LTM4680
Dual 30A or Single 60A µModule Regulator with Digital Power System Management

DESCRIPTION

Demonstration circuit 2844A is a dual-output, high efficiency, high density, µModule® regulator with 4.5V to 16V input range. Each output can supply 30A maximum load current. The demo board has a LTM®4680 µModule regulator, which is a dual 30A or single 60A step-down regulator with digital power system management. Please see LTM4680 data sheet for more detailed information.

DC2844A powers up to default settings and produces 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 ADI'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: LTpowerPlay

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay GUI for LTM4680 Quick Start Guide.

Design files for this circuit board are available.

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BOARD PHOTO

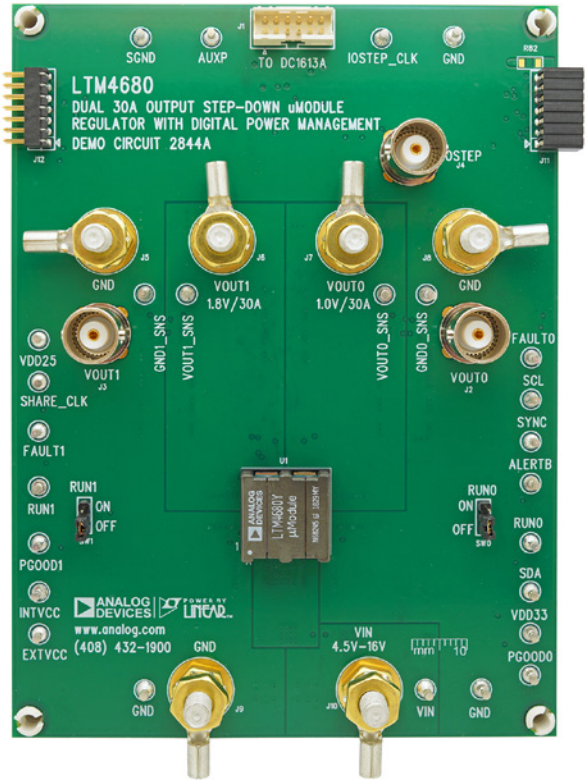


Figure 1. Dual-Output LTM4680/DC2844A Demo Circuit

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		4.5		16	V
Output Voltage, V_{OUT0}	V_{IN} = 4.5V – 16V, I_{OUT0} = 0A to 30A	0.5	1.0	3.3	V
Maximum Output Current, I_{OUT0}	V_{IN} = 4.5V – 16V, V_{OUT0} = 0.5V to 3.3V		30		A
Output Voltage, V_{OUT1}	V_{IN} = 4.5V – 16V, I_{OUT1} = 0A to 30A	0.5	1.8	3.3	V
Maximum Output Current, I_{OUT1}	V_{IN} = 4.5V – 16V, V_{OUT1} = 0.5V to 3.3V		30		A
Typical Efficiency of CH0	V_{IN} = 12V, V_{OUT0} = 1.0V, I_{OUT0} = 30A		88.4 (See Figure 5)		%
Typical Efficiency of CH1	V_{IN} = 12V, V_{OUT1} = 1.8V, I_{OUT1} = 30A		92.1 (See Figure 6)		%
Default Switching Frequency			500		kHz

QUICK START PROCEDURE

Table 1. LTM4680 Demo Boards for Up to 120A Point-of-Load Regulation

MAXIMUM OUTPUT CURRENT	NUMBER OF OUTPUTS	NUMBER OF LTM4680 µModule REGULATORS ON THE BOARD	DEMO BOARD NUMBER
30A	2	1	DC2844A
60A	1	1	DC2845A
120A	1	2	DC2863A

Demonstration circuit 2844A is easy to set up to evaluate the performance of the LTM4680EY. 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 – 16V) and GND (input return).
2. Connect the 1.0V output load between V_{OUT0} and GND (initial load: no load).
3. Connect the 1.8V output load between V_{OUT1} and GND (initial load: no load).
4. Connect the DVMs to the input and outputs. Set default jumper position: SW1: ON; SW2: ON.
5. Turn on the input power supply and check for the proper output voltages. V_{OUT0} should be 1.0V ± 0.5%, and V_{OUT1} should be 1.8V ± 0.5%.
6. 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.
7. Connect the dongle and control the output voltages from the GUI. See “LTpowerPlay GUI for the LTM4680 Quick Start Guide” 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.

