

## LT4294, LT4321 IEEE 802.3bt Powered Device

### DESCRIPTION

Demonstration circuit 2583 is an IEEE 802.3bt (Draft 2.3) compliant Power over Ethernet (PoE) powered device (PD). It features the **LT<sup>®</sup>4294** PD interface controller and the LT4321 PoE ideal diode bridge controller.

The LT4294 provides 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  $R_{DS(ON)}$  (57m $\Omega$  typical) N-channel FET for the hot swap function to improve efficiency. Additional features include power good (PWRGD) and  $\overline{T2P}$  output indicators for interfacing with downstream electronics. The 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) to the downstream load. This signal can be used to limit the load and prevent overloading the PSE.

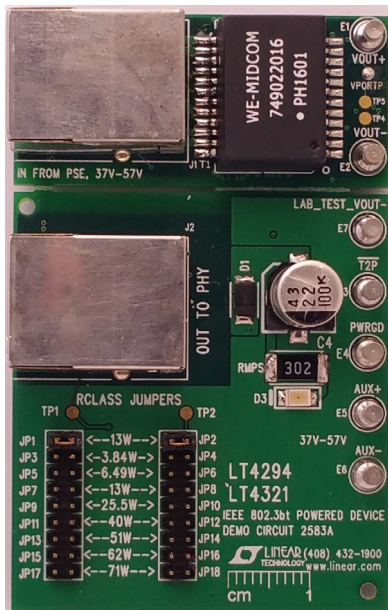
The LT4321 controls eight low  $R_{DS(ON)}$  (57m $\Omega$  typical) N-channel FETs to further improve end-to-end power delivery efficiency and ease thermal design. This solution replaces the eight diodes typically found in a passive PoE rectifier bridge.

The DC2583A accepts up to 71W 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.

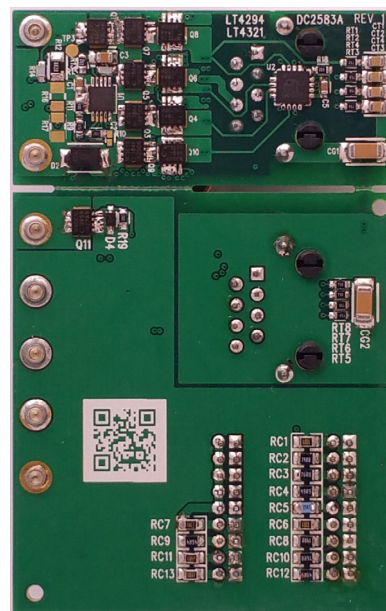
**Design files for this circuit board are available at <http://www.linear.com/demo/DC2583A>**

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### BOARD PHOTO



Top Side



Bottom Side

# DEMO MANUAL DC2583A

## PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Port Voltage ( $V_{\text{PORT}}$ )	At RJ45	37		57	V
Auxiliary Voltage	From AUX+ to AUX- Terminals	37		57	V
Efficiency	$V_{\text{PORT}} = 48\text{V}$ , $I_{\text{OUT}} = 1.2\text{A}$		99.2		%
T2P Switching Frequency			840		Hz

