

PR33MF51NSLF Series

$I_T(\text{rms}) \leq 0.3\text{A}$, Non-Zero Cross type
DIP 8pin
Triac output SSR



■ Description

PR33MF51NSLF Series Solid State Relays (SSR) are an integration of an infrared emitting diode (IRED), a Phototriac Detector and a main output Triac. These devices are ideally suited for controlling high voltage AC loads with solid state reliability while providing 4kV isolation ($V_{\text{iso}}(\text{rms})$) from input to output.

■ Features

1. Output current, $I_T(\text{rms}) \leq 0.3\text{A}$
2. Non-zero crossing functionary
3. 8 pin DIP package (SMT gullwing also available)
4. High repetitive peak off-state voltage ($V_{\text{DRM}} : 600\text{V}$)
5. Superior noise immunity ($dV/dt : \text{MIN. } 100\text{V}/\mu\text{s}$)
6. Response time, $t_{\text{on}} : \text{MAX. } 100\mu\text{s}$
7. High isolation voltage between input and output ($V_{\text{iso}}(\text{rms}) : 4\text{kV}$)
8. RoHS directive compliant

■ Agency approvals/Compliance

1. Recognized by UL508 file No. E94758 (as model No. **R33MF5**)
2. Approved by CSA 22.2 No.14, file No. LR63705 (as model No. **R33MF5**)
3. Optionary available VDE approved (DIN EN 60747-5-2)^(*), file No. 40008898 (as model No. **R33MF5**)
4. Package resin : UL flammability grade (94V-0)

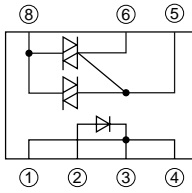
^(*) DIN EN60747-5-2 : successor standard of DIN VDE0884.

■ Applications

1. Isolated interface between high voltage AC devices and lower voltage DC control circuitry.
2. Switching motors, fans, heaters, solenoids, and valves.
3. Phase or power control in applications such as lighting and temperature control equipment.

Notice The content of data sheet is subject to change without prior notice.
In the absence of confirmation by device specification sheets, SHARP takes no responsibility for any defects that may occur in equipment using any SHARP devices shown in catalogs, data books, etc. Contact SHARP in order to obtain the latest device specification sheets before using any SHARP device.

Internal Connection Diagram

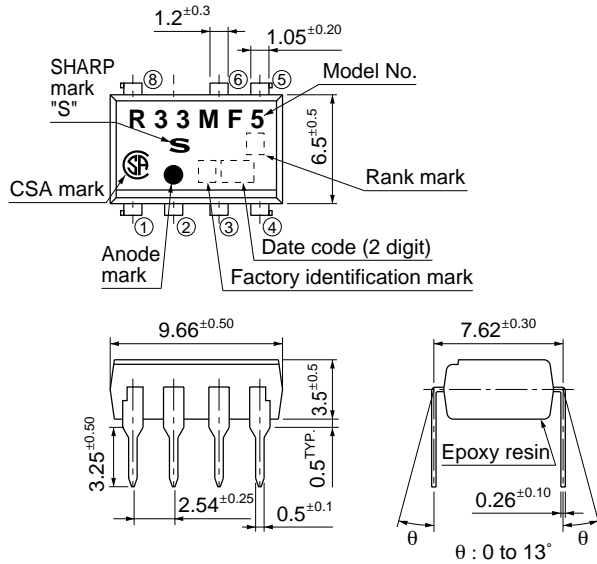


- ① Cathode
- ② Anode
- ③ Cathode
- ④ Cathode
- ⑤ Gate
- ⑥ Output (T₁)
- ⑧ Output (T₂)

Outline Dimensions

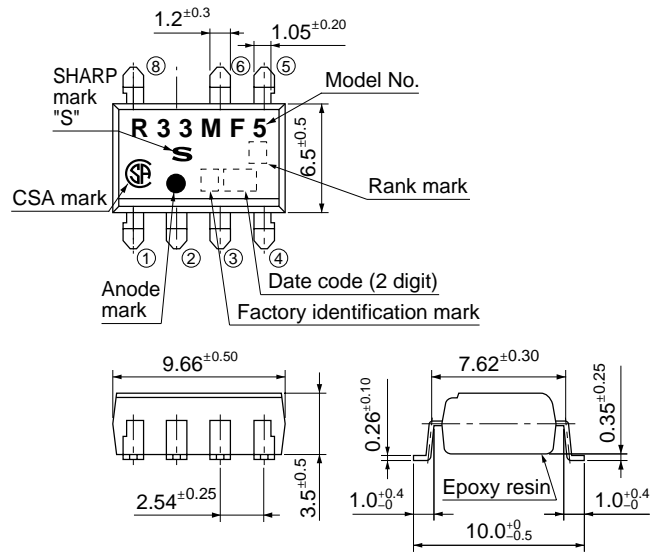
(Unit : mm)

