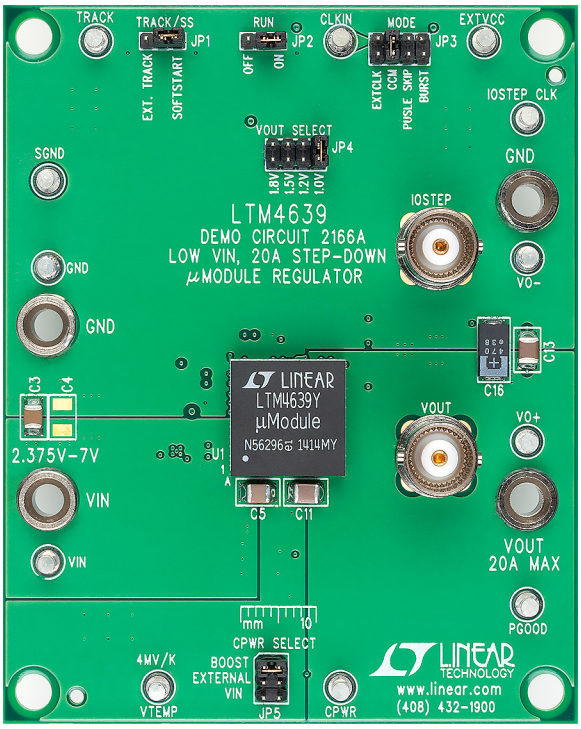
LTM4639
Low V_{IN} 20A DC/DC µModule Step-Down Regulator

DESCRIPTION

Demonstration circuit 2166A features the LTM®4639EY, a 20A high efficiency, switch mode step-down power µModule® regulator. The input voltage range is from 2.375V to 7V. The output voltage range is 0.6V to 5.5V. Derating is necessary for certain V_{IN}, V_{OUT}, frequency and thermal conditions. The DC2166A offers the TRACK/SS pin 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 (JP3) selects pulse-skipping mode for noise sensitive applications or Burst Mode® operation in less noise sensitive applications. There is an on board boost circuit using LT1935 to provide control power to LTM4639 when V_{IN} is less than 4.5V. LTM4639 has on board diode connected PNP transistors to monitor its internal temperature. A temperature sensor LTC2997 converts the internal temperature to an analog voltage output. The LTM4639 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2166A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2166A

BOARD PHOTO



PERFORMANCE SUMMARY

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		2.375V to 7V
Output Voltages		1.0V, 1.2V, 1.5V, 1.8V ± 1.5%
Maximum Continuous Output Current	Derating is necessary for certain operating conditions. See data sheet for details.	20ADC
Operating Frequency		500kHz
Efficiency	V_{IN} = 3.3V, I_{OUT} = 20A	83.2% (V_{OUT1} = 1.0V) (Figure 2) 85.3% (V_{OUT1} = 1.2V) (Figure 2) 87.7% (V_{OUT1} = 1.5V) (Figure 2) 89.1% (V_{OUT1} = 1.8V) (Figure 2)
Load Transient	V_{IN} = 3.3V, V_{OUT} = 1.0V, I_{STEP} = 0A to 10A	156mV (Figure 4)

QUICK START PROCEDURE

Demonstration circuit DC2166A is an easy way to evaluate the performance of the LTM4639EY. 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:

RUN	TRACK/SS	MODE	V_{OUT} SELECT	CPWR SELECT
ON	SOFT-START	CCM	1.0V	BOOST

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 3.3V.
3. Turn on the power supply at the input. The output voltage should be 1.0V ± 1.5% (0.985V to 1.015V).
4. Vary the input voltage from 2.375V to 7V and adjust the load current from 0A to 20A. 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) LTM4639 can be synchronized to an external clock signal. Place the JP3 jumper on EXTCLK and apply a clock signal (0V to 5V, square wave) on the CLKIN test point.
7. (Optional) The outputs of LTM4639 can track another supply by setting JP1 to EXT. TRACK. If tracking external voltage is selected, the corresponding test point TRACK need to be connected to a valid voltage signal.

