

LT4295, LT4321

High Efficiency IEEE 802.3bt (PoE++, Type 4, 71W) PD with Forward DC/DC Converter

DESCRIPTION

Demonstration circuit 2584A is an IEEE 802.3bt (Draft 2.1) compliant Power over Ethernet (PoE) Powered Device (PD). It features the **LT[®]4295** PD interface and switching regulator controller and the **LT4321** PoE ideal diode bridge controller.

The LT4295 provides IEEE 802.3af (PoE, Type 1), IEEE 802.3at (PoE+, Type 2), and IEEE 802.3bt (PoE++, Type 3 and 4) compliant interfacing and power supply control. It utilizes an external, low $R_{DS(on)}$ (30m Ω typical) N-channel FET for the hot swap function to improve efficiency. The LT4295 controls a DC/DC converter that utilizes a highly efficient active-clamp forward converter topology with synchronous rectification.

The LT4321 controls eight low $R_{DS(on)}$ (30m Ω 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 DC2584A-A accepts up to 71W of delivered power from a Power Sourcing Equipment (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. The DC2584A-A supplies a 12V output at up to 5.5A.

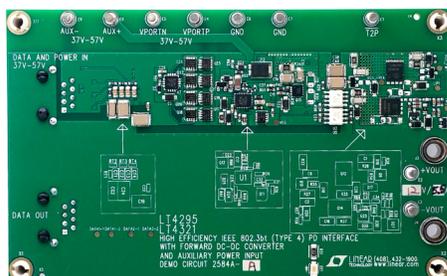
Design files for this circuit board are available at <http://www.linear.com/demo/DC2584A-A>

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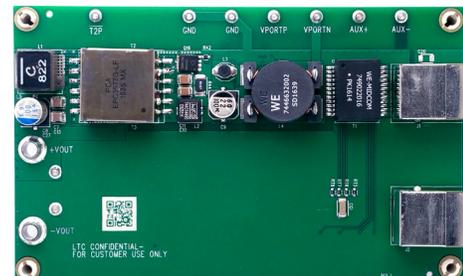
PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{PORT}	Port Voltage	At RJ45	37		57	V
	Auxiliary Voltage	From AUX ⁺ to AUX ⁻ Terminals	37		57	V
V_{OUT}	Output Voltage			12		V
I_{OUT}	Output Current				5.5	A
	Output Voltage Ripple	$V_{PORT} = 57\text{V}$, $I_{OUT} = 5.5\text{A}$		45		mV _{p-p}
	Load Regulation			0.05		%
	Efficiency	$V_{PORT} = 41\text{V}$, $I_{OUT} = 5.5\text{A}$, End-to-End		93		%
	Switching Frequency			250		kHz

BOARD PHOTO



Top Side



Bottom Side

TYPICAL PERFORMANCE CHARACTERISTICS

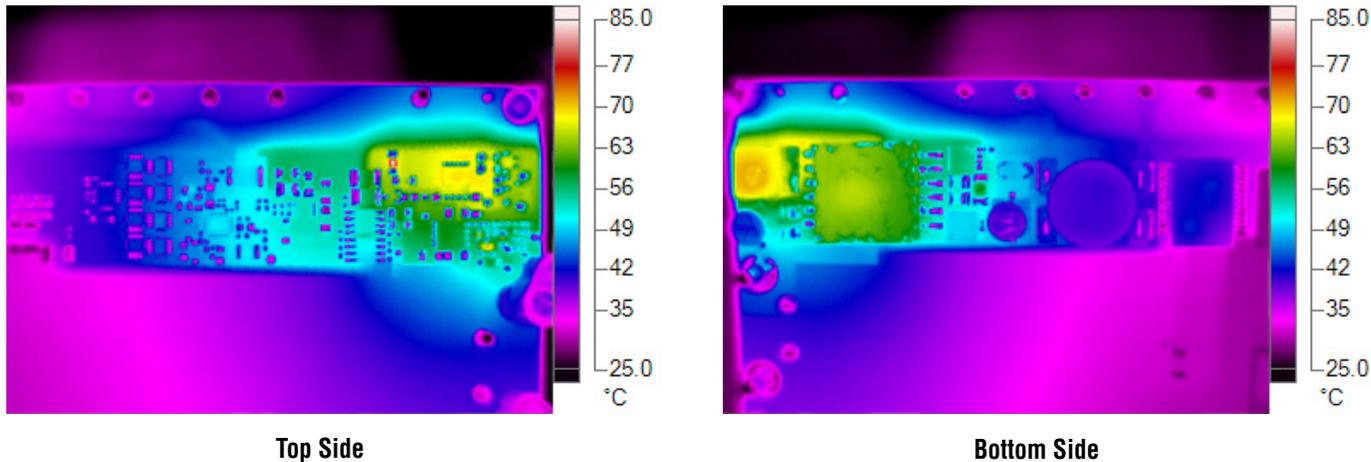


Figure 1. Thermal Pictures (Conditions: $V_{PORT} = 57V$, $V_{OUT} = 12V$, $I_{OUT} = 5.5A$)

