

PROTECTION PRODUCTS

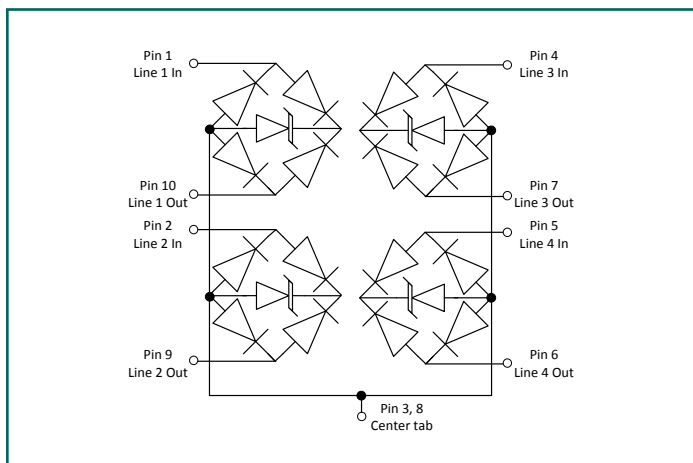
Description

RailClamp® TVS diodes 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. The RClamp®3374N is designed to replace up to two components for board level GbE protection. Each device is designed to protect two line pairs. This is accomplished by routing traces through the device. When connected in this fashion, the device can withstand a high level of surge current (40A, $t_p = 8/20\mu s$) while maintaining a low loading capacitance of less than 5pF. The high surge capability means it can be used in high threat environments in applications such as Gigabit Ethernet, telecommunication lines, and LVDS interfaces.

The RClamp3374N is constructed using Semtech's proprietary EPD process technology. The EPD process provides low stand-off voltages with significant reductions in leakage current and capacitance over silicon avalanche diode processes. It features a true operating voltage of 3.3 volts for superior protection. RClamp3374N is in a DFN 3.0 x 2.0 x 0.6mm 10 Lead package. The leads are finished with lead-free NiPdAu.

Functional Schematic



Features

- Transient protection for high-speed data lines to **IEC 61000-4-2 (ESD) $\pm 30kV$ (air), $\pm 30kV$ (contact)**
- **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- **IEC 61000-4-5 (Lightning) 40A (8/20 μs)**
- Array of surge rated diodes with internal TVS Diode
- Protects up to eight lines
- Low capacitance for high-speed interfaces
- Low variation in capacitance vs. bias voltage
- Low clamping voltage
- Low operating voltage: 3.3V
- Solid-state silicon-avalanche technology

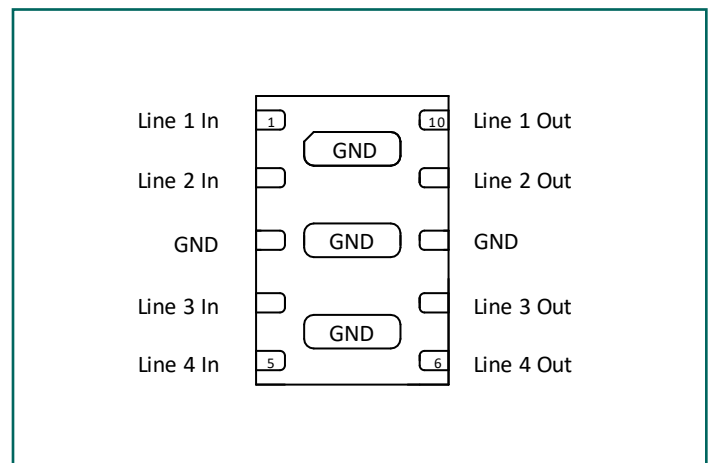
Mechanical Characteristics

- Package: DFN 3.0 x 2.0 x 0.6mm 10 Lead
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Lead Finish: NiPdAu
- Molding Compound Flammability Rating: UL 94V-0
- Marking : Marking Code + Date Code
- Packaging : Tape and Reel

Applications

- 10/100/1000 Ethernet
- Central Office Equipment
- LVDS Interfaces
- MagJacks / Integrated Magnetics
- Notebooks / Desktops / Servers

