

Evaluating the ADE9430 High Performance, Polyphase Energy, and Class S Power Quality Monitoring IC**FEATURES**

- ▶ Energy and Class S power quality measurement evaluation board with [ADE9430](#) multiphase energy and power quality monitoring IC
- ▶ 3-phase 4-wire, 3-phase 3-wire, or 3-wire single-phase measurements
- ▶ Direct interface with current output current transformers
- ▶ Up to 240 V rms nominal line neutral voltage measurement
- ▶ For use with the ADSW-PQ-CLS Power Quality Library

EVALUATION KIT CONTENTS

- ▶ STM32 NUCLEO-F413ZH
- ▶ EVAL-ADE9430ARDZ evaluation board
- ▶ Current transformers

ADDITIONAL EQUIPMENT AND SOFTWARE NEEDED

- ▶ Micro USB cable
- ▶ Voltage channel interconnects
- ▶ ADSW-PQ-CLS Power Quality Library

DOCUMENTS NEEDED

- ▶ ADE9430 data sheet
- ▶ ADSW-PQ-CLS Power Quality Library User Guide

GENERAL DESCRIPTION

The EVAL-ADE9430ARDZ is for use with the STM32 NUCLEO-F413ZH. The EVAL-ADE9430ARDZ can be directly interfaced with current transformers and voltage leads. The EVAL-ADE9430ARDZ enables quick evaluation and prototyping of energy and Class S power quality measurement systems with the ADE9430. The ADSW-PQ-CLS Power Quality Library and application examples are provided to simplify implementation of larger systems. To request access to the ADSW-PQ-CLS, fill out the software request form at: [Software Request Form | Analog Devices](#), where the target technology must be power quality monitoring and the processor/system on chip (SoC) is the ADE9430.

HAZARDOUS HIGH VOLTAGE

This equipment is connected to hazardous line voltages. Exercise proper caution when connecting the sensors and voltage leads. Ensure that the system is enclosed in a protective casing.

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REVISION HISTORY**1/2024—Rev. 0 to Rev. A**

Changes to Figure 9.....	8
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5/2022—Revision 0: Initial Version

EVAL-ADE9430ARDZ CONNECTION DIAGRAM

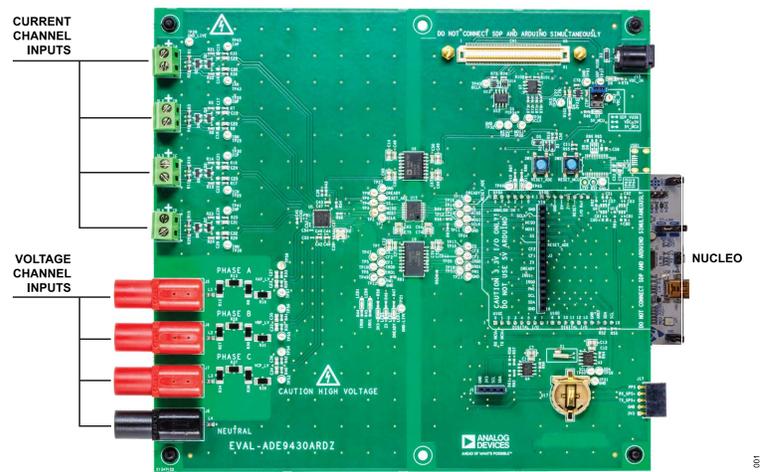


Figure 1. EVAL-ADE9430ARDZ Connection Diagram

MODULE HARDWARE

CURRENT SENSORS

The EVAL-ADE9430ARDZ is designed to work directly with the provided current output current transformers (CTs). Connect the CT leads to the SL1, SL2, SL3, and SL4 terminal blocks.

Current Output CTs

The EVAL-ADE9430ARDZ has on-board burden resistors in the differential configuration to allow direct connection with current output CTs. With a typical 2500:1 CT, the maximum recommended current is 86 A rms. Refer to the [ADE9430](#) data sheet to modify burden resistors for different current ranges.

Voltage Output CTs

To use voltage output CTs, remove the R1, R2, R3, R4, R10, R11, R19, and R20 burden resistors. The maximum recommended CT output voltage is ± 0.353 V rms.

VOLTAGE SENSORS

The EVAL-ADE9430ARDZ has on-board resistor dividers to attenuate the incoming input voltage. The attenuation factor is 801. Do not exceed the 240 V rms nominal line to neutral voltage in the 3-phase, 4-wire (3P4W) wye configuration. In the 3-wire delta configuration, when Phase B is used as the reference, do not exceed 250 V rms line to line voltage. There are 4 mm banana jacks on board to connect the voltage inputs. Use TPI A079 or equivalent leads with alligator clips to connect the voltage inputs.

POWERING THE EVAL-ADE9430ARDZ

To power the EVAL-ADE9430ARDZ, users have two options: use a barrel power jack or the USB cable coming from the STM32 NUCLEO-F413ZH. Take the following steps to power up the EVAL-ADE9430ARDZ:

1. Remove the EVAL-ADE9430ARDZ and STM32 NUCLEO-F413ZH from their packaging.
2. Plug the STM32 NUCLEO-F413ZH into the EVAL-ADE9430ARDZ using the Arduino® UNO headers on the EVAL-ADE9430ARDZ.

