LTM4650AEY
Dual 25A or Single 50A
DC/DC µModule Regulator

DESCRIPTION

Demonstration circuit 2603A-A features the LTM®4650AEY, the high efficiency, high density, dual 25A, single 50A switch mode step-down power module regulator. The input voltage is from 4.5V to 16V. The output voltage is programmable from 0.6V to 5.5V. DC2603A-A can deliver 25A maximum current from each channel. The board designs with minimum components to demonstrate this high efficiency, high density µModule®. As explained in the data sheet, output current derating is necessary for certain V_{IN}, V_{OUT}, and thermal conditions. The board operates in continuous conduction mode in heavy load conditions. For high efficiency at low load currents, the MODE jumper (JP1) selects pulse-skipping mode for noise sensitive applications or Burst Mode® operation in less noise sensitive applications. Two outputs can be connected in parallel for a single 50A output solution with optional jumper resistors. The board allows the user to program how its output ramps up and down through the TRACK/SS pin. The output can be set up to either coincidentally or ratiometrically track with another supply's output. Remote output voltage sensing is available for improved output voltage regulation at the load point. These features and the availability of the LTM4650AEY in a compact 16mm × 16mm × 5.01mm BGA package make it ideal for use in many high-density point-of-load applications. The LTM4650A data sheet must be read in conjunction with this demo manual for working on or modifying the demo circuit DC2603A-A. **Design files for this circuit board are available at http://www.analog.com/DC2603A-A**

BOARD PHOTO

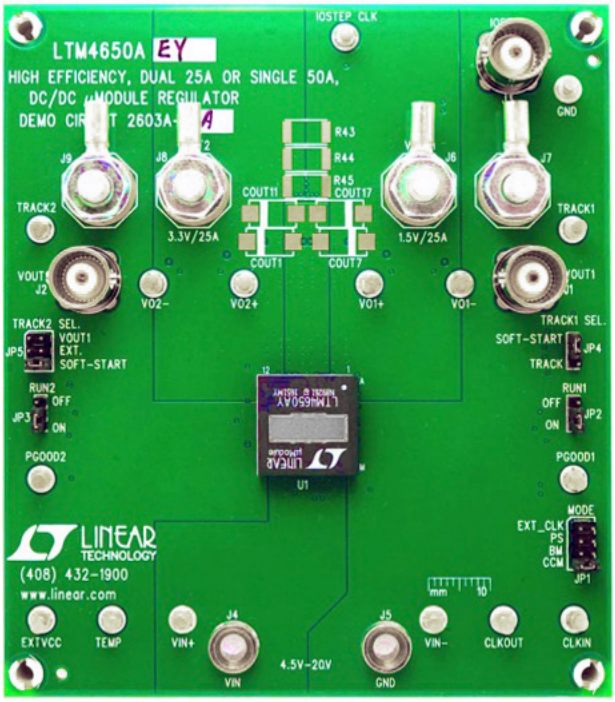


Figure 1. LTM4650A/DC2603A-A Demo Board

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		4.5V ~ 16V
Output Voltage V_{OUT1}	V_{IN} = 4.5~16V, I_{OUT1} = 0~25A, JP1: CCM	1.5V ± 1% (1.485V ~ 1.515V)
Output Voltage V_{OUT2}	V_{IN} = 4.5~16V, I_{OUT1} = 0~25A, JP1: CCM	3.3V ± 1% (3.267V ~ 3.333V)
Per- Channel Maximum Continuous Output Current	De-rating is Necessary for Certain V_{IN}, V_{OUT} and Thermal Conditions, see Data Sheet for Detail	25A
Default Operating Frequency		600kHz
Resistor Programmable Frequency Range		250kHz to 780kHz
External Clock Sync. Frequency Range		400kHz to 780kHz
Efficiency of Channel 1	V_{IN} = 12V, V_{OUT} = 1.5V, I_{OUT} = 25A, f_{SW} = 600 kHz	90.4%, See Figure 3
Efficiency of Channel 2	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 25A, f_{SW} = 600 kHz	94.2%, See Figure 4
Load Transient of Channel 1	V_{IN} = 12V, V_{OUT} = 1.5V, I_{STEP} = 12.5~18.75A	< ±3% (90mV_{P-P}), See Figure 5
Load Transient of Channel 2	V_{IN} = 12V, V_{OUT} = 3.3V, I_{STEP} = 12.5~18.75A	< ±3% (198mV_{P-P}), See Figure 6

