PD70288 Ideal Diode Bridge Evaluation Board User Guide

EV65N25A

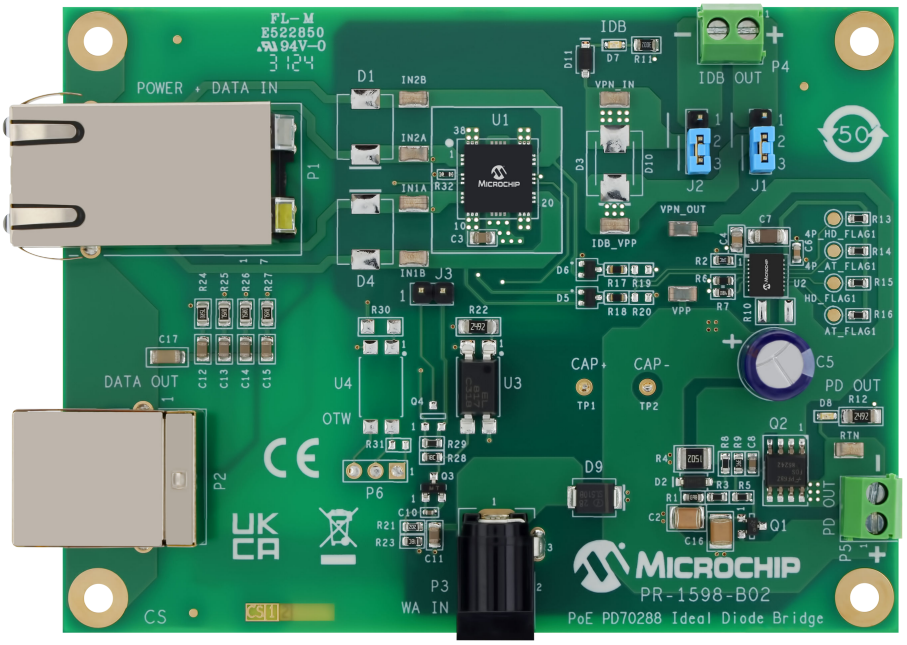
Introduction

The EV65N25A Evaluation Board (EVB) is developed based on Microchip's PD70288 Ideal Diode Bridge (IDB). The PD70288 device is a part of the third generation IEEE® 802.3bt compliant Power over Ethernet (PoE) Powered Devices (PD) family. The device is a dual-active bridge with internal MOSFETs having a total path resistance of 140 mΩ (typical), and is available in a 38-pin, 8 mm x 8 mm QFN package.

The EV65N25A demonstrates a Single Signature Powered Device (SSPD) application. The board uses the PD70210AILQ, PD front end device to support the detection, classification, and power supplying phases on the 2/4 pairs. The board supports up to 90W output power when connected to a 4-pair PoE input. The board output current should be limited to 1.5A when connected to a 2-pair PoE input.

This document provides all the necessary steps and connection instructions required to install and operate this board. The following figure shows the top view of the EVB.

Figure 1. Evaluation Board – Top View



Features

The EV65N25A evaluation board has the following features:

- Input RJ45 Connector (Power + Data)
- Output RJ45 Connector for Data
- IDB Output Connector
- PoE PD Output Connector
- Green Status Indication LEDs

