LTM4675, LTM4676A LTM4677, LTM4620A PSM µModule Power Stick

DESCRIPTION

Demonstration circuit 2204A is a very compact demo board that showcases five different Linear Technology devices – LTM4675, LTM4676A, LTM4677, LTM4620A and LTC2974. These devices cover various product lines including DC/DC µModule® regulator with digital power system management (LTM4675, LTM4676A and LTM4677), high current analog DC/DC µModule regulator (LTM4620A) and I²C/SMBus/PMBus power system managers with EEPROM (LTC2974). Please see data sheets for more detailed information.

DC2204A contains seven different rails, including six single-phase rails and one dual-phase single-output rail from LTM4677. The µModule regulators used on this board only require only a few external components and therefore can greatly save the footprint, reduce the design effort and improve the system reliability. The LTC2974 monitors LTM4620A's output voltage, load current and temperature through external diodes.

DC2204A powers up to default settings and produce power based on configuration resistors without the need for any serial bus communication. This allows easy evaluation of the DC/DC µModule regulators. There is also a connector to wall adapter which allows easy demonstration without DC/DC power supply. Multiple DC2204A boards can be cascaded together to form a high channel count power supply.

To fully explore the extensive power system management features of the part, download the GUI software LTpowerPlay™ onto your PC and use LTC's I²C/SMBus/PMBus dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on the fly and store the configuration in EEPROM, view telemetry of voltage, current, temperature and fault status.

GUI Download

The software can be downloaded from:
http://www.linear.com/ltpowerplay

Design files for this circuit board are available at http://www.linear.com/demo/DC2204A

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BOARD PHOTO

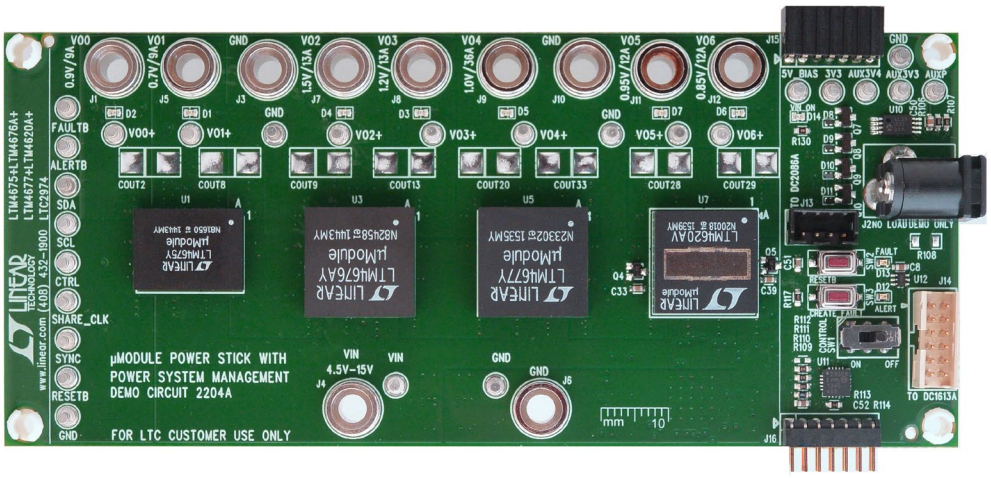


Figure 1. Board Picture of DC2204A PSM µModule Power Stick

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	µMODULE PART NUMBER	CONDITION	UNITS
Input Voltage Range			4.5V to 15V
Output Voltage, V_{O0}	LTM4675	V_{IN} = 4.5V to 15V, I_{O0} = 0A to 9A	0.5V to 3.5V*, Default: 0.9V
Maximum Output Current, I_{O0}	LTM4675	V_{IN} = 4.5V to 15V, V_{O0} = 0.5V to 5.5V	9A**
Output Voltage, V_{O1}	LTM4675	V_{IN} = 4.5V to 15V, I_{O1} = 0A to 9A	0.5V to 3.5V*, Default: 0.7V
Maximum Output Current, I_{O1}	LTM4675	V_{IN} = 4.5V to 15V, V_{O1} = 0.5V to 5.5V	9A**
Output Voltage, V_{O2}	LTM4676A	V_{IN} = 4.5V to 15V, I_{O2} = 0A to 13A	0.5V to 3.5V*, Default: 1.5V
Maximum Output Current, I_{O2}	LTM4676A	V_{IN} = 4.5V to 15V, V_{O2} = 0.5V to 5.5V	13A**
Output Voltage, V_{O3}	LTM4676A	V_{IN} = 4.5V to 15V, I_{O3} = 0A to 13A	0.5V to 3.5V*, Default: 1.2V
Maximum Output Current, I_{O3}	LTM4676A	V_{IN} = 4.5V to 15V, V_{O3} = 0.5V to 5.5V	13A**
Output Voltage, V_{O4}	LTM4677	V_{IN} = 4.5V to 15V, I_{O4} = 0A to 36A	0.5V to 1.8V, Default: 1V
Maximum Output Current, I_{O4}	LTM4677	V_{IN} = 4.5V to 15V, V_{O4} = 0.5V to 1.8V	36A**
Output Voltage, V_{O5}	LTM4620A	V_{IN} = 4.5V to 15V, I_{O5} = 0A to 13A	0.6V to 3.5V*, Default: 0.95V
Maximum Output Current, I_{O5}	LTM4620A	V_{IN} = 4.5V to 15V, V_{O5} = 0.6V to 5.3V	13A**
Output Voltage, V_{O6}	LTM4620A	V_{IN} = 4.5V to 15V, I_{O6} = 0A to 13A	0.6V to 3.5V*, Default: 0.85V
Maximum Output Current, I_{O6}	LTM4620A	V_{IN} = 4.5V to 15V, V_{O6} = 0.6V to 5.3V	13A**

*Note: The LTM4675, LTM4676A and LTM4620A can provide outputs up to 5.5V (5.3V for LTM4620A); however 4V-rated output ceramic capacitors are used on board. When running at higher output voltage, 6.3V-rated output capacitors should be used.

**Note: When running at full load, forced air flow is needed.

QUICK START PROCEDURE

Demonstration circuit 2204A is easy to set up to evaluate the performance of four µModules. The following procedure describes how to set up a DC2204A demo system. Please refer to Figure 2 for the test setup and Figure 3 for the DC2204A top side details.

