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# RClamp7535M

## Low Capacitance TVS for LVDS Interfaces

### PROTECTION PRODUCTS - RailClamp®

#### Description

RailClamp® TVS diode arrays are specifically designed to protect sensitive components which are connected to high-speed data and transmission lines from over-voltage caused by **ESD** (electrostatic discharge), **CDE** (Cable Discharge Events), and **EFT** (electrical fast transients).

The unique design incorporates surge rated, low capacitance steering diodes and a TVS diode in a single package. This allows the device to absorb large amounts of energy while protecting downstream components from harmful transient events.

The RClamp®7535M is in a 10-pin MSOP package. The leads are finished with lead-free matte tin. Each device will protect up to eight high-speed lines. They may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 (15kV air, 8kV contact discharge). The combination of small size, low capacitance, and high ESD surge capability makes them ideal for use in applications such as next generation color LCD displays and LVDS interfaces.

#### Features

- ◆ Transient protection for high-speed data lines to **IEC 61000-4-2 (ESD) ±15kV (air), ±8kV (contact)**  
**IEC 61000-4-4 (EFT) 40A (5/50ns)**  
**IEC 61000-4-5 (Lightning) 25A (8/20µs)**
- ◆ Array of surge rated diodes with internal TVS Diode
- ◆ Small package saves board space
- ◆ Protects up to eight I/O lines
- ◆ Low capacitance (**<5pF**) for high-speed interfaces
- ◆ Low leakage current and clamping voltage
- ◆ Low operating voltage: 2.5V
- ◆ Solid-state silicon-avalanche technology

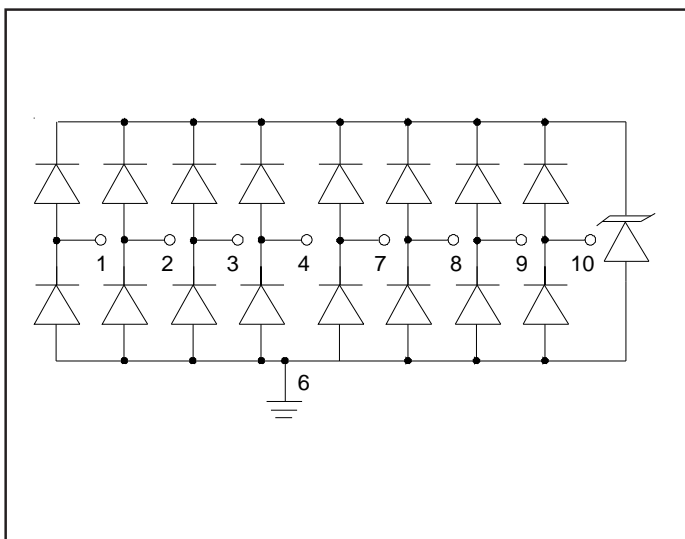
#### Mechanical Characteristics

- ◆ JEDEC MSOP-10L package
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Lead Finish: Matte Sn
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking code + Date code
- ◆ Packaging : Tape and Reel

