TPS23750 PMP1360 12 V at 1 A PoE PD

PMP1360 is a high efficiency, isolated, non-synchronous flyback Power-over-Ethernet PD power-supply reference design intended to ease implementation of PoE in devices such as IP phones, WLAN AP's and security cameras. The reference design uses a TPS23750 PoE Powered Device Controller with integrated, current-mode DC/DC controller. The TPS23750 implements all necessary detection, classification, inrush current limiting and UVLO functions necessary to comply with the IEEE802.3af Power-over-Ethernet standard. The 48-V PoE input is converted to 12 V at 1 A at the output. This reference design is optimized for 86% efficiency in the smallest board area possible. The scheamtic diagram is shown in Figure 8.

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1 Performance

1.1 Efficiency

Efficiency was measured with the following loads and 48-V input at J2 and J4,

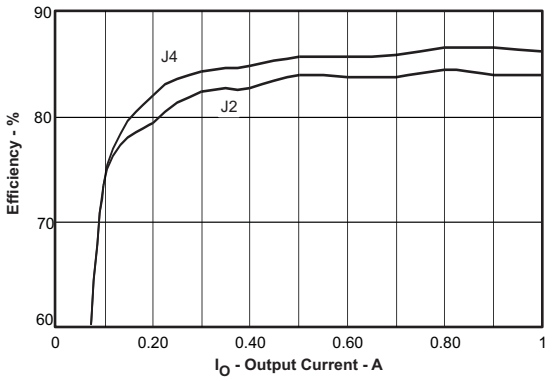

Figure 1. Efficiency

1.2 Turn On Response

The turn-on response with a 48-V input and 0-A load is shown in Figure 2.

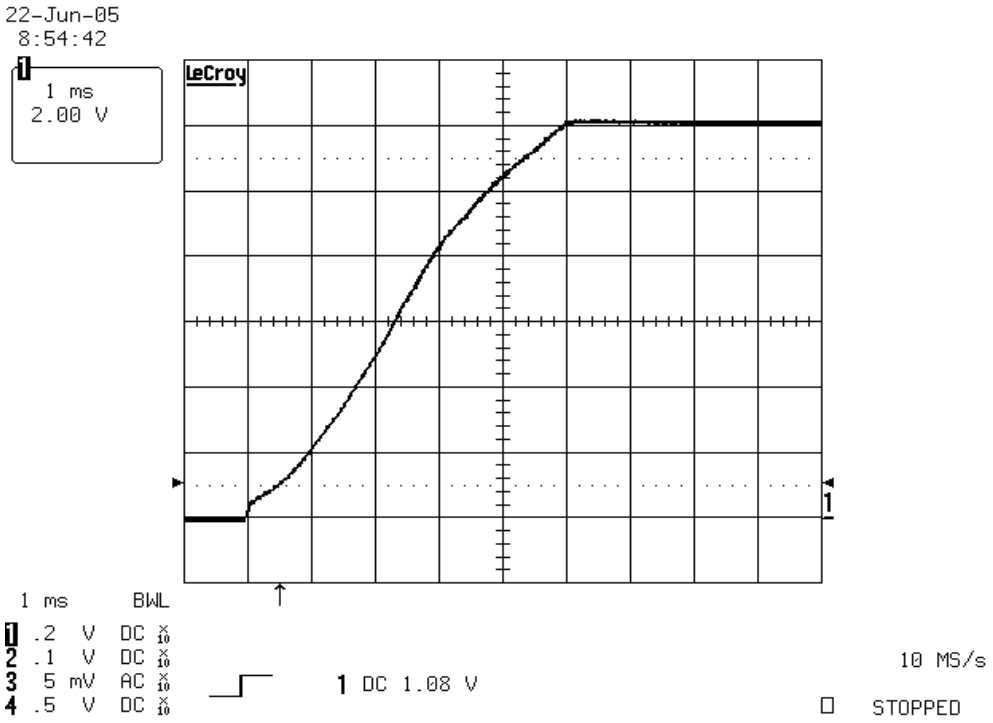

Figure 2. Turn-On Response, No Load

The turn-on response with a 48-V input and 1-A load is shown in Figure 3.

