LTM4677EY and LTM4650 Step-Down µModule Regulator with PMBus Power System Management LTM4677 + LTM4650, 86A

DESCRIPTION

Demonstration circuit 2481B-A is a high efficiency, high density, µModule® regulator with 4.5V to 15V input range. The output voltage is adjustable from 0.6V to 1.8V, and it can supply 86A maximum load current. The demo board has 1× LTM®4677 and 1× LTM4650 µModule regulators. The LTM4677 is a dual 18A or single 36A step-down regulator with PMBus power system management, and the LTM4650 is a dual 25A or single 50A step-down regulator. Please see LTM4677 and LTM4650 data sheets for more detailed information.

DC2481B-A 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 converter. To fully explore the extensive power system management features of the part, download the GUI software LTpowerPlay® onto your PC and use Analog Devices 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.analog.com/ltpowerplay

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay Software GUI.

Design files for this circuit board are available.

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BOARD PHOTO

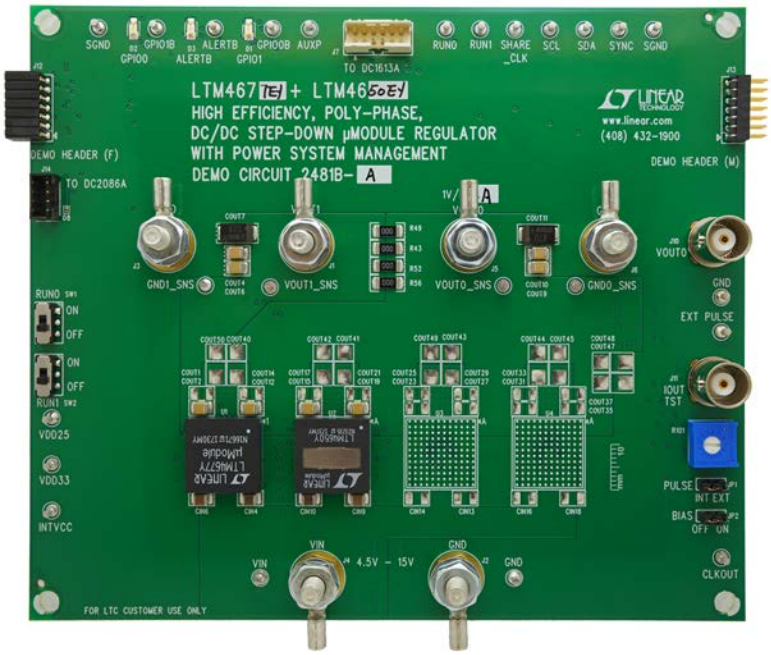


Figure 1. LTM4677 + LTM4650; 86A DC2481B-A Demo Circuit

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		4.5V to 15V
Output Voltage, V_{OUT0}	V_{IN} = 4.5V to 15V, I_{OUT0} = 0A to 86A	0.6 to 1.8V, Default: 1V
Maximum Output Current, I_{OUT0}	V_{IN} = 4.5V to 15V, V_{OUT} = 0.6V to 1.8V	86A
Typical Efficiency	V_{IN} = 12V, V_{OUT} = 1.0V, I_{OUT} = 86A	84.1%
Default Switching Frequency		425kHz

QUICK START PROCEDURE

MAXIMUM OUTPUT CURRENT	NUMBER OF OUTPUT VOLTAGES	NUMBER OF LTM4677 µMODULE REGULATORS ON THE BOARD	DEMO BOARD NUMBER
Dual 18A	2	1× LTM4677	DC2066A
72A	1	2× LTM4677	DC2143A-A
108A	1	3× LTM4677	DC2143A-B
144A	1	4× LTM4677	DC2143A-C
86A	1	1× LTM4677 (+1×LTM4650)	DC2481B-A
186A	1	1× LTM4677 (+3×LTM4650)	DC2481A-B

Demonstration circuit 2481B-A is easy to set up to evaluate the performance of the LTM4677EY. Refer to Figure 2 for the proper measurement equipment setup and follow the procedure below.

1. With power off, connect the input power supply to V_{IN} (4.5V to 15V) and GND (input return).
2. Connect the 1.0V output load between V_{OUT0} and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs. Set default switch position: SW1: ON; SW2: ON.
4. Turn on the input power supply and check for the proper output voltages. V_{OUT0} should be 1.0V ±1%.
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.
6. Connect the dongle and control the output voltages from the GUI. See "LTpowerPlay Software GUI" for details.

Note: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 3 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (–) terminals of an output capacitor. The probe's ground ring needs to touch the (–) lead and the probe tip needs to touch the (+) lead.

Connecting a PC to DC2481B-A

You can use a PC to reconfigure the power management features of the LTM4677 such as: nominal V_{OUT}, margin set points, OV/UV limits, temperature fault limits, sequencing parameters, the fault log, fault responses, GPIOs and other functionality. The DC1613A dongle may be plugged when V_{IN} is present.

