

LT4293, LT4321 IEEE 802.3bt and LTPoE++ Interoperable Powered Device

DESCRIPTION

Demonstration circuit 2911A is an IEEE 802.3bt compliant and LTPoE++ interoperable Power over Ethernet (PoE) Powered Device (PD). It features the [LT®4293](#) PD interface controller and the [LT4321](#) PoE ideal diode bridge controller.

The LT4293 provides LTPoE++, IEEE 802.3af (PoE, Type 1), IEEE 802.3at (PoE+, Type 2), and IEEE 802.3bt (PoE++, Type 3 and 4) compliant interfacing. It utilizes an external, low $R_{DS(ON)}$ (30mΩ typical) N-channel MOSFET for the Hot Swap function to improve efficiency.

Power good (PWRGD) output indicates the PD controller is ready to provide power to the downstream load. This signal can be used to enable an isolated power supply. The $\overline{T2P}$ output indicates the available power from the Power Sourcing Equipment (PSE). This signal

communicates allocated power from either LTPoE++ or IEEE 802.3bt-compliant PSEs to the downstream PD circuitry.

The LT4321 controls eight low $R_{DS(ON)}$ (57mΩ typical) N-channel MOSFETs to further improve end-to-end power delivery efficiency and ease thermal design. This solution replaces the eight diodes typically found in a passive PoE rectifier bridge.

The DC2911A accepts up to 90W of delivered power from a PSE via the RJ45 connector (J1) or a local 48V DC power supply using the auxiliary supply input. When both supplies are connected, the auxiliary supply input has priority over the PoE input.

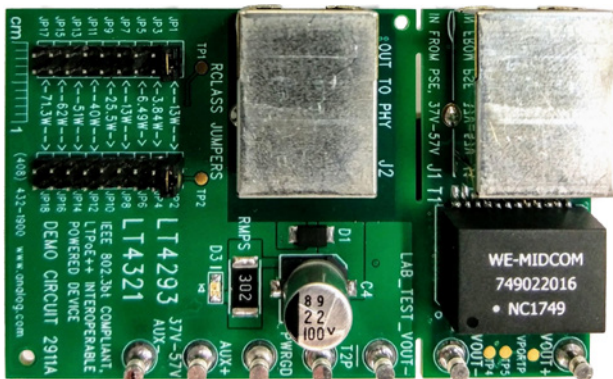
Design files for this circuit board are available.

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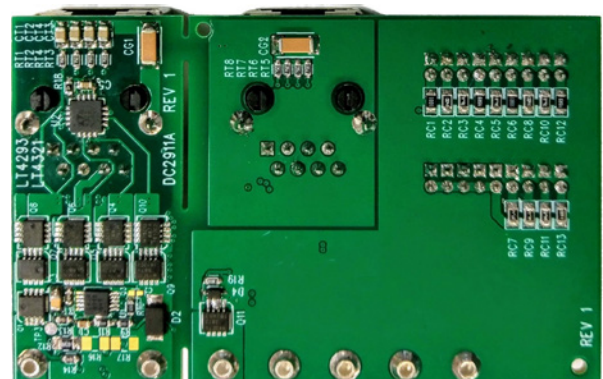
PERFORMANCE SUMMARY

PARAMETER	CONDITIONS	VALUE
Port Voltage (V_{PORT})	At RJ45	37V to 57V
Auxiliary Voltage	From AUX+ to AUX- Terminals	37V to 57V
Efficiency	$V_{PORT} = 48V$, $I_{OUT} = 1.5A$	99.2% (Typical)
$\overline{T2P}$ Switching Frequency	Connected to an IEEE 802.3bt or LTPoE++ PSE That Allocates at Least 38.7W	840Hz (Typical)