1. Through-Hole [ex. PR33MF51NSLF]



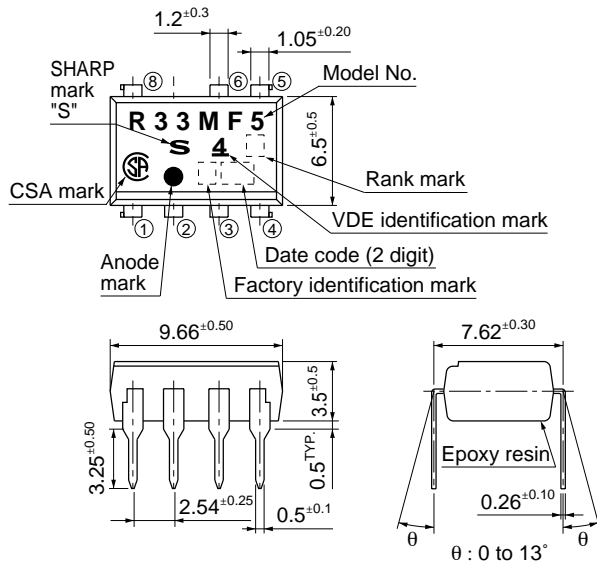
Product mass : approx. 0.56g

2. SMT Gullwing Lead-Form [ex. PR33MF51NPLF]



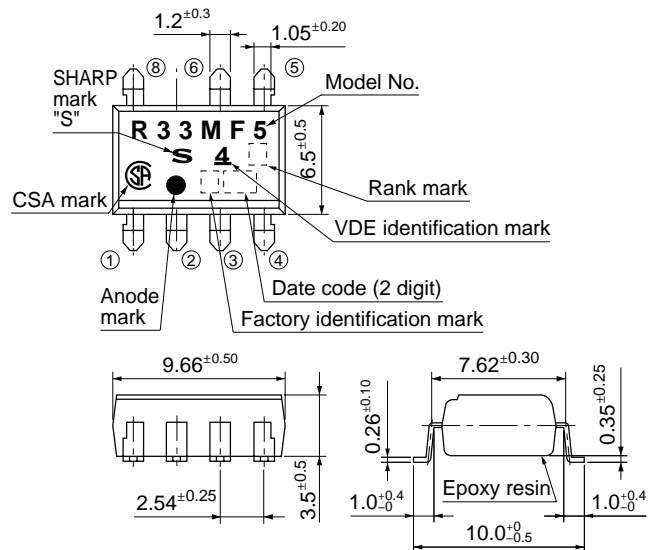
Product mass : approx. 0.54g

3. Through-Hole VDE option [ex. PR33MF51YSLF]



Product mass : approx. 0.56g

4. SMT Gullwing Lead-Form VDE option [ex. PR33MF51YPLF]



Product mass : approx. 0.54g


Plating material : SnCu (Cu : TYP. 2%)

Date code (2 digit)

| 1st digit | | | | 2nd digit | |
|--------------------|------|------|------|---------------------|------|
| Year of production | | | | Month of production | |
| A.D. | Mark | A.D. | Mark | Month | Mark |
| 1990 | A | 2002 | P | January | 1 |
| 1991 | B | 2003 | R | February | 2 |
| 1992 | C | 2004 | S | March | 3 |
| 1993 | D | 2005 | T | April | 4 |
| 1994 | E | 2006 | U | May | 5 |
| 1995 | F | 2007 | V | June | 6 |
| 1996 | H | 2008 | W | July | 7 |
| 1997 | J | 2009 | X | August | 8 |
| 1998 | K | 2010 | A | September | 9 |
| 1999 | L | 2011 | B | October | O |
| 2000 | M | 2012 | C | November | N |
| 2001 | N | : | : | December | D |

repeats in a 20 year cycle

Factory identification mark

| Factory identification Mark | Country of origin |
|--|-------------------|
| no mark | Japan |
|  | China |

* This factory marking is for identification purpose only.
Please contact the local SHARP sales representative to see the actual status of the production.