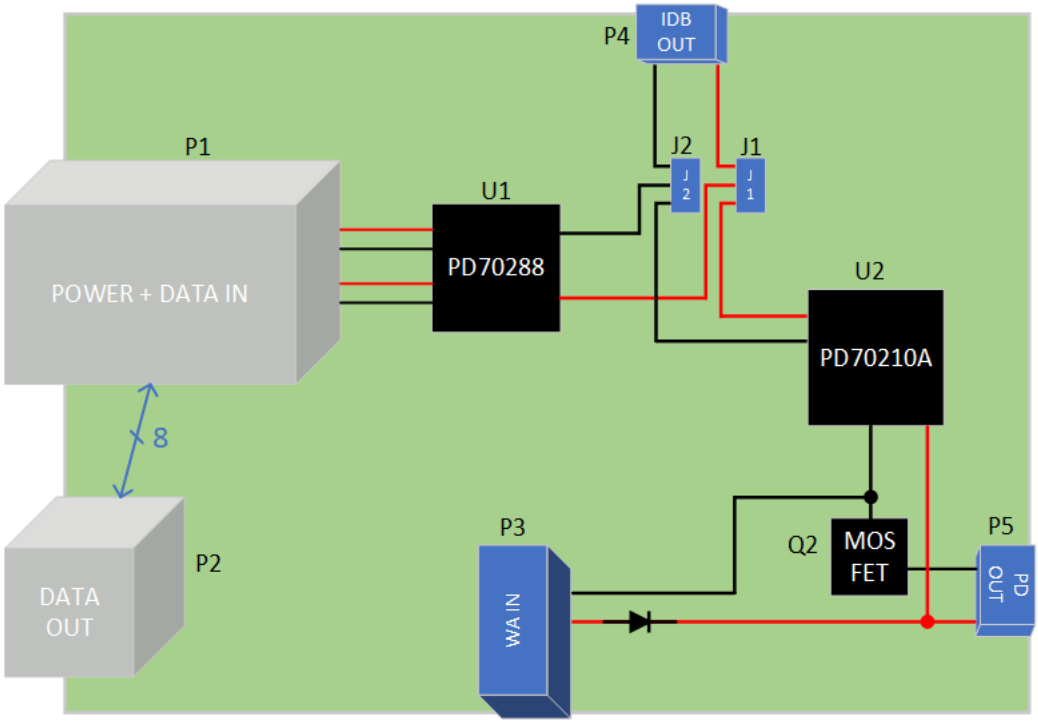
- Wall-Adapter Connections
- Isolation Transformer for Routing the Data to the PD Application to Enable Full PD Evaluation
- Surge Compliance, up to 2 kV Common Mode per IEC61000-4-5:2014
- 0 °C to 40 °C Operating Temperature
- RoHS Compliant

Table of Contents

1. Overview

This section provides the basic overview of the EV65N25A Evaluation Board. The following figure shows the system block diagram.

Figure 1-1. EV65N25A Evaluation Board Block Diagram



1.1 Power

1.1.1 Output

There are two output connectors, P4 and P5 on the EVB. P4 is the IDB output and P5 is the PD output.

When a user wants to evaluate a complete PD application, the output load should be connected to the P5 connector. A connector P4 provision is given to connect the PD70288 output to an existing PD application for evaluating the PD70288 performance.

Jumpers J1 and J2 are used to select the output connection to P4 or P5 connector. By shorting pin 1 and pin 2 of jumpers J1 and J2, the output is available on connector P4. By shorting pin 2 and pin 3 of jumpers J1 and J2 (default connection), the output is available on connector P5.

Note: The PD70288 should not be overloaded when the load is connected to P4 connector. For information on maximum allowed input and output currents, see *PD70288 datasheet*.

1.1.2 Input

When the EVB is powered by a Power Sourcing Equipment (PSE) through the connector P1, the PD70210A performs the detection and classification required to power on the EVB. The output voltage is available on connector P5, provided the jumpers J1 and J2 are in the default state (that is pin 2 should be connected to pin 3).

1.2 Delay circuit

Per the IEEE802.3 standard, the application must provide 80 ms inrush to the operating state delay. So, a MOSFET based delay circuit is connected on the PD70210A output.

1.3 Optional Isolated OTW circuit

By installing U4 (opto-coupler) circuit, the Over Temperature Warning (OTW) signal of PD70288 will be isolated and can be connected to an external circuit to turn-off the load on PD70288 during over temperature conditions. The OTW signal is an active-low, momentary signal.

1.4 Test Points

The following test points are provided on the board for measurement purposes:

- IN1A, IN1B – To measure the input voltage on 2 pairs of IDB input
- IN2A, IN2B – To measure the input voltage on another 2 pairs of IDB input
- IDB_VPP, VPN_IN – To measure the IDB output voltage
- VPP, VPN_OUT – To measure the PD70210A output voltage
- VPP, RTN – To measure the PD70210A output voltage after delay circuit

Test points TP1 and TP2 are used to install a 360uF/100V, ± 20% capacitor to validate the inrush current support of PD70288 IDB. The output capacitor on PD should not exceed 360uF+20%.

1.5 LED Indication

The evaluation board contains output status indication LEDs.

Table 1-1. LED Indication

Designation	Function
D7	Indicates IDB output is high
D8	Indicates PD output is high or wall adapter input is connected

Note: The LED D8 turns off when PD70288 detects over temperature by asserting the OTW signal or when PD70210A activates over current or thermal protections, provided the load is connected to the P5 connector. The input PSE should be disconnected and connected to restart the board.

2. Physical Description

The following sections describe the physical characteristics of the EVB that includes the jumpers and connectors.

2.1 Package Contents

Package content for standard shipments is: EV65N25A Evaluation Board.

The following table lists the physical characteristics of the evaluation board.

Table 2-1. Physical Characteristics

Parameter	Value
Mechanical dimensions (in mm)	104 x 75 x 19

2.2 Jumpers

The following sections provide information regarding the evaluation board jumpers.

