

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, $V_{PORT} = 48V$, $I_{LOAD} = 1.1A$	99.2% (Typical)
	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

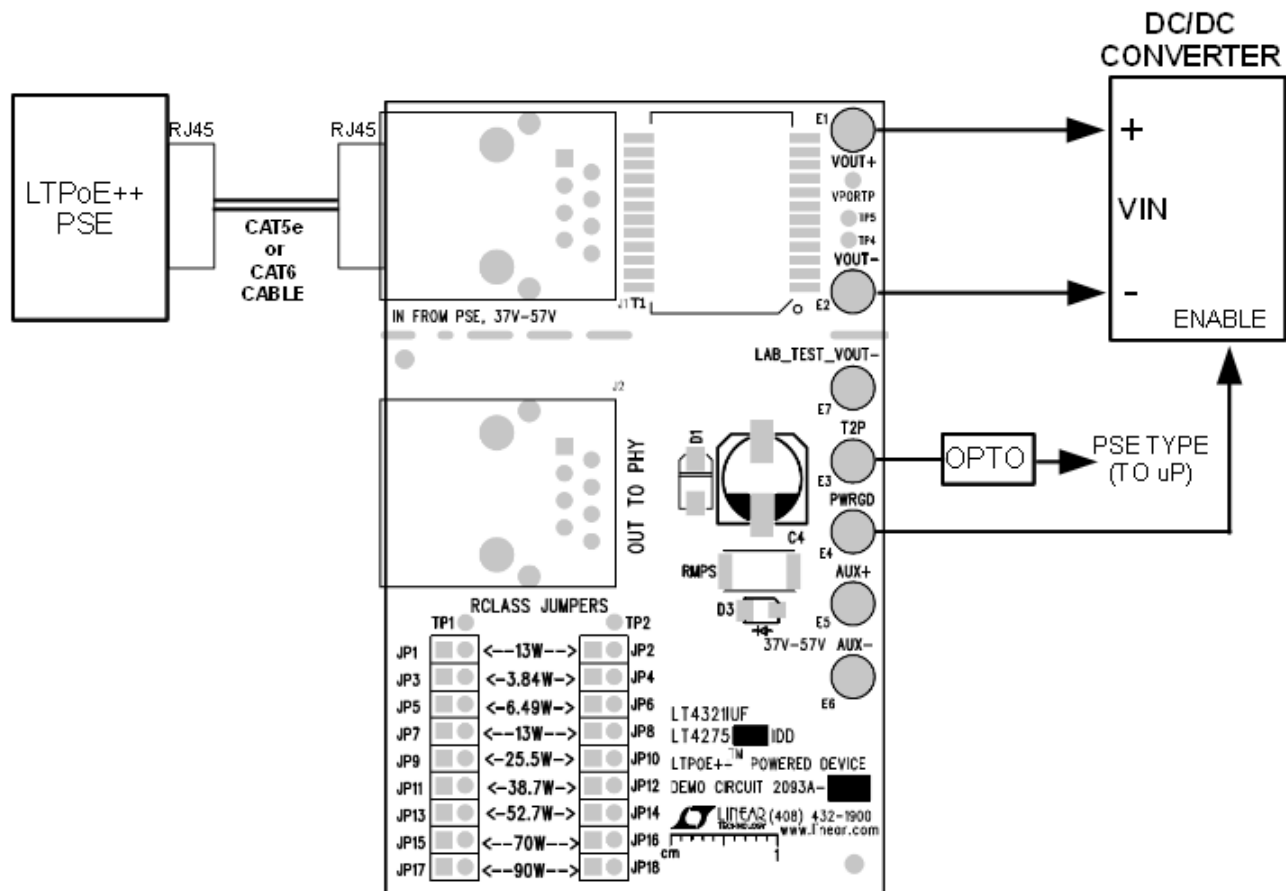


Figure 1. Setup Diagram for the DC2093A-A with a DC-DC Converter, a Microprocessor, and an LTPoE++ PSE

