TPS2379 EVM User's Guide

This User's Guide describes the evaluation module (EVM) for the TPS2379 (TPS2379EVM-106). TPS2379 is an IEEE802.3at type 2 compliant powered device (PD) controller with a GATE output for controlling external booster MOSFETs.

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1 Introduction

The TPS2379EVM allows reference circuit evaluation of the TI TPS2379 PD controller. The TPS2379 features GATE output for controlling external MOSFETs for extended power applications. It also features a 100 V pass transistor, 140 mA inrush current limiting, type-2 indication, auto-retry fault protection, and an open-drain power-good output.

1.1 Features

- Gigabit Ethernet pass through interface
- Switched output return for “ease of use” loading
- GATE output to drive the external MOSFET
- Extra detection and class signature selection for non-standard applications
- IEEE 802.3at type-2 hardware classification with status flag (T2P) and LED
- DC/DC converter enable (CDB)
- Robust 100 V, 0.5 Ω internal hotswap MOSFET and 100 V, 64 mΩ external MOSFET
- Operating power in excess of 60W with four-pair PSE

1.2 Applications

- IEEE 802.3at-compliant devices
- Video and VoIP telephones
- Multiband access points
- Security cameras
- Pico-base stations

2 Electrical Specifications at 25°C

Table 1. TPS2379EVM Electrical and Performance Specifications

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
POWER INTERFACE					
Input Voltage	Applied to the power pins of connectors J1 or J3	0	–	57	V
Operating Voltage	After start up.	30	–	57	V
Input UVLO	Rising input voltage at device terminals.	–	–	40	V
	Falling input voltage.	30.5	–	–	
Detection voltage	At device terminals	1.4	–	10.1	V
Classification voltage	At device terminals	11.9	–	23.0	V
Detection signature	J6 shunt removed		24.9		kΩ
	J6 shunt installed		12.5		
Classification current	J7 shunt removed	38	–	42	mA
	J7 shunt installed	64	–	72	
Inrush current-limit		100	–	180	mA
Operating current-limit	Internal MOSFET only (R13 removed)	850	–	1200	mA
	Internal plus external (R13 installed)		2260		
Efficiency	Four input pairs. Measured from J1 to J4 60W output power		97.5%		

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3 Description

TPS2379EVM-106 enables full evaluation of the TPS2379 device. Refer to the schematic shown in Figure 1. Ethernet power is applied from J1 to T1/T2 and is dropped to the diode bridges (D3/D4/D8/D9 or D5/D6/D10/D11) from the T1/T2 center taps. The series R-C circuit from each center tap help balance the Ethernet cable impedance and are critical for ESD and EMI/EMC performance. These circuits are terminated at TP10 (EGND) through the high voltage capacitor, C9. At the output of the diode bridges is the EMI/EMC filter and transient protection for the TPS2379. R7 provides the detection signature and R8 provides the class 4 signature resistance to the PSE. A shunt on J6 can be installed to present a 12.5kΩ detection signature resistance. A shunt on J7 can be installed to present a 45.2Ω (55mA) class signature resistance.

To the right of the TPS2379 (U1) is the switched side of the PD controller. The TPS2379 RTN pin provides inrush limited turn on and charge of the bulk capacitor, C3. During inrush, the TPS2379 GATE pin is pulled low (with respect to VSS) disabling the external boost MOSFET, Q2. When inrush is complete, the GATE pin goes high and enables a parallel conduction path through Q2 and the TPS2379 internal MOSFET. Q1 provides current limit for the external MOSFET when the voltage between TP12 and TP11 reaches the base-emitter on threshold of Q1.

Additionally during inrush, the TPS2379 CDB pin is pulled low (with respect to the RTN pin). Since the CDB pin is connected to the GATE of Q3, Q3 is off during inrush and J4 pin 1 is not connected to the RTN pin. This allows the output load to remain connected during EVM testing. LED's D1 and D2 provide operational visual indications of T2P and ON respectively.

