

# SL05T1G Series

## ESD Protection Diode

### Low Capacitance

This family of surge protection offers transient overvoltage protection with significantly reduced capacitance. The capacitance is lowered by integrating a compensating diode in series. This integrated solution offers ESD protection for high speed interfaces such as communication systems, computers, and computer peripherals.

#### Features

- Surge protection Diode in Series with a Compensating Diode Offers <5 pF Capacitance
- ESD Protection Meeting IEC 61000-4-2, 4-4, 4-5
- Peak Power Rating of 300 W,  $8 \times 20 \mu\text{s}$
- Bi-Direction Protection Can Be Achieved By Using Two Devices
- Flammability Rating UL 94 V-0
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Mechanical Characteristics:

**CASE:** Void-free, transfer-molded, thermosetting plastic case

**FINISH:** Corrosion resistant finish, easily solderable

#### MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES:

260°C for 10 Seconds

Package designed for optimal automated board assembly

Small package size for high density applications

Available in 8 mm Tape and Reel

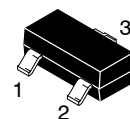
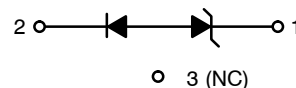
Use the Device Number to order the 7 inch/3,000 unit reel.

Replace the "T1" with "T3" in the Device Number to order the 13 inch/10,000 unit reel.



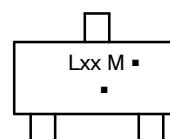
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SOT-23 (TO-236)  
CASE 318  
STYLE 26

#### MARKING DIAGRAM



Lxx = Device Code  
xx = 05, 12, 15, or 24  
M = Date Code\*  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

#### ORDERING INFORMATION

| Device    | Package          | Shipping†        |
|-----------|------------------|------------------|
| SL05T1G   | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SZSL05T1G | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SL12T1G   | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SZSL12T1G | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SL15T1G   | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SZSL15T1G | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SL24T1G   | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| SZSL24T1G | SOT-23 (Pb-Free) | 3000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

#### DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the table on page 2 of this data sheet.

# SL05T1G Series

## MAXIMUM RATINGS

| Rating                                                                                                              | Symbol          | Value                           | Unit                       |
|---------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------|----------------------------|
| Peak Power Dissipation @ 8x20 usec (Note 1)<br>@ $T_L \leq 25^\circ\text{C}$                                        | $P_{pk}$        | 300                             | W                          |
| IEC 61000-4-2 Level 4<br>Contact Discharge<br>Air Discharge<br>IEC 61000-4-4 EFT<br>IEC 61000-4-5 Lightning         | $V_{pp}$        | $\pm 8$<br>$\pm 16$<br>40<br>12 | kV<br>kV<br>A<br>A         |
| Total Power Dissipation on FR-5 Board (Note 2) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$        | $P_D$           | 225<br>1.8                      | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient                                                                              | $R_{\theta JA}$ | 556                             | $^\circ\text{C}/\text{W}$  |
| Total Power Dissipation on Alumina Substrate (Note 3) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4                      | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction-to-Ambient                                                                              | $R_{\theta JA}$ | 417                             | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature Range                                                                              | $T_J, T_{stg}$  | - 55 to +150                    | $^\circ\text{C}$           |
| Lead Solder Temperature – Maximum (10 Second Duration)                                                              | $T_L$           | 260                             | $^\circ\text{C}$           |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

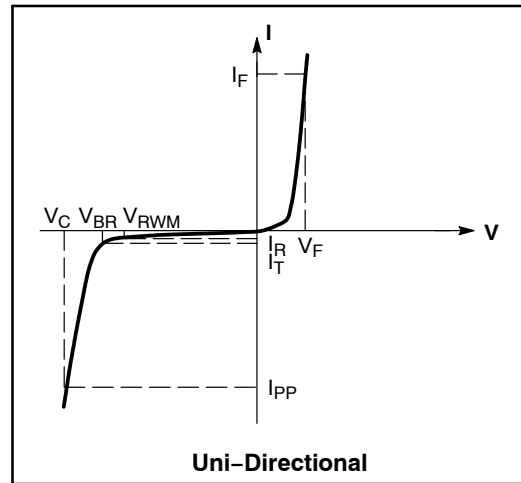
1. Non-repetitive current pulse per Figure 2
2. FR-5 = 1.0 x 0.75 x 0.62 in.
3. Alumina = 0.4 x 0.3 x 0.024 in., 99.5% alumina

## ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

### UNIDIRECTIONAL

| Symbol          | Parameter                                   |
|-----------------|---------------------------------------------|
| $I_{PP}$        | Maximum Reverse Peak Pulse Current          |
| $V_C$           | Clamping Voltage @ $I_{PP}$                 |
| $V_{RWM}$       | Working Peak Reverse Voltage                |
| $I_R$           | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$        | Breakdown Voltage @ $I_T$                   |
| $I_T$           | Test Current                                |
| $\Theta V_{BR}$ | Maximum Temperature Coefficient of $V_{BR}$ |
| $I_F$           | Forward Current                             |
| $V_F$           | Forward Voltage @ $I_F$                     |
| $Z_{ZT}$        | Maximum Zener Impedance @ $I_{ZT}$          |
| $I_{ZK}$        | Reverse Current                             |
| $Z_{ZK}$        | Maximum Zener Impedance @ $I_{ZK}$          |



Uni-Directional

## ELECTRICAL CHARACTERISTICS

| Device | Device Marking | $V_{RWM}$<br>(V) | $I_R$ @ $V_{RWM}$<br>( $\mu\text{A}$ ) | Breakdown Voltage<br>(Note 4) |      | $V_C$ , Clamping Voltage<br>(Note 5) |       | Max<br>$I_{PP}$<br>(A) | Capacitance<br>@ $V_R = 0\text{ V}$ , 1 MHz (pF) |     |
|--------|----------------|------------------|----------------------------------------|-------------------------------|------|--------------------------------------|-------|------------------------|--------------------------------------------------|-----|
|        |                |                  |                                        | $V_{BR}$ @ 1 mA (Volts)       |      | @ 1 A                                | @ 5 A |                        | Typ                                              | Max |
|        |                |                  |                                        | Min                           | Max  | (V)                                  | (V)   |                        |                                                  |     |
| SL05   | L05            | 5.0              | 20                                     | 6.0                           | 8.0  | 9.8                                  | 11    | 17                     | 3.5                                              | 5.0 |
| SL12   | L12            | 12               | 1.0                                    | 13.3                          | 15.5 | 19                                   | 24    | 12                     | 3.5                                              | 5.0 |
| SL15   | L15            | 15               | 1.0                                    | 16.7                          | 18.5 | 24                                   | 30    | 10                     | 3.5                                              | 5.0 |
| SL24   | L24            | 24               | 1.0                                    | 26.7                          | 29   | 43                                   | 55    | 5.0                    | 3.5                                              | 5.0 |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4.  $V_{BR}$  measured at pulse test current of 1 mA at an ambient temperature of  $25^\circ\text{C}$
5. Surge current waveform per Figure 2

