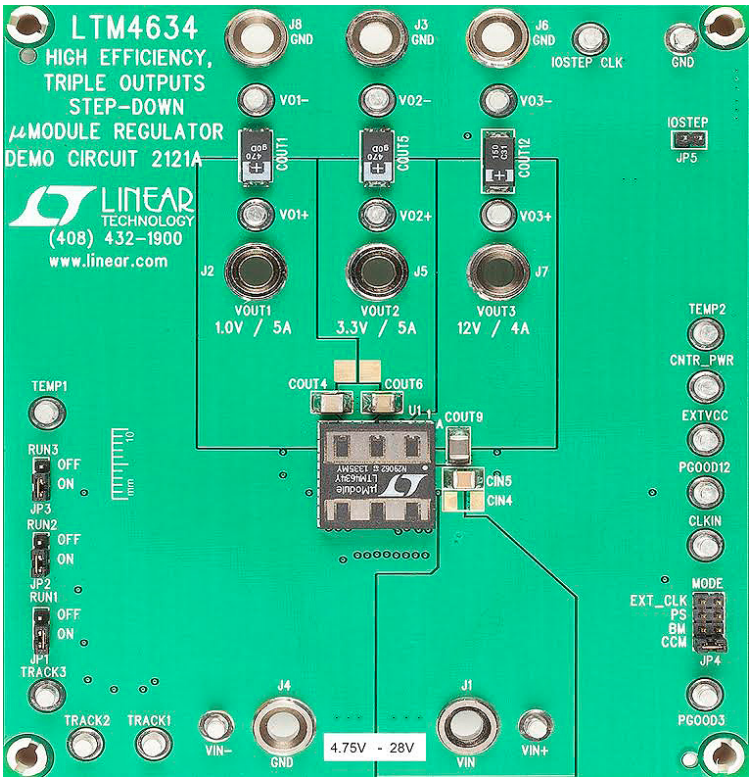
LTM4634
Triple Output 5A/5A/4A Step-Down DC/DC µModule Regulator

DESCRIPTION

Demonstration circuit 2121A features the LTM®4634, a high efficiency, triple 5A/5A/4A step-down power µModule regulator. The input voltage range is from 4.75V to 28V. The output voltage range is 0.8V to 5.5V for Channel 1 and Channel 2, 0.8V to 13.5V for Channel 3. Derating is necessary for certain V_{IN}, V_{OUT}, frequency and thermal conditions. The DC2121A offers access to the TK/SS pins allowing the user to program output tracking or soft-start period. The board operates in continuous conduction mode in heavy load conditions. For high efficiency at low load currents, the MODE jumper (JP4) selects pulse-skipping mode for noise sensitive applications or Burst Mode® operation in less noise sensitive applications. Channel 1 and 2 can be connected in parallel for a single 10A output solution with optional jumper resistors. The LTM4634 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2121A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2121A

BOARD PHOTO



PERFORMANCE SUMMARY

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		4.75V to 28V
Output Voltages		1.0V, 3.3V, 12.0V ± 1.5%
Maximum Continuous Output Current	Derating Is Necessary for Certain Operating Conditions. See Data Sheet for Details.	5ADC for Ch1 5ADC for Ch2 4ADC for Ch3
Operating Frequency		500kHz
Efficiency of Channel 1	V_{IN} = 12V, V_{OUT1} = 1.0V, I_{OUT1} = 5A	79.7% See Figure 2
Efficiency of Channel 2	V_{IN} = 12V, V_{OUT2} = 3.3V, I_{OUT2} = 5A	91% See Figure 3
Efficiency of Channel 3	V_{IN} = 24V, V_{OUT3} = 12.0V, I_{OUT3} = 4A	94.5% See Figure 4
Load Transient of Channel 1	V_{IN} = 12V, V_{OUT1} = 1.0V, I_{STEP} = 0A to 2.5A	See Figure 5
Load Transient of Channel 2	V_{IN} = 12V, V_{OUT2} = 3.3V, I_{STEP} = 0A to 2.5A	See Figure 6
Load Transient of Channel 3	V_{IN} = 24V, V_{OUT3} = 12.0V, I_{STEP} = 0A to 2A	See Figure 7