DC2093A-A QUICK START PROCEDURE

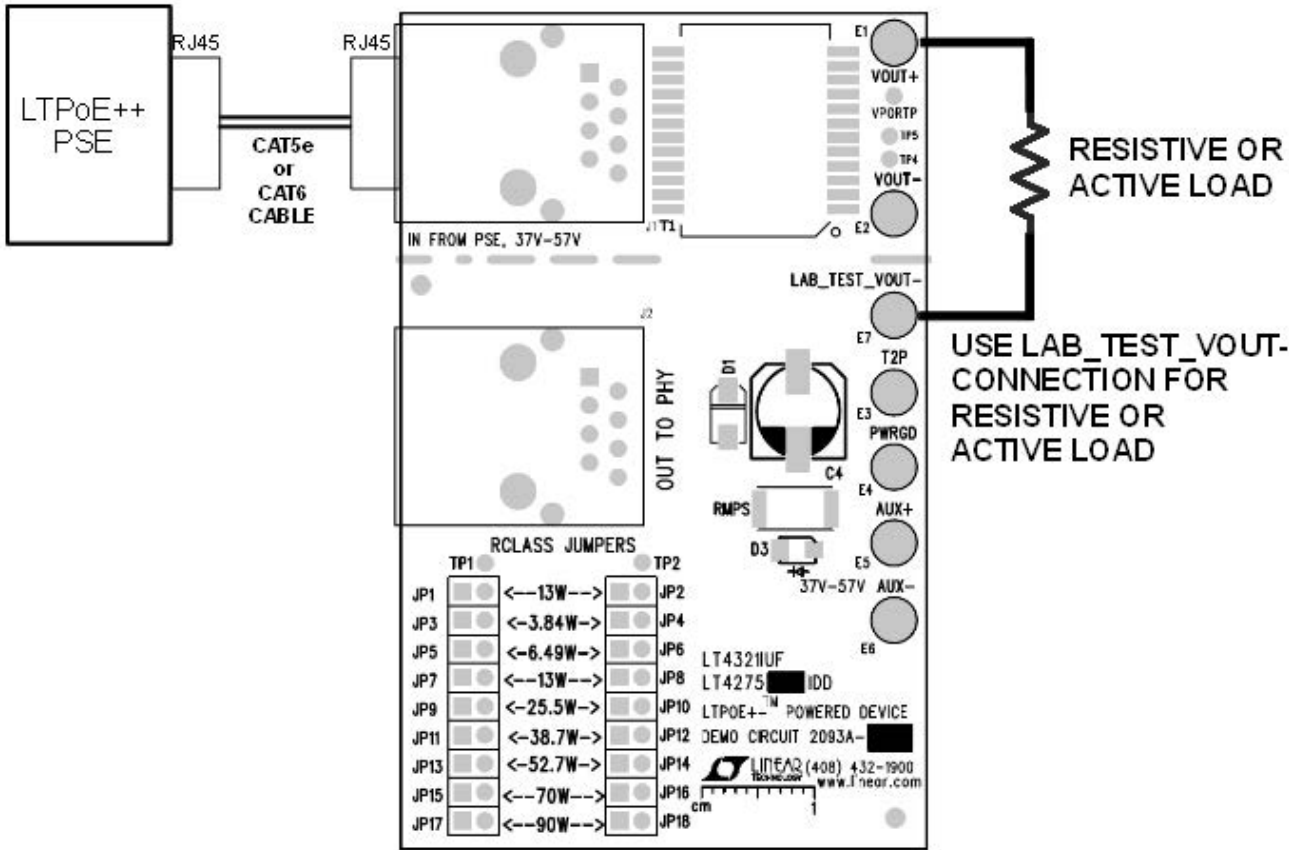


Figure 2. Setup Diagram for DC2093A-A with a Resistive or an Active Load

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.

