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Evaluating the ADM1075 –48 V Hot-Swap Controller and Digital Power Monitor with PMBus Interface

FEATURES

Full support evaluation kit for the ADM1075
Supports LFCSP device package
Board populated and tested with –48 V, 10 A, 680 µF design
Input voltage range of –36 V to –75 V
PMBus™ communication supported
Isolated PMBus interface for –48 V operation
Special N-MOSFET footprint to accommodate different FET packages
Supports up to 3 sense resistors in parallel
Supports up to 3 field effect transistors (FETs) in parallel
3 on-board ADT75 accurate temperature sensors
Supports cascade setup for multiple boards
Toggle and push-button switches for easy input control
LED indicated status outputs

PACKAGE CONTENTS

EVAL-ADM1075EBZ evaluation board

HARDWARE REQUIREMENTS

USB-to-serial-I/O interface USB-SDP-CABLEZ (The USB-SDP-CABLEZ is not supplied in the evaluation kit and should be ordered separately from Analog Devices, Inc. Only one USB-SDP-CABLEZ is required in the multiboard cascade setup.)
8-way, 150 mm Micro-MaTch ribbon cable (optional)

SOFTWARE REQUIREMENT

Analog Devices hot-swap and power monitoring evaluation software

GENERAL DESCRIPTION

The EVAL-ADM1075EBZ is a compact full feature evaluation board for the ADM1075-1ACPZ and ADM1075-2ACPZ devices. The layout gives users a clear visual of all the peripheral components and the hot-swap power path. The layout also maximizes the ability of the board to dissipate heat for some of the key components on the power path, allowing evaluation of high current hot-swap setups.

Three sense-resistor slots and three multipackage FET slots give users great flexibility and allow them to simulate a wide range of application setups.

Multiple test points allow easy access to all critical points/pins. Seven LEDs give users a direct visual indication of variations in the board status, such as system input voltage, isolation power, IC $\overline{\text{PWRGD}}$ output, $\overline{\text{LATCH}}$ output, and GPO outputs. Three ADT75 digital temperature sensors on the back of the board allow users to obtain the FET temperature through an I^2C bus in real time.

The board supports I^2C communication, allowing users to communicate with the ADM1075 and the ADT75. A 64 Kb I^2C EEPROM is used to store the ADC resistor divider and sense resistor values on board for use with the evaluation software. The evaluation kit also supports cascade setup so that multiple evaluation boards can be connected and share the same I^2C bus.

The boards are fully compatible with the ADM1075 evaluation software tool, which can be downloaded at http://www.analog.com/hotswaptools.

Users need a USB-SDP-CABLEZ USB-to-I^2C dongle to use the evaluation software tools. A Micro-MaTch ribbon cable may also be required if multiple evaluation boards are cascaded. This cable can be ordered through Farnell.

The evaluation board is prepopulated and tested with a –48 V (–36 V minimum to –75 V maximum), 10 A hot-swap design with a 680 µF output capacitor. The part is configured to retry seven times; however, the board is easily reconfigurable to select different retry schemes (see Table 6).

Complete specifications for the ADM1075 can be found in the ADM1075 data sheet available from Analog Devices and should be consulted in conjunction with this user guide when using the evaluation board.

TABLE OF CONTENTS

REVISION HISTORY

8/14—Rev. B to Rev. A

Changes to Figure 17 11
Changes to Figure 18 12
Changes to Table 8 14

4/13—Rev. A to Rev. B

Changes Figure 1 3
Changes to Table 7 9
Changes to Figure 17 11
Changes to Table 8 14

9/12—Rev. 0 to Rev. A

Changes to Package Contents, to Hardware Requirements, and to General Description 1
Changes to Evaluation Board Description Section 3
Changes to Figure 2 4
Changes to Table 2 5
Changes to Figure 10 9

11/11—Revision 0: Initial Version

EVALUATION BOARD DESCRIPTION

The evaluation board is designed to demonstrate many different features of the ADM1075. Not all components are required in a typical design. The functional block diagram in Figure 1 shows the key components of the evaluation board.

The typical lab setup is shown in Figure 2. The hot-swap line input voltage is connected across the RTN IN and −48V IN connectors. A resistive load can be connected across RTN OUT and −48V OUT. The mini-USB connector is used to supply 5 V power to the isolated section of the board while the USB-SDP-CABLEZ is connected to the 10-way connector, SK3, for isolated I²C communication.

Isolation is required in most −48 V applications because there is a large ground potential difference between the −48 V section of the board and a PC or microcontroller. The ADuM1250 is used to demonstrate I²C isolation on the board, and the ADuM3200 is used to demonstrate isolation of other digital signals. The ADuM5404 provides quad-channel digital isolation with *iso*Power®. An integrated dc-to-dc converter provides up to 500 mW of regulated, isolated power from the isolated side to the −48 V side. When the isolated section is powered, the *iso*Power is switched in to power the 5 V components on the primary side of the board.

