LTC7800EUDC
High Frequency Synchronous Buck Converter with GaN Transistors

DESCRIPTION

Demonstration circuit 2736A is a single output high voltage nonisolated synchronous step-down converter that drives all GaN transistor power stage. It features the LTC®7800, a low quiescent current high frequency (programmable fixed frequency from 320kHz up to 2.25MHz) synchronous step-down DC/DC controller housed in a small 3mm × 4mm QFN package.

This DC2736A operates over an input voltage range from 30V to 55V, while the LTC7800 can operate up to 60V. This demo board produces a 12V output voltage with up to 20A output current, and is configured with a sense resistor for current sensing. A mode selector allows the DC2736A to operate in forced continuous operation, pulse-skipping or Burst Mode® operation during light loads.

The LTC7800 features two integrated 5V gate drivers with 20ns dead time which is good for GaN transistors or logic-level MOSFETs to maximize efficiency. The $EXTV_{CC}$ pin permits the LTC7800 to be powered from the output of the switching regulator or other available source, reducing power dissipation and improving efficiency. Please refer to the LTC7800 data sheet for a complete description of the part operation and application information.

Design files for this circuit board are available at http://www.linear.com/demo/DC2736A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		30V to 55V
Output Voltage, V_{OUT}	V_{IN} = 30V – 55V, Single Output, I_{OUT} = 0A to 20A	12V
Maximum Output Current, I_{OUT}	V_{IN} = 30V – 55V	20A
Typical Efficiency	V_{IN} = 48V, Single Output, V_{OUT} = 12V, 20A Load	96%
Default Switching Frequency		500kHz

QUICK START PROCEDURE

Demonstration circuit 2736A is easy to set up to evaluate the performance of the LTC7800. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

1. With board not connected, adjust the input power supply to 48V, then turn off the input power supply. Make sure the input power supply is capable of 10A at 30V.
2. With power off, connect the input power supply to V_{IN} and GND terminal of the board.
3. Connect the output load between V_{OUT} and GND (Initial load: no load). Refer to Figure 1.
4. Connect the DVMs to the input and output.
5. Check the default jumper/switch position: JP7: ON; JP13: CCM.
6. Turn on the input power supply.

   NOTE: The input voltage range for the board is 30V to 55V.
7. Check for the proper output voltage from V_{OUT} to GND. The output voltage should be between 11.76V to 12.24V.
8. Once the proper output voltage is established, adjust the loads within the operating range (0A to 20A) and observe the output voltage regulation, ripple voltage and other parameters.
9. After completing all tests, adjust the load to 0A, turn off the input power supply.

Notes:

1. When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (–) terminals of an output capacitor. The probe's ground ring needs to touch the (–) lead and the probe tip needs to touch the (+) lead.
2. Please set the electronic load in *CR (constant resistance) mode* for the evaluation of the board. The default setup of the 2736A board is to have $EXTV_{CC}$ pin connected to V_{OUT}. Some electronic load outputs negative voltage when doing output overcurrent test of the board, which exceeds the absolute maximum rating –0.3V on $EXTV_{CC}$ pin of LTC7800.

External $EXTV_{CC}$ Option

By default, the $EXTV_{CC}$ pin of LTC7800 on DC2736A board is connected to the output of the converter with R69 (0Ω) for good efficiency and good thermal performance. Please follow the below procedure if an external power supply is used to bias the LTC7800 $EXTV_{CC}$ pin (Do not float this pin).

1. Remove R69 on the board.
2. Apply a DC voltage (recommend 5.5V – 13V) on $EXTV_{CC}$ and GND turret after the input voltage is established. Make sure $EXTV_{CC} < V_{IN}$.
3. Turn off the DC bias on the $EXTV_{CC}$ before powering off the input power supply.