Rank mark

Please refer to the Model Line-up table.

Absolute Maximum Ratings

(T_a=25°C)

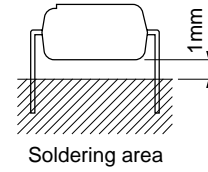
| Parameter | | Symbol | Rating | Unit |
|-----------|-----------------------------------|-----------------------|-------------------|------|
| Input | Forward current | I _F | 50 ^{*3} | mA |
| | Reverse voltage | V _R | 6 | V |
| Output | RMS ON-state current | I _{T(rms)} | 0.3 ^{*3} | A |
| | Peak one cycle surge current | I _{surge} | 3 ^{*4} | A |
| | Repetitive peak OFF-state voltage | V _{DRM} | 600 | V |
| *1 | Isolation voltage | V _{iso(rms)} | 4 | kV |
| | Operating temperature | T _{opr} | -30 to +85 | °C |
| | Storage temperature | T _{stg} | -40 to +125 | °C |
| *2 | Soldering temperature | T _{sol} | 270 | °C |

*1 40 to 60%RH, AC for 1minute, f=60Hz

*2 For 10s

*3 Refer to Fig.1, Fig.2

*4 f=50Hz sine wave



Electro-optical Characteristics

(T_a=25°C)

| Parameter | | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|--------------------------|--|------------------|--|--------------------|------------------|------|------|
| Input | Forward voltage | V _F | I _F =20mA | - | 1.2 | 1.4 | V |
| | Reverse current | I _R | V _R =3V | - | - | 10 | μA |
| Output | Repetitive peak OFF-state current | I _{DRM} | V _D =V _{DRM} | - | - | 100 | μA |
| | ON-state voltage | V _T | I _T =0.3A | - | - | 3 | V |
| | Holding current | I _H | V _D =6V | - | - | 25 | mA |
| | Critical rate of rise of OFF-state voltage | dV/dt | V _D =1/√2 · V _{DRM} | 100 | - | - | V/μs |
| Transfer characteristics | Minimum trigger current | I _{FT} | V _D =6V, R _L =100Ω | - | - | 10 | mA |
| | Isolation resistance | R _{ISO} | DC500V, 40 to 60%RH | 5×10 ¹⁰ | 10 ¹¹ | - | Ω |
| | Turn-on time | t _{ON} | V _D =6V, R _L =100Ω, I _F =20mA | - | - | 100 | μs |

■ Model Line-up

| Lead Form | Through-Hole | | SMT Gullwing | | V _{DRM} [V] | Rank mark | I _{FT} [mA] (V _D =6V, R _L =100Ω) |
|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------------|--------------|---|
| Shipping Package | Sleeve | | Taping | | | | |
| DIN | Approved | | Approved | | | | |
| EN60747-5-2 | — | Approved | — | Approved | 600 | 1 | MAX.10 |
| Model No. | PR33MF51NSLF | PR33MF51YSLF | PR33MF51NPLF | PR33MF51YPLF | 600 | 1 | MAX.10 |

Please contact a local SHARP sales representative to inquire about production status.

