

Evaluating the LTC4287 High Voltage Positive Hot Swap Controller with Power Monitor and PMBus**FEATURES**

- ▶ Fully functional evaluation board for the [LTC4287](#) in the parallel mode
- ▶ Populated with 54 V, 72 A, 5 mF design
- ▶ 40 V undervoltage and 60 V overvoltage settings
- ▶ Flexible NMOSFET footprint suits different packages
- ▶ Supports up to eight parallel sense resistors and four parallel MOSFETs in each channel
- ▶ LED indicated status outputs
- ▶ Wide input voltage range: 8.5 V to 80 V
- ▶ 100 V absolute maximum
- ▶ MOSFET temperature measurement capability
- ▶ I²C/PMBus communication

EVALUATION KIT CONTENTS

- ▶ EVAL-LTC4287-A1Z evaluation board

DOCUMENTS NEEDED

- ▶ LTC4287 data sheet

ADDITIONAL HARDWARE NEEDED

- ▶ USB-to-PMBus controller for use with LTpowerPlay®, [DC1613A](#) (not included, must be ordered separately)

SOFTWARE NEEDED

LTpowerPlay, Windows-based development software (download from [LTpowerPlay | Analog Devices](#))

GENERAL DESCRIPTION

The EVAL-LTC4287-A1Z is a fully featured evaluation board for the LTC4287. The board layout provides a clear example 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 the evaluation of high-current hot-swap setups.

Eight sense resistor footprints and four (two on the bottom side) multipackage metal-oxide semiconductor field-effect transistor MOSFET footprints provide great flexibility and allow a wide range of application setups.

Multiple test points allow easy access to all critical points and pins. Seven light emitting diodes LEDs provide direct visual indication of board status, such as supply input, output, SDA, SCL, ALERT, power good, and fault.

The board supports PMBus™ communication, allowing the user to communicate with the LTC4287.

The board is fully compatible with the LTpowerPlay evaluation software, which can be downloaded from the LTpowerPlay page.

A USB-to-I²C controller (DC1613A) is required to use the evaluation software.

The standard evaluation kit is prepopulated and tested with a 54 V, 72 A hot-swap design capable of working with a 5 mF output capacitor.

Full specifications on the LTC4287 are available in the LTC4287 data sheet available from Analog Devices, Inc., and must be consulted with this user guide when using the EVAL-LTC4287-A1Z evaluation board.

TABLE OF CONTENTS

Features.....	1	Setup.....	8
Evaluation Kit Contents.....	1	MOSFET.....	8
Documents Needed.....	1	Sense Resistors.....	9
Additional Hardware Needed.....	1	Board EVAL-LTC4287-A1Z Specifications.....	10
Software Needed.....	1	Evaluation Board Hardware.....	11
General Description.....	1	Connector and LED Functions.....	11
EVAL-LTC4287-A1Z Evaluation Board Layout.....	3	Test Plots.....	13
Quick Start Guide.....	4	Evaluation Board Schematics and Artwork.....	14
Warning and Measurement Techniques.....	4	Ordering Information.....	21
EVAL-LTC4287-A1Z Setup.....	5	Bill of Materials.....	21
Control with LTpowerPlay.....	6	Notes.....	23

REVISION HISTORY**6/2023—Revision 0: Initial Version**

EVAL-LTC4287-A1Z EVALUATION BOARD LAYOUT

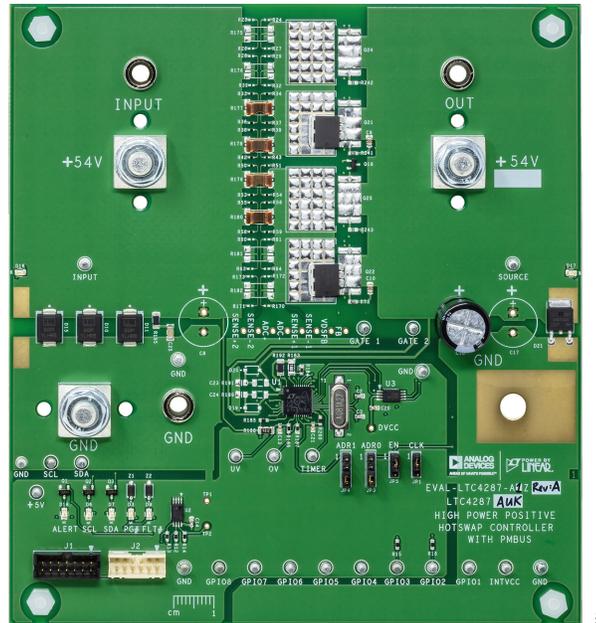


Figure 1. Evaluation Board Layout

QUICK START GUIDE

The EVAL-LTC4287-A1Z evaluation board is easy to setup to evaluate the performance of the [LTC4287](#). See [Figure 2](#) for the proper measurement equipment setup and refer to the following procedures.

WARNING AND MEASUREMENT TECHNIQUES

The EVAL-LTC4287-A1Z is capable of operation in excess of 80 A. At this current and power level, there is a danger of serious personal injury and equipment damage if proper techniques are not used. All cabling between the power supply and the load should be capable of handling the current levels used, including the GND connection to the EVAL-LTC4287A1Z.

Additionally, the high currents and fast transients can cause unexpected voltage drops in cables connecting the test equipment to the EVAL-LTC4287A1Z due to parasitic resistance and inductance. The cable drops may cause ground loops for the current through various cables and scope probes. This causes unexplained ringing, distorted oscilloscope waveforms, voltage and current spikes, and signals appearing to be below ground.

A common sneak path for current is the third wire grounds used on power cords of test equipment in use. Using ground lifting connectors at the wall outlet do not necessarily alleviate these effects since most equipment has line bypassing capacitors between the mains voltage and local chassis ground. Isolating test equipment using line isolation transformers with low primary to secondary capacitance is recommended. Probe ground leads may intercept induced fields from the high current paths and should be minimized or avoided.

Another method to remove these artifacts is the use of a differential scope probe connected between the signal to be observed and a ground connection located close to the point of measurement.

A very large, low effective series resistance (ESR) capacitor from INPUT to GND can reduce supply droop and ground bounce during testing.

Also be careful to not allow an open ground from the power supply or load to cause return current through the grounds of the various devices connected to the demo board. This may present a fire hazard or cause damage to the test equipment.

The EVAL-LTC4287-A1Z is set up to operate in a 54 V system at current levels up to 72 A. The board is designed to work at 72 A in a normal laboratory environment with natural convection.

