TPS2378EVM-602 Evaluation Module

This user's guide describes the TPS2378 evaluation module (TPS2378EVM-602). TPS2378EVM-602 contains evaluation and reference circuitry for a forced four-pair UPOE compliant application.

Contents

List of Figures

List of Tables

Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The TPS2378EVM-602 allows reference circuitry evaluation of a dual TPS2378 forced four pair UPOE compliant application. It contains input and output power connectors and an array of onboard test points for circuit and evaluation.

1.1 Features

- Excellent efficiency, driven, synchronous flyback design.
- Forced four-pair UPOE compliant
- 19 V at 2.3 A DC output (2.9-A capable)

1.2 Applications

- Universal power over ethernet (UPOE) compliant devices
- Video and VoIP telephones
- Multiband access points
- Security cameras
- Pico-base stations

2 Electrical Specifications

Table 1. TPS2378EVM-602 Electrical and Performance Specifications at 25°C

Parameter	Condition		MIN	TYP	MAX	Unit
Power Interface						
Input Voltage	Applied to the power pins of connectors J1 or J3		42.5		57	V
Operating Voltage(1)	After start up.		30		57	
Input UVLO, POE input J1(1)	Rising input voltage				40	
	Falling input voltage		30			
Detection voltage(1)	at device terminals		1.4		10.1	
Classification voltage(1)	at device terminals		11.9		23.0	
Classification current(1)	R_{class} = 63.4 Ω		38		42	mA
Inrush current-limit(1)			100		180	
Operating current-limit(1)			850		1200	
DC/DC Converter						
Output Voltage	42.5 ≤ V_{IN} ≤ 57 V, I_{LOAD} ≤ I_{LOAD} (max)	19-V output	19.01	19.04	19.07	V
Output Current	42.5 ≤ V_{IN} ≤ 57 V	19-V output			2.9	A
Output ripple voltage, pk-to-pk	V_{IN} = 48 V, I_{LOAD} = 2.9 A	19-V output		225		mV
Efficiency, dc-dc converter	V_{IN} = 48 V, I_{LOAD} = 2.9 A			93%		
Efficiency, end- to-end	V_{IN} = 48 V, I_{LOAD} = 2.9 A	19-V output		90%		
Switching frequency			225		270	kHz

(1) Per TPS2378 PD

3 Description

TPS2378EVM-602 enables full evaluation of a forced four pair UPOE compliant application. A detailed discussion regarding this type of high power PoE can be found in SLVA625.

The TPS23861EVM-612 contains two high power ports in which either one can be connected to the TPS2378EVM-602 with a CAT5E cable to power the EVM. This is described in Section 5.2.

