

PD70201EVB-U-25F-5
User Guide
Isolated Flyback Converter Evaluation Board

April 2018



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1 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.

1.1 Revision 1.0

Revision 1.0 was published in April 2018. It was the first publication of this document.

2 Product Overview

This document provides the description and operating procedures for Microsemi's PD70201EVB-U-25F-5 board. This board type is used for evaluating the performance of the PD70201 device in both standard IEEE802.3at and non-standard applications with input 17-54 V_{DC}. The board is a 25 W PD consisting of isolated DC-DC converter to step down voltage to 5 V. The AUX input gets priority in supplying the load, when it is connected to the application and the PD inputs act as backup power if the AUX is disconnected.

Microsemi's PD70201ILQ device is part of a family of devices that support the IEEE 802.3at standard PD interface, and a PWM controller that is used for PD operational voltages DC/DC.

The PD interface includes the following family of devices.

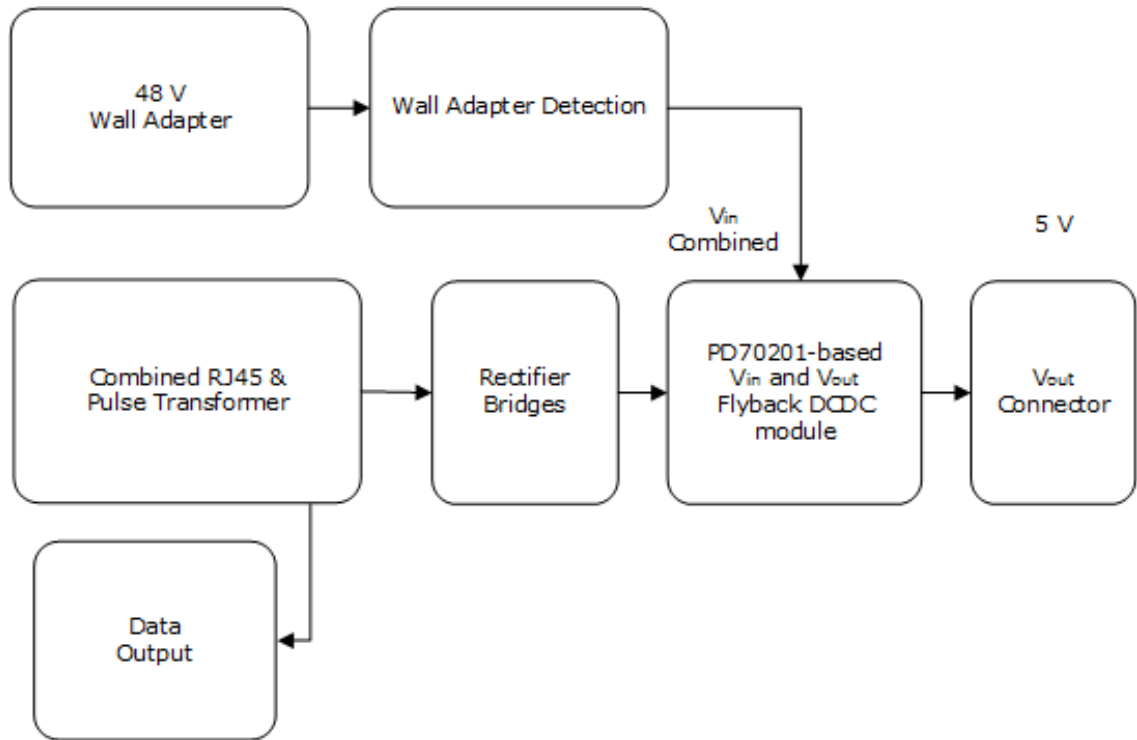
Table 1 • PD Family of Devices

| Device type | Power Capability | Integrates PWM Controller | WA_EN support |
|-------------|---|---------------------------|---------------|
| PD70100 | IEEE 802.3at Type 1 (IEEE 802.3 af level) | No | No |
| PD70101 | IEEE 802.3at Type 1 (IEEE 802.3 af level) | Yes | No |
| PD70200 | IEEE 802.3at Type 2 | No | No |
| PD70201 | IEEE 802.3at Type 2 | Yes | No |
| PD70210 | IEEE 802.3at Type 2 | No | No |
| PD70210A | IEEE 802.3at Type 2 | No | Yes |
| PD70211 | IEEE 802.3at Type 2, HDBT | Yes | Yes |
| PD70224 | IEEE 802.3at Type 2, HDBT | No | Yes |

Microsemi's PD70201EVB-U-25F-5 Evaluation Board provides designers with the environment needed for evaluating the performance and implementation of PD applications based on the PD70201 device.

The board uses a single PD device (PD70201ILQ) to support the Detection, Classification, and Power Supplying phases on the 2/4 pairs of the Cat5 cable. PD70201ILQ supports a standard IEEE802.3at Type 2 interface as well as wide range non-standard input voltage.

This document provides all necessary procedures and instructions to install and operate this board.