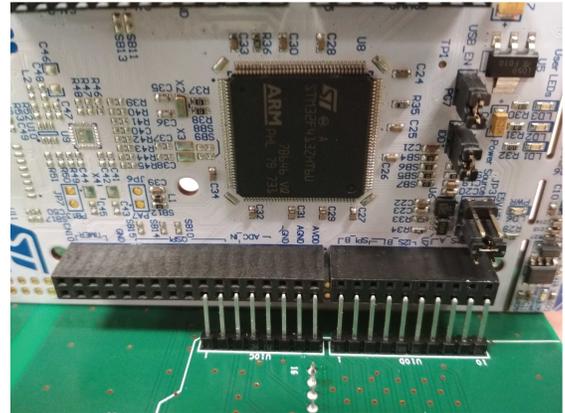


Figure 2. EVAL-ADE9430ARDZ to NUCLEO Pin Alignment, Align the U10 Header with the Row Farthest from the STM32 Microcontroller on the NUCLEO-F413ZH Board (U8 on the PCB)

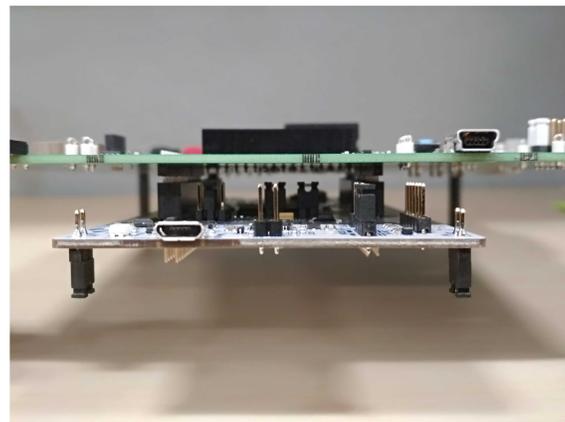


Figure 3. EVAL-ADE9430ARDZ to STM32 NUCLEO-F413ZH Pin Alignment, Align the U10 Header with the Connectors on Each Side

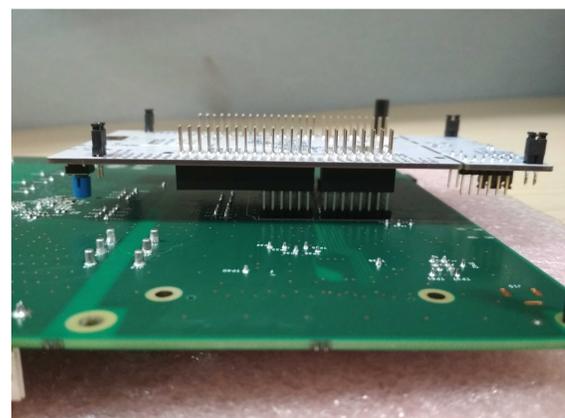


Figure 4. The EVAL-ADE9430ARDZ and STM32 NUCLEO-F413ZH Mated Completely

3. Then, select one of the two power-up options that follow:

MODULE HARDWARE

- a. Power the EVAL-ADE9430ARDZ by using the J15, 5.1 mm barrel connector. However, do not apply more than 12 V dc, and place a jumper on J2 and set it to the middle position.

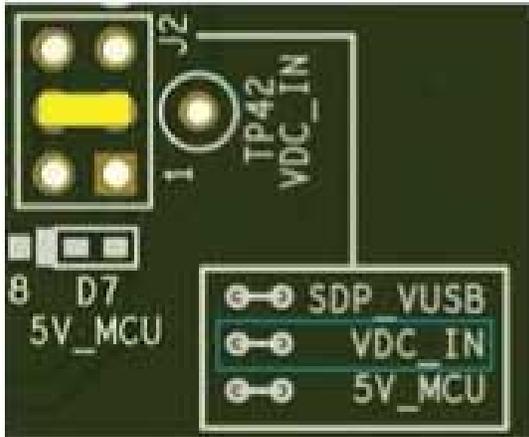


Figure 5. Jumper Position for External Power Jack

- b. Power the EVAL-ADE9430ARDZ through the USB cable connected to the STM32 NUCLEO-F413ZH, and place a jumper on J2 in the position next to D7.

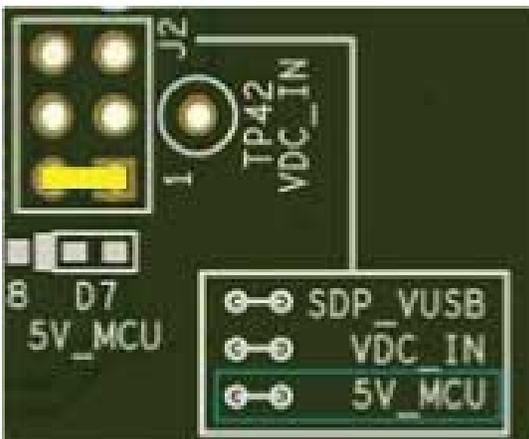


Figure 6. Jumper Position for STM32 NUCLEO-F413ZH Power

- 4. Securely screw the leads of the provided CTs to the current inputs (SL1, SL2, SL3, and SL4).
- 5. Connect the voltage terminals to the J5, J6, J7, and J8 connectors.
- 6. After setting the power jumper, plug the STM32 NUCLEO-F413ZH into the PC via the USB port.
- 7. Program the example from the PQLib software. Refer to the ADSW-PQ-CLS Power Quality Library User Guide for this software information. To request access to the ADSW-PQ-CLS, fill out the software request form at: [Software Request Form | Analog Devices](#), where the target technology must be power quality monitoring and the processor/system on chip (SoC) is the ADE9430.
- 8. Configure the serial port to talk to the PQLib via the command line interface (CLI), if applicable.