QUICK START PROCEDURE

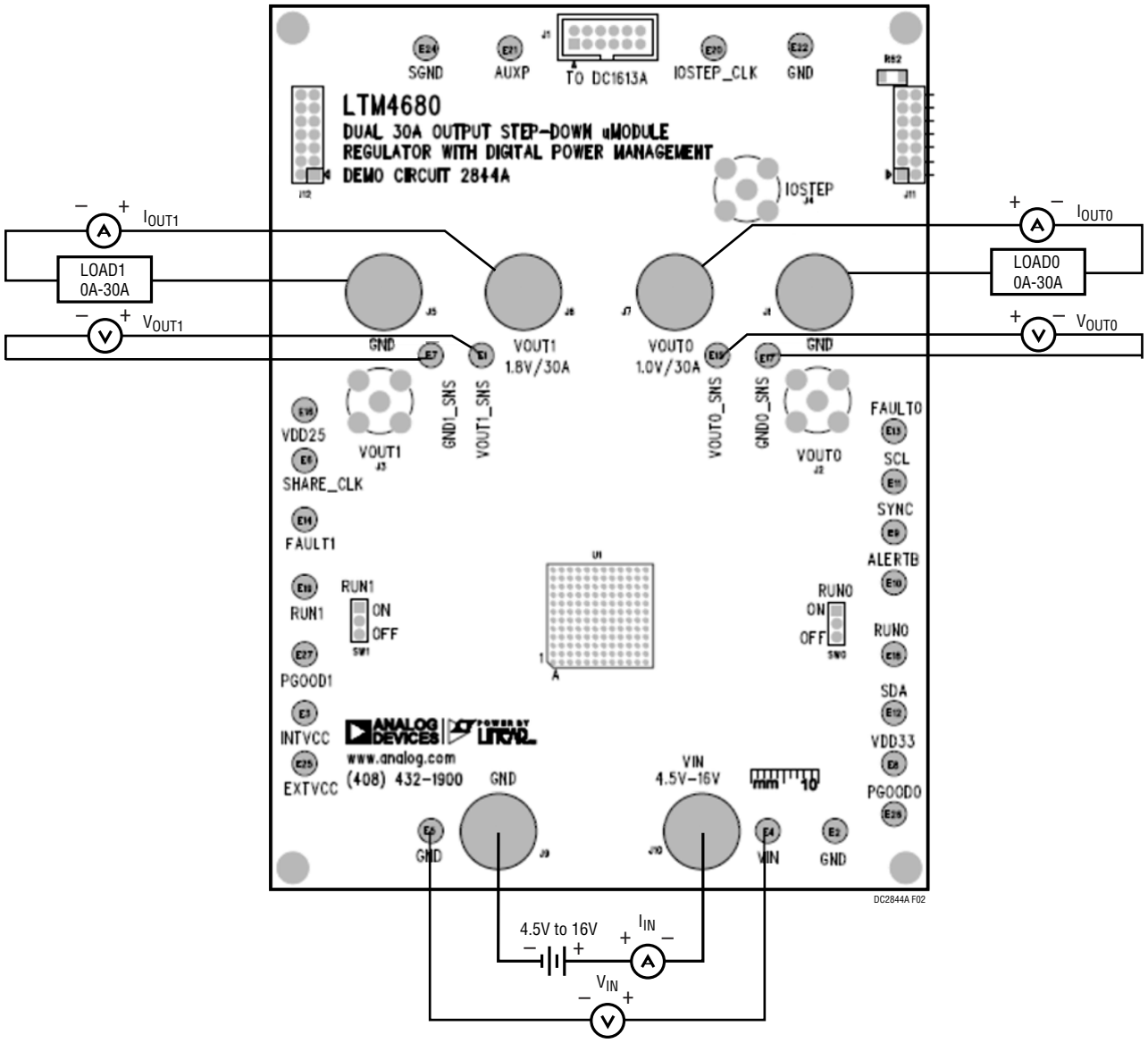


Figure 2. Proper Measurement Equipment Setup

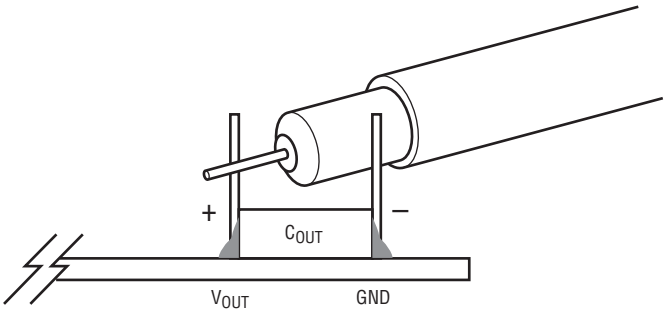


Figure 3. Measuring Output Voltage Ripple

QUICK START PROCEDURE

Connecting a PC to DC2844A

You can use a PC to reconfigure the power management features of the LTM4680 such as: nominal V_{OUT}, margin set points, OV/UV limits, temperature fault limits, sequencing parameters, the fault log, fault responses, GPIOs and other functionalities. The DC1613A dongle may be plugged when V_{IN} is present.