QUICK START PROCEDURE

Demonstration circuit DC2603A-A is easy to set up to evaluate the performance of the LTM4650AEY. Please refer to Figure 2 for proper measurement setup and follow the procedure below:

1. Place jumpers in the following positions for a typical application:

JP1	JP2	JP3	JP4	JP5
MODE	**RUN1**	**RUN2**	**TRACK1 SEL**	**TRACK2 SEL**
CCM	ON	ON	SOFT-START	SOFT-START

2. With power off, connect the input power supply, load and meters as shown in Figure 2. Preset the load to 0A and V_{IN} supply to 12V.
3. Turn on the power supply at the input. The output voltage in channel 1 should be 1.5V ± 1.0% (0.985V~1.015V) and the output voltage in channel 2 should be 3.3V±1.0% (3.267V~3.333V)
4. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters. Output ripple can be measured at J1 and J2 with BNC cables.50Ω termination should be set on the oscilloscope or BNC cables.
5. (Optional) For optional load transient test, apply an adjustable pulse signal between "IOSTEP CLK" and "GND" test point. Pulse amplitude (3V~3.5V) sets the load step current amplitude. The output transient current can be monitored at the BNC connector J3 (10mV/A). The pulse signal should have very small duty cycle (< 10%) to limit the thermal stress on the transient load circuit. Switch the jumper resistors R34 or R35 (on the backside of boards) to apply load transient on channel 1 or channel 2 correspondingly.
6. (Optional) LTM4650A can be synchronized to an external clock signal. Place the JP1 jumper on EXT_CLK and apply a clock signal (0V~5V, square wave) on the CLKIN test point.
7. (Optional) The outputs of LTM4650A-1 can track another supply. The jumpers JP4 and JP5 allow choosing soft-start or output tracking. If tracking external voltage is selected, the corresponding test points, TRACK1 and TRACK2, need to be connected to a valid voltage signal.
8. (Optional) LTM4650A-1 can be configured for a 2-phase single output at up to 50A on DC2603A-A. Install 0Ω resistors on R14, R17, R28, R39, R43, R44, R45 and remove R7, R19. Output voltage is set by R25 based on equation:

