LTC7800
Low Quiescent Current High Frequency Step-Down Converter

DESCRIPTION

Demonstration circuit 2786A is a single output non-isolated synchronous step-down converter that drives an all N-channel MOSFET 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 x 4mm QFN package.

This DC2786A operates over an input voltage range from 8V to 40V, while the LTC®7800 can operate up to 60V. This demo board produces a 3.3V output voltage with up to 10A output current, and is configured with a sense resistor for current sensing. A mode selector allows the DC2786A 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 deadtime which is good for GaN transistors or logic-level MOSFETs to maximize efficiency. The EXTVCC 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.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE	UNITS
Input Voltage Range		8 to 40	V
Output Voltage, V_{OUT}	V_{IN} = 8-40V, I_{OUT} = 0A to 10A	3.3	V
Maximum Output Current, I_{OUT}	V_{IN} = 8-40V, V_{OUT} = 3.3V	10	A
Typical Efficiency	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 10A	88.6	%
Peak Efficiency	V_{IN} = 12V, V_{OUT} = 3.3V	89	%
Switching Frequency		2	MHz

Note 1: 200LFM forced airflow is required for V_{IN} > 24V

BOARD PHOTO

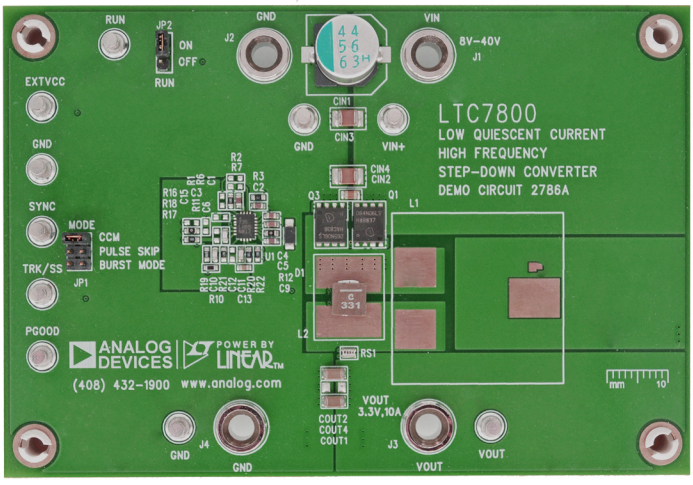


Figure 1. LTC7800; 10A DC2786A Demo Circuit

QUICK START PROCEDURE

Demonstration circuit 2786A is easy to set up to evaluate the performance of the LTC7800. Refer to Figure 2 for the proper measurement equipment setup and follow the procedure below.

1. With power off, connect the input power supply to VIN (8V-40V) and GND (input return).
2. Connect the output loads between VOUT and GND (**Initial load: no load**). Refer to Figure 2.

NOTE: Please use J1, J2 (Not E2, E4) and J3, J4 (Not E5, E7) for input power supply and output load connection.

3. Connect the DVMs to the input and output.
4. Check the default jumper/switch position: JP2 (RUN): OFF
5. Turn on the input power supply and adjust voltage to 12V;

NOTE. Make sure that the input voltage does not exceed 40V.

6. Turn on the switches: JP2: ON.
7. Check for the proper output voltages from VOUT to GND.
8. Once the proper output voltage is established, adjust the loads within the operating range and measure the efficiency, output ripple voltage and other parameters.
9. After completing all tests, adjust the load to 0A, power 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 3 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.

External EXTVCC Option

The $EXTV_{CC}$ pin of the LTC7800 on the DC2786A board can be utilized for better efficiency and better 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. Populate R24 with a 0Ω resistor.
2. Apply a DC voltage (recommend 6V – 13V) on EXTVCC 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