4 Schematic

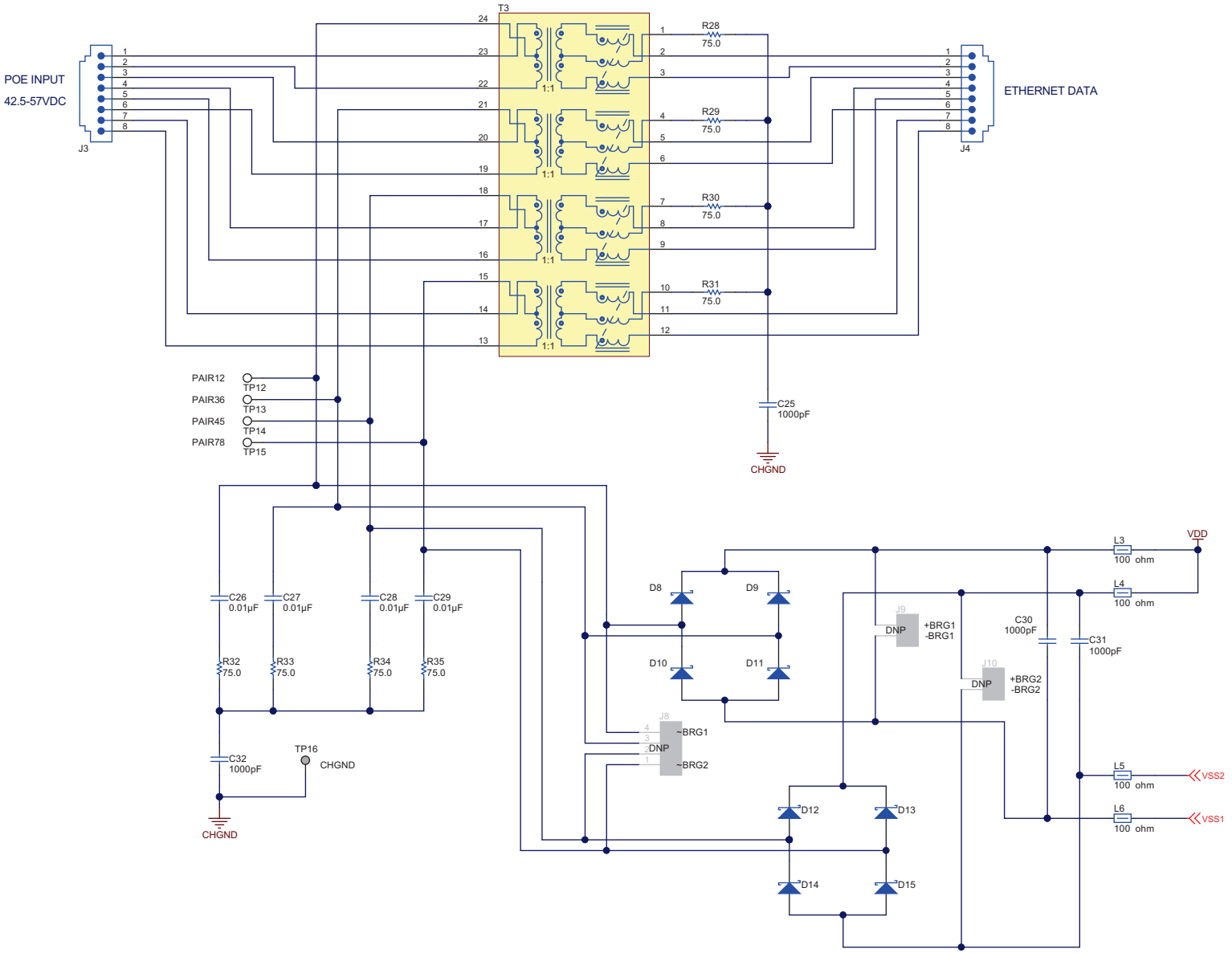

Figure 1. TPS2378EVM-602 PD Front-End Schematic

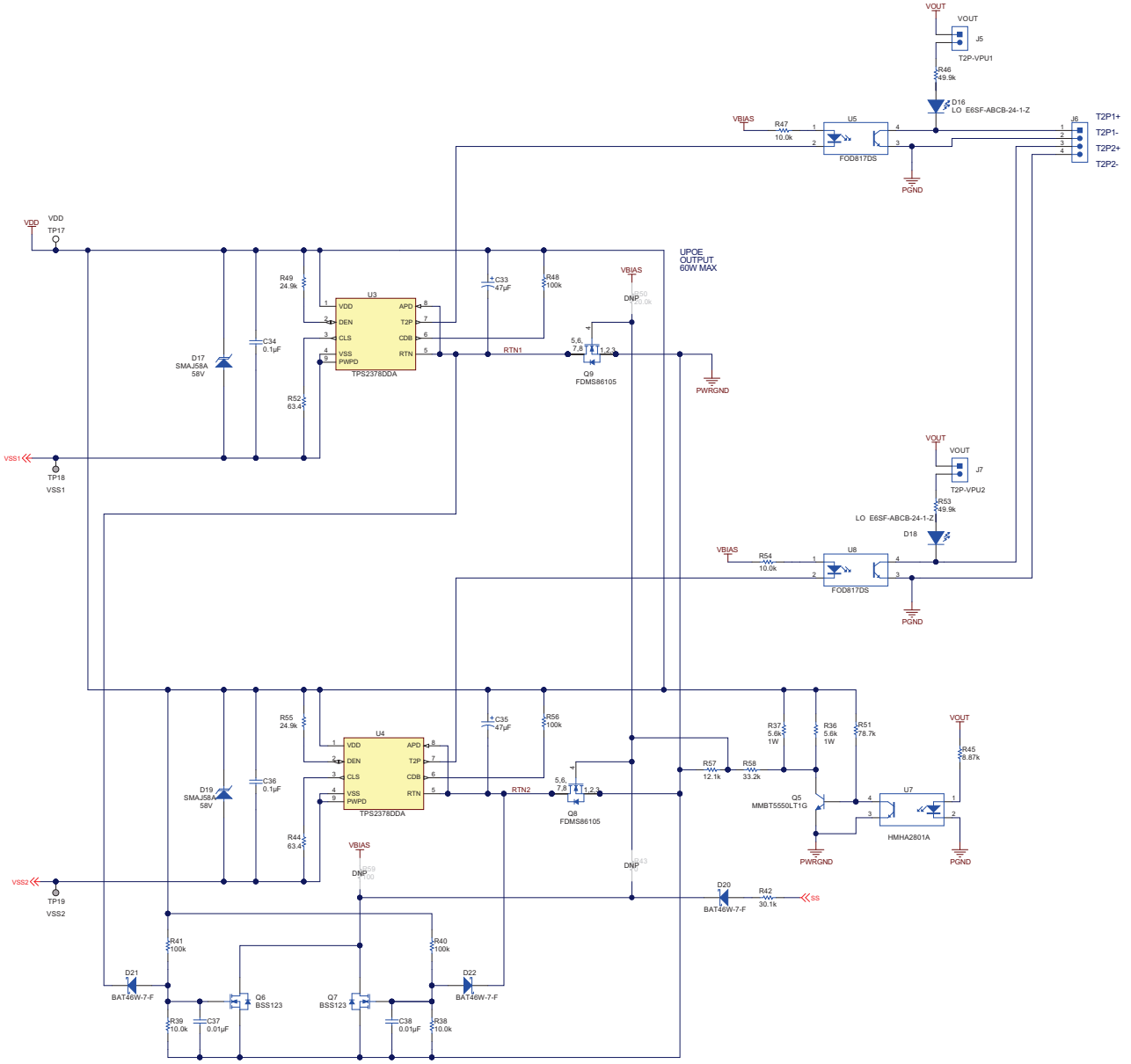

Figure 2. TPS2378EVM-602 Dual PD section

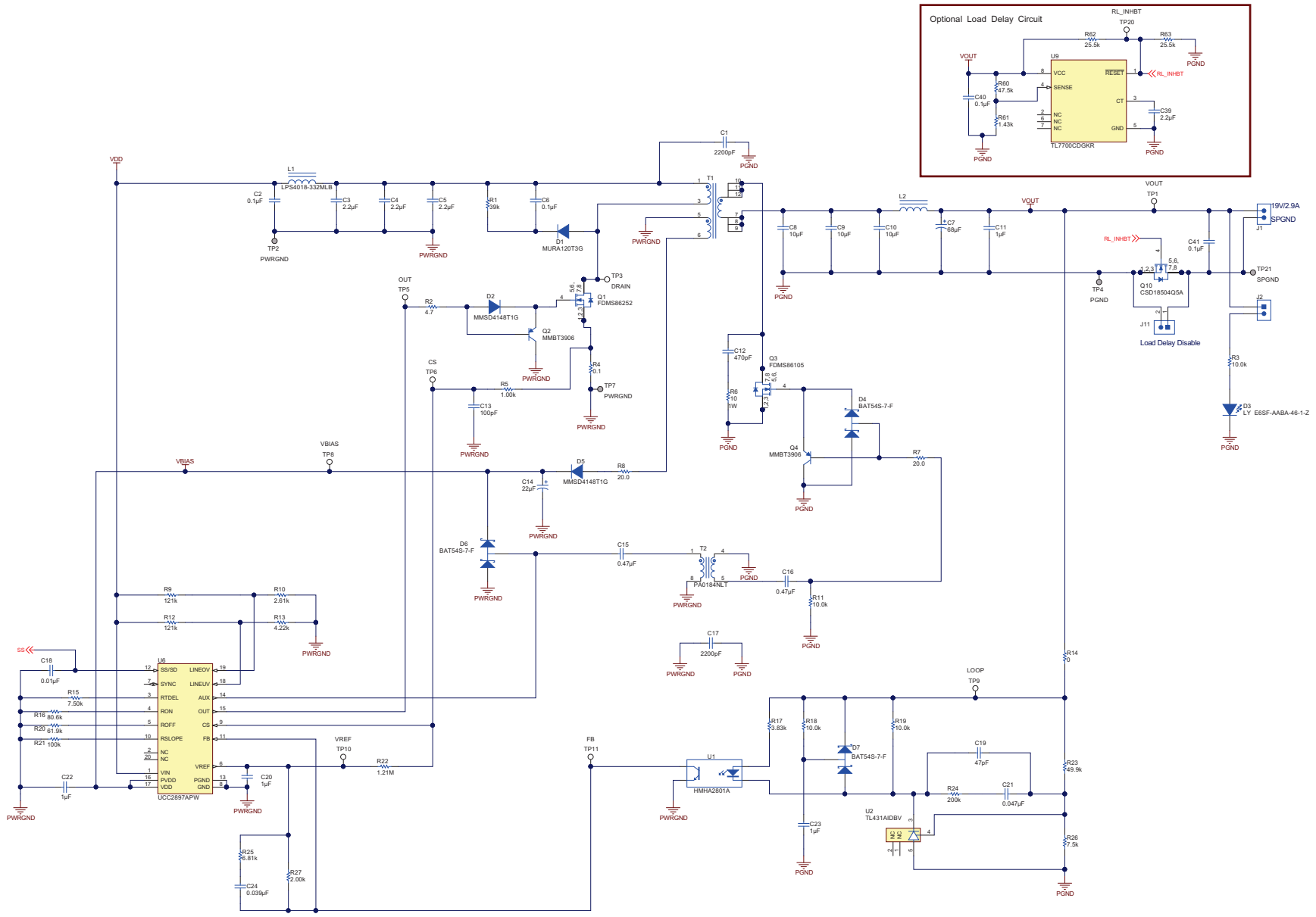

Figure 3. TPS2378EVM-602 DCDC Converter Section

5 General Configuration and Description

5.1 Physical Access

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

Table 2. Connector Functionality

Connector	Label	Description
J1	VOUT	19-V output voltage of the DCDC converter
J2		LED output ON signal
J3	PWR+DATA	PoE input. Connect to PSE power and data source.
J4	DATA	Ethernet data passthrough. Connect to downstream Ethernet device
J5	T2P-VPU1	T2P Pull up voltage of PD1
J6	T2P	T2P output signals for both TPS2378 PDs
J7	T2P-VPU2	T2P Pull up voltage of PD2
J11	Load Delay Disable	Disables load delay

Table 3. Test Points

Test Points	Label	Description
TP1	Output	Output voltage
TP2, TP7	PWRGND	Primary Ground
TP3	DRAIN	Primary FET drain voltage
TP4	PGND	Secondary Ground
TP5	OUT	Primary FET gate voltage
TP6	CS	Current sense voltage
TP8	VBIAS	Aux bias voltage
TP9	LOOP	AC Injector point for measuring loop response
TP10	VREF	Reference voltage
TP11	FB	Opto Feedback voltage
TP12	PAIR12	Voltage on pairs 1 and 2 of the Ethernet cable
TP13	PAIR36	Voltage on pairs 3 and 6 of the Ethernet cable
TP14	PAIR45	Voltage on pairs 4 and 5 of the Ethernet cable
TP15	PAIR78	Voltage on pairs 7 and 8 of the Ethernet cable
TP16	CHGND	Chassis ground
TP17	VDD	Chassis ground