If the current limit is increased or the board is operated in a high temperature environment, additional airflow is needed to keep it within safe thermal operating limits for continuous operation. If additional current is required without sufficient airflow, multiple MOSFETs should be connected in parallel with the existing MOSFETs to lower their I^2R losses.

EVAL-LTC4287-A1Z SETUP

To set up and start using the evaluation board, take the following steps:

1. On a Windows PC, download and install the LTpowerPlay application from <https://www.analog.com/en/design-center/ltpower-play.html>.
2. Connect the evaluation board (EVAL-LTC4287-A1Z) to the above PC through the 12-way connector, J2, and the USB-to-I²C controller (DC1613A).
3. Connect a power supply to the evaluation board using thick wires (8 AWG or 10 mm²) suitable for the current levels to be observed.
4. To confirm that the boards are configured correctly, set the output of the power supply to 54 V with less than 1 A current limit and with no load capacitance. If the boards are configured correctly, the green LED (labeled PG#) on the evaluation board illuminates.
5. Move the EN jumper, JP5, to the lower position. The green LED (labeled PG#) turns off and then turns back on again when JP5 is moved back to the upper position.
6. If a fault event occurs (for example, a short-circuit during operation), the red LED (labeled FLT#) illuminates. This fault can be cleared by toggling the ENABLE pin after the fault condition has been removed.
7. Disable the hot swap using the **Hot-Swap Control** section in the **Basic Operation** tab of the software graphical user interface (GUI). Disabling the hot-swap turns off the green LED (labeled PG#) on the evaluation board.

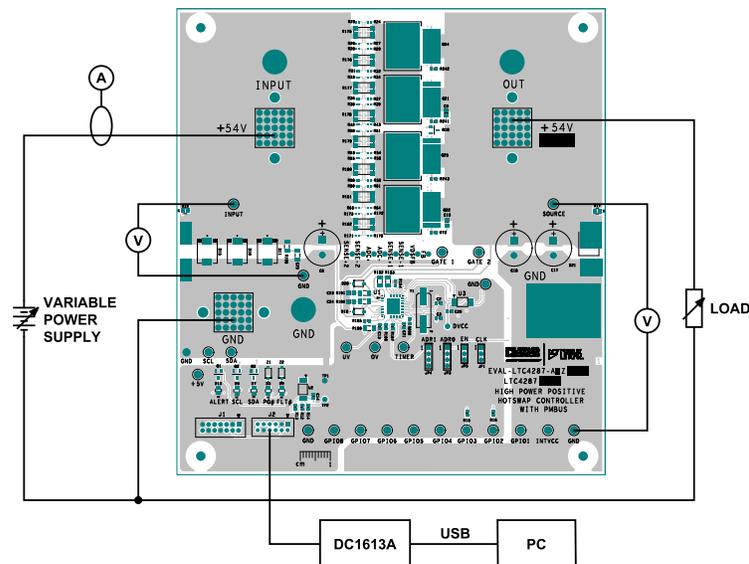


Figure 2. Basic EVAL-LTC4287-A1Z Connection Diagram

EVAL-LTC4287-A1Z SETUP

CONTROL WITH LTpowerPlay

LTpowerPlay is a convenient PC GUI that gives complete access to the registers of the [LTC4287](#) and many other Analog Devices power system management devices. It can be used to configure and debug the application. LTpowerPlay communicates using the I²C bus in the demo system (covered in this user guide) or in a real-world product environment. It provides unprecedented control over the Analog Devices chips on the I²C bus. Use it during board bring-up to tune and optimize the power system parameters and during system debug to view critical system information and troubleshoot board design or manufacturing issues. LTpowerPlay includes extensive help and documentation under the **Help** menu. Online help includes quick-start videos and tutorials, and detailed technical documentation from the Analog Device website.

Launch the LTpowerPlay GUI on the PC. The software identifies the [DC1613A](#) controller. Click on the **Detect Chips** button.

LTpowerPlay searches the PMBus for all supported devices. After establishing communication with the LTC4287, the GUI displays the main window ([Figure 4](#)).

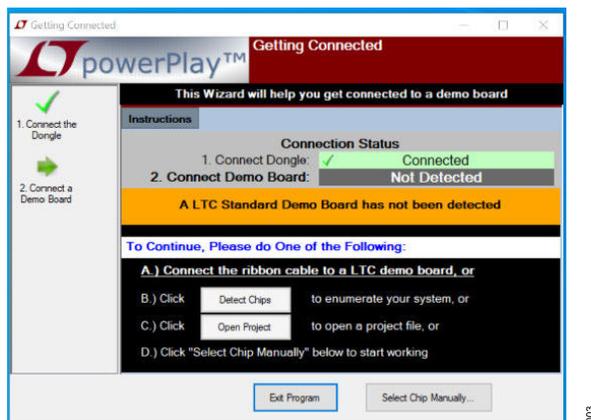


Figure 3. LTpowerPlay – Getting Connected Window

EVAL-LTC4287-A1Z SETUP

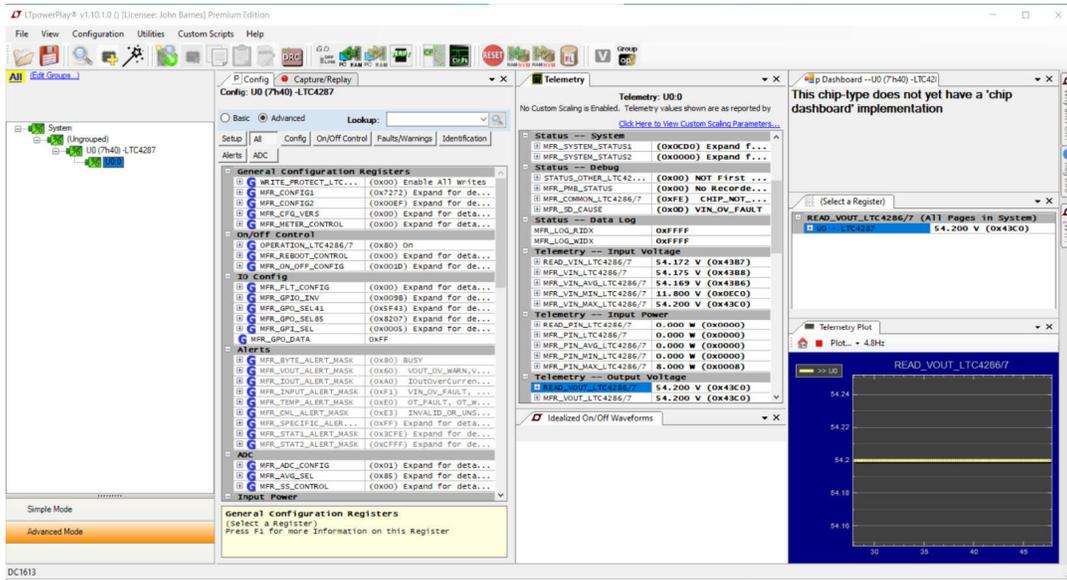


Figure 4. LTpowerPlay—Main Window

EVAL-LTC4287-A1Z SETUP

SETUP

The value of the current-sense resistors RS1 (SENSE) and RS2 (SENSE2) must be set in LTpowerPlay.