QUICK START PROCEDURE

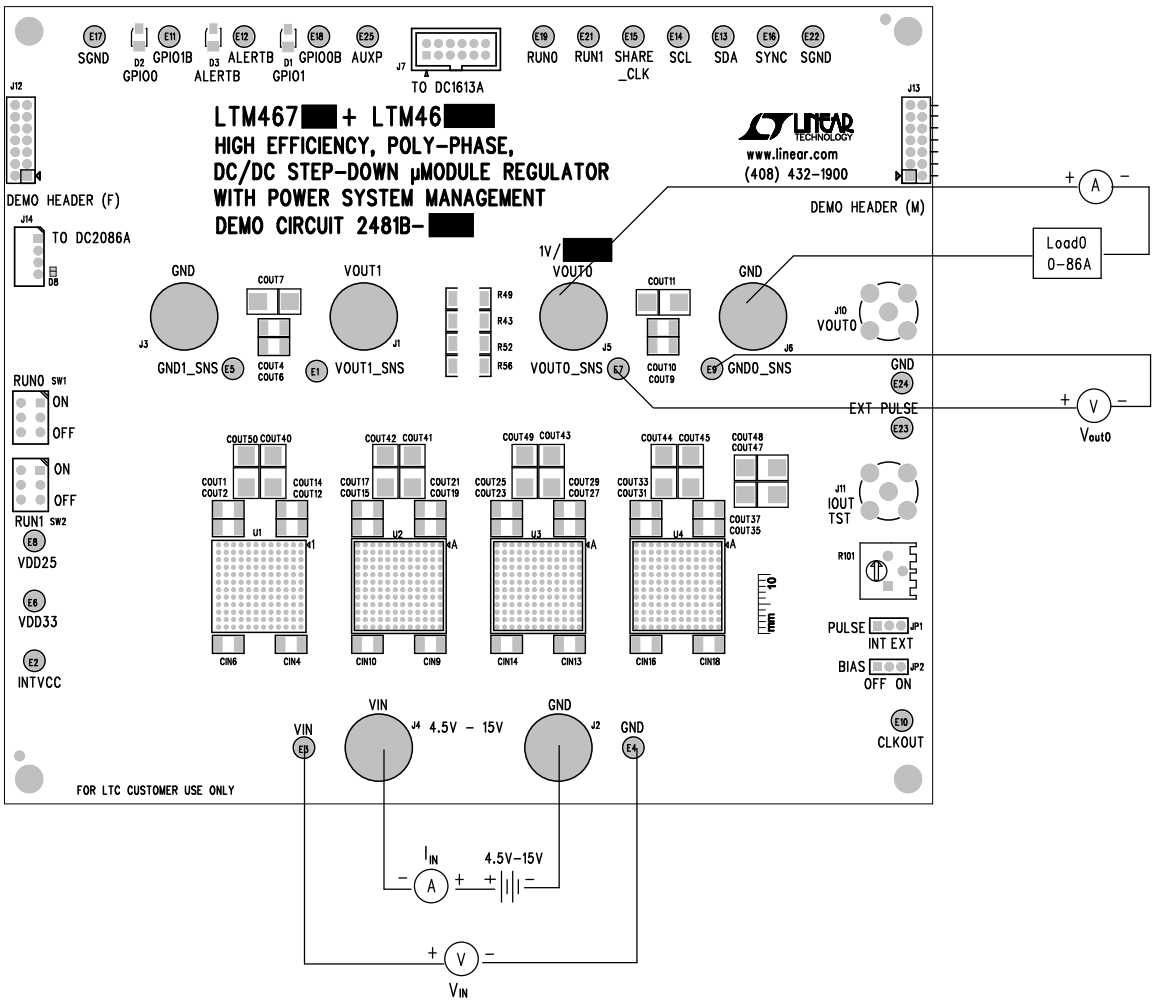


Figure 2. Proper Measurement Equipment Setup

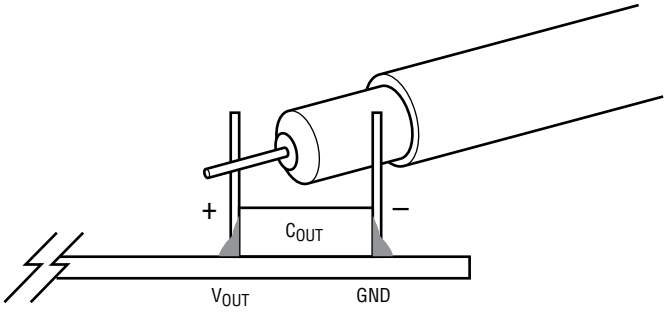


Figure 3. Measuring Output Voltage Ripple

QUICK START PROCEDURE

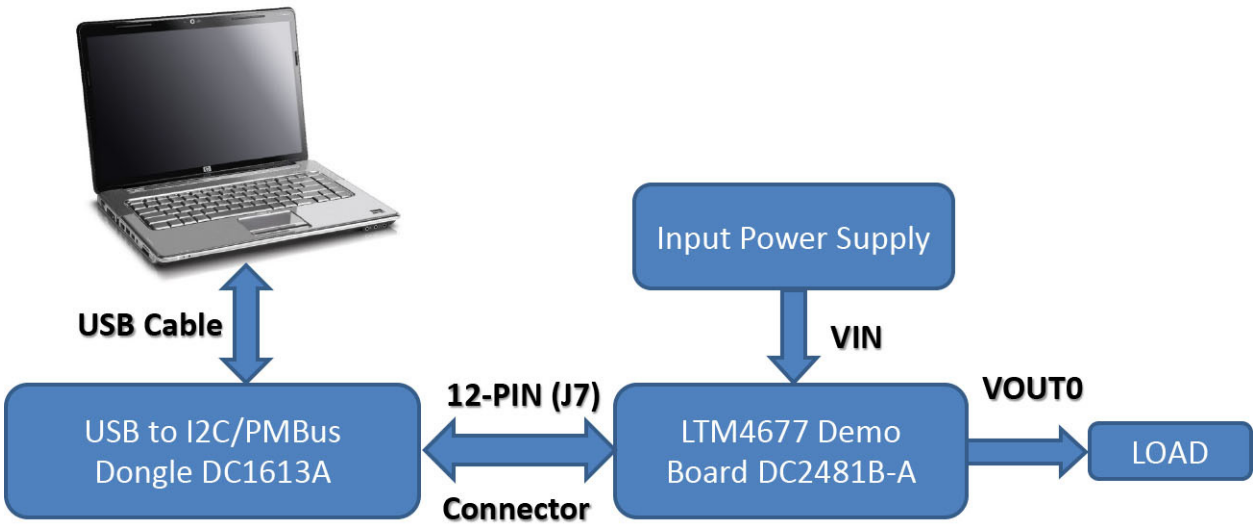


Figure 4. Demo Setup with PC

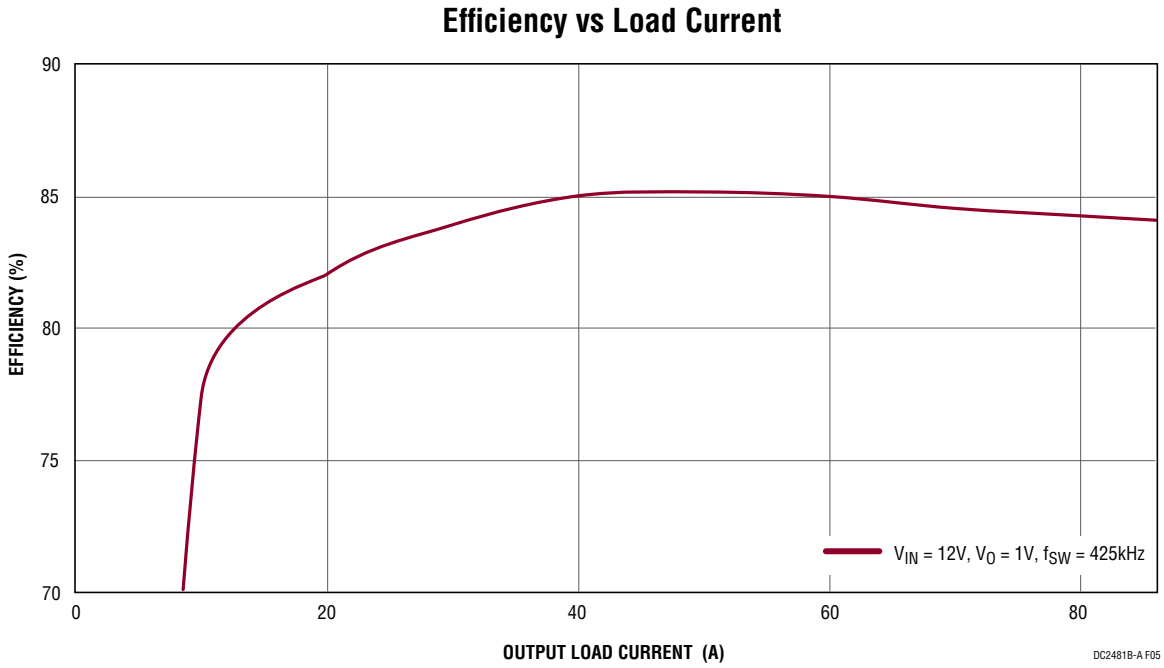


Figure 5. Efficiency vs Load Current at V_{IN} = 12V, V_O = 1V and f_{SW} = 425kHz

QUICK START PROCEDURE

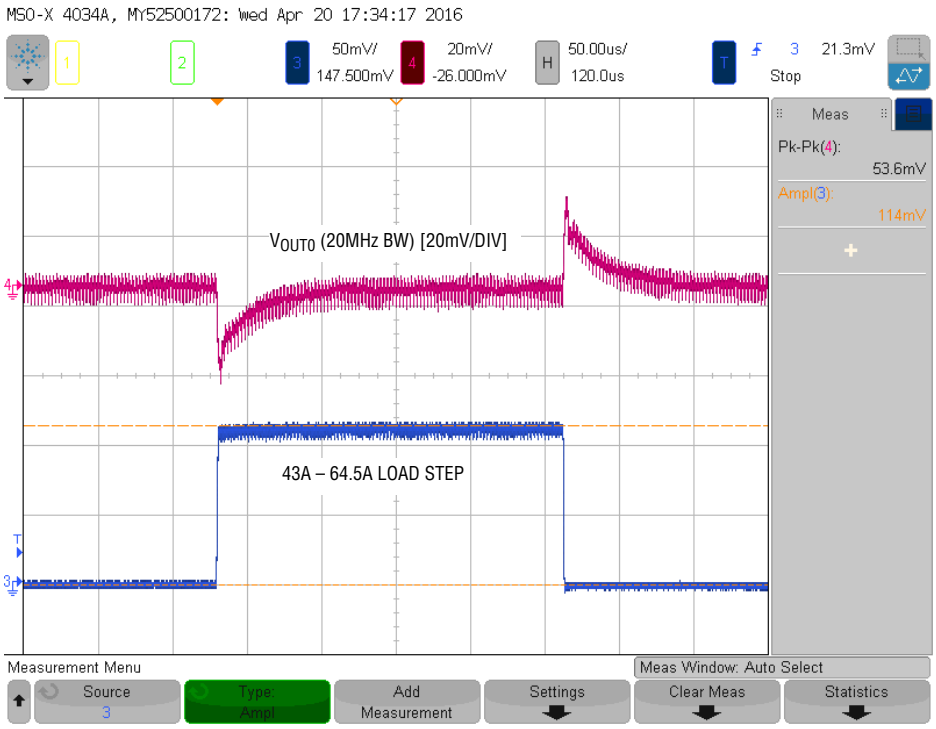


Figure 6. Output Voltage V_{OUT0} vs Load Current at V_{IN} = 12V, V_{OUT0} = 1V (V_{OUT0} Range = 0)