TP18	VSS1	VSS1 pin of PD1
TP19	VSS2	VSS2 pin of PD2
TP20	RL_INHBT	Gate voltage of load delay FET
TP21	SPGND	Load ground

5.2 Test Setup

Figure 4 shows the typical test set for the TPS2378EVM-602 using the TPS23861EVM-612.

1. Power the TPS23861EVM-612 as described in SLUUAY8.
2. Connect J3 of the TPS2378EVM-602 to J9 or J21 of the TPS23861EVM-612 using a standard CAT5E cable.
3. Vary the load as necessary for test purposes.

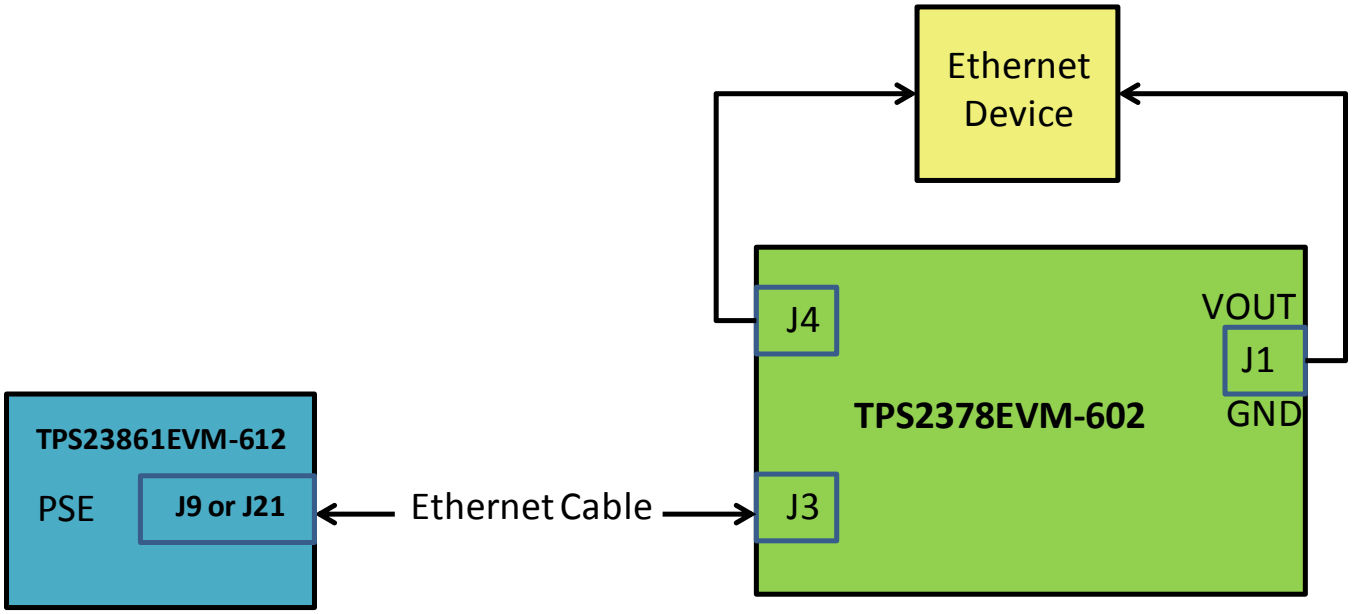

Figure 4. Typical TPS2378EVM-602 Test Setup

5.2.1 Testing the TPS2378EVM-602 without a PSE

The TPS2378EVM-602 can be evaluated without a PSE and only a power supply.

1. Set the power supply between 42.5 V – 57 V Turn off the power supply
2. Short TP15 to TP13
3. Short TP14 to TP12
4. Connect the positive lead of the power supply to TP15
5. Connect the return lead of the power supply to TP14
6. Turn on the power supply
7. Vary the input voltage and output load as necessary for test purposes

6 TPS2378EVM-602 Performance Data

6.1 Startup

Figure 5 illustrates the startup response of the TPS2378EVM-602 (Ch2-VOUT) with 26-W output load. Ch1 and Ch4 show the input current of each TPS2378 PD when the TPS23861EVM-612 is connected to the EVM. It shows Type 2 hardware classification and subsequent inrush before starting up and sharing current.

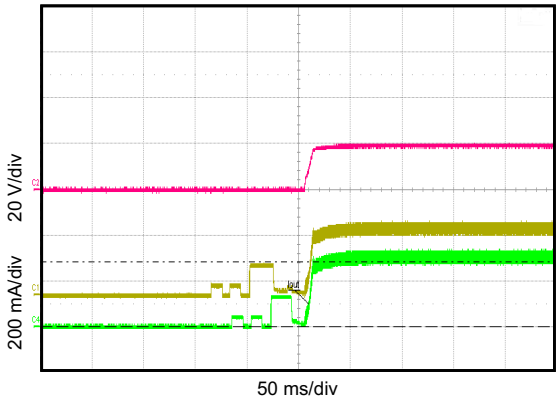

Figure 5. Startup Response to 26-W Load for a 48-V Input

6.2 Transient Response

Figure 6 illustrates the transient response of the TPS2378EVM-602.

