LT8601
42V Triple Monolithic Synchronous Step-Down Regulator

DESCRIPTION

Demonstration circuit 2346A is a triple power supply featuring the LT®8601. LT8601 is a 42V triple monolithic synchronous step-down regulator. The demo circuit is designed for 5V, 3.3V, and 1.8V outputs from a nominal 12V input, with switching frequency set at 2MHz to avoid audio band. The 1.8V converter is powered from the 3.3V output, and the 5V, 3.3V are powered from a wide range of 6V to 24V, transient to 42V. The current capability is 2.5A for the 3.3V output, 1.5A for the 5V output, and 1.8A for the 1.8V output when running individually. Up to 1A load current can be applied to all the channels simultaneously without special cooling.

Individual soft-start, current limit, input voltage, power good for each output simplify the complex design of quad-output power converters. All regulators are synchronized to a common external clock input or a resistor programmable 250kHz to 2.2MHz internal oscillator. At all frequencies, a 180° phase shift is maintained between 1 and 2 channels, reducing the input peak current and voltage ripple. Programmable frequency allows optimization between efficiency and external component size. Each output can be independently disabled using its own TRKSS or RUN pin and be placed in a low quiescent current shutdown mode. Table 1 summarizes the performance of the demo board at room temperature. The circuit can be easily modified for different applications. Figure 4 shows the typical thermal performance of the circuit.

The demo board has an EMI filter installed on the bottom layer. The radiated EMI performance of the board is shown on Figure 3. The limit in Figure 3 is CISPR Class 5, Peak. It shows the circuit passes the CISPR Class 5, Peak test with a wide margin.

The LT8601 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 2346A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2346A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

Table 1.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range, V_{IN}		6	12	24	V
Maximum Transient V_{IN}	Transient			42	V
Standby Current When Switching	$I_{OUT1,2,3}$ = 0mA, V_{IN} = 12V		60		µA
Output Voltage V_{OUT1}	V_{IN} = 12V, I_{OUT1} = 1A	4.80	5	5.20	V
Output Voltage V_{OUT2}	V_{IN} = 12V, I_{OUT2} = 1A	3.17	3.3	3.43	V
Output Voltage V_{OUT3}	I_{OUT3} = 1A	1.73	1.8	1.87	V
Maximum Output Current I_{OUT1}	V_{IN} = 12V, $I_{OUT2,3}$ = 0A	1.5			A
Maximum Output Current I_{OUT2}	V_{IN} = 12V, $I_{OUT1,3}$ = 0A	2.5			A
Maximum Output Current I_{OUT3}	$I_{OUT1,2}$ = 0A	1.8			A
Switching Frequency	V_{IN} = 12V, $I_{OUT1,2,3}$ = 1A	1.85	2	2.15	MHz
Efficiency, Channel 1	V_{IN} = 12V, I_{OUT1} = 1A		91		%
Efficiency, Channel 2	V_{IN} = 12V, I_{OUT2} = 1A		89		%
Efficiency, Channel 3	V_{IN} = 12V, I_{OUT3} = 1A		90		%

QUICK START PROCEDURE

Demo circuit 2346A is easy to set up to evaluate the performance of the LT8601. Refer to Figure 1 for proper equipment setup and follow the procedure below.

1. With power off, connect the input power supply to the board through V_{IN} and GND terminals on the top layer. Connect the loads to the terminals V_{OUT1} and GND, V_{OUT2} and GND, V_{OUT3} and GND on the board. The default positions of the headers are given in Table 2.

Table 2. Default Positions of the Headers

NAME		POSITION
EN/UVLO	JP1	ON
TRKSS1	JP4	ON
TRKSS2	JP5	ON
RUN3	JP2	RUN
SYNC	JP7	BURST

2. Turn on the power at the input. Increase V_{IN} to 12V.

   NOTE: Make sure that the input voltage is always within spec. Refer to data sheet on the Burst Mode® operation in light load and high V_{IN} condition.

3. Check for the proper output voltages. The output should be regulated at 5V (±4%), 3.3V (±4%), 1.8V (±4%).

   NOTE: Do not overload unless proper thermal cooling method such as air flow or heat sink is applied.

   NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high, and the headers of EN/UVLO, TRKSS1, TRKSS2, and RUN3 are set in right positions.

4. Once the proper output voltage is established, adjust the input voltage and load currents within the operating range, and observe the output voltage regulation, transient, ripple voltage, efficiency and other parameters.

   NOTE: Refer to the thermal derating curves in LT8601 data sheet for high input voltage and/or high ambient temperature operations.

   NOTE: By default, SYNC is grounded, and the circuit is set in low ripple Burst Mode operation. The circuit can be set in pulse-skipping Mode, and it runs in full frequency with lower load current. Refer to the data sheet for details on the input voltage and load current ranges that the circuit runs in full frequency. To synchronize to an external clock, apply the external clock to the SYNC turret.

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

QUICK START PROCEDURE

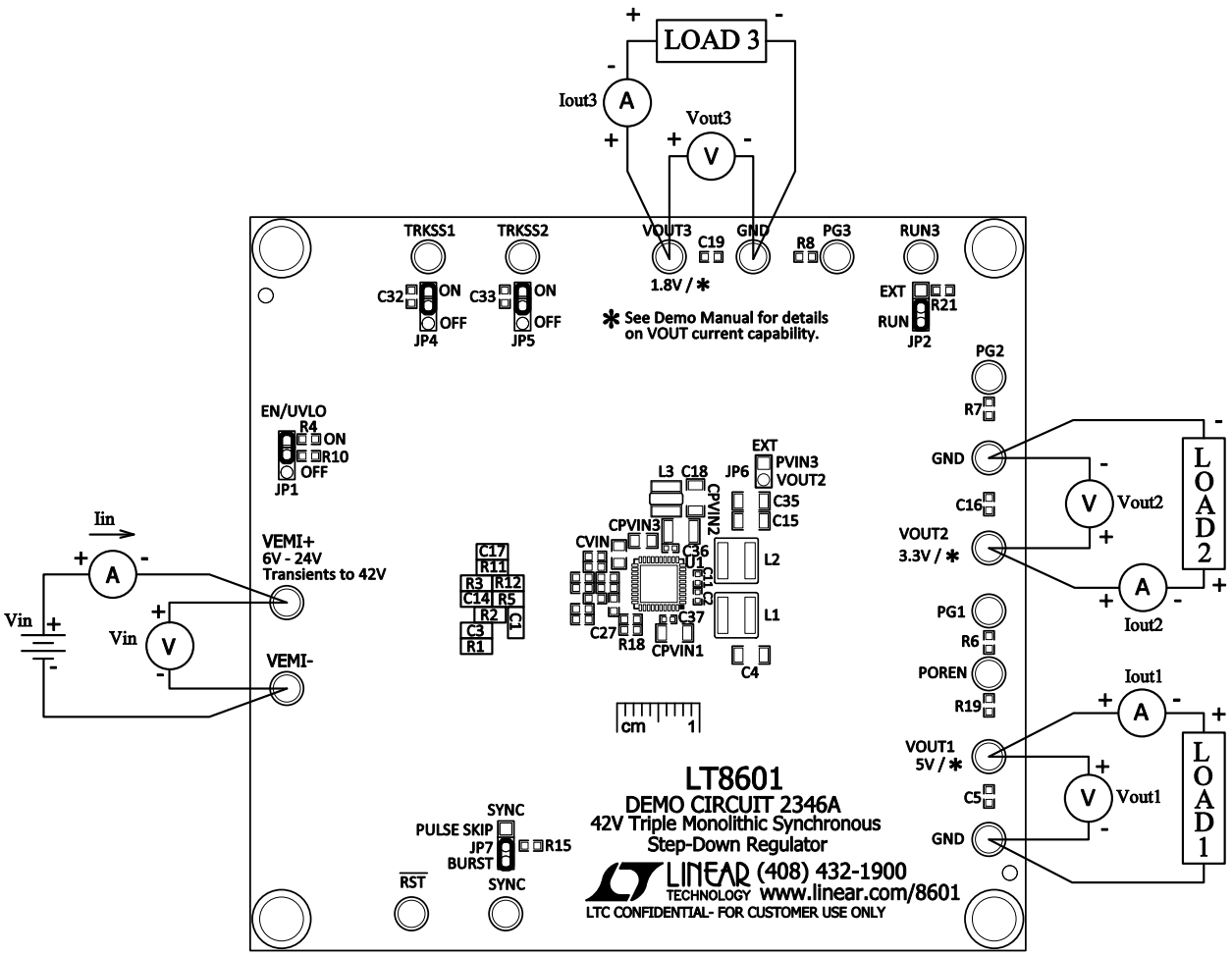


Figure 1. Proper Measurement Equipment Setup

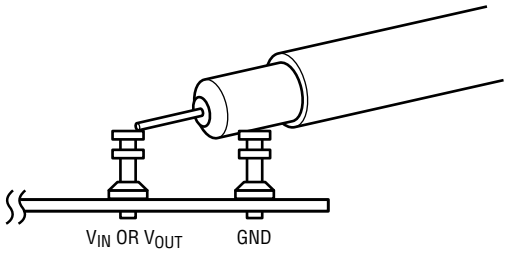


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

QUICK START PROCEDURE

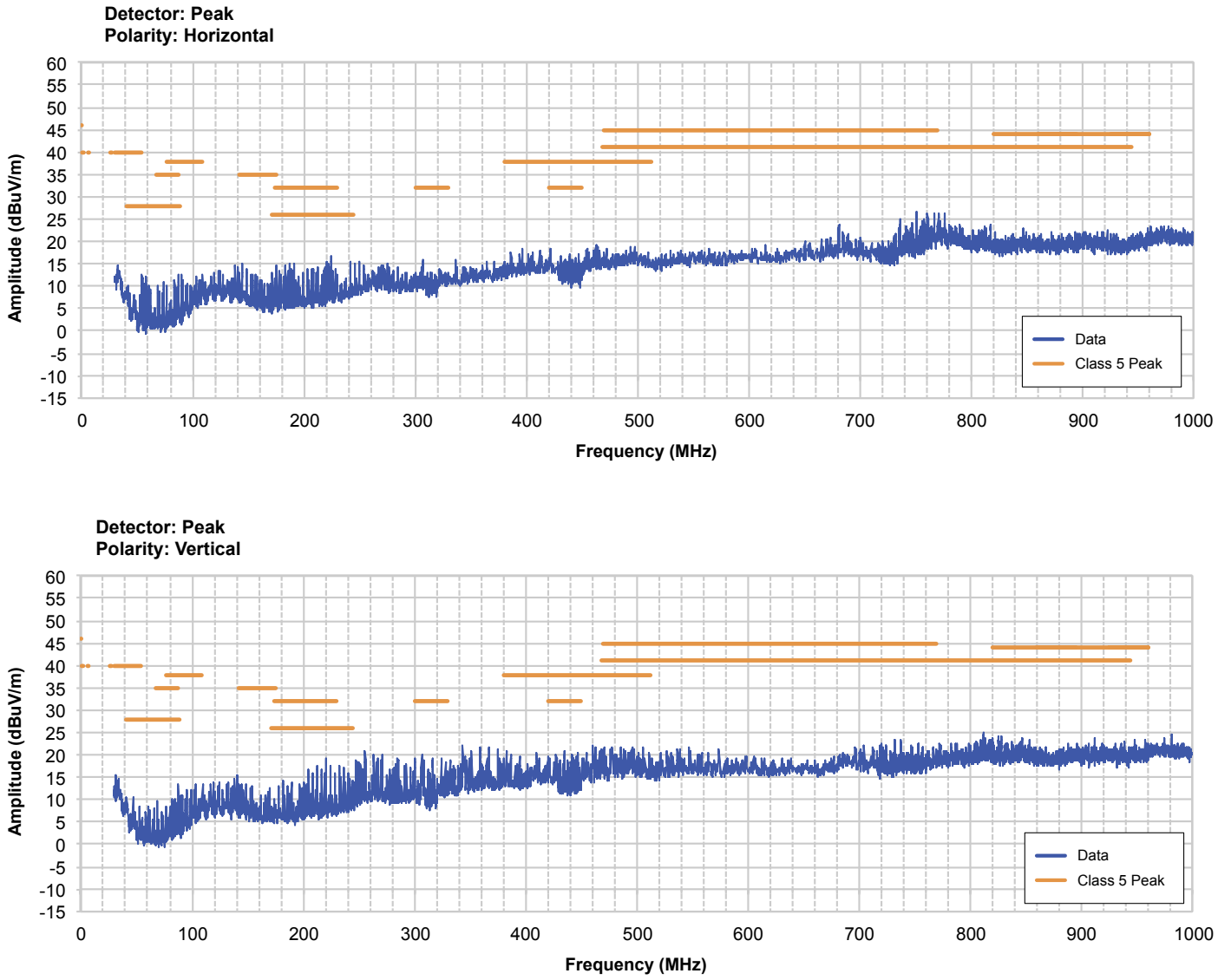
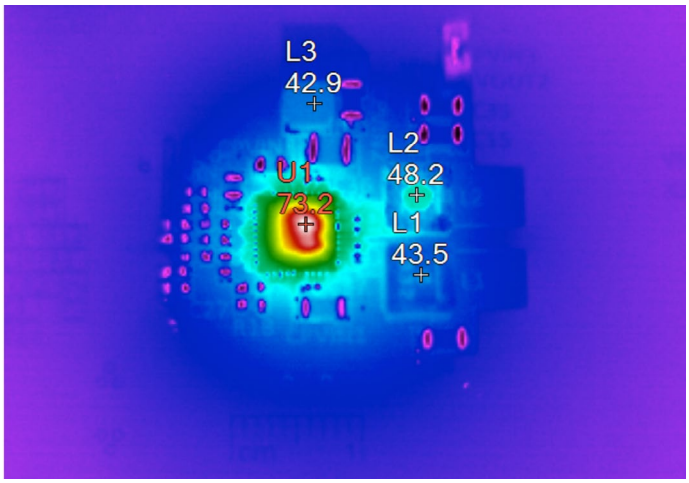
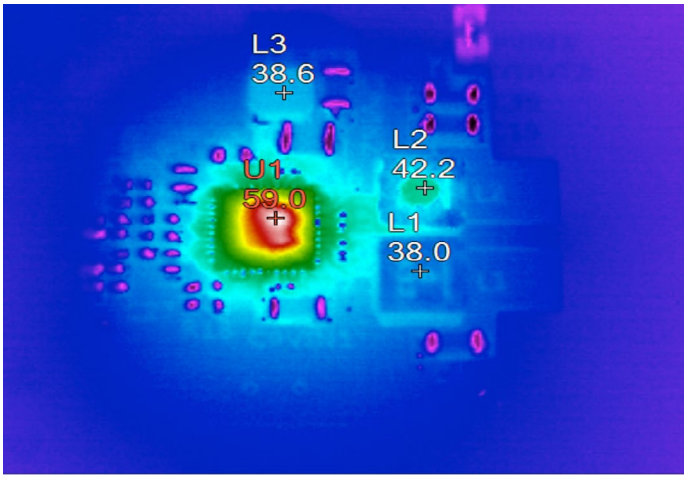


Figure 3. Radiated EMI Performance (Vertical/Horizontal), V_{IN} = 14V, $I_{OUT1,2,3}$ = 1A (CISPR25 Radiated Emission Test with Class 5 Peak Limits)

