

LT4275/LT4321 LTPoE++/IEEE 802.3at/ IEEE 802.3af Compliant Powered Device Interface

DESCRIPTION

Demonstration circuit 2093A features the [LT[®]4275](#), a fourth generation powered device (PD) controller and the LT4321, an ideal diode bridge controller for Power over Ethernet (PoE) applications.

The DC2093A is available in DC2093A-A, DC2093A-B, and DC2093A-C versions to meet the power level required by the PD application. The DC2093A-A features the LT4275A PD controller. This controller supports the IEEE 802.3at (Type 2, PoE+), IEEE 802.3af (Type 1, PoE) and LTPoE++[™] specifications. LTPoE++ adds four power levels to the existing IEEE standard with 38.7W, 52.7W, 70W, and 90W of delivered PD power at the RJ45 jack. The DC2093A-B features the LT4275B PD controller and is compliant with the IEEE 802.3at and IEEE 802.3af specifications. The DC2093A-C features the LT4275C PD controller and is compliant with the IEEE 802.3af specification.

All three assemblies of the DC2093A include a PoE ideal diode bridge controller, LT4321, and eight N-channel FETs to reduce heat, maximize power efficiency, and increase delivered power compared to a conventional diode bridge rectifier. This controller is designed to be used in PoE applications without corrupting the PD's signature resistance during detection and prevent reverse current during a short at the Ethernet cable.

Many of the main features from the previous generation PD controller are included in the LT4275 PD controller. These include a power good indicator, a power sourcing equipment (PSE) type indicator, and support for an auxiliary power input. The major difference from the previous generation PD controller is that the LT4275 drives an external N-channel Hot Swap[™] FET at the PoE high side voltage rail. This allows the user to choose a low $R_{DS(ON)}$ N-channel MOSFET to maximize power efficiency, reduce heat dissipation, and ease thermal design. An LED status indicator is included to indicate that the Hot Swap FET is fully turned on and the PSE is powering the PD. A sufficient load to sink more than 10mA is also included to assure the PSE maintains power to the PD and to meet the DC maintain power signature current required by the IEEE 802.3at/IEEE 802.3af specification.

Simply connect the output of the DC2093A to the DC/DC converter that is right for the application. Linear Technology offers a variety of DC/DC converter solutions that can be used with the DC2093A (eg DC894, DC1317, etc).

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

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Table 1. Summary of Features Supported by the DC2093A Assemblies

| ASSEMBLY | PoE STANDARD | MAXIMUM POWER LEVEL | POWER GOOD INDICATOR (PWRGD) | PSE TYPE INDICATOR (T2P) | AUXILIARY SUPPLY SUPPORT |
|-----------|------------------------|---------------------|------------------------------|--------------------------|--------------------------|
| DC2093A-A | LTPoE++ PoE+ PoE | 90W | Yes | Yes | No |
| DC2093A-B | PoE+ PoE | 25.5W | Yes | Yes | Yes |
| DC2093A-C | PoE | 13W | Yes | No | Yes |

PERFORMANCE SUMMARY

Table 2. DC2093A Performance Summary

| PARAMETER | CONDITION | VALUE |
|--|--|---|
| PD Input Voltage After Start-Up (V_{PORT}) | At the PD Ethernet Port LTPoE++ 38.7W | 49.8V to 57V |
| | LTPoE++ 52.7W | 47.8V to 57V |
| | LTPoE++ 70W | 45.1V to 57V |
| | LTPoE++ 90W | 41.0V to 57V |
| | IEEE 802.3at (Type 2, 25.5W) | 42.5V to 57V |
| | IEEE 802.3af (Type 1, 13W) | 37V to 57V |
| | Efficiency | DC2093A-A, $V_{PORT} = 48V$, $I_{LOAD} = 1.1A$ |
| DC2093A-B, $V_{PORT} = 48V$, $I_{LOAD} = 600mA$ | | 98.9% (Typical) |
| DC2093A-C, $V_{PORT} = 48V$, $I_{LOAD} = 350mA$ | | 98.5% (Typical) |
| PoE Type Switching Frequency | An LTPoE++ PSE is Powering a DC2093A-A | 840Hz |

THEORY OF OPERATION

When an LTPoE++ PSE is connected to the DC2093A demo board RJ45 connector, J1, via a CAT5e or CAT6 Ethernet cable, the PSE initiates the detection process. During this process, the PoE ideal diode bridge controller is inactive and the body diodes of the PoE ideal diode bridge MOSFETs form a silicon diode bridge. The PD solution presents a 25k resistive load to the PSE. After the PD has passed the detection process, the PSE uses an IEEE 802.3at/IEEE 802.3af or LTPoE++ classification method to determine the power level the PSE can deliver to the PD. The PSE turns on the port and provides power to the PD if the classification is successful. Once the LT4275 detects the PSE has turned on the port, it drives an external N-channel MOSFET to ramp up the output voltage. After a successful PD controller output turn on, the LT4275 drives a power good indicator (PWRGD) and a PSE type indicator ($\overline{T2P}$) (DC2093A-A and DC2093A-B only). The PWRGD indicator signals the load to start drawing current and the LT4321 to turn on the appropriate PoE ideal diode bridge MOSFETs with low $R_{DS(ON)}$ in the high current path. This reduces heat dissipation and increases delivered power compared to the conventional diode bridge. The $\overline{T2P}$ indicator signals the load the type of PSE powering the PD.

Classification Signaling

The resistors at R_{CLS} and R_{CLS++} determine the classification signature and sequence. The DC2093A-A includes user-selectable jumpers to support IEEE 802.3af,

IEEE 802.3at, and LTPoE++ power levels from 3.84W to 90W. Refer to Table 3 for the power levels. If an LTPoE++ power level is selected, an IEEE 802.3af or IEEE 802.3at compliant PSE will classify this PD as a Class 4 PD. The DC2093A-B includes a preselected R_{CLS} resistor to support IEEE 802.3at 2-event classification and this board does not contain jumper blocks. The DC2093A-C includes multiple jumpers to support all IEEE 802.3af power levels. Table 3 shows each shunt position and its associated class number and power level for the DC2093A-A and -C boards. Use Table 3 as a selection guide to choose a suitable power level for the load.

Table 3. DC2093A-A and DC2093A-C Shunt Positions for PoE Power Levels

| ASSEMBLY | PoE CLASS | POWER LEVEL AT THE PD INPUT | RCLASS JUMPERS | |
|----------------|-----------|-----------------------------|----------------|------|
| DC2093A-A & -C | 0 | 13W | JP1 | JP2 |
| DC2093A-A & -C | 1 | 3.84W | JP3 | JP4 |
| DC2093A-A & -C | 2 | 6.49W | JP5 | JP6 |
| DC2093A-A & -C | 3 | 13W | JP7 | JP8 |
| DC2093A-A | 4 | 25.5W | JP9 | JP10 |
| DC2093A-A | 4* | 38.7W | JP11 | JP12 |
| DC2093A-A | 4* | 52.7W | JP13 | JP14 |
| DC2093A-A | 4* | 70W | JP15 | JP16 |
| DC2093A-A | 4* | 90W | JP17 | JP18 |

*An LTPoE++ PD will be classified as Class 4 by an IEEE 802.3at/af compliant PSE.

THEORY OF OPERATION

Power Good Indicator and Power Supply Start-Up

The LT4275 limits the inrush current to the output bulk capacitor by controlling the output voltage slew rate during turn-on. The slew rate is preprogrammed via a resistor and a capacitor at the LT4275 HSGATE pin on the DC2093A to limit the inrush current to the bulk capacitor on board. If more capacitance is desired at the output, refer to Inrush and Powered On section in the LT4275 data sheet to recalculate the inrush current and ensure it is below the IEEE requirement of approximately 100mA. The inrush current limit will cause startup problems if an attached load draws more than 100mA of current during inrush. Therefore, it is strongly recommended to use the PWRGD indicator on the DC2093A to interface to a load such as a DC/DC converter as shown in Figures 1, 2 and 4.

PSE Type Indicator

Refer to Table 4 for the summary of $\overline{T2P}$ indicator signals supported by the DC2093A assembly. The $\overline{T2P}$ signal is valid after PWRGD is active. This indicator is not connected on the DC2093A-C.

Table 4. Summary of $\overline{T2P}$ Signals Supported by the DC2093A Assemblies

| ASSEMBLY | PSE TYPE | $\overline{T2P}$ SIGNAL |
|-----------|-----------------------------|-------------------------|
| DC2093A-A | LTPoE++ | 840Hz, 50% Duty Cycle |
| | IEEE 802.3at (Type 2, PoE+) | Logic Low |
| | IEEE 802.3af (Type 1, PoE) | Logic High |
| DC2093A-B | LTPoE++ | Logic Low |
| | IEEE 802.3at (Type 2, PoE+) | Logic Low |
| | IEEE 802.3af (Type 1, PoE) | Logic High |
| DC2093A-C | Any PSE | Not Supported |

Auxiliary Supply Support

The DC2093A-B and DC2093A-C versions support an auxiliary supply input. The auxiliary supply input has priority over the PoE input. When the PD controller detects a valid voltage from the auxiliary supply input, it turns off the N-channel MOSFET (Q2) to cut the power from the PSE and lets the auxiliary supply take over powering the load. The PSE may detect the disconnected PD and turn off the port. The PWRGD indicator outputs a logic high signal when an auxiliary supply is present. The $\overline{T2P}$ indicator outputs a logic low signal on the DC2093A-B board when an auxiliary supply is present. The auxiliary supply input is an assembly option on the DC2093A-A board.