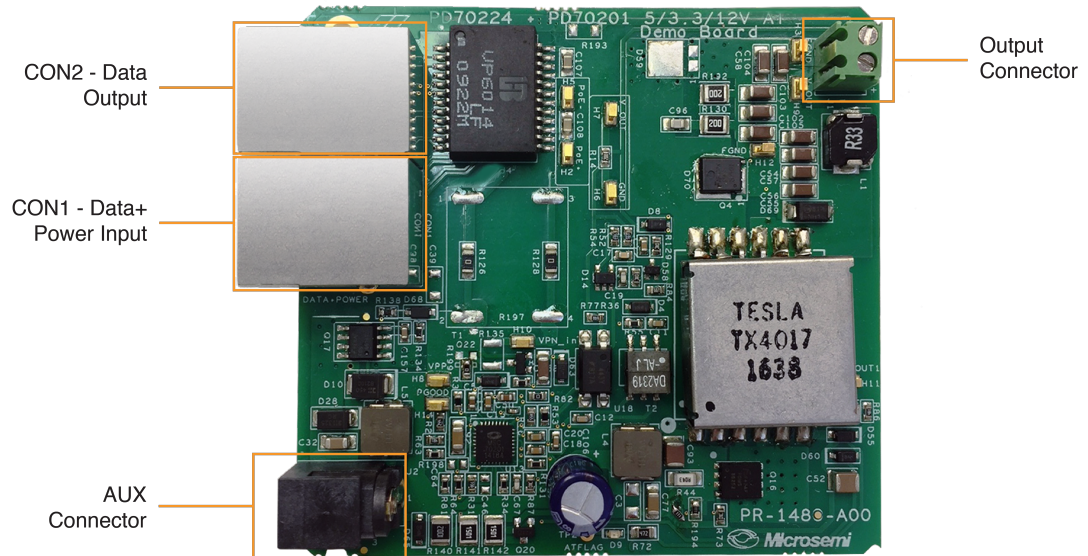
Figure 1 • PD70201EVB-U-25F-5 Block Diagram


The board can be powered either by a PSE through CON1 or by an auxiliary connector (AUX connector), see [electrical characteristics \(see page 6\)](#) for the input voltage range. The external load is connected to evaluation board using output connector (J1)(refer to [evaluation board \(see page 4\)](#) for the output connector). The evaluation board can be powered by connecting an external AC adaptor to the AUX connector (J2) (refer to [evaluation board \(see page 4\)](#) for the AUX connector).

D9 is the AT flag indication LED, a PD70201 device output signal indicating that the device has detected two fingers class, so the PSE side is AT level capable. This signal in the PD environment indicates that AT power level is supported.

The following image shows a top view of the evaluation board.

Figure 2 • PD70201EVB-U-25F-5 Evaluation Board – General View



2.1 Evaluation Board Features

- Designed to support data and spare current by a single PD70201 device
- Two RJ45 connectors (Data and Power Input, Data Output)
- Output voltage connector
- On board AT detected LED indicator
- Pulse transformer for routing the data to PD application to enable full PD evaluation
- Wide input voltage range
- Evaluation Board working temperature: 0°C to 70°C
- RoHS compliant

2.2 Evaluation Board Connectors

The evaluation board connectors are listed in the following table.

Table 2 • Connector Details

| # | Connector | Name | Description |
|---|-----------|------------------|--|
| 1 | CON1 | RJ45 Connector | RJ45 port for Data and Power Input for PSE connection |
| 2 | CON2 | RJ45 Connectors | RJ45 port for Data Output for PD data connection |
| 3 | J1 | Output connector | Terminal blocks for connecting a load to output regulator |
| 4 | J2 | AUX connector | Auxiliary input connection to power the EVB using AC adaptor, see the Electrical Characteristics section for operating voltage ranges. |

2.2.1 RJ45 Connectors

There are two dedicated RJ45 connectors (refer to [evaluation board \(see page 4\)](#) for the RJ45 connectors), one input connector (CON1) for power and data and one output connector (CON2) for data. The pin connections of the input and output connectors are described in the following table.

Table 3 • RJ45 Input Connector (CON1)

| CON1 Pin No | Alternative A (MDI-X) | Alternative A (MDI) | Alternative B (MDI-X/MDI) |
|-------------|--------------------------|------------------------|------------------------------|
| 1 | DATA - Vport_Neg | DATA - Vport_Pos | |
| 2 | DATA - Vport_Neg | DATA - Vport_Pos | |
| 3 | DATA - Vport_Pos | DATA - Vport_Neg | |
| 4 | | | SPARE - Vport_Pos |
| 5 | | | SPARE - Vport_Pos |
| 6 | DATA - Vport_Pos | DATA - Vport_Neg | |
| 7 | | | SPARE - Vport_Neg |
| 8 | | | SPARE - Vport_Neg |

Table 4 • RJ45 Output Connector (CON2)

| CON2 Pin No | Signal Name | Description |
|------------------------|-------------|-------------------|
| 1, 2, 3, 4, 5, 6, 7, 8 | Data Out | Data output to PD |

- Manufacturer: Bel Stewart
- Manufacturer part number: SS71800-007F or equivalent

2.2.2 Output Connector

An external load is connected to the evaluation board using the output connector (J1). The pin connections of the output connector is described in the following table.

Table 5 • J1 Connector

| Pin No. | Signal Name | Description |
|---------|----------------------|--------------------------------|
| Pin 1 | V _{OUT} | Positive DC/DC output voltage |
| Pin 2 | V _{OUT_RTN} | Return of DC/DC output voltage |

- Manufacturer: DECA
- Manufacturer part number: MB332-350M02

2.2.3 AUX Connector

The evaluation board can be powered by an external AC adaptor using the auxiliary connector (J2). The pin connections of AUX Connector are described in the following table.

