

## LT4294, LT4321 IEEE 802.3bt Powered Device

### DESCRIPTION

Demonstration circuit 2583 is an Ethernet Alliance™ certified IEEE 802.3bt compliant Power over Ethernet (PoE) powered device (PD). It features the [LT®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  $R_{DS(ON)}$  (57mΩ 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.

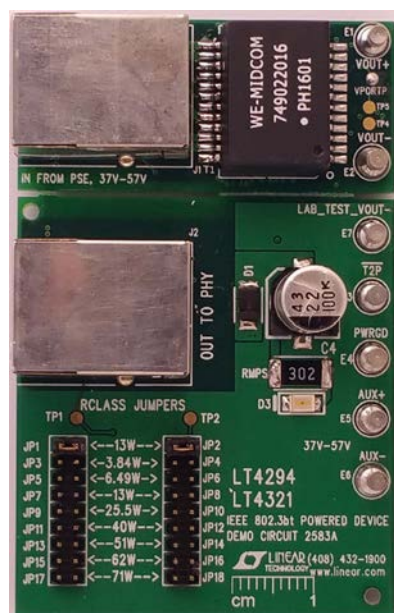
The LT4321 controls eight low  $R_{DS(ON)}$  (57mΩ typical) N-channel FETs to further improve end-to-end power delivery efficiency and ease thermal design. This solution replaces the eight diodes typically found in a passive PoE rectifier bridge.

The DC2583A accepts up to 71.3W 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.

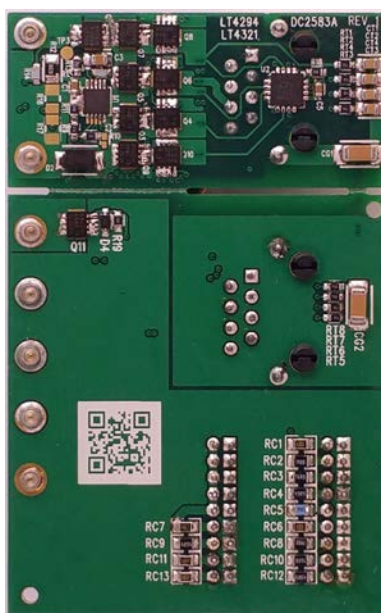
**[Design files for this circuit board are available.](#)**

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### BOARD PHOTO



Top Side



Bottom Side



PERFORMANCE SUMMARY Specifications are at T<sub>A</sub> = 25°C

| PARAMETER                         | CONDITIONS                                       | MIN | TYP  | MAX | UNITS |
|-----------------------------------|--------------------------------------------------|-----|------|-----|-------|
| Port Voltage (V <sub>PORT</sub> ) | At RJ45                                          | 37  |      | 57  | V     |
| Auxiliary Voltage                 | From AUX+ to AUX- Terminals                      | 37  |      | 57  | V     |
| Efficiency                        | V <sub>PORT</sub> = 48V, I <sub>OUT</sub> = 1.2A |     | 99.2 |     | %     |
| T2P Switching Frequency           |                                                  |     | 840  |     | Hz    |

TYPICAL PERFORMANCE CHARACTERISTICS

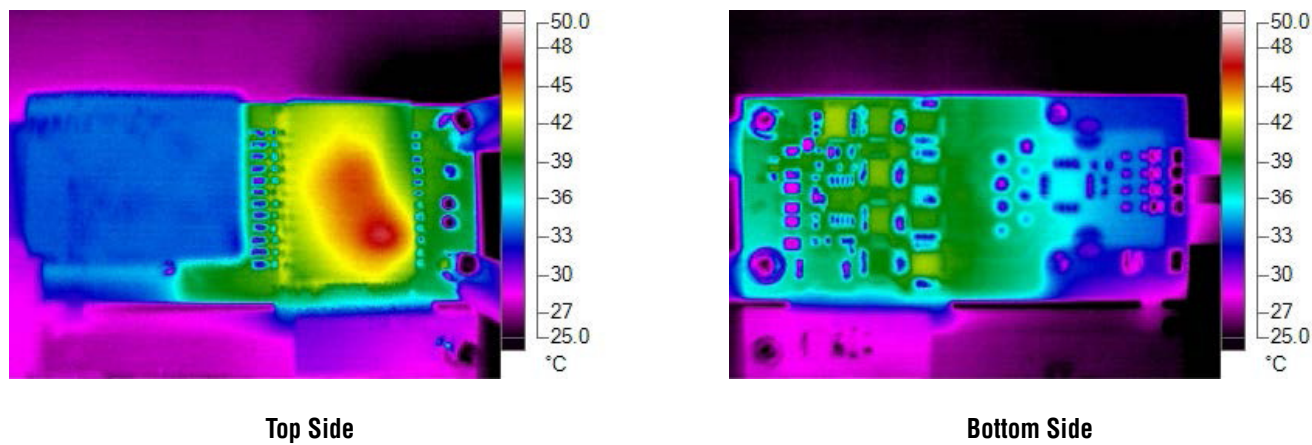


Figure 1. Thermal Pictures (Conditions: V<sub>PORT</sub> = 41.2V, V<sub>OUT</sub> = 40.8V, I<sub>OUT</sub> = 1.72A)

