One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluating the ADP2450 Power Management IC for Circuit Breaker Applications

FEATURES

Fully featured evaluation board for the ADP2450
Compact solution size
4-layer high glass transition temperature (T_G) PCB for superior thermal performance
Connections through vertical printed circuit tail pin headers
Compatible with ac current source input or CT input
Supports single coil and dual coil application
Adjustable output for buck regulator
On-board precision reference
On-board PGA gain setting
Supports both high and low analog trip function
Supports power detection function
Voltage monitor and reset output
Flexible connection with external MCU

APPLICATIONS

Full evaluation of the ADP2450

EVALUATION KIT CONTENTS

ADP2450ACPZ-3-EVBZ evaluation board
ADP2450ASTZ-3-EVBZ evaluation board

DOCUMENTS NEEDED

ADP2450 data sheet

EQUIPMENT NEEDED

AC current source or current transformer
Electronic load
Oscilloscope
MCU (optional)

GENERAL DESCRIPTION

The ADP2450ACPZ-3-EVBZ and ADP2450ASTZ-3-EVBZ evaluation boards provide a complete and compact solution that allows users to evaluate the performance of the ADP2450 with a printed circuit board (PCB) layout. These evaluation boards are compatible with either a current transformer (CT) or an ac current source as the input power source.

The main device on the evaluation boards, the ADP2450, integrates a boost shunt controller with power detection, a high efficiency buck regulator, four low offset low power consumption programmable gain amplifiers (PGAs), a low offset operation amplifier, a fast analog trip circuit, and an actuator driver.

With an external microcontroller unit (MCU) connected, the evaluation boards are suitable for a quick system evaluation of the circuit breaker application. The MCU is not provided with the evaluation boards.

More information on the ADP2450 is provided in the ADP2450 data sheet. Consult the data sheet in conjunction with this user guide when using the ADP2450ACPZ-3-EVBZ and ADP2450ASTZ-3-EVBZ boards.

TABLE OF CONTENTS

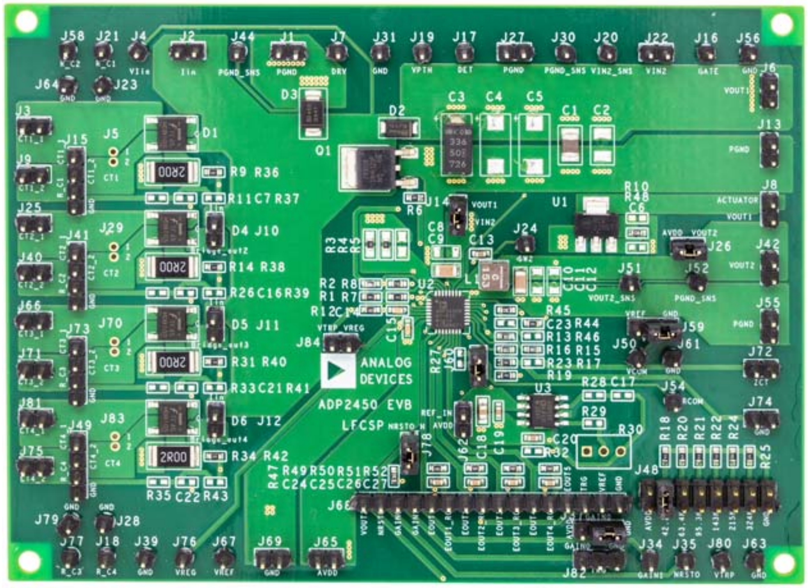
REVISION HISTORY

4/2019—Rev. 0 to Rev. A

Added ADP2450ASTZ-3-EVBZ ... Universal
Changes to Features Section, Evaluation Kit Contents Section, Equipment Needed Section, and General Description Section ... 1
Added Figure 2; Renumbered Sequentially ... 3
Changes to Powering Up the Evaluation Boards Section and Measuring the Metal-Oxide Semiconductor (MOSFET) Driver Waveform of the Boost Shunt Controller Section ... 4
Added Jumper J85 Section ... 4
Changed Change the Analog Trip Threshold Section to Change the High and Low Analog Trip Thresholds Section ... 5
Changes to Change the Output Voltage of the Boost Shunt Controller Section, Change the Output Voltage of the Buck Regulator Section, Change the V_{PTH} Threshold Section, Change the High and Low Analog Trip Thresholds Section, Change the PGA Gain Section, and Change to Dual Coil Application Section ... 5
Deleted Schematic Section ... 5
Changed Evaluation Board Schematic and PCB Layout Section to Evaluation Board Schematics and Artwork Section ... 6
Changes to Figure 3 ... 6
Added Figure 4 ... 7
Added Figure 9 to Figure 12 ... 9
Change to Table 2 ... 10
Added Table 3; Renumbered Sequentially ... 11

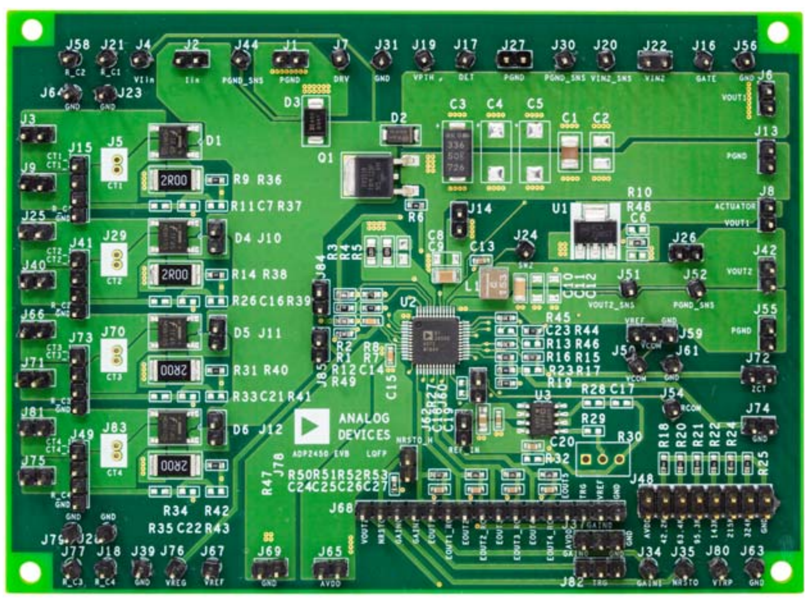
8/2018—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPHS



