

## Description

The P9242-R-EVK Mass-Market Evaluation Board demonstrates the features of the P9242-R 15W Wireless Power Transmitter (TX). It is intended to evaluate the functionality and performance of the P9242-R when combined with a power receiver in a wireless charging system. The P9242-R-EVK offers the flexibility to select parameters, such as the over-current limit threshold, LED pattern, and external temperature sensing function. The printed circuit board (PCB) has four layers. The P9242-R Evaluation Board is designed to function with the P9221-R Receiver Evaluation Board, which is ordered separately. It can also be used with the user's WPC-1.2.2 compliant receiver.

The high-efficiency, turnkey reference design is supported by comprehensive online, digital resources to significantly expedite the design-in effort and enable rapid prototyping. The total active area is optimized to 32mm x 32mm.

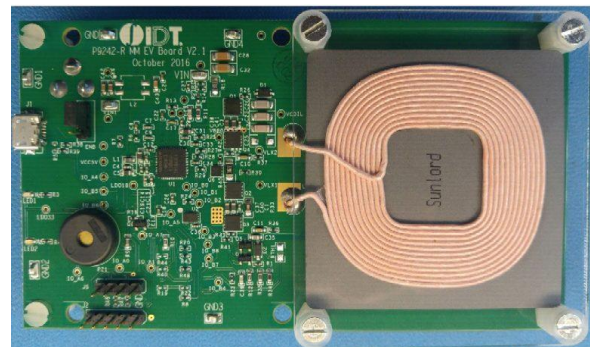
## Kit Contents

- P9242-R-EVK Mass-Market Evaluation Board
- Adaptor: 12V/2A AC

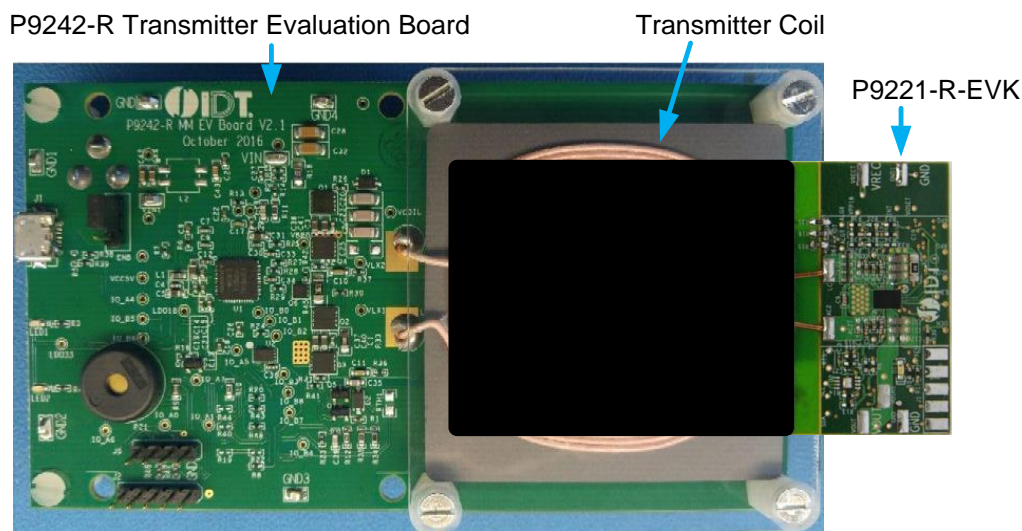
## Features

- P9242-R Evaluation Board with support for WPC-1.2.2
- Up to 15W output power
- Adjustable over-current limit
- Adjustable temperature shutdown
- Two programmable LED status indicators
- Four-layer PCB
- Total active area: 1024 mm<sup>2</sup>
- Fully assembled with test points and coil fixture

### P9242-R-EVK Mass-Market Evaluation Board



### P9242-R Transmitter Board Connected to P9221-R-EVK



12V/2A AC Adapter (Not to scale)

**Important Notes**

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**Restrictions in Use**

IDT’s P9242-R-EVK Mass Market Evaluation Board is designed for evaluation purposes only. It must not be used for module production or production test setups.

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# 1. Setup

## 1.1 Required or Recommended User Equipment

The following additional lab equipment is required for using the kit:

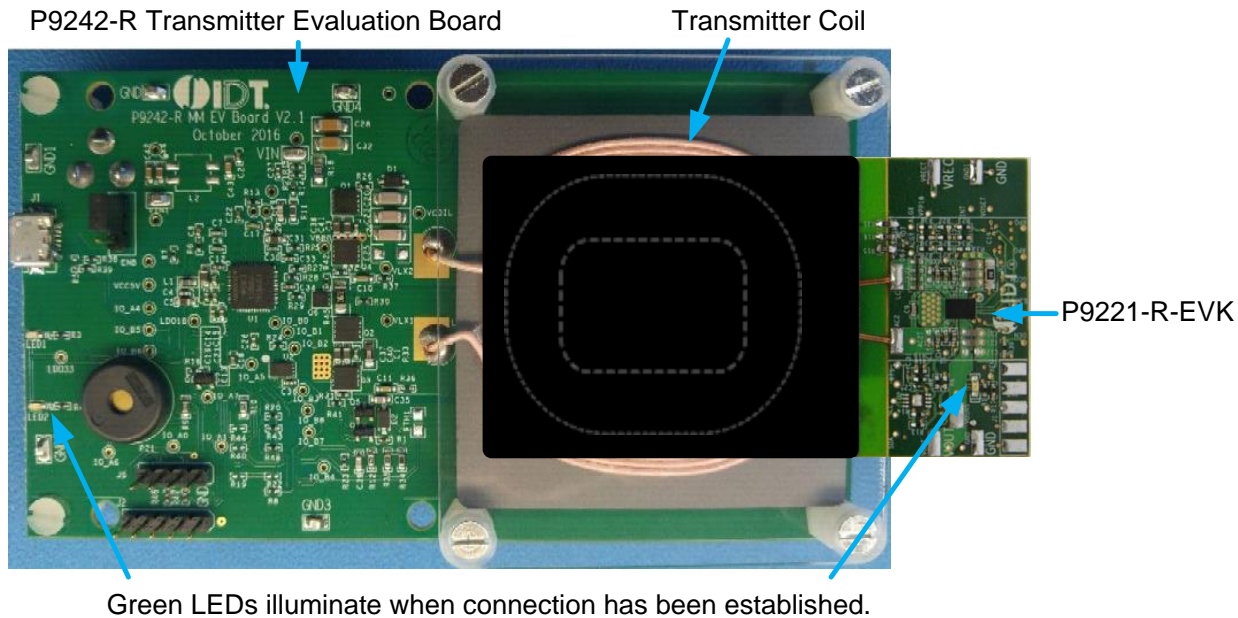
- P9221-R-EVK Receiver Evaluation Board or any WPC-1.2.2 compliant receiver
- Power supply or 12V/2A AC adaptor

## 1.2 Kit Hardware Connections

Follow these procedures to set up the kit as shown in Figure 1.

1. Set up the P9242-R Evaluation Board: Plug the 12V adapter or user’s power supply into the J3 (barrel connector on the bottom of the board) or J1 (micro USB connector).
2. Place the P9221-R-EVK or the user’s receiver on the transmitter (TX) pad with the components facing up as shown in Figure 1.
3. Verify that the two green LEDs identified in Figure 1 are illuminated indicating that coupling has been established.
4. If using the P9221-R-EVK Evaluation Board as the receiver, connect wires to the VOUT and GND test points on the P9221-R-EVK receiver to measure the output voltage and apply a load.