Table 2-2. Jumpers List

Connector	Name	Description
J1, J2	PD front-end isolator	Jumpers to connect/isolate PD front-end (PD70210A)
J3	IDB disable	Jumper to disable PD70288 internal MOSFETs

2.2.1 Jumpers Detailed Explanation

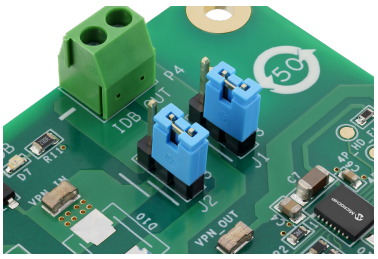
The following sections provide detailed information on the J1, J2, and J3 jumpers.

2.2.1.1 J1 and J2 Jumpers

The pin description in the following table refers to the jumpers listed in Table 2-2. Jumpers J1 and J2 selects the connection of PD70288 output to either P4 connector or PD70210A (front-end) circuit.

- To connect PD70288 output to PD70210A circuitry, short J1.2 and J1.3, and short J2.2 and J2.3

Figure 2-1. Connecting the PD70288 Output to PD70210A Circuitry



- To connect PD70288 output to P4 connector, short J1.1 and J1.2 and short J2.1 and J2.2

Figure 2-2. Connecting the PD70288 Output to P4 Connector

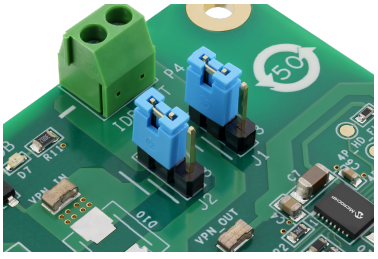


Table 2-3. J1 and J2 Jumper Connections

Pin Number	Signal name	Description
J1.1	CONN_VPP	This pin is connected to P4.1 (Pin 1 in P4 connector).
J1.2	IDB_VPP	This pin is connected to the positive output terminal of PD70288.
J1.3	VPP	This pin is connected to the positive input terminal of PD70210A.
J2.1	CONN_IDB_GND	This pin is connected to P4.2 (Pin 2 in P4 connector)
J2.2	IDB_GND	This pin is connected to the negative output terminal of PD70288.
J2.3	GND	This pin is connected to the negative input terminal of PD70210A.

Note: The jumpers supplied with the EVB can withstand 3A of current. Use the jumpers supplied with the EVB to short pins of J1 and J2. The part number of jumpers is SNT-100-BL-G, Manufacturer - Samtec.

2.2.1.2 J3 Jumpers

A provision is given on the board to either enable or disable internal MOSFETs of IDB, to compare the power losses and voltage drop with PD70288 and a diode bridge.

To disable IDB, short J3.1 and J3.2, otherwise open J3.1 and J3.2. The default configuration is open J3.1 and J3.2.

Note: The PD70288 internal circuit controls the enable pin and there is no need of any external circuit to enable/disable the PD70288 internal MOSFETs.

Table 2-4. J3 Jumper Connections

Pin Number	Signal Name	Description
J3.1	IDB_EN	PD70288 Enable pin
J3.2	IDB_GND	PD70288 output negative terminal/ground

2.3 Connectors

This section provides information regarding the evaluation boards connectors. The following table lists the connectors of the evaluation board.

Table 2-5. Connectors List

Connector	Name	Description
P4	IDB Output	Terminal blocks for connecting an external PoE PD circuit
P5	PD Output	Terminal blocks for connecting a load on PD70210 output
P1	RJ45 Connector	RJ45 port for Data and Power Input for PSE connection
P2	RJ45 Connector	RJ45 port for Data Output for PD data connection
P3	Wall Adapter Input	Standard Barrel Jack used for 48V Wall Adapter

2.3.1 Connectors Detailed Explanation

The following sections provide detailed information on the evaluation board connectors.

2.3.1.1 RJ45 Connectors

The following table lists the pin description of the P1 and P2 connectors.

Table 2-6. RJ45 Connections

P1 and P2 Pin Number	Signal Name	Description
P1 - 1,2	Data and Power In	Data and power input to powered device (PoE Master Negative data port)
P1 - 3,6	Data and Power In	Data and power input to powered device (PoE Master Positive data port)

.....continued		
P1 and P2 Pin Number	**Signal Name**	**Description**
P1 - 4,5	Data and Power In	Data and power input to powered device (PoE Master Positive data port)
P1 - 7,8	Data and Power In	Data and power input to powered device (PoE Master Negative data port)
P2 - 1,2	Data Output	Isolated data pass-through to external monitoring device.
P2 - 3,6	Data Output	Isolated data pass-through to external monitoring device.
P2 - 4,5	Data Output	Isolated data pass-through to external monitoring device.
P2 - 7,8	Data Output	Isolated data pass-through to external monitoring device.

