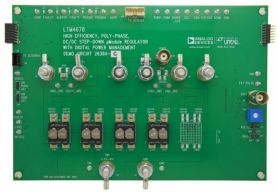
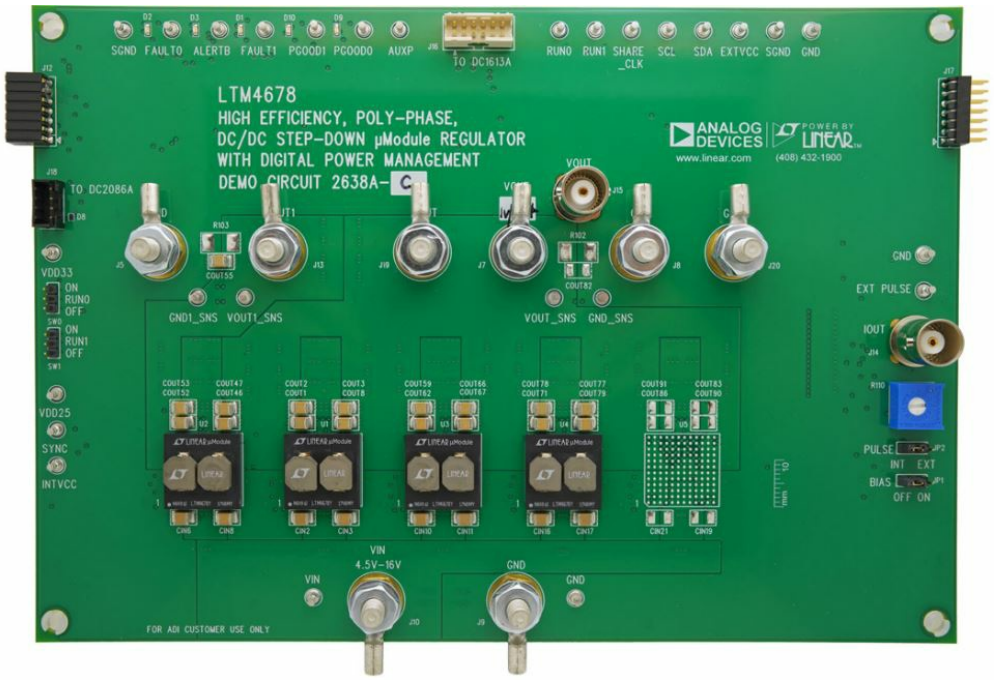


ANALOG DEVICES DC2638A-C Dual 25A or Single 50A µModule Regulator with Digital Power System Instruction Manual

Contents

ANALOG DEVICES DC2638A-C Dual 25A or Single 50A µModule Regulator with Digital Power System



Product Information

The DC2638A-C is a demo board for evaluating the performance of the LTM4678EY DC/DC converter. It can be easily set up to evaluate the extensive power system management features of the converter.

The demo board powers up to default settings and produces power based on configuration resistors without the need for any serial bus communication. It has an input voltage range of 4.5V to 16V and an output voltage range of 0.5V to 3.3V (default: 1.0V). The maximum output current is 200A, and the typical efficiency is 86%. The default switching frequency is 350kHz.

Product Usage Instructions

1. Connect the demo board to the proper measurement equipment setup as shown in **Figure 2**.
2. Connect the load (1.0V output load) between VOUT and GND with no initial load.
3. Connect the digital voltmeters (DVMs) to the input and output.
4. Set the default jumper position: SW0 ON and SW1 ON.
5. Adjust the load within the operating range and observe the output voltage regulation, ripple voltage, and other parameters.
6. Connect the dongle and control the output voltage from the GUI. Refer to the LTpowerPlay GUI for the LTM4678 Quick Start Guide for detailed instructions.

Figure 2: Proper Measurement Equipment Setup

Note: You can also connect a PC to the DC2638A-C demo board to reconfigure the power management features of the LTM4678 using the DC1613A dongle. This allows you to adjust parameters such as nominal VOUT, margin set points, OV/UV limits, temperature fault limits, sequencing parameters, fault log, fault responses, GPIOs, and other functionalities. The DC1613A dongle can be plugged in when VIN is present.

DESCRIPTION

Demonstration circuit 2638A-C is a high efficiency, high density, µModule regulator with 4.5V to 16V input range. The output voltage is adjustable from 0.5V to 3.3V, and it can supply 200A maximum load current. The demo

board has four LTM®4678 µModule® regulators, and the LTM4678 is a dual 25A or single 50A step-down regulator with PMBus power system management. Please see LTM4678 data sheet for more detailed information.

DC2638A-C powers up to default settings and produce power based on configuration resistors without the need for any serial bus communication. This allows easy evalu- ation 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.

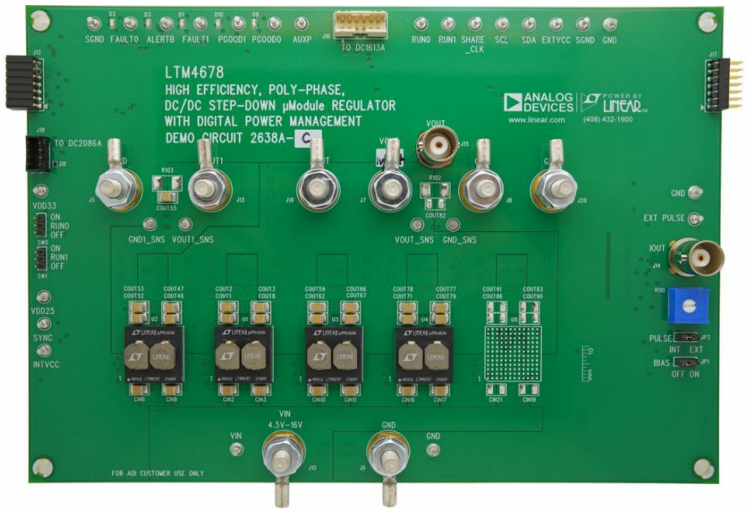
GUI Download
The software can be downloaded from: LTpowerPlay For more details and instructions of LTpowerPlay, please refer to LTpowerPlay GUI for LTM4678 Quick Start Guide.

Design files for this circuit board are available

PERFORMANCE SUMMARY

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		4.5V to 16V
Output Voltage, VOUT	VIN = 4.5V–16V, IOUT = 0A to 200 A	0.5V to 3.3V, Default: 1.0V
Maximum Output Current, IOUT	VIN = 4.5V–16V, VOUT = 0.5V to 3. 3V	200A
Typical Efficiency	VIN = 12V, VOUT = 1.0V, IOUT = 2 00A	86% (See Figure 5)
Default Switching Frequency		350kHz

BOARD PHOTO



QUICK START PROCEDURE

Table 1: LTM4678 Demo Boards for up to 250A Point-of-Load Regulation

MAXIMUM OUTPUT CURRENT	NUMBER OF OUTPUTS	NUMBER OF LTM4678 µ Module REGULATORS ON THE BOARD	DEMO BOARD NUMBER
25A	2	1	DC2552A
50A	1	1	DC2570A
100A	1	2	DC2638A-A
150A	1	3	DC2638A-B
200A	1	4	DC2638A-C
250A	1	5	DC2638A-D

Demonstration circuit 2638A-C is easy to set up to evalu- ate the performance of the LTM4678EY. 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 VIN(4.5V–16V) and GND (input return).
2. Connect the 1.0V output load between VOUT and GND (Initial load: no load).
3. Connect the DVMs to the input and output. Set default jumper position: SW0: ON; SW1:
4. Turn on the input power supply and check for the proper output VOUT should be 1.0V±0.5%.
5. Once the proper output voltages are established, ad- just the load within the operating range and observe the output voltage regulation, ripple voltage and other
6. Connect the dongle and control the output voltage from the See “LTpowerPlay GUI for the LTM4678 Quick Start Guide” for details.