Table 6 • J2 Connector

| Pin No. | Signal Name | Description |
|-----------|---------------------|---------------------------|
| Pin 1 | V _{IN,RTN} | Return of AUX connector |
| Pin 2 & 3 | V _{IN} | Positive of AUX connector |

- Manufacturer: Switchcraft
- Manufacturer part number: RAPC712X

The polarity of the AUX connector is shown in the following illustration.

Figure 3 • AUX Connector Cable Polarity



2.3 Physical Characteristics

The mechanical dimensions of the board are 81 mm x 65 mm x 15 mm (L x W x H).

2.4 Electrical Characteristics

Following are electrical characteristics of the evaluation board.

Table 7 • Electrical Characteristics

| Parameter | Min | Max | Unit |
|---------------------------|-----|------|-------|
| Main DC Supply – Con1, J2 | 17 | 57 | V |
| Output voltage | 4.8 | 5.25 | V |
| Maximum Output Current | -- | 5 | A |
| Port Isolation to Chassis | -- | 1.5 | kVrms |

3 Installation

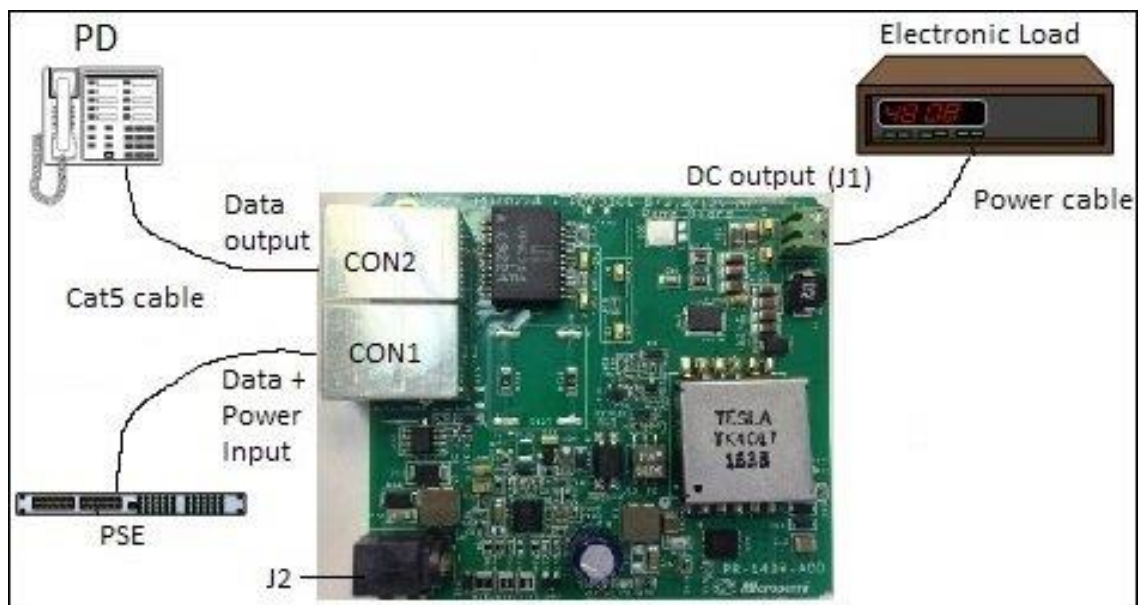
Ensure board's power supply is turned OFF before all peripheral devices are connected.

3.1 Initial Configuration

Note: Prior to starting any operation, it is important to verify that the evaluation board is setup as shown in the following figure.

- Connect load to the main board (using J1).
- Connect a Cat5 cable from PSE to evaluation board (using CON1). Alternatively, connect a power cable from the power supply to evaluation board (using J2).
- To test the Ethernet data, connect Ethernet cable from evaluation board (using CON2) to the PD Ethernet Host.

