

# TVSL02

## TVS Diode ESD suppressor



### Product features

- Protects one bi-directional I/O line
- 0201 (0603 metric) package size
- Low clamping voltage
- Low leakage current
- Ultra-low capacitance
- Meets moisture sensitivity level (MSL) 1

### Applications

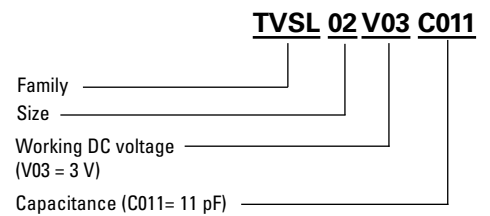
- Computer interface protection
- Microprocessor protection
- Serial and parallel ports protection
- Control signal lines protection
- Latch-up protection

### Environmental compliance and general specifications

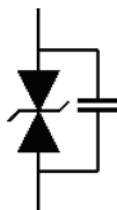
- IEC61000-4-2 (ESD)
  - up to ± 25 kV (air)
  - up to ± 25 kV (contact)



### Ordering part number



### Pin out/functional diagram



**Electrical characteristics**

(+25 °C)

**TVSL02V03C011**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	3	-	V <sub>dc</sub>
Reverse stand-off voltage	+25 °C	-3	-	+3	V <sub>RWM</sub> (V)
Reverse breakdown voltage	I <sub>BV</sub> = 1 mA, T = +25 °C	4.7	6.7	8.7	V <sub>BV</sub> (V)
Reverse leakage current	V <sub>RWM</sub> = 5 V, T = +25 °C	-	-	1	I <sub>Leak</sub> (μA)
Peak pulse current	t <sub>p</sub> = 8/20 μs	-	8	-	I <sub>PP</sub> (A)
Peak pulse power	t <sub>p</sub> = 8/20 μs	-	50	-	P <sub>PP</sub> (W)
Clamping voltage	I <sub>TLP</sub> = 1 A (100 ns transmission line)	-	5.4	-	V <sub>TLP</sub> (V)
	I <sub>TLP</sub> = 16 A (100 ns transmission line)	-	6.3	-	V <sub>TLP</sub> (V)
Channel input capacitance	V <sub>R</sub> = 0 V, f = 1 MHz	-	11.5	13.5	C <sub>IN</sub> (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±25	-	V <sub>ESD</sub> (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±25	-	V <sub>ESD</sub> (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	T <sub>SOL</sub> °C
Operating temperature range	-	-55	-	+85	T <sub>OP</sub> °C

**TVSL02V05C005**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	5	-	V <sub>dc</sub>
Reverse stand-off voltage	+25 °C	-5	-	+5	V <sub>RWM</sub> (V)
Reverse breakdown voltage	I <sub>BV</sub> = 1 mA, T = +25 °C	7	10	13	V <sub>BV</sub> (V)
Reverse leakage current	V <sub>RWM</sub> = 5 V, T = +25 °C	-	-	1	I <sub>Leak</sub> (μA)
Peak pulse current	t <sub>p</sub> = 8/20 μs	-	6	-	I <sub>PP</sub> (A)
Peak pulse power	t <sub>p</sub> = 8/20 μs	-	46	-	P <sub>PP</sub> (W)
Clamping voltage	I <sub>TLP</sub> = 1 A (100 ns transmission line)	-	7.5	-	V <sub>TLP</sub> (V)
	I <sub>TLP</sub> = 16 A (100 ns transmission line)	-	11.5	-	V <sub>TLP</sub> (V)
Channel input capacitance	V <sub>R</sub> = 0 V, f = 1 MHz	-	5	-	C <sub>IN</sub> (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±15	-	V <sub>ESD</sub> (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±15	-	V <sub>ESD</sub> (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	T <sub>SOL</sub> °C
Operating temperature range	-	-55	-	+85	T <sub>OP</sub> °C

