PRODUCT CHANGE NOTIFICATION
PCN-000581
Date: 13SEP2019

☒ Semtech Corporation, 200 Flynn Road, Camarillo CA 93012
☐ Semtech Canada Corporation, 4281 Harvester Road, Burlington, Ontario L7L 5M4 Canada
☐ Semtech Irvine, 5141 California Ave., Suite 100, Irvine CA 92617
☐ Semtech Neuchatel Sarl, Route des Gouttes d'Or 40, CH-2000 Neuchatel Switzerland
☐ Semtech Bristol - EMEA Limited, Block B, St James Court, Great Park Road, Bristol BS32 4QJ, UK
☐ Semtech Corpus Christi SA de CV, Carretera Matamorros Edificio 7, Reynosa, Tamaulipas, Mexico 88780
☐ Semtech Plano, 1101 Resource Drive, Suite 121, Plano TX 75074

Change Details

Part Number(s) Affected:	**Customer Part Number(s) Affected:** ☒ N/A
RClamp2594N.TCT	

Description, Purpose and Effect of Change:

- Semtech has moved assembly of this part from Diodes, Shanghai, to Huatian, Xi'an. The assembly process implemented at Huatian, Xi'an uses a pre-plated lead frame (change from Sn plating to NiPdAu plating), which improves the assembly process for this part. Due to this transition and change in the lead frame plating and associated assembly process steps, material is no longer available from Diodes, Shanghai. We have also moved wafer fabrication from the TowerJazz Israel location to the TowerJazz Texas fabrication location.

a. Wafer fabrication at TowerJazz, Texas, United States [POR = TowerJazz, Israel]
b. Assembly capacity at Huatian, Xi'an, Shaanxi, China [POR = Diodes, Shanghai]

Change Classification	☒ **Major** ☐ **Minor**	**Impact to Form, Fit, Function**	☐ **Yes** ☒ **No**
Impact to Data Sheet	☒ **Yes** ☐ **No**	**New Revision or Date**	☒ **N/A**

Impact to Performance, Characteristics or Reliability:

- NO impact to package dimensions
- NO impact to performance, characteristics; or reliability
- NO change in Lead Frame base material
- Lead Finish is now NiPdAu.

Implementation Date	**15OCT2019**	**Work Week**	**TBD**
Last Time Ship (LTS) **Of unchanged product**	**N/A**	**Affecting Lot No. / Serial No. (SN)**	**N/A**
Sample Availability	**Immediate**	**Qualification Report Availability**	**Attached as supporting doc.**

Supporting Documents for Change Validation/Attachments:

- **Final Reliability Report attached.**

Issuing Authority

Semtech Business Unit:	Protection	
Semtech Contact Info:	Les Fang Yuen Semtech Corporation Sr. Engineering Manager, QA 200 Flynn Road Camarillo, CA 93012 lfangyuen@semtech.com Office: (949) 269-4443	

FOR FURTHER INFORMATION & WORLDWIDE SALES COVERAGE: http://www.semtech.com/contact/index.html#support

RCLAMP2594N PACKAGE QUALIFICATION

Semtech Job#	6953
Accepted Date	05-29-2019
Job Type	New Product on qualified process with un-qualified package
Business Unit	Protection
Package Type	SLF3020P10T
Package Lead	10
Assembly Designator	Huatian Xi
Master Process	PALM E
Fab Designator	Tower Texas
Rel Job Status	Rel Testing Complete Passes All Requirements

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Completed Tasks

Sub Lot #	Part	Lot	Assembly Lot	Date Code
1	RClamp2594N	AER-005965	AER-005965	1916

Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
1	Data-Prep	None	None	0	06-17-2019
2	HTRB_Pre_Elect_150°C_RT24	105	Pass on Zero Fails	0	06-26-2019
3	HTRB_150°C_Real Time_0024	105	Pass on Zero Fails	0	06-27-2019
4	HTRB_Pre_Elect	105	Pass on Zero Fails	0	06-18-2019
5	BI_BD_Valid	105	Meet HTOL Schematics	0	06-18-2019
6	HTRB_150°C_0072	105	Pass on Zero Fails	0	06-18-2019
7	HTRB_150°C _0408	105	Pass on Zero Fails	0	06-21-2019
8	HTS_Pre_Elect	77	Pass on Zero Fails	0	06-19-2019
9	HTS_0168	77	Pass on Zero Fails	0	06-19-2019
10	HTS_0500	77	Pass on Zero Fails	0	06-26-2019
11	HTS_1000	77	Pass on Zero Fails	0	07-12-2019
12	ROSE Clean/ Test	174	Pass on Zero Fails	0	06-14-2019
13	85°C/85%RH_N/Pre_Pre Elec	20	Pass with 0 fail	0	06-19-2019
14	85°C/85%RH_BD_Valid	20	Pass on Zero Fails	0	06-19-2019
15	85/85_120hr_On/Off	20	Pass on Zero Fails	0	06-19-2019
16	Pre_Conditioning_Level_1	NA	MSL 1	0	06-17-2019
17	Pre_Elect_Precond	154	Pass on Zero Fails	0	06-17-2019
18	Precond_Temp_Cyc_5cyc	154	Pass on Zero Fails	0	06-17-2019
19	Precond_HTS_24hr	154	Pass on Zero Fails	0	06-17-2019
20	Precond_85/85_NoElec168hr	154	Pass on Zero Fails	0	06-18-2019
21	Precond_260°C_IR_Ref_Char	154	Pass on Zero Fails	0	06-25-2019
22	T/C_Pre_Elect	77	Pass on Zero Fails	0	06-25-2019