QUICK START PROCEDURE

Demonstration circuit DC2121A is an easy way to evaluate the performance of the LTM4634. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

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

RUN1	RUN2	RUN3	MODE
ON	ON	ON	CCM

2. With power off, connect the input power supply, loads and meters as shown in Figure 1. Preset the load to 0A and V_{IN} supply to 24V.
3. Turn on the power supply at the input. The output voltage of channel 1 should be 1.0V ± 1.5% (0.985V to 1.015V). The output voltage of channel 2 should be 3.3V ± 1.5% (3.25V to 3.349V). The output voltage of channel 3 should be 12.0V ± 1.5% (11.82V to 12.18V).
4. Vary the input voltage and adjust the load current of channel 1 and channel 2 from 0A to 5A and channel 3 from 0A to 4A. Observe the output voltage regulation, ripple voltage, efficiency, and other parameters.
5. (Optional) For optional load transient test, apply an adjustable pulse signal between IOSTEP_CLK and GND test points. The pulse amplitude sets the load step current amplitude. Keep the pulse width short (<1ms) and pulse duty cycle low (<5%) to limit the thermal stress on the load transient circuit. Switch the jumper resistors R30, R31 or R34 (on the backside of boards) to apply load transient on channel 1, channel 2, or channel 3 correspondingly.
6. (Optional) LTM4634 can be synchronized to an external clock signal. Place the JP4 jumper on EXT_CLK and apply a clock signal (0V to 5V, square wave) on the CLKIN test point.
7. (Optional) The outputs of LTM4634 can track another supply. If tracking external voltage is selected, the corresponding test points, TRACK1, TRACK2, and TRACK3, need to be connected to a valid voltage signal.
8. (Optional) Channel 1 and 2 can be connected in parallel for a 10A polyphase operation on DC2121A. Install 0Ω resistors on R32, R33, R35, R36 and remove R15. Output voltage is set by R4 based on equation:

