

# LT8644S 8V, 16A Synchronous Step-Down Silent Switcher 2

## DESCRIPTION

Demonstration circuit 2779A is an 8V, 16A synchronous step-down Silent Switcher® 2 with spread spectrum frequency modulation featuring the [LT®8644S](#). The demo board is designed for 1.2V output from a 2.7V to 8V input. The LT8644S is a compact, ultralow emission, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated bypass capacitors optimize all the fast current loops and make it easier to minimize EMI emissions by reducing layout sensitivity. Selectable spread spectrum mode further improves EMI performance, making it perfect solution to the noise sensitive applications.

Peak current mode control with minimum on-time of as low as 20ns allows high step-down conversion even at high frequency. The LT8644S switching frequency can be programmed either via an external resistor or an external clock over a 300kHz to 3.5MHz range. The default frequency of demo circuit 2779A is 2MHz.

The SYNC/MODE pin on the demo board DC2779A is grounded (JP1 at BURST position) by default for low ripple Burst Mode® operation. It can be configured into different operation modes through JP1 and SYNC terminal (Table 1).

**Table 1. Operation Mode Configuration**

JP1 Position	SYNC (E5) Input	Operation Mode
SPREAD-SPECTRUM	N/A	Forced Continuous Mode with Spread-Spectrum
BURST	N/A	Low Ripple Burst Mode
FCM/SYNC	Floating	Forced Continuous Mode without Spread-Spectrum
FCM/SYNC	External Clock	Forced Continuous Mode with Synchronization

Figure 4 shows the efficiency of the circuit at 3.3V input and 5V input in force continuous mode operation (input from VIN terminal). To get accurate efficiency measurement, measure the input voltage at the VIN\_SENSE/GND terminals and measure the output voltage at the VOUT+ SENSE/VOUT– SENSE terminals. Figure 5 shows the LT8644S temperature rise on DC2779A demo board at 3.3V input and 5V input in forced continuous mode.

The LT8644S is assembled in a 4mm × 4mm LQFN package with exposed pads for low thermal resistance. The rated maximum continuous load current is 16A, while derating may be necessary for certain input voltage and thermal conditions.

The demo board has an EMI filter installed. This EMI filter can be included by applying the input voltage at the VEMI terminal. The EMI performance of the board (with EMI filter) is shown on Figure 6. The red lines in EMI Performance are CISPR25 Class 5 limits. The figure shows that the LT8644S circuit passes the test with a wide margin. To achieve EMI performance as shown in Figure 6, the input EMI filter is required and the input voltage should be applied to VEMI terminal, and the test setup can be referred to the CISPR25 standards. If the input is applied to VIN terminal, the EMI filter is bypassed.

The LT8644S data sheet gives a complete description of the part, the operation and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 2779A. The layout recommendations for low EMI operation and maximum thermal performance are available in the data sheet section Low EMI PCB Layout and Thermal Considerations. Contact ADI applications engineer for support.

**Design files for this circuit board are available.**

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## PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{IN}$	Input Supply Range		2.7		8	V
$V_{OUT}$	Output Voltage	$V_{IN} = 5\text{V}$	1.18	1.2	1.22	V
$I_{OUT}$	Maximum Continuous Output Current		16			A
$f_{SW}$	Switching Frequency		1.95	2	2.05	MHz
EFF	Efficiency	$V_{IN} = 5\text{V}$ , $V_{OUT} = 1.2\text{V}$ , $I_{OUT} = 8\text{A}$		90.2		%

## QUICK START PROCEDURE

Demonstration circuit 2779A is easy to set up to evaluate the performance of the LT8644S. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE:** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the output capacitor. See Figure 2 for the proper scope technique.