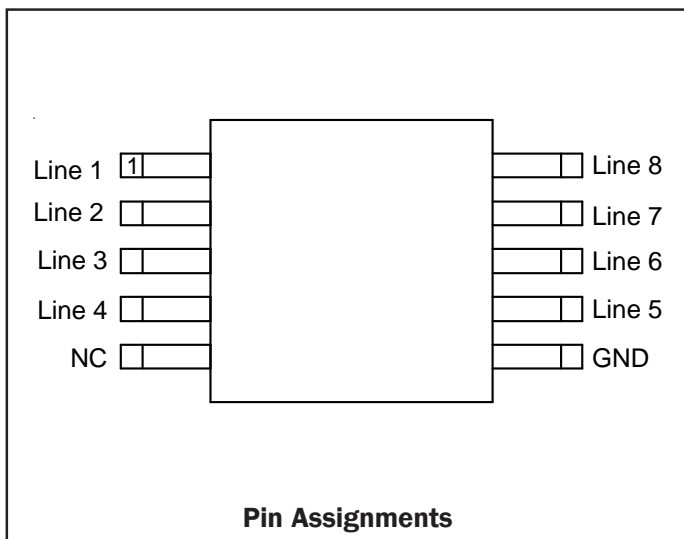
#### Applications

- ◆ LVDS Interfaces
- ◆ LCD TV

#### Circuit Diagram



#### PIN Configuration



## PROTECTION PRODUCTS

### Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P <sub>pk</sub>	300	Watts
Peak Pulse Current (tp = 8/20μs)	I <sub>pp</sub>	30	A
ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	V <sub>ESD</sub>	25 15	kV
Operating Temperature	T <sub>J</sub>	-55 to +125	°C
Storage Temperature	T <sub>STG</sub>	-55 to +150	°C

### Electrical Characteristics (T=25°C)

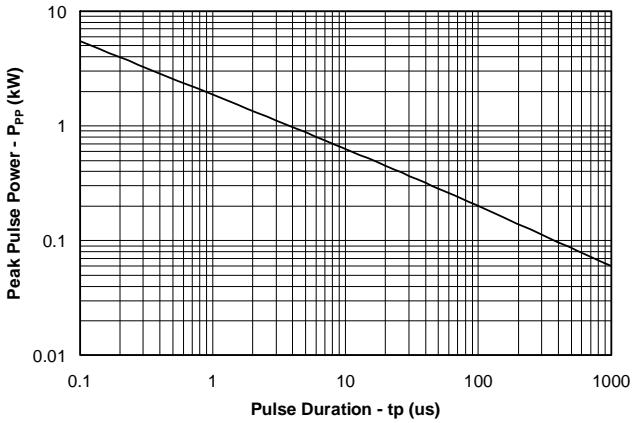
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V <sub>RWM</sub>				2.5	V
Punch-Through Voltage	V <sub>PT</sub>	I <sub>PT</sub> = 2μA Any I/O to GND	2.7			V
Snap-Back Voltage	V <sub>SB</sub>	I <sub>SB</sub> = 50mA Any I/O to GND	2.0			V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 2.5V, T=25°C Any I/O to GND			0.5	μA
Clamping Voltage	V <sub>C</sub>	I <sub>pp</sub> = 1A, t <sub>p</sub> = 8/20μs Any I/O to GND			4.5	V
Clamping Voltage	V <sub>C</sub>	I <sub>pp</sub> = 10A, t <sub>p</sub> = 8/20μs Any I/O to GND			6.5	V
Clamping Voltage	V <sub>C</sub>	I <sub>pp</sub> = 25A, t <sub>p</sub> = 8/20μs Any I/O to GND			10	V
Junction Capacitance	C <sub>J</sub>	Between I/O pins and Ground V <sub>R</sub> = 0V - 2.5V, f = 1MHz			5	pF
		Between I/O pins V <sub>R</sub> = 0V - 2.5V, f = 1MHz		2.0		pF