$$V_{OUT} = 0.8V\left(\frac{\frac{60.4k}{2}}{R4}+1\right)$$

QUICK START PROCEDURE

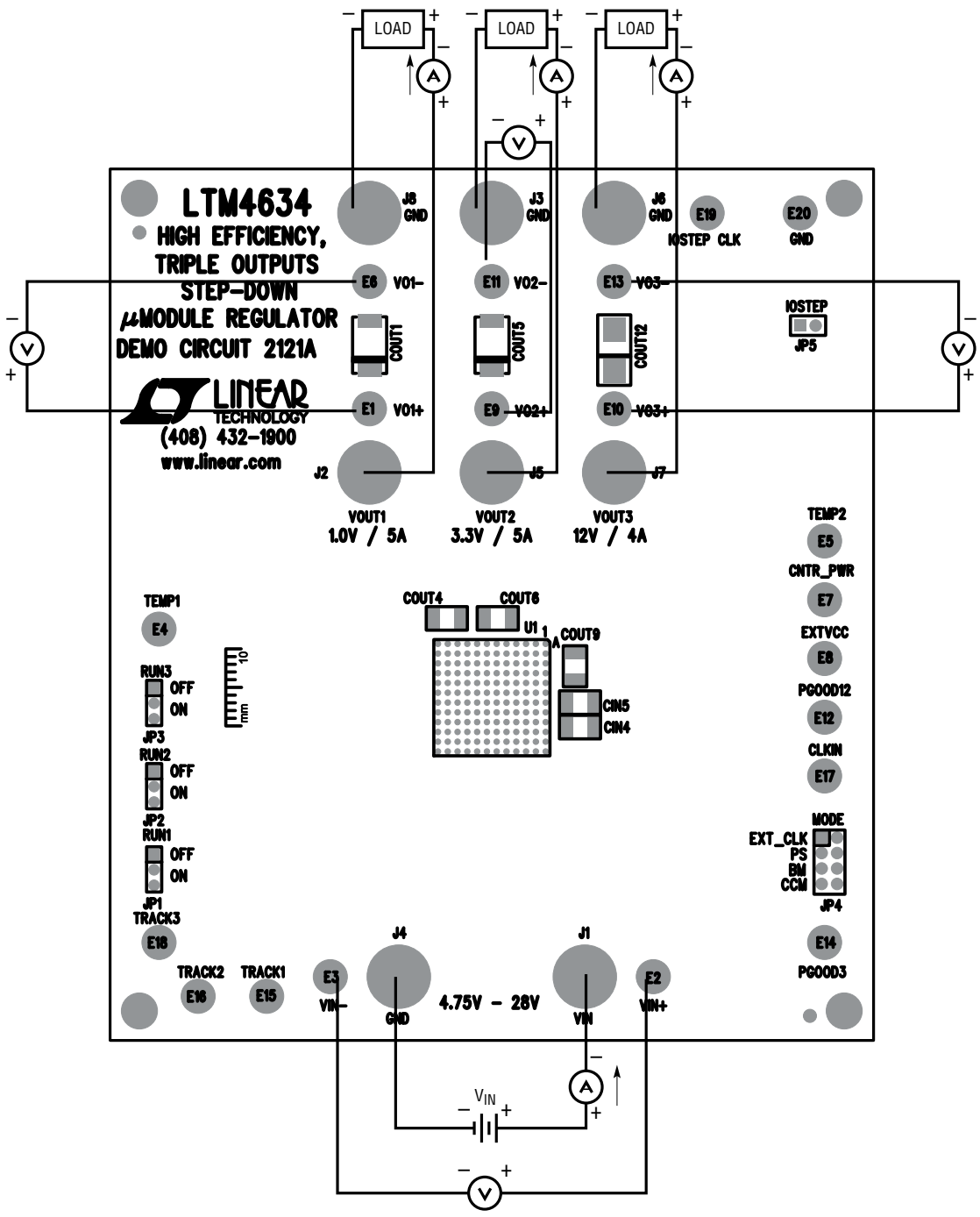


Figure 1. Measurement Setup of DC2121A

QUICK START PROCEDURE

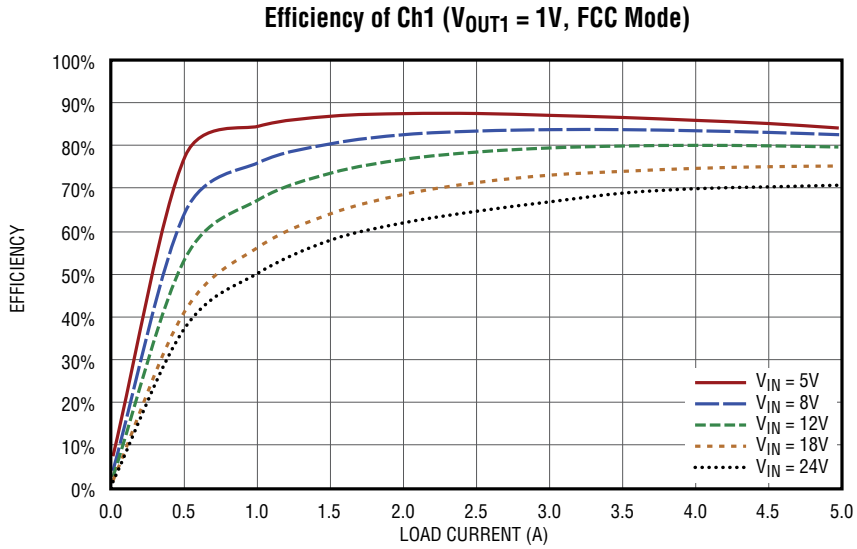


Figure 2. Measured Efficiency on Channel 1
V_{OUT1} = 1.0V, f_{SW} = 500kHz, CCM, Channel 2, 3 Disabled