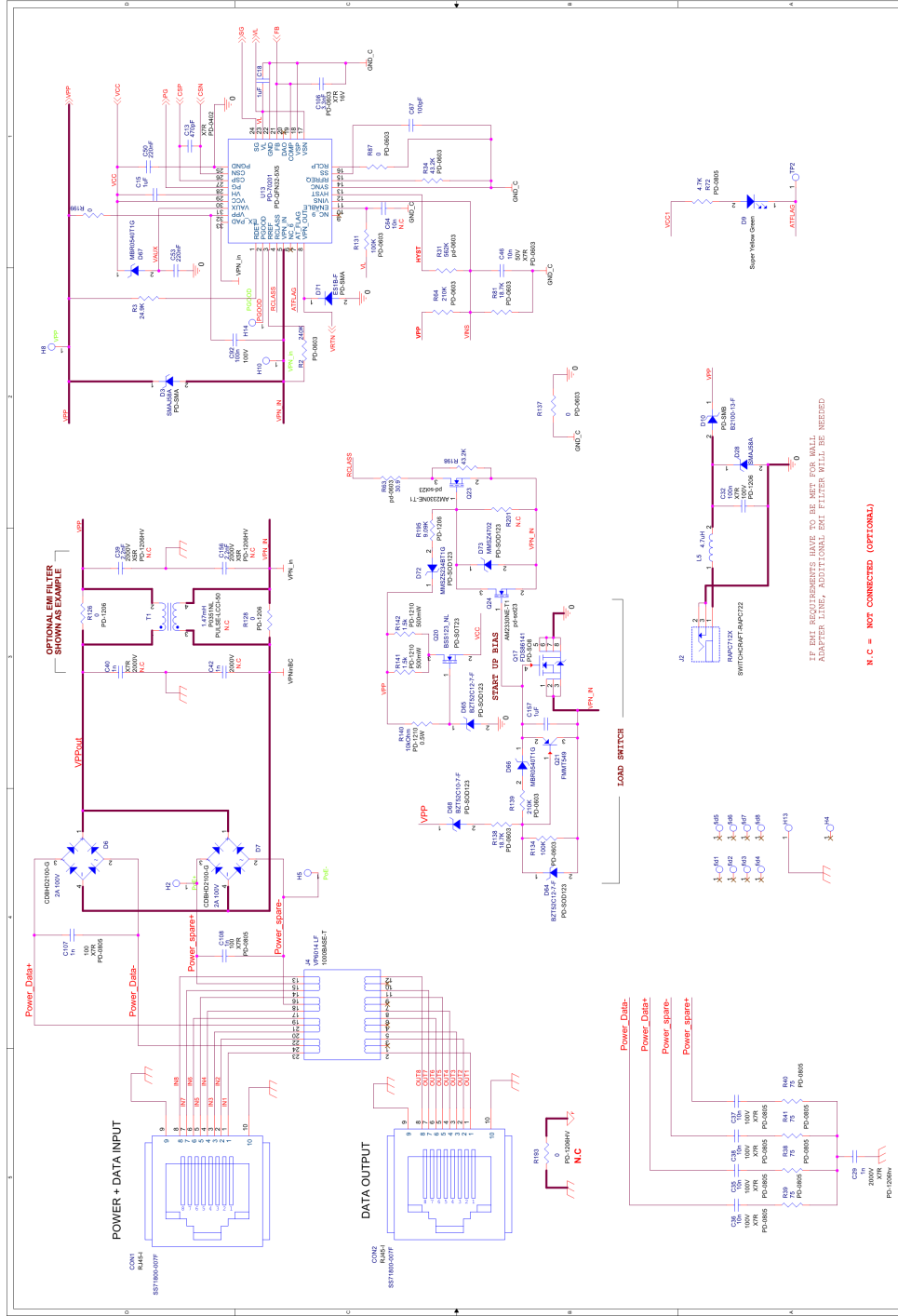
Figure 4 • Test Setup



4 PD70201EVB-U-25F-5 Schematics

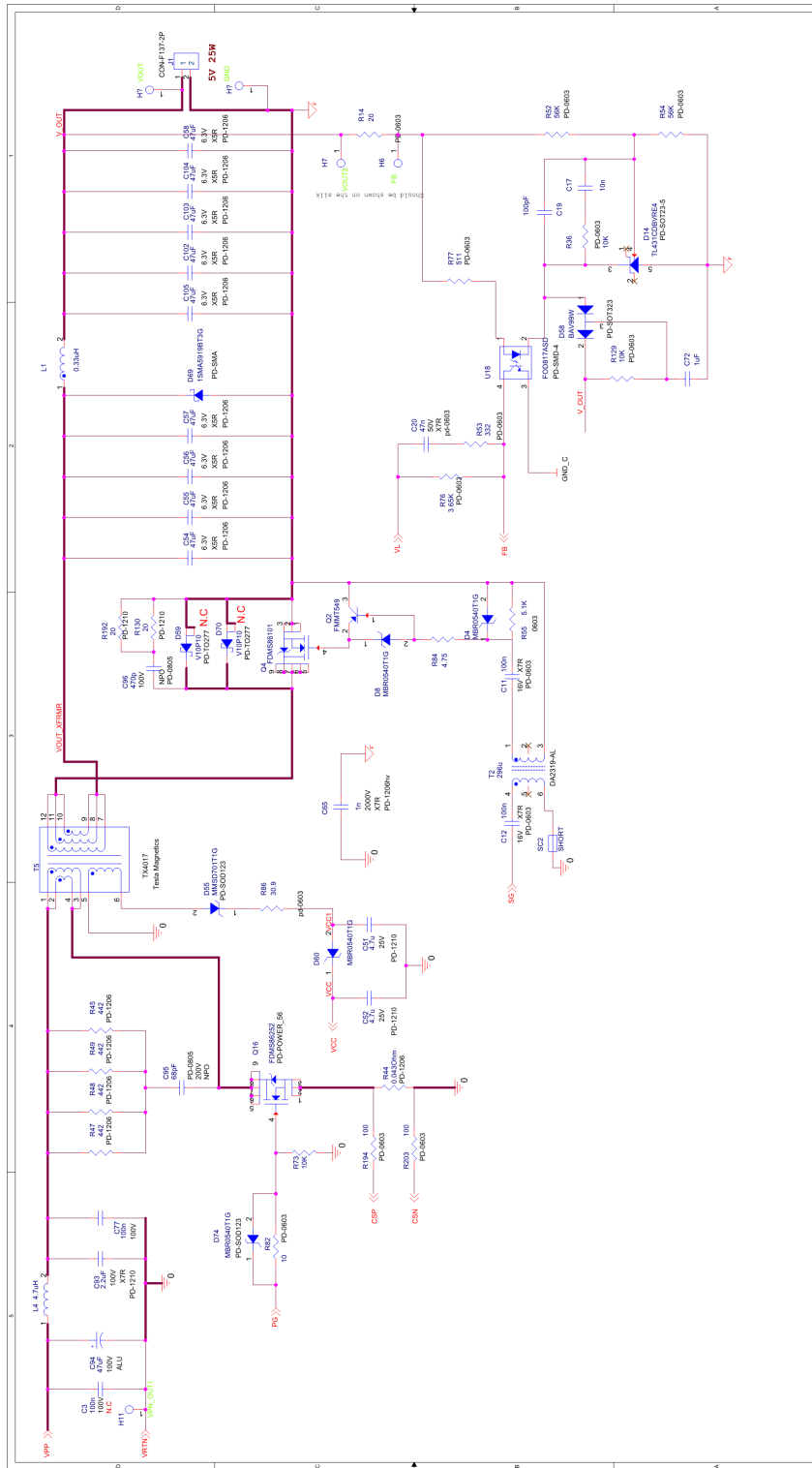
The following image shows the front-end section, EMI, and PD70201 circuitry.