Fig.1 Forward Current vs. Ambient Temperature

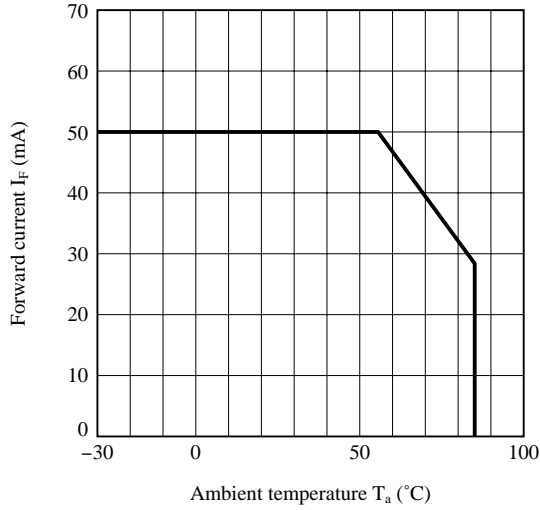


Fig.2 RMS ON-state Current vs. Ambient Temperature

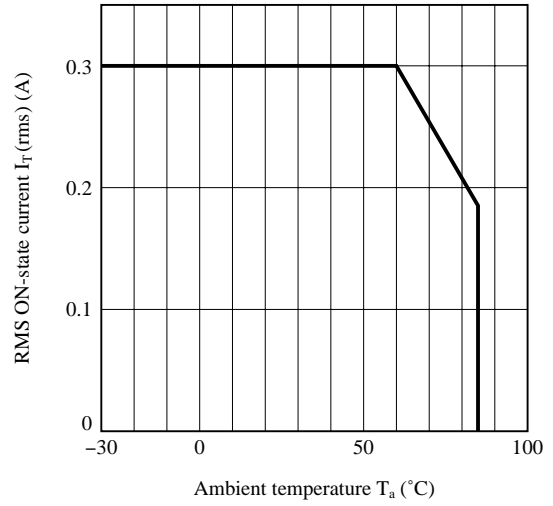


Fig.3 Forward Current vs. Forward Voltage

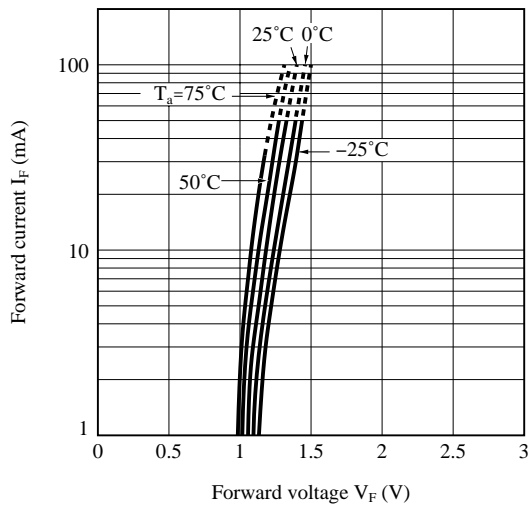


Fig.4 Minimum Trigger Current vs. Ambient Temperature

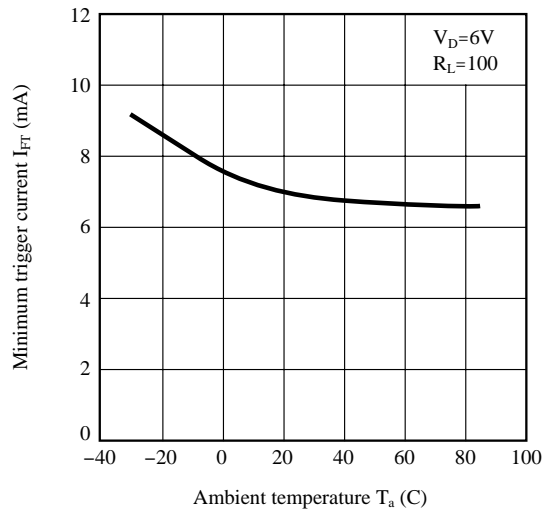


Fig.5 ON-state Voltage vs. Ambient Temperature

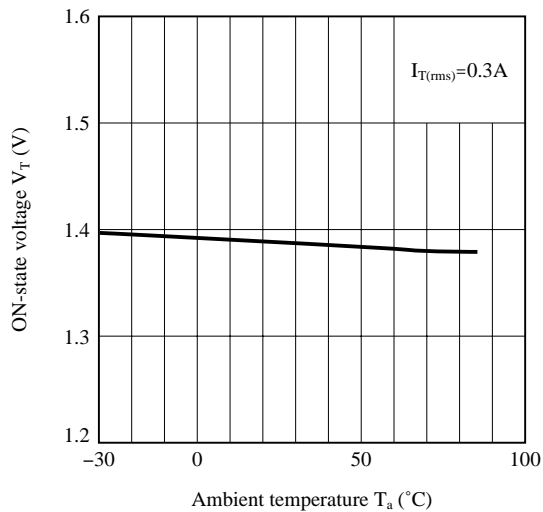


Fig.6 Relative Holding Current vs. Ambient Temperature

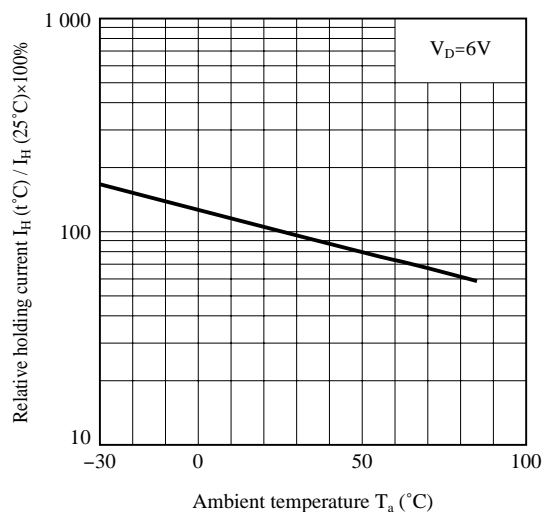


Fig.7 ON-state Current vs. ON-state Voltage

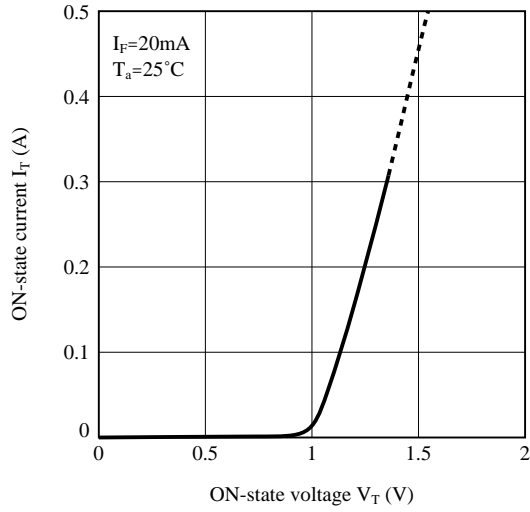
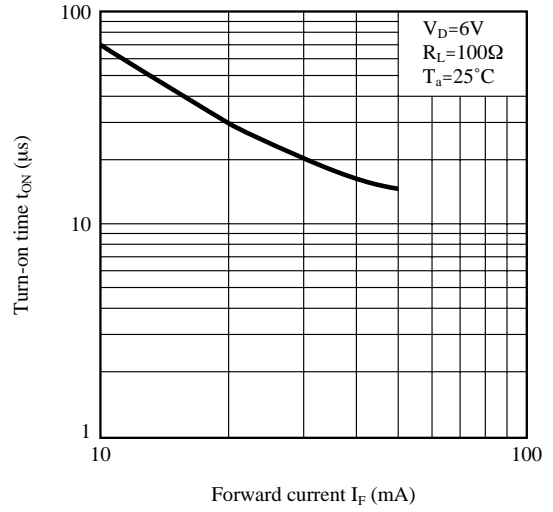


Fig.8 Turn-on Time vs. Forward Current



Remarks : Please be aware that all data in the graph are just for reference and not for guarantee.

■ Design Considerations

● Recommended Operating Conditions

| Parameter | | Symbol | Condition | MIN. | MAX. | Unit |
|-----------------------|-----------------------------------|----------------|--|------|----------------------------|------|
| Input | Input signal current at ON state | $I_F(ON)$ | – | 20 | 25 | mA |
| | Input signal current at OFF state | $I_F(OFF)$ | – | 0 | 0.1 | mA |
| Output | Load supply voltage | $V_{OUT(rms)}$ | – | – | 240 | V |