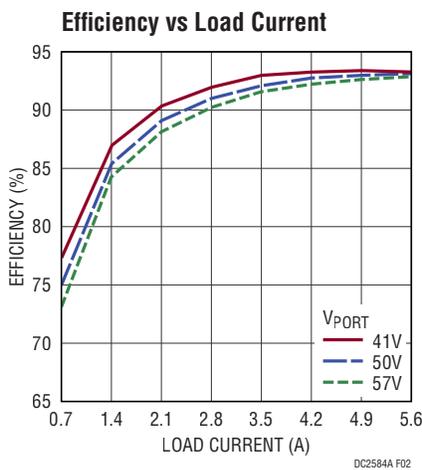


Figure 2. Efficiency (End-to-End)

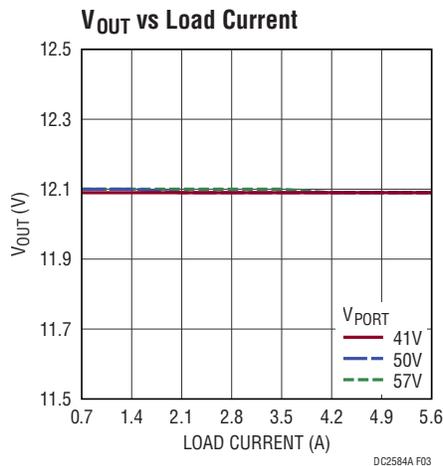


Figure 3. Load Regulation

TYPICAL PERFORMANCE CHARACTERISTICS

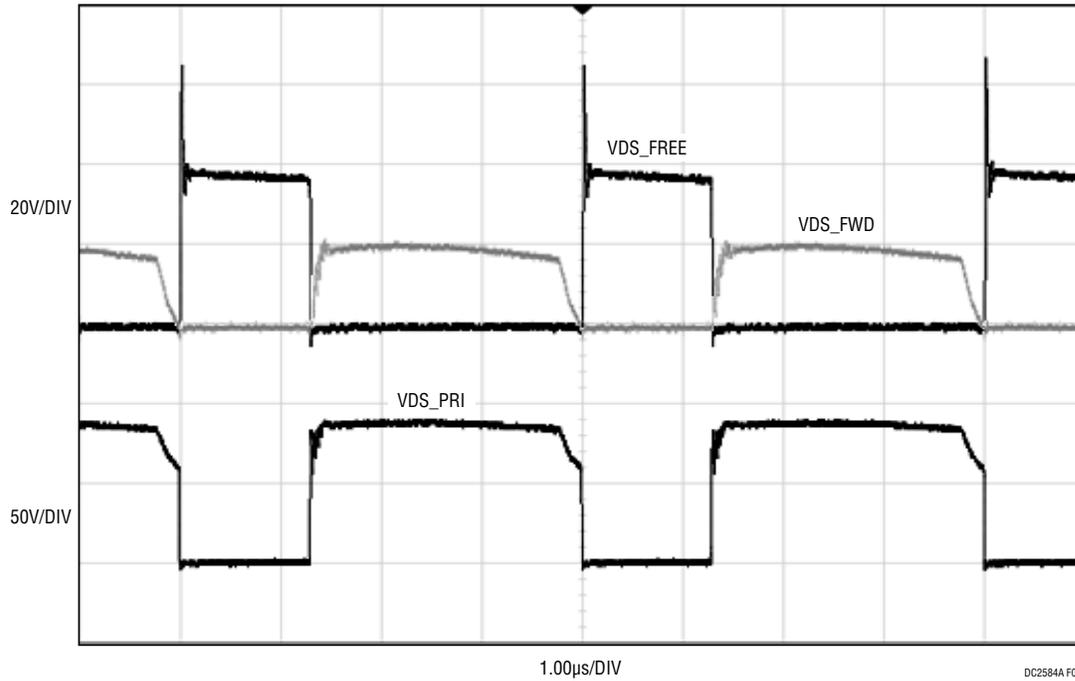


Figure 4. Switch Node Waveforms (Conditions: $V_{PORT} = 57V$, $V_{OUT} = 12V$, $I_{OUT} = 5.5A$)

