LC03-6 Low Capacitance TVS for High-Speed Data Interfaces

PROTECTION PRODUCTS

Description

The LCO3-6 transient voltage suppressor is designed to protect components which are connected to high speed telecommunication lines from voltage surges caused by **lightning**, electrostatic discharge **(ESD)**, cable discharge events **(CDE)**, and electrical fast transients **(EFT)**.

TVS diodes are ideal for use as board level protection of sensitive semiconductor components. The LCO3-6 combines a TVS diode with a rectifier bridge to provide transient protection in both common and differential mode with a single device. The capacitance of the device is minimized (< 25pF) to ensure correct signal transmission on high speed lines . The LCO3-6 meets the short-haul (intra-building) transient immunity requirements of Bellcore 1089 for telecommunications applications.

The SO-8 surface mount package allows flexibility in the design of crowded PC boards.

Features

- 2000 watts peak pulse power ($t_p = 8/20\mu s$)
- Transient protection for high-speed data lines to Bellcore 1089 (Intra-Building) 100A (2/10μs)
 ITU K.20 I_{pp}=40A (5/310μs)
 IEC 61000-4-2 (ESD) ±15kV (air), ±8kV (contact)
 IEC 61000-4-4 (EFT) 40A (5/50ns)
 IEC 61000-4-5 (Lightning) 100A (8/20μs)
- Protects two lines in common and differential mode
- Low capacitance for high-speed interfaces
- Low clamping and operating voltage
- Integrated structure saves board space and increases reliability
- Solid-state silicon avalanche technology

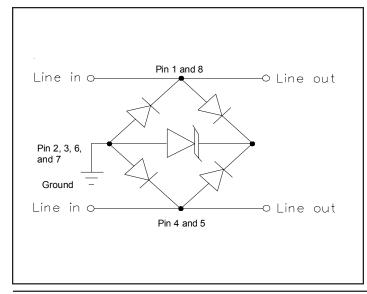
Mechanical Characteristics

- ◆ JEDEC SO-8 package
- ◆ RoHS/WEEE Compliant
- ◆ UL 497B listed
- Molding compound flammability rating: UL 94V-0
- Marking: Part number, date code
- Packaging: Tube or Tape and Reel per EIA 481

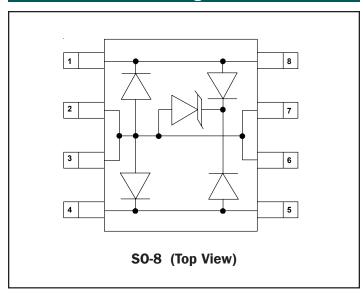
Applications

- ◆ T1/E1 Line Cards
- ◆ T3/E3 and DS3 Interfaces
- STS-1 Interfaces
- ◆ ISDN S/T-Interfaces
- ISDN U-Interfaces
- ◆ 10/100 Ethernet

Circuit Diagram



Schematic & PIN Configuration





Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power ($t_p = 8/20\mu s$)	P_{pk}	2000	Watts
Peak Pulse Current ($t_p = 8/20\mu s$)	I _{PP}	100	А
Lead Soldering Temperature	T _L	260 (10 sec.)	°C
Operating Temperature	T,	-55 to +125	°C
Storage Temperature	T _{stg}	-55 to +150	°C

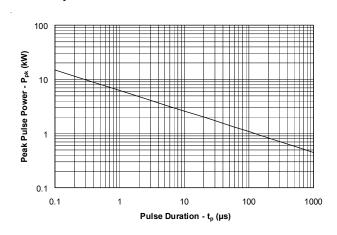
Electrical Characteristics

LC03-6						
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V _{RWM}				6	V
Reverse Breakdown Voltage	V _{BR}	I _t = 1mA	6.8			V
Reverse Leakage Current	I _R	V _{RWM} = 6V, T=25°C			25	μΑ
Clamping Voltage	V _c	I _{pp} = 50A, t _p = 8/20μs Line-to-Ground			15	V
Clamping Voltage	V _c	$I_{pp} = 100A$, $t_p = 8/20\mu s$ Line-to-Ground			20	V
Junction Capacitance	C _j	Between I/O pins and Ground V _R = 0V, f = 1MHz		16	25	pF
		Between I/O pins V _R = OV, f = 1MHz		8	12	pF