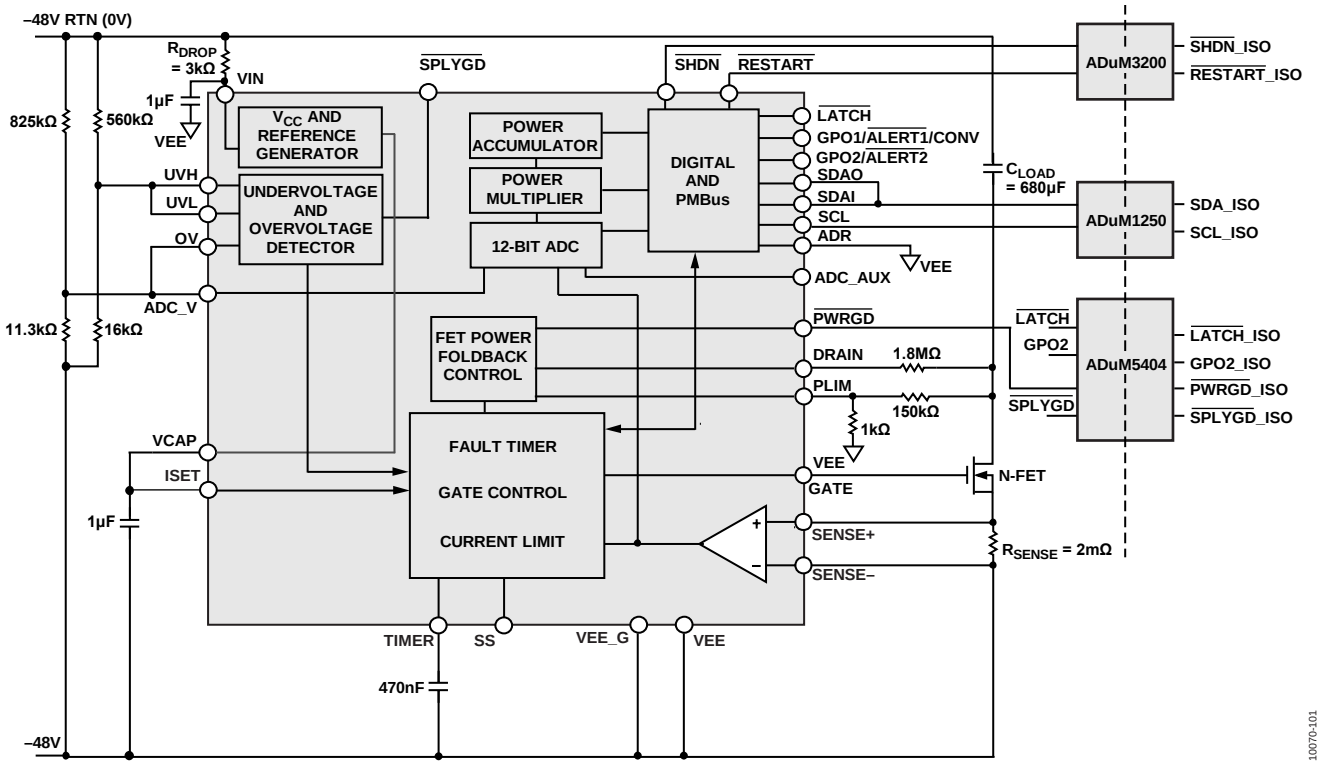

Figure 1. Functional Block Diagram

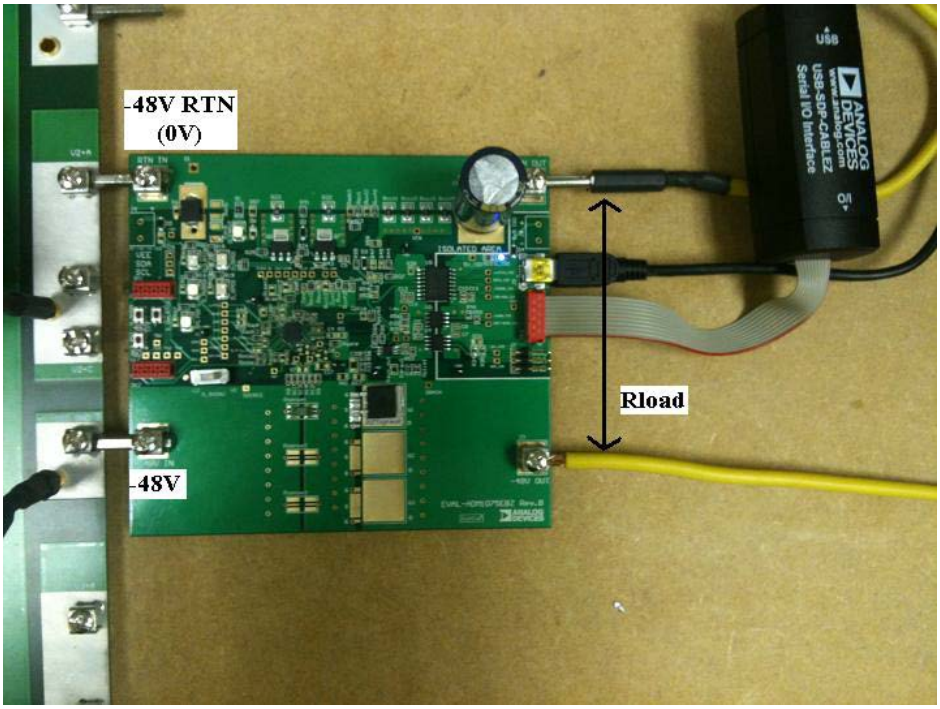

Figure 2. Board Lab Setup

Table 1. Emitter Follower Configuration

Component	Value	Effect
R57	0 Ω	System power to Emitter Follower 1
R25	Not populated	Isolates Emitter Follower 1 from Emitter Follower 2
R59	Not populated	Power 5 V LED off other emitter follower (Emitter Follower 2)
R43	0 Ω	Powers 5 V LED off Emitter Follower 2
R58	0 Ω	Powers VIN directly via emitter follower 1
D5	11 V Zener	Powers VIN directly with ~10.5 V

The ADM1075 can be powered via a shunt resistor from the hot-swap line voltage or can be powered directly from a 9.2 V to 11.5 V supply. The shunt power option is the default on the evaluation board; however, an emitter follower can be reconfigured to generate the chip voltage directly. The required board modifications are shown in Table 1. More information on powering the ADM1075 can be found in the ADM1075 data sheet. The default power configuration is shown in Figure 3, and the emitter follower configuration is shown in Figure 4.

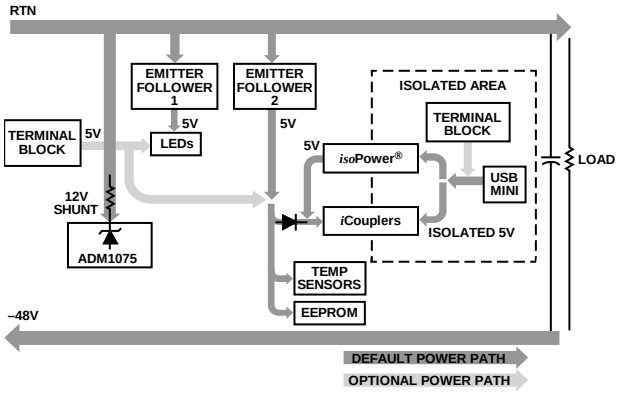

Figure 3. Board Power (Shunt)

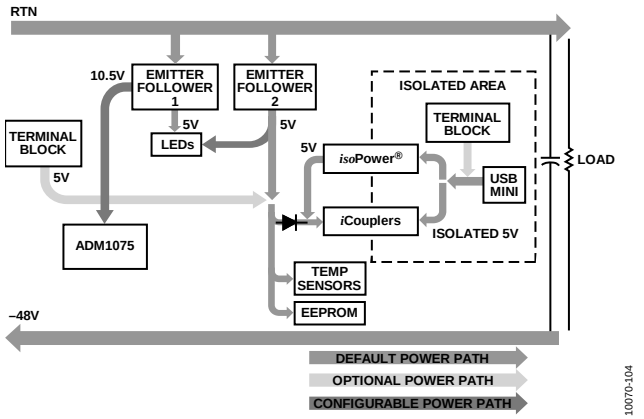

Figure 4. Board Power (Emitter Follower)

EVALUATION BOARD HARDWARE

SWITCH, JUMPER, AND LED FUNCTIONS

Table 2. Connector Functions

Connector	Description
RTN IN, −48V IN	Hot-swap line voltage inputs that also power the board components. Input voltage is 36 V to 75 V.
RTN OUT, −48V OUT	Hot-swap line voltage outputs.
J6	5 V auxiliary board voltage. Not required; emitter follower circuit used to generate 5 V from 48 V input.
SK1, SK2	Bottom and top cascade connectors; connect with a Micro-MaTch ribbon cable to link with other EVAL-ADM1075EBZ boards.
J9	I²C/PMBus communication dongle connector. From top down: VEE, SDA, SCL. Note that the dongle should only be connected at this side (primary side) if using a 0 V to 48 V supply. If using a −48 V to 0 V supply, the USB port can be damaged. This 3-pin connector is designed to be used with the USB-SMBUS-CABLEZ dongle. Not required if using USB-SDP-CABLEZ.
J7	Isolated side I²C/PMBus communication dongle connector. From top down: SCL, SDA, GND. This 3-pin connector is designed to be used with the USB-SMBUS-CABLEZ dongle. Not required if using USB-SDP-CABLEZ.
J8	5 V isolation supply voltage (power supply).
J5	5 V isolation supply voltage (mini-USB).
SK3	10-way isolated side connector for USB-SDP-CABLEZ; I²C communication and 5 V supply.

