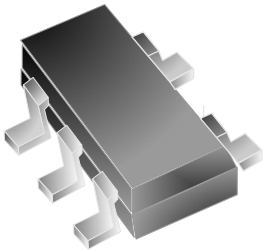
WS05MF through WS24MF

Transient Voltage Suppressor

Features

- Solid-state silicon-avalanche technology
- 100 Watts Peak Pulse Power per Line (t_p=8/20μs)
- Low operating and clamping voltages
- Up to Four (4) Lines of Protection
- Working Voltages: 5 V, 12V, 15V and 24V
- Low Leakage Current



SOT-353

IEC COMPATIBILITY (EN61000-4)

- **IEC 61000-4-2 (ESD) ±15kV (air), ±8kV (contact)**
- **IEC 61000-4-4 (EFT) 40A (5/50ns)**

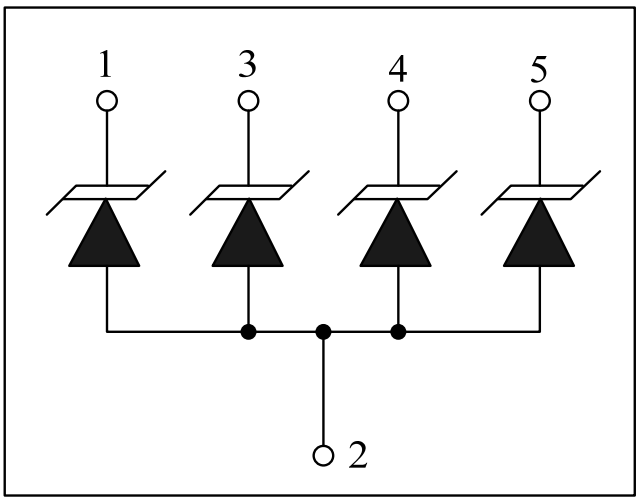
Mechanical Characteristics

- SOT-353 package
- Molding compound flammability rating: UL 94V-0
- Marking: Marking Code
- Packaging: Tape and Reel
- RoHS/WEEE Compliant

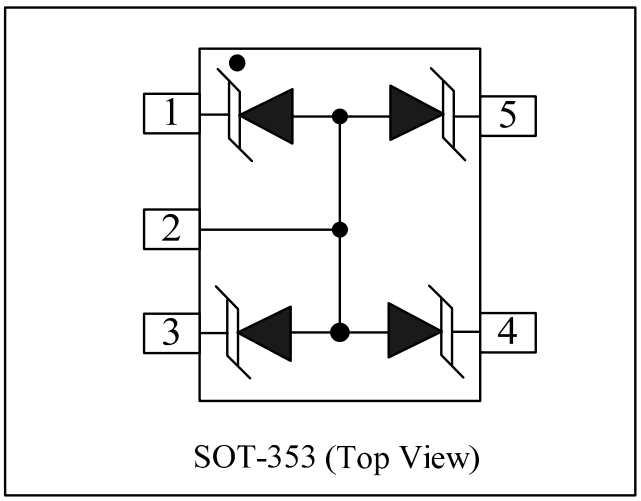
Applications

- Cellular Handsets & Accessories
- Personal Digital Assistants (PDAs)
- Notebooks & Handhelds
- Portable Instrumentation
- Digital Cameras
- MP3 Player

Circuit Diagram



Schematic & PIN Configuration

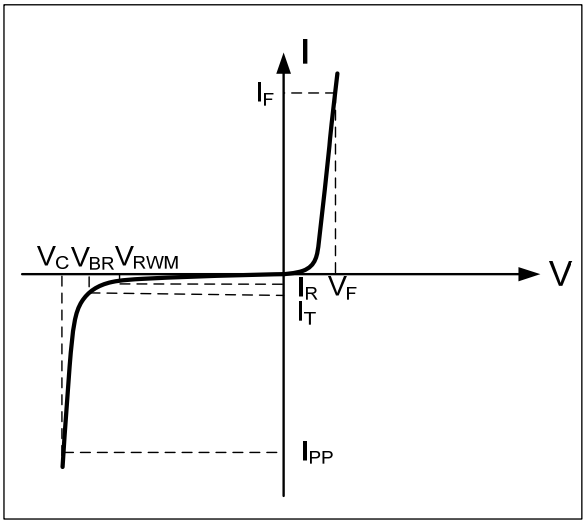


SOT-353 (Top View)