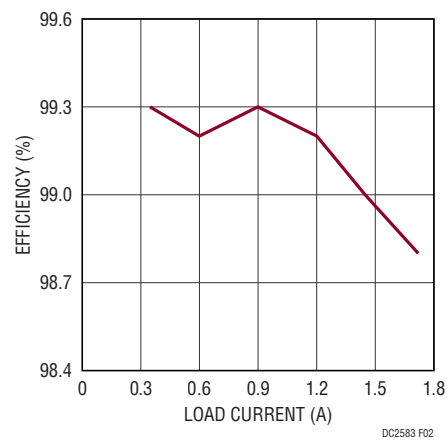


Figure 2. Efficiency (End-to-End)

## QUICK START PROCEDURE

### Power Over Ethernet (PoE) Input

1. Disconnect auxiliary supply if it is connected to AUX+ and AUX– inputs of the 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.

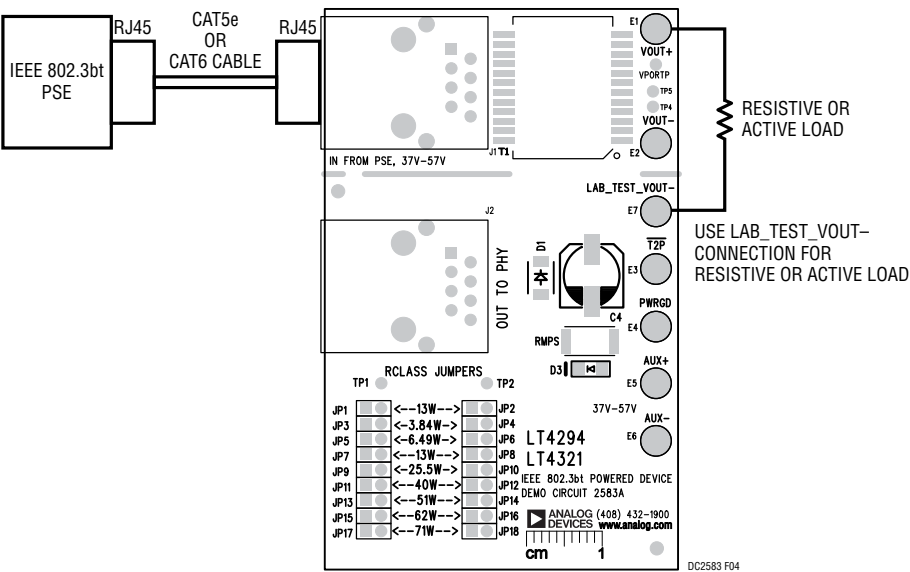
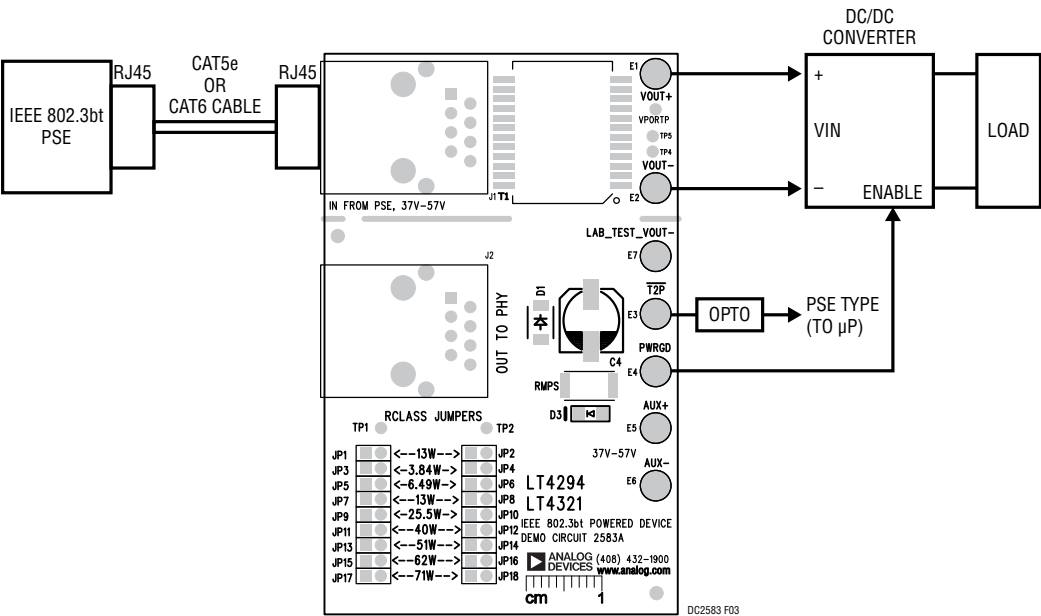
4. Connect the output of the IEEE 802.3bt compliant PSE (see note) to the RJ45 connector (J1) of the DC2583A using a CAT5e or CAT6 Ethernet cable.
5. After connection has been established, verify that the LED (D3) is lit. This indicates the PSE has successfully detected and powered the PD.
6. Verify  $\overline{T2P}$  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



