LTM4636-1
PolyPhase 160A Step-Down Power µModule Regulator with Overvoltage and Overtemperature Protection

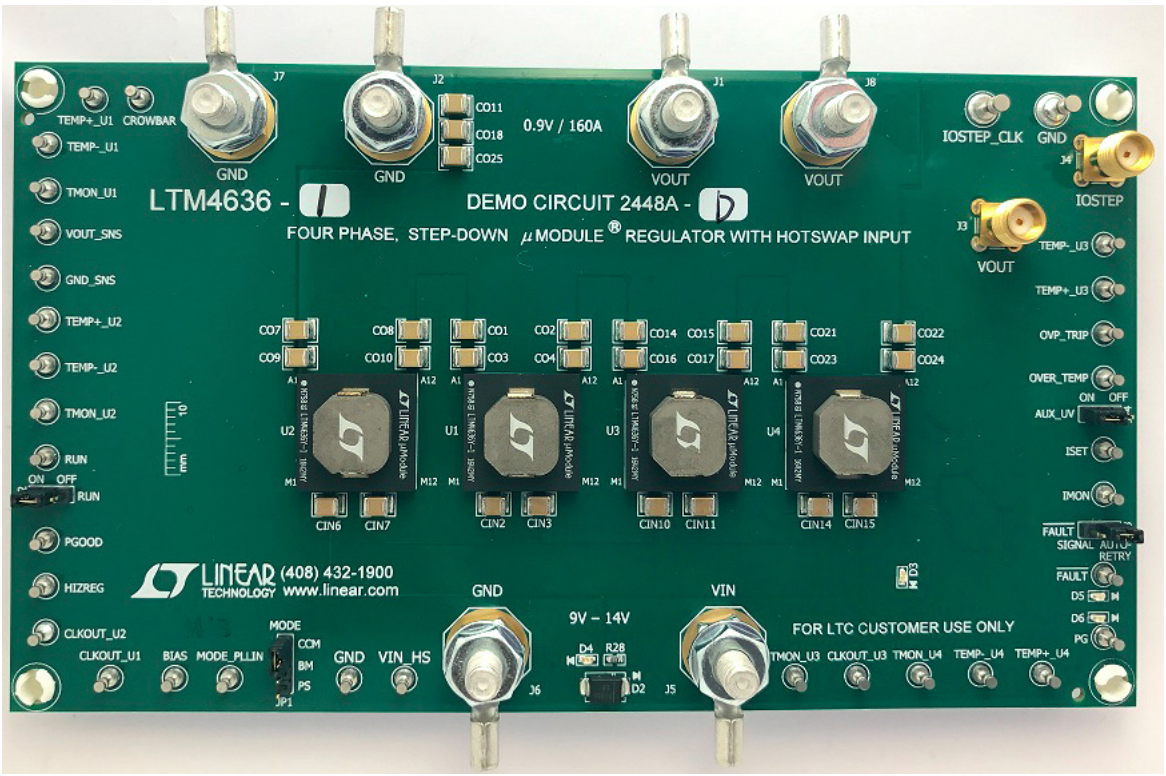
DESCRIPTION

Demonstration circuit DC2448A-D features a PolyPhase® design using the LTM®4636-1EY, a 40A high efficiency, switch mode step-down power µModule® regulator with overvoltage and overtemperature protection features. The input voltage range is from 9V to 15V. The output voltage range is 0.6V to 3.3V. The DC2448A-D can deliver a nominal 160A output current. DC2448A-D has on-board hot swap circuit that can disconnect input supply and protect the LTM4636-1 and the load under overvoltage and overtemperature conditions. 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 LTM4636-1 to synchronize to an external clock signal. DC2448A-D has the option of choosing both internal and external compensation circuits for LTM4636-1. The LTM4636-1 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2448A-D.

Design files for this circuit board are available.

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		9V to 15V
Output Voltages		0.9V ±1.3%
Maximum Continuous Output Current	Derating is necessary for certain operating conditions. See data sheet for details.	$160A_{DC}$
Operating Frequency		350kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 0.9V, I_{OUT} = 160A	86.1% Figure 2
Load Transient $V_{OUT(P-P)}$	V_{IN} = 12V, V_{OUT} = 0.9V, I_{STEP} = 0A TO 40A	95mV Figure 3
V_{OUT} Overvoltage Threshold	R11 = 100kΩ	1V
Overtemperature Threshold	R71 = R73 = R74 = R75 = 66.5kΩ, V_{BIAS} = 5V	130°C

QUICK START PROCEDURE

Demonstration circuit DC2448A-D is an easy way to evaluate the performance of PolyPhase operation of the LTM4636-1EY. 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 9V to 15V and adjust the load current from 0A to 160A. 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) LTM4636-1 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 LTM4636-1 can track another supply. The output voltage tracks the voltage on TRACK when a valid signal is applied on the test point.
8. (Optional) To test the OVP and OTP circuitry of LTM4636-1, another external 5V power supply is needed at the BIAS pin.

