

**PD70211EVB72FW-12**

**12V/72W Isolated Active Clamp Forward Converter PD**

**Evaluation Board User Guide**

Revision 1.01



## 1 About this guide

This user guide provides both description and operation procedures for Microsemi's PD70211EVB72FW-12 evaluating board. This board is used for evaluating the performance of PD70211A PD controller with integrated switching regulator, and PD70224 Dual MOSFET – Based Active Bridge Rectifier.

PD70211ILQ device supports both the standard IEEE802.3at PD application interface, and a PWM controller that is used to provide the PD operational voltage.

The evaluation board supports a 72 Watt, 12V output in its existing configuration, with no heat sink, at room temperature.

### 1.1 Audience

This user guide is intended for qualified personnel, meaning operators and technicians who have a background in basic concepts of electronics.

### 1.2 Organization

This guide is divided into several sections as follows:

|                                                                                                     |                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Chapter <b>Error! Reference source not found.</b></li> </ul> | <b>Error! Reference source not found.:</b> Describes the objectives, audience, and organization.                                                |
| <ul style="list-style-type: none"> <li>Chapter 2</li> </ul>                                         | <b>Introduction:</b> Provides an overview about evaluation board's main functions, features, physical characteristics and ordering information. |
| <ul style="list-style-type: none"> <li>Chapter 3</li> </ul>                                         | <b>Physical Description:</b> Provides explanation related to the physical description (switches, jumpers, connectors).                          |
| <ul style="list-style-type: none"> <li>Chapter 4</li> </ul>                                         | <b>Electrical Characteristics:</b> Provides electrical characteristics of the evaluation board.                                                 |
| <ul style="list-style-type: none"> <li>Chapter 5</li> </ul>                                         | <b>Installation:</b> Provides description of the installation process.                                                                          |
| <ul style="list-style-type: none"> <li>Chapter 6</li> </ul>                                         | <b>Test Data:</b> Provides board test data information                                                                                          |
| <ul style="list-style-type: none"> <li>Chapter 7</li> </ul>                                         | <b>Schematic:</b> Provides board schematic diagram                                                                                              |
| <ul style="list-style-type: none"> <li>Chapter 8</li> </ul>                                         | <b>List of Material:</b> Provides board's list of materials.                                                                                    |
| <ul style="list-style-type: none"> <li>Chapter 9</li> </ul>                                         | <b>Board Layout:</b> Provides board Gerber files description for all layers..                                                                   |

### 1.3 Reference Documents

PD70211 datasheet, catalogue number DS\_PD70211

PD70224 datasheet, catalogue number DS\_PD70224

PD System Layout Guidelines, catalogue number AN208

Implementing Auxiliary Power in PoE, catalogue number TN\_214

## 2 Introduction

Microsemi's PD70211ILQ device is part of a family of devices which are targeted for realizing the 802.3at standard PD interface.

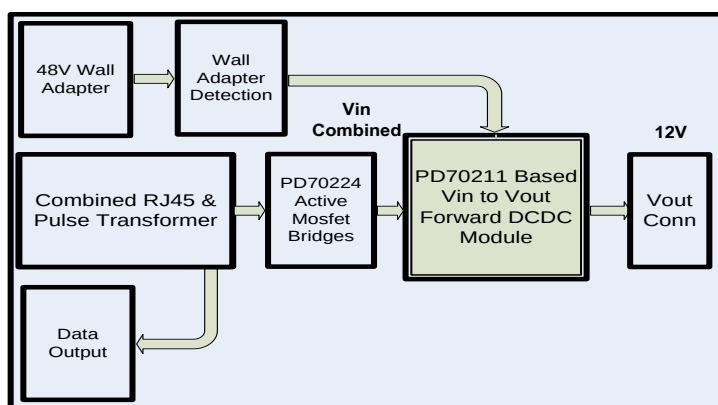
The PD interface family of devices includes the following:

| Device type | Power capability                                 | Integrates PWM controller |
|-------------|--------------------------------------------------|---------------------------|
| PD70100     | IEEE802.3at Type 1<br>(IEEE802.3 af level)       | No                        |
| PD70101     | IEEE802.3at Type 1<br>(IEEE802.3 af level)       | Yes                       |
| PD70200     | IEEE802.3at Type 2                               | No                        |
| PD70201     | IEEE802.3at Type 2                               | Yes                       |
| PD70210(A)  | 2 x IEEE802.3at Type 2 (4 pair)<br>HDBaseT (95W) | No                        |
| PD70211     | 2 x IEEE802.3at Type 2 (4 pair)<br>HDBaseT (95W) | Yes                       |

Microsemi's PD70211EVB72FW-12 Evaluation Board (see Figure 2) provides designers with an environment needed for evaluating the performance and implementation of PD applications based on PD70211 controller.

The board is using a single PD controller, PD70211ILQ, to support the Detection, Class, and Power Supplying phases on the 4 Pairs of the Cat5 cable. The board supports sync detection of the 4 pairs. PD70211ILQ supports the current of the HDBaseT over 4 Pairs, which is more than twice the power of a standard IEEE802.3AT Type 2 interface.

All necessary steps and connection instructions required to install and operate this board are provided within this document.



**Figure 1: PD70211EVB72FW-12 Block Diagram**



Figure 2: PD70211EVB72FW-12 Evaluation Board – General View

## Evaluation Boards Ordering Information

Microsemi supplies the following Evaluation Board as shown below:

| Ordering Number   | Description                                                                                                                                                           |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PD70211EVB72FW-12 | 2 x IEEE802.3at Type 2 (4 pair) PD based on PD70211 device having 4 pair supply, controlling an <b>isolated Forward converter</b> , having a <b>12V 6 Amp</b> output. |

## 2.1 Evaluation Board Features

- Designed to support Data and Spare current by a single PD70211A device
- Power is supplied through the 4-pairs of the Cat5 cable
- Wall Adapter input – Standard Barrel Jack available for connecting to an external 48-54V Wall Adapter.
- Data pass-through connector
- On board PSE class type LED indicators
- On board AT detected LED indicator
- On board 4P\_AT detected LED indicator
- On board HD detected LED indicator
- On board 4P\_HD detected LED indicator
- On board Power Good LED indicator which may be configured to monitor PD Front End or VPP UVLO.
- Ta: -40° to +70°C (with derating curve)
- RoHS compliant

## 2.2 Physical Characteristics

Table 1 lists evaluation board's physical characteristics.

**Table 1: Physical Characteristics**

| Parameter                   | Value                        |
|-----------------------------|------------------------------|
| Mechanical dimensions in mm | 202 x 57 x 16 mm (L x W x H) |

## 3 Physical Description

### 3.1 Package Contents

Upon opening the Evaluation Board package, verify the following part is included.

If it seems damaged, contact local representative or Microsemi's headquarters.

Package content for standard shipments is:

- PD70211EVB72FW-12 Evaluation Board.
- Wall Adapter Input Cable

### 3.2 Connectors

The following sections provide both general and detailed information regarding unit's connectors.

#### 3.2.1 Connectors Table

Table 2 lists the Evaluation Board's connectors.

**Table 2: Connectors List**

| # | Connector | Name               | Description                                                                                                                                           |
|---|-----------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | J1        | RJ45 Connector     | RJ45 port for Data + Power In for PSE connection                                                                                                      |
| 2 | J2        | Wall Adapter Input | Standard Barrel Jack used for 48V Wall Adapter. Wall adapter connection will be automatically sensed and will override the PSE power connected to J1. |
| 3 | J3        | Converter Output   | Terminal pins for connecting a load to 5V output. J3 provides screw terminals for easy connection                                                     |
| 4 | J4        | RJ45 Connector     | RJ45 port for Data pass – through output                                                                                                              |

#### 3.2.2 Connectors Detailed Explanation

(The numbering is in reference to the numbers listed in Table 2.)

