

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.

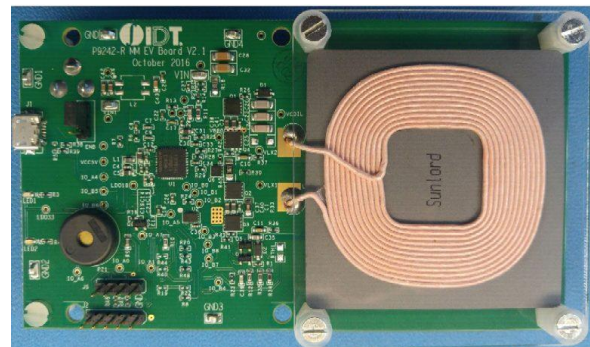
Kit Contents

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

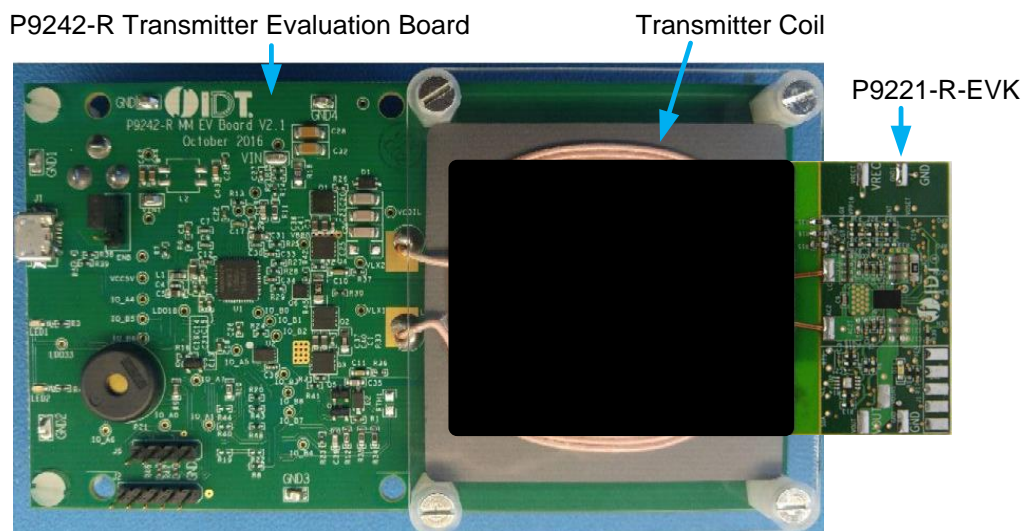
Features

- 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 mm²
- 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

Disclaimer

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- (i) delivered hardware or software
- (ii) non-observance of instructions contained in this manual and in any other documentation provided to user, or
- (iii) misuse, abuse, use under abnormal conditions, or alteration by anyone other than IDT.

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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:

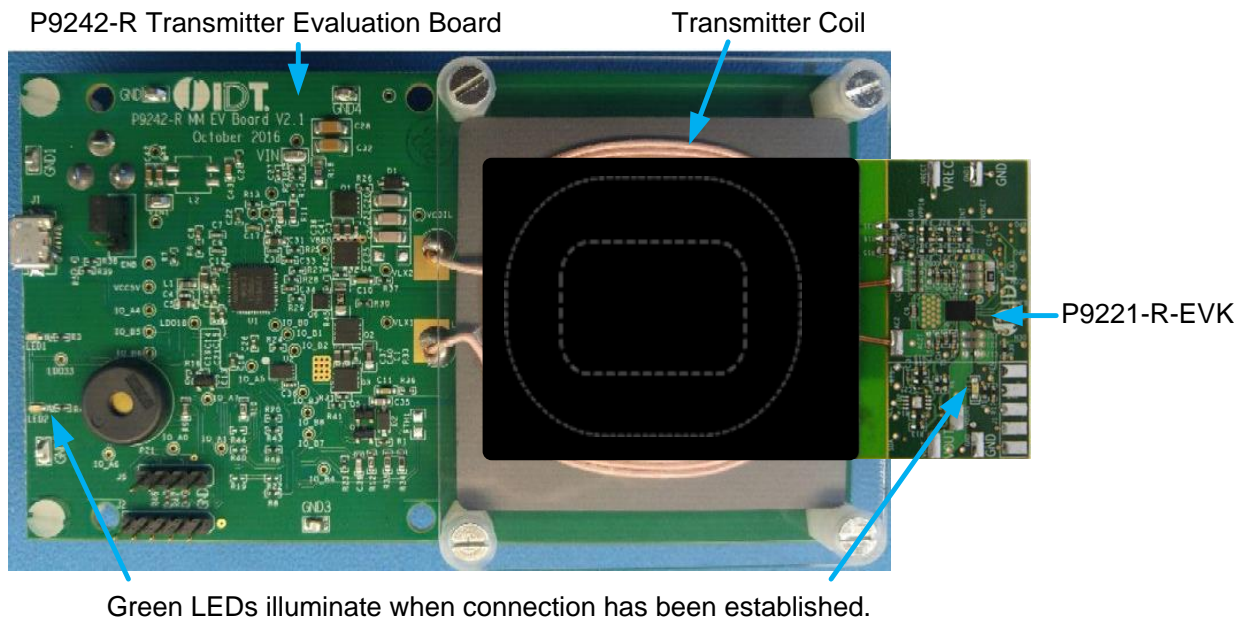
- P9221-R-EVK Receiver Evaluation Board or any WPC-1.2.2 compliant receiver
- Power supply or 12V/2A AC adaptor