BOARD PHOTOS



Top Side



Bottom Side

TYPICAL PERFORMANCE CHARACTERISTICS

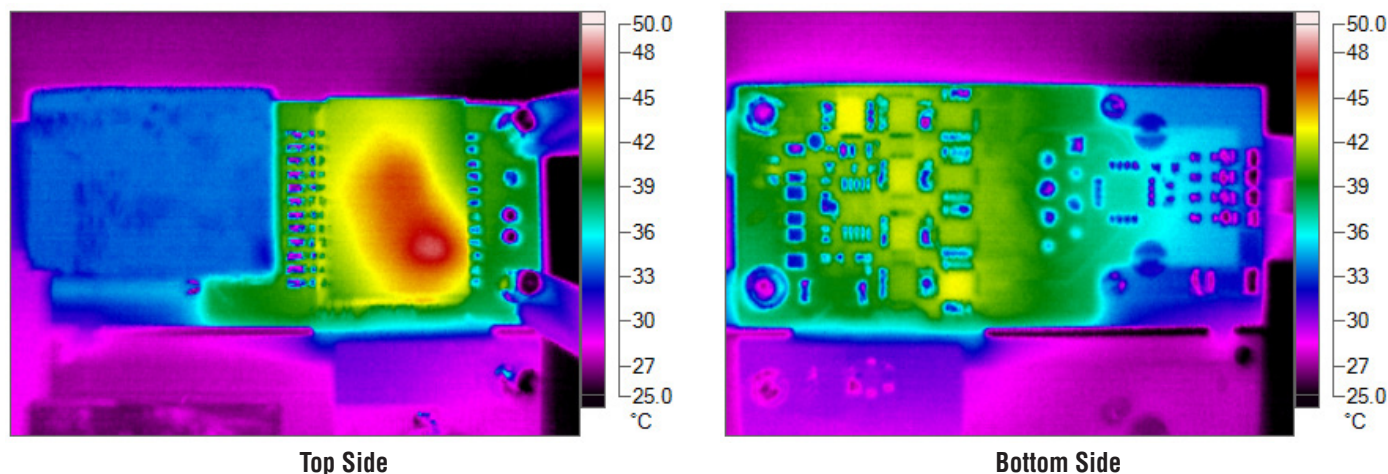


Figure 1. Thermal Pictures (Conditions: $V_{PORT} = 41.2V$, $V_{OUT} = 40.8V$, $I_{OUT} = 1.72A$)

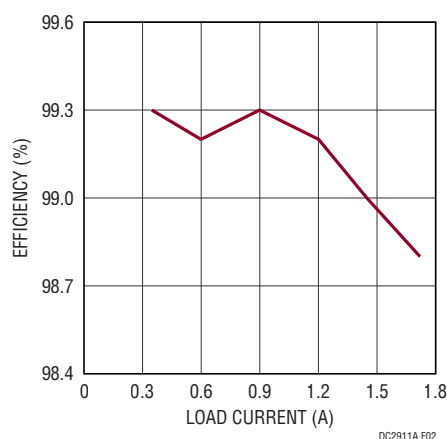


Figure 2. Efficiency (End-to-End)

QUICK START PROCEDURE

POWER OVER ETHERNET (PoE) INPUT

1. Disconnect auxiliary supply if it is connected to AUX+ and AUX- inputs of the DC2911A.
2. Refer to Figure 3 or Figure 4 to evaluate the DC2911A with a DC/DC converter. If a resistive or an active load is used to evaluate the DC2911A, use the setup diagram as shown in Figure 5.
3. Default class shunt positions are at JP1 and JP2 on the DC2911A board. In this configuration, any PSE with enough power will turn on this PD. Choose a power level from Table 1 and select the corresponding shunt positions.
4. Connect the output of the LTPoE++ or IEEE 802.3bt compliant PSE to the RJ45 connector (J1) of the DC2911A using a CAT5e or CAT6 Ethernet cable. (See Note.)
5. After connection has been established, verify that the LED (D3) is lit. This indicates the PSE has successfully detected and powered the PD.
6. Verify $\overline{T2P}$ response with a digital multimeter or an oscilloscope. The $\overline{T2P}$ response to the type of PSE connected to the DC2911A is provided in Table 2.