##### 1. RJ45 Connectors.

See

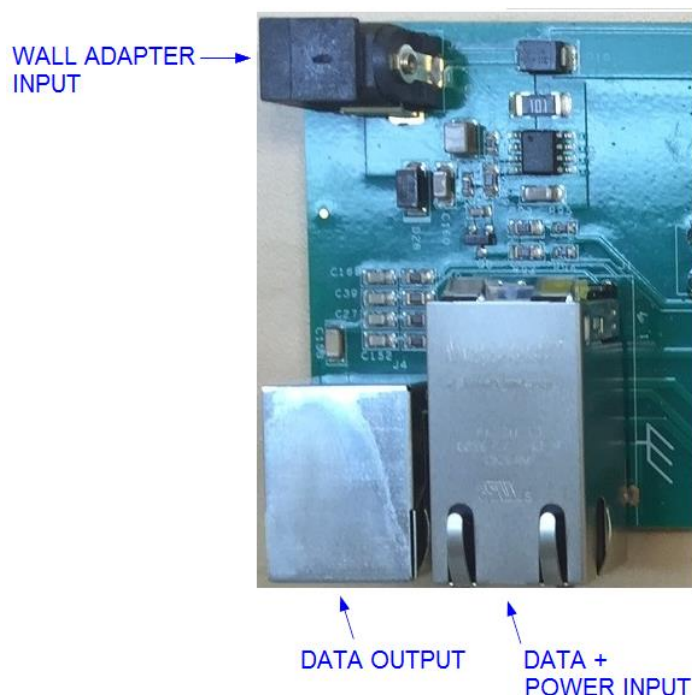
Figure 3.

**Table 3: RJ45 Connectors**

| J1 & J4 Pin No | Signal Name       | Description                                                            |
|----------------|-------------------|------------------------------------------------------------------------|
| J1 - 1, 2      | Data and Power In | Data and power input to powered device (PoE Master Negative data port) |
| J1 - 3, 6      | Data and Power In | Data and power input to powered device (PoE Master Positive data port) |
| J1 - 4, 5      | Data and Power In | Data and power input to powered device (PoE Master Positive data port) |
| J1 - 7, 8      | Data and Power In | Data and power input to powered device (PoE Master Negative data port) |



| J1 & J4 Pin No | Signal Name | Description                                               |
|----------------|-------------|-----------------------------------------------------------|
| J4 - 1, 2      | Data Output | Isolated data pass-through to external monitoring device. |
| J4 - 3, 6      | Data Output | Isolated data pass-through to external monitoring device. |
| J4 - 4, 5      | Data Output | Isolated data pass-through to external monitoring device. |
| J4 - 7, 8      | Data Output | Isolated data pass-through to external monitoring device. |



**Figure 3: Front RJ45 and Auxiliary 48V Wall Adapter Connectors**

### 2. Wall Adapter Connections

See Figure 3.

| J2 Pin No    | Signal Name | Description                         |
|--------------|-------------|-------------------------------------|
| Center Pin   | VIN (+)     | 42V to 57V input from wall adapter. |
| Outer Barrel | VIN (-)     | Wall Adapter Return                 |

### 3. V<sub>out</sub> Connections

See Figure 4.

**Table 4: Output Load Connections**

| Pin No. | Signal Name | Description                   |
|---------|-------------|-------------------------------|
| J3 - 2  | Vout (-)    | Return of DCDC output voltage |
| J3 - 1  | Vout (+)    | Positive DCDC output voltage  |


**Figure 4: V<sub>out</sub> Connections**

### 3.3 Indications

The following sections provide general information regarding unit's indications.

#### 1. LED Indication

See Figure 5.

##### 3.3.1.1 LED Indication

See Figure 5.

D16 is the AT\_FLAG indication LED, a PD70211 device output signal indicating the device has detected a 2 finger class event from the PSE side in the class stage. The flag will be operative at 3, 4, and 6 fingers detection as well.

D15 is the 4P\_AT indication LED, a PD70211 device output signal indicating the device has detected a 4 finger class event from the PSE side in the class stage, or a 2 finger class event from the PSE side in the class stage, and SUPP\_SA and SUPP\_SB are both High.

The flag will be operative at 6 fingers detection as well.

D20 is the HD\_FLAG indication LED, a PD70211 device output signal indicating the device has detected a 3 finger class event from the PSE side in the class stage.

The flag will be operative at 6 fingers detection as well.

D19 is the 4P\_HD indication LED, a PD70211 device output signal indicating the device has detected a 6 finger class event from the PSE side in the class stage.

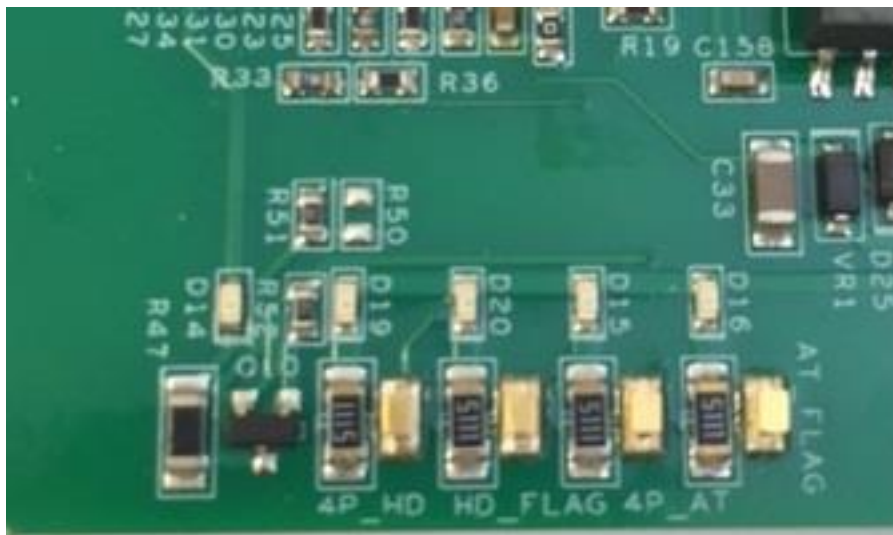
D14 is the Power Good indication. This LED indicates the presence of power. This indicator may be configured to monitor PD Front End VAUX (Asserts when VPP = 36V min.; de-asserts when VPP = 31V min.), or it may be configured to monitor the VPP UVLO, which is user selectable by the resistor values at VINS and HYST pins (R13, R19, and R25). See the PD70211 datasheet for further details regarding setting VPP UVLO limits. EVB default for





Power Good EVB is monitoring VPP UVLO, and will track the operation of the DC-DC converter. To change Power Good to monitor PD Front End VAUX:

- 1) Remove R51, 100 Ohm Resistor (located on top of PCB near D19).
- 2) Add R50 Zero Ohm Jumper (also located on top of PCB near D19).
- 3) Insure that only R51 or R50 are installed; do not operate with both resistors installed.



**Figure 5: LED Indications**

## 4 Electrical Characteristics

Evaluation board's electrical characteristics are described below:

**Table 5: Electrical Characteristics**

| Parameter                              |  | Min  | Max  |       |
|----------------------------------------|--|------|------|-------|
| Main DC Supply – J1, VIN+, VINRTN      |  | 42*  | 57   | V     |
| Wall Adapter Supply – J2, VIN+, VINRTN |  | 42   | 57   | V     |
| Output voltage                         |  | 11.8 | 12.2 | V     |
| Maximum Output Current                 |  |      | 6    | A     |
| Port Isolation to Chassis              |  | -    | 1.5  | kVrms |

\*After start-up, the minimum voltage is 36V with load  $\leq 13W$  per IEEE specification.