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

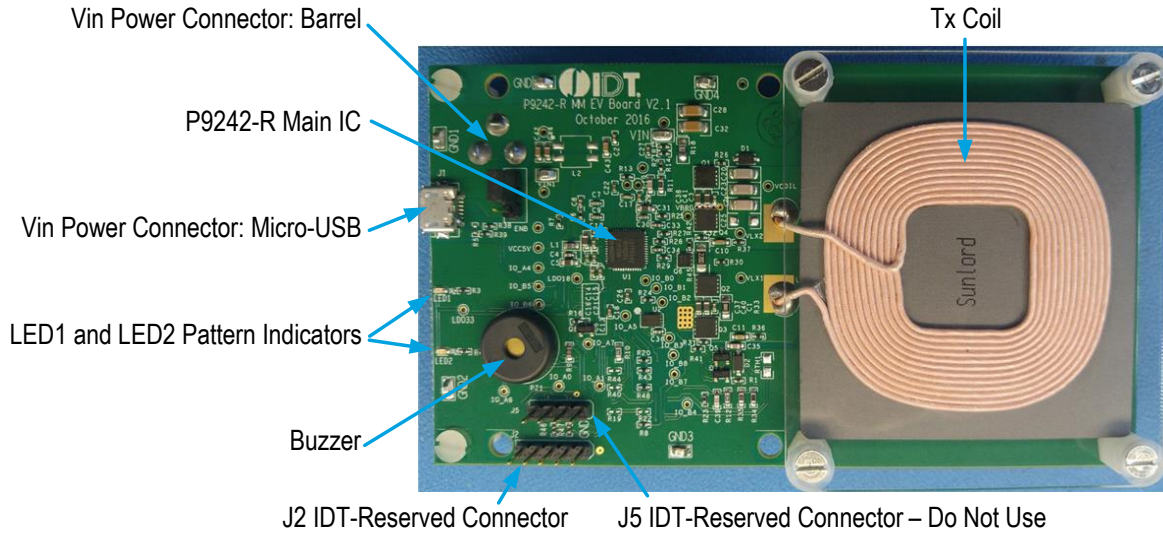
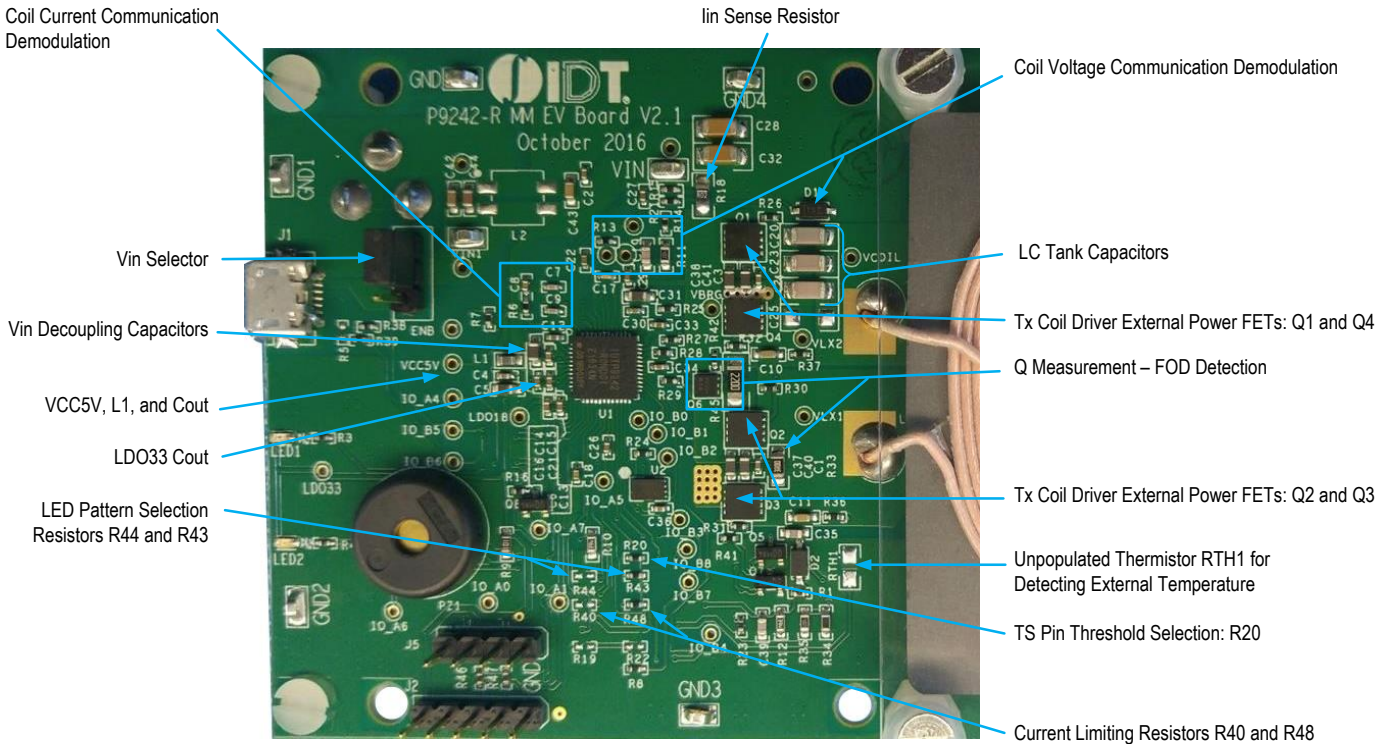