1. Make sure the Jump JP1 is on the BURST position. Refer to the schematic.
2. With power off, connect the input power supply to  $V_{IN}$  and GND. If the input EMI filter is desired, connect the input power supply to  $V_{EMI}$  and GND.
3. With power off, connect the load from  $V_{OUT+}$  to  $V_{OUT-}$ .
4. Connect the voltage meter across the  $V_{IN\_SENSE}$  and GND for  $V_{IN}$  measurement, and  $V_{OUT+}$  SENSE and  $V_{OUT-}$  SENSE for  $V_{OUT}$  measurement.
5. Turn on the power at the input.

**NOTE:** Make sure that the input voltage does not exceed 8V.

6. Check for the proper output voltage ( $V_{OUT} = 1.2\text{V}$ ).

**NOTE:** If there is no output, temporarily disconnect the load to make sure that the load is not set too high or is shorted.

7. Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency, and other parameters.
8. An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the FCM/SYNC position). Please make sure that R2 should be chose to set the LT8644S switching frequency equal to or below the lowest SYNC frequency. When JP1 is in FCM/SYNC position and no external clock is connected to the SYNC terminal of the board, the SYNC/MODE pin is floating and the LT8644S runs in forced continuous mode. JP1 can also set LT8644S in spread spectrum mode (JP1 on the SPREAD-SPECTRUM position).
9. To test the transient response, connect a signal generator to PULSE GEN terminal, and add a desired base load between  $V_{OUT+}$  and  $V_{OUT-}$  (LOAD shown on Figure 1). Adjust the signal generator with a 2ms period, 5% duty cycle and an amplitude from 1V to 2V to start. Measure the LOAD STEP voltage to observe the current ( $I_{LOADSTEP} = V_{LOAD\_STEP}/10\text{m}\Omega$ ). Adjust the amplitude of the pulse to provide the desired transient. Adjust the rising and falling edge of the pulse to provide the desired ramp rate. Figure 3 shows a load step from 4A to 12A. The 4A base load is added between  $V_{OUT+}$  and  $V_{OUT-}$ , while the 8A step load is controlled by the signal generator at PULSE\_GEN and measured at LOAD\_STEP with 0.01V/A ratio.

