SMA5127	Transistors (Array)
SMA5105	SMA5106	Transistors (Array)
SMA5114	–	Transistors (Array)
SMA5126	–	Transistors (Array)
SMA7022M	SMA7022MU	ICs (Motor Driver)

Part No.	Alternative	Category
SML19460C	–	LEDs
SMLU12D16W	SMLT12D16W-S	LEDs
SMLU12E16C	SMLT12E16C-S	LEDs
SMLU12E16W	SMLT12E16W-S	LEDs
SMLU18D16C	SMLT18D16C-S	LEDs
SMLU18D16W	SMLT18D16W-S	LEDs
SMLU18E16C	SMLT18E16C-S	LEDs
STA304A	–	Transistors (Array)
STA341M	–	Transistors (Array)
STA414A	–	Transistors (Array)
STA451C	–	Transistors (Array)
STA455C	–	Transistors (Array)
STA501A	–	Transistors (Array)
STA506A	–	Transistors (Array)
STA802M	–	ICs (Regulator)
STR20005	SI-8050S	ICs (Regulator)
STR20012	SI-8120S	ICs (Regulator)
STR2005	SI-8050S	ICs (Regulator)
STR2012	SI-8120S	ICs (Regulator)
STR2013	–	ICs (Regulator)
STR2015	SI-8150S	ICs (Regulator)
STR2024	–	ICs (Regulator)
STR7001	–	ICs (Regulator)
STR7002	–	ICs (Regulator)
STR7003	–	ICs (Regulator)
STR7101	–	ICs (Regulator)
STR7102	–	ICs (Regulator)
STR7103	–	ICs (Regulator)
STR9005	–	ICs (Regulator)
STR9012	–	ICs (Regulator)
STR9015	–	ICs (Regulator)
TF320M	TF341M	Thyristors & Triacs
TF320M-A	TF321M-A	Thyristors & Triacs
TF321M	TF341M	Thyristors & Triacs
TF325P	–	Thyristors & Triacs
TF521S	TF541S	Thyristors & Triacs
TF620M	TF861M	Thyristors & Triacs
TF640M	TF841M	Thyristors & Triacs
TFD312M	–	Thyristors & Triacs
TFD312S	–	Thyristors & Triacs
TFD315M	–	Thyristors & Triacs
TFH341S	–	Thyristors & Triacs
TFH361S	–	Thyristors & Triacs
TGH340M	–	Thyristors & Triacs
TM1041M-L	TMA104S-L	Thyristors & Triacs
TM1061M-L	TMA106S-L	Thyristors & Triacs
TM1241M-L	TMA124S-L	Thyristors & Triacs
TM1261M-L	TMA126S-L	Thyristors & Triacs
TM1262B-R	–	Thyristors & Triacs
TM1641M-L	TMA164S-L	Thyristors & Triacs
TM1641P-L	TMA164P-L	Thyristors & Triacs
TM1661M-L	TMA166S-L	Thyristors & Triacs
UX-C2B	–	Diodes
UX-F5B	–	Diodes

■Service Parts (Not for New Design)

Part No.	Alternative	Category
2SA1491	2SA1695	Transistors
2SA1643	2SA1725	Transistors
2SA1672	2SA1909	Transistors
2SB1626	2SB1686	Transistors
2SC1983	2SC3852,3852A	Transistors
2SC1984	2SC3852,3852A	Transistors
2SC1985	2SC4511,4512	Transistors
2SC1986	2SC4511,4512	Transistors
2SC2167	2SC4381,4382	Transistors
2SC2168	2SC4381,4382	Transistors
2SC2315	2SD2642	Transistors
2SC2316	2SD2642	Transistors
2SC2810	2SC4546	Transistors
2SC3300	2SC4131	Transistors
2SC3854	2SC4467	Transistors
2SC3855	2SC4468	Transistors
2SC4386	2SC5100	Transistors
2SC4503	2SD2083	Transistors
2SC4558	2SD2642	Transistors
2SD2493	2SD2641	Transistors
2SD2494	2SD2643	Transistors
2SD2495	2SD2642	Transistors
2SK1366	2SK2803	MOS FETs
A8181SLB	–	ICs (Regulator)
FML-11S	–	Diodes
FML-21S	–	Diodes
FML-G26S	FMD-G26S	Diodes
FMU-11S	–	Diodes
FMU-31R	–	Diodes
FMU-32U	–	Diodes
LM3875	–	ICs (Audio Amplifier)
PZ 427	–	Diodes
RL 2A	RD 2A	Diodes
SAP08N	–	Transistors
SAP08P	–	Transistors
SEL1111R	–	LEDs
SEL1120R	–	LEDs
SEL1124R	–	LEDs
SEL1220R	–	LEDs
SEL1420G	–	LEDs
SEL1424G	–	LEDs
SEL1711Y	–	LEDs
SEL1720Y	–	LEDs
SEL1721Y	–	LEDs
SEL1722Y	–	LEDs
SEL1724Y	–	LEDs
SEL1811D	–	LEDs
SEL1820D	–	LEDs
SEL1822D	–	LEDs
SEL1824D	–	LEDs
SEL1911D	–	LEDs
SEL1920D	–	LEDs
SEL1921D	–	LEDs
SEL1924D	–	LEDs
SEL1E24W	–	LEDs
SEL2911D	–	LEDs
SEL4225C	–	LEDs
SEL4226C	–	LEDs
SEL4226R	–	LEDs
SEL4425E	–	LEDs
SEL4426E	–	LEDs
SEL4426G	–	LEDs
SEL4717Y	–	LEDs
SEL4725K	–	LEDs
SEL4726K	–	LEDs
SEL4726Y	–	LEDs
SEL4825A	–	LEDs
SEL4826A	–	LEDs
SEL4826D	–	LEDs
SEL4925A	–	LEDs
SEL4926A	–	LEDs
SEL4926D	–	LEDs
SELS2J11W	–	LEDs
SHV-08UK	–	Diodes
SHV-10K	–	Diodes
SHV-10UK	–	Diodes
SHV-12K	–	Diodes
SHV-12UK	–	Diodes
SHV-16KM	–	Diodes
SHV-16UK	–	Diodes
SI-18752	–	ICs (Audio Amplifier)
SI-3048LSA	–	ICs (Regulator)
SI-8406L	–	ICs (Regulator)
SI-8921L	–	ICs (Regulator)
SI-8922L	–	ICs (Regulator)
SML12460C	–	LEDs
SML16760CN	–	LEDs
STA342M	–	Transistors (Array)

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