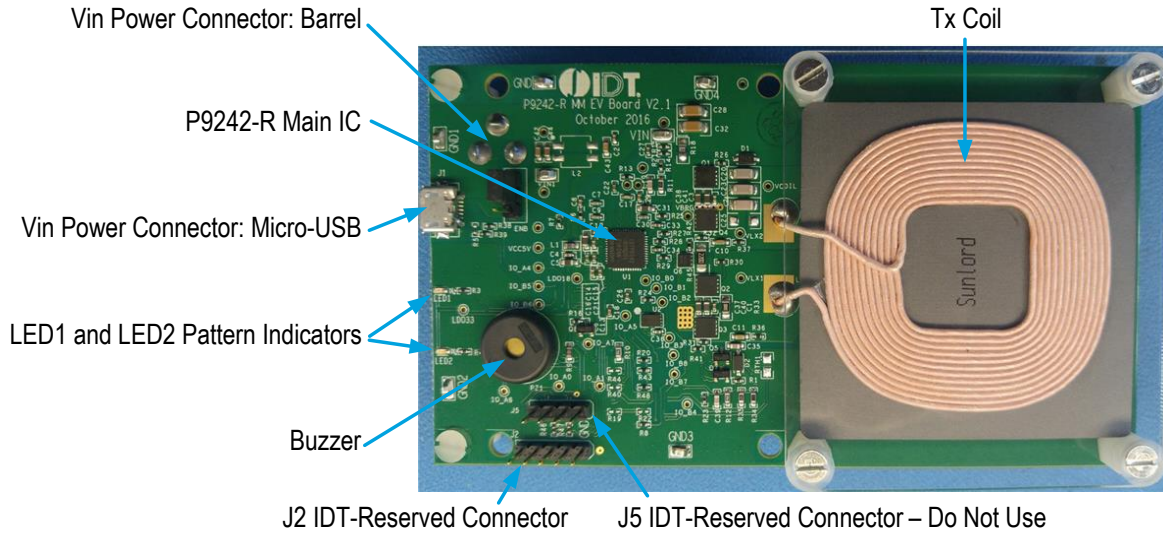
**Figure 1. Evaluation Kit Connections using the P9221-R Receiver Evaluation Board**



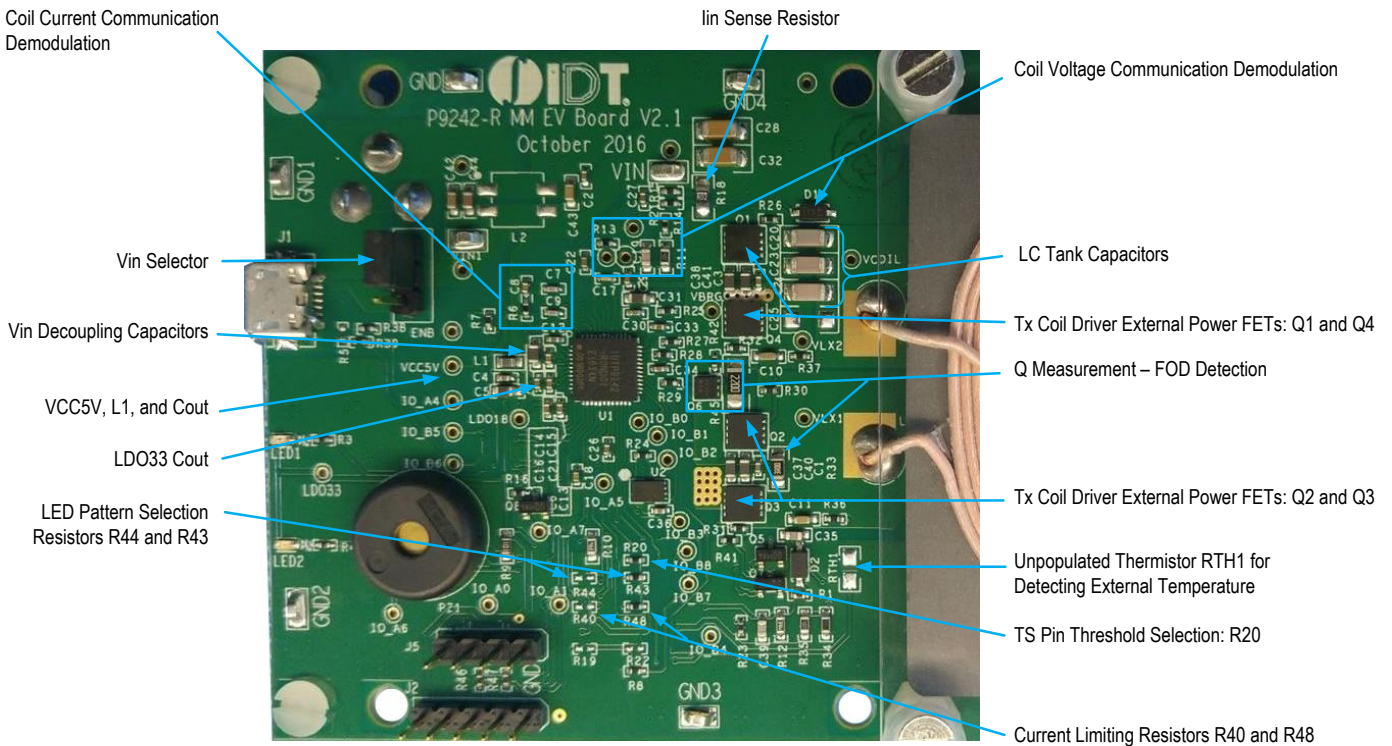
## 2. Usage Guide

### 2.1 Overview of the P9242-R-EVK

**Figure 2. P9242-R V2.1 Evaluation Board Features**



**Figure 3. P9242-R V2.1 Evaluation Board Details**



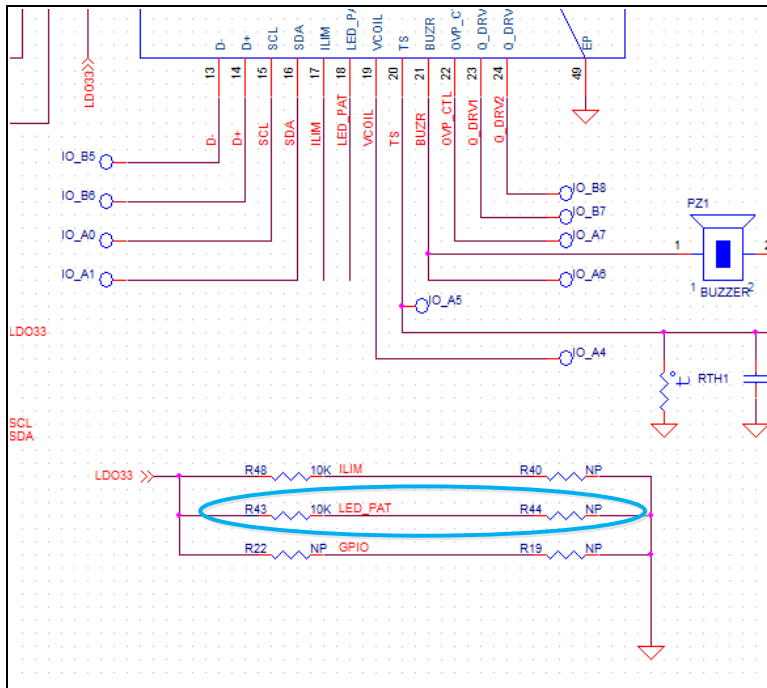
## 2.2 LED Pattern Selection

The P9242-R-EVK uses two LEDs (LED1 and LED2; see Figure 2) to indicate the power transfer status, faults, and operating modes. The LEDs are connected to the LED1 and LED2 pins as shown on P9242-R-EVK schematics (see section 3.1). The LED patterns can be selected by setting the voltage on the LED\_PAT pin through the resistor divider R43 and R44; see Table 1 for the options. On the evaluation board the LED\_PAT pin is pulled up to 3.3V through R43. R44 is unpopulated; therefore, option 7 is the default option.

