Evaluation Board User Guide
UG-304

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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.

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REVISION HISTORY

4/13—Rev. A to Rev. B

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9/12—Rev. 0 to Rev. A

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Changes to Evaluation Board Description Section 3
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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.

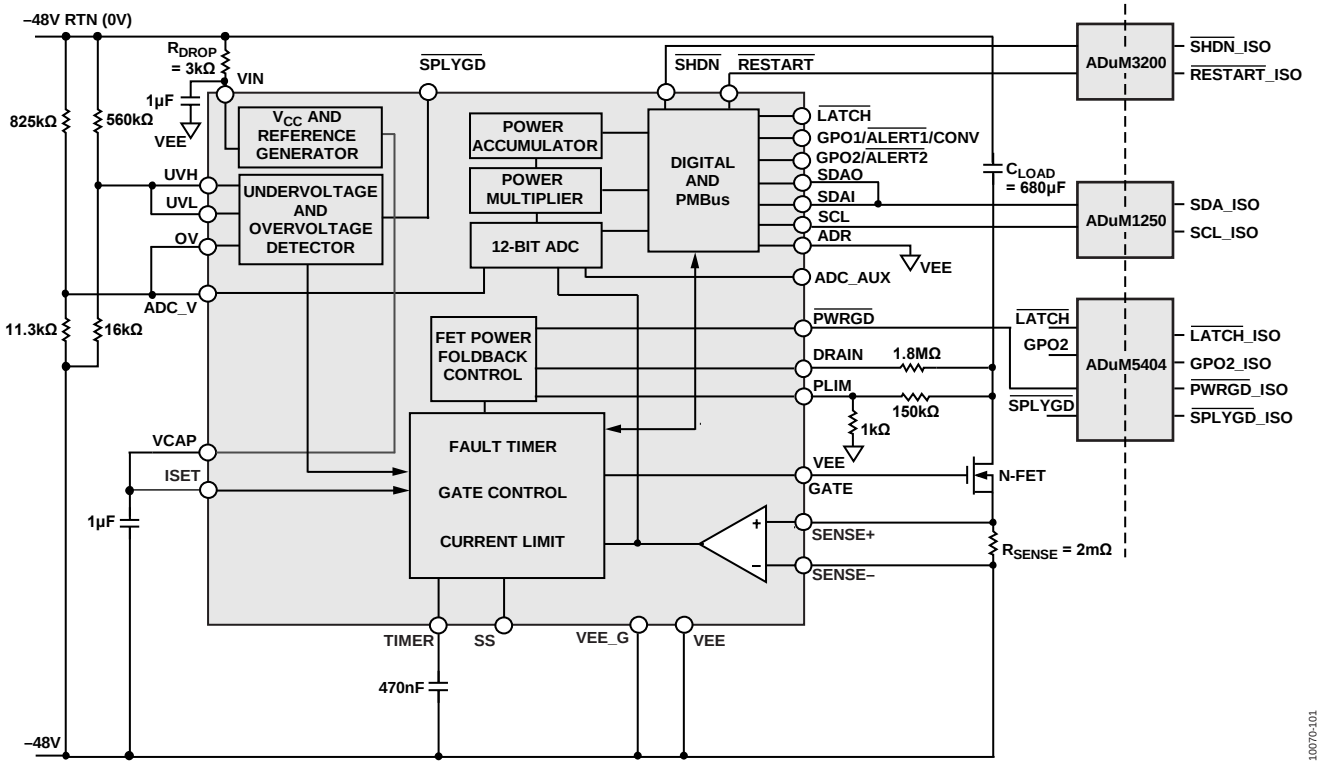

Figure 1. Functional Block Diagram

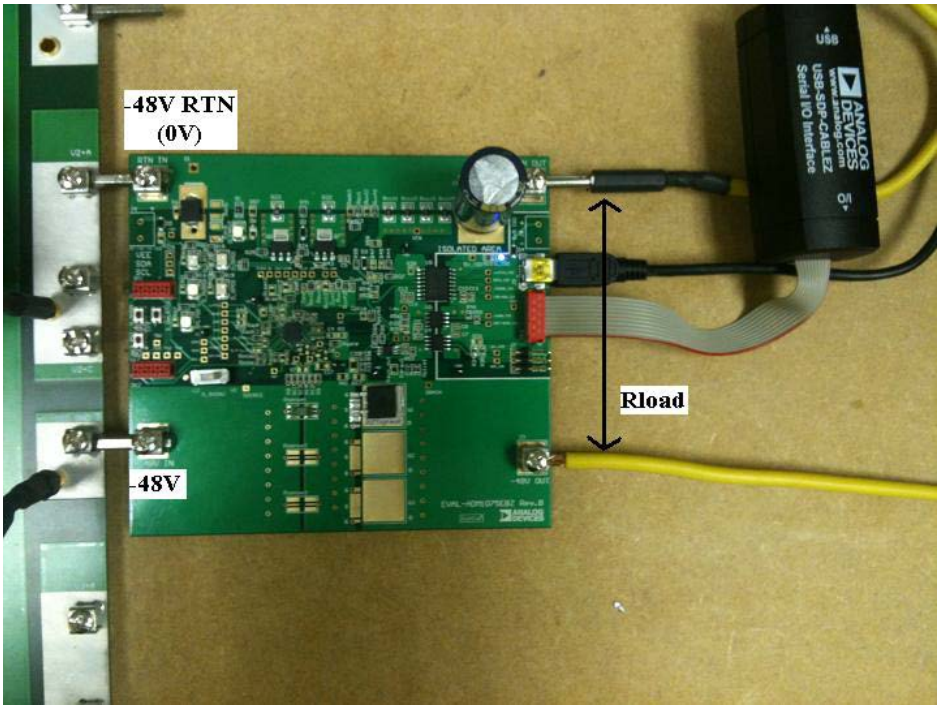

Figure 2. Board Lab Setup

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.