**TVSL02V05C018**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	5	-	V <sub>dc</sub>
Reverse stand-off voltage		-5	-	+5	V <sub>RWM</sub> (V)
Reverse breakdown voltage	I <sub>BV</sub> = 1 mA, T = +25 °C	7	9	11.5	V <sub>BV</sub> (V)
Reverse leakage current	V <sub>RWM</sub> = 5 V, T = +25 °C	-	-	1	I <sub>Leak</sub> (μA)
Peak pulse current	t <sub>p</sub> = 8/20 μs	-	8	-	I <sub>PP</sub> (A)
Peak pulse power	t <sub>p</sub> = 8/20 μs	-	68	-	P <sub>PP</sub> (W)
Clamping voltage	I <sub>TLP</sub> = 1 A (100 ns transmission line)	-	6.2	-	V <sub>TLP</sub> (V)
	I <sub>TLP</sub> = 16 A (100 ns transmission line)	-	7.4	-	V <sub>TLP</sub> (V)
Channel input capacitance	V <sub>R</sub> = 0 V, f = 1 MHz	-	18	-	C <sub>IN</sub> (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±20	-	V <sub>ESD</sub> (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±20	-	V <sub>ESD</sub> (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	T <sub>SOL</sub> °C
Operating temperature range	-	-55	-	+85	T <sub>OP</sub> °C

**Electrical characteristics**

(+25 °C)

**TVSL02V07C006**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	7	-	Vdc
Reverse stand-off voltage	+25 °C	-7	-	+7	$V_{RWM}$ (V)
Reverse breakdown voltage	$I_{BV} = 1$ mA, T = +25 °C	7.5	8.8	10.5	$V_{BV}$ (V)
Reverse leakage current	$V_{RWM} = 7$ V, T = +25 °C	-	-	1	$I_{Leak}$ (μA)
Peak pulse current	$t_p = 8/20$ μs	-	8	-	$I_{PP}$ (A)
Peak pulse power	$t_p = 8/20$ μs	-	90	-	$P_{PP}$ (W)
Clamping voltage	$I_{TLP} = 1$ A (100 ns transmission line)	-	9.2	-	$V_{TLP}$ (V)
	$I_{TLP} = 16$ A (100 ns transmission line)	-	12.8	-	$V_{TLP}$ (V)
Channel input capacitance	$V_R = 0$ V, f = 1 MHz	6.8	8.5	10.3	$C_{IN}$ (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±25	-	$V_{ESD}$ (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±20	-	$V_{ESD}$ (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	$T_{SOL}$ °C
Operating temperature range	-	-55	-	+85	$T_{OP}$ °C

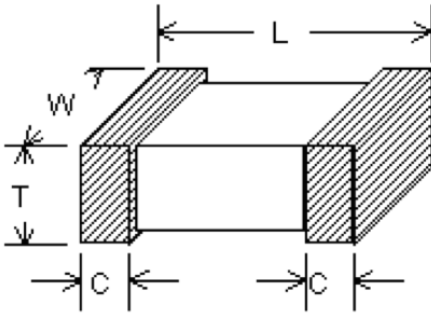
**TVSL02V09C005**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	9	-	Vdc
Reverse stand-off voltage	+25 °C	-9	-	9	$V_{RWM}$ (V)
Reverse breakdown voltage	$I_{BV} = 1$ mA, T = +25 °C	10	11.8	14	$V_{BV}$ (V)
Reverse leakage current	$V_{RWM} = 9$ V, T = +25 °C	-	-	1	$I_{Leak}$ (μA)
Peak pulse current	$t_p = 8/20$ μs	-	6	-	$I_{PP}$ (A)
Peak pulse power	$t_p = 8/20$ μs	-	80	-	$P_{PP}$ (W)
Clamping voltage	$I_{TLP} = 1$ A (100 ns transmission line)	-	12.3	-	$V_{TLP}$ (V)
	$I_{TLP} = 16$ A (100 ns transmission line)	-	17.3	-	$V_{TLP}$ (V)
Channel input capacitance	$V_R = 0$ V, f = 1 MHz	-	7.5	-	$C_{IN}$ (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±20	-	$V_{ESD}$ (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±20	-	$V_{ESD}$ (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	$T_{SOL}$ °C
Operating temperature range	-	-55	-	+85	$T_{OP}$ °C