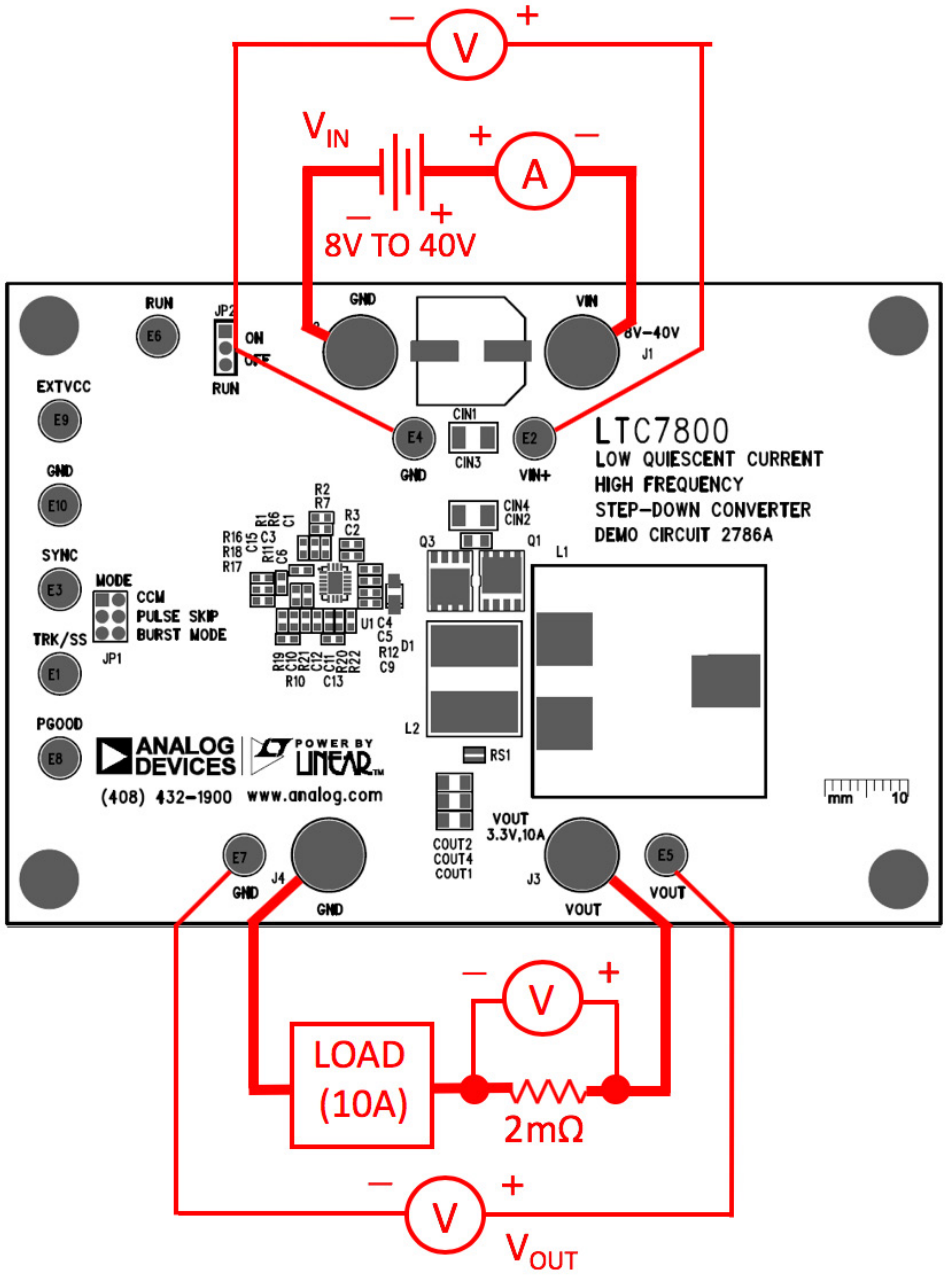


Figure 2. Proper Measurement Equipment Setup

QUICK START PROCEDURE

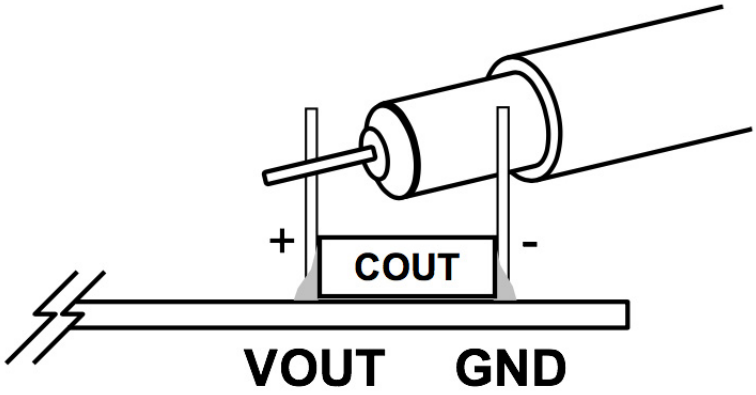


Figure 3. Measuring Output Voltage Ripple

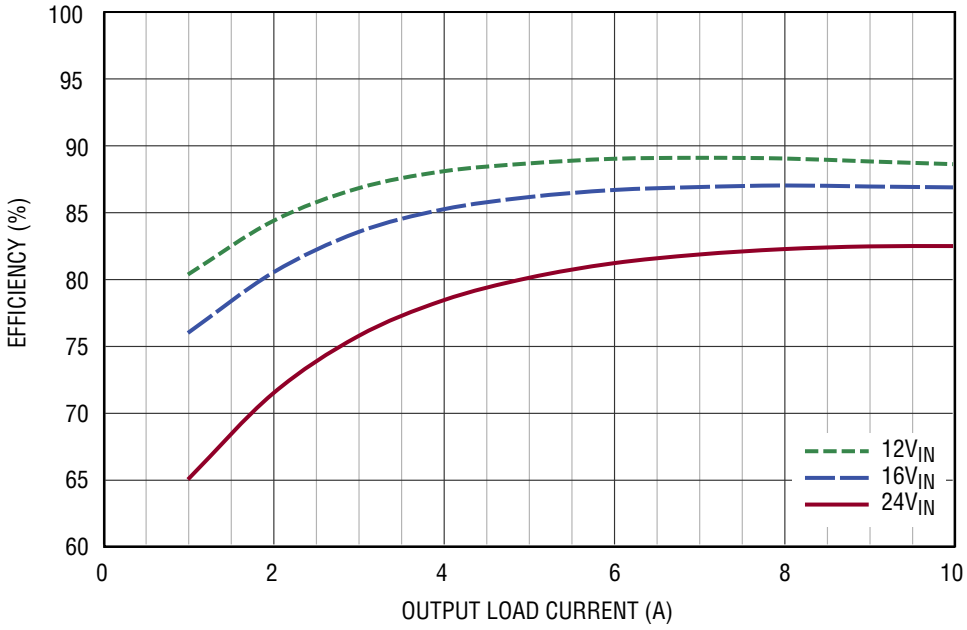