QUICK START PROCEDURE

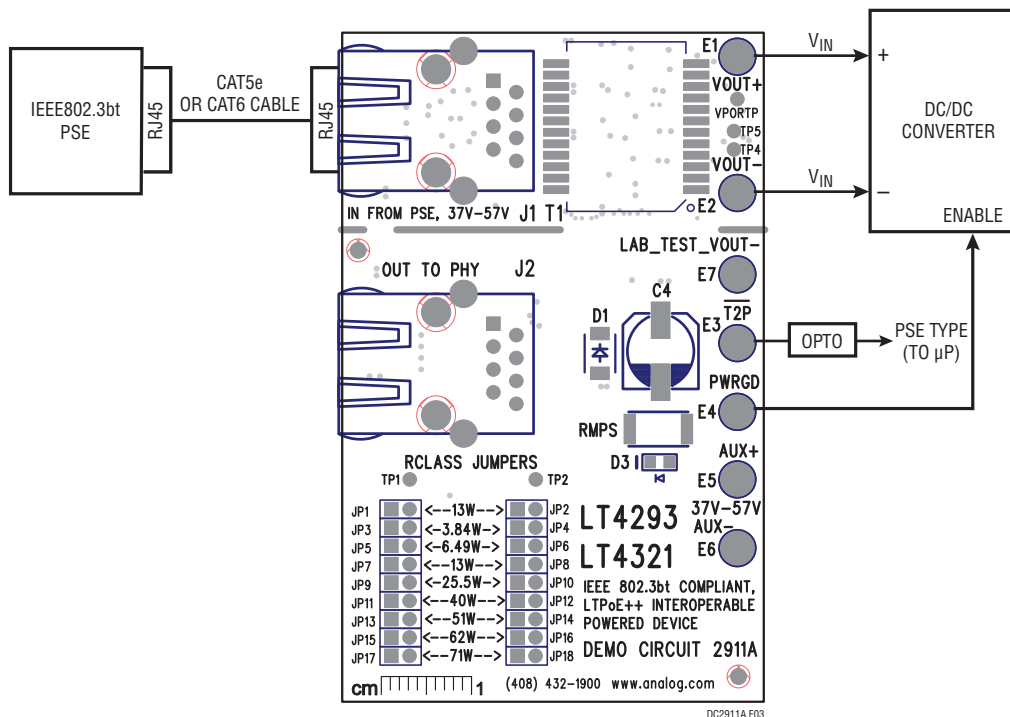


Figure 3. Setup Diagram for DC2911A with a DC/DC Converter, a Microprocessor, and an IEEE 802.3bt PSE

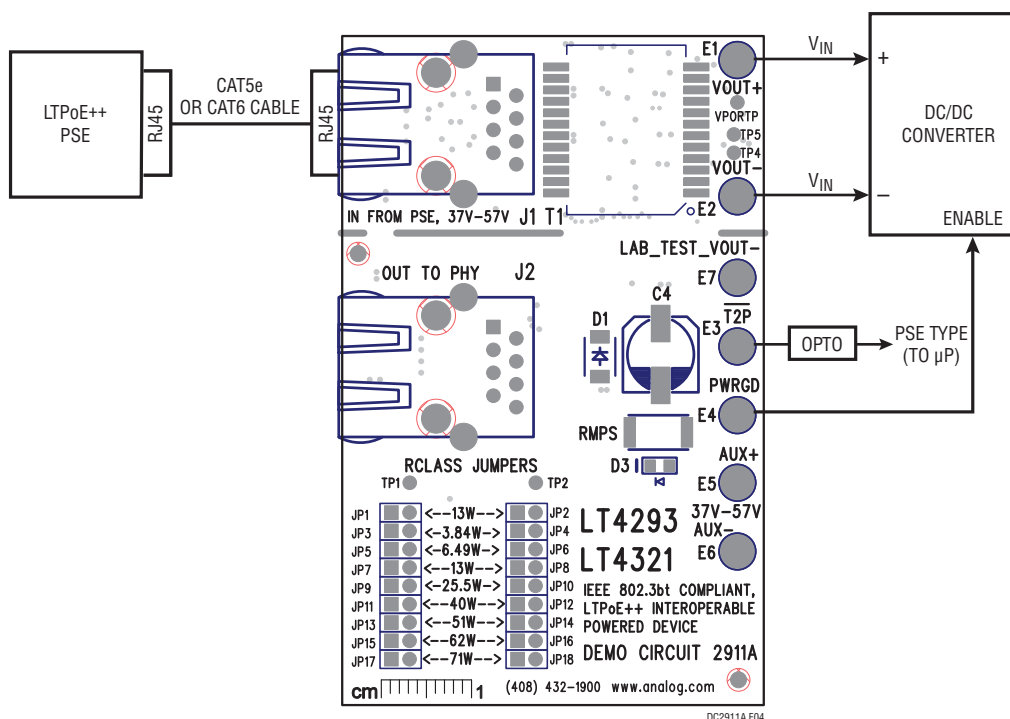


Figure 4. Setup Diagram for DC2911A with a DC/DC Converter, a Microprocessor, and an LTPoE++ PSE

