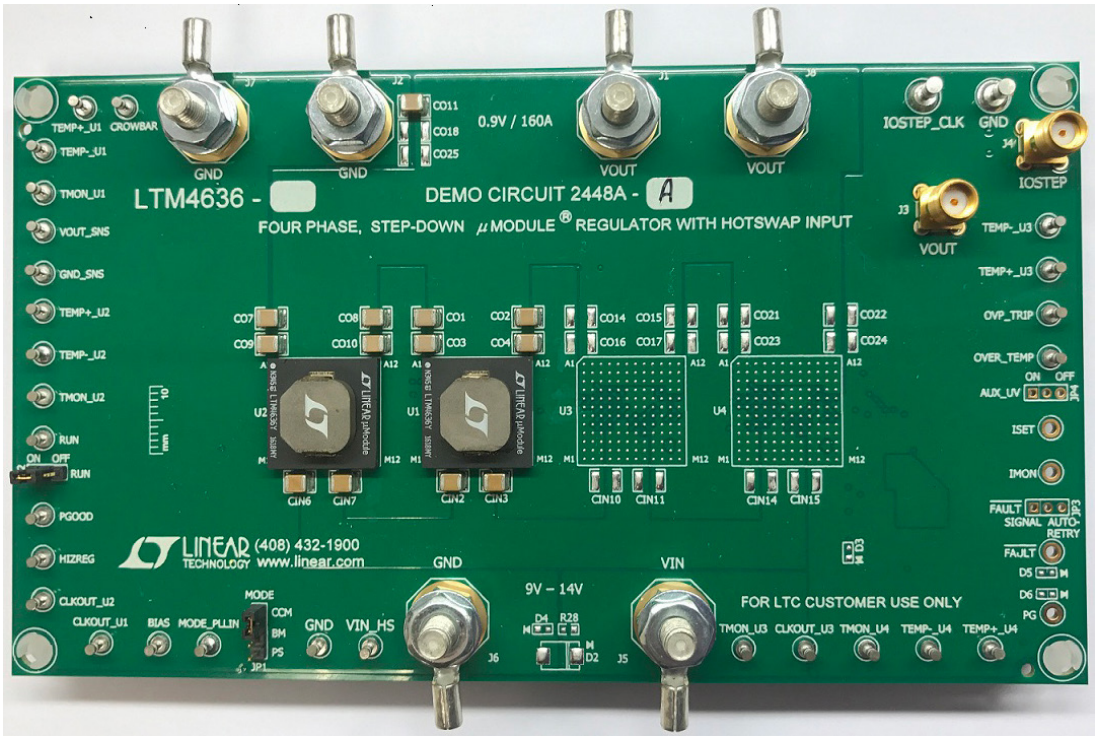
LTM4636
High Efficiency, PolyPhase 80A Step-Down Power µModule Regulator

DESCRIPTION

Demonstration circuit DC2448A-A features a PolyPhase® design using the LTM®4636EY, a 40A high efficiency, switch mode step-down power µModule® regulator. The input voltage range is from 4.7V to 15V. When V_{IN} < 5.5V, short PVCC to VIN with R1 = 0Ω, and set R3 = 0Ω and remove R2. The output voltage range is 0.6V to 3.3V. The DC2448A-A can deliver a nominal 80A output current. 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_PLLIN jumper selects pulse-skipping mode for noise sensitive applications or Burst Mode® operation in less noise sensitive applications. The MODE_PLLIN pin also allows the LTM4636 to synchronize to an external clock signal. The phase shift between the two phases is 180 degree. DC2448A-A has the option of choosing both internal and external compensation circuit for LTM4636. The LTM4636 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2448A-A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2448A-A

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		4.7V to 15V
Output Voltages		0.9V ±1.3%
Maximum Continuous Output Current	Derating is necessary for certain operating conditions. See data sheet for details.	$80A_{DC}$
Operating Frequency		350kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 0.9V, I_{OUT} = 80A	87.0% Figure 2
Load Transient $V_{OUT(P-P)}$	V_{IN} = 12V, V_{OUT} = 0.9V, I_{STEP} = 0A TO 20A	109mV Figure 3

QUICK START PROCEDURE

Demonstration circuit DC2448A-A is an easy way to evaluate the performance of PolyPhase operation of the LTM4636EY. Due to the high input/output current, the user should select the proper input supply/load/cable which can sustain the full load operation. 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:

MODE	RUN
CCM	ON

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 should be 0.9V ± 1.3% (0.888V to 0.912V).
4. Vary the input voltage from 6V to 15V and adjust the load current from 0A to 80A. 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.
6. (Optional) LTM4636 can be synchronized to an external clock signal. Apply a clock signal (0V to 5V, square wave) on the MODE_PLLIN test point.
7. (Optional) The outputs of LTM4636 can track another supply. The output voltage tracks the voltage on TRACK when a valid signal is applied on the test point.

