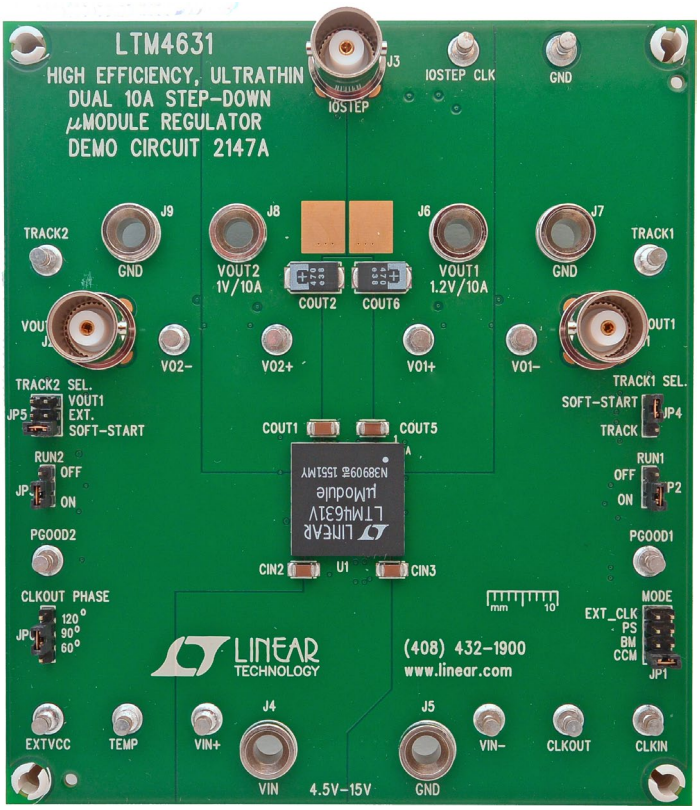
LTM4631
Ultrathin Dual 10A or Single 20A DC/DC µModule Regulator

DESCRIPTION

Demonstration circuit 2147A features the LTM®4631, the high efficiency, high density, dual 10A, switch mode step-down µModule® power module regulator. The input voltage is from 4.5V to 15V. The output voltage is programmable from 0.6V to 1.8V. DC2147A can deliver up to 10A maximum in each channel. 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 20A 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 ratio-metrically 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 LTM4631 in a compact 16mm × 16mm × 1.91mm LGA package make it ideal for use in many high density point-of-load regulation applications. The LTM4631 data sheet must be read in conjunction with this demo manual for working on or modifying the demo circuit DC2147A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2147A

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		4.5V ~ 15V
Output Voltage V_{OUT1}	V_{IN} = 4.5V ~ 15V, I_{OUT1} = 0A ~ 10A, JP1: CCM	1.2V ± 1.5% (1.182V ~ 1.218V)
Output Voltage V_{OUT2}	V_{IN} = 4.5V ~ 15V, I_{OUT2} = 0A ~ 10A, JP1: CCM	1V ± 1.5% (0.985V ~ 1.015V)
Per-Channel Maximum Continuous Output Current	Derating Is Necessary for Certain V_{IN}, V_{OUT} and Thermal Conditions, See Data Sheet for Detail.	10A
Default Operating Frequency		650kHz
Resistor Programmable Frequency Range		250kHz to 780kHz
External Clock Sync Frequency Range		400kHz to 780kHz
Efficiency of Channel 1	V_{IN} = 12V, V_{OUT1} = 1.2V, I_{OUT1} = 10A, f_{SW} = 650kHz	81.5% See Figure 2
Efficiency of Channel 2	V_{IN} = 12V, V_{OUT2} = 1V, I_{OUT2} = 10A, f_{SW} = 650kHz	78.7% See Figure 3
Load Transient of Channel 1	V_{IN} = 12V, V_{OUT1} = 1.2V, I_{STEP} = 5A ~ 10A	See Figure 4
Load Transient of Channel 2	V_{IN} = 12V, V_{OUT2} = 1V, I_{STEP} = 5A ~ 10A	See Figure 5

QUICK START PROCEDURE

Demonstration circuit 2147A is easy to set up to evaluate the performance of the LTM4631EV. Please refer to Figure 1 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	JP6
MODE	RUN1	RUN2	TRACK1 SELECT	TRACK2 SELECT	CLKOUT PHASE
CCM	ON	ON	SOFT-START	SOFT-START	90°

2. With power off, connect the input power supply, load and meters as shown in Figure 1. 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 1.2V ± 1.5% (1.182V ~ 1.218V) and the output voltage in channel 2 should be 1V ± 1.5% (0.985V ~ 1.015V).