DEMO MANUAL DC2911A

QUICK START PROCEDURE

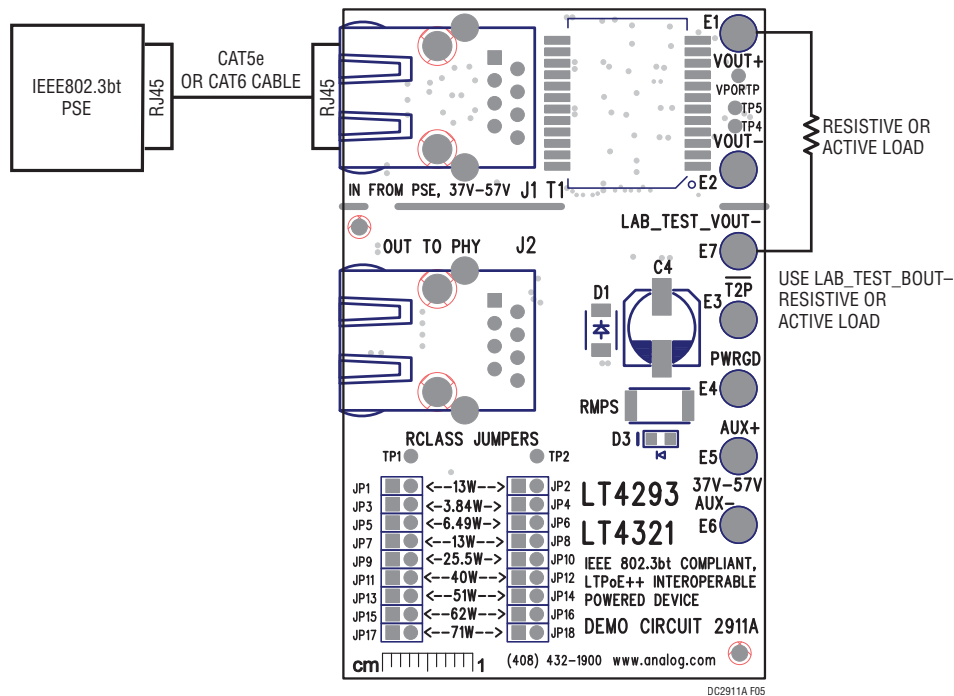


Figure 5. Setup Diagram for DC2911A with a Resistive or an Active Load. Do Not Capacitively Load LAB_TEST_VOUT-

Table 1. Single-Signature Classification, Power Levels and Jumper Selection

PD REQUESTED CLASS	PD REQUESTED POWER (AT THE PD INPUT)		RCLASS JUMPERS	
	IEEE 802.3	LTPoE++		
0	13W		JP1	JP2
1	3.84W		JP3	JP4
2	6.49W		JP5	JP6
3	13W		JP7	JP8
4	25.5W		JP9	JP10
5	40W	38.7W	JP11	JP12
6	51W	52.7W	JP13	JP14
7	62W	70W	JP15	JP16
8	71.3W	90W	JP17	JP18

Table 2. $\overline{T2P}$ Response vs PSE Type

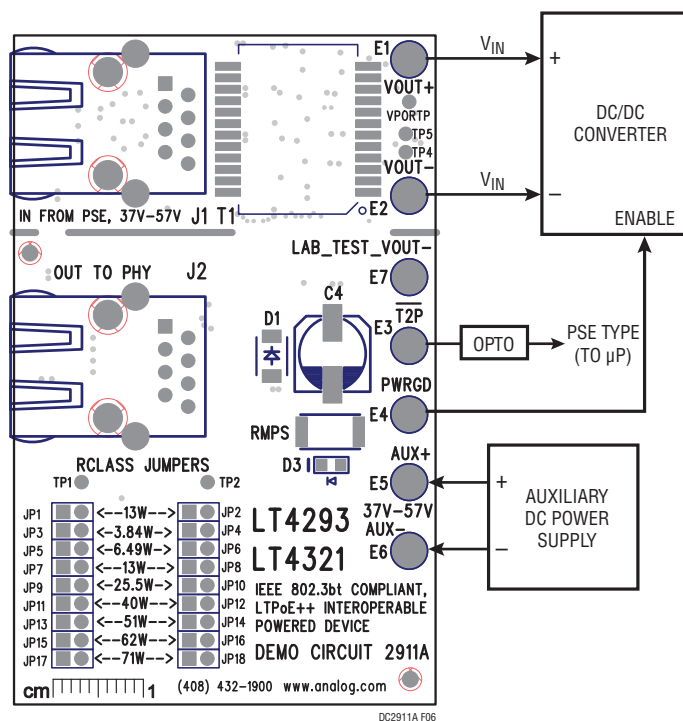
PSE TYPE	$\overline{T2P}$ RESPONSE
1 (PoE, 13W)	Logic High
2 (PoE+, 25.5W)	Logic Low
3 (PoE++, 51W)	50% Logic Low*
4 (PoE++, 71.3W)	25% Logic Low*
LTPoE++, 90W	75% Logic Low*