QUICK START PROCEDURE

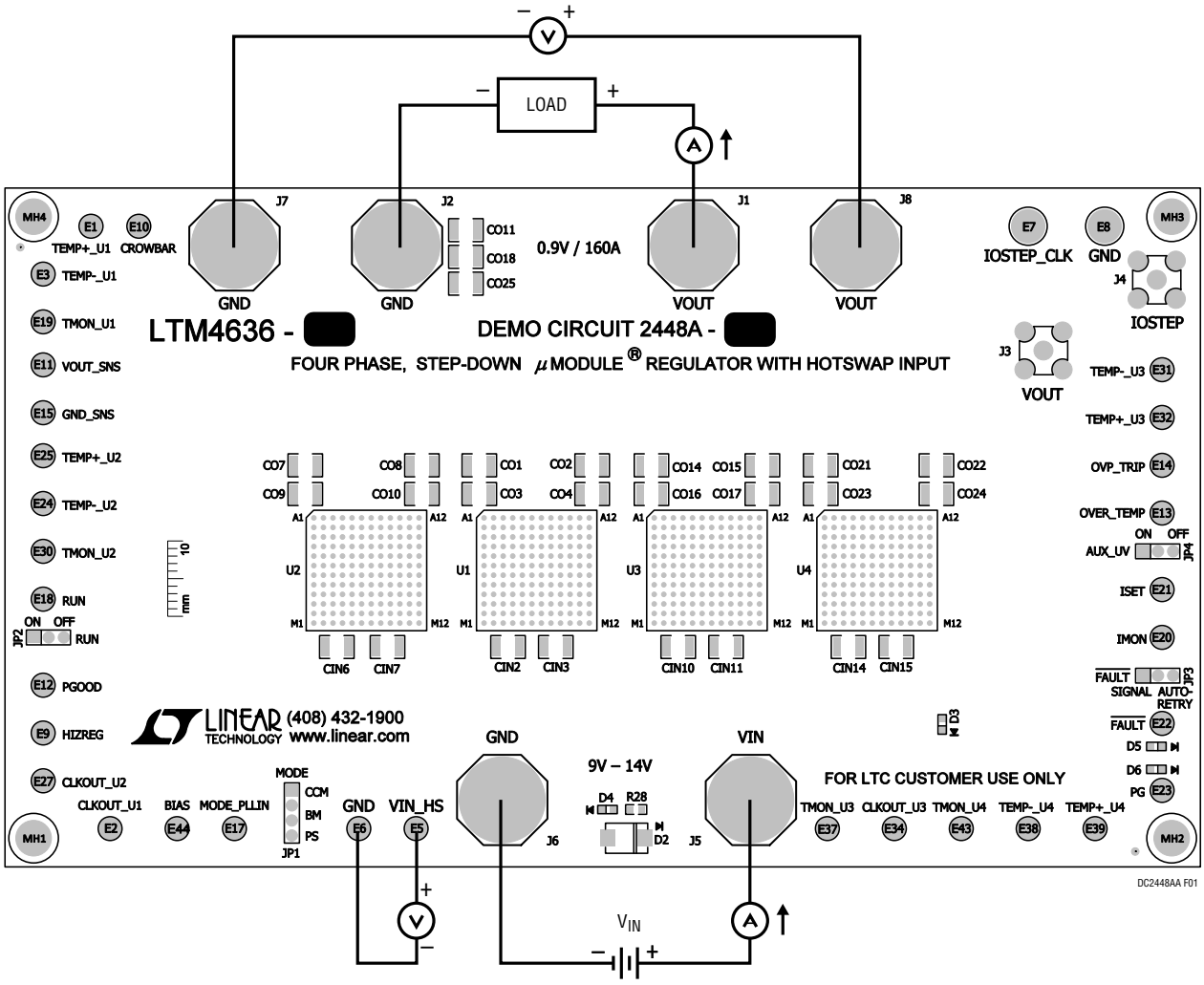


Figure 1. Measurement Setup of DC2448A-A

QUICK START PROCEDURE

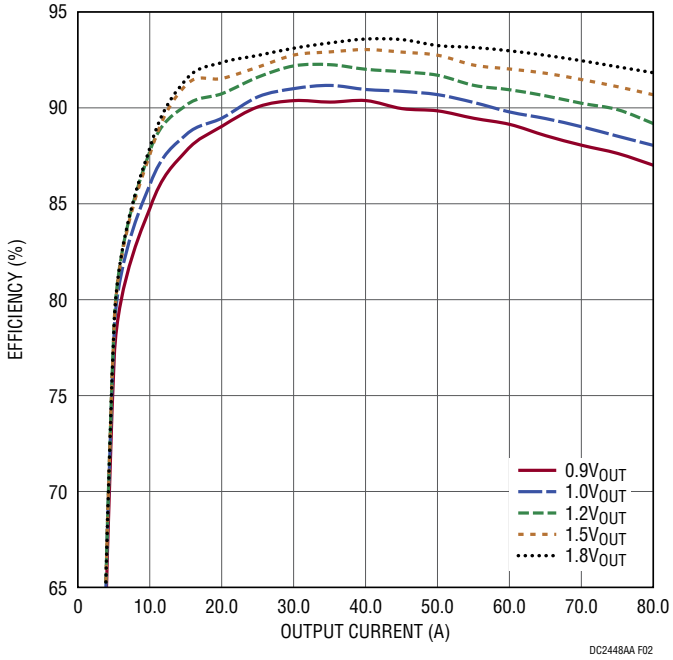


Figure 2. Measured Efficiency at V_{IN} = 12V, f_{SW} = 350kHz, CCM

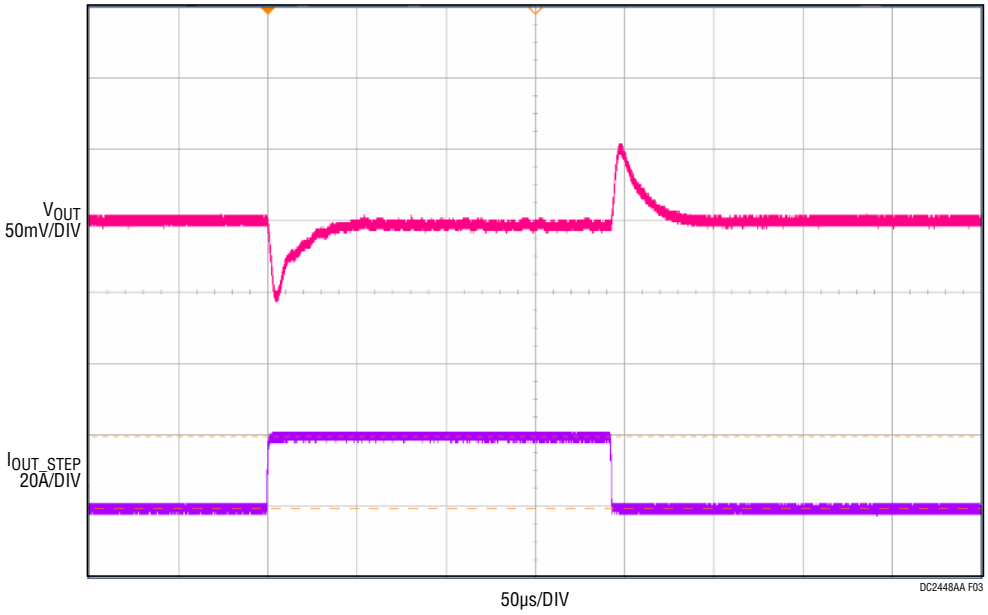