QUICK START PROCEDURE

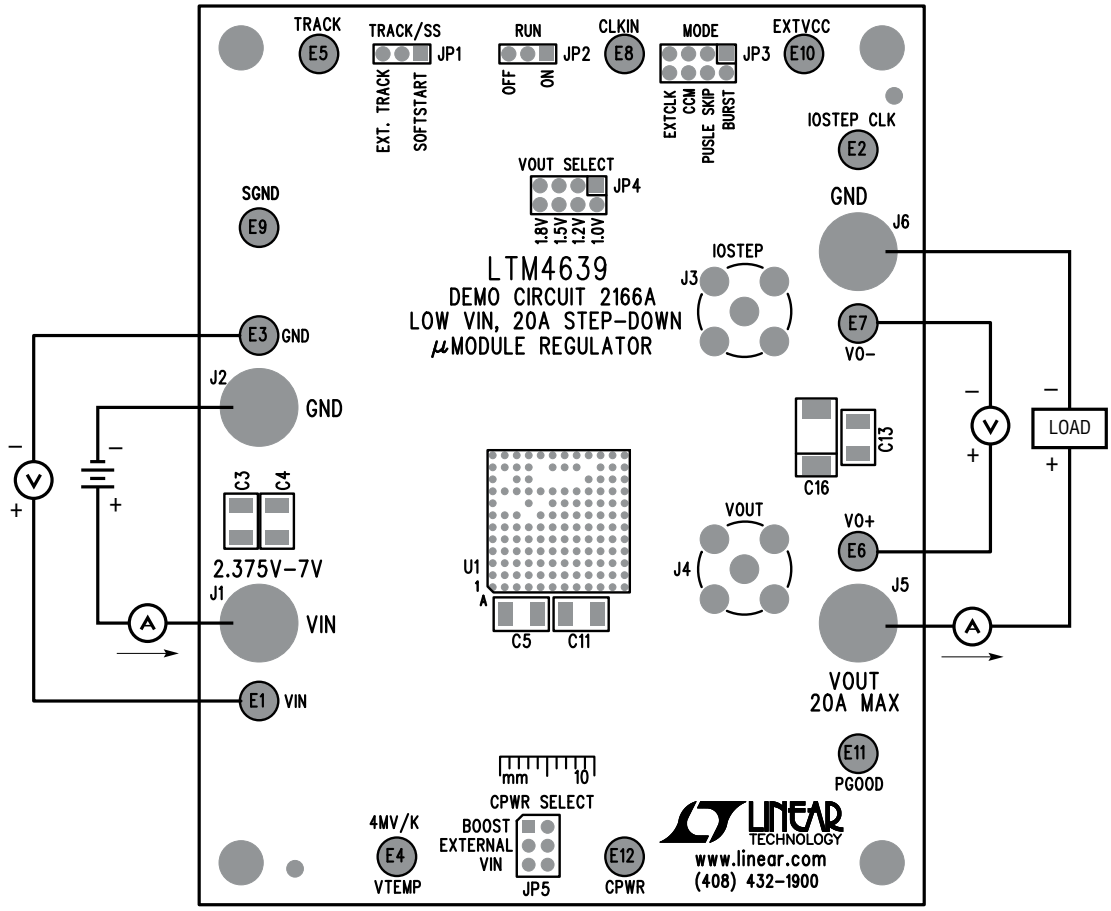


Figure 1. Measurement Setup of DC2166A

QUICK START PROCEDURE

