

Description

The Renesas WP15WBD-RK Evaluation Kit demonstrates 15W wireless power transfer and bi-directional data communication between a transmitter (Tx) board with the Renesas P9242-R3 Wireless Power Transmitter IC and a receiver (Rx) board with the Renesas P9221-R3 Wireless Power Receiver IC. The bi-directional data communication channel enables users to authenticate a wirelessly charged receiver device with a specific charging transmitter base or to transfer system data without any additional hardware.

This evaluation kit adds bi-directional communication to Renesas' standard, WPC 1.2-compliant, 15W transmitter P9242-R and receiver P9221-R evaluation kits without compromising any existing features. Its main contents are the transmitter P9242-R3-EVK Evaluation Board and the receiver P9221-R3-EVK Evaluation Board.

In customer end systems, the transmitter and receiver boards need to have external microcontrollers (MCU) to orchestrate the bi-directional communication. The MCU on the receiver board loads data into the user outgoing data registers and triggers the communication by writing to the *Command* register. The transmitter receives the data and interrupts the external MCU on the transmitter pad. The transmitter follows the same procedure to send the data to the receiver. There are no external MCU's on the P9242-R3-EVK and P9221-R3-EVK Evaluation Boards. Instead, *IDT I2C Lite*, an intuitive I2C-based graphical user interface (GUI), and two USB-to-I2C dongles are used to emulate external MCUs. The USB-to-I2C dongles are included in the kit. The latest version of the *IDT I2C Lite* software is available on the IDT webpage.

This manual focuses on demonstrating the bi-directional data communication features of the P9242-R3 and P9221-R3. The P9242-R3-EVK and P9221-R3-EVK offer the flexibility to program parameters such as the over-current limit and foreign-object detection (FOD) limits by changing resistors. Refer to the user manuals for the P9242-R-EVK Transmitter Evaluation Board and P9221-R-EVK Receiver Evaluation Board for more details related to programming parameters.

Features

- Supports bi-directional data communication
- Enables device authentication and system data transfer
- Up to 15W of power transfer
- 87% end-to-end efficiency
- Flexibility to program parameters
- Intuitive *IDT I2C Lite* GUI
- Base kit is WPC-1.2-compliant

Kit Contents

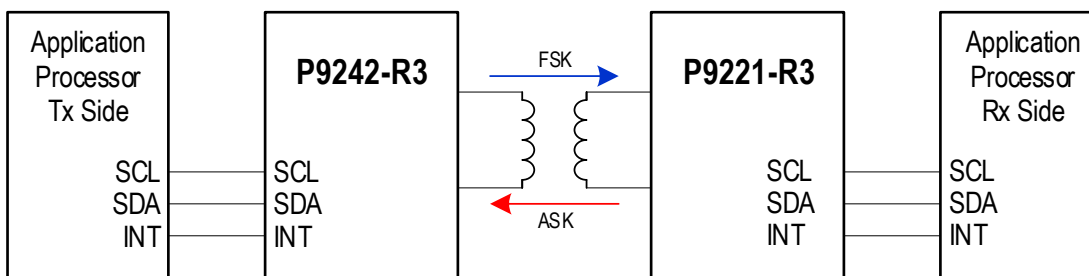
- P9242-R3-EVK V 2.1 Transmitter Evaluation Board
- P9221-R3-EVK V2.2 Receiver Evaluation Board
- Two USB-to-I2C Dongles
- Adapter: 12V/2A AC

Additional Support

This flexible, turn-key reference design is supported by online design resources to significantly expedite the design-in effort and enable rapid prototyping:

- Schematics
- Allegro® layout files

System Block Diagram



* Allegro® is a trademark of Cadence Systems.

Important Notes

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Restrictions in Use

Renesas' WP15WBD-RK Evaluation Kit 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:

- Computer with the Windows® 7 or Windows® 10 operating system.
Note: An optional second computer can expedite the evaluation. For this option, a second USB-to-I2C dongle is provided in the kit. In this case, repeat the setup procedures in section 1.2 for the second computer using the second dongle.
- Oscilloscope
- Multimeter
- Power cables