Figure 4. Efficiency vs Load Current at V_{OUT} = 3.3V, f_{SW} = 2MHz

QUICK START PROCEDURE

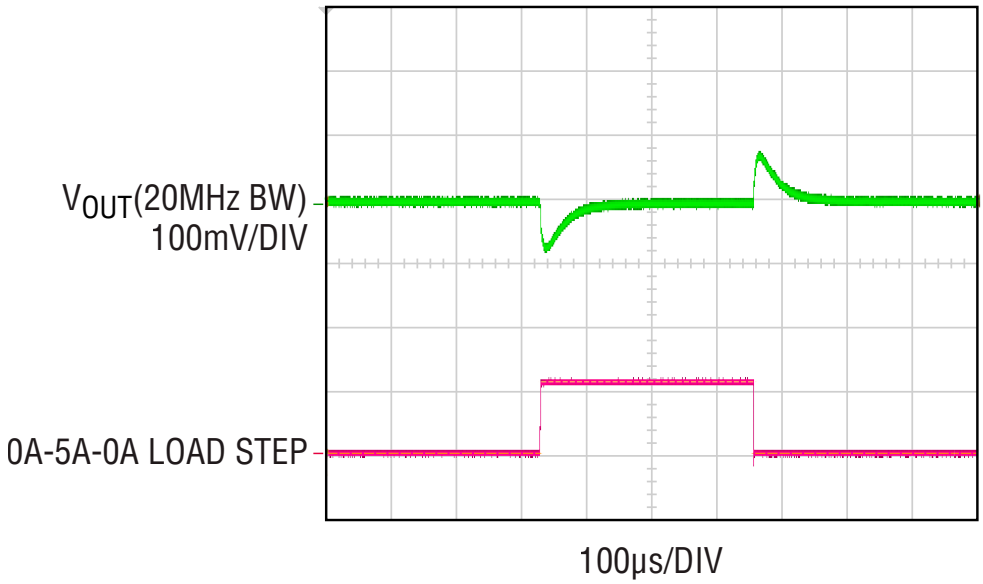


Figure 5. Load Step at V_{IN} = 12V, V_{OUT} = 3.3V, di/dt=5A/µs

QUICK START PROCEDURE

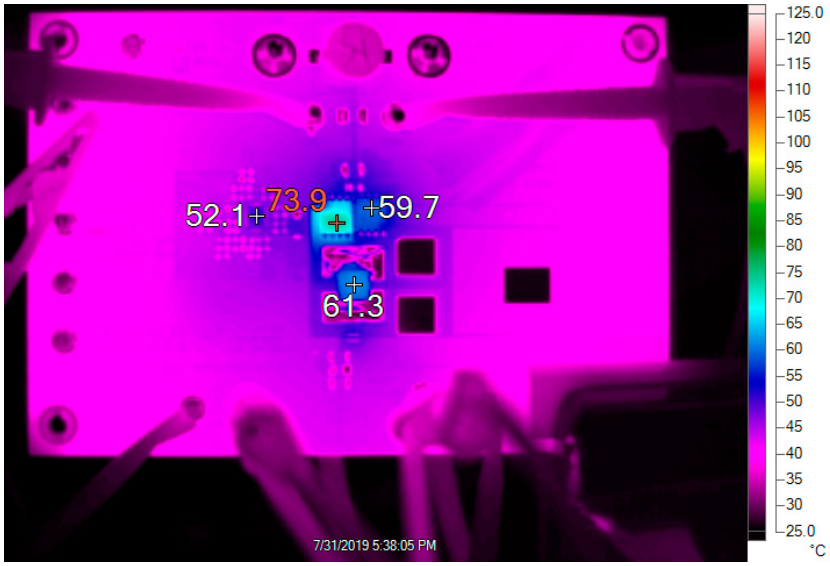