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Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
23	T/C_wPre_0250	77	Pass on Zero Fails	0	06-25-2019
24	T/C_wPre_0500	77	Pass on Zero Fails	0	07-01-2019
25	T/C_wPre_1000	77	Pass on Zero Fails	0	07-12-2019
26	Cross_Section TC 1000 Cyc	5	Pass on Zero Fails	0	07-16-2019
27	85°C/85%RH_W/Pre_Pre Elec	77	Pass on Zero Fails	0	06-25-2019
28	85°C/85%RH_BD_Valid	77	Pass on Zero Fails	0	06-26-2019
29	85°C/85%RH_Biased_168hrs	77	Pass on Zero Fails	0	06-26-2019
30	85°C/85%RH_Biased_500hrs	77	Pass on Zero Fails	0	07-03-2019
31	85°C/85%RH_Biased_1000hrs	77	Pass on Zero Fails	0	07-17-2019
32	Cross_Section 85°C/85%RH	5	Pass on Zero Fails	0	08-07-2019
33	CSAM Analysis	22	Pass on Zero Fails	0	07-03-2019
34	Precond_Temp_Cyc_5cyc	22	Pass on Zero Fails	0	07-09-2019
35	Precond_HTS_24hr	22	Pass on Zero Fails	0	07-09-2019
36	Precond_85/85_NoElec168hr	22	Pass on Zero Fails	0	07-10-2019
37	Precond_260°C_IR_Ref_Char	22	Pass on Zero Fails	0	07-17-2019
38	CSAM Analysis	22	Pass on Zero Fails	0	07-19-2019
39	Construct_Package	5 unique packaged devices minimum.	No Major Findings, Q&R to review construction analysis report.	0	06-17-2019
40	Pack_Clos	0	0	0	08-08-2019

Sub Lot #	Part	Lot	Assembly Lot	Date Code
2	RClamp2594N	AER-005966	1AER-005966	1916

Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
1	Data-Prep	None	None	0	06-17-2019
2	HTRB_Pre_Elect_150°C_RT24	105	Pass on Zero Fails	0	07-01-2019
3	HTRB_150°C_Real Time_0024	105	Pass on Zero Fails	0	07-02-2019
4	HTRB_Pre_Elect	105	Pass on Zero Fails	0	06-18-2019
5	BI_BD_Valid	105	Meet HTOL Schematics	0	06-18-2019

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Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
6	HTRB_150°C_0072	105	Pass on Zero Fails	0	06-18-2019
7	HTRB_150°C _0408	105	Pass on Zero Fails	0	06-21-2019
8	HTS_Pre_Elect	77	Pass on Zero Fails	0	06-19-2019
9	HTS_0168	77	Pass on Zero Fails	0	06-19-2019
10	HTS_0500	77	Pass on Zero Fails	0	06-26-2019
11	HTS_1000	77	Pass on Zero Fails	0	07-12-2019
12	ROSE Clean/ Test	174	Pass on Zero Fails	0	06-14-2019
13	85°C/85%RH_N/Pre_Pre Elec	20	Pass with 0 fail	0	06-19-2019
14	85°C/85%RH_BD_Valid	20	Pass on Zero Fails	0	06-19-2019
15	85/85_120hr_On/Off	20	Pass on Zero Fails	0	06-19-2019
16	Pre_Conditioning_Level_1	NA	MSL 1	0	06-17-2019
17	Pre_Elect_Precond	154	Pass on Zero Fails	0	06-17-2019
18	Precond_Temp_Cyc_5cyc	154	Pass on Zero Fails	0	06-17-2019
19	Precond_HTS_24hr	154	Pass on Zero Fails	0	06-17-2019
20	Precond_85/85_NoElec168hr	154	Pass on Zero Fails	0	06-18-2019
21	Precond_260°C_IR_Ref_Char	154	Pass on Zero Fails	0	06-25-2019
22	T/C_Pre_Elect	77	Pass on Zero Fails	0	06-25-2019
23	T/C_wPre_0250	77	Pass on Zero Fails	0	06-25-2019
24	T/C_wPre_0500	77	Pass on Zero Fails	0	07-01-2019
25	T/C_wPre_1000	77	Pass on Zero Fails	0	07-12-2019
26	Cross_Section TC 1000 Cyc	5	Pass on Zero Fails	0	07-16-2019
27	85°C/85%RH_W/Pre_Pre Elec	77	Pass on Zero Fails	0	06-25-2019
28	85°C/85%RH_BD_Valid	77	Pass on Zero Fails	0	06-26-2019
29	85°C/85%RH_Biased_168hrs	77	Pass on Zero Fails	0	06-26-2019
30	85°C/85%RH_Biased_500hrs	77	Pass on Zero Fails	0	07-03-2019
31	85°C/85%RH_Biased_1000hrs	77	Pass on Zero Fails	0	07-17-2019
32	Cross_Section 85°C/85%RH	5	Pass on Zero Fails	0	08-07-2019
33	CSAM Analysis	22	Pass on Zero Fails	0	07-03-2019
34	Precond_Temp_Cyc_5cyc	22	Pass on Zero Fails	0	07-09-2019
35	Precond_HTS_24hr	22	Pass on Zero Fails	0	07-09-2019