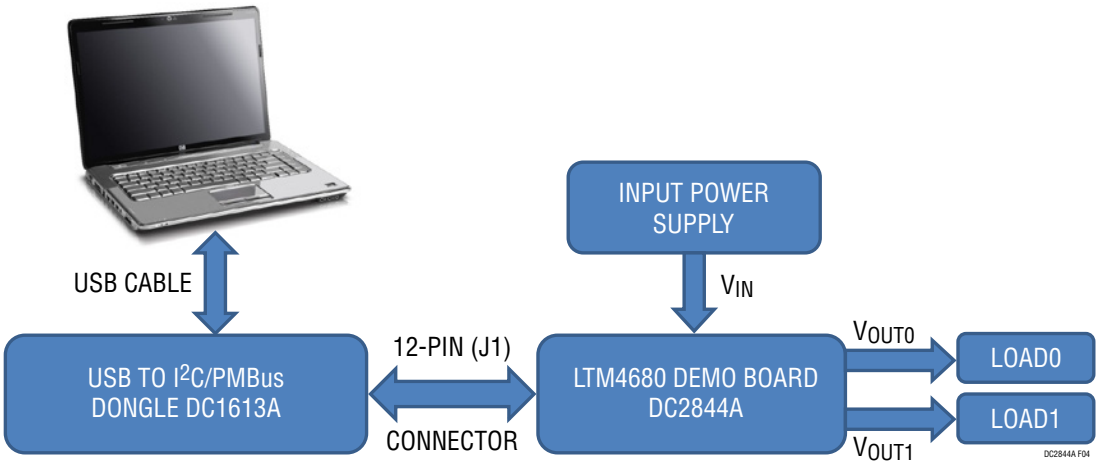


Figure 4. Demo Setup with PC

Efficiency vs Load at V_{OUT0} = 1V, f_{SW} = 500kHz

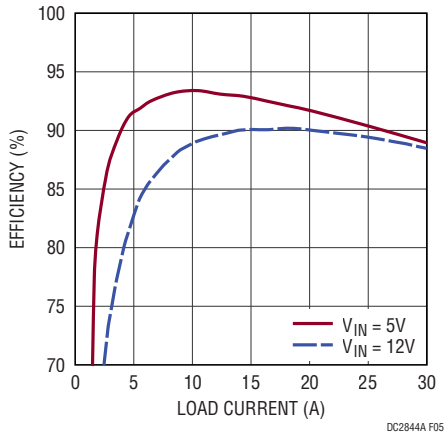


Figure 5. Efficiency vs Load Current on CH0 (CH1 is Disabled)

Efficiency vs Load at V_{OUT1} = 1.8V, f_{SW} = 500kHz

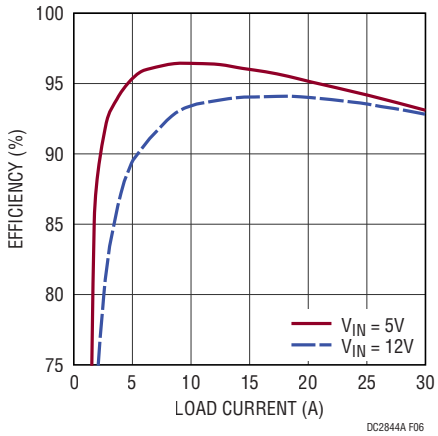


Figure 6. Efficiency vs Load Current on CH1 (CH0 is Disabled)

QUICK START PROCEDURE

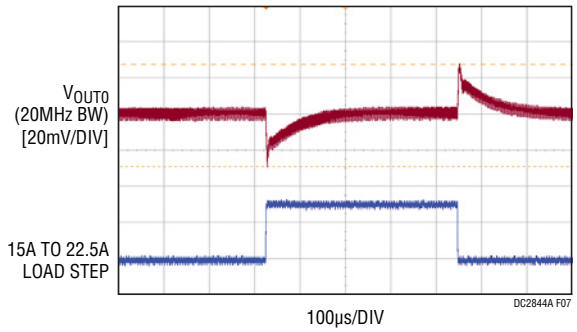


Figure 7. V_{OUT0} Load Transient Response at V_{IN} = 12V, V_{OUT0} = 1V

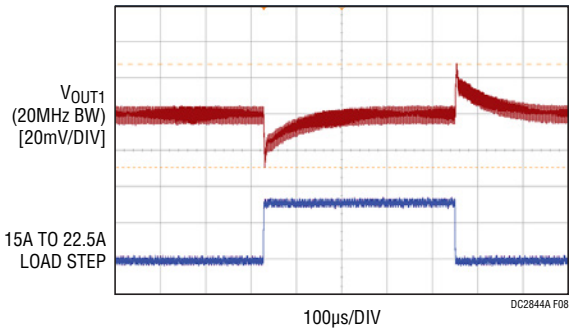


Figure 8. V_{OUT1} Load Transient Response at V_{IN} = 12V, V_{OUT1} = 1.8V

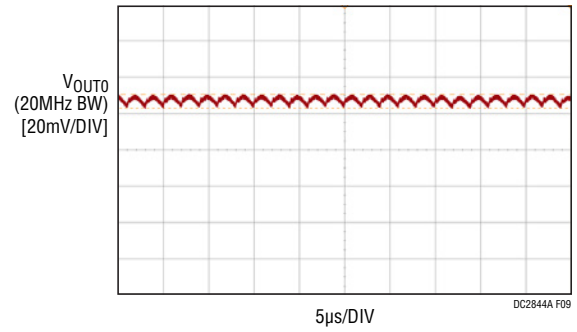


Figure 9. V_{OUT0} Voltage Ripple at V_{IN} = 12V, V_{OUT0} = 1V, I_{OUT0} = 30A

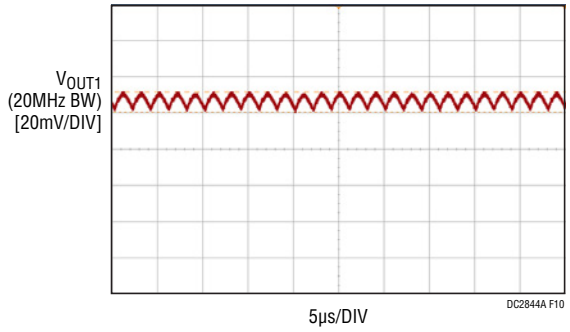


Figure 10. V_{OUT1} Voltage Ripple at V_{IN} = 12V, V_{OUT1} = 1.8V, I_{OUT1} = 30A