COMPONENTS

Table 1 lists the required voltage leads and clips that can connect voltages and external current sensors to the EVAL-ADE9430ARDZ. These leads and clips are not provided with the EVAL-ADE9430ARDZ but equivalent components can also be used.

Table 1. Required Voltage Leads and Clips

Manufacturer	Part No.
Leads	
Test Products International	A079
Clips	
Test Products International	A058
Ponoma Electronics	6041B

LINE VOLTAGE CONNECTIONS

The EVAL-ADE9430ARDZ is connected to hazardous line voltages. Exercise proper caution when connecting the sensors and voltage leads. Ensure that the system is enclosed in a protective casing.

3-PHASE, 4-WIRE (3P4W) WYE

The 3P4W wye connection is shown in Figure 7. Do not exceed the nominal voltage of a 240 V rms line to neutral in the wye configuration.

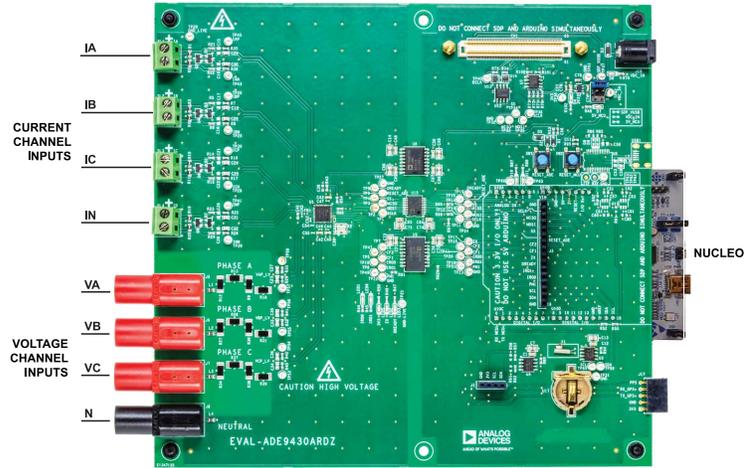


Figure 7. 3P4W Wye Connection

LINE VOLTAGE CONNECTIONS

3-PHASE, 3-WIRE (3P3W) DELTA

The 3P3W delta connection is shown in [Figure 8](#). Phase B is used as the reference. Therefore, the neutral channel on the EVAL-ADE9430ARDZ is connected to Phase B. Do not exceed the 250 V rms line to line voltage in the delta configuration.

Set VCONSEL and ICONSEL to the following values to correctly set the ADE9430 for the 3P3W connection:

- ▶ Set VCONSEL to 001 so that $V_B = V_A - V_C$.
- ▶ Set ICONSEL to 1 so that $I_B = -I_A - I_C$.