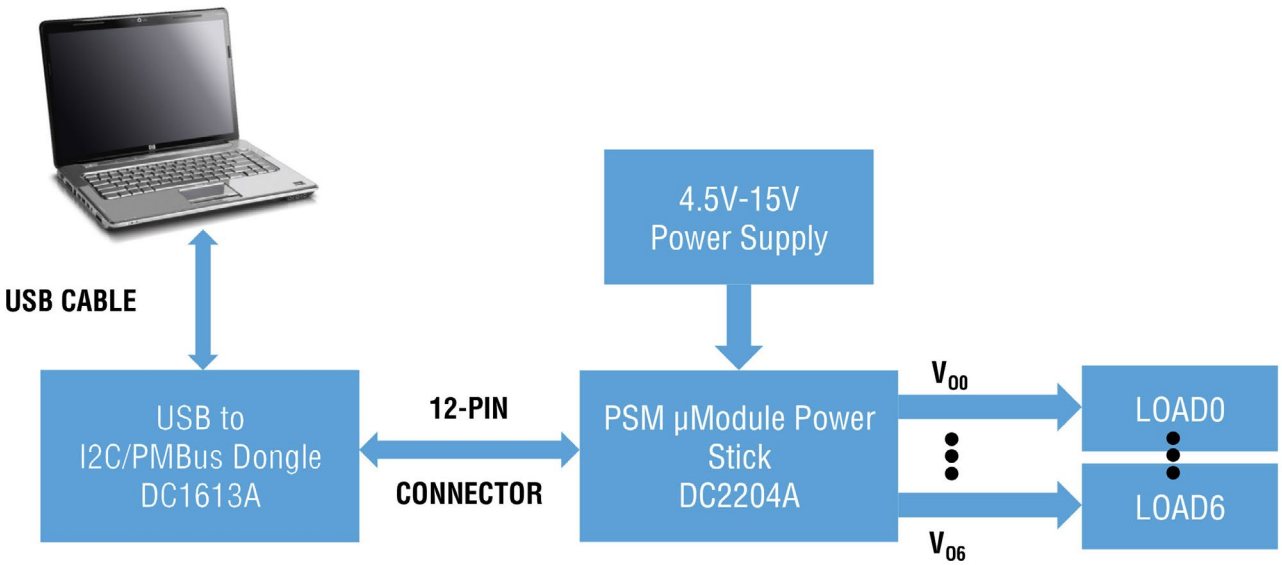


Figure 2. DC2204A Test Setup

QUICK START PROCEDURE

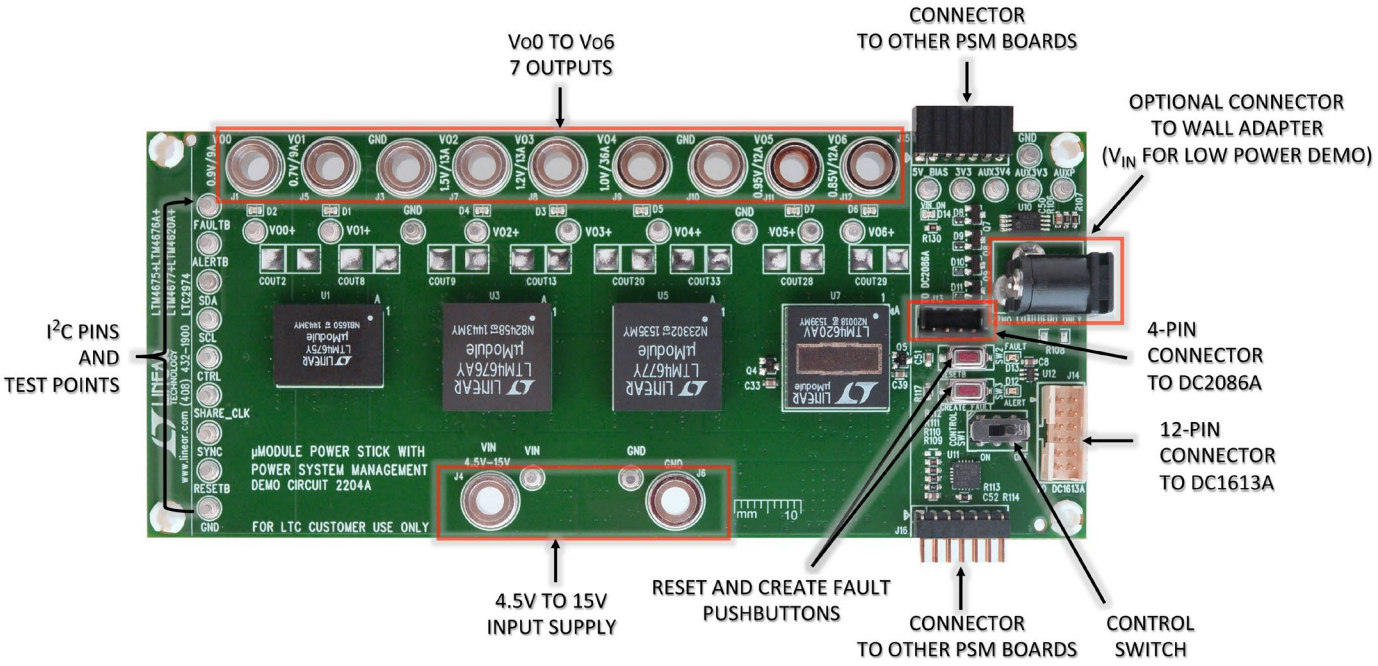


Figure 3. DC2204A Top Side Details

QUICK START PROCEDURE

1. Download and install the LTpowerPlay GUI;
2. Connect the DC1613A dongle to the DC2204A using the 12-pin ribbon cable;
3. With power off, connect the input power supply (4.5V to 15V) to V_{IN} and GND;
4. Launch the LTpowerPlay GUI (the LTpowerPlay Main Interface is shown in Figure 4):