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Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
36	Precond_85/85_NoElec168hr	22	Pass on Zero Fails	0	07-10-2019
37	Precond_260°C_IR_Ref_Char	22	Pass on Zero Fails	0	07-17-2019
38	CSAM Analysis	22	Pass on Zero Fails	0	07-19-2019
39	Pack_Clos	0	0	0	08-08-2019

Sub Lot #	Part	Lot	Assembly Lot	Date Code
3	RClamp2594N	AER-005967	AER-005967	1916

Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
1	Data-Prep	None	None	0	06-17-2019
2	HTRB_Pre_Elect_150°C_RT24	105	Pass on Zero Fails	0	06-26-2019
3	HTRB_150°C_Real Time_0024	105	Pass on Zero Fails	0	06-27-2019
4	HTRB_Pre_Elect	105	Pass on Zero Fails	0	06-18-2019
5	BI_BD_Valid	105	Meet HTOL Schematics	0	06-18-2019
6	HTRB_150°C_0072	105	Pass on Zero Fails	0	06-18-2019
7	HTRB_150°C _0408	105	Pass on Zero Fails	0	06-21-2019
8	HTS_Pre_Elect	77	Pass on Zero Fails	0	06-19-2019
9	HTS_0168	77	Pass on Zero Fails	0	06-19-2019
10	HTS_0500	77	Pass on Zero Fails	0	06-26-2019
11	HTS_1000	77	Pass on Zero Fails	0	07-12-2019
12	ROSE Clean/ Test	174	Pass on Zero Fails	0	06-14-2019
13	85°C/85%RH_N/Pre_Pre Elec	20	Pass with 0 fail	0	06-19-2019
14	85°C/85%RH_BD_Valid	20	Pass on Zero Fails	0	06-19-2019
15	85/85_120hr_On/Off	20	Pass on Zero Fails	0	06-19-2019
16	Pre_Conditioning_Level_1	NA	MSL 1	0	06-17-2019
17	Pre_Elect_Precond	154	Pass on Zero Fails	0	06-17-2019
18	Precond_Temp_Cyc_5cyc	154	Pass on Zero Fails	0	06-17-2019
19	Precond_HTS_24hr	154	Pass on Zero Fails	0	06-17-2019

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Task#	Task Code	Sample Size	Criteria	Failures	Task On Actual
20	Precond_85/85_NoElec168hr	154	Pass on Zero Fails	0	06-18-2019
21	Precond_260°C_IR_Ref_Char	154	Pass on Zero Fails	0	06-25-2019
22	T/C_Pre_Elect	77	Pass on Zero Fails	0	06-25-2019
23	T/C_wPre_0250	77	Pass on Zero Fails	0	06-25-2019
24	T/C_wPre_0500	77	Pass on Zero Fails	0	07-01-2019
25	T/C_wPre_1000	77	Pass on Zero Fails	0	07-12-2019
26	Cross_Section TC 1000 Cyc	5	Pass on Zero Fails	0	07-16-2019
27	85°C/85%RH_W/Pre_Pre Elec	77	Pass on Zero Fails	0	06-25-2019
28	85°C/85%RH_BD_Valid	77	Pass on Zero Fails	0	06-26-2019
29	85°C/85%RH_Biased_168hrs	77	Pass on Zero Fails	0	07-02-2019
30	85°C/85%RH_Biased_500hrs	77	Pass on Zero Fails	0	07-09-2019
31	85°C/85%RH_Biased_1000hrs	77	Pass on Zero Fails	0	07-19-2019
32	Cross_Section 85°C/85%RH	5	Pass on Zero Fails	0	08-12-2019
33	CSAM Analysis	22	Pass on Zero Fails	0	07-03-2019
34	Precond_Temp_Cyc_5cyc	22	Pass on Zero Fails	0	07-09-2019
35	Precond_HTS_24hr	22	Pass on Zero Fails	0	07-09-2019
36	Precond_85/85_NoElec168hr	22	Pass on Zero Fails	0	07-10-2019
37	Precond_260°C_IR_Ref_Char	22	Pass on Zero Fails	0	07-17-2019
38	CSAM Analysis	22	Pass on Zero Fails	0	07-19-2019
39	Pack_Clos	0	0	0	08-13-2019