2.3.1.2 Wall Adapter

The following table lists the pin description of wall adapter connector.

Table 2-7. Wall Adapter Connections

P3 Pin Number	Signal Name	Description
Center Pin	VIN (+)	42V to 57V input from wall adapter
Outer Barrel	VIN (-)	Wall adapter return

2.3.1.3 Output Connectors

The following table lists the pin description of P4 and P5 connector.

Table 2-8. Output Connectors

P4 and P5 Pin Number	Signal Name	Description
P4– 1	VOUT (+)	Positive IDB Output voltage
P4– 2	VOUT (-)	Return IDB Output voltage
P5 – 1	VOUT (+)	Positive PD Output voltage
P5 – 2	VOUT (-)	Return PD Output voltage

3. Electrical Characteristics

The following table describes the EV65N25A evaluation board electrical characteristics.

Table 3-1. Electrical Characteristics

Parameter	Conditions	Min.	Max.	Unit
Input Voltage range	Voltage between IN1A and IN1B, IN2A and IN2B VIN1 = |VIN1A–VIN1B| or |VIN1B–VIN1A| VIN2 = |VIN2A–VIN2B| or |VIN2B–VIN2A|	0	57	V
Output Voltage range	Voltage between IDB_VPP and VPN_IN, VPP and RTN.	0	57	V
Input Forward current	Current on IN1A respect to IN1B, IN2A respect to IN2B	0	1.5	A
Average forward output current	—	0	3	A

4. Installation

The following sections describes the installation steps for the evaluation board.

4.1 Preliminary Considerations and Safety Precautions

Verify that the power supply of the board is turned off before connecting all the peripheral devices.

Note: The maximum allowable load current on P4 or P5 is 1.5A when connected to a 2-pair PoE input.

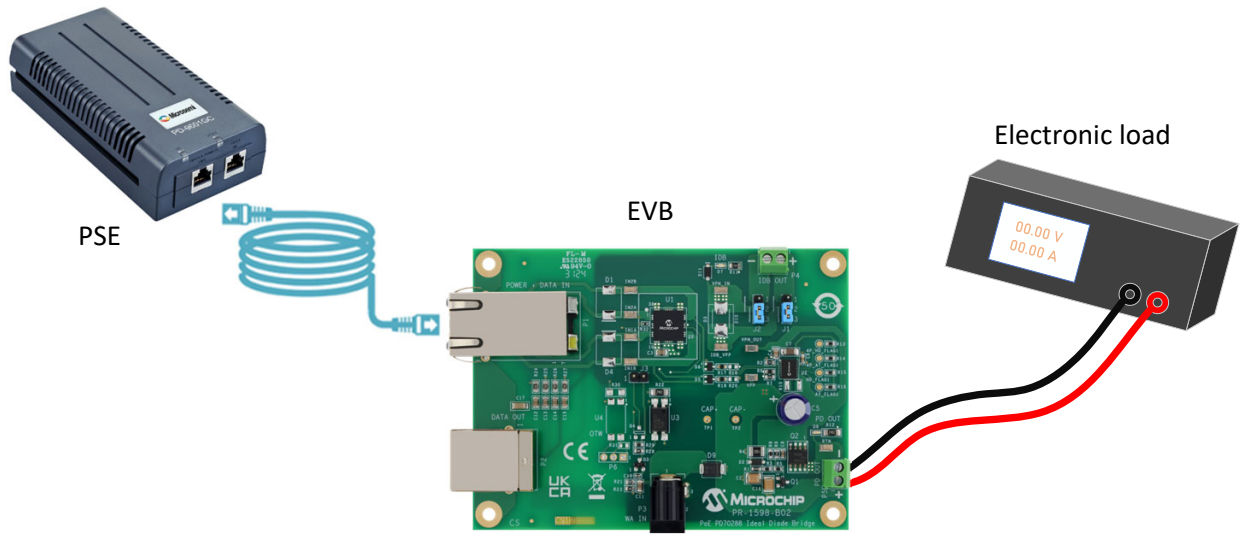
4.2 Initial Configuration

Prior to starting any operation, verify that the evaluation board is set up as shown in the following figure.