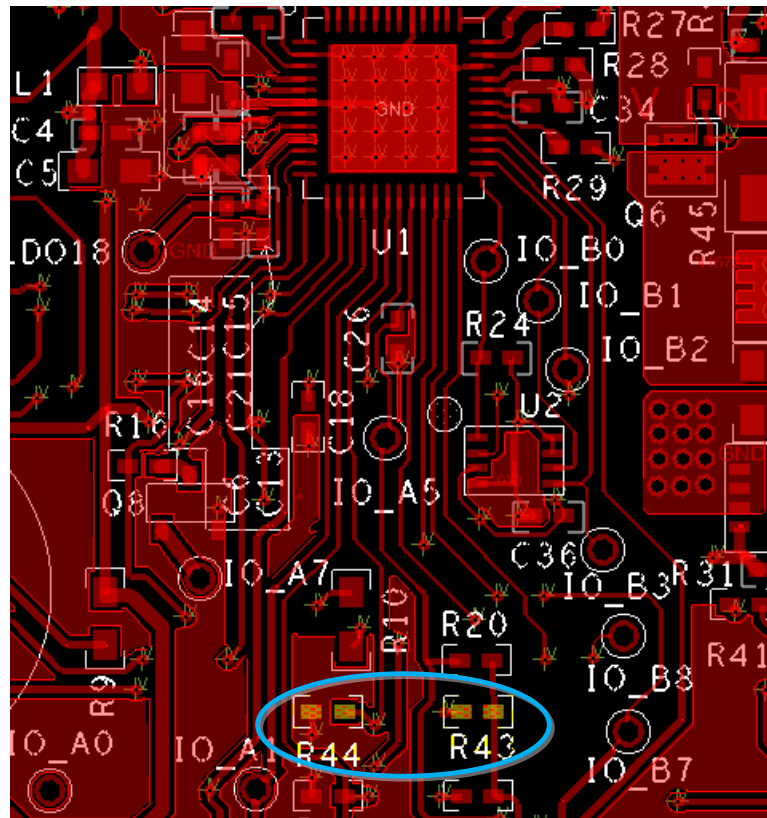
**Table 1. Selecting the LED Pattern**

Option	Voltage on LED_PAT Pin	LED1/LED2 Pin	Status			
			Standby	Transfer	Complete	Fault
1	Pull-Down or 0.075V	LED1 – GREEN	Off	On	Off	Off
		LED2 – RED	Off	Off	Off	Blink 4Hz
2	0.225V	LED1 – GREEN	On	On	Off	Off
		LED2 – RED	On	Off	Off	Blink 4Hz
3	0.375V	LED1 – GREEN	Off	Blink 1Hz	On	Blink 4Hz
		LED2 – RED	Off	Off	Off	Off
4	0.525V	LED1 – GREEN	Off	On	Off	Blink 4Hz
		LED2 – RED	Off	Off	Off	Off
5	0.675V	LED1 – GREEN	On	Blink 1Hz	On	Off
		LED2 – RED	On	Off	Off	Blink 4Hz
6	0.825V	LED1 – GREEN	Off	Off	On	Off
		LED2 – RED	Off	On	Off	Blink 4Hz
7	0.975V or Pull-Up	LED1 – GREEN	Off	Blink 1Hz	On	Off
		LED2 – RED	Off	Off	Off	Blink 4Hz

**Figure 4. R43 and R44 Schematic Location**



**Figure 5. R33 and R34 PCB Location**



### 2.3 Adjustment of Over-Current Limit

The over-current protection (OCP) is designed to protect the transmitter from operating conditions that could potentially cause damage or unexpected behavior from the system. The input current is continuously monitored during the power transfer stage. If the input current goes above the OCP threshold of the programmed current limit, the P9242-R will increase the switching frequency or reduce the duty cycle in order to keep the input current below the OCP value. The current limit can be selected by setting the voltage on the ILIM pin through the resistor divider R48 and R40. On the P9242-R-EVK, the ILIM pin is pulled up to 3.3V through R48. R40 is unpopulated; therefore, the current limit is set to 2.3A.