## TYPICAL PERFORMANCE CHARACTERISTICS

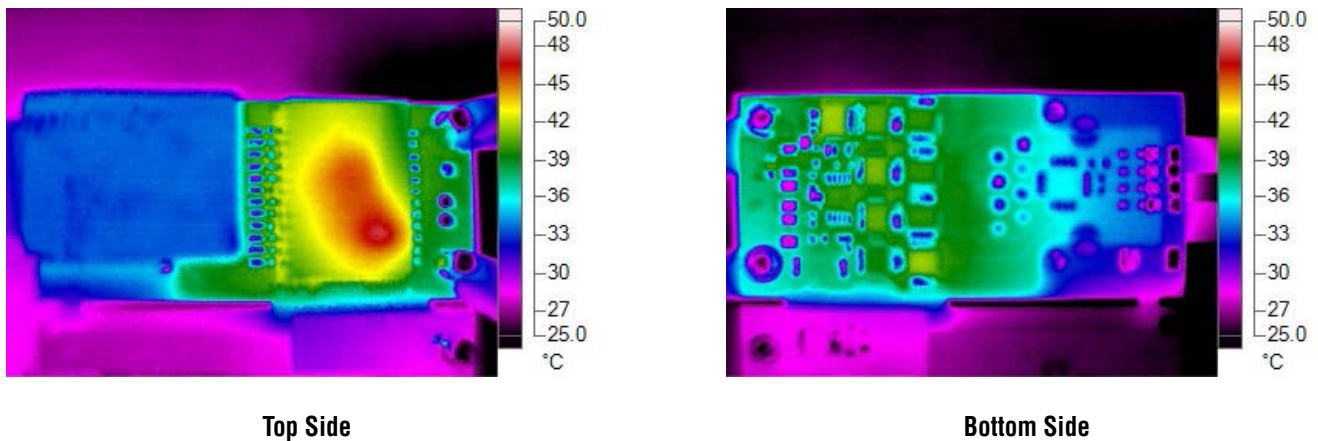


Figure 1. Thermal Pictures (Conditions:  $V_{\text{PORT}} = 41.2\text{V}$ ,  $V_{\text{OUT}} = 40.8\text{V}$ ,  $I_{\text{OUT}} = 1.72\text{A}$ )

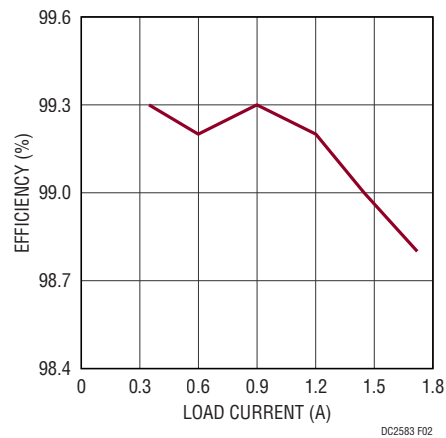


Figure 2. Efficiency (End-to-End)

## QUICK START PROCEDURE

### Power Over Ethernet (PoE) Input

1. Disconnect auxiliary supply if it is connected to AUX+ and AUX- inputs of the DC2583A.
2. Refer to Figure 3 to evaluate the DC2583A with a DC/DC converter. If a resistive or an active load is used to evaluate the DC2583A, use the setup diagram as shown in Figure 4.
3. Default class shunt positions are at JP1 and JP2 on the DC2583A board. Choose a power level from Table 1 and select the corresponding shunt positions.

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

PD CLASS	ALLOCATED CLASS POWER AT THE PD INPUT	RCLASS JUMPERS	
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	JP11	JP12
6	51W	JP13	JP14
7	62W	JP15	JP16
8	71W	JP17	JP18

\*Class 0 is not defined for 802.3bt PDs.

4. Connect the output of the IEEE 802.3bt compliant PSE (see note) to the RJ45 connector (J1) of the DC2583A using a CAT5e or CAT6 Ethernet cable.
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 for the type of PSE connected to the DC2583A is provided in Table 2.

Note: An 802.3bt PSE has not yet been released. In the interim, an LTPoE++<sup>®</sup> compliant PSE (DC1814A-D) may be used to provide power to the DC2583A. The LTPoE++ classification will not be 802.3bt compliant, but the PSE will provide a compatible detection and power output. Specifically, the  $\overline{T2P}$  output of the DC2583A is different from the behavior stated in Table 2 and will indicate connection to a Type 2 PSE. Otherwise PD behavior will be unaffected.