Absolute Maximum Rating			
Rating	**Symbol**	**Value**	**Units**
Peak Pulse Power（t_p =8/20μs）	P_{PP}	100	Watts
Peak Forward Voltage (I_F = 1A, t_p=8/20μs)	V_{FP}	1.5	V
Operating Temperature	T_J	-55 to + 125	℃
Storage Temperature	T_{STG}	-55 to +150	℃

Electrical Parameters (T=25℃)

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
I_F	Forward Current
V_F	Forward Voltage @ I_F



Electrical Characteristics

WS05MF						
Parameter	**Symbol**	**Conditions**	**Minimum**	**Typical**	**Maximum**	**Units**
Reverse Stand-Off Voltage	V_{RWM}				5.0	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA	6.0			V
Reverse Leakage Current	I_R	V_{RWM}=5V,T=25℃			1	μA
Peak Pulse Current	I_{PP}	t_p =8/20μs			6.5	A
Clamping Voltage	V_C	I_{PP}=1A, t_p=8/20μs			9.5	V
Clamping Voltage	V_C	I_{PP}=6.5A, t_p=8/20μs		13.5	15	V
Junction Capacitance	C_j	Between I/O pins and Ground V_R = 0V, f = 1MHz		22		pF

Electrical Characteristics (Continued)

WS12MF

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}				12.0	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA	13.3			V
Reverse Leakage Current	I_R	V_{RWM}=12V,T=25℃			1	μA
Peak Pulse Current	I_{PP}	t_p =8/20μs			5.0	A
Clamping Voltage	V_C	I_{PP}=1A, t_p=8/20μs			15.0	V
Maximum Clamping Voltage	V_C	I_{PP}=5A, t_p=8/20μs			22.0	V
Junction Capacitance	C_j	Between I/O pins and Ground V_R = 0V, f = 1MHz		9		pF

WS15MF

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}				15	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA	16.7			V
Reverse Leakage Current	I_R	V_{RWM}=15V,T=25℃			1	μA
Peak Pulse Current	I_{PP}	t_p =8/20μs			3	A
Clamping Voltage	V_C	I_{PP}=1A, t_p=8/20μs			24	V
Maximum Clamping Voltage	V_C	I_{PP}=3A, t_p=8/20μs			33	V
Junction Capacitance	C_j	Between I/O pins and Ground V_R = 0V, f = 1MHz		7		pF

WS24MF

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}				24	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA	26.7			V
Reverse Leakage Current	I_R	V_{RWM}=24V,T=25℃			1	μA
Peak Pulse Current	I_{PP}	t_p =8/20μs			1.8	A
Clamping Voltage	V_C	I_{PP}=1A, t_p=8/20μs			43	V
Maximum Clamping Voltage	V_C	I_{PP}=1.8A, t_p=8/20μs			56	V
Junction Capacitance	C_j	Between I/O pins and Ground V_R = 0V, f = 1MHz		5		pF