| | Load supply current | $I_{OUT(rms)}$ | Locate snubber circuit between output terminals ($C_s=0.022\mu F$, $R_s=47\Omega$) | – | $I_T(rms) \times 80\%$ (*) | A |
| | Frequency | f | – | 50 | 60 | Hz |
| Operating temperature | | T_{opr} | – | –20 | 80 | °C |

(*) See Fig.2 about derating curve ($I_T(rms)$ vs. ambient temperature).

● Degradation

In order for the SSR to turn off, the triggering current (I_F) must be 0.1mA or less

In phase control applications or where the SSR is being by a pulse signal, please ensure that the pulse width is a minimum of 1ms.

When the input current (I_F) is below 0.1mA, the output Triac will be in the open circuit mode. However, if the voltage across the Triac, V_D , increases faster than rated dV/dt , the Triac may turn on. To avoid this situation, please incorporate a snubber circuit. Due to the many different types of load that can be driven, we can merely recommend some circuit values to start with : $C_s=0.022\mu F$ and $R_s=47\Omega$. The operation of the SSR and snubber circuit should be tested and if unintentional switching occurs, please adjust the snubber circuit component values accordingly

When making the transition from On to Off state, a snubber circuit should be used ensure that sudden drops in current are not accompanied by large instantaneous changes in voltage across the Triac.

