

SP712 Series 640W Asymmetrical TVS Diode Array

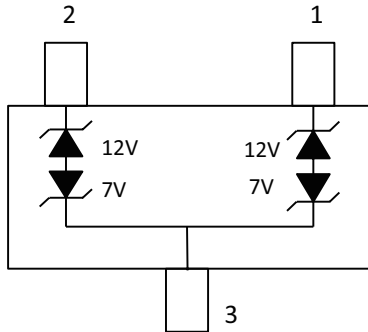


**Description**

The SP712 TVS Diode Array is designed to protect RS-485 applications with asymmetrical working voltages (-7V to 12V) from damage due to electrostatic discharge (ESD), electrical fast transients (EFT), and lightning induced surges.

The SP712 can absorb repetitive ESD strikes above the maximum level specified in IEC 61000-4-2 international standard without performance degradation and safely dissipate up to 20A of 8/20us induced surge current (IEC 61000-4-5) with very low clamping voltages.

**Pinout and Functional Block Diagram**



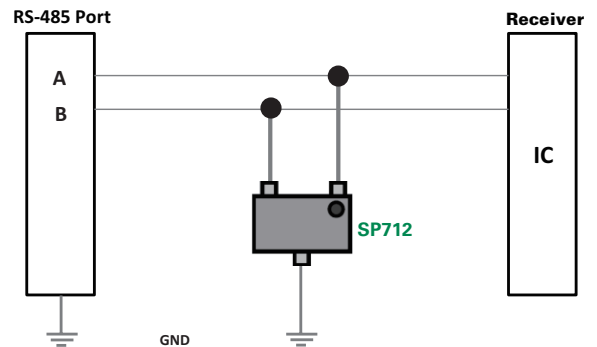
**Features**

- ESD, IEC 61000-4-2, ±30kV contact, ±30kV air
- EFT, IEC 61000-4-4, 50A (5/50ns)
- Lightning, IEC 61000-4-5 2<sup>nd</sup> edition, 20A (t<sub>p</sub>=8/20μs)
- Working Voltages: -7V to 12V
- Low clamping voltage
- Low leakage current
- Halogen free, Lead free and RoHS compliant
- Moisture Sensitivity Level(MSL -1)
- AEC-Q101 qualified

**Applications**

- RS-485
- Fieldbus
- Modbus
- Profibus
- DMX512
- Security Systems
- Automated Teller Machines (ATMs)
- Lighting Control - DALI
- Communication Equipments

**RS-485 Application Example**



Life Support Note:

**Not Intended for Use in Life Support or Life Saving Applications**

The products shown herein are not designed for use in life sustaining or life saving applications unless otherwise expressly indicated.

### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$P_{PK}$	Peak Pulse Power ( $t_p=8/20\mu s$ )	640	W
$I_{PP}$	Peak Pulse Current ( $t_p=8/20\mu s$ )	20	A
$T_{OP}$	Operating Temperature	-40 to 125	°C
$T_{STOR}$	Storage Temperature	-55 to 150	°C

Notes:

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

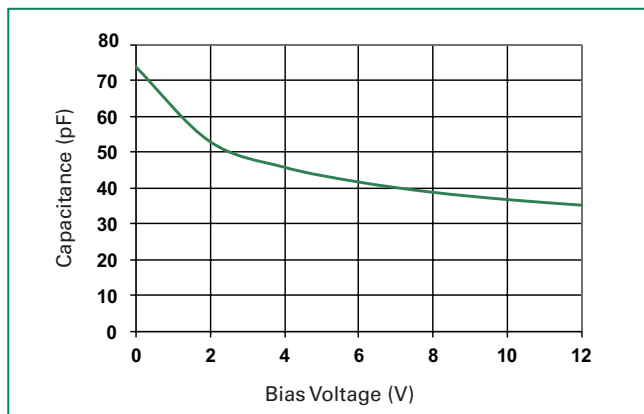
### Electrical Characteristics ( $T_{OP}=25^\circ C$ )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	$V_{RWM}$	$I_R=1\mu A$ , Pin 3 to Pin 1 or Pin 2			7.0	V
		$I_R=1\mu A$ , Pin 1 or Pin 2 to Pin 3			12.0	V
Breakdown Voltage	$V_{BR}$	$I_R=1mA$ , Pin 3 to Pin 1 or Pin 2	7.5	9		V
		$I_R=1mA$ , Pin 1 or Pin 2 to Pin 3	13.3	14.5		V
Reverse Leakage Current	$I_{LEAK}$	$V_R=7V$			20	$\mu A$
		$V_R=12V$			1	$\mu A$
Clamp Voltage <sup>1</sup>	$V_C$	$I_{PP}=1A$ , $t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		17	19	V
		$I_{PP}=1A$ , $t_p=8/20\mu s$ , Pin 3 to Pin 1 or Pin 2		10	11	V
		$I_{PP}=20A$ , $t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		28	32	V
		$I_{PP}=20A$ , $t_p=8/20\mu s$ , Pin 3 to Pin 1 or Pin 2		17	20	V
Dynamic Resistance <sup>2</sup>	$R_{DYN}$	TLP, $t_p=100ns$		0.26		$\Omega$
ESD Withstand Voltage <sup>1</sup>	$V_{ESD}$	IEC 61000-4-2 (Contact Discharge)	$\pm 30$			kV
		IEC 61000-4-2 (Air Discharge)	$\pm 30$			kV
Diode Capacitance <sup>1</sup>	$C_{I/O-GND}$	Reverse Bias=0V, $f=1MHz$ ; Pin 1 or Pin 2 to Pin 3			75	pF