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4 Schematic

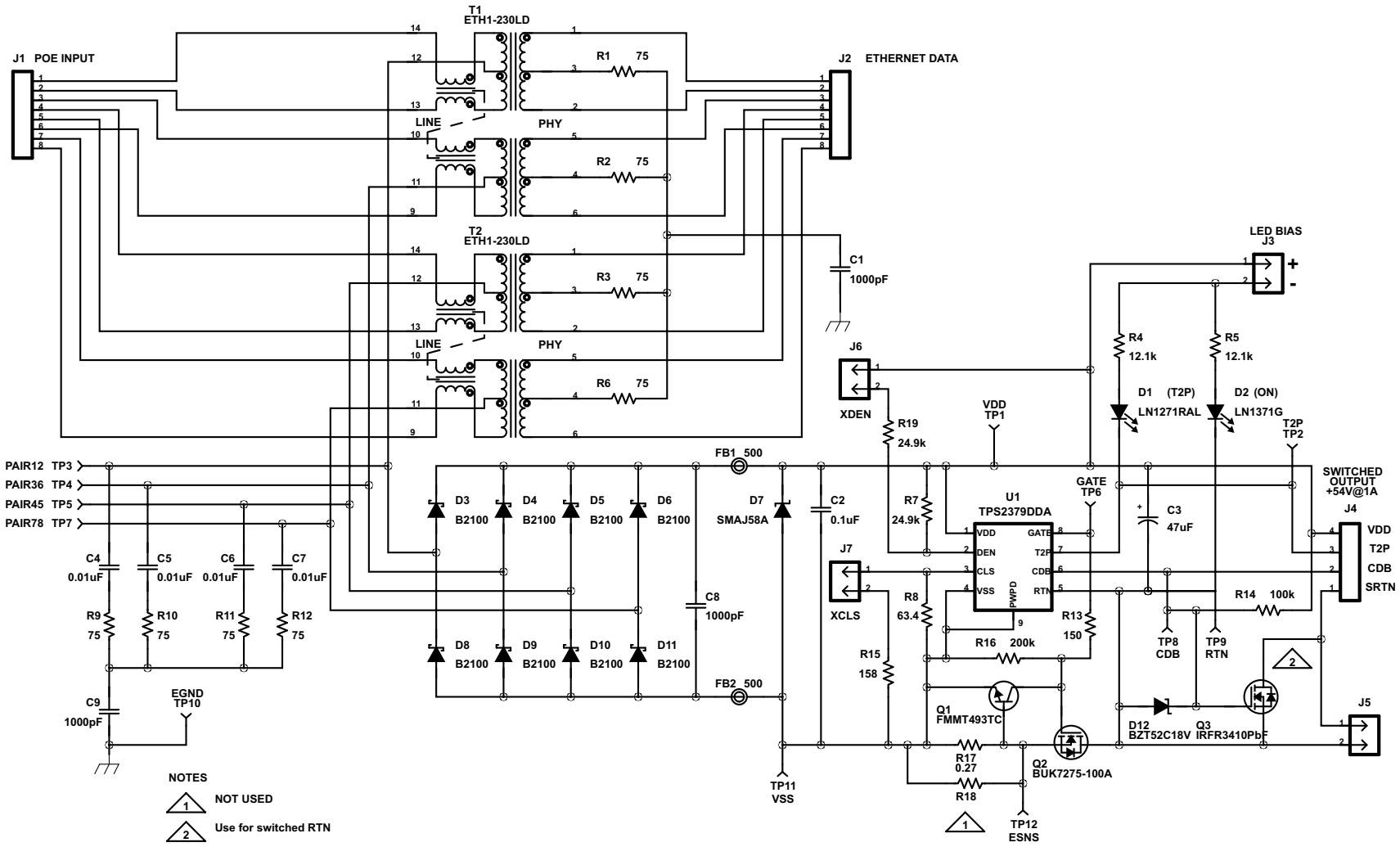


Figure 1. TPS2379EVM Schematic

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5 General Configuration and Description

5.1 Physical Access

Table 2 lists the TPS2379EVM connector functionality, Table 3 describes the test point availability and Table 4 describes the jumper functionality.