**Figure 6. Over-Current Limit vs.  $V_{ILIM}$**

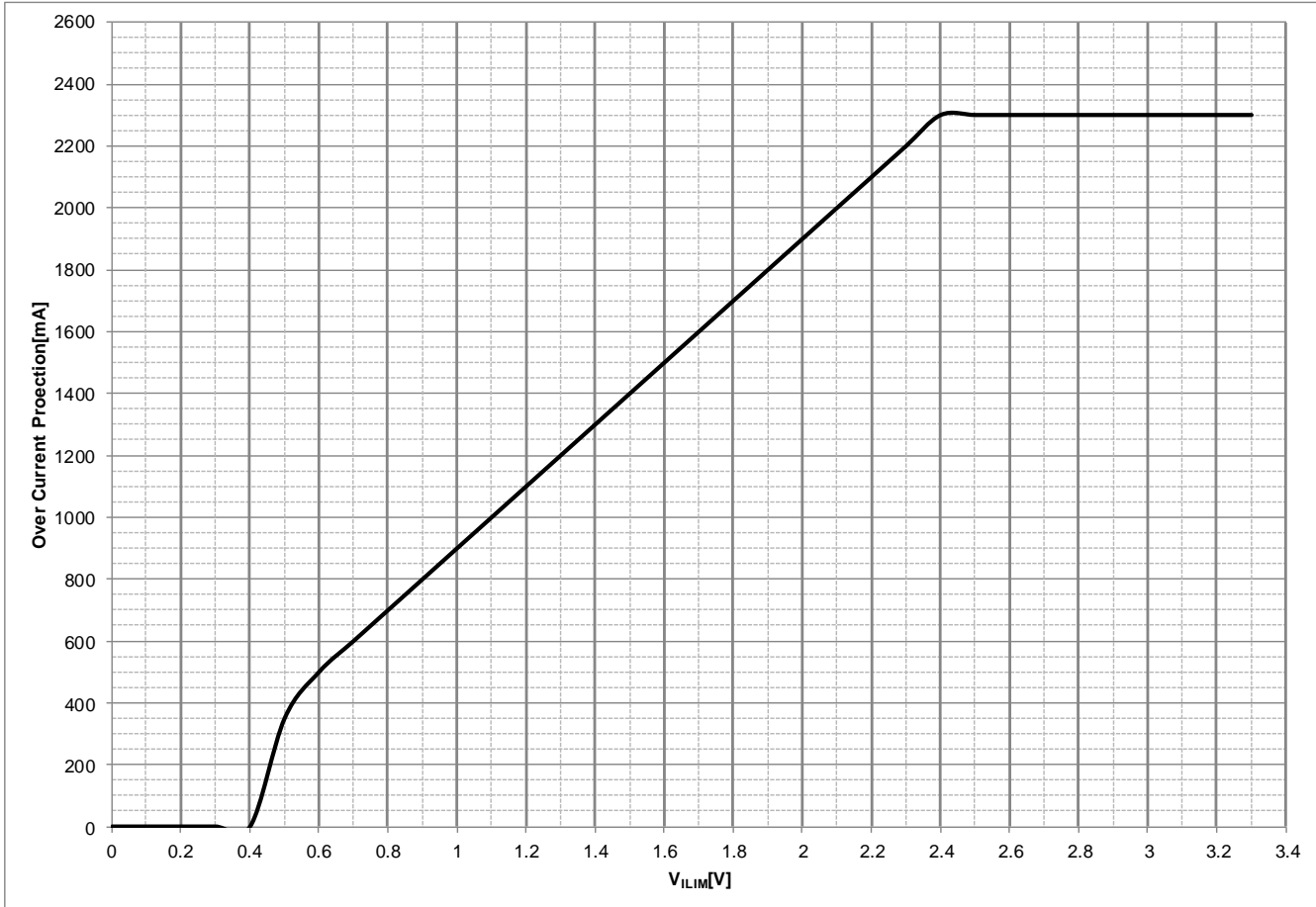




Figure 7. R48 and R40 Schematic Location

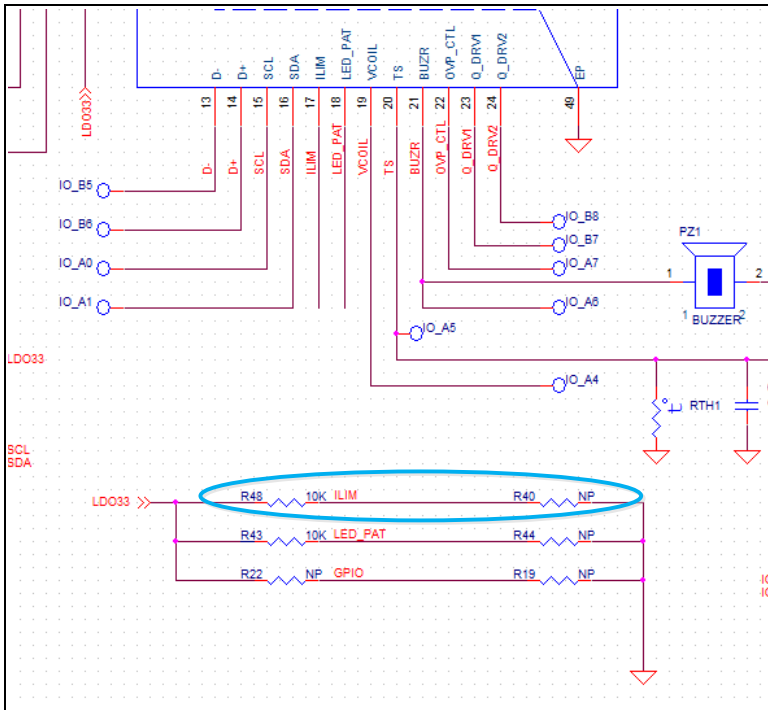
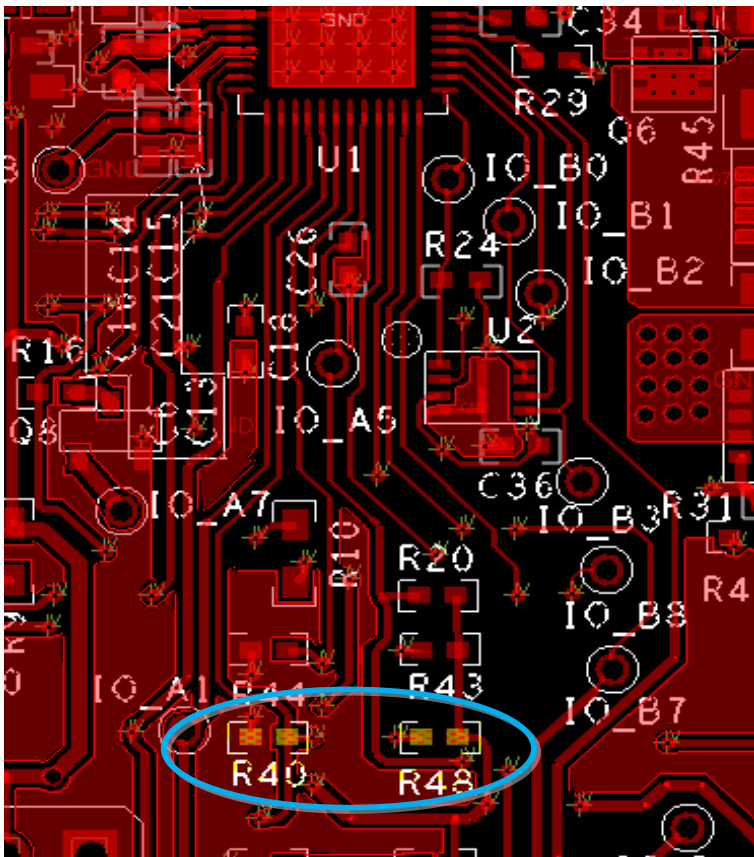


Figure 8. R48 and R40 PCB Location



## 2.4 External Temperature Sensing – TS

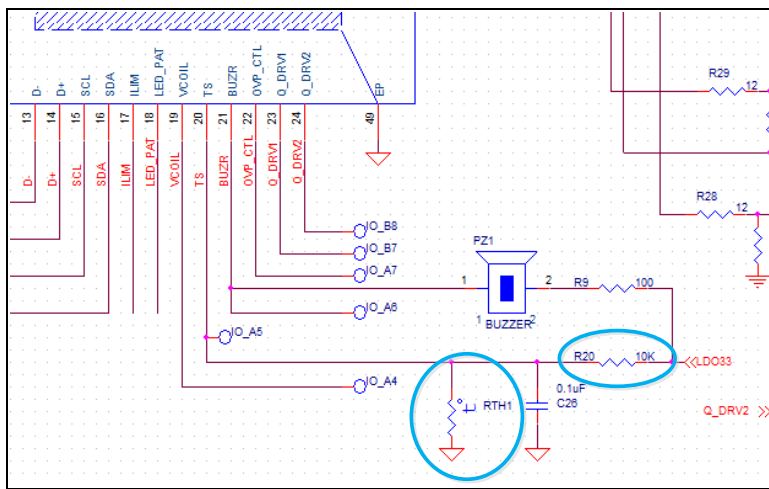
The P9242-R includes an optional temperature sense input pin, TS, used to monitor a remote temperature, such as for a coil or a battery charger.

The TS pin voltage can be calculated by Equation 1.

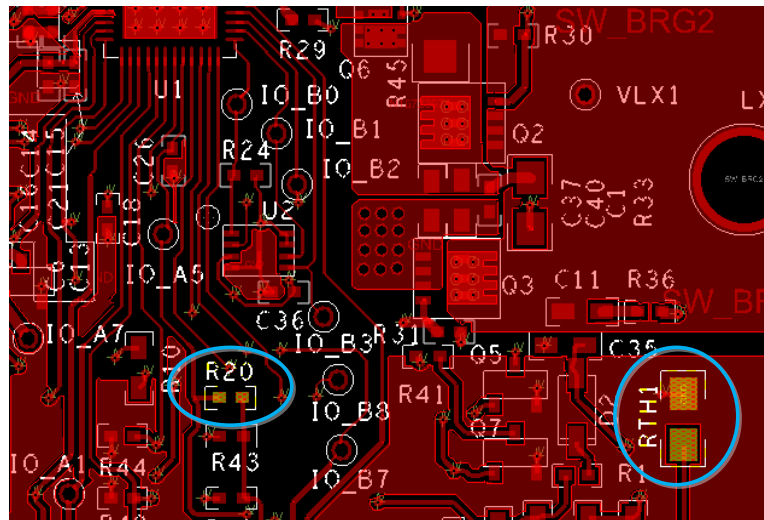
$$V_{TS} = V_{LD033} \times \frac{NTC}{R20 + NTC} \tag{Equation 1}$$

Where NTC is the thermistor’s resistance (RTH1) and R20 is the pull-up resistor connected to the 3.3V supply voltage on the P9242-R Evaluation Board. The over-temperature shutdown is triggered if the voltage on the TS pin is lower than 0.6V. The RTH1 is not populated on the P9242-R Evaluation Board.

**Figure 9. RTH1 and R20 Schematic Location**



**Figure 10. RTH1 and R20 R40 PCB Location**



## 2.5 Reserved Pins

There are multiple reserved pins listed in the schematic: pins 13 through 16, 25 through 29, 42, and 43. These GPIOs are proprietary and for factory use only.