DC2093A Companion PSE Demo Boards

Linear Technology offers a variety of PSE solutions to evaluate with DC2093A. Refer to Table 5 to select a PSE demo board based on the DC2093A assembly and the application power requirement.

Table 5. Selection of Companion PSE Demo Board depending on the DC2093 Assembly and the PoE Power Level

| DC2093 ASSEMBLY | PoE POWER LEVEL | COMPANION PSE DEMO BOARD |
|-----------------|-----------------|--------------------------|
| DC2093A-A | 90W | DC1814A-D |
| | 70W | DC1814A-C |
| | 52.7W | DC1814A-B |
| | 38.7W | DC1814A-A |
| DC2093A-B | 25.5W | DC1567A |
| DC2093A-C | 13W | DC981A/B |

**Contact Linear for multi-port PSE demo board options.

DC2093A-A QUICK START PROCEDURE

NOTE: Handle the DC2093A-A by the edge of the board.

Power over Ethernet Input

1. Refer to Figure 1 to evaluate the DC2093A-A with a DC/DC converter. If a resistive or an active load is used to evaluate the DC2093A-A, use the setup diagram as shown in Figure 2.
2. Default class select shunt positions are at JP1 and JP2 on the DC2093A-A board. In this configuration, any PSE with enough power will turn on this PD. Choose a power level from Table 3 and select the corresponding shunt positions.
3. Check the power delivery capability of the LTPoE++ PSE to ensure it can power the PD and the load. Do not select a jumper position corresponding to a higher power level than the LTPoE++ PSE can provide. Otherwise, the LTPoE++ PSE will not turn on the PD after classification.
4. Connect the output of the PSE to the RJ45 connector (J1) on the DC2093A-A board with 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

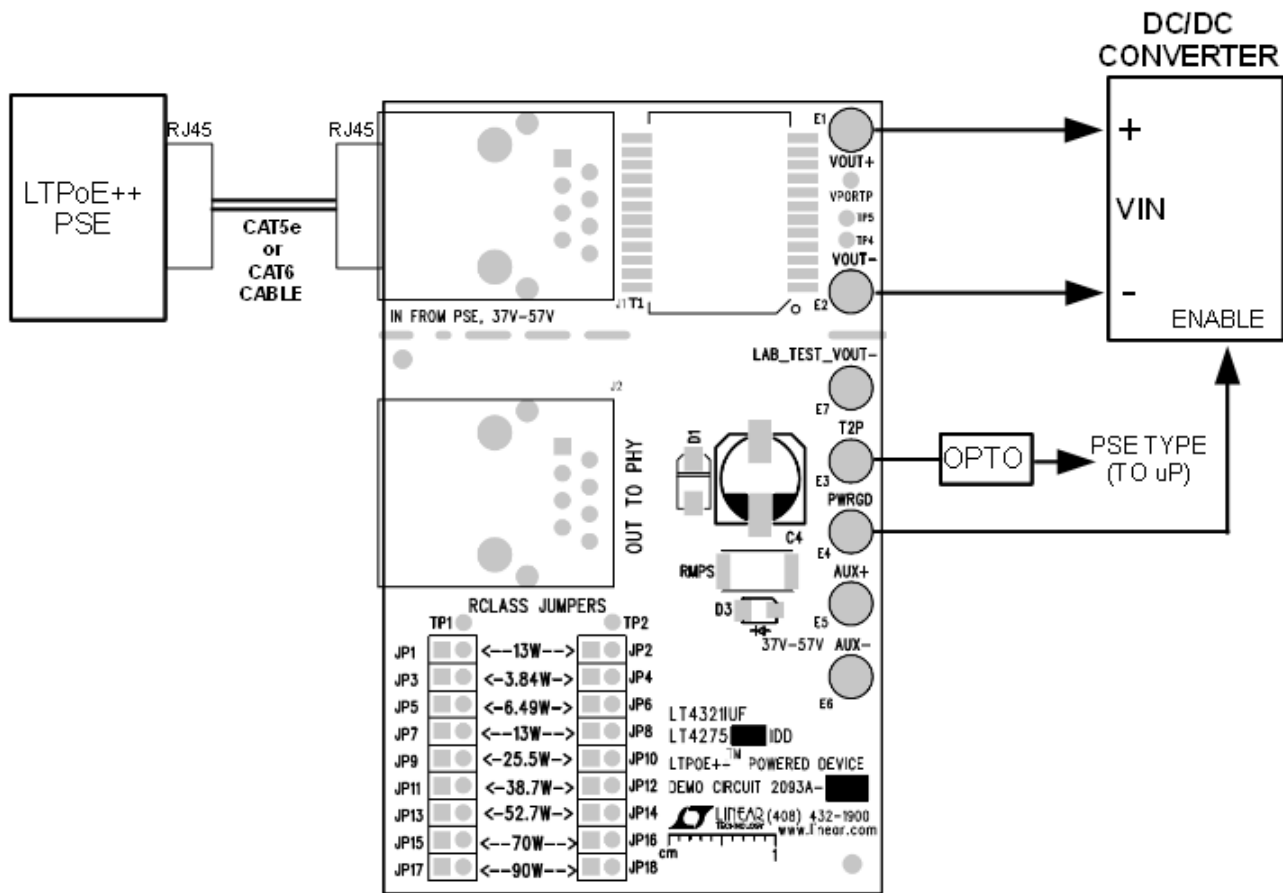


Figure 1. Setup Diagram for the DC2093A-A with a DC-DC Converter, a Microprocessor, and an LTPoE++ PSE

DC2093A-A QUICK START PROCEDURE

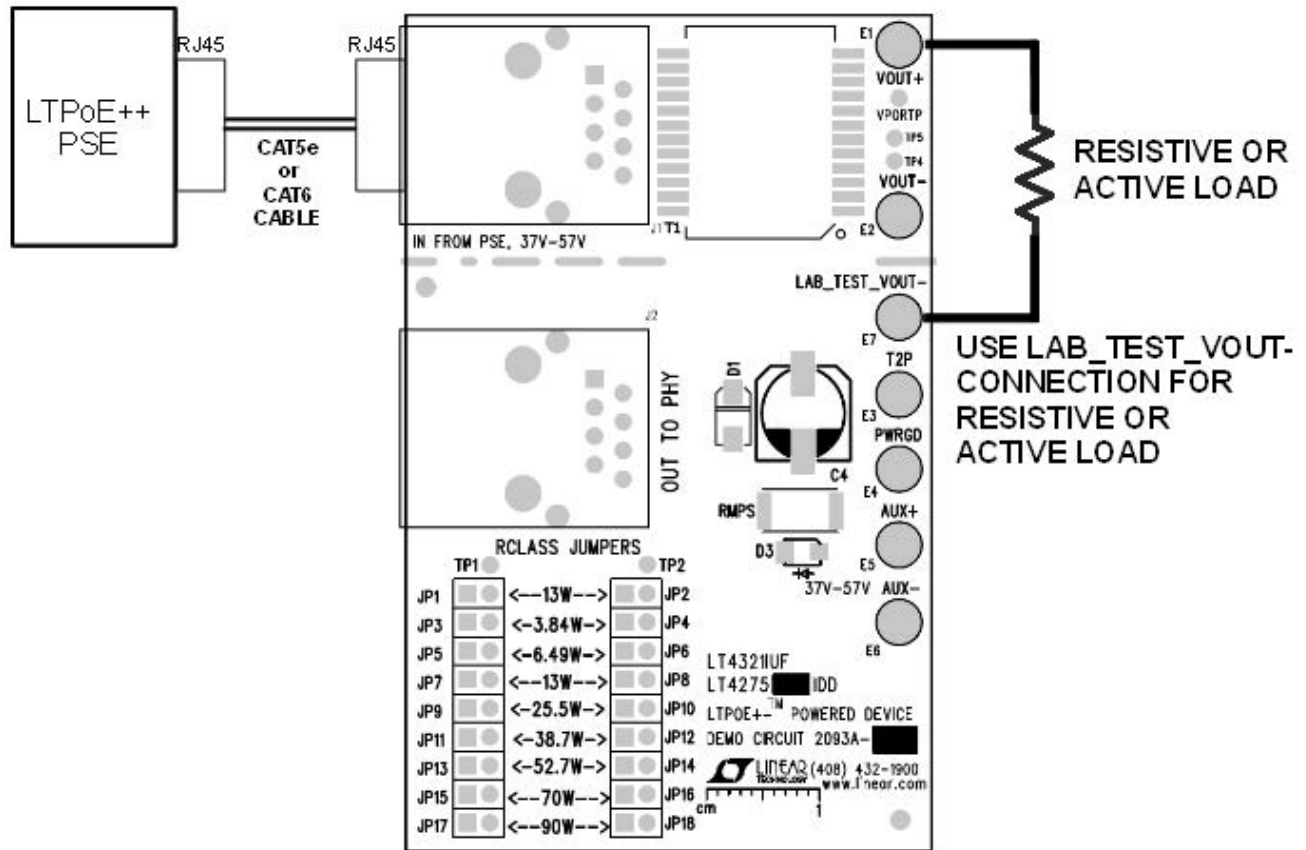


Figure 2. Setup Diagram for DC2093A-A with a Resistive or an Active Load

DC2093A-B QUICK START PROCEDURE

NOTE: Handle the DC2093A-B by the edge of the board.