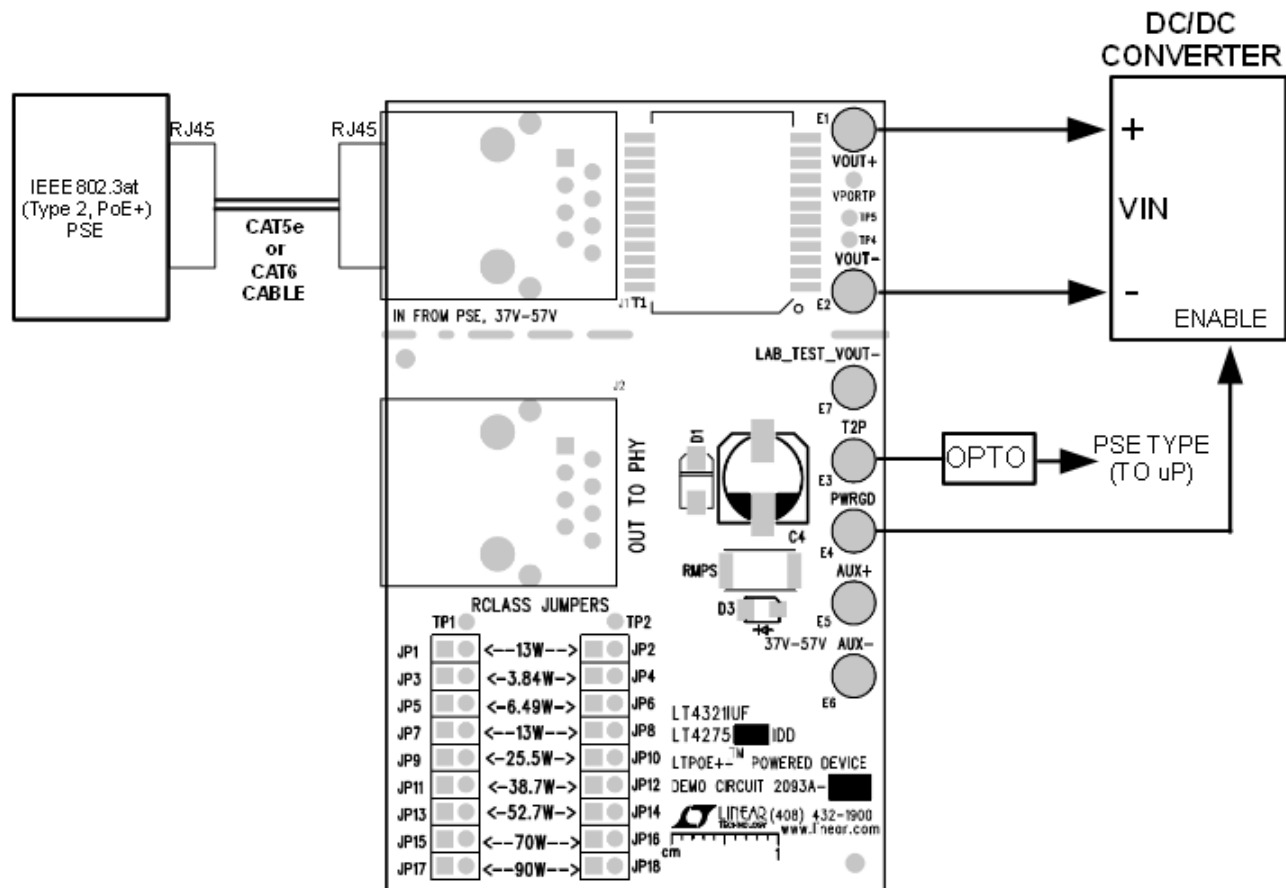


Figure 3. Setup Diagram for the DC2093A-B with a DC/DC Converter, a Microprocessor, and a Type 2 PSE