Click on the **SETUP** button. Locate the setting for **RS1** and **RS2**. Enter the value of the current-sense resistor.

For the EVAL-LTC4287-A1Z enter 0.500 as shown in [Figure 5](#).

It is necessary to set the value of RS each time LTpowerPlay is launched. The value of RS is used in the calculation of current and power.

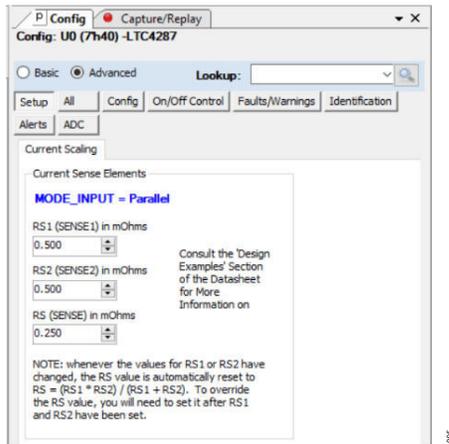


Figure 5. LTpowerPlay Settings RS1 and RS2

To update registers contents, click or type to change the required registers,, then in the top toolbar, click the **PC to RAM** button. LTpowerPlay writes changes to the updated registers.



Figure 6. PC to RAM Button Transfers Data Programmed from the GUI to the LTC4287 Volatile Registers

Note that to program the registers in the [LTC4287](#), turn off the pass MOSFET.

Most of the registers have immediate control over their respective chip functions. Changing them while the MOSFET is on has unpredictable and adverse effects. LTpowerPlay implements limits to writing some registers, based upon the device state, and pops up warnings when necessary. In the LTpowerPlay main window (see [Figure 4](#)), there is the **Telemetry** pane window (see [Figure 7](#)) that displays read-only information contained in the status registers of the selected part. The GUI periodically polls the I²C bus and updates the telemetry contents in real time, along with a user-friendly interpretation of the bits.

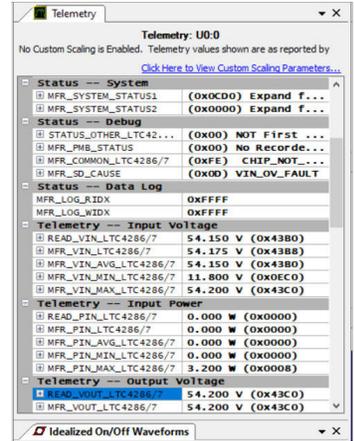


Figure 7. LTpowerPlay – Telemetry Pane Window

MOSFET

The EVAL-LTC4287-A1Z uses a custom MOSFET footprint, shown in [Figure 8](#), to accommodate a variety of common MOSFET packages, including D2PAK, DPAK, LFPAK, and other SO-8 variants.

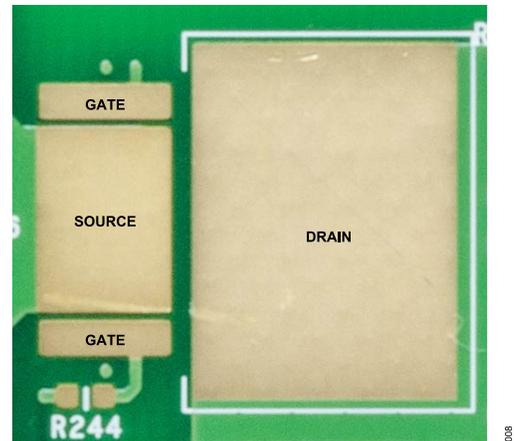


Figure 8. Multipackage N-Channel MOSFET Footprint

SENSE RESISTORS

For optimum current sensing accuracy with standard 2512 sense resistors, the footprint shown in [Figure 9](#) is preferred. This footprint may not be optimized to all resistors, and results may vary depending on resistor composition and size. The center pads are used as the Kelvin connection to sense the voltage at the resistor. Some resistors provide more accurate results if sensed at the inner edge of the resistor (labeled A in [Figure 9](#)).

Consult and follow the guidance provided by the resistor manufacturer.

The board can be configured with up to twelve current-sense resistors.

The Kelvin connections are combined using a resistive network made with 0402 resistors.

If replacing the current-sense resistors, it is the responsibility of the user to ensure that the layout dimensions and structure of the footprint comply with individual SMT manufacturing requirements. Failure to do this may result in inaccurate telemetry.

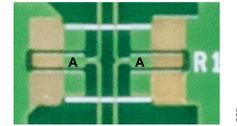


Figure 9. Sense Resistor – Kelvin Footprint

BOARD EVAL-LTC4287-A1Z SPECIFICATIONS**Table 1. EVAL-LTC4287-A1Z Specifications**

Parameter	Typical Value	Unit
Load Capacitance	5000	μF
Severe Circuit Breaker Current	216	A
Normal Current Limit	72	A
Start-Up time	100	ms
Maximum Ambient Temperature	60	°C
UV (Falling) Threshold	32	V
OV (Rising) Threshold	63	V
PG# Falling Threshold	30	V

EVALUATION BOARD HARDWARE

CONNECTOR AND LED FUNCTIONS

Table 2. Power Input and Signal Connections

Nomenclature	Connector	Description
+V Input	M6 stud, E30 (banana)	Power input
+V Output	M6 stud, E31 (banana)	Power output
GND	M6 stud, E21 (banana)	Power supply common
DC1613A	J2	I ² C/SMBus/PMBus
DC590B or DC2026C (optional)	J1	I ² C



Figure 10. Jumper Configuration

Table 3. Default Jumper Configuration

Jumper Name	Description	Default
JP1	CLOCK SELECT	1-2 (internal)
JP3, JP4	ADRO and ADR1	3-4 (address 7h40)
JP5	EN	1-2 (enabled)

Table 4. Test Points, Turrets

Nomenclature	Description
INPUT	+V Input test point
SOURCE	+V Output test point
GND	Multiple GND test points
INTV _{CC}	Internal INTV _{CC} pin
UV	UV input pin
OV	OV input pin
TIMER	Current Limit TMR pin
GATE1	GATE1 pin
GATE2	GATE2 pin
SCL	I ² C clock
SDA	I ² C data
GPI01	Power Good, PG# ¹
GPI02	Fault, FLT# ¹
GPI03	Temp Sensor (Q18) ¹
GPI04	ALERT
GPI05	Reserved
GPI06	Reserved
GPI07	Reserved
GPI08	OP1_STATUS, Over-Power ¹

¹ With the default EVAL-LTC4287-A1Z settings.