Power over Ethernet Input

1. Refer to Figure 3 to evaluate the DC2093A-B with a DC/DC converter. If a resistive or an active load is used to evaluate the DC2093A-B, use the setup diagram as shown in Figure 4.
2. Connect the output of the PSE to the RJ45 connector (J1) on the DC2093A-B board with a CAT5e or CAT6 Ethernet cable.
3. After connection has been established, verify that the LED (D3) is lit. This indicates the PSE has successfully detected and powered the PD.

Auxiliary Supply Input

1. Refer to Figure 5 to evaluate the DC2093A-B with a DC/DC converter and an auxiliary DC power supply.
2. Connect the auxiliary supply to the AUX+ to AUX- inputs. Check to make sure the voltage polarity is correct before turning on the auxiliary power supply.
3. Turn on the auxiliary power supply and verify that the LED (D3) is lit.

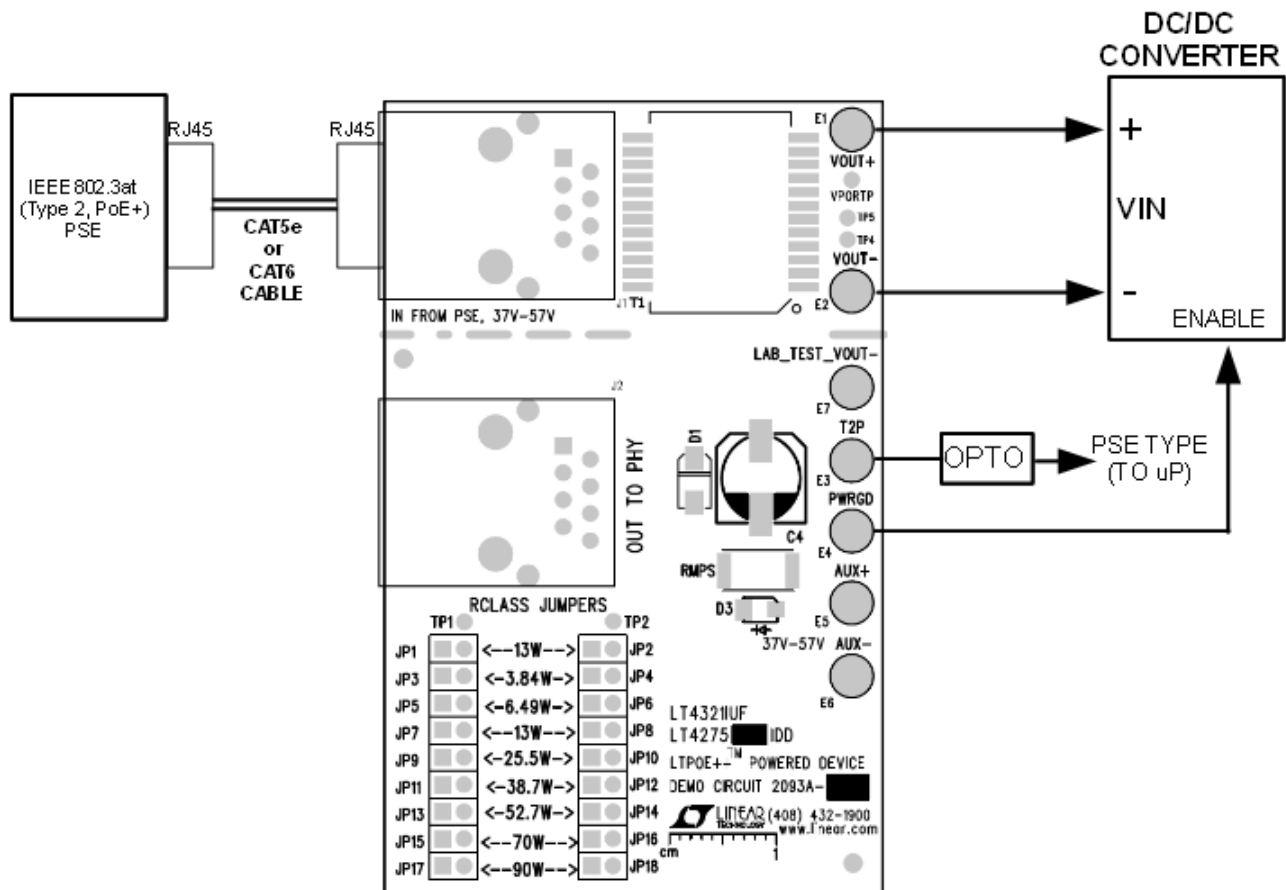


Figure 3. Setup Diagram for the DC2093A-B with a DC/DC Converter, a Microprocessor, and a Type 2 PSE