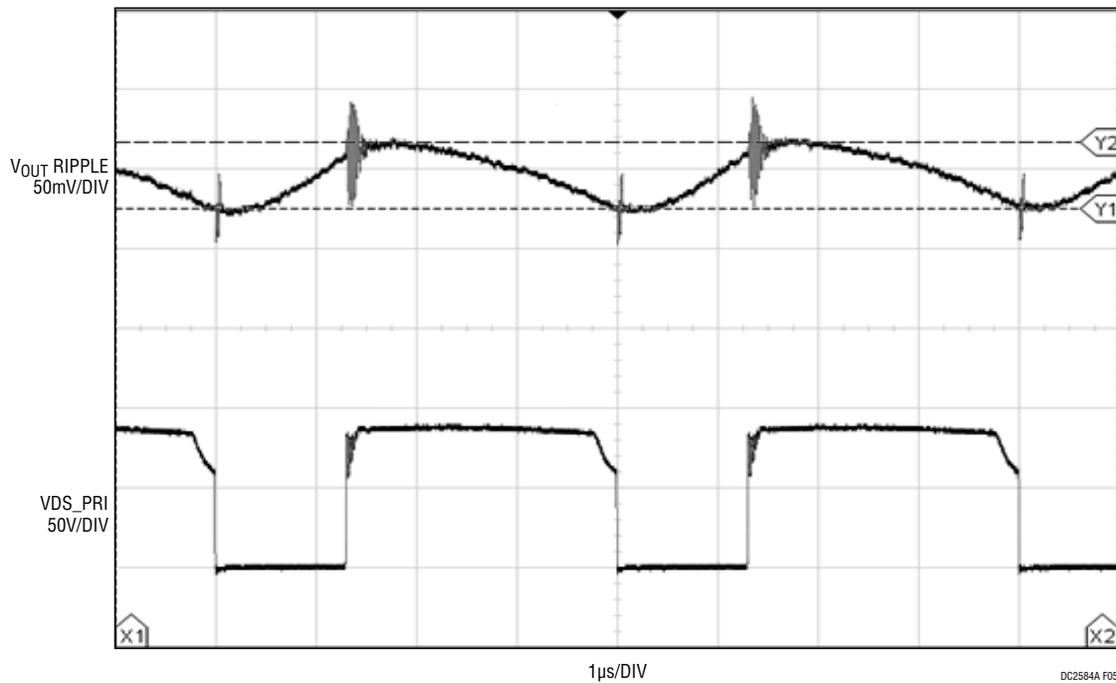


Figure 5. Output Voltage Ripple (Conditions: $V_{PORT} = 57V$, $V_{OUT} = 12V$, $I_{OUT} = 5.5A$)

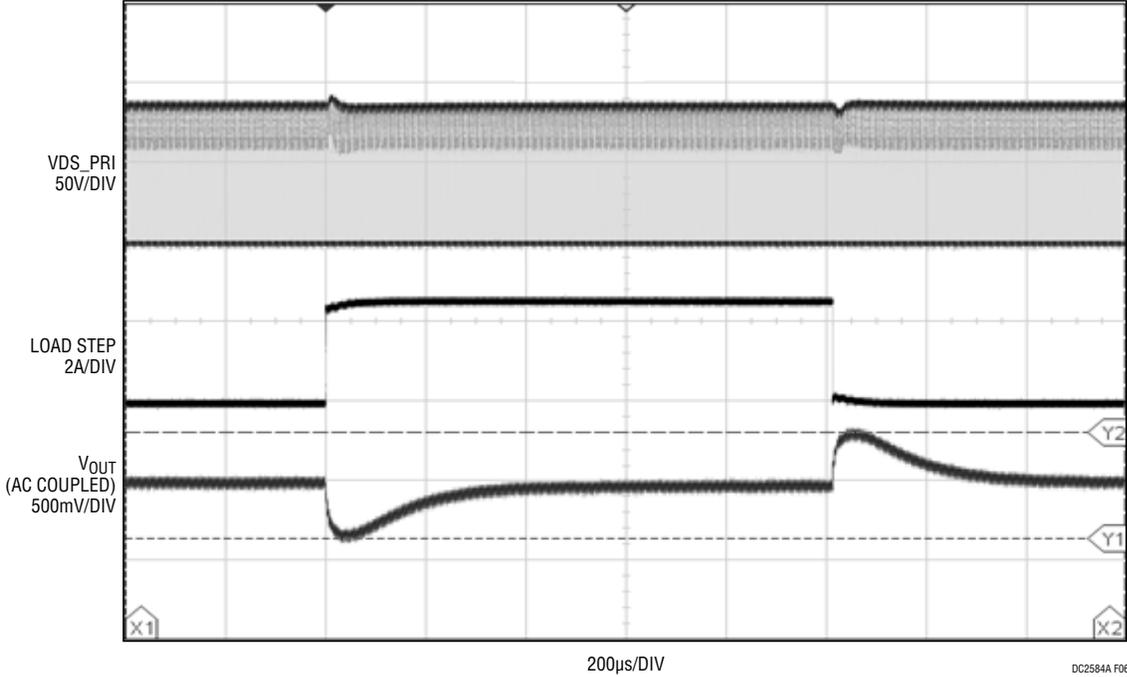


Figure 6. Load Transient Response (Conditions: $V_{PORT} = 57V$, Load Step: 0A to 2.8A with 2.7A DC Load)

QUICK START PROCEDURE

Power Over Ethernet (PoE) Input

1. Disconnect auxiliary supply if it is connected to AUX+ and AUX- inputs of the DC2584A-A.
2. Place and connect test equipment (voltmeter, ammeter, oscilloscope, and electronic load) as shown in Figure 7.
3. Turn down the electronic load to a minimum value and turn off the electronic load.
4. Connect the output of the IEEE 802.3bt compliant PSE to the RJ45 connector (J1) of the DC2584A using a CAT5e or CAT6 Ethernet cable. (See note)
5. After the LED (D21) on the DC2584A is lit, check the output voltage using a voltmeter. Output voltage should be within $12.0V \pm 0.2V$.
6. Turn on the electronic load and increase its load current up to 5.5A. Observe the output voltage regulation, efficiency, and other parameters.
7. Verify $\overline{T2P}$ response with an oscilloscope as shown in Figure 7. The $\overline{T2P}$ response to the type of PSE connected to the DC2584A-A is provided in Table 1.