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RClamp2594N

Low Capacitance RailClamp® 4-Line Surge and ESD Protection for Ethernet Interfaces

PROTECTION PRODUCTS

Description

RClamp®2594N is specifically designed to provide secondary surge and ESD protection on high-speed ports. RClamp2594N integrates low capacitance, surge-rated steering diodes with a high power transient voltage suppressor (TVS). The TVS utilizes snap-back or "crow-bar" technology to minimize device clamping voltage and features high surge current capability of 35A (tp=8/20us). ESD characteristics are highlighted by high ESD withstand voltage (+/-30kV per IEC 61000-4-2) and extremely low dynamic resistance (0.05 Ohms typical). Each device will protect four lines operating at 5 volts.

RClamp2594N is in a DFN 3.0 x 2.0 x 0.4mm 10 Lead package. The leads are finished with NiPdAu.

Features

- Transient Protection to
  - IEC 61000-4-2 (ESD) 30kV (Air), 30kV (Contact)
  - IEC 61000-4-4 (EFT) 4kV (5/50ns)
  - IEC 61000-4-5 (Lightning) 35A (8/20µs)
- Very Small PCB Area
- Protects four High-Speed Data Lines
- Working Voltage: 5V
- Low Capacitance: 3pF Maximum
- Dynamic Resistance: 0.05 Ohms (Typ)
- Solid-State Silicon-Avalanche Technology

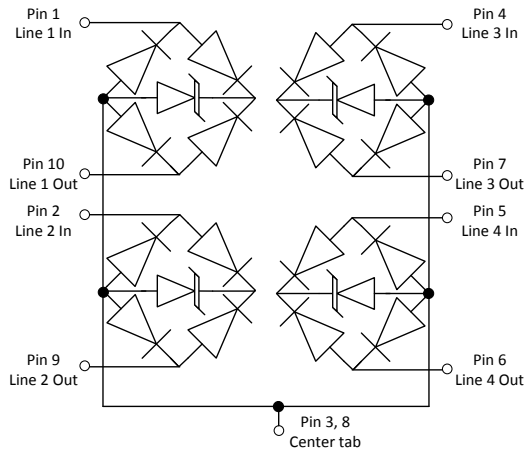
Mechanical Characteristics

- Package: DFN 3.0 x 2.0 x 0.4mm 10 Lead
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Nominal Dimensions: 3.0 x 2.0 x 0.40 mm
- Lead Finish: NiPdAu
- Molding Compound Flammability Rating: UL 94V-0
- Marking : Marking Code + Date Code
- Packaging : Tape and Reel

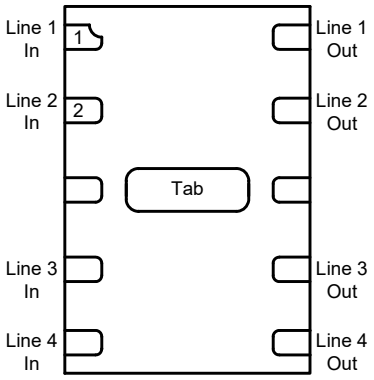
Applications

- Gigabit Ethernet
- 2.5GbE
- Integrated Magnetics / RJ-45 Connectors
- Central office Equipment
- Industrial Equipment
- LVDS Interfaces

Functional Schematic



Pin Configuration



Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	P_{PK}	300	W
Peak Pulse Current (tp = 8/20µs)	I_{PP}	35	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

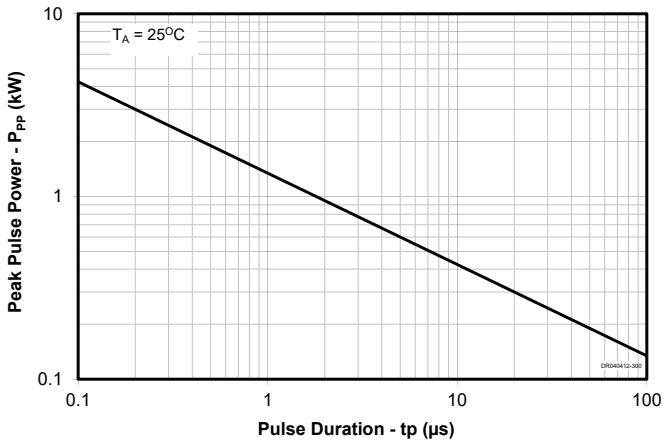
Electrical Characteristics (T=25°C unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C, any I/O Pin to GND				5	V
Reverse Breakdown Voltage	V_{BR}	I_t = 10mA, Any I/O Pin to GND	-40°C to 125°C	6.5	9.5	11.5	V
Holding Current	I_H	T = 25°C		75	150	250	mA
Reverse Leakage Current	I_R	V_{RWM} = 5V	T = 25°C		0.01	0.100	µA
			T = 125°C		0.03	0.325	µA
Clamping Voltage(2)	V_C	I_{PP} = 35A, tp = 8/20µs, Line 1 to Line 2 or Line 3 to Line 4			7.5	8.5	V
ESD Clamping Voltage(3)	V_C	I_{PP} = 4A, tp = 0.2/100ns (TLP) Any I/O Pin to GND			4.2		V
ESD Clamping Voltage(3)	V_C	I_{PP} = 16A, tp = 0.2/100ns (TLP) Any I/O Pin to GND			4.7		V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP)			0.05		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz, any I/O Pin to GND			2.1	3	pF