Figure 3. P9242-R V2.1 Evaluation Board Details



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

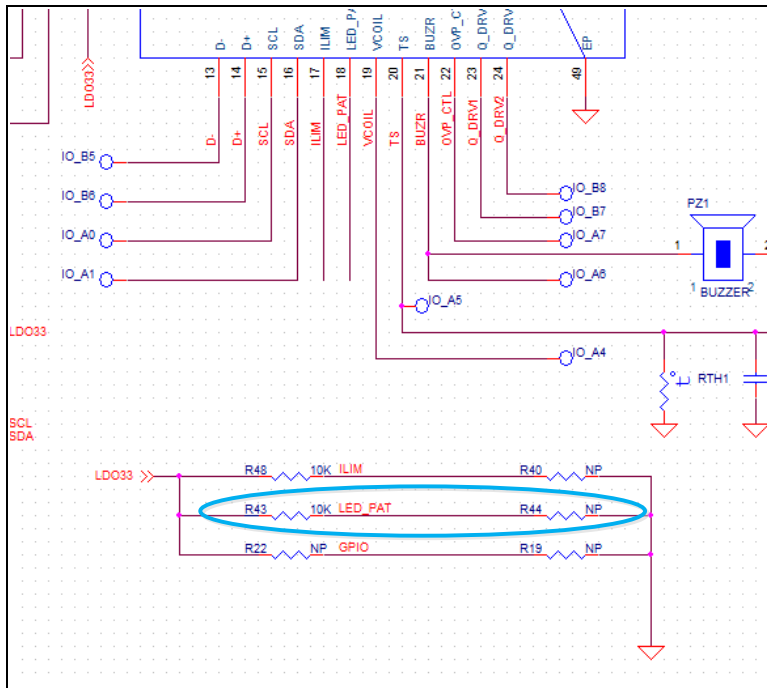
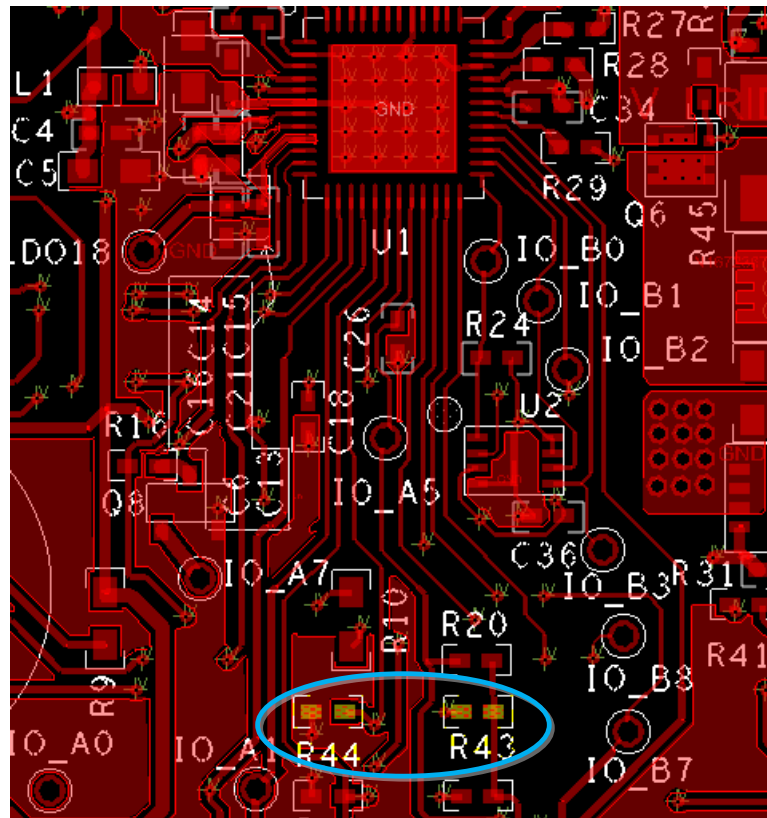