QUICK START PROCEDURE

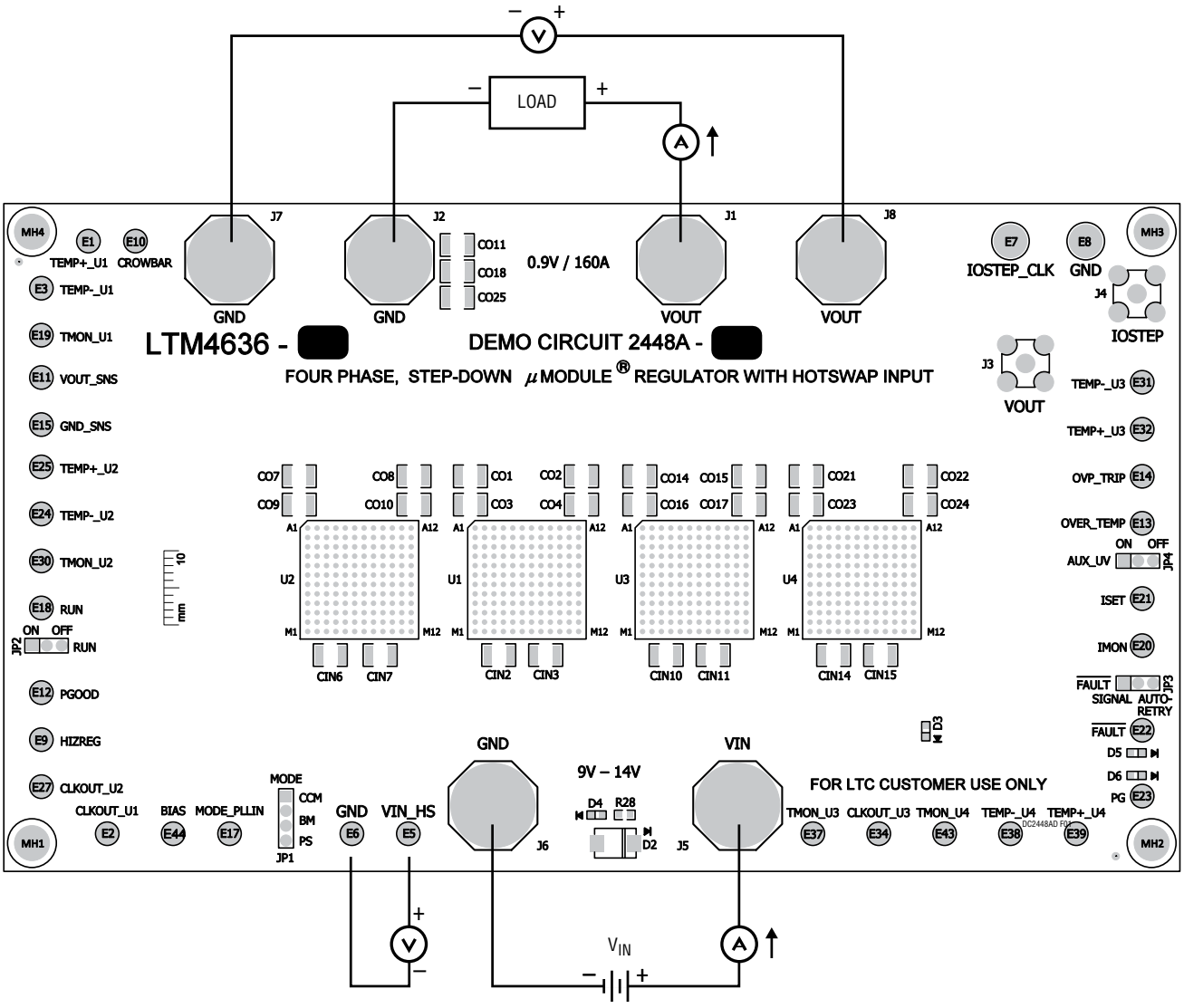


Figure 1. Measurement Setup of DC2448A-D

QUICK START PROCEDURE

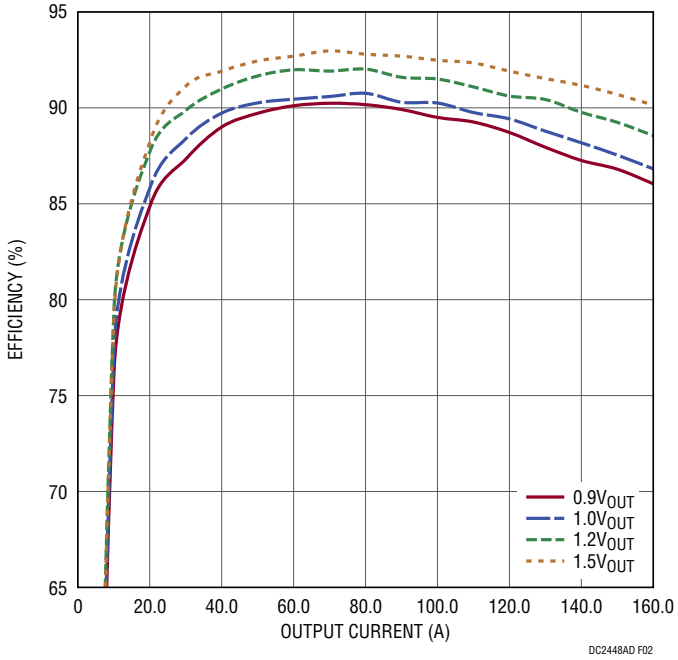


Figure 2. Measured Efficiency at V_{IN} = 12V, f_{SW} = 350kHz, CCM

QUICK START PROCEDURE

