

# SL05T1 Series

## 300 Watt, SOT-23 Low Capacitance TVS for High Speed Line Protections

This new family of TVS 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.

### Specification Features:

- TVS 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 Watts,  $8 \times 20 \mu\text{s}$
- Bi-Direction Protection Can Be Achieved By Using Two Devices
- Flammability Rating UL 94 V-0

### 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

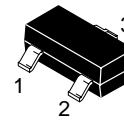
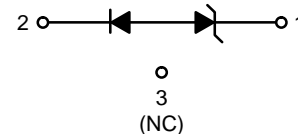
Use the Device Number to order the 7 inch/3,000 unit reel.

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



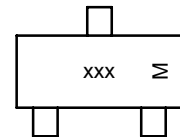
ON Semiconductor®

<http://onsemi.com>



SOT-23  
CASE 318  
STYLE 26

### MARKING DIAGRAM



xxx = Device Code  
M = Date Code

### ORDERING INFORMATION

Device	Package	Shipping
SL05T1	SOT-23	3000/Tape & Reel
SL15T1	SOT-23	3000/Tape & Reel
SL24T1	SOT-23	3000/Tape & Reel
SL05T3	SOT-23	10,000/Tape & Reel
SL15T3	SOT-23	10,000/Tape & Reel
SL24T3	SOT-23	10,000/Tape & Reel

### DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the table on page 3 of this data sheet.

# SL05T1 Series

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation @ 8x20 usec (Note 1) @ $T_L \leq 25^\circ\text{C}$	$P_{pk}$	300	W
IEC 61000-4-2 Level 4 Contact Discharge	$V_{pp}$	$\pm 8$	kV
Air Discharge		$\pm 16$	kV
IEC 61000-4-4 EFT		40	Amps
IEC 61000-4-5 Lightning		12	Amps
Total Power Dissipation on FR-5 Board (Note 2) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	225	mW
Thermal Resistance Junction to Ambient		1.8	$\text{mW}/^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Power Dissipation on Alumina Substrate (Note 3) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300	mW
Thermal Resistance Junction to Ambient		2.4	$\text{mW}/^\circ\text{C}$
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	$^\circ\text{C}$

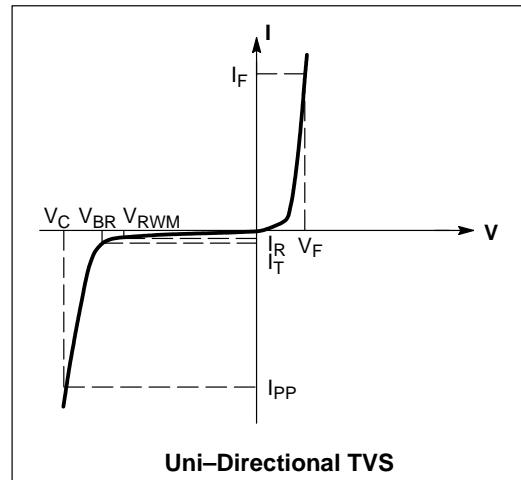
1. Non-repetitive current pulse per Figure 2
2. FR-5 = 1.0 x 0.75 x 0.62 in.
3. Alumina = 0.4 x 0.3 x 0.024 in., 99.5% alumina

## ELECTRICAL CHARACTERISTICS

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

**UNIDIRECTIONAL** (Circuit tied to Pins 1 and 3 or 2 and 3)

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 @ $I_{ZK}$



# SL05T1 Series

## ELECTRICAL CHARACTERISTICS

Device	Device Marking	$V_{RWM}$ (Volts)	$I_R @ V_{RWM}$ ( $\mu A$ )	Breakdown Voltage (Note 4)		$V_C$ , Clamping Voltage (Note 5)		Max $I_{PP}$ (Amps)	Capacitance @ $V_R = 0 V$ , 1 MHz (pF)	
				$V_{BR} @ 1 mA$ (Volts)		@ 1 Amp	@ 5 Amp		Typ	Max
				Min	Max	(Volts)	(Volts)			
SL05	L05	5.0	20	6.0	8.0	9.8	11	17	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

