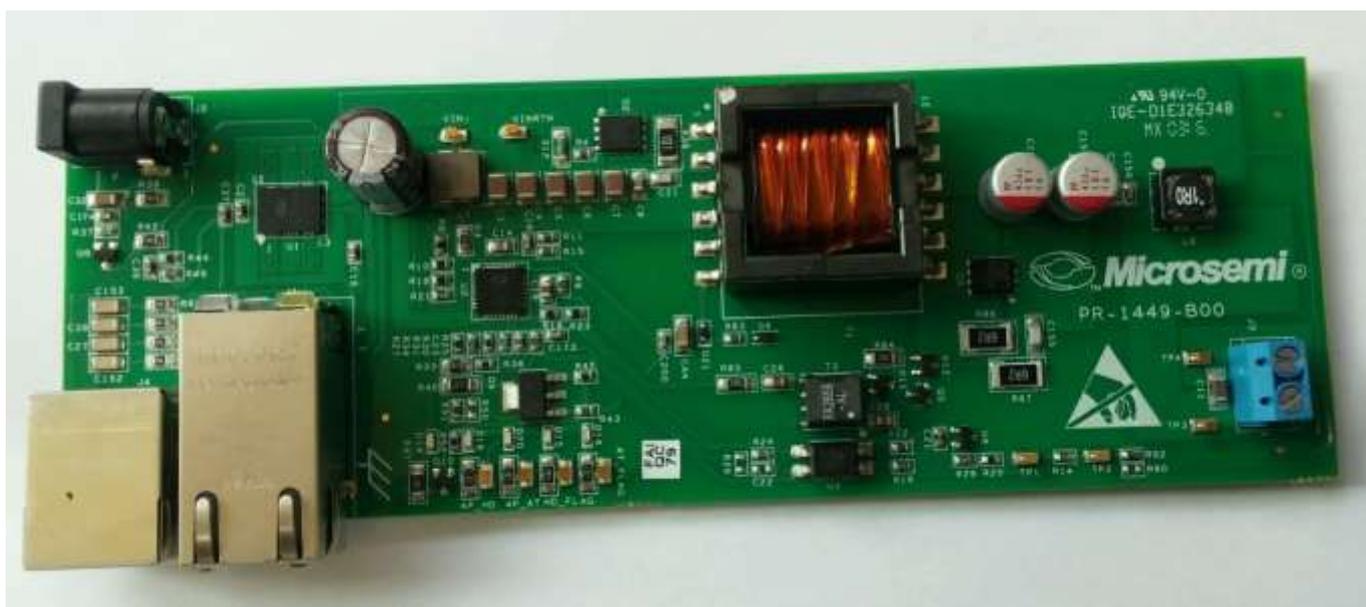


## PD70211EVB51F-12

### 12V/50W Isolated Flyback Converter PD

### Evaluation Board User Guide

Revision 1.2



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# 1 About this Guide

This user guide provides both description and operation procedures for Microsemi's PD70211EVB51F evaluating board. This board is used for evaluating the performance of PD70211A PD controller with integrated switching regulator, and PD70224 Dual Mosfet – Based 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 50 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:

• Chapter 1	<b>About this Guide:</b> Describes the objectives, audience, and organization.
• Chapter 2	<b>Introduction:</b> Provides an overview about evaluation board's main functions, features, physical characteristics and ordering information.
• Chapter 3	<b>Physical Description:</b> Provides explanation related to the physical description (switches, jumpers, connectors).
• Chapter 4	<b>Electrical Characteristics:</b> Provides electrical characteristics of the evaluation board.
• Chapter 5	<b>Installation:</b> Provides description of the installation process.
• Chapter 6	<b>Test Data:</b> Provides board test data information
• Chapter 7	<b>Schematic:</b> Provides board schematic diagram
• Chapter 8	<b>List of Material:</b> Provides board's list of materials.
• Chapter 9	<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

## 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 (IEEE802.3 af level)	No
PD70101	IEEE802.3at Type 1 (IEEE802.3 af level)	Yes
PD70200	IEEE802.3at Type 2	No
PD70201	IEEE802.3at Type 2	Yes
PD70210	2 x IEEE802.3at Type 2 (4 pair) HDBaseT (95W)	No
PD70211	2 x IEEE802.3at Type 2 (4 pair) HDBaseT (95W)	Yes

Microsemi’s PD70211EVB51F 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.

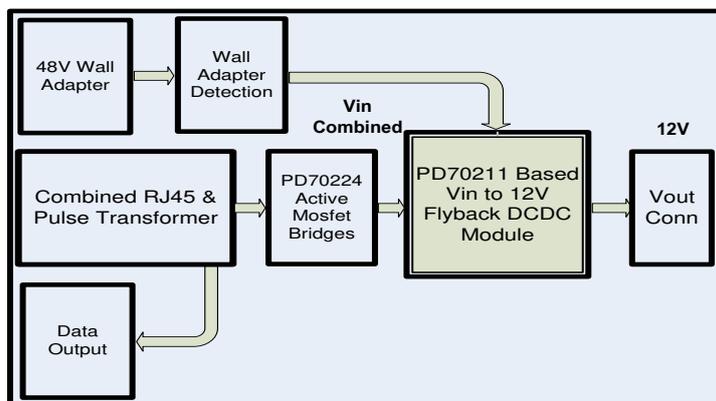
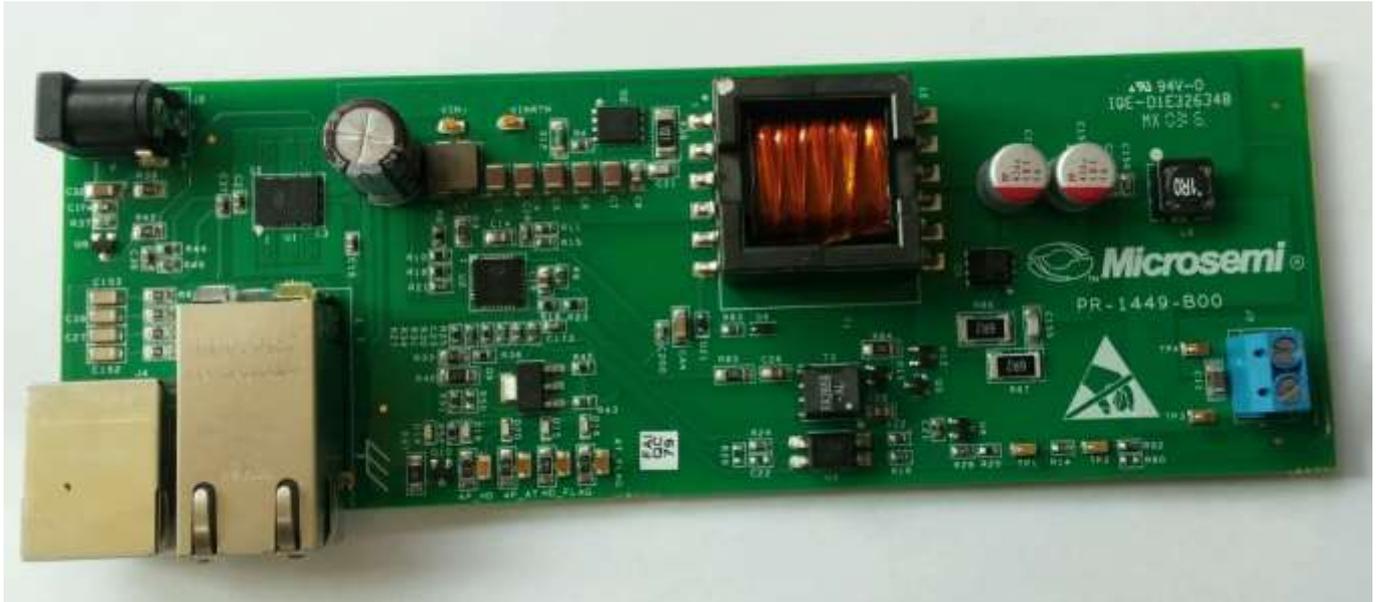