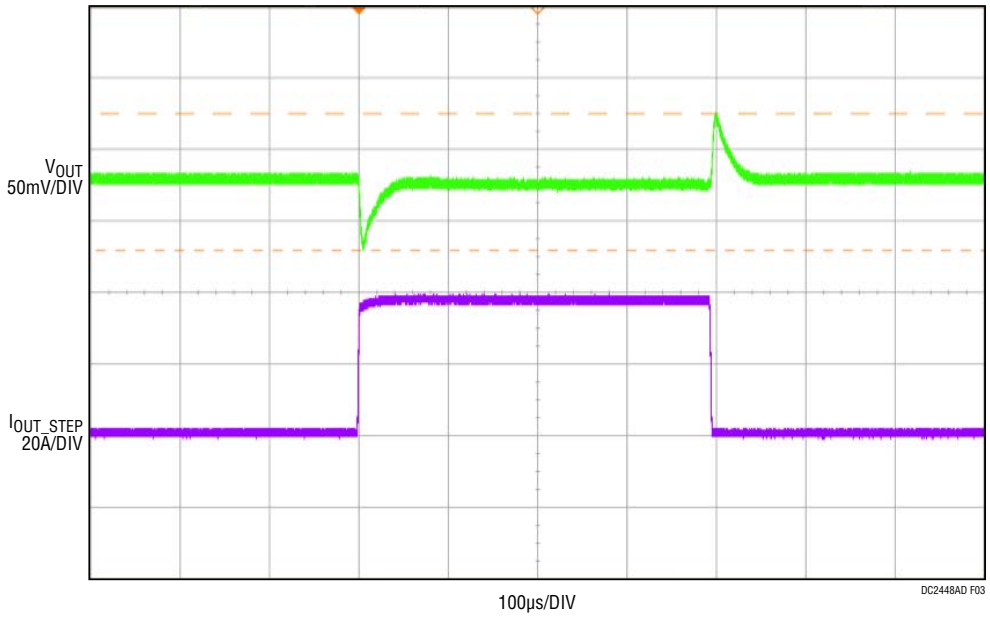


Figure 3. Measured Load Transient
V_{IN} = 12V, V_{OUT} = 0.9V, I_{STEP} = 0A to 40A

QUICK START PROCEDURE

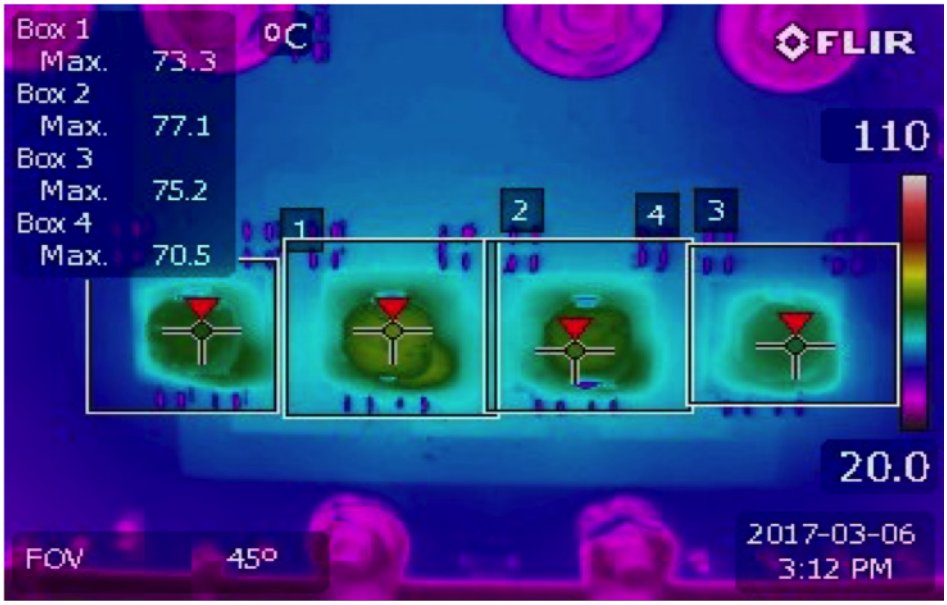


Figure 4. Thermal Capture at V_{IN} = 12V, V_{OUT} = 0.9V, 160A (T_A = 25°C, 400LFM Airflow and No Heat Sink)