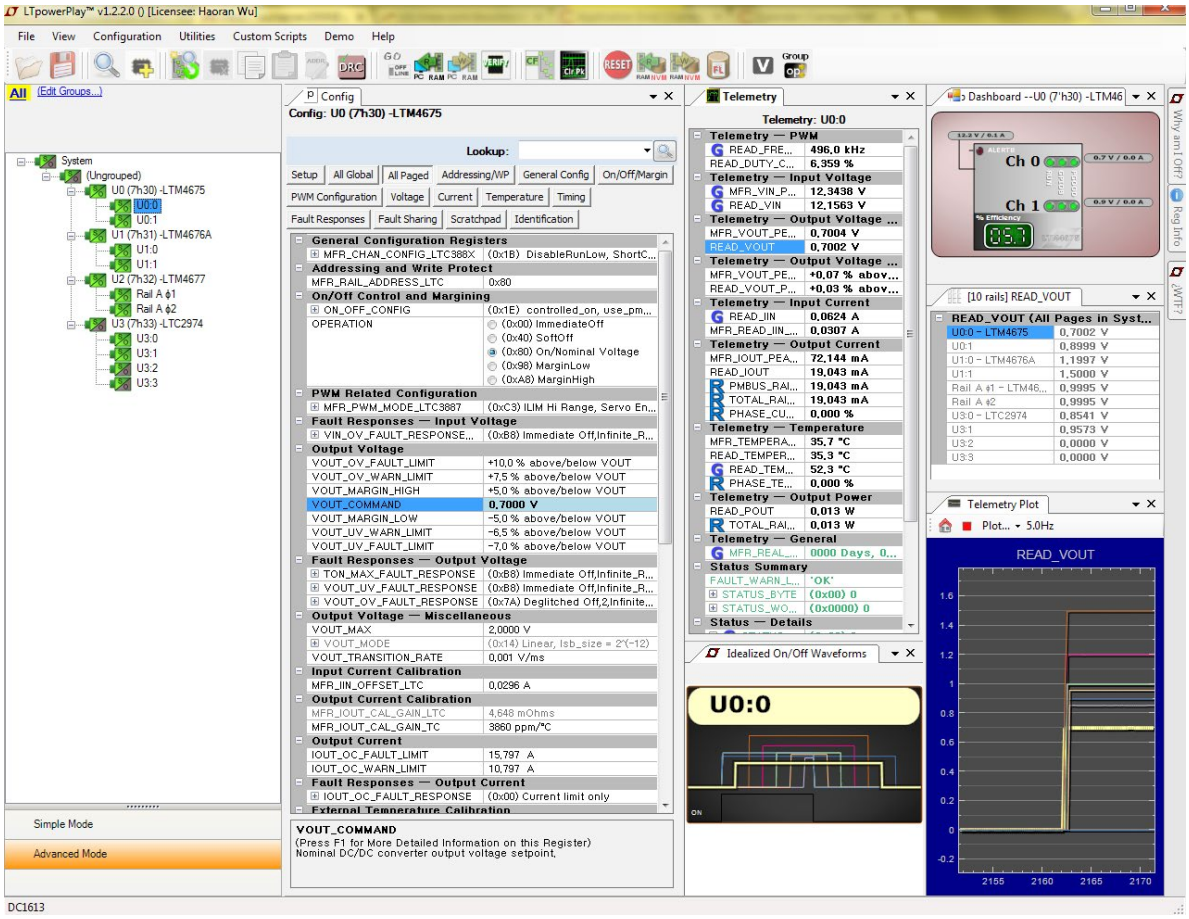
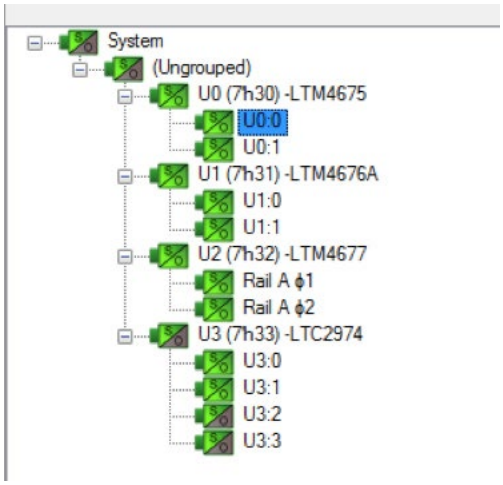


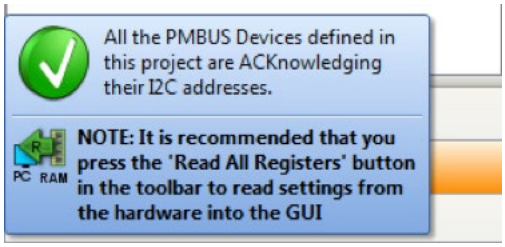
Figure 4. LTpowerPlay Main Interface

QUICK START PROCEDURE

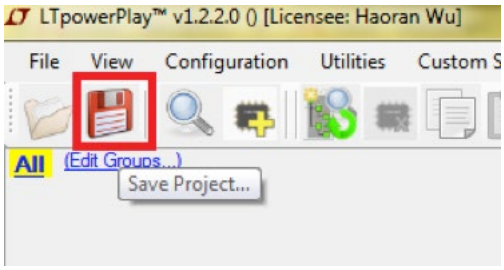
a. The GUI will automatically identify the DC2204A and build a system tree for each PSM µModules and manager. The system tree on the left hand side will look as below:



b. A green message box will be displayed momentarily in the lower left hand corner confirming that the DC2204A is communicating.



c. Save the demo board configuration to a (*.proj) file by clicking the Save icon. This creates a backup file.



5. The CONTROL switch is configured to control all seven rails. Slide the switch to ON to enable, OFF to disable all rails.

COMMON DEMO BOARD OPERATIONS

DC2204A On-Board LEDs

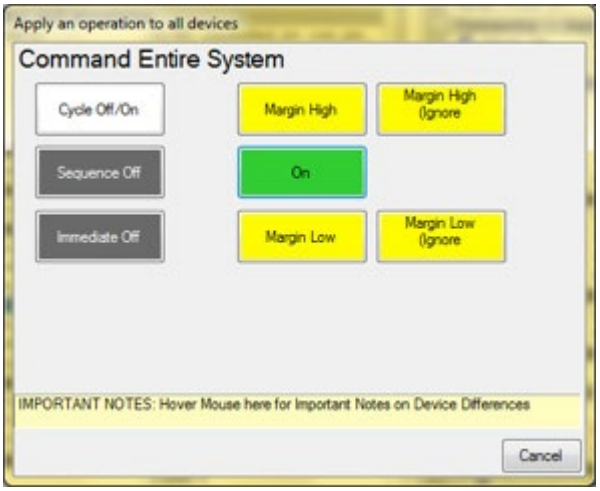
Each individual rail on DC2204A has its own green power-good LED indicator (D1 through D7). There is another green LED (D12) which is on after V_{IN} supply is applied. Two red LEDs (D12 and D13) will illuminate when an alert or a fault has occurred.