EVALUATION BOARD HARDWARE

Table 5. Other Test Points

Nomenclature	Description
INTV _{CC}	LTC4287
DV _{CC}	LTC4287 Internal Logic Supply
SENSE+1	Positive Current Limit input, Channel 1
SENSE-1	Negative Current Limit input, Channel 1
SENSE+2	Positive Current Limit input, Channel 2
SENSE-2	Negative Current Limit input, Channel 2
ADC+	Positive Sense Input to the ADC
ADC-	Negative Sense Input to the ADC

Table 6. LED Indicators

Nomenclature	Designation	Description
INPUT	D16 (Green)	Input Power Indicator
OUTPUT	D17 (Green)	Output Indicator
PG#	D3 (Green)	Power Good ¹
SCL	D6 (Green)	I ² C clock
SDA	D7 (Green)	I ² C data
FLT#	D9 (Red)	FLT# ¹
ALERT	D18 (Red)	ALERT ²

¹ With the default EVAL-LTC4287-A1Z settings.

² The ALERT LED is driven by the IOUT_OC_STATUS OUTPUT in the default configuration. This can be changed by writing to the registers.

TEST PLOTS

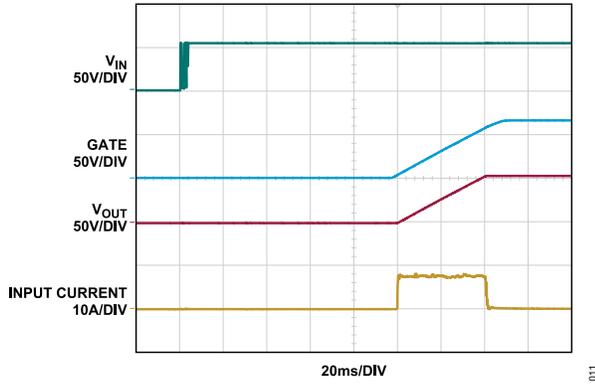


Figure 11. Power Up with a 5 mF Load Capacitor and No DC Load

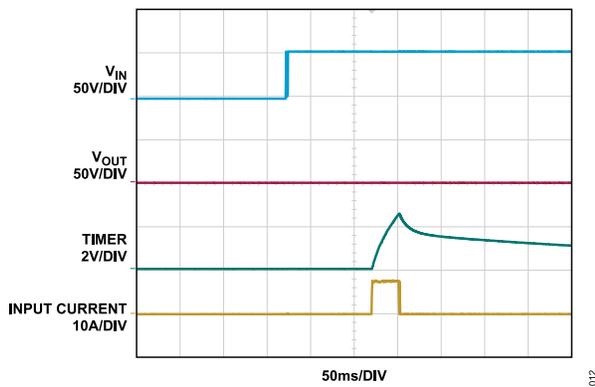


Figure 12. Power Up into a Short Circuit

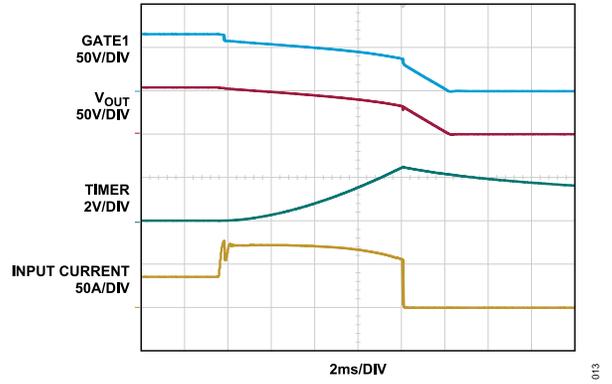


Figure 13. Overcurrent (Load Current Stepped from 35 A to 84 A)

The LTC4287 responds by limiting the current to 72 A. The excess load current is supplied from the output capacitor and the output voltage falls. The timer expires and the MOSFET is turned off.

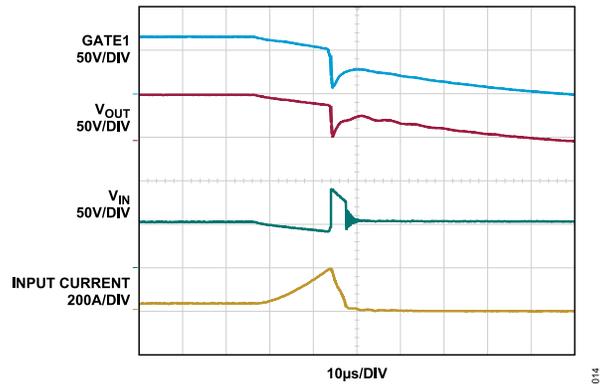


Figure 14. Severe Overcurrent (Hot-Swap Supplied at 35 A and Short-Circuit Applied)