1.2 Required Software on Computer

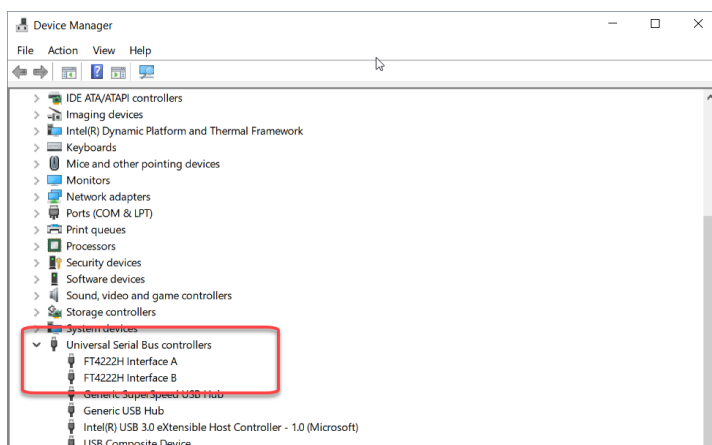
Visit the WP15WBD-RK website at www.IDT.com/WP15WBD-RK, and download latest version of the *IDT I2C Lite* software, script files, and USB drivers from the IDT website. The software provides an intuitive graphical user interface for sending I2C commands using the USB-to-I2C dongle shipped with the Evaluation Kit.

1.2.1 Software Installation

Follow these procedures to install the software:

1. Do not connect the USB-to-I2C dongle before installing the software.
2. Run the downloaded *USB Drivers Setup* executable file and follow the user prompts to install the USB drivers.
3. After finishing the setup of the USB drivers, connect one of the USB-to-I2C dongles to the USB port. Wait for a few moments to let Windows® map the drivers for the dongle.
4. Open the Device Manager from the Windows control panel and check the devices listed under “Universal Serial Bus controllers” section. “FT4222H Interface A” and “FT4222H Interface B” should appear in this section as shown in Figure 1.
5. Run the *IDT I2C Lite Setup* file and follow the user prompts to install the *IDT I2C Lite* software.
6. Place the downloaded script files in the *C:\Users\...\AppData\Roaming\IDT I2C Lite* folder to expedite loading the script files into the *IDT I2C Lite* software. These scripts contain a series of I2C commands to send and receive data on the receiver and transmitter.