Follow the given steps to verify the board set up:

1. Connect J1 and J2 jumper pins as per the required output connections, that is, P4 or P5.
2. Connect load to the main board (P4/P5).
3. Connect a Cat 5e or a better cable from PSE/Input power supply to the evaluation board (P1). Alternatively, connect a power cable from the power supply to the evaluation board (P3).
4. When there is a need to test the Ethernet data, connect Ethernet cable from the evaluation board (P2) to the PD Ethernet host.

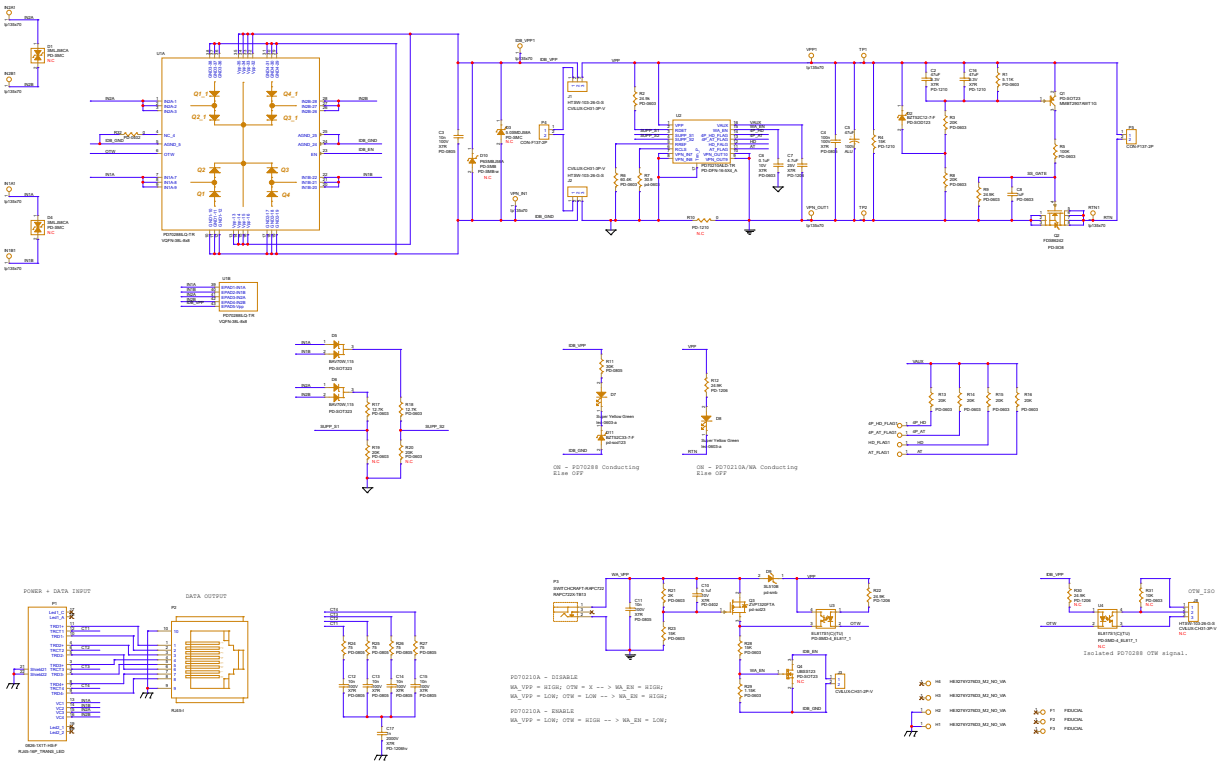
Figure 4-1. Test Setup



5. Schematics

The following section shows the detailed schematic.

Figure 5-1. Schematic Diagram



6. Bill of Materials

The following table details the bill of materials for the product.