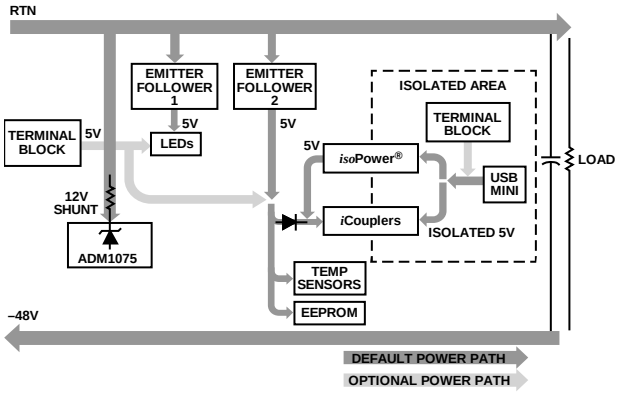

Figure 3. Board Power (Shunt)

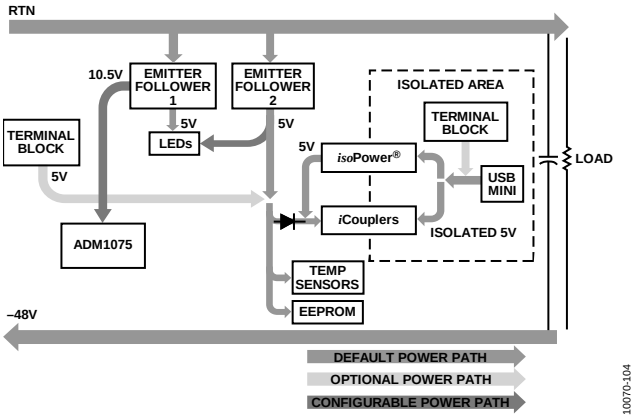

Figure 4. Board Power (Emitter Follower)

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

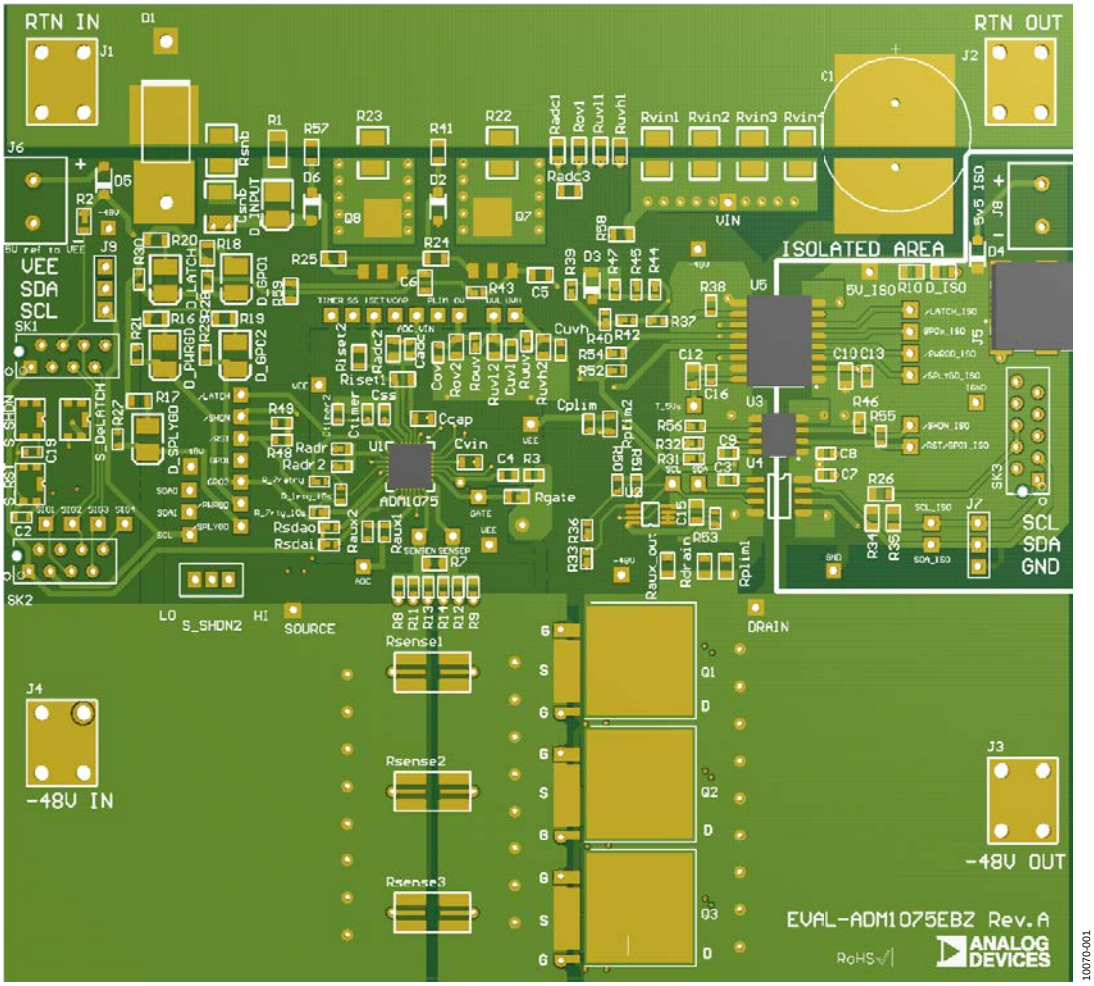

Figure 5. Evaluation Board Top Side (Rev. A)