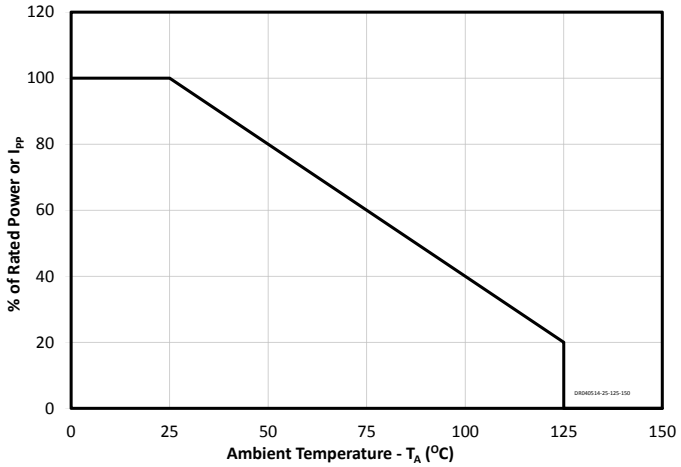
Notes:
(1): ESD Gun return path to Ground Reference Plane (GRP)
(2): Measured using a 1.2/50µs voltage, 8/20µs current combination waveform, R_S = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
(3): Transmission Line Pulse Test (TLP) Settings: tp = 100ns, tr = 0.2ns, I_{TLP} and V_{TLP} averaging window: t_1 = 70ns to t_2 = 90ns.
(4): Dynamic resistance calculated from I_{TLP} = 4A to I_{TLP} = 16A

Typical Characteristics

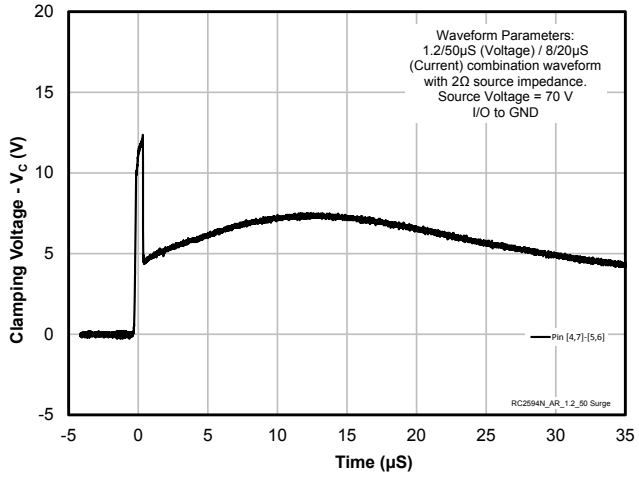
Non-Repetitive Peak Pulse Power vs. Pulse Time