Figure 1: PD70211EVB51F-12 Block Diagram



**Figure 2: PD70211EVB51F Evaluation Board – General View**

### Evaluation Boards Ordering Information

Microsemi supplies the following Evaluation Board as shown below:

Ordering Number	Description
PD70211EVB51F-12	2 x IEEE802.3at Type 2 (4 pair) PD based on PD70211 device having 4 pair supply, controlling an <b>isolated flyback converter</b> , having a <b>12V 4.17 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 48V 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: 0° 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	147 x 51 x 15 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:

- PD70211EVB51F 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, TP16 (-) and TP17 (+)	Converter Output	Terminal pins for connecting a load to 12V output. J3 provides screw terminals for easy connection; TP16 and TP17 provides through-holes for soldered connection.
4	J4	RJ45 Connector	RJ45 port for Data pass – through output
5	VIN+, VINRTN	Converter Input Monitor	Converter Input Rail Monitor – Used as a monitor for DC-DC primary rail voltage.
6	TP12 and TP13	Frequency Analyzer Connection	Used to connect to an external frequency response analyzer for measuring loop stability.

##### 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 & J4 Pin No	Signal Name	Description
J1 - 7, 8	Data and Power In	Data and power input to powered device (PoE Master Negative data port)
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.

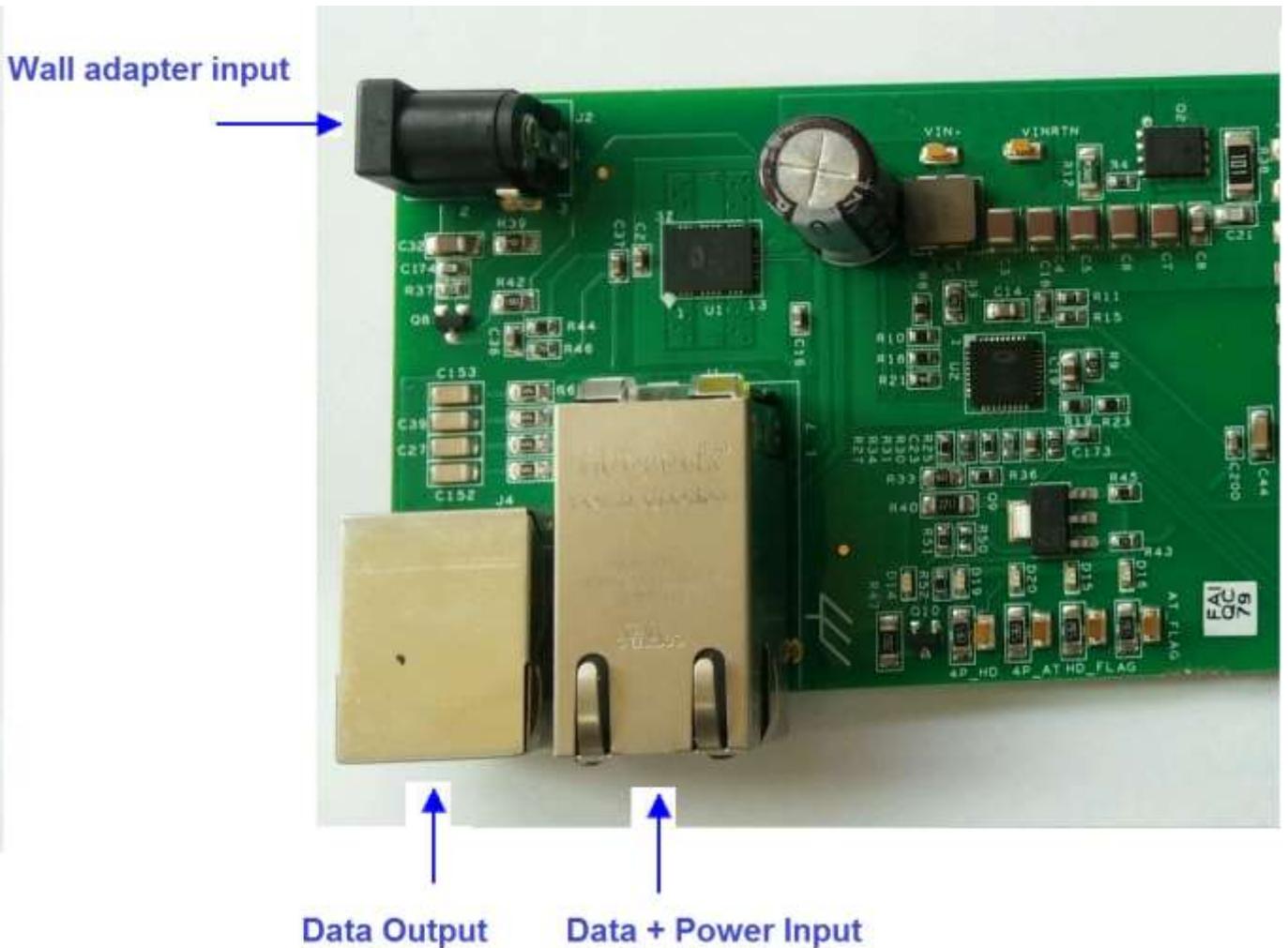


Figure 3: Front RJ45 and Auxiliary 48V Wall Adapter Connectors

## 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
TP16	Vout (-)	Return of DCDC output voltage
TP17	Vout (+)	Positive DCDC output voltage

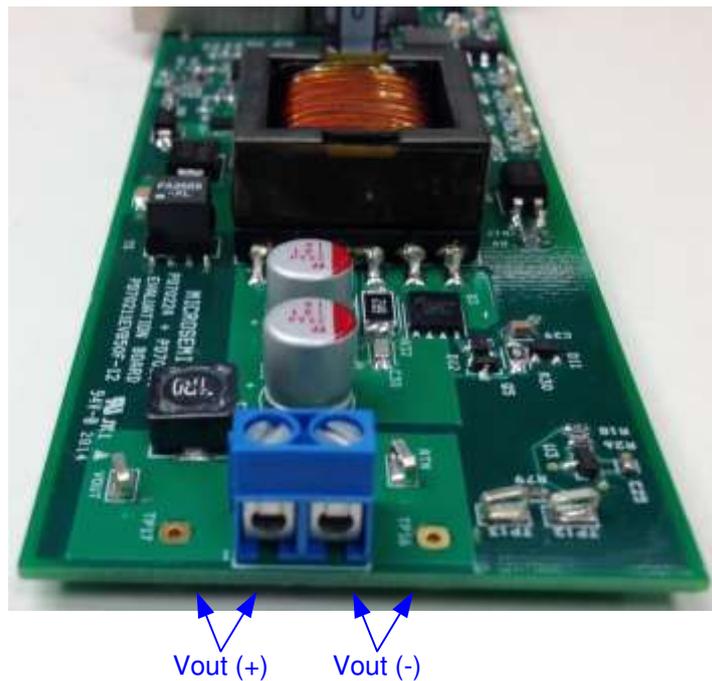


Figure 4: V<sub>out</sub> Connections

### 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.

D10 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.

D15 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.

D9 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.

D18 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 R40, 100 Ohm Resistor (located on PCB bottom under D18).
- 2) Add R39 Zero Ohm Jumper (Also located on PCB bottom under D18).
- 3) Insure that only R39 or R40 are installed; do not operate with both resistors installed.