NOTE: An 802.3bt PSE has not yet been released. In the interim, an LTPoE++[®] compliant PSE (DC1814A-D) may be used to provide power to the DC2584A-A. 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 DC2584A-A is different from the behavior stated in Table 1 and will indicate connection to a Type 2 PSE. Otherwise PD behavior will be unaffected.

Table 1. $\overline{T2P}$ 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 $976Hz \pm 7\%$	51W
	75% Logic High/25% Logic Low, Toggle at $976Hz \pm 7\%$	71W
LTPoE++, 90W	Logic Low	71W

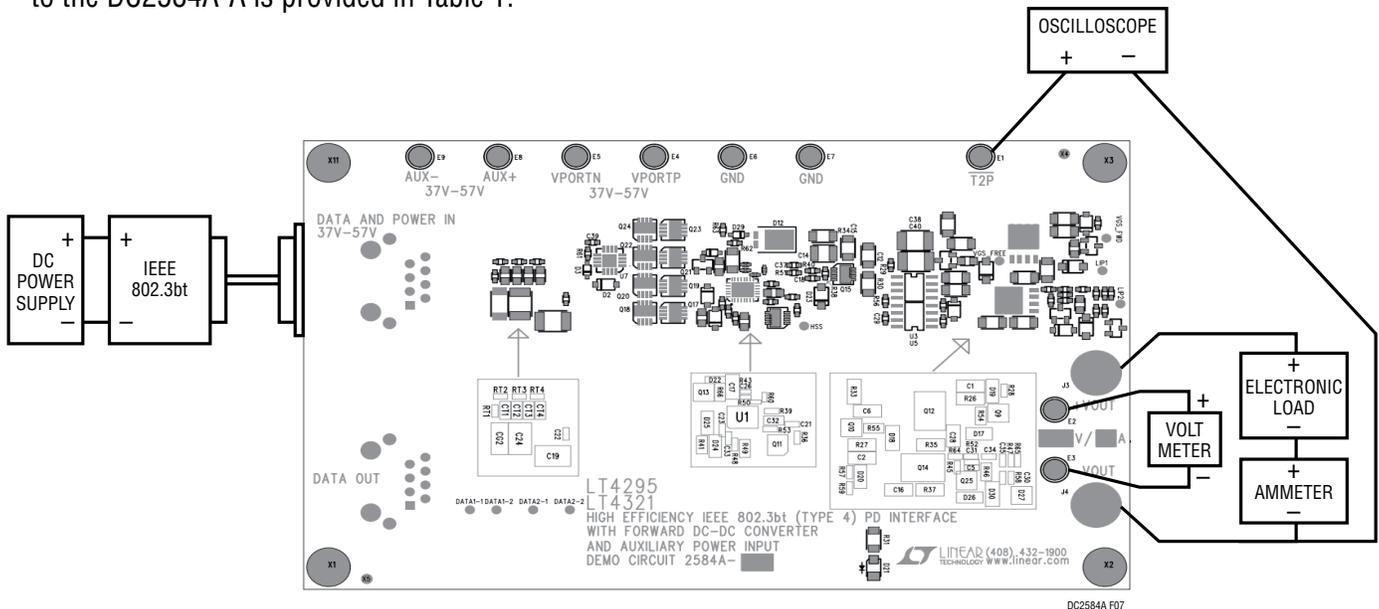


Figure 7. Setup Diagram for PoE Input

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
DC2584A General BOM				
1	2	CG1, CG2	CAP, CER, X7R 1000pF 2kV 10% 1808	MURATA, GR442QR73D102KW01L
2	4	CT1, CT2, CT3, CT4	CAP, CER, X7R 0.01µF 100V 20% 0805	MURATA, GRM21BR72A103MA01L
3	1	C9	CAP, ELEC, 22µF 100V 20% 8 X 10.2	SUNCON, 100CE22KX
4	2	C10, C11	CAP, CER, X7R 2.2µF 100V 10% 1210	MURATA, GRM32ER72A225KA35
5	0	C20	CAP, CER, X7R OPT 250V 10% 1206	OPT
6	1	C17	CAP, CER, X7R 10µF 10V 10% 1206	MURATA, GRM31CR71A106KA01
7	4	C5, C18, C29, C31	CAP, CER, X7R 0.1µF 50V 20% 0603	MURATA, GRM188R71H104MA93
8	4	C19, C24, C38, C40	CAP, CER, X7R 2.2nF 2kV 10% 1812	MURATA, GR443QR73D222KW01L
9	1	C21	CAP, CER, X7R 10nF 100V 10% 0603	MURATA, GRM188R72A103KA01D
10	1	C22	CAP, CER, X7R 1nF 100V 10% 0603	MURATA, GRM188R72A102KA01
11	2	C23, C39	CAP, CER, X7R 0.047µF 100V 10% 0603	KEMET, C0603C473K1RACTU
12	0	C26	CAP, CER, X7R OPT 50V 20% 0402	OPT
13	1	C33	CAP, CER, X7R 100pF 50V 10% 0603	AVX, 06035C101KAT2A
14	1	C37	CAP, CER, X7R 100pF 50V 10% 0603	AVX, 06035C101KAT2A
15	3	D2, D24, D25	DIODE, TVS, PTVS58VS1UR 58V SOD123	NXP, PTVS58VS1UR
16	1	D3	DIODE, ZENER, MMSZ5252BS 24V SOD323	DIODES INC, MMSZ5252BS
17	1	D12	DIODE, SCHOTTKY, PDS5100H 100V PowerDI5	DIODES INC, PDS5100H
18	1	D21	DIODE, LED, 1208, GREEN	ROHM, SML-010FTT86L
19	1	D22	DIODE, SILICON, BAV19WS 120V SOD-323	DIODES INC., BAV19WS
20	1	D23	DIODE, SCHOTTKY, CMMSH1-40L 40V SOD-123F	CENTRAL SEMI., CMMSH1-40L
21	1	D27	IC, REFERENCE, ZR431F01TA SOT23	DIODES INC, ZR431F01TA