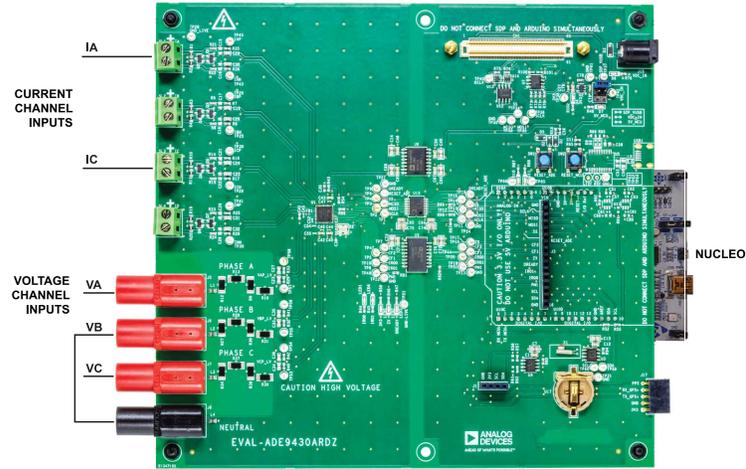


Figure 8. 3P3W Delta Connection

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

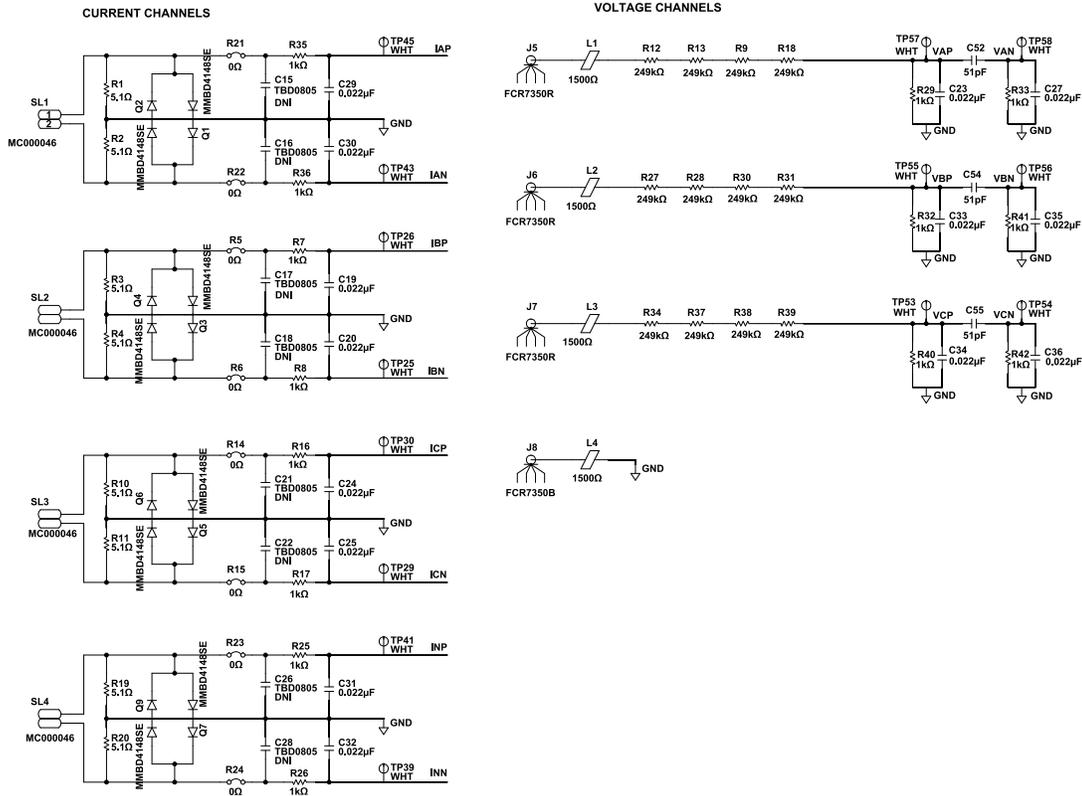


Figure 9. EVAL-ADE9430ARDZ Evaluation Board Schematic Sheet 1

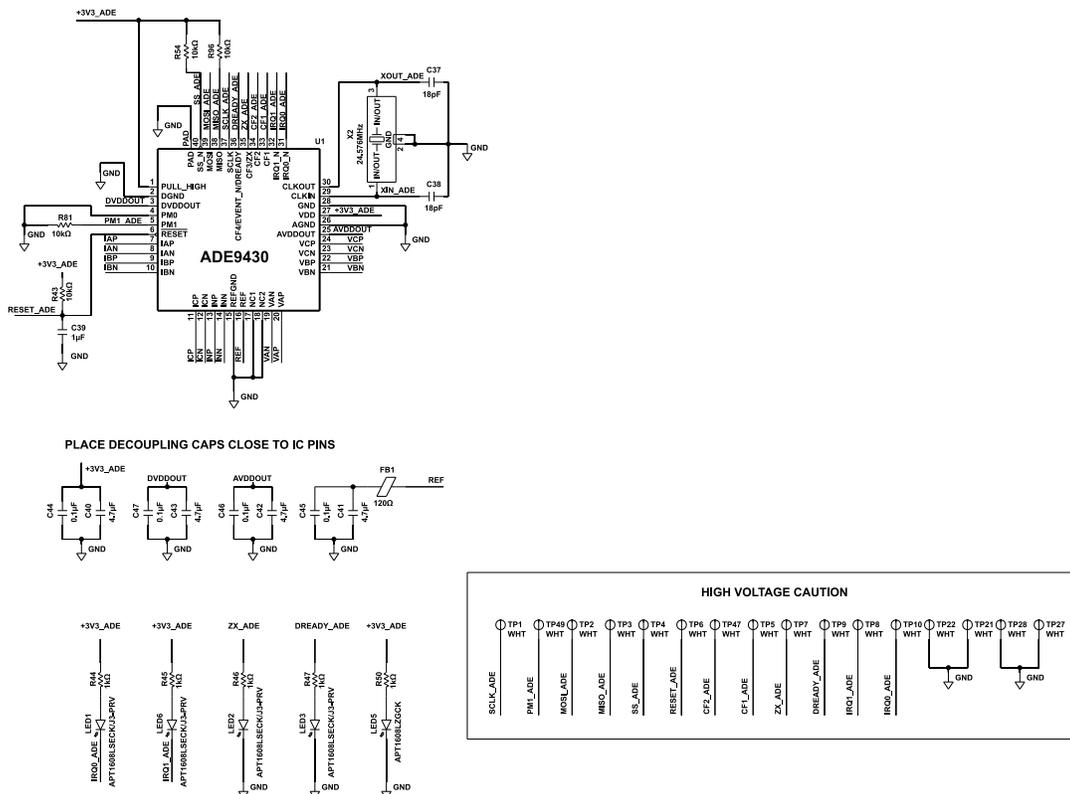


Figure 10. EVAL-ADE9430ARDZ Evaluation Board Schematic Sheet 2

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

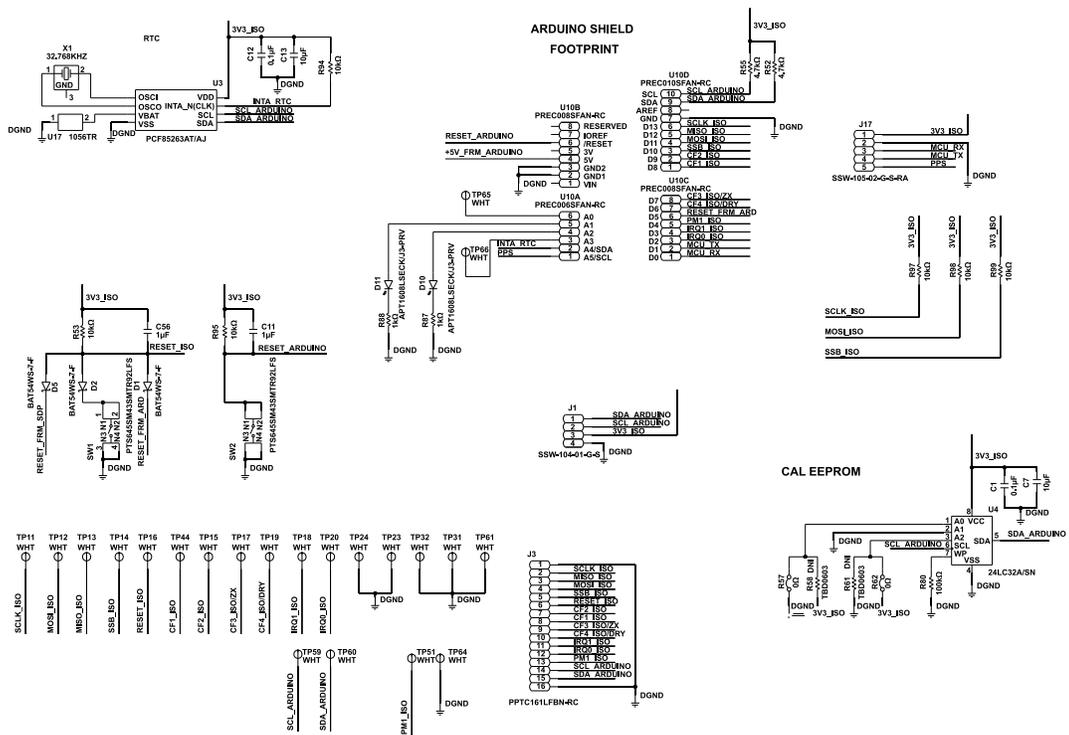


Figure 11. EVAL-ADE9430ARDZ Evaluation Board Schematic Sheet 3

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

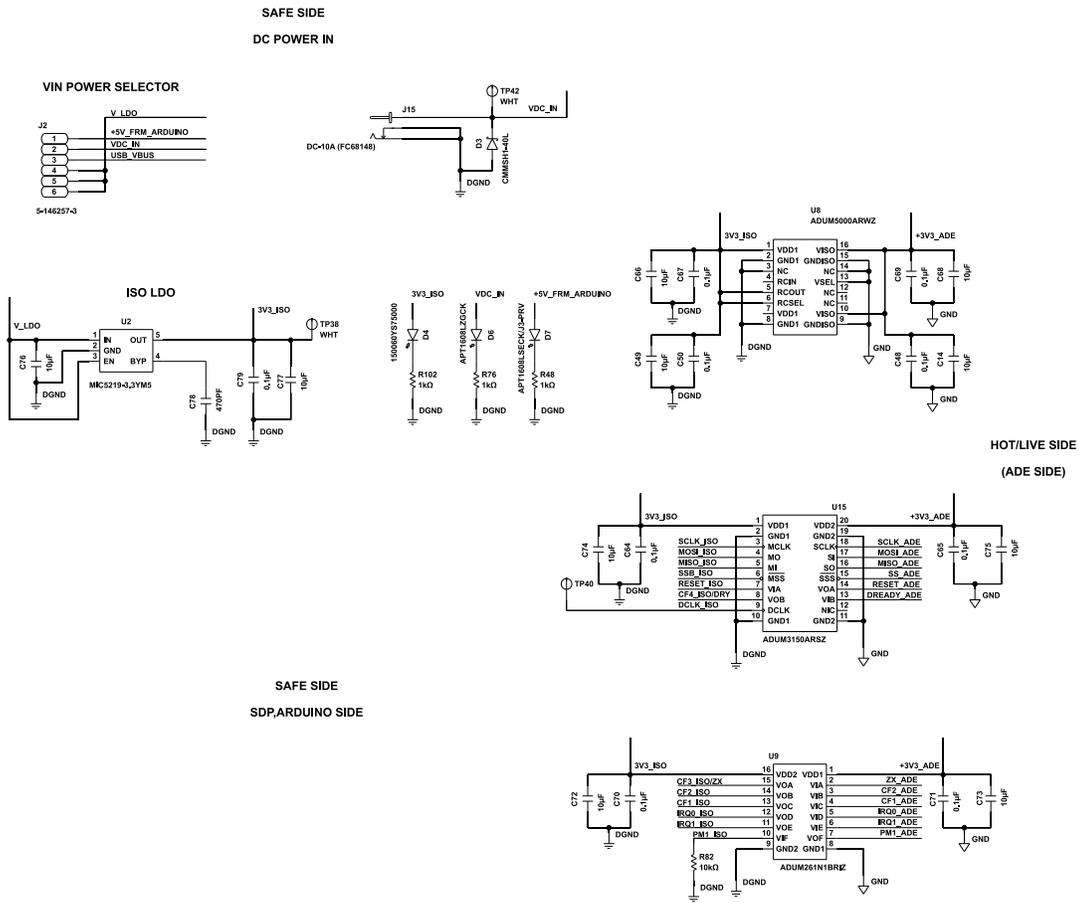


Figure 12. EVAL-ADE9430ARDZ Evaluation Board Schematic Sheet 4

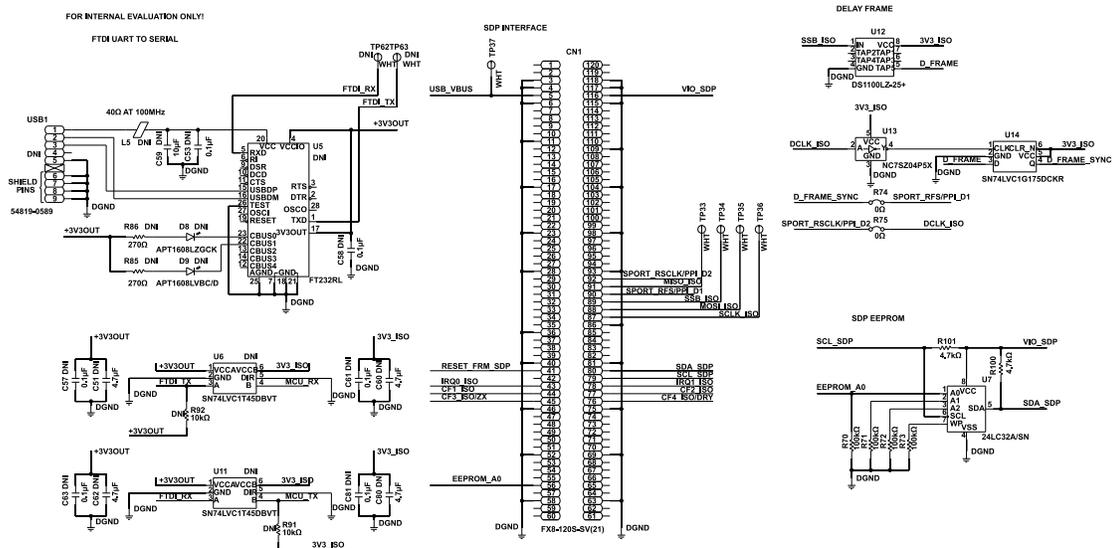


Figure 13. EVAL-ADE9430ARDZ Evaluation Board Schematic Sheet 5

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

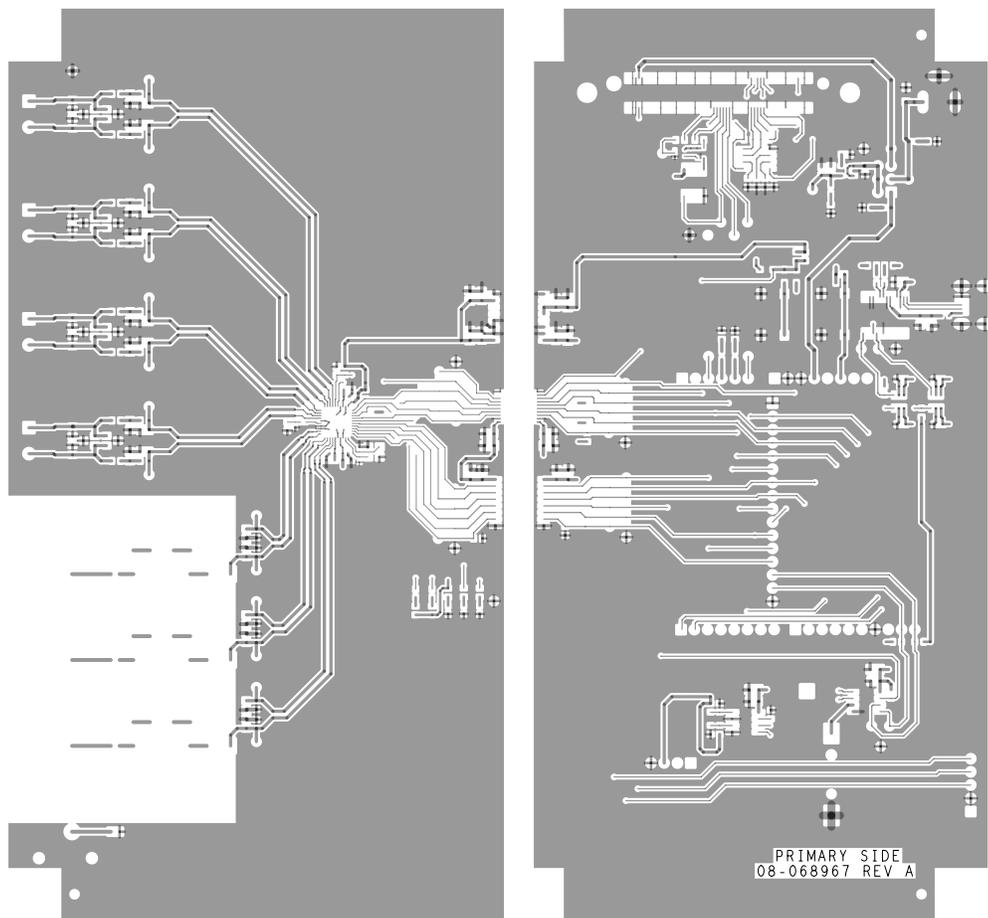


Figure 14. EVAL-ADE9430ARDZ Top Layer

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

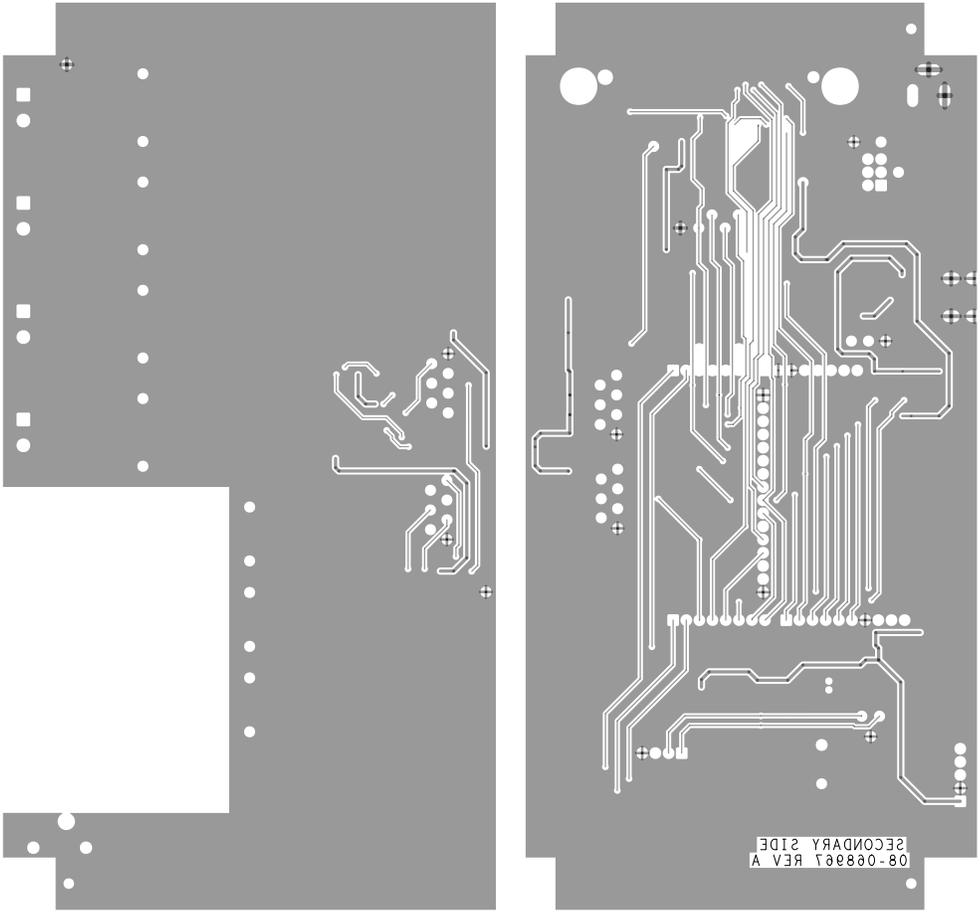


Figure 15. EVAL-ADE9430ARDZ Bottom Layer

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