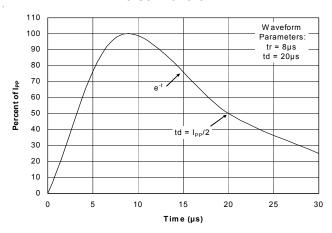


Typical Characteristics

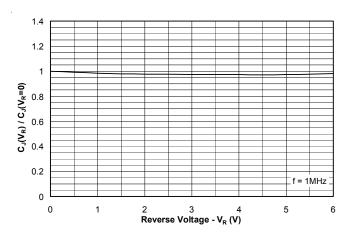
Non-Repetitive Peak Pulse Power vs. Pulse Time



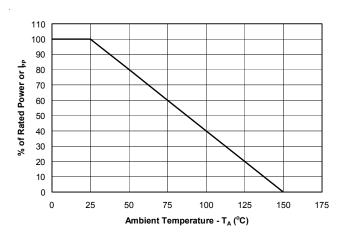
Pulse Waveform



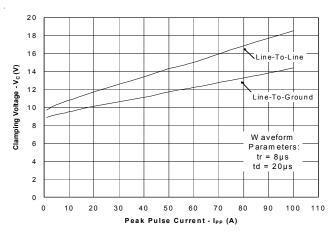
Normalized Capacitance vs. Reverse Voltage



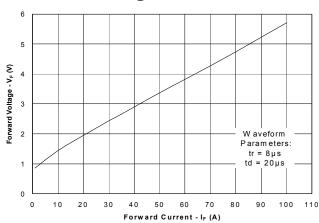
Power Derating Curve



Clamping Voltage vs. Peak Pulse Current



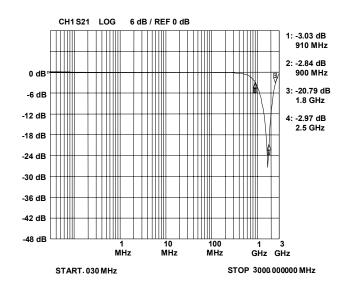
Forward Voltage vs. Forward Current



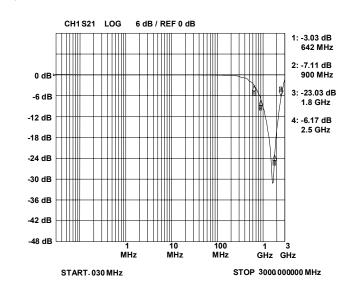


Typical Characteristics

Insertion Loss S21 - I/O to I/O



Insertion Loss S21 - I/O to Gnd





Applications Information

Device Connection Options for Protection of Two High-Speed Data Lines

The LCO3-6 is designed to protect two high-speed data lines (one differential pair) from transient over-voltages which result from lightning and ESD. The device can be configured to protect in differential (Line-to-Line) and common (Line-to-Ground) mode. Data line inputs/outputs are connected at pins 1 to 8, and 4 to 5 as shown. Pins 2, 3, 6, and 7 are connected to ground. These pins should be connected directly to a ground plane on the board for best results. The path length is kept as short as possible to minimize parasitic inductance. In applications where high common mode voltages are present, differential protection is achieved by leaving pins 2, 3, 6, and 7 not connected.

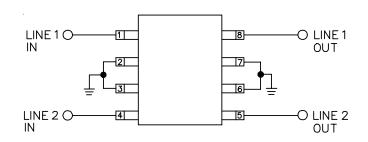
T1/E1 Linecard Protection (Intra-Building)

A typical T1/E1 linecard protection circuit is shown below. The LCO3-6 is connected between Tip and Ring on the transmit and receive line pairs. It provides protection to metallic and common mode lightning surges per Bellcore 1089. This design takes advantage of the isolation of the transformer to suppress common mode surges. To complete the protection circuit, the RClamp3304N (or RClamp0504N for 5V supplies) is employed as the IC side protection element. This device helps prevent the transceiver from latching up by providing fine clamping of transients that are coupled through the transformer. For further information, reference Semtech application note AN97-10.

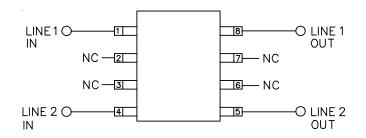
T3/E3 and STS-1 Protection

The LCO3-6 can also be used to protect T3/E3 and STS-1 interfaces. The data lines from the BNC interface are run through the LCO3-6 (i.e. enters at pin 1 and exits at pin 8) with the ground connection made at the other side of the device (pins 4 and 5). The center pins (2, 3, 6, and 7) are not connected. In this configuration, the LCO3-6 adds less than 12pF of capacitance to each line and provides surge protection to 100A (tp=8/20 μ s).