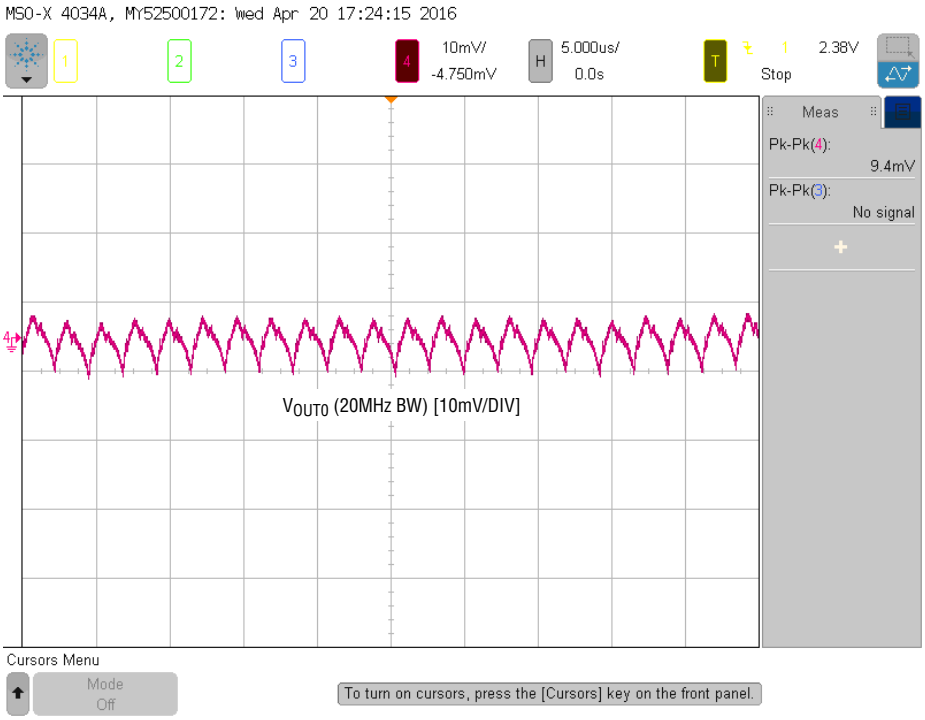


Figure 7. Output Voltage Ripple at V_{IN} = 12V, V_{OUT0} = 1V, I_{OUT0} = 86A

QUICK START PROCEDURE

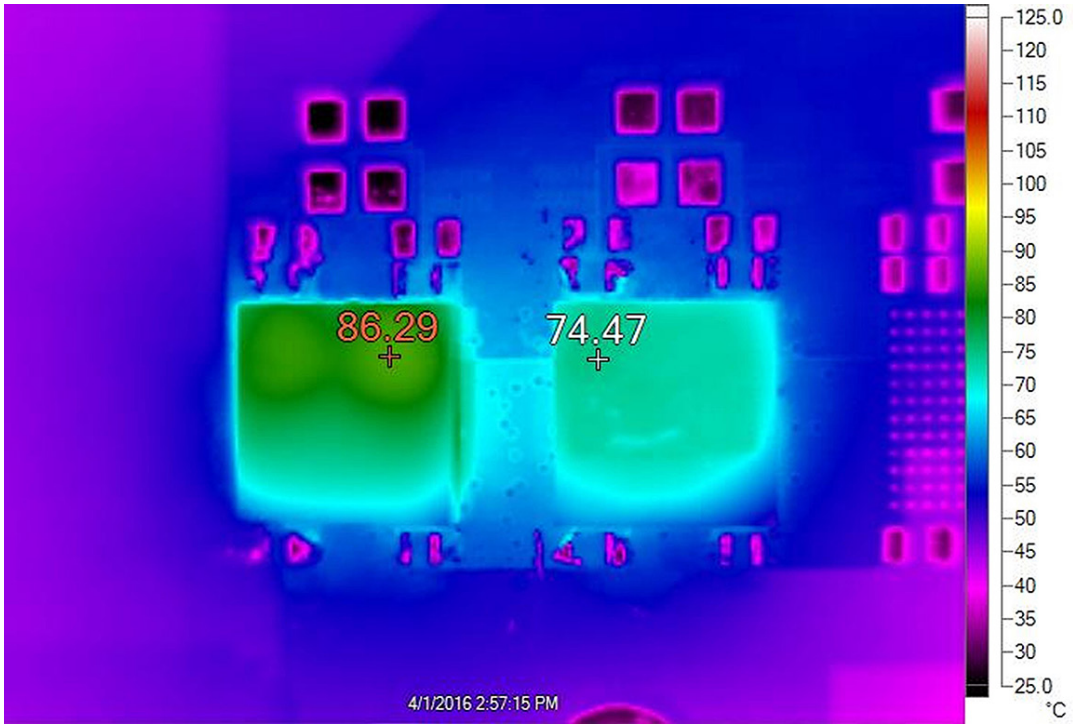


Figure 8. Thermal Performance at V_{IN} = 12V, V_{OUT0} = 1V, I_{OUT0} = 86A, T_A = 23.8°C, Air Flow 300LFM

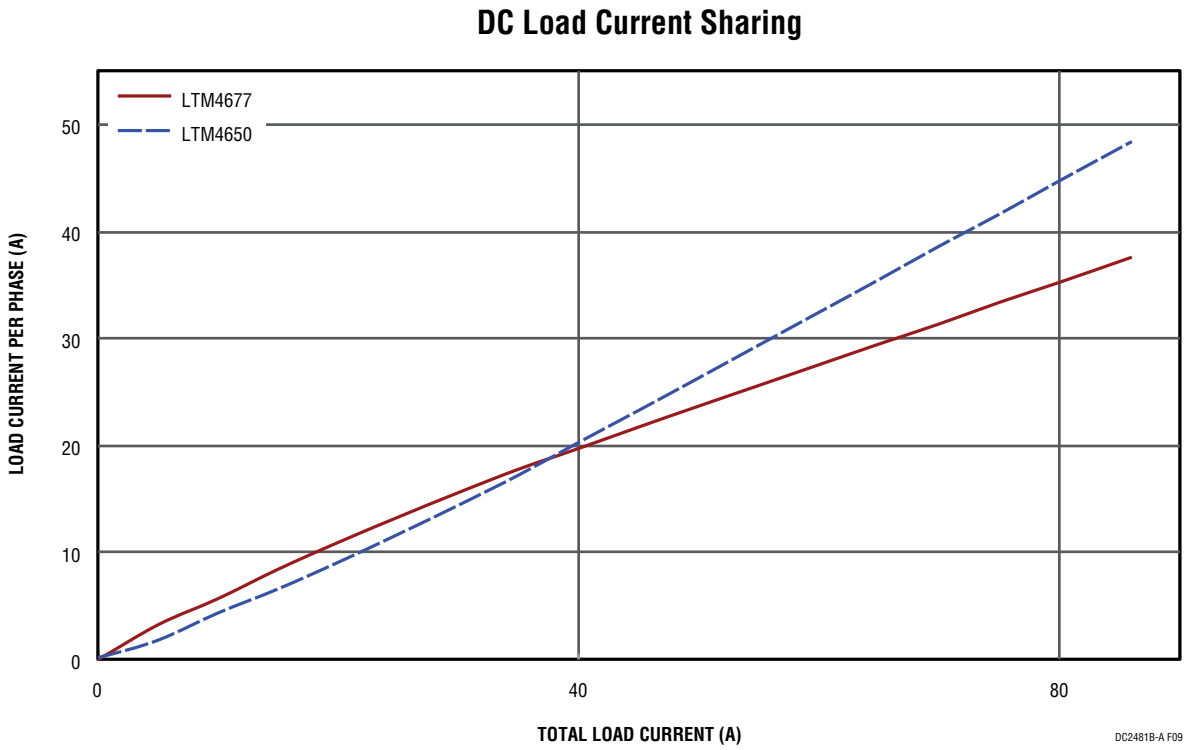


Figure 9. Current Sharing Performance at V_{IN} = 12V, V_{OUT0} = 1V

LTPOWERPLAY SOFTWARE GUI

LTpowerPlay is a powerful Windows based development environment that supports Analog Devices power system management ICs, including the LTM4677, LTC®3880, LTC3883, LTC2974 and LTC2978. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Analog Devices ICs by connecting to a demo board system. LTpowerPlay can also be used in an offline mode (with no hardware present) in order to build a multichip configuration file that can be saved and reloaded at a later time. LTpowerPlay provides unprecedented diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power management scheme in a system, or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential targets, including the LTM4677, the LTC3880 and the LTC3883's demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

http://analog.com/ltpowerplay

To access technical support documents for Analog Devices Digital Power Products visit Help. View online help on the LTpowerPlay menu.