Figure 3. Measured Load Transient
V_{IN} = 12V, V_{OUT} = 0.9V, I_{STEP} = 0A to 20A

QUICK START PROCEDURE

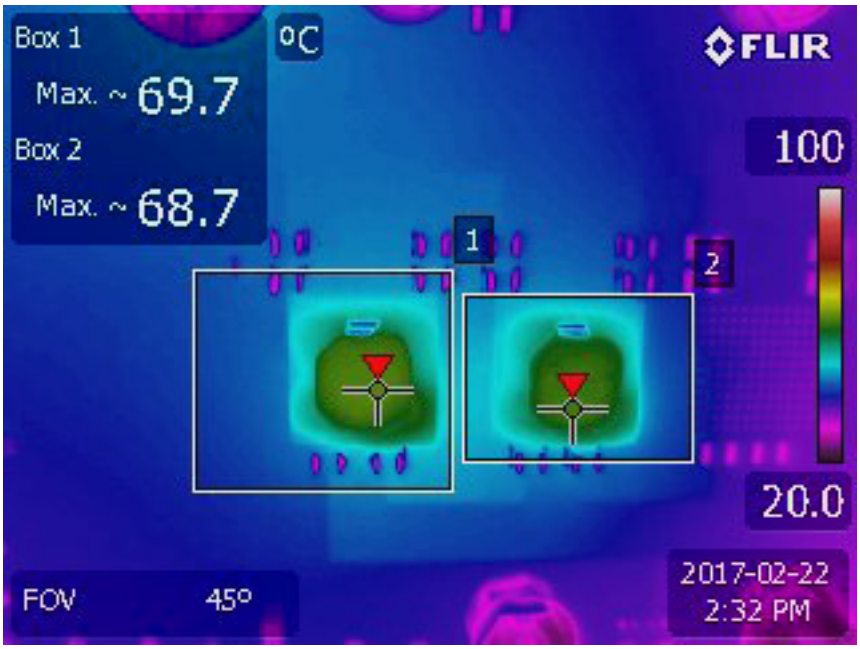


Figure 4. Thermal Capture at V_{IN} = 12V, V_{OUT} = 0.9V, 80A (T_A = 25°C, 200LFM Airflow and No Heat Sink)