Margin All Rails

The digital power products on the DC2204A not only monitor each of their respective outputs but can margin the outputs either high or low. Margining is the operation that moves a rail either up or down for testing purposes. It allows a system to be fully characterized over supply limits without the use of external hardware or resources. The GUI provides an easy way to margin all rails high or all low by clicking one of four buttons. To invoke the margining dialog, click the GroupOp icon in the

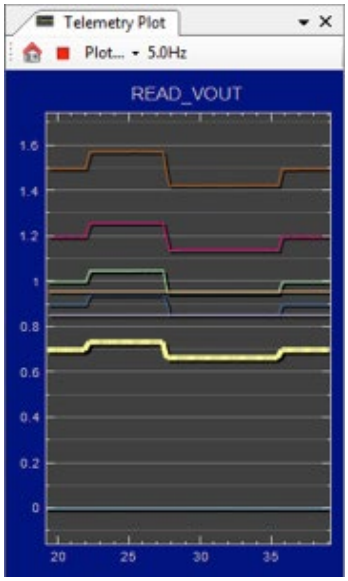
toolbar.

Then the user can choose Margin High, Margin Low or some other operations to all the devices from the window in below.



COMMON DEMO BOARD OPERATIONS

The telemetry window in the lower right hand corner shows the effect of the margin high or margin low operation. The following screen shot shows all rails going from nominal set points to margin high, margin low and back to nominal voltages.



Creating and Clearing a Fault

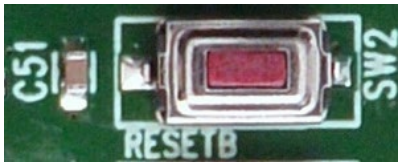
There is a pushbutton on the DC2204A board which is used to force a fault and demonstrate the demo board's ability to detect it and respond according to the configuration.

When pressing this button (SW3), it creates a VOUT_UV fault on Vo6, by pulling COMP pin low externally. The user should see Vo6 output power off, the green LED (D6) off and the red LED (D12) on. After a retry period, the rail will be back on.

To clear a fault, the user may click the CF icon in the GUI or simply push the RESET pushbutton on the demo board. In both cases, the red (+) on the CF icon and alert LED on the board will be cleared. The user will notice that all rails are automatically re-enabled after a programmable retry period.

Reset the DC2204A

A reset pushbutton is provided on the board. To reset all devices on the DC2204A board and reload the EEPROM contents into operating memory (RAM), press RESETB (SW2) on the DC2204A.



PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CIN1, CIN2	POS-CAP, 100µF, 20V, D3L	PANASONIC, 20TQC100MYF
2	8	CIN3 TO CIN10	CAP, X5R, 10µF, 35V, 10%, 1210	NIC, NMC1210X5R106K35TRPLPF
3	2	C55, C56	CAP, X7R, 10µF, 25V, 10%, 1206	NIC, NMC1206X7R106K25TRPLPF
4	24	COUT1, COUT3, COUT4, COUT5, COUT6, COUT7, COUT10, COUT11, COUT12, COUT14, COUT15, COUT16, COUT17, COUT18, COUT21, COUT22, COUT23, COUT25, COUT26, COUT27, COUT30, COUT31, COUT32, COUT34	CAP, X5R, 220µF, 4V, 20%, 1206	MURATA, GRM31CR60G227ME11L
5	1	C4	CAP, X7R, 4.7nF, 25V, 10%, 0603	MURATA, GRM188R71E472KA01D
6	6	C8, C15, C20, C48, C52, C53	CAP, X7R, 1µF, 16V, 10%, 0603	AVX, 0603YC105KAT2A
7	1	C54	CAP, X7R, 1µF, 25V, 10%, 1206	AVX, 12063C105KAT2A
8	2	C9, C12	CAP, X7R, 2200pF, 25V, 10%, 0603	AVX, 06033C222KAT2A
9	1	C21	CAP, X5R, 4.7µF, 10V, 10%, 0805	TDK C2012X5R1A475K
10	1	R24	RES, CHIP, 1.65k, 1%, 0603	VISHAY, CRCW06031K65FKEA
11	1	R22	RES, CHIP, 787, 1%, 0603	VISHAY, CRCW0603787RFKEA
12	1	U1	IC, LTM4675EY#PBF	LINEAR TECHNOLOGY, LTM4675EY#PBF
13	3	U2, U4, U6	IC, LT6700CS6-2#PBF, TSOT23	LINEAR TECHNOLOGY, LT6700CS6-2#PBF
14	1	U3	IC, LTM4676AEY#PBF	LINEAR TECHNOLOGY, LTM4676AEY#PBF
15	1	U5	IC, LTM4677EY#PBF	LINEAR TECHNOLOGY, LTM4677EY#PBF
16	1	U7	IC, LTM4620AEV#PBF	LINEAR TECHNOLOGY, LTM4620AEV#PBF
17	1	U8	IC, LTC2974CUP#PBF QFN 9mm × 9mm	LINEAR TECHNOLOGY, LTC2974CUP#PBF
18	1	U9	IC, LTC4313CMS8-2#PBF, MSOP	LINEAR TECHNOLOGY, LTC4313CMS8-2#PBF
19	1	U10	IC, 24LC025-I/ST TSSOP 8-PIN	MICROCHIP, 24LC025-I/ST
20	1	U11	IC, MCP23008-E/ML QFN 4 × 4 × 0.9 mm	MICROCHIP, MCP23008-E/ML
21	1	U12	IC, SN74LVC2G34DCKR DCK	TEXAS INSTR, SN74LVC2G34DCKR
22	1	U13	IC, LT3029MPMSE#PBF, MSOP	LINEAR TECHNOLOGY, LT3029MPMSE#PBF
Additional Demo Board Circuit Components				
23	0	COUT2, COUT8, COUT9, COUT13, COUT20, COUT28, COUT29, COUT33, C1, C2, C3, C5, C6, C7, C10, C11, C13, C14, C16, C17, C18, C19, C26, C31, C32, C34, C35, C59, C60 (OPT)	CAP, OPTIONAL	
24	16	C22, C23, C27, C29, C36, C38, C42, C44, C50, C24, C25, C37, C40, C45, C46, C47	CAP, X5R, 100nF(0.1µF), 16V, 10%, 0603	NIC, NMC0603X5R104K16TRPF
25	4	C28, C30, C41, C43	CAP, X7R, 3.3nF, 25V, 10%, 0603	MURATA, GRM188R71E332KA01D
26	6	C33, C39, C49, C51, C57, C58	CAP, X7R, 10nF (0.01µF), 16V, 10%, 0603	AVX, 0603YC103KAT2A
27	8	D1, D2, D3, D4, D5, D6, D7, D14	SMT CHIP LED, YELLOW-GREEN	PANASONIC, LNJ337W83RA
28	2	D12, D13	SMT CHIP LED, RED	PANASONIC, LNJ214R82RA
29	4	D8, D9, D10, D11	DIODE, ULTRA LOW SCHOTTKY RECTIEIER	NXP SEMI, PMEG2005AEL, 315
30	1	Q1	MOSFET P-CH 1.8V SOT-323	VISHAY, Si1315DL-T1-GE3