Table 3. Switch Functions

Switch	Description
S_SHDN2	Toggle switch to shut down hot swap. Right = hot swap enabled, and left = hot swap disabled.
S_SHDN	Push-button switch to generate shutdown. Can be used to clear faults. Note that $\overline{\text{SHDN}}$ has a seven-retry counter. After seven $\overline{\text{SHDN}}$ events, GPO2 goes active low. A restart or clear via PMBus is required to enable the hot swap again.
S_DeLATCH	Push-button switch to clear latch after seven shutdown events (not on Rev. 0 boards).
S_RST	Push-button switch to generate 10 sec restart.

Table 4. LED Functions

LED	Description
D_INPUT	Voltage input > ~10 V detected. Active high; green.
D_LATCH	$\overline{\text{LATCH}}$, active low; red.
D_PWRGD	$\overline{\text{PWRGD}}$, active low; green.
D_SPLYGD	$\overline{\text{SPLYGD}}$, active low; green.
D_GPO1	GPO1/$\overline{\text{ALERT1}}$/CONV, active low; yellow.
D_GPO2	GPO2/$\overline{\text{ALERT2}}$, active low; yellow.
D_ISO	Isolation 5 V power supply. Active high; blue (not on Rev. 0 boards).

Table 5. On-Board ICs

IC	Description
U1	ADM1075 main IC
U2	64 kb I²C EEPROM
U3	ADuM3200, dual-channel digital isolator
U4	ADuM1250, dual I²C isolator
U5	ADuM5404, quad-channel isolator with integrated dc-to-dc converter
UT1 to UT3	ADT75, ±2°C accurate, 12-bit digital temperature sensor, sensing temperature on the MOSFETs

Table 6. Retry Configuration

	BOM Component		
Retry Scheme	**R_7retry**	**R_1rty_10s**	**R_7rty_10s**
No Retries (Latch Off)	Not populated	Not populated	Not populated
7 Retries, Then Latch Off (Default)	0 Ω	Not populated	Not populated
1 Retry Every 10 Seconds	Not populated	0 Ω	Not populated
7 Retries Every 10 Seconds	Not populated	Not populated	0 Ω

EVALUATION BOARD OVERVIEW

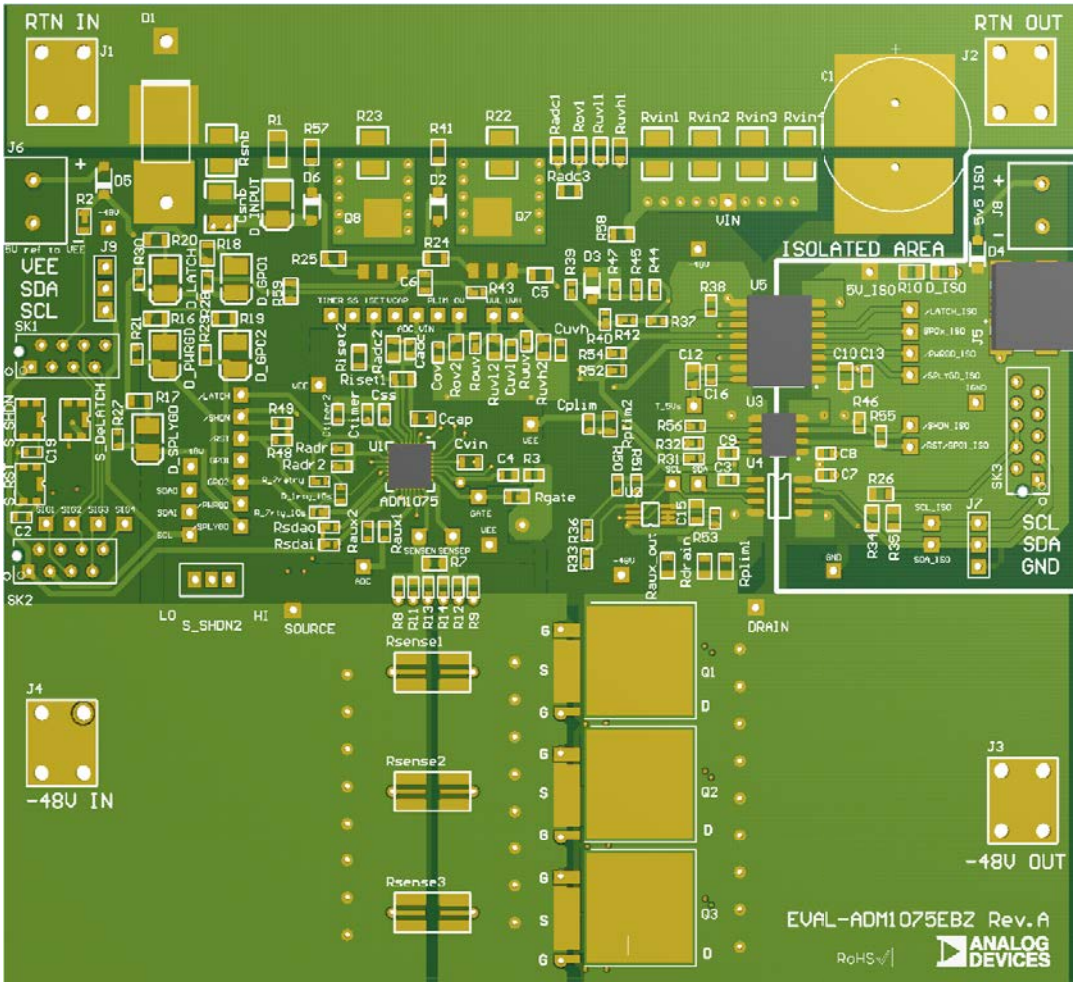

Figure 5. Evaluation Board Top Side (Rev. A)