Note: When measuring the output or input voltage rip- ple, 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 DC2638A-C
You can use a PC to reconfigure the power management features of the LTM4678 such as: nominal VOUT, mar- gin 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 VIN is present

QUICK START PROCEDURE

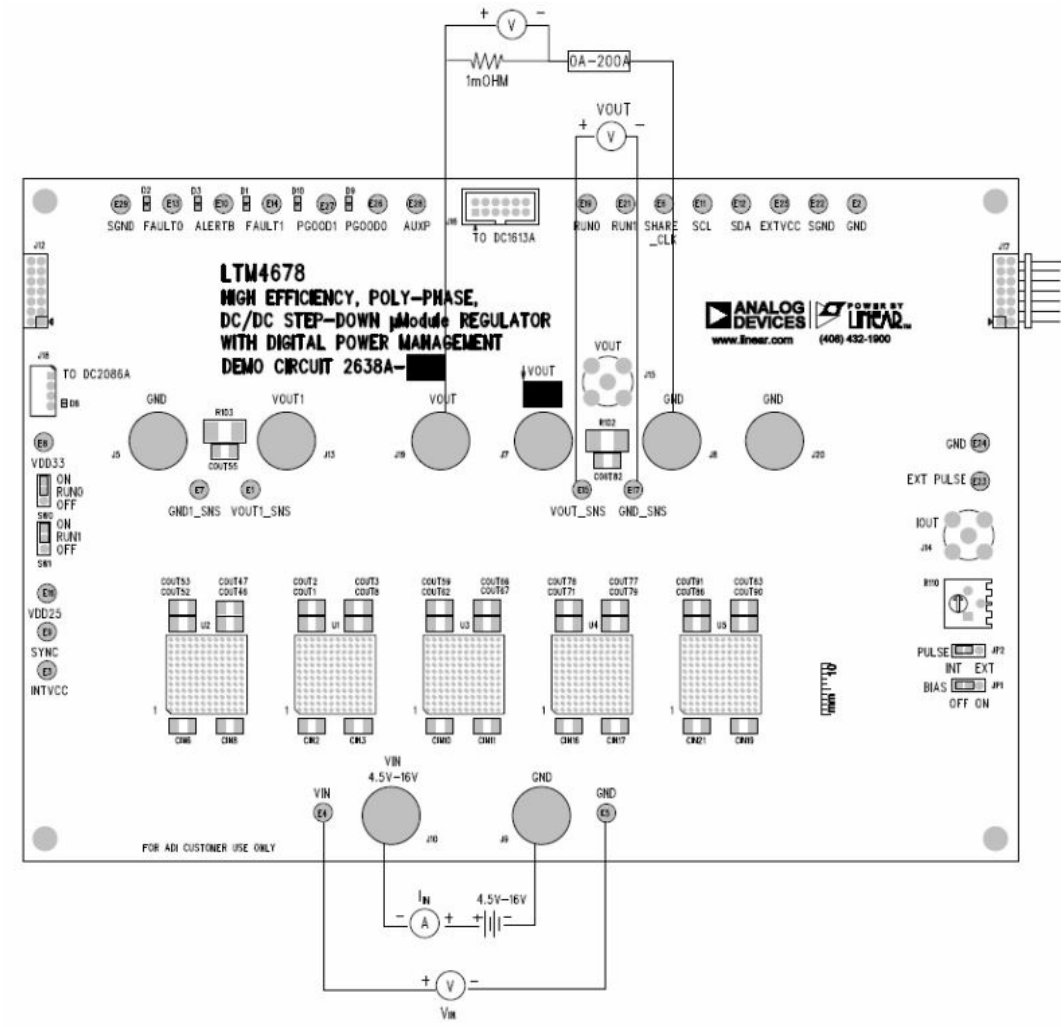


Figure 2. Proper Measurement Equipment Setup

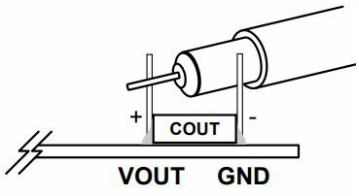


Figure 3. Measuring Output Voltage Ripple

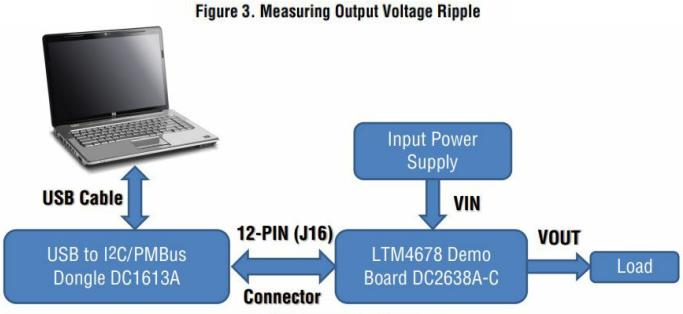


Figure 4. Demo Setup with PC

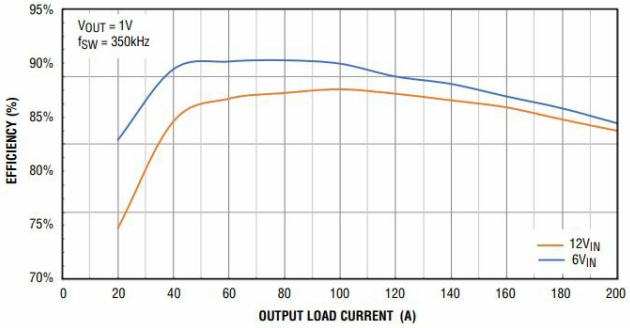


Figure 5. Efficiency vs Load Current

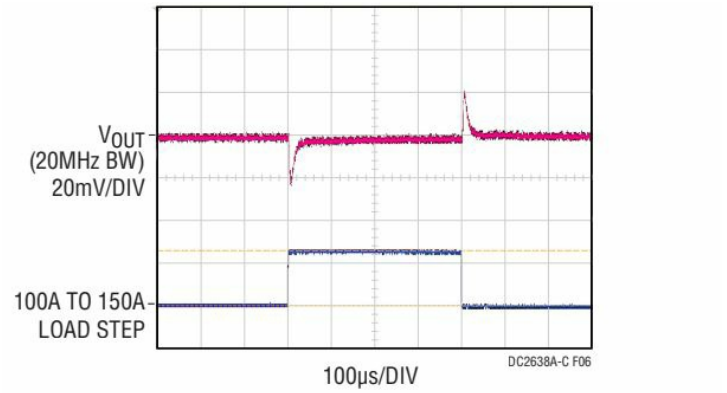


Figure 6. Output Voltage V_{OUT} vs Load Current @ V_{IN} = 12V, V_{OUT} = 1V, f_{SW} = 350kHz

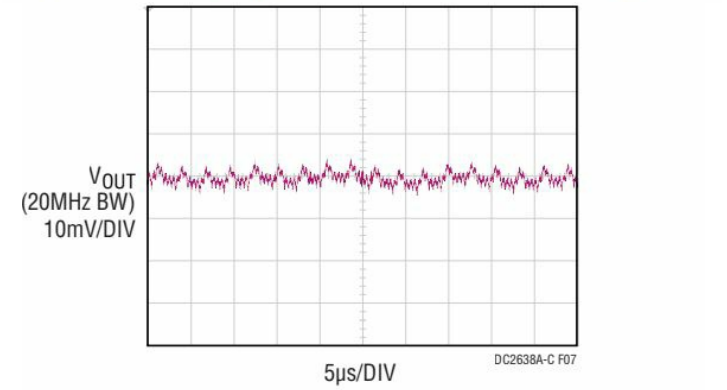


Figure 7. Output Voltage Ripple @ V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 200A, f_{SW} = 350kHz

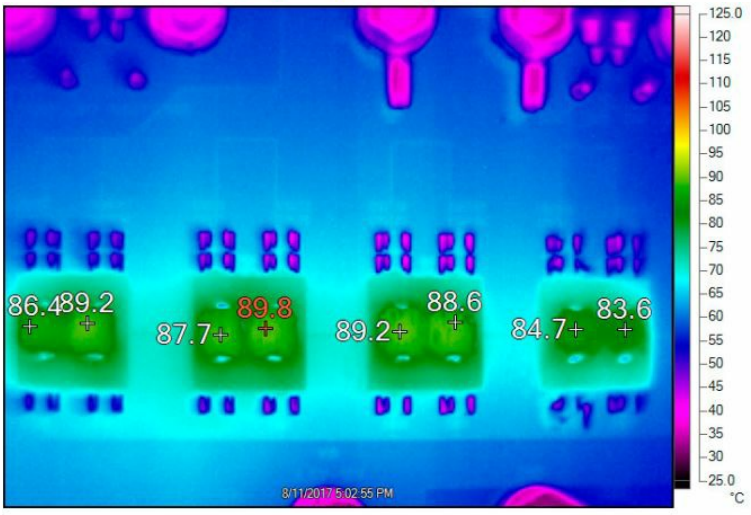


Figure 8. Thermal @ V_{IN} = 12V, V_{OUT} = 1.0V, I_{OUT} = 130A, T_A = 25°C, No Airflow