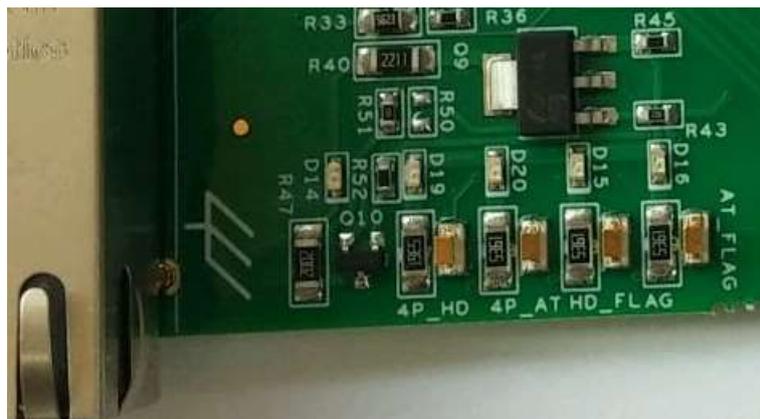


Figure 5: LED Indications

## 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
Maximum Available Current			4.25	A
Port Isolation to Chassis		-	1.5	kVrms

## 5 Installation

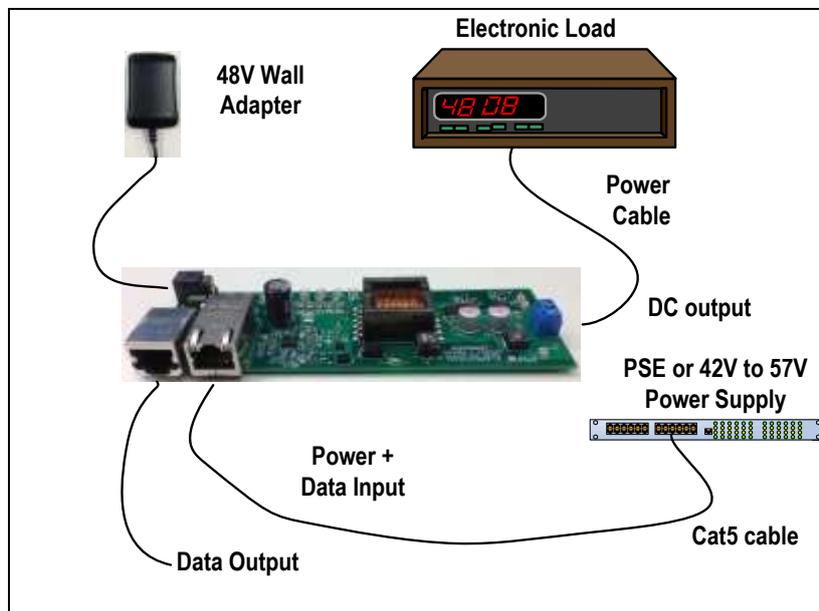
### 5.1 Preliminary Considerations and Safety Precautions

- 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

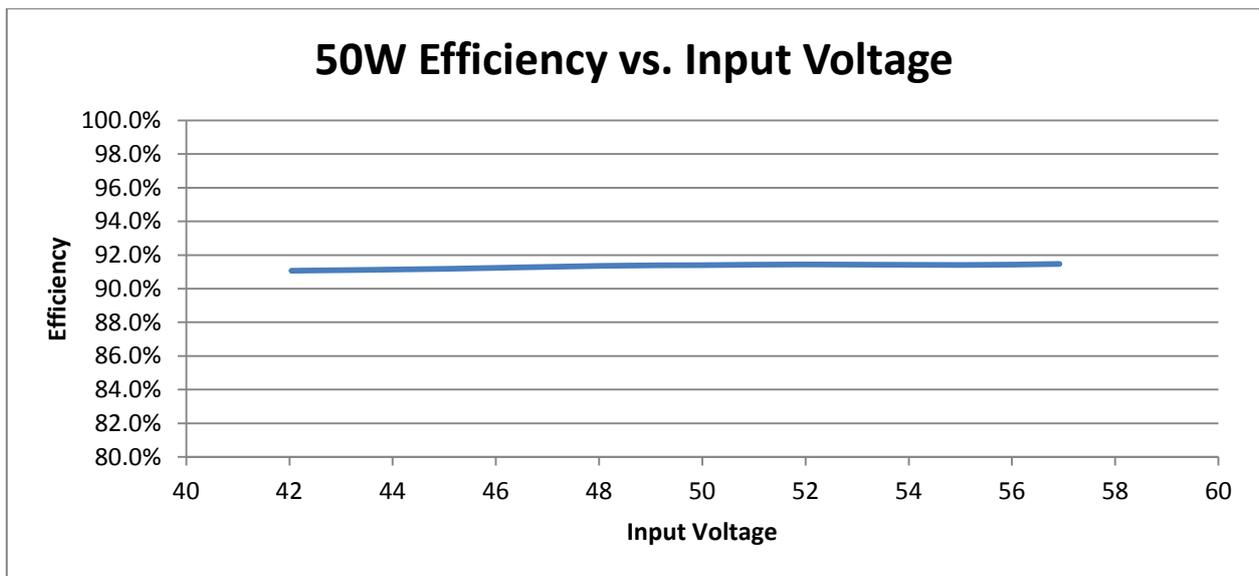
This chapter describes EVB test data under various loads and POE input voltage levels.

The efficiency is indicated up to 50W output power.

- Efficiency is measured at the input to the PD70224. It does not contain the RJ45 Connector or Magnetics