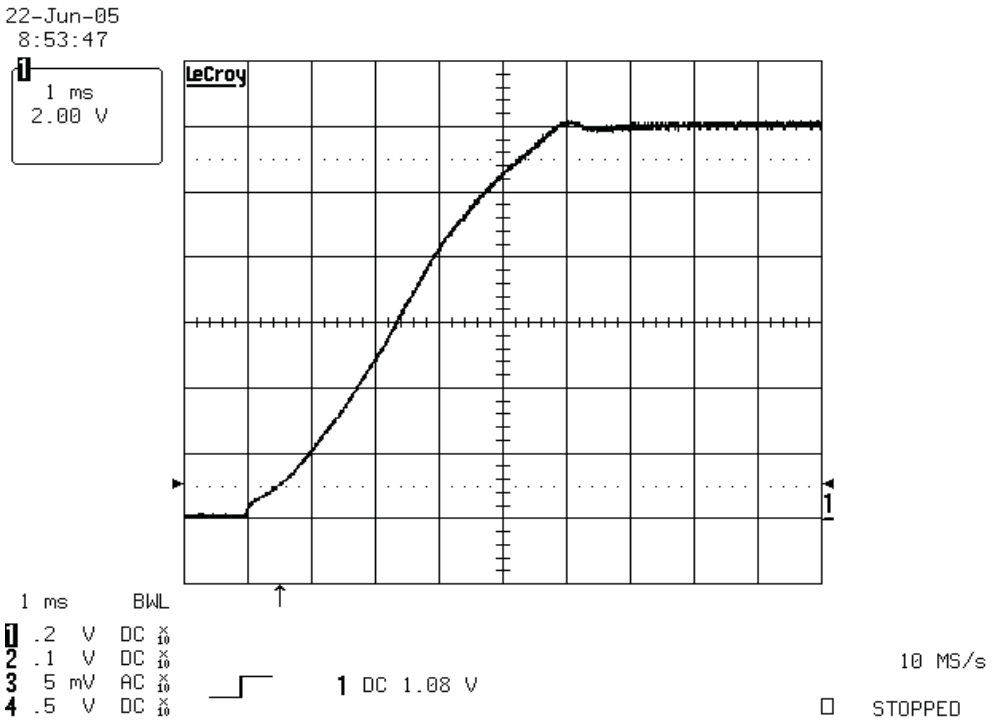

Figure 3. Turn-On Response, 1-A Load

1.3 Output Ripple and Noise

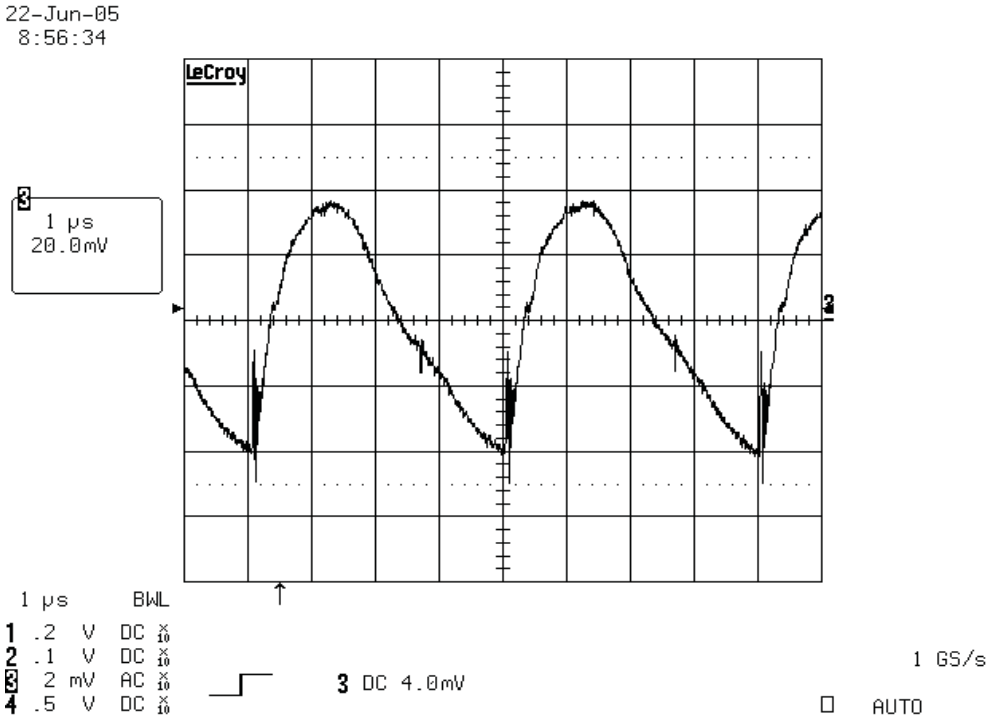

Figure 4. Output Ripple Voltage With 48-V Input and 1-A Load (across C10)