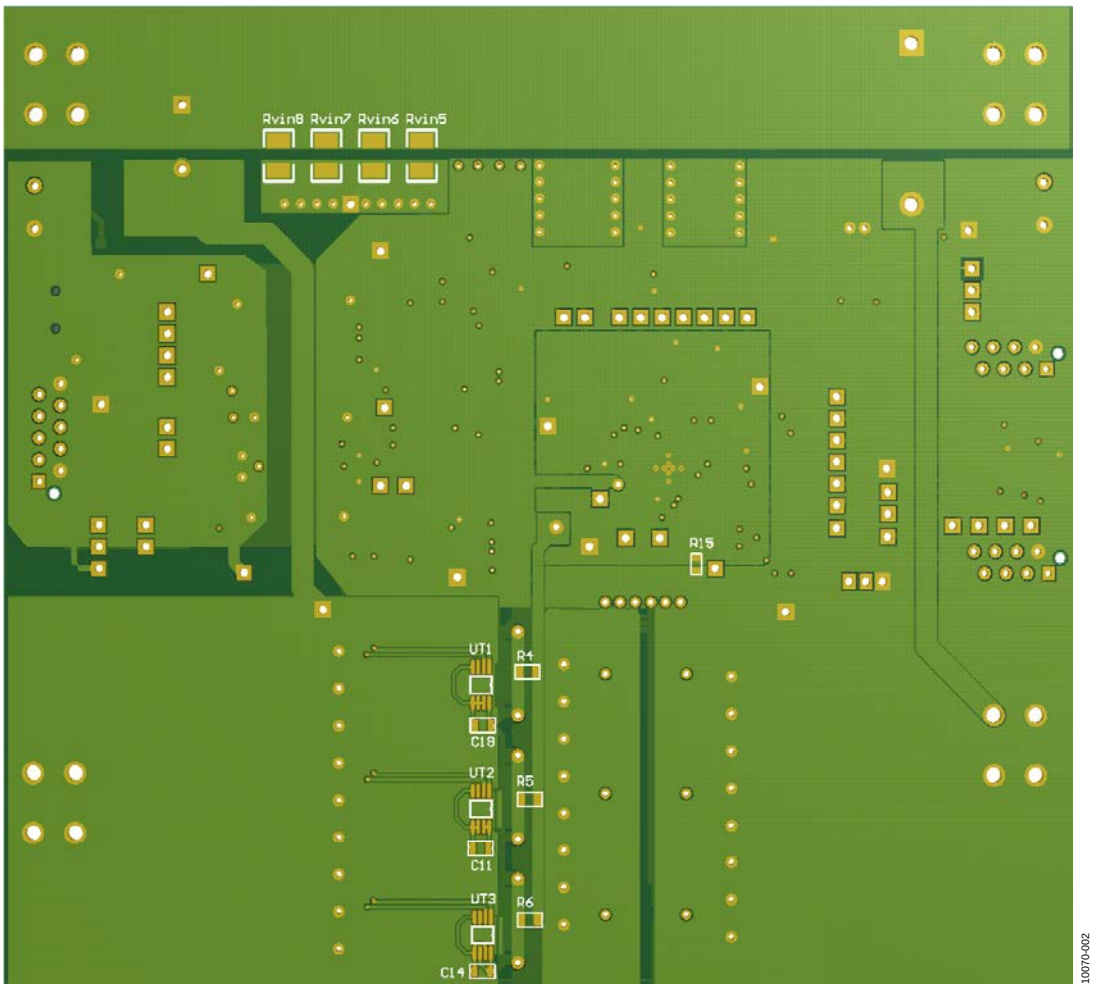

Figure 6. Evaluation Board Bottom Side

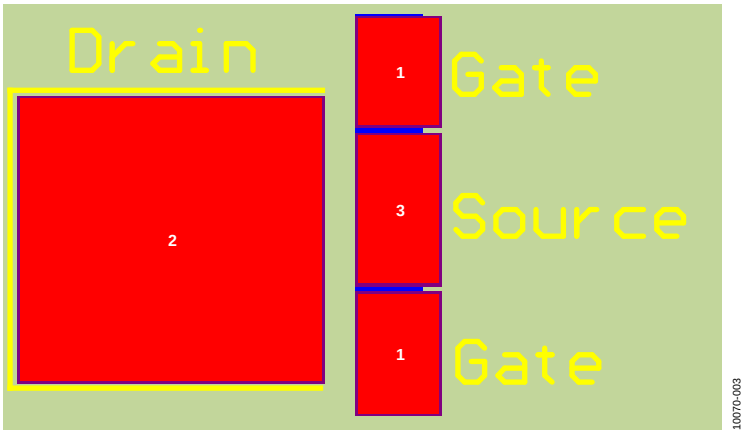

Figure 7. Multipackage N-MOSFET Footprint

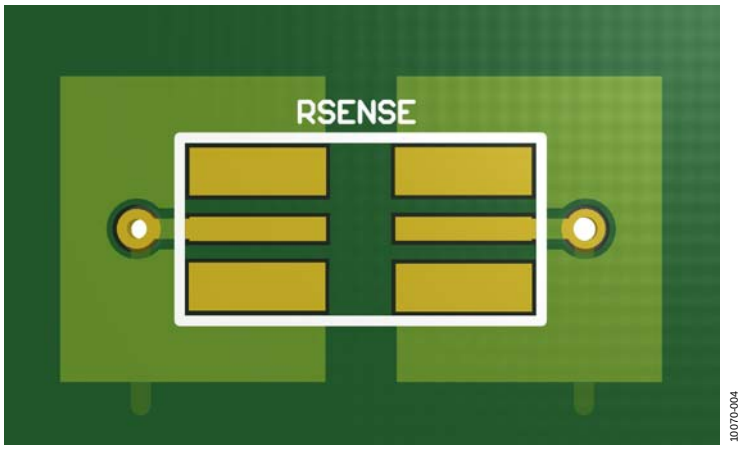

Figure 8. Recommended Sense Resistor Layout (Not on Rev. 0 Boards)

For the best current sensing accuracy with the footprint shown in Figure 8, chip resistors without a nickel barrier layer (usually in green) are recommended. The data in this user guide may not be applicable to all resistors and results may vary depending on resistor composition and size. Test alternative resistors independently. It is the responsibility of the user to ensure that the layout dimensions and structure of the footprint comply with the individual SMT manufacturing requirements. Analog Devices does not accept responsibility for any issues that may arise because of using this footprint.

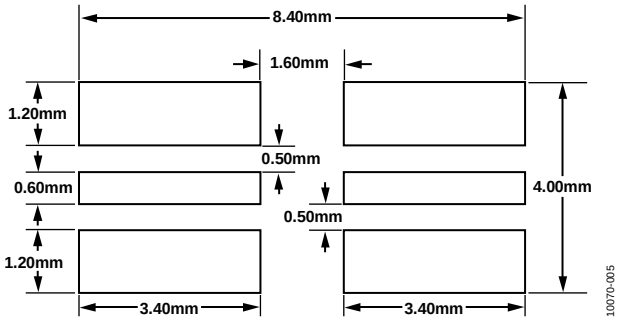

Figure 9. Optimum Footprint Dimensions (Based on Welwyn ULR Green Resistor and Layout in Figure 8)