## QUICK START PROCEDURE

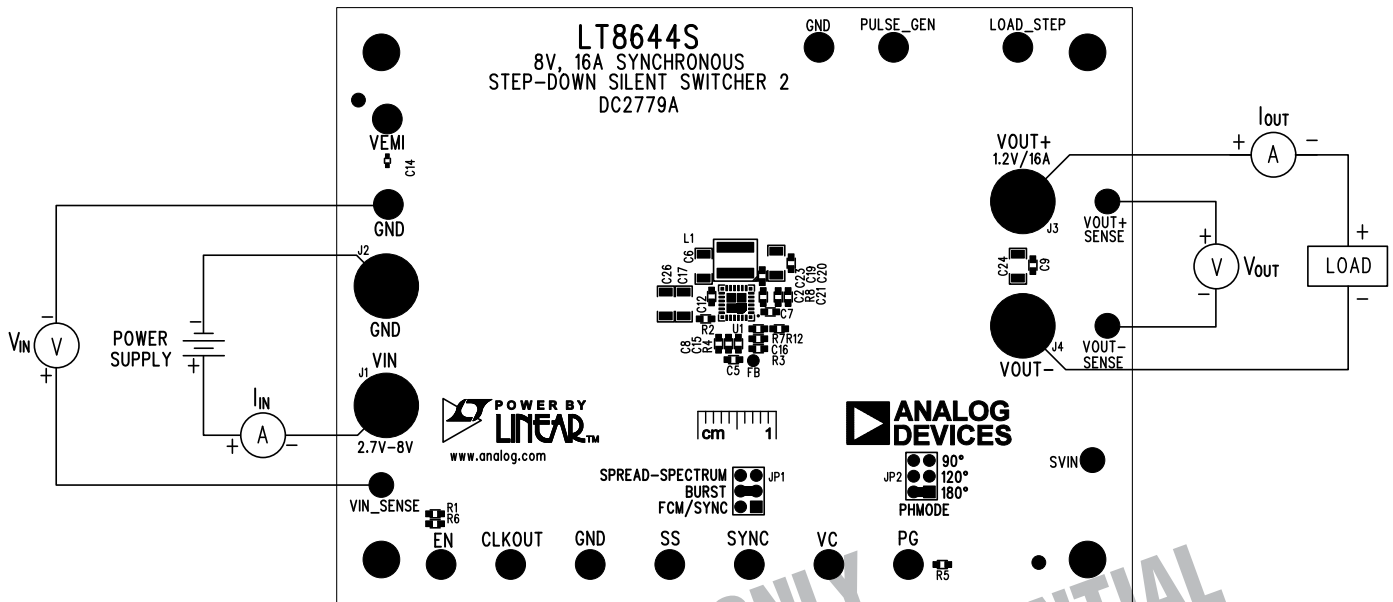


Figure 1. Proper Measurement Equipment Setup

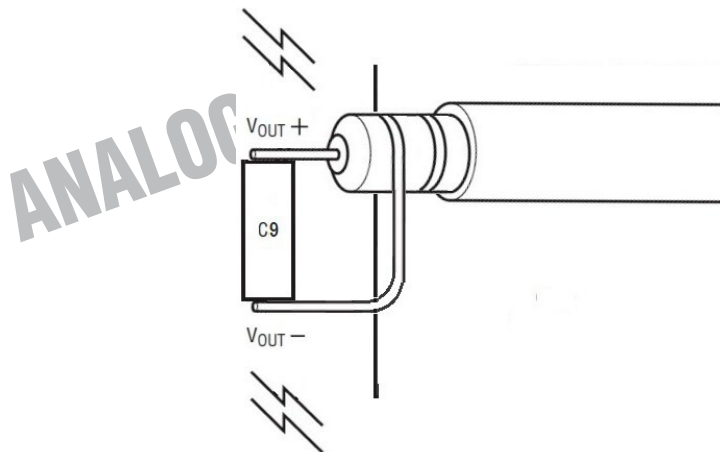


Figure 2. Measuring Output Ripple at Output Capacitor C9

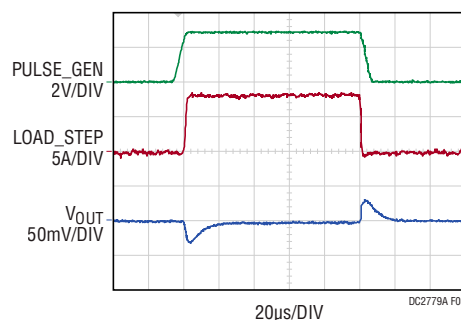


Figure 3. LT8644S Demo Circuit DC2779A Transient Response ( $V_{IN} = 5V$ , 4A to 12A Load Step)