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 should be measured at J1 and J2 with BNC cables. 50Ω termination should be set on the oscilloscope or BNC cables.

QUICK START PROCEDURE

5. (Optional) For optional load transient test, apply an adjustable pulse signal between IOSTEP CLK and GND test point. Pulse amplitude sets the load step current amplitude. The output transient current can be monitored at the BNC connector J3 (50mV/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) LTM4631 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 LTM4631 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) LTM4631 can be configured for a 2-phase single output at up to 20A on DC2147A. Install 0Ω resistors on R_{14}, R_{17}, R_{28}, R_{39} and remove R_7, R_{19}. Output voltage is set by R_{25} based on equation $V_{OUT} = 0.6V(1+60.4K/R_{25})$.

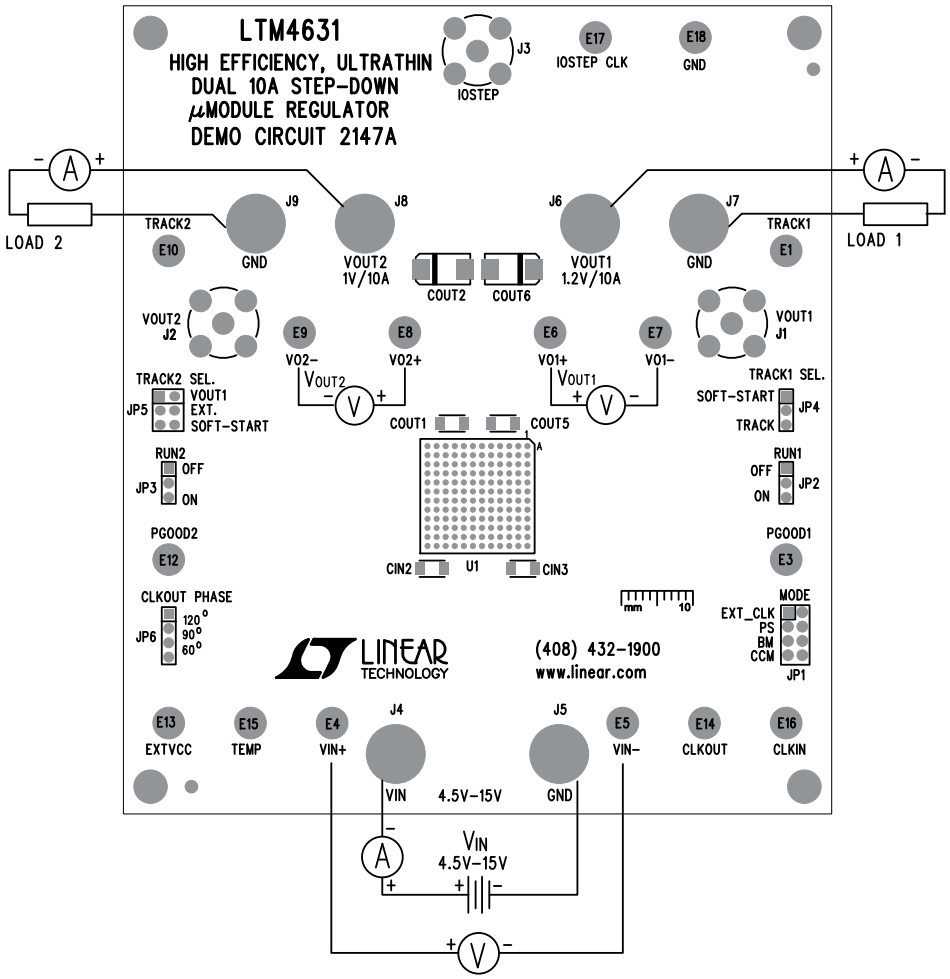


Figure 1. Test Setup of DC2147A

QUICK START PROCEDURE

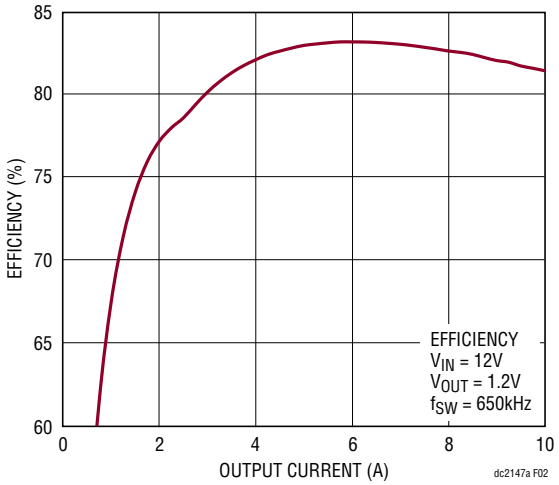


Figure 2. Measured Efficiency on Channel 1 (V_{OUT1} = 1.2V, f_{SW} = 650kHz, Channel 2 Disabled)

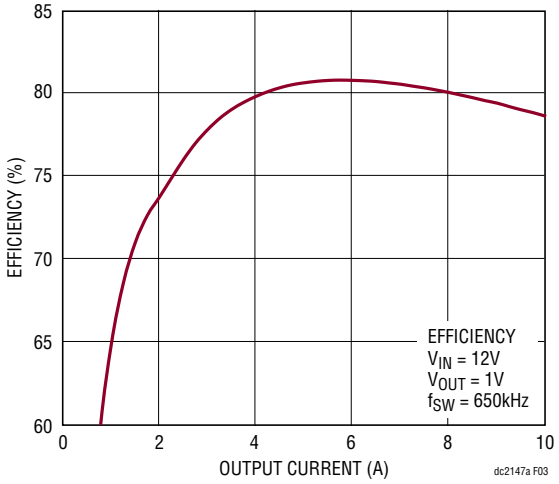


Figure 3. Measured Efficiency on Channel 2 (V_{OUT2} = 1V, f_{SW} = 650kHz, Channel 1 Disabled)

QUICK START PROCEDURE

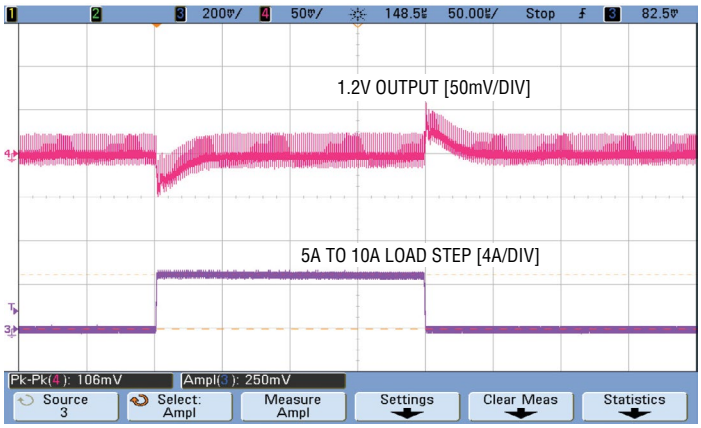


Figure 4. Measured Channel 1 5A to 10A Load Transient (V_{IN} = 12V, V_{OUT1} = 1.2V)