**Table 2.  $\overline{T2P}$  Response**

PSE	$\overline{T2P}$ RESPONSE	NEGOTIATED PD INPUT POWER
IEEE	Logic High	13W
	Logic Low	25.5W
	50% Logic High/50% Logic Low, Toggle at 840Hz (typical)	51W
	75% Logic High/25% Logic Low, Toggle at 840Hz (typical)	71W
LTPoE++, 90W	Logic Low	71W

## QUICK START PROCEDURE

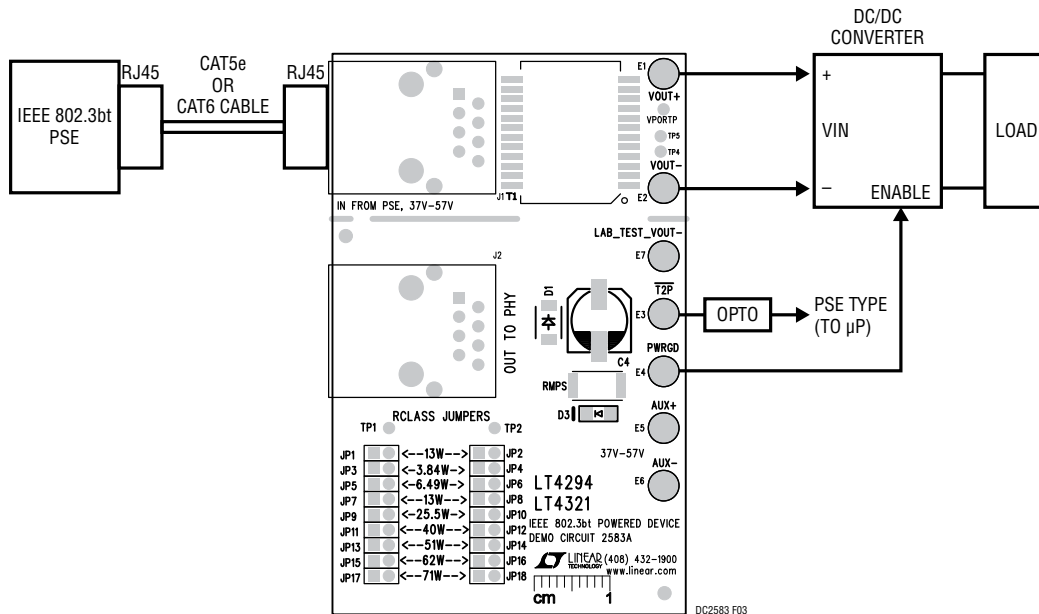


Figure 3. Setup Diagram for DC2583A with a DC/DC Converter, a Microprocessor and an IEEE 802.3bt PSE

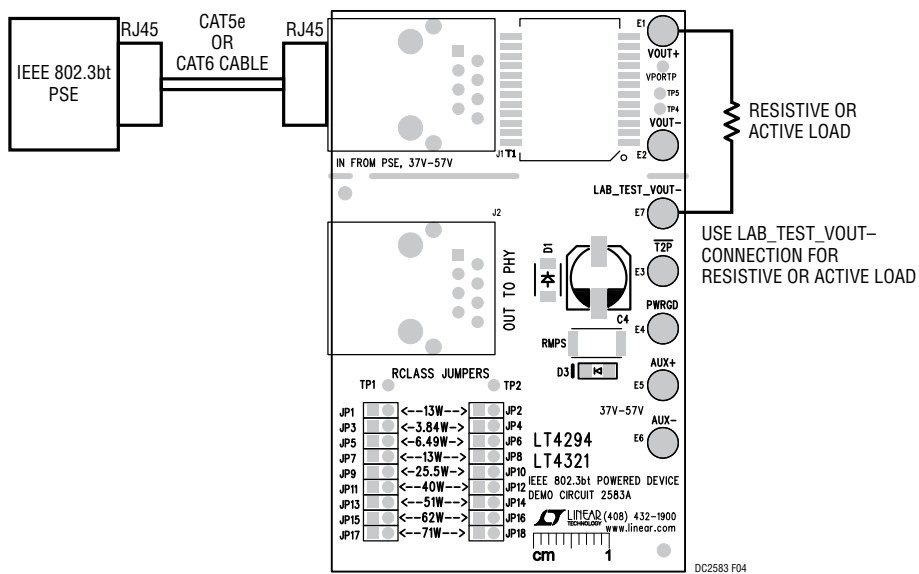


Figure 4. Setup Diagram for DC2583A with a Resistive or an Active Load

## QUICK START PROCEDURE

### Auxiliary Supply Input

1. Place and connect test equipment as shown in Figure 5.
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 DC2583A as shown in Figure 5. 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 DC2583A is lit, check the output voltage using a voltmeter. Output voltage should be within 37-57V.
5. Verify  $\overline{T2P}$  response with an oscilloscope as shown in Figure 5. The  $\overline{T2P}$  response during auxiliary power operation is provided in Table 3.