# SL05T1G Series

## TYPICAL CHARACTERISTICS

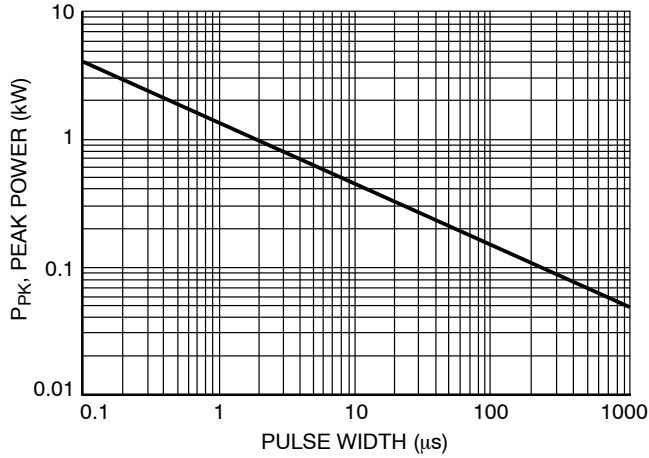


Figure 1. Maximum Peak Power Rating

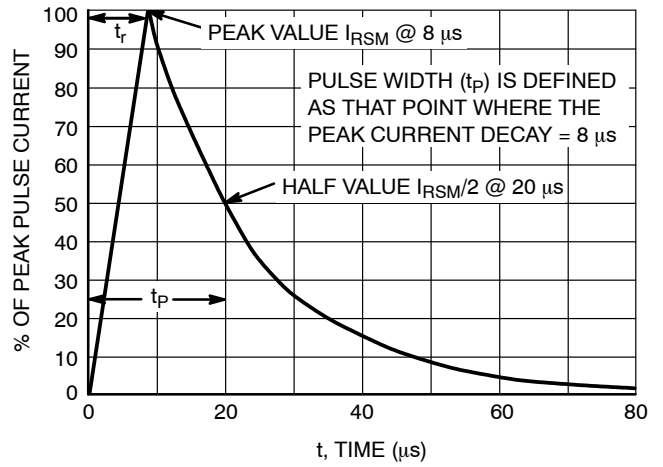


Figure 2. 8  $\times$  20  $\mu s$  Pulse Waveform

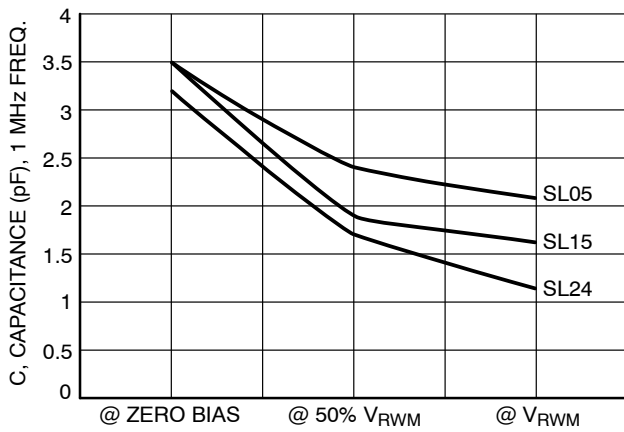


Figure 3. Typical Junction Capacitance

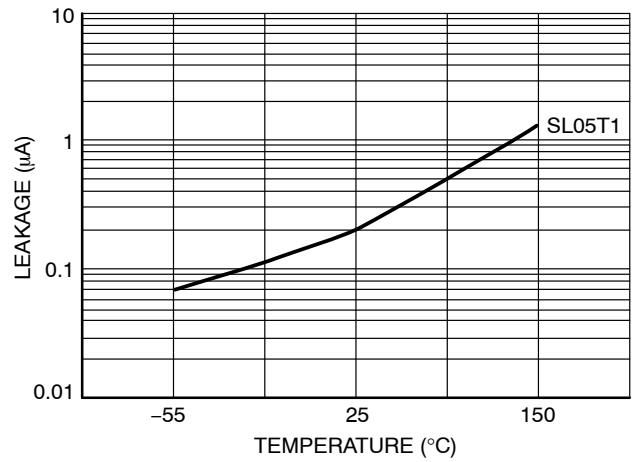


Figure 4. Typical Leakage Over Temperature

## SL05T1G Series

### Applications Background

This family of surge protection devices (SL05T1 series) are designed to protect sensitive electronics such as communications systems, computers, and computer peripherals against damage due to ESD conditions or transient voltage conditions. Because of their low capacitance value (less than 5 pF), they can be used in high speed I/O data lines. Low capacitance is achieved by integrating a compensating diode in series with the surge protection which is basically based in the below theoretical principle:

- Capacitance in parallel:  $C_T = C_1 + C_2 + \dots + C_n$
- Capacitance in series:  $1/C_T = (1/C_1) + (1/C_2) + \dots + (1/C_n)$

The Figure 5 shows the integrated solution of the SL05T1 series device:

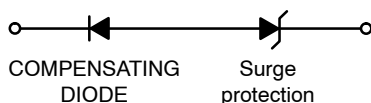


Figure 5.

In the case that an over-voltage condition occurs in the I/O line protected by the SL05T1 series device, the surge protection is reversed-biased while the compensation diode is forward-biased so the resulting current due to the transient voltage is drained to ground.

If protection in both polarities is required, an additional device is connected in inverse-parallel with reference to the first one, the Figure 6 illustrates the inverse-parallel connection for bi-directional or unidirectional lines:

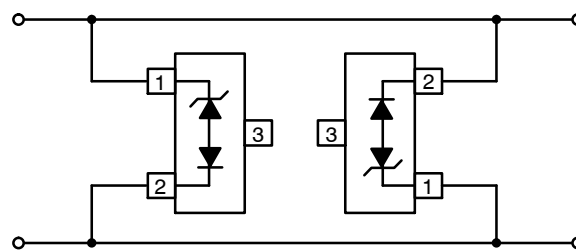


Figure 6.

An alternative solution to protect unidirectional lines, is to connect a fast switching steering diode in parallel with the SL05T1 series device. When the steering diode is forward-biased, the surge protection will avalanche and conduct in reverse direction. It is important to note that by adding a steering diode, the effective capacitance in the circuit will be increased, therefore the impact of adding a steering diode must be taken in consideration to establish whether the incremental capacitance will affect the circuit functionality or not. The Figure 7 shows the connection between the steering diode and the SL05T1 series device:

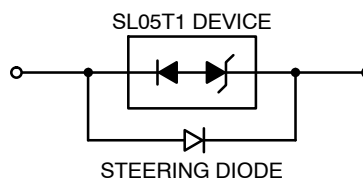


Figure 7.