DC2093A-B QUICK START PROCEDURE

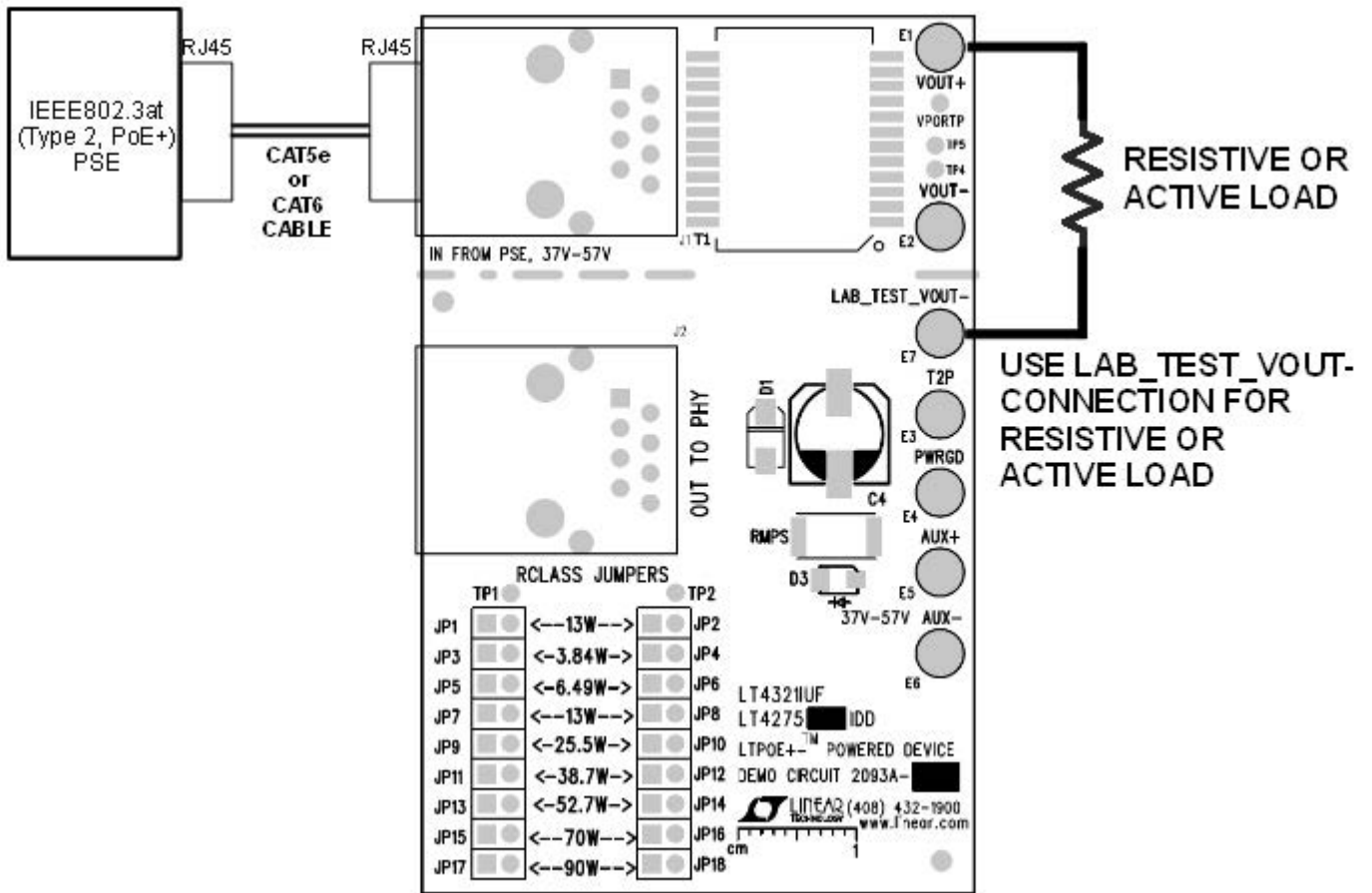


Figure 4. Setup Diagram for DC2093A-B with a Resistive or an Active Load

DC2093A-B QUICK START PROCEDURE

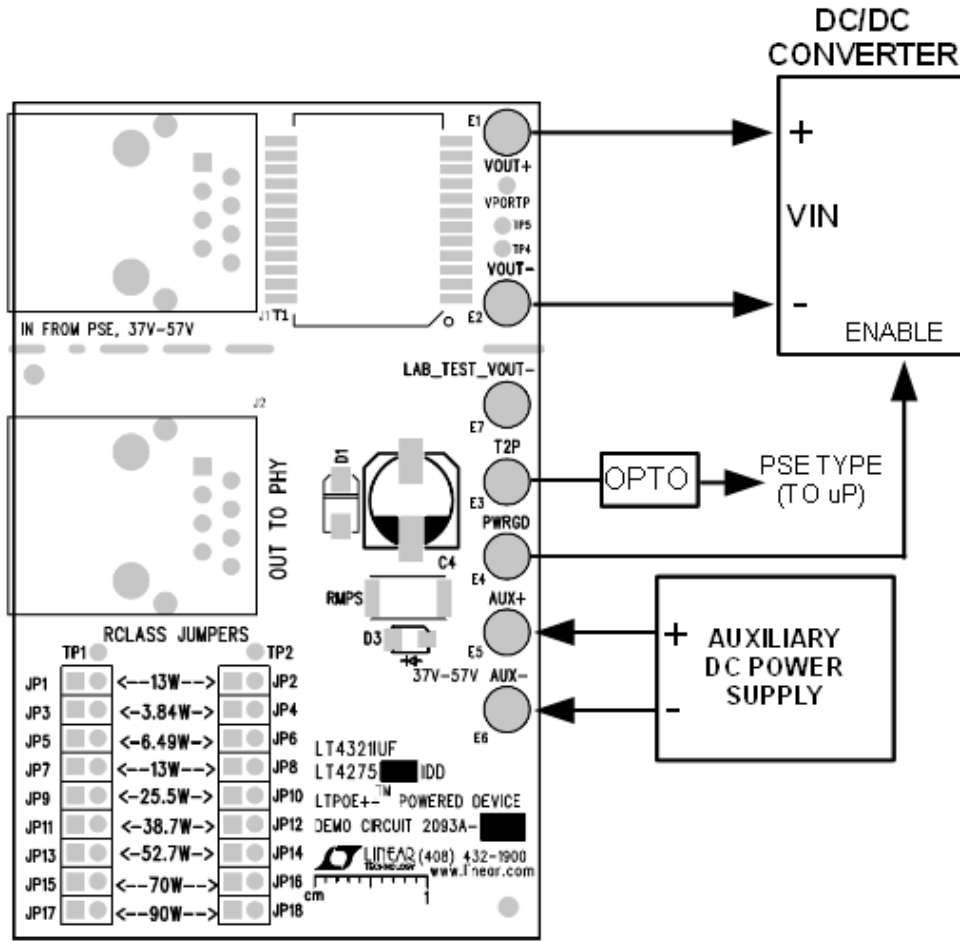


Figure 5. Setup Diagram for the DC2093A-B with a DC/DC Converter

DC2093A-C QUICK START PROCEDURE

NOTE: Handle the DC2093A-C by the edge of the board.

Power over Ethernet Input

1. Refer to Figure 6 to evaluate the DC2093A-C with a DC/DC converter. If a resistive or an active load is used to evaluate the DC2093A-C, use the setup diagram as shown in Figure 7.
2. Connect the output of the PSE to the RJ45 connector (J1) on the DC2093A-C board with a CAT5e or CAT6 Ethernet cable.
3. After connection has been established, verify that the LED (D3) is lit. This indicates the PSE has successfully detected and powered the PD.

Auxiliary Supply Input

1. Refer to Figure 8 to evaluate the DC2093A-C with a DC/DC converter and an auxiliary DC power supply.
2. Connect the auxiliary supply to the AUX+ to AUX- inputs. Check to make sure the voltage polarity is correct before turning on the auxiliary power supply.
3. Turn on the auxiliary power supply and verify that the LED (D3) is lit.

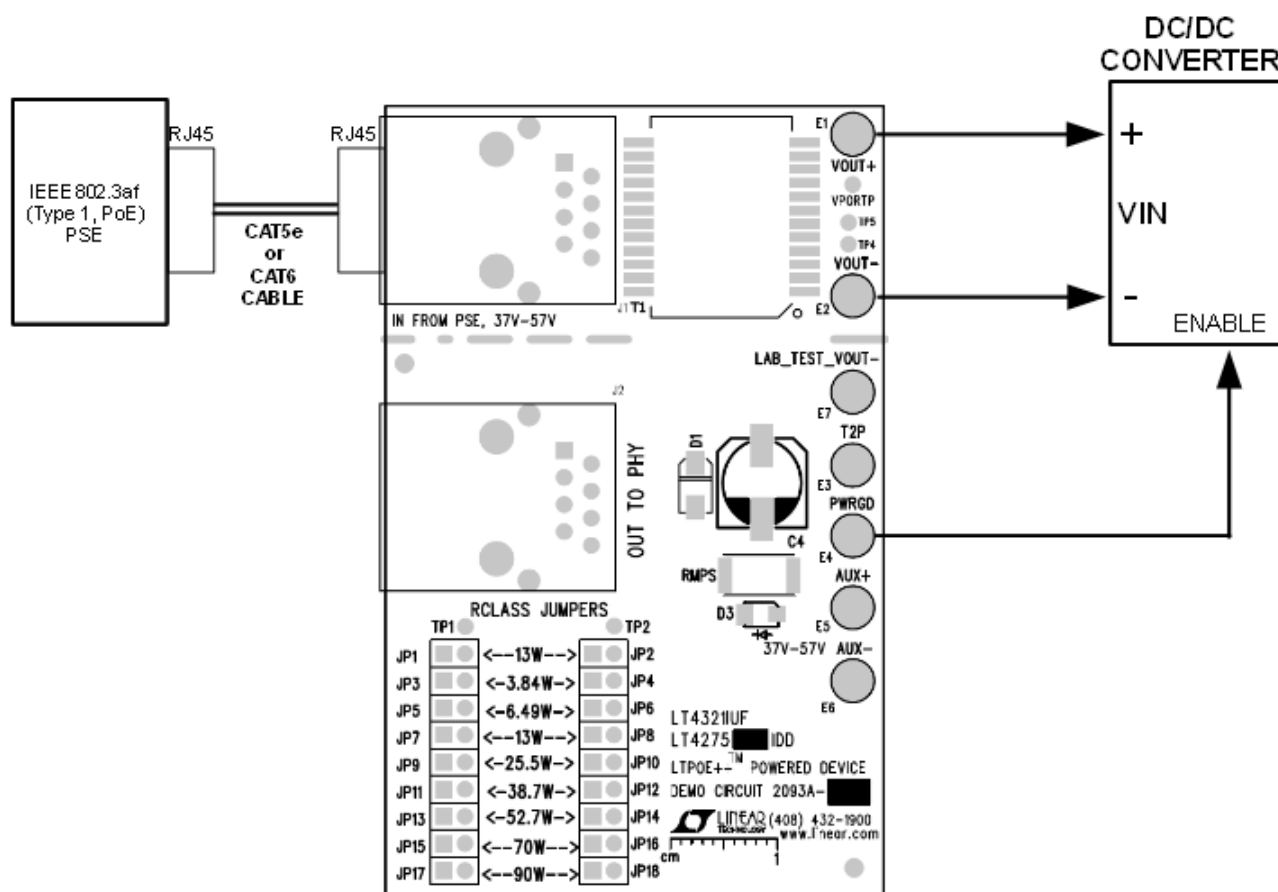


Figure 6. Setup Diagram for the DC2093A-C with a DC/DC Converter and a Type 1 PSE