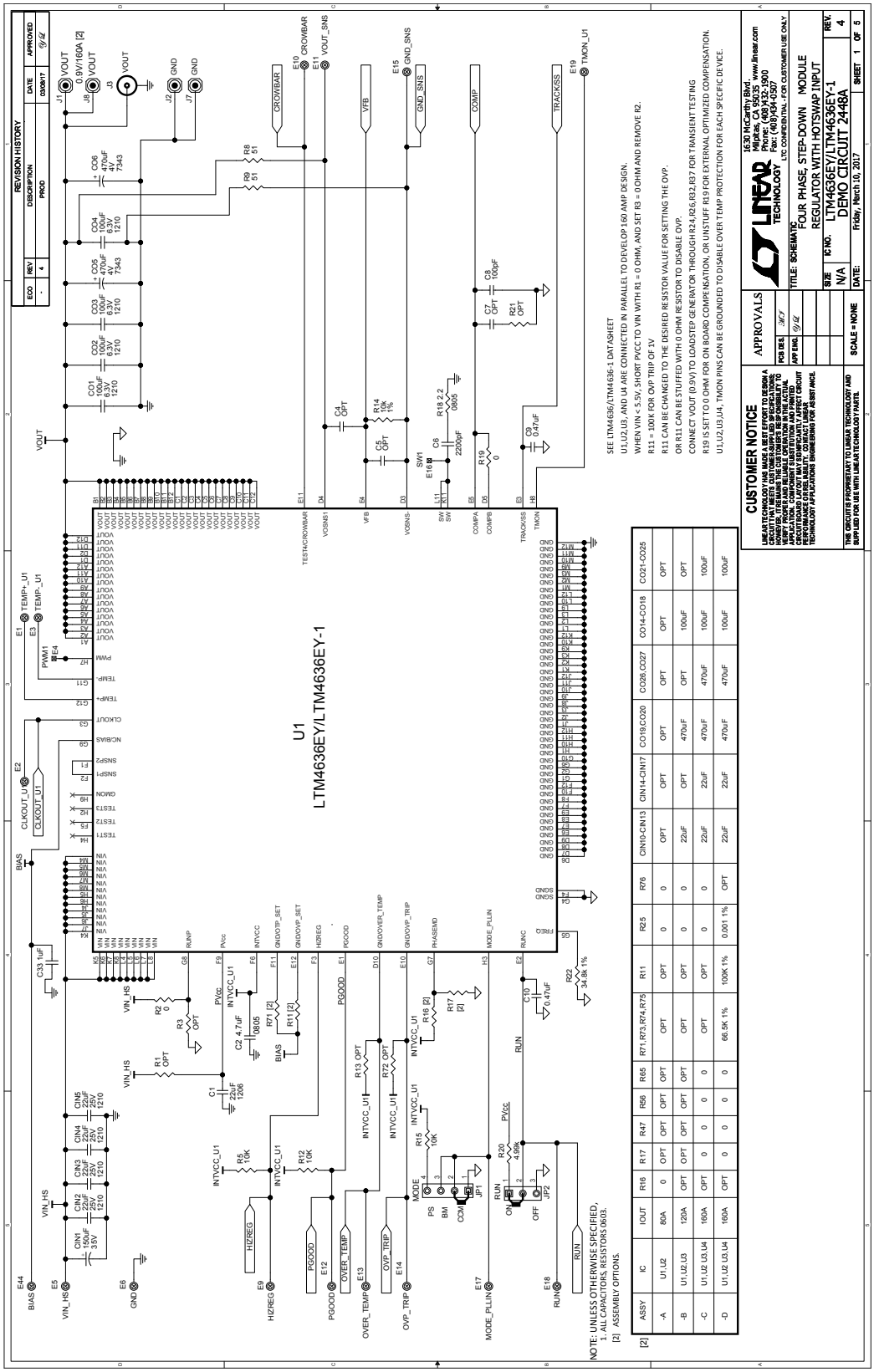
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C14	CAP., 22µF, X7R, 10V, 10%, 1206	MURATA, GRM31CR71A226KE15L
2	2	C2, C15	CAP., 4.7µF, X5R, 25V, 20%, 0805	MURATA, GRM21BR61E475MA12L
3	1	C8	CAP., 100pF, X7R, 50V, 10%, 0603	AVX, 06035C101KAT2A
4	2	C9, C10	CAP., 0.47µF, X7R, 10V, 10%, 0603	AVX, 0603ZC474KAT2A MURATA, GRM188R71A474KA61D
5	2	C29, C30	CAP., 10µF, X5R, 6.3V, 10%, 0805	MURATA, GRM21BR60J106KE19L
6	11	C31, C32, CO1, CO2, CO3, CO4, CO7, CO8, CO9, CO10, CO11	CAP., 100µF, X5R, 6.3V, 20%, 1210	MURATA, GRM32ER60J107ME20L
7	1	CIN1	CAP., 150µF, ALUM., 35V, 20%, 10x10.5mm, SMD, HVH Series	SUN ELECTRONIC INDUSTRIES CORP, 35HVH150M
8	8	CIN2, CIN3, CIN4, CIN5, CIN6, CIN7, CIN8, CIN9	CAP., 22µF, X5R, 25V, 10%, 1210	AVX, 12103D226KAT2A MURATA, GRM32ER61E226KE15L
9	4	CO5, CO6, CO12, CO13	CAP., 470µF, TANT. POLY., 4V, 20%, 7343, D3L	PANASONIC, 4TPE470MCL
10	1	R14	RES., 10k, 1%, 1/10W, 0603	KOA SPEER, RK73H1JTTD1002F PANASONIC, ERJ3EKF1002V VISHAY, CRCW060310K0FKEA
11	1	R20	RES., 4.99k, 1%, 1/10W, 0603	NIC, NRC06F4991TRF VISHAY, CRCW06034K99FKEA
12	2	R22, R51	RES., 34.8k, 1%, 1/10W, 0603	VISHAY, CRCW060334K8FKEA YAGEO, RC0603FR-0734K8L
13	2	U1, U2	IC, HIGH EFFICIENCY 40A µMODULE	LINEAR TECHNOLOGY, LTM4636EY#PBF
Additional Demo Board Circuit Components				
1	2	C6, C17	CAP., 2200pF, X7R, 50V, 10%, 0603	AVX, 06035C222KAT2A
2	1	C33	CAP., 1µF, X7R, 16V, 10%, 0603	AVX, 0603YC105KAT2A NIC, NMC0603X7R105K16TRPF TDK, C1608X7R1C105K080AC
3	1	Q3	XSTR., MOSFET, N-CH, 40V, TO-252	VISHAY, SUD50N04-8M8P-4GE3
4	5	R2, R16, R19, R45, R50	RES., 0Ω, 1/10W, 0603	NIC, NRC06Z0TRF VISHAY, CRCW06030000Z0EA
5	4	R4, R5, R12, R15	RES., 10k, 5%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEYJ103V VISHAY, CRCW060310K0JNEA
6	1	R7	RES., 0.01Ω, 1%, 1W, 2010, HIGH POWER	VISHAY, WSL2010R0100FEA18
7	2	R8, R9	RES., 51Ω, 5%, 1/10W, 0603	VISHAY, CRCW060351R0JNEA
8	2	R18, R49	RES., 2.2Ω, 5%, 1/8W, 0805, AEC-Q200	VISHAY, CRCW08052R20JNEA
9	4	R24, R26, R32, R37	RES., 0Ω, 3/4W, 2010, AEC-Q200	VISHAY, CRCW20100000Z0EF
10	1	R25	RES., 0Ω, 1W, 2512, SENSE	VISHAY, WSL251200000ZEA9
11	1	R76	RES., 0Ω, 1W, 2010, SENSE, AEC-Q200	VISHAY, WSL201000000ZEA9