Pin Configuration



Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P _{PK}	1000	W
Peak Pulse Current (tp = 8/20μs)	I _{PP}	40	A
ESD per IEC 61000-4-2 (Contact) ⁽¹⁾ ESD per IEC 61000-4-2 (Air) ⁽¹⁾	V _{ESD}	±30 ±30	kV
Operating Temperature	T _{OP}	-40 to +125	°C
Storage Temperature	T _{STG}	-55 to +150	°C

Electrical Characteristics (T=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V _{RWM}				3.3	V
Reverse Breakdown Voltage	V _{PT}	I _{PT} = 2μA	3.5			V
Snapback Voltage	V _{SB}	I _{SB} = 50mA	2.8			V
Reverse Leakage Current	I _R	V _{RWM} = 5V	T = 25°C		0.5	μA
			T = 125°C		1	μA
Clamping Voltage ⁽²⁾	V _C	tp = 8/20μs Any I/O to GND	I _{PP} = 1A		5.5	V
			I _{PP} = 10A		10.5	V
			I _{PP} = 25A		18	V
Clamping Voltage ^{(2) (3)}	V _C	tp = 8/20μs, Line to Line	I _{PP} = 40A		25	V
Junction Capacitance ⁽²⁾	C _J	V _R = 0V, f = 1MHz, any I/O Pin to GND		3.6	5	pF
		V _R = 0V, f = 1MHz, between I/O pins		1.7		pF

Notes:

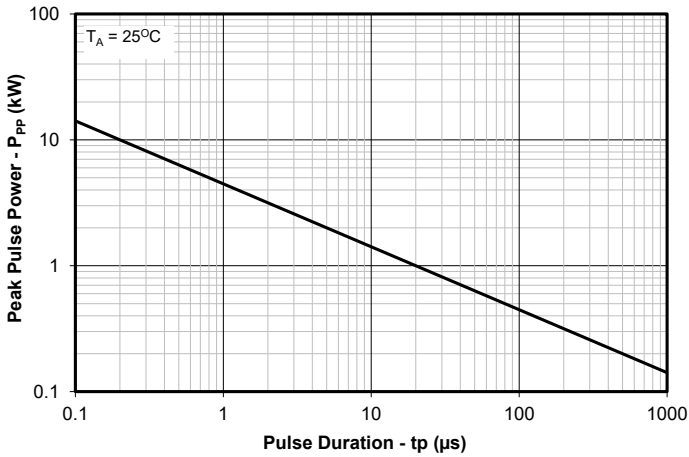
(1): ESD Gun return path to Ground Reference Plane (GRP)

(2): Guaranteed by design (not production tested)

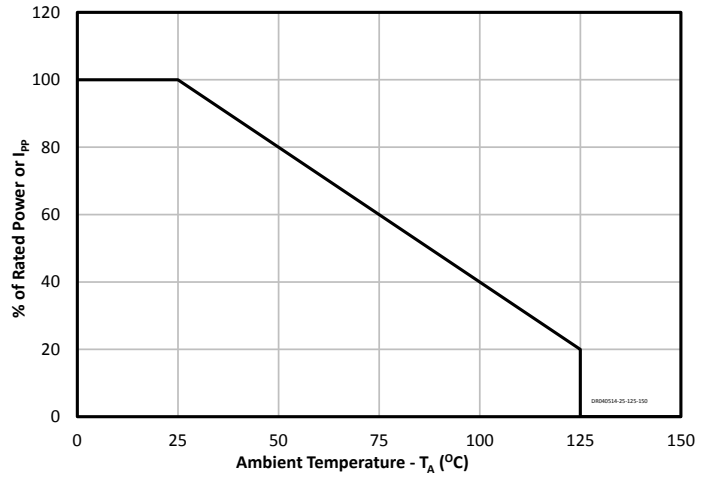
(3): Ratings with 2 pins connected together per the recommended configuration (i.e. pin 1 connected to pin 10, pin 2 connected to pin 9, pin 4 connected to pin 7, and pin 5 connected to pin 6).