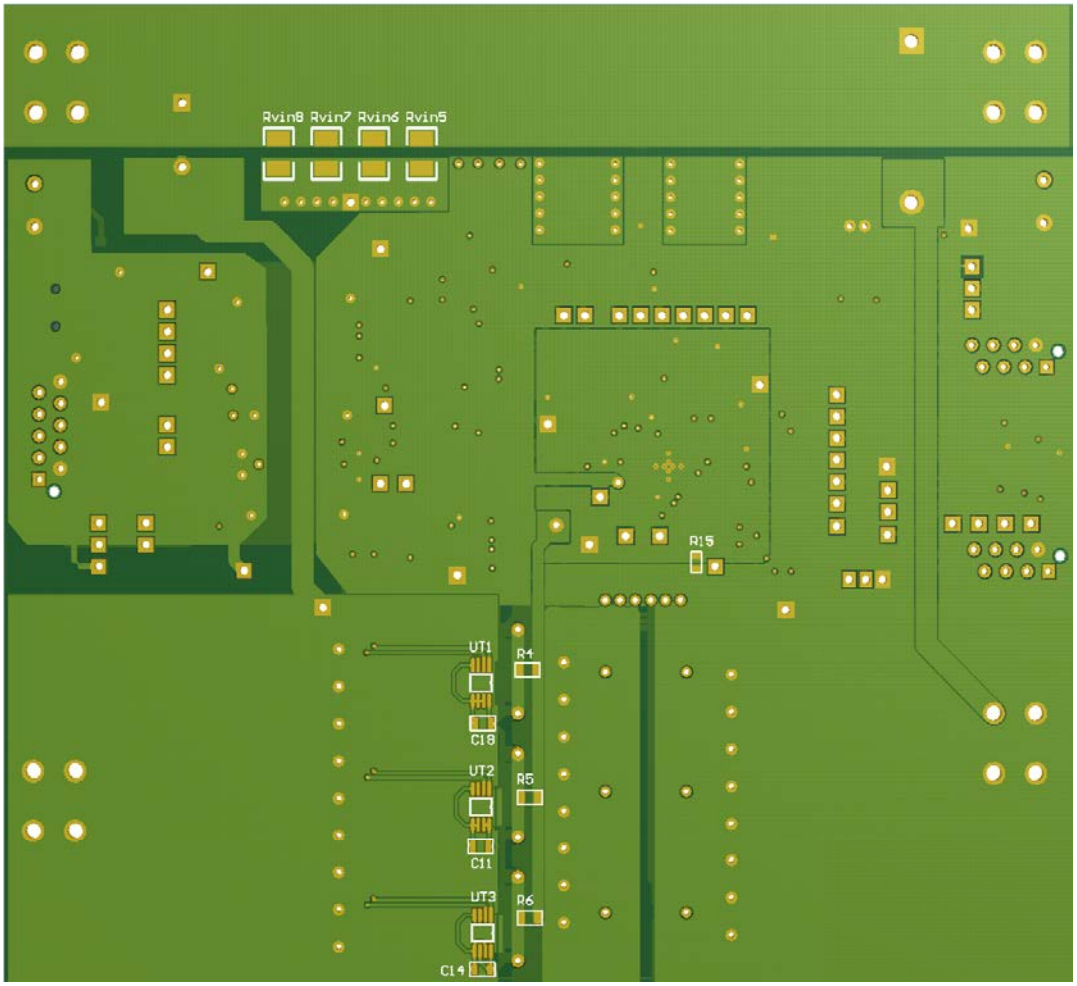

Figure 6. Evaluation Board Bottom Side

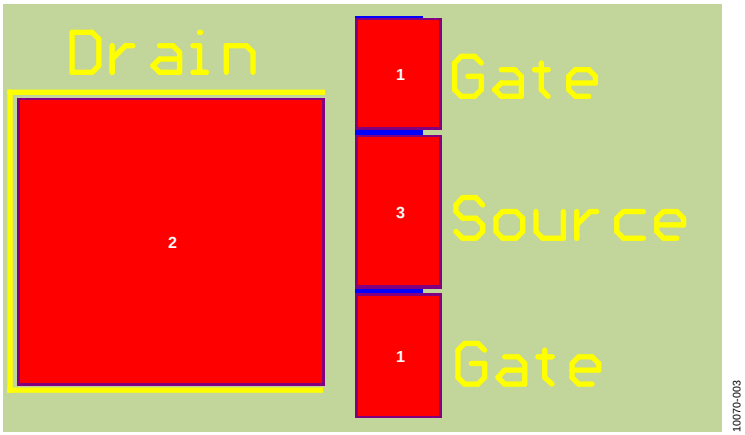

Figure 7. Multipackage N-MOSFET Footprint

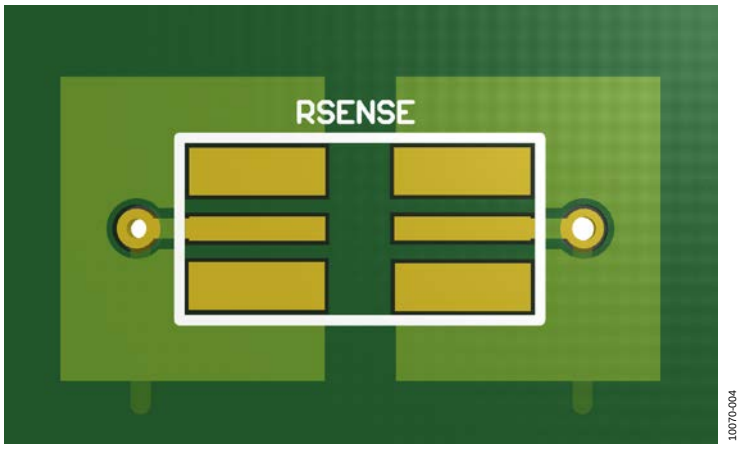

Figure 8. Recommended Sense Resistor Layout (Not on Rev. 0 Boards)

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.

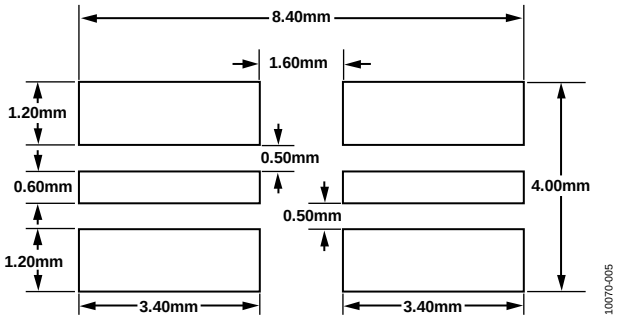