Figure 1. Windows Device Manager Display for Troubleshooting the USB Connection

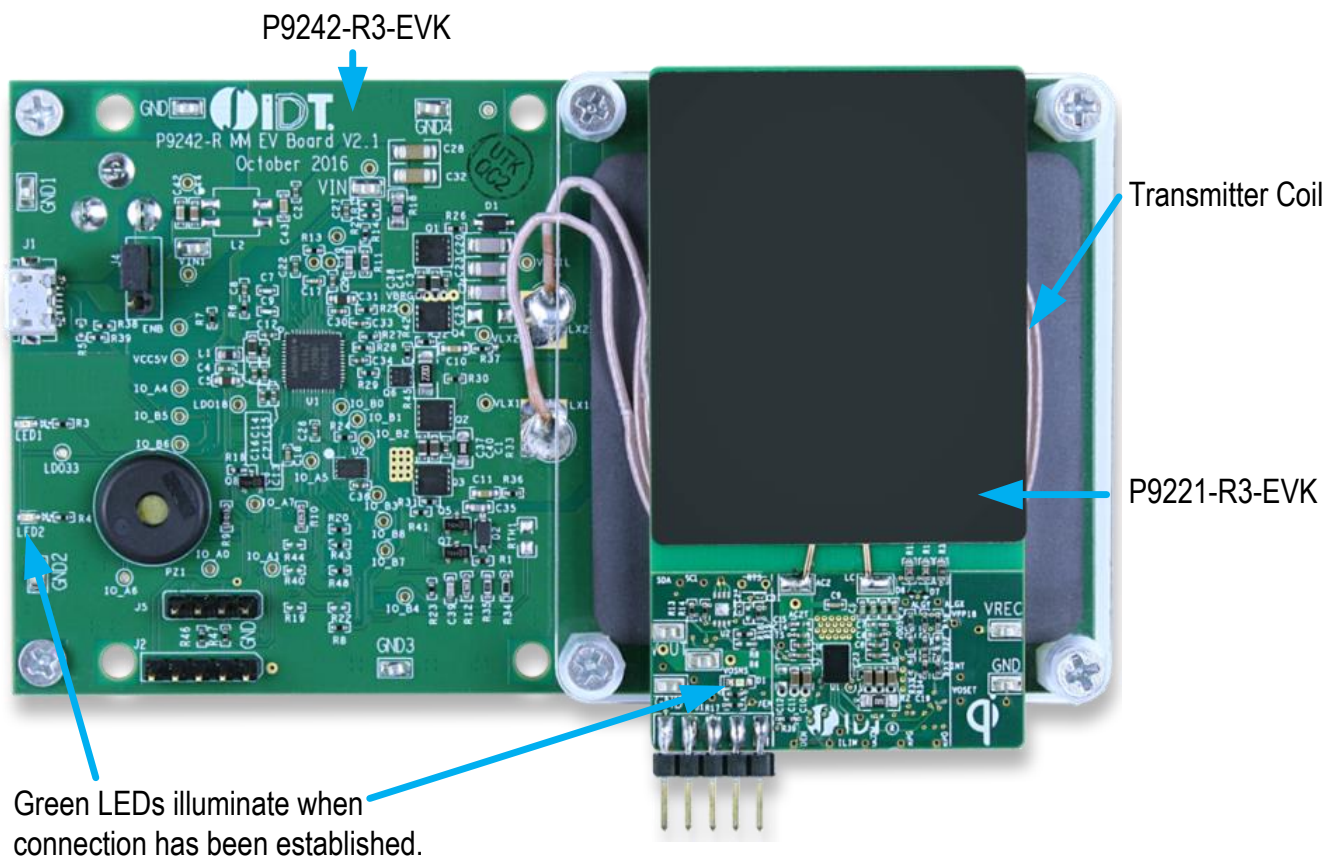


1.3 Kit Hardware Connections

Follow these procedures to set up the kit as shown in Figure 2.

1. Plug the 12V adapter or user's power supply into the J3 barrel connector on the bottom of the P9242-R3-EVK board (see Figure 7).
2. Place the P9221-R3-EVK on the transmitter (TX) pad with the components facing up as shown in Figure 2.
3. Verify that the two green LEDs identified in Figure 2 are illuminated indicating that coupling has been established.
4. Connect wires to the VOUT and GND test points on the P9221-R3-EVK receiver to measure the output voltage (see Figure 6) and apply a load requiring less than the programmed current limit.
5. Connect the USB-to-I2C dongle to the computer's USB port. If using a second computer, connect the second dongle to its USB port.
6. To send I2C commands to the P9221-R3-EVK, connect the I2C header on one of the connected dongles to J1 on the P9221-R3-EVK as shown in Figure 3. The black wire on the dongle should be on the GND pin of the J1 Header. See sections 3.1 and 3.2 for detailed instructions.
7. To send I2C commands to the P9242-R3-EVK, connect the I2C header on one of the connected dongles to J2 on the P9242-R3-EVK as shown in Figure 4. The black wire on the dongle should be on the GND pin of the J2 header. See sections 3.1 and 3.2 for detailed instructions.

Figure 2. Evaluation Kit Connections using the P9242-R3 Transmitter Evaluation Board and the P9221-R3 Receiver Evaluation Board



Note: The buzzer shown on the P9242-R3-EVK is not placed for this kit.