## 2.6 Transmitter Coil

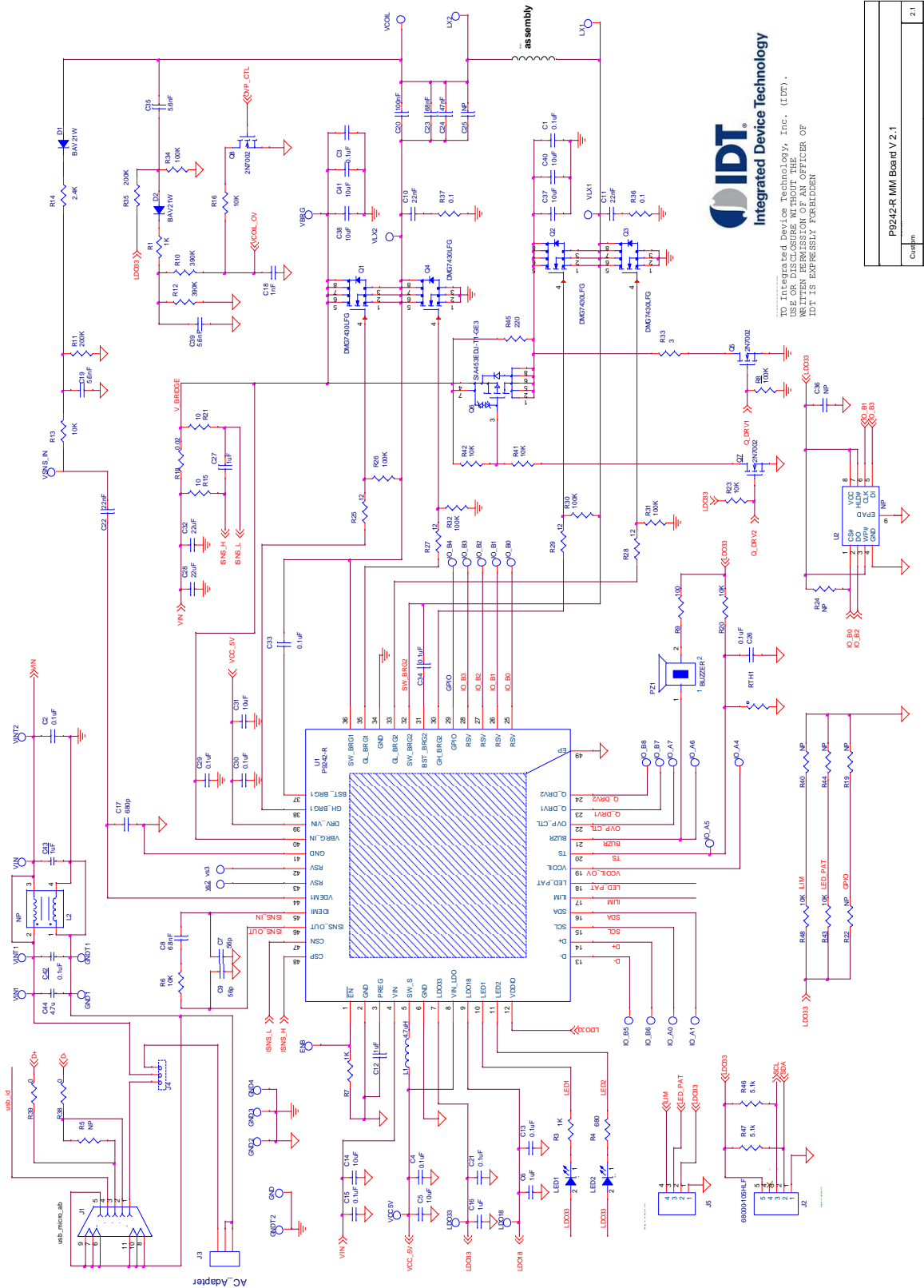
The following coil is recommended with P9242-R transmitter for 15W applications for optimum performance. The recommended vendor has been tested and verified.

**Table 2. Recommend Coil Manufacturer**

Output Power	Vendor	Part Number	Inductance at 100kHz	DCR at 20°C
15W	SUNLORD	SWA53N53H30C11B	10 $\mu$ H	50m $\Omega$

### 3. Schematics, Bill of Materials (BOM), and Board Layout

#### 3.1 P9242-R Evaluation Board Schematics



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P9242-R MM Board V.2.1	
Confidential	2.1
1. revision: December 20, 2016	

## 4. Bill of Materials (BOM)

**Table 3. P9242-R-EVK BOM**

Item	Quantity	Reference	Value	Description	Part Number	PCB Footprint
1	12	C1, C2, C3, C4, C13, C15, C21, C26, C29, C30, C33, C34	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 25V 10% X7R 0402	C1005X7R1E104K050BB	0402
2	7	C5, C14, C31, C37, C38, C40, C41	10 $\mu$ F	CAP CER 10 $\mu$ F 25V 20% X5R 0603	C1608X5R1E106M080AC	0603
3	4	C6, C12, C16, C27	1 $\mu$ F	CAP CER 1 $\mu$ F 25V 20% X5R 0402	C1005X5R1E105M050BC	0402
4	2	C7, C9	56pF	CAP CER 56PF 50V NP0 0402	CL05C560JB5NNNC	0402
5	1	C8	6.8nF	CAP CER 6800PF 25V X7R 0402	GRM155R71E682KA01D	0402
6	2	C10, C11	22nF	0.022 $\mu$ F 50V Ceramic Capacitor X7R 0603	GCM188R71H223KA37D	0603
7	1	C17	680pF	CAP CER 680PF 50V X7R 0402	CL05B681KB5NNNC	0402
8	1	C18	1nF	CAP CER 1000pF $\pm$ 10% 50V X7R 0402	GRM155R71H102KA01D	0402
9	3	C19, C35, C39	5.6nF	5600pF 100V Ceramic Capacitor C0G, NP0 0603	C1608C0G2A562J080AC	0603
10	1	C20	100nF	CAP CER 0.1 $\mu$ F 100V C0G 1206	C3216C0G2A104K160AC	1206
11	1	C22	22nF	CAP CER 0.022 $\mu$ F 50V 10% X7R 0402	GRM155R71H223KA12D	0402
12	1	C23	68nF	CAP CER 0.068 $\mu$ F 100V NP0 1206	C3216C0G2A683K160AC	1206
13	1	C24	47nF	CAP CER 0.047 $\mu$ F 100V NP0 1206	C3216C0G2A473J115AC	1206
14	1	C25	NP	CAP CER 10000PF 100V C0G 1206	C3216C0G2A103J115AA	1206
15	2	C28, C32	22 $\mu$ F	CAP CER 22 $\mu$ F 25V 20% X5R 1206	GRM31CR61E226KE15L	1206
16	1	C36	NP	CAP CER 0.1 $\mu$ F 25V 10% X7R 0402	C1005X7R1E104K050BB	0402
17	1	C42	0.1 $\mu$ F	0.10 $\mu$ F 50V Ceramic Capacitor X7R 0603	GRM188R71H104KA93D	0603
18	1	C43	1 $\mu$ F	1 $\mu$ F 25V Ceramic Capacitor X5R 0603	GRM188R61E105KA12D	0603
19	1	C44	4.7 $\mu$ F	4.7 $\mu$ F 25V Ceramic Capacitor X5R 0603	GRM188R61E475KE11D	0603
20	2	D1, D2	BAV21W	DIODE GEN PURP 80V 125MA DFN	BAV21W-7-F	sod123