$$V_{OUT} = 0.6V \bullet \left(1 + \frac{60.4k}{R25}\right)$$

QUICK START PROCEDURE

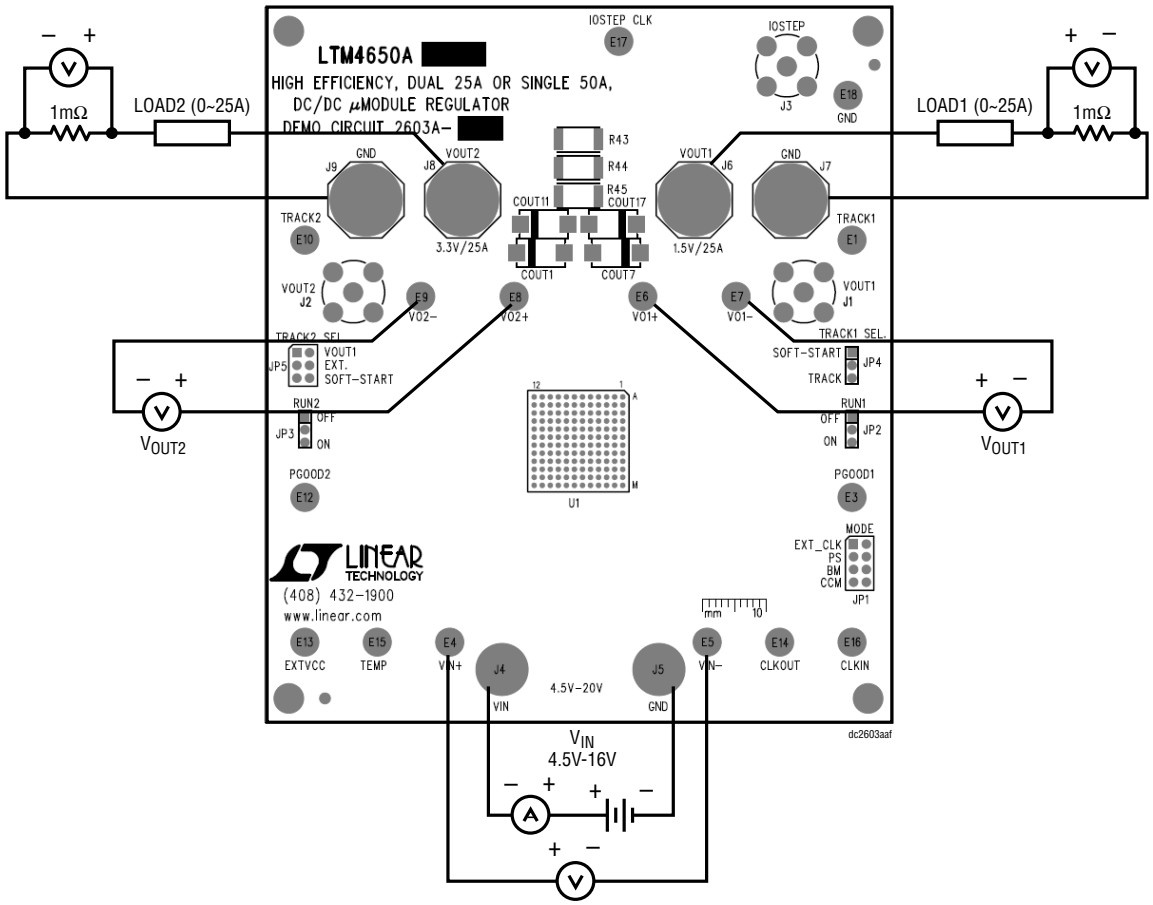


Figure 2. Test Setup of DC2603A-A

QUICK START PROCEDURE

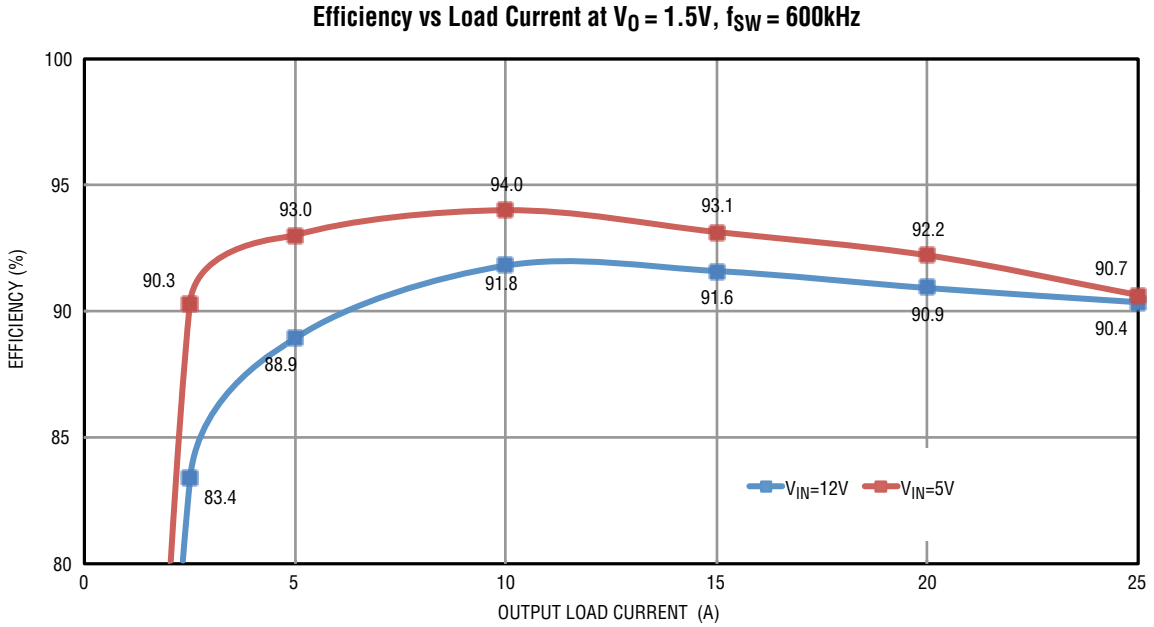


Figure 3. Measured Efficiency on Channel 1 (V_{OUT1} = 1.5V, f_{SW} = 600kHz, Channel2 Disabled)