1.4 Input Ripple and Noise

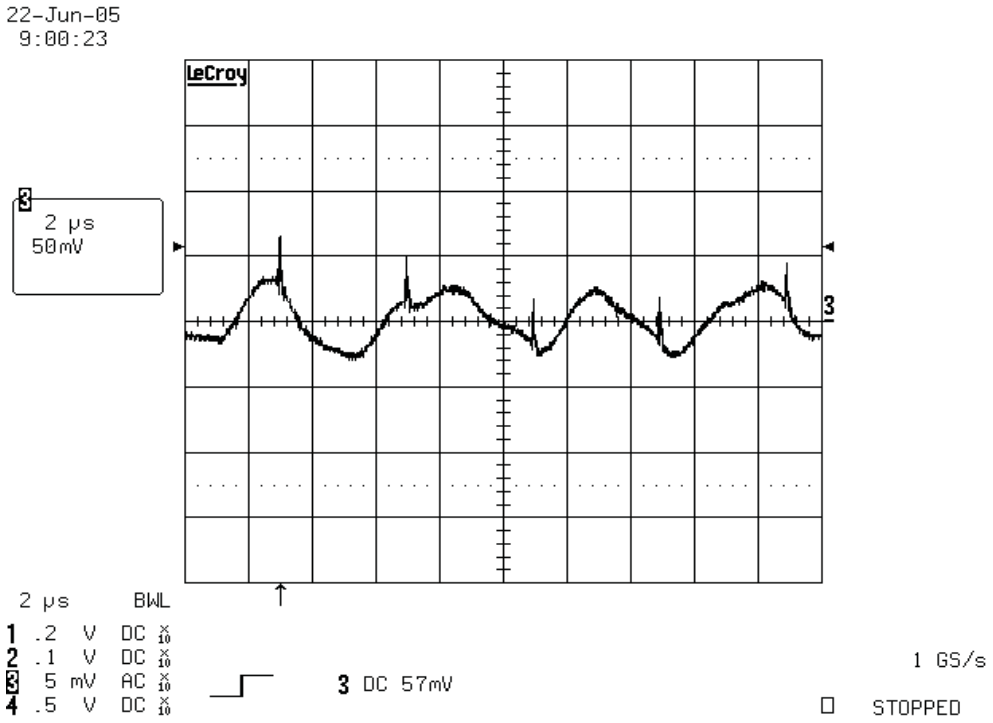

Figure 5. Input Ripple Voltage With 48-V Input and a 1-A Load (across J2-1 and 3)

1.5 Dynamic Loading

The output voltage transient response was measured with a load step from 50% to 100% and 100% to 50%.