Connection for Differential (Line-to-Line) and Common Mode Protection (Line-to-Ground)



Connection for Differential Protection (Line-to-Line)

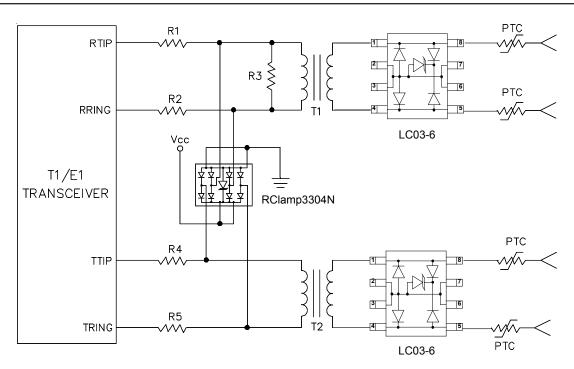


Matte Tin Lead Finish

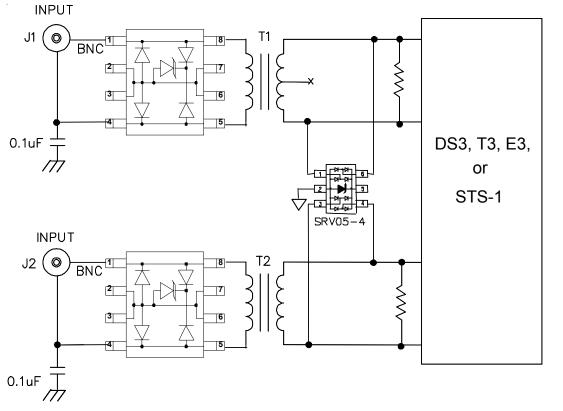
Matte tin has become the industry standard lead-free replacement for SnPb lead finishes. A matte tin finish is composed of 100% tin solder with large grains. Since the solder volume on the leads is small compared to the solder paste volume that is placed on the land pattern of the PCB, the reflow profile will be determined by the requirements of the solder paste. Therefore, these devices are compatible with both lead-free and SnPb assembly techniques. In addition, unlike other lead-free compositions, matte tin does not have any added alloys that can cause degradation of the solder joint.



Typical Applications



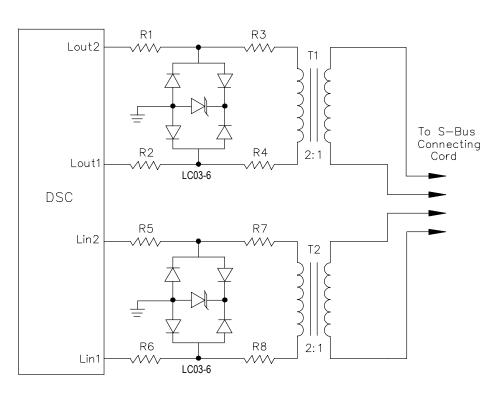
T1 Line Card Protection (Short-Haul Applications)



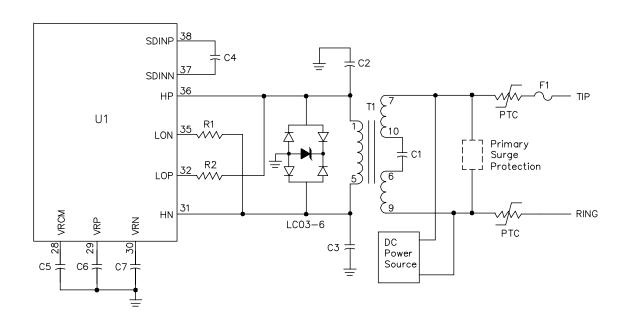
T3/E3 and STS-1 Protection



Typical Applications (Continued)



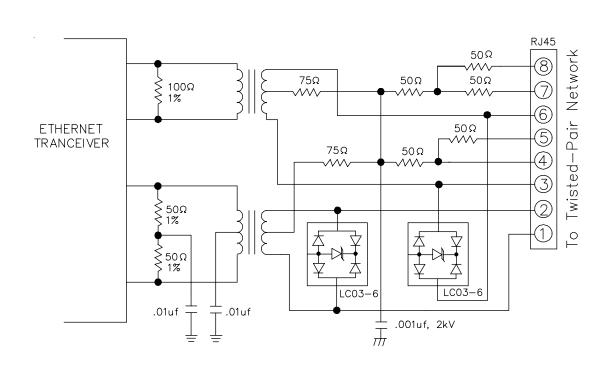
ISDN S-Interface Protection



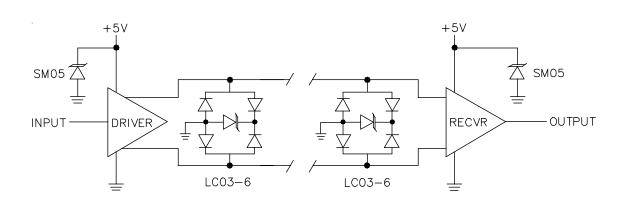
ISDN U-Interface Secondary Protection



Typical Applications (Continued)