Another typical application in which the SL05T1 series device can be utilized, is to protect multiple I/O lines. The protection in each of the I/O lines is achieved by connecting two devices in inverse-parallel. The Figure 8 illustrates how multiple I/O line protection is achieved:

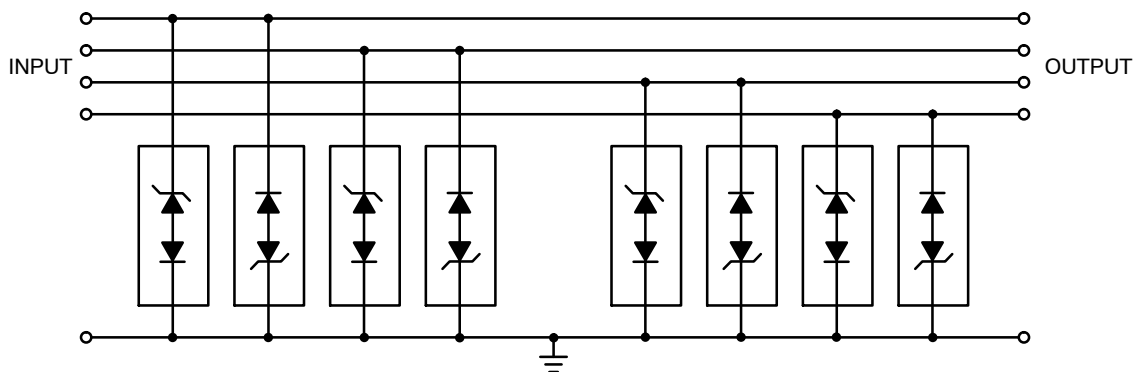


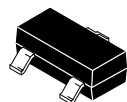
Figure 8.

For optimizing the protection, it is recommended to use ground planes and short path lengths to minimize the PCB's ground inductance.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

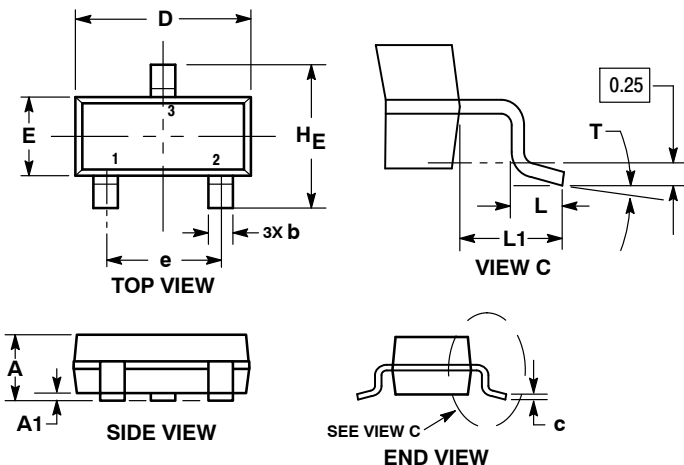
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### SOT-23 (TO-236) CASE 318-08 ISSUE AS

DATE 30 JAN 2018

SCALE 4:1

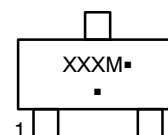


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.039 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.000  | 0.002 | 0.004 |
| b   | 0.37        | 0.44 | 0.50 | 0.015  | 0.017 | 0.020 |
| c   | 0.08        | 0.14 | 0.20 | 0.003  | 0.006 | 0.008 |
| D   | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E   | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e   | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.080 |
| L   | 0.30        | 0.43 | 0.55 | 0.012  | 0.017 | 0.022 |
| L1  | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.027 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T   | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

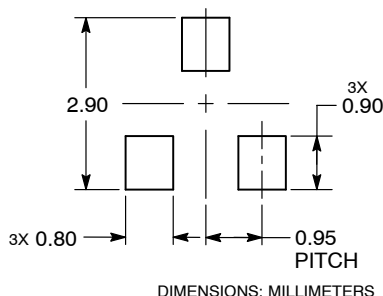
#### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

#### RECOMMENDED SOLDERING FOOTPRINT



STYLE 1 THRU 5:  
CANCELLED

STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

|                         |                        |                                                                                                                                                                                  |
|-------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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