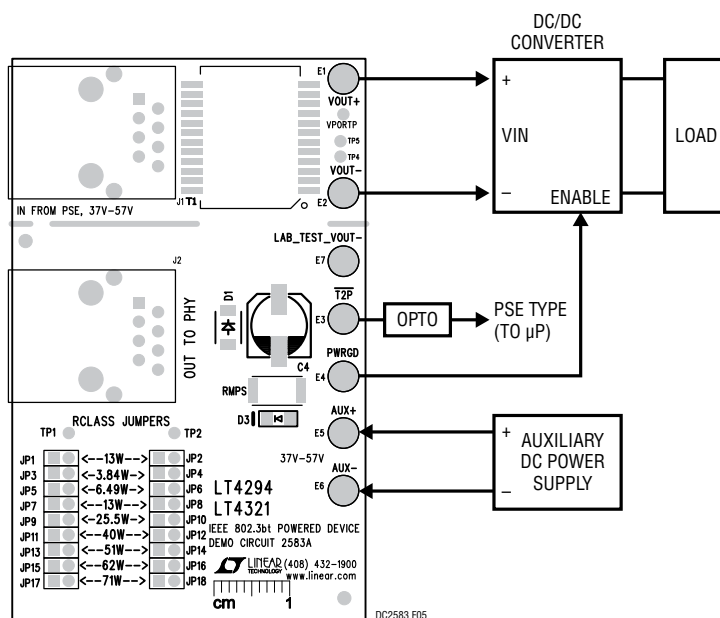


Figure 5. Setup Diagram for Auxiliary Supply Input

Table 3.  $\overline{T2P}$  Response During Auxiliary Power Operation

PD CLASS	$\overline{T2P}$ RESPONSE
0-4	Logic Low
5-8	75% Logic High/25% Logic Low, Toggle at 840Hz (typical)