Table 2. Connector Functionality

Connector	Label	Description
J1	PWR+DATA	Power over ethernet (POE) input. Connect to power sourcing equipment (PSE) power and data source.
J2	DATA	Ethernet data pass through. Connect to downstream ethernet device.
J4	J4	Output connector to load. Connect pin #4 (VDD) to positive input and pin #1 (RTN) to low side of load. Pin #2 (CDB) can be used to inhibit the converter while the TPS2379 output is ramping up. Pin #3 (T2P) can be used to notify the load of when high power source is present.
D1 (RED)	T2P	T2P (type 2 PSE) LED. When ON this indicates that a type 2 PSE is detected.
D2 (GREEN)	ON	TPS2379 Output Powered.

Table 3. Test Points

Test Point	Color	Label	Description
TP6	WHT	GATE	Gate output to external MOSFET
TP3	RED	PAIR12	Data pair from pins 1 and 2 of J1
TP4	ORG	PAIR36	Data pair from pins 3 and 6 of J1
TP5	RED	PAIR45	Spare pair from pins 4 and 5 of J1
TP7	ORG	PAIR78	Spare pair from pins 7 and 8 of J1
TP1	RED	VDD	High side output from bridge
TP2	WHT	T2P	Type 2 PSE output from TPS2379
TP9	BLK	RTN	Switched low side from TPS2379
TP8	WHT	CDB	Converter disable output from TPS2379
TP11	BLK	VSS	Low side output from bridge
TP10	SM	EGND	Earth or chassis ground point
TP12	BLK	ESNS	External MOSFET current sense point

Table 4. Jumpers

Jumper	Label	Description
J3	J4	LED bias jumper. Install to furnish LED bias for T2P and ON LED's
J5	J5	Switched output return bypass jumper.
J6	XDEN	This jumper can be used to switch in alternate non-standard detection resistors. When the shunt is removed, the standard 24.9kΩ is used and when the shunt is installed, the detection resistance is ~12.5kΩ
J7	XCLS	This jumper can be used to switch in alternate non-standard classification resistors. When the shunt is removed, the standard class 4 63.4Ω (40mA) resistor is used and when the shunt is installed, the classification resistance is ~45.2Ω (55mA).

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5.2 Test Setup

Figure 2 shows a typical test setup for TPS2379EVM. Connect J1 to the power sourcing equipment (PSE) Power for the Ethernet device is available at J4 and the pass through Ethernet data is available at J2.

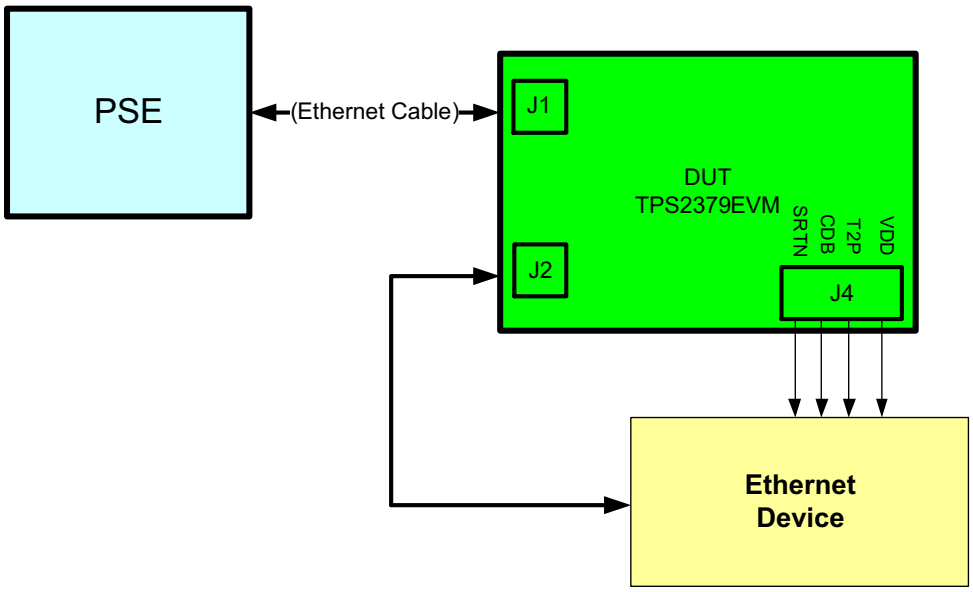


Figure 2. Typical TPS2379EVM Test Setup

6 EVM Assembly Drawings and Layout Guidelines

6.1 PC Drawings

The following figures show component placement and layout of the EVM.