Table 6-1. Bill of Materials

QTY	Ref. Designator	Value	Description	Manufacturer	Mfr. Part Number
2	C2, C16	47uF	CAP CER 47uF 6.3V 20% X7R 1210 SMT	Kemet	C1210C476M9RACTU
5	C3, C12, C13, C14, C15	10n	CAP CRM 10nF 100V 5%X7R 0805 SMT	Kemet	C0805C103J1RAC
1	C4	100n	Capacitor, X7R, 100nF 100V 10% 0805	AVX	08051C104KAT2A
1	C5	47uF	CAP ALU 47uF 100V 20%8X11.5 105C P=3.5mm T/H	Nippon Chemi-Con	EKMQ101ETD470MHB5D
1	C6	0.1uF	Capacitor,0.1uF, X7R, 10V, 10% 0603	Kemet	C0603C104K8RACTU
1	C7	4.7uF	CAP CRM X7R 4.7uF 25V 10% 1206 SMT	Samsung	CL31B475KAHNNNE
1	C8	1uF	Capacitor,X7R, 1uF, 25V, 10% 0603	Murata	GRM188R71E105KA12D
1	C10	0.1uf	CAP CER 0.1uF 10V X7R 10% 0402 SMT	Nic	NMC0402X7R104K10TRP
1	C11	10n		Kemet	C0805C103J1RAC
1	C17	1n	CAP CRM 1nF/2000V 10%++X7R 1206 SMT	Yageo	CC1206KKX7RDBB102
1	D2	BZT52C12-7-F	DIO ZENER 12V 500MW SOD123 SMT	Diodes Inc.	BZT52C12-7-F
2	D5, D6	BAV70W,115	Diode,Dual Switching SOT323 BAV70W	Nexperia	BAV70W,115
2	D7, D8	19-21-SYGCS530E3TR8	LED SuperYelGrn 100-130o 20-40mcd h=1 0603 SMD	—	19-21-SYGCS530E3TR8
1	D9	SL510B	DIODE SCHOTTKY 5A 100V SMB	Surge Components, Incorporated	SL510B
1	D11	BZT52C33-7-F	DIODE ZENER 33V 500mW 5% SOD123 - BZT52C33	Diodes Inc.	BZT52C33-7-F
9	VPP1, VPN_OUT1, VPN_IN1, RTN1, IDB_VPP1, IN1B1, IN1A1, IN2B1, IN2A1	RCSCTE	TEST POINT TIN PLATEDHEAD 1.7mm H-3mm L-3.2mm	KOA	RCSCTE
2	J1, J2	HTSW-103-26-G-S	PIN HEADER 3P 0.1" PIN SQUER+Gold T/H	Samtec	HTSW-103-26-G-S
1	J3	CH31022VA00	Pin Header 2pin Singlerow Vertical 2.54mm	CviLux	CH31022VA00
1	P1	0826-1X1T-HS-F	CONN MAGJACK 1PORT 100W 1A 1000 BASE-T	Bel Stewart	0826-1X1T-HS-F

.....continued

QTY	Ref. Designator	Value	Description	Manufacturer	Mfr. Part Number
1	P2	6116526-1	CON RJ45 SINGLE PORT8 POSITION SHILDED	Tyco Electronics	6116526-1
1	P3	RAPC722X-TB13	CON DC POWER JACK RA2.0X6.3 T/H	Switchcraft	RAPC722X-TB13
2	P4, P5	MB332-350M02	Terminal block 2 Pole interlocking 3.5mm pitch	DECA	MB332-350M02
1	Q1	MMBT2907AWT1G	TRN PNP 60V 600mA SOT323 SMT 250mW MMBT2907AW	ON Semiconductor	MMBT2907AWT1G
1	Q2	FDS86242	IC, N-CH POWER MOSFET 150v 4.1A SO8	Fairchild	FDS86242
1	Q3	ZVP1320FTA	MOSFET P-CH 200V 35MA SOT23-3	Diodes Inc.	ZVP1320FTA
1	R1	5.11K	RES 5.11K 0.1W 1%0603 SMT MTL FLM	Samsung	RC1608F5111CS
1	R2	24.9k	RES 24.9K 0.1% 1/10W 0603 SMT 25 ppm	Yageo	RT0603BRD0724K9L
6	R3, R8, R13, R14, R15, R16	20K	RES 20K 62.5mW 1%0603 SMT MTL FLM	ASJ	CR16-2002FL
1	R4	15K	RES 15K 333mW 1%1210	VENKEL	LCR1210-2W-1502FSNT
1	R5	100K	RES 100K 62.5mW 1%0603 SMT MTL FLM	Panasonic	ERJ3EKF1003V
1	R6	60.4K	RES TCK FLM 60.4K 62.5mW 1%0603 SMT	Samsung	RC1608F6042CS
1	R7	30.9	Resistor, 30.9R 1%, 1/10W 0603	Yageo	RC0603FR-0730R9L
1	R9	24.9K	RES TCK FLM 24.9K 62.5mW 1%0603 SMT	Panasonic	ERJ3EKF2492V
1	R11	30K	RES 30K 1/8W 0.1%0805 25ppm	Yageo	RT0805BRD0730KL
2	R12, R22	24.9K	RES TCK FLM 24.9K 250mW1% 1206 SMT 100 ppm	Panasonic	ERJ8ENF2492V
2	R17, R18	12.7K	RES 12.7K 62.5mW 1%0603 SMT MTL FLM	Rohm	MCR03EZPFX1272
1	R21	2K	RES TCK FLM 2K 62.5mW 5%0603 SMT	Samsung	RC1608J202CS
2	R23,R28	15K	RES TCK FLM 15K 62.5mW 1%0603 SMT	Samsung	RC1608F1502CS
4	R24, R25, R26, R27	75	RES 75R 125mW 1% 0805SMT	Bourns	CR0805-FX-75R0-ELF