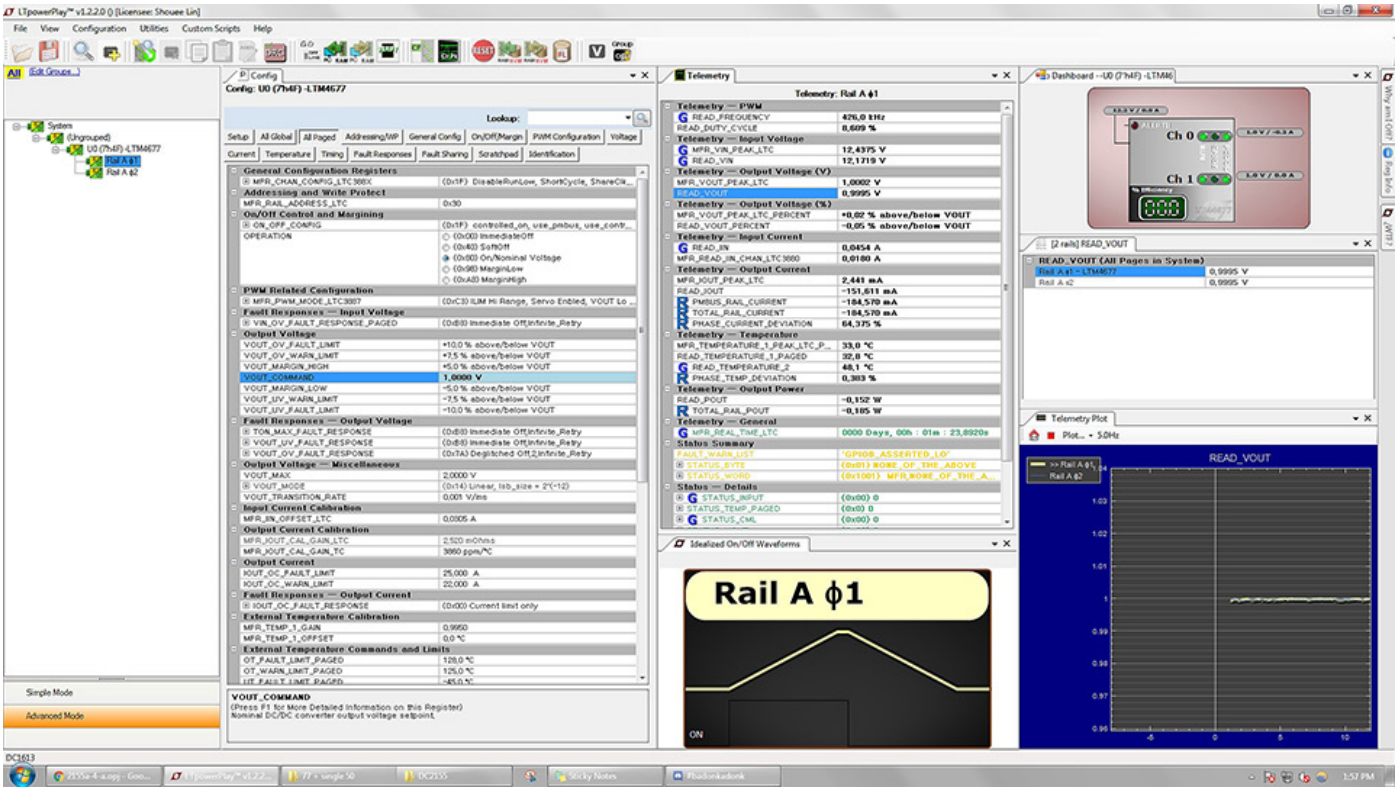


Figure 10. LTpowerPlay Main Interface

LTPOWERPLAY QUICK START PROCEDURE

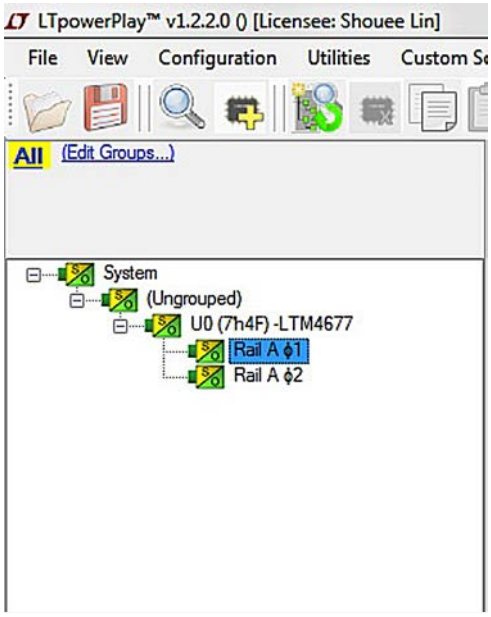
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTM4677.

1. Download and install the LTPowerPlay GUI:

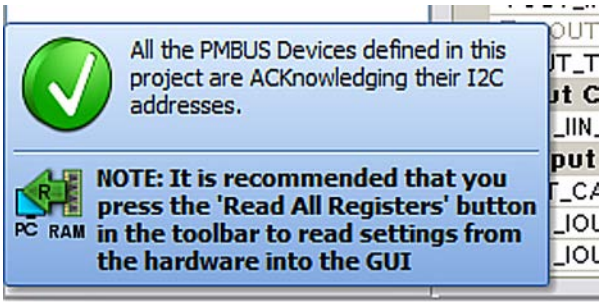
   http://analog.com/ltpowerplay

2. Launch the LTpowerPlay GUI.

a. The GUI should automatically identify the DC2481B-A. The system tree on the left hand side should look like this:



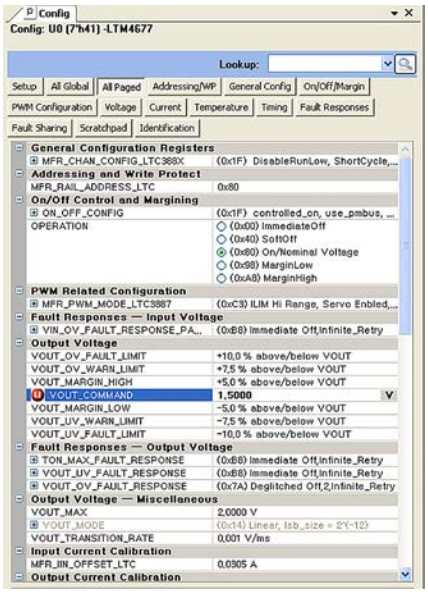
b. A green message box shows for a few seconds in the lower left hand corner, confirming that LTM4677 is communicating:



c. In the Toolbar, click the "R" (RAM to PC) icon to read the RAM from the TM4677. This reads the configuration from the RAM of LTM4677 and loads it into the GUI.



d. If you want to change the output voltage to a different value, like 1.5V. In the Config tab, type in 1.5 in the VOUT_COMMAND box, like this:



Then, click the "W" (PC to RAM) icon to write these register values to the LTM4677. After finishing this step, you will see the output voltage will change to 1.5V.