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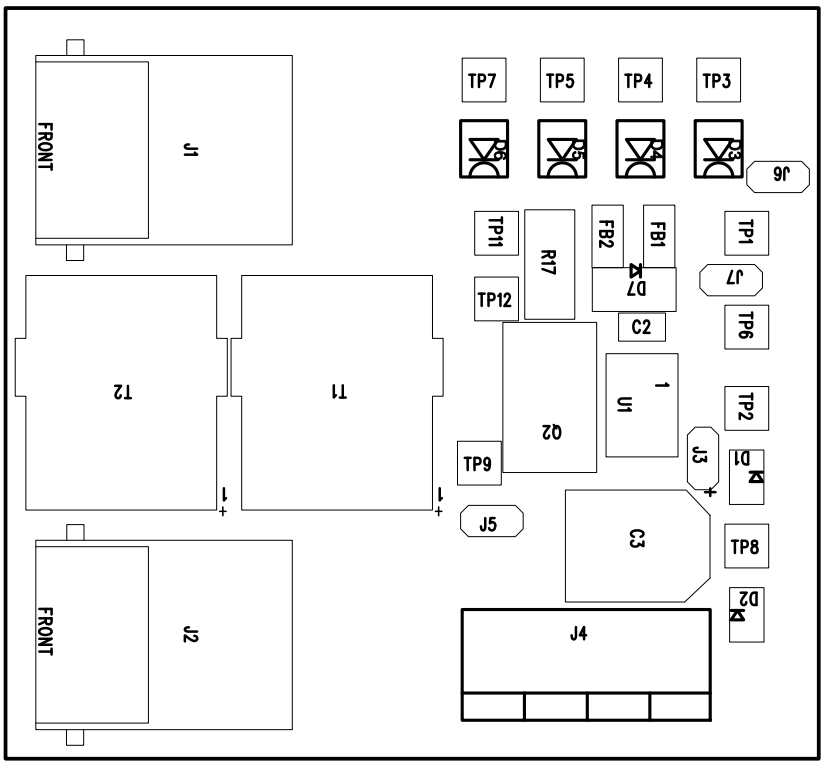