QUICK START PROCEDURE

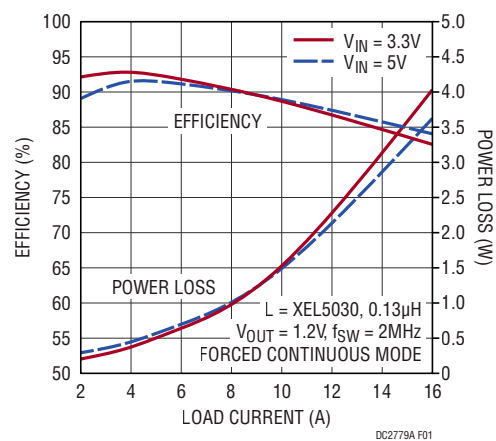


Figure 4. LT8644S Demo Circuit DC2779A Efficiency vs Load Current

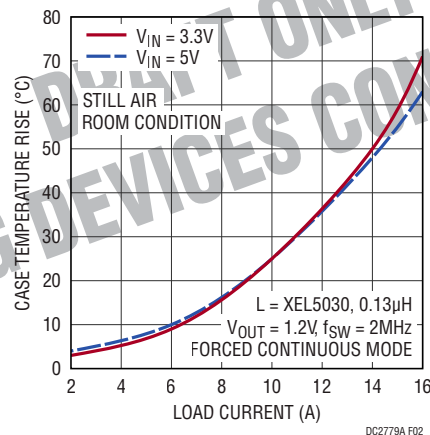
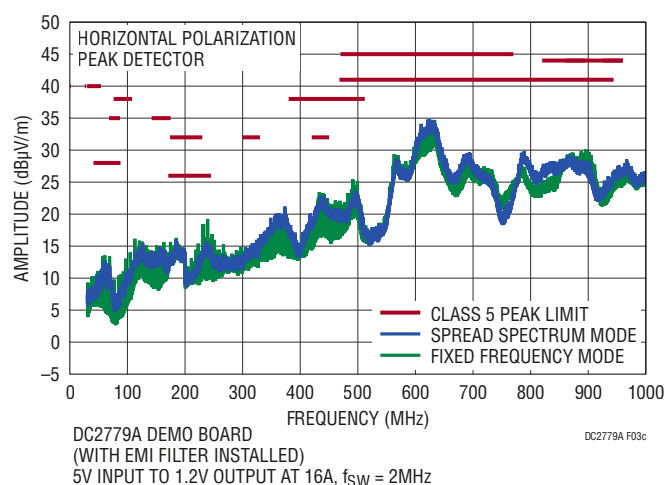
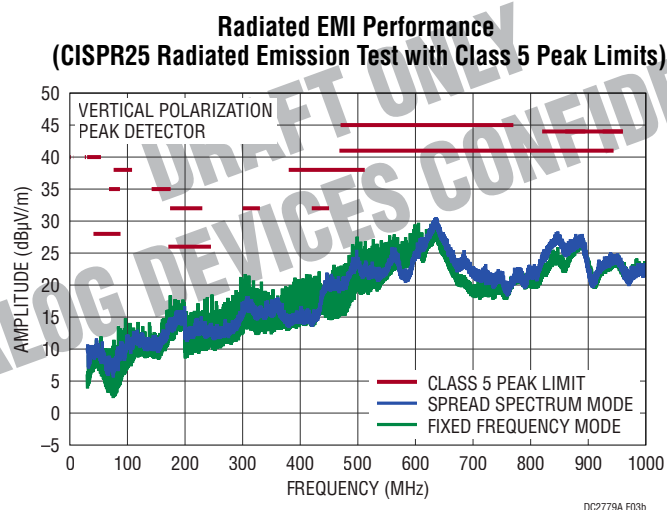
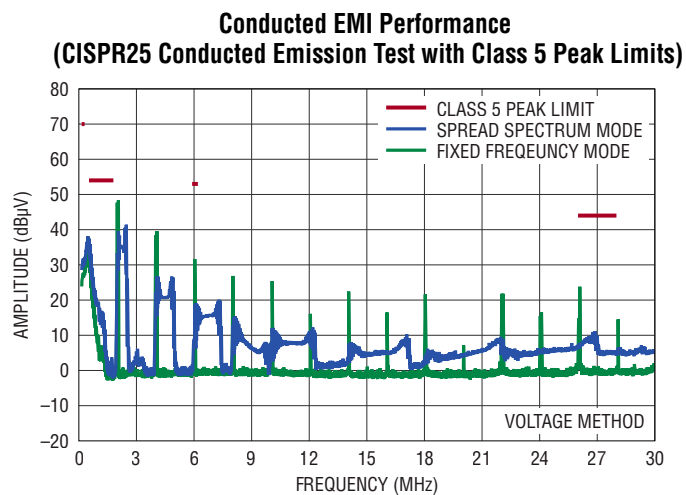