EVALUATION BOARD LAB SETUP

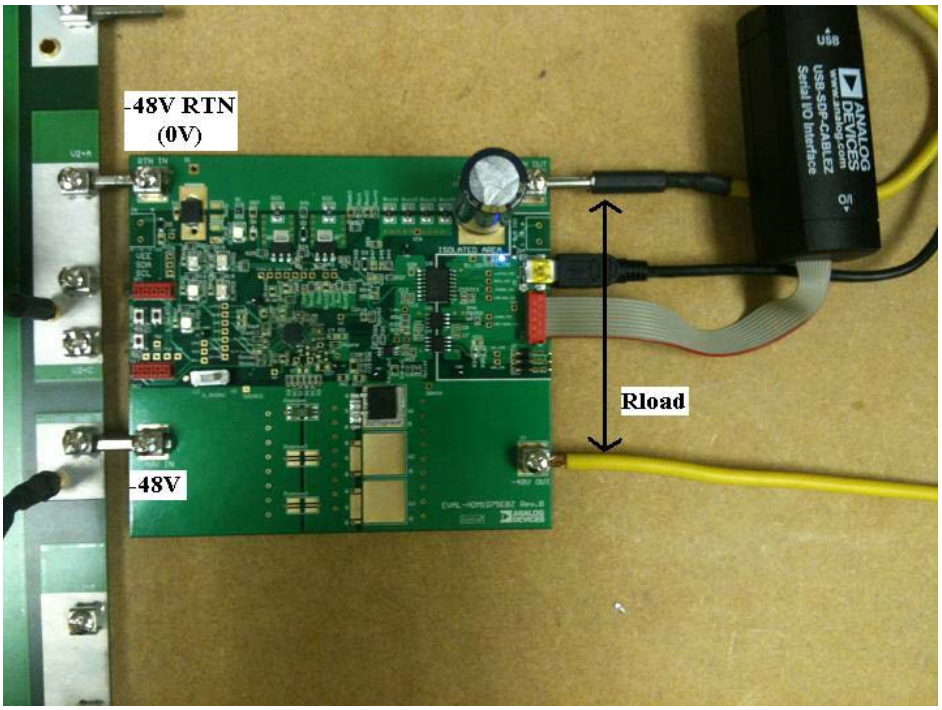

Figure 10. Board Lab Setup

BOARD SPECIFICATIONS

Table 7. Board Specifications

Parameter	Rating
UVL	32.4 V
UVH	36 V
OV Rising	74.0 V
OV Falling	69.9 V
Load Capacitance	680 µF
Trip Current (Nominal)	9.56 A
Regulation Current (Nominal)	10 A
Constant Power Level	155 W

TEST PLOTS

Figure 11. Power-Up Profile; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green); M1 = FET Power (CH2 × CH4) (Orange)

Figure 12. Power-Up into a Fault (TIMER); Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = TIMER (Pink); Channel 4 = System Current (Green)

Figure 13. TIMER During a Fault; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = TIMER (Pink); Channel 4 = System Current (Green)

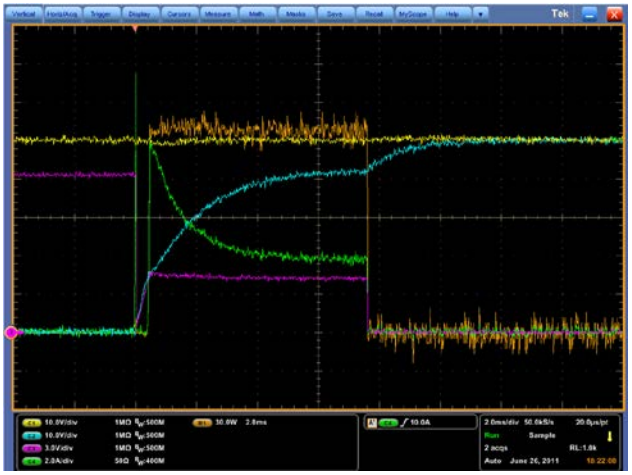

Figure 14. Severe OC Event; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green); M1 = FET Power (CH2 × CH4) (Orange)

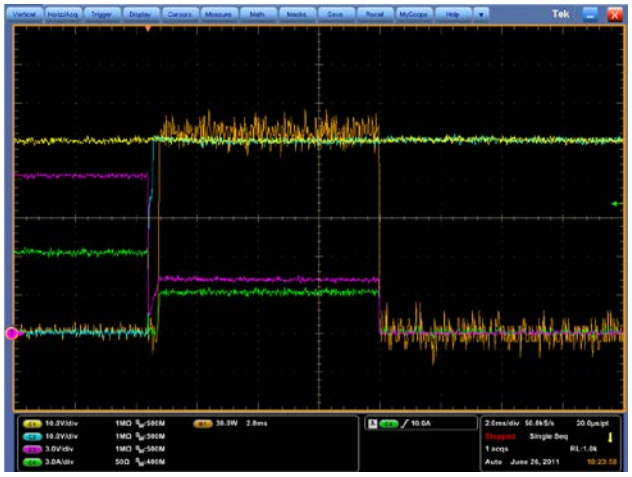

Figure 15. Short Circuit Event; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green); M1 = FET Power (CH2 × CH4) (Orange)

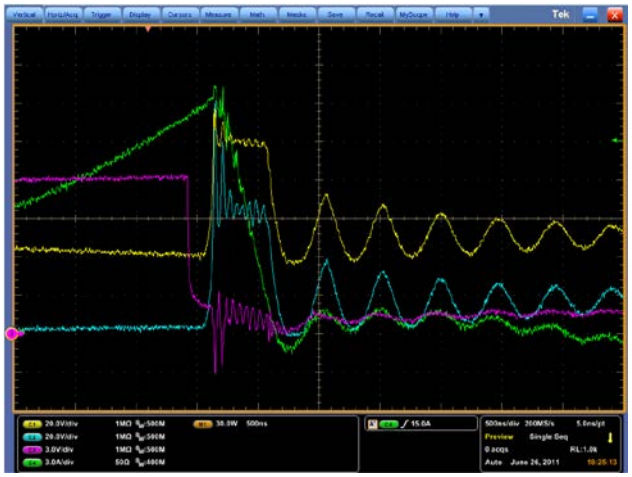

Figure 16. Short-Circuit Event (Zoom); Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green)