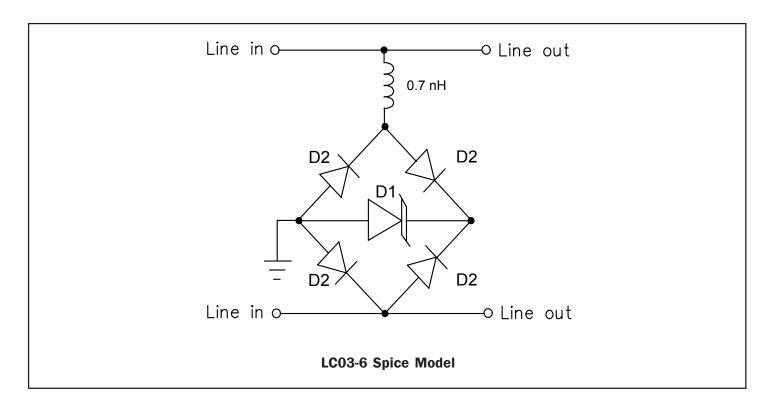
10/100 Ethernet Protection



High Speed Driver/Receiver Protection



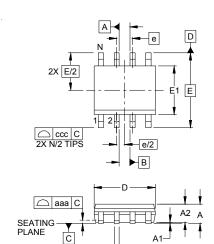
Applications Information - SPICE Model

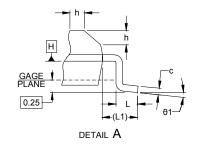


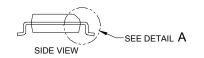
LC03-6 Spice Parameters						
Parameter	Unit D1 (TVS)		D2 (LCRD)			
IS	Amp	1.0E-20	3.98E-13			
BV	Volt	7.9	240			
VJ	Volt	0.6	0.64			
RS	Ohm	0.102	0.048			
IBV	Amp	1E-3	1E-3			
CJO	Farad	3.4e-9	8.0E-12			
TT	sec	2.541E-9	2.541E-9			
M		0.007	0.022			
N		1.1	1.1			
EG	eV	1.11	1.11			



Outline Drawing - SO-8







	DIMENSIONS						
DIM NIN NOMBAN		MILLIMETERS					
ווועו	MIN	NOM	MAX	MIN	NOM	MAX	
Α	.053	-	.069	1.35	-	1.75	
A1	.004	-	.010	0.10	-	0.25	
A2	.049	-	.065	1.25	-	1.65	
b	.012	-	.020	0.31	-	0.51	
С	.007	-	.010	0.17	-	0.25	
D	.189	.193	.197	4.80	4.90	5.00	
E1	.150	.154	.157	3.80	3.90	4.00	
E	.2	.236 BSC			6.00 BSC		
е	.050 BSC		1.27 BSC				
h	.010	-	.020	0.25	-	0.50	
L	.016	.028	.041	0.40	0.72	1.04	
L1	(.041)			(1.04)			
N	8		8				
θ1	0°	-	8°	0°	-	8°	
aaa	.004		0.10				
bbb	.010			0.25			
ccc	.008			0.20			

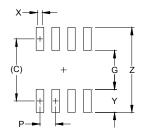
NOTES:

- 1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
- 2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-

| ___bxN | ⊕ | bbb∭ | C | A-B | D |

- DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
- 4. REFERENCE JEDEC STD MS-012, VARIATION AA.

Land Pattern - SO-8



	DIMENSIONS				
DIM	INCHES	MILLIMETERS			
С	(.205)	(5.20)			
G	.118	3.00			
Р	.050	1.27			
Х	.024	0.60			
Υ	.087	2.20			
Z	.291	7.40			

NOTES:

- THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
 CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR
 COMPANY'S MANUFACTURING GUIDELINES ARE MET.
- 2. REFERENCE IPC-SM-782A, RLP NO. 300A.



Ordering Information

Part Number	Lead Finish	Qty per Reel	Reel Size
LC03-6.TB	SnPb	500	7 Inch
LC03-6.TBT	Pb free	500	7 Inch

Contact Information

Semtech Corporation Protection Products Division 200 Flynn Rd., Camarillo, CA 93012 Phone: (805)498-2111 FAX (805)498-3804