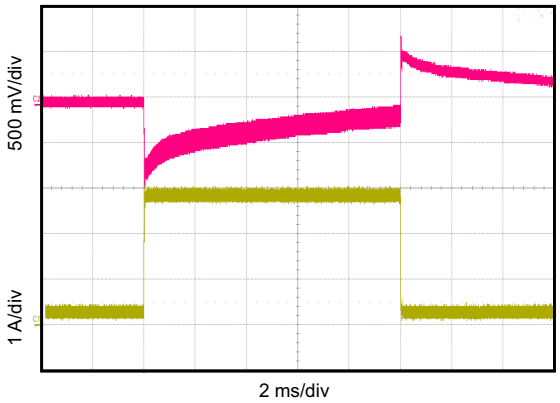

Figure 6. Transient Response from 290 mA to 2.9 A for a 48-V Input

6.3 Efficiency

Figure 7 illustrates the efficiency of the TPS2378EVM-602.

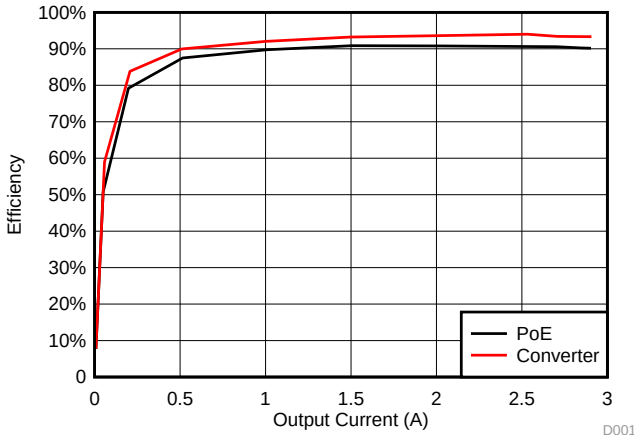

Figure 7. Efficiency of the TPS2378EVM-602

6.4 Startup to Resistive Overload with TPS23861EVM-612

The IEEE802.3at standard requires the PD to startup with less than 13 W (per pair) for 80 ms during PSE inrush. When using the TPS2378EVM-602 EVM with the TPS23861EVM-612 for evaluation while using resistive loads, the output load must be light enough (< 1 A) at startup to meet this requirement. When the output is operational, the load can be further increased to nominal 2.3A.

For startup to higher loads (> 1 A) the TPS2378EVM-602 contains an optional load delay circuit (shown in Figure 3) that delays connecting the resistive load while the PSE finishes inrush.

The load delay circuit is for evaluation only of the EVM using resistive loads. In final system PD designs, it is the load's task to accommodate the PSEs inrush time.

To disable the load delay circuit, shunt J11.

7 EVM Assembly Drawing and Layout Guidelines

7.1 PCB Drawings

Figure 8 to Figure 13 show component placement and layout of the TPS2378EVM-602.