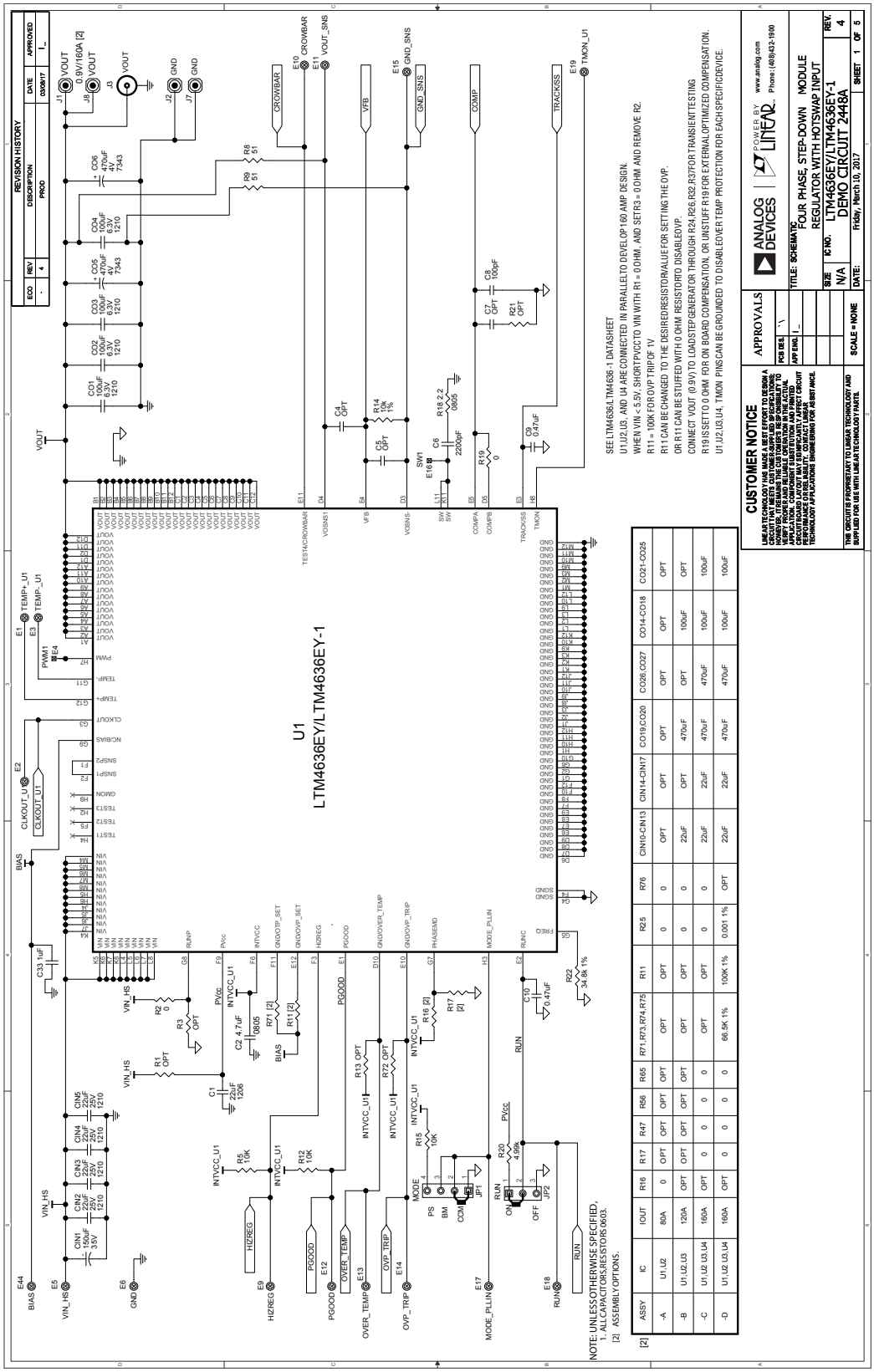
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C14, C19, C24	CAP., 22µF, X7R, 10V, 10%, 1206	MURATA, GRM31CR71A226KE15L
2	4	C2, C15, C20, C25	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	21	C31, C32, CO1, CO2, CO3, CO4, CO7, CO8, CO9, CO10, CO11, CO14, CO15, CO16, CO17, CO18, CO21, CO22, CO23, CO24, CO25	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	16	CIN2, CIN3, CIN4, CIN5, CIN6, CIN7, CIN8, CIN9, CIN10, CIN11, CIN12, CIN13, CIN14, CIN15, CIN16, CIN17	CAP., 22µF, X5R, 25V, 10%, 1210	AVX, 12103D226KAT2A MURATA, GRM32ER61E226KE15L
9	8	CO5, CO6, CO12, CO13, CO19, CO20, CO26, CO27	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	4	R22, R51, R60, R70	RES., 34.8k, 1%, 1/10W, 0603	VISHAY, CRCW060334K8FKEA YAGEO, RC0603FR-0734K8L
13	3	U1, U2, U3, U4	IC, HIGH EFFICIENCY 40A µMODULE	ANALOG DEVICES, LTM4636EY#PBF
Additional Demo Board Circuit Components				
1	4	C3, C11, C12, C34	CAP., 0.01µF, X7R, 100V, 10%, 0603	AVX, 06031C103KAT2A
2	4	C6, C17, C22, C27	CAP., 2200pF, X7R, 50V, 10%, 0603	AVX, 06035C222KAT2A
3	1	C13	CAP., 0.1µF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
4	1	C33	CAP., 1µF, X7R, 16V, 10%, 0603	AVX, 0603YC105KAT2A NIC, NMC0603X7R105K16TRPF TDK, C1608X7R1C105K080AC
5	1	C35	CAP., 22pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H220JA01J
6	1	D2	DIODE, TVS, 12V, 600W, SMB/DO-214AA	FAIRCHILD SEMI, SMBJ12A
7	2	D3, D4	LED, GREEN, WATERCLEAR, 0603	WURTH ELEKTRONIK, 150060GS75000
8	2	D5, D6	LED, SUPER RED, WATERCLEAR, 0603	WURTH ELEKTRONIK, 150060SS75000
9	3	Q1, Q2, Q3	XSTR., MOSFET, N-CH, 40V, TO-252	VISHAY, SUD50N04-8M8P-4GE3
10		Q4	XSTR., MOSFET, N-CH, 30V, 100A, LFPAK, SO8(SOT669)	NXP SEMICONDUCTORS, PSMN2R0-30YLE, 115
11	14	R2, R10, R17, R19, R45, R47, R50, R54, R56, R59, R62, R65, R68, R69	RES., 0Ω, 1/10W, 0603	NIC, NRC06Z0TRF VISHAY, CRCW06030000Z0EA
12	8	R4, R5, R12, R15, R28, R31, R35, R36	RES., 10k, 5%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEYJ103V VISHAY, CRCW060310K0JNEA