Figure 9. Optimum Footprint Dimensions (Based on Welwyn ULR Green Resistor and Layout in Figure 8)

EVALUATION BOARD LAB SETUP

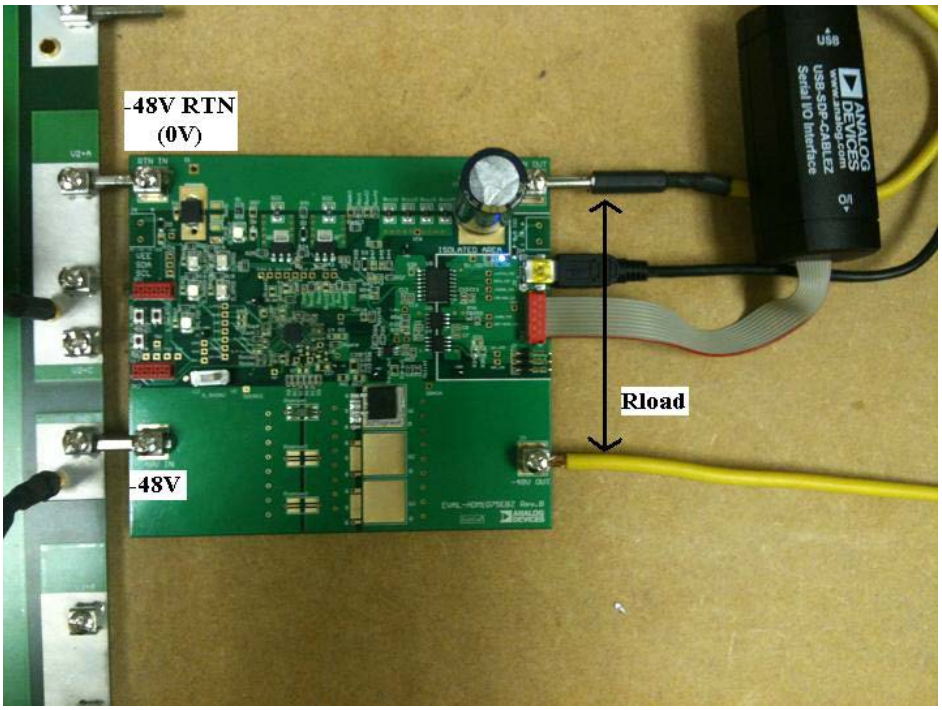

Figure 10. Board Lab Setup

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)

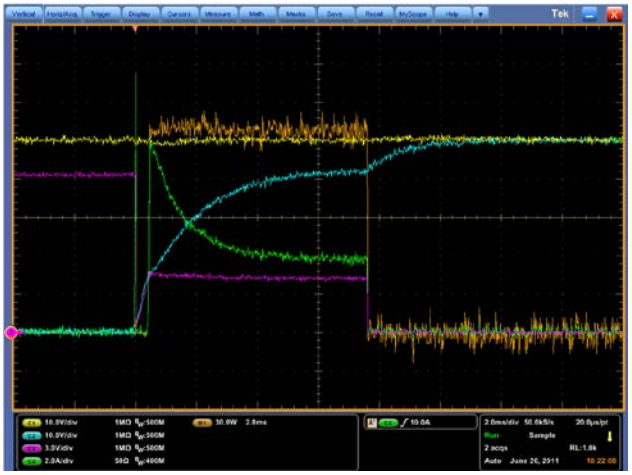

Figure 14. Severe OC Event; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green); M1 = FET Power (CH2 × CH4) (Orange)