17089-001

Figure 1. ADP2450ACPZ-3-EVBZ Evaluation Board Photograph



17089-101

Figure 2. ADP2450ASTZ-3-EVBZ Evaluation Board Photograph

USING THE EVALUATION BOARDS

POWERING UP THE EVALUATION BOARDS

The ADP2450ACPZ-3-EVBZ and ADP2450ASTZ-3-EVBZ evaluation boards are supplied both fully assembled and tested. Before applying any power to the ADP2450ACPZ-3-EVBZ and ADP2450ASTZ-3-EVBZ evaluation boards, follow the procedures in this section to configure the boards as a single coil, one phase application. All jumpers are located on the evaluation boards, see Figure 3 and Figure 4 for specific jumper locations.

Jumper J10, Jumper J11, and Jumper J12

Leave Jumper J10, Jumper J11, and Jumper J12 open in a one phase application.

Jumper J14

Short Jumper J14 to connect the boost shunt output to the buck input.

Jumper J26

Short Jumper J26 to connect the buck output to AVDD.

Jumper J37

Short the middle pin of Jumper J37 to GND to connect GAIN0 to GND.

Jumper J48

Short Pin 3 and Pin 4 of J48 to connect the 42.2 kΩ resistor between GAIN1 and GND (see Figure 3 and Figure 4).

Jumper J59

Short the Jumper J59 middle pin to GND to connect VCOM to GND.

Jumper J60

Short Jumper J60 to connect RCOM to GND.

Jumper J78

Short Jumper J78 to pull $\overline{\text{RSTO}}$ to high.

Jumper J85

Short Jumper J85 to connect VTRPL to VREG. Note that this only applies to the ADP2450ASTZ-3-EVBZ evaluation board.

Input Power Source

If the ac current source is used, connect the terminals of the ac current source to Jumper J3 (Connector CT1_1) and Jumper J9 (Connector CT1_2) on the evaluation boards.

If a CT is used as the input power source, connect the CT secondary side terminals to Jumper J5 (Connector CT1) on the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards.

Output Voltmeters

Measure the output voltages of the boost shunt controller and buck regulator using voltmeters. Ensure the voltmeters are connected to the positive terminal and negative terminal of the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards. If the voltmeters are not connected directly to the boards, the measured voltages are incorrect because the voltage drops across the leads and/or connections between the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards and the power source.

To measure the output voltage of the boost shunt controller, connect the positive terminal of the voltmeter to Jumper J6 (VOUT1) and the negative terminal to Jumper J13 (PGND). To measure the output voltage of the buck regulator, connect the positive terminal of the voltmeter to Jumper J51 (VOUT2_SNS), and connect the negative terminal to Jumper J52 (PGND_SNS) (see Figure 3 and Figure 4).

Turning On the Evaluation Boards

When the input power source and voltmeters are connected to the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards, the boards can be powered on.

Take the following steps to turn on the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards:

1. Set the input ac root mean square (rms) current higher than 15 mA.
2. Set the frequency of the input ac current to 50 Hz.
3. Turn on the ac current source and monitor the output voltages of the boost shunt controller and the buck regulator.

MEASURING THE PERFORMANCE OF THE EVALUATION BOARDS

Measuring the Metal-Oxide-Semiconductor (MOSFET) Driver Waveform of the Boost Shunt Controller

To observe the driver waveform of the external MOSFET (Q1) with an oscilloscope, place the oscilloscope probe tip at the J7 test point (DRV) and place the probe ground at Jumper J31 (GND), see Figure 3 and Figure 4 for details. Set the oscilloscope to dc with the appropriate voltage and time divisions desired by the user. The driver waveform limits alternate between 0 V and 8 V.

Measuring the Switching Waveform of Buck Regulator

To observe the switching waveform of the buck regulator with an oscilloscope, place the oscilloscope probe tip at the Jumper J24 test point (SW) and place the probe ground at Jumper J31 (PGND). Set the oscilloscope to dc with the appropriate user desired voltage and time divisions desired by the user and based on the input voltage of the buck regulator. The switching waveform limits alternate between 0 V and the buck regulator input voltage.

Measuring the PGA Output Waveform

Take PGA1 as an example of how to measure the PGA output waveform. To observe the output waveform of PGA1 with an oscilloscope, place the oscilloscope probe tip at Pin 5 (EOUT1) of Jumper J68 and place the probe ground at Jumper J39 (PGND). Set the oscilloscope to dc with the appropriate voltage and time divisions desired by the user. The PGA1 output waveform is 100 Hz positive and half-sinusoid with the same amplitude as the PGA1 input signal.

MODIFYING THE EVALUATION BOARDS

To modify the configurations of the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards, unsolder, replace, or remove the passive components or jumpers on the boards as needed.