PARTS LIST

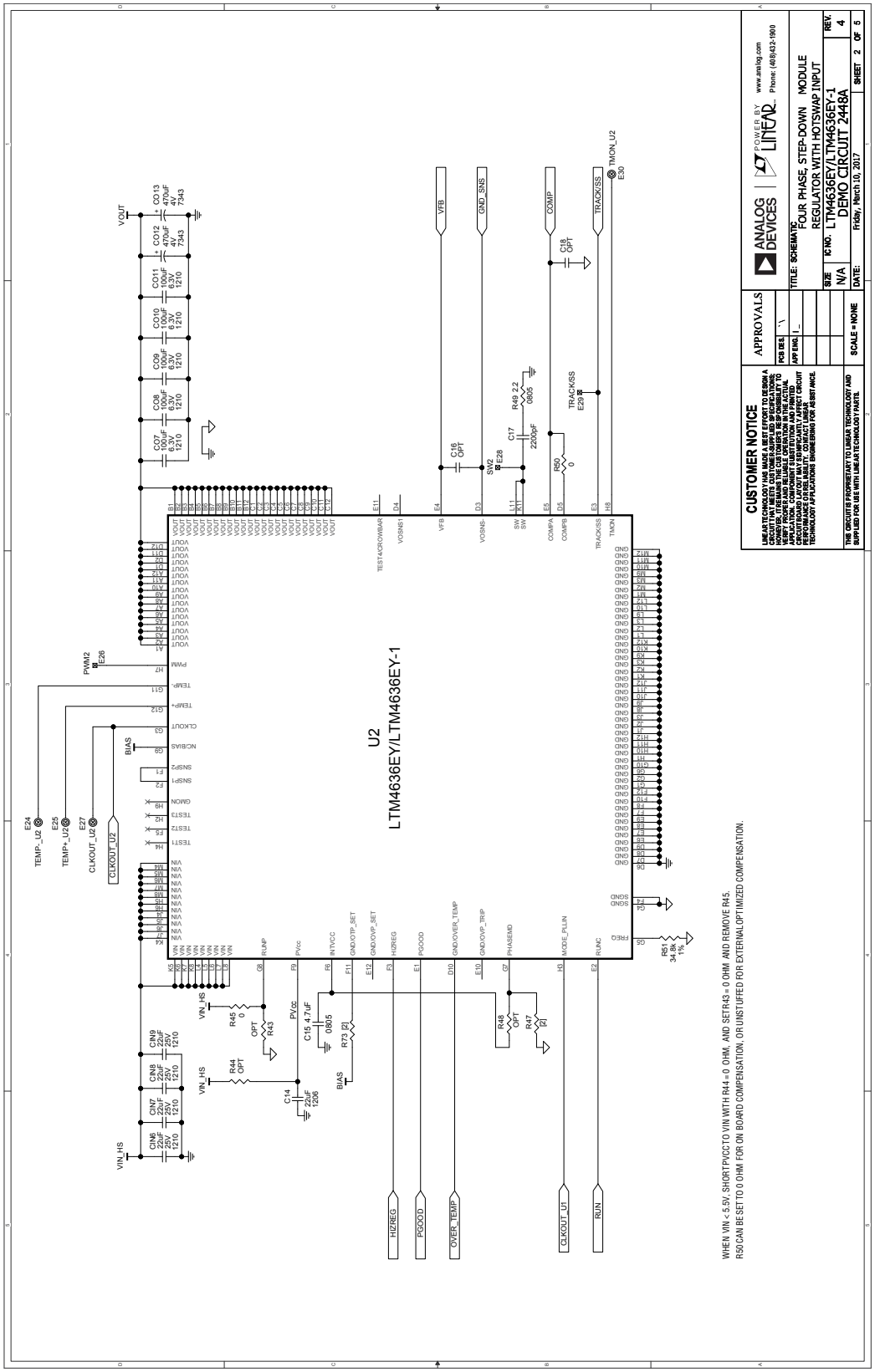
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
13	6	R6, R11, R29, R46, R55, R64	RES., 100k, 1%, 1/10W, 0603	NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, CRCW0603100KFKEA
14	1	R7	RES., 0.01Ω, 1%, 1W, 2010, HIGH POWER	VISHAY, WSL2010R0100FEA18
15	2	R8, R9	RES., 51Ω, 5%, 1/10W, 0603	VISHAY, CRCW060351R0JNEA
16	4	R18, R49, R58, R67	RES., 2.2Ω, 5%, 1/8W, 0805, AEC-Q200	VISHAY, CRCW08052R20JNEA
17	4	R24, R26, R32, R37	RES., 0Ω, 3/4W, 2010, AEC-Q200	VISHAY, CRCW20100000Z0EF
18	2	R25, R27	RES., 0.001Ω, 1%, 1W, 2512, SENSE	VISHAY, WSL25121L000FEA
19	1	R30	RES., 107k, 1%, 1/10W, 0603	NIC, NRC06F1073TRF VISHAY, CRCW0603107KFKEA
20	1	R38	RES., 10Ω, 5%, 1/10W, 0603	NIC, NRC06J100TRF VISHAY, CRCW060310R0JNEA
21	2	RMON1, R39	RES., 20k, 1%, 1/10W, 0603	VISHAY, CRCW060320K0FKEA YAGEO, RC0603FR-0720KL
22	1	R40	RES., 6.49k, 1%, 1/10W, 0603	VISHAY, CRCW06036K49FKEA YAGEO, RC0603FR-076K49L
23	1	R41	RES., 1k, 5%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031K00JNEA
24	1	R42	RES., 9.53k, 1%, 1/10W, 0603	VISHAY, CRCW06039K53FKEA
25	4	R71, R73, R74, R75	RES., 66.5k, 1%, 1/10W, 0603	NIC, NRC06F6652TRF VISHAY, CRCW060366K5FKEA YAGEO, RC0603FR-0766K5L
26	1	U5	IC, HOTSWAP CONTROLLER, SSOP-16	ANALOG DEVICES, LTC4218CGN#PBF ANALOG DEVICES, LTC4218CGN#TRPBF
Hardware: For Demo Board Only				
1	31	E1, E2, E3, E5, E6, E9, E10, E11, E12, E13, E14, E15, E17, E18, E19, E20, E21, E22, E23, 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	4	XJP1, XJP2, XJP3, XJP4	CONN., SHUNT, FEMALE, 2 POS, 2mm	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM

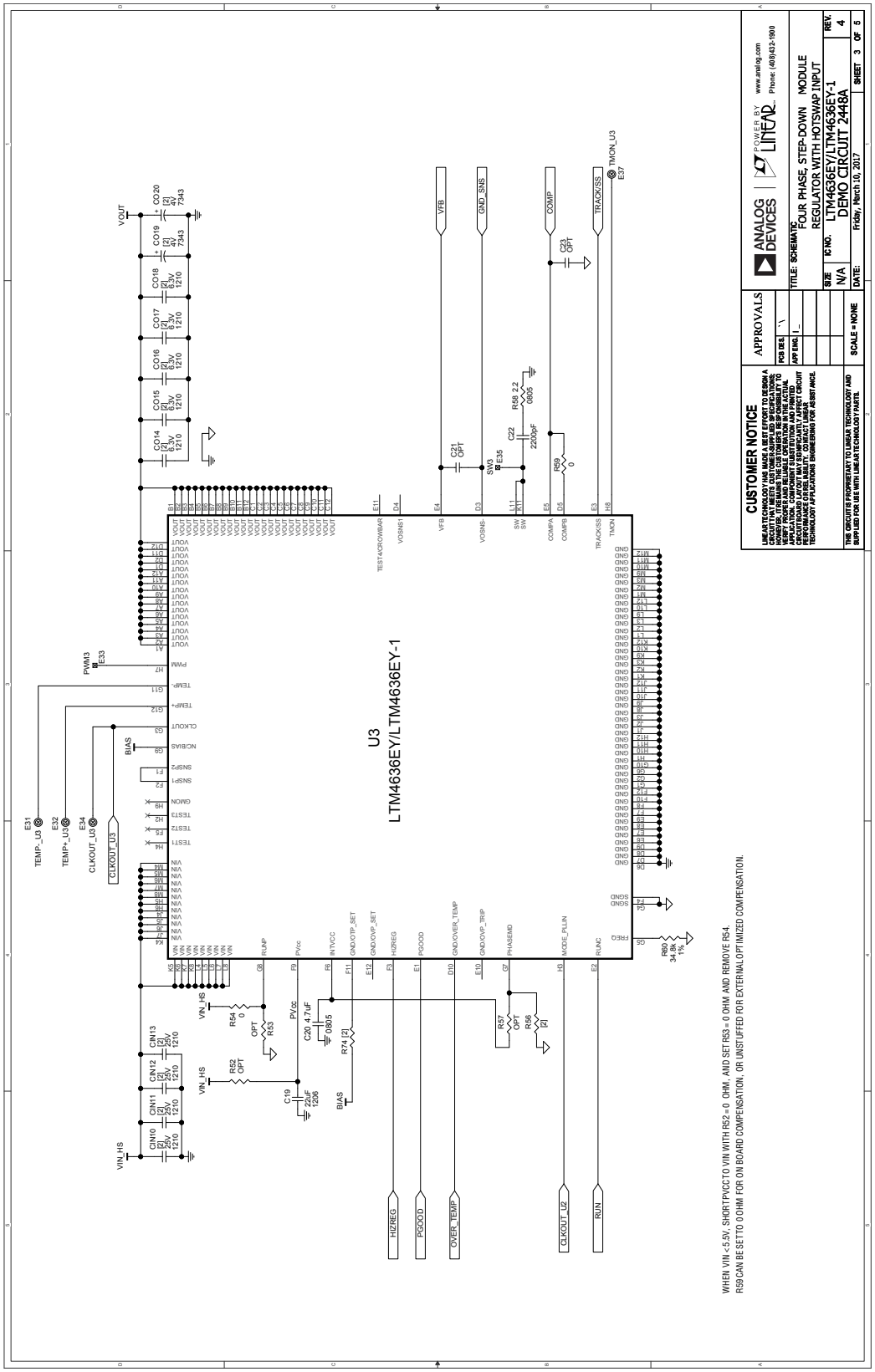


[2]	ASSY	IC	IOUT	R16	R17	R47	R56	R65	R71,R73,R74,R75	R11	R25	R76	CIN10-CIN13	CIN14-CIN17	CO19,CO20	CO26,CO27	CO14-CO18	CO21-CO25
	-A	U1,U2	80A	0	OPT	OPT	OPT	OPT	OPT	OPT	0	0	OPT	OPT	OPT	OPT	OPT	OPT