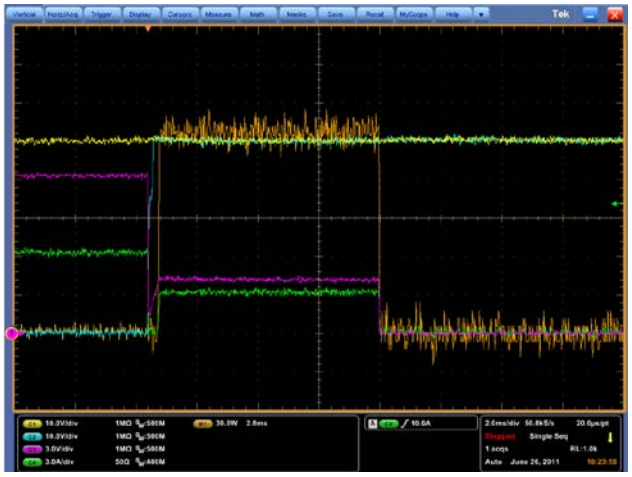

Figure 15. Short Circuit Event; Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green); M1 = FET Power (CH2 × CH4) (Orange)

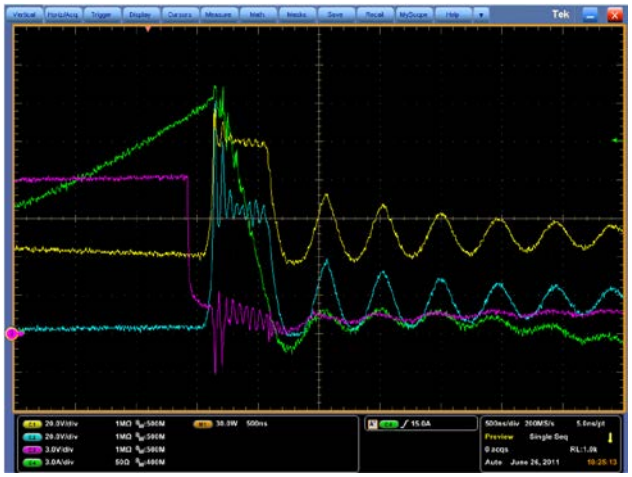

Figure 16. Short-Circuit Event (Zoom); Channel 1 = VIN (Yellow); Channel 2 = V_{DS} (Blue); Channel 3 = Gate (Pink); Channel 4 = System Current (Green)