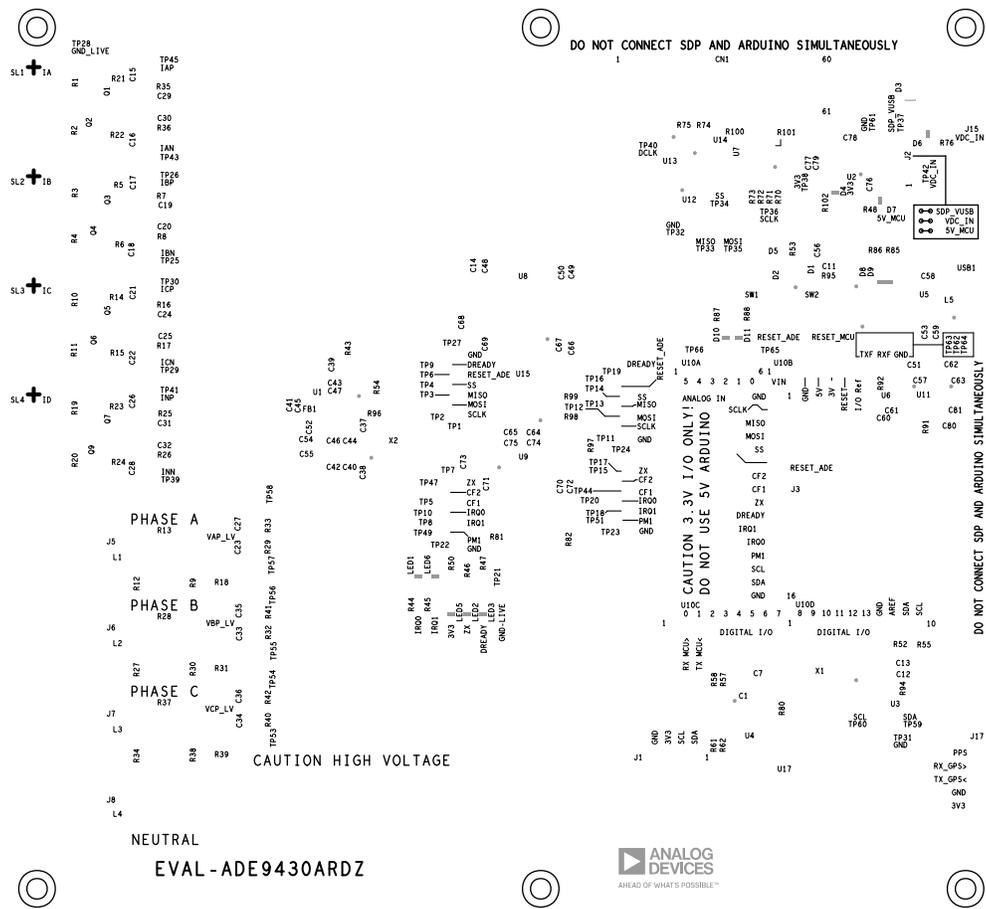


Figure 16. EVAL-ADE9430ARDZ Top Silk

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. Bill of Materials

Quantity	Designator	Description	Manufacturer	Part No.
11	C1, C12, C48, C50, C64, C65, C67, C69, C70, C71, C79	0.1 μ F capacitors	AVX Corporation	08055C104JAT2A
3	C11, C39, C56	1 μ F capacitors	TDK	CGA3E1X7R1C105K080AC
10	C7, C13, C14, C49, C66, C68, C72, C73, C74, C75	10 μ F capacitors	Samsung	CL21A106KAYNNNE
14	C19, C20, C23, C24, C25, C27, C29, C30, C31, C32, C33, C34, C35, C36	0.022 μ F capacitors	TDK	CGA4J2NP01H223J125AA
2	C37, C38	18 pF capacitors	Murata	GJM1555C1H180JB01D
4	C40, C41, C42, C43	4.7 μ F capacitors	KEMET	C0603C475K8PACTU
4	C44, C45, C46, C47	0.1 μ F capacitors	Taiyo Yuden	TMK105B7104KVHF
3	C52, C54, C55	51 pF capacitors	AVX Corporation	04025A510JAT2A
2	C76, C77	10 μ F capacitors	Murata	GRM188R60J106ME47D
1	C78	470 pF capacitor	Vishay	VJ0603Y471KXBAC
1	CN1	120 position receptacle connector	Hirose Electric	FX8-120S-SV(21)
3	D1, D2, D5	Schottky diode, 30 V, 100 mA	Diodes Incorporated	BAT54WS-7-F