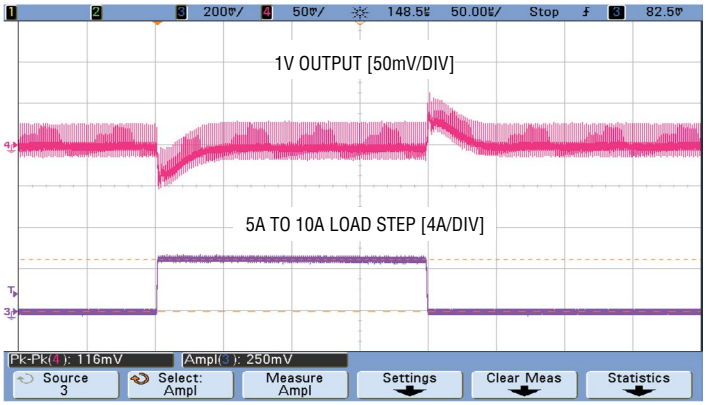


Figure 5. Measured Channel 2 5A to 10A Load Transient (V_{IN} = 12V, V_{OUT2} = 1V)

QUICK START PROCEDURE

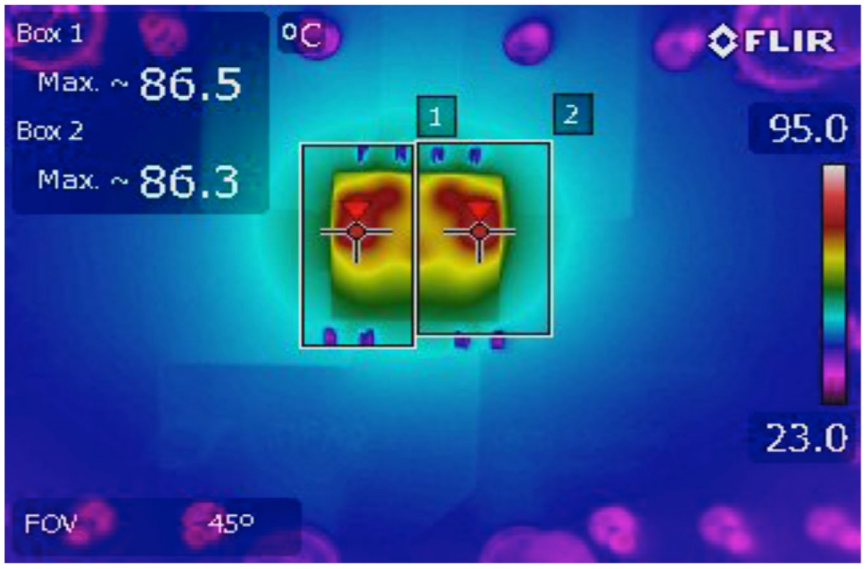


Figure 6. Thermal Capture at $12V_{IN}$, $1.2V_{OUT1}$ at 10A and $1V_{OUT2}$ at 10A (T_A = 25°C, No Forced Airflow and No Heat Sink)