* $\overline{T2P}$ Frequency is 840Hz typical for Type 3, Type 4 and LTPoE++ PSEs

QUICK START PROCEDURE

AUXILIARY SUPPLY INPUT

1. Place and connect test equipment (voltmeter, ammeter, oscilloscope and electronic load) as shown in Figure 6.
2. Turn down the electronic load to a minimum value and turn off the electronic load.
3. Connect the output of the auxiliary supply to the DC2911A as shown in Figure 6. Turn on the auxiliary supply and set its current limit to 2A. Then increase its output voltage to 48V.
4. Once the LED (D3) on the DC2911A is lit, check the output voltage using a voltmeter. Output voltage should be within 37V to 57V.
5. Verify $\overline{T2P}$ response with an oscilloscope as shown in Figure 6. The $\overline{T2P}$ response during auxiliary power operation is provided in Table 3.



QUICK START PROCEDURE

Table 4. Interoperability (T2P Response*, PSE Allocated Power, Number of Class/Mark Events)

PD REQUESTED CLASS (PD REQUESTED POWER)	PSE TYPE, CLASS (POWER)											AUXILIARY POWER SOURCE**
	IEEE 802.3 TYPE 1	IEEE 802.3 TYPE 2	IEEE 802.3 TYPE 3			IEEE 802.3 TYPE 4		LTPoE++				
	CLASS 3 (13W)	CLASS 4 (25.5W)	CLASS 4 (25.5W)	CLASS 5 (40W)	CLASS 6 (51W)	CLASS 7 (62W)	CLASS 8 (71.3W)	(38.7W)	(52.7W)	(70W)	(90W)	
CLASS 0-3 (Up to 13W)	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Hi-Z Up to 13W 1-Event	Low-Z Aux. Power N/A
CLASS 4 (25.5W)	Hi-Z 13W 1-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 2-Event	Low-Z Aux. Power N/A
CLASS 5 (40W)	Hi-Z 13W 1-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 3-Event	50% 40W 4-Event	50% 40W 4-Event	50% 40W 4-Event	50% 40W 4-Event	75% 38.7W 3-Event	75% 38.7W 3-Event	75% 38.7W 3-Event	75% 38.7W 3-Event	75% Aux. Power N/A
CLASS 6 (51W)	Hi-Z 13W 1-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	50% 51W 4-Event	50% 51W 4-Event	50% 51W 4-Event	DENIED	75% 52.7W 3-Event	75% 52.7W 3-Event	75% 52.7W 3-Event	75% Aux. Power N/A
CLASS 7 (62W)	Hi-Z 13W 1-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	50% 51W 4-Event	25% 62W 5-Event	25% 62W 5-Event	DENIED	DENIED	75% 70W 3-Event	75% 70W 3-Event	75% Aux. Power N/A
CLASS 8 (71.3W)	Hi-Z 13W 1-Event	Low-Z 25.5W 2-Event	Low-Z 25.5W 3-Event	Low-Z 25.5W 3-Event	50% 51W 4-Event	50% 51W 4-Event	25% 71.3W 5-Event	DENIED	DENIED	DENIED	75% 90W 3-Event	75% Aux. Power N/A

	↓
T2P Response* →	75%
PSE Allocated Power →	90W
Number of Classification Events →	3-Event

Note 1. Shade of blue indicates the PD has been demoted or denied power.

* Specified as the percentage of the period which T2P is low impedance with respect to GND.