**TVSL02V12C008**

Parameter	Test condition	Minimum	Typical	Maximum	Symbol (Units)
Operating supply voltage		-	12	-	Vdc
Reverse stand-off voltage		-12	-	+12	$V_{RWM}$ (V)
Reverse breakdown voltage	$I_{BV} = 5$ μA, T = +25 °C	15.5	19	22.5	$V_{BV}$ (V)
Reverse leakage current	$V_{RWM} = 12$ V, T = +25 °C	-	-	1	$I_{Leak}$ (μA)
Peak pulse current	$t_p = 8/20$ μs	-	4	-	$I_{PP}$ (A)
Peak pulse power	$t_p = 8/20$ μs	-	60	-	$P_{PP}$ (W)
Clamping voltage	$I_{TLP} = 1$ A (100 ns transmission line)	-	15.8	-	$V_{TLP}$ (V)
	$I_{TLP} = 16$ A (100 ns transmission line)	-	19.4	-	$V_{TLP}$ (V)
Channel input capacitance	$V_R = 0$ V, f = 1 MHz	-	8.5	-	$C_{IN}$ (pF)
ESD per IEC 61000-4-2 (Air)	-	-	±25	-	$V_{ESD}$ (kV)
ESD per IEC 61000-4-2 (Contact)	-	-	±20	-	$V_{ESD}$ (kV)
Lead soldering temperature	-	-	260 (20 - 40 seconds)	-	$T_{SOL}$ °C
Operating temperature range	-	-55	-	+85	$T_{OP}$ °C

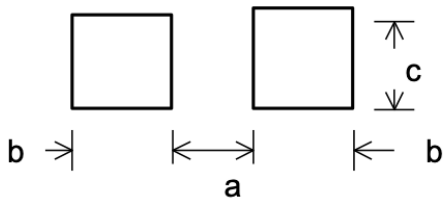
**Mechanical parameters- mm**



Dimension	Value
L	0.60 ± 0.05
W	0.30 ± 0.04
T	0.30 ± 0.04
C	0.20 ± 0.06

Part marking: (No marking)  
Terminal plating: Ni > 2.5 µm; Sn > 3.5 µm

**Recommended pad layout**



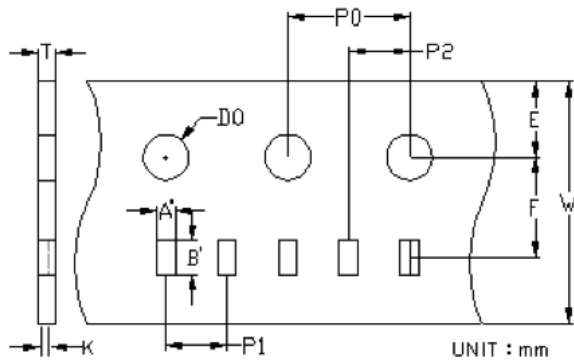
Dimension	Value
a	0.2 to 0.3
b	0.25 to 0.30
c	0.3 to 0.4

Print solder in a thickness of 150 to 200 µm

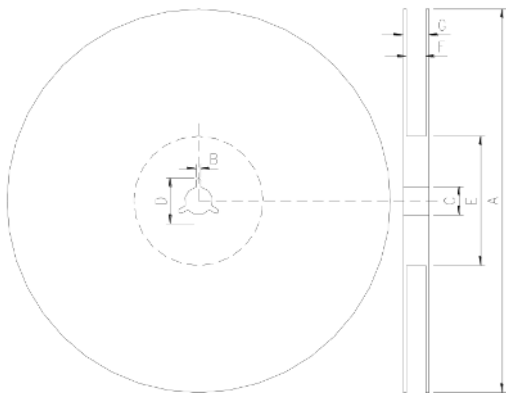
**Packaging information- mm/inches**

Drawing not to scale.