7	D7, D10, D11, LED1, LED2, LED3, LED6	Red light emitting diodes (LEDs)	Kingbright Electronic	APT1608LSECK/J3-PRV
1	D3	Schottky diode, 40 V, 1 A	Central Semiconductor	CMMSH1-40L
1	D4	Yellow LED	Würth Elektronik	150060YS75000
2	D6, LED5	Green LEDs	Kingbright Electronic	APT1608LZGCK
1	FB1	120 Ω ferrite bead	Würth Elektronik	7427927112
1	J1	4 position receptacle connector	Samtec Inc.	SSW-104-01-G-S
1	J15	DC power connector, 2.1 mm	Cliff Electronic Components Ltd.	DC-10A (FC68148)
1	J17	5 position receptacle connector	Samtec	SSW-105-02-G-S-RA
1	J2	6 position header connector	TE Connectivity Ltd.	5-146257-3
1	J3	16 position header connector	Sullins	PPTC161LFBN-RC
3	J5, J6, J7	Red banana jack connectors	Cliff Electronic Components Ltd.	FCR7350R
1	J8	Black banana jack connector	Cliff Electronic Components Ltd.	FCR7350B
4	L1, L2, L3, L4	1500 Ω ferrite beads	Murata	BLM21BD152SN1D
8	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q9	Diode array, 100 V, 200 mA	Fairchild Semiconductor	MMBD4148SE
8	R1, R2, R3, R4, R10, R11, R19, R20	5.1 Ω resistors	Panasonic	ERJ-6GEYJ5R1V
4	R52, R55, R100, R101	4.7 k Ω resistors	Yageo	RC0603JR-074K7L