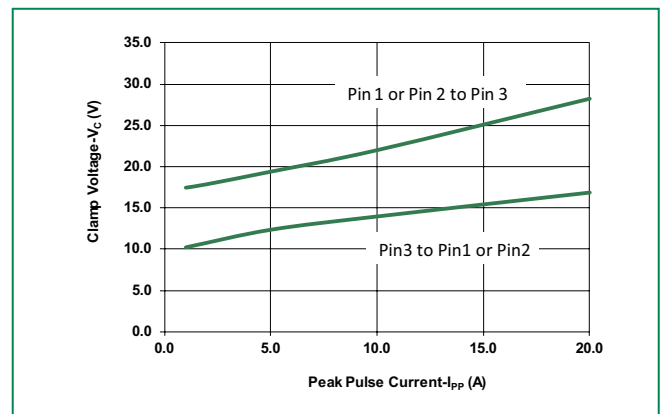
Notes : 1. Parameter is guaranteed by design and/or component characterization.

2. Transmission Line Pulse (TLP) test setting : Std.TDR(50 $\Omega$ ),  $t_p=100ns$ ,  $t_r=0.2ns$  ITLP and VTLP averaging window: start  $t_1=70ns$  to end  $t_2=90ns$

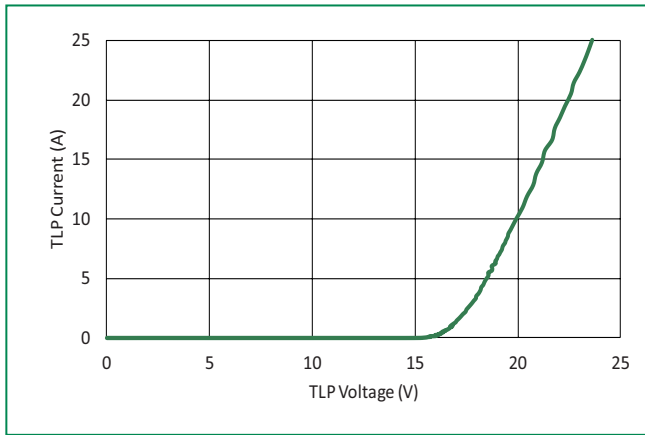
### Capacitance vs. Reverse Bias



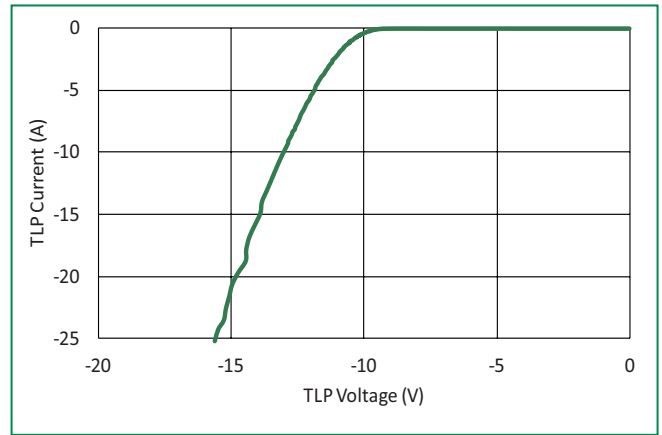
### Clamping Voltage vs. $I_{PP}$



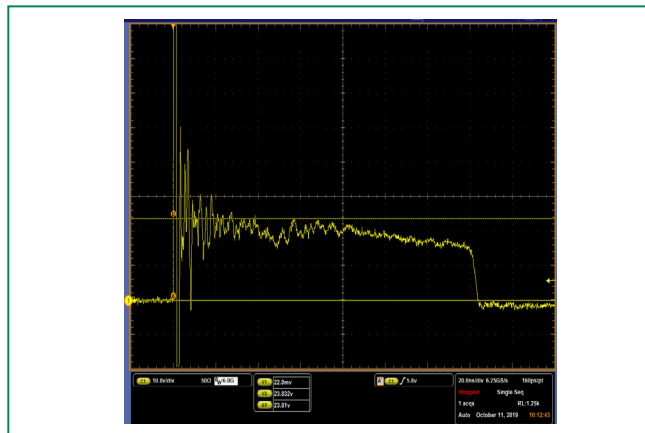
**Positive Transmission Line Pulsing (TLP) Plot**