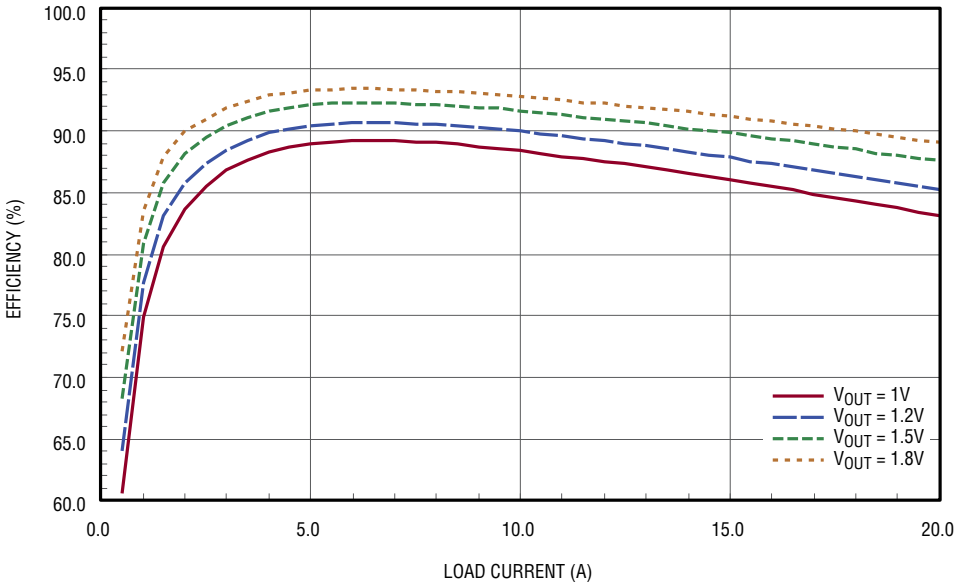


Figure 2. Measured Efficiency at V_{IN} = 3.3V, f_{SW} = 500kHz, CCM

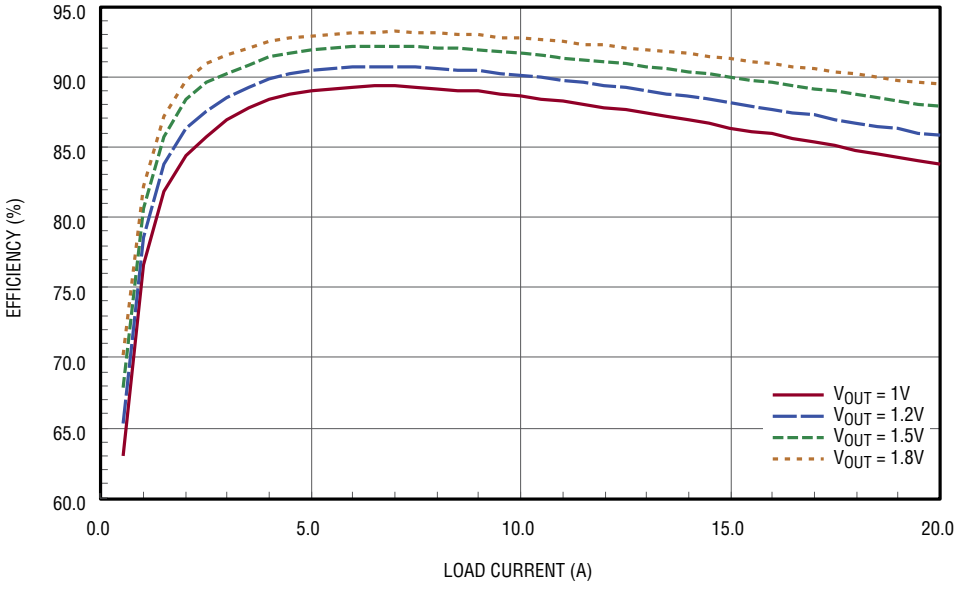