24	R7, R8, R16, R17, R25, R26, R29, R32, R33, R35, R36, R40, R41, R42, R44, R45, R46, R47, R48, R50, R76, R87, R88, R102	1 k Ω resistors	Vishay	TNPW06031K00BEEA
12	R9, R12, R13, R18, R27, R28, R30, R31, R34, R37, R38, R39	249 k Ω resistors	Vishay	RC2010FK-07249KL
12	R5, R6, R14, R15, R21, R22, R23, R24, R57, R62, R74, R75	0 Ω resistors	Panasonic	ERJ-3GEY0R00V
11	R43, R53, R54, R81, R82, R94, R95, R96, R97, R98, R99	10 k Ω resistors	Yageo	RC0603JR-0710KL
5	R70, R71, R72, R73, R80	100 k Ω resistors	Panasonic	ERJ-3EKF1003V
4	SL1, SL2, SL3, SL4	Terminal blocks, 5 mm, 3 position	Multicomp Company	MC000046
2	SW1, SW2	Tactile switches	C&K	PTS645SM43SMTR92LFS
60	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11,	White test points	Keystone Electronics	5002

ORDERING INFORMATION

Table 2. Bill of Materials (Continued)

Quantity	Designator	Description	Manufacturer	Part No.
	TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36, TP37, TP38, TP39, TP40, TP41, TP42, TP43, TP44, TP45, TP47, TP49, TP51, TP53, TP54, TP55, TP56, TP57, TP58, TP59, TP60, TP61, TP64, TP65, TP66			
1	U1	High performance, polyphase energy, and Class S power quality monitoring IC	Analog Devices, Inc.	ADE9430