If the write is successful, you will see the following message:



e. You can save the changes into the NVM. In the tool bar, click "RAM to NVM" button, as following



f. Save the demo board configuration to a (*.proj) file. Click the Save icon and save the file. Name it whatever you want.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	10	CIN1, CIN2, CIN4-CIN11	CAP., X5R, 10µF, 35V, 10%,1210	MURATA, GRM32ER6YA106KA12L
2	1	CIN3	CAP., 150µF, 35V, Aluminum Electr.,	SUN ELECT., 35CE150AX
3	12	COUT2-COUT4, COUT6, COUT9, COUT10, COUT12, COUT13, COUT15, COUT16, COUT19, COUT20	CAP., X5R, 100µF, 6.3V, 20% 1210	MURATA, GRM32ER60J107M20L
4	6	COUT5, COUT7, COUT8, COUT11, COUT18, COUT22	CAP., 470µF, 2.5V, SPCAP, D3L	PANASONIC, EEF-LX0E471E4
5	1	C5	CAP., CER 4700PF 16V X7R 0603	MURATA, GRM188R71C472KA01D
6	4	C7,C8,C33.C34	CAP., X7R, 0.01uF, 16V, 10%,0603	MURATA, GRM188R71C103KA01D
7	3	C11,C18,C22	CAP., X5R, 2.2uF, 16V, 10%, 0603	MURATA, GRM188R61C225KE15D
8	3	C12,C19,C23	CAP., X7R, 1uF, 16V, 10%, 0603	MURATA, GRM188R71C105KA12D
9	2	C31,C28	CAP., X7R, 1uF, 25V,10%, 1206	MURATA, GRM31MR71E105KA01L
10	1	C25	CAP., X7R, 0.22uF, 25V,10%, 0805	MURATA, GRM21BR71E224KA01L
11	1	C26	CAP., X7R, 0.1uF, 25V,10%, 1206	MURATA, GRM319R71E104KA01J
12	1	C29	CAP., X5R, 1uF, 25V, 10%, 0805	MURATA, GRM216R61E105KA12D
13	1	C27	CAP., X7R, 150pF, 25V, 10%, 0603	Wurth Elektronik, 885012206054
14	1	C30	CAP., X5R, 4.7uF, 10V, 10%, 0603	MURATA, GRM188R61A475KE15D
15	2	D1,D2	LED, GREEN CLEAR 1208 SMD	ROHM, SML-010FTT86
16	1	D3	LED, RED CLEAR 1208 SMD	ROHM, SML-010VTT86
17	3	Q1,Q3,Q4	MOSFET N-CH 60V 115MA SOT-23	FAIRCHILD, 2N7002K
18	1	Q2	MOSFET P-CH 20V 0.58A SOT-23	VISHAY, Si2365EDS-T1-GE3 (ALTERNATE TP0101K-T1-E3)
19	2	Q5,Q6	MOSFET SPEED SRS 30V 30A LFPAK	RENESAS, RJK0305DPB-02#J0
20	1	Q19	P-Channel 30-V Mosfet	DIODES INC., DMP3130L-7
21	1	R25	RES., CHIP,18.0K, 1%, 0603	VISHAY, CRCW060322K6FKEA
22	22	R4, R8, R23, R31, R32, R34, R37,R41, R42, R44, R46, R47, R50, R51, R55, R61, R64, R66, R75, R80, R114, R116	RES., CHIP, 0, 1%, 0603	VISHAY, CRCW06030000Z0EA
23	4	R43, R49, R52, R56	RES., CHIP, 0, 1%, 2010	VISHAY, CRCW20100000Z0EA
24	11	R10, R11, R12, R13, R16, R17, R21, R58, R77, R94, R118	RES., CHIP, 10k, 1%, 0603	VISHAY, CRCW060310K0FKEA
25	1	R9	RES., CHIP, 7.15k, 1%, 0603	VISHAY, CRCW06037K15FKEA
26	4	R22, R26, R70, R73	RES., CHIP, 10, 1%, 0603	VISHAY, CRCW060310R0FKEA
27	1	R102	RES., CHIP, 732, 1%, 0603	VISHAY, CRCW0603732RFKEA
28	1	R98	RES., CHIP, 511, 1%, 0603	VISHAY, CRCW0603511RFKEA
29	3	R33, R60, R65	RES., CHIP, 121k, 1%, 0603	VISHAY, CRCW0603121KFKEA
30	3	R40, R63, R68	RES., CHIP, 80.6k, 1%, 0603	VISHAY, CRCW060380K6FKEA
31	1	R35	RES., CHIP, 60.4k, 1%, 0603	VISHAY, CRCW060360K4FKEA
32	1	R36	RES., CHIP, 8.25k, 1%, 0603	VISHAY, CRCW06038K25FKEA
33	1	R19	RES., CHIP, 6.04k, 1%, 0603	VISHAY, CRCW06032K94FKEA
34	3	R45, R84, R85	RES., CHIP, 200, 1%, 0603	VISHAY, CRCW0603200RFKEA
	1	R54,	RES., CHIP, 2k, 1%, 0603	VISHAY, CRCW06032K00FKEA