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

### 6.1 50W Efficiency vs Input Voltage to the PD70224



**Figure 7: Efficiency vs Input Voltage**

## 6.2 Efficiency vs Load Current at 50V Input to the PD70224

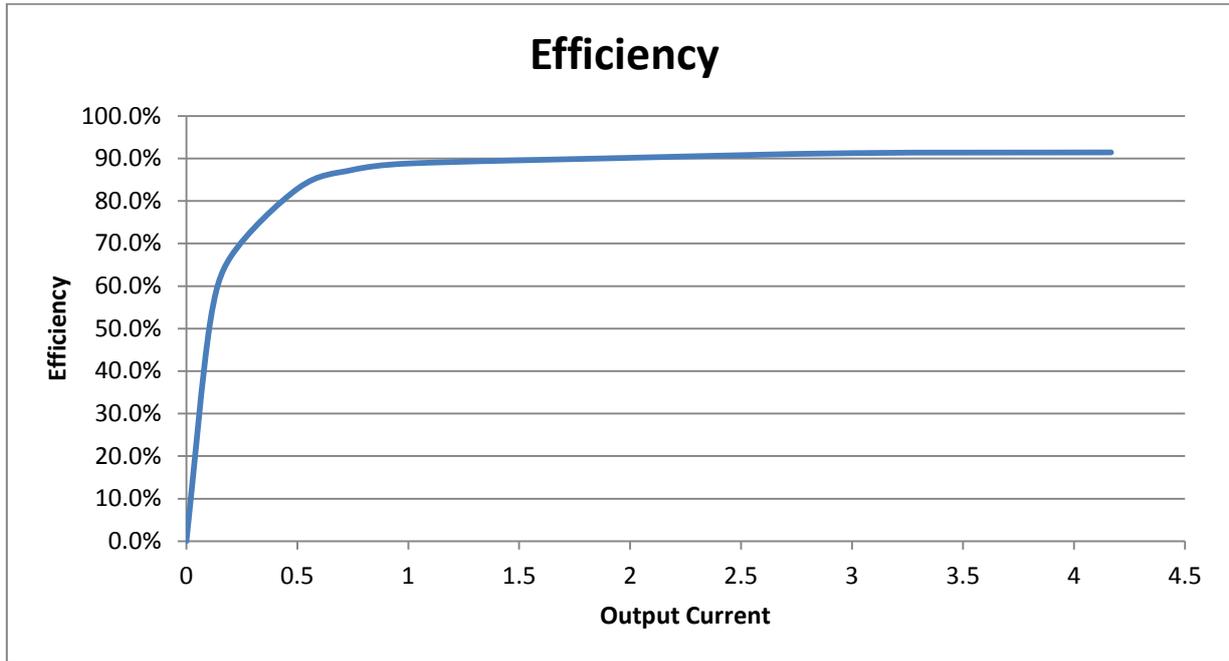


Figure 8: Efficiency at 50V Input

## 6.3 Load Regulation

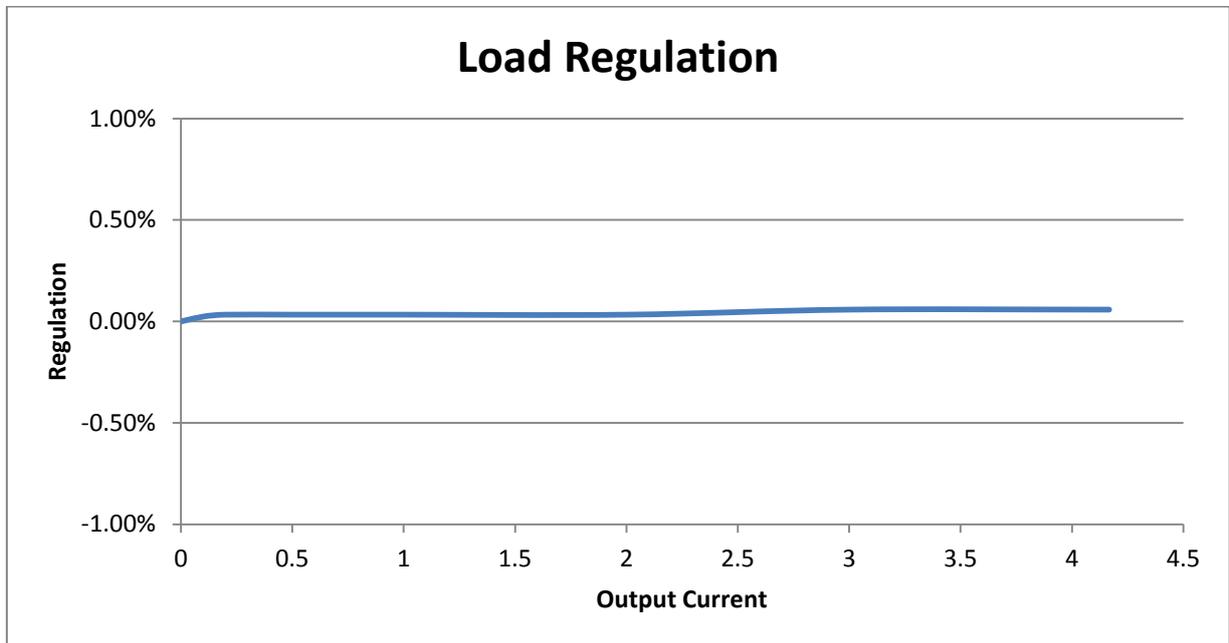


Figure 9: Load Regulation at 50V Input

### 6.4 Output Ripple

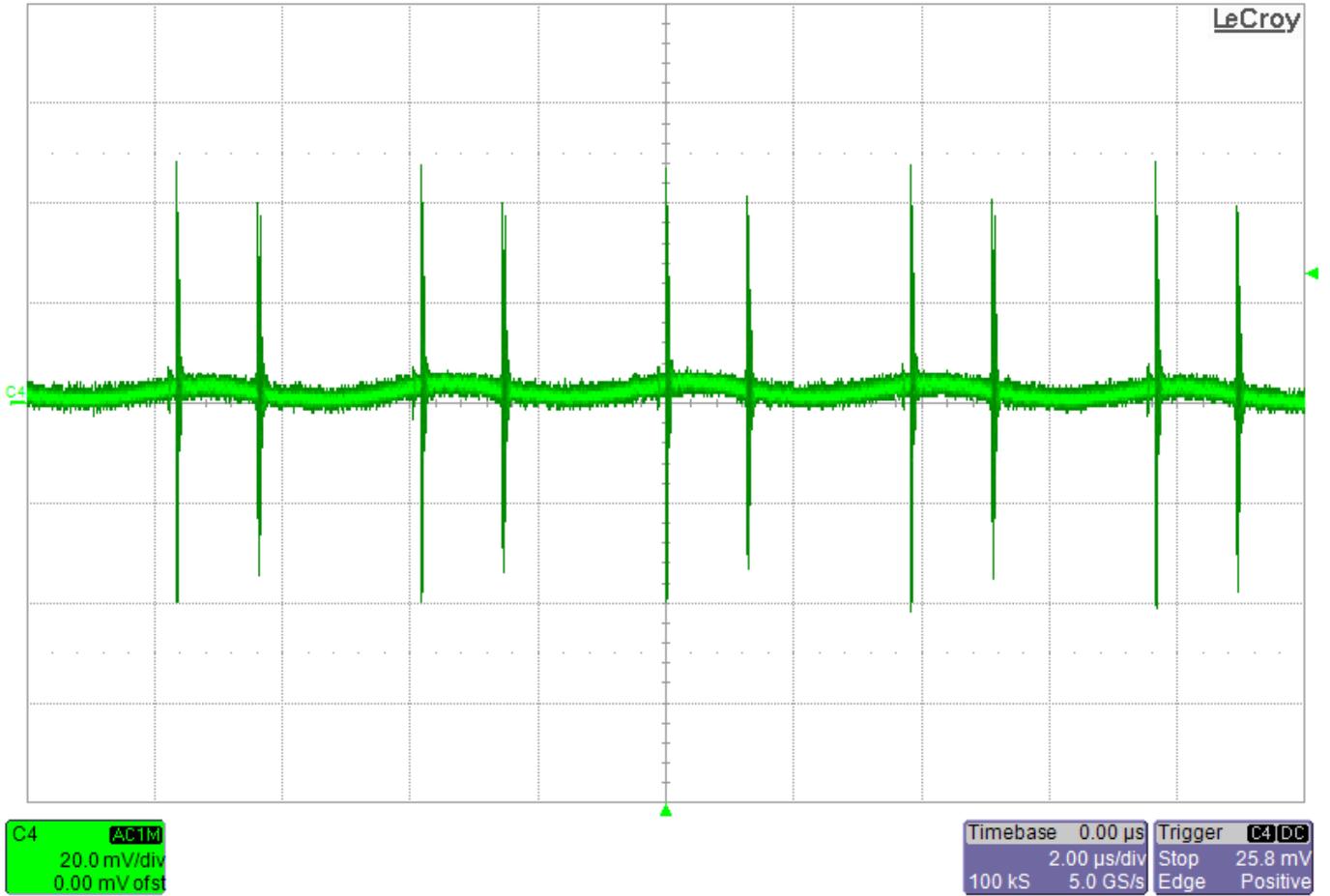


Figure 10: Full Load Voltage Ripple and Noise (with optional LC Filter)