	-B	U1,U2,U3	120A	OPT	OPT	OPT	OPT	OPT	OPT	OPT	0	0	22uF	OPT	470uF	OPT	100uF	OPT
	-C	U1,U2,U3,U4	160A	OPT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

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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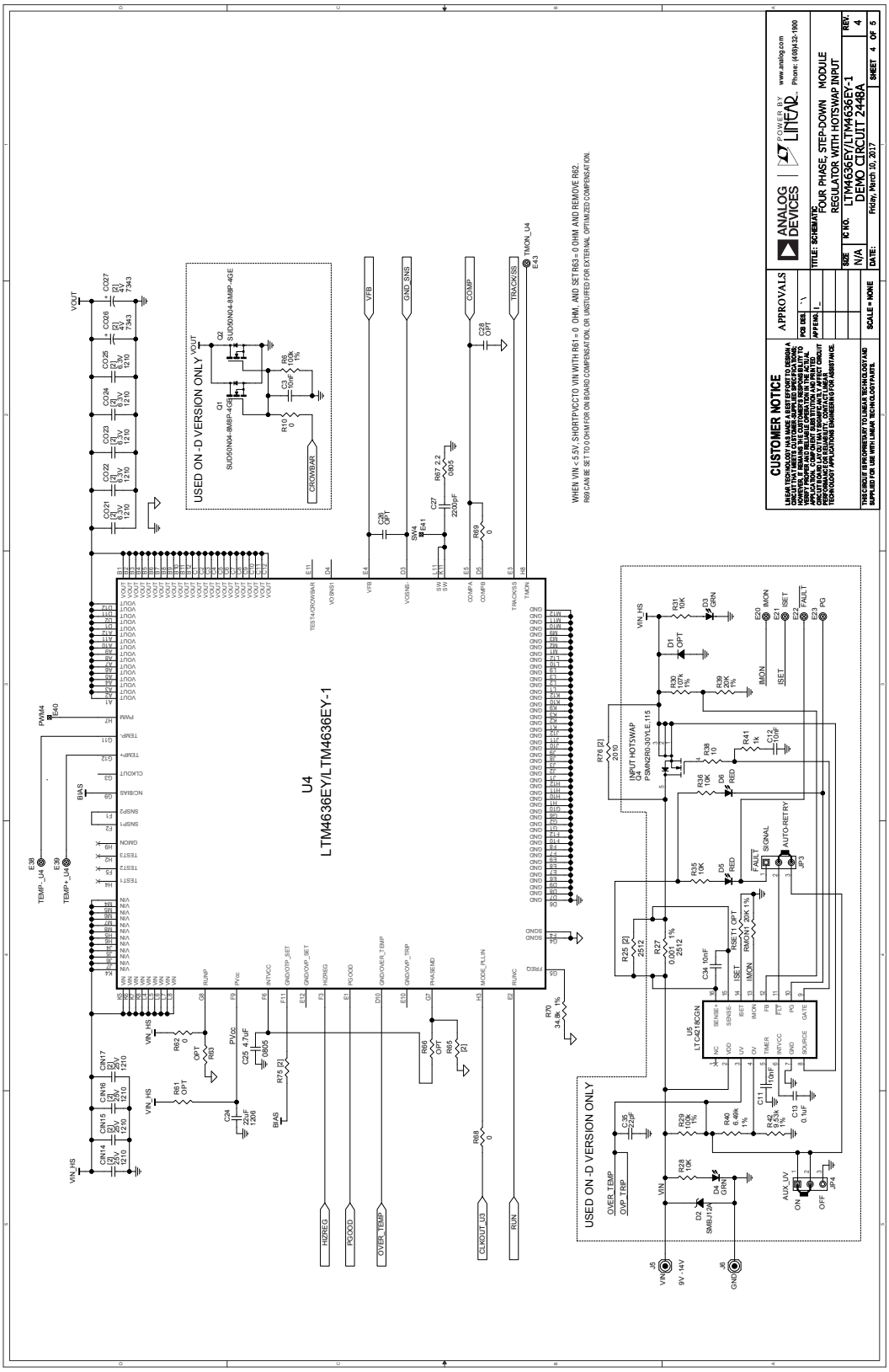