EVALUATION BOARD SCHEMATICS AND ARTWORK

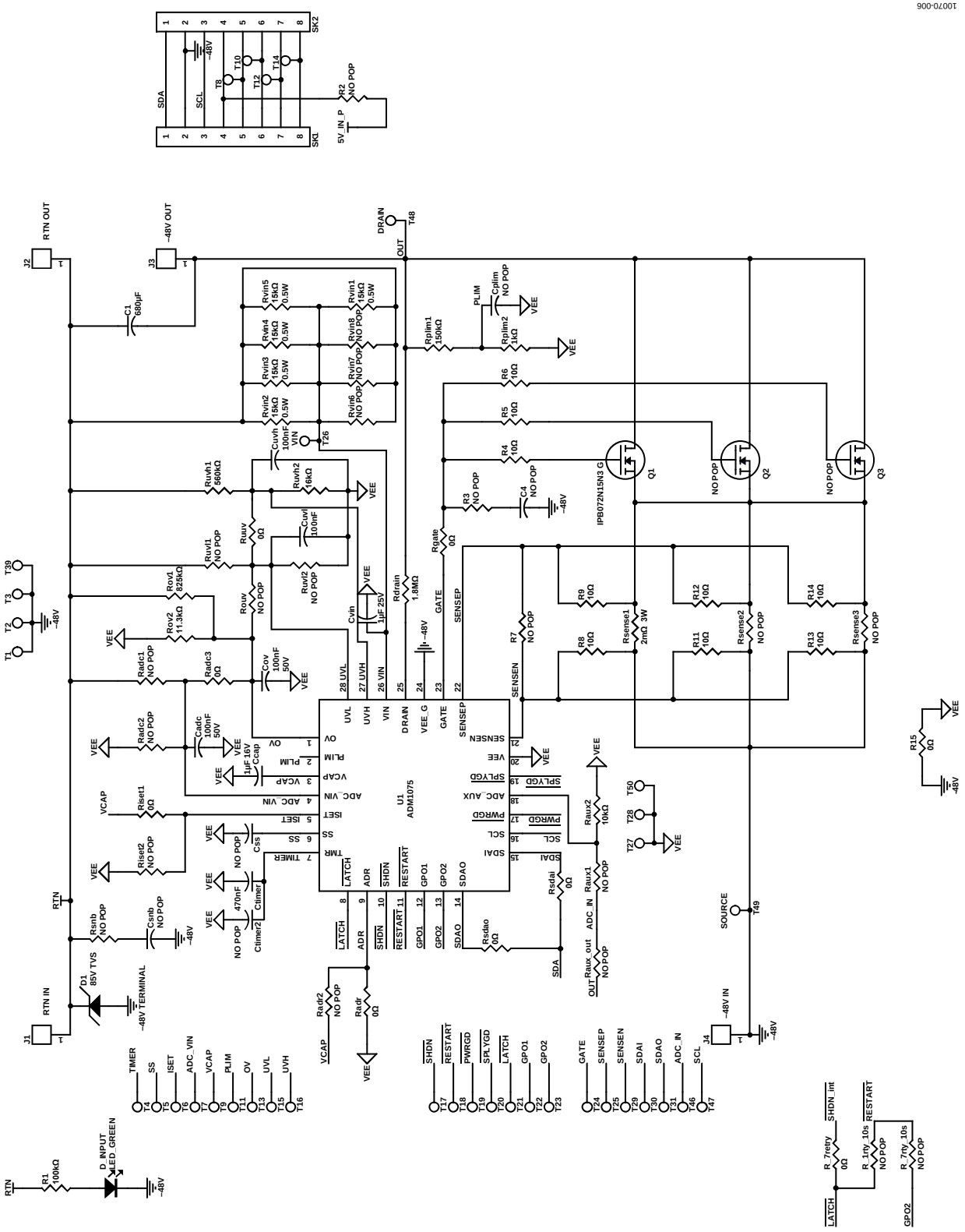

Figure 17. Evaluation Board Schematic, Page 1

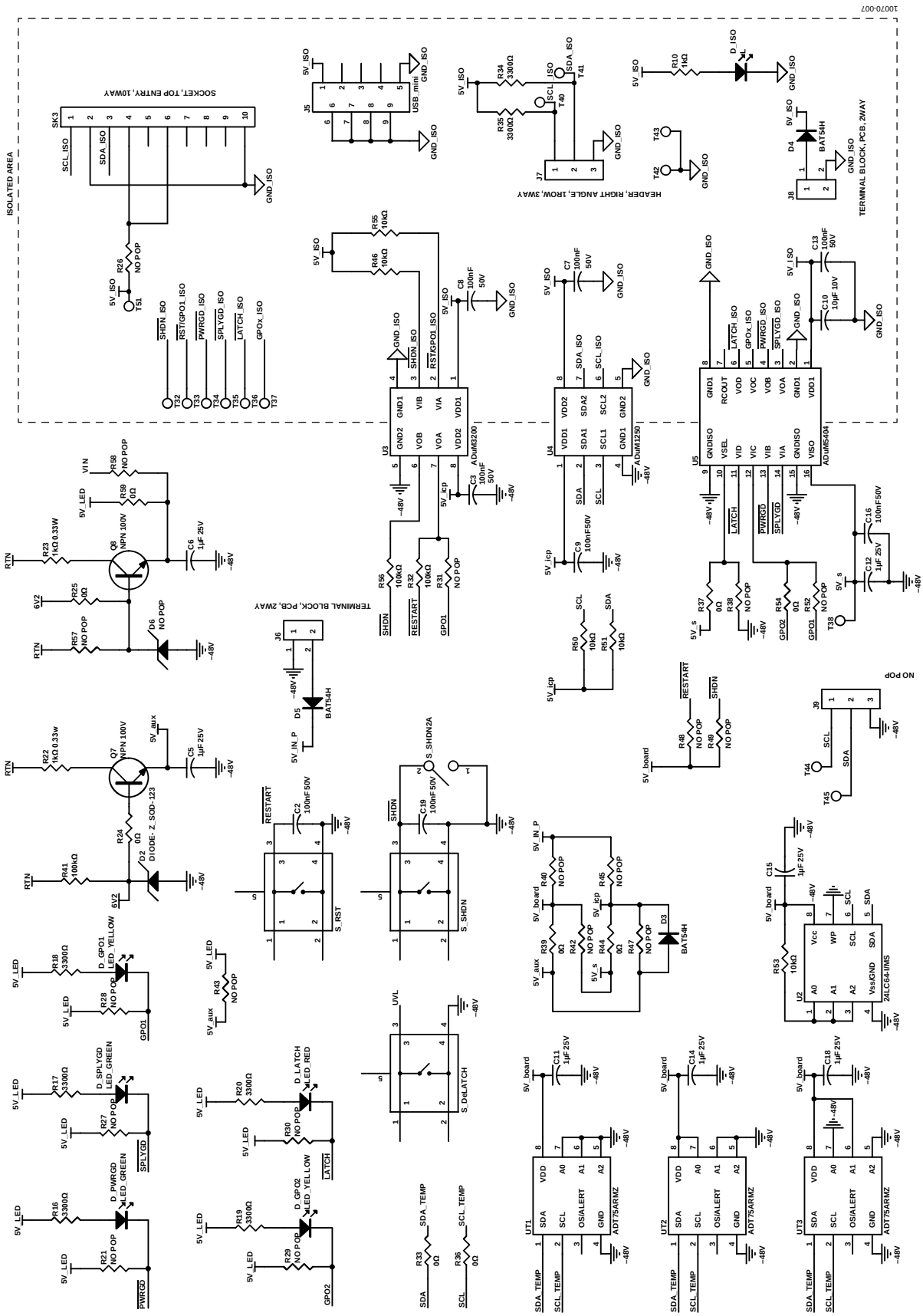

Figure 18. Evaluation Board Schematic, Page 2

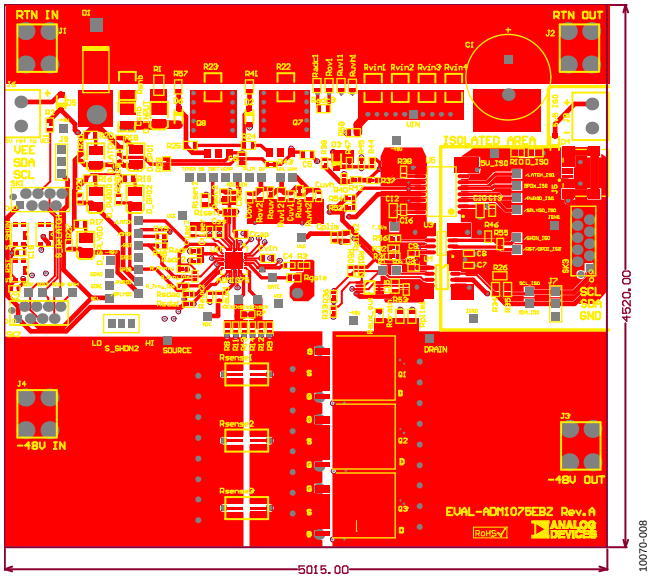