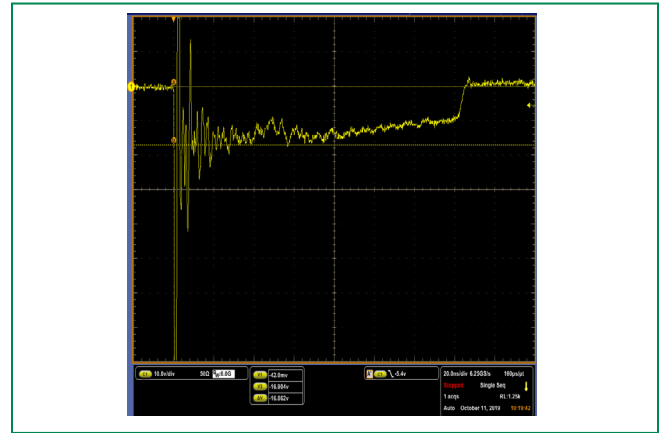
**Negative Transmission Line Pulsing (TLP) Plot**



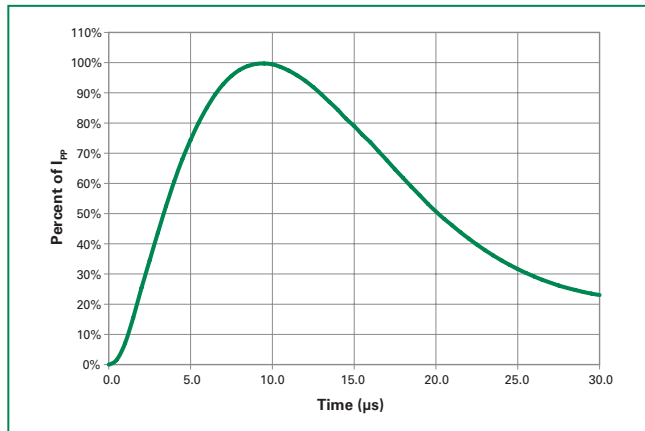
**IEC 61000-4-2 +8kV Contact ESD Clamping Voltage**



**IEC 61000-4-2 -8kV Contact ESD Clamping Voltage**

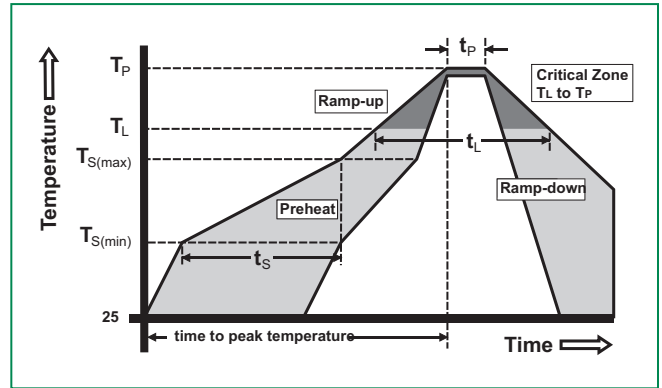


**8/20µs Pulse Waveform**

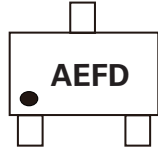


**Soldering Parameters**

Reflow Condition		Pb – Free assembly
Pre Heat	- Temperature Min ( $T_{s(min)}$ )	150°C
	- Temperature Max ( $T_{s(max)}$ )	200°C
	- Time (min to max) ( $t_s$ )	60 – 180 secs
Average ramp up rate (Liquidus) Temp ( $T_L$ ) to peak		3°C/second max
$T_{s(max)}$ to $T_L$ - Ramp-up Rate		3°C/second max
Reflow	- Temperature ( $T_L$ ) (Liquidus)	217°C
	- Temperature ( $t_L$ )	60 – 150 seconds
Peak Temperature ( $T_p$ )		260 <sup>+0/-5</sup> °C
Time within 5°C of actual peak Temperature ( $t_p$ )		20 – 40 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature ( $T_p$ )		8 minutes Max.
Do not exceed		260°C



