PMP1563 ATCA Board Power Reference Design

This document explains the features and operating instructions for the TI PMP1563 Demonstration Board. The 1563 is a full-sized Advanced Telecommunications Computing Architecture (ATCA) printed circuit board capable of plugging into a standard ATCA slot. The board includes a dual, –48V input stage, high-voltage energy storage, a 240W intermediate bus converter, a 10W, 3.3 V isolated management power supply, and five point-of-load (POL) converters of various voltages and power levels.

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1 Introduction

The PMP1563 demo board contains a complete ATCA board power system for test and evaluation. It is possible to test the power system itself, or test a specific customer load. It has six common supply voltages provided by POL devices as well as an isolated 3.3V converter for the required Intelligent Platform Management Interface (IPMI) power. Blank locations for three additional POLA™ power modules are provided. A current-controlled hotswap circuit is included along with a holdup circuit that will ride through a 5ms dropout on a 200W board. Sequencing connections are also provided for POL supply sequencing.

2 Input Stage

The input stage includes fuses, ORing diodes, inrush control, and EMI filtering. Two transistors and eight resistors are used on the ENABLE A and ENABLE B pins to prevent false extraction detection when an RTN feed is lost. Not all applications use the ENABLE pins; this circuit is included to highlight the risk of nuisance shutdowns if the ENABLE pins are allowed to shut off the board directly.

Inrush, current limiting, and OV/UV functions are handled by a TPS2393A; the fault time has been set to ~2ms. That is, when the TPS2393 goes into current limit mode, it stays in current limit for approximately 2ms before shutting off all current to the load.

3 Hotswap and Inrush Control

The 4mΩ sense resistor sets the TPS2393A overcurrent level at a nominal 10A. Over temperature and tolerance, the overcurrent level can range from 8.1A to 11.9A. This operating range ensures that the board can get a full 200W without going into current limit mode even if the input voltage magnitude is as low as 32V.

3.1 Energy Storage for Holdup

The ATCA specification requires a board to continue operatng despite losing power for up to 5ms; in reality, the power loss period is closer to 9.3ms when the specified slew rates are factored in. The PMP1563 demo board stores the holdup energy at –80V, and the amount of capacitance required drops by almost a factor of ten. A UC2572 negative boost converter uses the –48V input and charges a 1320µF capacitor to –80V. When a dropout condition is detected, the –80V capacitor is shorted to the –48V rail on the board for 12ms. Since many telecom converters are designed to take in up to –80V, no special conversion is required. It is only necessary to ensure, through proper layout, that the high di/dt during such an event does not disrupt downstream power circuitry. For more information, see application note SLUA331, available for download from the TI web site.

3.2 3.3V IPMI Power

3.3V IPMI power is generated by a PTMA403033 isolated module capable of 3A output. This device is available with positive or negative logic enable.

4 12V Intermediate Bus Converter (IBC)

The 12V isolated bus converter is an Artesyn Typhoon module rated at 28A output, 12V ±5% over all inputs, loads, and temperatures.

5 Point-of-Load Converters (POL)

Four non-isolated POL converters are part of the PMP1563 board. There are slots for three additional converters.

The four POLs supplied with the board are powered by the 12V IBC; Table 1 lists the respective part numbers for each

Table 1. PMP1563 Demo Board POL Converter Part Numbers

Part Number	V_{OUT} (V)	I_{OUT} (A)
PTH12050	2.5	6
PTH12050	1.8	6
PTH12040	1.5	50
PTH12020	1.2	18

5.1 Sequencing

All four POLs have $\overline{\text{INHIBIT}}$ pins that are active low; these pins disable the POL output when pulled low. The $\overline{\text{INHIBIT}}$ pins are brought out to test points on the PMP1563 as shown in the schematic (see Section 6.1). An internal pull-up resistor in each POL enables the output unless the INHIBIT input is pulled low.

5.2 Spare Locations

Three locations are provided for additional PTH-style POL modules. Location U10 accommodates a PTH12040 module; U15 allows a PTH12050 module; and U16 can hold a PTH12020 module. Actual output voltage for each of these modules is set using an external resistor.

6 Hardware Reference

This section contains the schematics, board layout and bill of materials for the PMP1563 demo board.