Figure 3. I2C Header Connection to the P9221-R3-EVK Receiver Board

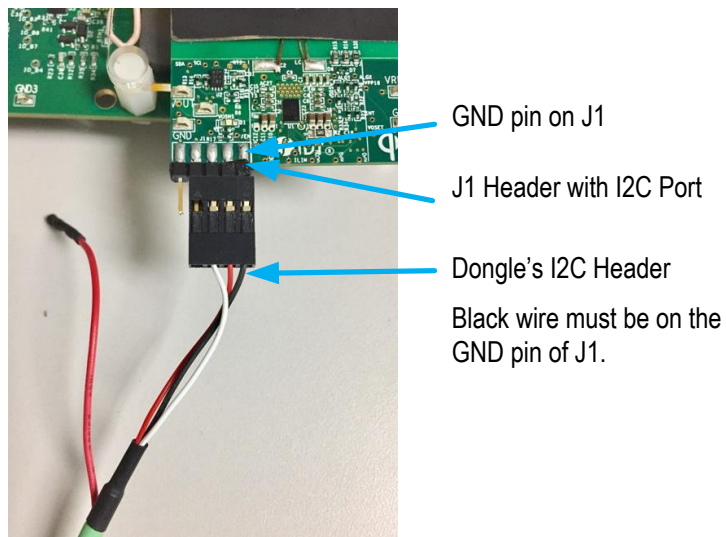


Figure 4. I2C Header Connection to the P9242-R3-EVK Transmitter Board

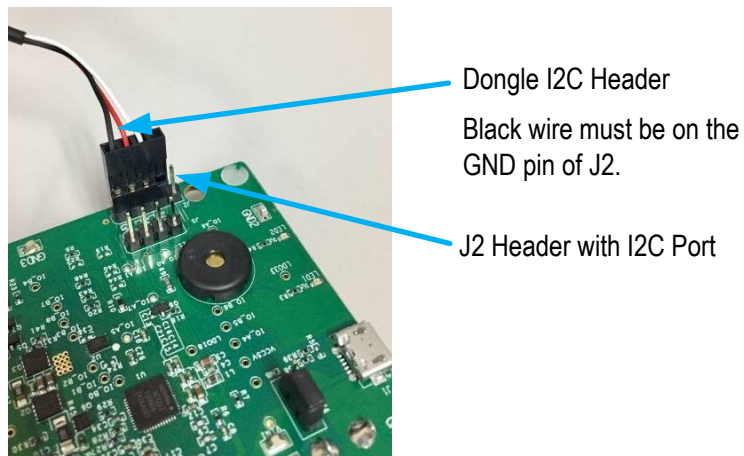
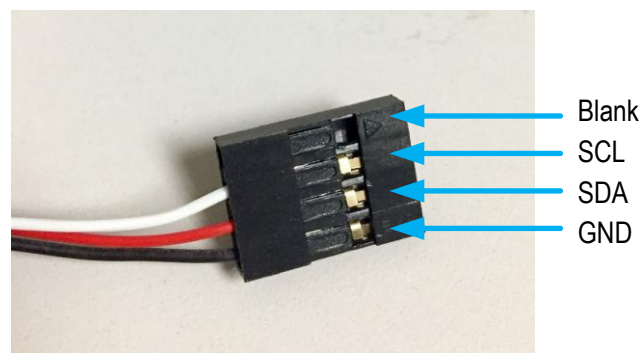