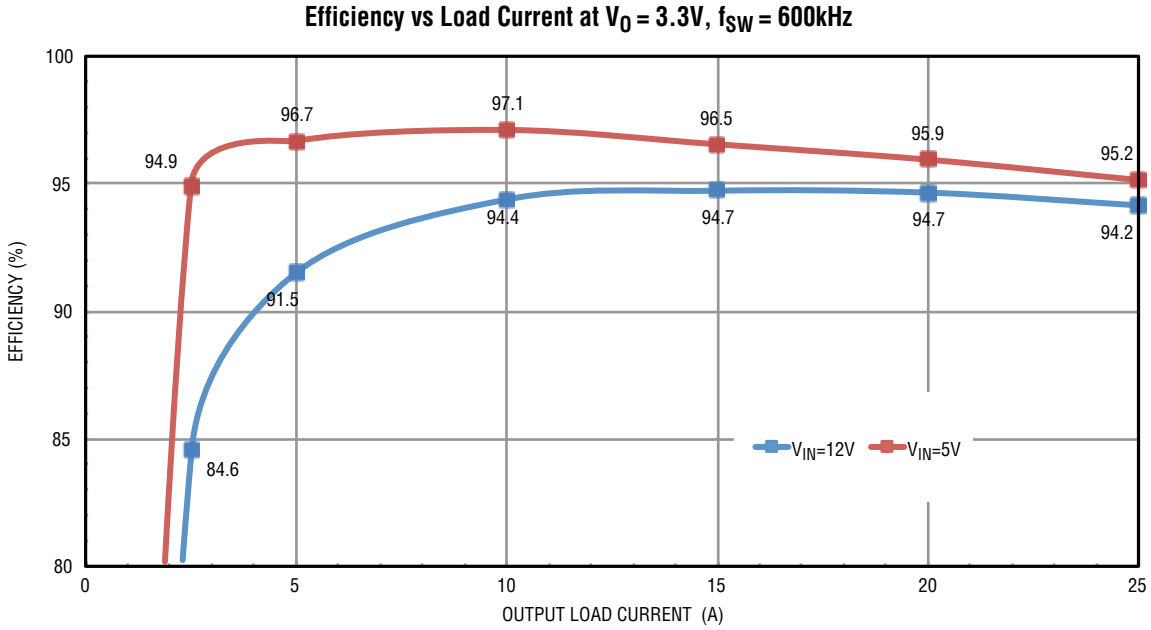


Figure 4. Measured Efficiency on Channel 2 (V_{OUT2} = 3.3V, f_{SW} = 600kHz, Channel1 Disabled)

QUICK START PROCEDURE

Figure 5. Measured Channel 1 12.5A-18.75A Load Transient (V_{IN} = 12V, V_{OUT1} = 1.5V)

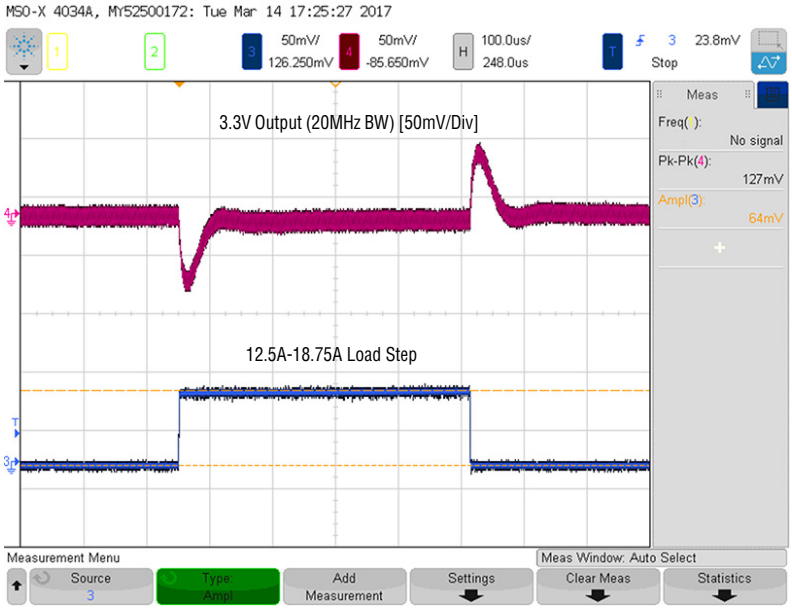


Figure 6. Measured Channel 2 12.5A-18.75A Load Transient (V_{IN} = 12V, V_{OUT2} = 3.3V)