QUICK START PROCEDURE

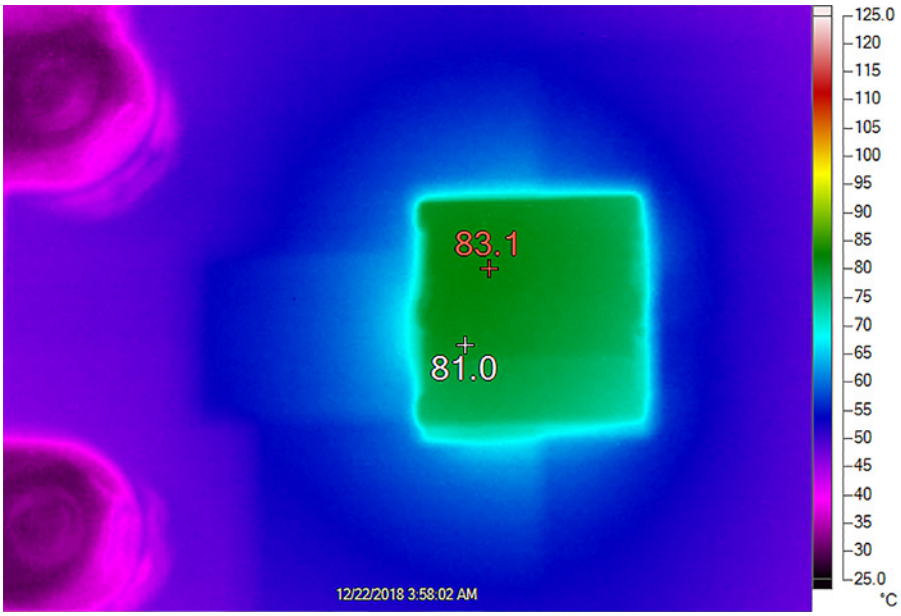


Figure 11. Thermal at V_{IN} = 12V, V_{OUT0} =1V, I_{OUT0} = 30A, V_{OUT1} = 1.8V, I_{OUT1} = 30A, T_A = 25°C, No Forced Airflow

LTPOWERPLAY SOFTWARE GUI

LTpowerPlay is a powerful Windows based development environment that supports Analog Devices power system management ICs and µModules, including LTM4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTC®3880, LTC3882, LTC3883 and LTC3884. 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 LTM4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTC3880, LTC3882, LTC3883 and LTC3884'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: LTpowerPlay

To access technical support documents for Analog Devices Digital Power Products visit the LTpowerPlay Help menu. Online help also available through the LTpowerPlay.