### 6.5 Step Load Response

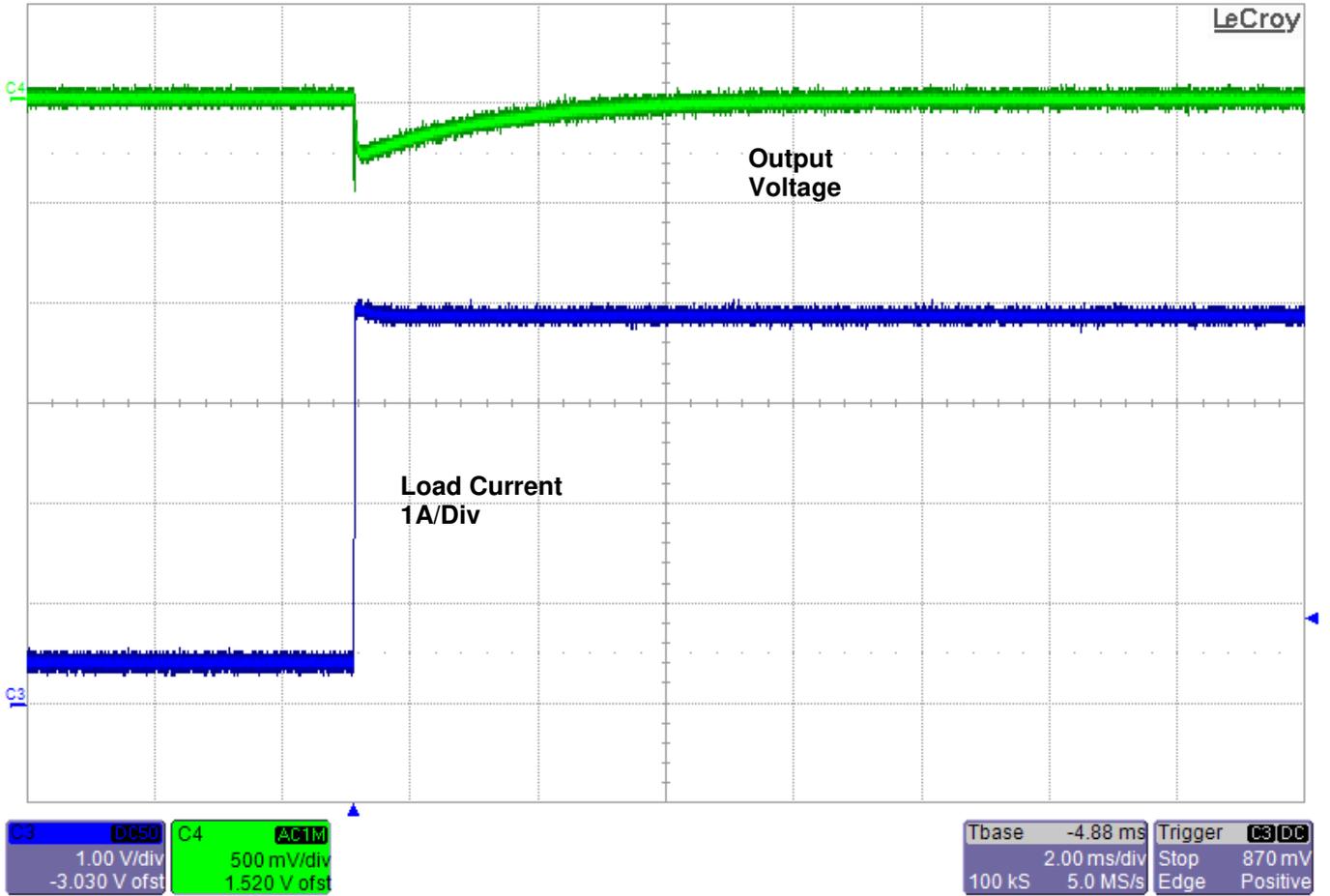


Figure 11: Load Step Response



# 7 Schematic

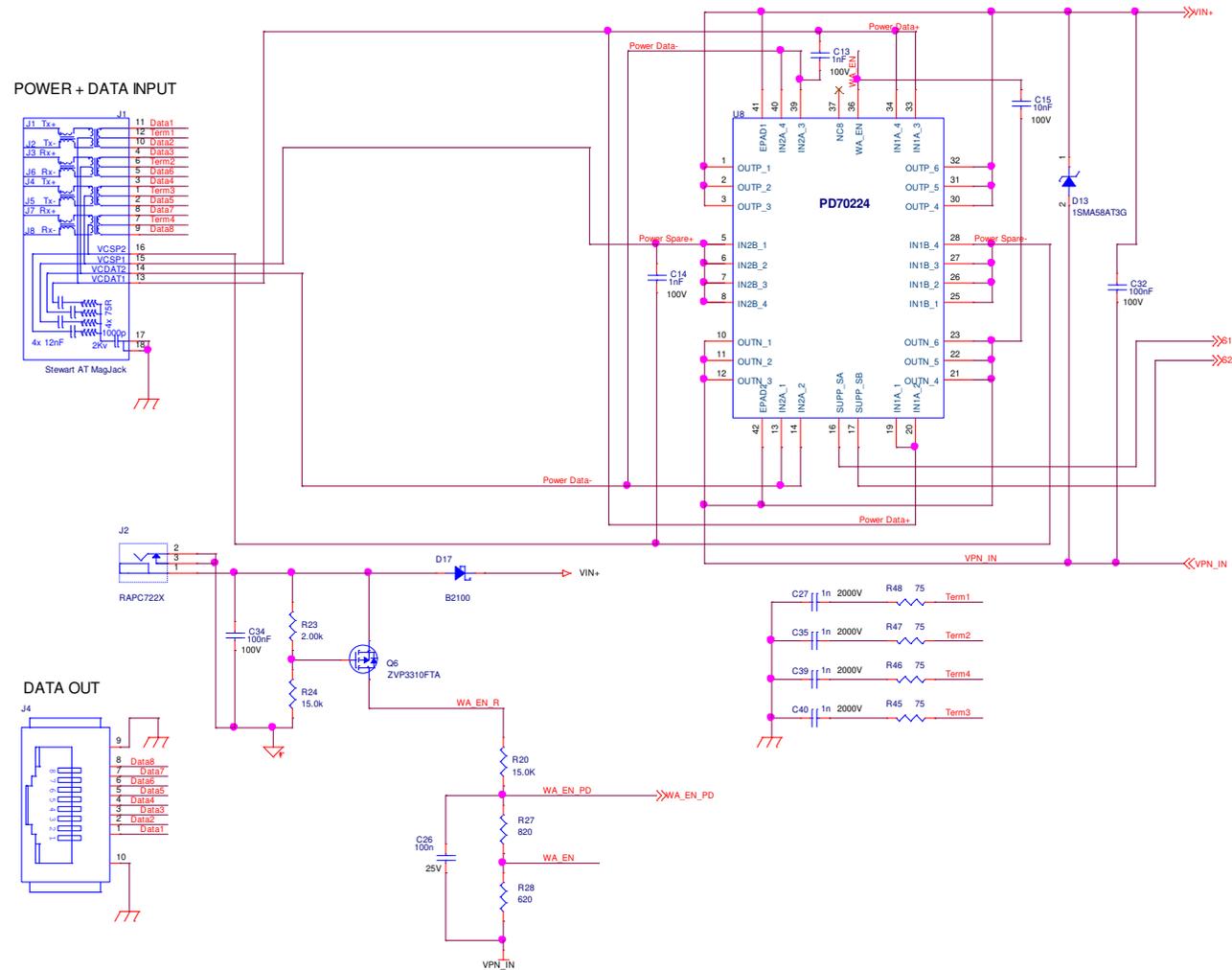


Figure 12: Evaluation Board Schematic (1 of 2)