DC2093A-C QUICK START PROCEDURE

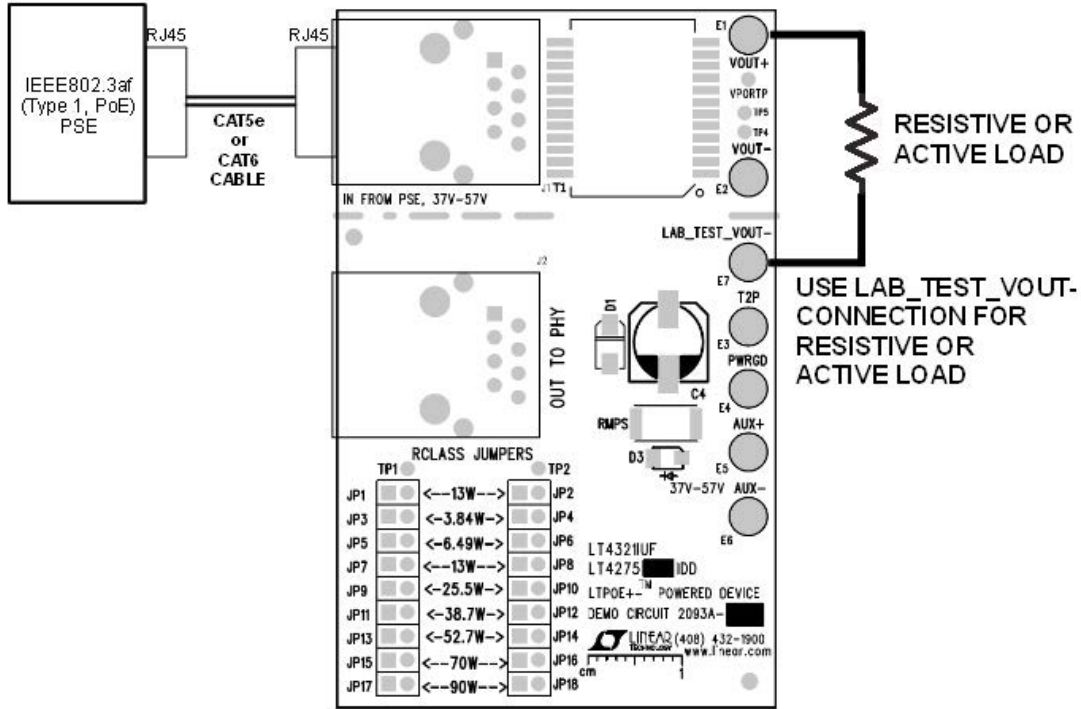


Figure 7. Setup Diagram for DC2093A-C with a Resistive or an Active Load

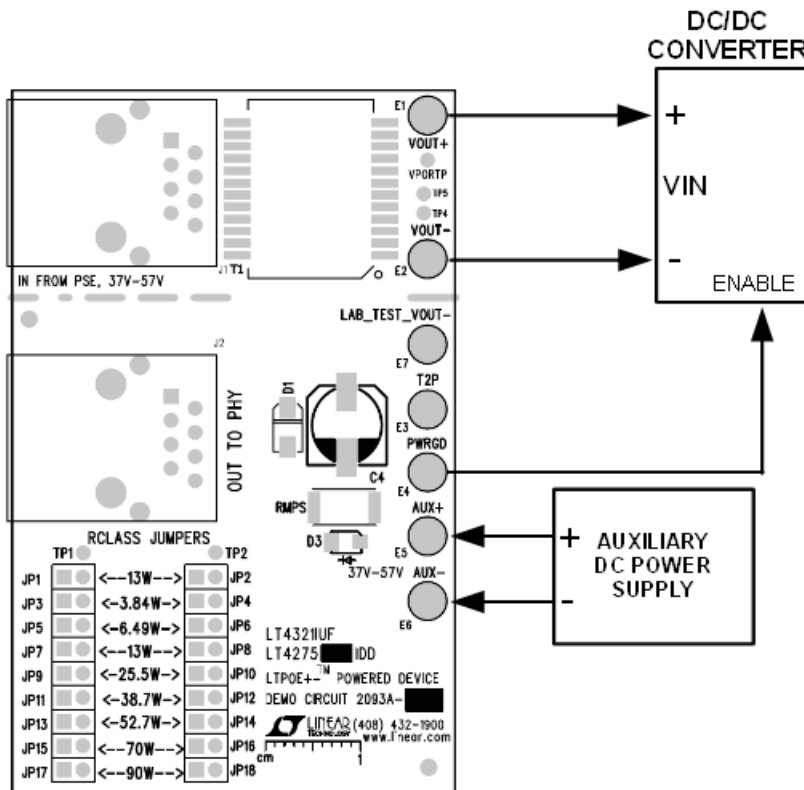


Figure 8. Setup Diagram for the DC2093A-C with a DC/DC Converter and an Auxiliary DC Power Supply

QUICK START PROCEDURE

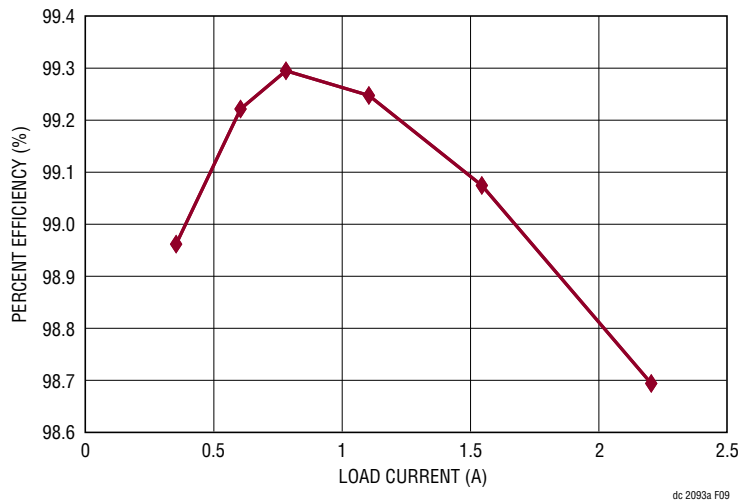


Figure 9. DC2093A-A Efficiency at Various PoE Load Currents (without LED D3)