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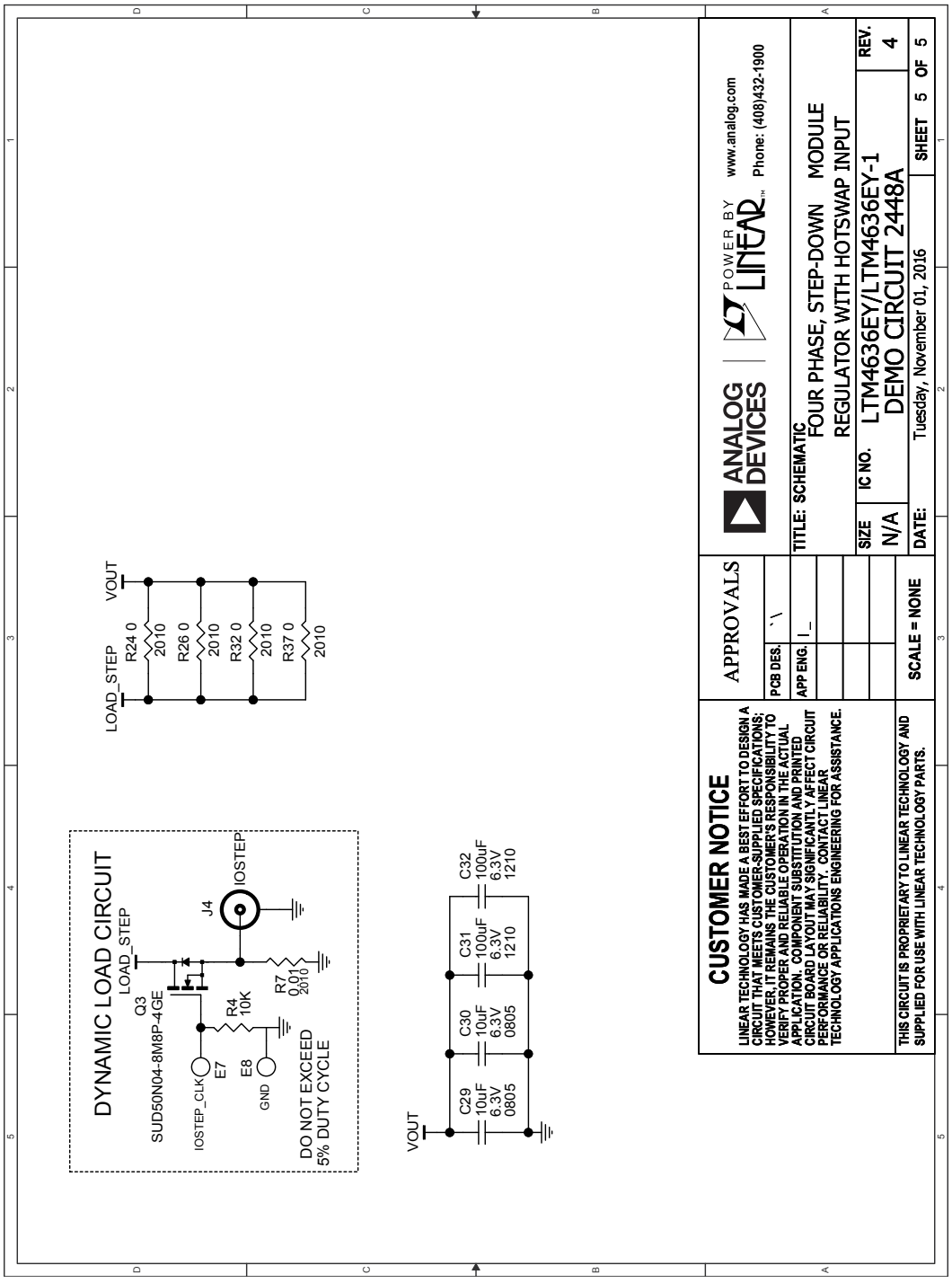

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