Figure 9. Thermal @ V_{IN} = 12V, V_{OUT} = 1.0V, I_{OUT} = 180A, T_A = 25°C, 400LFM Airflow

LTPOWERPLAY SOFTWARE GUI

LTpowerPlay is a powerful Windows-based develop- ment environment that supports Analog Devices power system management ICs and µModules, including the LTM4675, LTM4676, LTM4677, LTM4678, LTC3880,

LTC3882 and LTC3883. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Analog Devices ICs by connecting to a demo board sys- tem. 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 bringup 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 LTM4675, LTM4676, LTM4677, LTM4678, LTC3880, LTC3882, LTC3883's demo system, or a customer board. The soft- ware 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 ADI Digital Power Products visit the LTpowerPlay Help menu. Online help also available through the LTpowerPlay.

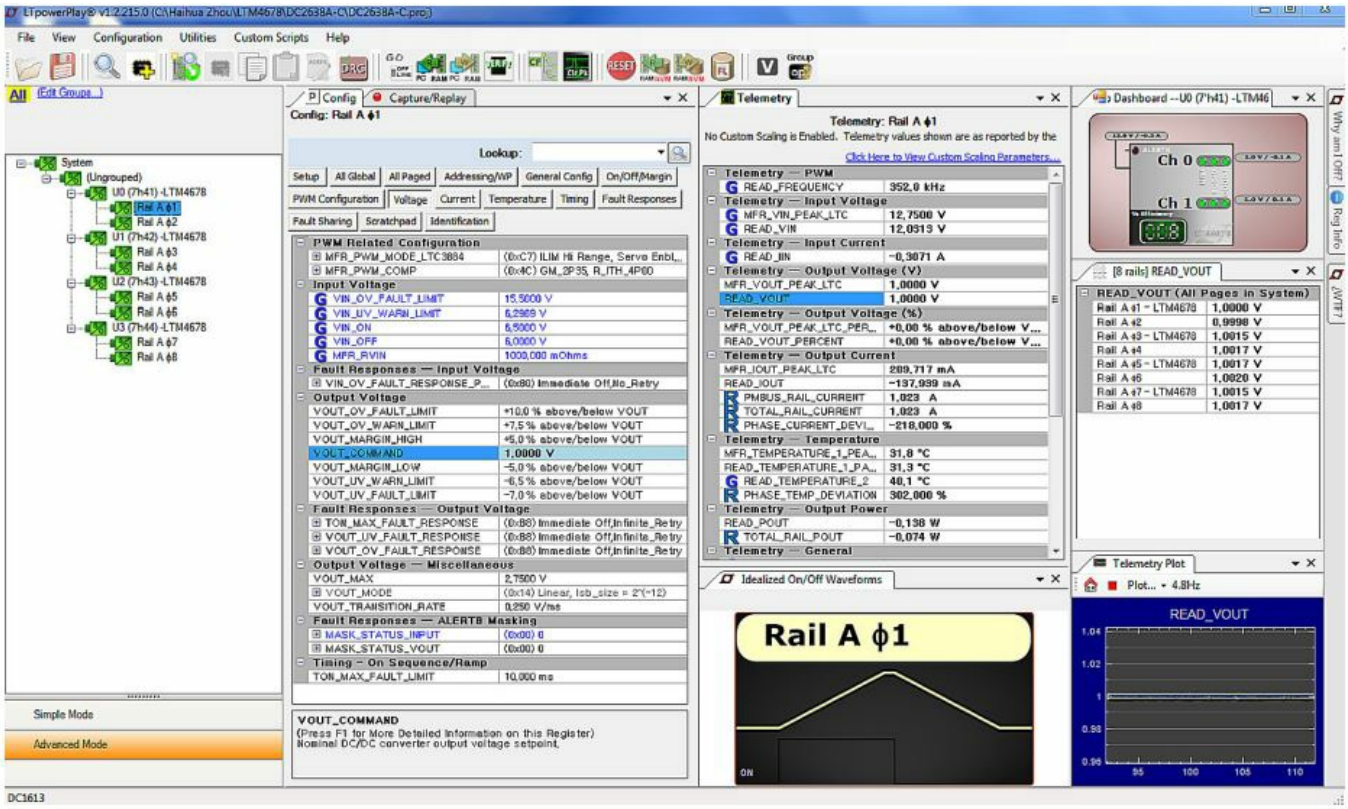
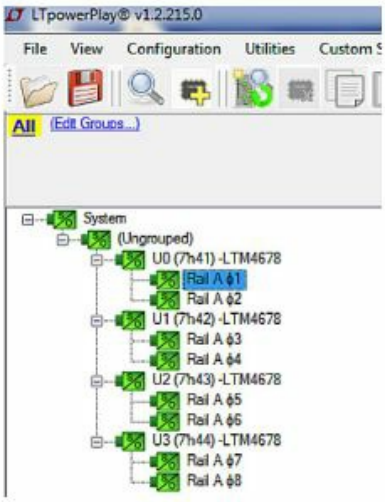


Figure 10. LTpowerPlay Main Interface

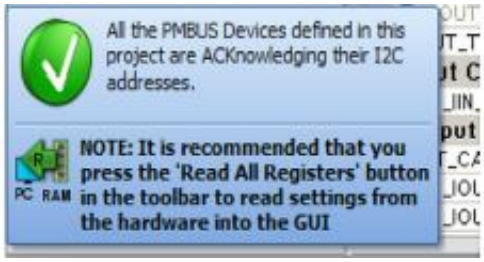
LTPOWERPLAY QUICK START PROCEDURE

The following procedure describes how to use LTpow- erPlay to monitor and change the settings of LTM4678.

1. Download and install the LTpowerPlay GUI: LTpowerPlay
2. Launch the LTpowerPlay GUI
3. The GUI should automatically identify the DC2638A-C. The system tree on the left hand side should look like this:

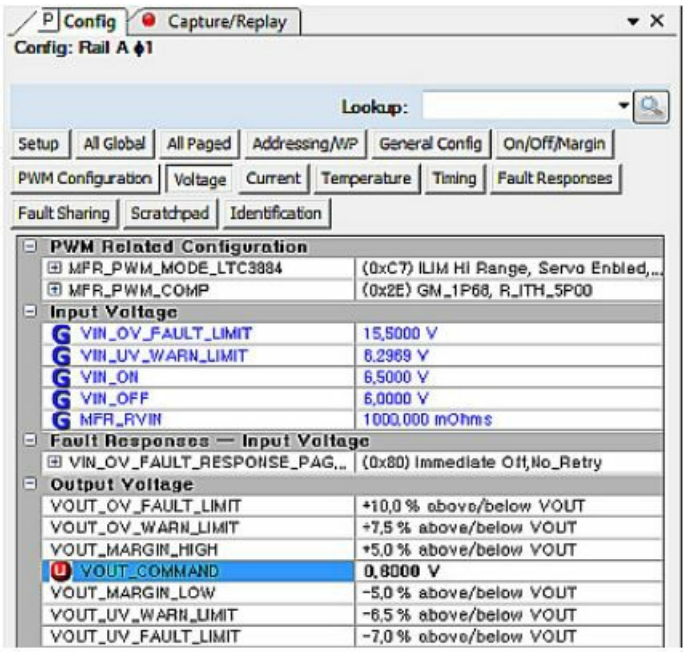


- A green message box shows for a few seconds in the lower left hand corner, confirming that LTM4678 is com- municating:



- In the Toolbar, click the “R” (RAM to PC) icon to read the RAM from the LTM4678. This reads the configuration from the RAM of LTM4678 and loads it into the gull.

output voltage to a differ- ent value, like 8V. In the Config tab, type in 0.8 in the VOUT_COMMAND box, like this:



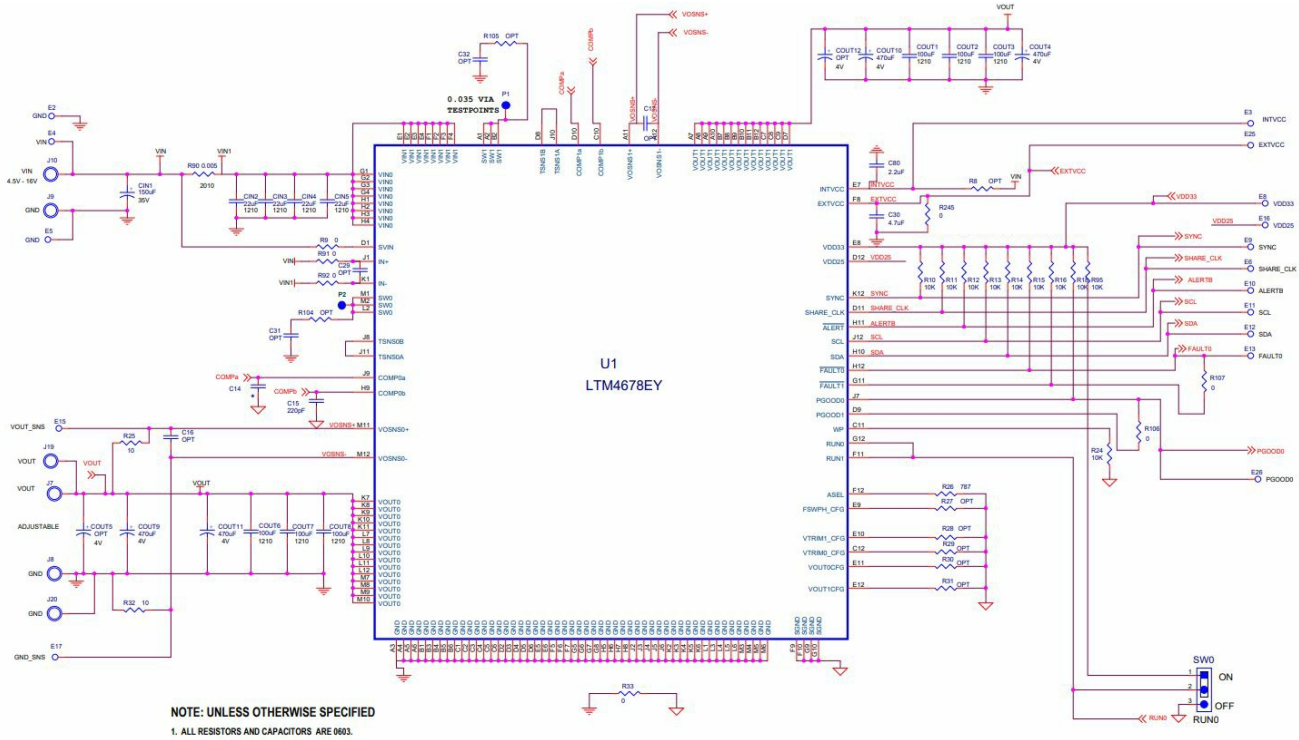
Then, click the “W” (PC to RAM) icon to write these reg- ister values to the LTM4678. After finishing this step, you will see the output voltage will change to 0.8V.

Then, click the “W” (PC to RAM) icon to write these reg- ister values to the LTM4678. After finishing this step, you will see the output voltage will change to 0.8V.

You can save the changes into the In the tool bar, click “RAM to NVM” button, as following

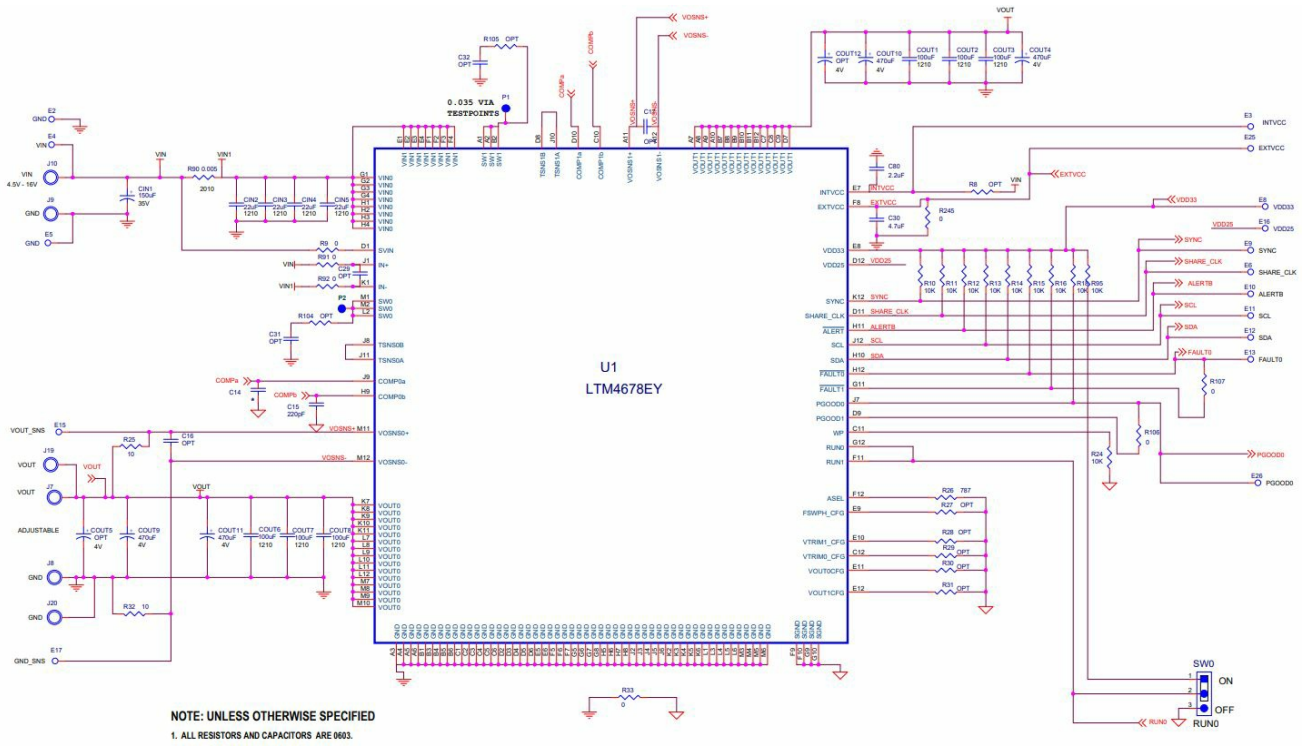
Save the demo board configuration to a (*.proj) file. Click the Save icon and save the Name it whatever you want.