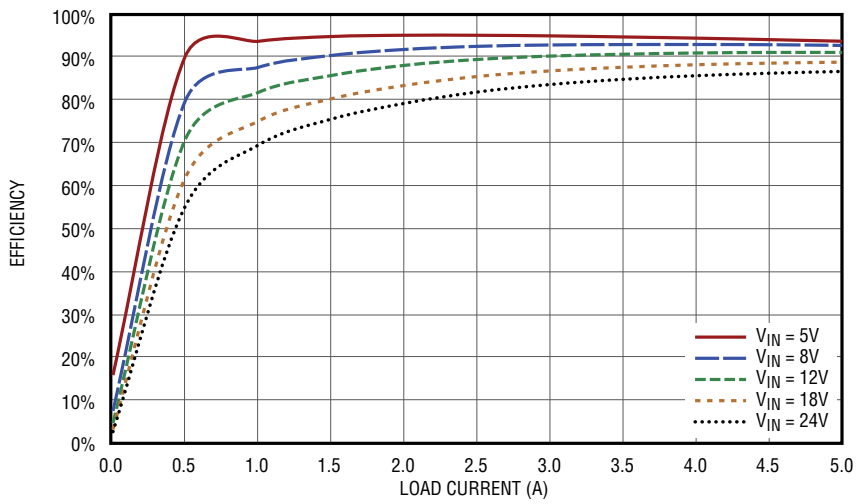


Figure 3. Measured Efficiency on Channel 2
V_{OUT2} = 3.3V, f_{SW} = 500kHz, CCM, Channel 1, 3 Disabled

QUICK START PROCEDURE

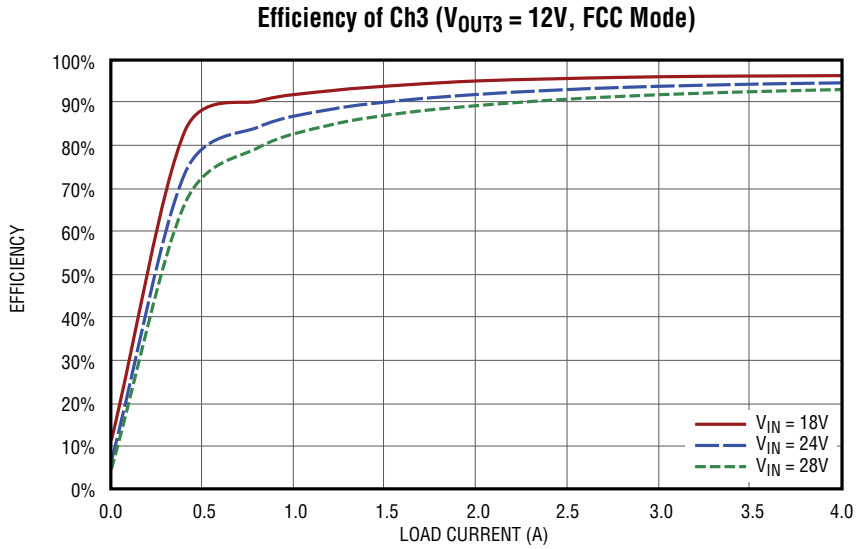


Figure 4. Measured Efficiency on Channel 3
V_{OUT3} = 12.0V, f_{SW} = 500kHz, CCM, Channel 1, 2 Disabled

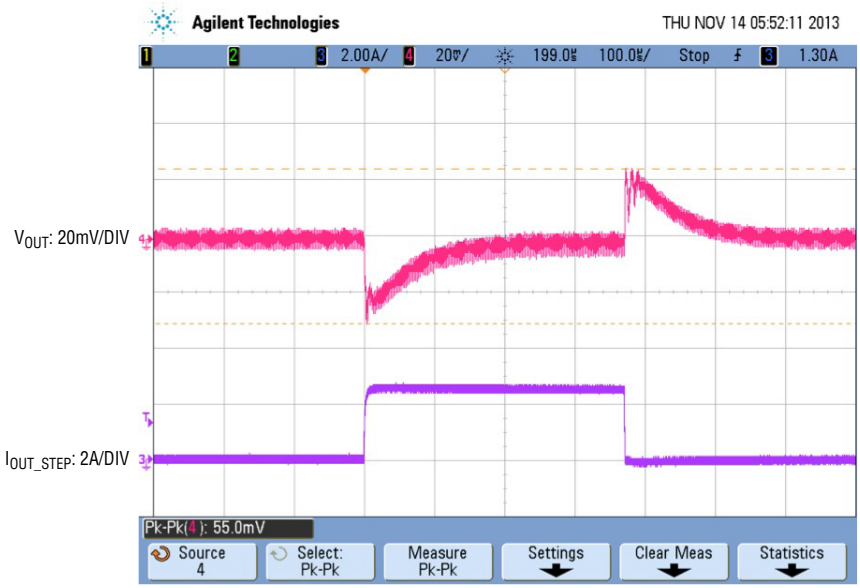


Figure 5. Measured Channel 1 Load Transient
V_{IN} = 12V, V_{OUT1} = 1.0V, I_{STEP} = 0A to 2.5A
I_{STEP} Slew Rate = 1A/µs