## 5 Installation

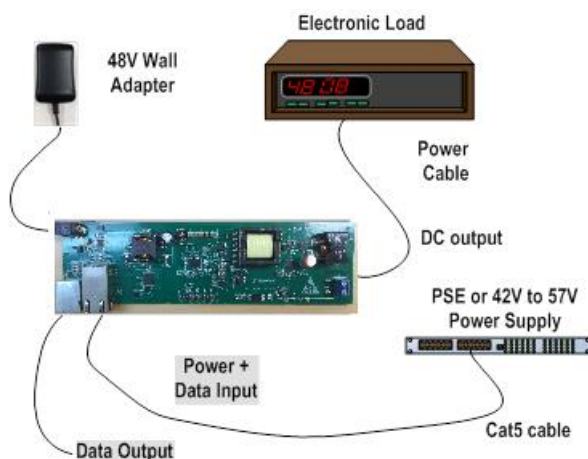
### 5.1 Preliminary Considerations and Safety Precautions

- If using an external supply in place of a PSE, verify the external power supply is turned “off” before all peripheral devices are connected. Insure the external supply is connected to the RJ45 input (J1) per Table 3.

### 5.2 Initial Configuration

**Note:** It is important to verify evaluation board is setup as shown in Figure 6 prior to starting any operation.

1. Connect load to evaluation board (J3 -1 (+) & J3 - 2 (-), or TP17 (+) & TP16 (-)).
  2. Connect a Cat5 cable from PSE to Evaluation Board (J1), or a 48V Wall Adapter to Evaluation Board (J2).
- Note: Wall Adapter will override power from PSE.



**Figure 6: Test Setup**

## 6 Test Data

This chapter describes typical EVB test data under various loads and POE input voltage levels.

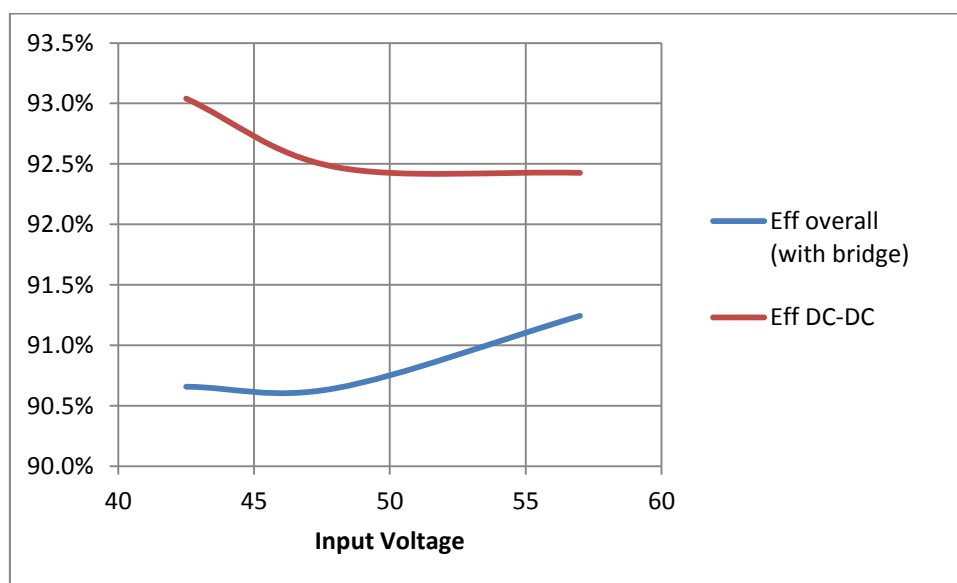
The efficiency is indicated up to 72W output power.

Overall efficiency is measured at the input to the bridge. It does not include system-level components (input/output connectors, data transformer, and EMI filter).

$$Eff = \frac{V_{out} * I_{out}}{V_{in} * I_{in}}$$

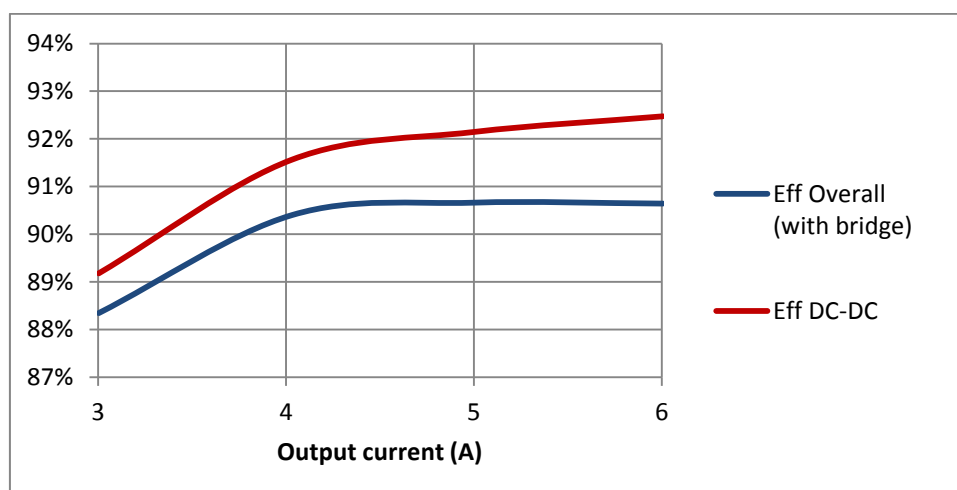
DC-DC efficiency is measured after the PD chip.

### 6.1 Efficiency vs. Input Voltage to the bridge at full load (72W output)



**Figure 7: Efficiency vs. Input Voltage**

### 6.2 Efficiency vs. Load Current at 48V Input to the bridge



**Figure 8: Efficiency at 48V Input**

### 6.3 Efficiency vs. ambient temperature at 48V input

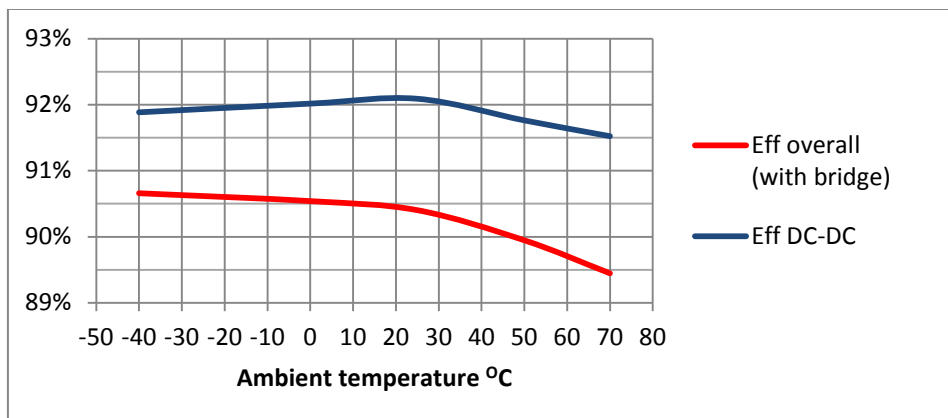


Figure 9: Efficiency vs. temperature at 48V Input

### 6.4 Output Ripple measured with 20MHz bandwidth

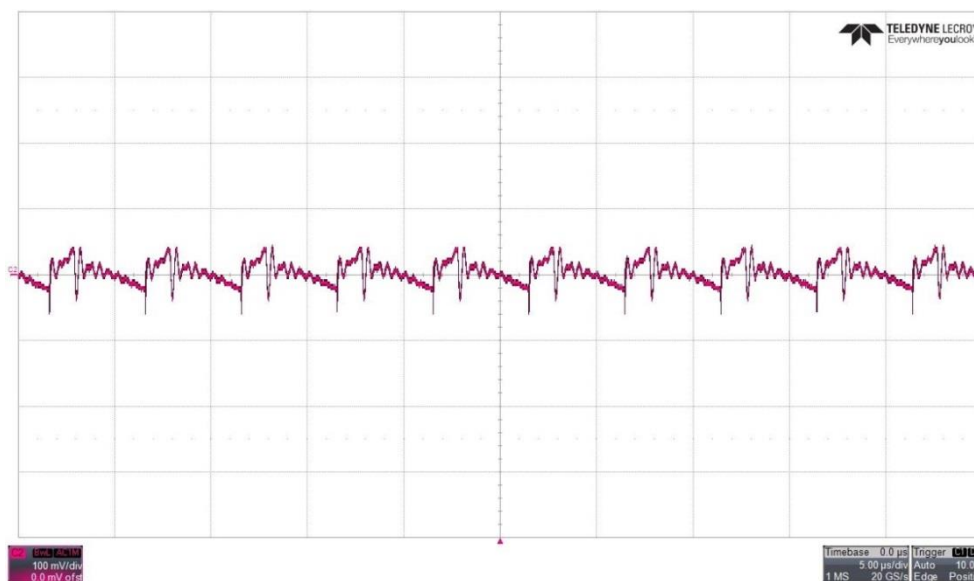


Figure 10: Full Load Voltage Ripple and Noise at 48V Input (100mV/div)