Typical Characteristics

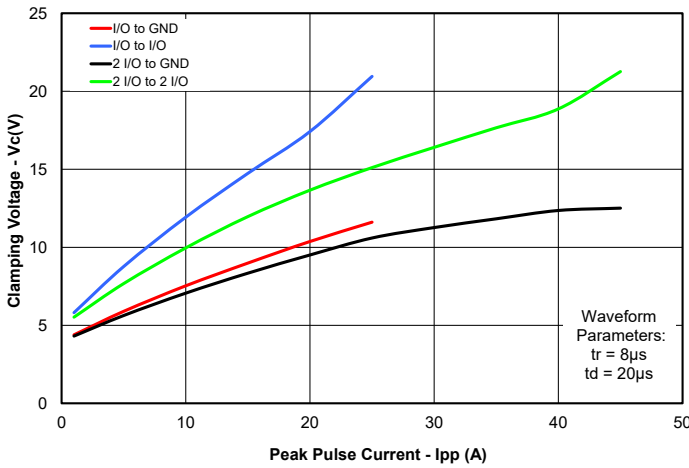
Non-Repetitive Peak Pulse Power vs. Pulse Time



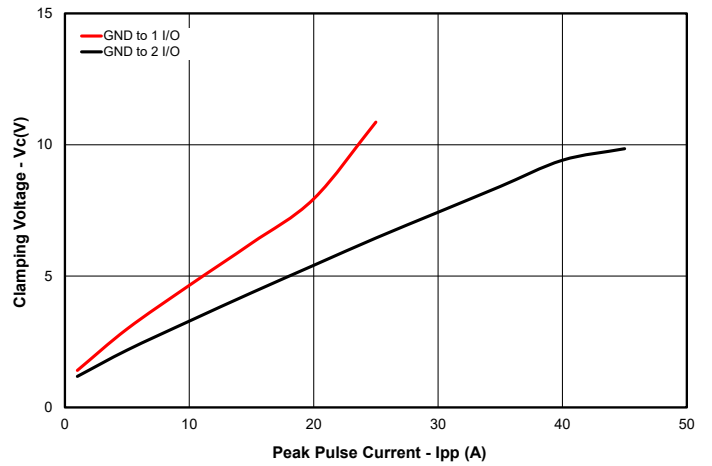
Power Derating Curve



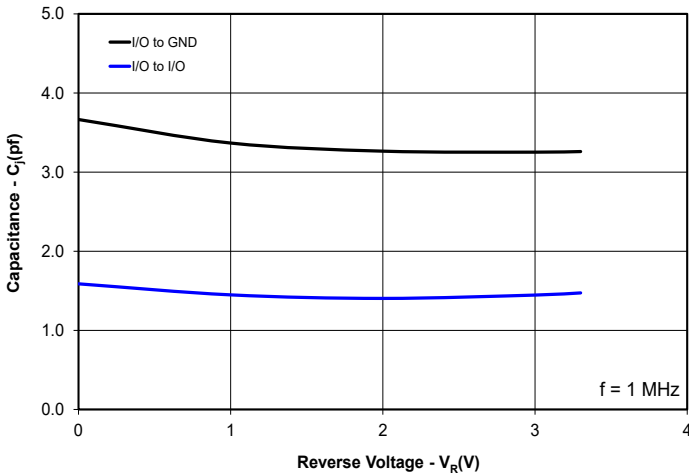
Clamping Voltage vs. Peak Pulse Current



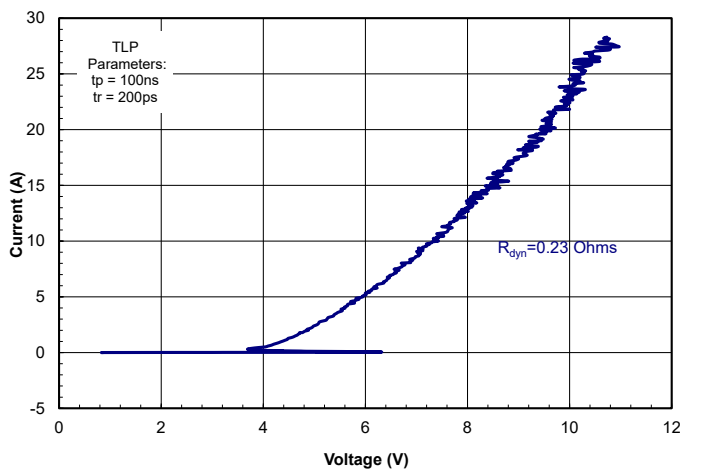
Forward Clamping Voltage vs. Peak Pulse Current