6.1 Schematics

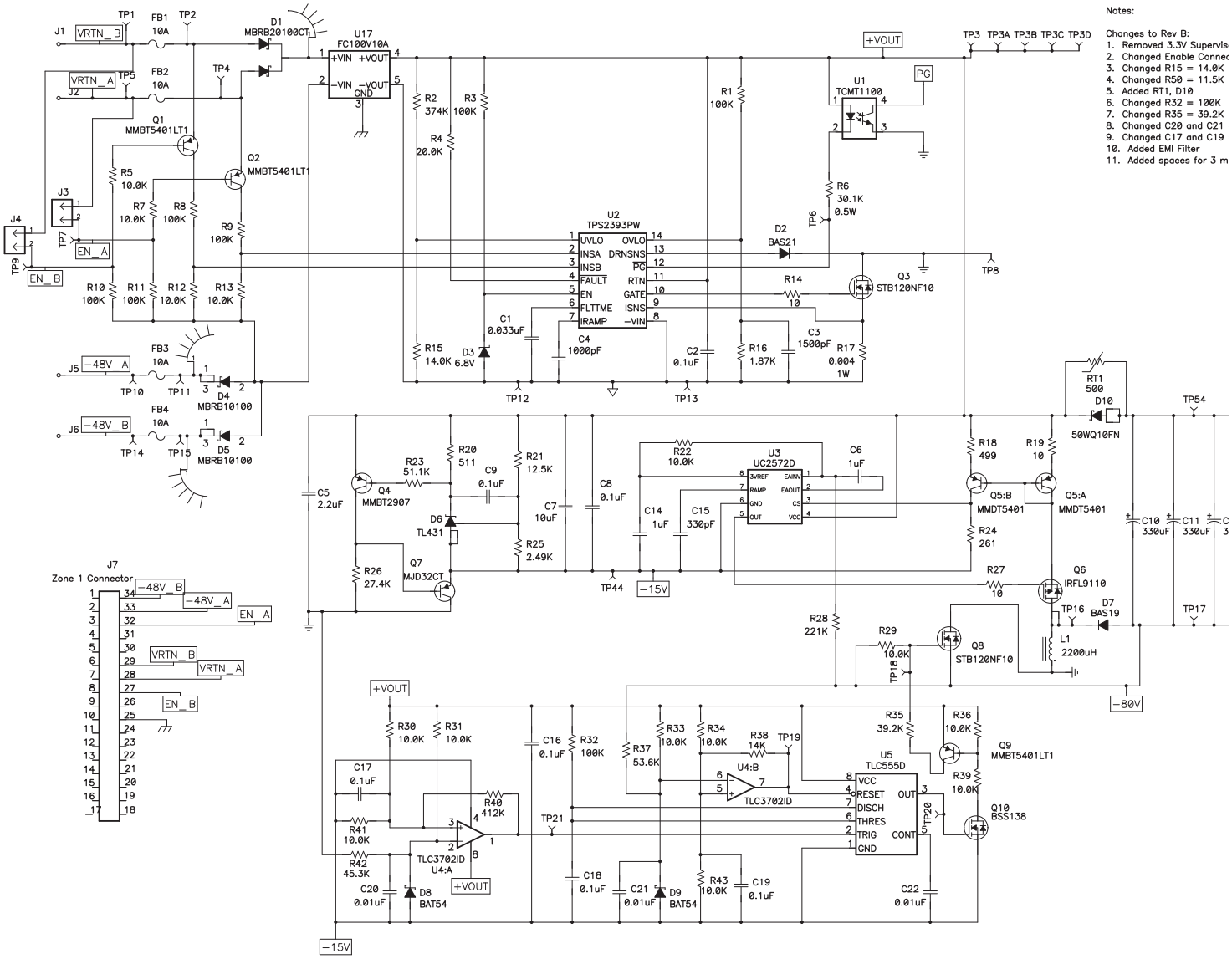

Figure 1. Input Stage with Hotswap, Energy Storage, and EMI