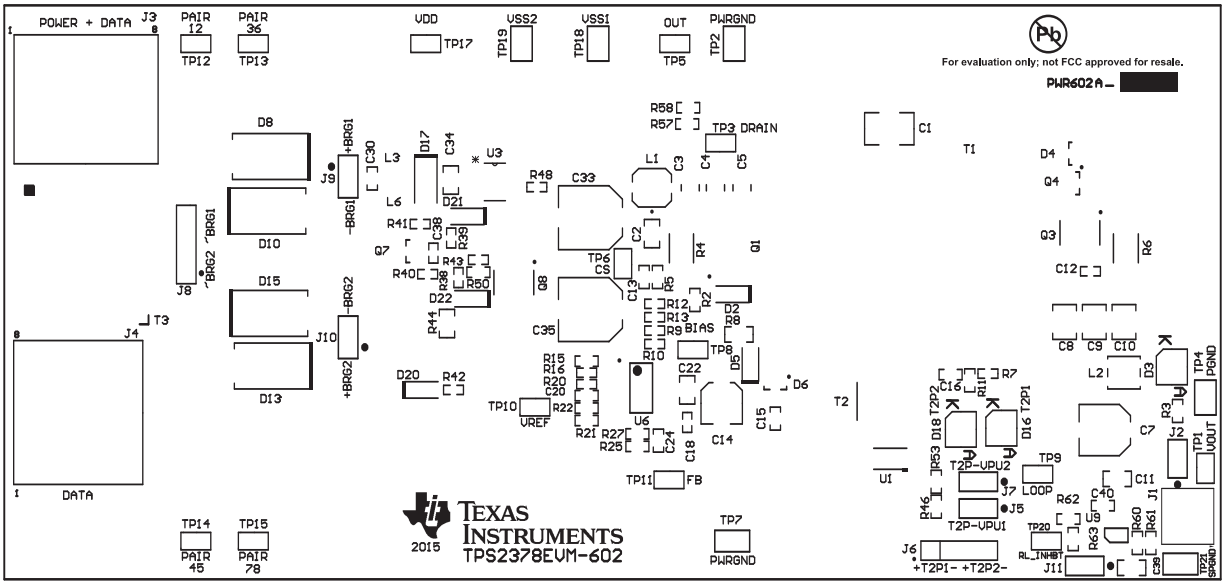

Figure 8. Top Side Component Placement

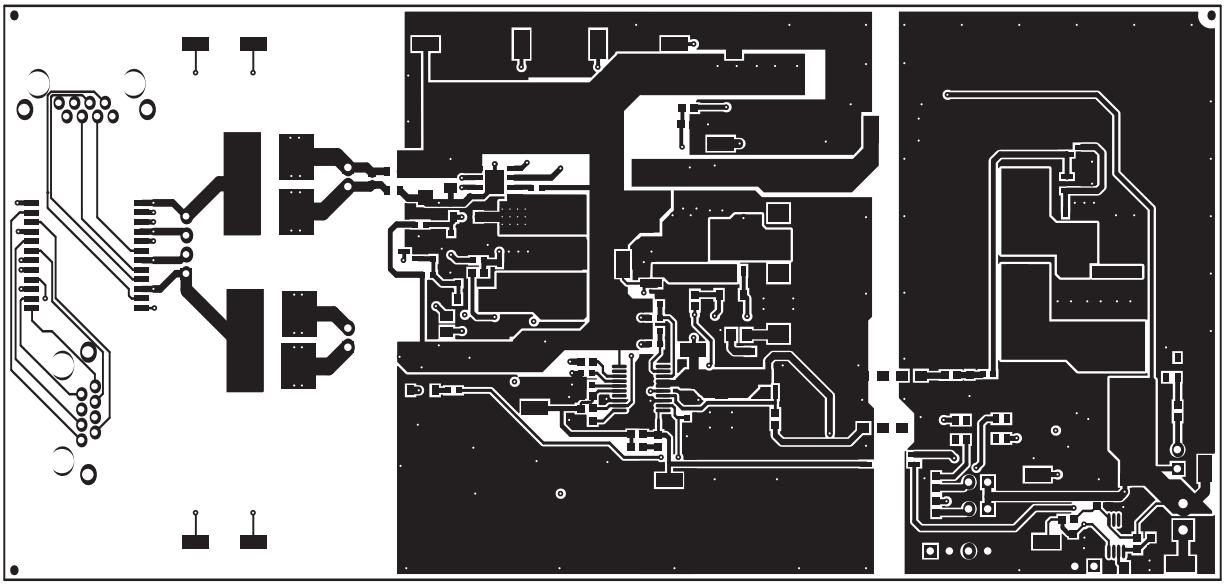

Figure 9. Top Side Routing

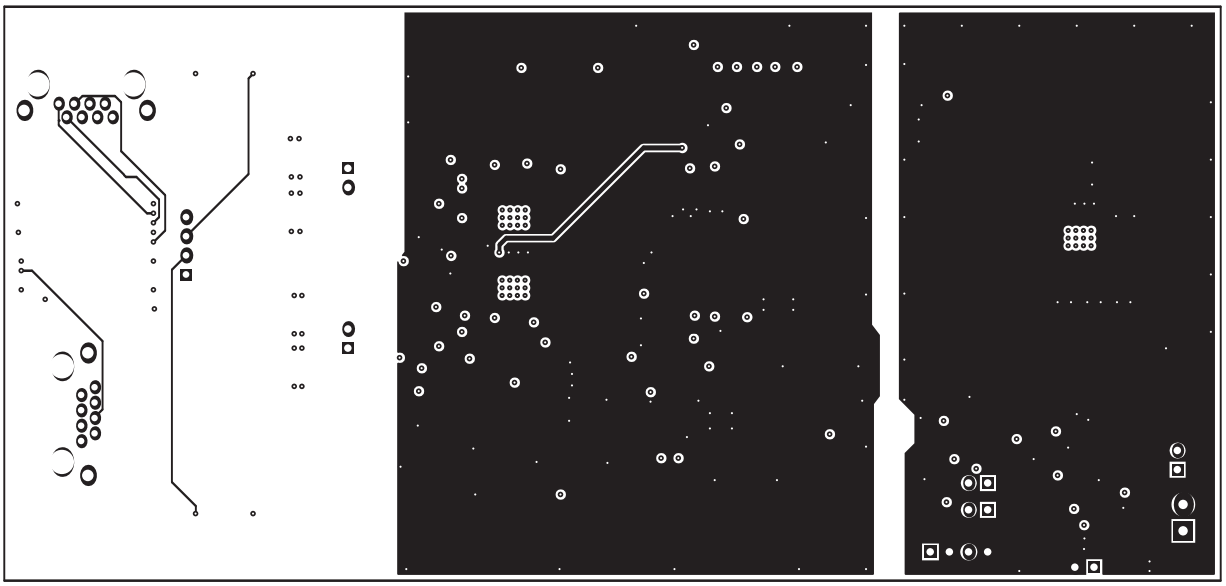

Figure 10. Layer 2 Routing

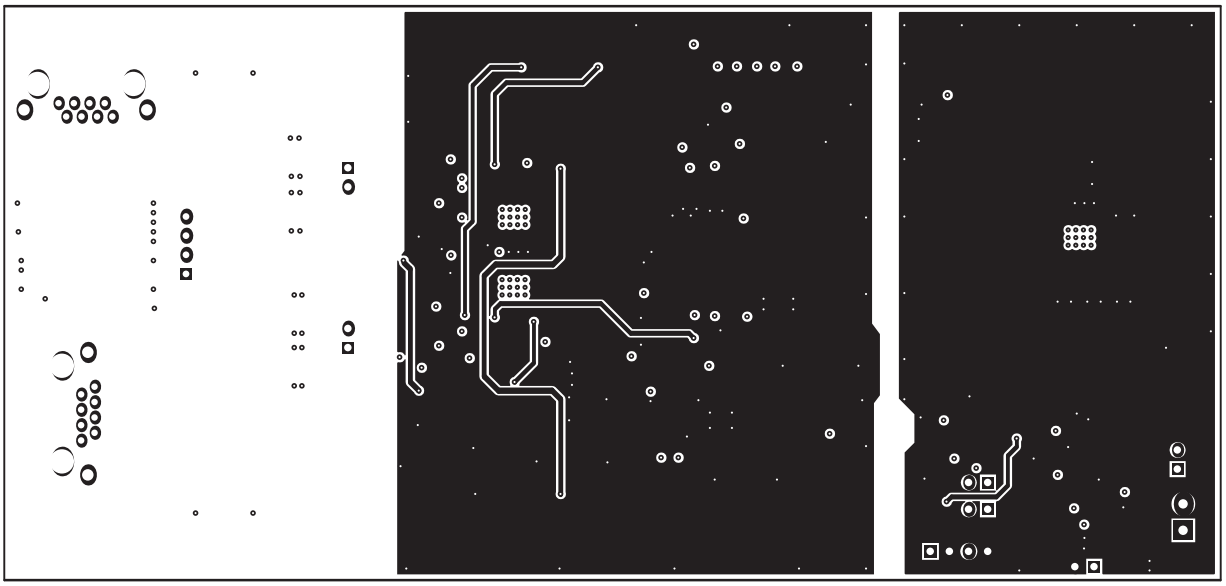

Figure 11. Layer 3 Routing

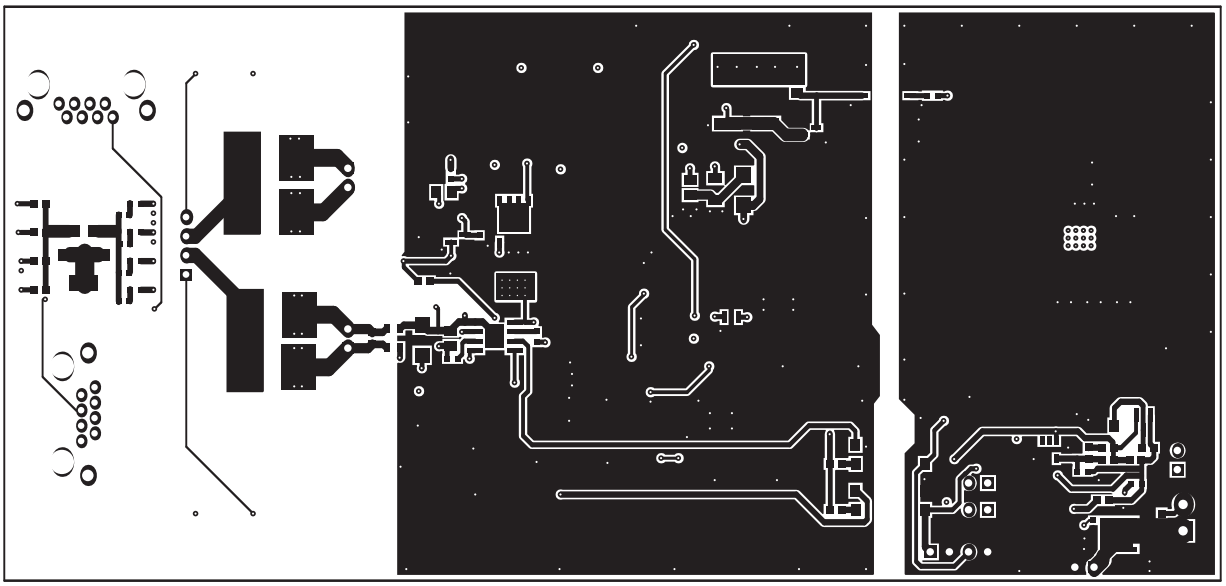

Figure 12. Bottom Side Routing

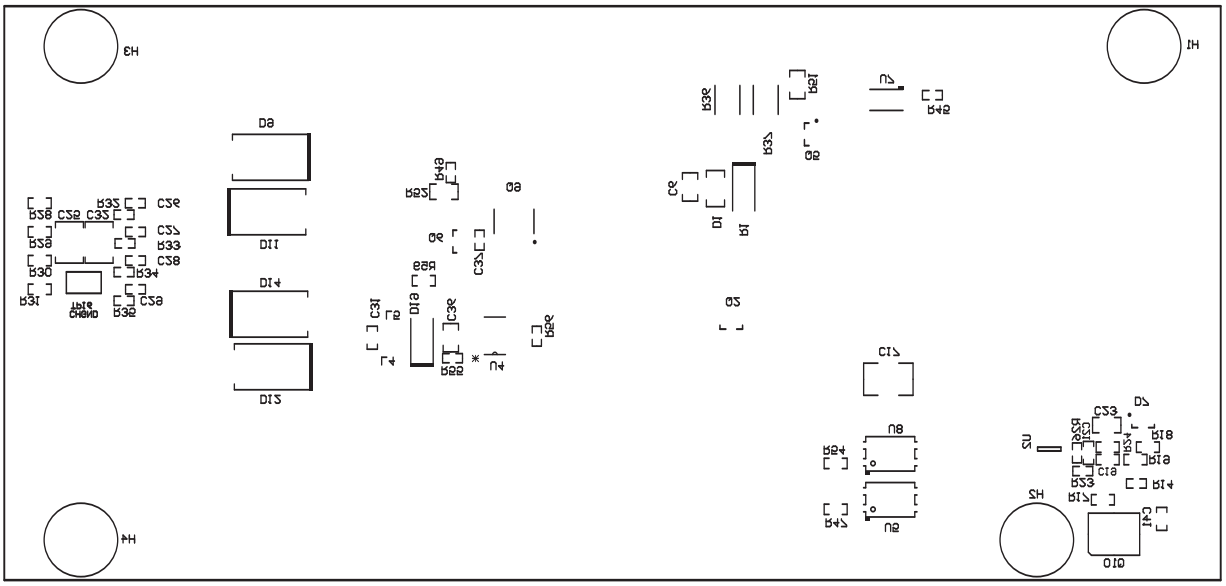

Figure 13. Bottom Component Placement

7.2 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 TPS2378 converter input bulk capacitor.
- Make all leads as short as possible with wide power traces and paired signal and return.
- No crossovers of signals from one part of the flow to another are allowed.
- 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.
- Place the TPS2378 over split, local ground planes referenced to VSS for the PoE input and to COM/RTN for the converter. Whereas the PoE side may operate without a ground plane, the converter side must have one. Do not place logic ground and power layers under the Ethernet input or the converter primary side.
- Use large copper fills and traces on SMT power-dissipating devices, and use wide traces or overlay copper fills in the power path.

The DC/DC Converter layout benefits from basic rules such as:

- Use large copper fills and traces on SMT power-dissipating devices, and use wide traces or overlay copper fills in the power path.
- Minimize trace length of high current, power semiconductors, and magnetic components.
- Where possible, use vertical pairing
- Use the ground plane for the switching currents carefully.
- Keep the high-current and high-voltage switching away from low-level sensing circuits including those outside the power supply.
- Proper spacing around the high-voltage sections of the converter

7.3 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 a 4-layer PCB, if economically feasible (for better grounding)
- Minimize the amount of copper area associated with input traces (to minimize radiated pickup)
- Hide copper associated with switching nodes under shielded magnetics, where possible
- Heat sink the quiet side of components instead of the switching side, where possible (like the output side of inductor)
- 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 LC filter at DC/DC input
- Dampen high-frequency ringing on all switching nodes, if present (allow for possible snubbers)
- Control rise times with gate-drive resistors and possibly snubbers
- Switching frequency considerations
- Use of EMI bridge capacitor across isolation boundary (isolated topologies)
- Observe the polarity dot on inductors (embed noisy end)
- Use of ferrite beads on input (allow for possible use of beads or 0-Ω resistors)
- Maintain physical separation between input-related circuitry and power circuitry (use ferrite beads as boundary line)
- Balance efficiency versus acceptable noise margin
- 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)
- countless