## 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.

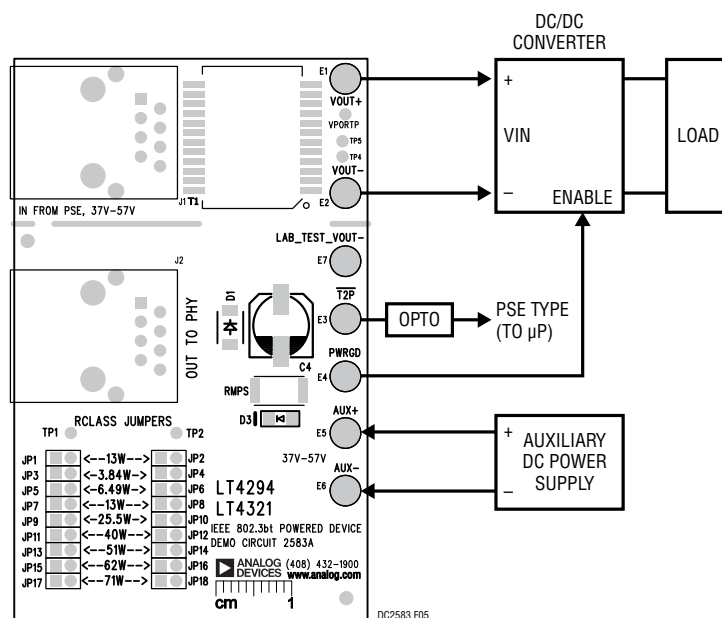


Figure 5. Setup Diagram for Auxiliary Supply Input

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, 0.047μF, X7S, 100V, 10%, 0603                                  | TDK, C1608X7S2A473K080AB         |
| 2                                  | 0   | C2                              | CAP, OPTION, 0402                                                   | OPT                              |
| 3                                  | 1   | C3                              | CAP, 0.047μF, 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 0.01μF 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, 36.6mΩ, 30A, 91W, LFPAK33                       | NEXPERIA, PSMN040-100MSE         |
| 10                                 | 8   | Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10 | MOSFET, N-CH, 100V, 71mΩ, 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., 0Ω, 1/10W, 0603                                               | VISHAY, CRCW06030000Z0EA         |
| 14                                 | 1   | R12                             | RES., 8.2Ω, 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., 140Ω, 1/8W, 1%, 0805                                          | VISHAY, CRCW0805140RFKEA         |
| 20                                 | 2   | RC3, RC10                       | RES., 76.8Ω, 1/8W, 1%, 0805                                         | VISHAY, CRCW080576R8FKEA         |
| 21                                 | 2   | RC4, RC12                       | RES., 49.9Ω, 1/8W, 1%, 0805                                         | VISHAY, CRCW080549R9FKEA         |
| 22                                 | 1   | RC5                             | RES., 34.8Ω, 1/8W, 1%, 0805                                         | VISHAY, CRCW080534R8FKEA         |
| 23                                 | 1   | RC7                             | RES., 37.4Ω, 1/8W, 1%, 0805                                         | VISHAY, CRCW080537R4FKEA         |
| 24                                 | 1   | RC9                             | RES., 46.4Ω, 1/8W, 1%, 0805                                         | PANASONIC, ERJ-6ENF46R4V         |
| 25                                 | 1   | RC11                            | RES., 64.9Ω, 1/8W, 1%, 0805                                         | VISHAY, CRCW080564R9FKEA         |
| 26                                 | 1   | RC13                            | RES., 118Ω, 1/8W, 1%, 0805                                          | VISHAY, CRCW0805118RFKEA         |
| 27                                 | 4   | RT1, RT2, RT3, RT4              | RES., 75Ω, 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                 | ANALOG DEVICES, LT4294IDD#PBF    |
| 32                                 | 1   | U2                              | I.C., PoE IDEAL DIODE BRIDGE CONTROLLER, QFN16-UF, 4mm x 4mm        | ANALOG DEVICES, 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                 |