QUICK START PROCEDURE

Figure 7. Measured Output Voltage Ripple at 12V Voltage Input, 1.5V/25A, f_{SW} = 600kHz, Measured Across C_{OUT6} Using 1× Probe

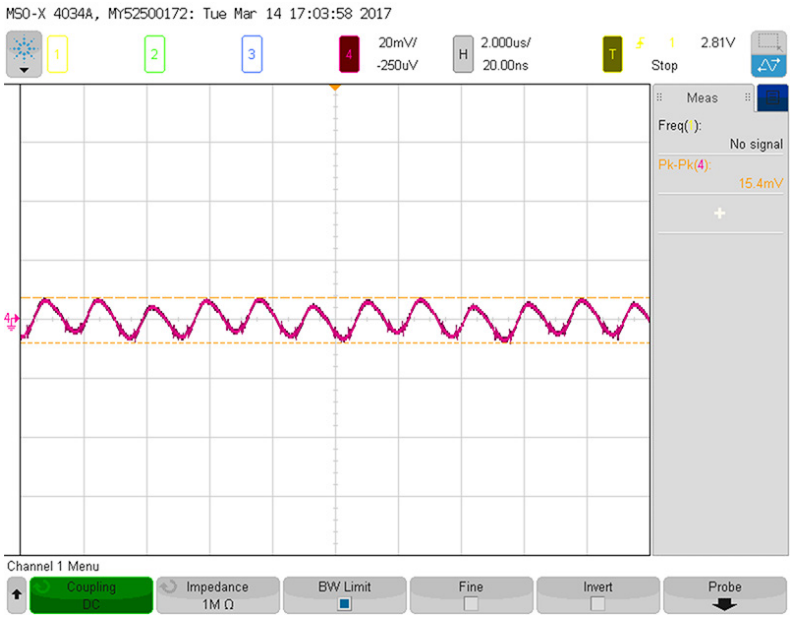


Figure 8. Measured Output Voltage Ripple at 12V Voltage Input, 3.3V/25A, f_{SW} = 600kHz, Measured Across C_{OUT2} Using 1× Probe

QUICK START PROCEDURE

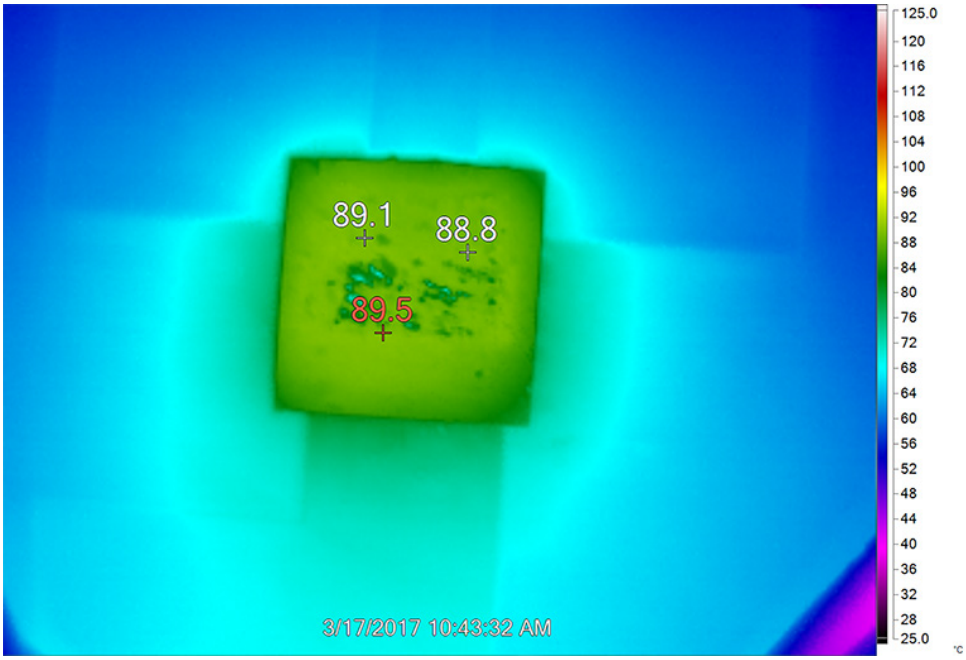


Figure 9. Thermal Performance at V_{IN} = 12V, V_{OUT1} = 1.5V/25A, V_{OUT2} = 3.3V/25A, f_{SW} = 600kHz, T_A = 23 °C, No Forced Air Airflow