DC2093A-B QUICK START PROCEDURE

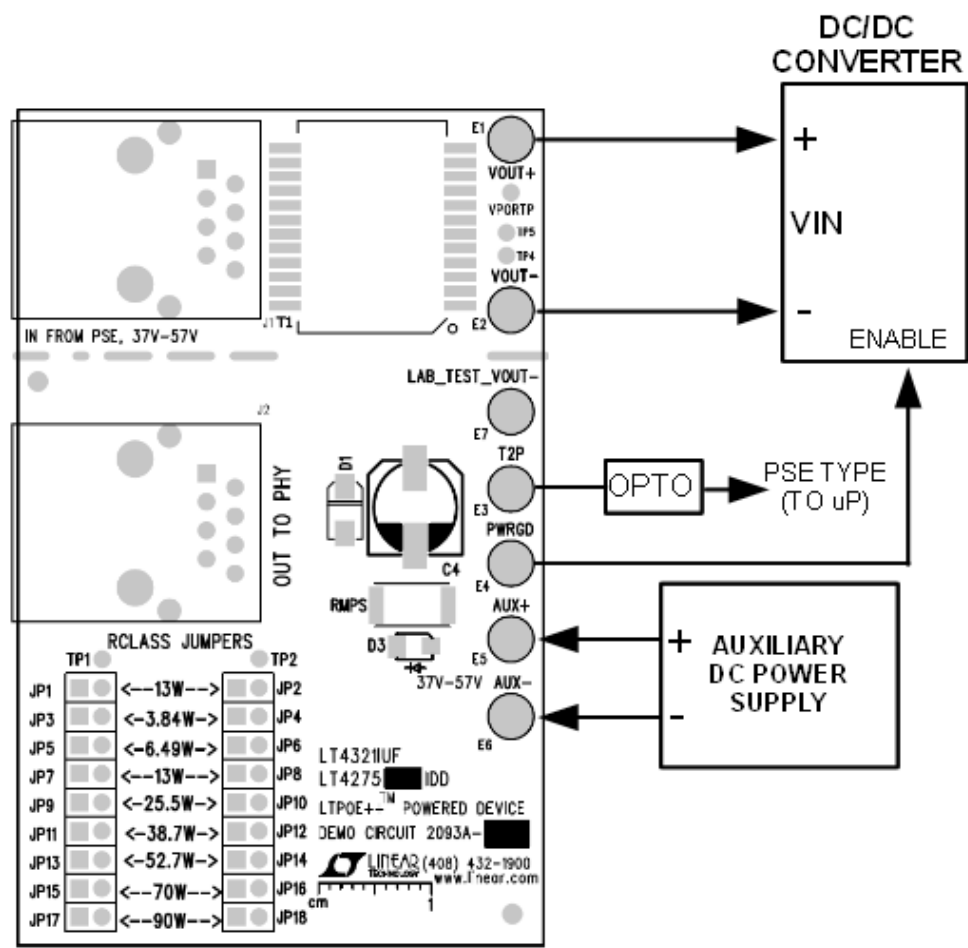


Figure 5. Setup Diagram for the DC2093A-B with a DC/DC Converter

DC2093A-C QUICK START PROCEDURE

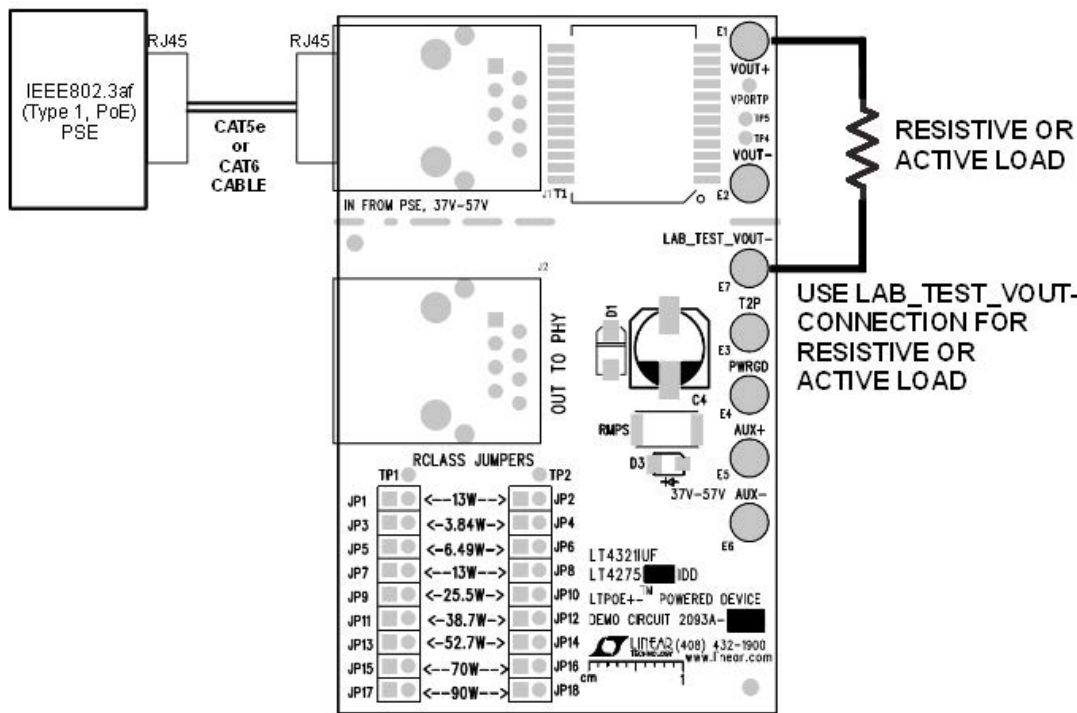


Figure 7. Setup Diagram for DC2093A-C with a Resistive or an Active Load