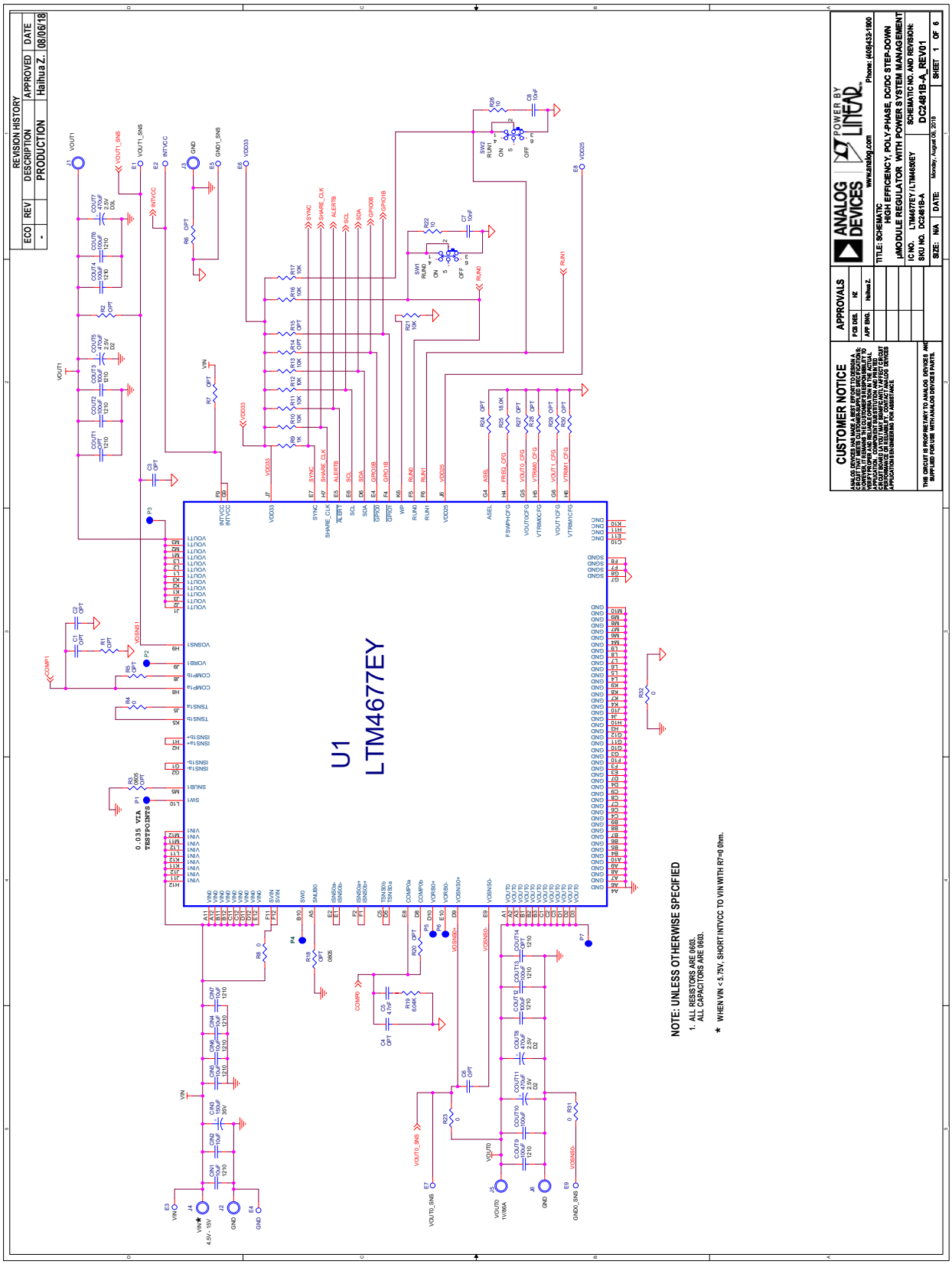
PARTS LIST

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35	3	R89, R92, R117	RES., CHIP, 20k, 1%, 0603	VISHAY, CRCW060320K0FKEA
36	2	R76, R115	RES., CHIP, 4.99k, 1%, 0603	VISHAY, CRCW06034K99FKEA
37	1	R86	RES., CHIP, 127, 1%, 0603	VISHAY, CRCW0603127RFKEA
38	1	R87	RES., CHIP, 2, 1%, 0603	VISHAY, CRCW06032R00FKEA
39	1	R88	RES., CHIP, 1M, 1%, 0603	VISHAY, CRCW06031M00FKEA
40	1	R90	RES., CHIP, 154k, 1%, 0603	VISHAY, CRCW0603154KFKEA
41	1	R91	RES., CHIP, 3.3, 1%, 0603	VISHAY, CRCW06033R30FKEA
42	1	R93	RES., CHIP, 681k, 1%, 0603	VISHAY, CRCW0603681KFKEA
43	1	R95	RES., CHIP, 82.5, 1%, 0603	VISHAY, CRCW060382R5FKEA
44	1	R112	RES., CHIP, 15.8k, 1%, 0603	VISHAY, CRCW060315K8FKEA
45	2	R99, R100	RES., CHIP, 0.01, 1%, 2010	VISHAY, WSL2010R0100FEA
46	1	R101	TRIMMING POTENTIOMETER, 5k	BOURNS, 3386P-1-502LF
47	1	R103	RES., CHIP, 100k, 1%, 0603	VISHAY CRCW0603100KFKEA
48	1	U1	IC., LTM4677EY	ANALOG DEVICES, LTM4677EY#PBF
49	1	U2	IC., LTM4650EY	ANALOG DEVICES, LTM4650EY#PBF
50	1	U5	IC., LT1801CMS8, MSOP	ANALOG DEVICES, LT1801CMS8#PBF
51	1	U6	IC., EEPROM 2KBIT 400KHZ 8TSSOP	MICROCHIP, 24LC025-I/ST
52	1	U7	IC., LTC6992-1, S6-TSOT23	ANALOG DEVICES, LTC6992CS6-1#PBF
53	1	U8	IC., LT1803IS5, S5-TSOT23	ANALOG DEVICES, LT1803IS5#PBF
54	1	U9	IC., LT1129CS8-5, S8	ANALOG DEVICES, LT1129CS8-5#PBF
Additional Demo Board Circuit Components				
1	0	CIN12-CIN19	CAP., OPTIONAL	
2	0	C1, C2, C3, C4, C6, C13, COUT14, COUT17, COUT21, COUT23-COUT50	CAP., OPTIONAL	
3	0	C9, C10, C16, C17, C20, C21	CAP., OPTIONAL	
4	0	D10	DIODE, OPT	
5	0	R1-R3, R5-R7, R14, R15, R18, R20, R24, R27-R30, R38, R39, R41, R48, R59, R62, R67,R69, R71, R72, R78, R79, R96, R97, R104-R109		
6	0	R39, R62, R67, R69	RES., OPTIONAL	
7	0	U3, U4	IC., OPTIONAL	

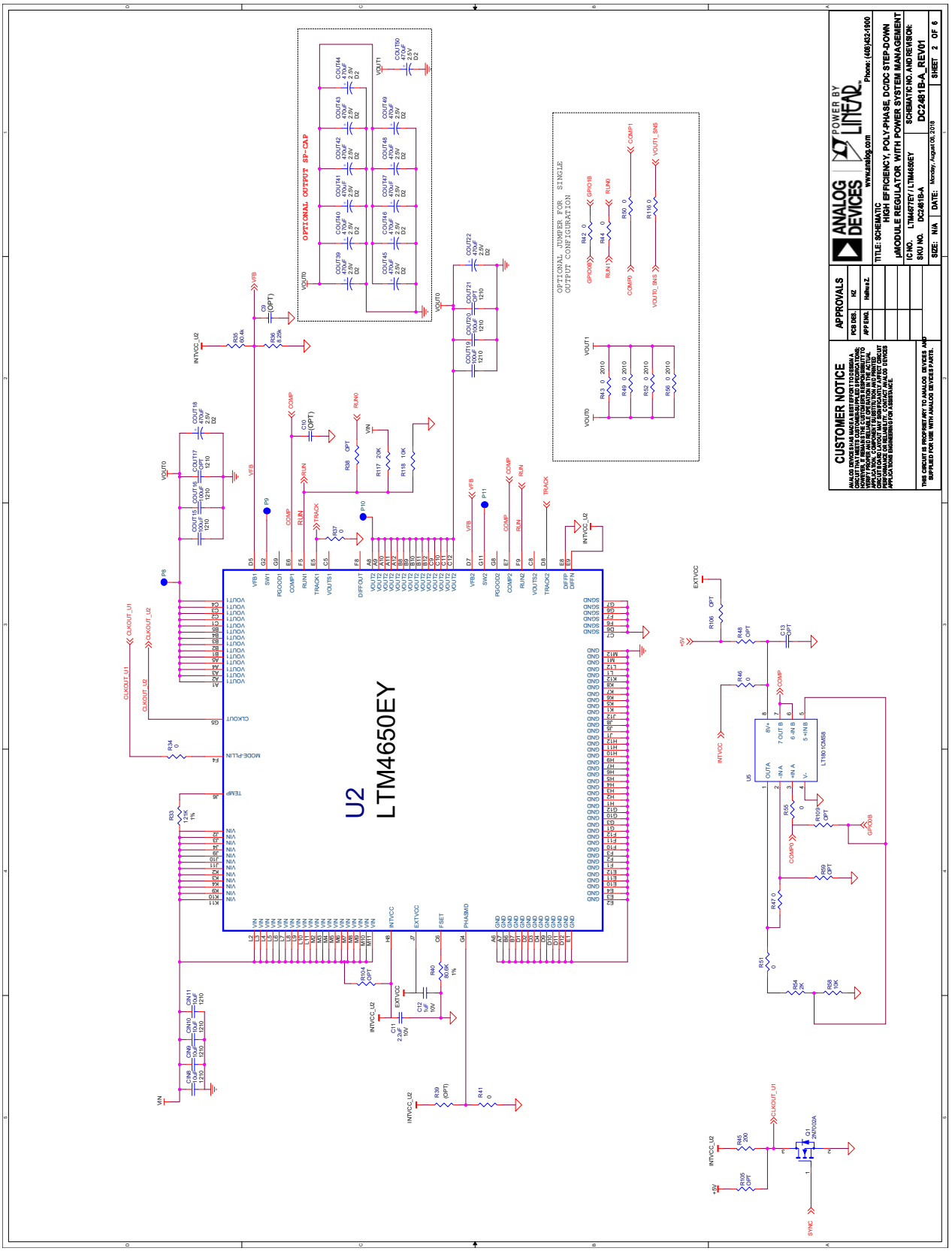
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	24	E1-E24	TESTPOINT, TURRET, .062"	MILL-MAX, 2308-2-00-80-00-00-07-0
2	2	JP1, JP2	HEADER, 3 PIN 0.079 SINGLE ROW	Wurth Elektronik, 62000311121
3	2	XJP1, XJP2	SHUNT, .079" CENTER	Wurth Elektronik, 60800213421
4	2	J1, J3	JACK, BANANA	KEYSTONE, 575-4
5	4	J2, J4, J5, J6	STUD, TESTPIN	PEM, KFH-032-10
6	8	J1, J2, J3, J4, J5, J6 (×2)	NUT, BRASS 10-32	ANY, 10-32M/S BR PL
7	4	J1, J2, J3, J4, J5, J6	RING, LUG #10	KEYSTONE, 8205
8	4	J1, J2, J3, J4, J5, J6	WASHER, TIN PLATED BRASS	ANY #10, #10EXT BZ TN
9	2	SW1, SW2	CONN, SUB MINIATURE SLIDE SWITCHES	C&K., JS202011CQN
10	1	J7	CONN HEADER 12POS 2MM STR DL PCB	FCI, 98414-G06-12ULF
11	2	J10, J11	CONN, BNC, 5PINS	CONNEX, 112404
12	1	J14	HEADER, 4 PINS, SHROUDED	HIROSE, DF3A-4P-2DSA
13	1	J12	CONN RECEPT 2MM DUAL R/A 14POS (F)	SULLINS, NPPN072FJFN-RC
14	1	J13	HEADER 14POS 2MM R/A GOLD (M)	MOLEX, 87760-1416
15	4	(STAND-OFF)	STAND-OFF, NYLON 0.50" tall	WURTH ELEKTRONIK, 702935000
16	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2481B Rev 1
17	2		STENCIL (TOP & BOTTOM)	STENCIL DC2481B