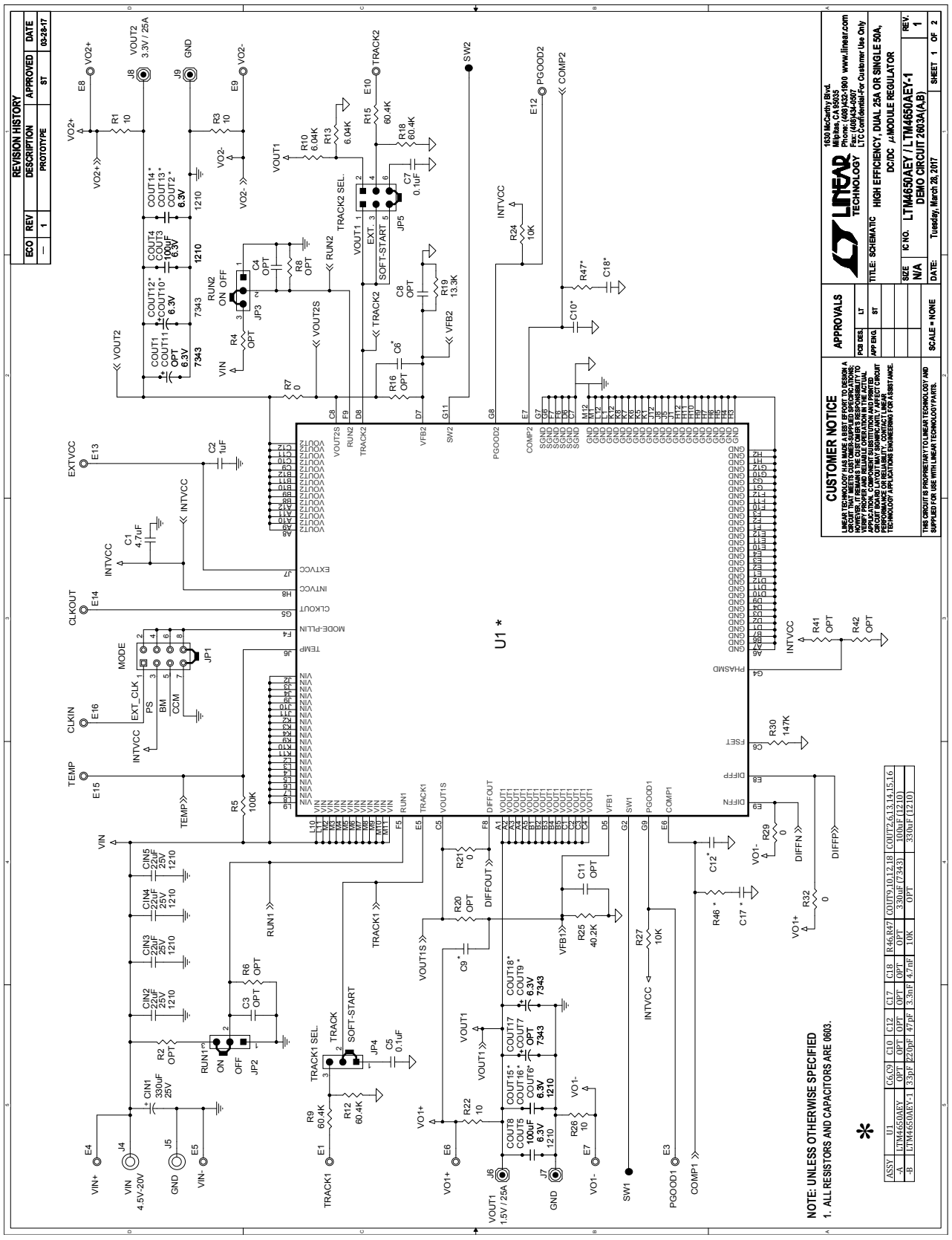
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP., 330µF, ALUM, OS-CON, 25V, 20%, SMD 10mm × 12.6mm, F12, SVPF Series	PANASONIC, 25SVPF330M
2	4	CIN2,CIN3,CIN4,CIN5	CAP., 22µF, X5R, 25V, 10%,1210	MURATA, GRM32ER61E226KE15L
3	6	COUT2, COUT6, COUT13, COUT14, COUT15, COUT16	CAP., 100µF, X5R, 6.3V, 20%, 1210	AVX, 12106D107MAT2A
4	4	COUT3, COUT4, COUT5, COUT8	CAP., 100µF, X5R, 6.3V, 20%, 1210	AVX, 12106D107MAT2A
5	4	COUT9, COUT10, COUT12, COUT18	CAP., 330µF, TANT, POSCAP, 6.3V, 20%, 7343, D3L, TPE Series	PANASONIC, 6TPE330ML
6	1	C1	CAP., 4.7µF, X5R, 16V, 20%, 0805	KEMET, C0805C475M4PACTU
7	1	C2	CAP., 1µF, X7R, 25V,10%, 0805	AVX, 08053C105KAT2A
8	2	C5,C7	CAP., 0.1µF, X5R, 25V, 10%, 0603	AVX, 06033D104KAT2A
9	4	C13, C14, C15, C16	CAP., 1µF, X7R, 10V,10%, 0603	AVX, 0603ZC105KAT2A
10	4	R1, R3, R22, R26	RES., 10Ω, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA
11	1	R5	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
12	4	R9, R12, R15, R18	RES.., 60.4k, 1/10W, 1%, 0603	VISHAY, CRCW060360K4FKEA