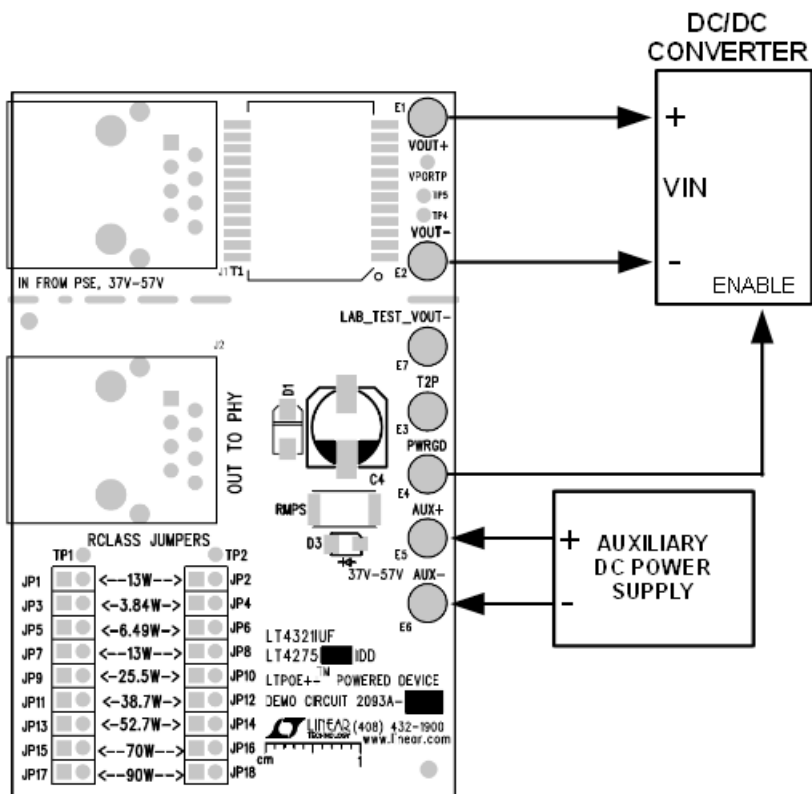


Figure 8. Setup Diagram for the DC2093A-C with a DC/DC Converter and an Auxiliary DC Power Supply

QUICK START PROCEDURE

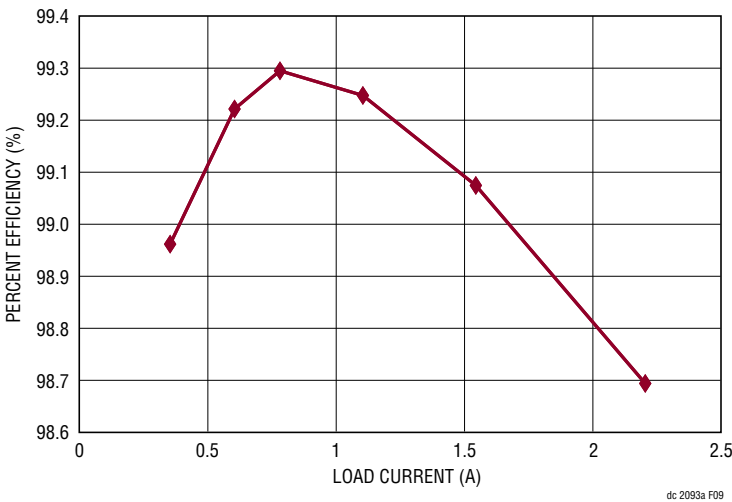


Figure 9. DC2093A-A Efficiency at Various PoE Load Currents (without LED D3)