22	1	D29	DIODE, SCHOTTKY, BAT54WS 30V SOD323	DIODE INC, BAT54WS
23	9	E1, E2, E3, E4, E5, E6, E7, E8, E9	TP, TURRET, PAD150-094 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
24	2	J1, J2	CONN, RJ-45, SS-6488-NF-K1	STEWART CONNECTOR, SS-6488-NF-K1
25	2	J3, J4	CONN, BANANA, 575-4 0.175"	KEYSTONE, 575-4
26	1	L3	IND, 100µH DO1608	COILCRAFT, DO1608C-104
27	1	L4	IND, CMC, 2.2mH WE-LF	WURTH ELEKTRONIK, 7446632002
28	1	Q11	MOSFET, N-CH, PSMN040-100MSE 100V LFPK33	NXP, PSMN040-100MSE
29	1	Q13	TRANSISTOR, PNP, FM723 100V SOT23	DIODES INC., FM723
30	1	Q15	MOSFET, P-CH, FDMC2523P 150V POWER33	FAIRCHILD, FDMC2523P
31	8	Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24	MOSFET, N-CH, PSMN075-100MSE 100 LFPK33	NXP, PSMN075-100MSE
32	8	RT1, RT2, RT3, RT4, RT5, RT6, RT7, RT8	RES, CHIP, 75Ω 5% 0603	NIC, NRC06J750TRF

DEMO MANUAL DC2584A-A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
33	1	R28	RES, CHIP, 10k 5% 0603	NIC, NRC06J103TRF
34	1	R29	RES, CHIP, 4.7k 5% 0603	NIC, NRC06J472TRF
35	2	R38, R57	RES, CHIP, 10k 5% 0603	NIC, NRC06J103TRF
36	1	R36	RES, CHIP, 3.3k 5% 0603	NIC, NRC06J332TRF
37	3	R40, R42, R65	RES, CHIP, 0 Ω 5% 0603	NIC, NRC06Z0TRF
38	1	R41	RES, CHIP, 8.2 Ω 5% 0805	NIC, NRC10J8R2TRF
39	3	R43, R50, R60	RES, CHIP, 0 Ω 5% 0402	NIC, NRC04Z0TRF
40	1	R51	RES, CHIP, 100k 5% 0603	NIC, NRC06J104TRF
41	1	R53	RES, CHIP, 107k 1% 0603	NIC, NRC06F1073TRF
42	1	R56	RES, CHIP, 750 Ω 5% 0603	NIC, NRC06J751TRF
43	1	R61	RES, CHIP, 0 Ω 5% 0603	NIC, NRC06Z0TRF
44	1	R62	RES, CHIP, 52.3k 1% 0603	NIC, NRC06F5232TRF
45	1	R63	RES, CHIP, 174k 1% 0603	NIC, NRC06F1743TRF
46	1	R66	RES, CHIP, 20 Ω 5% 0805	NIC, NRC06F20R0TRF
47	1	T1	TRANSFORMER, ETHERNET, 749022016	WURTH ELEKTRONIK, 749022016
48	0	T1 (ALTERNATE)	TRANSFORMER, ETHERNET, ETH1-460LD	COILCRAFT, ETH1-460LD
49	0	T1 (ALTERNATE)	TRANSFORMER, ETHERNET, EPG4260S-LF	PCA, EPG4260S-LF
50	2	U3, U5	OPTO, MOC207M SOIC-8	FAIRCHILD, MOC207M
51	1	U7	IC, PoE IDEAL DIODE BRIDGE CONTROLLER, LT4321IUF QFN16	LINEAR TECH., LT4321HUF
52	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON, .625"	KEYSTONE, 8834
53	2		STENCIL (TOP & BOTTOM)	STENCIL, DC2584A