Change the Output Voltage of the Boost Shunt Controller

The boost shunt controller output voltage is preset to 12 V and is changed by replacing R1 and R7, the feedback resistors of the boost shunt controller (see Figure 3 and Figure 4).

To limit the output voltage accuracy degradation caused by the FB1 pin bias current (0.1 μA maximum) to less than 0.5% (maximum), ensure the bottom divider string resistor, R7, is less than 60 kΩ.

Use the following equation to calculate the top resistor (placed between FB and VOUT), R1, value:

$$R1 = R7 \times (V_{OUT1} - 1.2\ \text{V})/1.2\ \text{V}$$

where V_{OUT1} is the output voltage of the boost shunt controller.

Change the Output Voltage of the Buck Regulator

The buck regulator output voltage is preset to 5 V and is changed by replacing the buck regulator feedback resistors, R44 and R45.

Use the following equation to calculate the feedback resistor string values:

$$V_{OUT2} = 0.6\ \text{V}\ (1 + R44/R45)$$

where V_{OUT2} is the output voltage of the buck regulator.

Change the V_{PTH} Threshold

The V_{PTH} rising threshold is preset to 9 V and the falling threshold is preset to 7 V. These thresholds are changed by replacing the V_{PTH} resistors, R2 and R8.

Use the following equations to calculate the V_{PTH} resistor string values:

$$R2 = \frac{(1.09\ \text{V} \times V_{PTH\_R}) - (1.22\ \text{V} \times V_{PTH\_F})}{(1.09\ \text{V} \times 4.8\ \mu\text{A}) - (1.22\ \text{V} \times 1\ \mu\text{A})}$$

$$R8 = \frac{1.22\ \text{V} \times R2}{V_{PTH\_R} - (R2 \times 4.8\ \mu\text{A}) - 1.22\ \text{V}}$$

where:
V_{PTH_R} is the V_{PTH} rising threshold.
V_{PTH_F} is the V_{PTH} falling threshold.

Change the High and Low Analog Trip Thresholds

Note that the ADP2450ACPZ-3-EVBZ has one analog trip threshold setting (V_{TRPH}) but the ADP2450ASTZ-3-EVBZ has two.

The ADP2450ASTZ-3-EVBZ high and low analog trip thresholds are preset to 2.49 V and 0.499 V, respectively. Change the analog trip thresholds by replacing the analog trip setting resistors, R12 and R49.

Use the following equations to calculate the analog trip thresholds:

$$V_{TRPH}\ (\text{V}) = 0.01 \times R12\ (\text{k}\Omega)$$

$$V_{TRPL}\ (\text{V}) = 0.01 \times R49\ (\text{k}\Omega)$$

where:
V_{TRPH} is the high analog trip threshold.
V_{TRPL} is the low analog trip threshold.

Change the PGA Gain

The default PGA gain of the ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation board are set to ×1. The gain is changed by shorting different pins of Jumper J37 and Jumper J48 (see Figure 3 and Figure 4).

Table 1 shows the relationship between PGA gain values and the GAIN0 and GAIN1 configurations.

Table 1. Gain Settings for PGAx

	GAIN	
Resistance on GAIN1 (kΩ)	GAIN0 = GND	GAIN0 = AVDD
0	0.75	3
42.2	1	4
63.4	1.25	5
95.3	1.5	6
143	1.75	7
215	2	8
324	2.5	10
AVDD	4	16

Change to Dual Coil Application

The ADP2450ACPZ-3-EVBZ and the ADP2450ASTZ-3-EVBZ evaluation boards support a dual coil input application. To change the boards to a one phase, dual coil configuration, take the following steps:

1. Either remove the ac current source connected to Jumper J3 and Jumper J9, or remove the CT connected to Jumper J5.
2. Unsolder Resistor R36 and solder Resistor R37 with the 0 Ω resistor.
3. Solder the resistor capacitor (RC) filter to Resistor R11 and Capacitor C7.
4. Leave Jumper J60 open.
5. Solder Resistor R27 with a resistor with a value equal to or close to the internal impedance of the dual coil.
6. Short the Jumper J59 middle pin to Pin 1 (see Figure 3 and Figure 4) to connect VCOM to VREF.
7. Short Jumper J62 to connect AVDD to the ADR433 input.
8. For the ADP2450ACPZ-3-EVBZ board, leave Jumper J84 open to enable the high analog trip function. For the ADP24-50ASTZ-3-EVBZ board, leave Jumper J84 and Jumper J85 open to enable both the high and low analog trip functions.
9. Connect the power coil to Pin 3 and Pin 4 of Jumper J15 (see Figure 3 and Figure 4).
10. Connect the signal coil to Pin 2 of Jumper J15 (see Figure 3 and Figure 4).

If multiple phase applications are required, repeat the previous steps to modify the other three phases and short Jumper J10, Jumper J11, and Jumper J12.