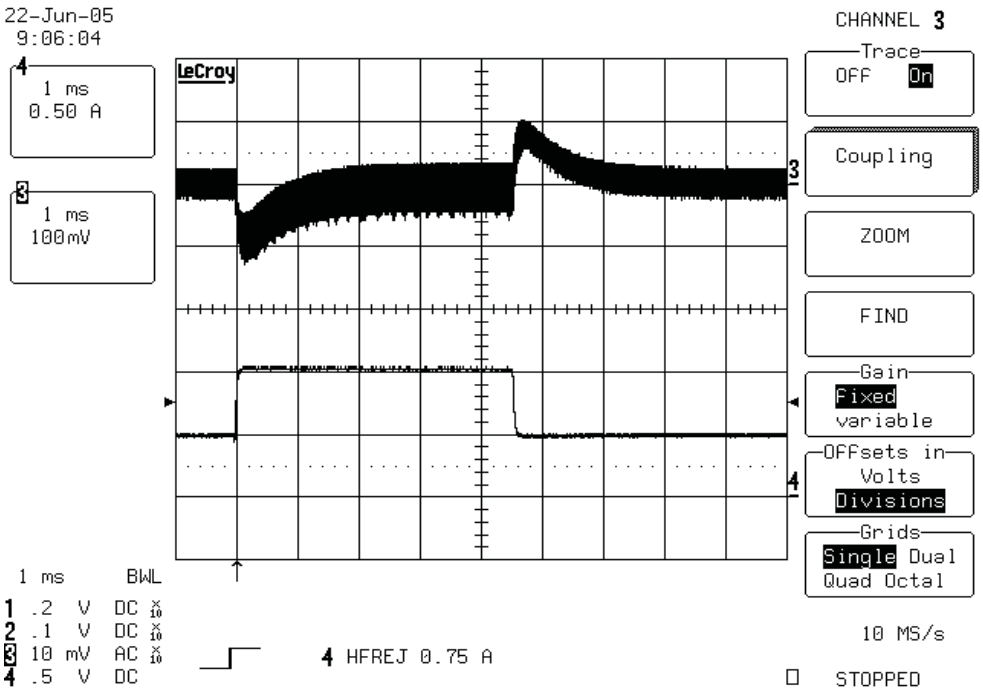

Figure 6. Output Voltage Transient Response

1.6 Stability Analysis (Loop Gain)

Figure 7 shows the loop gain of the converter. The bandwidth is 3 kHz, the phase margin is 90°, and the gain margin is 20 dB.

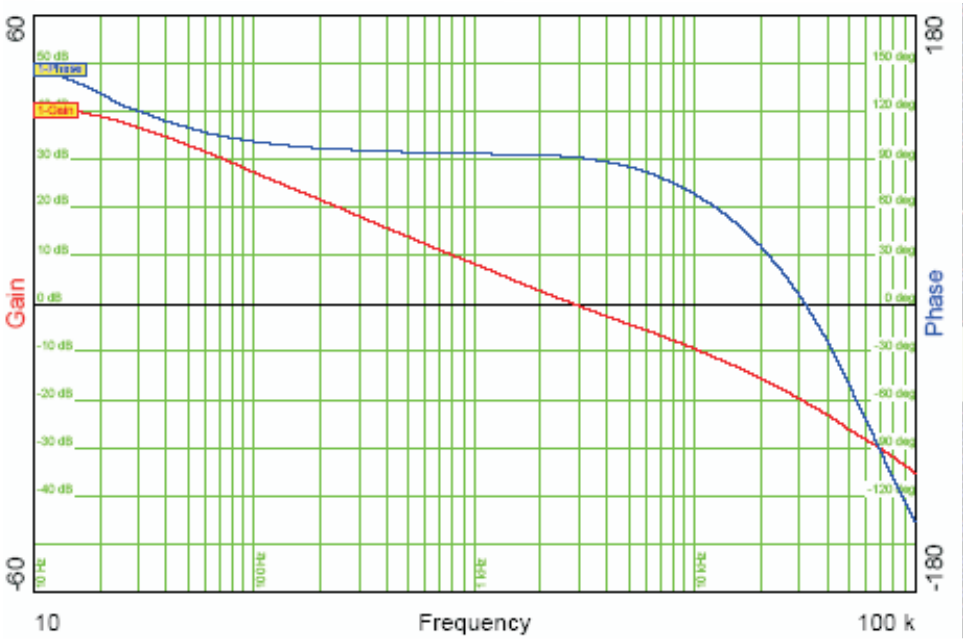

Figure 7. Loop Gain

2 Reference Design Schematic and Bill of Materials

Support Alternate A, Fetch power from center tap of transformers.

Support Alternate B Fetch power from 4/5+7/8.