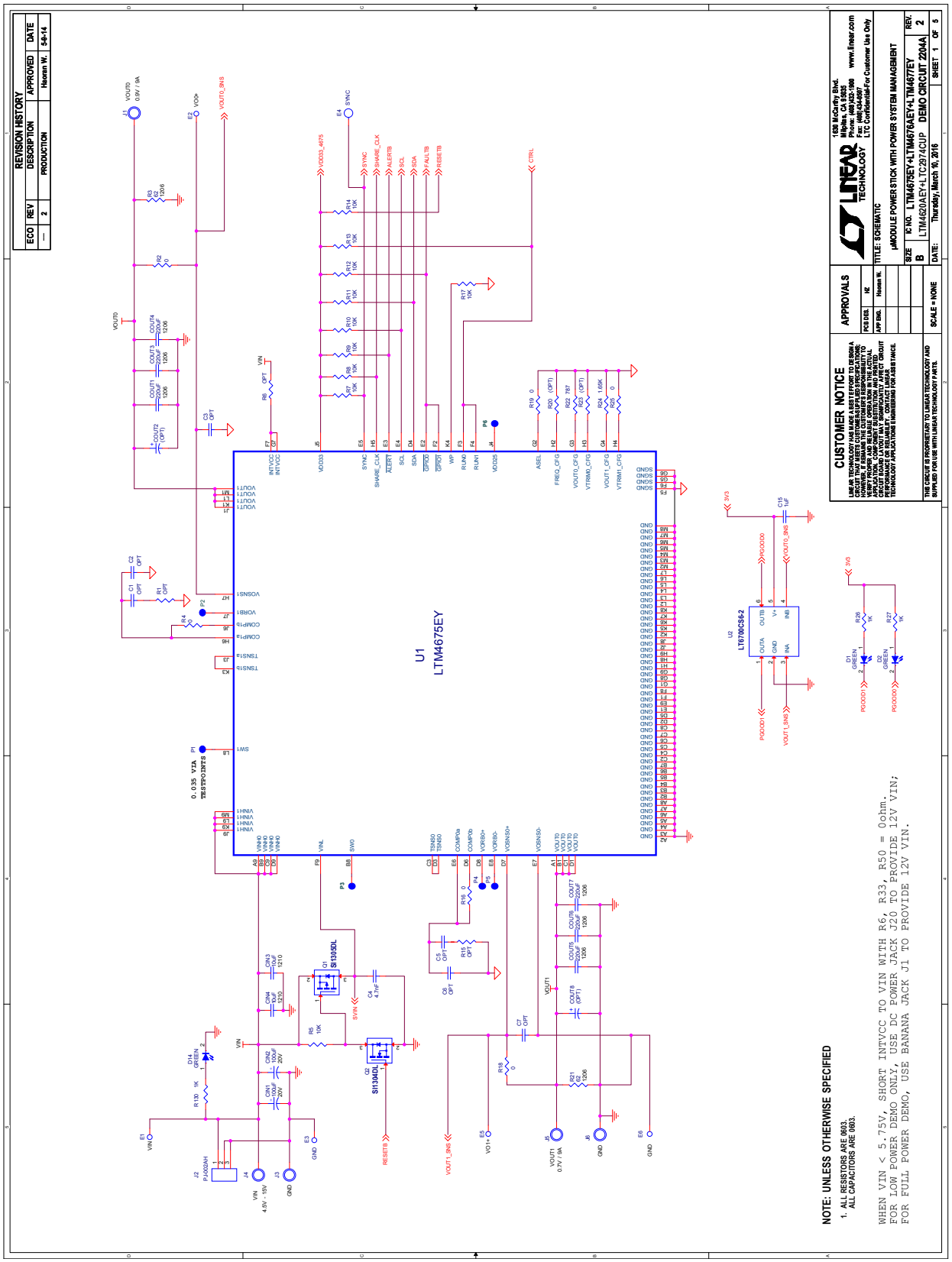
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
31	3	Q2, Q3, Q6	MOSFET N-CH 25V SOT-323	VISHAY, Si1308EDL-T1-GE3
32	2	Q4, Q5	XSTR GP SS PNP 40V SOT-323	ON SEMI, MMBT3906WT1G
33	4	Q7, Q8, Q9, Q10	MOSFET P-CH SOT-323	DIODES INC, DMP3130L-7
34	2	Q11,Q12	MOSFET N-CH 60V 115MA SOT-23	DIODES INC, 2N7002A-7
Additional Demo Board Circuit Components				
35	14	R2, R4, R16, R18, R19, R25, R32, R38, R45, R48, R53, R55, R67, R77	RES, CHIP, 0Ω, 1%, 0603	NIC, NRC06Z0TRF
36	8	R3, R21, R28, R41, R58, R65, R80, R131	RES, CHIP, 62Ω, 5%, 2/3W, 1206	PANASONIC, ERJ-P08J620V
37	25	R5, R7, R8, R9, R10, R11, R12, R13, R14, R17, R36, R54, R99, R100, R101, R102, R103, R109, R110, R111, R114, R122, R123, R125, R127	RES, CHIP, 10k, 1%, 0603	NIC, NRC06F1002TRF
38	18	R26, R27, R46, R47, R63, R97, R98, R115, R116, R72, R73, R78, R79, R92, R93, R95, R96, R130	RES, CHIP, 1k, 1%, 0603	NIC, NRC06F1001TRF
39	3	R29, R106, R107	RES, CHIP, 4.99k, 1%, 0603	NIC, NRC06F4992TRF
40	0	R20, R23, R34, R40, R43, R1, R6, R57, R59, R60, R61, R62, R49, R50, R51, R52, R75, R89, R94, R108, R112, R15, R30, R31, R33, R37, R124, R126, R128, R129	RES, OPTIONAL	
41	2	R35, R44	RES, CHIP, 4.22k, 1%, 0603	NRC, NRC06F4221TRF
42	1	R39	RES, CHIP, 787Ω, 1%, 0603	NIC, NRC06F7870TRF
43	1	R42	RES, CHIP, 3.24k, 1%, 0603	NIC, NRC06F3241TRF
44	1	R56	RES, CHIP, 1.65k, 1%, 0603	NRC, NRC06F1651TRF
45	1	R64	RES, CHIP, 200Ω, 1%, 0603	NIC, NRC06F2000TRF
46	3	R66, R76, R105	RES, CHIP, 10Ω, 1%, 0603	NIC, NRC06F10R0TRF
47	2	R68, R88	RES, CHIP, 121k, 1%, 0603	NIC, NRC06F1213TRF
48	5	R69, R70, R85, R86, R87	RES, CHIP, 100Ω, 1%, 0603	NIC, NRC06F1000TRF
49	2	R71, R120	RES, CHIP, 200k, 1%, 0603	NIC, NRC06F2003TRF
50	1	R74	RES, CHIP, 102k, 1%, 0603	NIC, NRC06F1023TRF
51	1	R81	RES, CHIP, 143k, 1%, 0603	NIC, NRC06F1433TRF
52	1	R82	RES, CHIP, 162k, 1%, 0603	NIC, NRC06F1623TRF
53	1	R104	RES, CHIP, 15.8k, 1%, 0603	NIC, NRC06F1582TRF
54	1	R113	RES, CHIP, 249Ω, 1%, 0603	NIC, NRC06F2490TRF
55	1	R117	RES, CHIP, 100k, 1%, 0603	NIC, NRC06F1003TRF
56	1	R118	RES, CHIP, 619k, 1%, 0603	NIC, NRC06F6193TRF
57	1	R119	RES, CHIP, 357k, 1%, 0603	NIC, NRC06F3573TRF
58	1	R121	RES, CHIP, 210k, 1%, 0603	NIC, NRC06F2103TRF
59	1	D15	DIODE, SOD-323	CENTRAL SEMI, CMDD4448