Capacitance vs. Reverse Voltage

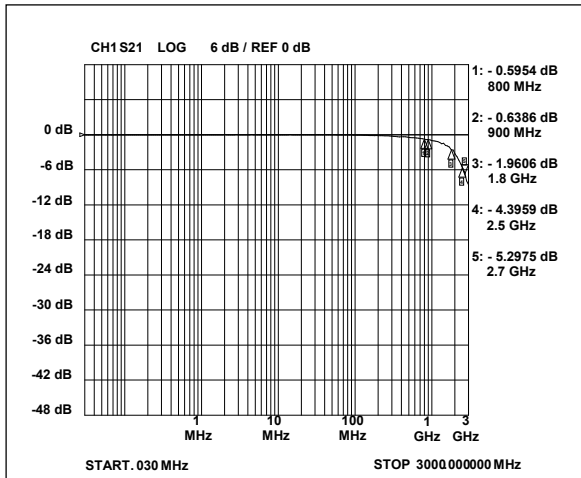


Typical TLP Characteristic

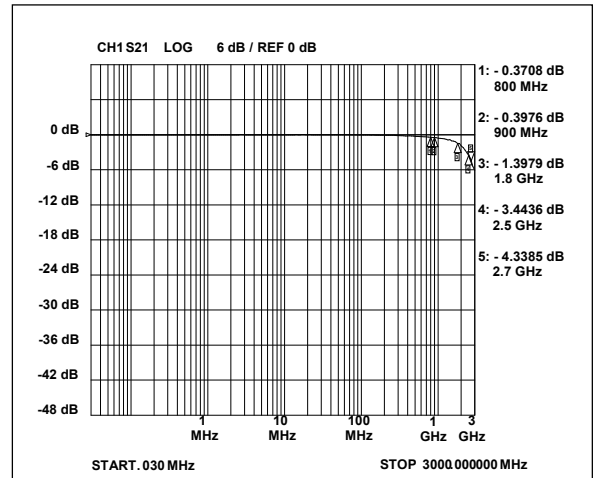


Typical Characteristics (Continued)

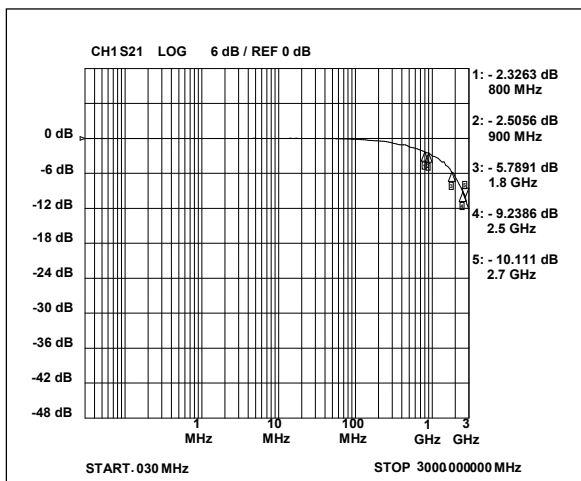
Insertion Loss (I/O to GND)



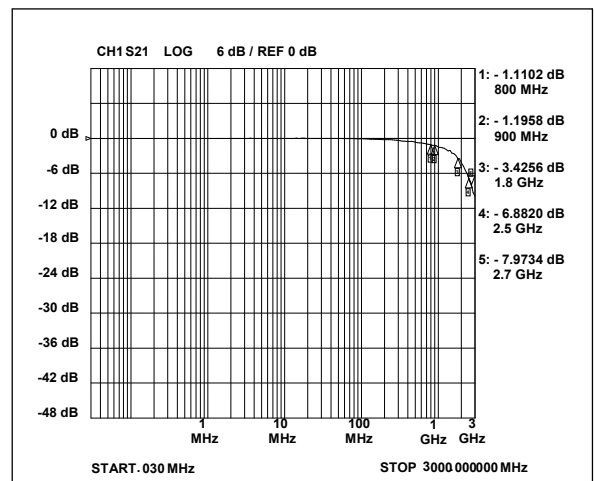
Insertion Loss (I/O to I/O)