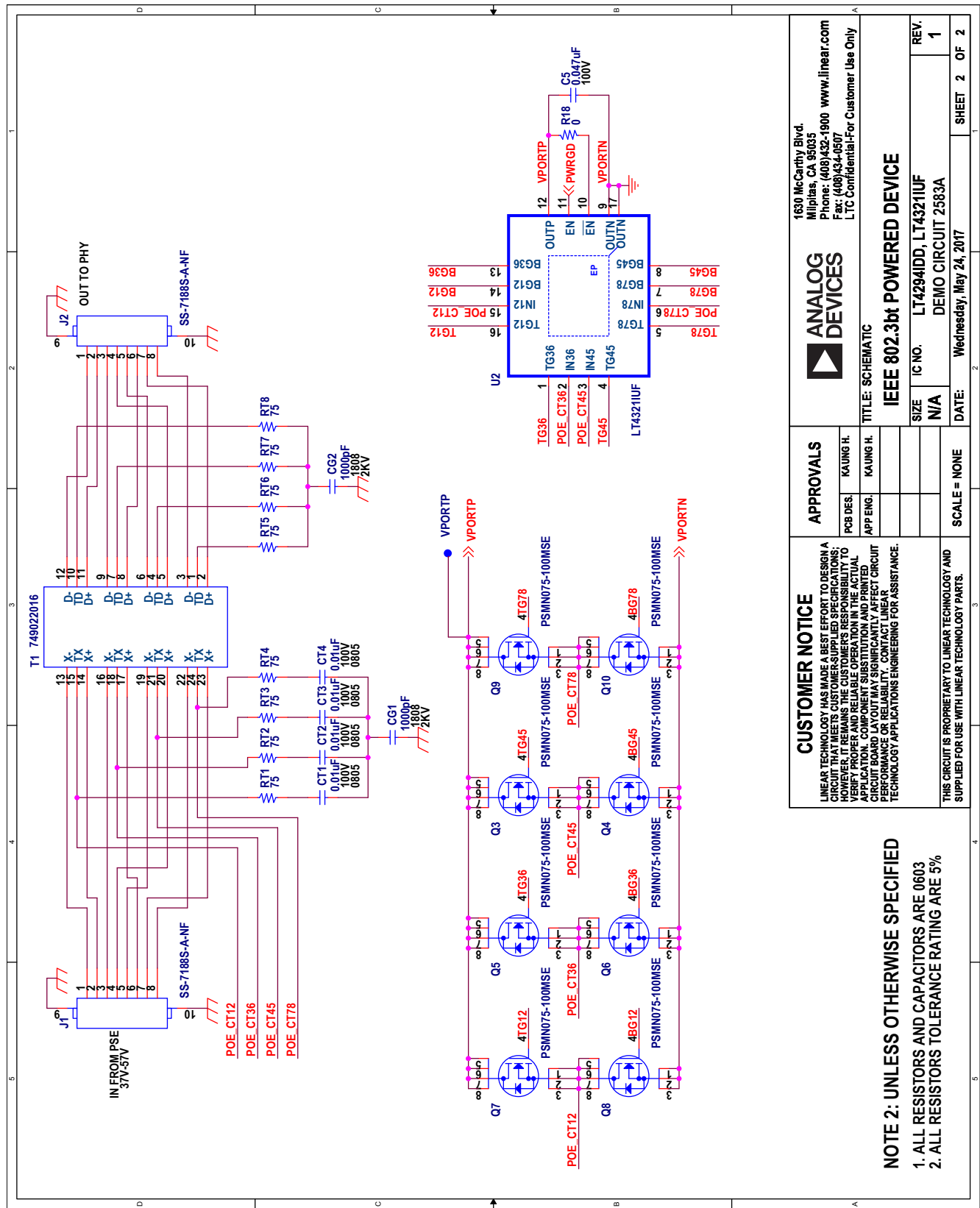
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SCHEMATIC DIAGRAM



# DEMO MANUAL DC2583A

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## 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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Rev A

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