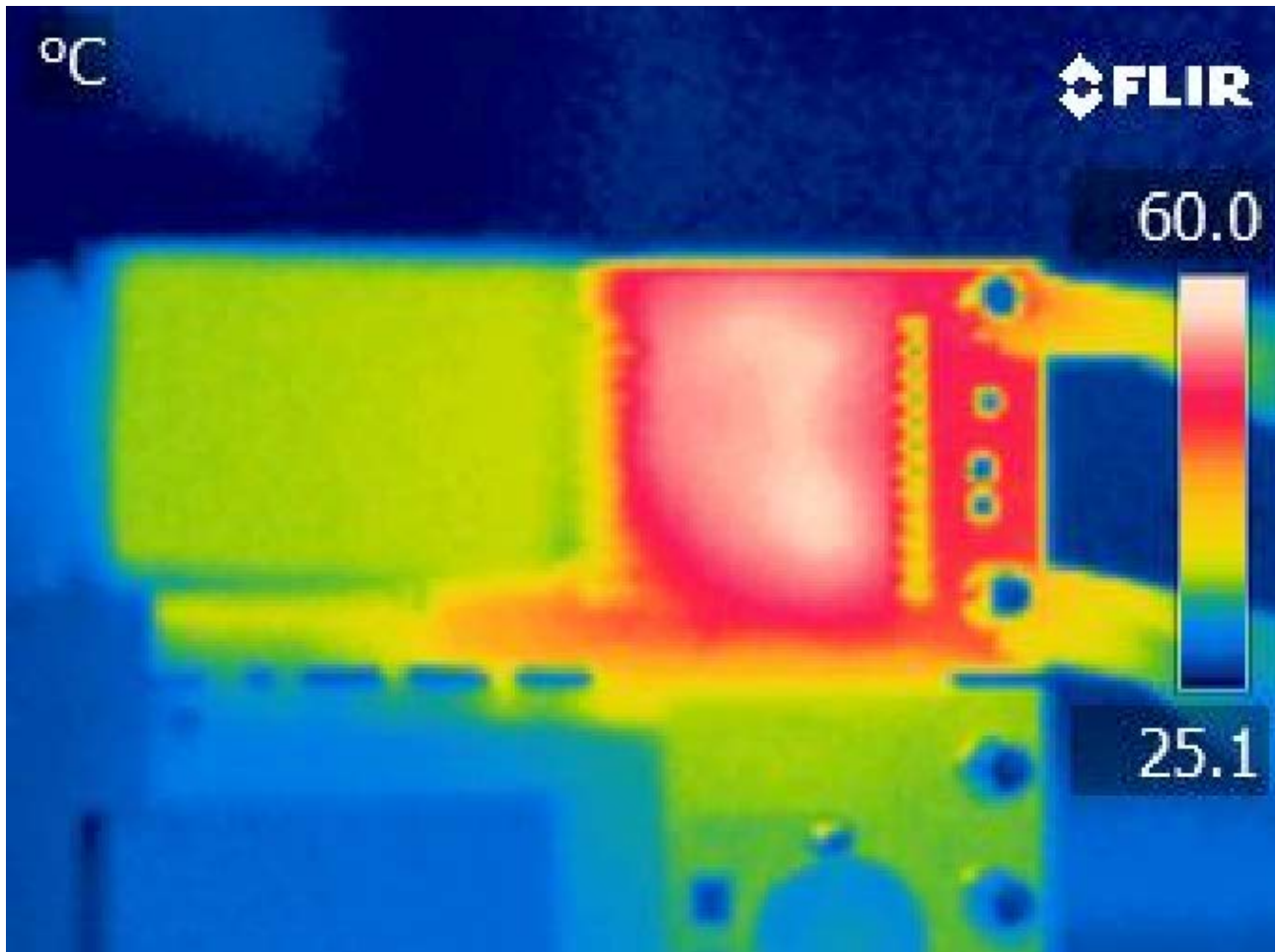


Figure 10. Thermal Image. DC2093A-A with 90W Load. Top View

QUICK START PROCEDURE

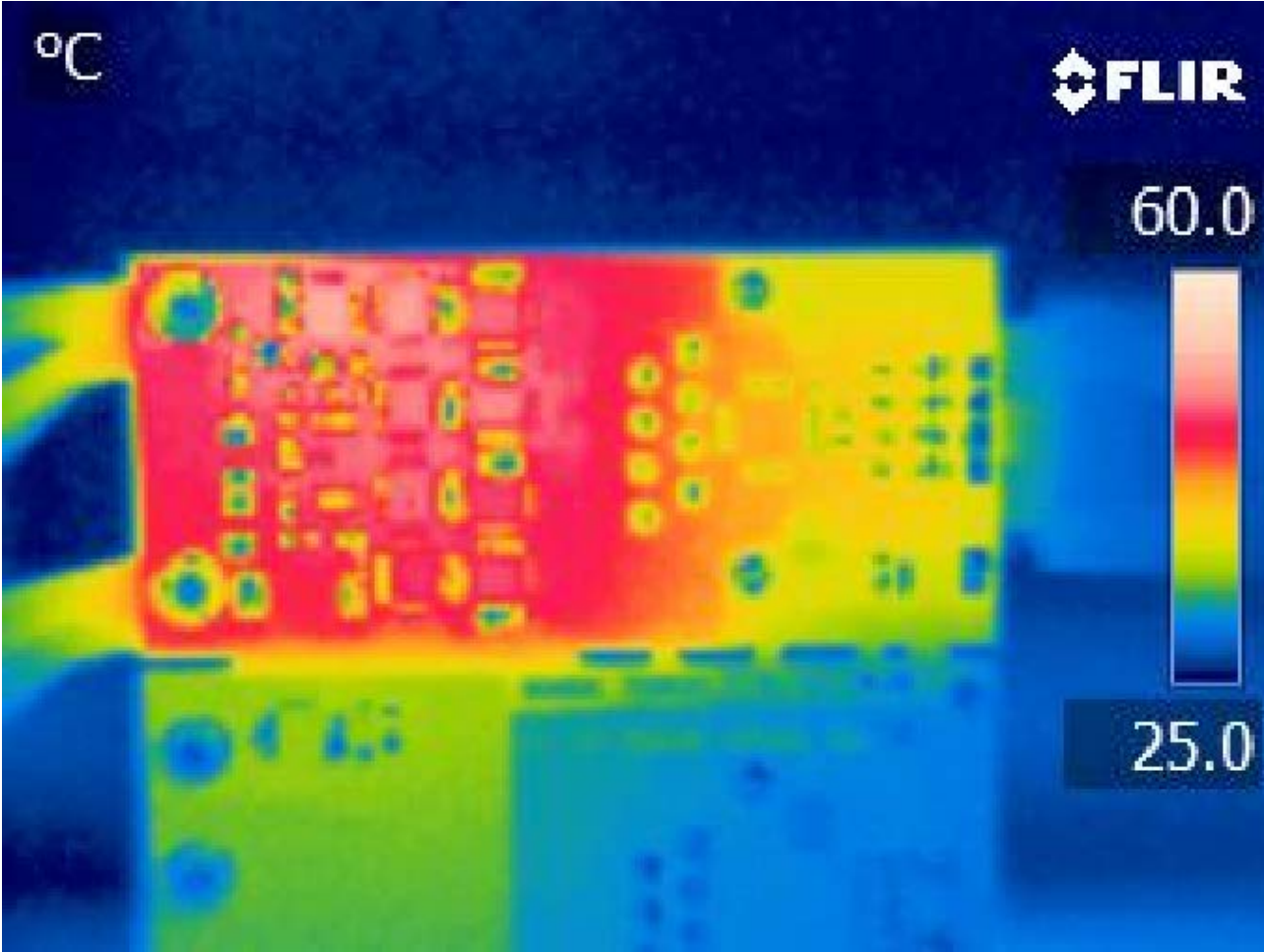


Figure 11. Thermal Image. DC2093A-A with 90W Load. Bottom View

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|-------------------------------------|-----|--------------------|------------------------------------|----------------------------------|
| Required Circuit Components | | | | |
| DC2093A General BOM | | | | |
| 1 | 2 | C1, C5 | CAP, X7S, 0.047µF, 100V, 10%, 0603 | TDK, C1608X7S2A473K080AB |
| 2 | 0 | C2 | CAP, OPT, 0402 | OPT |
| 3 | 1 | C3 | CAP, X7R, 47nF, 100V, 10% 0805 | AVX, 08051C473KAT2A |
| 4 | 1 | CG1 | CAP, X7R, 1nF, 2kV, 10% 1808 | TDK, C4520X7R3D102K |
| 5 | 4 | CT1, CT2, CT3, CT4 | CAP, X7R 0.01µF 10% 200V 0805 | AVX, 08052C103KAZ2A |
| 6 | 1 | D2 | DIODE, SMBJ58A, SMA-DIODE | DIODE, INC, SMBJ58A-13-F |
| 7 | 8 | Q3 TO Q10 | TRANS, PSMN075-100MSE LFPAK33 | NXP, PSMN075-100MSE |
| 8 | 1 | R11, R18 | RES, CHIP, 0Ω, 5%, 0603 | VISHAY, CRCW06030000Z0EA |
| 9 | 1 | R12 | RES, CHIP, 8.2Ω, 5%, 0603 | VISHAY, CRCW06038R20JNEA |
| 10 | 1 | R13 | RES, CHIP, 3.3k, 5%, 0603 | VISHAY, CRCW06033K3JNEA |
| 11 | 0 | R17 | RES, OPT | OPT |
| 12 | 1 | R14 | RES, CHIP, 100k, 5%, 0603 | VISHAY, CRCW0603100KJNEA |
| 13 | 4 | RT1 TO RT4 | RES, CHIP, 75Ω, 5%, 0603 | VISHAY, CRCW060375R0JNEA |
| 14 | 0 | RV1 TO RV4 | VARISTOR, OPT | SANKOSHA, SD4-90, OPT |
| 15 | 1 | U2 | IC, LT4321IUF, QFN16UF | LINEAR TECHNOLOGY, LT4321IUF |
| 16 | 2 | XJP1, XJP2 | SHUNT, 0.079" CENTER | SAMTEC, 2SN-BK-G |
| 17 | 2 | | STENCILS (TOP & BOTTOM) | STENCIL DC2093A |
| DC2093A-A BOM | | | | |
| 1 | 1 | DC2093A | DC2093A GENERAL BOM | |
| 2 | 1 | Q1 | TRANS, PSMN040-100MSE, LFPAK33 | NXP, PSMN040-100MSE |
| 3 | 1 | R10 | RES, CHIP, 0, 5%, 0603 | VISHAY, CRCW06030000Z0EA |
| 4 | 1 | R15 | RES, CHIP, 100k, 5%, 0603 | VISHAY, CRCW0603100KJNEA |
| 5 | 2 | RC1, RC6 | RES, CHIP, 140, 1%, 0805 | PANASONIC, ERJ-6ENF1400V |
| 6 | 2 | RC2, RC8 | RES, CHIP, 76.8, 1%, 0805 | PANASONIC, ERJ-6ENF76R8V |
| 7 | 2 | RC3, RC10 | RES, CHIP, 49.9, 1%, 0805 | VISHAY, CRCW080549R9FKEA |
| 8 | 2 | RC4, RC5 | RES, CHIP, 34.8, 1%, 0805 | VISHAY, CRCW080534R8FKEA |
| 9 | 1 | RC7 | RES, CHIP, 46.4, 1%, 0805 | PANASONIC, ERJ-6ENF46R4V |
| 10 | 1 | RC9 | RES, CHIP, 64.9, 1%, 0805 | VISHAY, CRCW080564R9FKEA |
| 11 | 1 | RC11 | RES, CHIP, 118, 1%, 0805 | VISHAY, CRCW0805118RFKEA |
| 12 | 1 | T1 | XFMR, WÜRTH 749022016 | WÜRTH 749022016 |
| 13 | 1 | U1 | IC, LT4275AIDD DFN10DD/MSOP10MS | LINEAR TECHNOLOGY, LT4275AIDD |
| Optional Circuit Components | | | | |
| 1 | 0 | D1 | DIODE, OPT, SMA | OPT |
| 2 | 0 | E5, E6 | TP, OPT | OPT |
| 3 | 0 | Q2 | TRANS, Si2328DS-T1-GE3, SOT23 | VISHAY, Si2328DS-T1-GE3 |
| 4 | 0 | R9, R16 | RES, OPT | OPT |
| Hardware for Demo Board Only | | | | |
| 1 | 1 | C4 | CAP, 22µF, 100V, OSCON | SUN ELECT, 100CE22BS |
| 2 | 1 | CG2 | CAP, X7R, 1nF, 2kV, 10% 1808 | TDK, C4520X7R3D102K |
| 3 | 1 | D3 | LED, GREEN | ROHM, SML-010FTT86L |
| 4 | 1 | D4 | DIODE, MMSZ5242BS-7-F, SOD323 | DIODES INC, MMSZ5242BS-7-F |
| 5 | 4 | E1, E2, E4, E7 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 6 | 1 | E3 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |

DEMO MANUAL DC2093A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------|-----|-------------|--------------------------------|----------------------------------|
| 7 | 2 | J1, J2 | CONN, SS-7188S-A-NF | STEWART CONNECTOR, SS-7188S-A-NF |
| 8 | 18 | JP1 TO JP18 | HDR, 1X2 2MM, HD1X2-079 | SULLINS, NRPNO21PAEN-RC |
| 9 | 1 | Q11 | TRANS, PSMN040-100MSE, LFPAK33 | NXP, PSMN040-100MSE |
| 10 | 1 | R19 | RES, CHIP, 30k, 5%, 0603 | VISHAY, CRCW060330K0JNEA |
| 11 | 1 | RMPS1 | RES, CHIP, 5.1k, 5%, 2512 | VISHAY, CRCW25125K10JNEA |
| 12 | 4 | RT5 TO RT8 | RES, CHIP, 75Ω, 5%, 0603 | VISHAY, CRCW060375R0JNEA |
| 13 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT 2093A |

DC2093A-B BOM

| | | | | |
|----|---|---------|---------------------------------|----------------------------------|
| 1 | 1 | DC2093A | DC2093A GENERAL BOM | |
| 2 | 1 | D1 | DIODE, B1100A, 100V, SMA | DIODE INC B1100A |
| 3 | 1 | E3 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 4 | 2 | E5, E6 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 5 | 1 | Q2 | TRANS, Si2328DS-T1-GE3, SOT23 | VISHAY, Si2328DS-T1-GE3 |
| 6 | 1 | R9 | RES, CHIP, 82.5k, 1%, 0603 | VISHAY, CRCW060382K5FKEA |
| 7 | 1 | R10 | RES, CHIP, 20k, 1%, 0603 | VISHAY, CRCW060320K5FKEA |
| 8 | 1 | R15 | RES, CHIP, 100k, 5%, 0603 | VISHAY, CRCW0603100KJNEA |
| 9 | 1 | R16 | RES, CHIP, 34.8Ω, 1%, 0805 | VISHAY, CRCW080534R8FKEA |
| 10 | 1 | RMPS1 | RES, CHIP, 4.7k, 5%, 2512 | VISHAY, CRCW25124K70JNEG |
| 11 | 1 | T1 | XFMR, WÜRTH 749022017 | WÜRTH 749022017 |
| 12 | 1 | U1 | IC, LT4275BIDD DFN10DD/MSOP10MS | LINEAR TECHNOLOGY, LT4275BIDD |
| 13 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT 2093A |

Optional Circuit Components

| | | | | |
|---|---|-------------|-------------------|-----|
| 1 | 0 | JP1 TO JP18 | HDR, 1X2 2MM, OPT | OPT |
| 2 | 0 | Q1 | TRANS, OPT | OPT |
| 3 | 0 | RC1 TO RC11 | RES, OPT | OPT |

Hardware for Demo Board Only

| | | | | |
|----|---|----------------|--------------------------------|----------------------------------|
| 1 | 1 | C4 | CAP, 22μF, 100V, OSCON | SUN ELECT, 100CE22BS |
| 2 | 1 | CG2 | CAP, X7R, 1nF, 2kV, 10% 1808 | TDK, C4520X7R3D102K |
| 3 | 1 | D3 | LED, GREEN | ROHM, SML-010FTT86L |
| 4 | 1 | D4 | DIODE, MMSZ5242BS-7-F, SOD323 | DIODES INC, MMSZ5242BS-7-F |
| 5 | 4 | E1, E2, E4, E7 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 6 | 1 | E3 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 7 | 2 | J1, J2 | CONN, SS-7188S-A-NF | STEWART CONNECTOR, SS-7188S-A-NF |
| 8 | 1 | Q11 | TRANS, PSMN040-100MSE, LFPAK33 | NXP, PSMN040-100MSE |
| 9 | 1 | R19 | RES, CHIP, 30k, 5%, 0603 | VISHAY, CRCW060330K0JNEA |
| 10 | 1 | RMPS1 | RES, CHIP, 4.7k, 5%, 2512 | VISHAY, CRCW25124K70JNEG |
| 11 | 4 | RT5 TO RT8 | RES, CHIP, 75Ω, 5%, 0603 | VISHAY, CRCW060375R0JNEA |
| 12 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT 2093A |

DC2093A-C BOM

| | | | | |
|---|---|--------------------|-------------------------------|----------------------------------|
| 1 | 1 | DC2093A | DC2093A GENERAL BOM | |
| 2 | 1 | D1 | DIODE, B1100A, 100V, SMA | DIODE INC. B1100A |
| 3 | 2 | E5, E6 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 4 | 4 | JP1, JP3, JP5, JP7 | HDR, 1X2 2MM | SAMTEC, TMM-102-02-L-S |
| 5 | 1 | Q2 | TRANS, Si2328DS-T1-GE3, SOT23 | VISHAY, Si2328DS-T1-GE3 |
| 6 | 1 | R9 | RES, CHIP, 82.5k, 1%, 0603 | VISHAY, CRCW060382K5FKEA |

dc2093af

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------|-----|-----------|---------------------------------|-------------------------------|
| 7 | 1 | R10 | RES, CHIP, 20k, 1%, 0603 | VISHAY, CRCW060320KFKEA |
| 8 | 1 | RC1 | RES, CHIP, 140, 1%, 0805 | PANASONIC, ERJ-6ENF1400V |
| 9 | 1 | RC2 | RES, CHIP, 76.8, 1%, 0805 | PANASONIC, ERJ-6ENF76R8V |
| 10 | 1 | RC3 | RES, CHIP, 49.9, 1%, 0805 | VISHAY, CRCW080549R9FKEA |
| 11 | 1 | RMPS1 | RES, CHIP, 4.3k, 5%, 2512 | PANASONIC, ERJ-1TYJ432U |
| 12 | 1 | T1 | XFMR, WÜRTH 749023015 | WÜRTH 749023015 |
| 13 | 1 | U1 | IC, LT4275CIDD DFN10DD/MSOP10MS | LINEAR TECHNOLOGY, LT4275CIDD |
| 14 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT 2093A |