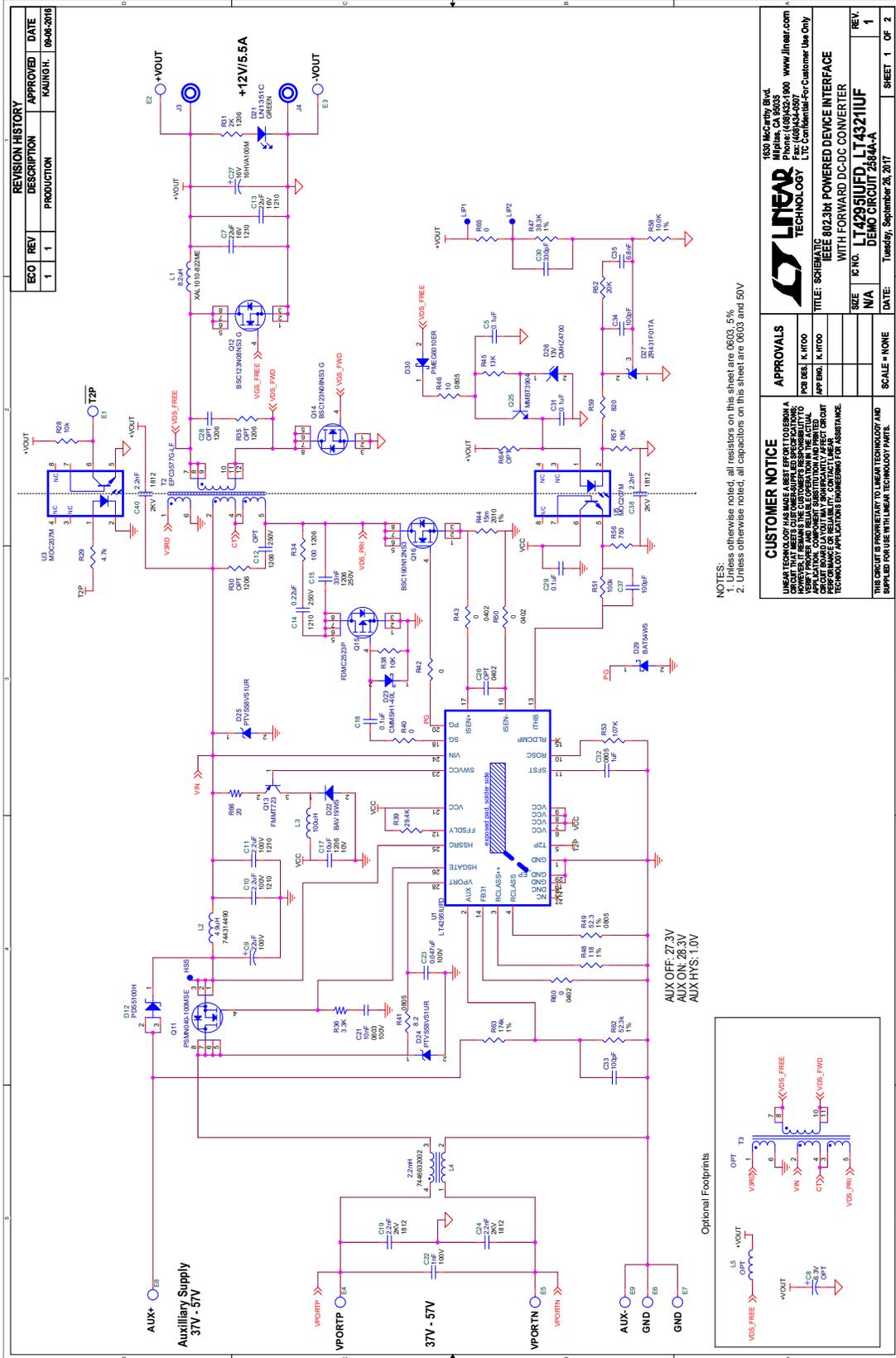
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
DC2584A-A				
1	2	C1, C2	CAP, CER, NP0/COG 100pF 100V 1206	AVX, 12061A101KAT2A
2	0	C16	CAP, CER, X7R OPT 1206	OPT
3	1	C6	CAP, CER, NP0/COG 820pF 100V 1206	AVX, 12061A821JAT2A
4	2	C7, C13	CAP, CER, X5R 22µF 16V 20% 1210	MURATA, GRM32ER61C226ME20
5	0	C8	CAP, ELEC, OPT 6.3 X 6.0	OPT
6	0	C12, C28	CAP, CER, X7R OPT 1206	OPT
7	1	C14	CAP, CER, X7R 0.22µF 250V 10% 1210	MURATA, GRM32DR72E224KW01
8	1	C15	CAP, CER, X5R 33nF 250V 1206	MURATA, GRM31CR72E333KW03
9	1	C27	CAP, ELEC, 100µF 16V 20% 8 X 10.5	SUNCON, 16HVA100M
10	1	C30	CAP, CER, X7R 330pF 50V 10% 0603	AVX, 06035A331KAT2A
11	1	C32	CAP, CER, X7R 1µF 10V 10% 0805	MURATA, GRM21BR71A105KA01L
12	1	C34	CAP, CER, X7R 100pF 50V 10% 0603	AVX, 06035C101KAT2A
13	1	C35	CAP, CER, X7R 6.8nF 50V 10% 0603	MURATA, GRM188R71H682KA01D
14	1	D26	DIODE, ZENER, CMHZ4700 13V SOD-123	ON-SEMI, MMSZ4700T1G
15	2	D17, D18	DIODE, SCHOTTKY, CMMSH1-100 100V SOD-123F	CENTRAL SEMI., CMMSH1-100