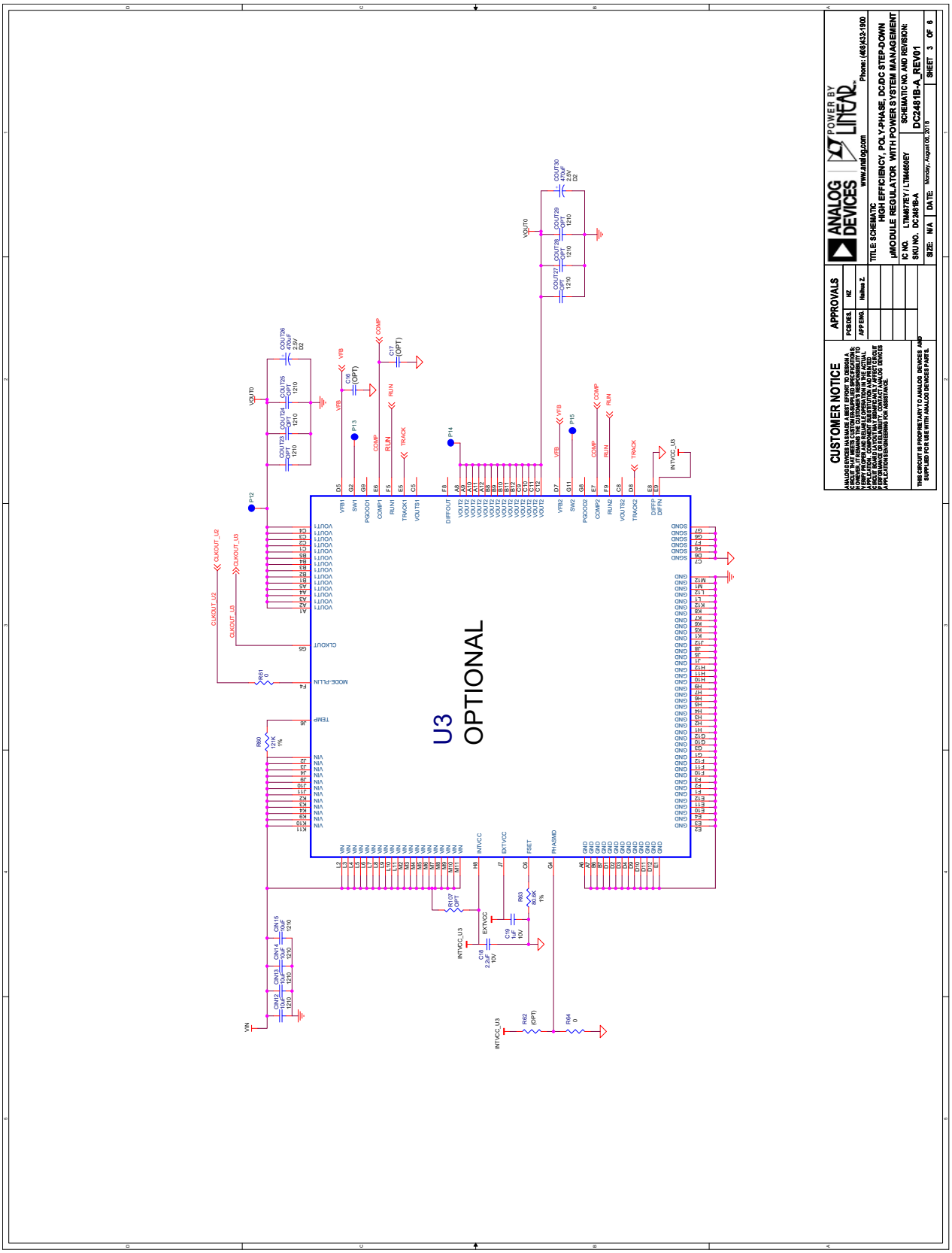
SCHEMATIC DIAGRAM



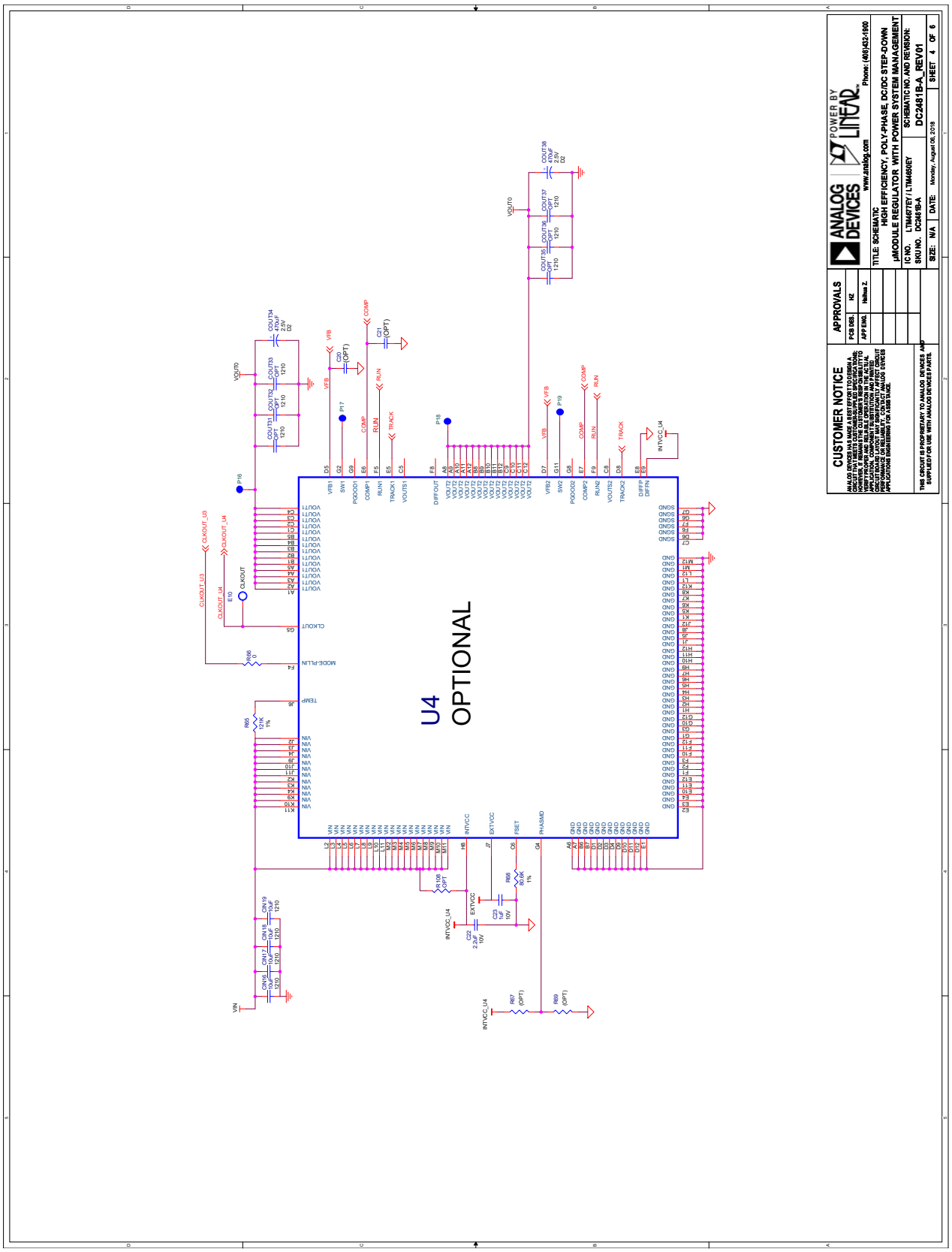
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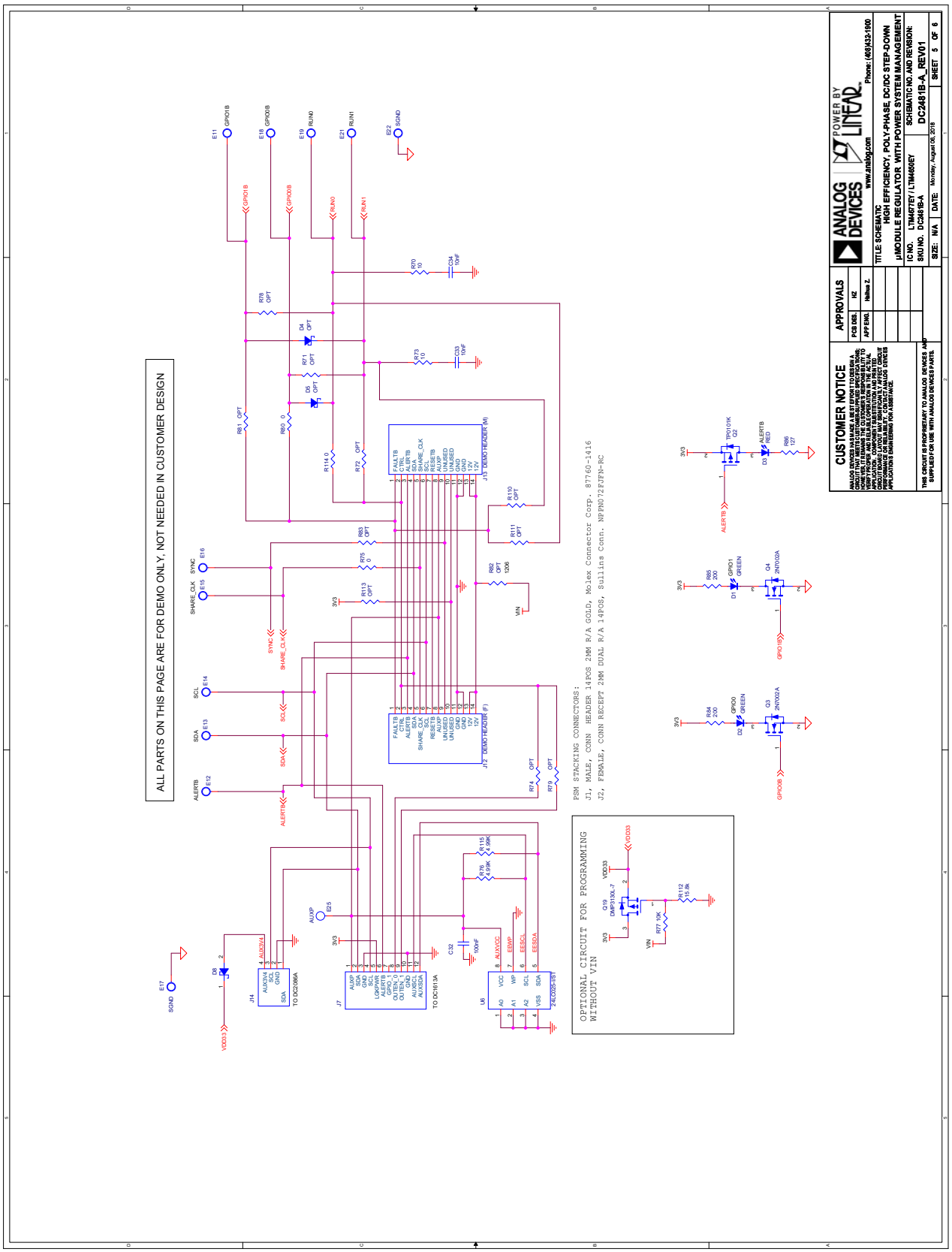
SCHEMATIC DIAGRAM



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