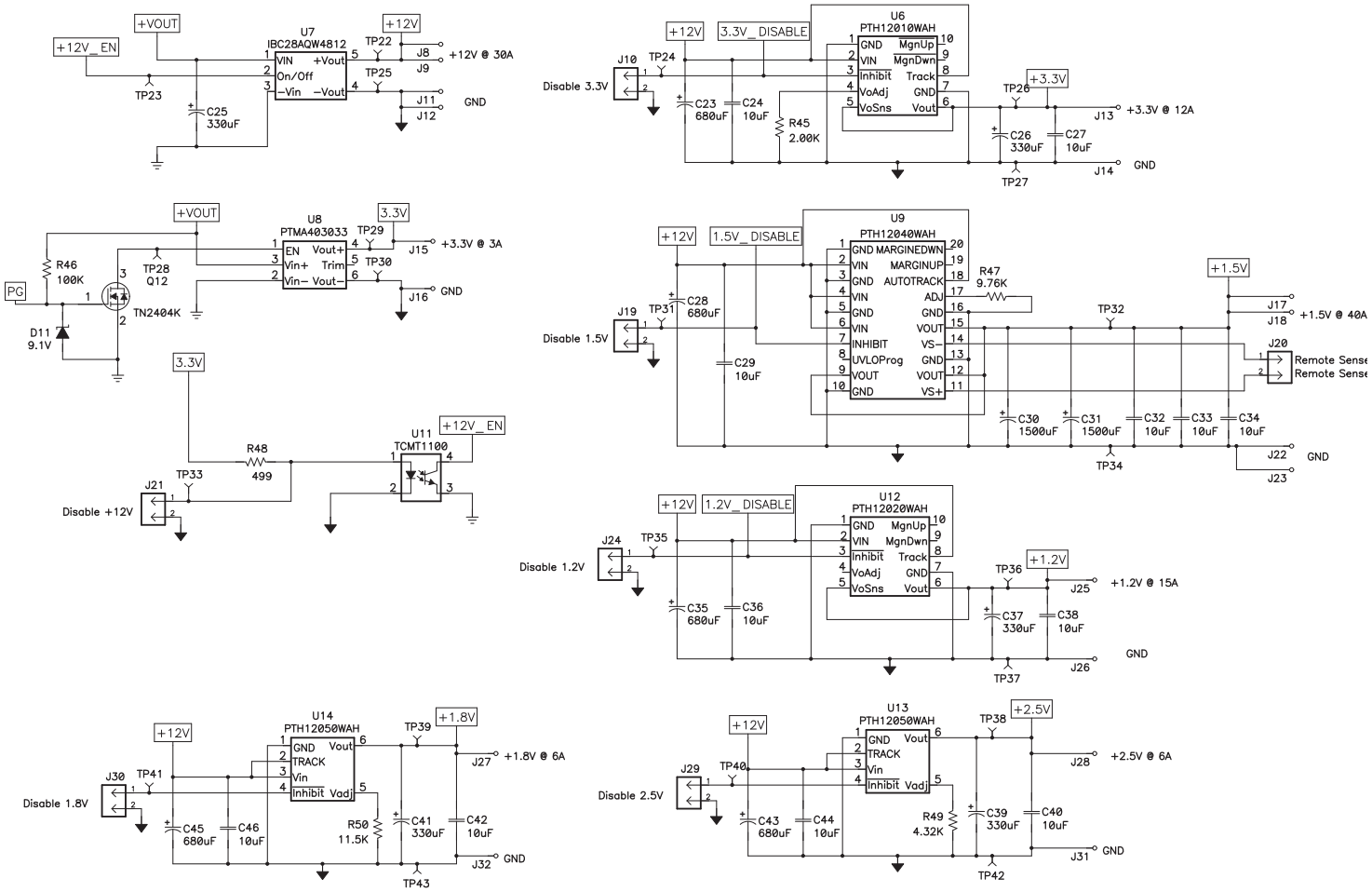

Figure 2. Intermediate Bus Converter and Point-of-Load Converters

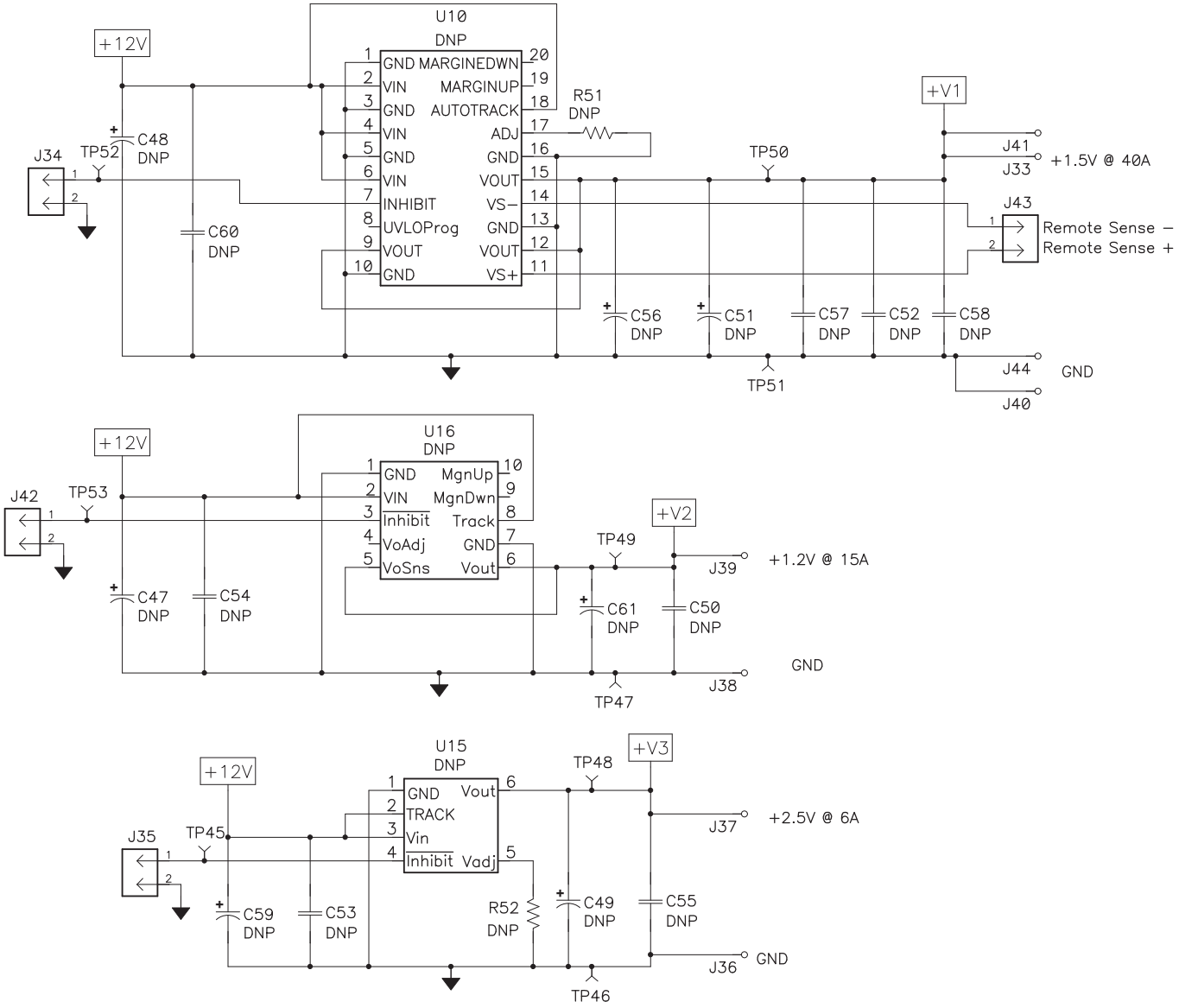