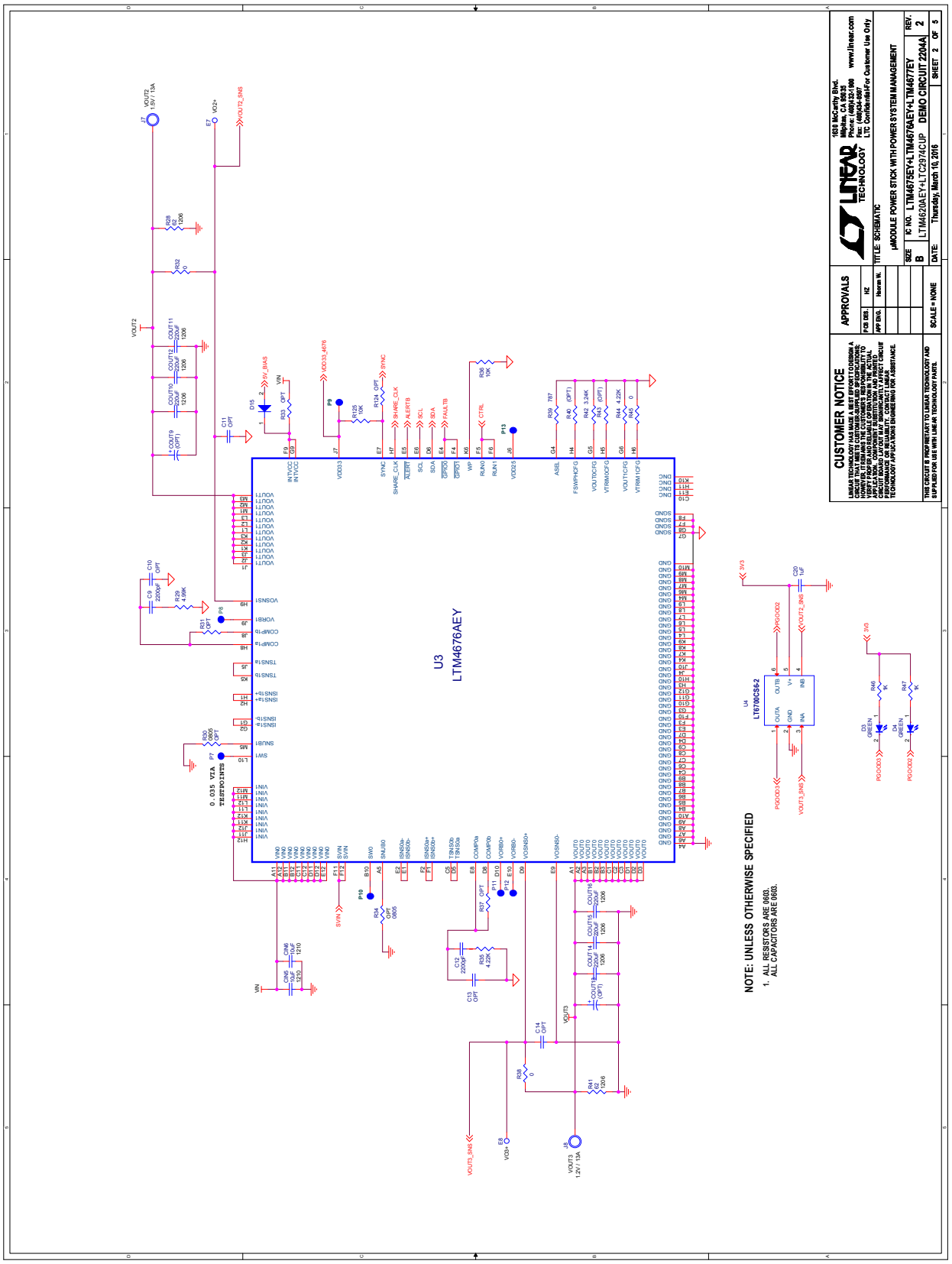
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
60	26	E1 TO E26	TESTPOINT, TURRET, 0.062"	MILL-MAX, 2308-2-00-80-00-00-07-0
61	11	J1, J3 TO J12	JACK, BANANA	KEYSTONE, 575-4
62	1	J2	CONN PWR JACK 2.1 × 5.5MM HIGH CUR	CUI INC, PJ-002AH
63	1	J13	HEADER, 4 PINS, SHROUDED	HIROSE, DF3A-4P-2DSA
64	1	J14	HEADER 12POS 2MM STR DL PCB	FCI, 98414-G06-12ULF (14full tbs.@40)
65	1	J15	CONN RECEPT 2MM DUAL R/A 14POS(F)	SULLINS, NPPN072FJFN-RC
66	1	J16	HEADER 14POS 2MM R/A GOLD (M)	MOLEX, 87760-1416
67	1	SW1	SWITCH, SUB MINIATURE SLIDE	C&K, JS202011CQN
68	2	SW2, SW3	SWITCH, 3.5MM SMT (1lrg.rl)	C&K, PTS635SK25SMTR LFS
69	1	SW4	SWITCH, SMT TERMINALS 3PINS	C&K, SDA03H0SBR (1lrg.rl)
70	2	XJP1, XJP2	SHUNT	SAMTEC, 2SN-BK-G