Item	Quantity	Reference	Value	Description	Part Number	PCB Footprint
21	30	VLX1, VINT1, IO_B1, IO_A1, GNDT1, vs2, VLX2, VINT2, IO_B2, GNDT2, vs3, IO_B3, IO_B4, IO_A4, VCC5V, IO_B5, IO_A5, IO_B6, IO_A6, IO_B7, IO_A7, IO_B8, LDO18, LDO33, VSNS_IN, VCOIL, VBRG, IO_B0, IO_A0, ENB	PTH_TP	30 GAUGE WIRE PAD	NP	TEST_PT30DPAD
22	7	VIN1, GND1, GND2, GND3, GND4, VIN, GND	TP	TEST POINT PC MINIATURE SMT	5015	test_pt_sm_135x70
23	1	J1	5P	CONN RCPT MCR USB AB SMD TH SHLL	ZX62D-AB-5P8	usb_micro_ab
24	1	J2	68000-105HLF	BERGSTIK II .100" SR STRAIGHT	68000-105HLF	sip5
25	1	J3	AC_Adapter	CONN POWER JACK 2.5X5.5MM HI CUR	PJ-002AH	CONN_POWER_JACK5_5MM
26	1	J4	TP	CONN HEADER 3POS .100" STR GOLD	901200763	sip3
27	1	J5	SIP con	4 Positions Header, Unshrouded Connector 0.100" (2.54mm) Through Hole Gold or Gold, GXT™	961104-6404-AR	sip-4
28	1	LED1	LED	LED RED CLEAR 0603 SMD	150060RS75000	0603_diode
29	1	LED2	LED	LED GREEN CLEAR 0603 SMD	150060GS75000	0603_diode
30	2	LX1, LX2	NP	Tx Coil assemble through hole	NA	TP_TXCoil
31	1	L1	4.7μH	FIXED IND 4.7μH 620MA 500 MOHM	CIG10W4R7MNC	L0603
32	1	L2	NP	Common mode EMI choke	ACM4520-901-2P-T-000	EMI_TDK_ACM4520L
33	1	PZ1	BUZZER	BUZZER PIEZO 4KHZ 12.2MM PC MNT	PS1240P02CT3	9235_buzzer
34	4	Q1, Q2, Q3, Q4	DMG7430LFG	MOSFET N-CH 30V 10.5A PWRDI3333	DMG7430LFG-7	powerdi3333_8ld_fet
35	3	Q5, Q7, Q8	2N7002	N-Channel 60-V (D-S) MOSFET	2N7002KT1G	SOT23_3
36	1	Q6	SIA453EDJ-T1-GE3	MOSFET P-CH 30V 24A PPAK SC-70-6	SIA453EDJ-T1-GE3	sc70_6ld_fet
37	1	RTH1	NP	NTC Thermistor 10k Bead	NTCLE203E3103JB0	0805
38	3	R1, R3, R7	1K	RES SMD 1K OHM 5% 1/16W 0402	RC0402JR-071KL	0402
39	1	R4	680	RES SMD 680 OHM 5% 1/16W 0402	RC0402JR-07680RL	0402
40	1	R5	NP	RES SMD 0.0 OHM JUMPER 1/10W	RC0402JR-070RL	0402
41	9	R6, R13, , R16, R20, R23, R41, R42, R43, R48	10K	RES SMD 10K OHM 1% 1/10W 0402	RC0402FR-0710KL	0402
42	5	R8, R26, R30, R31, R32	100K	RES SMD 100K OHM 5% 1/10W 0402	ERJ-2GEJ104X	0402
43	1	R24	NP	RES SMD 100K OHM 5% 1/10W 0402	ERJ-2GEJ104X	0402
44	1	R9	100	RES SMD 100 OHM 5% 1/10W 0603	RC0603JR-07100RL	0603
45	2	R10, R12	390K	RES SMD 390K OHM 5% 1/10W 0603	ERJ-3GEYJ394V	0603
46	1	R14	2.4K	RES SMD 2.4K OHM 5% 1/10W 0402	ERJ-2GEJ242X	0402
47	2	R11, R35	200K	RES SMD 200K OHM 1% 1/10W 0603	RC1608F204CS	0603
48	2	R15, R21	10	RES SMD 10 OHM 1% 1/10W 0402	ERJ-2RKF10R0X	0402

Item	Quantity	Reference	Value	Description	Part Number	PCB Footprint
49	1	R18	0.02	RES SMD 0.02 OHM 1% 1/8W 0805	WSL0805R0200FE A	0805
50	4	R19, R22, R40, R44	NP	RES SMD 10K OHM 1% 1/10W 0402	RC0402FR-0710KL	0402
51	4	R25, R27, R28, R29	12	RES SMD 12 OHM 5% 1/10W 0402	ERJ-2GEJ120X	0402
52	1	R33	3	RES SMD 3 OHM 1% 1/8W 0805	RC0805FR-073RL	0805
53	1	R34	100K	RES SMD 100K OHM 1% 1/10W 0603	ERJ-3EKF1003V	0603
54	2	R36, R37	0.1	RES SMD 0.1 OHM 5% 1/6W 0402	ERJ-2BSJR10X	0402
55	2	R38, R39	0	RES SMD 0.0 OHM JUMPER 1/10W	RC0402JR-070RL	0402
56	1	R45	220	RES SMD 220 OHM 1% 0.4W 0805	RC1206FR- 07220RL	1206
57	2	R46, R47	5.1k	RES SMD 5.1K OHM 5% 1/16W 0402	MCR01MRTJ512	0402
58	1	U1	P9242-R	Medium Power Transmitter	P9242-R	socketqfn_48_6x6_ 0p4
59	1	U2	NP	SPIFLASH 2M-BIT 4KB UNIFORM SECT	W25X20CLUXIG TR	uson_2x3_8LD