# PD70211EVB51F Evaluation Board – User Guide

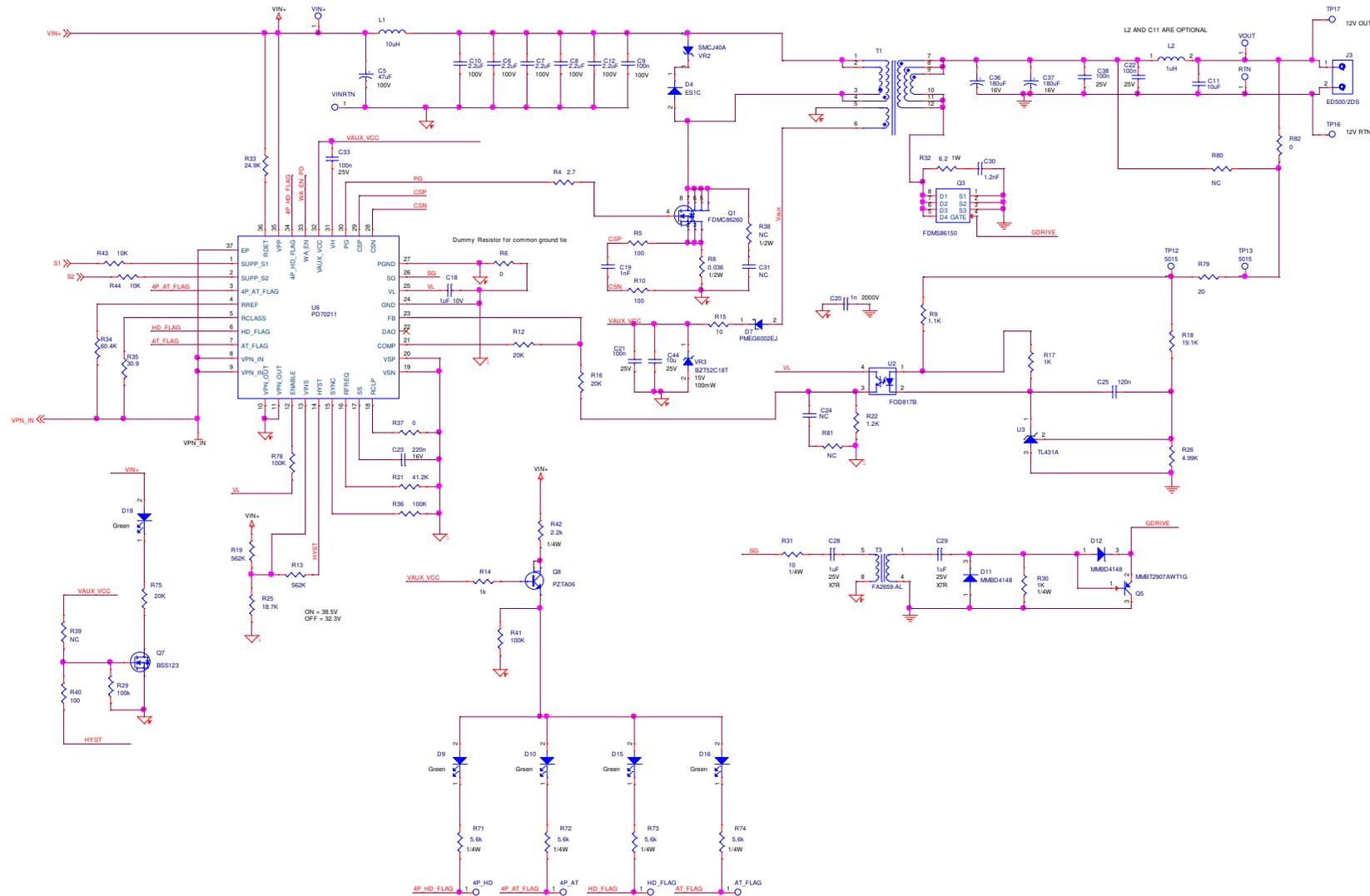


Figure 13: Evaluation Board Schematic (2 of 2)



## 8 List of Materials

Qty	Ref Des	Part Value	Description	Mfr. Name	Mfr. Part Number
9	4P_HD,4P_AT,VOUT,VIN+,HD_F LAG,AT_F LAG,RTN,TP12,TP13	5015	TEST POINT PC MINIATURE SMT	Keystone	5015
1	C5	47uF	CAP ALUM 47UF 100V 20% RADIAL	Nichicon	UPW2A470MPD6
5	C6,C7,C8,C10,C12	2.2uF	CAP CER 2.2UF 100V 10% X7R 1210	TAIYOYUDEN	HMK325B7225KN-T
1	C9	100n	CAP CER 0.1UF 100V 10% X7R 0805	TDK	C2012X7R2A104K125AA
1	C11	10uF	CAP X7R 10uF 16V 10% 1206	TDK	C3216X7R1C106K
1	C18	1uF	Capacitor, Ceramic, 10V, X7R, 0805	Any	Any
1	C19	1nF	Capacitor, Ceramic, X7R, 16V, 0603	Any	Any
5	C20,C27,C35,C39,C40	1n	CAP CRM 1nF/2000V 10%++X7R 1206 SMT	AVX	1206GC102KAT1A
4	C21,C22,C26,C38	100n	Capacitor, Ceramic, 25V, X7R, 0603	Any	Any
1	C23	220n	Capacitor, X7R, 16V, 10% 0603	Any	Any
1	C24	NC	Capacitor, Ceramic, 10V, X7R, 0603	Any	Any
1	C25	120n	Capacitor, X7R, 16V, 10% 0603	Any	Any
2	C28,C29	1uF	CAP CER 1UF 25V 10% X7R 0805	TDK	C2012X7R1E105K
1	C30	1.2nF	CAP CER 1200PF 100V 5% NP0 1206	Any	Any
2	C31,R38	NC			
2	C32,C34	100nF	CAP CRM 100nF 100V 10% <sup>^^</sup> X7R 1206 SMT	Any	Any
1	C33	100n	Capacitor, Ceramic, 10V, X7R, 0805	Any	Any
2	C36,C37	180uF	CAP ALUM 180UF 16V 20% RADIAL	Nichicon	RL81C181MDN1KX
1	C44	10u	Capacitor, Ceramic, 25V, X7R, 1206	Any	Any
1	D4	ES1C	DIO FAST SWI 150V, 1A	Fairchild	ES1C
1	D7	PMEG6002EJ	Diode, Schottky, 200mA, 60V,SOD323 Type SMT	NXP	PMEG6002EJ
5	D9,D10,D15,D16,D18	LTST-C193KGKT-5A	LED GREEN RECT CLEAR 0603	LITE-ON	LTST-C193KGKT-5A



## PD70211EVB51F Evaluation Board – User Guide

Qty	Ref Des	Part Value	Description	Mfr. Name	Mfr. Part Number
2	D11,D12	MMBD4148	DIODE SML SIG 100V 0.2A SOT23-3	Fairchild Semiconductor	MMBD4148
1	D13	1SMA58AT3G	DIO TVS 58V 40A SRG^400WPK SMA SMT	ON Semiconductor	1SMA58AT3G
1	D17	B2100	DIODE SCHOTTKY 100V 2A SMB	Diodes Inc	B2100-13-F
1	J1	Stewart AT MagJack	CONN MAGJACK 1PORT 1000 BASE-T	Bel Stewart	8261X1TGH-F
1	J2	RAPC722X	DC Power Jack 16V 5A TH	Switchcraft	RAPC722X
1	J3	ED500/2DS	TERMINAL BLOCK 5MM 2POS PCB	On Shore Technology	ED500/2DS
1	L1	10uH	INDUCTOR POWER 10UH 3A SMD	Vishay	IHLP2525CZER100M01
1	L2	1uH	Inductor, 1uH SMD Inductor, 5.3A, 11m Ohm	Würth	7447779001
1	Q1	FDMC86260	MOSFET N-CH 150V 16A POWER33	Fairchild	FDMC86260
1	Q3	FDMS86150	MOSFET N CH 100V 16A POWER56	Fairchild Semiconductor	FDMS86150
1	Q5	MMBT2907AWT1G	TRN PNP 60V 600mA SOT323 SMT 250mW MMBT2907AW^	ON Semiconductor	MMBT2907AWT1G
1	Q6	ZVP3310FTA	MOSFET P-CH 100V 75MA SOT23-3A	Diodes Inc	ZVP3310FTA
1	Q7	BSS123	MOSFET N-CH 100V 170MA SOT-23	Fairchild	BSS123
1	VINRTN	5016	Terminal, Compact style test point, SMT PCB Mount	Keystone	5016
1	R4	2.7	Resistor, 5%, 1/10W, 0603	Any	Any
3	R5,R10,R40	100	Resistor, 1%, 1/16W, 0603	Any	Any
1	R6	0	Resistor, 1%, 1/16W, 0603	Any	Any
1	R8	0.036	RES 0.036 OHM 1/2W 1% 1206	TE Connectivity	RLP73M2BR036FTDF
1	R9	1.1k	Resistor, 5%, 1/10W, 0603	Any	Any
2	R12,R16	20k	Resistor, 5%, 1/10W, 0603	Any	Any
1	R13	562k	Resistor, 1%, 1/16W, 0603	Any	Any
1	R15	10	Resistor, 5%, 1/10W, 0603 SMD	Any	Any
2	R14,R17	1k	Resistor, 5%, 1/10W, 0603	Any	Any
1	R18	19.1k	Resistor, 1%, 1/16W, 0603	Any	Any
1	R19	562k	Resistor, 1%, 1/10W, 0805	Any	Any