EVALUATION BOARD SCHEMATICS

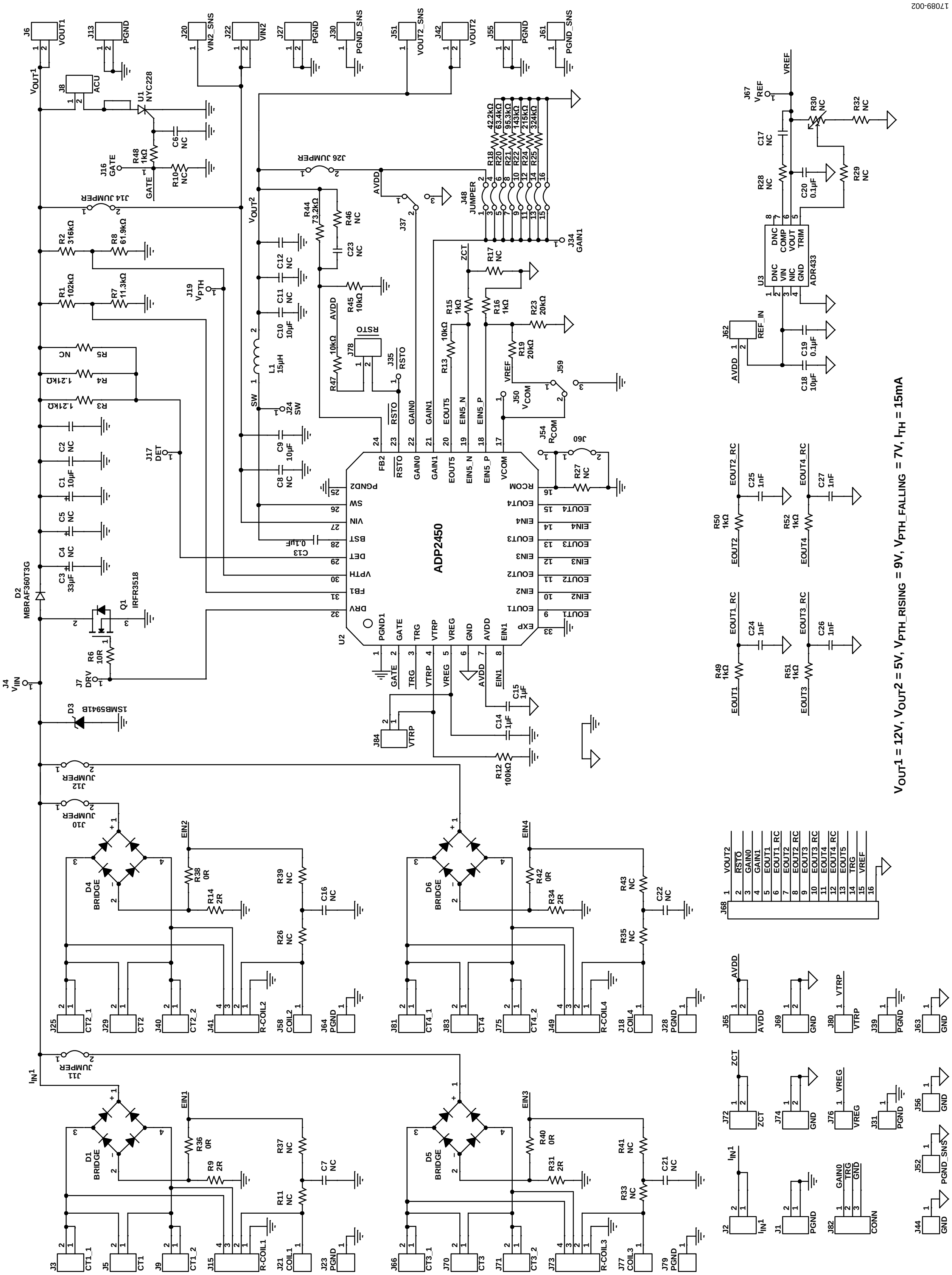


Figure 3. Evaluation Board Schematic for the ADP2450ACPZ-3-EVBZ

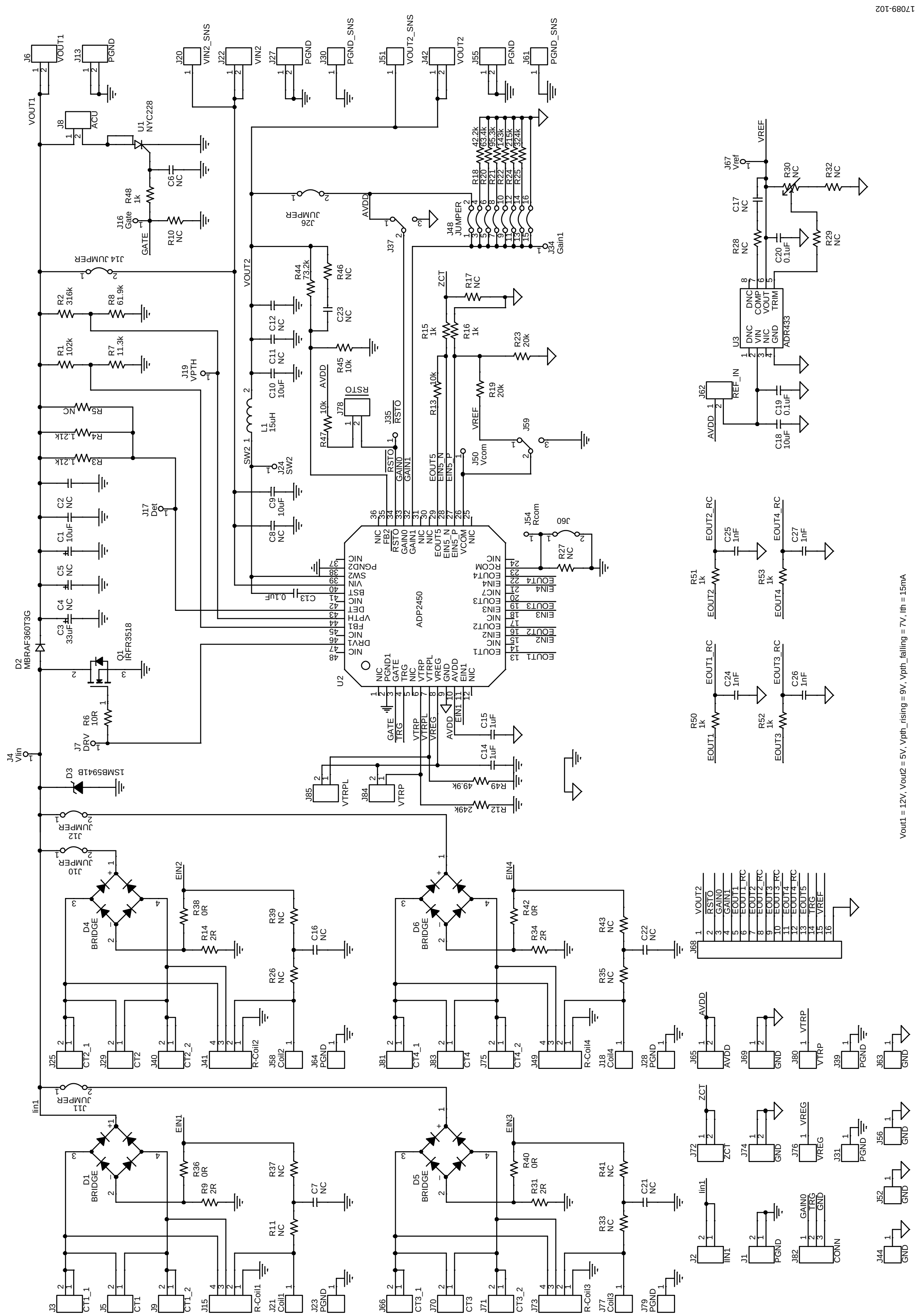


Figure 4. Evaluation Board Schematic for the ADP2450ASTZ-3-EVBZ

PCB LAYOUTS

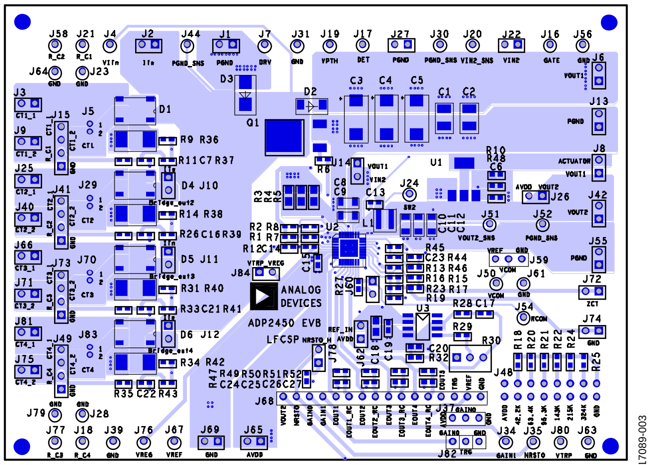


Figure 5. ADP2450ACPZ-3-EVBZ Layer 1, Component Side