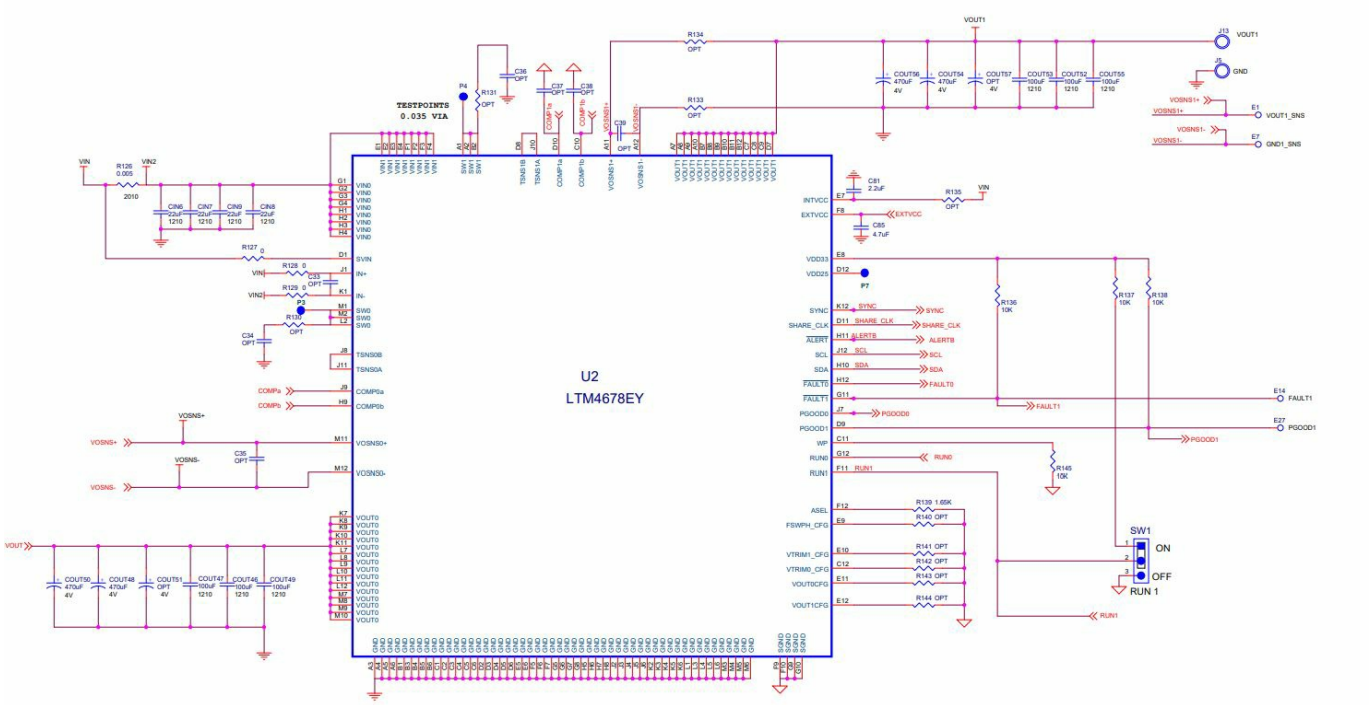
SCHEMATIC DIAGRAM



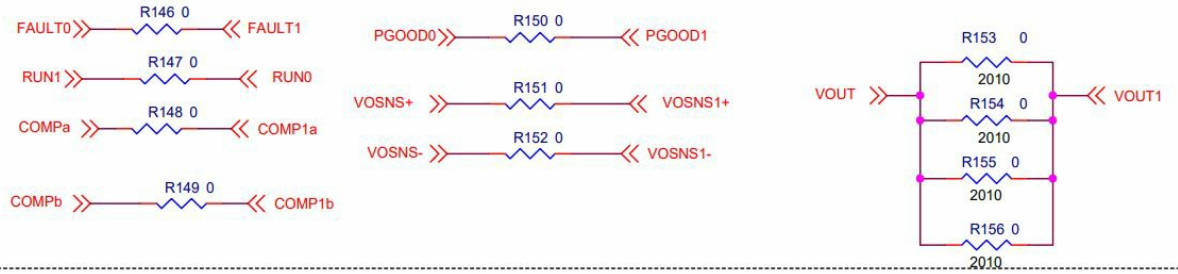
ASSY	Module	Iout	C14	CIN10, 11, 12,13	CIN14, 15,16,17	CIN18, 19, 20,21	COUT60, 61,64,63	COUT72, 73,75,80	COUT84, 87,88,93	COUT58,59, 62,65,66,67	COUT70,71, 74,77,78,79	COUT82,83, 86,89,90,91
-A	U1,U2	100A	10nF	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
-B	U1,U2,U3	150A	12nF	22uF	OPT	OPT	470uF	OPT	OPT	100uF	OPT	OPT
-C	U1,U2,U3, U4	up to 200A	18nF	22uF	22uF	OPT	470uF	470uF	OPT	100uF	100uF	OPT
-D	U1,U2,U3, U4,U5	up to 250A	27nF	22uF	22uF	22uF	470uF	470uF	470uF	100uF	100uF	100uF

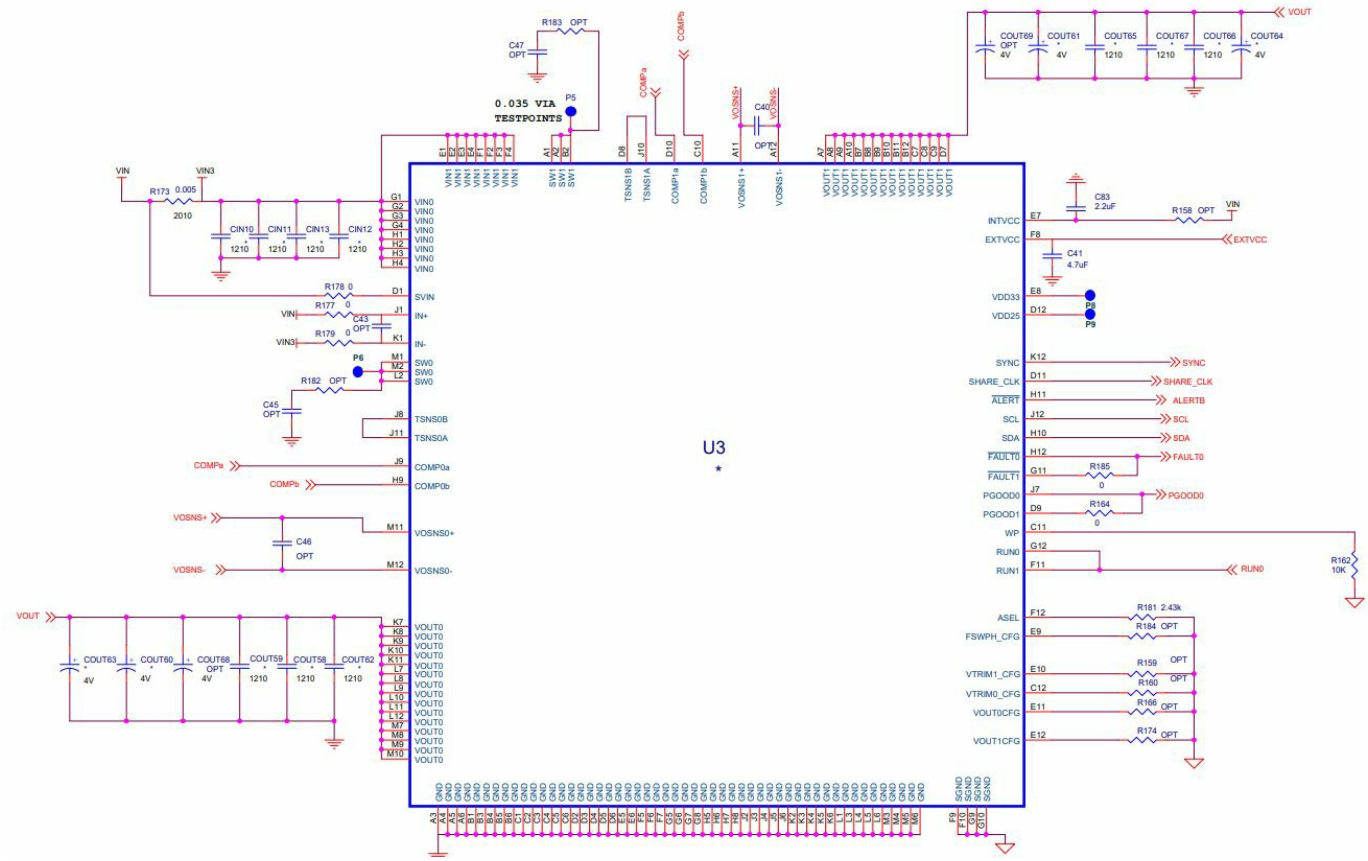
- WHEN VIN <5.75V, SHORT INTVCC to VIN WITH R8=R135=R158=R188=R231=0
- WHEN EXTVCC IS USED, R245=OPEN