Figure 6. Thermal performance V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 10A T_A = 23°C, No Airflow

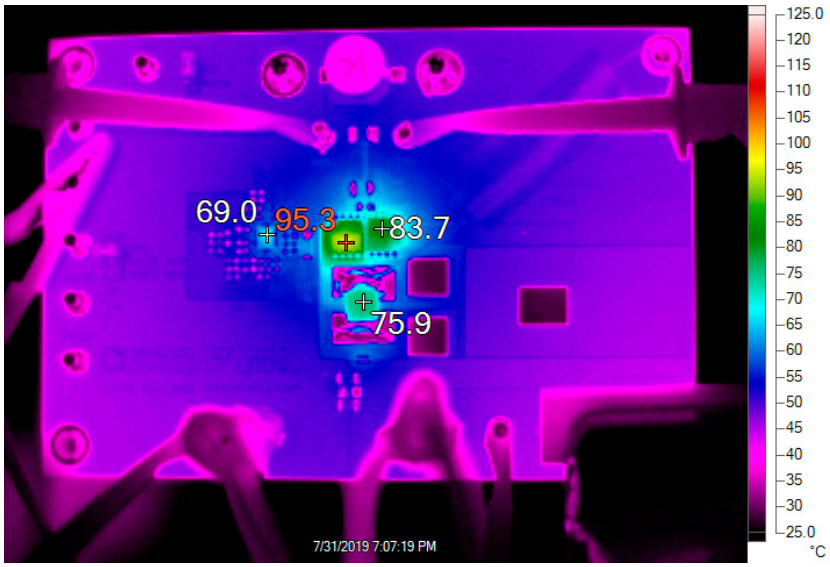


Figure 7. Thermal performance V_{IN} = 24V, V_{OUT} = 3.3V, I_{OUT} = 10A T_A = 23°C, No Airflow