Figure 5 • Front-end and PD70201 Circuitry



The following image shows the power section of flyback converter.

Figure 6 • Flyback Converter Power Section



5 PD70201EVB25FX Bill of Materials

Table 8 • PD70201EVB25F5 Assembly

| Item | Description | Quantity | Reference Designation | Manufacturer Name | Manufacturer Part Number |
|------|--|----------|---|-------------------|--------------------------|
| 1 | CON RJ45 SINGLE 8 POS. SHILDED after vibration | 2 | CON1, CON2 | Bel Stewart | SS71800-007F |
| 2 | CAP CER 100nF 100V 10% X7R 1206 SMT | 4 | C3, 32, C77, C92 | AVX | 12061C104KAT2A |
| 3 | CAP CER 100nF 16V 10% X7R 0603 SMT | 2 | C11, C12 | Taiyo Yuden | EMK107B7104KA-T |
| 4 | CAP CER 470pF 50V X7R 0402 | 1 | C13 | Yageo | CC0402KRX7R9BB471 |
| 5 | CAP CER X7R 1uF 25V 10% 0603 | 4 | C15, C18, C72, C157 | Murata | GRM188R71E105KA12D |
| 6 | CAP CER 10nF 50v 10% X7R 0603 SMT | 3 | C17, C46, C64 | Rohm | MCH185CN103KK |
| 7 | CAP C0G 100pF 50V 5% 0603 | 2 | C19, C67 | TDK | C1608C0G1H101J |
| 8 | CAP CER 0.047UF 50V X7R 0603 | 1 | C20 | Samsung | CL10B473KB8NNNC |
| 9 | CAP CER 1nF/2000V 10% X7R 1206 SMT | 4 | C29, C40, C42, C65 | AVX | 1206GC102KAT1A |
| 10 | CAP CER 10000PF 100V X7R 0805 | 4 | C35, C36, C37, C38 | Kemet | C0805C103J1RAC |
| 11 | CAP CER 2.2nF 2000V X7R 1206 | 2 | C39, C156 | Walsin | 1206B222K202CT |
| 12 | CAP 220NF 25V X7R 10% 0603 | 2 | C50, C53 | TDK | C1608X7R1E224K |
| 13 | CAP X5R 4.7uF 25V 10% 1210 | 2 | C51, C52 | Taiyo Yuden | TMK325BJ475KN-T |
| 14 | CAP CER 47UF 6.3V X5R 1206 | 9 | C54, C55, C56, C57, C58, C102, C103, C104, C105 | AVX | 12066D476MAT2A |
| 15 | CAP CER 2.2UF 100V X7R 1210 | 1 | C93 | TDK | C3225X7R2A225K |
| 16 | CAP ALU 47uF 100V 20% 8X11.5 105C P=3.5mm T /H | 1 | C94 | Rubycon | 100PX47M EFC T7 8X11.5 |
| 17 | CAP CER 68pF 200V 10% NPO 0805 | 1 | C95 | AVX | 08052A680KAT2A |
| 18 | CAP CER 470pF 100V 2% NPO 0805 SMT | 1 | C96 | Walsin | 0805N471G101LT |
| 19 | CAP CER X7R 3.3nF 16V 10% 0603 | 1 | C106 | TDK | C1608X7R1C332K |
| 20 | CAP CER 1000PF 100V X7R 0805 | 2 | C107, C108 | TDK | C2012X7R2A102K |