Figure 5. R33 and R34 PCB Location



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}

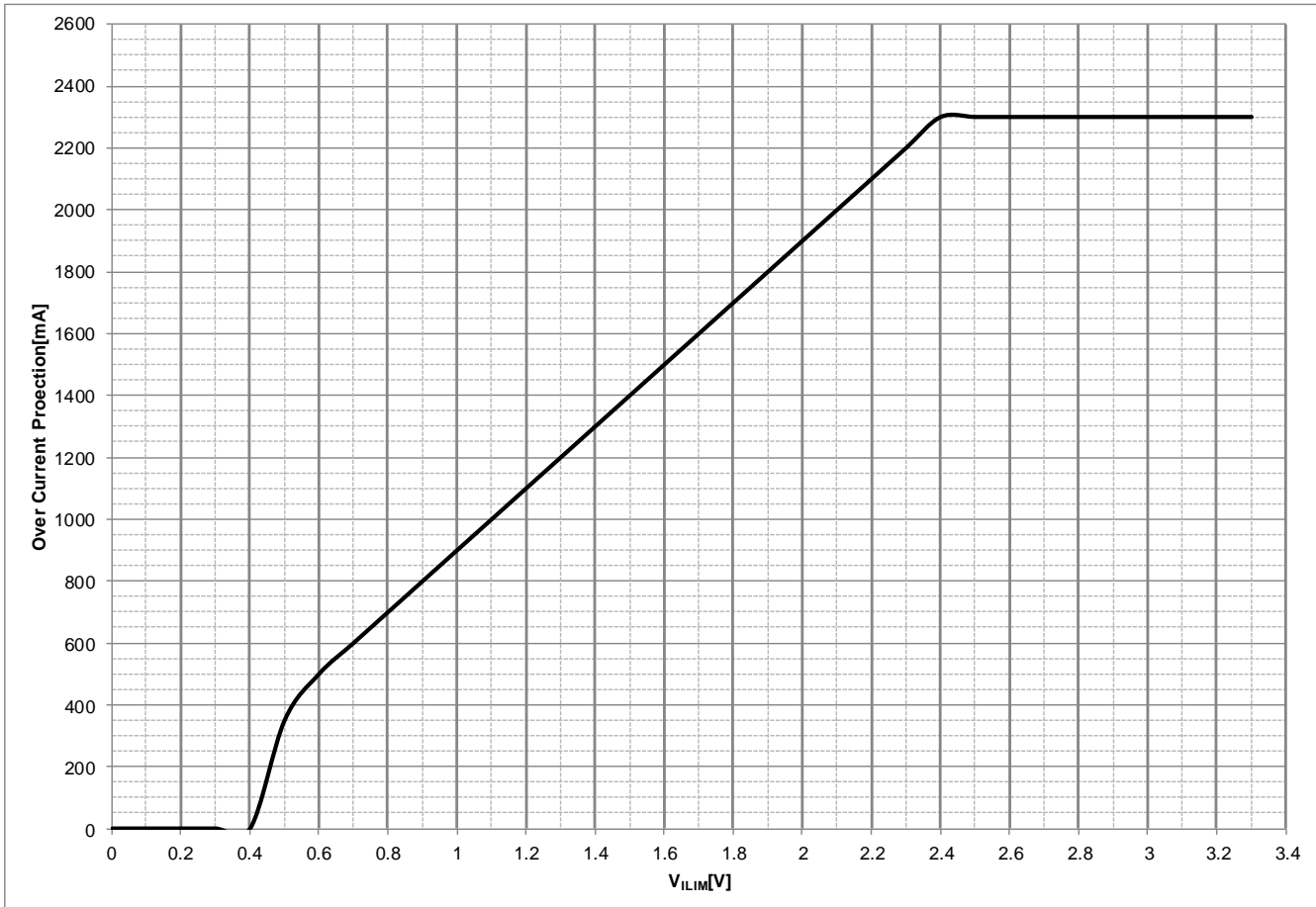


Figure 7. R48 and R40 Schematic Location

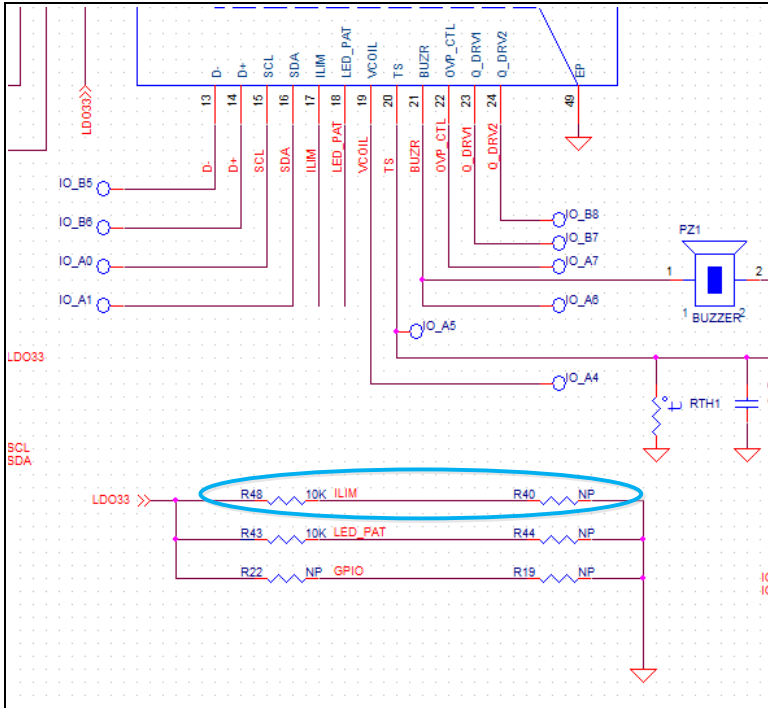
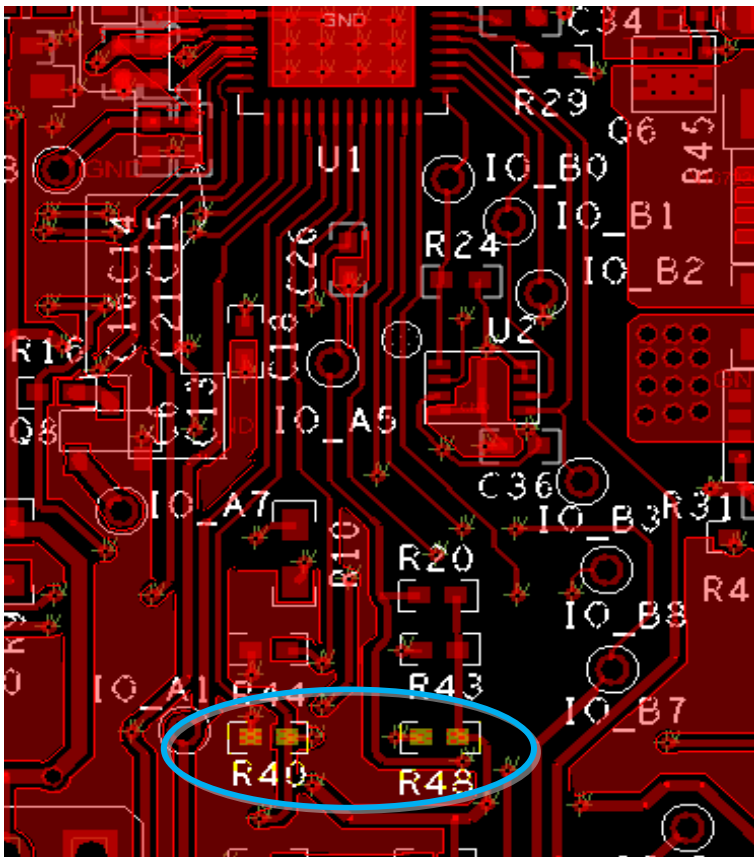


Figure 8. R48 and R40 PCB Location



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.

$$V_{TS} = V_{LDO33} \times \frac{NTC}{R20 + NTC} \tag{Equation 1}$$

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

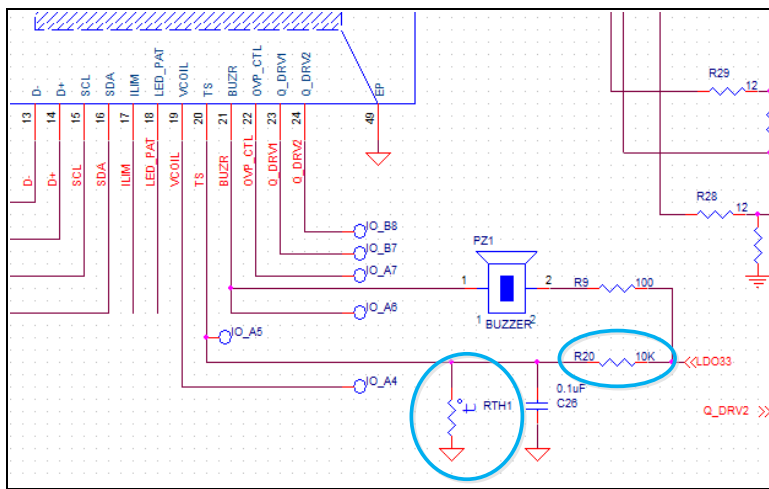
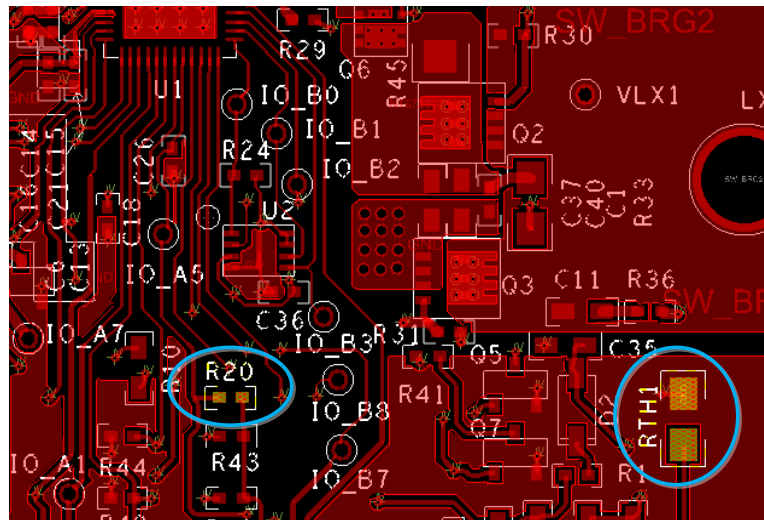