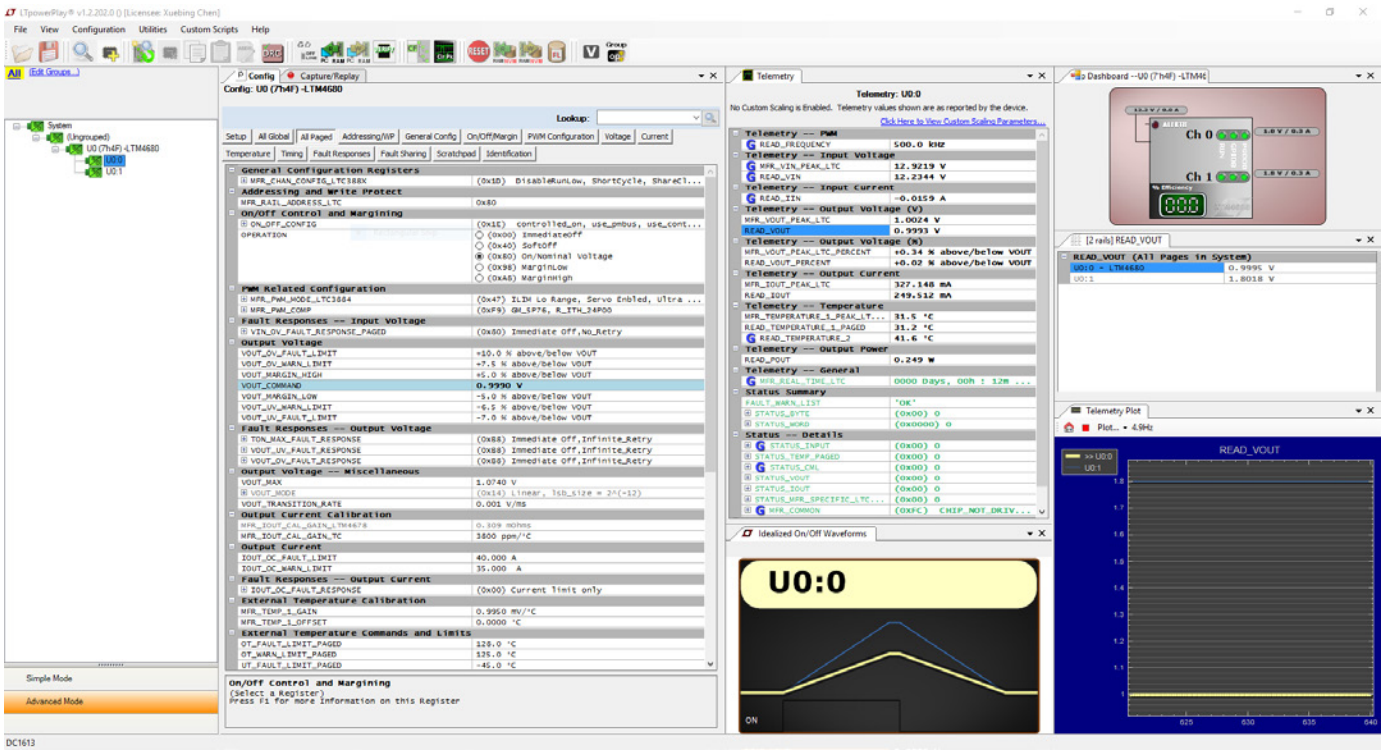


Figure 12. LTpowerPlay Main Interface

LTPOWERPLAY QUICK START PROCEDURE

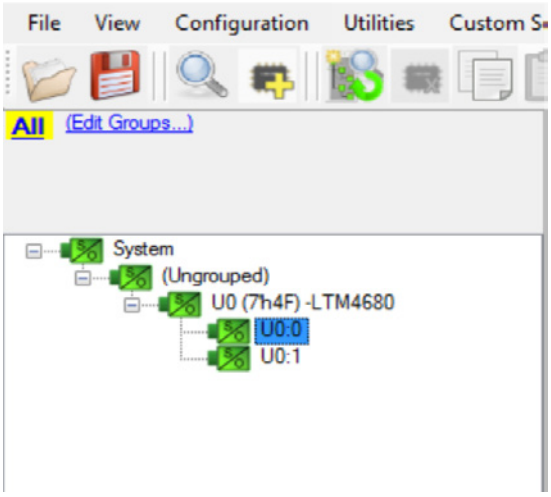
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTM4680.

1. Download and install the LTpowerPlay GUI:

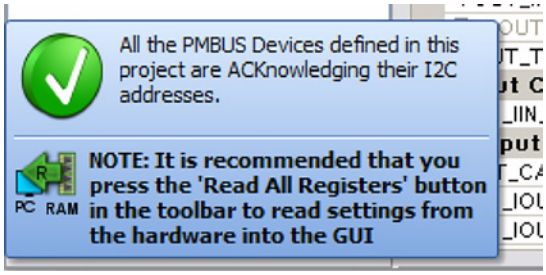
   LTpowerPlay

2. Launch the LTpowerPlay GUI.

a. The GUI should automatically identify the DC2844A. The system tree on the left hand side should look like this:

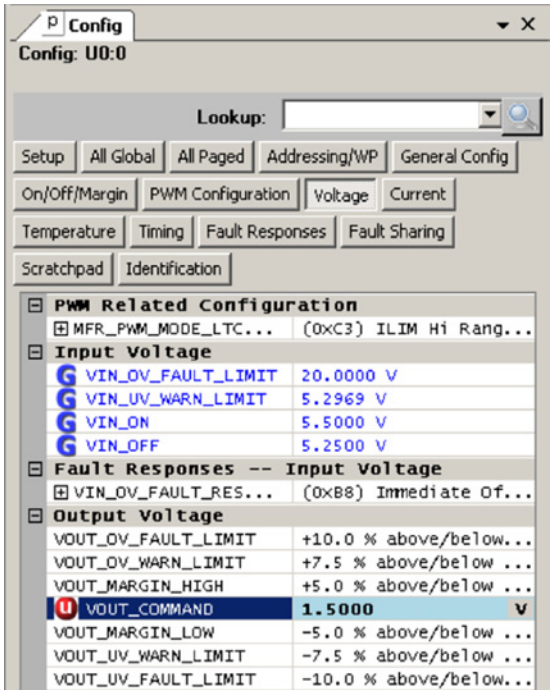


b. A green message box shows for a few seconds in the lower left hand corner, confirming that LTM4680 is communicating:



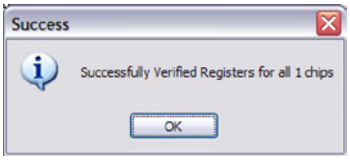
c. In the Toolbar, click the "R" (RAM to PC) icon to read the RAM from the LTM4680. This reads the configuration from the RAM of LTM4680 and loads it into the GUI.

d. If you want to change the output voltage to a different value, like 1.5V. In the Configuration 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 LTM4680. 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