13	2	R10, R13	RES.., 6.04k, 1/10W, 1%, 0603	VISHAY, CRCW06036K04FKEA
14	1	R19	RES., 13.3k, 1/10W, 1%, 0603	VISHAY, CRCW060313K3FKEA
15	3	R24, R27, R36	RES., 10k, 1/10W, 1%, 0603	VISHAY, CRCW060310K0FKEA
16	1	R25	RES., 40.2k, 1/10W, 1%, 0603	VISHAY, CRCW060340K2FKDA
17	1	R30	RES., 147k, 1/10W, 1%, 0603	VISHAY, CRCW0603147KFKEA
18	1	R37	RES., HIGH POWER, 0.01Ω, 2W, 1%, 2512	VISHAY, WSL2512R0100FEA18
19	1	U1	I.C., 16 × 16 × 5.01 BGA	Linear Tech, LTM4650AEY#PBF
Additional Demo Board Circuit Components				
1	0	COUT1, COUT7, COUT11, COUT17	CAP., OPT, 7343	OPT
2	0	C3, C4, C8, C11	CAP., OPTION, 0603	OPT
3	0	C6, C9, C10, C12, C17, C18	CAP., OPT, 0603	OPT
4	0	R2, R4, R6, R8, R11, R14, R16, R17, R20, R23, R28, R31, R33, R39, R40, R41, R42, R46, R47, R48	RES., OPTION, 0603	OPT
5	4	R7, R21, R29, R32	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
6	1	R34	RES., 0Ω, 3/4W, 2010	VISHAY, CRCW20100000Z0EF
7	0	R35	RES., OPTION, 2010	OPT
8	0	R38, R43, R44, R45	RES., OPTION, 2512	OPT