Note 1: I/O pins are pin 1, 2, 3, 4, 7, 8, 9, 10

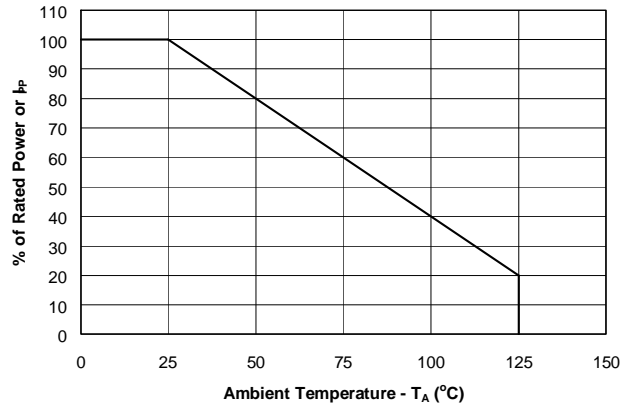
**PROTECTION PRODUCTS**

**Typical Characteristics**

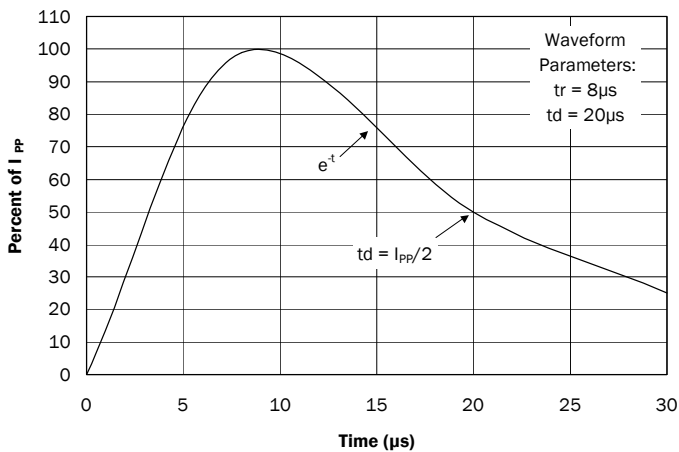
**Non-Repetitive Peak Pulse Power vs. Pulse Time**



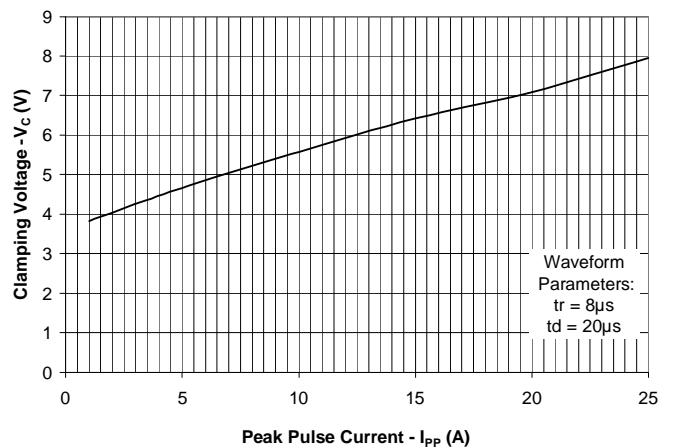
**Power Derating Curve**



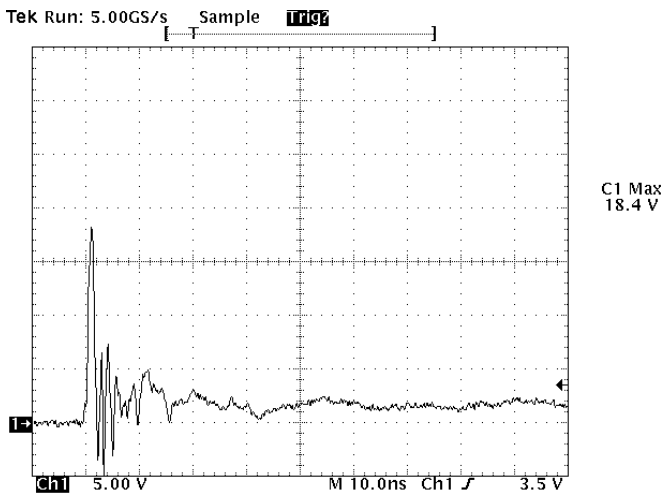
**Surge Current Output Waveform (tp = 8/20us)**