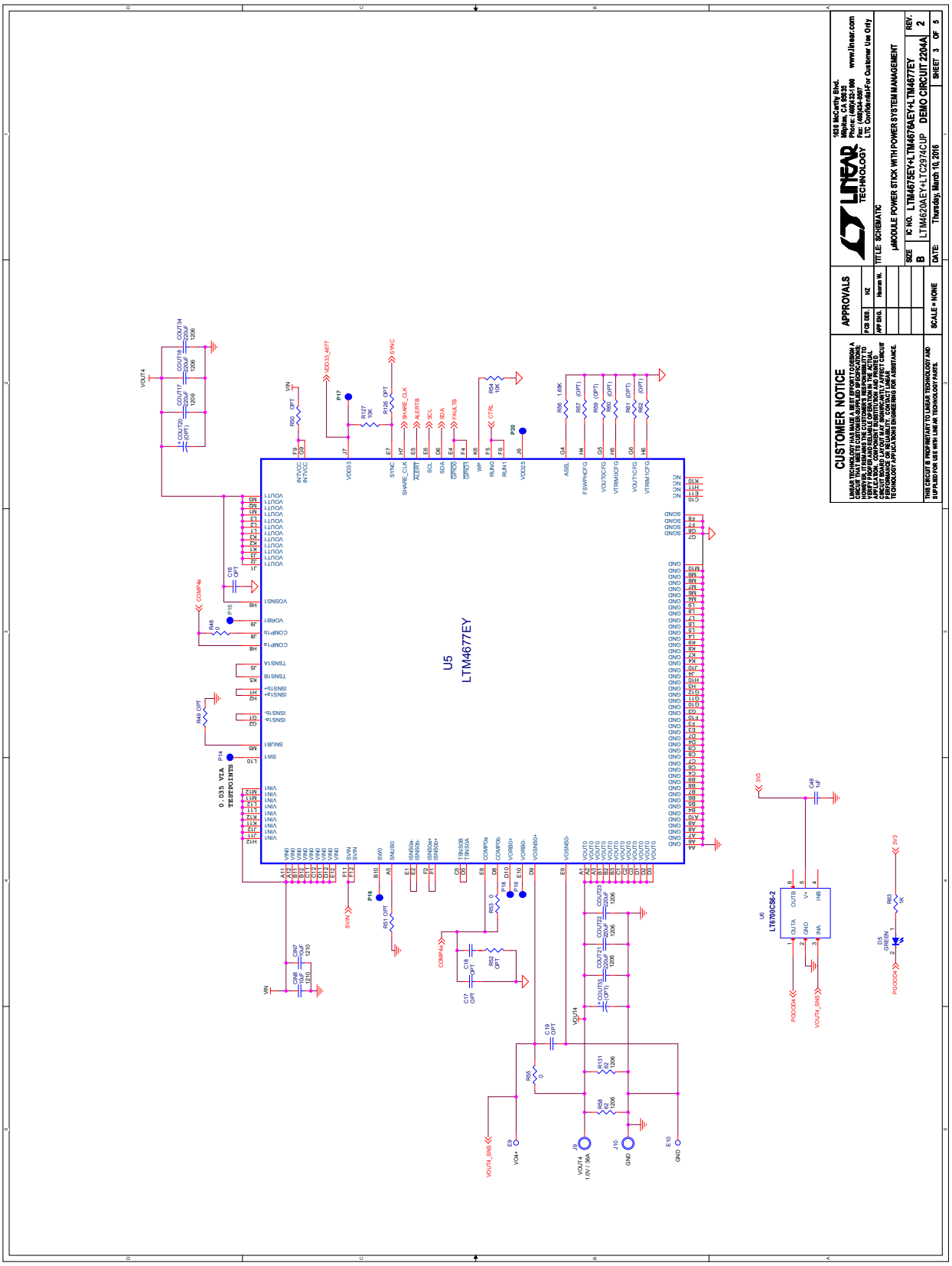
SCHEMATIC DIAGRAM



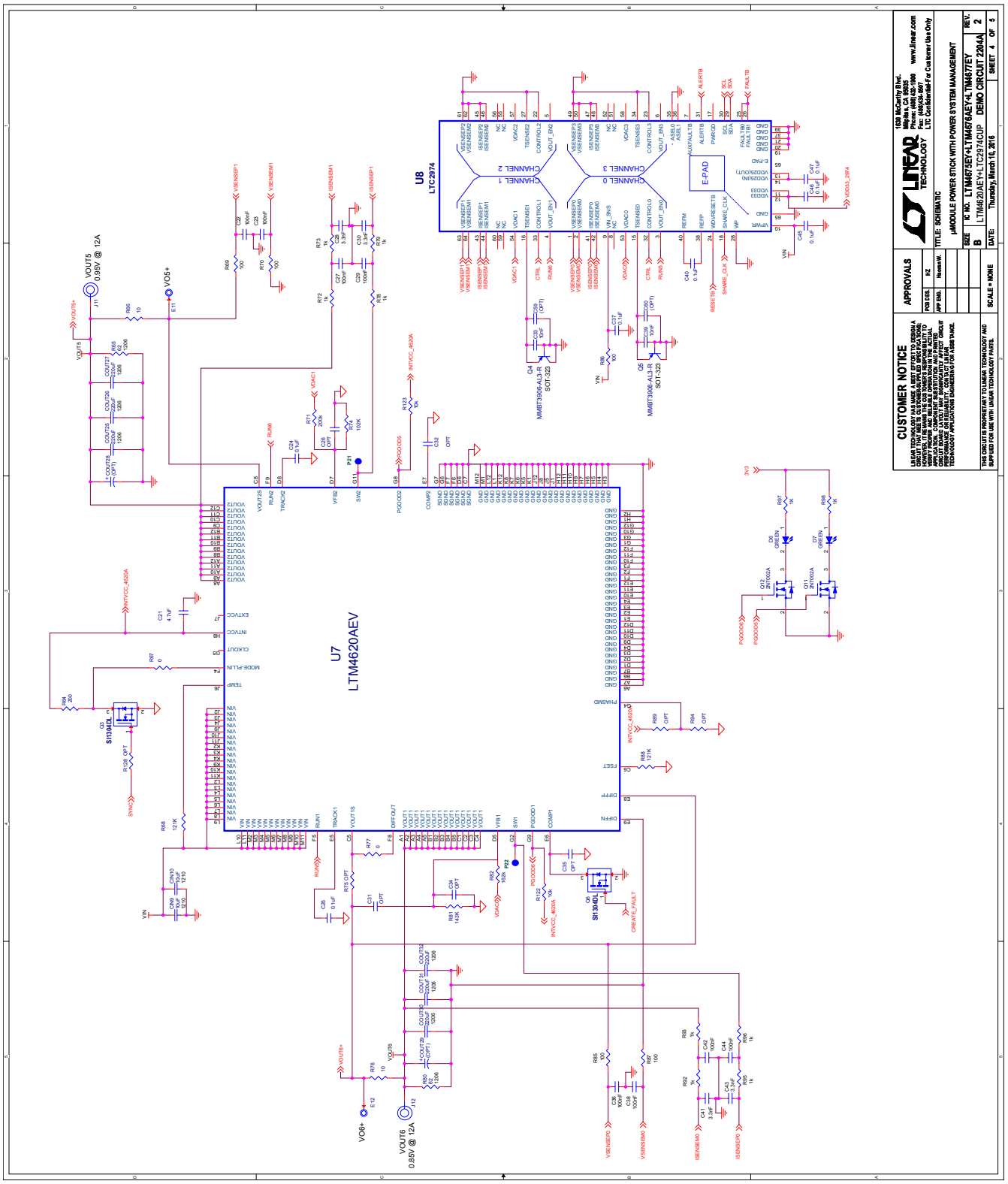
SCHEMATIC DIAGRAM