QUICK START PROCEDURE

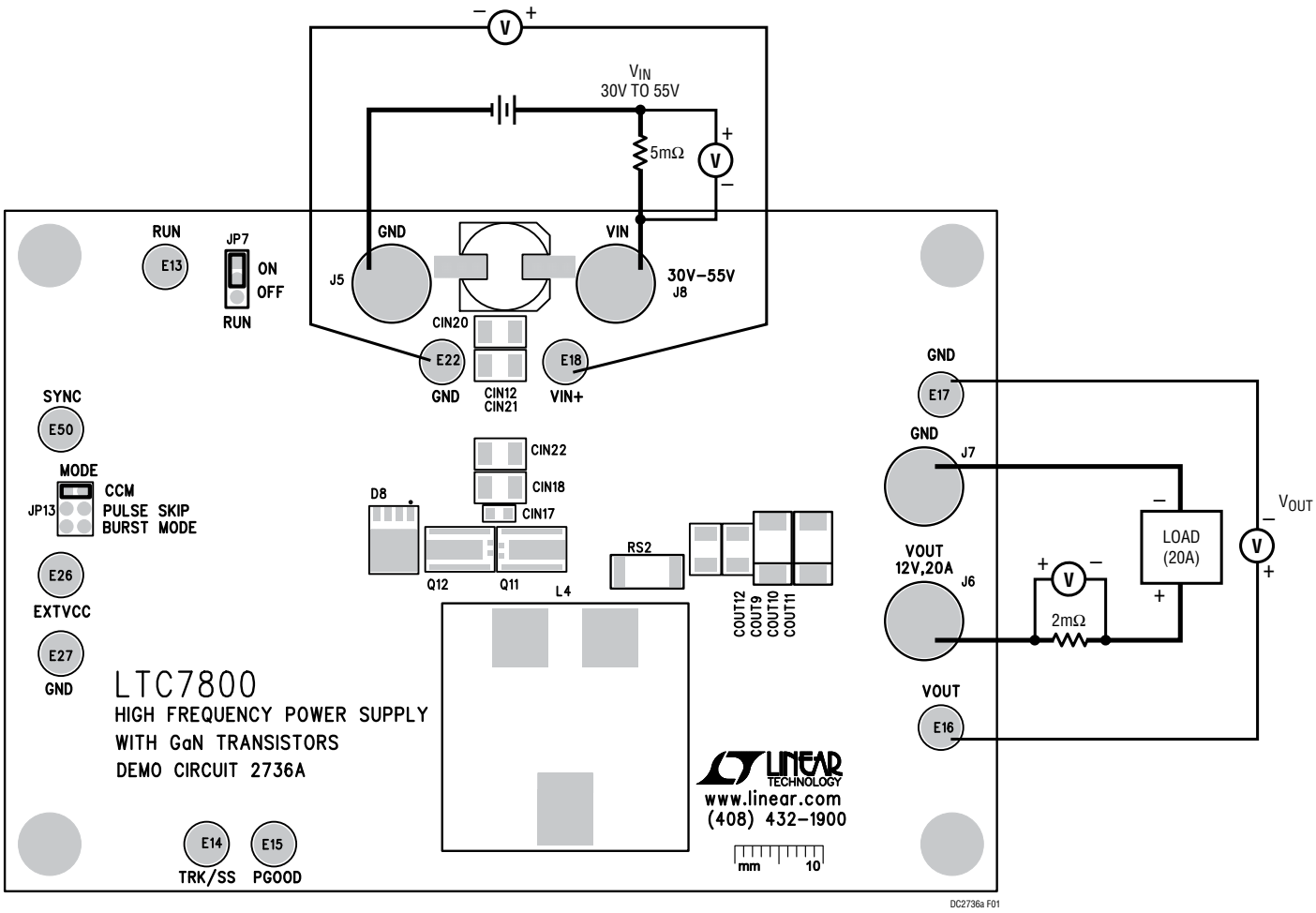


Figure 1. Proper Measurement Equipment Setup

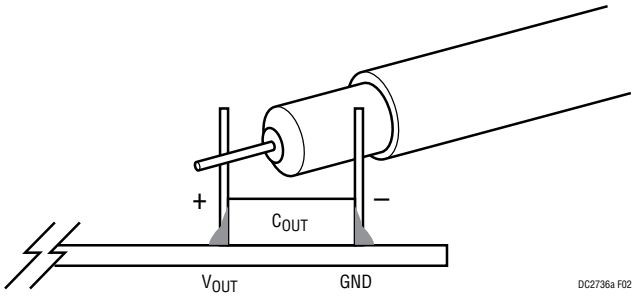


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

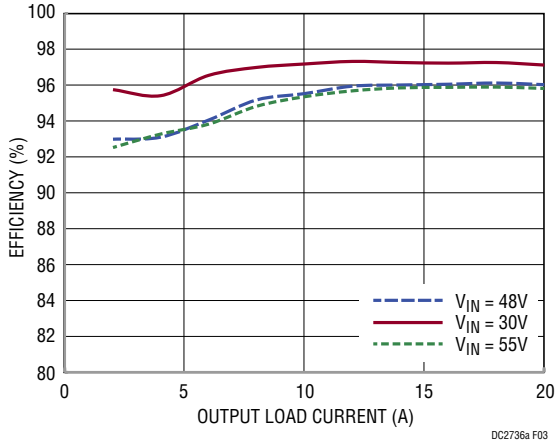


Figure 3. Efficiency vs Load Current at V_{OUT} = 12V, f_{SW} = 500kHz