Figure 19. Top Layer

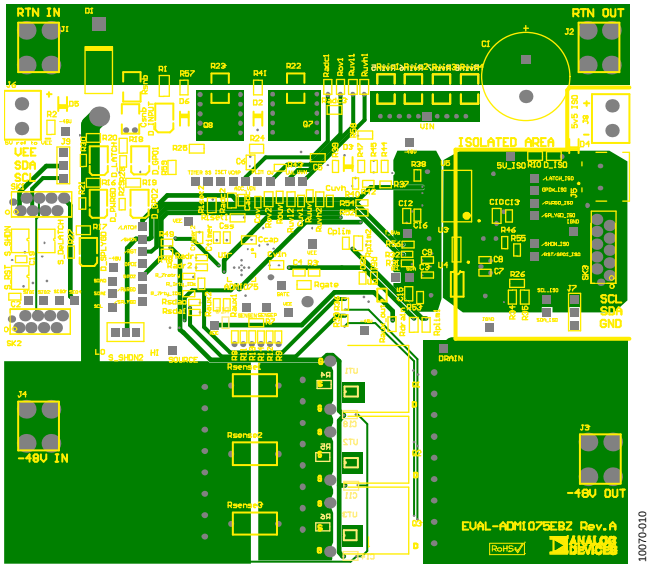

Figure 21. Middle Layer 2

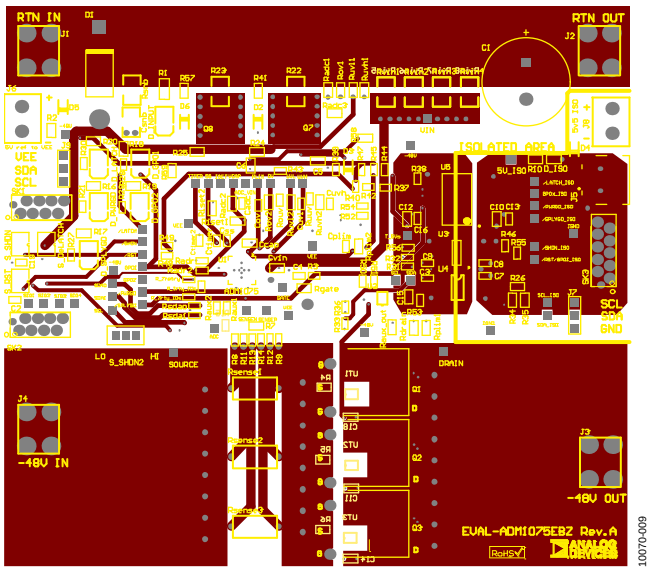

Figure 20. Middle Layer 1

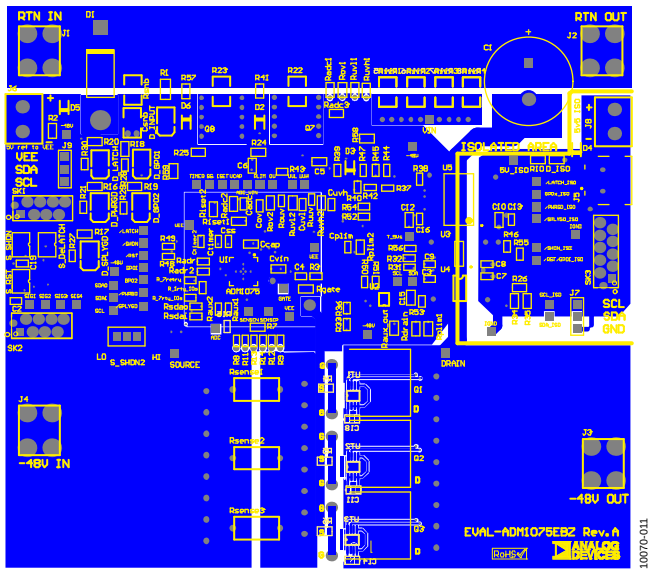

Figure 22. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 8.