Supplied in tape and reel packaging, 15,000 parts per 7" diameter reel (EIA-481 compliant)



Dimension	Milimeter
A	0.35
B	0.67
W	8
E	1.75
F	3.5
P0	4
P1	2
P2	2
D0	1.55
T	0.42
K	0.35

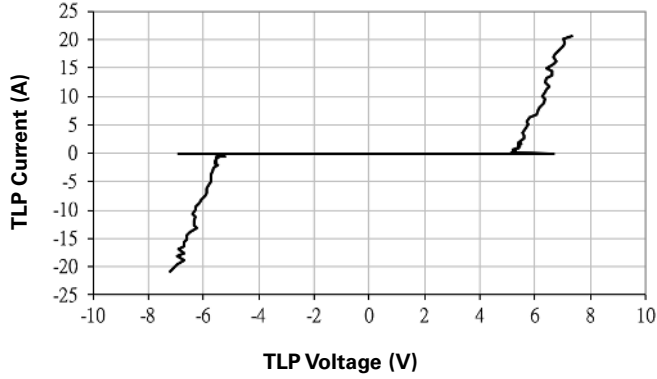


Dimension	Milimeter
A	178
B	2
C	13
D	21
E	62
F	9
G	13

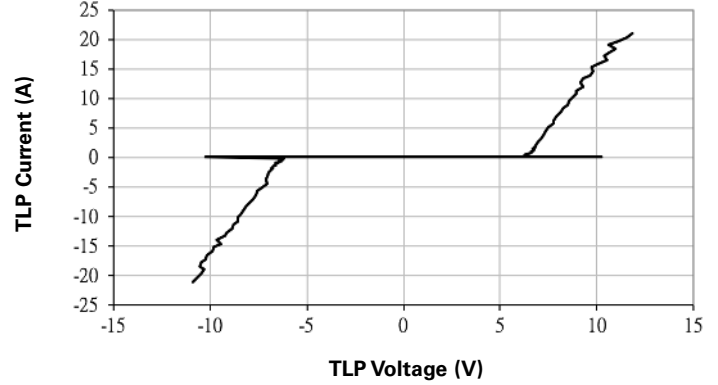
**Ratings and V-I characteristic curves** (+25 °C unless otherwise noted)