Figure 3. Measured Efficiency at V_{IN} = 5.0V, f_{SW} = 500kHz, CCM

QUICK START PROCEDURE

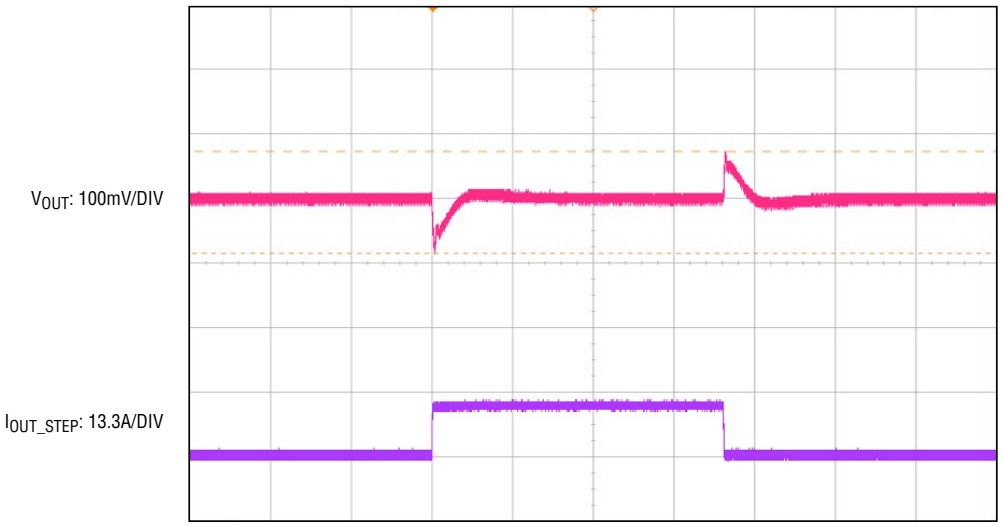


Figure 4. Measured Load Transient