Figure 3. Spare Point-of-Load Locations

6.2 Board Layout

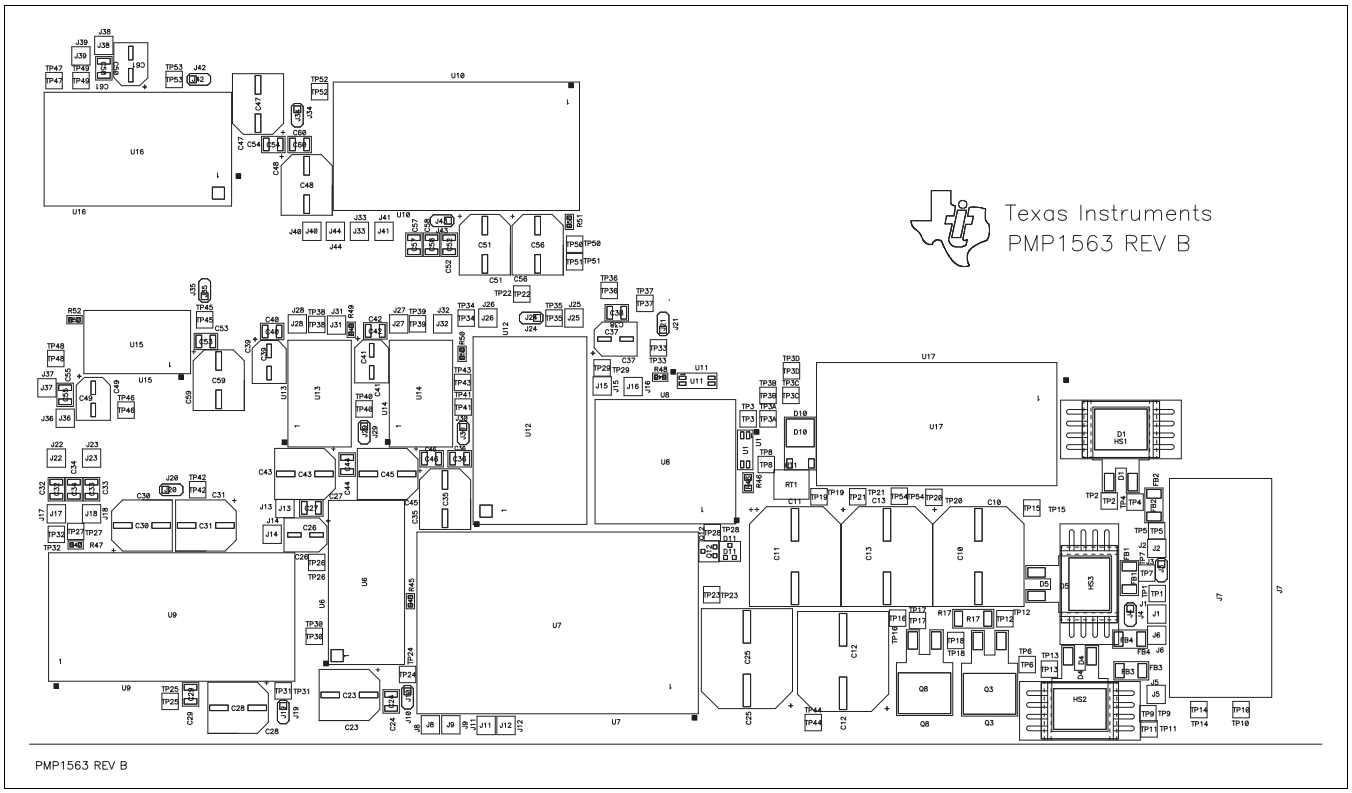

Figure 4. PMP1563 Top Layer

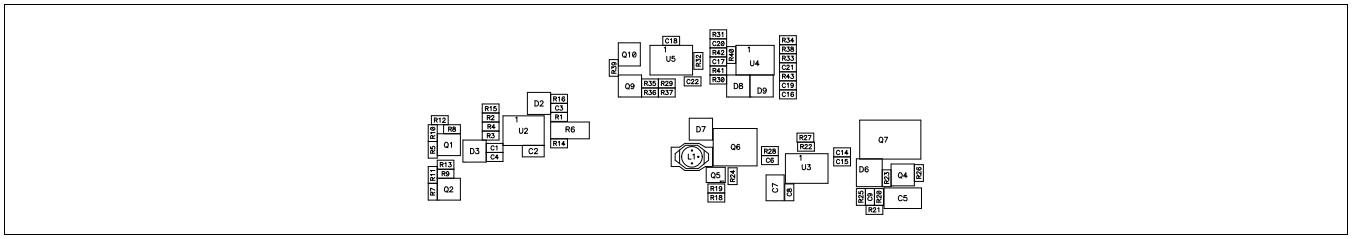

Figure 5. PMP1563 Bottom Layer

6.3 Bill of Materials

The bill of materials for the PMP1563 is listed in Table 2.