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	27	E1, E2, E3, E5, E6, E9, E10, E11, E12, E13, E14, E15, E17, E18, E19, E24, E25, E27, E30, E31, E32, E34, E37, E38, E39, E43, E44	TEST POINT, TURRET, 0.064", MTG. HOLE	MILL-MAX, 2308-2-00-80-00-00-07-0
2	2	E7, E8	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
3	6	J1, J2, J5, J6, J7, J8	WASHER, FLAT, STEEL, ZINC PLATE, OD: 0.436 [11.1]	KEYSTONE, 4703
4	6	J1, J2, J5, J6, J7, J8	RING, LUG, CRIMP, #10, NON-INSULATED, SOLDERLESS TERMINALS	KEYSTONE, 8205
5	6	J1, J2, J5, J6, J7, J8	STUD, FASTENER, #10-32	PENNENGINEERING, KFH-032-10ET
6	6	J1, J2, J5, J6, J7, J8	NUT, HEX, STEEL, ZINC PLATE, 10-32	KEYSTONE, 4705
7	2	J3, J4	CONN., SMA RF COAX, PCB JACK RCPT, THT, STR	MOLEX, 73391-0060
8	1	JP1	CONN., HDR., MALE, 1x4, 2mm, THT, STR	SAMTEC, TMM-104-02-L-S
9	1	JP2	CONN., HDR., MALE, 1x3, 2mm, THT, STR	SAMTEC, TMM-103-02-L-S
10	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.250"	KEYSTONE, 8831 WURTH ELEKTRONIK, 702931000
11	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2 POS, 2mm	SAMTEC, 2SN-BK-G