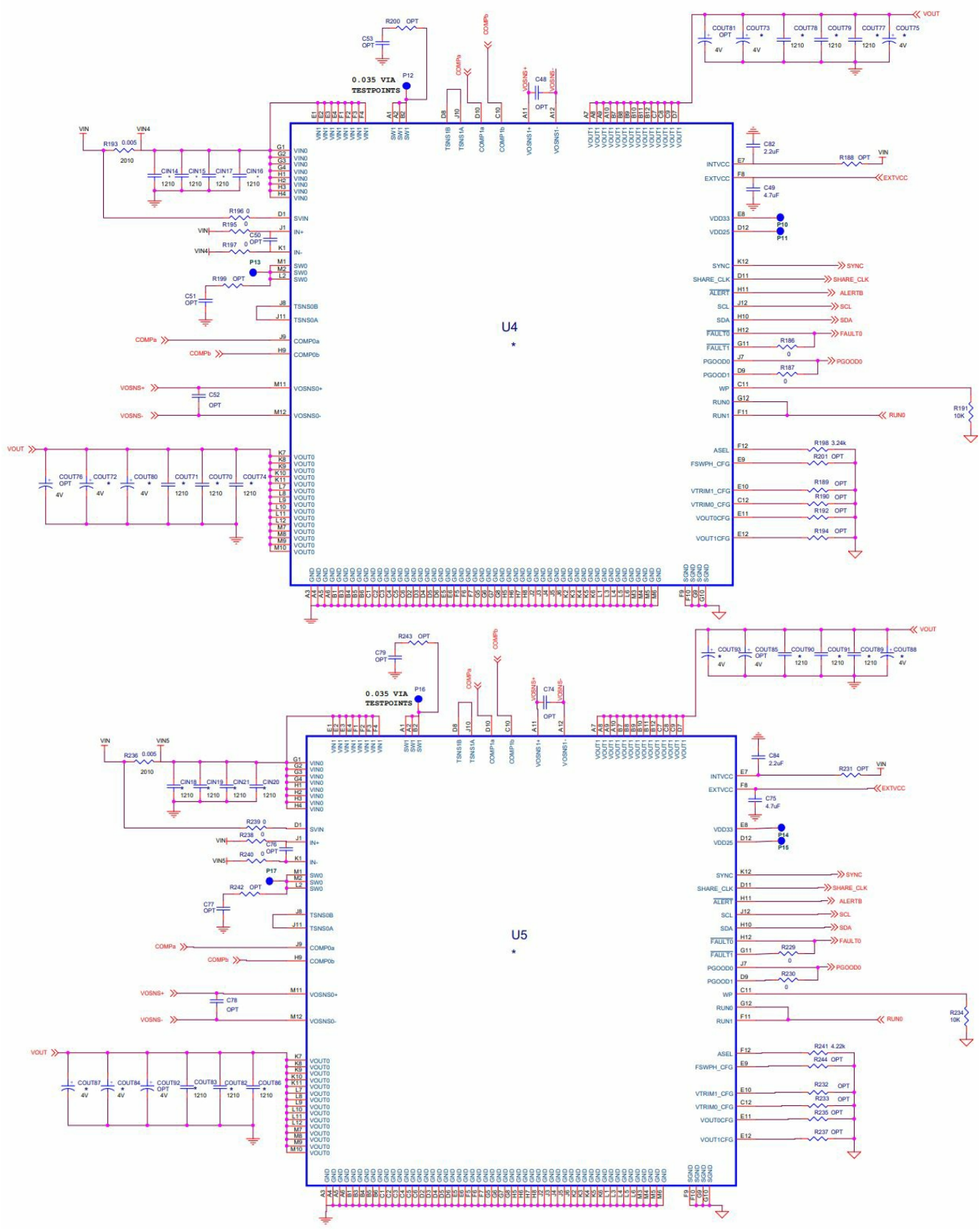




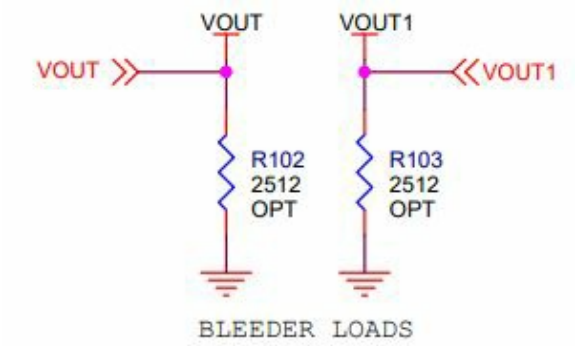
OPTIONAL JUMPER FOR SINGLE OUTPUT CONFIGURATION



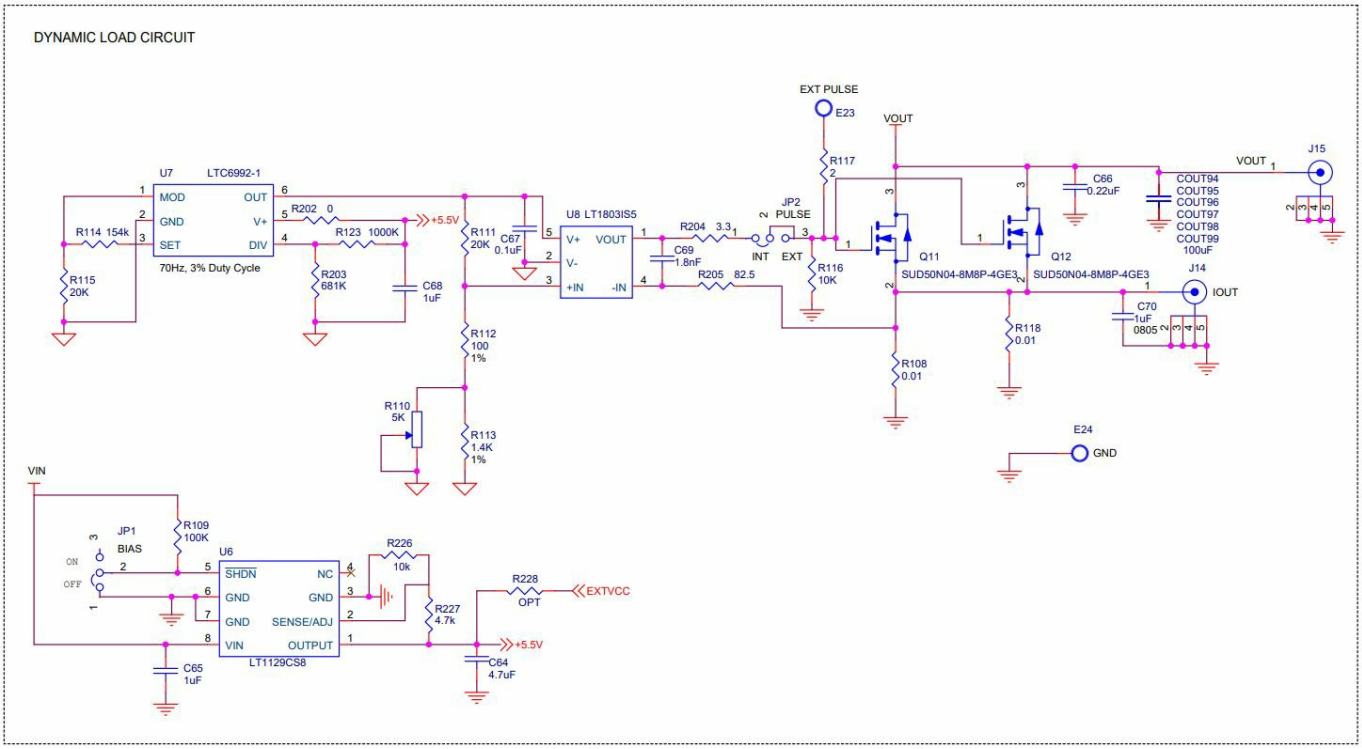




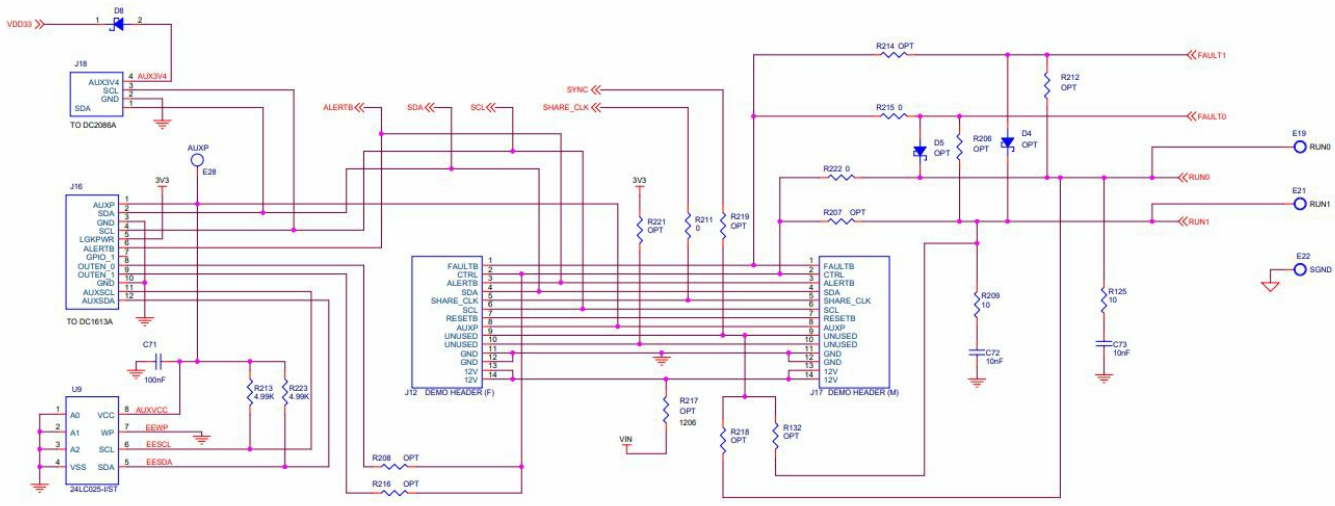
ALL PARTS ON THIS PAGE ARE FOR DEMO ONLY, NOT NEEDED IN CUSTOMER DESIGN



BLEEDER LOADS



ALL PARTS ON THIS PAGE ARE FOR DEMO ONLY, NOT NEEDED IN CUSTOMER DESIGN

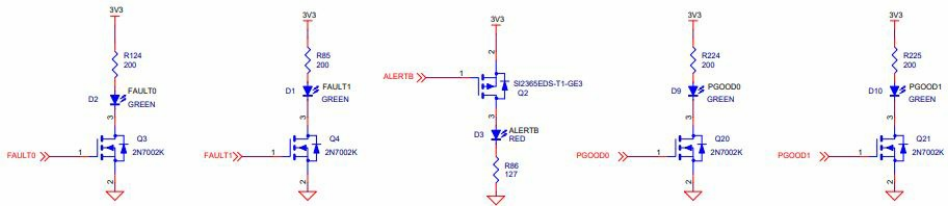


OPTIONAL CIRCUIT FOR PROGRAMMING WITHOUT VIN

PSM STACKING CONNECTORS:

J1, MALE, CONN HEADER 14POS 2MM R/A GOLD, Molex Connector Corp. 87760-1416

J2, FEMALE, CONN RECEPT 2MM DUAL R/A 14POS, Sullins Conn. NPPN072FJFN-RC



PARTS LIST

1	1	CIN1	CAP., 150µF, ALUM. ELECT., 35V, 20%, 8mm × 10.2mm SMD, RADIAL, AEC-Q200	PANASONIC, EEHZA1V151P
2	30	COUT1, COUT2, COUT3, COUT6, COUT7, COUT8, COUT46, COUT47, COUT49, COUT52, COUT53, COUT55, COUT58, COUT59, COUT62, COUT65, COUT66, COUT67, COUT70, COUT71, COUT74, COUT77, COUT78, COUT79, COUT94, COUT95, COUT96, COUT97, COUT98, COUT99	CAP., 100µF, X5R, 6.3V, 20%, 1210	AVX, 12106D107MAT2A MURATA, GRM32ER60J107ME20L TDK, C3225X5R0J107M250AC
3	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 TAIYO YUDEN, TMK325BJ226KM-P TAIYO YUDEN, TMK325BJ226KM-T
4	16	COUT4, COUT9, COUT10, COUT11, COUT48, COUT50, COUT54, COUT56, COUT60, COUT61, COUT63, COUT64, COUT72, COUT73, COUT75, COUT80	CAP., 470µF, TANT. POSCAP, 4V, 20%, 7343, 10mΩ, TPF, NO SUBS. ALLOWED	PANASONIC, 4TPF470ML
5	0	COUT5, COUT12, COUT51, COUT57, COUT68, COUT69, COUT76, COUT81, COUT84, COUT85, COUT87, COUT88, COUT92, COUT93	CAP., OPTION, D3L	
6	1	C14	CAP., 0.018µF, X7R, 16V, 10%, 0603	AVX, 0603YC183KAT2A KEMET, C0603C183K4RACTU NIC, NMC0603X7R183K16TRPF

7	1	C15	CAP., 220pF, X7R, 16V, 10%, 0603	AVX, 0603YC221KAT2A KEMET, C0603C221K4RACTU NIC, NMC0603X7R221K16TRPF
10	6	C30, C41, C49, C64, C75, C85	CAP., 4.7µF, X5R, 25V, 10%, 0603, NO SUBS. ALLOWED	MURATA, GRM188R61E475KE11D
11	2	C65, C68	CAP., 1µF, X7R, 25V, 10%, 1206	AVX, 12063C105KAT2A MURATA, GRM31MR71E105KA01L TAIYO YUDEN, TMK316B7105KL-T TDK, C3216X7R1E105K160AA
12	1	C66	CAP., 0.22µF, X5R, 25V, 10%, 0805	AVX, 08053D224KAT2A TAIYO YUDEN, TMK212BJ224KGHT VENKEL LTD., C0805X5R250-224KNE