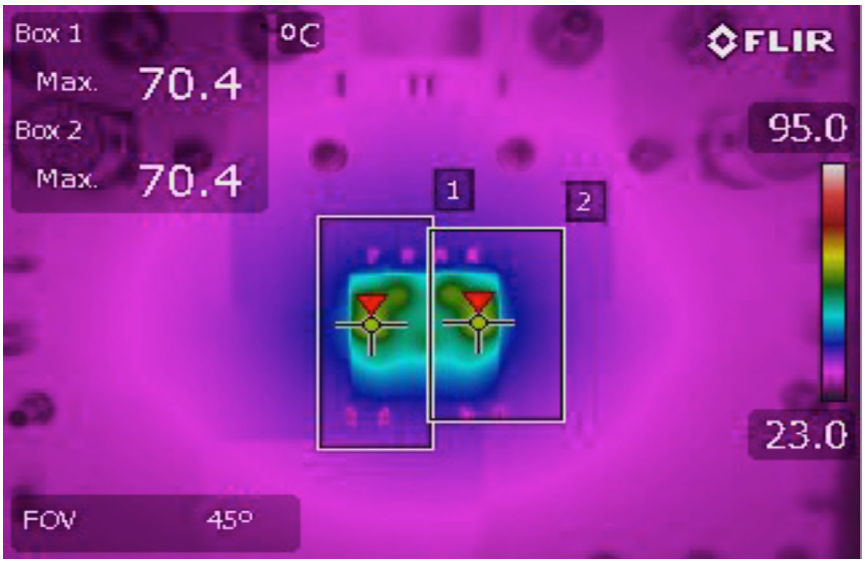
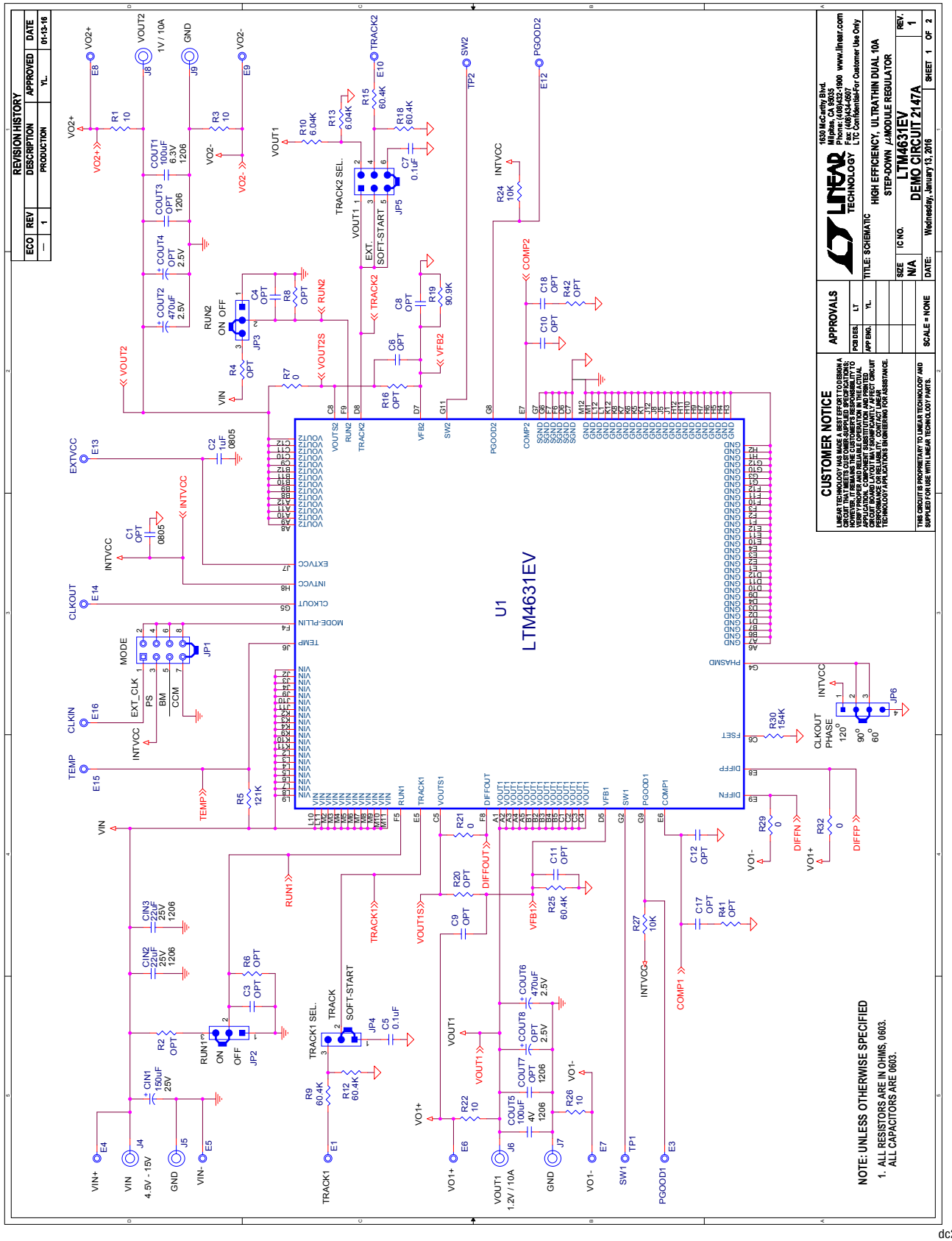