| Item | Description | Quantity | Reference Designation | Manufacturer Name | Manufacturer Part Number |
|------|--|----------|---|----------------------|--------------------------|
| 21 | DIO TVS 58V 40A SRG400WPK SMA SMT | 2 | D3, D28 | Vishay | SMAJ58A |
| 22 | DIO SCHOTTKY 40V 500mA SOD123 REC SMT | 6 | D4, D8, D60, D66, D67, D74 | ON Semiconductor | MBR0540T1G |
| 23 | Schottky bridge rectifier 100V 2A TO-269AA | 2 | D6, D7 | Comchip | CDBHD2100-G |
| 24 | LED SuperYelGrn 100- 130o 20-40mcd h=1 0603 SMD | 1 | D9 | Everlight | 19-21-SYGCS530E3TR8 |
| 25 | DIODE SCHOTTKY 100V 2A SMB | 1 | D10 | Diodes Inc. | B2100-13-F |
| 26 | IC Prog Shunt Ref 2.5V 2% SOT23-5 SMT | 1 | D14 | Texas Instruments | TL431CDBVRE4 |
| 27 | DIODE SCHOTTKY 70V 0.2 A, 225 mW, SOD123 | 1 | D55 | ON Semiconductor | MMSD701T1G |
| 28 | Diode, Dual Switching SOT323 | 1 | D58 | NXP | BAV99W |
| 29 | Diode Schottky 10A/100V Vf= 0.574V TO-277A SMT | 2 | D59, D70 | Vishay | V10P10 |
| 30 | Diode Zener 12V 500MW SOD123 SMT | 2 | D64, D65 | Diodes Inc. | BZT52C12-7-F |
| 31 | Diode Zener 10V 500MW SOD123 SMT | 1 | D68 | Diodes Inc. | BZT52C10-7-F |
| 32 | Diode Zener 5.6V 1.5W SMA case 403D | 1 | D69 | ON- Semiconductor | 1SMA5919BT3G |
| 33 | Diode 100V 1A SuperFastRec. trr=25nS SMA | 1 | D71 | Diodes Inc. | ES1B-F |
| 34 | Diode Zener 500mW 6.2V 5% SOD123 | 1 | D72 | ON Semiconductor | MMSZ5234BT1G |
| 35 | Diode Zener 15V 500MW SOD123 | 1 | D73 | ON Semiconductor | MMSZ4702 |
| 36 | TEST POINT TIN PLATEDHEAD 1.7mm H- 3mm L-3.2mm | 10 | H2, H3, H5, H6, H7, H8, H9, H10, H11, H14 | MAC-8 | HK-2-G |
| 37 | Terminal block 2 Pole interlocking 3.5mm pitch | 1 | J1 | DECA | MB332-350M02 |
| 38 | DC Power Jack 16V 5A TH Pin dia 2.5mm | 1 | J2 | Switchcraft | RAPC712X |
| 39 | 1000 BASE -T SINGLE PORT VOICE OVER IP MAGNETICS MODULE SMT | 1 | J4 | BOTHHAND | VP6014 LF |
| 40 | Power Inductor 0.33uH 20A Shilded SMT | 1 | L1 | Bourns | SRP7030-R33M |
| 41 | FIXED IND 4.7uH 5.5A 40m Ohm SMD | 2 | L4, L5 | Vishay | IHLP2525CZER4R7M01 |
| 42 | TRN PNP -30V -1A SOT23 | 2 | Q2, Q21 | Fairchild | FMMT549 |

| Item | Description | Quantity | Reference Designation | Manufacturer Name | Manufacturer Part Number |
|------|--|----------|-----------------------|------------------------------|--------------------------|
| 43 | MOSFET N-CH 100V 8mOhm 60A POWER56 SMT | 1 | Q4 | Fairchild | FDMS86101 |
| 44 | N-CH POWER MOSFET 150v 16A POWER56 | 1 | Q16 | Fairchild | FDMS86252 |
| 45 | MOSFET N-CH 100V 7A 8- SOIC SMT | 1 | Q17 | Fairchild | FDS86141 |
| 46 | FET NCH 100V 0.17A 6RLogic Level SOT23 | 1 | Q20 | Fairchild | BSS123_NL |
| 47 | N channel MOSFET 30V Rds=44mOhm SOT23 | 2 | Q23, Q24 | Analog Power | AM2330NE-T1 |
| 48 | RES 240K Ohm 1%, 1/10W 0603 | 1 | R2 | KOA | RK73H1JTTD2403F |
| 49 | RES 24.9K Ohm 1%, 1 /10W 0603 SMT | 1 | R3 | Samsung | RC1608F2492CS |
| 50 | RES 20 Ohm 5%, 1/10W 0603 | 1 | R14 | Rohm | MCR03EZPJ200 |
| 51 | RES 562K Ohm 1% 1/10W 0603 | 1 | R31 | Samsung | RC1608F5623CS |
| 52 | RES 43.2K Ohm 1% 100mW 0603 SMT | 2 | R34, R198 | Panasonic | ERJ3EKF4322V |
| 53 | RES 10K Ohm 1% 1/10W 0603 SMT | 3 | R36, R73, R129 | Yageo | RC0603FRF-0710KL |
| 54 | RES 75 Ohm 1% 125mW 0805 SMT | 4 | R38, R39, R40, R41 | Bourns | CR0805-FX-75R0-E |
| 55 | RES 0.043 Ohm 1% 1/2W 1206 SMD | 1 | R44 | Rohm | UCR18EVHFSR043 |
| 56 | RES 442 Ohm 1% 250mW 1206 SMT | 4 | R45, R47, R48, R49 | Stackpole Electronics Inc | RMCF1206FT442R |
| 57 | RES 56K Ohm 1% 1/10W 0603 | 2 | R52, R54 | Panasonic | ERJ3EKF5602V |
| 58 | RES 332 Ohm 1% 1/10W 0603 SMT | 1 | R53 | Yageo | RC0603FR-07332R |
| 59 | RES 5.1K Ohm 1% 1/10W 0603 SMT | 1 | R55 | Vishay | CRCW06035K10FKEA |
| 60 | RES 30.9 Ohm 1% 1/10W 0603 | 2 | R63, R86 | Panasonic | ERJ3EKF30R9V |
| 61 | RES 210K Ohm 1%, 1/10W 0603 | 2 | R64, R139 | Vishay | CRCW0603210KFKEA |
| 62 | RES 4.7K Ohm 5% 125mW 0805 SMT | 1 | R72 | Bourns | CR0805-JW-472ELF |
| 63 | RES 3.65K Ohm 1% 0.1W 0603 SMT | 1 | R76 | Panasonic | ERJ3EKF3651V |
| 64 | RES 511 Ohm 1% 100mW 0603 SMT | 1 | R77 | Panasonic | ERJ3EKF5110V |
| 65 | RES 18.7K Ohm 1% 1/10W 0603 | 2 | R81, R138 | ASJ | CR16-1872FL |