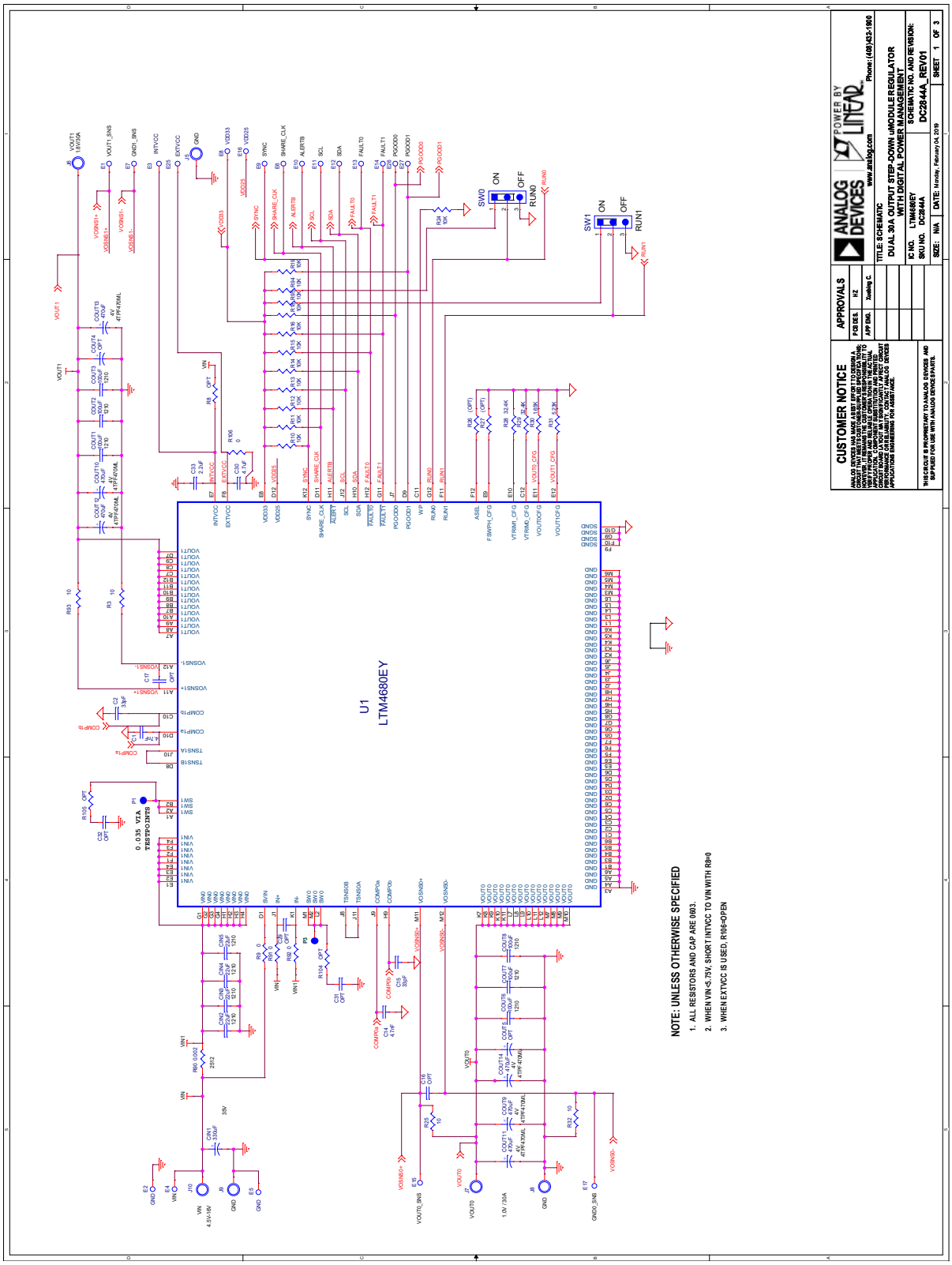
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C14	CAP., 4700pF, X7R, 25V, 5%, 0603	AVX, 06033C472JAT2A
2	2	C2, C15	CAP., 33pF, NP0, 25V, 5%,0603	AVX, 06035A330JAT2A
3	3	C21, C22, C24	CAP., 1µF, X5R, 25V, 10%, 0603	AVX, 06033D105KAT2A
4	1	C23	CAP., 1µF, X7R, 25V, 10%, 0805	AVX, 08053C105KAT2A
5	1	C26	CAP., 0.1µF, X5R, 16V, 10%, 0603	AVX, 0603YD104KAT2A
6	2	C27, C28	CAP., 0.01µF, X7R, 25V, 5%, 0603	AVX, 06033C103JAT2A
7	1	C30	CAP., 4.7µF, X5R, 6.3V, 10%, 0603	AVX, 06036D475KAT2A
8	1	C33	CAP., 2.2µF, X5R, 6.3V, 10%, 0603	AVX, 06036D225KAT2A
9	1	CIN1	CAP., 330µF, ALUM, POLY, 35V, 20%, RADIAL, SMD, AEC-Q200	PANASONIC, EEH-ZK1V331P
10	4	CIN2, CIN3, CIN4, CIN5	CAP., 22µF, X5R, 35V, 20%, 1210	TAIYO YUDEN, GMK325BJ226MM-P
11	8	COUT1, COUT2, COUT3, COUT6, COUT7, COUT8, C34, C35	CAP., 100µF, X5R, 6.3V, 20%, 1210	AVX, 12106D107MAT2A
12	6	COUT9, COUT10, COUT11, COUT12, COUT13, COUT14	CAP., 470µF, TANT. POSCAP, 4V, 20%, 7343, 10mΩ, TPF, NO SUBS. ALLOWED	PANASONIC, 4TPF470ML
13	1	Q1	XSTR., MOSFET, N-CH, 40V, TO-252 (DPAK)	VISHAY, SUD50N04-8M8P-4GE3
14	1	Q19	XSTR., MOSFET, P-CH, 20V, 5.9A, TO-236 (SOT23-3)	VISHAY, SI2365EDS-T1-GE3
15	14	R10, R11, R12, R13, R14, R15, R16, R18, R19, R24, R52, R77, R94, R95	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F
16	2	R28, R29	RES., 32.4k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF3242V
17	6	R3, R25, R32, R69, R70, R93	RES., 10Ω, 1%,1/10W, 0603	NIC, NRC06F10R0TRF
18	1	R30	RES., 1.65k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1651TRF
19	1	R31	RES., 5.23k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ-3EKF5231V
20	1	R48	RES., 0Ω, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL201000000ZEA9
21	2	R50, R51	RES., 30Ω, 1%, 1W, 2010, AEC-Q200	VISHAY, CRCW201030R0FKEFHP
22	1	R53	RES., 0.01Ω, 1%, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL2010R0100FEA
23	2	R72, R73	RES., 4.99k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4991TRF
24	1	R78	RES., 15.8k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1582TRF
25	7	R9, R63, R65, R66, R91, R92, R106	RES., 0Ω, 1/10W, 0603, AEC-Q200	NIC, NRC06Z0TRF
26	1	R90 (NOTE 1)	RES., 0.002Ω, 1%, 2W, 2512, AEC-Q200, CURRENT SENSE	BOURNS, CRF2512-FZ-R002ELF
27	1	U1	IC, HIGH EFFICIENCY, POLY-PHASE, BGA	ANALOG DEVICES INC., LTM4680EY#PBF
28	1	U2	IC, MEMORY, EEPROM, 2-Kb (256×8), TSSOP-8, 400kHz	MICROCHIP, 24LC025-I/ST