EVALUATION BOARD SCHEMATICS AND ARTWORK

510

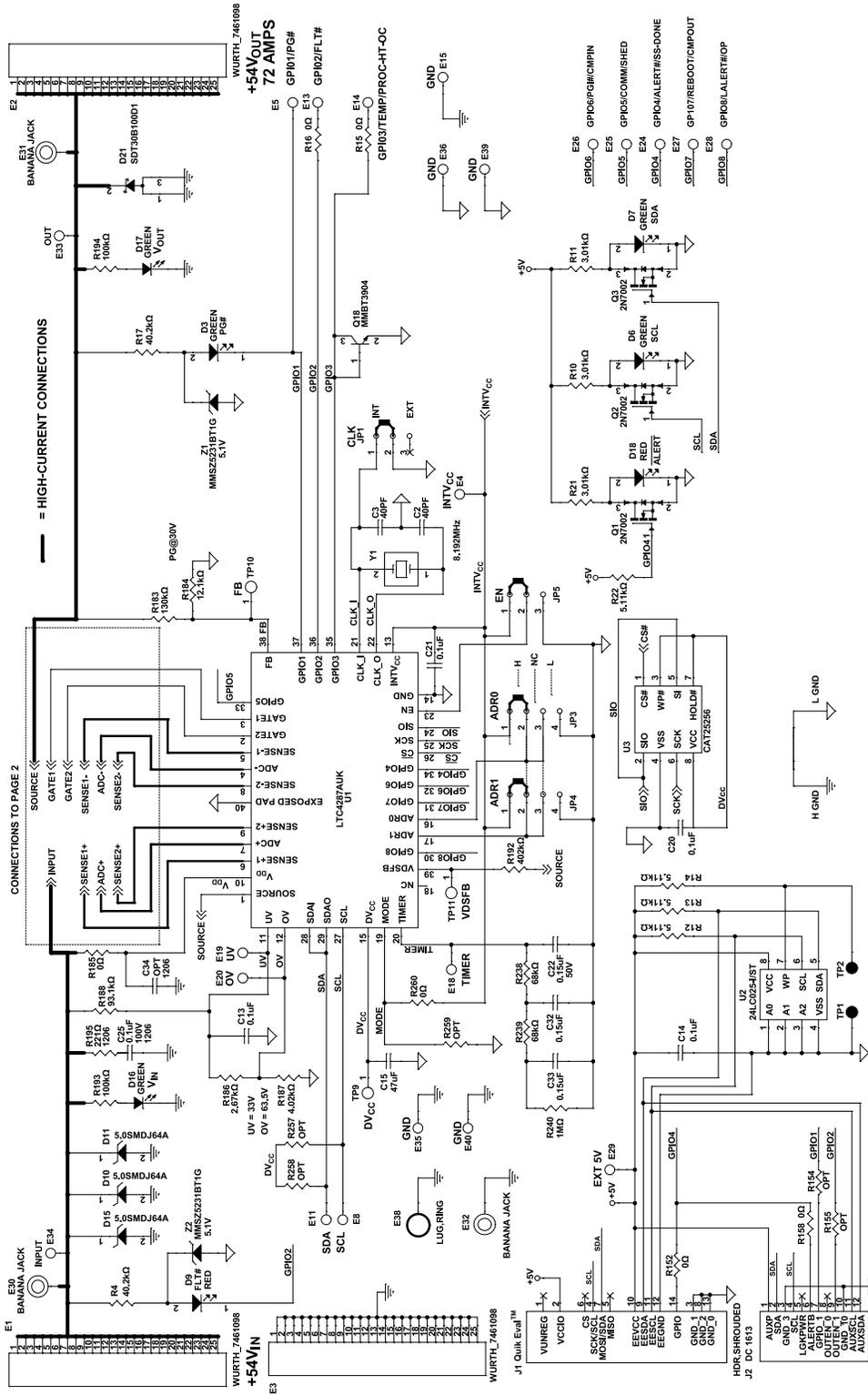
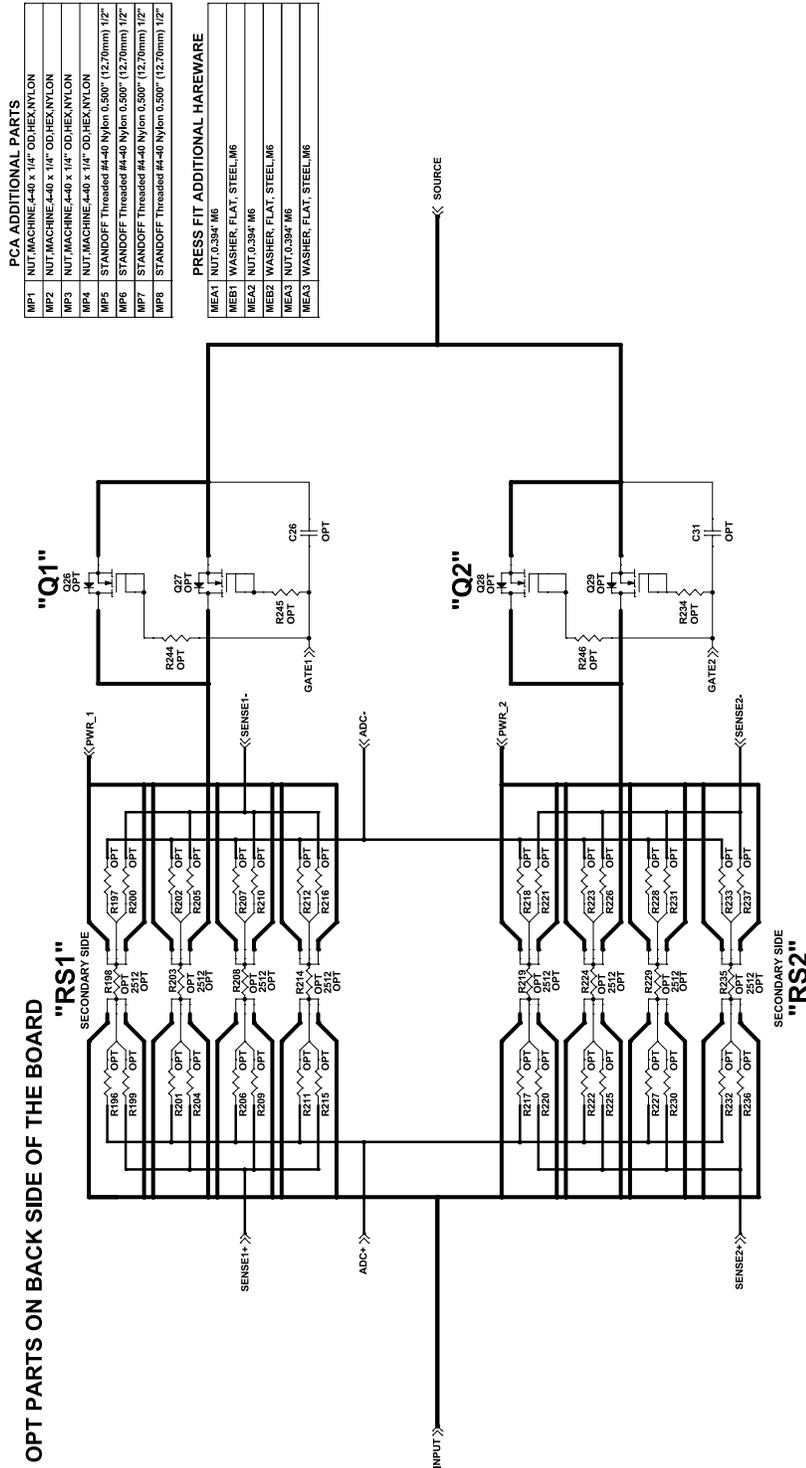