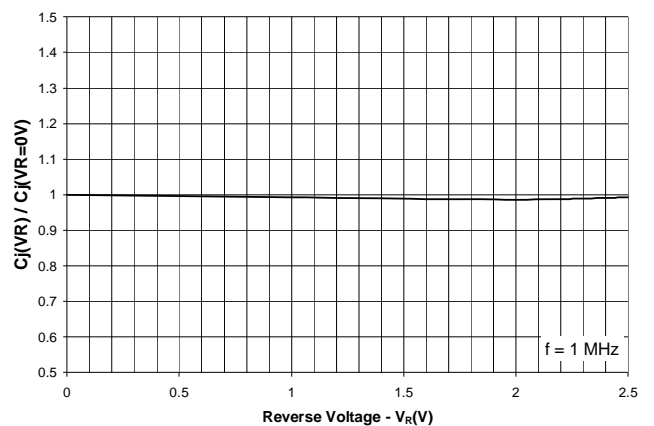
**Clamping Voltage vs. Peak Pulse Current Any I/O to GND (tp = 8/20us)**



**ESD Clamping (8kV Contact per IEC 61000-4-2)**



**Normalized Capacitance vs. Reverse Voltage**

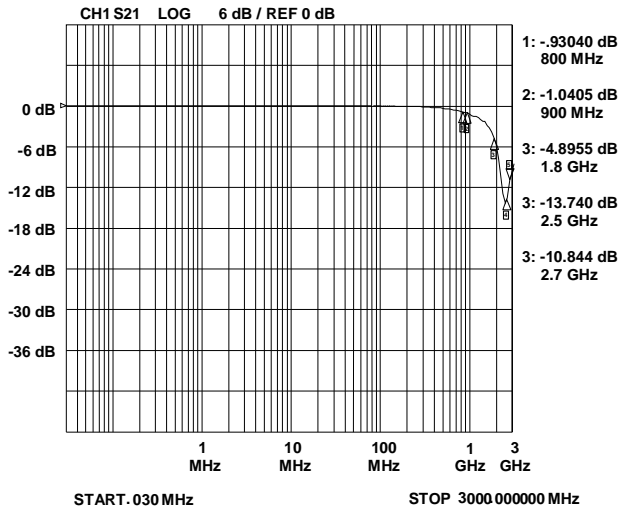


Note: Data is taken with a 10x attenuator

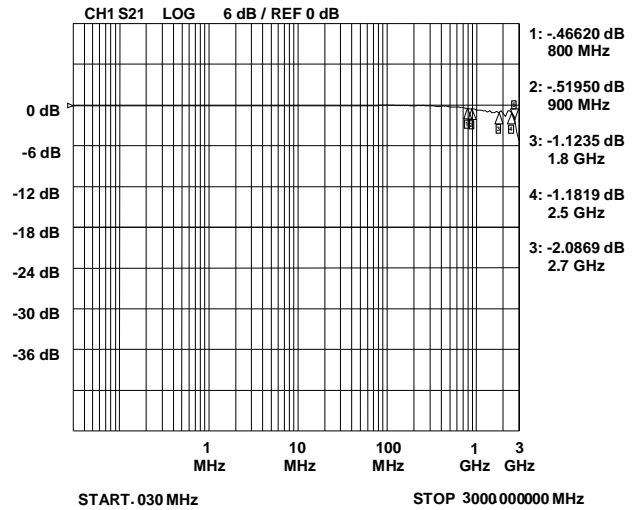
**PROTECTION PRODUCTS**

**Typical Characteristics**

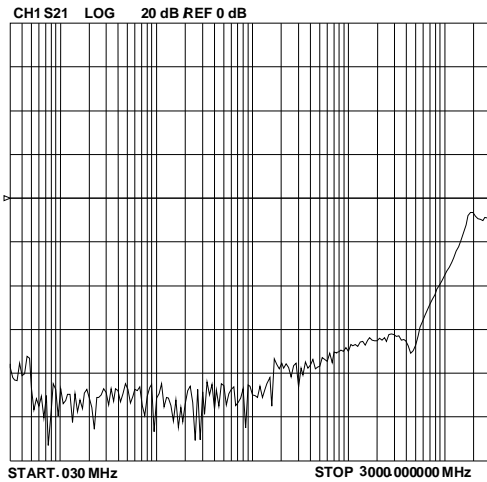