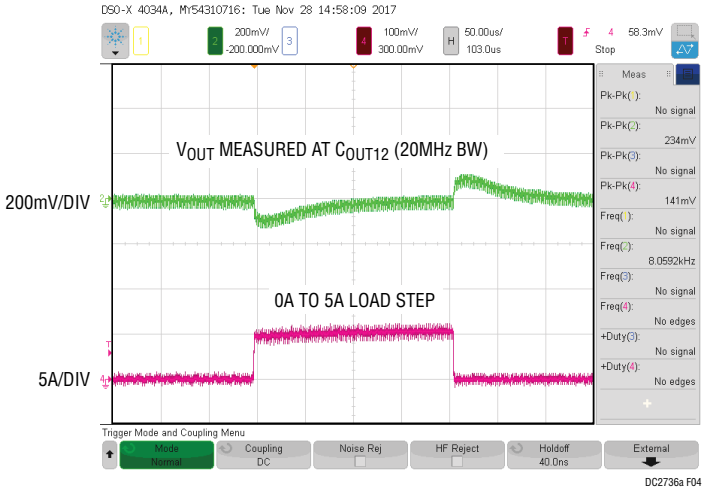


Figure 4. Transient Response at V_{IN} = 48V, V_{OUT} = 12V, f_{SW} = 500kHz

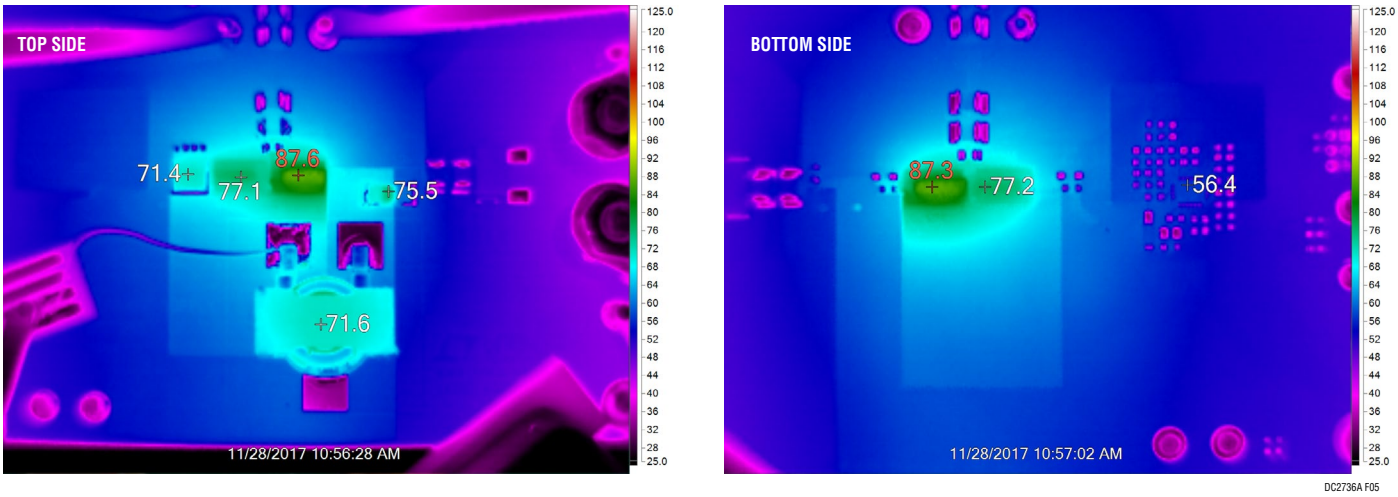


Figure 5. Thermal Performance at V_{IN} = 48V, V_{OUT} = 12V, I_{OUT} = 20A, T_A = 23°C, in Free Air