QUICK START PROCEDURE

Figure 6. Measured Channel 2 Load Transient
V_{IN} = 12V, V_{OUT1} = 3.3V, I_{STEP} = 0A to 2.5A
I_{STEP} Slew Rate = 1A/µs

Figure 7. Measured Channel 3 Load Transient
V_{IN} = 24V, V_{OUT3} = 12V, I_{STEP} = 0A to 2A
I_{STEP} Slew Rate = 1A/µs

QUICK START PROCEDURE

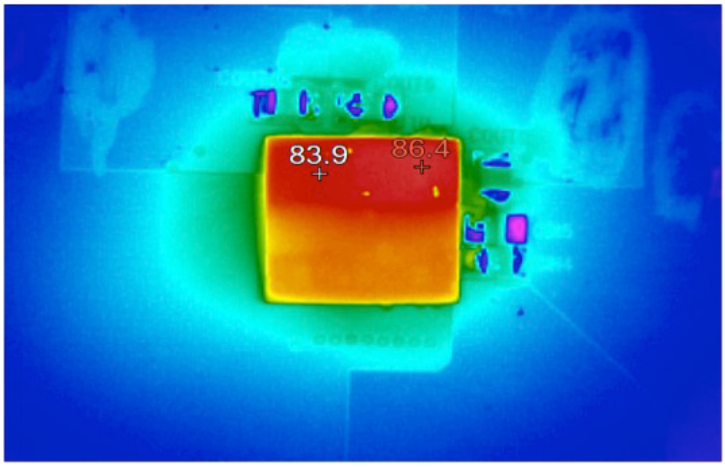


Figure 8. Thermal Image of LTM4634
V_{IN} = 24V, V_{OUT1} = 1.0V, I_{LOAD1} = 5A, V_{OUT2} = 3.3V, I_{LOAD2} = 5A, V_{OUT3} = 12.0V, I_{LOAD3} = 2A
Ambient Temperature = 23.2°C, No Forced Air Flow

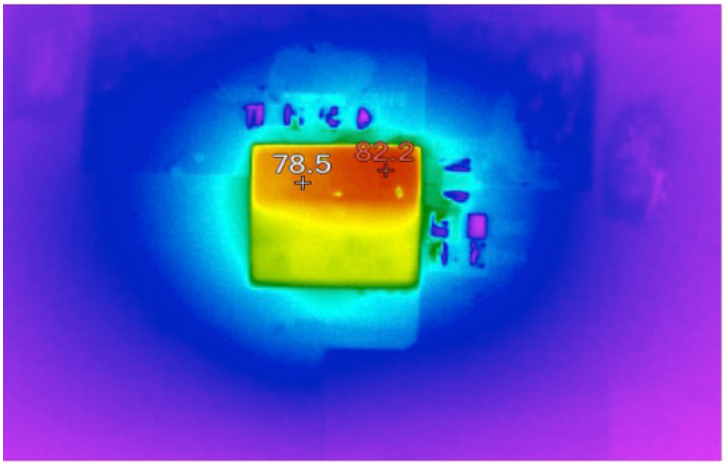


Figure 9. Thermal Image of LTM4634
V_{IN} = 24V, V_{OUT1} = 1.0V, I_{LOAD1} = 5A, V_{OUT2} = 3.3V, I_{LOAD2} = 5A, V_{OUT3} = 12.0V, I_{LOAD3} = 4A
Ambient Temperature= 23.2°C, with 200LFM Air Flow