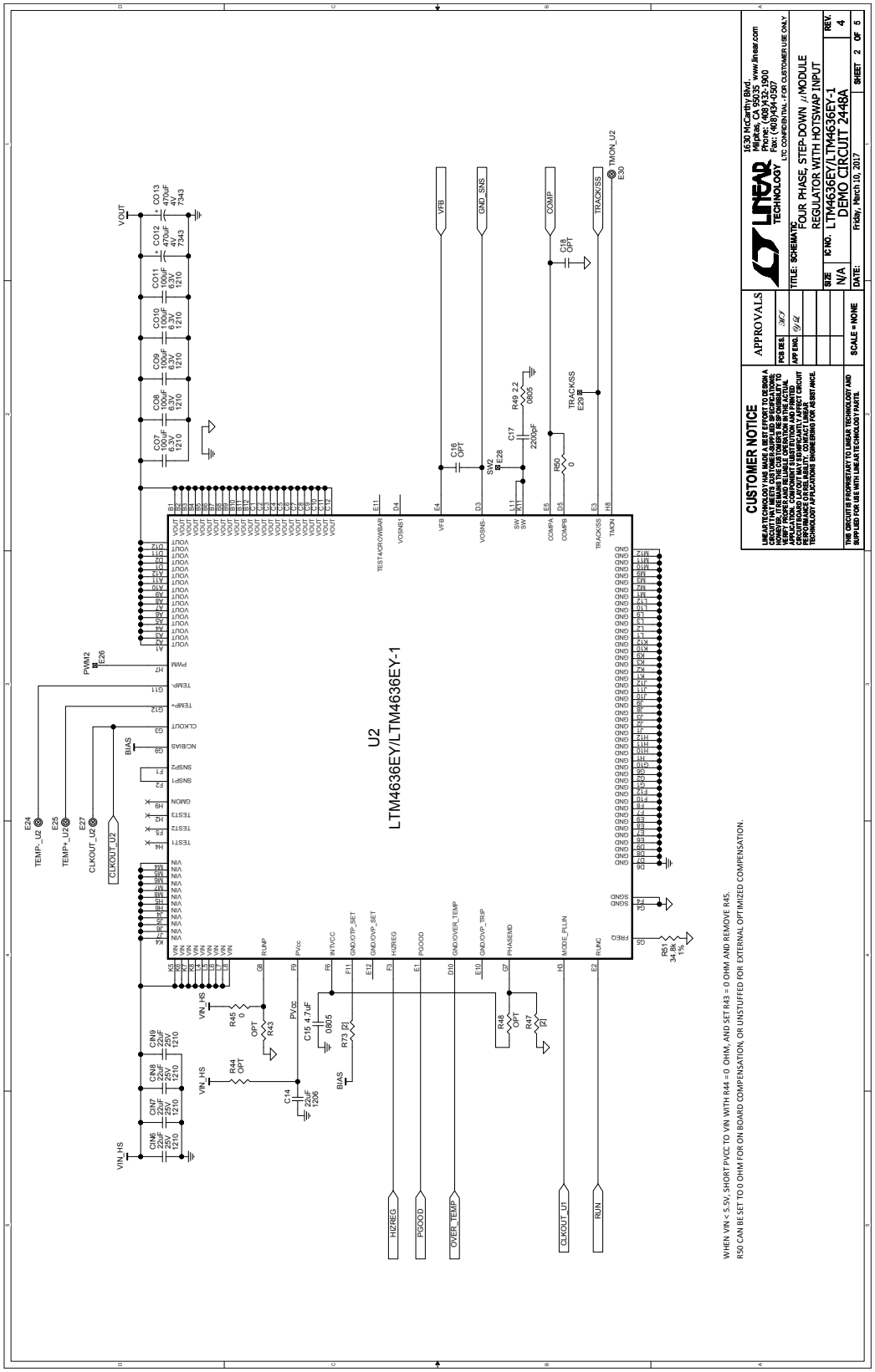
SCHEMATIC DIAGRAM



[2] ASSY	IC	IOUT	R16	R17	R47	R56	R65	R71,R73,R74,R75	R11	R25	R76	CIN10-CIN13	CIN14-CIN17	CO19,CO20	CO26,CO27	CO14-CO18	CO21-CO25
-A	U1,U2	80A	0	OPT	OPT	OPT	OPT	OPT	OPT	0	0	OPT	OPT	OPT	OPT	OPT	OPT
-B	U1,U2,U3	120A	OPT	OPT	OPT	OPT	OPT	OPT	OPT	0	0	22uF	OPT	470uF	OPT	100uF	OPT
-C	U1,U2,U3,U4	160A	OPT	0	0	0	OPT	OPT	OPT	0	0	22uF	22uF	470uF	470uF	100uF	100uF
-D	U1,U2,U3,U4	160A	OPT	0	0	0	0	66.5K 1%	100K 1%	0.001 1%	OPT	22uF	22uF	470uF	470uF	100uF	100uF