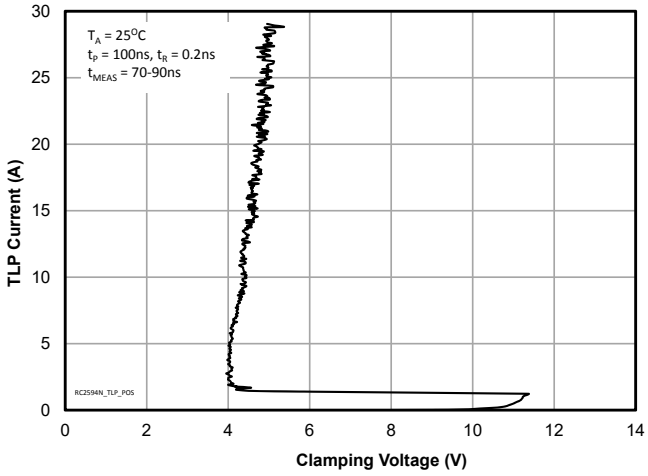
Power Derating Curve



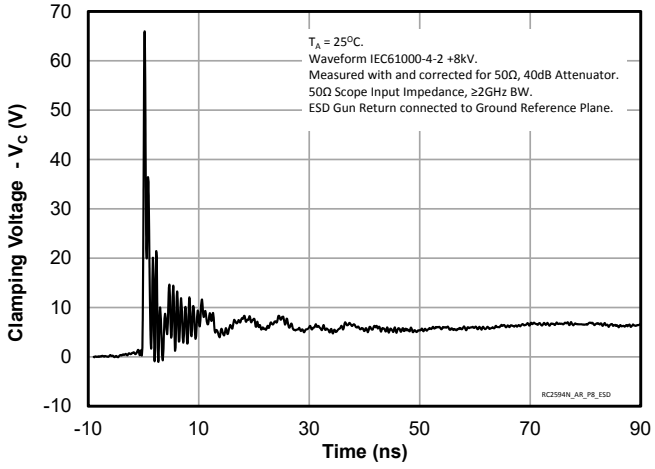
Clamping Characteristic (70V/2 Ohms, 1.2/50us Pulse)



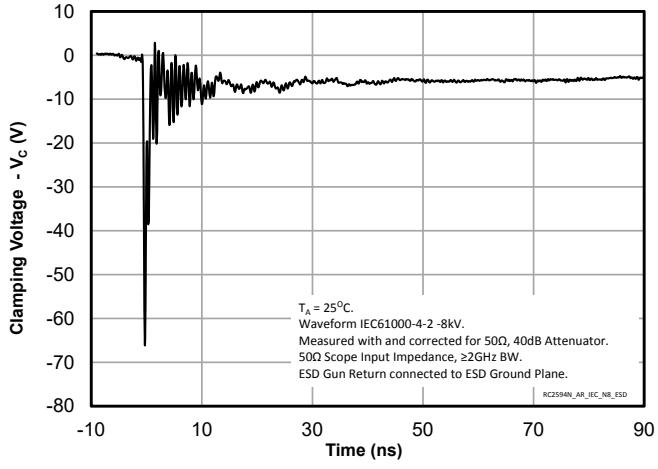
TLP IV Curve (Positive Pulse)



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

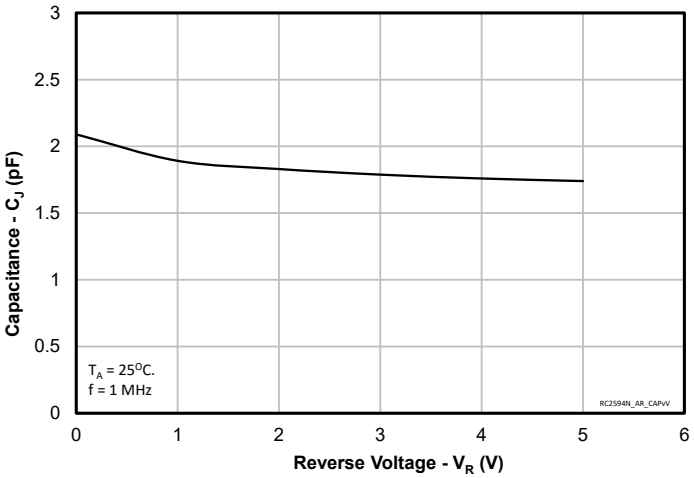


ESD Clamping (-8kV Contact per IEC 61000-4-2)

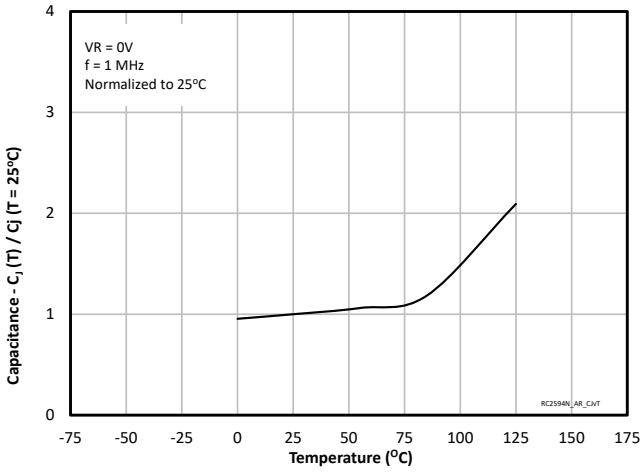


Typical Characteristics (Continued)

Capacitance vs. Reverse Voltage (Line to GND)



Capacitance vs. Temperature (Line to GND)



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 RClamp2594N 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 RClamp2594N 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 RClamp2594N. 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 tab 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 (tp=8/20µs) 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.