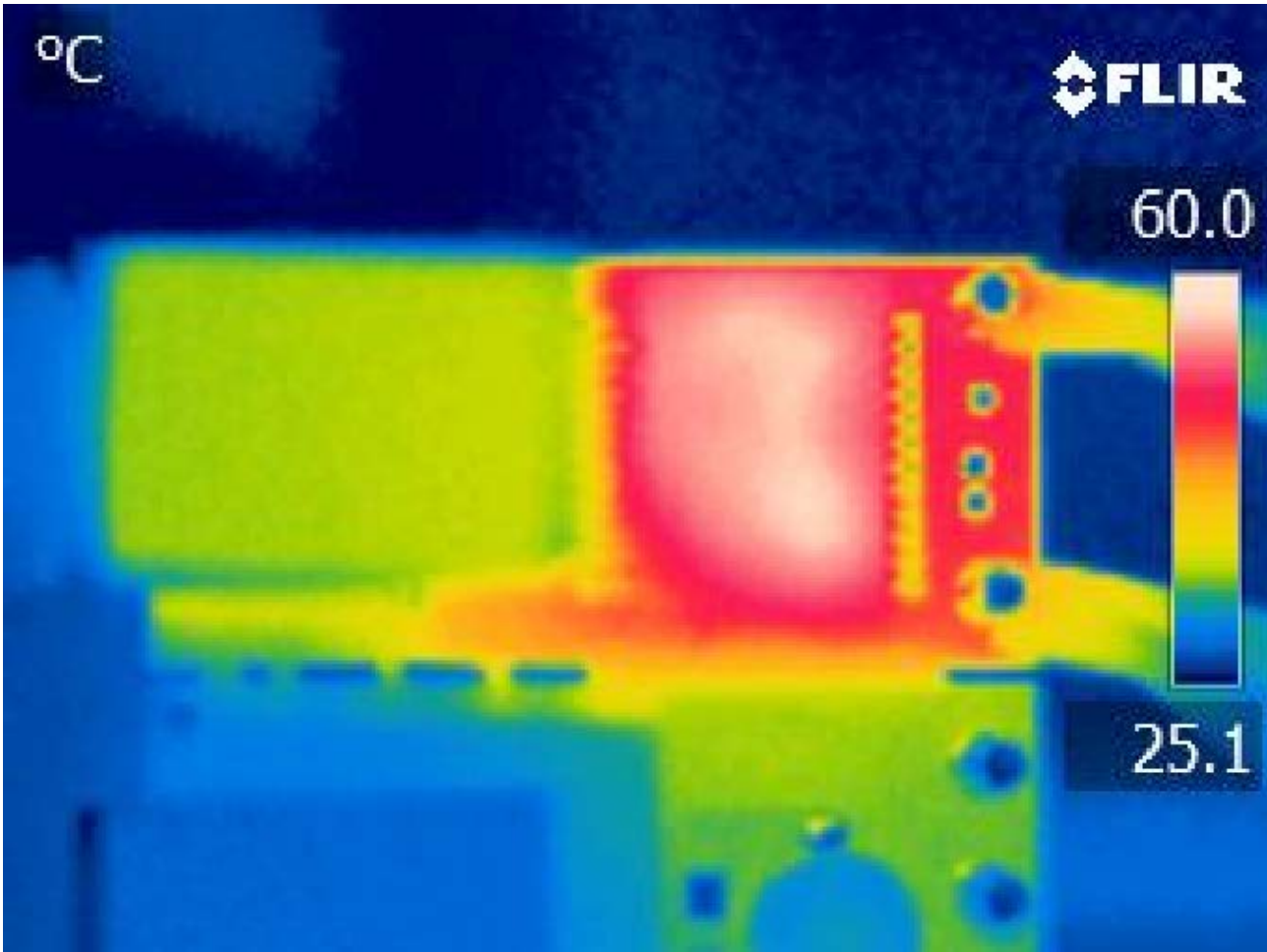


Figure 10. Thermal Image. DC2093A-A with 90W Load. Top View

QUICK START PROCEDURE

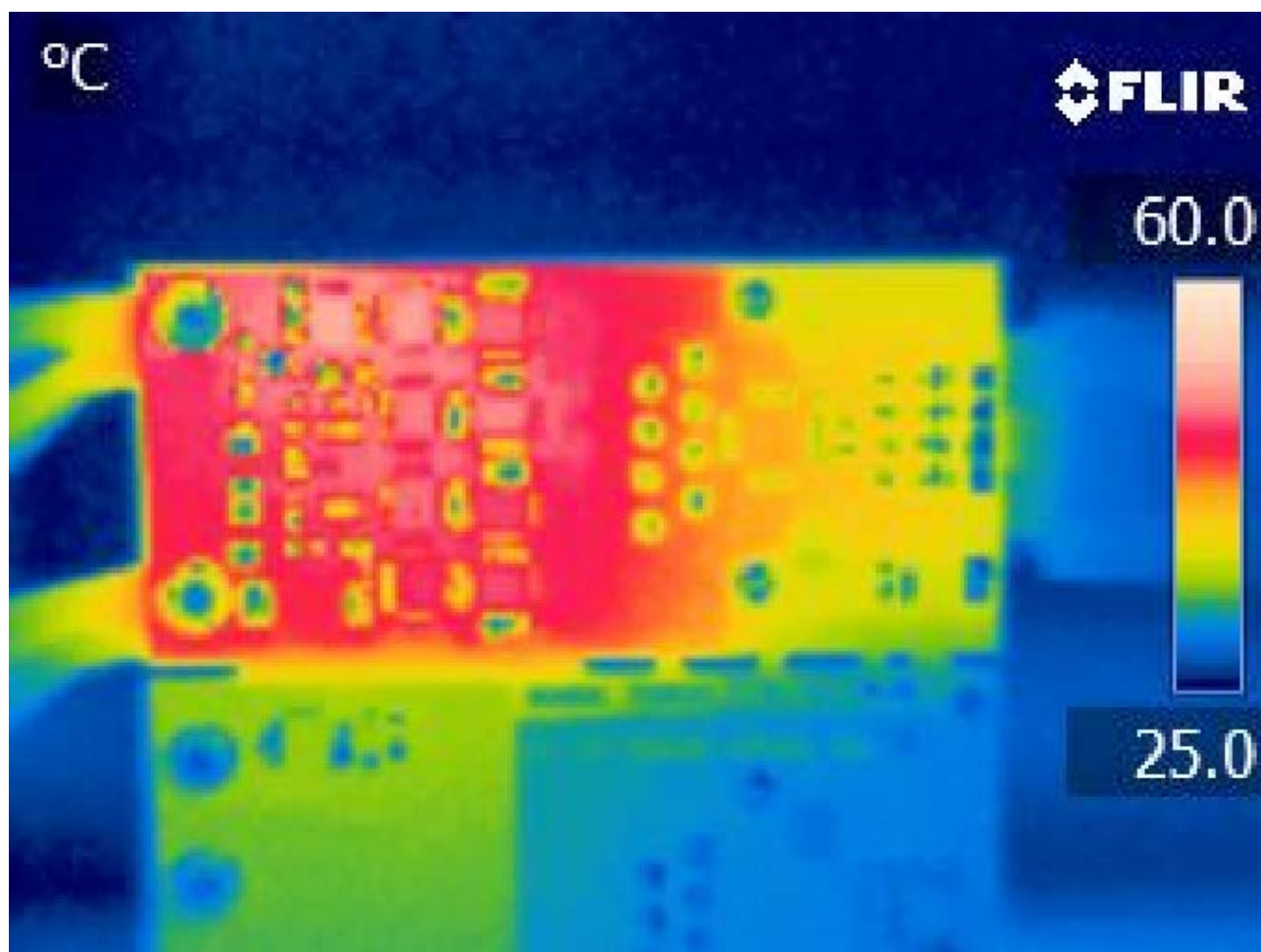


Figure 11. Thermal Image. DC2093A-A with 90W Load. Bottom View

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
DC2093A General BOM				
1	2	C1, C5	CAP, X7S, 0.047 μ F, 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 0.01 μ F 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 LFPK33	NXP, PSMN075-100MSE
8	1	R11, R18	RES, CHIP, 0 Ω , 5%, 0603	VISHAY, CRCW06030000Z0EA
9	1	R12	RES, CHIP, 8.2 Ω , 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, 75 Ω , 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, LFPK33	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, 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	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, NRPN021PAEN-RC
9	1	Q11	TRANS, PSMN040-100MSE, LFPK33	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, CRCW060320KFKEA
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, LFPK33	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