**Typical characteristics**

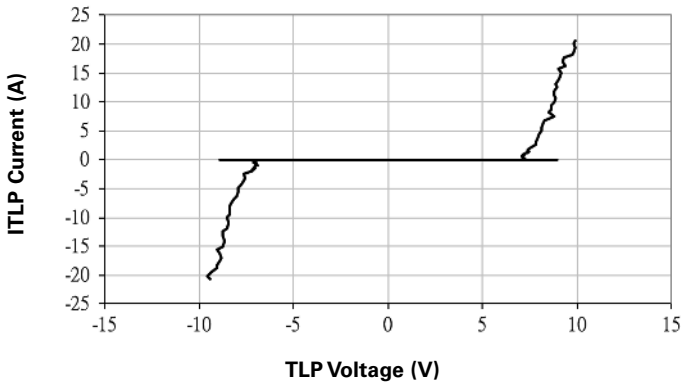
**TVSL02V03C011**



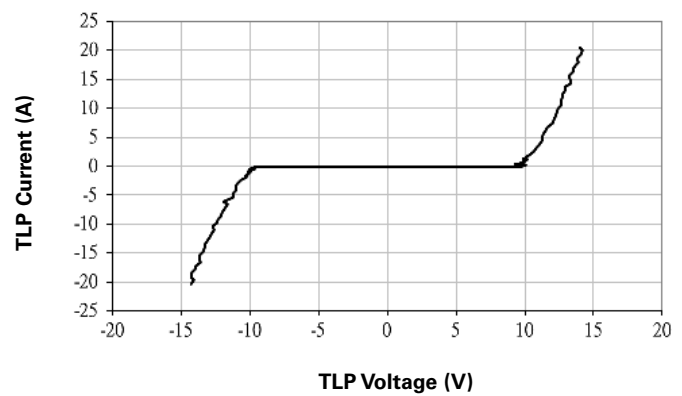
**TVSL02V05C005**



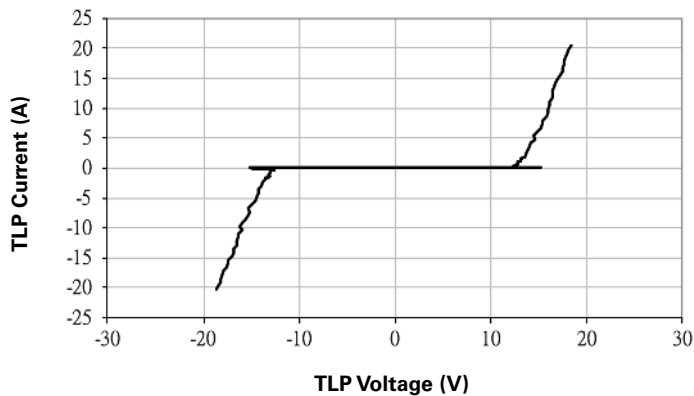
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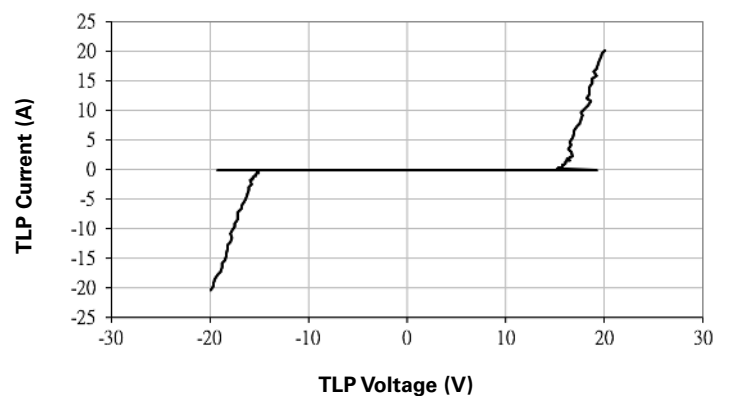
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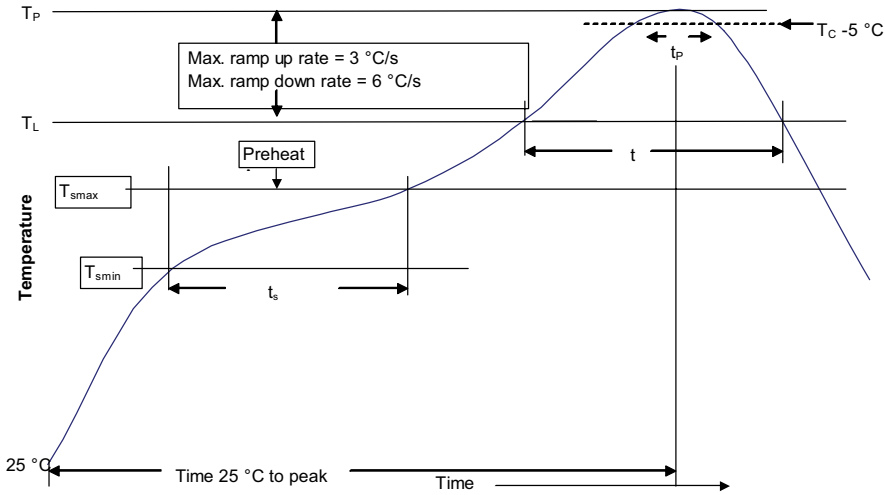
**TVSL02V09C005**



**TVSL02V12C008**



**Solder reflow profile**



**Table 1 - Standard SnPb solder ( $T_C$ )**

Package thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

**Table 2 - Lead (Pb) free solder ( $T_C$ )**

Package thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350 - 2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 – 2.5 mm	260 °C	250 °C	245 °C
>2.5 mm	250 °C	245 °C	245 °C

**Reference J-STD-020**

Profile feature	Standard SnPb solder	Lead (Pb) free solder
Preheat and soak		
• Temperature min. ( $T_{smin}$ )	100 °C	150 °C
• Temperature max. ( $T_{smax}$ )	150 °C	200 °C
• Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Ramp up rate $T_L$ to $T_P$	3 °C/ second max.	3 °C/ second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time ( $t_L$ ) maintained above $T_L$	60-150 seconds	60-150 seconds
Peak package body temperature ( $T_P$ )*	Table 1	Table 2
Time ( $t_p$ )* within 5 °C of the specified classification temperature ( $T_C$ )	20 seconds*	30 seconds*
Ramp-down rate ( $T_P$ to $T_L$ )	6 °C/ second max.	6 °C/ second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

\* Tolerance for peak profile temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.

**Manual solder**

+330 °C, 6 seconds maximum, 30 W maximum soldering iron, generally manual/hand soldering is not recommended

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