**Insertion Loss S21 (I/O to Gnd)**



**Insertion Loss S21 (I/O to I/O)**



**Analog Crosstalk**



**PROTECTION PRODUCTS**

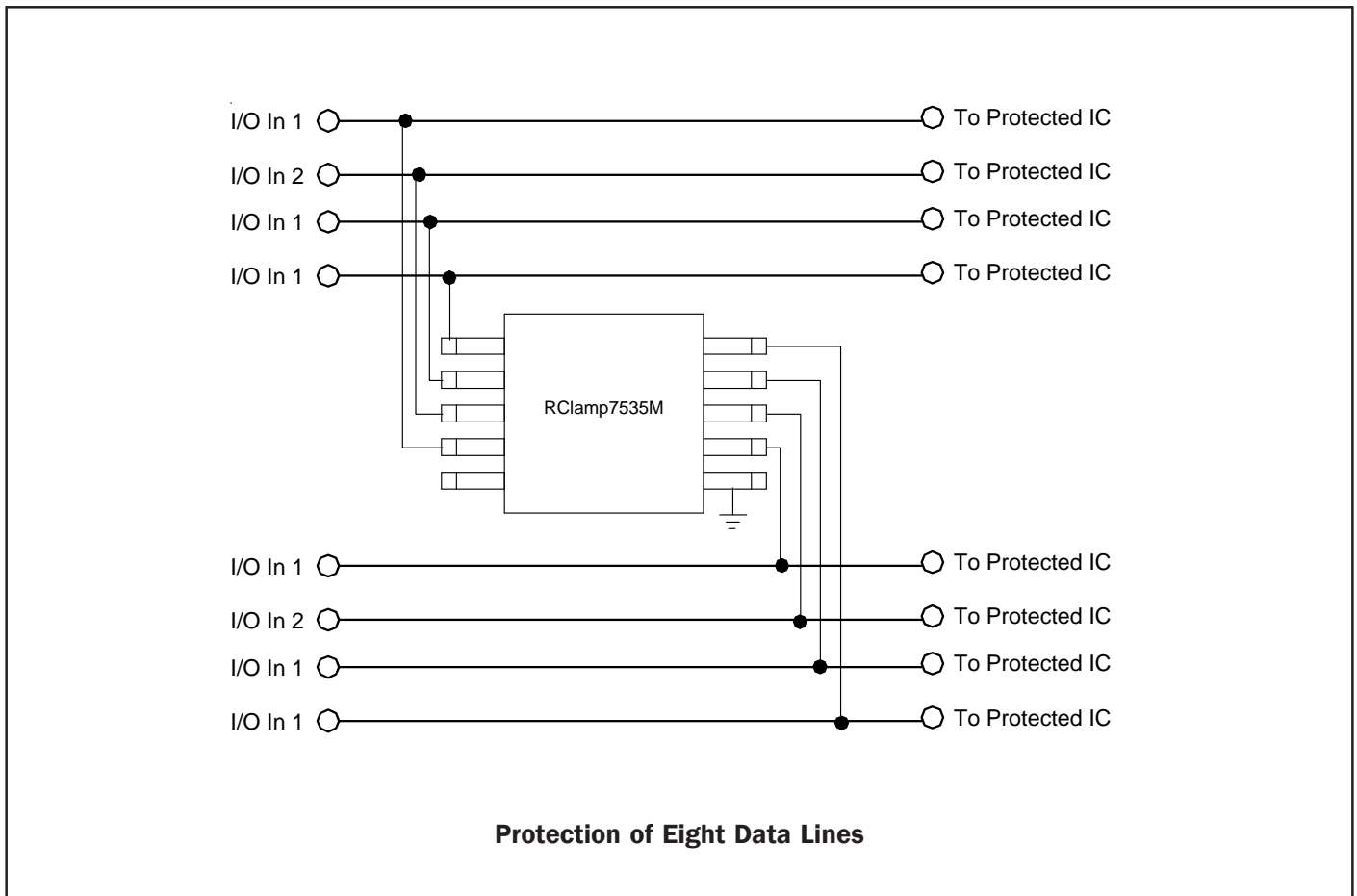
**Applications Information**

**Device Connection Options for Protection of Eight High-Speed Data Lines**

This device is designed to protect high-speed data lines. When the voltage on the protected line exceeds the breakdown voltage of the internal TVS diode, the steering diodes are forward biased, conducting the transient current away from the sensitive circuitry to ground.