Figure 15. EVAL-LTC4287-A1Z Schematic, Part 1

EVALUATION BOARD SCHEMATICS AND ARTWORK

110



PCA ADDITIONAL PARTS

MP1	NUT, MACHINE #4-40 x 1/4" OD, HEX, NYLON
MP2	NUT, MACHINE #4-40 x 1/4" OD, HEX, NYLON
MP3	NUT, MACHINE #4-40 x 1/4" OD, HEX, NYLON
MP4	NUT, MACHINE #4-40 x 1/4" OD, HEX, NYLON
MP5	STANDOFF Threaded #4-40 Nylon 0.500" (12.70mm) 1/2"
MP6	STANDOFF Threaded #4-40 Nylon 0.500" (12.70mm) 1/2"
MP7	STANDOFF Threaded #4-40 Nylon 0.500" (12.70mm) 1/2"
MP8	STANDOFF Threaded #4-40 Nylon 0.500" (12.70mm) 1/2"

PRESS FIT ADDITIONAL HARDWARE

MEA1	NUT, 0.394" M6
MEA2	WASHER, FLAT, STEEL, M6
MEA3	NUT, 0.394" M6
MEA4	WASHER, FLAT, STEEL, M6
MEA5	NUT, 0.394" M6
MEA6	WASHER, FLAT, STEEL, M6

OPT PARTS ON BACK SIDE OF THE BOARD

"RS1"

SECONDARY SIDE

INPUT

SOURCE

ADC+

ADC-

SENSE1+

SENSE1-

PWR_1

PWR_2

Q1

Q2

SENSE2+

SENSE2-

C26

C31

OPT

UNLESS OTHERWISE NOTED:
 1. ALL RESISTORS ON THIS PAGE ARE 1% 0603.
 2. ALL CAPACITORS ON THIS PAGE ARE RATED FOR 100V.