Table 2. PMP1563 Demonstration Board Bill of Materials

Count	Ref Des	Value	Description	Part Number	Manufacturer
1	C1	0.033µF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
5	C10–C13, C25	330µF	Capacitor, Aluminum, 100V, ±20%	EEVFK2A331K16	Panasonic
1	C15	330pF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
1	C2	0.1µF	Capacitor, Ceramic, 100V, X7R, 15%	Standard	TDK
3	C20–C22	0.01µF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
5	C23, C28, C35, C43, C45	680µF	Capacitor, Aluminum, 16V, 20%	EEVFK1C681P	Panasonic
4	C26, C37, C39, C41	330µF	Capacitor, Aluminum, 6.3V, ±20%	EEVFK0J331XP	Panasonic
1	C3	1500pF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
2	C30, C31	1500µF	Capacitor, Aluminum, 16V, 20%	EEVFK1C152Q	Panasonic
1	C4	1000pF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
1	C5	2.2µF	Capacitor, Ceramic, 100V, X7R, 15%	Standard	TDK
2	C6, C14	1µF	Capacitor, Ceramic, 16V, X7R, 15%	Standard	TDK
13	C7, C24, C27, C29, C32, C33, C34, C36, C38, C40, C42, C44, C46	10µF	Capacitor, Ceramic, 25V, X7R, 15%	Standard	TDK
6	C8, C9, C16–C19	0.1µF	Capacitor, Ceramic, 50V, X7R, 15%	Standard	TDK
1	D1	MBRB20100CT	Diode, Dual Schottky, 20A, 100V	MBRB20100CT	Vishay
1	D10	50WQ10FN	Diode, Schottky, 5.5A, 100V	50WQ10FN	IR
1	D11	9.1V	Diode, Zener, 9.1V, 350mW	BZX84C9V1T	Diodes, Inc.
1	D2	BAS21	Diode, Switching, 200mA, 200V, 330mW	BAS21	Zetex
1	D3	6.8V	Diode, Zener, 6.8V, 350mW	BZX84C6V8T	Diodes, Inc.
2	D4, D5	MBRB10100	Diode, Schottky, 10A, 100V	MBRB10100	Vishay
1	D6	TL431	IC, Adjustable precision shunt regulator	TL431CPKR	Texas Instruments
1	D7	BAS19	Diode, Switching, 400mA, 100V, 250mW	BAS19	Diodes, Inc.
2	D8, D9	BAT54	Diode, Schottky, 200mA, 30V	BAT54	Vishay
4	FB1–FB4	10A	Fuse, SMF Very Fast Acting, 125V, 10A	R451.010	Littelfuse
3	HS1–HS3	573300	Heatsink, D 2 PACK,SM	573300	Aavid
1	J7	Zone 1 Connector	Connector, 34P, Through-hole	VPB30W8M6200A1	Positronic
1	L1	2200µH	Inductor, SMT, 2200µH, 0.05A, 19Ω	DS1608BL	Coilcraft
3	Q1, Q2, Q9	MMBT5401LT1	Bipolar, PNP, 150V, 500mA	MMBT5401LT1	ON Semi

Table 2. PMP1563 Demonstration Board Bill of Materials (continued)