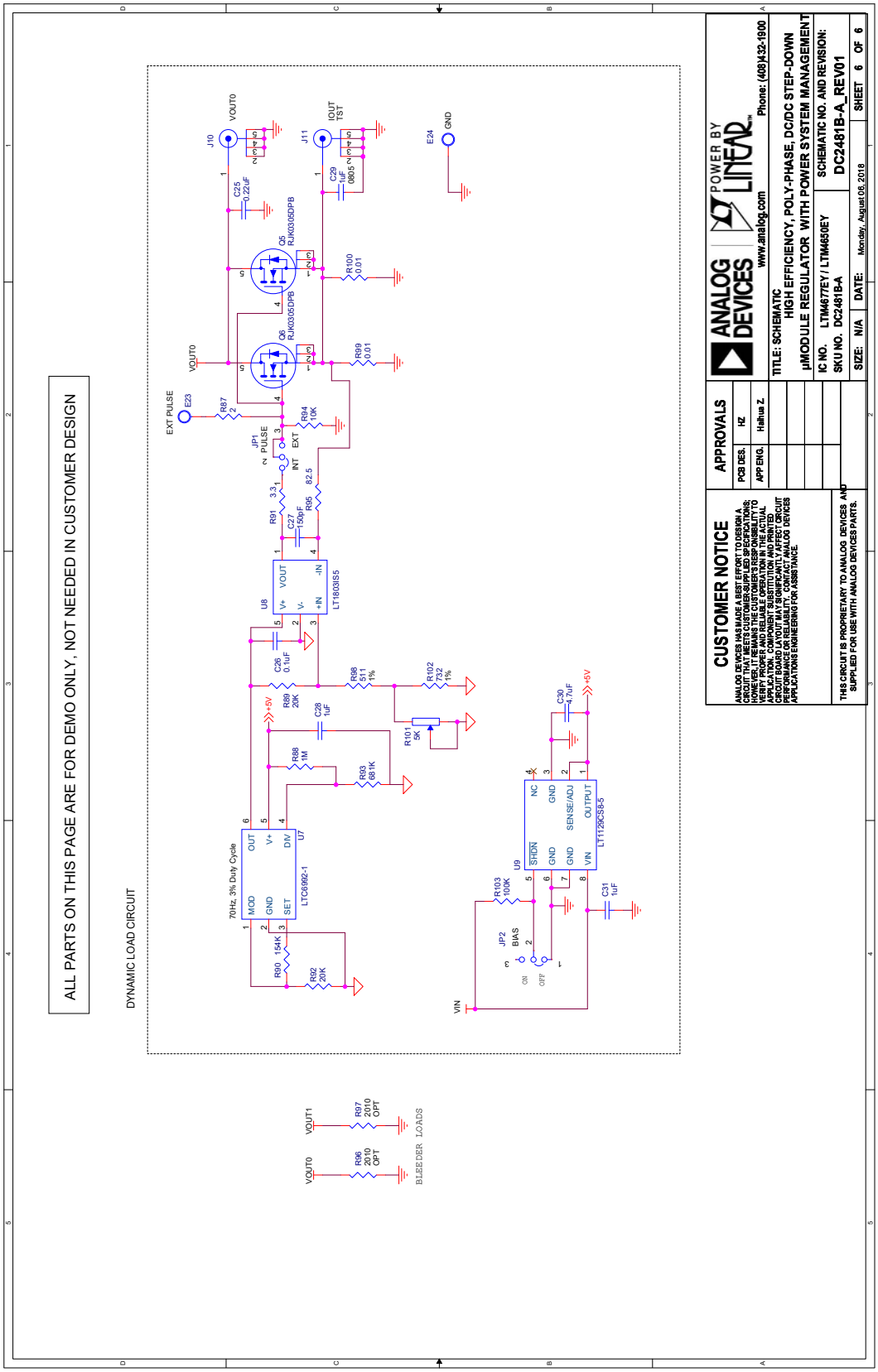


SCHEMATIC DIAGRAM



Rev 0

SCHEMATIC DIAGRAM



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ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

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