Typical Characteristics

Figure 1: Peak Pulse Power vs. Pulse Time

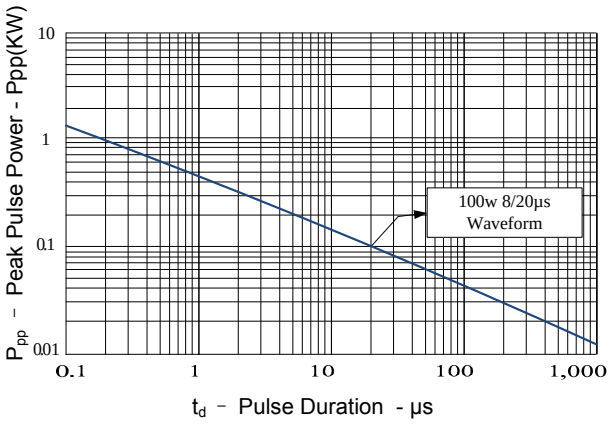


Figure 2: Power Derating Curve

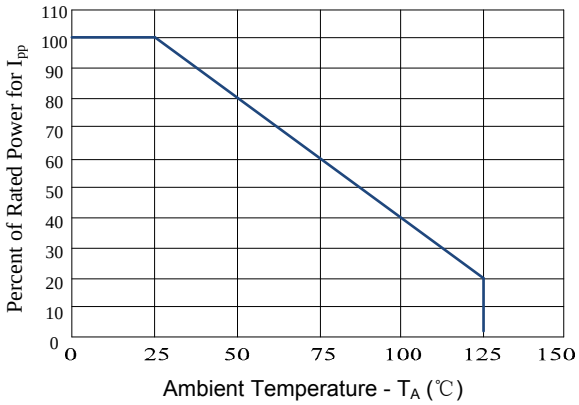


Figure 3: Clamping Voltage vs. Peak Pulse Current

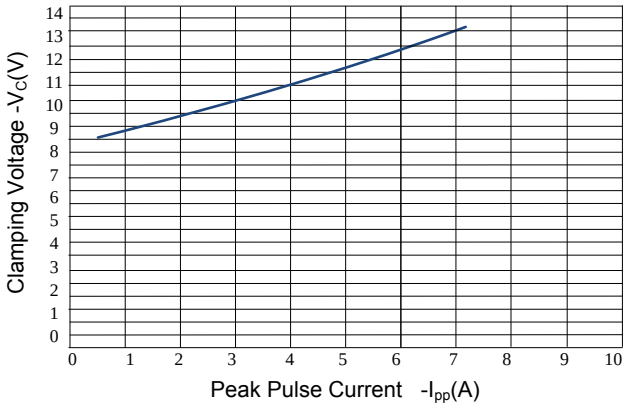


Figure 4: WS05MF Insertion Loss

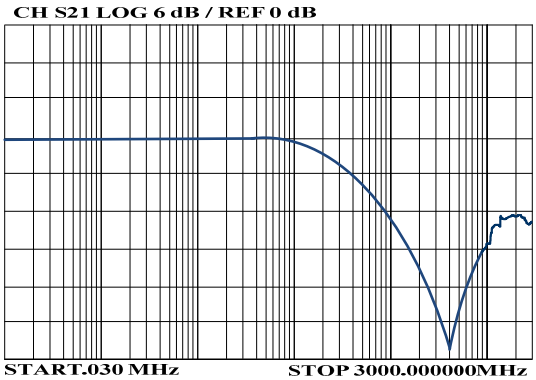


Figure 5: Normalized Junction Capacitance vs. Reverse Voltage

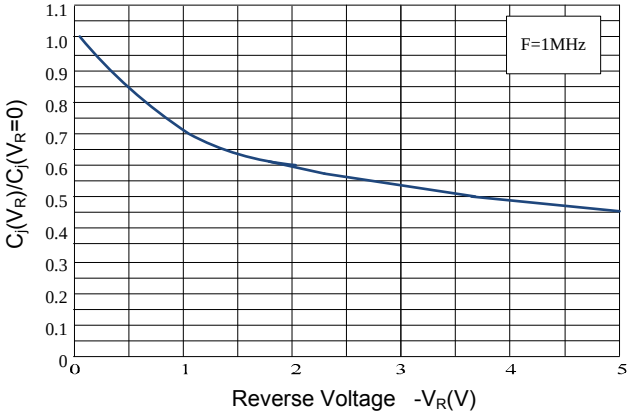
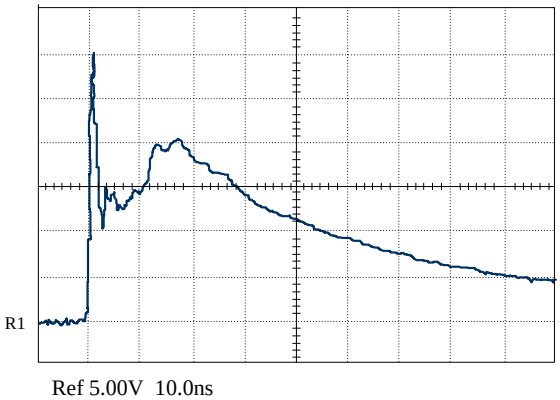


Figure 6: ESD Pulse Waveform (Per IEC 61000-4-2)



Application Information

The WSxxMF Series are TVS arrays designed to protect I/O or data lines from the damaging effects of ESD or EFT. This product provides unidirectional protection; the device is connected as follows:

UNIDIRECTIONAL COMMON-MODE CONFIGURATION

The WSxxMF Series provides up to four (4) lines of protection in a common-mode configuration as depicted in Figure 7. Circuit connectivity is as follows:

- I/O 1 is connected to Pin 1.
- I/O 2 is connected to Pin 3.
- I/O 3 is connected to Pin 4.
- I/O 4 is connected to Pin 5.
- Pin 2 is connected to ground.