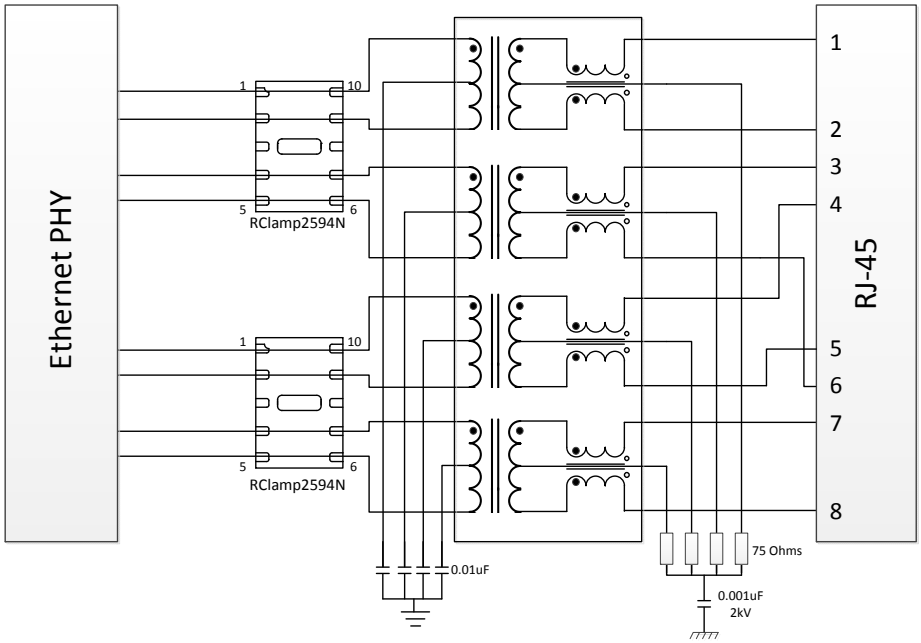
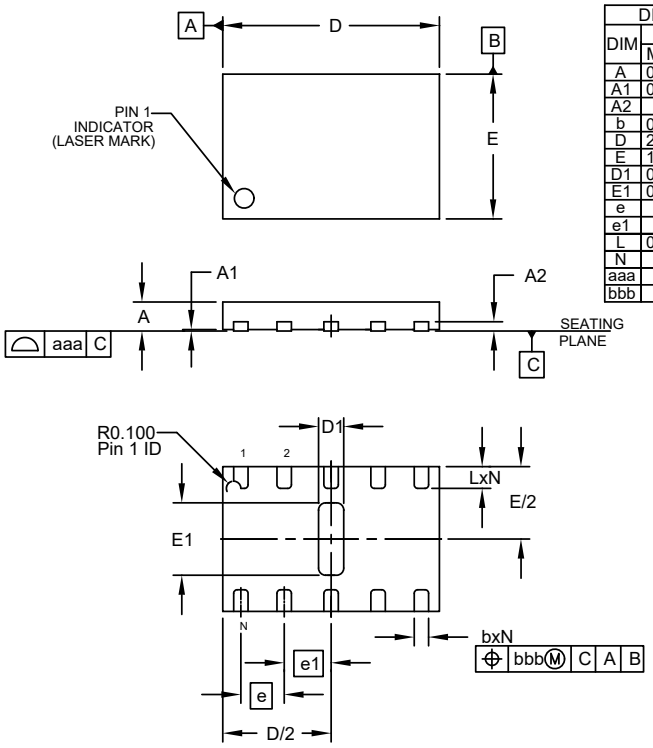


Figure 1 - Typical Ethernet Protection Circuit

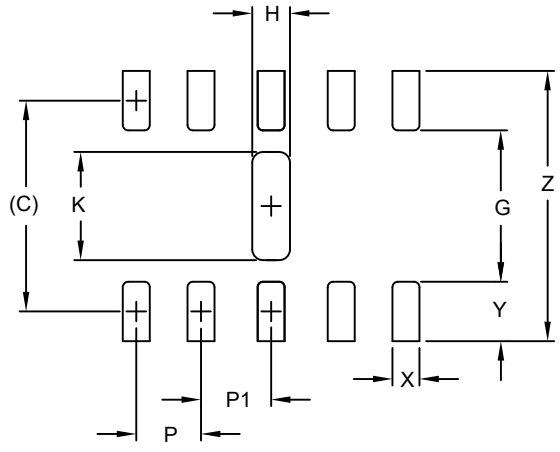
Outline Drawing - DFN 3.0 x 2.0 x 0.4mm 10 Lead



DIMENSIONS			
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.37	0.40	0.43
A1	0.00	0.02	0.05
A2		(0.127)	
b	0.15	0.20	0.25
D	2.95	3.00	3.05
E	1.95	2.00	2.05
D1	0.25	0.35	0.45
E1	0.90	1.00	1.10
e		0.60 BSC	
e1		0.65 BSC	
L	0.25	0.30	0.35
N		10	
aaa		0.08	
bbb		0.10	