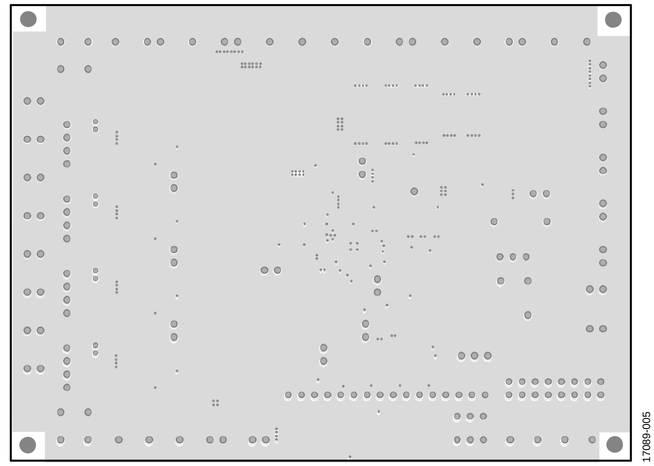


Figure 7. ADP2450ACPZ-3-EVBZ Layer 2, Ground Plane

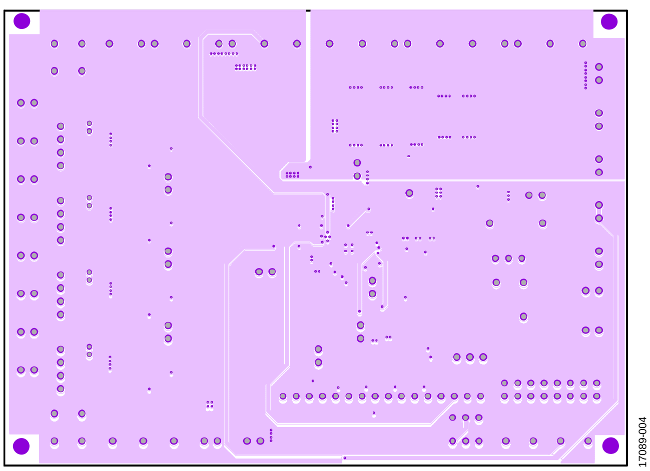


Figure 6. ADP2450ACPZ-3-EVBZ Layer 3, Power Plane

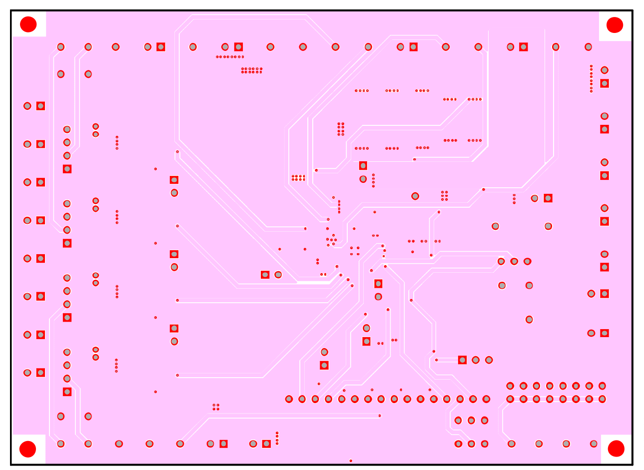


Figure 8. ADP2450ACPZ-3-EVBZ Layer 4, Bottom Side

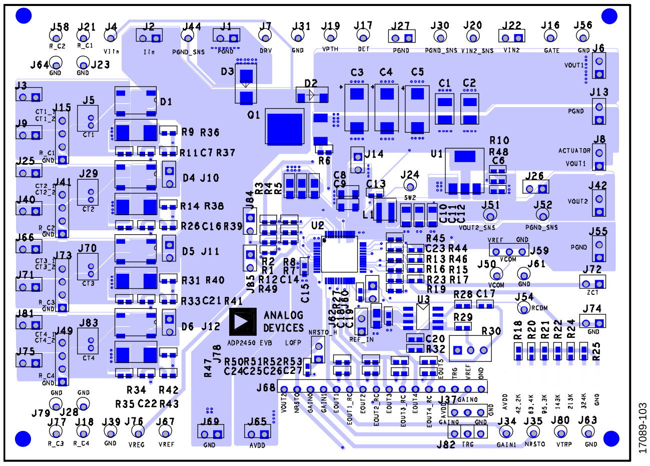


Figure 9. ADP2450ASTZ-3-EVBZ Layer 1, Component Side