**Part Marking System**



AE : Part code  
F : Assembly code  
D : Date code

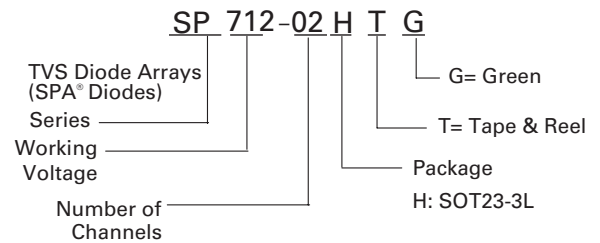
**Ordering Information**

Part Number	Package	Min. Order Qty.
SP712-02HTG	SOT23-3L	3000

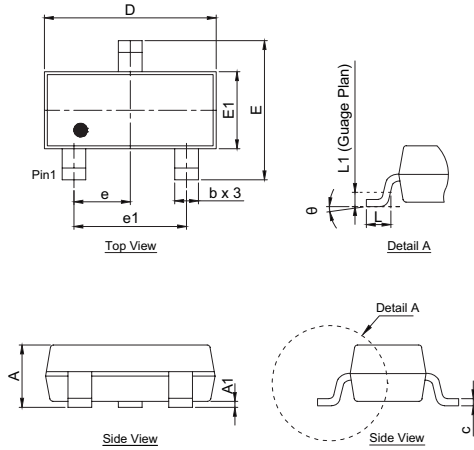
**Product Characteristics**

<b>Lead Plating</b>	Matte Tin
<b>Lead Material</b>	Copper Alloy
<b>Lead Coplanarity</b>	0.004 inches(0.102mm)
<b>Substrate Material</b>	Silicon
<b>Body Material</b>	Molded Compound
<b>Flammability</b>	UL Recognized compound meeting flammability rating V-0

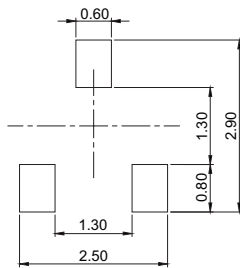
**Part Numbering System**



**Package Dimensions — SOT23-3**

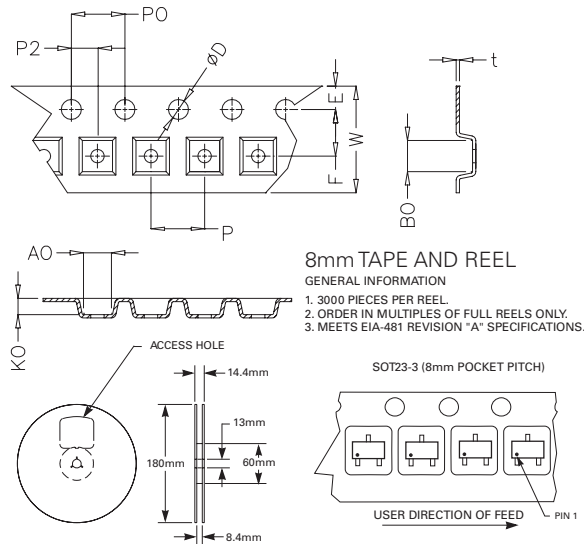


Package	SOT23-3			
Pins	3			
JEDEC	TO-236			
	Millimeters		Inches	
	Min	Max	Min	Max
<b>A</b>	0.90	1.15	0.035	0.045
<b>A1</b>	0.00	0.10	0.000	0.004
<b>b</b>	0.30	0.51	0.012	0.020
<b>c</b>	0.08	0.20	0.003	0.008
<b>D</b>	2.80	3.04	0.110	0.120
<b>E</b>	2.10	2.64	0.083	0.104
<b>E1</b>	1.20	1.40	0.047	0.055
<b>e</b>	0.95 BSC		0.038 BSC	
<b>e1</b>	1.90 BSC		0.075 BSC	
<b>L</b>	0.30	0.55	0.012	0.022
<b>L1</b>	0.25 BSC		0.010 BSC	
<b>θ</b>	0°	8°	0°	8°



Recommended soldering pad layout (unit :mm)  
Drawing# : H03-B

**Embossed Carrier Tape & Reel Specification — SOT23-3**



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
<b>E</b>	1.65	1.85	0.065	0.073
<b>F</b>	3.40	3.60	0.134	0.142
<b>P2</b>	1.90	2.10	0.075	0.083
<b>D</b>	1.40	1.60	0.055	0.063
<b>P0</b>	3.90	4.10	0.154	0.161
<b>W</b>	7.70	8.30	0.303	0.327
<b>P</b>	3.90	4.10	0.154	0.161
<b>A0</b>	3.05	3.25	0.120	0.128
<b>B0</b>	2.67	2.87	0.105	0.113
<b>K0</b>	1.12	1.32	0.044	0.052
<b>t</b>	0.22	0.24	0.009	0.009

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