Insertion Loss (2 I/O to GND)

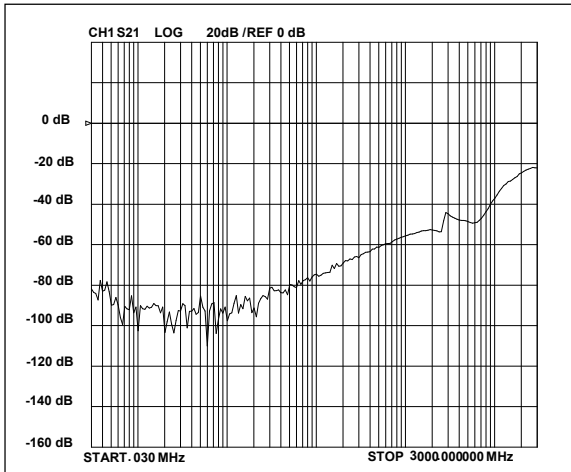


Insertion Loss (2 I/O to 2 I/O)

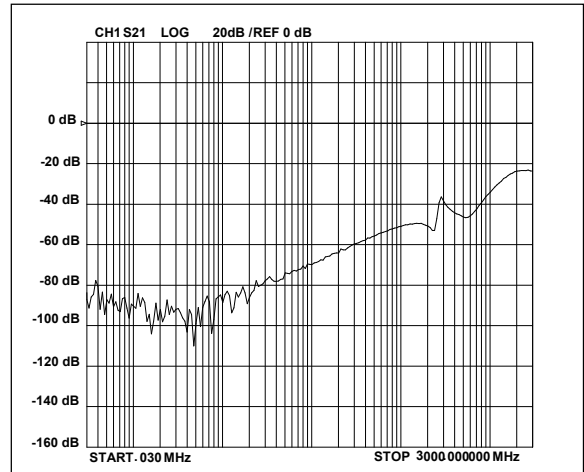


Typical Characteristics (Continued)

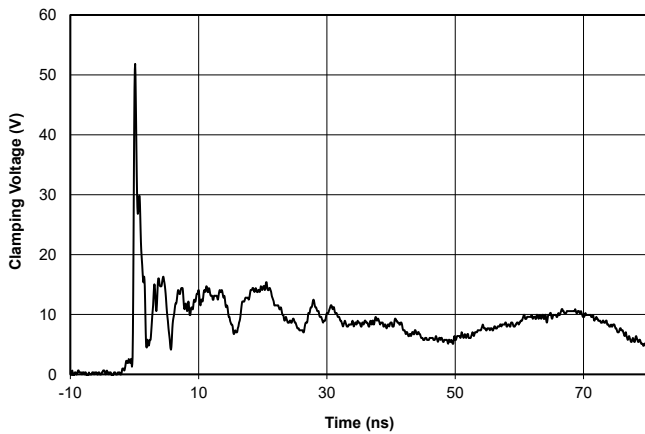
Analog Crosstalk (I/O to GND)



Analog Crosstalk (I/O to I/O)



8kV ESD Clamping (I/O to GND per IEC 61000-4-2)



Application Information

Ethernet Protection

Ethernet ports are exposed to external transient events in the form of ESD, EFT, lightning, and cable discharge events (CDE). Test standards that model these events include IEC 61000-4-2 for ESD, IEC 61000-4-4 for EFT, and IEC 61000-4-5 and GR-1089 for lightning. Any of these events can cause catastrophic damage to the PHY IC.

When designing Ethernet protection, the entire system must be considered. Over-voltage events can be common mode (with respect to ground) or differential (line-to-line). An Ethernet port includes interface magnetics consisting of transformers integrated with common mode chokes. The transformer center taps are connected to ground via an RC network or “Bob Smith” termination. The purpose of this termination is to reduce common mode emissions. The transformer provides common mode isolation to transient events, but no protection for differential surges. During a differential transient event, current will flow through the transformer, charging the windings on the line side. Energy is transferred to the secondary until the surge subsides or the transformer saturates.