| Item | Description | Quantity | Reference Designation | Manufacturer Name | Manufacturer Part Number |
|------|--|----------|-----------------------|-------------------|--------------------------|
| 66 | RES 10 Ohm 5% 1/10W 0603 | 1 | R82 | Rohm | MCR03EZPJ100 |
| 67 | RES 4.75 Ohm 1% 0.1W 0603 SMT | 1 | R84 | Vishay | CRCW06034R75FKEA |
| 68 | RES 0 Ohm 5% 250mW 1206 SMT JUMPER<0.05R | 2 | R126, R128 | Samsung | RC3216J000CS |
| 69 | RES 20 Ohm 5% 1/2W 1210 SMT | 2 | R130, R192 | KOA | RK73B2ETTD200J |
| 70 | RES 100K Ohm 1% 1/10W 0603 SMT | 2 | R131, R134 | Samsung | RC1608F1003CS |
| 71 | RES 0 Ohm 5% 1/10W 0603 SMT | 4 | R87, R137, R193, R199 | Rohm | MCR03EZPJ000 |
| 72 | RES 10K Ohm 1% 1/2W 1210 SMT | 1 | R140 | Yageo | RC1210FR-0710KL |
| 73 | RES 1.5K Ohm 1% 1/2W 1210 SMD | 2 | R141, R142 | Vishay | CRCW12101K50FKEA |
| 74 | RES 100 Ohm 5% 1/10W 0603 | 2 | R194, R203 | Samsung | RC1608J101CS |
| 75 | RES 9.09K Ohm 1% 250mW 1206 SMT | 1 | R195 | Samsung | RC3216F9091CS |
| 76 | RES 301K Ohm 1% 0.1W 0603 SMT | 1 | R201 | Rohm | MCR03EZPF3013 |
| 77 | Inductor common mode 1.47mH 2.8A SMD | 1 | T1 | Pulse | P0351NL |
| 78 | Transformer Gate driver SMT 296uH 0.795Ohm DCR | 1 | T2 | Coilcraft | DA2319-AL |
| 79 | Transformer Flyback 16-57V EFD20 5V 25W | 1 | T5 | Tesla Magnetics | TX4017 |
| 80 | AT POE PD controller for IEEE 802.3 PD70201 | 1 | U13 | Microsemi | PD-70201 |
| 81 | OPTOISOLATOR 5KV TRANSISTOR 4 SMD | 1 | U18 | Fairchild | FOD817ASD |

6 Board Layout

This section provides the layout of the evaluation board. The board is a two-layer board. The layers are two Oz layers. The following figures represent the two copper layers and the silk of the board for tracking devices placements.