## 6.5 Bode Plots at full load at 48Vin

### Frequency Sweep

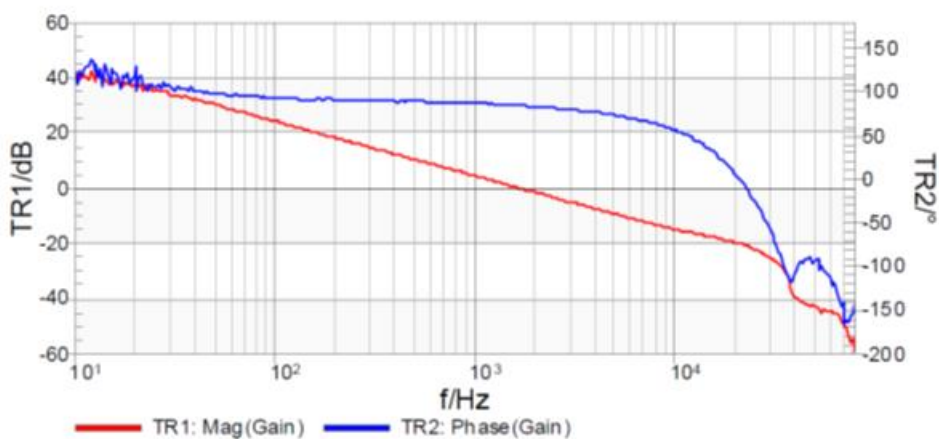


Figure 11. Bode plots

Phase Margin: 80°  
Gain Margin: -22 dB

## 6.6 Step Load Response for transitions between 10% load and 100% load (rise and fall time 100us)

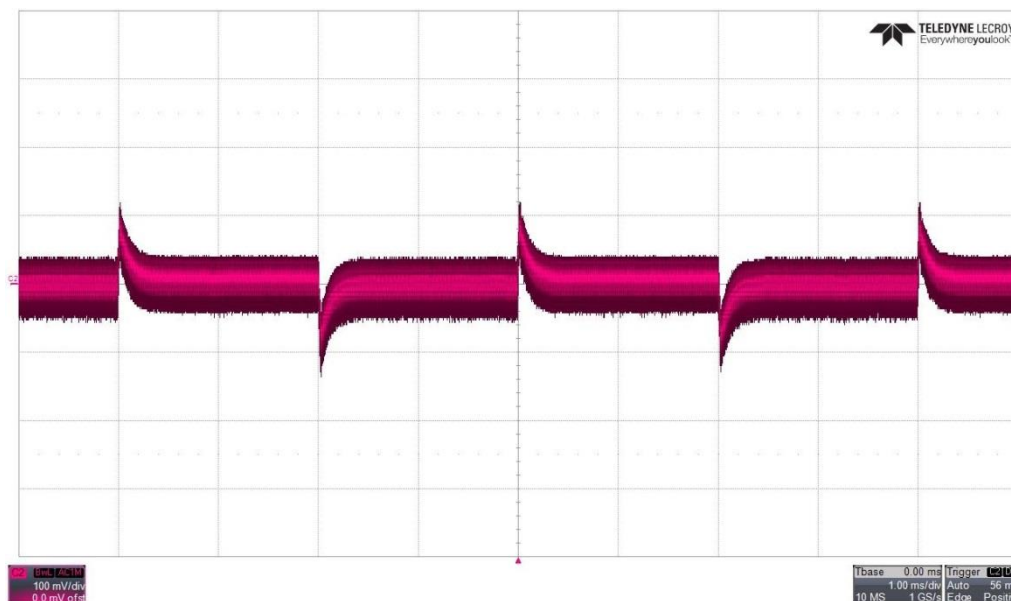


Figure 12: Load Step Response (100mV/div)





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## 7 Schematic

# PD70211EVB72FW-12

72W Isolated Forward Converter PD

Evaluation Board

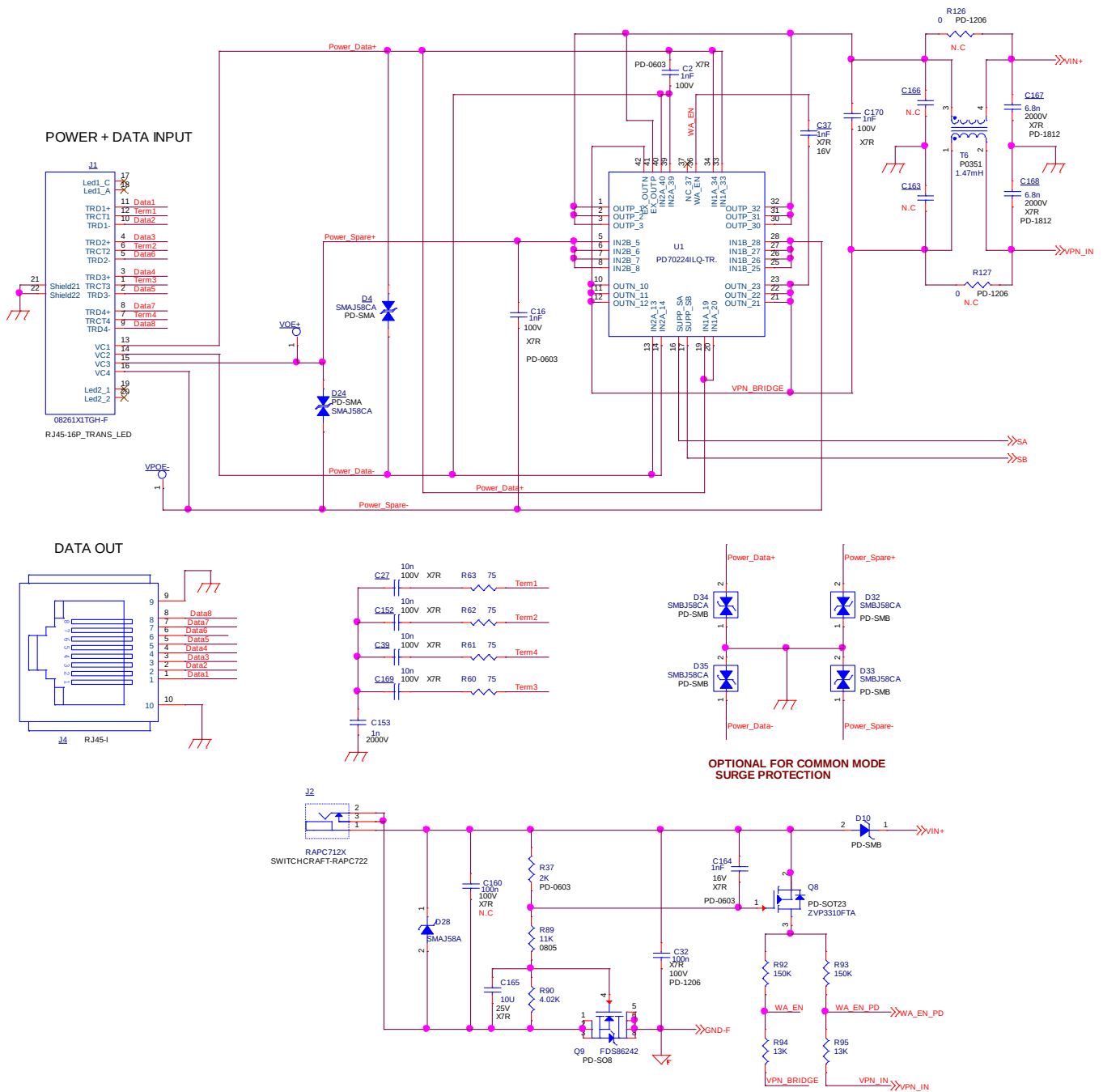


Figure 13: Evaluation Board Schematic (1 of 2)