** Auxiliary Power Supply must be sized to provide PD Requested Power.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
3	2	C1, C5	CAP., 0.047 μ F, X7S, 100V, 10%, 0603	TDK, C1608X7S2A473K080AB
4	0	C2	CAP., OPTION, 0402	OPT
5	1	C3	CAP., 0.047 μ F, X7R, 100V, 10%, 0805	AVX, 08051C473KAT2A
6	1	C4	CAP., 22 μ F, ALUM., 100V, 20%, SMD 8mm \times 10.2mm, CE-BS SERIES	SUN ELECTRONIC INDUSTRIES CORPORATION, 100CE22BS
1	2	CG1, CG2	CAP., 1000pF, X7R, 2000V, 10% 1808	TDK, C4520X7R3D102K130KA
2	4	CT1, CT2, CT3, CT4	CAP. 0.01 μ F, X7R, 200V, 10%, 0805	AVX, 08052C103KAZ2A
7	1	D1	DIODE, TVS, 58V, 600W, 2-PIN SOD128, AEC-Q101	NEXPERIA, PTVS58VP1UTP
8	1	D2	DIODE, SCHOTTKY, 100V, 3A, 2-PIN SOD-128, AEC-Q101	NEXPERIA, PMEG10030ELPX
9	1	D3	LED, GREEN, WATER-CLEAR	WURTH ELEKTRONIK, 150080VS75000
10	1	D4	DIODE, ZENER, 12V, 200mW, SOD-323	DIODES INC, MMSZ5242BS-7-F
11	7	E1-E7	TEST POINT, TURRET, 0.094 MTG. HOLE	MILL-MAX 2501-2-00-80-00-00-07-0
13	2	J1, J2	CONN., MOD JACK, RJ45, FEMALE, R/A THT, 1 PORT, 8P8C	STEWART CONN./BEL, SS-7188S-A-NF
12	18	JP1-JP18	CONN., HDR., MALE, 1 \times 2, 2mm, THT, STR	SULLINS CONNECTOR SOLUTIONS, NRPN021PAEN-RC
14	2	Q1, Q11	XSTR., MOSFET, N-CH, 100V, 36.6m Ω , 30A, 91W, LFPAK33	NEXPERIA, PSMN040-100MSE
15	8	Q3-Q10	XSTR., MOSFET, N-CH, 100V, 71m Ω , 18A, 65W, LFPAK33	NEXPERIA, PSMN075-100MSE
28	1	R10	RES., 52.3k, 1%, 1/10W, 0603	VISHAY, CRCW060352K3FKEA
29	2	R11, R18	RES., 0 Ω , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
30	1	R12	RES., 8.2 Ω , 1/8W, 1%, 0805	VISHAY, CRCW08058R20FKEA
31	1	R13	RES., 3.3k, 1/10W, 5%, 0603	VISHAY, CRCW06033K30JNEA
32	2	R14, R15	RES., 100k, 1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
33	0	R16, R17	RES., OPTION, 0805	OPT
34	1	R19	RES., 30k, 1/10W, 5%, 0603	VISHAY, CRCW060330K0JNEA
27	1	R9	RES., 174k, 1%, 1/10W, 0603	VISHAY, CRCW0603174KFKEA
16	2	RC1, RC6	RES., 1.00k, 1/8W, 1%, 0805	VISHAY, CRCW08051K00FKEA
23	1	RC11	RES., 64.9 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080564R9FKEA
24	1	RC13	RES., 118 Ω , 1/8W, 1%, 0805	VISHAY, CRCW0805118RFKEA
17	2	RC2, RC8	RES., 140 Ω , 1/8W, 1%, 0805	VISHAY, CRCW0805140RFKEA
18	2	RC3, RC10	RES., 76.8 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080576R8FKEA
19	2	RC4, RC12	RES., 49.9 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080549R9FKEA
20	1	RC5	RES., 34.8 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080534R8FKEA
21	1	RC7	RES., 37.4 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080537R4FKEA
22	1	RC9	RES., 46.4 Ω , 1/8W, 1%, 0805	VISHAY, CRCW080546R4FKEA
25	1	RMPS	RES., 3.0k, 5%, 1W, 2512	VISHAY, CRCW25123K00JNEG
26	8	RT1-RT8	RES., 75 Ω , 1/10W, 5%, 0603	VISHAY, CRCW060375R0JNEA
38	2	SHUNTS ON JP1 AND JP2	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421
35	1	T1	XFMR., 350 μ H, 1:1 \pm 2%	WURTH ELEKTRONIK, 749022016
36	1	U1	I.C., LTPoE++/802.3bt PD CONTROLLER, DFN10, 3mm \times 3mm	ANALOG DEVICES, LT4293IDD
37	1	U2	I.C., PoE IDEAL DIODE BRIDGE CONTROLLER, QFN16-UF, 4mm \times 4mm	ANALOG DEVICES, LT4321IUF
39	2		STENCILS, (TOP & BOTTOM)	STENCIL DC2911A-1





**ESD Caution**

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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