Figure 17. EVAL-LTC4287-A1Z Schematic, Part 3

EVALUATION BOARD SCHEMATICS AND ARTWORK

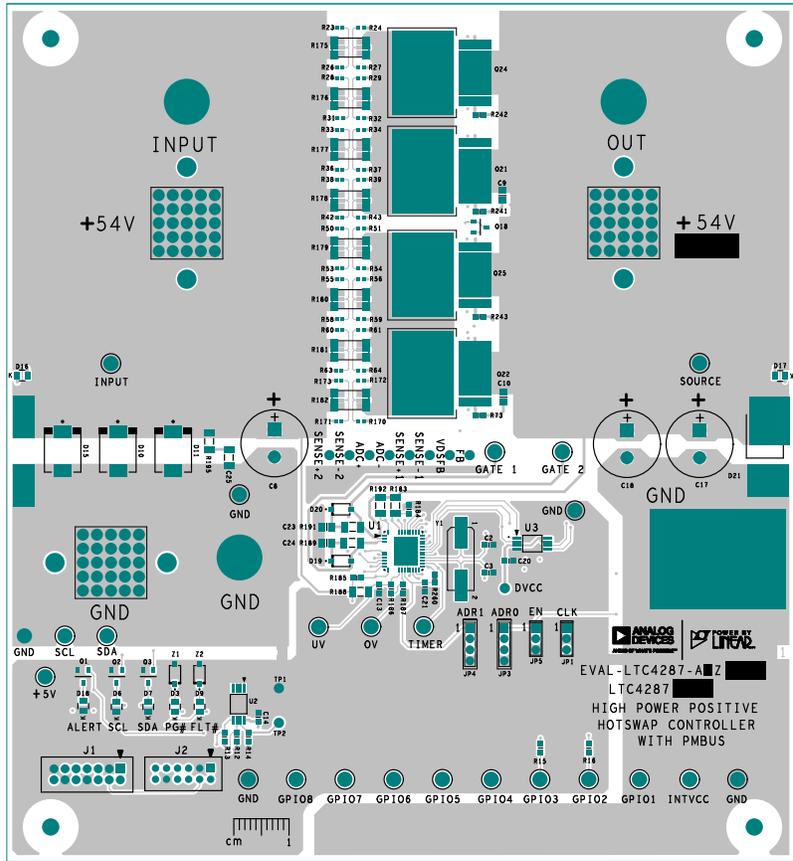


Figure 18. EVAL-LTC4287-A1Z Top Layer 1

EVALUATION BOARD SCHEMATICS AND ARTWORK

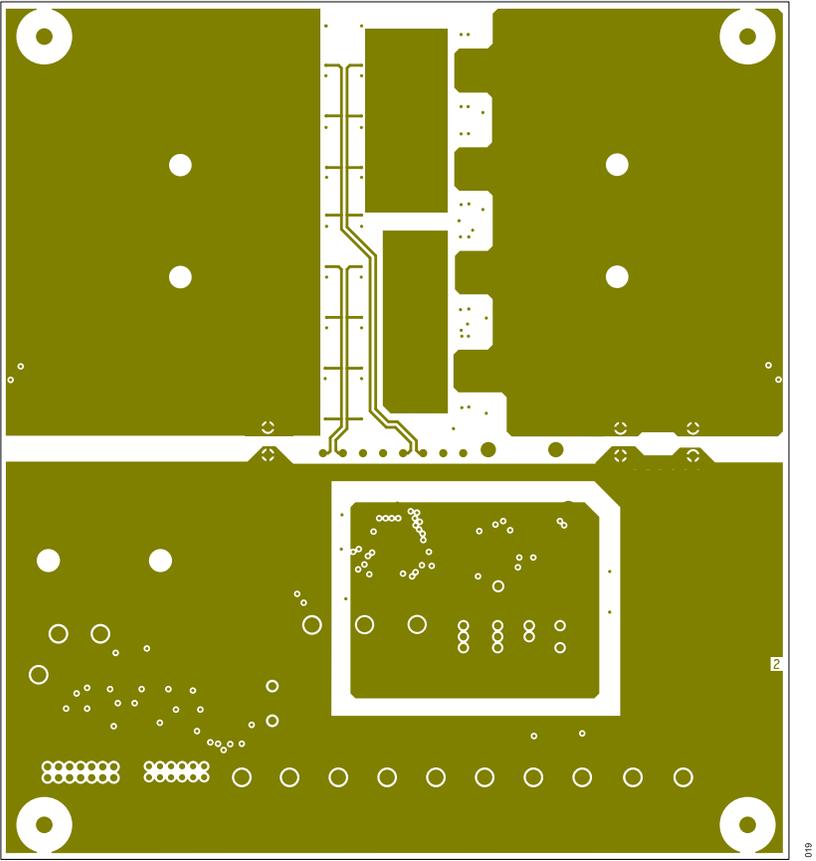


Figure 19. EVAL-LTC4287-A1Z Inner Layer 2

EVALUATION BOARD SCHEMATICS AND ARTWORK

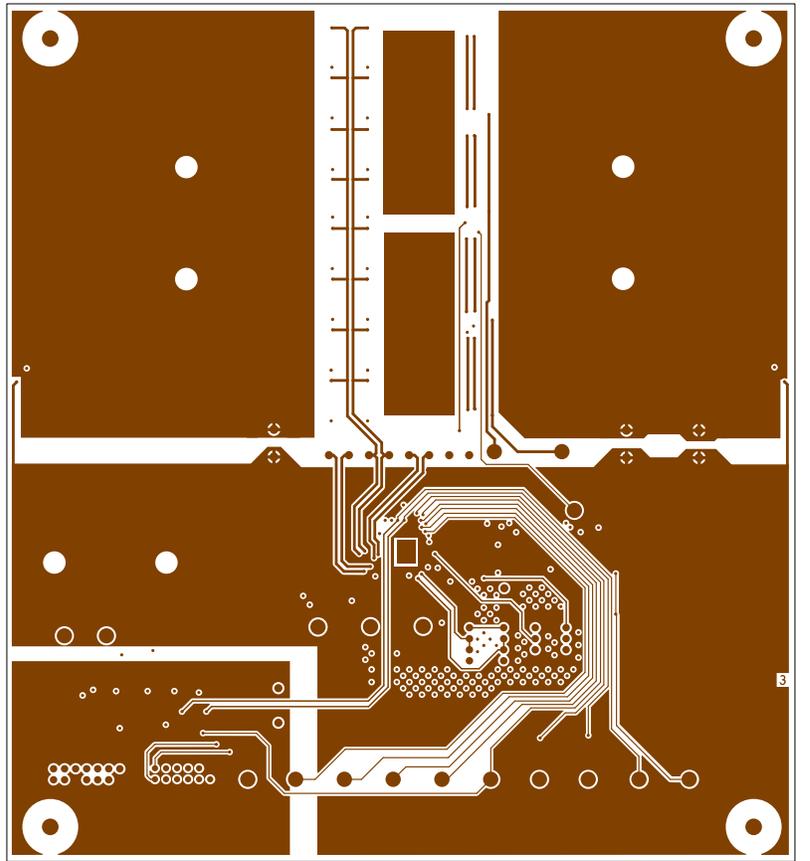


Figure 20. EVAL-LTC4287-A1Z Inner Layer 3

EVALUATION BOARD SCHEMATICS AND ARTWORK

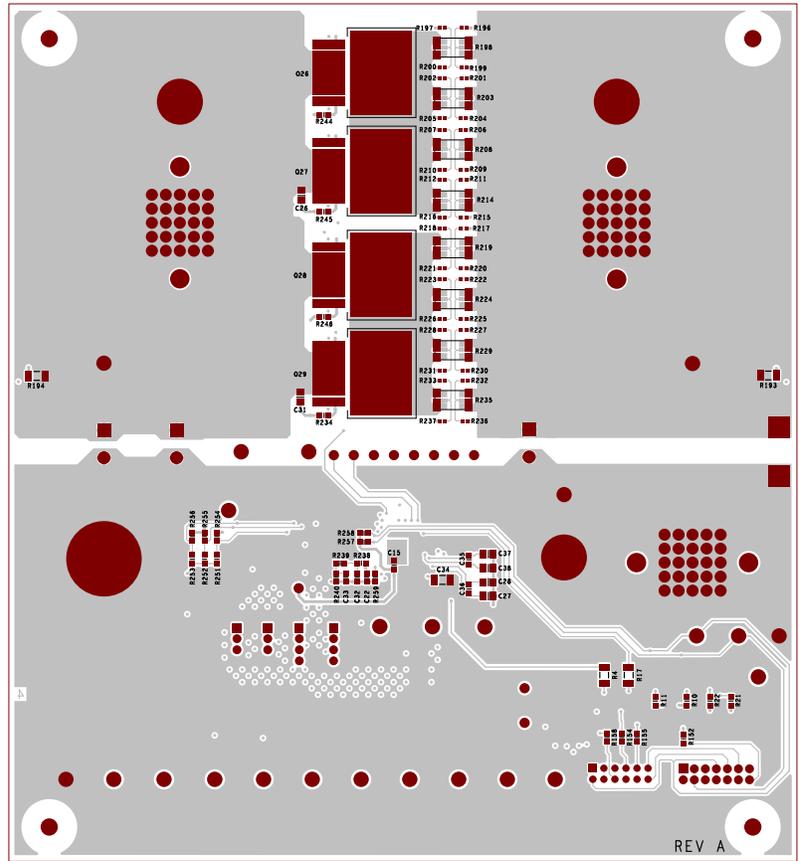


Figure 21. EVAL-LTC4287-A1Z Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 7. Bill of Materials