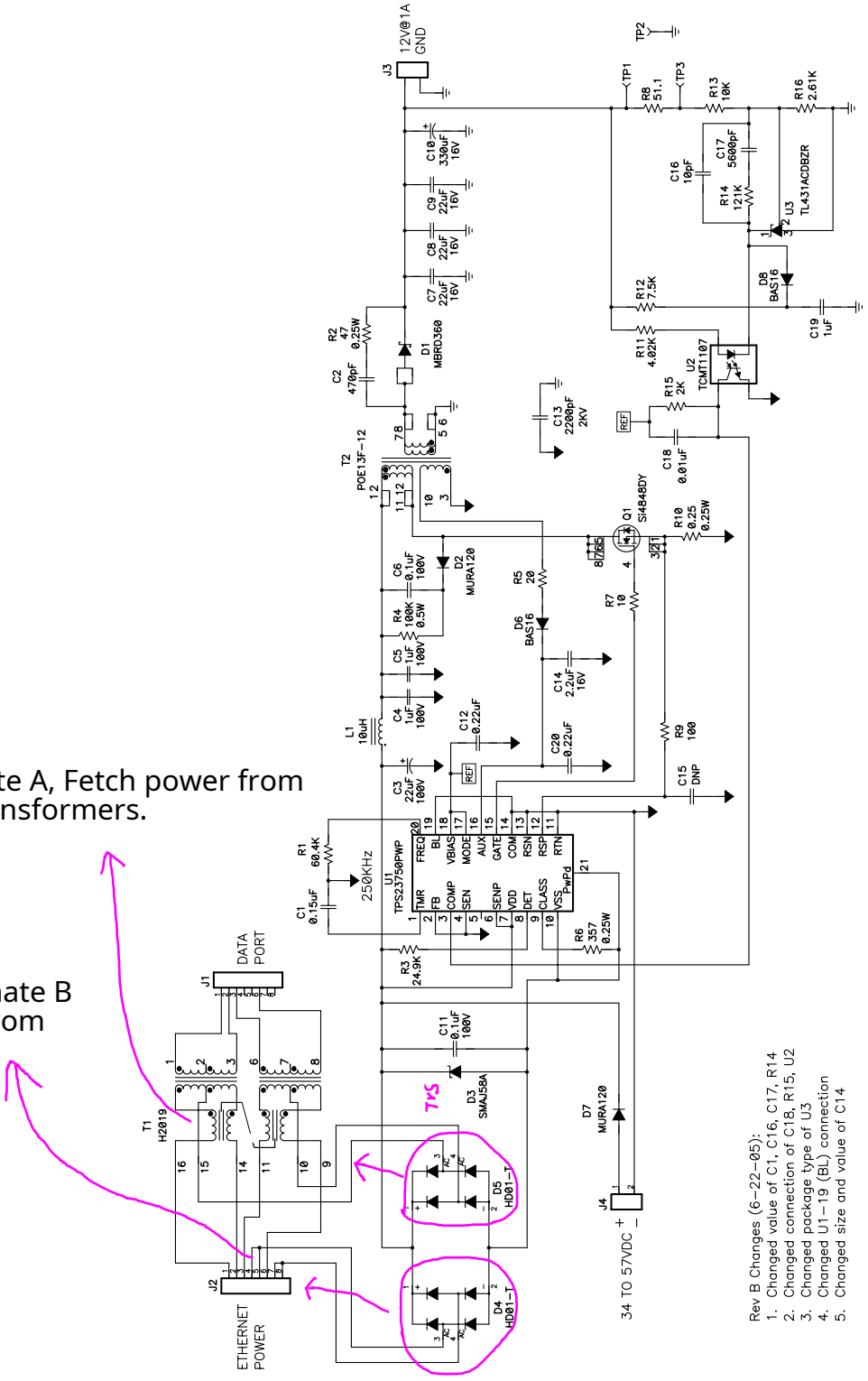

Figure 8. TPS23750 Power-Over-Ethernet PD Power Supply Reference Design

Table 1. Bill of Materials

Count	RefDes	Description	Size	MFR	Part Number
1	C16	Capacitor, Ceramic, 10pF, 50V, C0G, 5%	603	Std	Std
1	C17	Capacitor, Ceramic, 5600pF, 50V, X7R, 5%	603	Std	Std
1	C18	Capacitor, Ceramic, 0.01µF, 50V, X7R, 10%	603	Std	Std
1	C1	Capacitor, Ceramic, 0.15µF, 16V, X7R, 10%	603	Std	Std
1	C2	Capacitor, Ceramic, 470pF, 100V, C0G, 5%	805	Std	Std
2	C6, C11	Capacitor, Ceramic, 0.1µF, 100V, X7R, 10%	805	TDK	C2012X7R2A104K
2	C12, C20	Capacitor, Ceramic, 0.22µF, 25V, X7R, 10%	805	Std	Std
1	C19	Capacitor, Ceramic, 1µF, 16V, X7R, 10%	805	Std	Std
1	C14	Capacitor, Ceramic, 2.2µF, 16V, X7R, 10%	805	TDK	Std
2	C4, C5	Capacitor, Ceramic, 1µF, 100V, X7R, 10%	1210	TDK	C3225X7R2A105K
3	C7, C8,C9	Capacitor, Ceramic, 22µF, 16V, X5R, 20%	1210	TDK	C3225X5R1C226M
1	C13	Capacitor, Ceramic, 2200pF, 2kV, X7R, 10%	1812	TDK	C4532X7R3D222K
1	C3	Capacitor, Aluminum, 22 µF, 100V, 20%	8x10mm	Panasonic	EEVFJ2A220P
1	C10	Capacitor, Aluminum, 330 µF, 16V, 20%	8x10,2mm	Panasonic	EEVFK1C331P
1	D1	Diode, Schottky, 3A, 60V	DPAK	On Semi	MBRD360
2	D2, D7	Diode, Rectifier, 1A, 200V	SMA	On Semi	MURA120
1	D3	Diode, TVS, 58-V, 1W	SMA	Diodes, Inc	SMJ58A
2	D4, D5	Bridge Rectifier, 100V, 0.8V	MINI DIP4	Diodes, Inc	HD01-T
2	D6, D8	Diode, Switching, 200mA, 75V, 225mV	SOT-23	On Semi	BAS16LT1
2	J1, J2	Connector, Jack, Modular, 8 POS	0.705 X 0.820	AMP	520252
2	J3, J4	Terminal Block, 2-pin, 6-A, 3,5 mm	0.27 x 0.25	OST	ED1514