16	2	D19, D20	DIODE, ZENER, CMHZ5236B 7.5V SOD-123	CENTRAL SEMI., CMHZ5236B
17	1	D30	DIODE, SCHOTTKY, PMEG6010ER 60V SOD-123W	NXP ,PMEG6010ER
18	1	L1	IND, 8.2µH XAL1010-822ME	COILCRAFT, XAL1010-822ME
19	0	L1 (ALTERNATE)	IND, 8.2µH 74439369082	WURTH ELEKTRONIK, 74439369082
20	1	L2	IND, 4.9µH 744314490	WURTH ELEKTRONIK, 744314490
21	0	L5	IND, OPT	OPT
22	2	Q9, Q10	TRANSISTOR, NPN, FMMT624 50V SOT23	DIODES INC., FMMT624
23	2	Q12, Q14	MOSFET, N-CH, BSC123N08NS3 80V PG-TDSON-8	INFINEON, BSC123N08NS3
24	1	Q16	MOSFET, N-CH, BSC190N12NS3 120V PG-TDSON-8	INFINEON, BSC190N12NS3
25	1	Q25	TRANSISTOR, NPN, MMBT3904 40V SOT23	DIODES INC., MMBT3904
26	2	R26, R27	RES, CHIP, 5.1k 5% 1206	NIC, NRC12J512TRF
27	1	R52	RES, CHIP, 20k 5% 0603	NIC, NRC06J203TRF
28	0	R30	RES, CHIP, OPT 5% 1206	OPT
29	1	R31	RES, CHIP, 2k 5% 1206	NIC, NRC12J202TRF
30	0	R35	RES, CHIP, OPT 5% 1206	OPT
31	1	R33	RES, CHIP, 7.5Ω 5% 1/2W 1206	PANASONIC, ERJ-8BQJ7R5V
32	1	R34	RES, CHIP, 100Ω 5% 1206	NIC, NRC12J101TRF
33	0	R37	RES, CHIP, OPT 5% 1206	OPT