V_{IN} = 3.3V, V_{OUT1} = 1.0V, I_{STEP} = 0A to 10A

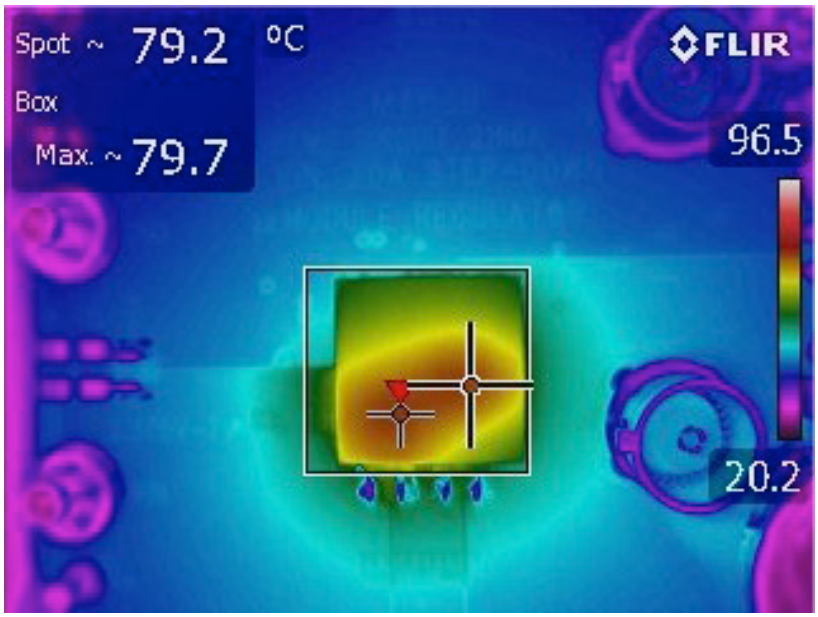
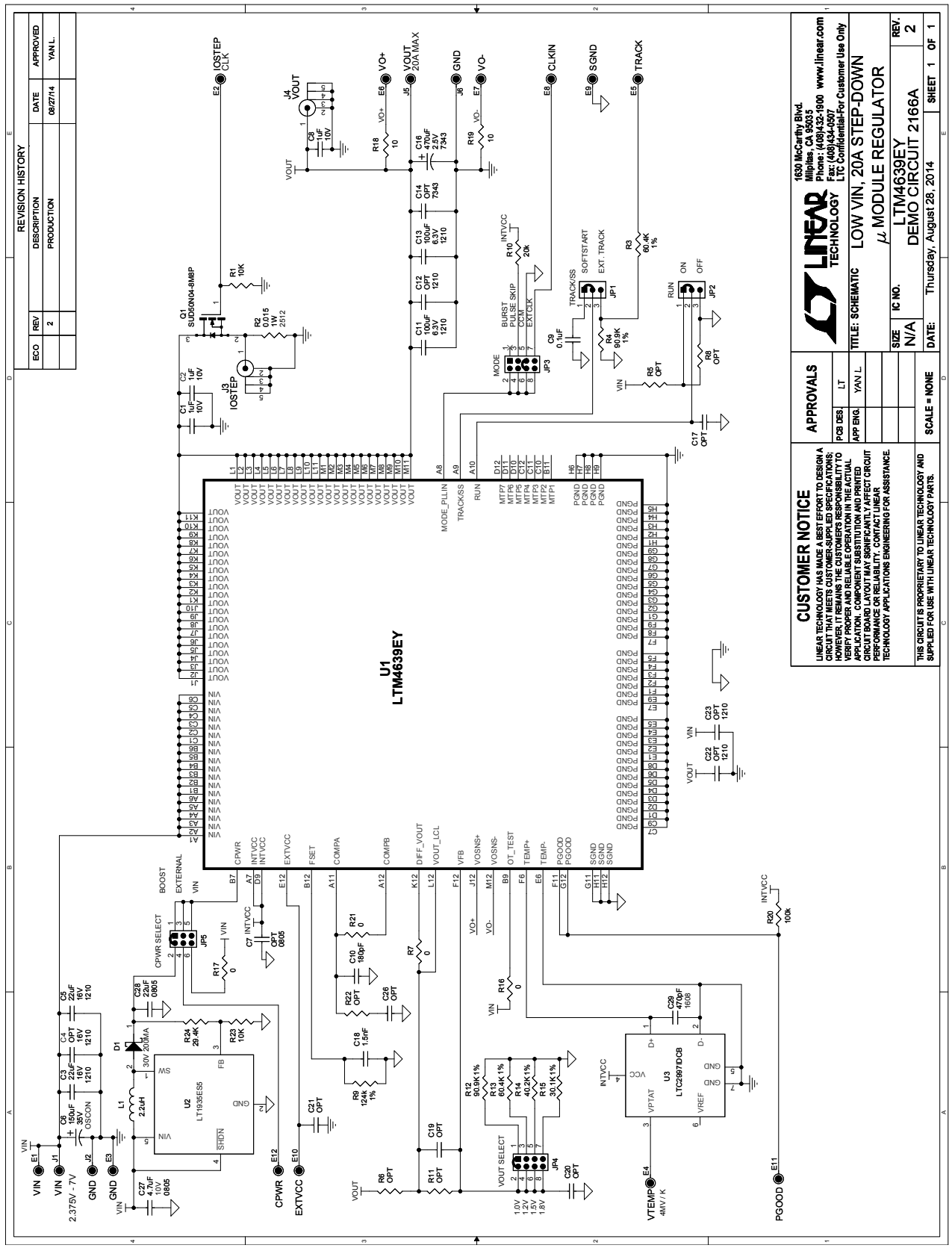