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

Land Pattern - DFN 3.0 x 2.0 x 0.4mm 10 Lead

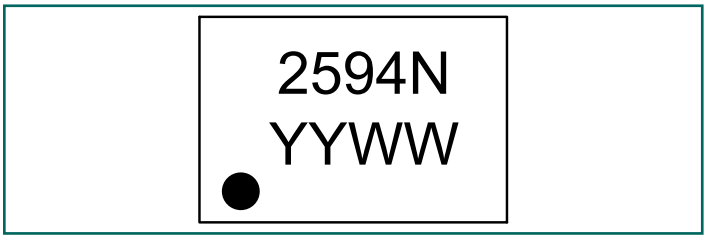


DIMENSIONS	
DIM	MILLIMETERS
C	(1.95)
G	1.40
H	0.35
K	1.00
P	0.60
P1	0.65
X	0.25
Y	0.55
Z	2.50

NOTES:

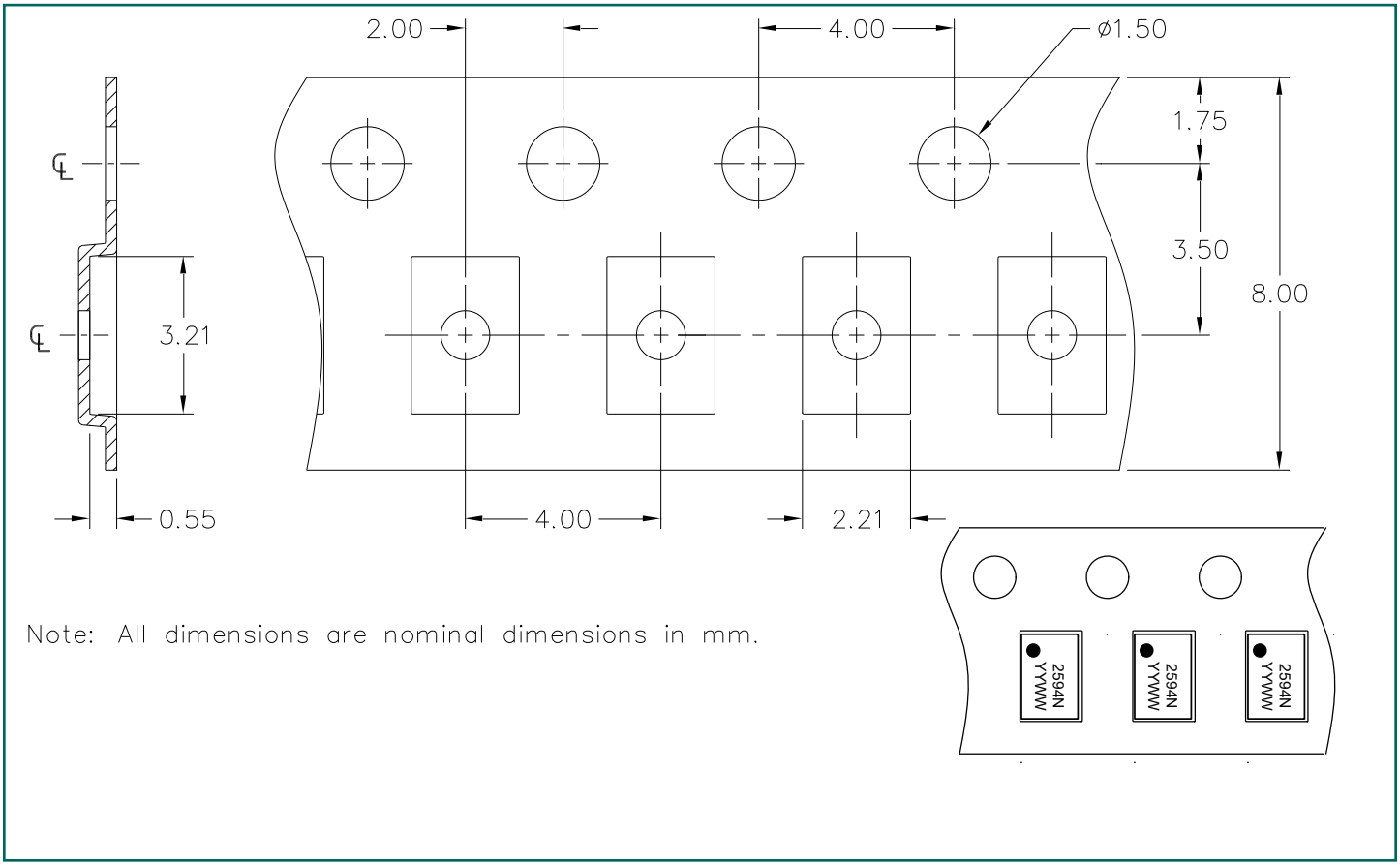
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
   CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR
   COMPANY'S MANUFACTURING GUIDELINES ARE MET.

Marking Code



Notes: Dot indicates Pin 1 Location

Tape and Reel Specification



Ordering Information

Part Number	Qty per Reel	Reel Size	Carrier Tape	Pitch
RClamp2594N.TCT	3000	7 Inch	Plastic	4mm
RailClamp and RClamp are registered trademarks of Semtech Corporation.				

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