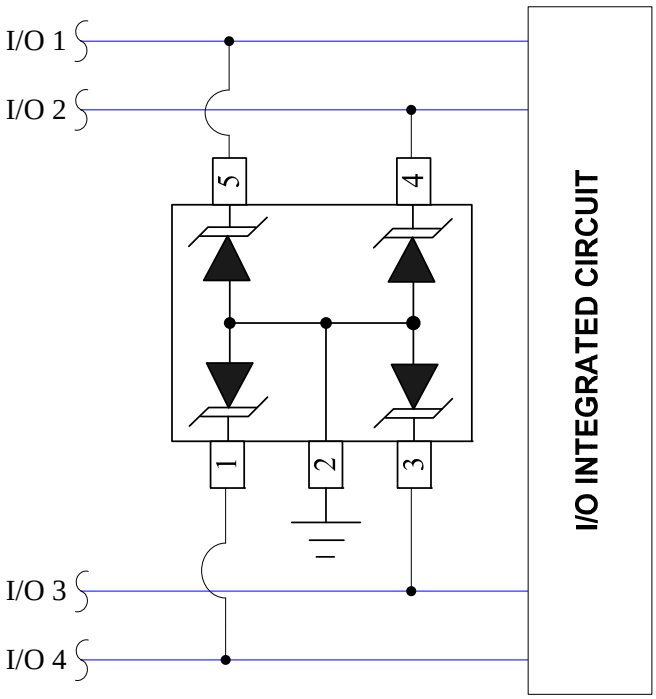


Figure 7 Unidirectional Configuration Common-Mode I/O Port Protections

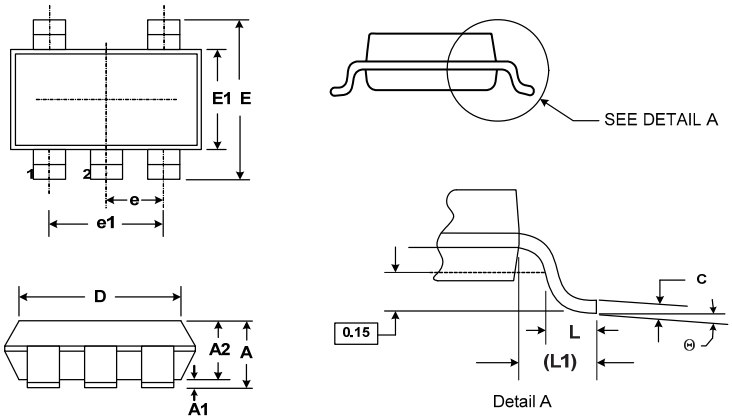
CIRCUIT BOARD LAYOUT RECOMMENDATIONS

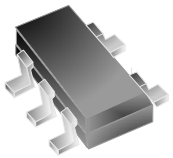
Circuit board layout is critical for Electromagnetic Compatibility (EMC) protection. The following guidelines are recommended:

- The protection device should be placed near the input terminals or connectors, the device will divert the transient current immediately before it can be coupled into the nearby traces.
- The path length between the TVS device and the protected line should be minimized.
- All conductive loops including power and ground loops should be minimized.
- The transient current return path to ground should be kept as short as possible to reduce parasitic inductance.
- Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

Outline Drawing – SOT-353

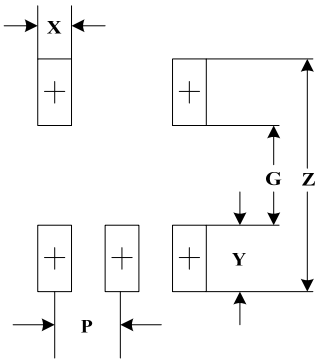
PACKAGE OUTLINE





SOT-353

SYMBOL	INCHES		MILLIMETER	
	MIN	MAX	MIN	MAX
A	0.035	0.043	0.900	1.100
A1	0.000	0.004	0.000	0.100
A2	0.035	0.039	0.900	1.000
D	0.079	0.087	2.000	2.200
E1	0.045	0.053	1.150	1.350
E	0.085	0.096	2.150	2.450
e	0.020 TYP		0.650 TYP	
e1	0.047	0.055	1.200	1.400
L	0.022 REF		0.525 REF	
L1	0.010	0.018	0.260	0.460
θ	0°		8°	0°



DIMENSIONS		
DIM	INCHES	MILLIMETERS
Z	0.090	2.30
G	0.073	1.85
P	0.020 TYP	0.65 TYP
X	0.008	0.20
Y	0.033	0.085

Notes

1. Dimensioning and tolerances per ANSI Y14.5M, 1985.
2. Controlling Dimension: Inches
3. Pin 3 is the cathode (Unidirectional Only).
4. Dimensions are exclusive of mold flash and metal burrs.

Marking Codes

Part Number	WS05MF	WS12MF	WS15MF	WS24MF
Marking Code	05F	12F	15F	24F