Figure 5. LT8644S Demo Circuit DC2779A Case Temperature Rise vs Load Current

## QUICK START PROCEDURE



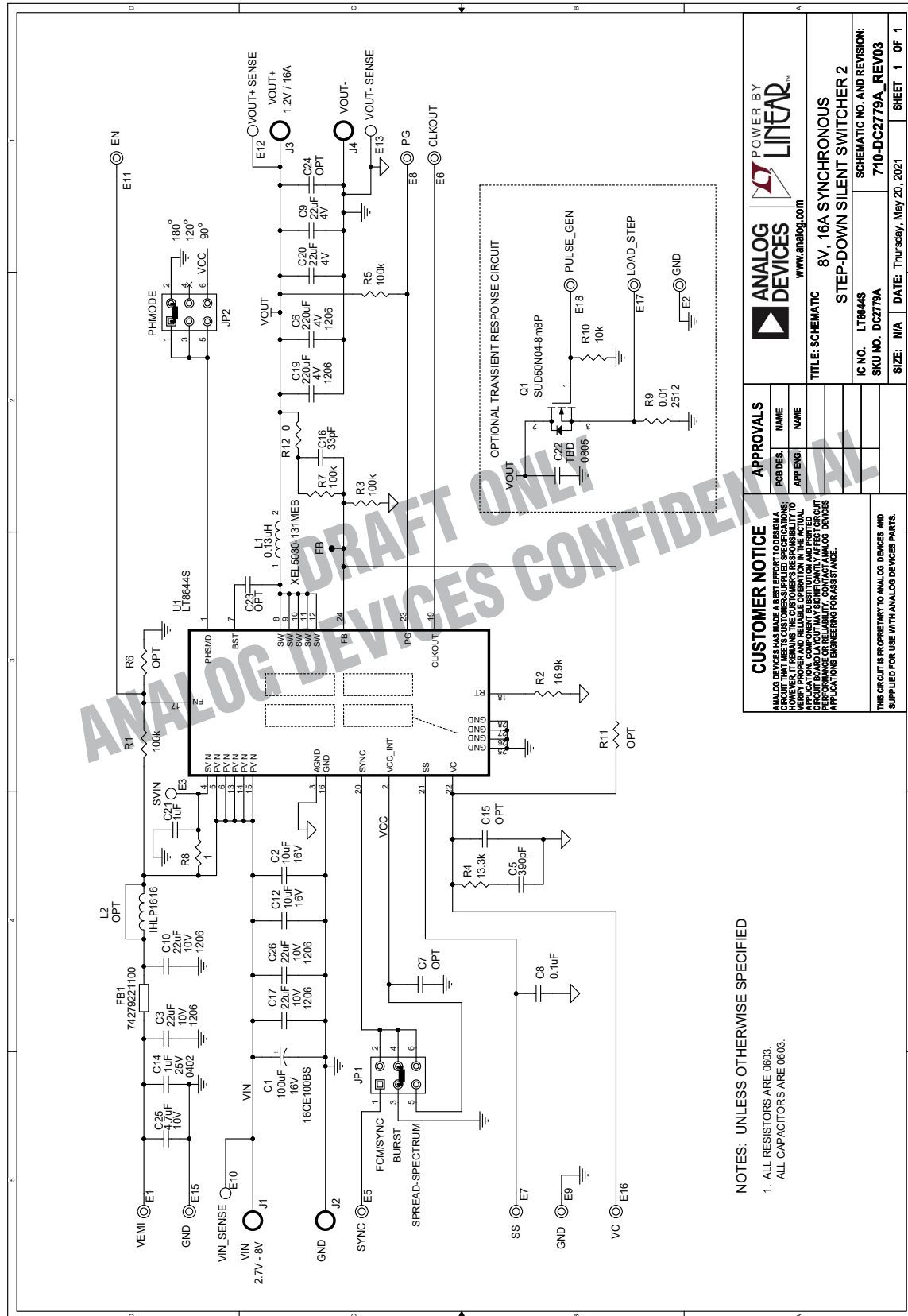
**Figure 6. LT8644S Demo Circuit DC2779A EMI Performance**