A typical protection scheme which utilizes RClamp3374N is shown in Figure 1. The devices are located on the PHY side of the transformer with one device placed across two line pairs. Parasitic inductance in the protection

path should be minimized by locating RClamp3374N as physically close to the magnetics as possible, and preferably on the same side of the PCB. Reducing parasitic inductance is especially important for suppressing fast rise time transients such as ESD and EFT. Inductance in the path of the protection device increases the peak clamping voltage seen by the protected device ($V = L di/dt$). Differential pairs are routed through each RClamp3374N. Traces are routed unbroken to connect pins 1 and 10 (Line 1), 2 and 9 (Line 2), 4 and 7 (Line 3) and 5 and 6 (Line 4). Pins 3 and 8 as well as the tabs are not connected.

Placing the protection on the PHY side of the magnetics is advantageous in that the magnitude and duration of the surge is attenuated by the transformer windings. The amount of attenuation will vary by vendor and configuration of the magnetics. The Ethernet transformer has to be able to support the impulse tests without failure. A typical Ethernet transformer can withstand a few hundred amperes ($t_p=8/20\mu s$) before failure occurs, but this needs to be verified by testing. Alternatively, the protection can be placed on the line side of the transformer. However, the additional protection afforded by the transformer is lost, and the ability of the system to withstand high energy surges is limited to the capability of the protection device.

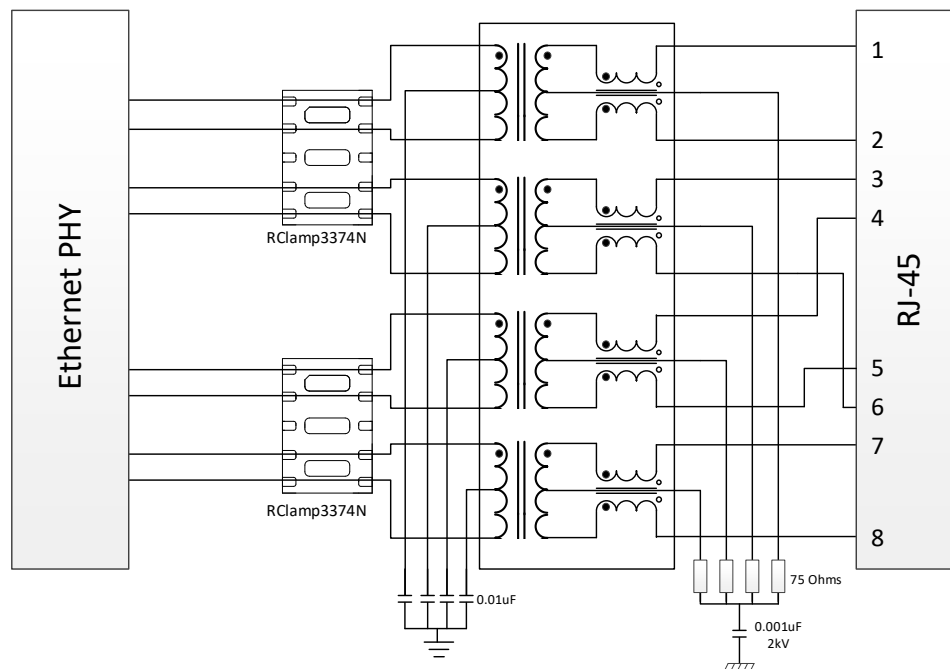
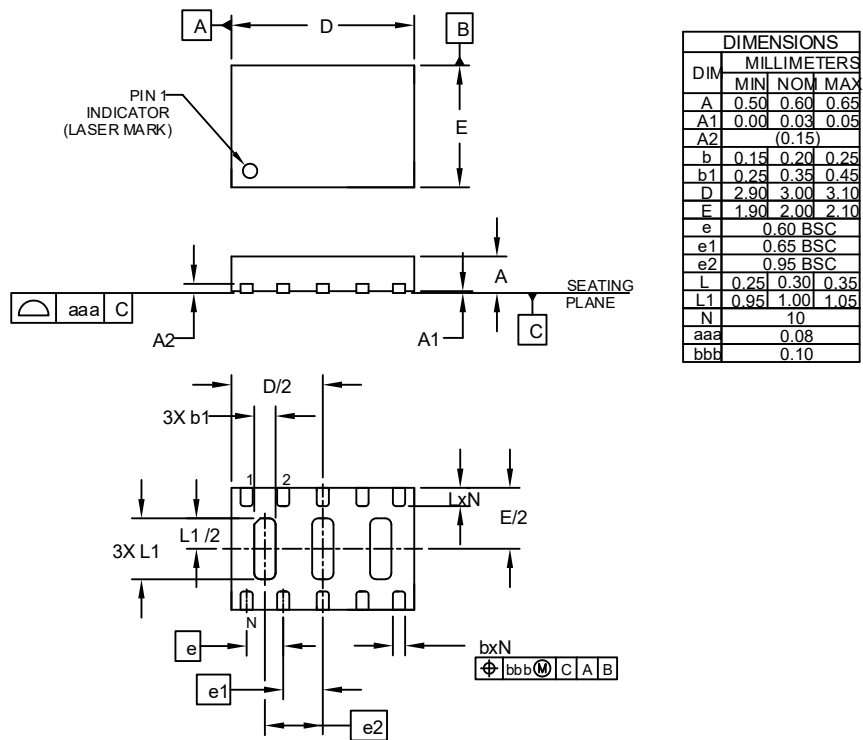