Figure 10. RTH1 and R20 R40 PCB Location



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

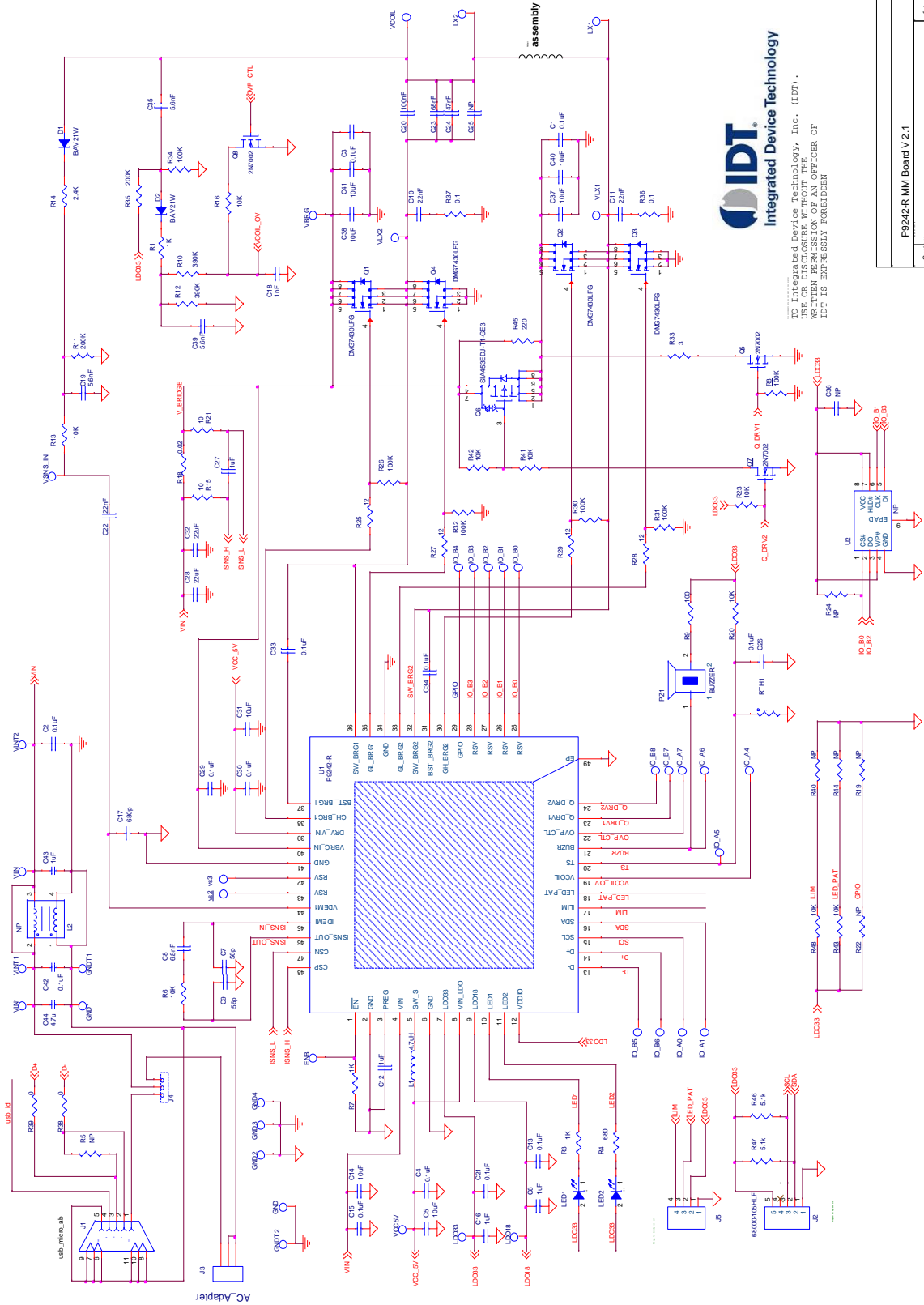
The following coil is recommended with P9242-R transmitter for 15W applications for optimum performance. The recommended vendor has been tested and verified.

Table 2. Recommend Coil Manufacturer

| Output Power | Vendor | Part Number | Inductance at 100kHz | DCR at 20°C |
|--------------|---------|-----------------|----------------------|--------------|
| 15W | SUNLORD | SWA53N53H30C11B | 10 μ H | 50m Ω |

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

3.1 P9242-R Evaluation Board Schematics



TO: Integrated Device Technology, Inc. (IDT).
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| | |
|------------------------------|-----|
| P9242-R MM Board V.2.1 | |
| ConfIdem | 2.1 |
| 1. revised 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 μ F | CAP CER 0.1 μ F 25V 10% X7R 0402 | C1005X7R1E104K050BB | 0402 |
| 2 | 7 | C5, C14, C31, C37, C38, C40, C41 | 10 μ F | CAP CER 10 μ F 25V 20% X5R 0603 | C1608X5R1E106M080AC | 0603 |
| 3 | 4 | C6, C12, C16, C27 | 1 μ F | CAP CER 1 μ 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 μ 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 μ F 100V C0G 1206 | C3216C0G2A104K160AC | 1206 |
| 11 | 1 | C22 | 22nF | CAP CER 0.022 μ F 50V 10% X7R 0402 | GRM155R71H223KA12D | 0402 |
| 12 | 1 | C23 | 68nF | CAP CER 0.068 μ F 100V NP0 1206 | C3216C0G2A683K160AC | 1206 |
| 13 | 1 | C24 | 47nF | CAP CER 0.047 μ F 100V NP0 1206 | C3216C0G2A473J115AC | 1206 |
| 14 | 1 | C25 | NP | CAP CER 10000PF 100V C0G 1206 | C3216C0G2A103J115AA | 1206 |
| 15 | 2 | C28, C32 | 22 μ F | CAP CER 22 μ F 25V 20% X5R 1206 | GRM31CR61E226KE15L | 1206 |
| 16 | 1 | C36 | NP | CAP CER 0.1 μ F 25V 10% X7R 0402 | C1005X7R1E104K050BB | 0402 |
| 17 | 1 | C42 | 0.1 μ F | 0.10 μ F 50V Ceramic Capacitor X7R 0603 | GRM188R71H104KA93D | 0603 |
| 18 | 1 | C43 | 1 μ F | 1 μ F 25V Ceramic Capacitor X5R 0603 | GRM188R61E105KA12D | 0603 |
| 19 | 1 | C44 | 4.7 μ F | 4.7 μ 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