Figure 3. Top Side Placement

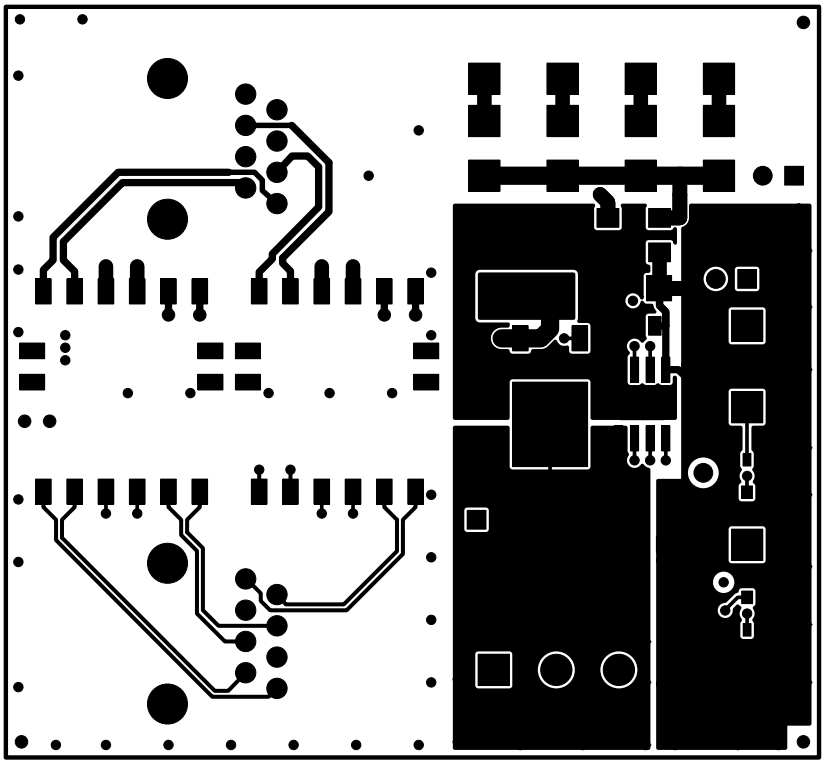


Figure 4. Top Side Routing

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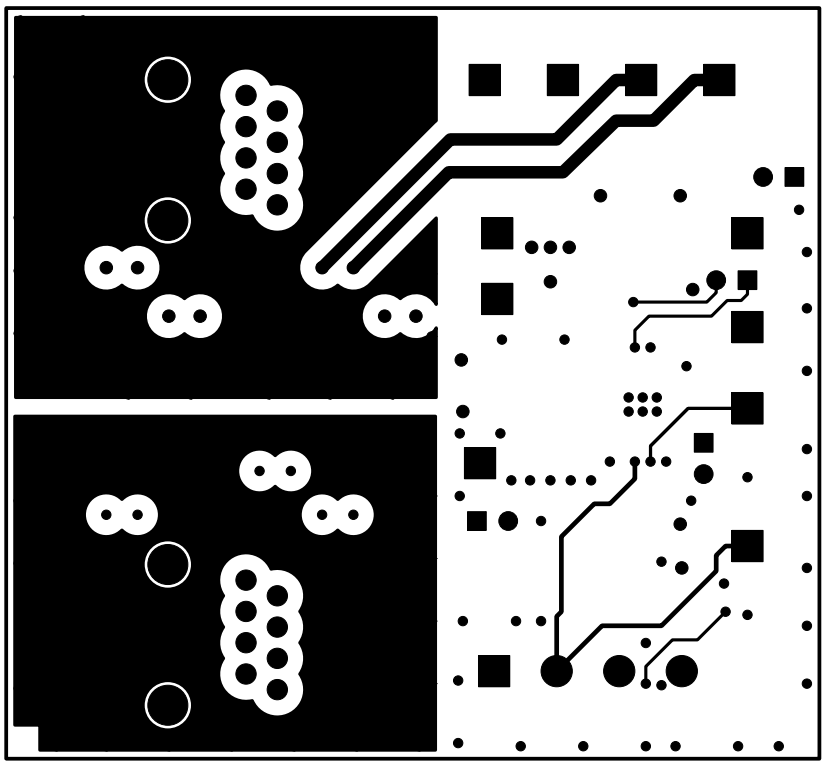