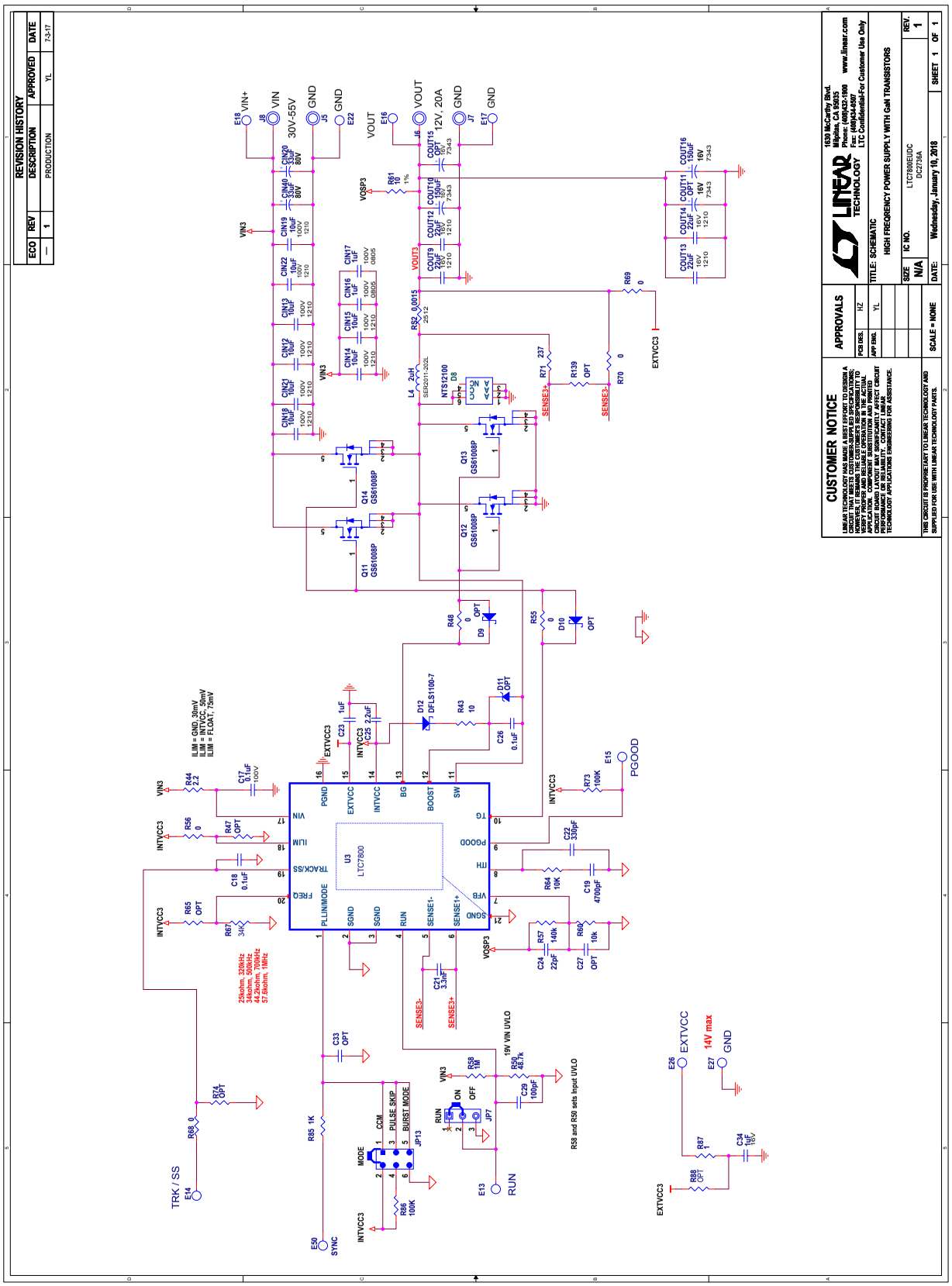
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	8	CIN12, CIN13, CIN14, CIN15, CIN18, CIN19, CIN21, CIN22	CAP, 1210 10µF 20% 100V X7S	MURATA, GRM32EC72A106K
2	2	CIN16, CIN17	CAP, 0805 1µF 20% 100V X7S	MURATA, GRM21BC72A105KE01L
3	2	CIN20, CIN40	CAP, 33µF 80V 10.3 × 10.3	PANASONIC, EEHZA1K330P
4	4	COUT9, COUT12, COUT13, COUT14	CAP, 1210 22µF 10% 16V X7R	TDK, C3225X7R1C226K
5	2	COUT10, COUT16	FAB, PRINTED CIRCUIT BOARD	PANASONIC, 16TQC150MYF
6	3	C17, C18, C26	CAP, 0603 0.1µF 10% 100V X7R	MURATA, GRM188R72A104KA35D
7	1	C19	CAP, 0603 4700pF 10% 50V X7R	AVX, 06035C472KAT2A
8	1	C21	CAP, 0603 3300pF 10% 50V X7R	AVX, 06035C332KAT2A
9	1	C22	CAP, 0603 330pF 10% 50V X7R	AVX, 06035C331KAT2A
10	2	C23, C34	CAP, 0603 1µF 20% 16V X7R	TDK, C1608X7R1C105M
11	1	C24	CAP, 0603 22pF 10% 50V X7R	AVX, 06035C220KAT2A
12	1	C25	CAP, 0603 2.2µF 10% 10V X5R	AVX, 0603ZD223KAT2A
13	1	C29	CAP, 0603 100pF 5% 50V NPO	AVX, 06035A101JAT2A
14	1	D8	DIODE,12A, 100V SO-8 FL	ON SEMI, NTS12100EMFST1G
15	1	D12	DIODE, Power DI-123	DIODES, INC, DFLS1100-7
16	1	L4	IND, 2µH	COILCRAFT, SER2011-202L
17	4	Q11, Q12, Q13, Q14	GaN TRANSISTOR	GaN SYSTEMS, GS61008P
18	1	RS2	RES, 1.5mΩ 2512	PANASONIC, ERJM1WTF1M5U
19	2	R43, R61	RES, 0603 10Ω 1%	VISHAY, CRCW060310R0FKEA
20	1	R44	RES, 0603 2.2Ω 5%	VISHAY, CRCW06032R20JNEA
21	6	R48, R55, R56, R68, R69, R70	RES, 0603 0Ω JUMPER	VISHAY, CRCW06030000Z0EA
22	1	R50	RES, 0603 48.7kΩ 1%	VISHAY, CRCW060348K7FKEA