1	U10A	6 position connector header	Sullins	PREC006SFAN-RC
2	U10B, U10C	8 position connector headers	Sullins	PREC008SFAN-RC
1	U10D	10 position connector header	Sullins	PREC010SFAN-RC
1	U12	3.3 V, 5-tap economy timing element	Analog Devices	DS1100LZ-25+
1	U13	Inverter IC, 1-channel	Fairchild Semiconductor	NC7SZ04P5X
1	U14	Flip flop IC, 1 element D-type	Texas Instruments	SN74LVC1G175DCKR
1	U15	3.75 kV, 6-channel, SPIsolator [®] digital isolator	Analog Devices	ADuM3150ARSZ
1	U17	Battery holder, 12.5 mm	Keystone	1056TR
1	U2	Linear voltage regulator IC, 3.3 V	Microchip Technology	MIC5219-3.3YM5-TR
1	U3	Real-time clock IC	NXP Semiconductors	PCF85263AT/AJ
2	U4, U7	EEPROM memory IC, 32 kb	Microchip Technology	24LC32A/SN
1	U8	Isolated dc-to-dc converter	Analog Devices	ADuM5000ARWZ
1	U9	5.0 kV rms, 6-channel digital isolators	Analog Devices	ADuM261N1BRIZ
1	X1	32.768 kHz crystal	ECS, INC.	ECS-327-12.5-13X-C
1	X2	24.576 MEGHZ crystal	ECS, INC.	ECS-245.7-12-33Q-JES-TR

**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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