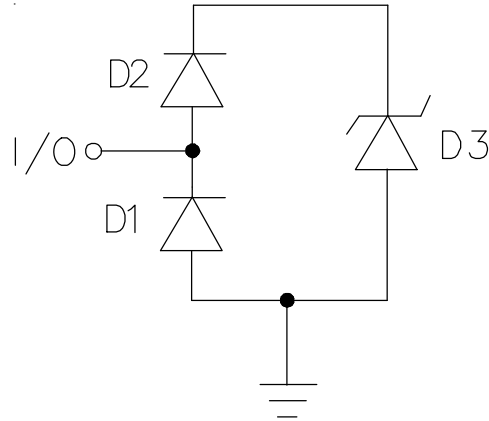
Data lines are connected at pins 1 - 4 and 7 - 10. Pin 6 should be connected directly to a ground plane. The path length is kept as short as possible to minimize parasitic inductance. When configured as shown, a LVDS chip may withstand up to 10A for a 2/10 us impulse waveform.

The RClamp7535M is constructed using Semtech's proprietary EPD process technology. The EPD process provides low stand-off (turn-on) voltages with significant reductions while maintaining good clamping characteristics and high surge capability. They feature a true operating voltage of 2.5 volts. The characteristics of the RClamp7535M eliminate the need to add an external resistor for protection of LVDS interfaces.



**PROTECTION PRODUCTS**

**Applications Information - Spice Model**

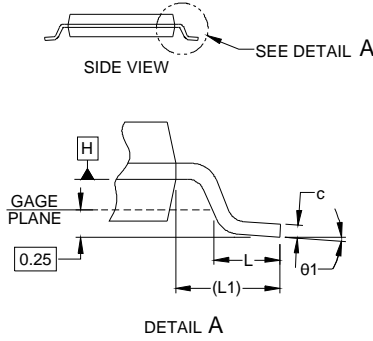
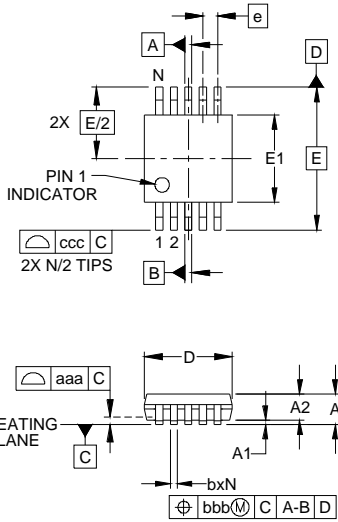


**Spice Model**

<b>RClamp7535M Spice Parameters</b>				
<b>Parameter</b>	<b>Unit</b>	<b>D1 (LCRD)</b>	<b>D2 (LCRD)</b>	<b>D3 (TVS)</b>
IS	Amp	1E-20	1E-20	1.66E-13
BV	Volt	100	100	2.89
VJ	Volt	0.72	0.67	0.53
RS	Ohm	0.329	0.241	0.06
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	1.7E-12	1.7E-12	288E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	-	0.01	0.01	0.17
N	-	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