13	1	C67	CAP., 0.1µF, X7R, 25V, 10%, 1206	AVX, 12063C104KAT2A NIC, NMC1206X7R104K25TRPF
14	1	C69	CAP., 1800pF, X7R, 16V, 10%, 0603	AVX, 0603YC182KAT2A KEMET, C0603C182K4RACTU NIC, NMC0603X7R182K16TRPF
15	1	C70	CAP., 1µF, X5R, 25V, 10%, 0805	AVX, 08053D105KAT2A MURATA, GRM216R61E105KA12D TDK, CGB4B3X5R1E105K055AB
16	1	C71	CAP., 0.1µF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A KEMET, C0603C104K3RACTU NIC, NMC0603X7R104K25TRPF TDK, C1608X7R1E104K080AA
17	2	C72, C73	CAP., 0.01µF, X7R, 25V, 10%, 0603	AVX, 06033C103KAT2A MURATA, GRM188R71E103KA01D YAGEO, CC0603KRX7R8BB103
18	5	C80, C81, C82, C83, C84	CAP., 2.2µF, X7R, 25V, 10%, 0603	MURATA, GRM188Z71E225KE43D

19	4	D1, D2, D9, D10	LED, GREEN, WATERCLEAR, 0603	WURTH ELEKTRONIK, 150 060GS75000

20	1	D3	LED, SUPER RED, WATERCLEAR, 0603	WURTH ELEKTRONIK, 150 060SS75000
22	1	D8	DIODE, SCHOTTKY RECT., 20V, 0. 5A, SOD-882D, LEADLESS, 2-TER M.	NEXPERIA, PMEG2005AEL D, 315
36	1	Q2	XSTR., MOSFET, P-CH, 20V, 5.9A, TO-236 (SOT23-3)	VISHAY, SI2365EDS-T1-GE 3
37	4	Q3, Q4, Q20, Q21	XSTR., MOSFET, SINGLE N-CH, 6 0V, 380mA, SOT23-3, AEC-Q101	ON SEMICONDUCTOR, 2N 7002KT1G
38	2	Q11, Q12	XSTR., MOSFET, N-CH, 40V, TO-252 (DPAK)	VISHAY, SUD50N04-8M8P-4GE3
39	1	Q19	XSTR., MOSFET, P-CH, 30V, 3.5A, SOT23-3, AEC-Q101	DIODES INC., DMP3130L-7
41	36	R9, R33, R91, R92, R106, R 107, R127, R128, R129, R1 46, R147, R148, R149, R150, R151, R152, R164, R 177, R178, R179, R185, R1 86, R187, R195, R196, R197, R202, R211, R215, R 222, R229, R230, R238, R2 39, R240, R245	RES., 0Ω, 1/10W, 0603, AEC-Q200	NIC, NRC06ZOTRF VISHAY, CRCW06030000Z0 EA
42	20	R10,R11,R12,R13,R14,R15, R16,R18,R2 4,R95,R116,R1 36,R137,R138,R145,R16 2,R191,R210,R226,R234	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F PANAS ONIC, ERJ3EKF1002V VIS HAY, CRCW060310K0FKEA
43	4	R25, R32, R125, R209	RES., 10Ω, 1%, 1/10W, 0603	NIC, NRC06F10R0TRF PA NASONIC, ERJ3EKF10R0V ROHM, MCR03EZPFX10R0 VISHAY, CRCW060310R0FKEA YAG EO, RC0603FR-0710RL
44	1	R26	RES., 787Ω, 1%, 1/10W, 0603, AEC -Q200	NIC, NRC06F7870TRF PAN ASONIC, ERJ3EKF7870V V ISHAY, CRCW0603787RFKEA
45	4	R85, R124, R224, R225	RES., 200Ω, 1%, 1/10W, 0603	NIC, NRC06F2000TRF VISHAY, CRCW0603200RFKEA YAG EO, RC0603FR-07200RL