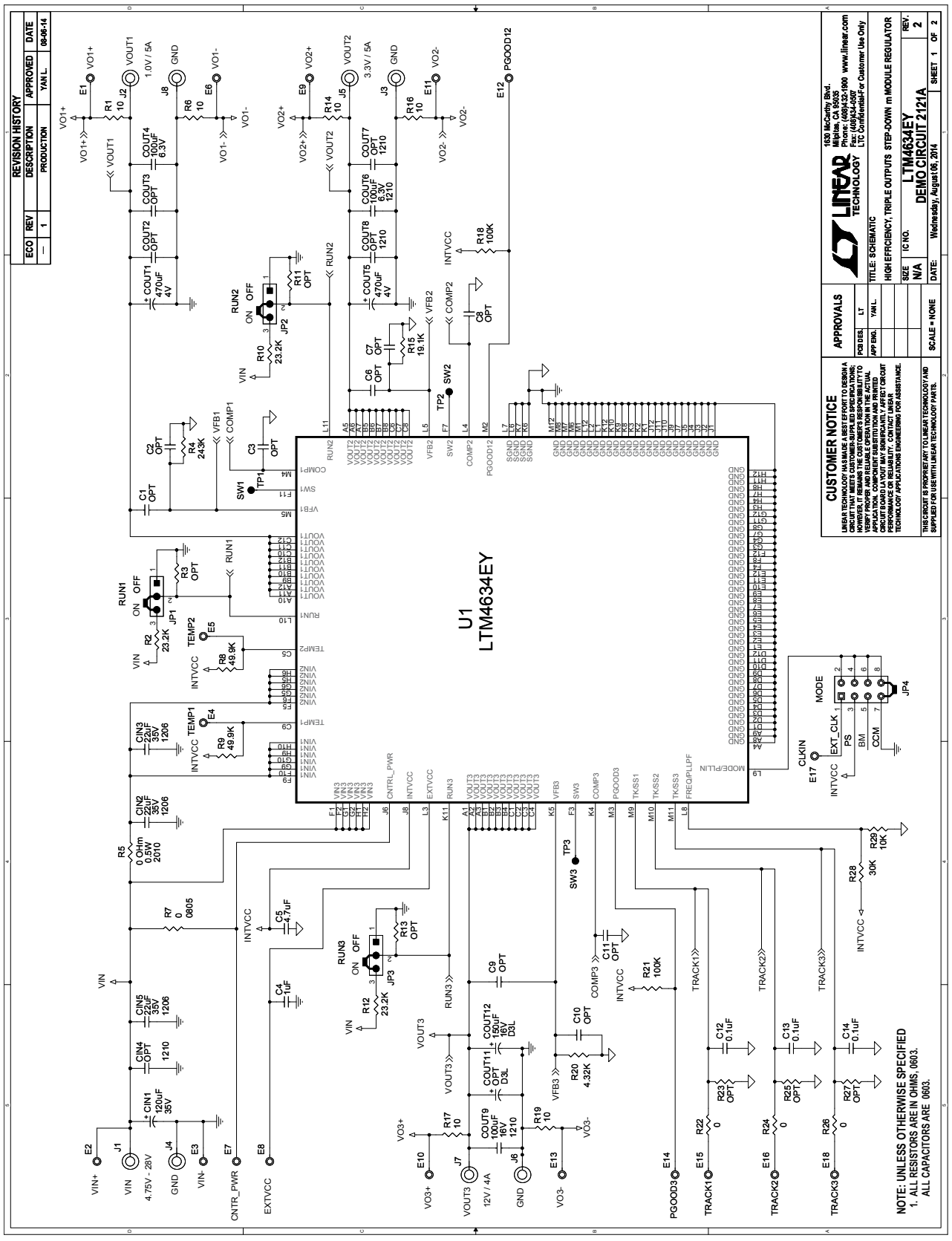
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	Cap., 120µF, 35V, Aluminum Electr.,	PANASONIC, 35SVPF120M
2	3	CIN2, CIN3, CIN5	Cap., X5R, 22µF, 35V, 20%,1206	TDK, C3216X5R1V226M160AC
3	2	COUT1, COUT5	Cap., 470µF, 4V, POSCAP, F8	PANASONIC, 4TPE470MCL
4	2	COUT4, COUT6	Cap., X5R, 100µF, 6.3V, 20% 1210	AVX, 12106D107MAT2A
5	1	COUT9	Cap., X5R, 100µF, 16V, 20% 1210	TAIYO YUDEN, EMK325ABJ107MM-T
6	1	COUT12	Cap., POS, 150µF, 16V, D3L	PANASONIC, 16TQC150MYF
7	1	C4	Cap., X7R, 1µF, 10V, 10%, 0603	AVX, 0603ZC105KAT2A
8	1	C5	Cap., X5R, 4.7µF, 10V,10%, 0603	AVX, 0603ZD475KAT2A
9	3	C12, C13, C14	Cap., X5R, 0.1µF, m25V, 10%, 0603	AVX, 06033D104KAT2A
10	1	R4	Res., Chip, 243k, 1%, 0603	VISHAY, CRCW0603243KFKEA
11	2	R8, R9	Res., Chip, 49.9k, 1%, 0603	VISHAY, CRCW060349K9FKEA
12	1	R29	Res., Chip, 10k, 1%, 0603	VISHAY, CRCW060310K0FKEA
13	1	R15	Res., Chip, 19.1k, 1%, 0603	VISHAY, CRCW060319K1FKEA
14	2	R18, R21	Res., Chip, 100k, 1%, 0603	VISHAY, CRCW0603100K0FKEA
15	1	R20	Res., Chip, 4.32k, 1%, 0603	VISHAY, CRCW06034K32FKEA