.....continued

QTY	Ref. Designator	Value	Description	Manufacturer	Mfr. Part Number
1	R29	1.15K	Resistor, SMT 1.15K, 1%, 1/10W 0603	ASJ	CR16-1151FL
1	R32	0	Resistor, 0 Ohm, 5%, 1/16W 0402	Vishay	CRCW04020000Z0ED
1	U1	PD70288ILQ-TR	IC-PD70288- Dual Ideal diode bridge for type 4 POE devices (90W)	Microchip	PD70288ILQ-TR
1	U2	PD70210AILD-TR	HDbaseT AF/AT PD CHIP Front End Aux Power Suppor	Microsemi	PD70210AILD-TR
1	U3	EL817S1(C)(TU)	OPTOCOUPLER PHOTOTRANS CTR 200%-400% 4Pin SMT	Everlight	EL817S1(C)(TU)

7. Board Layout

This section presents the layout of the EVB. The board is a 4-layer board where all the layers are 2 Oz layers.

The following figures show the top silk screen and copper layers of the board for tracking devices placements.

Figure 7-1. Top Silk Screen

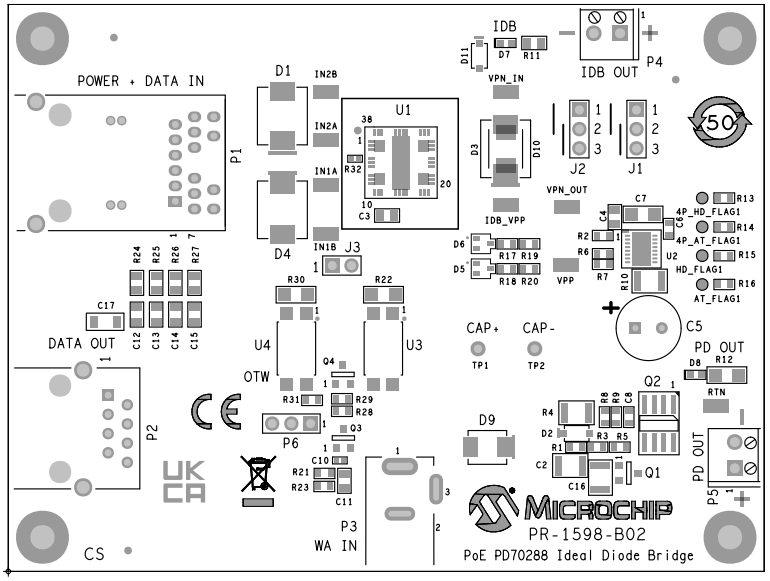


Figure 7-2. Top Layer

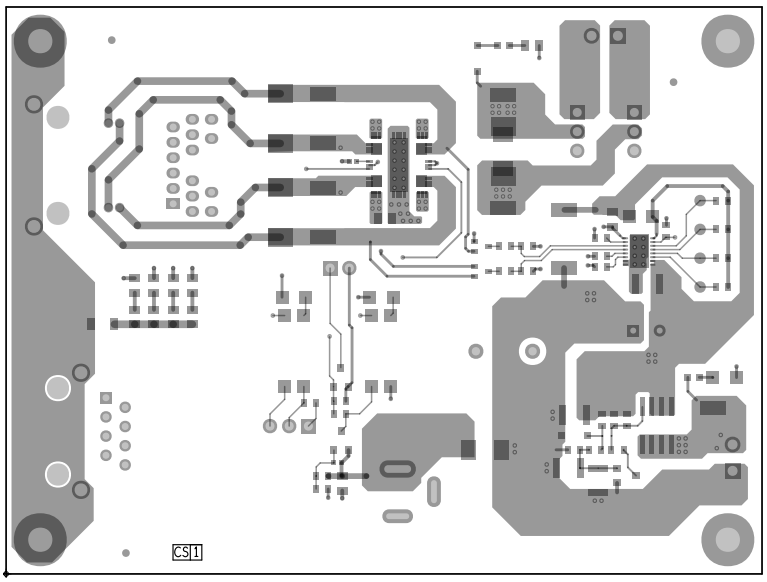


Figure 7-3. Inner Layer 1

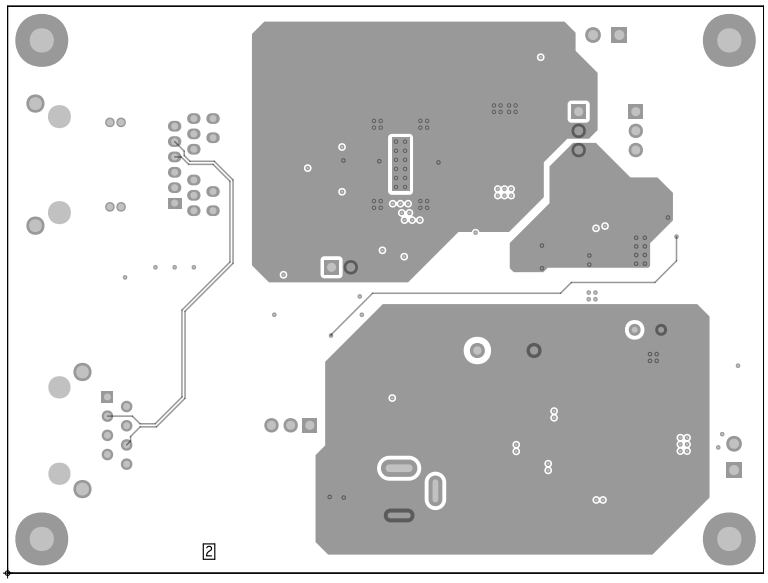


Figure 7-4. Inner Layer 2

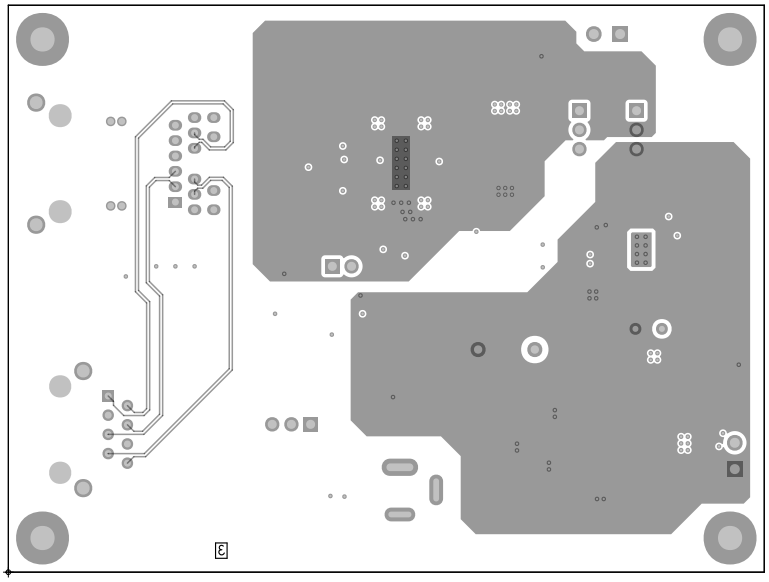
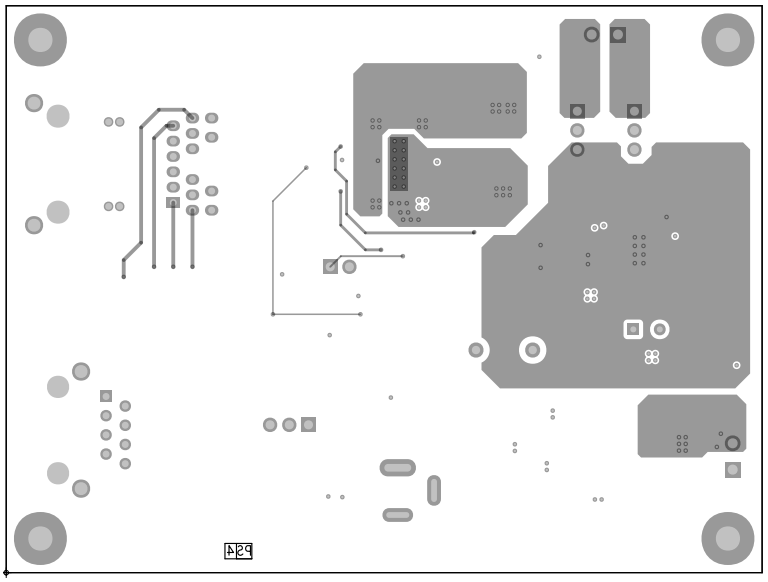


Figure 7-5. Bottom Layer



8. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Table 8-1. Revision History

Revision	Date	Description
A	09/2024	Initial Revision

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ISBN: 978-1-6683-0258-3

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