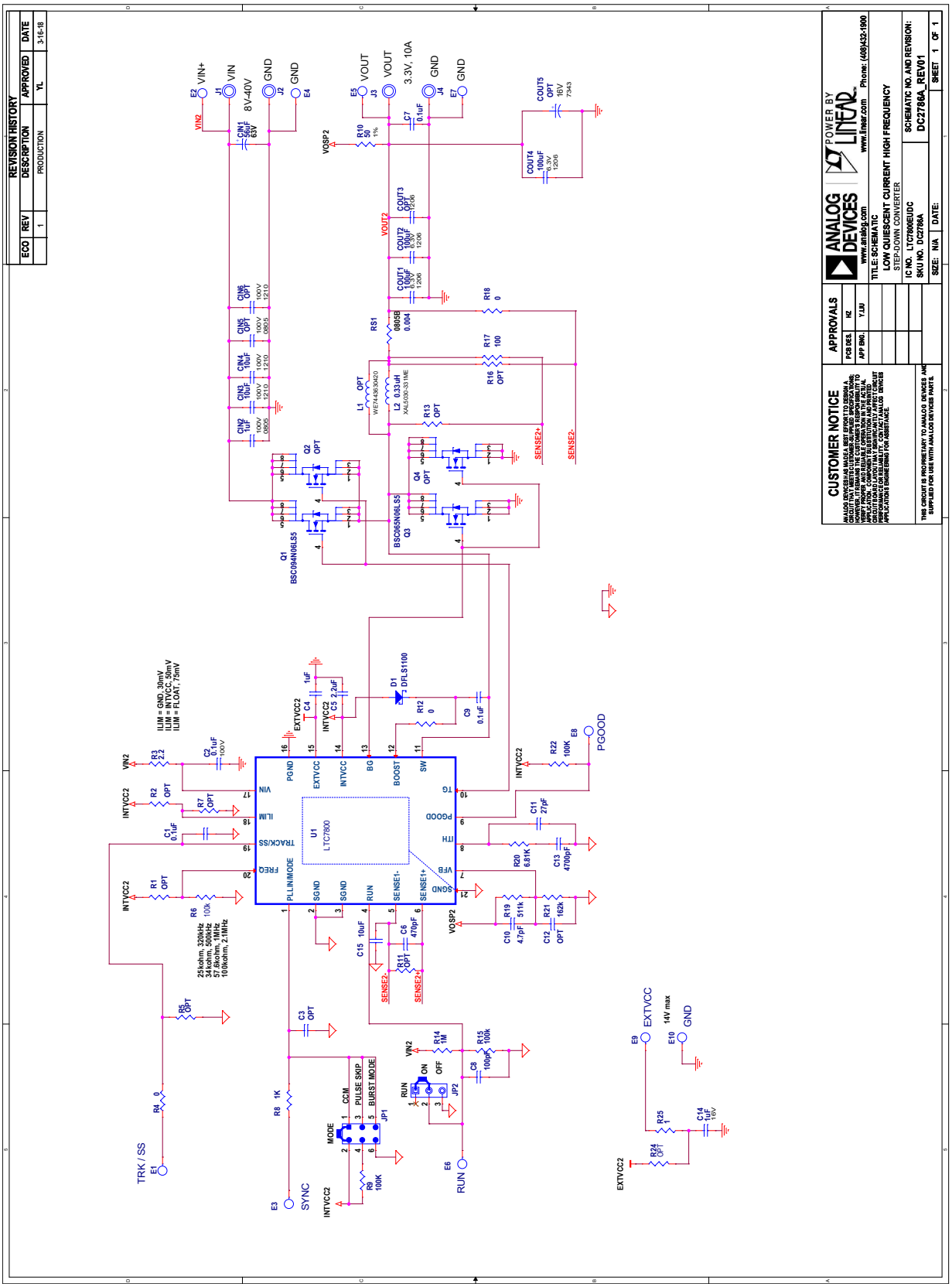
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP., 56uF 63V 13X13	SUNCON, 63HVH56M
2	1	CIN2	CAP., 0805 1uF 10% 100V X7S	MURATA, GRM21BC72A105KE01L
3	2	CIN3, CIN4	CAP., 1210 10uF 10% 100V X7S	MURATA, GRM32EC72A106KE05L
4	3	COUT1, COUT2, COUT4	CAP, 1206 100uF 10% 6.3V X5R	MURATA, GRM31CR60J107KE39L
5	4	C1, C2, C7, C9	CAP, 0603 0.1uF 10% 100V X7S	TDK, C1608X7S2A104K080AB
6	2	C4, C14	CAP, 0603 1uF 20% 25V X7R	TDK, C1608X7R1E105M080AE
7	1	C5	CAP, 0603 2.2uF 10% 10V X7R	MURATA, GRM188R71A225KE15D
8	1	C6	CAP, 0603 470pF 5% 50V C0G/NP0	AVX, 06035A471JAT2A
9	1	C8	CAP, 0603 100pF 5% 50V C0G/NP0	AVX, 06035A101JAT2A
10	1	C10	CAP, 0603 4.7pF 5% 25V C0G	AVX, 06033A4R7DAT2A
11	1	C11	CAP, 0603 27pF 10% 50V C0G	AVX, 06035A270KAT2A
12	1	C13	CAP, 0603 4700pF 10% 50V X7R	AVX, 06035C472KAT2A
13	1	C15	CAP, 0603 10uF 10V	TDK, C1608X5R1A106K080AC
14	1	D1	DIODE, SCHOTTKY 100V POWERDI123	DIODES INC., DFLS1100-7
15	1	L2	IND., 0.33uH	COILCRAFT, XAL5030-331MEB
16	1	Q1	POWER MOSFET	INFINEON, BSC094N06LS5ATMA1
17	1	Q3	POWER MOSFET	INFINEON, BSC065N06LS5
18	1	RS1	RES, 0805 0.004	SUSUMU, KRL2012E-C-R004-F-T5
19	1	R3	RES, 0603 2.2 OHMS 5%	VISHAY, CRCW06032R20JNEA
20	3	R4, R12, R18	RES, 0603 0 OHM JUMPER	VISHAY, CRCW06030000Z0EA
21	4	R6, R9, R15, R22	RES, 0603 100K OHMS 1%	VISHAY, CRCW0603100KFKEA
22	1	R8	RES, 0603 1K OHMS 5%	VISHAY, CRCW06031K00JNEA
23	1	R10	RES, 0603 49.9 OHMS 1%	VISHAY, CRCW060349R9FKEA