Figure 5. Thermal Image of LTM4639
V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{LOAD} = 20A
Ambient Temperature = 23.3°C, No Forced Air Flow

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C3, C5	CAP, 1210, 22µF, 10%, 16V, X5R	MURATA GRM32ER61E226KE20L
2	1	C6	CAP, 150µF, 35V, ELEC	SUN ELEC 35CE150AX
3	1	C9	CAP, 0603, 0.1µF, 10%, 50V, X7R	TDK C1608X7R1H104K
4	1	C10	CAP, 0603, 180pF, 10%, 10V, X7R	AVX, 0603ZC181KAT2A
5	2	C11, C13	CAP, 1210, 100µF, 20%, 6.3V, X5R	TDK C3225X5R0J107M
6	1	C16	CAP, 7343, 470µF, 20%, 2.5V POSCAP	PANASONIC 2R5TPE470M9
7	1	C18	CAP, 0603, 1.5nF, 5%, 25V, X7R	AVX 06033C152JAT2A
8	1	R13	RES, 0603, 60.4kΩ, 1%, 1/10W	VISHAY CRCW060360K4FKEA
9	1	R12	RES, 0603, 90.9kΩ, 1%, 1/10W	VISHAY CRCW060390K9FKEA
10	1	R9	RES, 0603, 124kΩ, 1%, 1/10W	VISHAY CRCW0603124K0FKEA
11	1	R14	RES, 0603, 40.2kΩ, 1%, 1/10W	VISHAY CRCW060340K2FKEA
12	1	R15	RES, 0603, 30.1kΩ, 1%, 1/10W	VISHAY CRCW060330K1FKEA
13	1	R20	RES. 0603, 100kΩ, 5%, 1/10W	VISHAY CRCW0603100KJNEA
14	1	U1	IC, LTM4639EY	LINEAR TECH LTM4639EY#PBF
Additional Demo Board Circuit Components				
1	3	C1, C2, C8	CAP, 0603, 1µF, 20%, 10V, X5R	TDK, C1608X5R1A105M
2	0	C4, C12, C22, C23	CAP, 1210 OPTION	OPTION
3	0	C7	CAP, 0805 OPTION	OPTION
4	0	C14	CAP, 7343 OPTION	OPTION
5	0	C17, C19, C20, C21, C26	CAP, 0603 OPTION	OPTION
6	1	C27	CAP, 0805, 4.7µF, 20%, 10V, X7R	TDK C2012X7R1A475M
7	1	C28	CAP, 0805, 22µF, 10%, 16V, X5R	TDK C2012X5R1C226K
8	1	C29	CAP, 0603, 470pF, 10%, 10V, X7R	AVX, 0603ZC471KAT2A
9	1	D1	DIODE, SCHOTTKY 30V	ON SEMI NSR0230P2T5G
10	1	L1	IND, 2.2µH, 2012	TAIYO YUDEN CBC2012T2R2M
11	1	Q1	XSTR, MOSFET, N-CHANNEL 30V	VISHAY SUD50N04-8M8P-4GE3
12	2	R1, R23	RES, 0603, 10kΩ, 5%, 1/10W	VISHAY CRCW060310K0JNEA
13	1	R2	RES, 2512, 0.015Ω, 1%, 1W	VISHAY WSL2512R0150FEA
14	1	R3	RES, 0603, 60.4kΩ, 1%, 1/10W	VISHAY CRCW060360K4FKEA
15	1	R4	RES, 0603, 90.9kΩ, 1%, 1/10W	VISHAY CRCW060390K9FKEA
16	0	R5, R6, R8, R11, R22	RES, 0603 OPTION	OPTION
17	4	R7, R16, R17, R21	RES, 0603, 0Ω JUMPER	VISHAY CRCW06030000Z0ED
18	1	R10	RES. 0603, 20kΩ, 5%, 1/10W	VISHAY CRCW060320K0JNEA
19	2	R18, R19	RES, 0603, 10Ω, 5%, 1/10W	VISHAY CRCW060310R0JNEA
20	1	R24	RES, 0603, 29.4kΩ, 1% 1/10W	VISHAY CRCW060329K4FKEA
21	1	U2	IC, LT1935AES5	LINEAR TECH. LT1935ES5#PBF
22	1	U3	IC, LTC2997IDCB	LINEAR TECH., LTC2997IDCB#PBF
Hardware				
1	12	E1-E12	TESTPOINT,TURRET,. 094"	MILL-MAX 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	HEADER, 1 × 3 , 2mm	SULINS, NRPN031PAEN-RC
3	2	JP3, JP4	HEADER, 2 × 4, DOUBLE ROW, 2mm	SULINS, NRPN042PAEN-RC
4	2	JP5	HEADER, 2 × 3, DOUBLE ROW, 2mm	SULINS, NRPN032PAEN-RC
5	4	J1, J2, J5, J6	JACK, BANANA	KEYSTONE 575-4
6	2	J3,J4	CONN., VERT. PC-MNT, BNC 50Ω	CONNEX 112404
7	5	XJP1, XJP2, XJP3, XJP4, XJP5	SHUNT	SAMTEC 2SN-BK-G
8	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE_8834
9	2		STENCILS TOP AND BOTTOM	STENCIL DC2166A

SCHEMATIC DIAGRAM



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Linear Technology
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