# DEMO MANUAL DC2583A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	2	C1, C5	CAP, 0.047 $\mu$ F, X7S, 100V, 10%, 0603	TDK, C1608X7S2A473K080AB
2	0	C2	CAP, OPTION, 0402	OPT
3	1	C3	CAP, 0.047 $\mu$ F, X7R, 100V, 10%, 0805	AVX, 08051C473KAT2A
4	1	CG1	CAP, 1000pF, X7R, 2000V, 10%, 1808	TDK, C4520X7R3D102K130KA
5	4	CT1, CT2, CT3, CT4	CAP, CER, X7R 0.01 $\mu$ F 200V 10%, 0805	AVX, 08052C103KAZ2A
6	1	D2	DIODE, TVS, 58V, 600W, SOD128	NEXPERIA, PTVS58VP1UTP
7	1	D1	DIODE, SCHOTTKY, 100V, 3A	NEXPERIA, PMEG10030
8	1	J1	CONN., MOD. JACK, FEMALE, 2.54mm, 8 TERMINAL, 1 PORT, R/A THRU-HOLE	STEWART CONNECTOR, SS-7188S-A-NF
9	2	Q1, Q11	MOSFET, N-CH, 100V, 36.6m $\Omega$ , 30A, 91W, LFPAK33	NEXPERIA, PSMN040-100MSE
10	8	Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10	MOSFET, N-CH, 100V, 71m $\Omega$ , 18A, 65W, LFPAK33	NEXPERIA, PSMN075-100MSE
11	1	R9	RES., 174k, 1%, 0603	NIC, NRC06F1743TRF
12	1	R10	RES., 52.3k, 1%, 0603	NIC, NRC06F5232TRF
13	2	R11, R18	RES., 0 $\Omega$ , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
14	1	R12	RES., 8.2 $\Omega$ , 1/5W, 5%, 0805	NIC, NRC10J8R2TRF
15	1	R13	RES., 3.3k, 1/10W, 5%, 0603	VISHAY, CRCW06033K30JNEA
16	2	R14, R15	RES., 100k, 1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
17	0	R16, R17	RES., OPT, 0805	OPT
18	2	RC1, RC6	RES., 1.00k, 1/8W, 1%, 0805	VISHAY, CRCW08051K00FKEA
19	2	RC2, RC8	RES., 140 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW0805140RFKEA
20	2	RC3, RC10	RES., 76.8 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW080576R8FKEA
21	2	RC4, RC12	RES., 49.9 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW080549R9FKEA
22	1	RC5	RES., 34.8 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW080534R8FKEA
23	1	RC7	RES., 37.4 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW080537R4FKEA
24	1	RC9	RES., 46.4 $\Omega$ , 1/8W, 1%, 0805	PANASONIC, ERJ-6ENF46R4V
25	1	RC11	RES., 64.9 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW080564R9FKEA
26	1	RC13	RES., 118 $\Omega$ , 1/8W, 1%, 0805	VISHAY, CRCW0805118RFKEA
27	4	RT1, RT2, RT3, RT4	RES., 75 $\Omega$ , 1/10W, 5%, 0603	VISHAY, CRCW060375R0JNEA
28	1	T1	TRANSFORMER, ETHERNET, 749022016	WURTH ELEKTRONIK, 749022016
29	0	T4 (ALTERNATE)	TRANSFORMER, ETHERNET, EPG4260S-LF	PCA EPG4260S-LF
30	0	T4 (ALTERNATE)	TRANSFORMER, ETHERNET, ETH1-460LD	COILCRAFT ETH1-460LD
31	1	U1	I.C., IEEE 802.3bt PD CONTROLLERS, DFN10, 3mm x 3mm	LINEAR TECH., LT4294IDD#PBF
32	1	U2	I.C., PoE IDEAL DIODE BRIDGE CONTROLLER, QFN16-UF, 4mm x 4mm	LINEAR TECH., LT4321IUF#PBF