# DEMO MANUAL DC2779A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	2	C2, C12	CAP, 10 $\mu$ F, X5R, 16V, 10%, 0603	MURATA, GRM188R61C106KAALD
2	1	C5	CAP, 390pF, C0G/NP0, 50V, 5%, 0603	AVX, 06035A391JAT2A
3	2	C6, C19	CAP, 220 $\mu$ F, X5R, 4V, 20%, 1206	MURATA, GRM31CR60G227ME11L
4	1	C8	CAP, 0.1 $\mu$ F, X7R, 16V, 10%, 0603	AVX, 0603YC104KAT2A
5	2	C9, C20	CAP, 22 $\mu$ F, X5R, 4V, 20%, 0603	MURATA, GRM188R60G226MEA0D
6	1	C16	CAP, 33pF, C0G, 50V, 5%, 0603	AVX, 06035A330JAT2A
7	2	C17, C26	CAP, 22 $\mu$ F, X7R, 10V, 10%, 1206	MURATA, GRM31CR71A226KE15L
8	1	C21	CAP, 1 $\mu$ F, X7R, 16V, 10%, 0603	AVX, 0603YC105KAT2A
9	1	L1	IND., 0.13 $\mu$ H, PWR, 20%, 35A, 1.83m $\Omega$ , 5.48mm $\times$ 5.28mm	COILCRAFT, XEL5030-131MEB
10	4	R1, R3, R5, R7	RES., 100k, 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
11	1	R2	RES., 16.9k, 1%, 1/10W, 0603	VISHAY, CRCW060316K9FKEA
12	1	R4	RES., 13.3k, 1%, 1/10W, 0603	VISHAY, CRCW060313K3FKEAC
13	1	R8	RES., 1 $\Omega$ , 1%, 1/10W, 0603	VISHAY, CRCW06031R00FKEA
14	1	U1	IC, STEP-DOWN SWITCHER, LQFN-24 (4mm $\times$ 4mm)	ANALOG DEVICES, LT8644SIV#TRMPBF
<b>Additional Demo Board Circuit Components</b>				
1	1	C1	CAP, 100 $\mu$ F, ALUM. ELECT., 16V, 20%, 6.3mm $\times$ 5.4mm	SUN ELECTRONIC INDUSTRIES CORP, 16CE100BS
2	2	C3, C10	CAP, 22 $\mu$ F, X7R, 10V, 10%, 1206	MURATA, GRM31CR71A226KE15L
3	0	C7, C15, C23 (OPT)	CAP, OPTION, 0603	
4	1	C14	CAP, 1 $\mu$ F, X5R, 25V, 10%, 0402	MURATA, GRM155R61E105KA12D
5	0	C22 (OPT)	CAP, OPTION, 0805	
6	0	C24 (OPT)	CAP, OPTION, 1206	
7	1	C25	CAP, 4.7 $\mu$ F, X7S, 10V, 10%, 0603	MURATA, GRM188C71A475KE11D
8	1	FB1	IND., 10 $\Omega$ AT 100MHz, FERRITE BEAD, 25%, 10.5A, 3m $\Omega$ , 1206	WURTH ELEKTRONIK, 74279221100
9	0	L2 (OPT)	IND., OPTION	
10	1	Q1	XSTR., MOSFET, N-CH, 40V, 14A, DPAK (TO-252)	VISHAY, SUD50N04-8M8P-4GE3
11	0	R6, R11 (OPT)	RES., OPTION, 0603	
12	1	R9	RES., 0.01 $\Omega$ , 1%, 1W, 2512, PWR, METAL, SENSE	VISHAY, WSL2512R0100FEA
13	1	R10	RES., 10k, 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEA
14	1	R12	RES., 0 $\Omega$ , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
<b>Hardware: For Demo Board Only</b>				
1	12	E1, E2, E5-E9, E11, E15-E18	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	E3, E10, E12, E13	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2308-2-00-80-00-00-07-0
3	2	JP1, JP2	CONN., HDR, MALE, 2x3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
4	4	J1-J4	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	WURTH ELEKTRONIK, 702935000
6	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

## SCHEMATIC DIAGRAM



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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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