## 5. Board Layout

Figure 11. Silkscreen – Top of Board

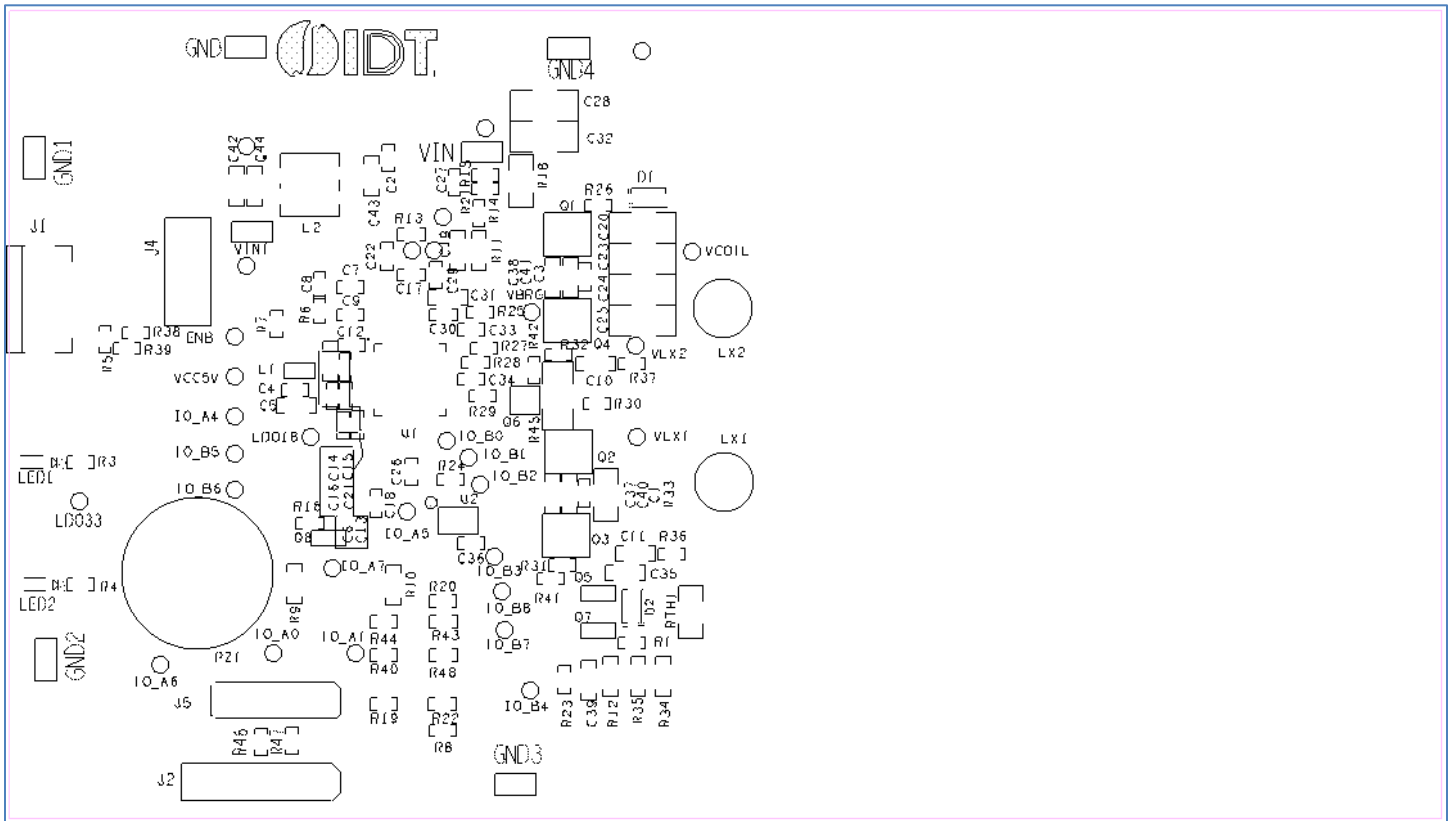




Figure 12. Copper – Top Layer

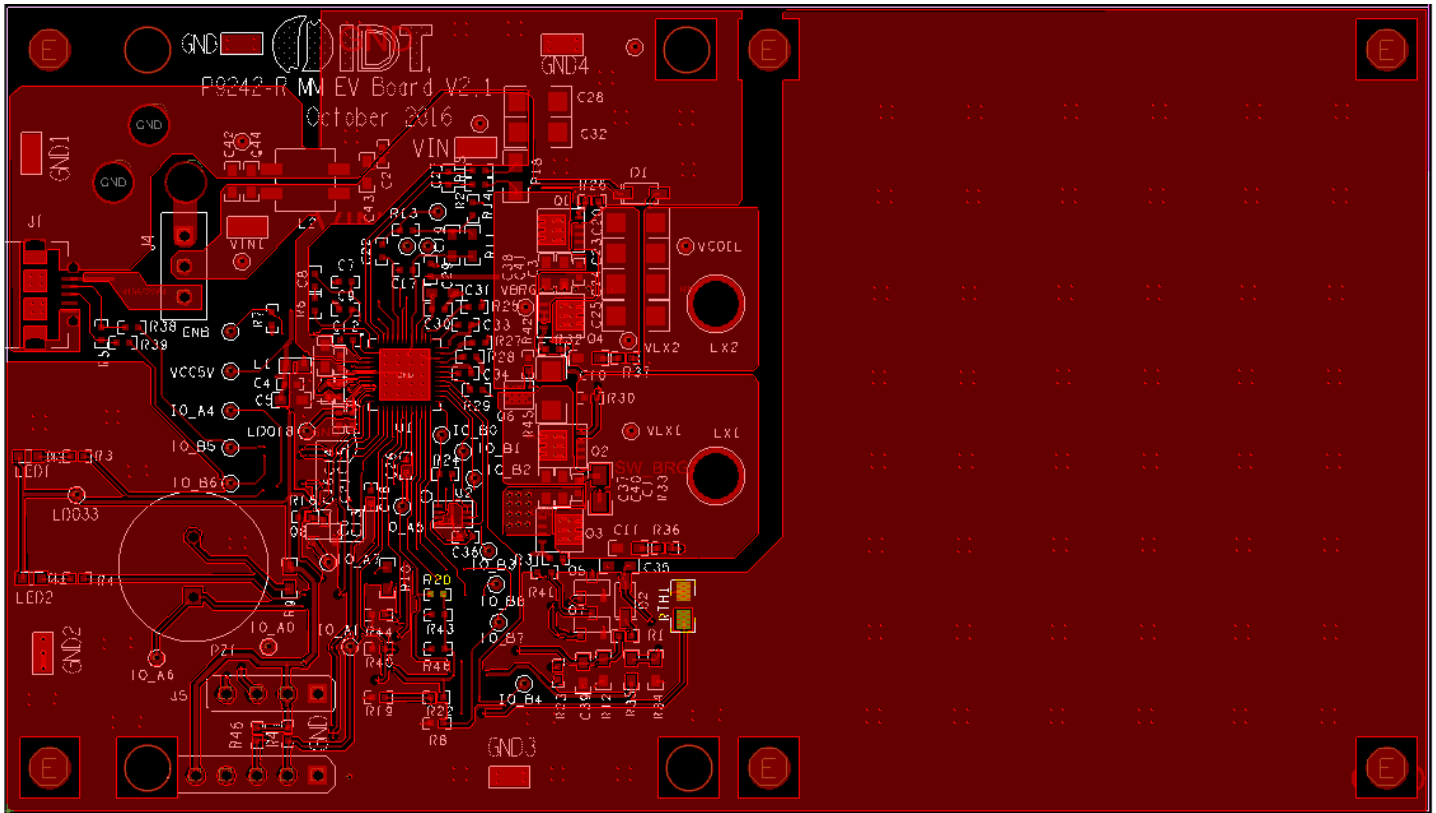


Figure 13. Copper L1 Layer

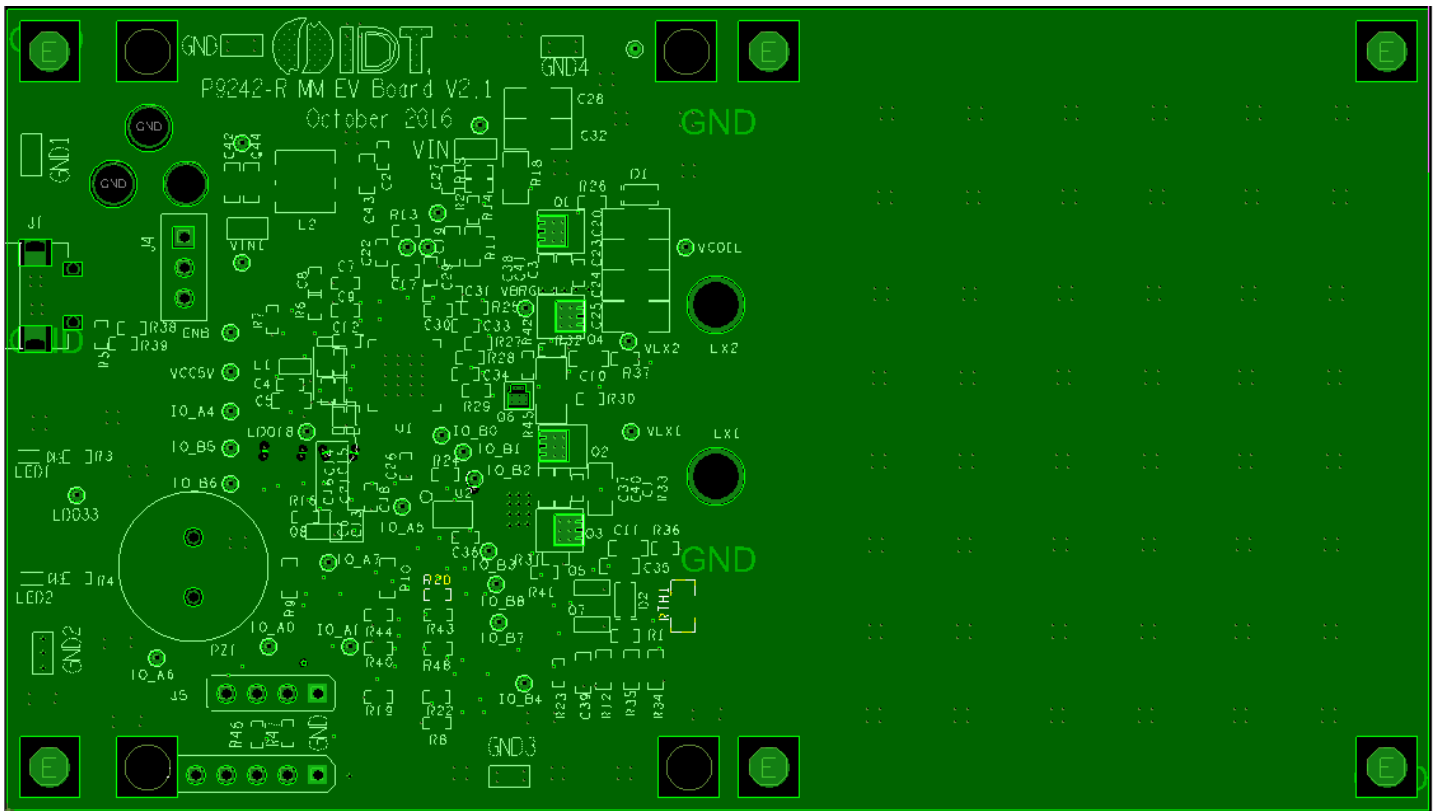


Figure 14. Copper L2 Layer

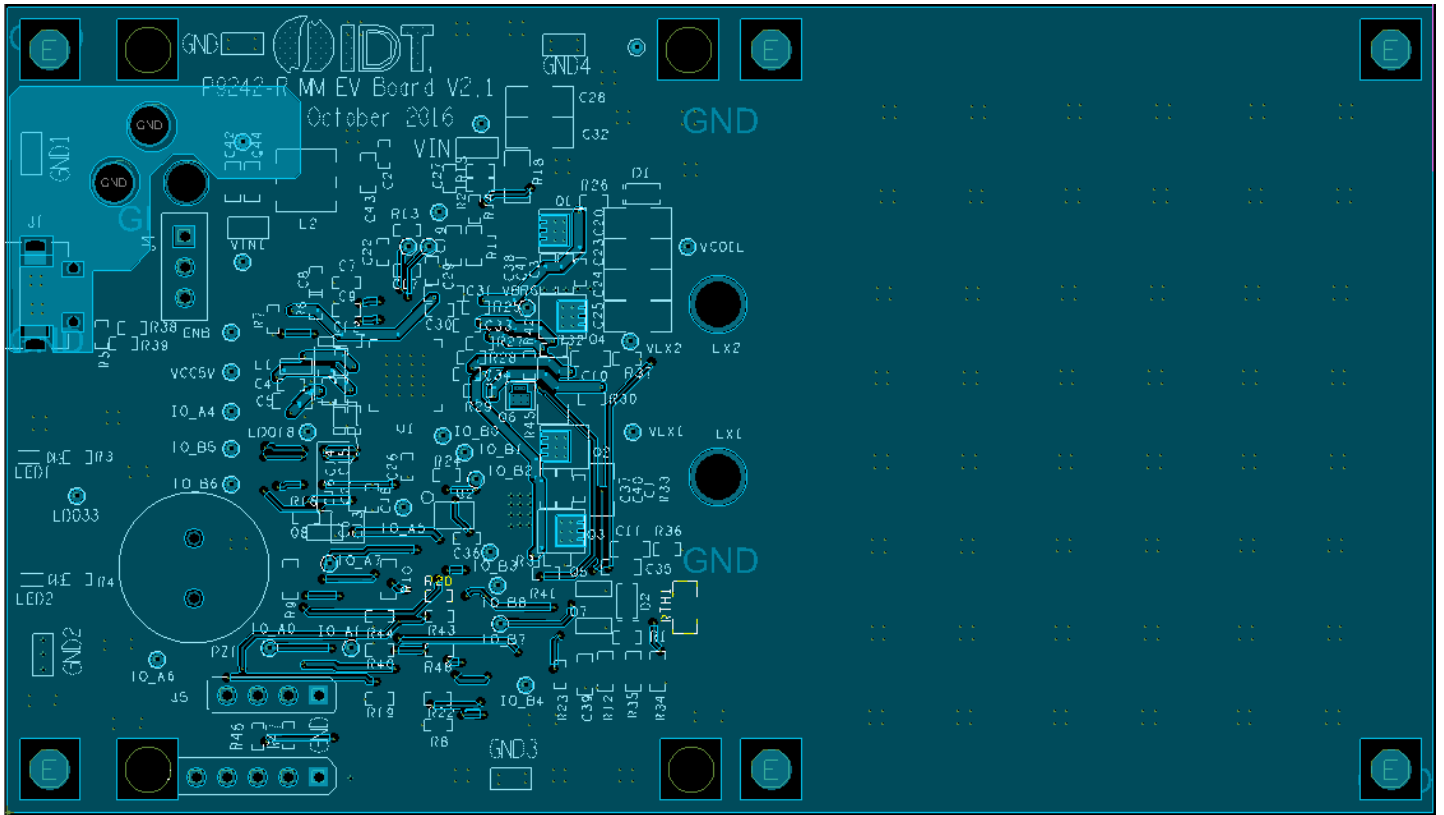