23	1	R57	RES, 0603 140kΩ 5%	VISHAY, CRCW0603140KJNEA
24	1	R58	RES, 0603 1M 5%	VISHAY,CRCW06031M00JNEA
25	1	R60	RES, 0603 10kΩ 1%	VISHAY, CRCW060310K0FKEA
26	1	R64	RES, 0603 10kΩ 1%	VISHAY, CRCW060310K0FKEA
27	1	R67	RES, 0603 34kΩ 1%	VISHAY, CRCW060334K0FKEA
28	1	R71	RES, 0603 237Ω 1%	VISHAY, CRCW0603237RFKEA
29	2	R73, R86	RES, 0603 100kΩ 5%	VISHAY, CRCW0603100KJNEA
30	1	R85	RES, 0603 1kΩ 1%	VISHAY, CRCW06031K00FKEA
31	1	R87	RES, 0603 1Ω 5%	VISHAY, CRCW06031R00JNEA
32	1	U3	IC, LTC7800EUD	LINEAR TECH, LTC7800EUDC#PBF

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	COUT11, COUT15	OPTIONAL 7343	
2	0	C27, C33	OPTIONAL 0603	
3	0	D9, D10	OPTIONAL SOD1608	
4	0	D11	OPTIONAL CD0603-1005	
5	0	R47, R65, R74, R88, R139	OPTIONAL 0603	
Hardware: For Demo Board Only				
1	1	E13 TO E16, E18, E26, E50	TESTPOINT, TURRET, 0.095"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP7	HEADER, 3 PIN 0.079 SINGLE ROW	SULLINS, NRPN031PAEN-RC
3	1	JP13	2MM DOUBLE ROW HEADER, 3X2	SAMTEC, TMM-103-02-L-D
4	4	J5 TO J8	STUD, TESTPIN	PEM KFH-032-10
5	8	J5 TO J8 X2	NUT, BRASS 10-32	ANY #10-32
6	4	J5 TO J8	RING, LUG #10	KEYSTONE (8205)
7	4	J5 TO J8	WASHER, TIN PLATED BRASS	ANY #10 EXT BZ TN
8	1	XJP13\+2mm CTRS	SHUNT, 2mm	SAMTEC, 2SN-BK-G
9	4		STAND-OFF, NYLON 0.50" TALL	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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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