## PD70211EVB51F Evaluation Board – User Guide

Qty	Ref Des	Part Value	Description	Mfr. Name	Mfr. Part Number
1	R21	41.2k	Resistor, 1%, 1/16W, 0603	Any	Any
1	R22	1.2k	Resistor, 5%, 1/10W, 0603	Any	Any
1	R23	2.00k	Resistor, 1%, 1/16W, 0603	Any	Any
2	R20,R24	15.0k	Resistor, 1%, 1/10W, 0805	Any	Any
1	R25	18.7k	Resistor, 1%, 1/16W, 0603	Any	Any
1	R26	4.99k	Resistor, 1%, 1/16W, 0603	Any	Any
1	R27	820	Resistor, 5%, 1/10W, 0603	Any	Any
1	R28	620	Resistor, 5%, 1/10W, 0603	Any	Any
3	R29,R36,R41	100k	Resistor, 5%, 1/10W, 0603	Any	Any
1	R30	1k	Resistor, 1K Ohms, 1/4 Watt, 5% 1206 Type SMD	Panasonic	ERJ-8GEYJ102
1	R31	10	Resistor, 10 Ohms, 1/4 Watt, 5% 1206 Type SMD	Any	Any
1	R32	6.2	RES 6.2 OHM 1W 5% 2512 SMD	Any	Any
1	R33	24.9k	Resistor, 1%, 1/10W, 0805	Any	Any
1	R34	60.4k	Resistor, 60.4K Ohms, 1/16 Watt, 1% 0603 Type SMD	Panasonic	ERJ-3EKF6042
1	R35	30.9	Resistor, 30.9 Ohms, 1/16 Watt, 1% 0603 Type SMD	Panasonic	ERJ-3EKF30R9
2	R37,R82	0	Resistor, 5%, 1/10W, 0603	Any	Any
3	R39,R80,R81	NC			
4	R71,R72,R73,R74	5.6k	Resistor, 5%, 1/4W, 1206	Any	Any
1	R75	Not used			
1	R78	100k	Resistor, 5%, 1/10W, 0603	Any	Any
1	R79	20	Resistor, 5%, 1/10W, 0603	Any	Any
2	R43,R44	10k	Resistor, 5%, 1/10W, 0603	Any	Any
1	T1	FB Transformer	51W transformer; EFD25 SMD	TMP	DG-EFD25-0004 GP
			Alternate transformer	Coilcraft	TA-7818-AE
1	T3	FA2659-AL	Transformer, Gate Drive, 1:1 turns ratio,	Coilcraft	FA2659-AL
1	U2	FOD817B	OPTOCOUPLER TRANS 5KVRMS 4SMD	Fairchild Semiconductor	FOD817BS



## PD70211EVB51F Evaluation Board – User Guide

Qty	Ref Des	Part Value	Description	Mfr. Name	Mfr. Part Number
1	U3	TL431A	IC VREF SHUNT PREC ADJ SOT-23-3	Texas Instruments	TL431AIDBZR
1	U6	PD70211	IC, Power Over Ethernet PD Controller	Microsemi	PD70211ILQ
1	U8	PD70224	IC, Ideal Diode Bridge	Microsemi	PD70224ILQ
1	VR2	SMCJ40A	TVS DIODE 40VWM 64.5VC SMC	Fairchild Semiconductor	SMCJ40A
1	VR3	BZT52C18T	Diode, Zener, 18V, 100mW, SOD-523	Micro Commercial Co.	BZT52C18T-TP
1	R42	2.2k	Resistor, 5%, 1/4W, 1206	Any	Any
1	Q8	PZTA06	TRANSISTOR GP NPN 80V SOT-223	Fairchild Semiconductor	PZTA06
2	C13,C14	1nF	Capacitor, Ceramic, X7R, 100V, 0603	Any	Any
1	C15	10nF	Capacitor, Ceramic, X7R, 100V, 0603	Any	Any
4	R45,R46,R47,R48	75	Resistor, 5%, 1/8W, 0805	Any	Any
1	J4	RJ45 Jack	CON RJ45 SINGLE 8 POS SHIELDED	Kinsun	3060115907

## 9 Board Layout

This paragraph presents the layout of the evaluation board.

The board is a 4 layer board. All layers are 2 Oz layers. Below figures present the 4 copper layers and the silk of the board for tracking devices placements.