Reference Designator	Description	Manufacturer	Part Number ¹
C2, C3	Capacitors, 40 pF, C0G, 25 V, 10%, 0603	AVX	06033A400KAT2A
C9, C10	Capacitors, 0.027 μF, X7R, 50 V, 10%, 0805	Kemet	C0805C273J5RAC7800
C13, C14, C20, C21	Capacitors, 0.1 μF, X7R, 25 V, 10%, 0603	AVX	06033C104KAT2A
C15	Capacitor, 47 μF, X5R, 6.3 V, 20%, 0603	Murata	GRM188R60J476ME15D
C18	Capacitor, 100 μF aluminium electrolytic 100 V 10 x 20mm	Nichicon	URZ2A101MHD1TO
C22, C32, C33	Capacitor, 0.15 μF, X7R, 16 V, 10%, 0603	Kemet	CC0603KRX7R7BB154
C23, C24, C26, C27, C28, C31, C37, C38	Capacitors, option, 0805	Not applicable	Not applicable
C25	Capacitor, 0.1 μF, X7R, 100 V, 10%, 1206	AVX	12061C104KAT2A
C34	Capacitor, option, 1206	Not applicable	Not applicable
C35, C36	Capacitors, option, 0603	Not applicable	Not applicable
D3, D6, D7, D16, D17	LEDs, green, water-clear, 0805	Würth Elektronik	150080GS75000
D9, D18	LEDs, RED, water-clear, 0805	Würth Elektronik	150080RS75000
D10, D11, D15	Diodes, TVS, ESD suppressor, 64 V, 5000 W, DO-214AB	Bourns	5.0SMDJ64A
D19, D20	Diodes, option, SOD-123	Not applicable	Not applicable
D21	Diode, Schottky, 100 V, 30 A, TO-252-3	Diodes Inc.	SDT30B100D1-13
E1, E2, E3	Connectors, TERM., shank red cube M6 25 pin, press-fit, THT, brass, tin	Würth Elektronik	7461098
E4, E5, E8, E11, E13, E14, E15, E18, E19, E20, E22, E23, E24, E25, E26, E27, E28, E29, E33, E34, E35, E36, E39, E40	Test points, turret, 0.064" MTG. HOLE, PCB 0.125" THK	Mill-max	2308-4-00-80-00-00-07-0
E30, E31, E32	Connectors, banana jack, female, THT, non-insulated, swage ,0.218"	Keystone	575-4
J1	Connector, header, shrouded plug male, 2 x 7, 2mm, vertical straight thru-hole, keyed	Molex	87831-1420
J2	Connector, header, shrouded male, 2 x 6, 2mm, vertical, straight, thru-hole	Amphenol	98414-G06-12ULF
JP1, JP5	Connectors, header male, 1 x 3, 2 mm, vertical, straight, thru-hole, 10μ" Au	Samtec	TMM-103-02-L-S
JP3, JP4	Connectors, header male, 1 x 4, 2 mm, vertical, straight, thru-hole, 10 μ" Au	Samtec	TMM-104-02-L-S
MEA1, MEA2, MEA3	Nuts, 10.01 mm; M6	B&F Fastener Supply	MHNZ 006
MEB1, MEB2, MEB3	Washers, flat, steel, M6	B&F Fastener Supply	MFWZ 006
MP1, MP2, MP3, MP4	Nuts, machine, 4-40 x 1/4" , hex, nylon	Keystone	9605
MP5, MP6, MP7, MP8	Standoffs threaded #4-40 Nylon 0.500" (12.70 mm) 1/2"	RAF Electronic Hardware	4534-440-N
Q1, Q2, Q3	Transistors, MOSFET, N-CH, 60 V, 300 mA, SOT-23-3 (TO-236)	Vishay	2N7002K-T1-GE3
Q18	Transistor, NPN, 40 V, 200 mA, SOT23-3, AEC-Q101	Diodes Inc.	MMBT3904-7-F
Q21, Q22	Transistors, N-channel 100 V, 2.3 mΩ MOSFET LFPK88	Nexperia	PSMN2R3-100SSE
Q24, Q25, Q26, Q27, Q28, Q29	Transistors, option, MOSFET N-channel	Not applicable	Not applicable
R4, R17	Resistors, 40.2 kΩ, 1%, 1/4W, 1206	Stackpole	RMCF1206FT40K2
R10, R11, R21	Resistors, 3.01 kΩ, 1%, 1/10W, 0603	Vishay	CRCW06033K01FKEA
R12, R13, R14, R22	Resistors, 5.11 kΩ, 1%, 1/10W, 0603	Panasonic	ERJ3EKF5111V
R15, R16, R152, R158, R185, R260	Resistors, 0 Ω, 1/10W, 0603, AEC-Q200	Vishay	CRCW06030000Z0EA
R23, R24, R26, R27, R28, R29, R31, R32, R60, R61, R63, R64, R170, R171, R172, R173, R196, R197, R199, R200, R201, R202, R204, R205, R206, R207, R209, R210, R211, R212, R215, R216, R217, R218, R220, R221, R222, R223, R225,	Resistors, option, 0402	Not applicable	Not applicable

ORDERING INFORMATION

Table 7. Bill of Materials (Continued)

Reference Designator	Description	Manufacturer	Part Number ¹
R226, R227, R228, R230, R231, R232, R233, R236, R237			
R33, R36, R38, R42, R50, R53, R55, R58	Resistors, 1 Ω , 1%, 1/16W, 0402, AEC-Q200	Vishay	CRCW04021R00FKED
R34, R37, R39, R43, R51, R54, R56, R59	Resistors, 10 Ω , 1%, 1/16W, 0402	Yageo	RC0402FR-0710RL
R73, R241	Resistors, 10 Ω , 5%, 1/10W, 0603, AEC-Q200	Panasonic	ERJ3GEYJ100V
R154, R155, R234, R242, R243, R244, R245, R246, R251, R252, R253, R254, R255, R256, R257, R258, R259	Resistors, option, 0603	Not applicable	Not applicable
R175, R176, R181, R182, R198, R203, R208, R214, R219, R224, R229, R235	Resistors, option, 2512	Not applicable	Not applicable
R177, R178, R179, R180	Resistors, 0.001 Ω , 1%, 5 W, 2512, METAL, SENSE, AEC-Q200	Bourns	CSS2H-2512R-1L00F
R183	Resistor, 130 k Ω , 1%, 1/4 W, 1206, AEC-Q200	Panasonic	ERJ-8ENF1303V
R184	Resistor, 12.1 k Ω , 1%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ3EKF1212V
R186	Resistor, 2.67 k Ω , 1%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ3EKF2671V
R187	Resistor, 4.02 k Ω , 1%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ3EKF4021V
R188	Resistor, 93.1 k Ω , 1%, 1/4 W, 1206, AEC-Q200	NIC	NRC12F9312TRF
R189, R191	Resistors, option, 1206	Not applicable	Not applicable
R192	Resistor, 402 k Ω , 1/4 W, 1206, AEC-Q200	Vishay	CRCW1206402KFKEA
R193, R194	Resistors, 100 k Ω , 1%, 1/4 W, 1206	Yageo	RC1206FR-07100KL
R195	Resistor, 221 Ω , 1%, 1/4 W, 1206	Vishay-Dale	CRCW1206221RFKEA
R238, R239	Resistor, 68 k Ω , 1%, 1/10 W, 0603,	Yageo	RC0603FR-0768KL
R240	Resistor, 1.0 M Ω , 1%, 1/10 W, 0603	Yageo	CRCW06031M00FKEA
TP9, TP10, TP11	Test points, PCB copper feature	Not applicable	Not applicable
U1	IC, power controller, QFN-40	Analog Devices	LTC4287AUK
U2	IC, memory, EEPROM, 2Kb (256x8), TSSOP-8, 400 kHz	Microchip	24LC025-I/ST
U3	IC, memory, EEPROM, 256 Kb (32K x 8) SPI, TSSOP-8	On Semiconductor	CAT25256YI-GT3
XJP2, XJP3, XJP4, XJP5	Connectors, shunt, female, 2-POS, 2 mm	Samtec	2SN-BK-G
Y1	Crystal, 8.192 MHz, 18 pF, +/-30 ppm stability, 2PAD, SMD	Abracon	ABLS2-8.192MHZ-D4Y-T
Z1, Z2	Diodes, Zener, 5.1V, 500 mW, SOD-123, AEC-Q101	On-Semiconductor	MMSZ5231BT1G

¹ Equivalent parts may be substituted.

NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

**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 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 NON-INFRINGEMENT 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.