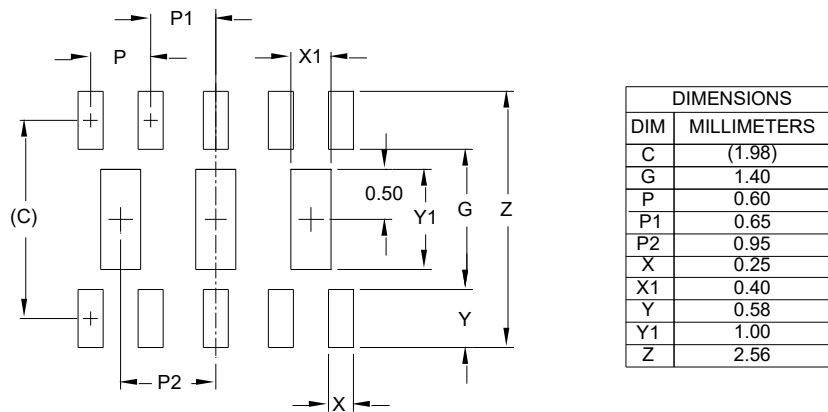
Figure 1 - Typical Ethernet Protection Circuit

Outline Drawing - DFN 3.0 x 2.0 x 0.6mm 10 Lead



NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).

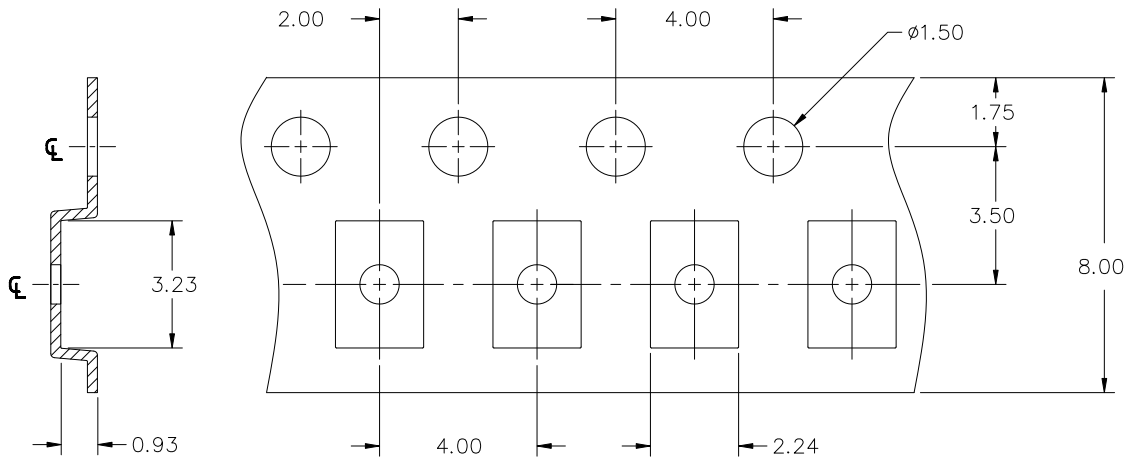
Land Pattern - DFN 3.0 x 2.0 x 0.6mm 10 Lead



NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

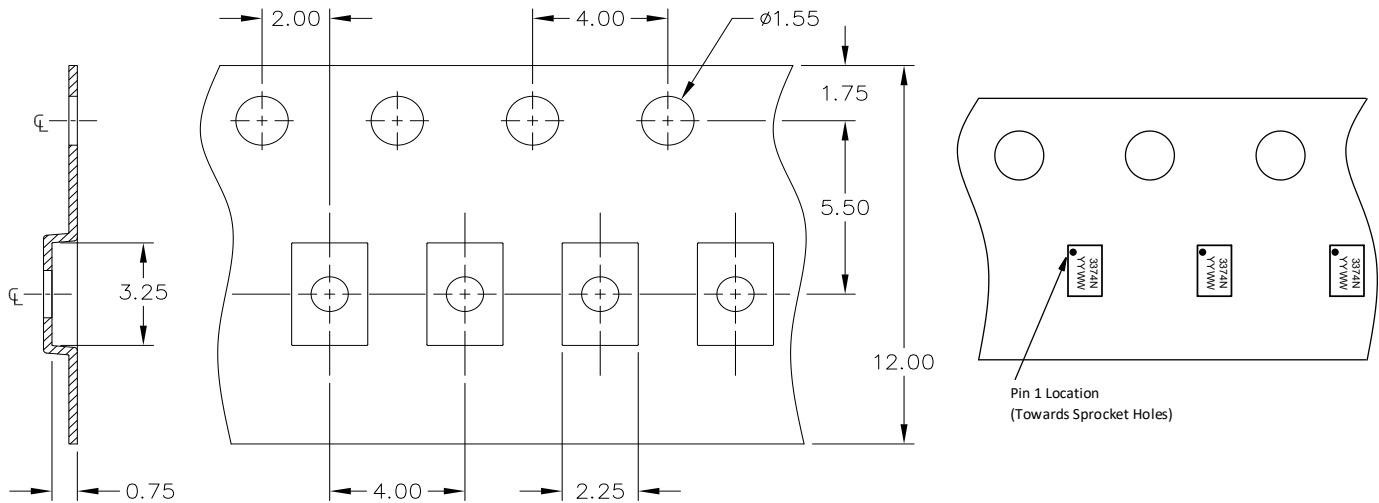
Tape and Reel Specification

4mm Pitch, 8mm wide plastic tape



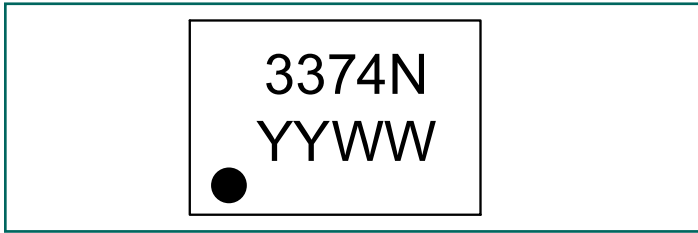
Note: All dimensions are nominal dimensions in mm.

4mm Pitch, 12mm wide plastic tape



Note: All dimensions are nominal dimensions in mm.

Marking Code



Notes: Dot indicates Pin 1 Location

Ordering Information

Part Number	Qty per Reel	Reel Size	Carrier Tape	Tape Width	Pitch
RClamp3374N.TCT	3000	7 Inch	Plastic	8mm	4mm
RClamp3374N.TRT	3000	7 Inch	Plastic	12mm	4mm

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