PARTS LIST

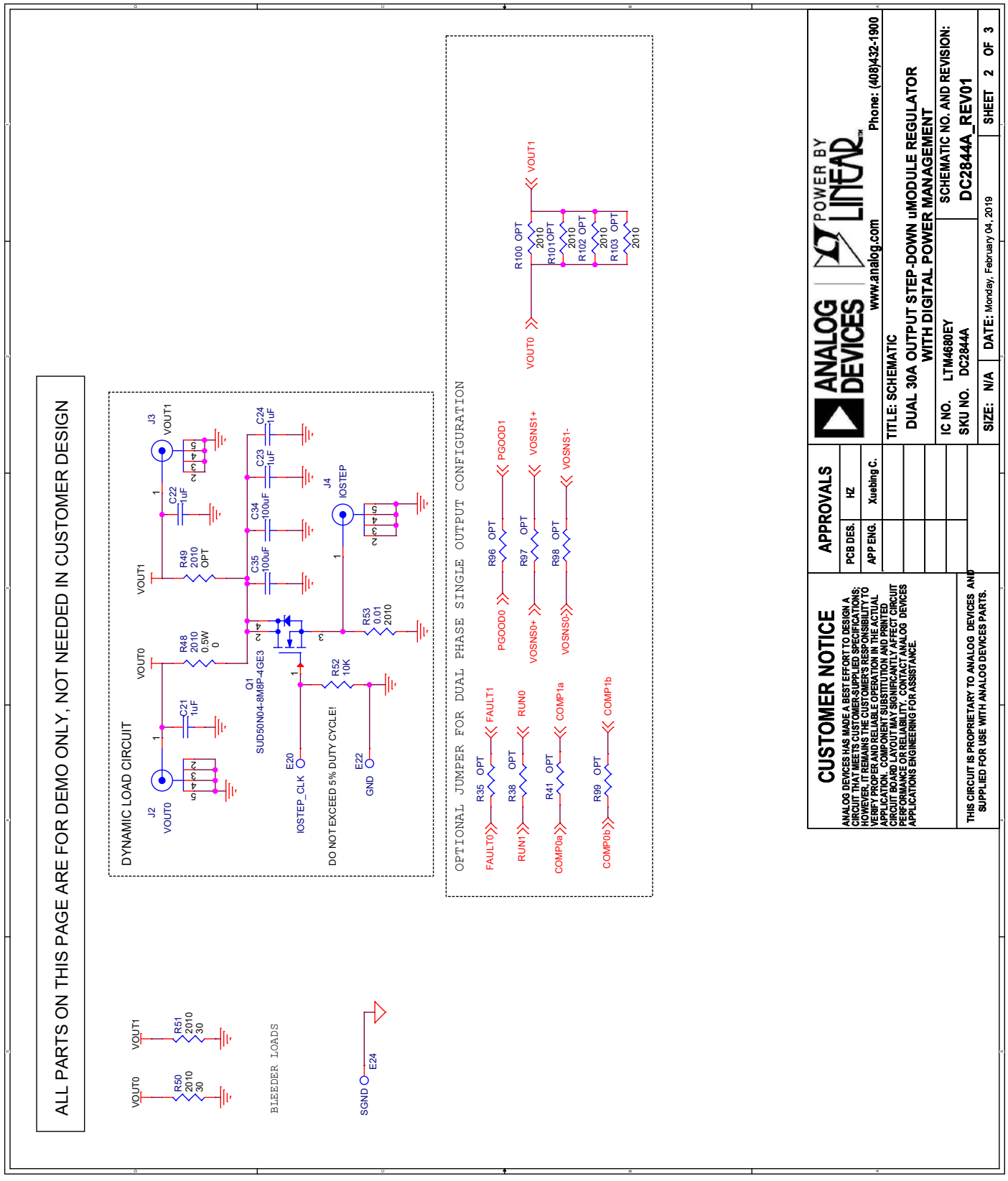
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C16, C17, C29, C31, C32	CAP., OPTION, 0603	OPT
2	0	COUT4, COUT5	CAP., OPTION, 1210	OPT
3	0	D1, D2	DIODE, OPTION, SOD-323	OPT
4	0	R8, R26, R27, R35, R38, R41, R49, R61, R62, R64, R67, R68, R74, R75, R82, R83, R88, R89, R96, R97, R98, R99, R100-R105	RES., OPTION, 0603	OPT
Hardware for Demo Board Only				
1	27	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21, E22, E24, E25, E26, E27	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2308-2-00-80-00-00-07-0
2	1	J1	CONN., SHROUDED HDR, MALE, 2mm × 6mm × 2mm,VERT, STR, THT	FCI, 98414-G06-12ULF
3	1	J11	CONN., HDR, MALE, 2mm × 7mm × 2mm, R/A THT	MOLEX, 0877601416
4	1	J12	CONN., HDR, FEMALE, 2mm × 7mm × 2mm, R/A THT	SULLINS CONNECTOR SOLUTIONS, NPPN072FJFN-RC
5	3	J2, J3, J4	CONN., RF, BNC, RCPT JACK, 5-PIN, STR, THT, 50Ω	AMPHENOL RF, 112404
6	6	J5, J6, J7, J8, J9, J10	STUD, TESTPIN	PEM, KFH-032-10ET
7	12	J5, J6, J7, J8, J9, J10 ×2	NUT, BRASS 10-32	ANY, 10-32M/S BR PL
8	6	J5, J6, J7, J8, J9, J10	RING, LUG #10	KEYSTONE, 8205
9	6	J5, J6, J7, J8, J9, J10	WASHER, TIN PLATED BRASS #10	ANY, #10EXT BZ TN
10	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE, 8833
11	2	SW0, SW1	CONN., HDR., MALE, 1mm × 3mm × 2mm, VERT, STR, THT	SULLINS CONNECTOR SOLUTIONS, NRPN031PAEN-RC
12	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G