24	1	R14	RES., 1M, 1%, 0603	NIC, NRC06f1004TRF
25	1	R17	RES, 0603 100 OHMS 1%	VISHAY, CRCW0603100RFKEA
26	1	R19	RES, 0603 511K OHMS 1%	VISHAY, CRCW0603511KFKEA
27	1	R20	RES, 0603 6.81K OHMS 1%	VISHAY, CRCW06036K81FKEA
28	1	R21	RES, 0603 162K OHMS 1%	VISHAY, CRCW0603162KFKEA
29	1	R25	RES, 0603 1 OHMS 1%	VISHAY, CRCW06031R00FKEA
30	1	U1	IC., LTC7800, QFN	ANALOG DEVICES, LTC7800EUDC#PBF
Additional Demo Board Circuit Components				
1	0	CIN5	CAP., 0805, OPTION	
2	0	CIN6	CAP., 1210, OPTION	
3	0	COUT3	CAP., 1206, OPTION	
4	0	COUT5	CAP., 7343, OPTION	
5	0	C3, C12	CAP., 0603, OPTION	
6	0	L1	IND., High Current Inductor, OPTION	WURTH, WE7443630420
7	0	Q2, Q4	XSTR, POWER MOSFET., OPTION	
8	0	R16, R24, R1, R2, R5, R7, R11	RES., 0603, OPTION	
9	0	R13	RES., 0805, OPTION	

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	9	E1, E2, E3, E4, E5, E6, E7, E8, E9	TESTPOINT, TURRET, .095"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	2MM DOUBLE ROW HEADER, 3X2	SAMTEC, TMM-103-02-L-D
3	1	JP2	HEADER, 3 PIN 0.079 SINGLE ROW	SULLINS, NRPN031PAEN-RC
4	4	J1, J2, J3, J4	STUD, TESTPIN	PEM, KFH-032-10
5	8	J1, J2, J3, J4	NUT, BRASS 10-32	ANY, #10-32
6	4	J1, J2, J3, J4	RING, LUG #10	KEYSTONE, #10
7	4	J1, J2, J3, J4	WASHER, TIN PLATED BRASS	ANY, #10
8	1	XJP1, XJP2	SHUNT, 2mm	SAMTEC, 2SN-BK-G
9	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.375"	KEYSTONE, 8832

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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