Figure 5. Layer Two Routing

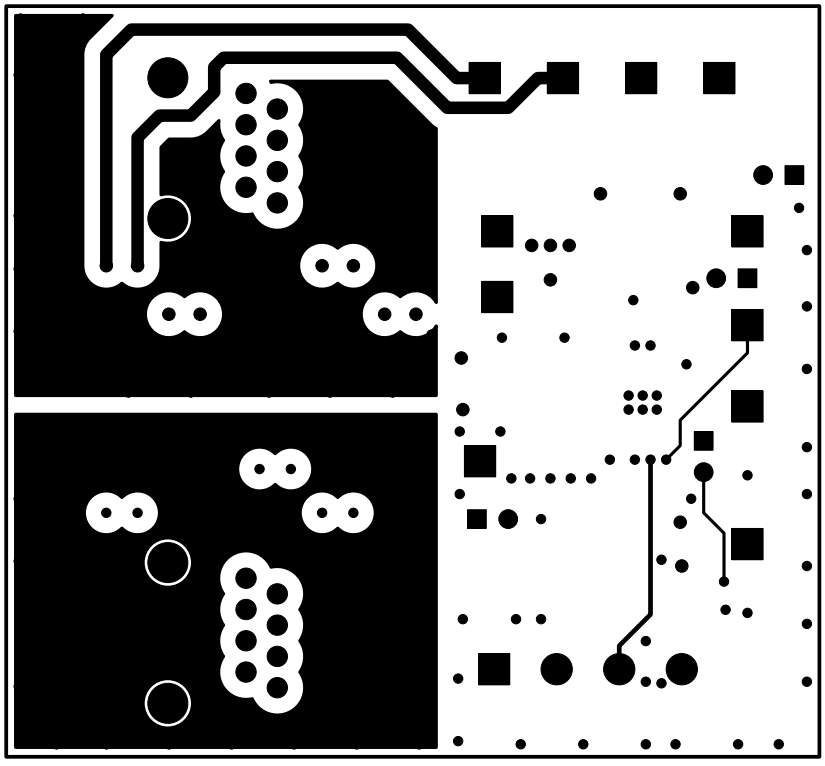


Figure 6. Layer Three Routing

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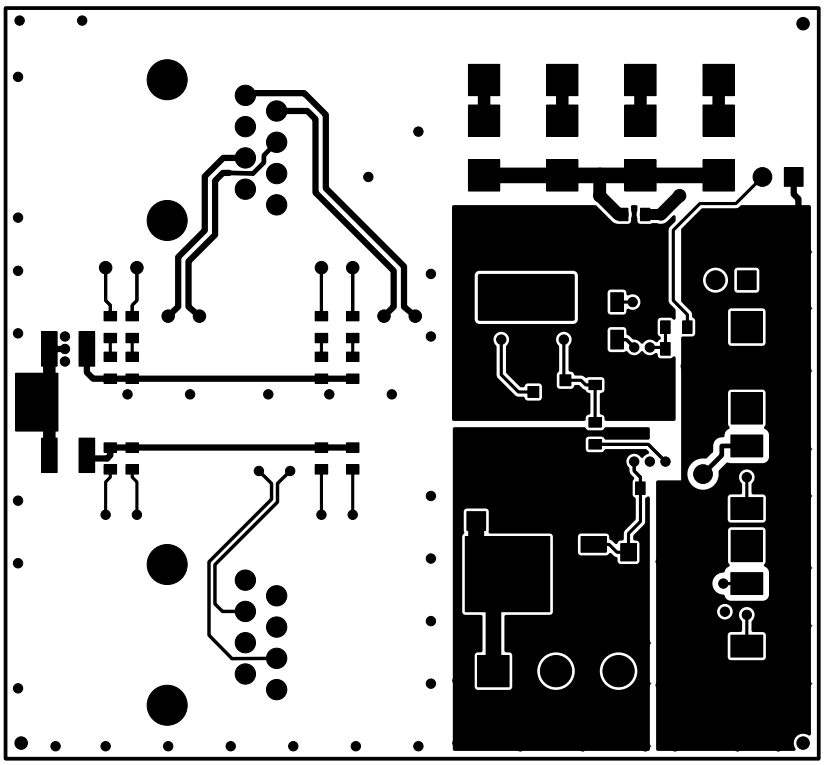