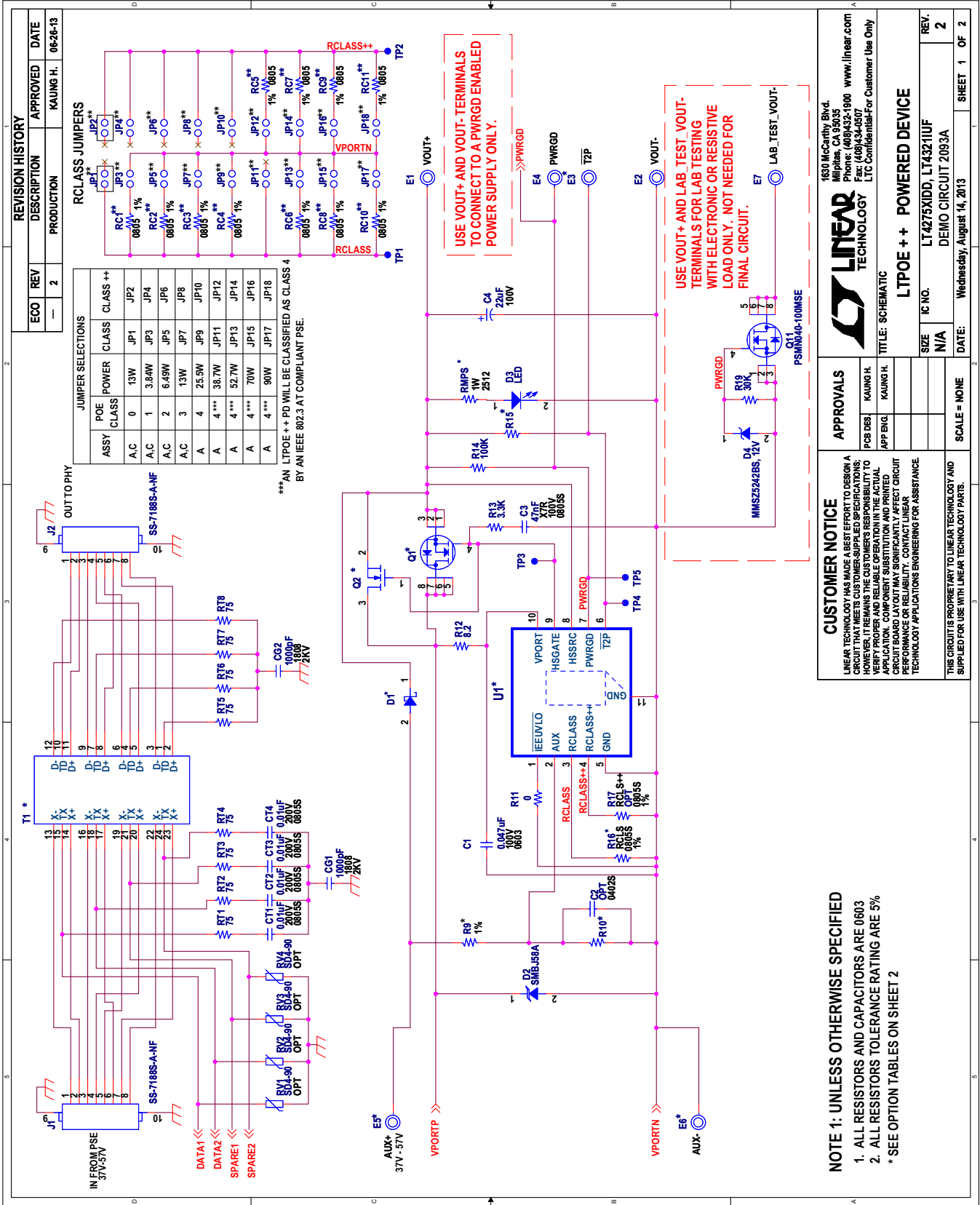
Optional Circuit Components

| | | | | |
|---|---|---------------------------------|-------------------------|-----|
| 1 | 0 | E3 | TP, TURRET, 0.094", OPT | OPT |
| 2 | 0 | JP2, JP4, JP6, JP8, JP9 TO JP18 | HDR, 1X2 2MM, OPT | OPT |
| 3 | 0 | Q1 | TRANS, OPT | OPT |
| 4 | 0 | R15 | RES, OPT | OPT |
| 5 | 0 | R16 | RES, OPT | OPT |
| 6 | 0 | RC4 TO RC11 | RES, OPT | OPT |

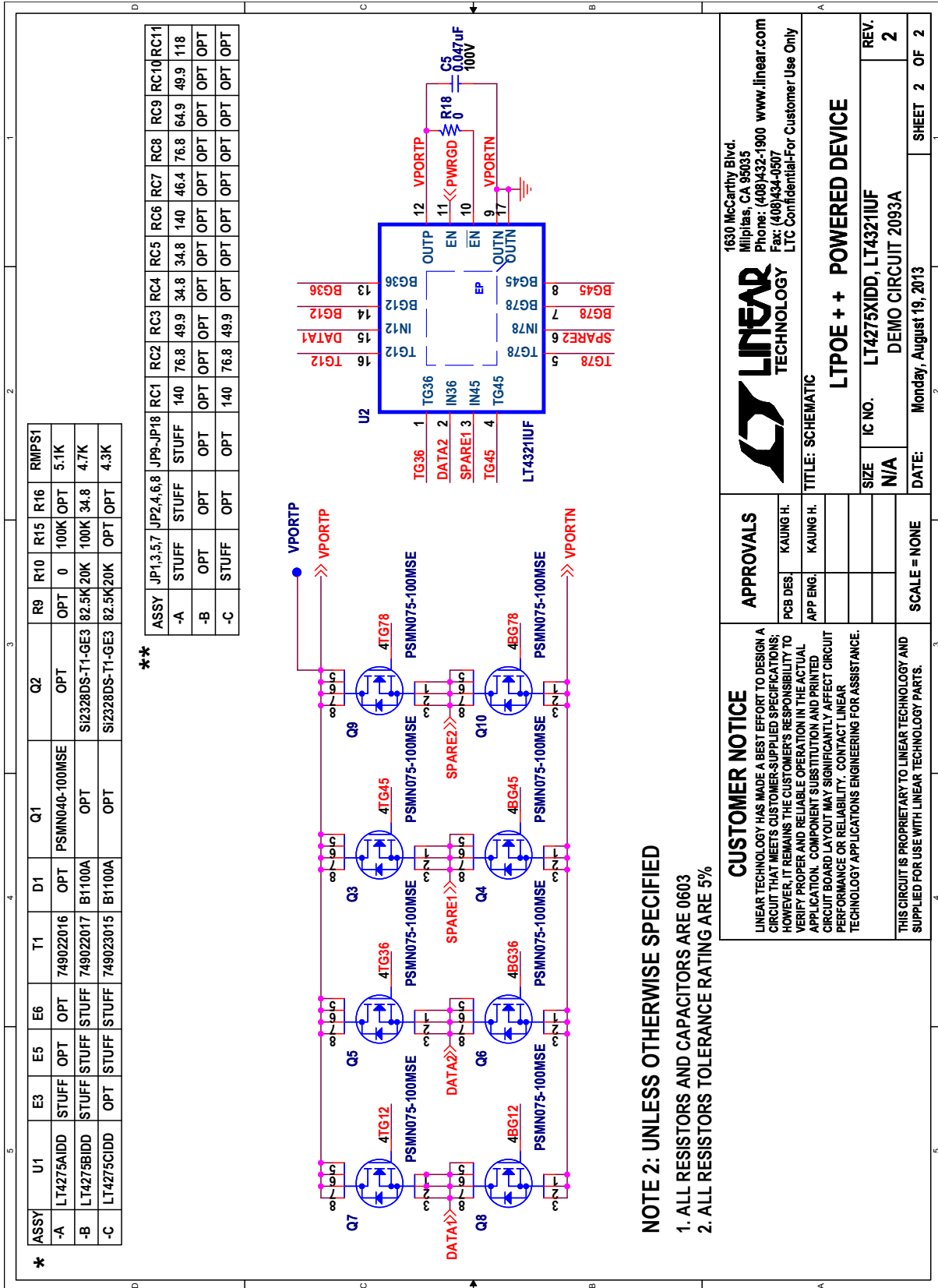
Hardware for Demo Board Only

| | | | | |
|----|---|--------------------|-----------------------------------|----------------------------------|
| 1 | 1 | C4 | CAP, 22 μ F, 100V, OSCON | SUN ELECT, 100CE22BS |
| 2 | 1 | CG2 | CAP, X7R, 1nF, 2kV, 10% 1808 | TDK, C4520X7R3D102K |
| 3 | 1 | D3 | LED, GREEN | ROHM, SML-010FTT86L |
| 4 | 1 | D4 | DIODE, MMSZ5242BS-7-F, SOD323 | DIODES INC, MMSZ5242BS-7-F |
| 5 | 4 | E1, E2, E4, E7 | TP, TURRET, 0.094" | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 6 | 2 | J1, J2 | CONN, SS-7188S-A-NF | STEWART CONNECTOR, SS-7188S-A-NF |
| 7 | 4 | JP1, JP3, JP5, JP7 | HDR, 1X2 2MM | SULLINS, NRPN021PAEN-RC |
| 8 | 1 | Q11 | TRANS, PSMN040-100MSE, LFPK33 | NXP, PSMN040-100MSE |
| 9 | 1 | R19 | RES, CHIP, 30k, 5%, 0603 | VISHAY, CRCW060330K0JNEA |
| 10 | 1 | RMPS1 | RES, CHIP, 4.3k, 5%, 2512 | PANASONIC, ERJ-1TYJ432U |
| 11 | 4 | RT5 TO RT8 | RES, CHIP, 75 Ω , 5%, 0603 | VISHAY, CRCW060375R0JNEA |
| 12 | 1 | | FAB, PRINTED CIRCUIT BOARDS | DEMO CIRCUIT 2093A |

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



NOTE 2: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS AND CAPACITORS ARE 0603
2. ALL RESISTORS TOLERANCE RATING ARE 5%

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 OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

APPROVALS

| | |
|---------|----------|
| PCB DES | KAUNG H. |
| APP ENG | KAUNG H. |
| SCALE | NONE |

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 Fax: (408)434-0907
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TITLE: SCHEMATIC

LTPOE + + POWERED DEVICE

| | | |
|-------|-------------------------|--------------|
| SIZE | IC NO. | REV. |
| N/A | LT4275XIDD, LT4321IUF | 2 |
| DATE: | Monday, August 19, 2013 | SHEET 2 OF 2 |



DEMO MANUAL DC2093A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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