16	1	R28	Res., Chip, 30k, 1%, 0603	NIC, NRC06F3002TRF
17	3	R2, R10, R12	Res., Chip, 23.2k, 1%, 0603	VISHAY, CRCW060323K2FKEA
18	1	U1	LTM4634EY#PBF, BGA-15X15-144P	LINEAR TECH., LTM4634EY#PBF
Additional Demo Board Circuit Components				
1	0	COUT2, COUT3, CIN4, COUT7, COUT8	OPT, 1210	OPT
2	0	COUT11	Cap., OPT, D3L	OPT
3	0	C1, C2, C3, C6, C7, C8, C9, C10, C11	OPT, 0603	OPT
4	1	Q1	MOSFET 40V, 50A, 48.1W, 8.8mΩ @ 10V	VISHAY, SUD50N04-8M8P-4GE3
5	0	R3, R11, R13, R23, R25, R27, R32, R33, R35, R36	OPT, 0603	OPT
6	2	R5, R30	Res., Chip, 0. Ω, 0.5W, 2010	VISHAY CRCW20100000Z0EF
7	1	R7	Res., Chip, 0, 1%, 0805	VISHAY, CRCW08050000Z0EA
8	3	R22, R24, R26	Res., Chip, 0, 1%, 0603	VISHAY, CRCW06030000Z0EA
9	0	R31, R34	OPT, 2010	OPT
10	3	C15, C16, C17	CAP., X7R, 0.01µF, 50V, 10%, 0603	AVX, 06035C103KAT2A
11	6	R1, R6, R14, R16, R17, R19	Res., Chip, 10, 1%, 0603	VISHAY, CRCW060310R0FKEA
12	2	C18, C19	Cap., X7R, 1µF, 10V, 10%, 0603	AVX, 0603ZC105KAT2A
13	4	R8, R9, R29, R37	Res., Chip, 10k, 1%, 0603	VISHAY, CRCW060310K0FKEA
14	1	R38	Res., Chip, 0.01Ω, 2W, 2512	VISHAY, WSL2512R0100FEA
15	0	R39	OPT, 2512	OPT