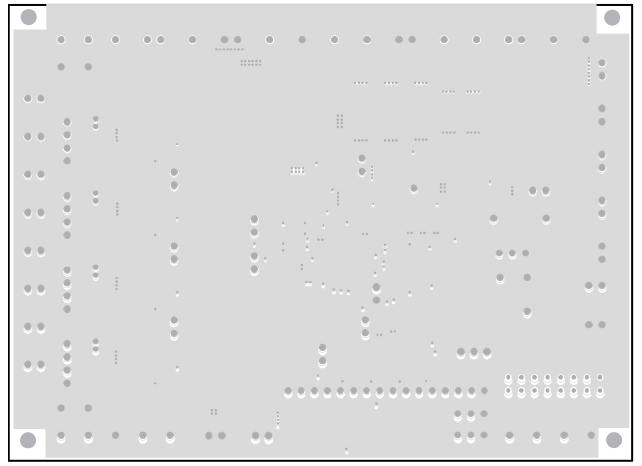


Figure 11. ADP2450ASTZ-3-EVBZ Layer 2, Ground Plane

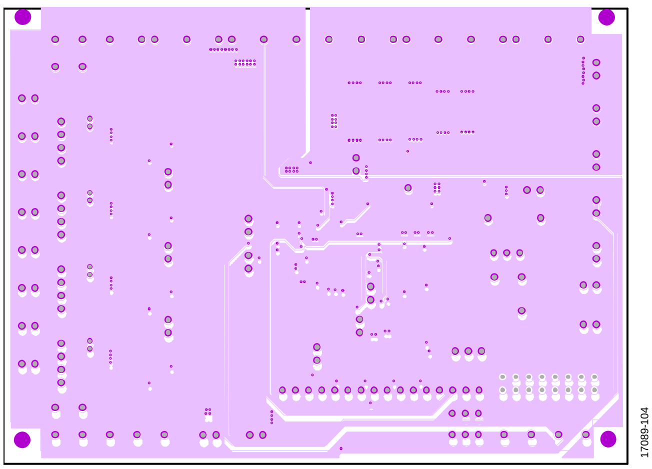


Figure 10. ADP2450ASTZ-3-EVBZ Layer 3, Power Plane

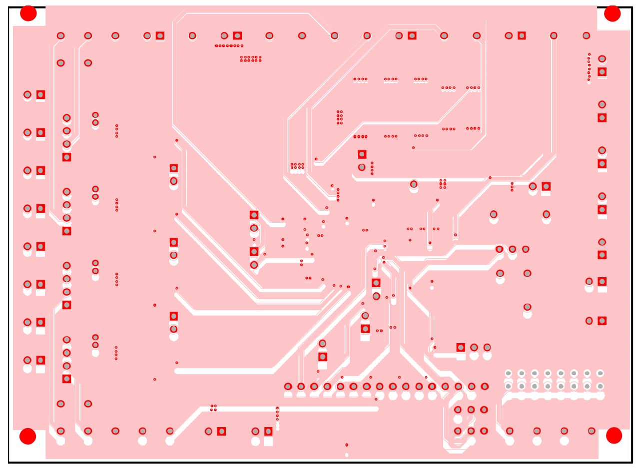


Figure 12. ADP2450ASTZ-3-EVBZ Layer 4, Bottom Side

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. ADP2450ACPZ-3-EVBZ Bill of Materials