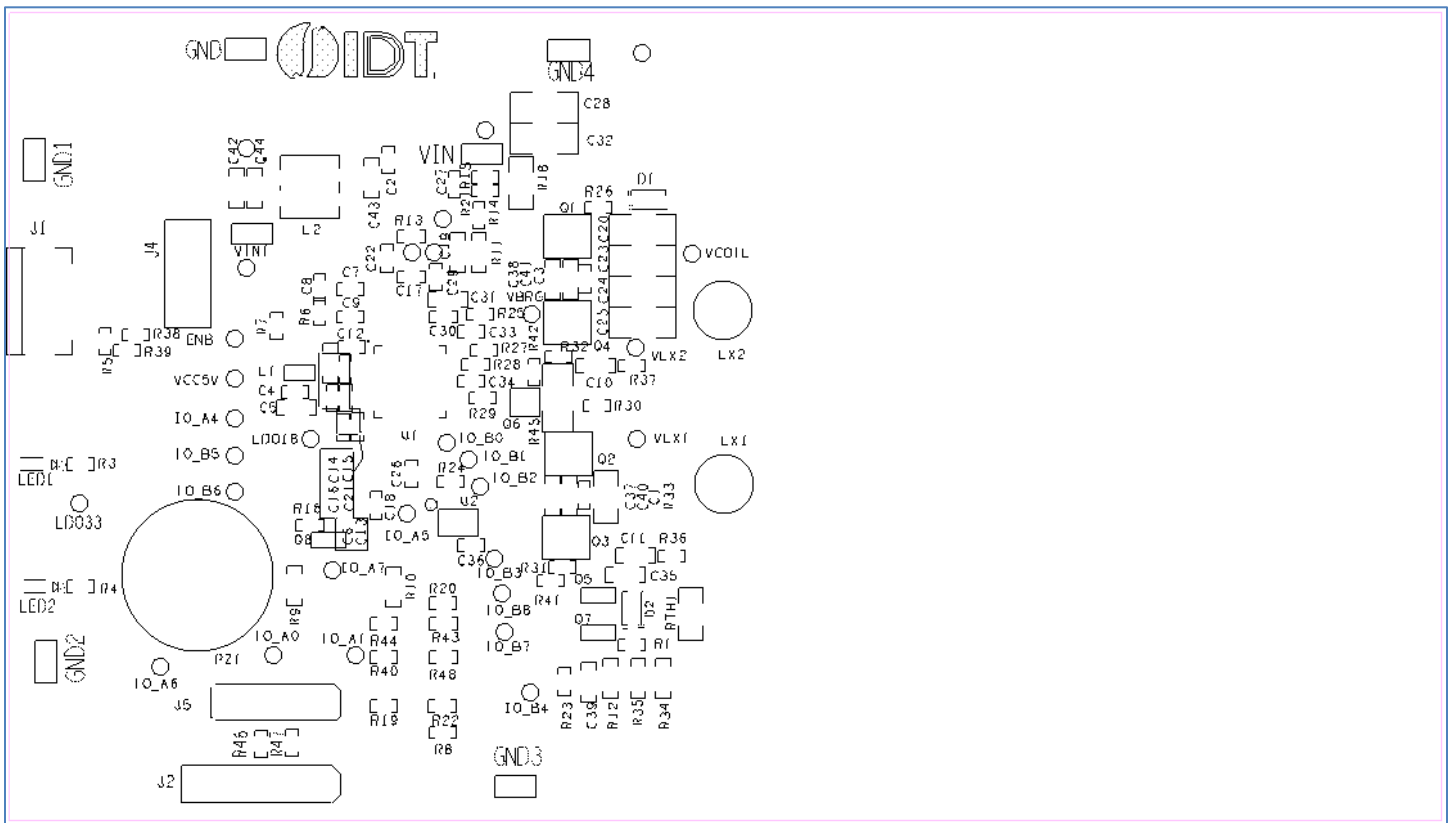


Figure 12. Copper – Top Layer

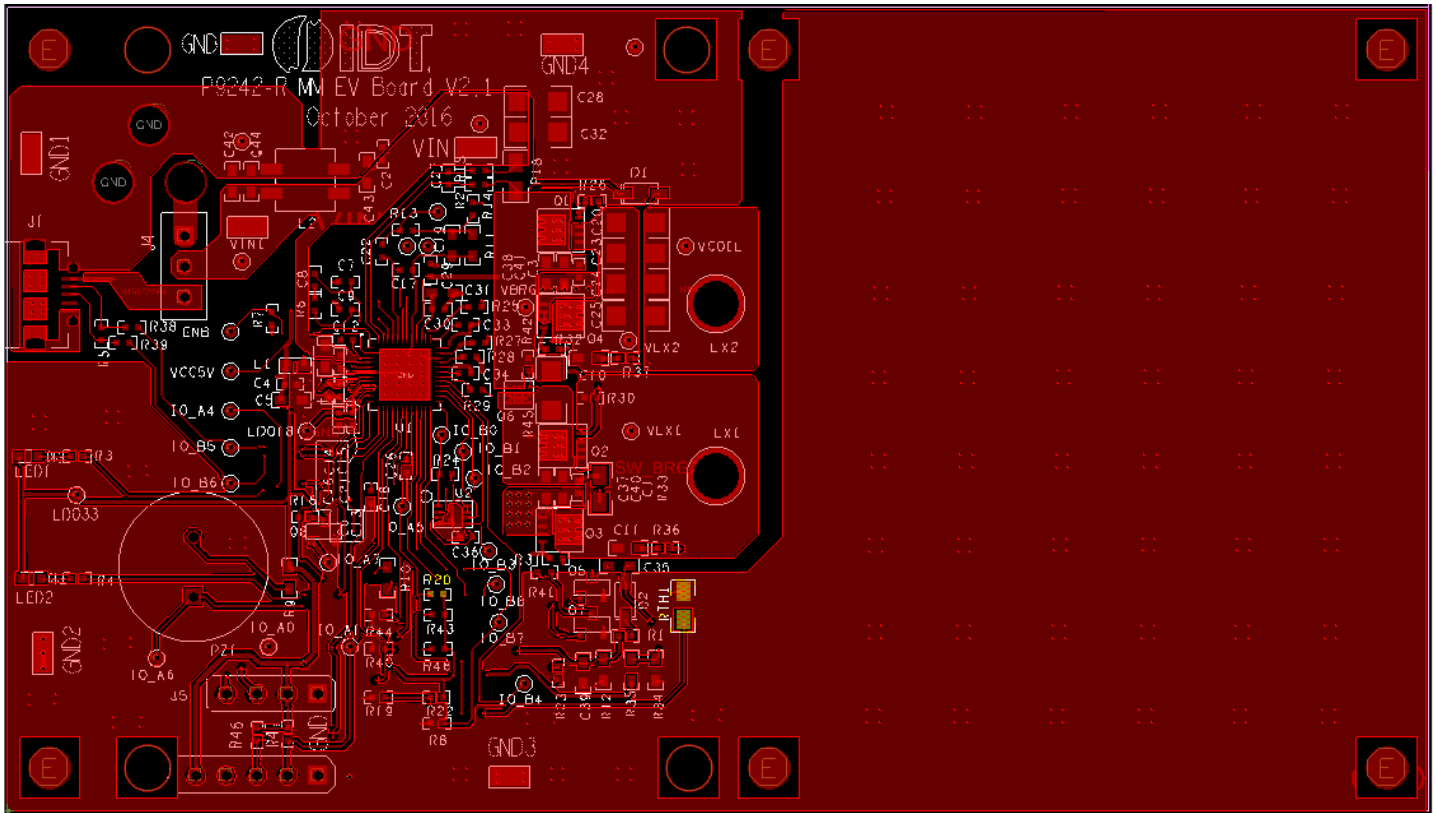