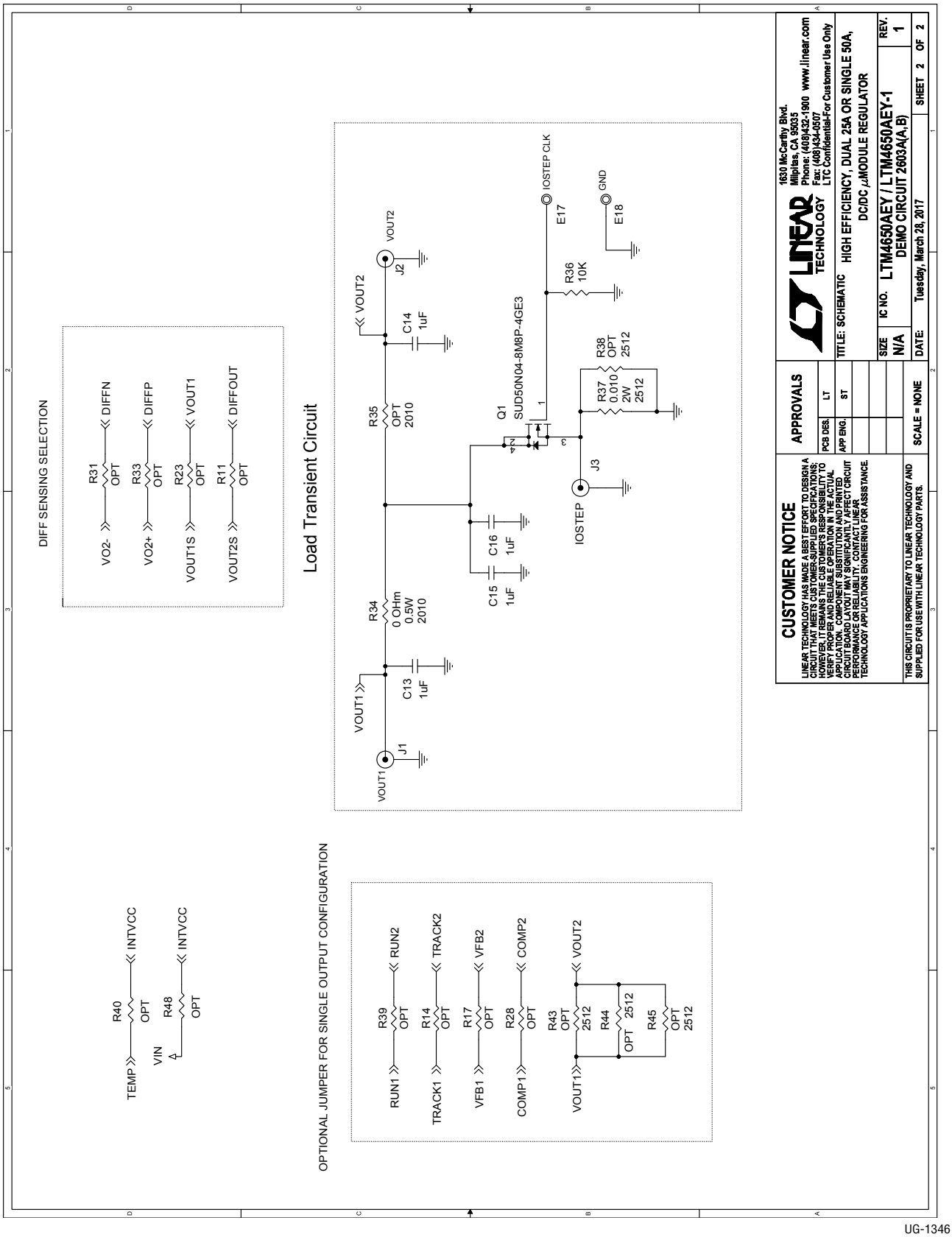
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	16	E1, E3, E4, E5, E6, E7, E8, E9, E10, E12, E13, E14, E15, E16, E17, E18	TEST POINT, TURRET, .094" MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	CONN., HDR, MALE, 2 × 4, 2mm, THT, STR	WURTH ELEKTRONIK, 62000821121
3	3	JP2, JP3, JP4	CONN., HDR, MALE, 1 × 3, 2mm, THT, STR	WURTH ELEKTRONIK, 62000311121
4	1	JP5	CONN., HDR, MALE, 2 × 3, 2mm, THT, STR	WURTH ELEKTRONIK, 62000621121
5	5	XJP1, XJP2, XJP3, XJP4, XJP5	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421
6	3	J1, J2, J3	CONN., RF, BNC, RCPT, THT, STR, 5-PIN	AMPHENOL CONNEX 112404
7	2	J4, J5	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
8	4	J6, J7, J8, J9	STUD, FASTENER, #10-32	PennEngineering, KFH-032-10ET
9	8	J6, J7, J8, J9 (×2)	NUT, HEX, STEEL, ZINC PLATE,10-32	KEYSTONE, 4705
10	4	J6, J7, J8, J9	RING, LUG, CRIMP, #10, NON-INSULATED, SOLDERLESS TERMINALS	KEYSTONE, 8205
11	4	J6, J7, J8, J9	WASHER, FLAT, STEEL, ZINC PLATE, OD: 0.436 [11.1]	KEYSTONE, 4703
12	4	(STAND-OFF)	STANDOFF, NYLON, SNAP-ON, 0.500"	KEYSTONE, 8833

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



UG-1346 Rev A

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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