This fast change in voltage is brought about by the phase difference between current and voltage.

Primarily, this is experienced in driving loads which are inductive such as motors and solenods.

Following the procedure outlined above should provide sufficient results.

Any snubber or Varistor used for the above mentioned scenarios should be located as close to the main output triac as possible.

All pins shall be used by soldering on the board. (Socket and others shall not be used.)

● Degradation

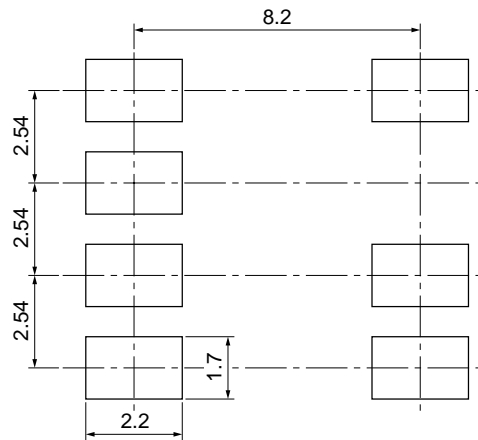
In general, the emission of the IRED used in SSR will degrade over time.

In the case where long term operation and / or constant extreme temperature fluctuations will be applied to the devices, please allow for a worst case scenario of 50% degradation over 5years.

Therefore in order to maintain proper operation, a design implementing these SSRs should provide at least twice the minimum required triggering current from initial operation.

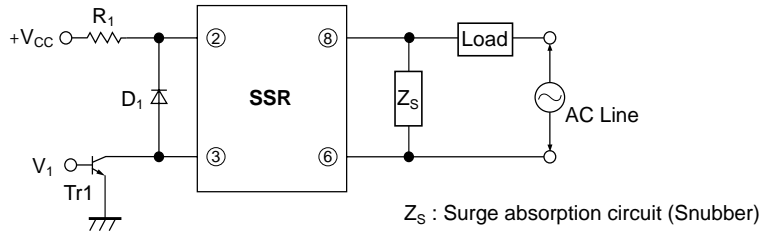
● Recommended Foot Print (reference)

SMT Gullwing Lead-form



(Unit : mm)

● Standard Circuit



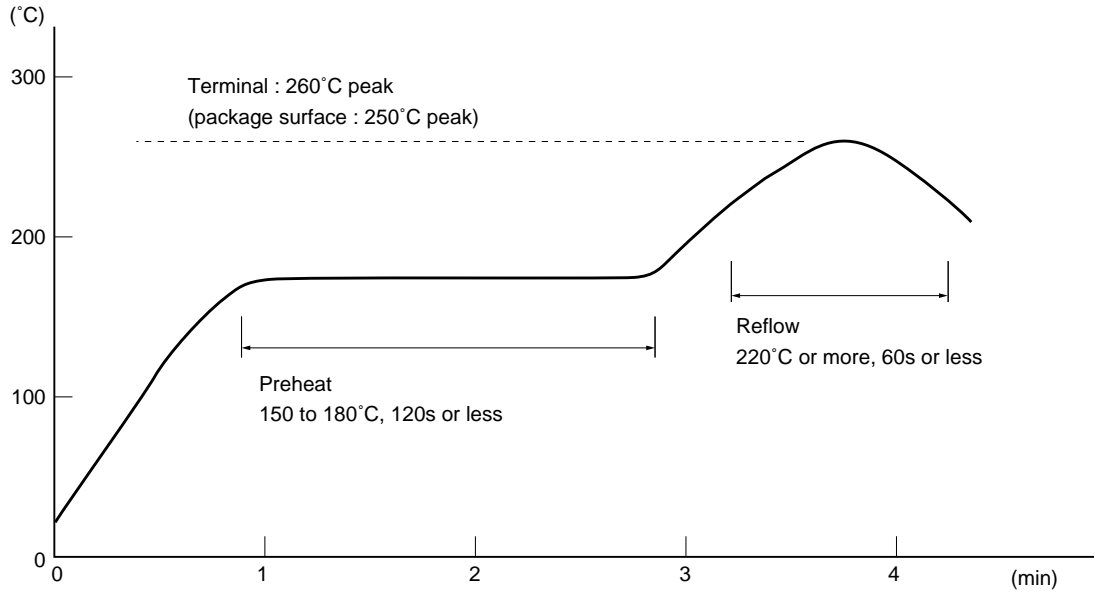
☆ For additional design assistance, please review our corresponding Optoelectronic Application Notes.