2	TP1, TP3	Test Point, Red, 1 mm	0.038	Keystone	5000
1	TP2	Test Point, Black, 1 mm	0.038	Keystone	5001
1	L1	Inductor, SMT, 10 µH, 1.1A, 160 mΩ	0.26 x 0.09	Coilcraft	DO1608C-103
1	Q1	MOSFET, N-ch, 150V, 3.7A, 85 mΩ	SO-8	Vishay	Si4848DY
1	R7	Resistor, Chip, 10 Ω, 1/16W, 5%	603	Std	Std
1	R5	Resistor, Chip, 20 Ω, 1/16W, 5%	603	Std	Std
1	R8	Resistor, Chip, 51.1 Ω, 1/16W, 1%	603	Std	Std
1	R9	Resistor, Chip, 100 Ω, 1/16W, 1%	603	Std	Std
1	R15	Resistor, Chip, 2.00 kΩ, 1/16W, 1%	603	Std	Std
1	R16	Resistor, Chip, 2.61 kΩ, 1/16W, 1%	603	Std	Std
1	R11	Resistor, Chip, 4.02 kΩ, 1/16W, 1%	603	Std	Std
1	R12	Resistor, Chip, 7.50 kΩ, 1/16W, 1%	603	Std	Std
1	R13	Resistor, Chip, 10.0 kΩ, 1/16W, 1%	603	Std	Std
1	R3	Resistor, Chip, 24.9 kΩ, 1/16W, 1%	603	Std	Std
1	R1	Resistor, Chip, 60.4 kΩ, 1/16W, 1%	603	Std	Std
1	R14	Resistor, Chip, 121 kΩ, 1/16W, 1%	603	Std	Std
1	R10	Resistor, Chip, 0.25 Ω, 0.25W, 5%	1206	Std	Std
1	R6	Resistor, Chip, 357 Ω, 1/4W, 1%	1206	Std	Std
1	R2	Resistor, Chip, 47 Ω, 0.25W, 5%	1206	Std	Std
1	R4	Resistor, Chip, 100 kΩ, 0.5W, 5%	2010	Std	Std
1	T1	Xfmr, Center-tapped, Voice Over IP	0.500 x 0.370	Pulse	H2019
1	T2	Transformer, SMT for PoE/PD, 12V, 13W, 1.1A	0.677 x 0.865 in	Coilcraft	POE13F-12
1	U2	IC, Photocoupler, 3750VRMS, 80-160% CTR	MF4	Vishay	TCMT1107
1	U3	IC, Preceision Adjustable Shunt Regulator	SOT23-3	TI	TL431ACDBZR
1	U1	IC, IEEE 802.3af Integrated primary side controller	PWP20	TI	TPS23750PWP

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