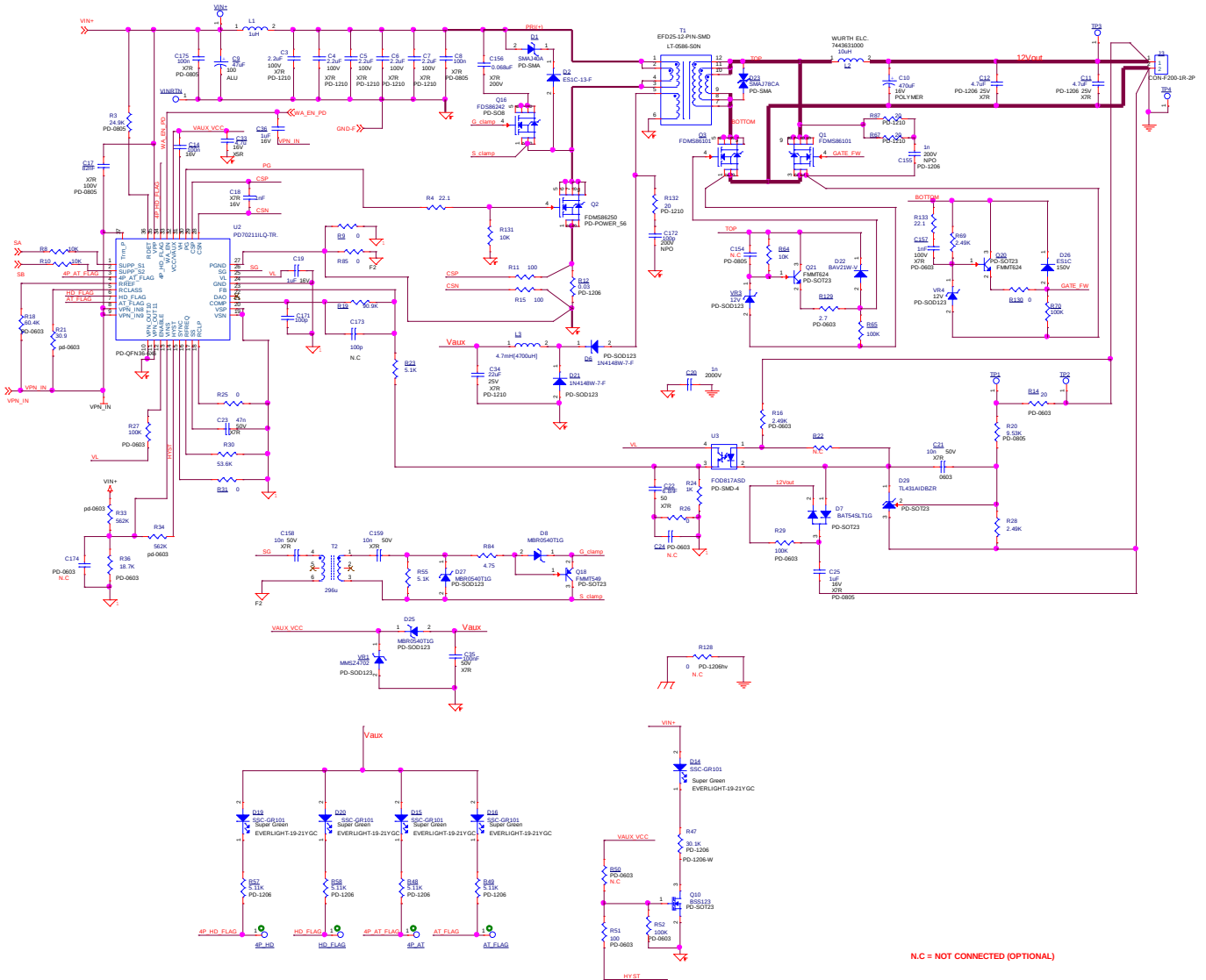


Figure 14: Evaluation Board Schematic (2 of 2)

## 8 List of Materials

| QTY | Reference             | Value  | Description                                | Mfr. Name | Mfr. Part Number   |
|-----|-----------------------|--------|--------------------------------------------|-----------|--------------------|
| 4   | C2,C16,<br>C157,C170  | 1nF    | Cap 1nF 100V 10% X7R<br>0603 SMT           | Samsung   | CL10B102KC8NNNC    |
| 5   | C3,C4,C5,<br>C6,C7    | 2.2uF  | CAP CER 2.2uF 100V 10%<br>X7R 1210 SMT     | Kemet     | C1210C225K1RACTU   |
| 2   | C8,C175               | 100n   | Capacitor, X7R, 100nF<br>100V 10% 0805     | TDK       | C2012X7R2A104K     |
| 1   | C9                    | 47uF   | CAP ALUM 47uF 100V<br>20% 105C RADIAL 8X15 | Samsung   | NHA100VB47M        |
| 1   | C10                   | 470uF  | CAP ALU POLYMER<br>470UF 20% 16V           | Nichicon  | RNE1C471MDN1PX     |
| 2   | C11,C12               | 4.7uF  | CAP CRM 100nF 50v 10%<br>X7R 0603          | TDK       | C3216X7R1E475KT    |
| 1   | C14                   | 100n   | Capacitor, X7R, 100nF,<br>16V, 20% 0805    | Kemet     | C0805C104M4RACTU   |
| 1   | C17                   | 82nF   | CAP CRM 100nF 100V<br>10%X7R 1206 SMT      | Kemet     | C0805C823K1RACTU   |
| 2   | C18,C37               | 1nF    | Capacitor, X7R, 1nF, 16V,<br>10% 0603      | Samsung   | CL10B102KANNNC     |
| 2   | C19,C36               | 1uF    | CAP CRM 1uF 10V<br>10%X7R 0805 SMT         | Samsung   | CL10A105MO8NNNC    |
| 2   | C20,C153              | 1n     | CAP CRM 1nF/2000V<br>10%++X7R 1206 SMT     | AVX       | 1206GC102KAT1A     |
| 3   | C21,C158,<br>C159     | 10n    | CAP CRM 10nF 50v<br>10%X7R 0603 SMT        | Rohm      | MCH185CN103KK      |
| 1   | C22                   | 6.8nF  | CAP CRM 4.7nF 16V 10%<br>X7R 0603 SMT      | Yageo     | CC0603KRX7R9BB682  |
| 1   | C23                   | 47n    | Capacitor, X7R, 47nF,<br>50V, 10% 0603     | TDK       | C1608X7R1H473K     |
| 2   | C24,C174              | 0.1 uF | Capacitor,0.1uF, X7R,<br>10V, 10% 0603     | Kemet     | C0603C104K8RACTU   |
| 1   | C25                   | 1uF    | CAP CRM 1uF 16V<br>10%0805 X7R SMT         | Murata    | GRM21BR71C105KA01  |
| 4   | C27,C39,<br>C152,C169 | 10n    | CAP CRM 10nF 100V 5%<br>X7R 0805 SMT       | Kemet     | C0805C103J1RAC     |
| 1   | C32                   | 100n   | CAP CRM 100nF 100V<br>10%X7R 1206 SMT      | Kemet     | C1206C104K1RACTU   |
| 1   | C33                   | 4.7u   | CAP CRM 4.7uF 16V 10%<br>X5R 1206 SMT      | Murata    | GRM31CR71C475KA01L |
| 1   | C34                   | 22uF   | CAP CRM 22uF 25V 20%<br>1210 X7R SMT       | Murata    | GRM32ER71E226ME15L |