46	1	R86	RES., 127Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1270TRF PANASONIC, ERJ3EKF1270V VISHAY, CRCW0603127RFKEA
47	5	R90, R126, R173, R193, R236	RES., 0.005Ω, 1%, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL20105L000FEA
49	2	R108, R118	RES., 0.01Ω, 1%, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL2010R0100FEA
50	1	R109	RES., 100k OHMS, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, CRCW0603100KFKEA
51	1	R110	RES., 5k, 10%, 1/2W, THT 3/8 SQ, 1-TURN, TOP ADJ., TRIMPOT	
52	2	R111, R115	RES., 20k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF2002V VISHAY, CRCW060320K0FKEA YAGEO, RC0603FR-0720KL
53	1	R112	RES., 100Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1000TRF PANASONIC, ERJ3EKF1000V VISHAY, CRCW0603100RFKEA
54	1	R113	RES., 1.4k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1401TRF PANASONIC, ERJ3EKF1401V VISHAY, CRCW06031K40FKEA
55	1	R114	RES., 154k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1543TRF PANASONIC, ERJ3EKF1543V VISHAY, CRCW0603154KFKEA

56	1	R117	RES., 2Ω, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06032R00FKEA
57	1	R123	RES., 1MΩ, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1004TRF PANASONIC, ERJ3EKF1004V VISHAY, CRCW06031M00FKEA
58	1	R139	RES., 1.65k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1651TRF PANASONIC, ERJ3EKF1651V VISHAY, CRCW06031K65FKEA
59	4	R153, R154, R155, R156	RES., 0Ω, 3/4W, 2010, AEC-Q200	NIC, NRC50ZOTRF PANASONIC, ERJ12ZY0R00U VISHAY, CRCW20100000Z0EF

60	1	R181	RES., 2.43k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F2431TRF PANASONIC, ERJ3EKF2431V VISHAY, CRCW06032K43FKEA
61	1	R198	RES., 3.24k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F3241TRF PANASONIC, ERJ3EKF3241V VISHAY, CRCW06033K24FKEA
62	1	R203	RES., 681k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F6813TRF PANASONIC, ERJ3EKF6813V VISHAY, CRCW0603681KFKEA
63	1	R204	RES., 3.3Ω, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06033R30FKEA
64	1	R205	RES., 82.5Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F82R5TRF PANASONIC, ERJ3EKF82R5V VISHAY, CRCW060382R5FKEA
65	2	R213, R223	RES., 4.99k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4991TRF PANASONIC, ERJ3EKF4991V VISHAY, CRCW06034K99FKEA
66	1	R220	RES., 15.8k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1582TRF PANASONIC, ERJ3EKF1582V VISHAY, CRCW060315K8FKEA
67	1	R227	RES., 4.7k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4701TRF PANASONIC, ERJ3EKF4701V VISHAY, CRCW06034K70FKEA
68	1	R241	RES., 4.22k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4221TRF PANASONIC, ERJ3EKF4221V VISHAY, CRCW06034K22FKEA
69				
70	4	U1, U2, U3, U4	IC, DUAL 25A POP PSM MODULE, BGA-144	ANALOG DEVICES, LTM4678EY#PBF
71	1	U6	IC, 700mA µPOWER LDO WITH SHUTDOWN, SO-8	ANALOG DEVICES, LT1129CS8#PBF ANALOG DEVICES, LT1129CS8#TRPBF
72	1	U7	IC, TIMERBLOX: VOLTAGE-CTRL. PWM, TSOT23-6	ANALOG DEVICES, LTC6992CS6-1#PBF ANALOG DEVICES, LTC6992CS6- 1#TRMPBF ANALOG DEVICES, LTC6992CS6-1#TRPBF

73	1	U8	IC, SINGLE R TO R IN/OUT OP AMP, TSOT23-5, 100V/µs, 85MHz	ANALOG DEVICES, LT1803IS5#PBF ANALOG DEVICES, LT1803IS5#TRMPBF ANALOG DEVICES, LT1803IS5#TRPBF
74	1	U9	IC, MEMORY, EEPROM, 2Kb (256×8), TSSOP-8, 400kHz	MICROCHIP, 24LC025-I/ST MICROCHIP, 24LC025T-I/ST

1	0	C16, C17, C29, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C43, C45, C46, C47, C48, C50, C51, C52, C53, C74, C76, C77, C78, C79	CAP., OPTION, 0603	
2	0	CIN18,CIN19,CIN20,CIN21COUT82,COUT83, COUT86,COUT89,COUT90, COUT91	CAP., OPTION, 1210	
3	0	D4, D5	DIODE, OPTION, SOD-323	
4	0	R8, R27, R28, R29, R30, R31, R104, R105, R130, R131, R132, R133, R134, R135, R140, R141, R142, R143, R144, R158, R159, R160, R166, R174, R182, R183, R184, R188, R189, R190, R192, R194, R199, R200, R201, R206, R207, R208, R212, R214, R216, R218, R219, R221, R228, R231, R232, R233, R235, R237, R242, R243, R244	RES., OPTION, 0603	
5	0	R217	RES., OPTION, 1206	
6	0	R102, R103	RES., OPTION, 2512	
7	0	U5	IC., OPTION, BGA-144	
8	0		PCA ASSY DWG, DC2638A	

Hardware: For Demo Board Only

1	27	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E20, E21, E22, E23, E24, E25, E26, E27, E28, E29	TEST POINT, TURRET, 0.064, MTG. HOLE	MILL-MAX, 2308-2-00-80-00-00-07-0
2	2	JP1, JP2	CONN., HDR, MALE, 1×3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000311121
3	8	J5, J7, J8, J9, J10, J13, J19, J20	RING, LUG, CRIMP, #10, NON-INSULATED, SOLDERLESS TERMINALS	KEYSTONE, 8205
4	16	J5, J7, J8, J9, J10, J13, J19, J20	NUT, HEX, STEEL, ZINC PLATE, 10-32	KEYSTONE, 4705
5	8	J5, J7, J8, J9, J10, J13, J19, J20	WASHER, FLAT, STEEL, ZINC PLATE, OD: 0.436 [11.1]	KEYSTONE, 4703
6	8	J5, J7, J8, J9, J10, J13, J19, J20	STUD, FASTENER, #10-32	PENNENGINEERING, KFH-032-10ET
7	1	J12	CONN., HDR, FEMALE, 2×7, 2mm, R/A THT	SULLINS CONNECTOR SOLUTIONS, NPPN072FJFN-RC
8	2	J14, J15	CONN., RF, BNC, RCPT JACK, 5-PIN, STR, THT, 50 OHMS	AMPHENOL RF, 112404
9	1	J16	CONN., SHROUDED HDR, MALE, 2×6, 2mm, VERT, STR, THT	FCI, 98414-G06-12ULF
10	1	J17	CONN., HDR, MALE, 2×7, 2mm, R/A THT	MOLEX, 0877601416 MOLEX, 87760-1416
11	1	J18	CONN., SHROUDED HDR, MALE, 1×4, 2mm, VERT, STR, THT	HIROSE ELECTRIC, DF3A-4P-2DSA
12	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY, THT-96-717-10
13	2	SW0, SW1	CONN., HDR., MALE, 1×3, 2mm, VERT, STR, THT, 10µ Au	SAMTEC, TMM-103-02-L-S
14	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.50	WURTH ELEKTRONIK, 702935000
15	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421
16				
17	1		PCB, DC2638A	MAO BANG, 600-DC2638A
18	1		TOOL, STENCIL, 700-DC2638A	ANALOG DEVICES, 830-DC2638A

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