Figure 7 • Top Silk

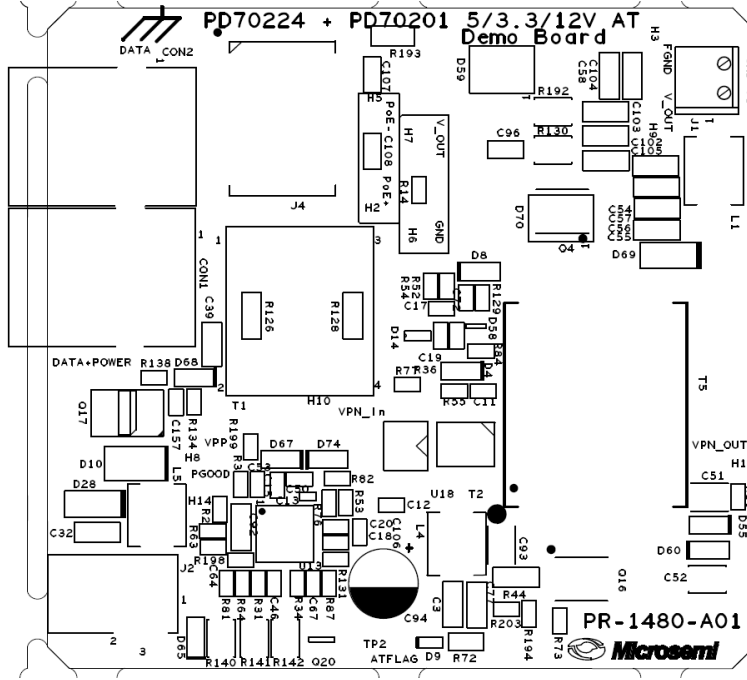


Figure 8 • Bottom Silk

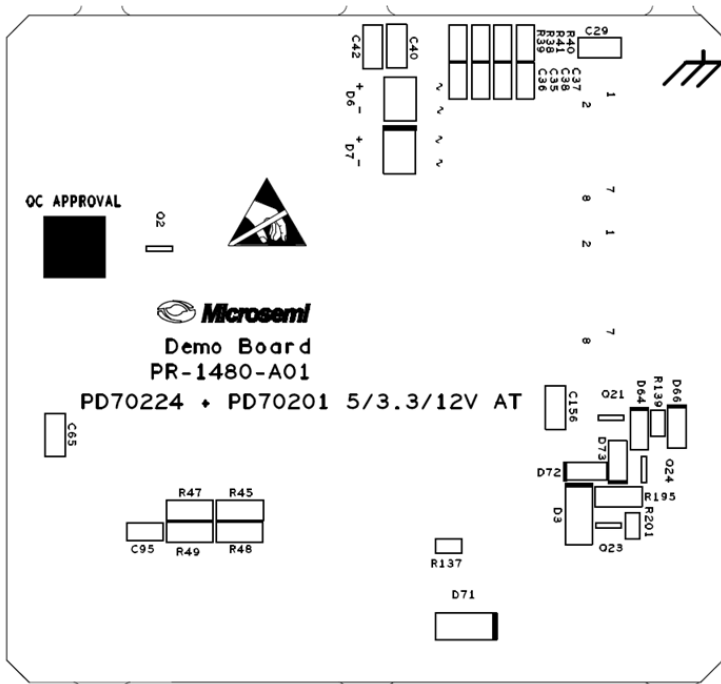


Figure 9 • Top Layer

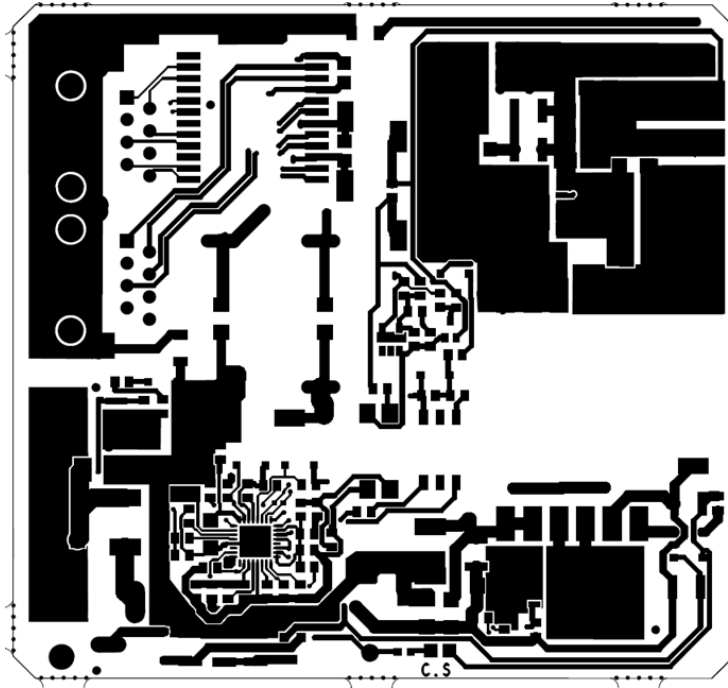
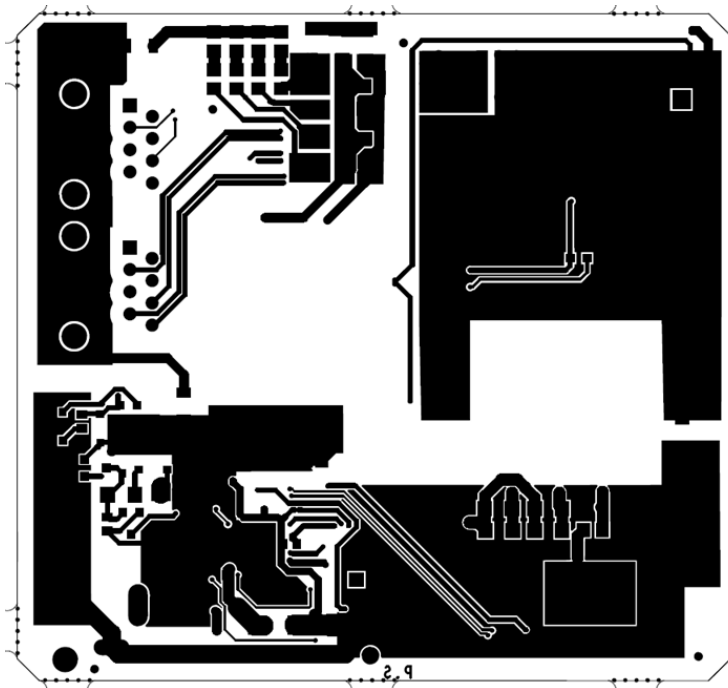


Figure 10 • Bottom Layer



7 Evaluation board Ordering information

Table 9 • Evaluation Board Ordering Information

| Ordering Number | Description |
|--------------------|---|
| PD70201EVB-U-25F-5 | IEEE802.3AT Type 2 PD, wide input voltage range, based on PD70201 device, controls an isolated flyback converter, has a 5 V 5 Amp output. |

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[KITA2GTC377SECGTWTOBO1](#) [MICRO125-KIT](#) [KSZ9031MNX-EVAL](#) [KSZ9031RNX-EVAL](#)