Qty	Reference Designator	Description	Part Number/Vendor	Vendor
1	C1	10 µF, 50 V, X7R, capacitor, 1210	GRM32ER71H106MA12L	Murata
1	C2	Optional capacitor, 1210	Optional	Murata
1	C3	33 µF, 50 V, X7R, capacitor, D7343	T521X336M050ATE075	KEMET
2	C4, C5	Optional capacitors, D7374	Optional	KEMET
7	C6, C7, C16, C17, C21 to C23	Optional capacitors, 0603	Optional	Murata
3	C8, C11, C12	Optional capacitors, 1206	Optional	Murata
2	C9, C10	10 µF, 50 V, X7R, capacitors, 1206	GRM31CR61H106KA12	Murata
3	C13, C19, C20	0.1 µF, 16 V, X7R, capacitors, 0603	GCM188R71C104KA37	Murata
2	C14, C15	1 µF, 16 V, X7R, capacitors, 0603	GCM188R71C105KA64	Murata
1	C18	10 µF, 6.3 V, X7R, capacitor, 0805	GCM21BR70J106KE22	Murata
4	C24, C25, C26, C27	1 nF, 25 V, X7R, capacitors, 0603	GCM188R71E102KA37D	Murata
4	D1, D4, D5, D6	1 A, MicroDIP, single-phase bridge rectifiers	MDB10S	FAIRCHILD
1	D2	3 A, 60 V, Schottky barrier rectifier	MBRAF360T3G	ON Semiconductor
1	D3	3 W, surface mount power Zener diode	1SMB5941B	DIODES
1	L1	Inductor, 15 µH	XAL4040-153ME	Coil Craft
1	Q1	80 V, 30 A, power MOSFET	IRFR3518	International Rectifier
1	R1	102 kΩ, 1%, resistor, 0603	CRCW0603102KFKEA	Vishay Dale
1	R2	316 kΩ, 1%, resistor, 0603	CRCW0603316KFKEA	Vishay Dale
2	R3, R4	1.21 kΩ, 1%, resistors, 0805	CRCW08051K21FKEA	Vishay Dale
1	R5	Optional resistor, 0805	Optional	Vishay Dale
1	R6	10 Ω, 1%, resistor, 0603	CRCW060310R0FKEA	Vishay Dale
1	R7	11.3 kΩ, 1%, resistor, 0603	CRCW060311K3FKEA	Vishay Dale
1	R8	61.9 kΩ, 1%, resistor, 0603	CRCW060361K9FKEA	Vishay Dale
4	R9, R14, R31, R34	2 Ω, 1%, resistors, 1 W	WSC25152R000FEA	Vishay Dale
15	R10, R11, R17, R26 to R29, R32, R33, R35, R37, R39, R41, R43, R46	Optional resistors, 0603	Optional	Vishay Dale
1	R12	100 kΩ, 1%, resistor, 0603	CRCW0603100KFKEA	Vishay Dale
7	R15, R16, R48 to R52	1 kΩ, 1%, resistors, 0603	CRCW06031K00FKEA	Vishay Dale
3	R13, R45, R47	10 kΩ, 1%, resistors, 0603	CRCW060310K0FKEA	Vishay Dale
1	R18	42.2 kΩ, 1%, resistor, 0603	CRCW060342K2FKEA	Vishay Dale
2	R19, R23	20 kΩ, 1%, resistors, 0603	CRCW060320K0FKEA	Vishay Dale
1	R20	63.4 kΩ, 1%, resistor, 0603	CRCW060363K4FKEA	Vishay Dale
1	R21	95.3 kΩ, 1%, resistor, 0603	CRCW060395K3FKEA	Vishay Dale
1	R22	143 kΩ, 1%, resistor, 0603	CRCW0603143KFKEA	Vishay Dale
1	R24	215 kΩ, 1%, resistor, 0603	CRCW0603215KFKEA	Vishay Dale
1	R25	324 kΩ, 1%, resistor, 0603	CRCW0603324KFKEA	Vishay Dale
1	R30	Optional resistor, through hole	3296W-1-103LF	Bourns
4	R36, R38, R40, R42	0 Ω, 1%, resistors, 0603	CRCW06030000Z0EA	Vishay Dale
1	R44	73.2 kΩ, 1%, resistor, 0603	CRCW060373K2FKEA	Vishay Dale
1	U1	Silicon controlled rectifier, 1.5 A rms current, 600 V, SOT-223	NYC228	ON Semiconductor
1	U2	Power management IC for industrial application, 32-lead LFCSP with exposed paddle	ADP2450	Analog Devices
1	U3	Ultralow noise XFET® voltage reference	ADR433	Analog Devices

Qty	Reference Designator	Description	Part Number/Vendor	Vendor
30	J1 to J3, J6, J8 to J14, J22, J25 to J27, J40, J42, J55, J60, J62, J65, J66, J69, J71, J72, J74, J75, J78, J81, J84	2 position header connectors, 2.54 mm pitch, through hole, gold	61300211121	Wurth
31	J4, J7, J16 to J21, J23, J24, J28, J30, J31, J34, J35, J39, J44, J50 to J52, J54, J56, J58, J61, J63, J64, J67, J76, J77, J79, J80	1 position header connectors, through hole, gold	61300111121	Wurth
4	J5, J29, J70, J83	Optional header connectors	Optional	Wurth
4	J15, J41, J49, J73	4 position header connectors, 2.54 mm pitch, through hole, gold	61300411121	Wurth
3	J37, J59, J82	3 position header connectors, 2.54 mm pitch, through hole, gold	61300311121	Wurth
1	J48	16 position header connector, dual, 2.54 mm pitch, through hole, gold	61301621121	Wurth
1	J68	16 position header connector, 2.54 mm pitch, through hole, gold	61301611121	Wurth