Count	Ref Des	Value	Description	Part Number	Manufacturer
1	Q10	BSS138	MOSFET, N-ch, 50V, 0.17A, 3.5Ω	BSS138	Zetex
1	Q12	TN2404K	MOSFET, N-ch, 240V, 115mA, 4Ω	TN2404K	Vishay
2	Q3, Q8	STB120NF10	MOSFET, N-ch, 100V, 120A, 0.009Ω	STB120NF10	ST Micro
1	Q4	MMBT2907	Transistor, PNP, –60V, –600mA, 225W	MMBT2907ALT1	ON Semi
1	Q5	MMDT5401	Transistor, NPN, Dual, 150V, 200ma	MMDT5401	Diodes, Inc.
1	Q6	IRFL9110	MOSFET, P-ch, 100V, 1200mA, 1.2mΩ	IRFL9110	IR
1	Q7	MJD32CT	Transistor, Power PNP, 100V, 3A, 15W	MJD32CT	ON Semi
7	R1, R3, R8–R11, R32	100k	Resistor, Chip, 1/16W, 1%	Standard	Standard
3	R14, R19, R27	10	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R15	14.0k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R16	1.87k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R17	0.004k	Resistor, Chip, 1W, 1%	Standard	Standard
2	R18, R46	499	Resistor, Chip, 1/16W, 1%	Standard	Vishay
1	R2	374k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R20	511	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R21	12.5k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R23	51.1k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R24	261	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R25	2.49k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R26	27.4k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R28	221k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R35	39.2k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R37	53.6k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R38	14k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R4	20.0k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R40	412k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R42	45.3k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R45	2.00k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R46	100k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R47	9.76k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R49	4.32k	Resistor, Chip, 1/16W, 1%	Standard	Standard
14	R5, R7, R12, R13, R22, R29, R30, R31, R33, R34, R36, R39, R41, R43	10.0k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R50	11.5k	Resistor, Chip, 1/16W, 1%	Standard	Standard
1	R6	30.1k	Resistor, Chip, 1/2W, 1%	Standard	Standard
1	RT1	500	Thermistor, PTC, 500Ω	2322 660 52893	Vishay
2	U1, U11	TCMT1100	Photocoupler	TCMT1100	Vishay
1	U12	PTH12020WAH	Module, Wide Output Adj, 1.2V to 5.5V, 18A, 12V Input	PTH12020WAH	Texas Instruments

Table 2. PMP1563 Demonstration Board Bill of Materials (continued)

Count	Ref Des	Value	Description	Part Number	Manufacturer
2	U13, U14	PTH12050WAH	Module, Wide Output, 6A, 0.8V to 3.6V, 12V Input	PTH12050WAH	Texas Instruments
1	U17	FC100V10A	Filter.FC Series 10A	FC100V10A	Texas Instruments
1	U2	TPS2393PW	IC, -48V Hot-Swap Power Controller	TPS2393PW	Texas Instruments
1	U3	UC2572D	IC, Pulse Width Modulator, Negative Flyback w/ driver for External P-FET	UC3572D	Texas Instruments
1	U4	TLC3702ID	IC, Dual Micropower Comparator	TLC3702ID	Texas Instruments
1	U5	TLC555D	IC, Timer, Low-Power CMOS	TLC555D	Texas Instruments
1	U6	PTH12010WAH	Module, Wide Output Adj, 15A, 0.8V to 3.6V, 12V Input	PTH12010WAH	Texas Instruments
1	U7	IBC28AQW4812	Typhoon Series Module, DC-DC Converter, $48V_{IN}$, $12V_{OUT}$, 240 W	IBC28AQW4812	Artesyn
1	U8	PTMA403033	Module, DSSMT 3A, 3.3V, 10W	PTMA403033	Texas Instruments
1	U9	PTH12040WAH	Module, Non-Isolated, Point of Load Module, 8-$14V_{IN}$, 0.8-8.5 V_{OUT}, 50 I_{OUT}	PTH12040WAH	Texas Instruments
For Test Purposes Only:					
30	J1, J2, J5, J6, J8, J9, J11, J12, J13, J14, J15, J16, J17, J18, J22, J23, J25, J26, J27, J28, J31, J32, J33, J36, J37, J38, J39, J40, J41, J44		Header, Single pin	8952-0-05-01-00-00-03-0	Mill-Max
9	J3, J4, J10, J19, J20, J21, J24, J29, J30	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	PTC36SAAN	Sullins
30	TP1–TP7, TP9, TP16–TP24, TP26, TP28–TP33, TP35, TP36, TP38, TP39, TP40, TP41, TP44	5000	Test Point, Red, Thru Hole Color Keyed	5000	Keystone
14	TP8, TP10–TP15, TP25, TP27, TP30, TP34, TP37, TP42, TP43	5001	Test Point, Black, Thru Hole Color Keyed	5001	Keystone

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