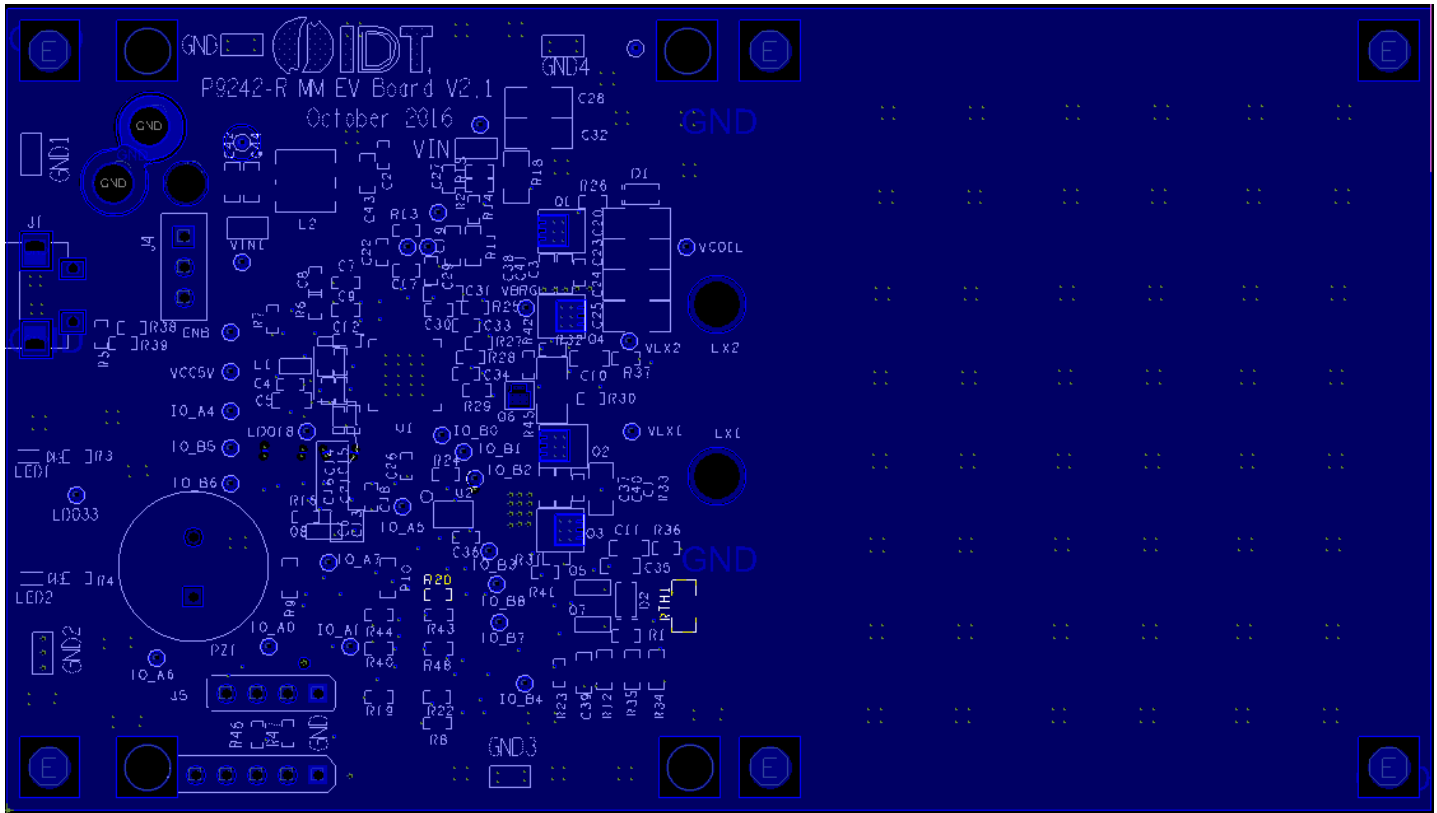


Figure 15. Copper Bottom



## 6. Ordering Information

Orderable Part Number	Description
P9242-R-EVK	P9242-R-EVK Evaluation Board

## 7. Revision History

Revision Date	Description of Change
December 22, 2016	Initial release of document.

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