SEE LTM4636/LTM4636-1 DATASHEET
U1,U2,U3, AND U4 ARE CONNECTED IN PARALLEL TO DEVELOP 160 AMP DESIGN.
WHEN VIN < 5.5V, SHORT PVCC TO VIN WITH R1 = 0 OHM, AND SET R3 = 0 OHM AND REMOVE R2.
R11 = 100K FOR OVP TRIP OF 1V
R11 CAN BE CHANGED TO THE DESIRED RESISTOR VALUE FOR SETTING THE OVP.
OR R11 CAN BE STUFFED WITH 0 OHM RESISTOR TO DISABLE OVP.
CONNECT VOUT (0.9V) TO LOADSTEP GENERATOR THROUGH R24,R26,R32,R37 FOR TRANSIENT TESTING
R19 IS SET TO 0 OHM FOR ON BOARD COMPENSATION, OR UNSTUFF R19 FOR EXTERNAL OPTIMIZED COMPENSATION.
U1,U2,U3,U4, TMON PINS CAN BE GROUNDED TO DISABLE OVER TEMP PROTECTION FOR EACH SPECIFIC DEVICE.

SCHEMATIC DIAGRAM



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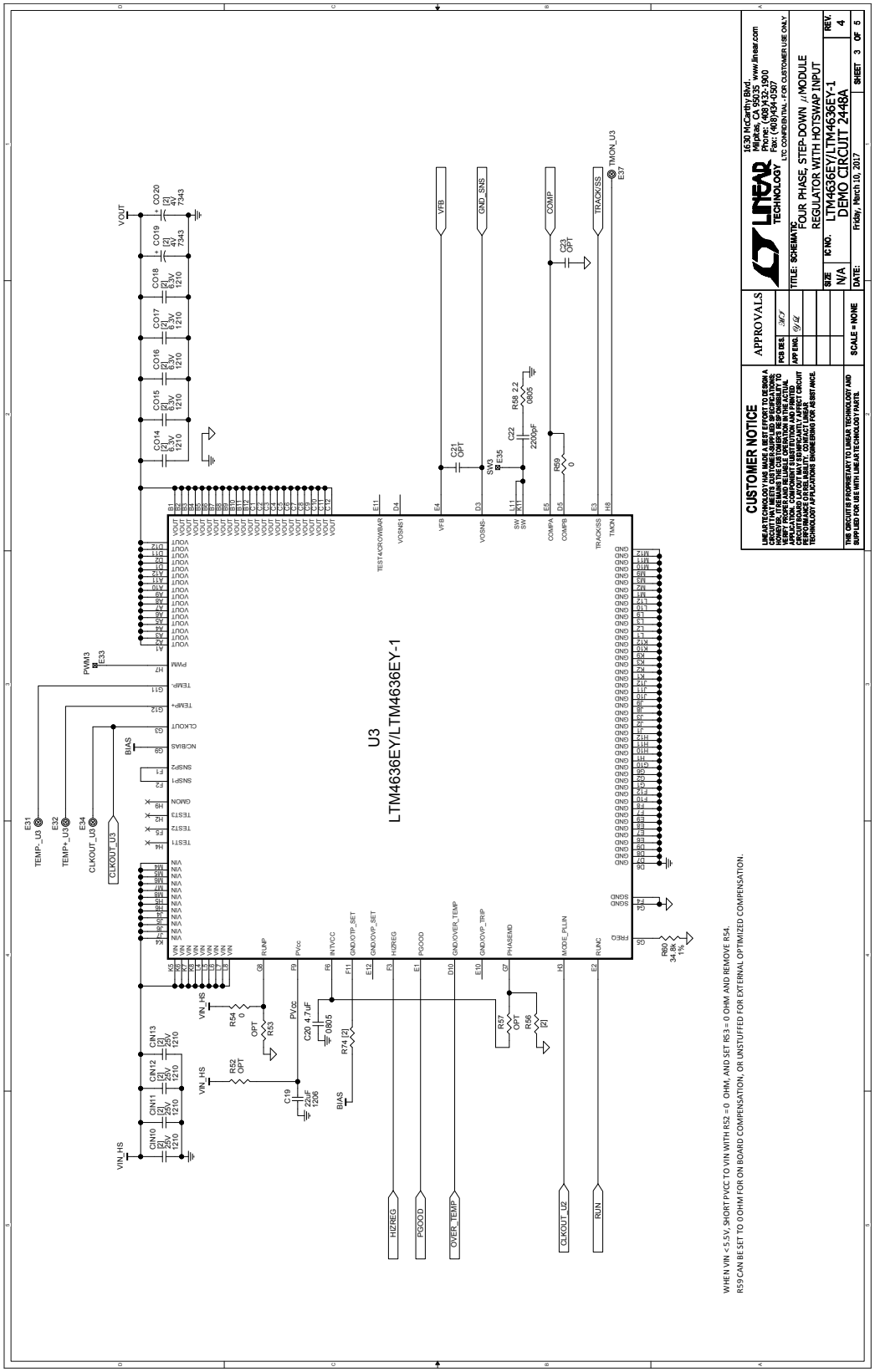
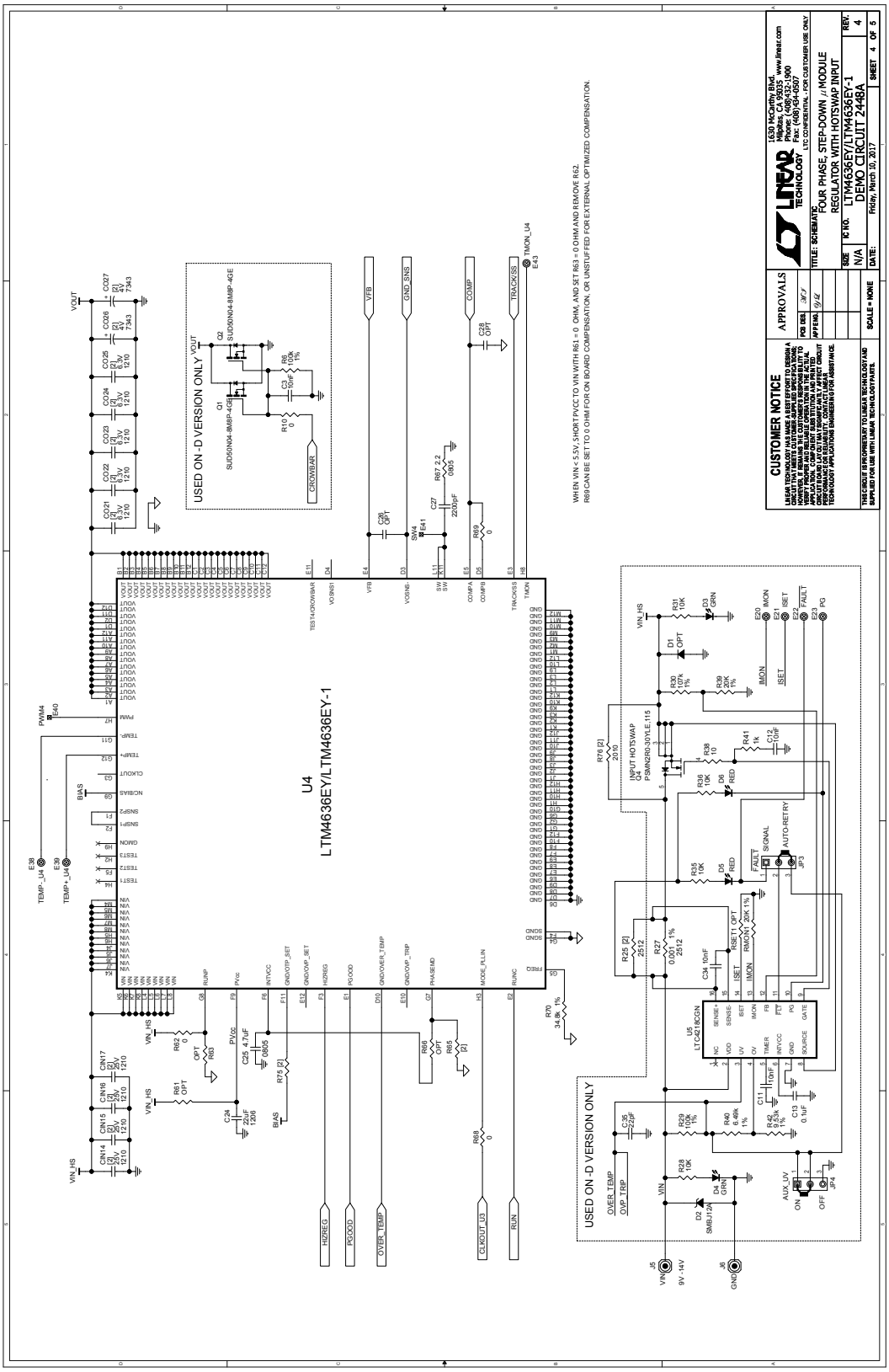


SCHEMATIC DIAGRAM



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