Figure 7. Bottom Side Routing

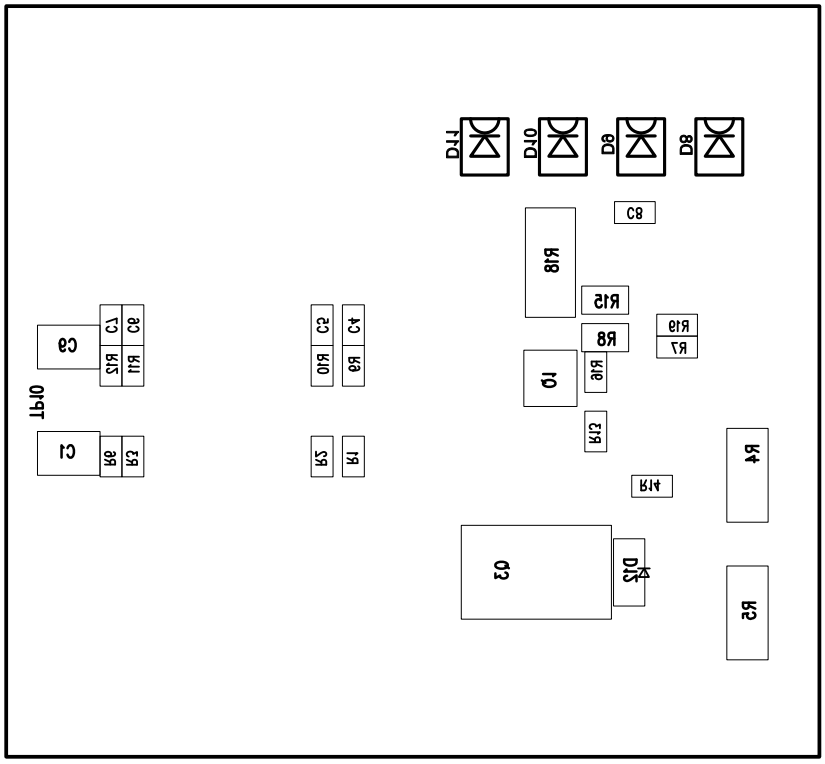


Figure 8. Bottom Side Placement

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6.2 Layout Guidelines

The layout of the PoE front end should follow power and EMI/ESD best practice guidelines. A basic set of recommendations include:

- Parts placement must be driven by power flow in a point-to-point manner; RJ-45, Ethernet transformer, diode bridges, TVS and 0.1-µF capacitor, and TPS2379.
- All leads should be as short as possible with wide power traces and paired signal and return.
- There should not be any crossovers of signals from one part of the flow to another.
- Spacing consistent with safety standards like IEC60950 must be observed between the 48-V input voltage rails and between the input and an isolated converter output.
- The TPS2379 should be located over split, local ground planes referenced to VSS for the PoE input and to RTN for the switched output.
- Large copper fills and traces should be used on SMT power-dissipating devices, and wide traces or overlay copper fills should be used in the power path.

6.3 EMI Containment

- Use compact loops for dv/dt and di/dt circuit paths (power loops and gate drives)
- Use minimal, yet thermally adequate, copper areas for heat sinking of components tied to switching nodes (minimize exposed radiating surface).
- Use copper ground planes (possible stitching) and top layer copper floods (surround circuitry with ground floods)
- Use 4 layer PCB if economically feasible (for better grounding)
- Minimize the amount of copper area associated with input traces (to minimize radiated pickup)
- Use Bob Smith terminations, Bob Smith EFT capacitor, and Bob Smith plane
- Use Bob Smith plane as ground shield on input side of PCB (creating a phantom or literal earth ground)
- Use of ferrite beads on input (allow for possible use of beads or 0 ohm resistors)
- Maintain physical separation between input-related circuitry and power circuitry (use ferrite beads as boundary line)
- Possible use of common-mode inductors
- Possible use of integrated RJ-45 jacks (shielded with internal transformer and Bob Smith terminations)
- End-product enclosure considerations (shielding)