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

## TYPICAL CHARACTERISTICS

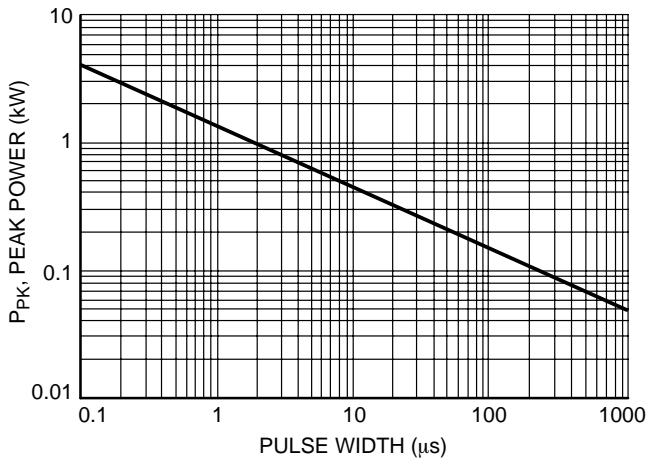


Figure 1. Maximum Peak Power Rating

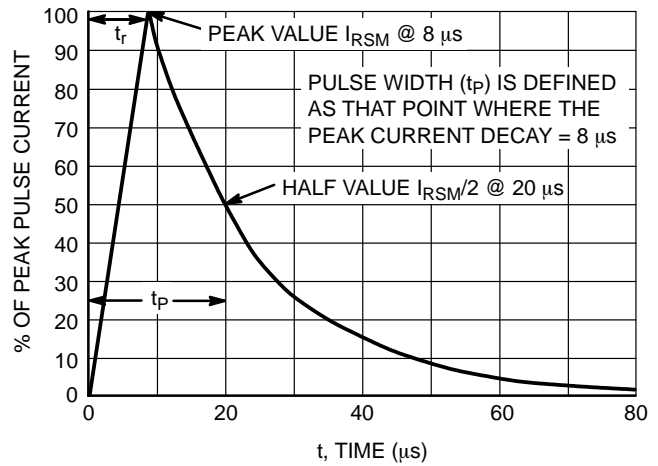


Figure 2.  $8 \times 20 \mu s$  Pulse Waveform

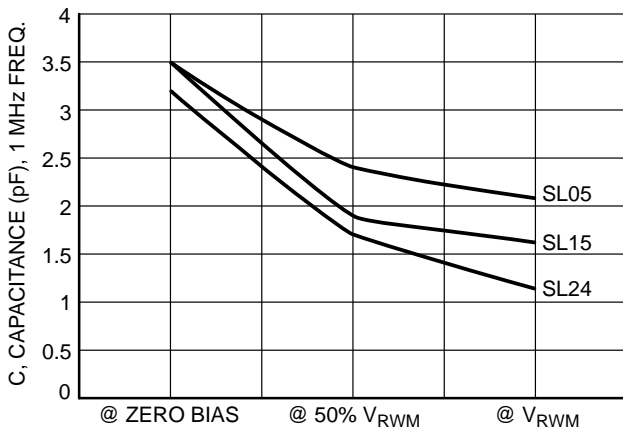


Figure 3. Typical Junction Capacitance

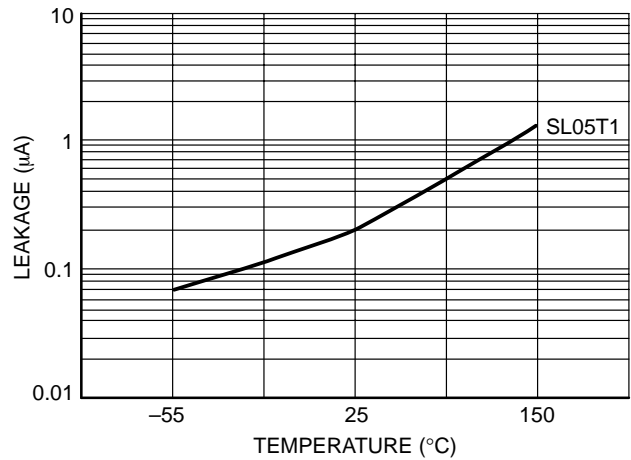


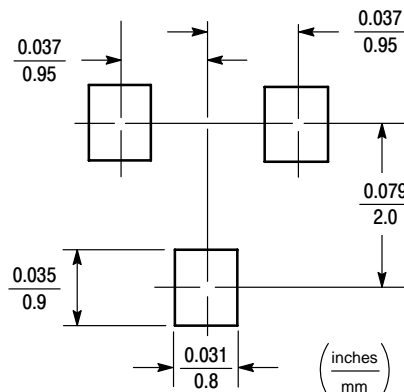
Figure 4. Typical Leakage Over Temperature