Reference Designator	Description	Farnell	Digi-Key
C1	680 µF, 100 V capacitor, CAPPR7.5-18 × 35.5	9692657	
Css	Not populated, 0603, capacitor		
Ctimer	470 nF, 0603, capacitor	1828894	
Q1	IPB072N15N3 G, FET_mix4		
Q2	Not populated, FET_mix4		
Q3	Not populated, FET_mix4		
Q7, Q8	NPN, 100 V, SOT-2-23	1700708	
Riset1	0 Ω, 0805, resistor		
Riset2	Not populated, 0805, resistor		
Ruvh1	560 kΩ, 0805, resistor	1570789	
Ruvh2	16 kΩ, 0805, resistor	1652925	
Rov1	825 kΩ, 0805, resistor	2139113	
Rov2	11.3 kΩ, 0805, resistor		541-11.3KCDKR-ND
Ruvl1	Not populated, 0805, resistor		
Ruvl2	Not populated, 0805, resistor		
Ruuv	0 Ω, 0603, resistor		
R_1rty_10s	Not populated, 0603, resistor		
R_7rty_10s	Not populated, 0603, resistor		
R_7retry	0 Ω, 0603, resistor		
Rplim1	150 kΩ, 0805, resistor	1500680	
Rplim2	1 kΩ, 0805, resistor	9333711	
Rdrain	1.8 MΩ, 0805, resistor	1576163	
Rsense1	2 mΩ, 3 W, Rsense_2512	1292508	
Rsense2	Not populated, Rsense_2512		
Rsense3	Not populated, Rsense_2512		
C2, C3, C7, C8, C9, C13, C16, C19, Cadc, Cov	100 nF, 50 V, 0603, capacitor	1692286	
C4, Cplim, Ctimer2	Not populated, 0603, capacitor		
C5, C6, C11, C12, C14, C15, C18, Cvin	1 µF, 25 V, 0805, capacitor	1637035	
C10	10 µF, 10 V, 0805, capacitor	1833812	
Ccap	1 µF, 16 V, 0805, capacitor	1288256	
Csnb, Rsnb, Rvin6, Rvin7, Rvin8	Not populated, 1210		
Cuvh, Cuvl	100 nF, 0603, capacitor	1692286	
D1	85 V TVS, DIO18.84-9.6 × 5.6		SMCJ85ABCT-ND
D2	DIODE-Z_SOD-123	1757814	
D3, D4, D5	BAT54H, SOD-123	1757752	
D6	Not populated, SOD-123		
D_GPO1, D_GPO2	Yellow LED, PLCC-2	1328365	
D_INPUT, D_PWRGD, D_SPLYGD	Green LED, PLCC-2	1226376	
D_ISO	Blue LED, 0805	8529876	
D_LATCH	Red LED, PLCC-2	1328348	
J1	RTN IN, TERMINAL-8191		7691K-ND
J2	RTN OUT, TERMINAL-8191		7691K-ND
J3	−48V OUT, TERMINAL-8191		7691K-ND
J4	−48V IN, TERMINAL-8191		7691K-ND
J5	USB_Mini, USB/SM0.8-6H5	1125348	
J6, J8	Terminal block, PCB, 2-way	151789	
J7	Header, right angle, 1 row, 3-way	9733450	
J9	Not populated, 3-pin header		
R1	100 kΩ, 1206, resistor	1576656	

Reference Designator	Description	Farnell	Digi-Key
R2, R7, R26, R57, R58, Radc1, Radc2, Raux_out	Not populated, 0805, resistor		
R3, R21, R27, R28, R29, R30, R31, R38, R40, R42	Not populated, 0603, resistor		
R43, R45, R47, R48, R49, R52, Radr2, Raux1, Rouv	Not populated, 0603, resistor		
R4, R5, R6	10 Ω, 0805, resistor	1469859	
R8, R9, R11, R12, R13, R14	10 Ω, 0603, resistor	1469751	
R10	1 kΩ, 0805, resistor	9333711	
R15, R33, R36, R37, R39, R44, R54, Radr, Rsdai, Rsdao	0 Ω, 0603, resistor		
R16, R17, R18, R19, R20, R34, R35	33 kΩ, 0805, resistor	1469911, 1738911	
R22, R23	1 kΩ, 0.33 W, 1210	1577394	
R24, R25, R59, Radc3, Rgate, Riset1	0 Ω, 0805, resistor		
R32, R56	100 kΩ, 0603, resistor	1469649	
R41	100 kΩ, 0805, resistor	1469860	
R46, R50, R51, R53, R55, Raux2	10 kΩ, 0603, resistor	1738918	
Rvin1, Rvin2, Rvin3, Rvin4, Rvin5	15 kΩ, 0.5 W, 1210	1739028	
SK1, SK2	8-way Micro-MaTch	148593	
SK3	Socket, top entry, 10-way Micro-MaTch	148600	
S_DeLATCH, S_RST, S_SHDN	Switch push-button MCIPTG23K-V	1605470	
S_SHDN2	3-pin switch SWITCH-DPST	1123875	
T1 to T51	Test points, not populated		
U1	ADM1075-1ACPZ, 28-lead LFCSP		
U2	24LC64-I/MS, MSOP-8	1331335	
U3	ADuM3200, dual-channel, digital isolator, enhanced system-level ESD reliability		
U4	ADuM1250, hot swappable dual I^2C isolator, 8-lead SOIC		
U5	ADuM5404, quad-channel isolators with integrated dc-to-dc converter, 16-lead SOIC		
UT1, UT2, UT3	ADT75ARMZ, ±2°C accurate, 12-bit digital temperature sensor, 8-lead MSOP		

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.

UG10070-0-4/13(B)

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