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7 Bill of Materials

Table 5. TPS2379EVM Bill of Materials

Count	Ref Des	Value	Description	Size	Part Number	Supplier
2	FB1-2	500	Bead, Ferrite, 2000mA, 60m-ohm	1206	MI1206L501R-10	Steward
4	C4-7	0.01uF	Capacitor, Ceramic, 100V, X7R, 10%	603	STD	STD
1	C8	1000pF	Capacitor, Ceramic, 100V, X7R, 10%	603	STD	STD
1	C2	0.1uF	Capacitor, Ceramic, 100V, X7R, 10%	805	STD	STD
2	C1 C9	1000pF	Capacitor, Ceramic, 2kV, X7R, 15%	1210	Std	STD
1	C3	47uF	Capacitor, Aluminum, 63V, ±20%	0.328 x 0.390 inch	EEE-FK1J470P	Panasonic
2	J1-2	5520252-4	Connector, Jack, Modular, 8 POS	0.705 x 0.820 inch	5520252-4	AMP
1	D12	BZT52C18V	Diode, Zener, Planar Power, 500mW, 18V	SOD-123	BZT52C18-7-F	Diodes, Inc
1	D1	LN1271RAL	Diode, LED, Ultra Bright Red, 10-mA, 5-mcd	0.114 X 0.049 inch	LN1271RAL	Panasonic
1	D2	LN1371G	Diode, LED, Green, 10-mA, 2.6-mcd	0.114 X 0.049 inch	LN1371G	Panasonic
8	D3-6 D8-11	B2100	Diode, Schottky, 2-A, 100-V	SMB	B2100-13-F	Diodes, Inc
1	D7	SMAJ58A	Diode, TVS, 58-V, 1W	SMA	SMAJ58A-13-F	Diodes, Inc
4	J3 J5-7	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	R14	100k	Resistor, Chip, 1/16W, 1%	603	STD	STD
1	R16	200k	Resistor, Chip, 1/16W, 1%	603	STD	STD
2	R7 R19	24.9k	Resistor, Chip, 1/16W, 1%	603	STD	STD
1	R13	150	Resistor, Chip, 1/16W, 1%	603	STD	STD
8	R1-3 R6 R9-12	75	Resistor, Chip, 1/16W, 1%	603	STD	STD
1	R8	63.4	Resistor, Chip, 1/10W, 1%	805	STD	STD
1	R15	158	Resistor, Chip, 1/10W, 1%	805	STD	STD
2	R4-5	12.1k	Resistor, Chip, 0.6W, 1%	2010	STD	STD
1	R17	0.27	Resistor, Chip, 1W, 1%	2512	STD	STD
0	R18	0.27	Resistor, Chip, 1W, 1%	2512	STD	STD
1	J4	ED120/4DS	Terminal Block, 4-pin, 15-A, 5.1mm	0.80 x 0.35 inch	ED120/4DS	OST
3	TP1 TP3 TP5	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone
3	TP9 TP11-12	5011	Test Point, Black, Thru Hole	0.125 x 0.125 inch	5011	Keystone
3	TP2 TP6 TP8	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
2	TP4 TP7	5013	Test Point, Orange, Thru Hole	0.125 x 0.125 inch	5013	Keystone
1	U1	TPS2379DDA	IC, IEEE 802.3at PoE High Power PD Controller	TPS2379DDA	TPS2379DDA	TI
1	TP10	5016	Test Point, SM, 0.150 x 0.090	0.185 x 0.135 inch	5016	Keystone
1	Q1	FMMT493TC	Trans, NPN Midium Power, 100V 1A	SOT-23	FMMT493TC	Diodes
1	Q2	BUK7275	MOSFET, N-ch, 100-V, 22-A, 75 milliohm	DPAK	BUK7275	NXP

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Table 5. TPS2379EVM Bill of Materials (continued)

Count	Ref Des	Value	Description	Size	Part Number	Supplier
1	Q3	IRFR3410	MOSFET, N-ch, 100-V, 31-A, 39 milliohm	DPAK	IRFR3410TRLPBF	IRF
2	T1-2	ETH1-230LD	Transformer, High-Power PoE Magnetics	S0 14 Wide	ETH1-230LD	Coilcraft
1			Shunt, Black	100-mil	929950-00	3M
1	—		PCB, 3.5 In x 1.7 In x 0.062 In		PWR106	Any

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Revision History

Changes from Original (March 2012) to A Revision **Page**

- Changed the Description From: 37.4Ω (68mA) class signature resistance. To: 45.2Ω (55mA) class signature resistance 3
- Changed R15 From 90.9 to 158 in Figure 1 4
- Changed the description of Jumper J7 in Table 4 From: ~37.4Ω (68mA) To: ~45.2Ω (55mA) 5
- Changed the value of R15 in the Bill of Materials table From: 90.9 To 158 11

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: For EVMs including a radio, the radio included in such EVMs is intended for development and/or professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability in such EVMs and their development application(s) must comply with local laws governing radio spectrum allocation and power limits for such EVMs. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by TI unless user has obtained appropriate experimental and/or development licenses from local regulatory authorities, which is the sole responsibility of the user, including its acceptable authorization.

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Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at its own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Compliance (English)

For EVMs Annotated as IC – INDUSTRY CANADA Compliant:

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs Including Radio Transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs Including Detachable Antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Canada Industry Canada Compliance (French)

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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Important Notice for Users of EVMs Considered "Radio Frequency Products" in Japan

EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If user uses EVMs in Japan, user is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after user obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after user obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless user gives the same notice above to the transferee. Please note that if user does not follow the instructions above, user will be subject to penalties of Radio Law of Japan.

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