Table 3. ADP2450ASTZ-3-EVBZ Bill of Materials

Qty	Reference Designator	Description	Part Number/Vendor	Vendor
1	C1	10 µF, 50 V, X7R, capacitor, 1210	GRM32ER71H106MA12L	Murata
1	C2	Optional capacitor, 1210	Optional	Murata
1	C3	33 µF, 50 V, X7R, capacitor, D7343	T521X336M050ATE075	KEMET
2	C4, C5	Optional capacitors, D7374	Optional	KEMET
7	C6, C7, C16, C17, C21 to C23	Optional capacitors, 0603	Optional	Murata
3	C8, C11, C12	Optional capacitors, 1206	Optional	Murata
2	C9, C10	10 µF, 50 V, X7R, capacitors, 1206	CL31B106KBHNNNE or GRM31CR61H106KA12	Samsung or Murata
3	C13, C19, C20	0.1 µF, 16 V, X7R, capacitors, 0603	06035C104KAT2A or GRM188R71C104KA01D	AVX or Murata
2	C14, C15	1 µF, 16 V, X7R, capacitors, 0603	0603YC105KAT2A or GRM188R71C105KA12D	AVX or Murata
1	C18	10 µF, 6.3 V, X7R, capacitor, 0805	GCM21BR70J106KE22 or GRM21BR70J106KA73L	Murata
4	C24 to C27	1 nF, 25 V, X7R, capacitors, 0603	CL10B102KA8NNNC or GCM188R71E102KA37D	Samsung or Murata
4	D1, D4 to D6	1 A, MicroDIP, single phase bridge rectifiers	MDB10S	FAIRCHILD
1	D2	3 A, 60 V, Schottky barrier rectifier	MBRAF360T3G	ON Semiconductor
1	D3	3 W, surface mount power Zener diode	1SMB5941B	DIODES
1	L1	Inductor, 15 µH	XAL4040-153ME	Coil Craft
1	Q1	80 V, 30 A, Power MOSFET	IRFR3518PBF	Infineon
1	R1	102 kΩ, 1%, resistor, 0603	CRCW0603102KFKEA	Vishay Dale
1	R2	316 kΩ, 1%, resistor, 0603	CRCW0603316KFKEA	Vishay Dale
2	R3, R4	1.21 kΩ, 1%, resistors, 0805	CRCW08051K21FKEA	Vishay Dale
1	R5	Optional resistor, 0805	Optional	Vishay Dale
1	R6	10 Ω, 1%, resistor, 0603	CRCW060310R0FKEA	Vishay Dale
1	R7	11.3 kΩ, 1%, resistor, 0603	CRCW060311K3FKEA	Vishay Dale
1	R8	61.9 kΩ, 1%, resistor, 0603	CRCW060361K9FKEA	Vishay Dale
4	R9, R14, R31, R34	2 Ω, 1%, resistors, 1 W	WSC25152R000FEA	Vishay Dale
15	R10, R11, R17, R26 to R29, R32, R33, R35, R37, R39, R41, R43, R46	Optional resistors, 0603	Optional	Vishay Dale
1	R12	249 kΩ, 1%, resistor, 0603	CRCW0603249KFKEA	Vishay Dale
7	R15, R16, R48, R50 to R53	1 kΩ, 1%, resistors, 0603	CRCW06031K00FKEA	Vishay Dale
3	R13, R45, R47	10 kΩ, 1%, resistors, 0603	CRCW060310K0FKEA	Vishay Dale
1	R18	42.2 kΩ, 1%, resistor, 0603	CRCW060342K2FKEA	Vishay Dale
2	R19, R23	20 kΩ, 1%, resistors, 0603	CRCW060320K0FKEA	Vishay Dale

Qty	Reference Designator	Description	Part Number/Vendor	Vendor
1	R20	63.4 kΩ, 1%, resistor, 0603	CRCW060363K4FKEA	Vishay Dale
1	R21	95.3 kΩ, 1%, resistor, 0603	CRCW060395K3FKEA	Vishay Dale
1	R22	143 kΩ, 1%, resistor, 0603	CRCW0603143KFKEA	Vishay Dale
1	R24	215 kΩ, 1%, resistor, 0603	CRCW0603215KFKEA	Vishay Dale
1	R25	324 kΩ, 1%, resistor, 0603	CRCW0603324KFKEA	Vishay Dale
1	R30	Optional resistor, through hole	3296W-1-103LF	Bourns
4	R36, R38, R40, R42	0 Ω, 1%, resistors, 0603	CRCW06030000Z0EA	Vishay Dale
1	R44	73.2 kΩ, 1%, resistor, 0603	CRCW060373K2FKEA	Vishay Dale
1	R49	49.9 kΩ, 1%, resistor, 0603	CRCW060349K9FKEA	Vishay Dale
1	U1	Silicon controlled rectifier, 1.5 A rms current, 600 V, SOT-223	NYC228	ON Semiconductor
1	U2	Power management IC for industrial application, 48-lead LQFP	ADP2450ASTZ-3-R7	Analog Devices
1	U3	Ultralow noise XFET® voltage reference	ADR433ARZ	Analog Devices
31	J1 to J3, J6, J8 to J14, J22, J25 to J27, J40, J42, J55, J60, J62, J65, J66, J69, J71, J72, J74, J75, J78, J81, J84, J85	2 position header connectors, 2.54 mm pitch, through hole, gold	61300211121	Wurth
31	J4, J7, J16 to J21, J23, J24, J28, J30, J31, J34, J35, J39, J44, J50 to J52, J54, J56, J58, J61, J63, J64, J67, J76, J77, J79, J80	1 position header connectors, through hole, gold	61300111121	Wurth
4	J5, J29, J70, J83	Optional header connectors	Optional	Wurth
4	J15, J41, J49, J73	4 position header connectors, 2.54 mm pitch, through hole, gold	61300411121	Wurth
3	J37, J59, J82	3 position header connectors, 2.54 mm pitch, through hole, gold	61300311121	Wurth
1	J48	16 position header connector, dual, 2.54 mm pitch, through hole, gold	61301621121	Wurth
1	J68	16 position header connector, 2.54 mm pitch, through hole, gold	61301611121	Wurth