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# PD70211EVB72FW-12

72W Isolated Forward Converter PD  
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|   |                       |            |                                                 |                  |                    |
|---|-----------------------|------------|-------------------------------------------------|------------------|--------------------|
| 1 | C35                   | 100nF      | CAP CRM 100nF 50v 10% X7R 0603                  | Meritek          | MA0603XR104K500    |
| 1 | C154                  | 10pF       | CAP CRM 10pF 50V 5%NPO 0805 SMT                 | Samsung          | CL21C100JBANNNC    |
| 1 | C155                  | 1n         | CAP CRM 1200pF 100V 5% NPO 1206 SMT             | EPCOS            | B37871-K2102-J62   |
| 1 | C156                  | 0.068uF    | CAP CRM 2.2uF 100V 10% X7R 1210 SMT             | AVX              | 12062C683KAT2A     |
| 1 | C160                  | 100n       | CAP CRM 100nF 100V 10%X7R 1206 SMT              | Samsung          | CL31B104KCFNNNE    |
| 2 | C163,C166             | 1n         | CAP CRM 1nF/2000V 10%++X7R 1206 SMT             | Kemet            | C1206C102KGRAC     |
| 1 | C164                  | 1nF        | Capacitor,X7R, 1nF, 16V, 10% 0603               | Kemet            | C0603C102K4RAC     |
| 1 | C165                  | 10uF       | Capacitor, X7R, 10uF, 25V, 20% 1210             | Murata           | GRM32DR71E106MA12L |
| 2 | C167,C168             | 6.8n       | CAP CRM 1nF/2000V 10%++X7R 1206 SMT             | Novacap          | 1812B682J202NXT    |
| 1 | C171                  | 100p       | CAP CRM 100pF 100v 5% NPO 0603 SMT              | Vishay           | VJ0603A101JXBT     |
| 1 | C172                  | 100p       | CAP CRM 100pF 200V 10% NPO 0805 SMT             | AVX              | 08052A101KAT2A     |
| 1 | D1                    | SMAJ40A    | DIODE TVS 40V 400W 5uA 6.2 Amps Uni-Dir SMT     | Bourns           | SMAJ40A            |
| 1 | D2                    | ES1C-13-F  | DIODE SUPER FAST 150V 1A SMA SMT                | Diodes Inc.      | ES1C-13-F          |
| 2 | D4,D24                | SMAJ58CA   | TVS DIODE 58VWM 93.6VC SMA                      | Diodes Inc.      | SMAJ58CA           |
| 2 | D6,D21                | 1N4148W    | DIODE SW 100V 0.15A SOD123 SMT                  | Diodes Inc.      | 1N4148W-7-F        |
| 1 | D7                    | BAT54SLT1G | Diode Schottky Dual 200mA 30V 230mWSOT23 BAT54S | ON Semiconductor | BAT54SLT1G         |
| 3 | D8,D25,D27            | MBR0540T1G | DIO SCHOTTKY 40V 500mASOD123 REC. SMT           | ON Semiconductor | MBR0540T1G         |
| 1 | D10                   | B2100-13-F | DIODE SCHOTTKY 100V 2A SMB                      | Diodes Inc.      | B2100-13-F         |
| 5 | D14,D15, D16,D19, D20 | SSC-GR101  | LED SuperGreen 16mcd h=0.8 0603 SMD             | SEOUL            | SSC-GR101          |
| 1 | D22                   | BAV21W-V   | DIODE SWITCH 200V 100MW SOD123 - BAV21W         | Vishay           | BAV21W-V           |
| 1 | D23                   | SMAJ78CA   | DIODE TVS 78V SMA                               | Littelfuse       | SMAJ78CA           |
| 1 | D26                   | ES1C       | DIODE SUPER FAST 150V 1A SMA SMT                | Fairchild        | ES1C               |



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# PD70211EVB72FW-12

72W Isolated Forward Converter PD  
Evaluation Board

|   |                      |              |                                              |                    |                    |
|---|----------------------|--------------|----------------------------------------------|--------------------|--------------------|
| 1 | D28                  | SMAJ58A      | DIO TVS 58V 40A<br>SRG400WPK SMA SMT         | STMicroelectronics | SMAJ58A            |
| 1 | D29                  | TL431AIDBZR  | IC VREF SHUNT PREC ADJ<br>SOT23-3 36V SMT    | Texas Instruments  | TL431AIDBZR        |
| 4 | D32,D33,<br>D34, D35 | SMBJ58CA     | DIO TVS 58V 6.4A 600W<br>DO-214AA SMT        | Bourns             | SMBJ58CA           |
| 1 | J1                   | 08261X1TGH-F | CONN MAGJACK 1PORT<br>1000 BASE-T            | Bel Stewart        | 08261X1TGH-F       |
| 1 | J2                   | RAPC712X     | DC Power Jack 16V 5A TH<br>Pin dia 2.5mm     | Switchcraft        | RAPC712X           |
| 1 | J3                   | ED500/2DS    | TERMINAL BLOCK 5MM<br>2POS PCB               | On Shore           | ED500/2DS          |
| 1 | J4                   | RJ45         | CON RJ45 SINGLE 8 POS.<br>SHILDED            | Bel Stewart        | SS71800-007F       |
| 1 | L1                   | 1uH          | INDUCTOR SHIELDED<br>PWR 1UH IRMS=11A SMT    | Bourns             | SRP7030-1R0M       |
| 1 | L2                   | 10uH         | FIXED IND 10UH 16A<br>7.96mOHM SMD           | WURTH ELC.         | 7443631000         |
| 1 | L3                   | 4.7mH        | FIXED IND 4700uH 40mA<br>48OHM SMD           | Bourns             | SDR0503-472JL      |
| 1 | Q1                   | FDMS86202    | MOSFET N-ch 120V 64A<br>7.2mOhm Power-56 SMT | Fairchild          | FDMS86202          |
| 1 | Q3                   | FDMS86101    | MOSFET N-CH 100V<br>8mOhm Power-56 SMT       | Fairchild          | FDMS86101          |
| 1 | Q2                   | FDMS86250    | MOSFET 150V 25mOhm<br>N-ch Power-56          | Fairchild          | FDMS86250          |
| 1 | Q8                   | ZVP3310FTA   | MOSFET P-CH 100V<br>75MA SOT23-3             | Diodes Inc.        | ZVP3310FTA         |
| 2 | Q9,Q16               | FDS86242     | IC, N-CH POWER MOSFET<br>150v 4.1A SO8       | Fairchild          | FDS86242           |
| 1 | Q10                  | BSS123       | FET NCH 100V 0.15A<br>Logic Level SOT23      | Infineon           | BSS123             |
| 1 | Q18                  | FMMT549      | TRN PNP -30V -1A SOT23                       | Fairchild          | FMMT549            |
| 2 | Q20,Q21              | FMMT624      | Transistor NPN 125V 1A<br>SOT23              | Fairchild          | FMMT624            |
| 1 | R3                   | 24.9K        | RES TK FLM 24.9K<br>100mW1% 0805             | Bourns             | CR0805-FX-2492-ELF |
| 2 | R4,R133              | 22.1         | RES TCK FLM 22.1R<br>62.5mW 1% 0603 SMT      | Yageo              | RC0603FRF0722R1    |
| 4 | R8,R10,<br>R64,R131  | 10K          | RES 10K 62.5mW 1%<br>0603 SMT MTL FLM        | Rohm               | MCR03EZPFX1002     |
| 3 | R9,R85,<br>R130      | 0            | RES TCK FLM 0R 62.5mW<br>5% 0603 SMT         | Panasonic          | ERJ3GEY0R00V       |
| 2 | R11,R15              | 100          | RES TCK FLM 100R<br>62.5mW 1% 0603 SMT       | Yageo              | RC0603FR-07100RL   |