Figure 13. Copper L1 Layer

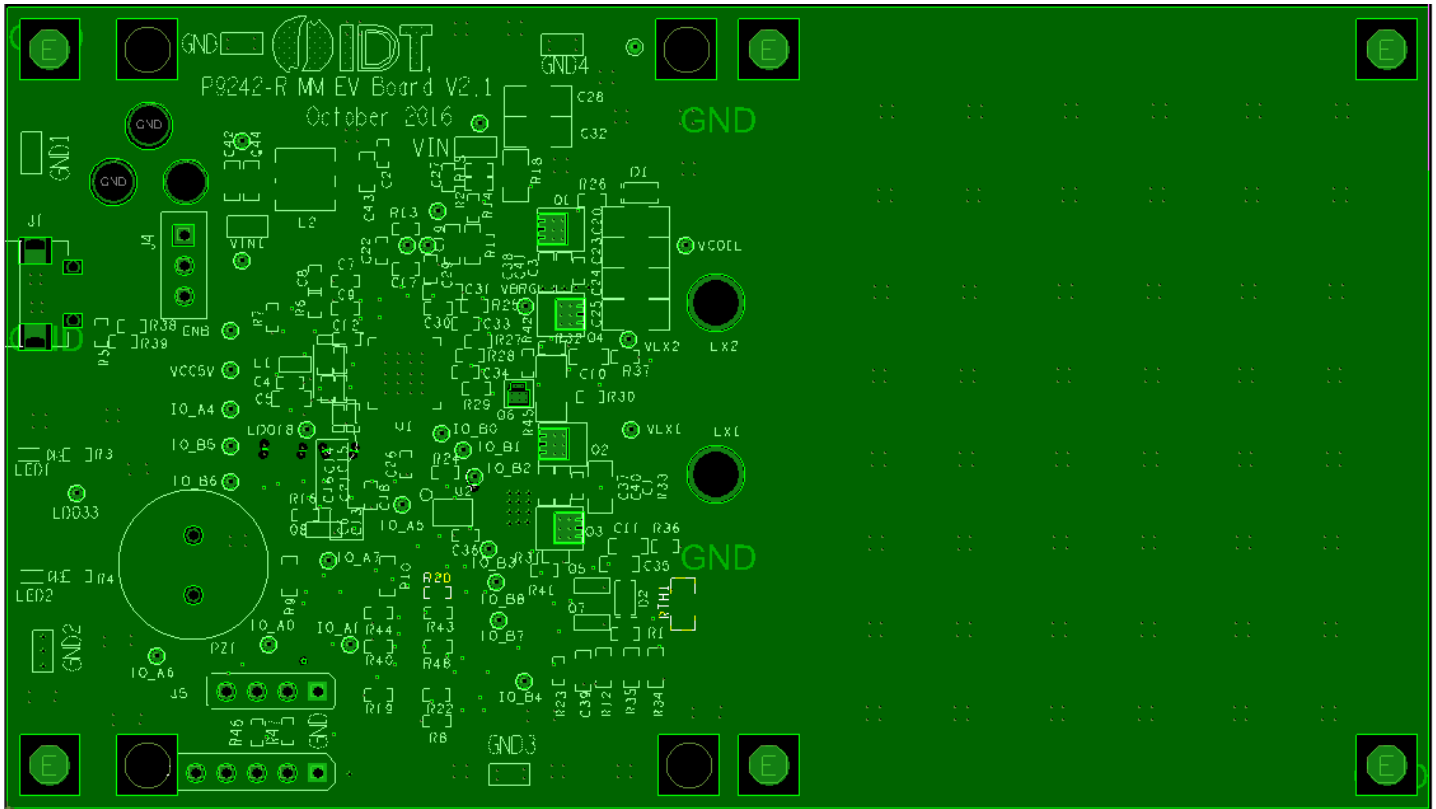


Figure 14. Copper L2 Layer

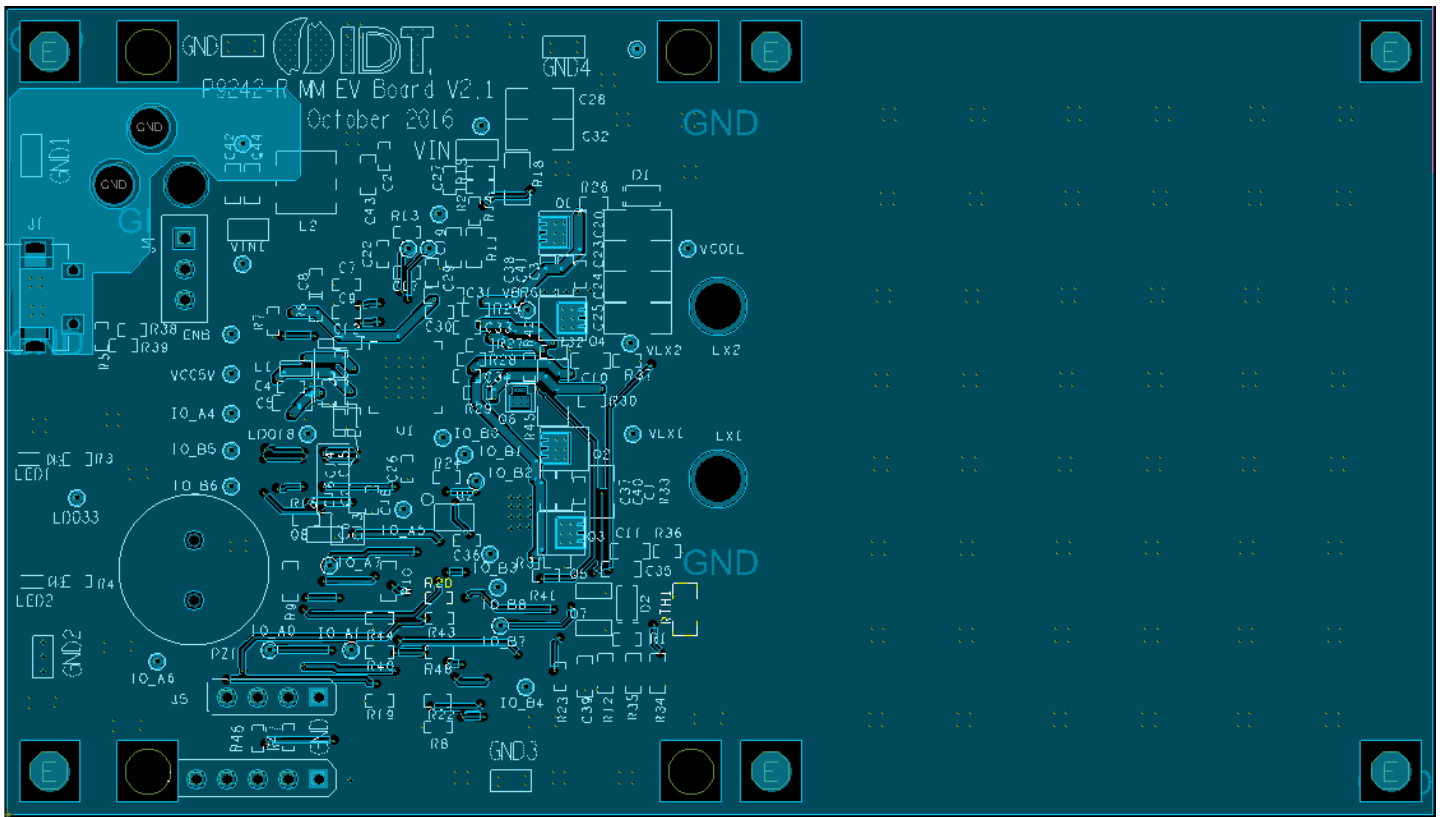