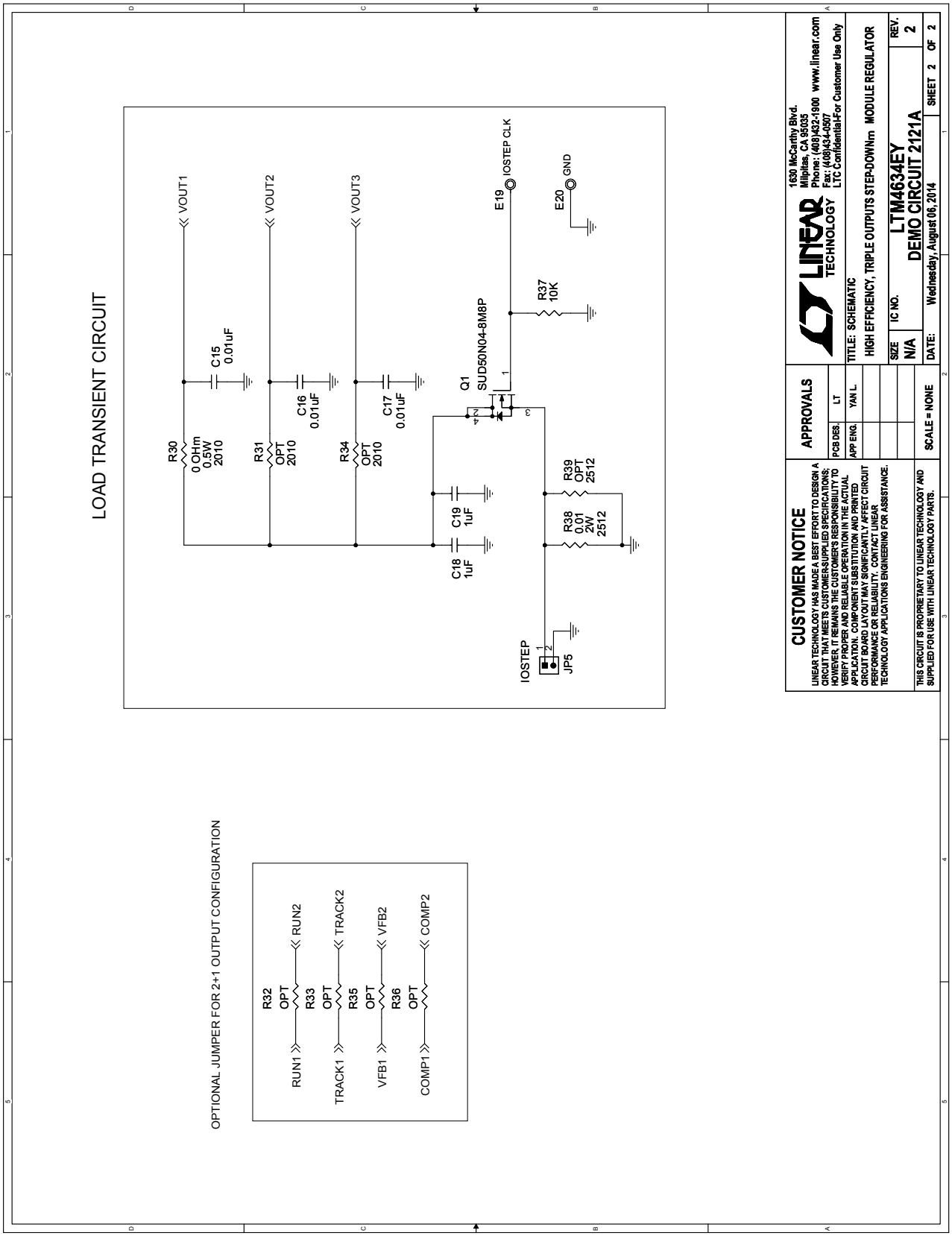
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	20	E1-E20	TESTPOINT, TURRET, .094" pbf	MILL-MAX, 2501-2-00-80-00-00-07-0
2	3	JP1, JP2, JP3	HEADER 3 PIN 0.079 SINGLE ROW	SULLIN, NRPN031PAEN-RC
3	1	JP4	HEADER 8 PIN 0.079 DOUBLE ROW	SULLIN, NRPN042PAEN-RC
4	1	JP5	HEADER 2 PIN 0.079 SINGLE ROW	SULLIN, NRPN021PAEN-RC
5	8	J1-J8	JACK BANANA	KEYSTONE, 575-4
6	5	XJP1-XJP5	SHUNT, .079" CENTER	SAMTEC, 2SN-BK-G
7	4	(STAND-OFF)	STAND-OFF, NYLON 0.50"	KEYSTONE, 8833(SNAP ON)
8	2	STENCILS	STENCILS TOP AND BOTTOM	STENCIL DC2121A

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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