■ **Manufacturing Guidelines**

● **Soldering Method**

Reflow Soldering :

Reflow soldering should follow the temperature profile shown below.
 Soldering should not exceed the curve of temperature profile and time.
 Please don't solder more than twice.



Flow Soldering (No Solder bathing)

Flow soldering should be completed below 270°C and within 10s.
 Preheating is within the bounds of 100 to 150°C and 30 to 80s.
 Please don't solder more than twice.

Hand soldering

Hand soldering should be completed within 3s when the point of solder iron is below 400°C.
 Please don't solder more than twice.

Other notice

Please test the soldering method in actual condition and make sure the soldering works fine, since the impact on the junction between the device and PCB varies depending on the tooling and soldering conditions.

● Cleaning instructions**Solvent cleaning :**

Solvent temperature should be 45°C or below. Immersion time should be 3minutes or less.

Ultrasonic cleaning :

The impact on the device varies depending on the size of the cleaning bath, ultrasonic output, cleaning time, size of PCB and mounting method of the device.

Therefore, please make sure the device withstands the ultrasonic cleaning in actual conditions in advance of mass production.

Recommended solvent materials :

Ethyl alcohol, Methyl alcohol and Isopropyl alcohol

In case the other type of solvent materials are intended to be used, please make sure they work fine in actual using conditions since some materials may erode the packaging resin.

● Presence of ODC

This product shall not contain the following materials.

And they are not used in the production process for this device.

Regulation substances : CFCs, Halon, Carbon tetrachloride, 1.1.1-Trichloroethane (Methylchloroform)

Specific brominated flame retardants such as the PBB and PBDE are not used in this product at all.

This product shall not contain the following materials banned in the RoHS Directive (2002/95/EC).

•Lead^(*), Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE).

^(*) High melting temperature type solders (i.e. tin-lead solder alloys containing more than 85% lead) is exempted from the requirements.

■ Package specification

● Sleeve package

Through-Hole

Package materials

Sleeve : HIPS (with anti-static material) or ABS

Stopper : Styrene-Elastomer

Package method

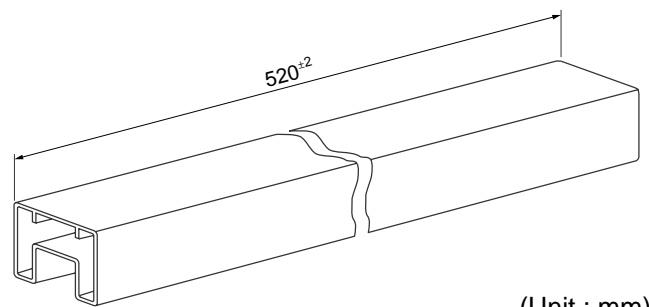
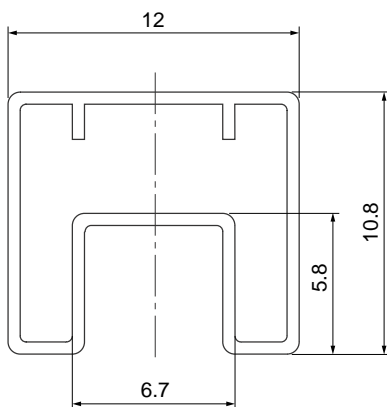
MAX. 50pcs of products shall be packaged in a sleeve.

Both ends shall be closed by tabbed and tabless stoppers.

The product shall be arranged in the sleeve with its anode mark on the tabless stopper side.

MAX. 20 sleeves in one case.

Sleeve outline dimensions



(Unit : mm)

- Note 1) Thickness : 0.5 ± 0.2 mm
 2) Process with applying antistatic treatment.
 3) Unless otherwise specified tolerances shall be ± 0.5 mm.
 (However except for deformation due to the rubber stopper in sleeve.)