QUICK START PROCEDURE



A. V_{IN} = 24V



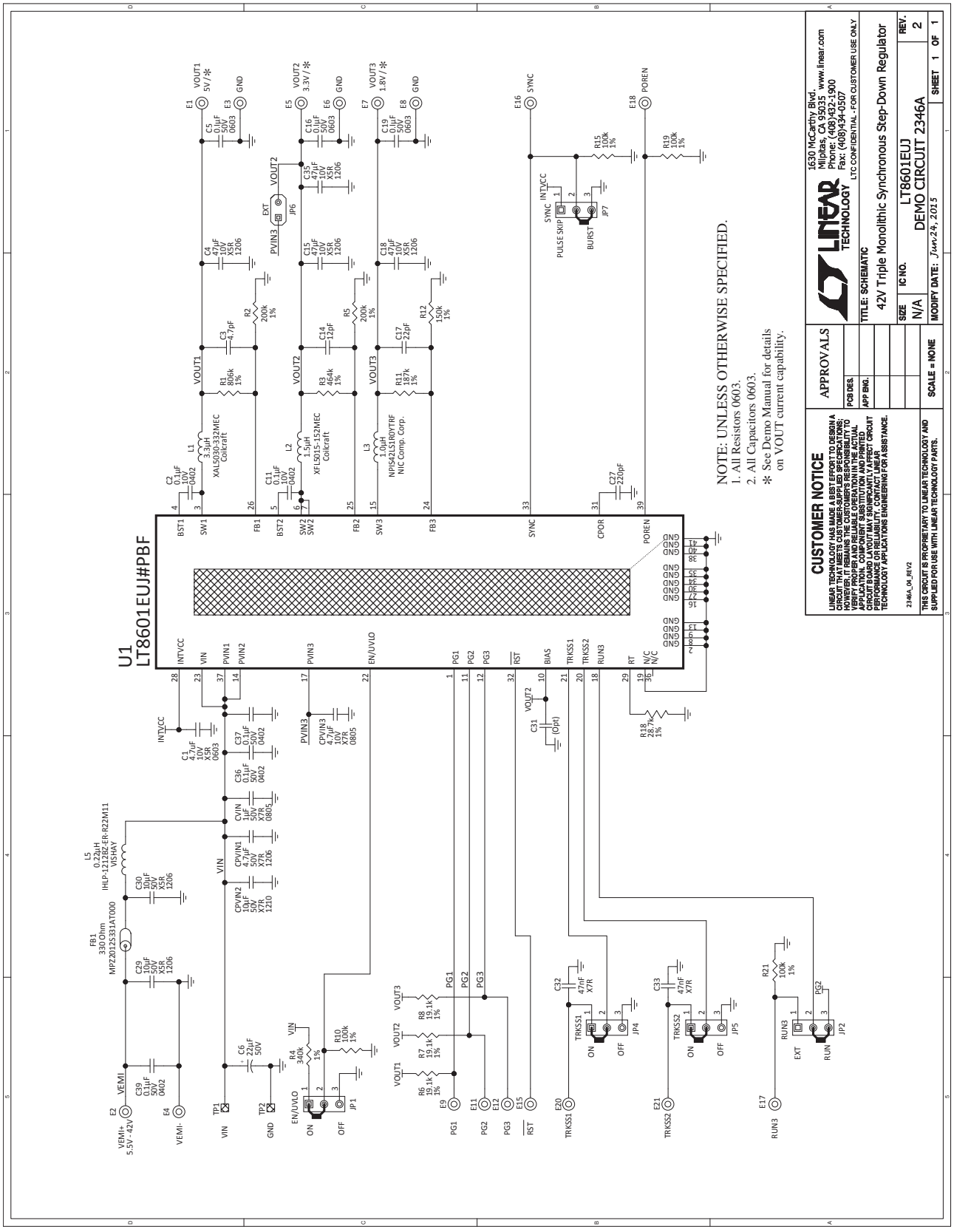
B. V_{IN} = 14V

Figure 4. Thermal Image Top View, $I_{OUT1,2,3}$ = 1A, T_A = 25°C, F_{SW} = 2MHz

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CPVIN1	Cap, 4.7µF X7R 50V 10% 1206	TDK C3216X7R1H475K
2	1	CPVIN2	Cap, 10µF X7R 50V 10% 1210	Murata GRM32ER71H106KA12L
3	1	CPVIN3	Cap, 4.7µF X7R 10V 10% 0805	Murata GRM21BR71A475KA73L
4	1	CVIN	Cap, 1µF X7R 50V 10% 0805	TDK C2012X7R1H105K
5	1	C1	Cap, 4.7µF X5R 10V 10% 0603	TDK C1608X5R1A475K
6	2	C2, C11	Cap, 0.1µF X5R 10V 10% 0402	AVX 0402ZD104KAT2A
7	1	C3	Cap, 4.7pF NPO 25V 10% 0603	AVX 06033A4R7KAT2A
8	4	C4, C15, C18, C35	Cap, 47µF X5R 10V 20% 1206	Murata GRM31CR61A476ME15L
9	3	C5, C16, C19	Cap, 0.1µF X7R 50V 10% 0603	Murata GRM188R71H104KA93D
10	1	C6	Cap, Alum 22µF 50V 10%	Sun Elect. 50CE22BSS
11	1	C14	Cap, 12pF NPO 25V 10% 0603	AVX 06033A120KAT2A
12	1	C17	Cap, 22pF NPO 25V 5% 0603	AVX 06033A220JAT2A
13	1	C27	Cap, 220pF X7R 25V 10% 0603	AVX 06033C221MAT2A
14	2	C29, C30	Cap, 10µF X5R 50V 10% 1206	TDK CGA5L3X5R1H106K160AB
15	2	C32, C33	Cap, 47nF X7R 25V 20% 0603	AVX 06033C473MAT2A
16	3	C36, C37, C39	Cap, 0.1µF X7R 50V 10% 0402	TDK CGA2B3X7R1H104K050BB
17	1	FB1	Ferrite Bead, 330Ω	TDK Corp. MPZ2012S331AT000
18	1	L1	Inductor, 3.3µH XAL5030	Coilcraft XAL5030-332MEC
19	1	L2	Inductor, 1.5µH XAL5030	Coilcraft XFL5015-152MEC