DEMO MANUAL DC2584A-A

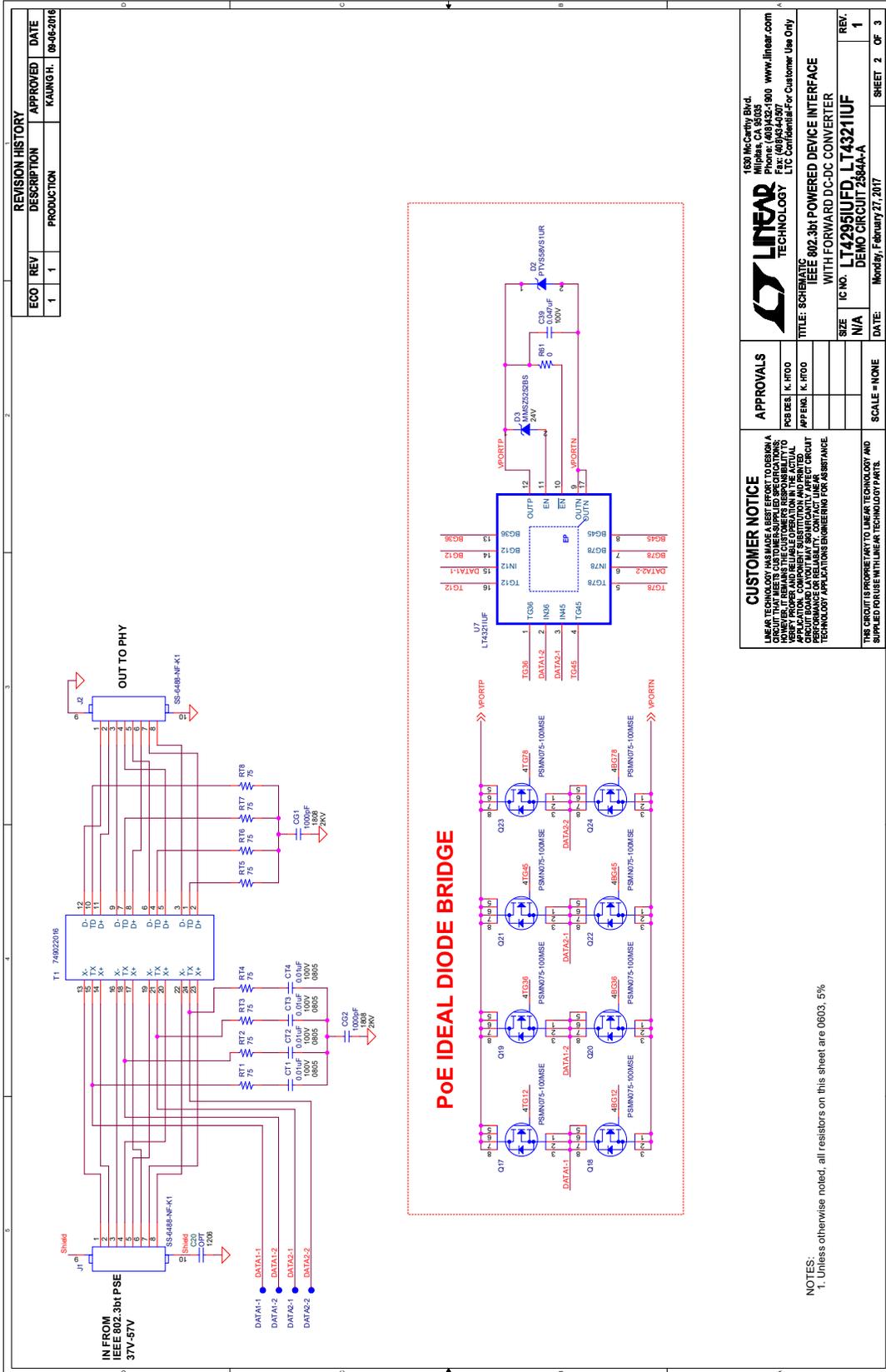
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34	1	R39	RES, CHIP, 29.4k 1% 0603	VISHAY, CRCW060329K4FKEA
35	1	R44	RES, CHIP, 15m 1% 2010	VISHAY, WSL2010R0150FEA
36	1	R45	RES, CHIP, 13k 5% 0603	NIC, NRC06J133TRF
37	1	R46	RES, CHIP, 10 Ω 5% 0805	NIC, NRC06J100TRF
38	0	R64	RES, CHIP, OPT 5% 0603	OPT
39	1	R47	RES, CHIP, 38.3k 1% 0603	NIC, NRC06F3832TRF
40	1	R48	RES, CHIP, 118 Ω 1% 0603	NIC, NRC06F1180TRF
41	1	R49	RES, CHIP, 52.3 Ω 1% 0805	NIC, NRC10F52R3TRF
42	0	R54, R55	RES, CHIP, OPT 1% 0805	OPT
43	1	R58	RES, CHIP, 10.0k 1% 0603	NIC, NRC06F1002TRF
44	1	R59	RES, CHIP, 820 Ω 5% 0603	NIC, NRC06J821TRF
45	1	T2	TRANSFORMER, FORWARD, EPC3577G-LF EFD20	PCA, EPC3577G-LF
46	0	T3	TRANSFORMER, FORWARD, OPT	OPT
47	1	U1	IC, PD INTERFACE & FORWARD/FLYBACK CONTROLLER, LT4295 QFN28	LINEAR TECH., LT4295IUFD
48	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2584A

SCHEMATIC DIAGRAM

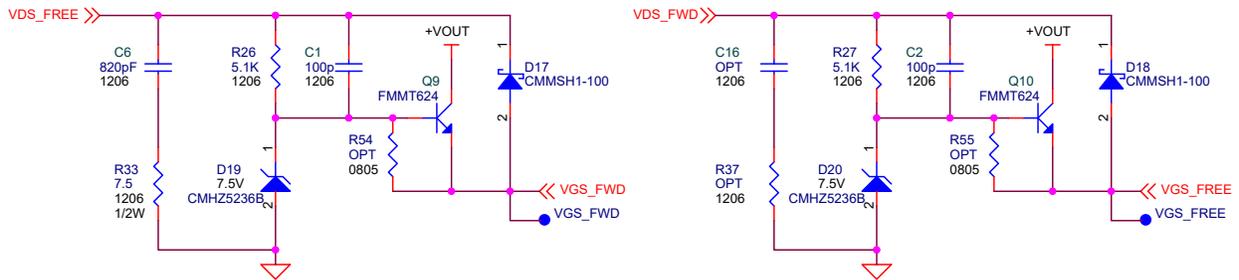


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SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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	PCB DES.	K. HTOO		<p>TITLE: SCHEMATIC</p> <p>IEEE 802.3bt POWERED DEVICE INTERFACE</p> <p>WITH FORWARD DC-DC CONVERTER</p>
	APP ENG.	K. HTOO		
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.	SCALE = NONE	SIZE N/A	IC NO. LT4295IUFD, LT4321IUF DEMO CIRCUIT 2584A-A	REV. 1
		DATE:	Monday, February 27, 2017	SHEET 3 OF 3

DEMO MANUAL DC2584A-A

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- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
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