Figure 7. Thermal Capture at $12V_{IN}$, $1.2V_{OUT1}$ at 10A and $1V_{OUT2}$ at 10A (T_A = 25°C, 200LFM Airflow and No Heat Sink)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP, 150µF, 25V, ALUMINUM ELECTR	SUN ELECT, 25CE150AX
2	2	CIN2, CIN3	CAP, X5R, 22µF, 25V, 20%, 1206	TDK, C3216X5R1E226M160AB
3	2	COUT1, COUT5	CAP, X5R, 100µF, 4V, 20%, 1206	TDK, C3216X5R0G107M160AB
4	2	COUT2, COUT6	CAP, 470µF, 2.5V, POSCAP, F8, 7343	SANYO, 2R5TPE470M9
5	1	C2	CAP, X7R, 1µF, 25V,10%, 0805	AVX, 08053C105KAT2A
6	2	C5, C7	CAP, X5R, 0.1µF, 25V, 10%, 0603	AVX, 06033D104KAT2A
7	2	C13, C14	CAP, X7R, 0.01µF, 50V, 10%, 0603	AVX, 06035C103KAT2A
8	2	C15, C16	CAP, X7R, 1µF, 10V,10%, 0603	AVX, 0603ZC105KAT2A
9	1	Q1	XSTR,SUD50N04-8M8P-4GE3, MOSFET, TO252	VISHAY, SUD50N04-8M8P-4GE3
10	4	R1, R3, R22, R26	RES, 10, 1%, 0603	VISHAY, CRCW060310R0FKEA
11	1	R5	RES, 121k, 1%, 0603	VISHAY,CRCW0603121KFKEA
12	5	R9, R12, R15, R18, R25	RES, 60.4k, 1%, 0603	VISHAY, CRCW060360K4FKEA
13	2	R10, R13	RES, 6.04k, 1%, 0603	VISHAY, CRCW06036K04FKEA
14	1	R19	RES, 90.9k, 1%, 0603	VISHAY, CRCW060390K9FKEA
15	3	R24, R27, R36	RES, 10k, 1%, 0603	VISHAY, CRCW060310K0FKEA
16	1	R30	RES, 154k, 1%, 0603	VISHAY,CRCW0603154KFKEA
17	1	R37	RES, 0.05Ω, 1W, 2512	VISHAY, WSL2512R0050FEA
18	1	U1	LTM4631EV#PBF, 16X16X4.41-LGA	LINEAR TECHNOLOGY, LTM4631EV#PBF
Additional Demo Board Circuit Components				
1	0	COUT3, COUT7	OPT, 1206	OPT
2	0	COUT4, COUT8	OPT, 7343	OPT
3	0	C1	OPT, 0805	OPT
4	0	C3, C4, C6, C8 TO C12, C17, C18	OPT, 0603	OPT
5	0	R2, R4, R6, R8, R11, R14, R16, R17, R20, R23, R28, R31, R33, R39, R40, R41, R42	OPT, 0603	OPT
6	4	R7, R21, R29, R32	RES, 0, 1%, 0603	VISHAY, CRCW06030000Z0EA
7	1	R34	RES, 0Ω, 0.5W, 2010	VISHAY, CRCW20100000Z0EF
8	0	R35	OPT, 2010	OPT
9	0	R38	OPT, 2512	OPT
Hardware: For Demo Board Only				
1	16	E1, E3 TO E10, E12 TO E18	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	HEADER, 2X4 0.079 DOUBLE ROW	SULLINS, NRPN042PAEN-RC
3	3	JP2, JP3, JP4	HEADER, 1X3 0.079 SINGLE ROW	SULLINS, NRPN031PAEN-RC
4	1	JP5	HEADER, 2X3 0.079 DOUBLE ROW	SULLINS, NRPN032PAEN-RC
5	1	JP6	HEADER, 1X4 0.079 SINGLE ROW	SULLINS, NRPN041PAEN-RC
6	6	XJP1 TO XJP6	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
7	3	J1, J2, J3	CONN, BNC, 5 PINS	CONNEX 112404
8	6	J4 TO J9	JACK BANANA	KEYSTONE, 575-4
9	4	(STAND-OFF)	STAND-OFF, NYLON 0.50"	KEYSTONE, 8833(SNAP ON)