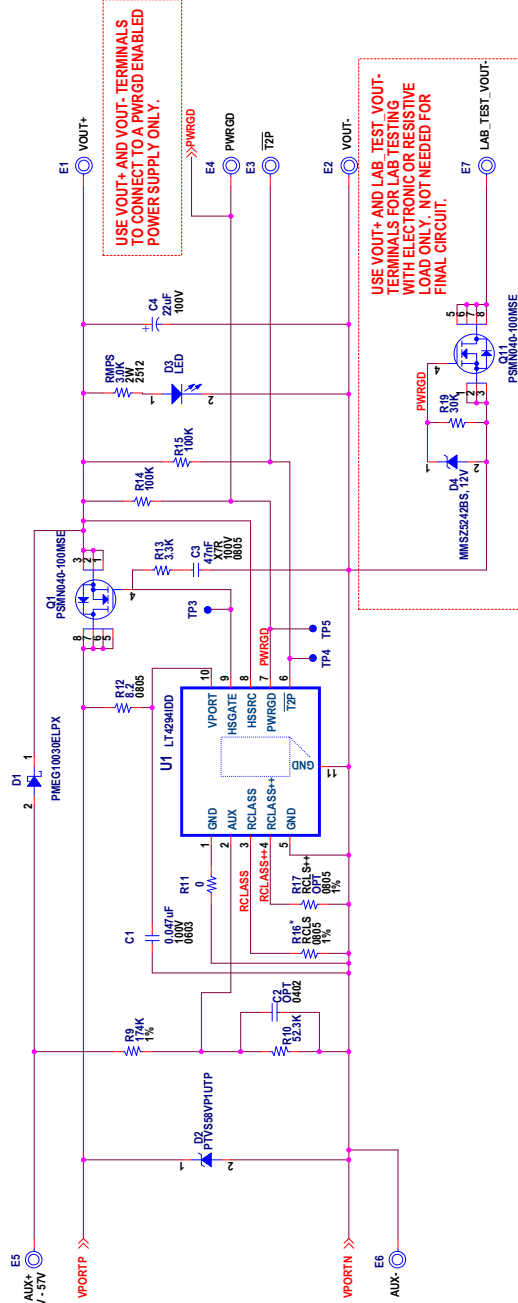
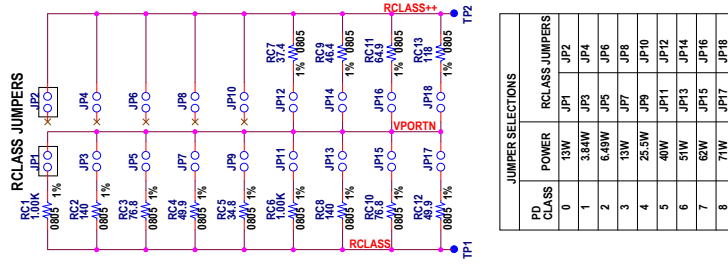
## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Hardware: For Demo Board Only</b>				
1	1	C4	CAP, ALUM. ELECT, 22 $\mu$ F, 100V, 20%	SUN ELECTRONIC, 100CE22BS
2	1	CG2	CAP, 1000pF, X7R, 2000V, 10%, 1808	TDK, C4520X7R3D102K130KA
3	1	D3	LED, GREEN, 560nm, 3x2mm, 1206	ROHM, SML-010FTT86L
4	1	D4	DIODE, 12V, 200mW, SOD-323	DIODES INC, MMSZ5242BS-7-F
5	7	E1, E2, E3, E4, E5, E6, E7	TURRET, 0.094" MTG. HOLE	MILL-MAX 2501-2-00-80-00-00-07-0
6	1	J2	CONN., MOD. JACK, FEMALE, 2.54mm, 8 TERMINAL, 1 PORT, R/A THRU-HOLE	STEWART CONNECTOR, SS-7188S-A-NF
7	18	JP1-JP18	CONN., HEADER, 1X2, 2mm	SULLINS, NRPN021PAEN-RC
8	1	R19	RES., 30k, 1/10W, 5%, 0603	VISHAY, CRCW060330K0JNEA
9	1	RMPS1	RES., 3.0k, 2W, 1%, 2512	TE CONNECTIVITY 35213K0FT
10	4	RT5, RT6, RT7, RT8	RES., 75 $\Omega$ , 1/10W, 5%, 0603	VISHAY, CRCW060375R0JNEA
11	2	XJP1, XJP2	SHUNT, 2mm	SAMTEC, 2SN-BK-G
12	1		PCB, DC2583A	DEMO CIRCUIT 2583A
13	2		STENCILS, DC2583A (TOP & BOTTOM)	STENCIL DC22583A

# DEMO MANUAL DC2583A

## SCHEMATIC DIAGRAM

REVISION HISTORY		APPROVED	DATE
ECO	REV	DESCRIPTION	
—	1	PRODUCTION	KAUNG H. 05-24-17



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**APPROVALS**

PCB DES.	KAUNG H.
APP'G	KAUNG H.