|   |                     |       |                                          |           |                  |
|---|---------------------|-------|------------------------------------------|-----------|------------------|
| 1 | R12                 | 0.03  | RES TCK FLM 0.03 OHM<br>0.5W 1% 1206 SMT | Stackpole | CSR1206FK30L0    |
| 1 | R14                 | 20    | Resistor, 20 OHM 5%<br>1/10W 0603        | Rohm      | MCR03EZPJ200     |
| 3 | R16,R28,<br>R69     | 2.49K | RES 2.49K 62.5mW 1%<br>0603 SMT MTL FLM  | Samsung   | RC1608F2491CS    |
| 1 | R18                 | 60.4K | RES TCK FLM 60.4K<br>62.5mW 1% 0603 SMT  | ASJ       | CR16-6042FL      |
| 1 | R19                 | 90.9K | Resistor, 90.9K, 1%,<br>1/16W 0603       | Rohm      | MCR03EZPFX9092   |
| 1 | R20                 | 9.53K | RES 9.53K 125mW %<br>0805 SMT MTL FLM    | Samsung   | RC2012F9531CS    |
| 1 | R21                 | 30.9  | Resistor, 30.9R 1%,<br>1/10W 0603        | Panasonic | ERJ3EKF30R9V     |
| 2 | R22,R50             | 2.94K | Resistor, 2.94K, 1%,<br>1/16W            | Rohm      | MCR03EZPF2941    |
| 2 | R23,R55             | 5.1K  | RES TCK FLM 5.1K<br>62.5mW 1% 0603 SMT   | Vishay    | CRCW06035K1FKEA  |
| 1 | R24                 | 1K    | RES 1K 62.5mW 1% 0603<br>SMT MTL FLM     | Panasonic | ERJ3EKF1001V     |
| 3 | R25,R26,<br>R31     | 0     | RES TCK FLM OR 62.5mW<br>5% 0603 SMT     | Rohm      | MCR03EZPJ000     |
| 3 | R27,R65,<br>R70     | 100K  | RES 100K 62.5mW 1%<br>0603 SMT MTL FLM   | Samsung   | RC1608F1003CS    |
| 2 | R29,R52             | 100K  | Resistor, 100K, 5%,<br>1/16W             | ASJ       | CR16-104JL       |
| 1 | R30                 | 53.6K | RES TCK FLM 53.6K<br>62.5mW 1% 0603 SMT  | Samsung   | RC1608F5362CS    |
| 2 | R33,R34             | 562K  | RES 562K, 1%, 1/16W,<br>0603             | Vishay    | CRCW0603562KFKEA |
| 1 | R36                 | 18.7K | Resistor, 18.7K, 1%,<br>1/16W 0603       | Rohm      | MCR03EZPFX1872   |
| 1 | R37                 | 2K    | RES 2K 62.5mW 1% 0603<br>SMT MTL FLM     | Vishay    | CRCW06032KFKEA   |
| 1 | R47                 | 30.1K | RES 30.1K 250mW<br>1%1206 SMT MTL FLM    | Yageo     | RC1206FR-0730K1L |
| 4 | R48,R49,<br>R57,R58 | 5.11K | RES TCK FLM 5.11K<br>250mW1% 1206 SMT    | Samsung   | RC3216F5111CS    |
| 1 | R51                 | 100   | Resistor, 100 Ohm, 5%,<br>1/16W 0603     | Samsung   | RC1608J101CS     |
| 4 | R60,R61,<br>R62,R63 | 75    | RES 75R 125mW 1%<br>0805SMT              | Yageo     | RC0805FK-0775RL  |
| 3 | R67,R87,<br>R132    | 20    | RES 20 OHM 1/2W 5%<br>1210 SMT           | KOA       | RK73B2ETTD200J   |
| 1 | R84                 | 4.75  | RES 4.75R 0.1W 1% 0603<br>SMT MTL FLM    | Vishay    | CRCW06034R75FKEA |

|    |                                                                              |            |                                                |                |                 |
|----|------------------------------------------------------------------------------|------------|------------------------------------------------|----------------|-----------------|
| 1  | R89                                                                          | 11K        | RES 11K 125mW 1% 0805 SMT MTL FLM              | Yageo          | RC0805FR-0711KL |
| 1  | R90                                                                          | 4.02K      | Resistor, 4.02K, 1%, 1/16W 0603                | Panasonic      | ERJ3EKF4021V    |
| 2  | R92,R93                                                                      | 150K       | RES 150K 125mW % 0805 SMT MTL FLM 100 ppm      | Panasonic      | ERJ6ENF1503V    |
| 2  | R94,R95                                                                      | 13K        | Resistor, 13K, 1%, 1/16W 0603                  | ASJ            | CR16-1302FL     |
| 3  | R126,R127, R128                                                              | 0          | RES OR 250mW 5% 1206 SMT JUMPER<0.05R          | Samsung        | RC3216J000CS    |
| 1  | R129                                                                         | 2.7        | Resistor, SMT 2.7 Ohm, 5%, 1/16W 0603          | Panasonic      | ERJ3GEYJ2R7V    |
| 1  | T1                                                                           | N/A        | Transformer 12V 72W forward 180 uH             | ICE Components | TX15061         |
|    |                                                                              |            | Alternate source                               | Shinohm        | STEF25-005      |
| 1  | T2                                                                           | 296u       | Transformer, Gate driver SMT 269uH 0.795 DCR   | Coilcraft      | DA2319-AL       |
| 1  | T6                                                                           | 1.47mH     | Inductor common mode 1.47mH 2.8A SMD           | Pulse          | P0351           |
| 1  | U1                                                                           | PD70224    | Ideal Diode Bridg dual bridge 6x8 SMT PD70224  | Microsemi      | PD70224ILQ-TR   |
| 1  | U2                                                                           | PD70211    | IEEE 802.3 AF/AT,HDBaseT Powere Device PD70211 | Microsemi      | PD70211ILQ-TR   |
| 1  | U3                                                                           | FOD817ASD  | OPTOISOLATOR 5KV TRANSISTOR 4 SMD              | Fairchild      | FOD817ASD       |
| 1  | VR1                                                                          | 15V        | DIODE ZENER 15V 500mW SOD123 MMSZ4702          | Fairchild      | MMSZ4702        |
| 1  | VR3                                                                          | 12V        | DIO ZENER 12V 500mW SOD123 SMT                 | Diodes Inc.    | BZT52C12-7-F    |
| 1  | VR4                                                                          | 12V        | DIO ZENER 12V 500mW SOD123 SMT                 | Diodes Inc.    | BZT52C12-7-F    |
| 12 | TP1,TP2,TP3, TP4, 4P_HD, 4P_AT, VPOE-, VPOE+, VINRTN, VIN+, HD_FLAG, AT_FLAG | HK-2-G-S05 | TEST POINT TIN PLATED HEAD                     | MAC-8          | K0-HK2H-S00     |

Parts may be replaced by approved equivalents.



## 9 Board Layout

This section presents the layout of the evaluation board.

The board is a 2 layer board. All layers are 2 Oz copper. Below figures present the copper layers and the silk of the board for tracking devices placements.