Note 1: For low V_{IN} and high V_{OUT} application, like V_{IN} = 5V and V_{OUT} = 3.3V, if $I_{IN} \geq$ 25A, it is recommended to use Bourns Inc. CRF-1512-FZ-R001ELF (1mΩ, 1%, 2W, 2512) for R90.

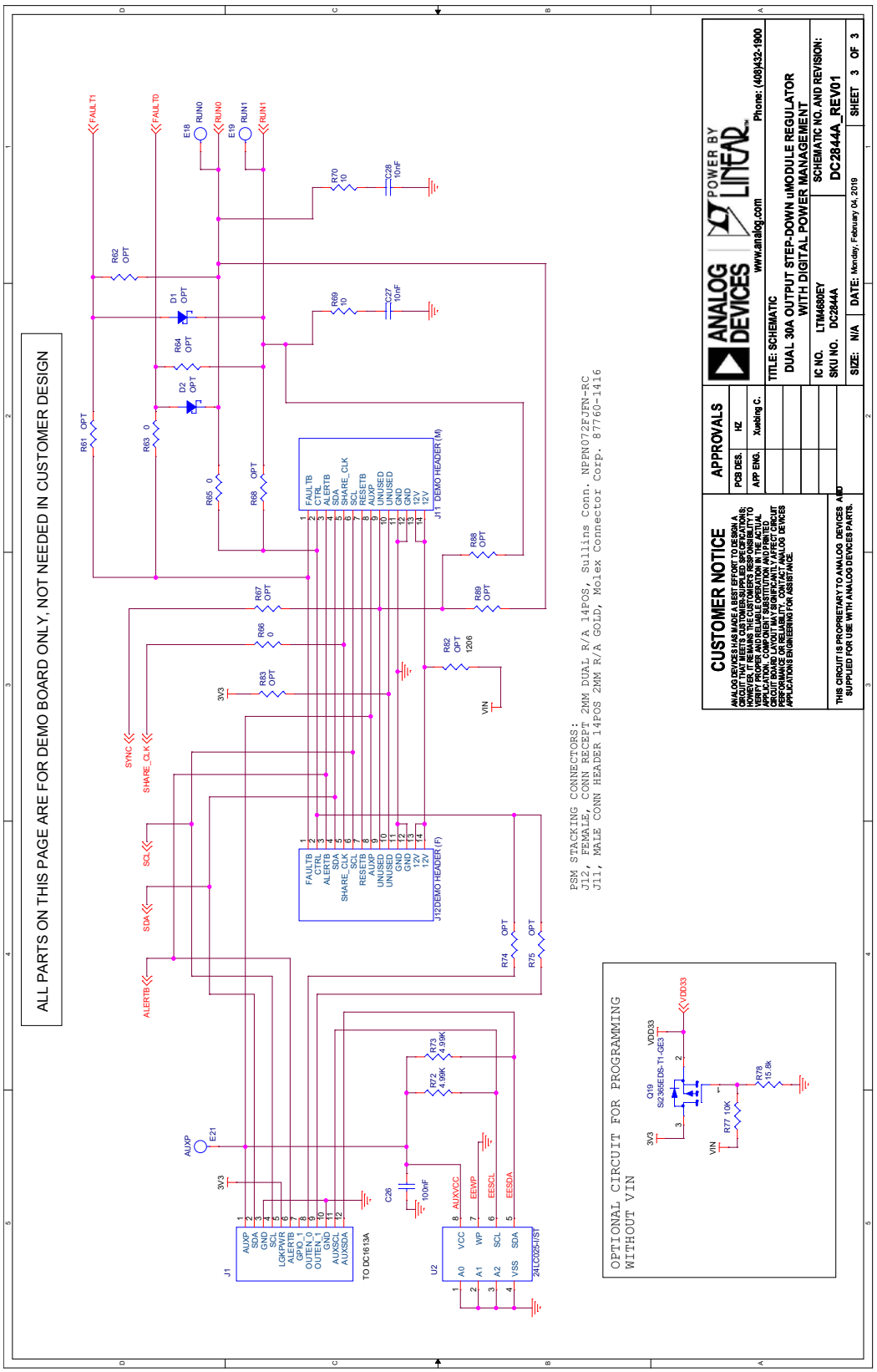
SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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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.

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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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