EVALUATION BOARD SCHEMATICS AND ARTWORK

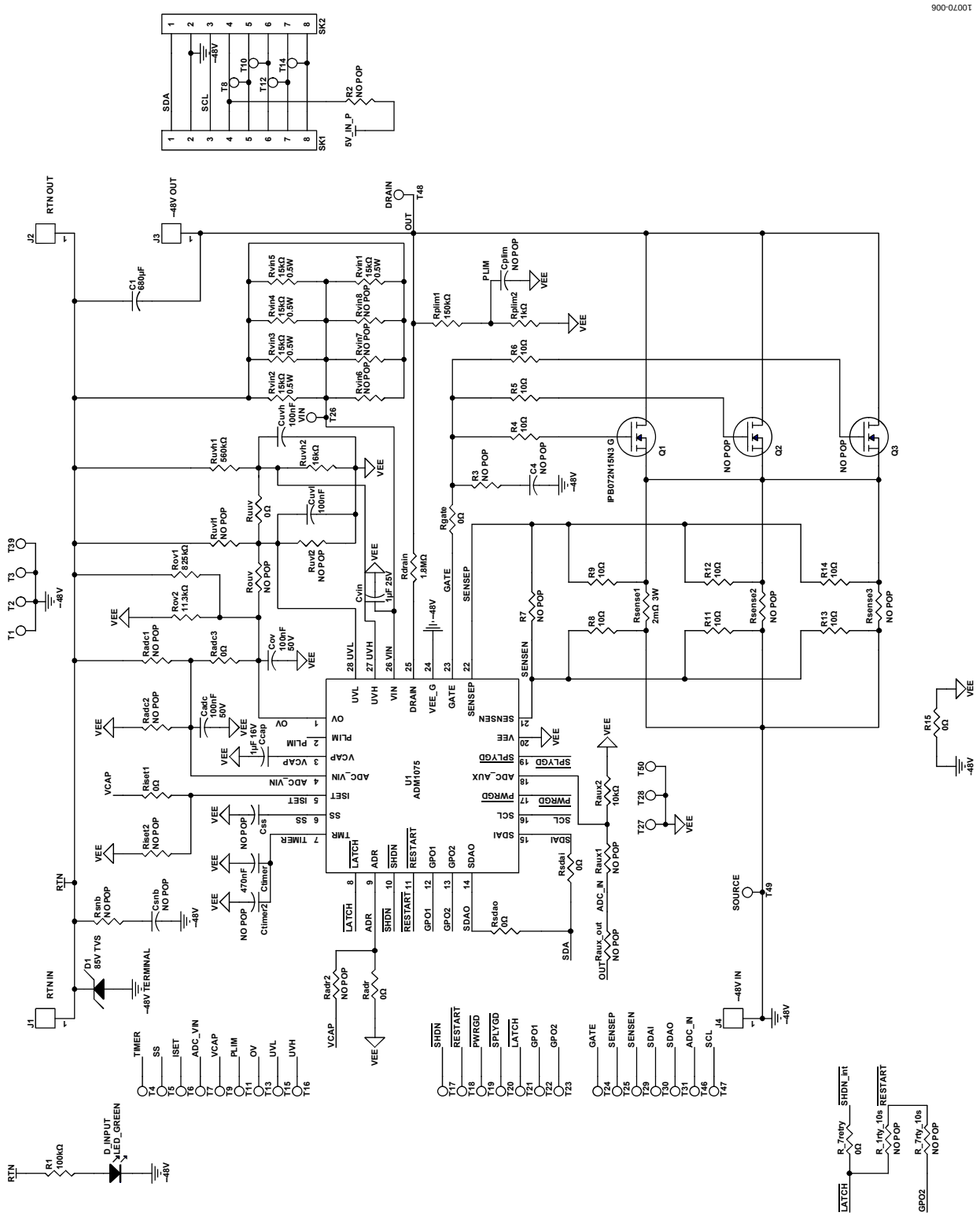

Figure 17. Evaluation Board Schematic, Page 1

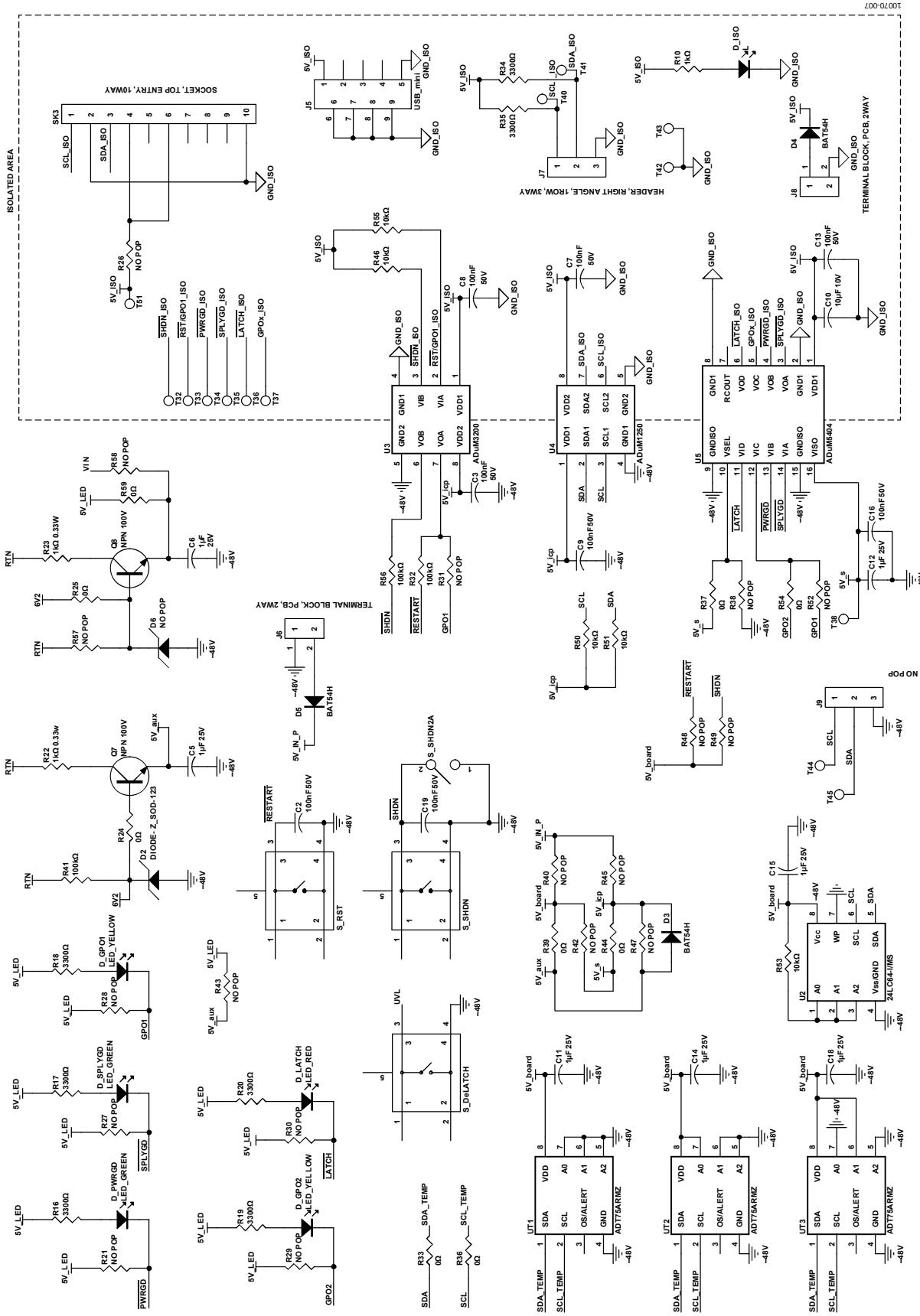

Figure 18. Evaluation Board Schematic, Page 2

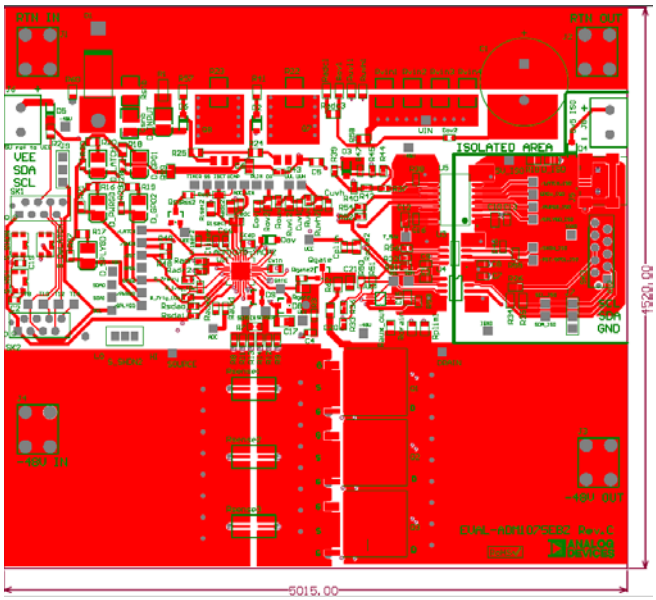

Figure 19. Top Layer

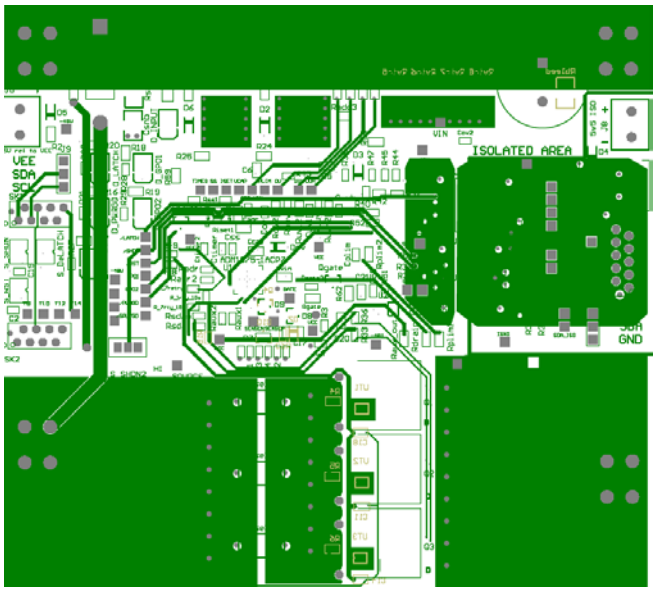

Figure 21. Middle Layer 2

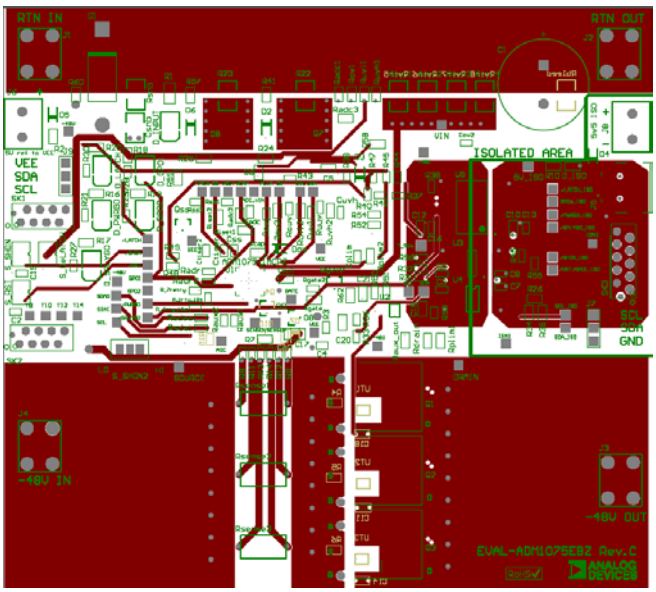

Figure 20. Middle Layer 1

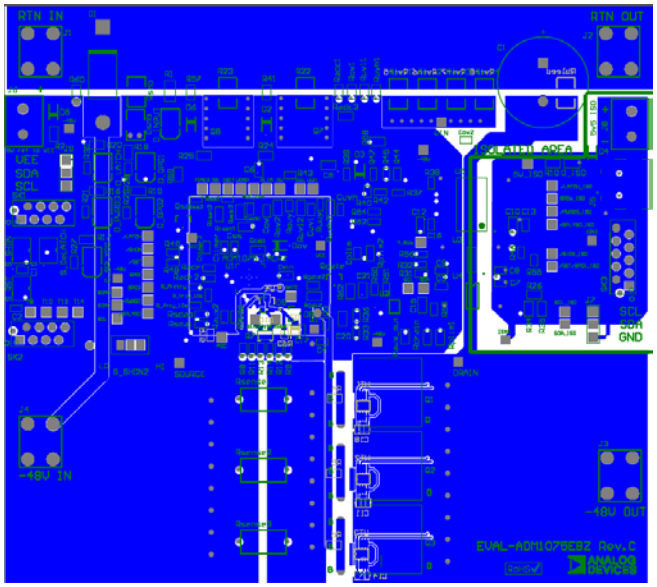

Figure 22. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 8.

Reference Designator	Description[1]	Stock Code
C1	680 µF 100 V	FEC 9692657
C10	10 µF 10 V	FEC 1833812
C11	1 µF 25 V	FEC 1637035
C12	1 µF 25 V	FEC 1637035
C13	100 nF 50 V	FEC 1692286
C14	1 µF 25 V	FEC 1637035
C15	1 µF 25 V	FEC 1637035
C16	100 nF 50 V	FEC 1692286
C17	NO POP	NO POP
C18	1 µF 25 V	FEC 1637035
C19	100 nF 50 V	FEC 1692286
C2	100 nF 50 V	FEC 1692286
C20	NO POP	NO POP