SCHEMATIC DIAGRAM



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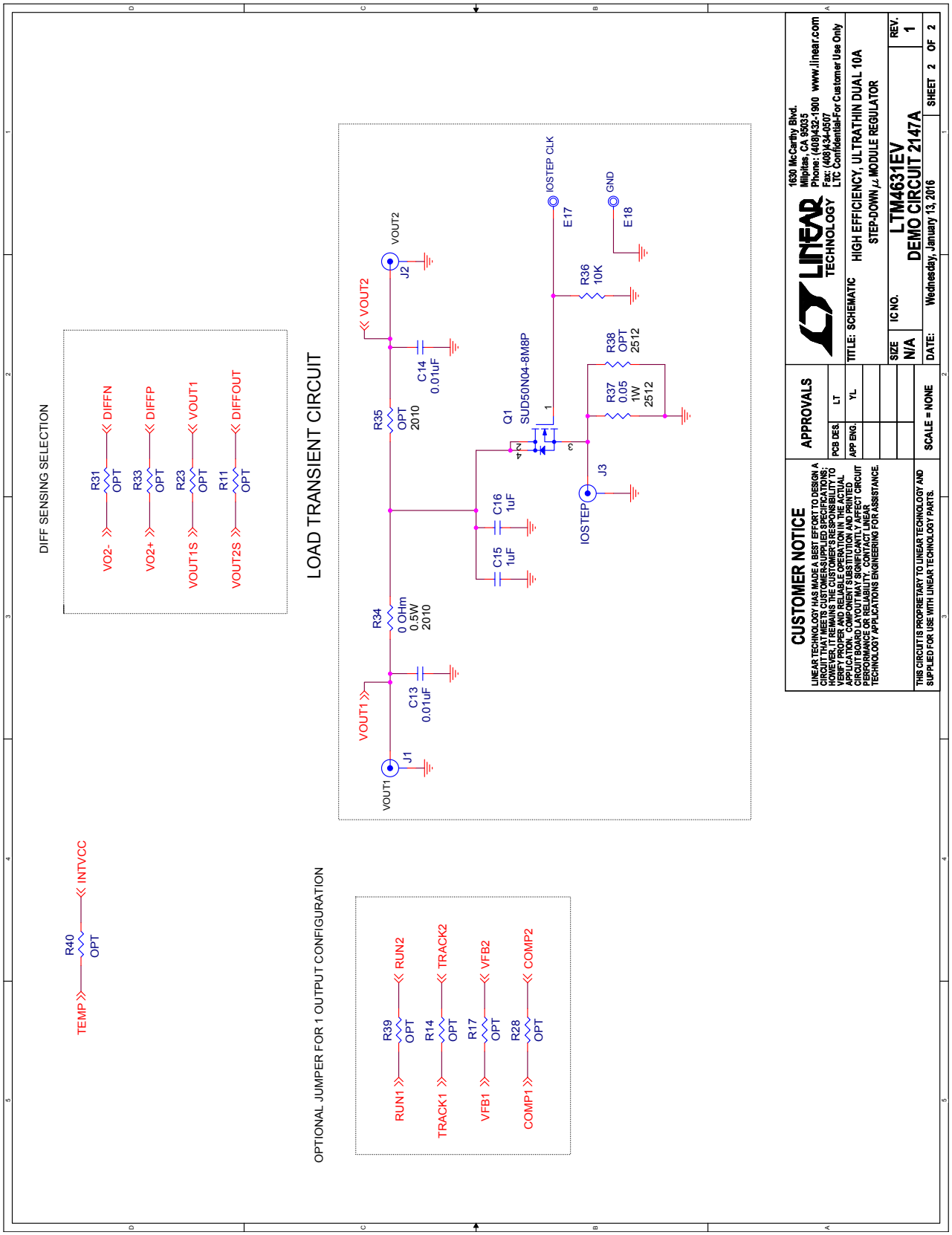
SCHEMATIC DIAGRAM



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