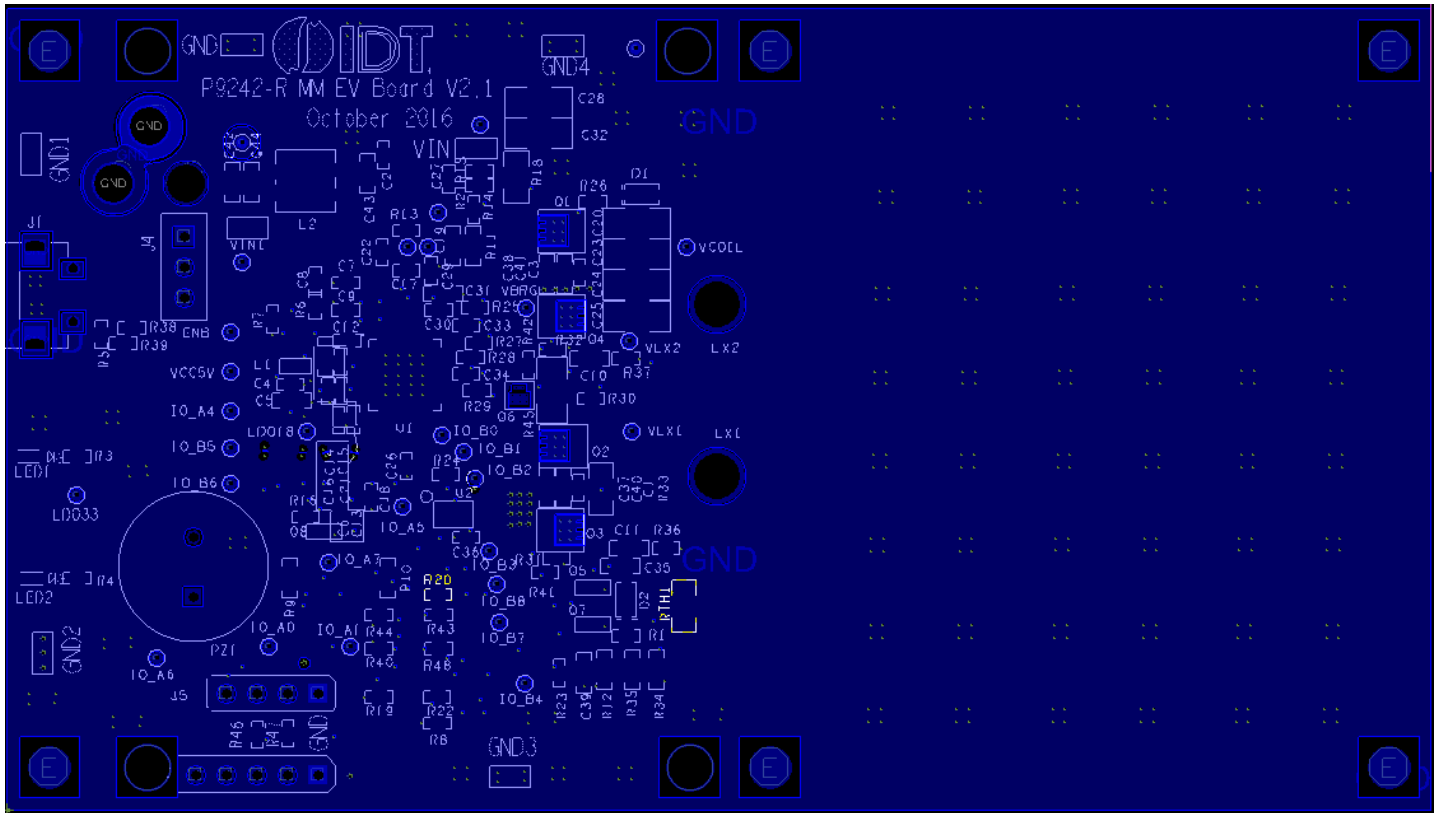


Figure 15. Copper Bottom



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. |