8 Bill of Materials

Table 4. TPS2378EVM-602 BOM

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C17	2	2200pF	CAP, CERM, 2200pF, 2000V, +/-10%, X7R, 1812	1812	C4532X7R3D222K	TDK
C2, C6, C34, C36	4	0.1uF	CAP, CERM, 0.1uF, 100V, +/-10%, X7R, 0805	0805	C0805C104K1RACTU	Kemet
C3	1		CAP, CERM, 2.2uF, 100V, +/-10%, X7R, 1210	1210	HMK325B7225KN-T	Taiyo Yuden
C4, C5	2	2.2uF	CAP, CERM, 2.2uF, 100V, +/-10%, X7R, 1210	1210	HMK325B7225KN-T	Taiyo Yuden
C7	1	68uF	CAP, AL, 68uF, 25V, +/-20%, 0.36 ohm, SMD	SMT Radial D	EEE-FK1E680P	Panasonic
C8, C9, C10	3	10uF	CAP, CERM, 10uF, 25V, +/-20%, X5R, 1210	1210	C3225X5R1E106K	TDK
C11, C22, C23	3	1uF	CAP, CERM, 1uF, 25V, +/-10%, X5R, 0805	0805	08053D105KAT2A	AVX
C12	1	470pF	CAP, CERM, 470pF, 100V, +/-5%, X7R, 0603	0603	06031C471JAT2A	AVX
C13	1	100pF	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0603	0603	C1608C0G1H101J	TDK
C14	1	22uF	CAP, AL, 22uF, 25V, +/-20%, 0.7 ohm, SMD	SMT Radial C	EEE-FK1E220R	Panasonic
C15, C16	2	0.47uF	CAP, CERM, 0.47uF, 16V, +/-10%, X7R, 0603	0603	C0603C474K4RACTU	Kemet
C18	1	0.01uF	CAP, CERM, 0.01uF, 50V, +/-5%, X7R, 0603	0603	C0603C103J5RACTU	Kemet
C19	1	47pF	CAP, CERM, 47pF, 50V, +/-5%, C0G/NP0, 0603	0603	06035A470JAT2A	AVX
C20	1	1uF	CAP, CERM, 1uF, 16V, +/-10%, X5R, 0603	0603	C0603C105K4PACTU	Kemet
C21	1	0.047uF	CAP, CERM, 0.047 µF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H473KA61D	Murata
C24	1	0.039uF	CAP, CERM, 0.039 µF, 25 V, +/- 10%, X7R, 0603	0603	06033C393KAT2A	AVX
C25, C32	2	1000pF	CAP, CERM, 1000pF, 2000V, +/-10%, X7R, 1210	1210	C1210C102KGRACTU	Kemet
C26, C27, C28, C29, C37, C38	6	0.01uF	CAP, CERM, 0.01uF, 100V, +/-10%, X7R, 0603	0603	06031C103KAT2A	AVX
C30, C31	2	1000pF	CAP, CERM, 1000pF, 100V, +/-10%, X7R, 0603	0603	06031C102KAT2A	AVX
C33, C35	2	47uF	CAP, AL, 47uF, 63V, +/-20%, 0.65 ohm, SMD	SMT Radial F	EEE-FK1J470P	Panasonic
C39	1	2.2uF	CAP, CERM, 2.2 µF, 50 V, +/- 10%, X5R, 0805	0805	C2012X5R1H225K125AB	TDK
C40, C41	2	0.1uF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603	06035C104KAT2A	AVX
D1	1	200V	Diode, Ultrafast, 200V, 1A, SMA	SMA	MURA120T3G	ON Semiconductor
D2, D5	2	100V	Diode, Switching, 100V, 0.2A, SOD-123	SOD-123	MMSD4148T1G	ON Semiconductor
D3	1	Yellow	LED, Yellow, SMD	Power TOPLED	LY E6SF-AABA-46-1-Z	OSRAM
D4, D6, D7	3	30V	Diode, Schottky, 30V, 0.2A, SOT-23	SOT-23	BAT54S-7-F	Diodes Inc.
D8, D9, D10, D11, D12, D13, D14, D15	8	100V	Diode, Schottky, 100V, 3A, SMC	SMC	B3100-13-F	Diodes Inc.
D16	1		LED, Orange, SMD	Power TOPLED	LO E6SF-ABCB-24-1-Z	OSRAM
D17, D19	2	58V	Diode, TVS, Uni, 58V, 400W, SMA	SMA	SMAJ58A	Diodes Inc.
D18	1	Orange	LED, Orange, SMD	Power TOPLED	LO E6SF-ABCB-24-1-Z	OSRAM
D20	1		Diode, Schottky, 100V, 0.15A, SOD-123	SOD-123	BAT46W-7-F	Diodes Inc.
D21, D22	2	100V	Diode, Schottky, 100V, 0.15A, SOD-123	SOD-123	BAT46W-7-F	Diodes Inc.
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.375 X 0.235, Black	Black Bumpon	SJ61A2	3M

Table 4. TPS2378EVM-602 BOM (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
J1	1		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J2, J5, J7, J11	4		Header, 100mil, 2x1, Gold plated, TH	Header, 2x1, 100mil	5-146261-1	TE Connectivity
J3, J4	2		RJ-45, Right Angle, No LED, tab up	RJ-45 Jack	1-406541-1	AMP
J6	1		Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	4x1 Header	TSW-104-07-G-S	Samtec
L1	1	3.3uH	Inductor, Shielded Drum Core, Ferrite, 3.3uH, 1.9A, 0.08 ohm, SMD	LPS4018	LPS4018-332MLB	Coilcraft
L2	1	400nH	Inductor, Shielded, Composite, 400nH, 12.5A, 0.01 ohm, SMD	4x2.1x4mm	XAL4020-401MEB	Coilcraft
L3, L4, L5, L6	4	100 ohm	4A Ferrite Bead, 100 ohm @ 100MHz, SMD	0805	MPZ2012S101A	Murata
Q1	1	150V	MOSFET, N-CH, 150V, 4.6A, PQFN08A	PQFN08A	FDMS86252	Fairchild Semiconductor
Q2, Q4	2	0.25V	Transistor, PNP, 40V, 0.2A, SOT-23	SOT-23	MMBT3906	Fairchild Semiconductor
Q3, Q8, Q9	3	100V	MOSFET, N-CH, 100V, 26A, PowerPAK SO-8	PowerPAK SO-8	FDMS86105	Fairchild Semiconductor
Q5	1	0.25V	Transistor, NPN, 140V, 0.6A, SOT-23	SOT-23	MMBT5550LT1G	ON Semiconductor
Q6, Q7	2	100V	MOSFET, N-CH, 100V, 0.17A, SOT-23	SOT-23	BSS123	Fairchild Semiconductor
Q10	1	40V	MOSFET, N-CH, 40 V, 15 A, SON 5x6mm	SON 5x6mm	CSD18504Q5A	Texas Instruments
R1	1	39k	RES, 39k ohm, 5%, 0.25W, 1206	1206	CRCW120639K0JNEA	Vishay-Dale
R2	1	4.7	RES, 4.7 ohm, 5%, 0.1W, 0603	0603	CRCW06034R70JNEA	Vishay-Dale
R3, R47, R54	3	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R4	1	0.1	RES, 0.1, 1%, 2 W, 2512	2512	CSRN2512FKR100	Stackpole Electronics Inc
R5	1	1.00k	RES, 1.00k ohm, 1%, 0.1W, 0603	0603	CRCW06031K00FKEA	Vishay-Dale
R6	1	10	RES, 10 ohm, 5%, 1W, 2512	2512	ERJ-1TYJ100U	Panasonic
R7	1	20.0	RES, 20.0 ohm, 1%, 0.1W, 0603	0603	CRCW060320R0FKEA	Vishay-Dale
R8	1	20.0	RES, 20.0 ohm, 1%, 0.125W, 0805	0805	CRCW080520R0FKEA	Vishay-Dale
R9, R12	2	121k	RES, 121k ohm, 1%, 0.1W, 0603	0603	CRCW0603121KFKEA	Vishay-Dale
R10	1	2.61k	RES, 2.61k ohm, 1%, 0.1W, 0603	0603	CRCW06032K61FKEA	Vishay-Dale
R11, R18, R19, R38, R39	5	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R13	1	4.22k	RES, 4.22k ohm, 1%, 0.1W, 0603	0603	CRCW06034K22FKEA	Vishay-Dale
R14	1	0	RES, 0 ohm, 5%, 0.1W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R15	1	7.50k	RES, 7.50k ohm, 1%, 0.1W, 0603	0603	ERJ-3EKF7501V	Panasonic
R16	1	80.6k	RES, 80.6k ohm, 1%, 0.1W, 0603	0603	CRCW060380K6FKEA	Vishay-Dale
R17	1	3.83k	RES, 3.83k ohm, 1%, 0.1W, 0603	0603	CRCW06033K83FKEA	Vishay-Dale
R20	1	61.9k	RES, 61.9k ohm, 1%, 0.1W, 0603	0603	CRCW060361K9FKEA	Vishay-Dale
R21, R40, R41, R48, R56	5	100k	RES, 100k ohm, 1%, 0.1W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R22	1	1.21Meg	RES, 1.21 M, 1%, 0.1 W, 0603	0603	CRCW06031M21FKEA	Vishay-Dale
R23	1	49.9k	RES, 49.9k ohm, 1%, 0.1W, 0603	0603	CRCW060349K9FKEA	Vishay-Dale
R24	1	200k	RES, 200 k, 1%, 0.1 W, 0603	0603	CRCW0603200KFKEA	Vishay-Dale
R25	1	6.81k	RES, 6.81 k, 1%, 0.1 W, 0603	0603	CRCW06036K81FKEA	Vishay-Dale