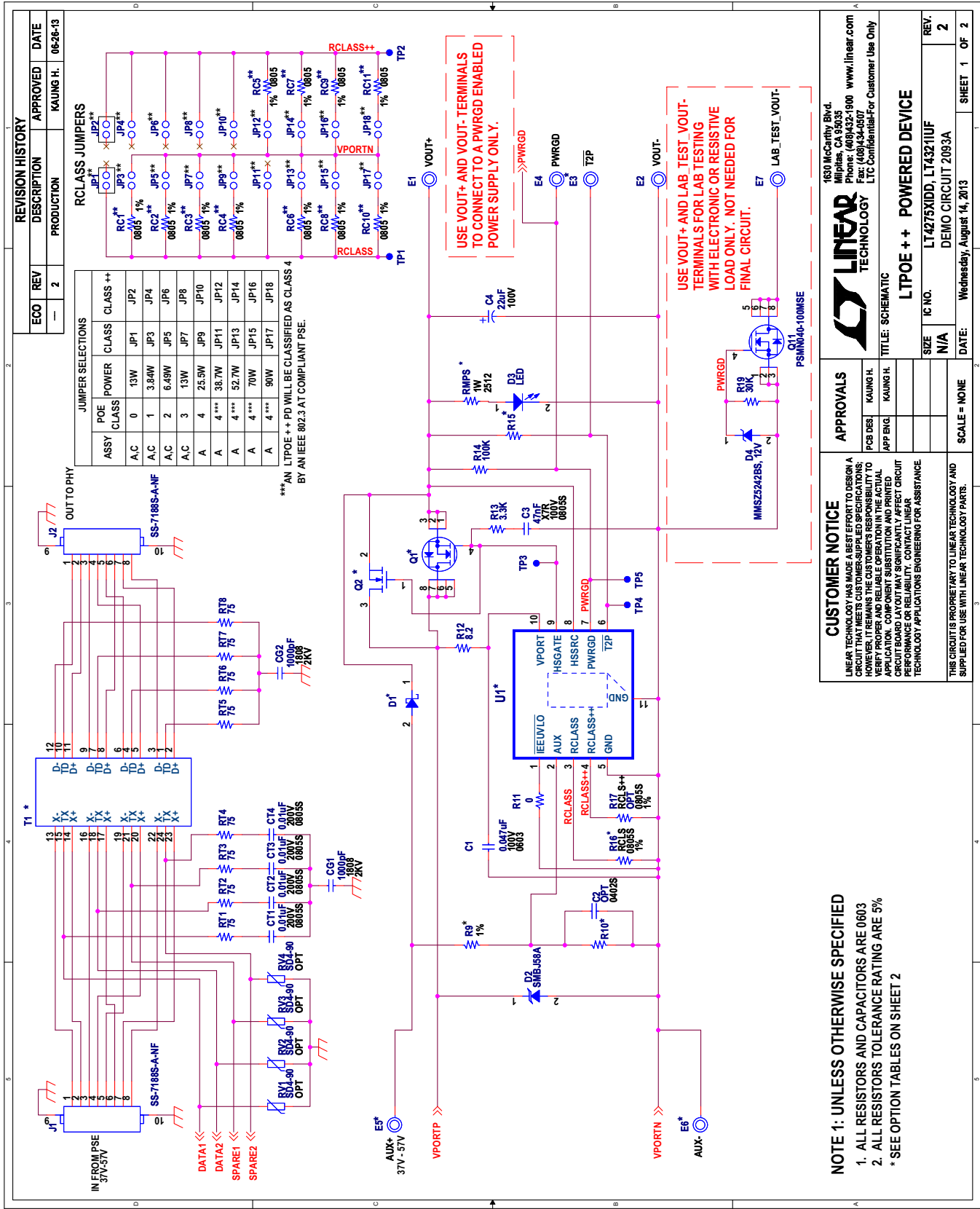
Optional Circuit Components

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





DEMO MANUAL DC2093A

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