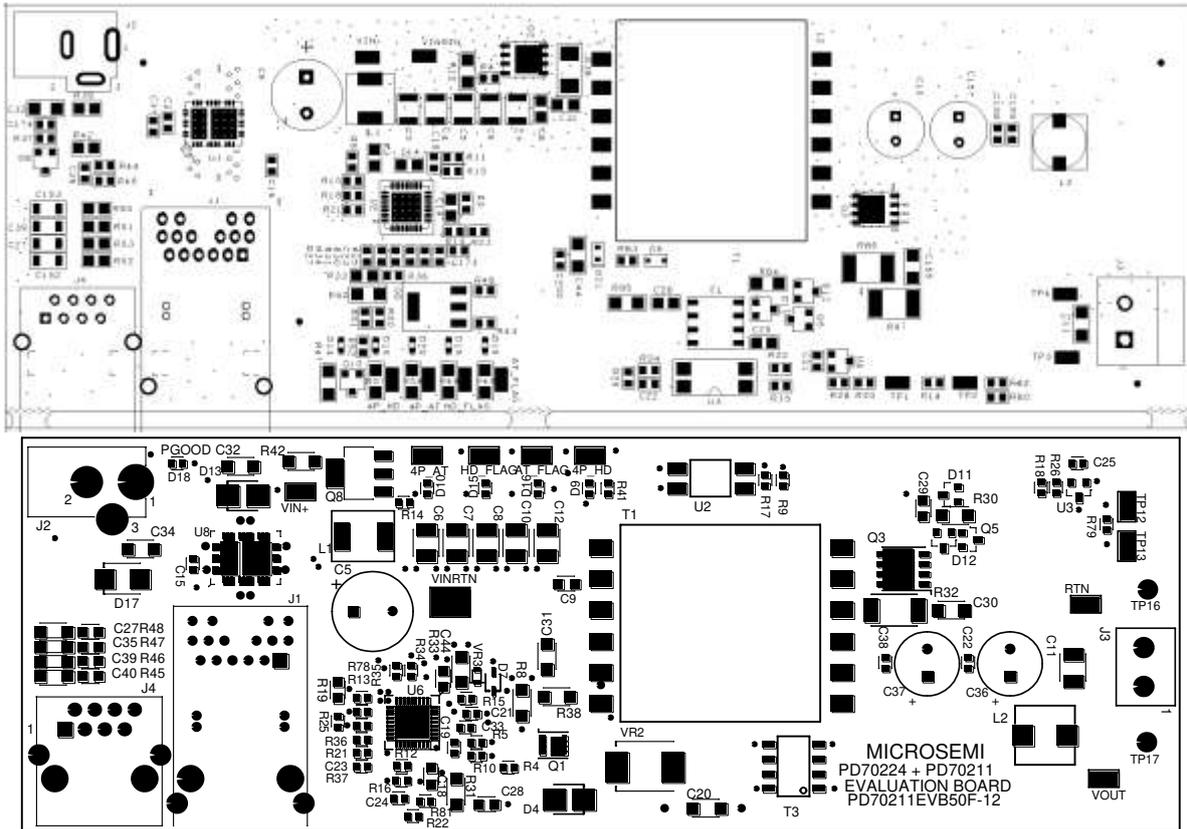


Figure 14: Top Silk and Solder mask

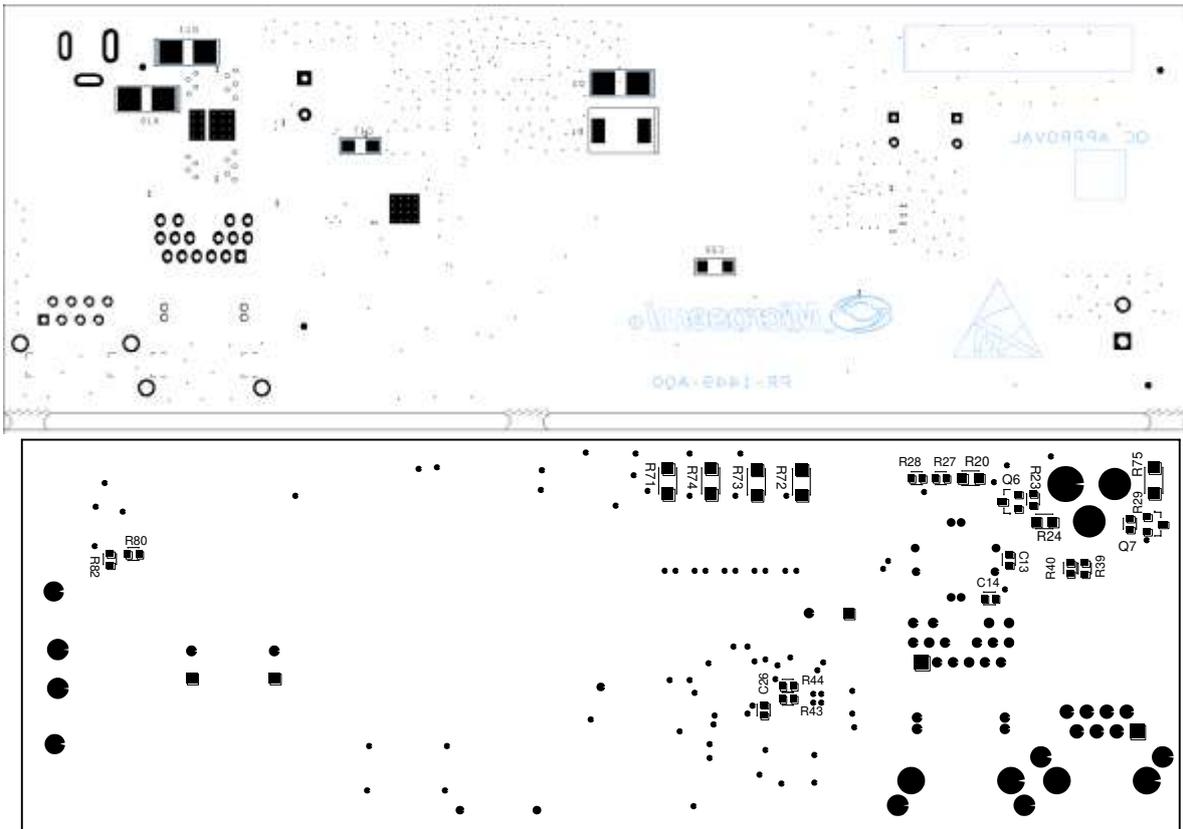


Figure 15: Bottom Silk and Solder mask (Image Looking From Bottom)

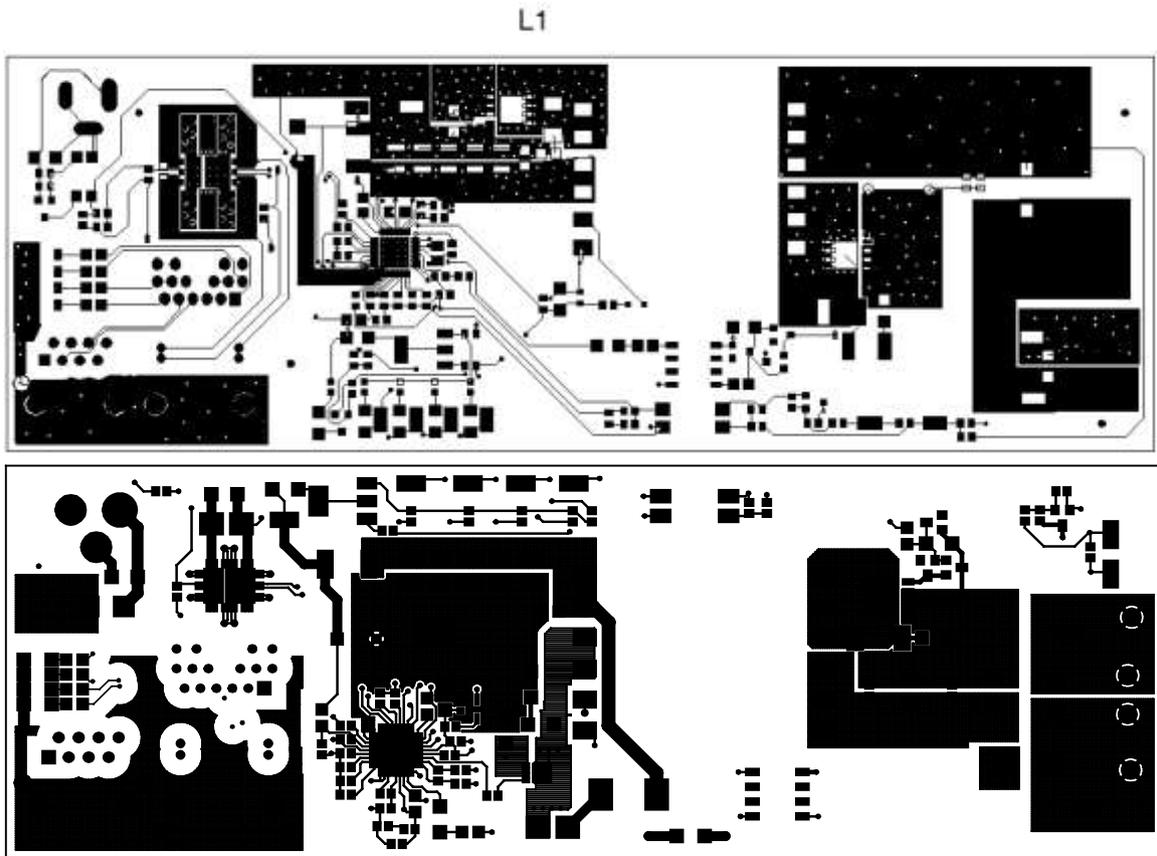


Figure 16: Top Layer



Figure 17: Bottom layer



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**Revision History**

Revision Level / Date	Para. Affected/Page	Description
1.0 / 24-July-14		Initial revision
1.1/17-Sep-14	Pgs 18, 19	BOM Correction
1.2/22-May-16		Updated pictures and BOM

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