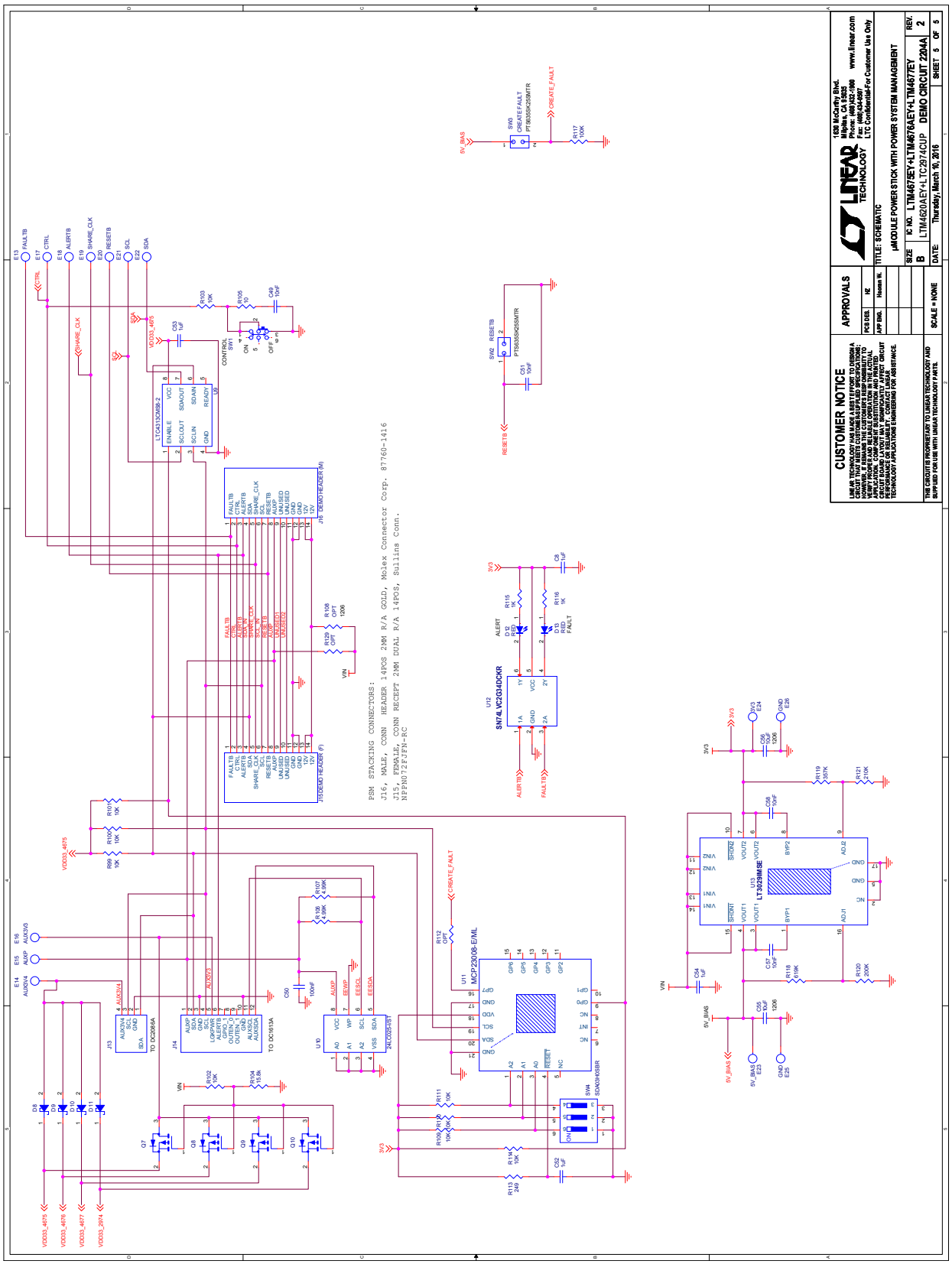
SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

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