**PROTECTION PRODUCTS**

**Outline Drawing - MSOP-10L**

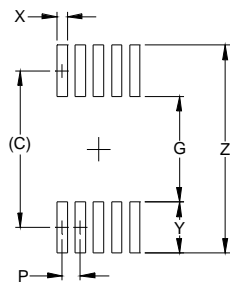


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	.043	-	-	1.10
A1	.000	-	.006	0.00	-	0.15
A2	.030	-	.037	0.75	-	0.95
b	.007	-	.011	0.17	-	0.27
c	.003	-	.009	0.08	-	0.23
D	.114	.118	.122	2.90	3.00	3.10
E1	.114	.118	.122	2.90	3.00	3.10
E	.193 BSC			4.90 BSC		
e	.020 BSC			0.50 BSC		
L	.016	.024	.032	0.40	0.60	0.80
L1	(.037)			(.95)		
N	10			10		
theta1	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.003			0.08		
ccc	.010			0.25		

**NOTES:**

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS [-A-] AND [-B-] TO BE DETERMINED AT DATUM PLANE [-H-]
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MO-187, VARIATION BA.

**Land Pattern - MSOP-10L**



DIM	DIMENSIONS	
	INCHES	MILLIMETERS
C	(.161)	(4.10)
G	.098	2.50
P	.020	0.50
X	.011	0.30
Y	.063	1.60
Z	.224	5.70

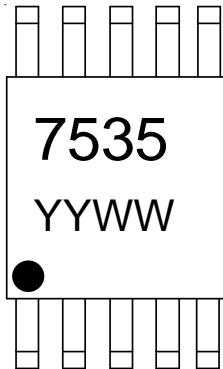
**NOTES:**

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.



**PROTECTION PRODUCTS**

**Marking**



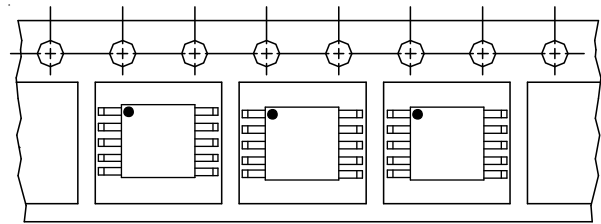
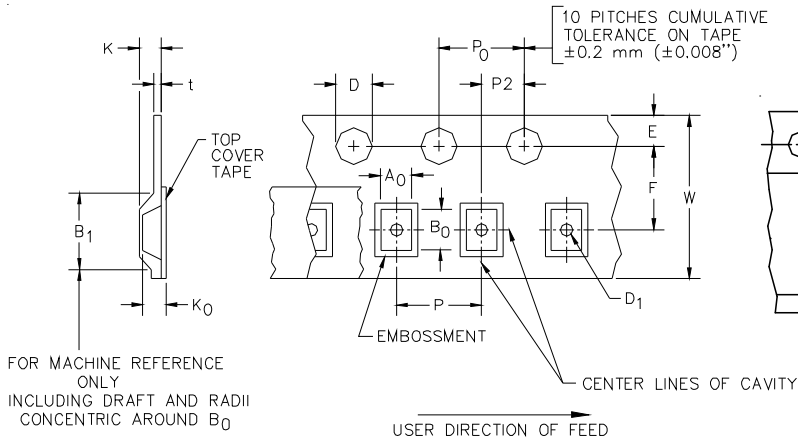
YYWW = Date Code

**Ordering Information**

Part Number	Lead Finish	Qty per Reel	Reel Size
RClamp7535M.TLT	Matte Sn	3000	13 Inch

RailClamp and RClamp are marks of Semtech Corporation

**Tape and Reel Specification**



**Device Orientation in Tape**

A0	B0	K0
5.30 +/-0.20 mm	3.40 +/-0.20 mm	1.40 +/-0.10 mm

Tape Width	B, (Max)	D	D1	E	F	K (MAX)	P	P0	P2	T(MAX)	W
12 mm	8.2 mm	1.5 + 0.1 mm - 0.0 mm )	0.5 mm ±0.05	1.750±.10 mm	5.5±0.05 mm	4.5 mm	8.0±0.1 mm	4.0±0.1 mm	2.0±0.05 mm	0.4 mm	12.0 mm ± 0.3 mm

**Contact Information**

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