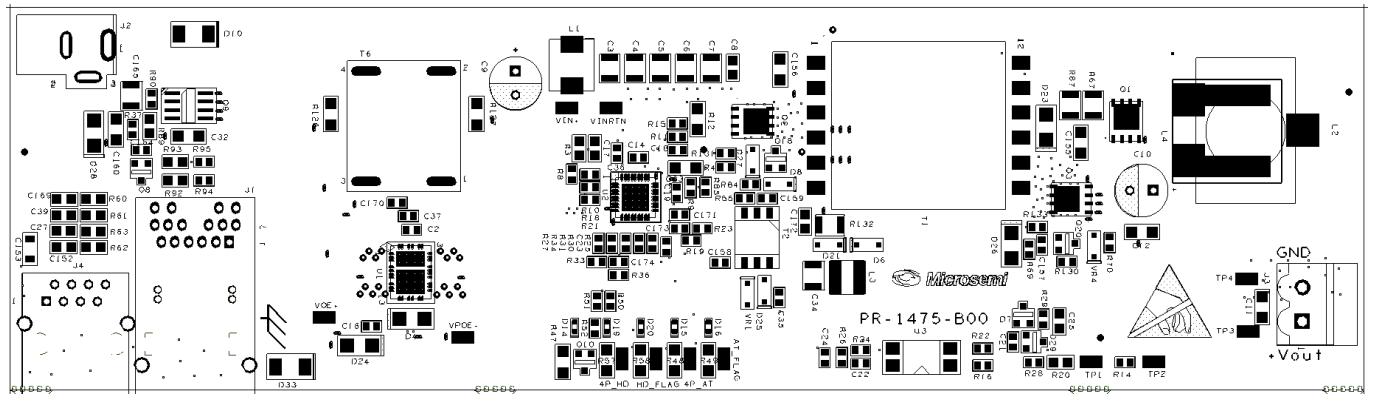


Figure 15: Top Silk and Solder Mask

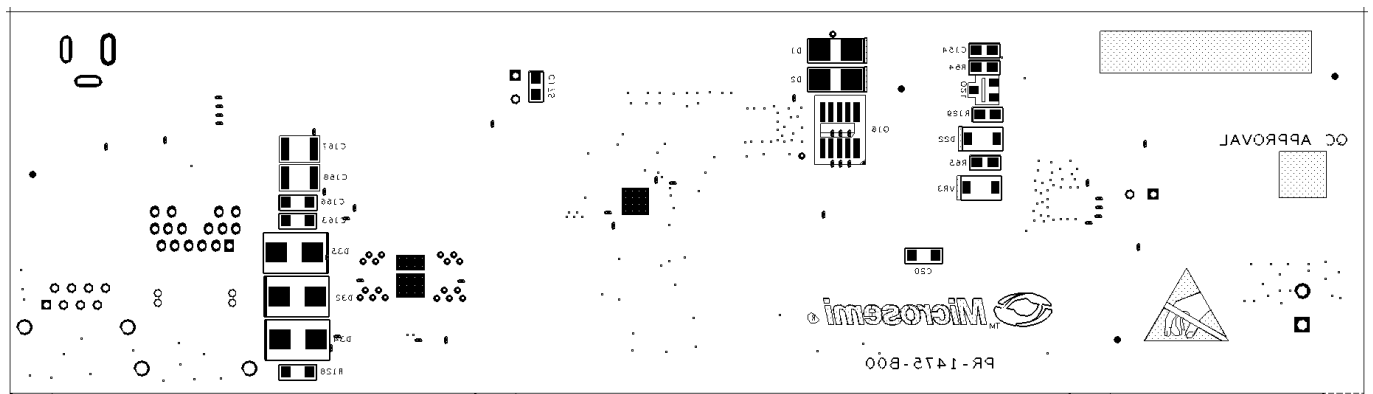


Figure 16: Bottom Silk and Solder Mask (Image Looking From Bottom)

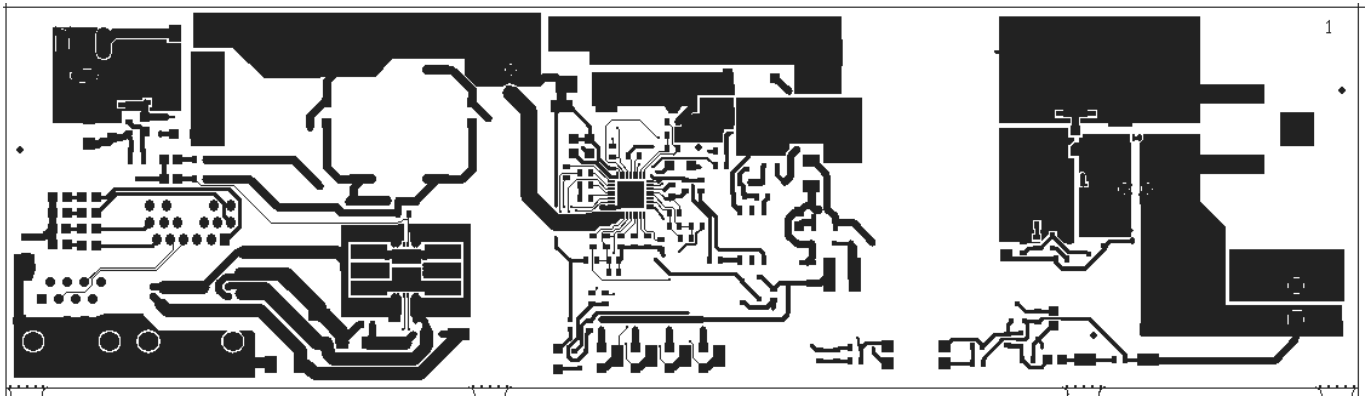


Figure 17: Top Layer

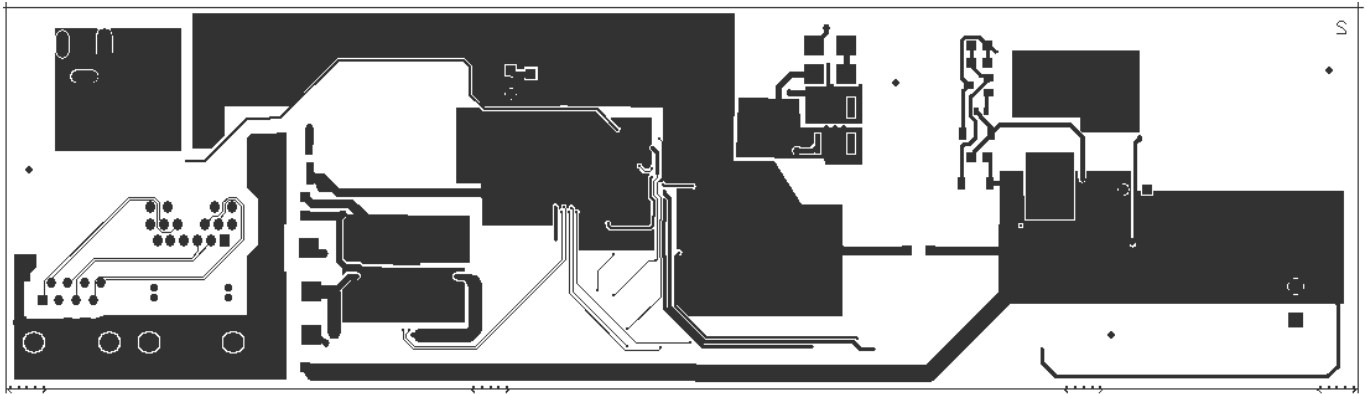


Figure 18: Bottom Layer

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## Revision History

| Revision Level / Date | Par. Affected/Page | Description     |
|-----------------------|--------------------|-----------------|
| 1.01 / 28-June-16     |                    | Initial release |
|                       |                    |                 |
|                       |                    |                 |
|                       |                    |                 |

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