## INFORMATION FOR USING THE SOT-23 SURFACE MOUNT PACKAGE

### MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection

interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SOT-23

### SOT-23 POWER DISSIPATION

The power dissipation of the SOT-23 is a function of the drain pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by  $T_{J(max)}$ , the maximum rated junction temperature of the die,  $R_{\theta JA}$ , the thermal resistance from the device junction to ambient, and the operating temperature,  $T_A$ . Using the values provided on the data sheet for the SOT-23 package,  $P_D$  can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature  $T_A$  of 25°C, one can calculate the power dissipation of the device which in this case is 225 milliwatts.

$$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{556^\circ\text{C/W}} = 225 \text{ milliwatts}$$

The 556°C/W for the SOT-23 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 225 milliwatts. There are other alternatives to achieving higher power dissipation from the SOT-23 package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad®. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

### SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.\*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

\* \* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

## SL05T1 Series

### Applications Background

This new family of TVS 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 TVS 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 TVS 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:

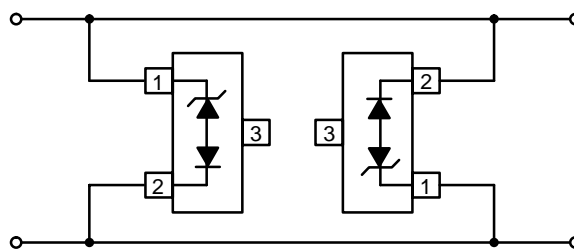


Figure 6.

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 TVS 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:

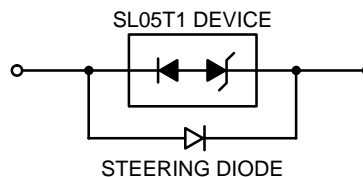


Figure 7.

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:

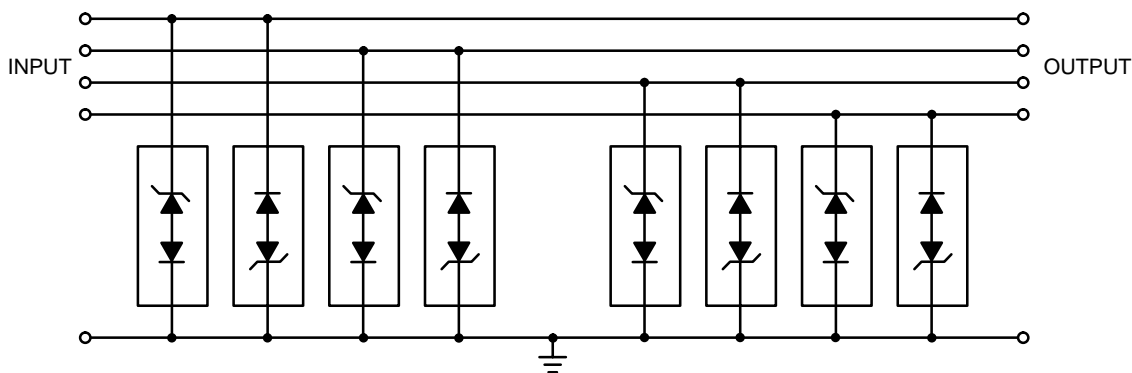


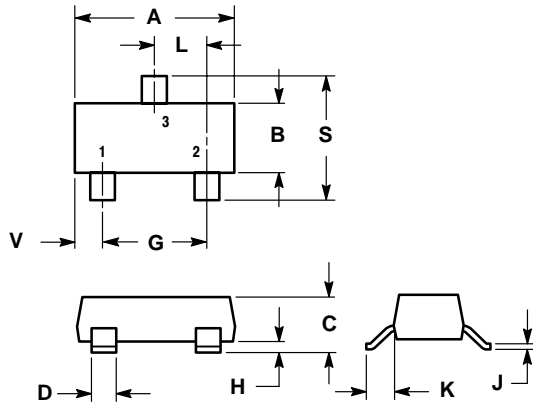
Figure 8.

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

# Transient Voltage Suppressors – Surface Mount

## 300 Watts Peak Power

SOT-23  
TO-236AB  
CASE 318-09  
ISSUE AH



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01, -02, AND -06 OBSOLETE, NEW STANDARD 318-09.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0385	0.0498	0.99	1.26
D	0.0140	0.0200	0.36	0.50
G	0.0670	0.0826	1.70	2.10
H	0.0040	0.0098	0.10	0.25
J	0.0034	0.0070	0.085	0.177
K	0.0180	0.0236	0.45	0.60
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.0984	2.10	2.50
V	0.0177	0.0236	0.45	0.60

STYLE 26:

- PIN 1. CATHODE
2. ANODE
3. NO CONNECTION

**Notes**

# SL05T1 Series

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