20	1	L3	Inductor, 1µH ±30% NPIS42LS	NIC Comp. Corp. NPIS42LS1R0YTRF
21	1	L5	Inductor, 0.22µH	Vishay IHLP-1212BZ-ER-R22M11
22	1	R1	Res, Chip 806k 0.06W 1% 0603	Vishay CRCW0603806KFKEA
23	2	R2, R5	Res, Chip 200k 0.06W 1% 0603	Vishay CRCW0603200KFKEA
24	1	R3	Res, Chip 464k 0.06W 1% 0603	Vishay CRCW0603464KFKEA
25	1	R4	Res, Chip 340k 0.06W 1% 0603	Vishay CRCW0603340KFKEA
26	3	R6, R7, R8	Res, Chip 19.1k 0.06W 1% 0603	Vishay CRCW060319K1FKEA
27	4	R10, R15, R19, R21	Res, Chip 100k 0.06W 1% 0603	Vishay CRCW0603100KFKEA
28	1	R11	Res, Chip 187k 0.06W 1% 0603	Vishay CRCW0603187KFKEA
29	1	R12	Res, Chip 150k 0.06W 1% 0603	Vishay CRCW0603150KFKEA
30	1	R18	Res, Chip 28.7k 0.06W 1% 0603	Vishay CRCW060328K7FKEA
31	1	U1	IC, Buck Regulator QFN(40) (UJ) 6MM × 6MM	Linear Technology Corporation LT8601EUJ#PBF
Additional Demo Board Circuit Components				
1	0	R31 (Opt)	Res, 0603	
Hardware: For Demo Board Only				
1	0	TP1,TP2 (Opt)	Testpoint	
2	5	XJP1, XJP2, XJP4, XJP5, XJP7	Shunt, 2mm Ctrs	Samtec 2SN-BK-G
3	17	E1, E2, E3, E4, E5, E6, E7, E8, E9, E11, E12, E15, E16, E17, E18, E20, E21	TEST POINT, TURRET, 0.094" MTH HOLE	Mill Max 2501-2-00-80-00-00-07-0
4	5	JP1, JP2, JP4, JP5, JP7	Headers, 3 Pins 2mm Ctrs	Samtec TMM-103-02-L-S
5	1	JP6	Jumper, 2 Pins 2mm Ctrs	Samtec TMM-102-02-L-S

SCHEMATIC DIAGRAM



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