C21	NO POP	NO POP
C3	100 nF 50 V	FEC 1692286
C4	NO POP	NO POP
C5	1 µF 25 V	FEC 1637035
C6	1 µF 25 V	FEC 1637035
C7	100 nF 50 V	FEC 1692286
C8	100 nF 50 V	FEC 1692286
C9	100 nF 50 V	FEC 1692286
Cadc	100 nF 50 V	FEC 1692286
Ccap	1 µF 16 V	FEC 1288256
Cov	100 nF 50 V	FEC 1692286
Cov2	10 nF 50 V	NO POP
Cplim	NO POP	NO POP
Csnb	NO POP	NO POP
Css	NO POP	NO POP
Ctimer	470 nF	FEC 1828894
Ctimer2	NO POP	NO POP
Cuvh	100 nF	FEC 1692286
Cuvl	100 nF	FEC 1692286
Cvin	1 µF 25 V	FEC 1637035
D_GPO1	LED yellow	FEC 1226421
D_GPO2	LED yellow	FEC 1226421
D_INPUT	LED green	FEC 1226376
D_ISO	LED blue	FEC 8529876
D_LATCH	LED red	FEC 1328348
D_PWRGD	LED green	FEC 1226376
D_SPLYGD	LED green	FEC 1226376
D1	85 V TVS	Digikey SMCJ85ABCT-ND
D10	NO POP	FEC 1228222
D2	DIODE- Z_SOD-123	FEC 1757814
D3	BAT54H	FEC 1757752
D4	BAT54H	FEC 1757752
D5	BAT54H	FEC 1757752
D6	NO POP	NO POP
D7	NO POP	FEC 1431256
D8	NO POP	FEC 1228222