● Tape and Reel package

SMT Gullwing

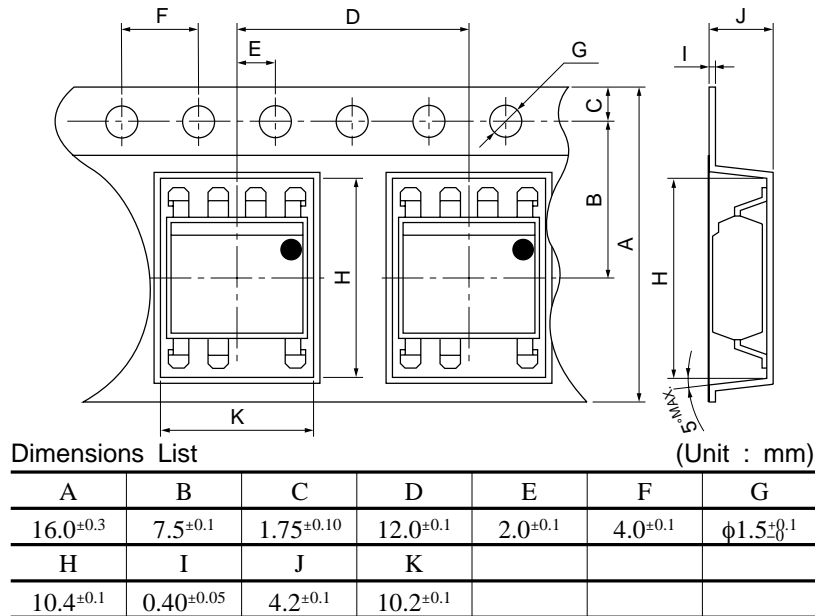
Package materials

Carrier tape : A-PET (with anti-static material) or PS

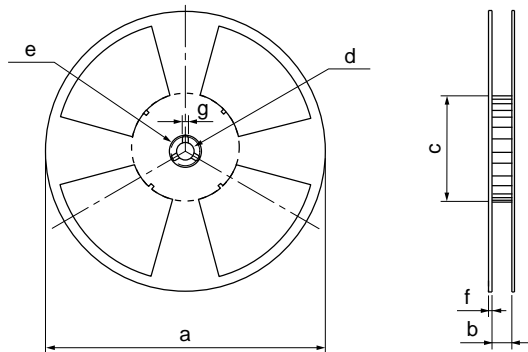
Cover tape : PET material base (three layer system)

Reel : PS

Carrier tape structure and Dimensions



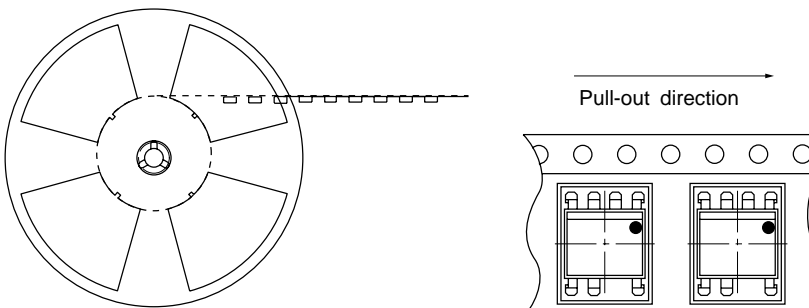
Reel structure and Dimensions



Dimensions List (Unit : mm)

| a | b | c | d |
|-------------------|----------------|--------------------|-----------------------|
| ϕ 330 | 17.5 \pm 1.5 | ϕ 100 \pm 1 | ϕ 13.0 \pm 0.5 |
| e | f | g | |
| ϕ 23 \pm 1 | 2.0 \pm 0.5 | 2.0 \pm 0.5 | |

Direction of product insertion



[Packing : 1 000pcs/reel]

■ Important Notices

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(i) The devices in this publication are designed for use in general electronic equipment designs such as:

- Personal computers
- Office automation equipment
- Telecommunication equipment [terminal]
- Test and measurement equipment
- Industrial control
- Audio visual equipment
- Consumer electronics

(ii) Measures such as fail-safe function and redundant design should be taken to ensure reliability and safety when SHARP devices are used for or in connection

with equipment that requires higher reliability such as:

- Transportation control and safety equipment (i.e., aircraft, trains, automobiles, etc.)
- Traffic signals
- Gas leakage sensor breakers
- Alarm equipment
- Various safety devices, etc.

(iii) SHARP devices shall not be used for or in connection with equipment that requires an extremely high level of reliability and safety such as:

- Space applications
- Telecommunication equipment [trunk lines]
- Nuclear power control equipment
- Medical and other life support equipment (e.g., scuba).

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