**IEEE 802.3BI POWERED DEVICE**

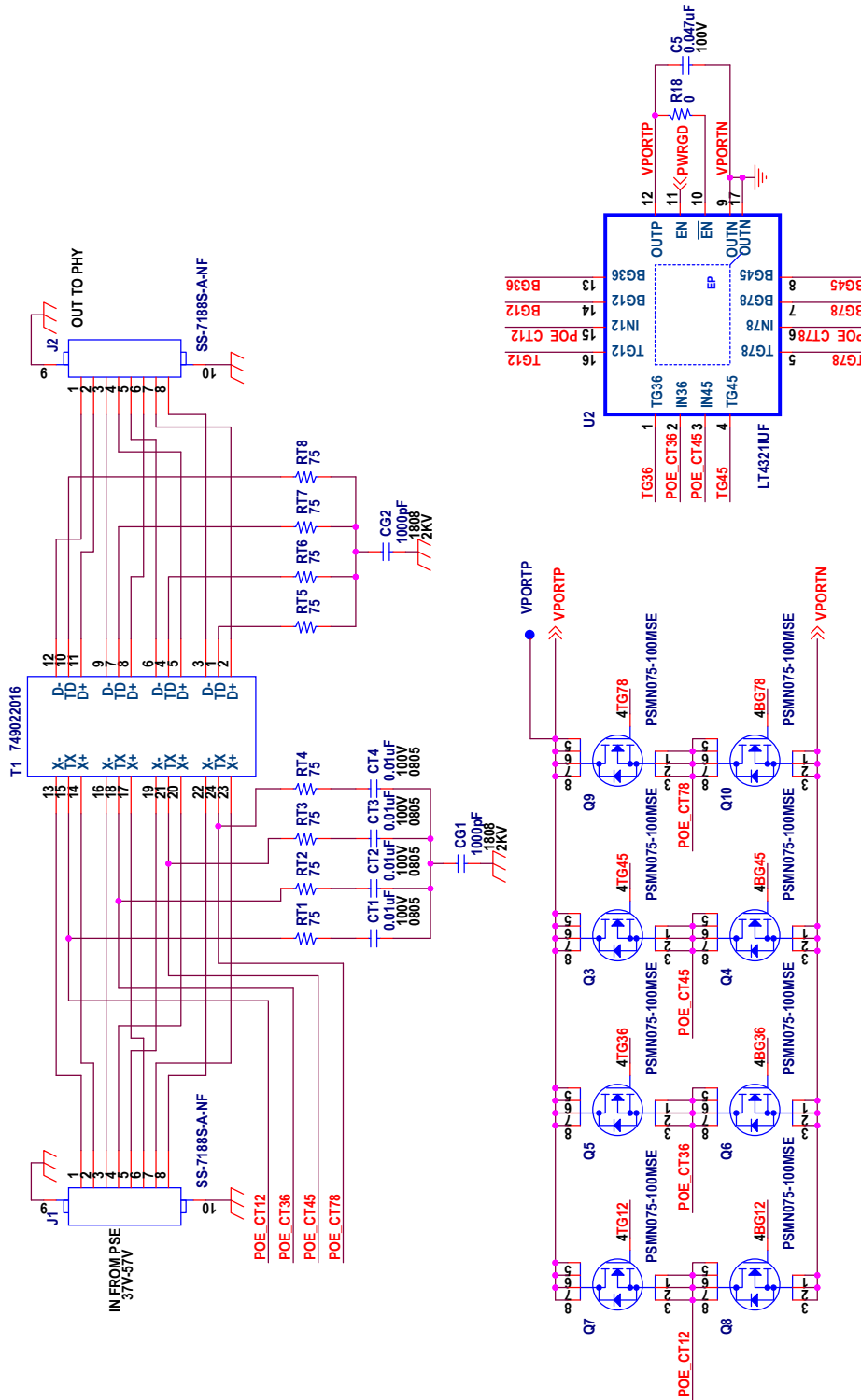
SIZE	IC NO.	REV.
N/A	LT4294IDD, LT4321IUF	1
DATE:	Wednesday, May 24, 2017	SHEET 1 OF 2

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**NOTE 1: UNLESS OTHERWISE SPECIFIED**  
 1. ALL RESISTORS AND CAPACITORS ARE 0805  
 2. ALL RESISTORS TOLERANCE RATING ARE 5%



**SCHEMATIC DIAGRAM**



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		TITLE: SCHEMATIC <b>IEEE 802.3bt POWERED DEVICE</b>	
APPROVALS	PCB DES.	IC NO.	REV.
KAWING H.	KAWING H.	N/A	1
APP ENG.	APP ENG.	LT4294IDD, LT4321IUF	DEMO CIRCUIT 2583A
SCALE = NONE		DATE:	WEDNESDAY, MAY 24, 2017
CUSTOMER NOTICE LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS. HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE. CONTACT YOUR LOCAL SALES REPRESENTATIVE FOR TECHNOLOGY APPLICATIONS ENGINEERING ASSISTANCE.		THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.	

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# DEMO MANUAL DC2583A

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