Reference Designator	Description[1]	Stock Code
D9	NO POP	FEC 1467519
Dov	DIODE- Z_SOD-123	NO POP
J1	RTN IN	Digikey 7691K-ND
J2	RTN OUT	Digikey 7691K-ND
J3	−48V OUT	Digikey 7691K-ND
J4	−48V IN	Digikey 7691K-ND
J5	USB_mini	FEC 1125348
J6	NO POP	FEC 151789
J7	Header, right angle, 1 row, 3-way	FEC 9733450
J8	NO POP	FEC 151789
J9	NO POP	NO POP
Q1	IPB072N15N3 G	Digikey IPB072N15N3 GCT-ND
Q2	NO POP	NO POP
Q3	NO POP	NO POP
Q4	NO POP	FEC 1791578
Q7	NPN 100 V	FEC 1700708
Q8	NPN 100 V	FEC 1700708
Qgate	NPNSOT-23	NO POP
Qss	FET-N_SOT-23	NO POP
R_1rty_10s	NO POP	NO POP
R_7retry	0 Ω	Select by assembly house
R_7rty_10s	NO POP	NO POP
R1	100 kΩ	FEC 1576656
R10	1 kΩ	FEC 9333711
R11	10 Ω	FEC 1469751
R12	10 Ω	FEC 1469751
R13	10 Ω	FEC 1469751
R14	10 Ω	FEC 1469751
R15	0 Ω	Select by assembly house
R16	3.3 kΩ	FEC 1469911
R17	3.3 kΩ	FEC 1469911
R18	3.3 kΩ	FEC 1469911
R19	3.3 kΩ	FEC 1469911
R2	NO POP	NO POP
R20	3.3 kΩ	FEC 1469911
R21	NO POP	NO POP
R22	1 kΩ 0.33 W	FEC 1577394
R23	1 kΩ 0.33 W	FEC 1577394
R24	0 Ω	Select by assembly house
R25	0 Ω	Select by assembly house
R26	NO POP	NO POP
R27	NO POP	NO POP
R28	NO POP	NO POP
R29	NO POP	NO POP
R3	NO POP	NO POP
R30	NO POP	NO POP
R31	NO POP	NO POP
R32	100 kΩ	FEC 1469649
R33	0 Ω	Select by assembly house
R34	3.3 kΩ	FEC 1738911
R35	3.3 kΩ	FEC 1738911
R36	0 Ω	Select by assembly house
R37	0 Ω	Select by assembly house

Reference Designator	Description[1]	Stock Code
R38	NO POP	NO POP
R39	0 Ω	Select by assembly house
R4	10 Ω	FEC 1469859
R40	NO POP	NO POP
R41	100 kΩ	FEC 1469860
R42	NO POP	NO POP
R43	NO POP	NO POP
R44	0 Ω	Select by assembly house
R45	NO POP	NO POP
R46	10 kΩ	FEC 1738918
R47	NO POP	NO POP
R48	NO POP	FEC 1469649
R49	NO POP	FEC 1469649
R5	10 Ω	FEC 1469859
R50	10 kΩ	FEC 1738918
R51	10 kΩ	FEC 1738918
R52	NO POP	NO POP
R53	10 kΩ	FEC 1738918
R54	0 Ω	Select by assembly house
R55	10 kΩ	FEC 1738918
R56	100 kΩ	FEC 1469649
R57	NO POP	NO POP
R58	NO POP	NO POP
R59	0 Ω	Select by assembly house
R6	10 Ω	FEC 1469859
R60	NO POP	NO POP
R62	NO POP	NO POP
R63	NO POP	NO POP
R7	NO POP	NO POP
R8	10 Ω	FEC 1469751
R9	10 Ω	FEC 1469751
Radc1	NO POP	NO POP
Radc2	NO POP	NO POP
Radc3	0 Ω	Select by assembly house
Radr	0 Ω	Select by assembly house
Radr2	NO POP	NO POP
Raux_out	NO POP	NO POP
Raux1	NO POP	NO POP
Raux2	10 kΩ	FEC 1738918
Rbleed	15 kΩ 0.5 W	FEC 1739028
Rdrain	1.8 M	FEC 1576163
Rgate	0 Ω	Select by assembly house
Rgate2		NO POP
Riset1	0 Ω	Select by assembly house
Riset2	NO POP	NO POP
Rouv	NO POP	NO POP
Rov1	820 kΩ	FEC 1278134
Rov2	11 kΩ	FEC 1635317
Rplim1	150 kΩ	FEC 1500680
Rplim2	1 kΩ	FEC 9333711
Rsdai	0 Ω	Select by assembly house
Rsdao	0 Ω	Select by assembly house
Rsense1	2 mΩ 3 W	FEC 1292508

Reference Designator	Description[1]	Stock Code
Rsense2	NO POP	NO POP
Rsense3	NO POP	NO POP
Rsnb	NO POP	NO POP
Rss1	NO POP	NO POP
Rss2	NO POP	NO POP
Ruuv	0 Ω	Select by assembly house
Ruvh1	560 kΩ	FEC 1570789
Ruvh2	16 kΩ	FEC 1652925
Ruvl1	NO POP	NO POP
Ruvl2	NO POP	NO POP
Rvin1	15 kΩ 0.5 W	FEC 1739028
Rvin2	15 kΩ 0.5 W	FEC 1739028
Rvin3	15 kΩ 0.5 W	FEC 1739028
Rvin4	15 kΩ 0.5 W	FEC 1739028
Rvin5	15 kΩ 0.5 W	FEC 1739028
Rvin6	NO POP	NO POP
Rvin7	NO POP	NO POP
Rvin8	NO POP	NO POP
S_DeLATCH	MCIPTG23K-V	FEC 1605470
S_RST	MCIPTG23K-V	FEC 1605470
S_SHDN	MCIPTG23K-V	FEC 1605470
S_SHDN2	SWITCH-DPST	FEC 1123875
SK1	micro match 8	FEC 148593
SK2	micro match 8	FEC 148593
SK3	SOCKET, TOP ENTRY, 10WAY	FEC 148600
T1	−48V	Test point
T10	SIG2	NO POP
T11	PLIM	NO POP
T12	SIG3	NO POP
T13	OV	NO POP
T14	SIG4	NO POP
T15	UVL	NO POP
T16	UVH	NO POP
T17	/SHDN	NO POP
T18	/RST	NO POP
T19	/PWRGD	NO POP
T2	−48V	Test point
T20	/SPLYGD	NO POP
T21	/LATCH	NO POP
T22	GPO1	NO POP
T23	GPO2	NO POP
T24	GATE	NO POP
T25	SENSEP	NO POP
T26	VIN	NO POP
T27	VEE	Test point
T28	VEE	NO POP
T29	SENSEN	NO POP
T3	−48V	Test point
T30	SDAI	NO POP
T31	SDAO	NO POP
T32	/SHDN_ISO	NO POP
T33	/RST/GPO1_ISO	NO POP
T34	/PWRGD_ISO	NO POP

Reference Designator	Description[1]	Stock Code
T35	/SPLYGD_ISO	NO POP
T36	/LATCH_ISO	NO POP
T37	GPOx_ISO	NO POP
T38	T_5Vs	NO POP
T39	−48V	NO POP
T4	TIMER	NO POP
T40	SCL_ISO	NO POP
T41	SDA_ISO	NO POP
T42	IGND	Select by assembly house
T43	IGND	NO POP
T44	SCL	NO POP
T45	SDA	NO POP
T46	ADC	NO POP
T47	SCL	NO POP
T48	DRAIN	NO POP
T49	SOURCE	NO POP
T5	SS	NO POP
T50	VEE	Test point
T51	5V_ISO	NO POP
T6	ISET	NO POP
T7	ADC_VIN	NO POP
T8	SIG1	NO POP
T9	VCAP	NO POP
U1	ADM1075-1ACPZ	
U2	24LC64-I/MS	FEC 1331335
U3	ADUM3200ARZ	
U4	ADUM1250ARZ	
U5	ADUM5404ARWZ	
UT1	ADT75ARMZ	
UT2	ADT75ARMZ	
UT3	ADT75ARMZ	

[1] NO POP = not populated.

NOTES

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.

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