Table 4. TPS2378EVM-602 BOM (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R26	1	7.5k	RES, 7.5k ohm, 5%, 0.1W, 0603	0603	CRCW06037K50JNEA	Vishay-Dale
R27	1	2.00k	RES, 2.00 k, 1%, 0.1 W, 0603	0603	CRCW06032K00FKEA	Vishay-Dale
R28, R29, R30, R31, R32, R33, R34, R35	8	75.0	RES, 75.0 ohm, 1%, 0.1W, 0603	0603	CRCW060375R0FKEA	Vishay-Dale
R36, R37	2	5.6k	RES, 5.6k ohm, 5%, 1W, 2512	2512	ERJ-1TYJ562U	Panasonic
R42	1	30.1k	RES, 30.1k ohm, 1%, 0.1W, 0603	0603	CRCW060330K1FKEA	Vishay-Dale
R44, R52	2	63.4	RES, 63.4 ohm, 1%, 0.125W, 0805	0805	CRCW080563R4FKEA	Vishay-Dale
R45	1	8.87k	RES, 8.87k ohm, 1%, 0.1W, 0603	0603	CRCW06038K87FKEA	Vishay-Dale
R46, R53	2	49.9k	RES, 49.9 k, 1%, 0.1 W, 0603	0603	CRCW060349K9FKEA	Vishay-Dale
R49, R55	2	24.9k	RES, 24.9k ohm, 1%, 0.1W, 0603	0603	CRCW060324K9FKEA	Vishay-Dale
R51	1	78.7k	RES, 78.7k ohm, 1%, 0.125W, 0805	0805	ERJ-6ENF7872V	Panasonic
R57	1	12.1k	RES, 12.1 k, 1%, 0.1 W, 0603	0603	CRCW060312K1FKEA	Vishay-Dale
R58	1	33.2k	RES, 33.2 k, 1%, 0.1 W, 0603	0603	CRCW060333K2FKEA	Vishay-Dale
R60	1	47.5k	RES, 47.5 k, 1%, 0.1 W, 0603	0603	CRCW060347K5FKEA	Vishay-Dale
R61	1	1.43k	RES, 1.43 k, 1%, 0.1 W, 0603	0603	CRCW06031K43FKEA	Vishay-Dale
R62, R63	2	25.5k	RES, 25.5 k, 1%, 0.1 W, 0603	0603	CRCW060325K5FKEA	Vishay-Dale
SH-J1, SH-J2, SH-J3, SH-J4	4	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
T1	1	62uH	Transformer, 62uH, SMT	26.4x13.7x32mm	750315775	Wurth Elektronik
T2	1	1.2mH	Transformer, Gate Drive, 1.2mH, SMT	9.02x7.62x8.64mm	PA0184NLT	Pulse Engineering
T3	1	350uH	TRANSFORMER/CMC MOD, GIGABIT POE+, SMT	12.2X6.6X18.16 mm	H6096NL	Pulse Engineering
TP1, TP3, TP5, TP6, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP17, TP20	14	SMT	Test Point, Miniature, SMT	Testpoint_Keystone_Miniature	5015	Keystone
TP2, TP4, TP7, TP16, TP18, TP19	6		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1, U7	2		Optocoupler, 3.75kV RMS, SMT	Mini Flat Package	HMHA2801A	Fairchild Semiconductor
U2	1		PRECISION PROGRAMMABLE REFERENCE, DBV0005A	DBV0005A	TL431AIDBV	Texas Instruments
U3, U4	2		IEEE 802.3at PoE High-Power PD Interface, DDA0008E	DDA0008E	TPS2378DDA	Texas Instruments
U5, U8	2		Optocoupler, 5kV RMS, SMT	DIP-4L Gullwing	FOD817DS	Fairchild Semiconductor
U6	1		Advanced Active Clamp PWM Controller with Current Control, -40 to +125 degC, 20-pin TSSOP (PW), Green (RoHS & no Sb/Br)	PW0020A	UCC2897APW	Texas Instruments
U9	1		SUPPLY-VOLTAGE SUPERVISOR, DGK0008A	DGK0008A	TL7700CDGKR	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
J8	0		Receptacle, 100mil, 4x1, TH	4x1 Receptacle	76308-204LF	FCI
J9, J10	0		Receptacle 100mil 2x1, Tin, TH	Receptacle, 2x1, 100mil, Tin	PPTC021LFBN-RC	Sullins Connector Solutions
R43	0	0	RES, 0 ohm, 5%, 0.1W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale

Table 4. TPS2378EVM-602 BOM (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R50	0	20.0k	RES, 20.0k ohm, 1%, 0.1W, 0603	0603	CRCW060320K0FKEA	Vishay-Dale
R59	0	100	RES, 100, 1%, 0.1 W, 0603	0603	CRCW0603100RFKEA	Vishay-Dale

Revision History

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

Changes from Original (May 2015) to A Revision	Page
• Changed T1 transformer in the BOM from PA4036NL (Pulse Engineering), to 750315775 (Wurth Elektronik).	15

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

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

      FCC Interference Statement for Class A EVM devices

      NOTE: 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 his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: 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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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.

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.

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.

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿６丁目２４番１号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ('TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products http://www.ti.com/sc/docs/stdterms.htm), evaluation modules, and samples (http://www.ti.com/sc/docs/sampterms.htm).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265