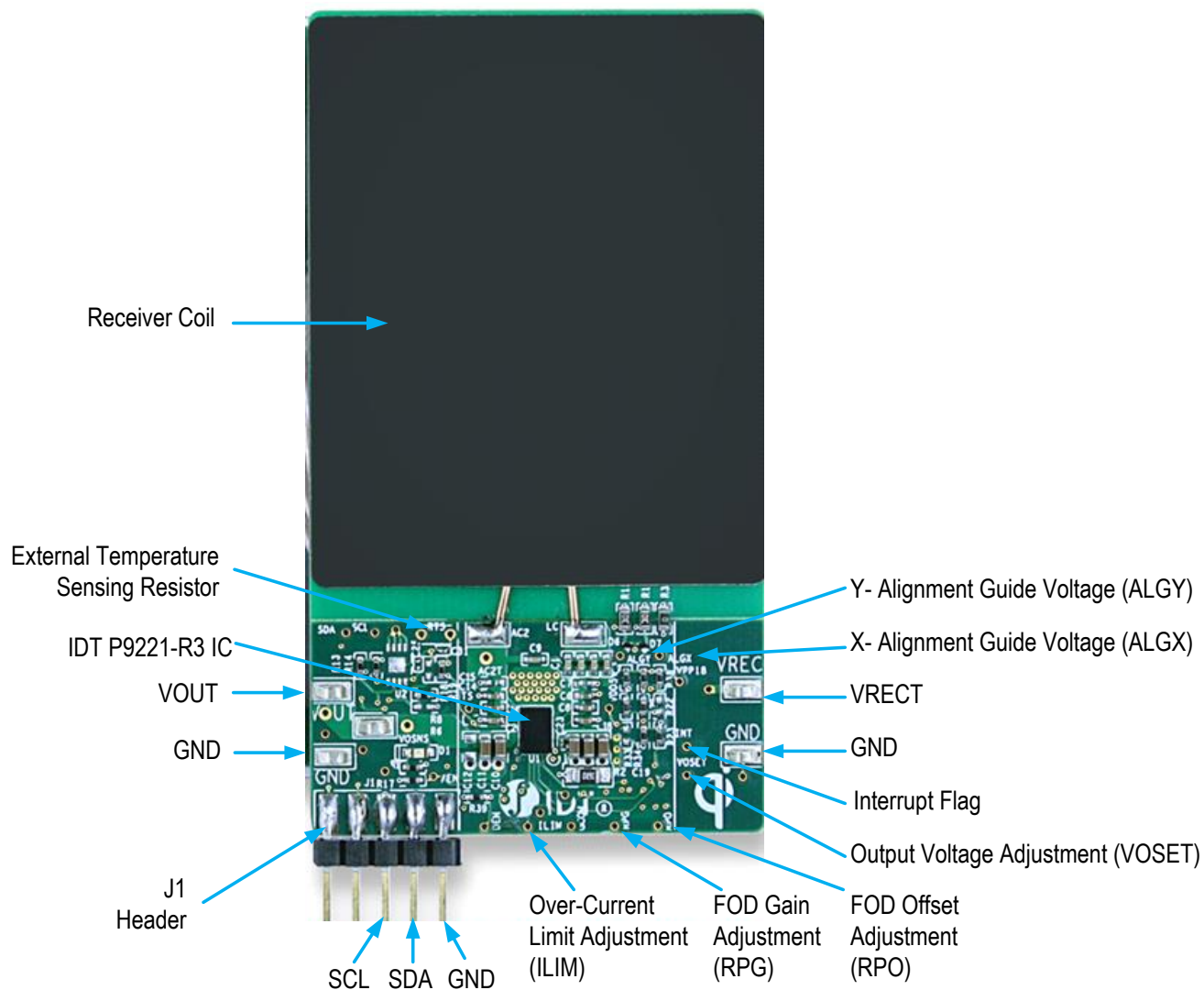
Figure 5. I2C Dongle Header



2. Usage Guide

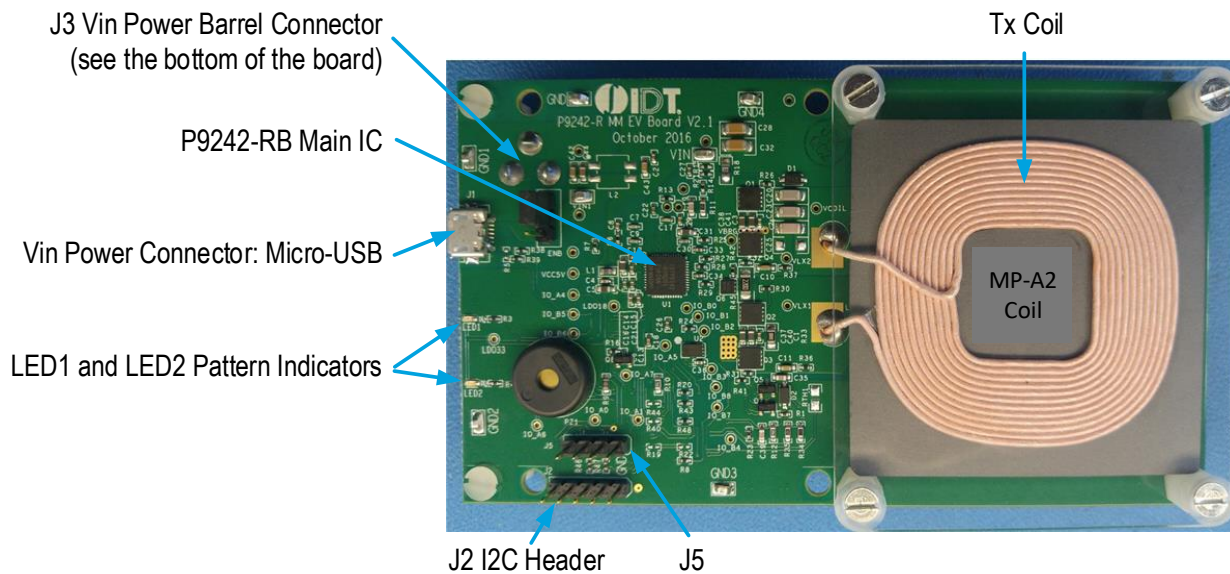
2.1 Overview of the P9221-R3-EVK

Figure 6. P9221-R3 V2.2 Evaluation Board Features



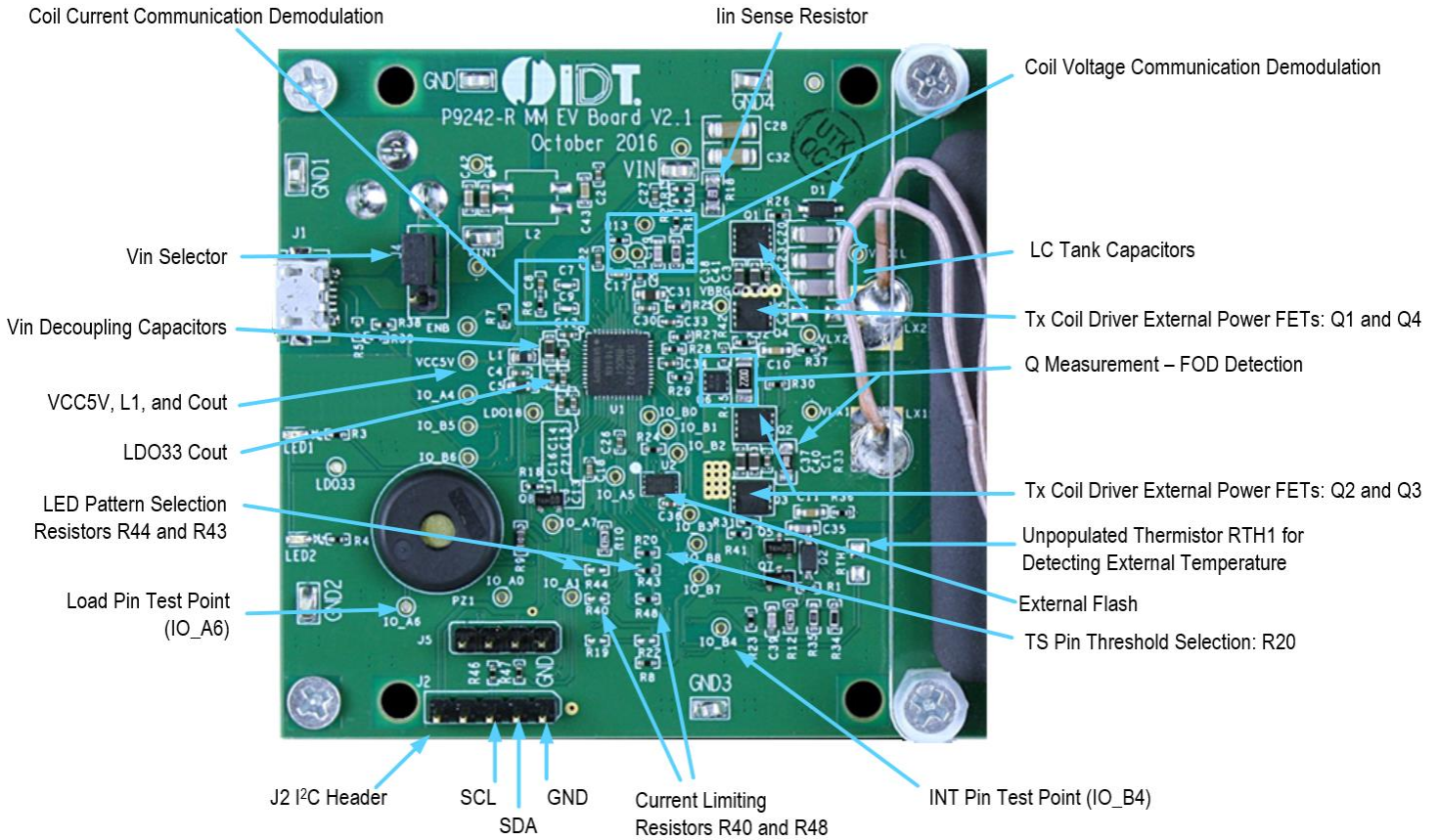
2.2 Overview of the P9242-R3-EVK

Figure 7. P9242-R3 V2.1 Evaluation Board Features



Note: The P9242-RB IC is used on the P9242-R3 V2.1 Evaluation board instead of the P9242-R3 IC. The P9242-R3 has bi-directional communication firmware pre-programmed into its one-time programmable memory and does not allow the firmware to be customized. The P9242-RB offers a pre-programmed bootloader that must be used in conjunction with an external flash. Bidirectional communications firmware is loaded into the external flash. The firmware can be customized in external flash. There is no functionality difference between the P9242-R3 V2.1 Evaluation board with P9242-R3 IC and the P9242-RB with external flash.

Figure 8. P9242-R3 V2.1 Evaluation Board Details



3. Evaluating Bi Directional Data Communication

3.1 Transferring Data from the Receiver to the Transmitter

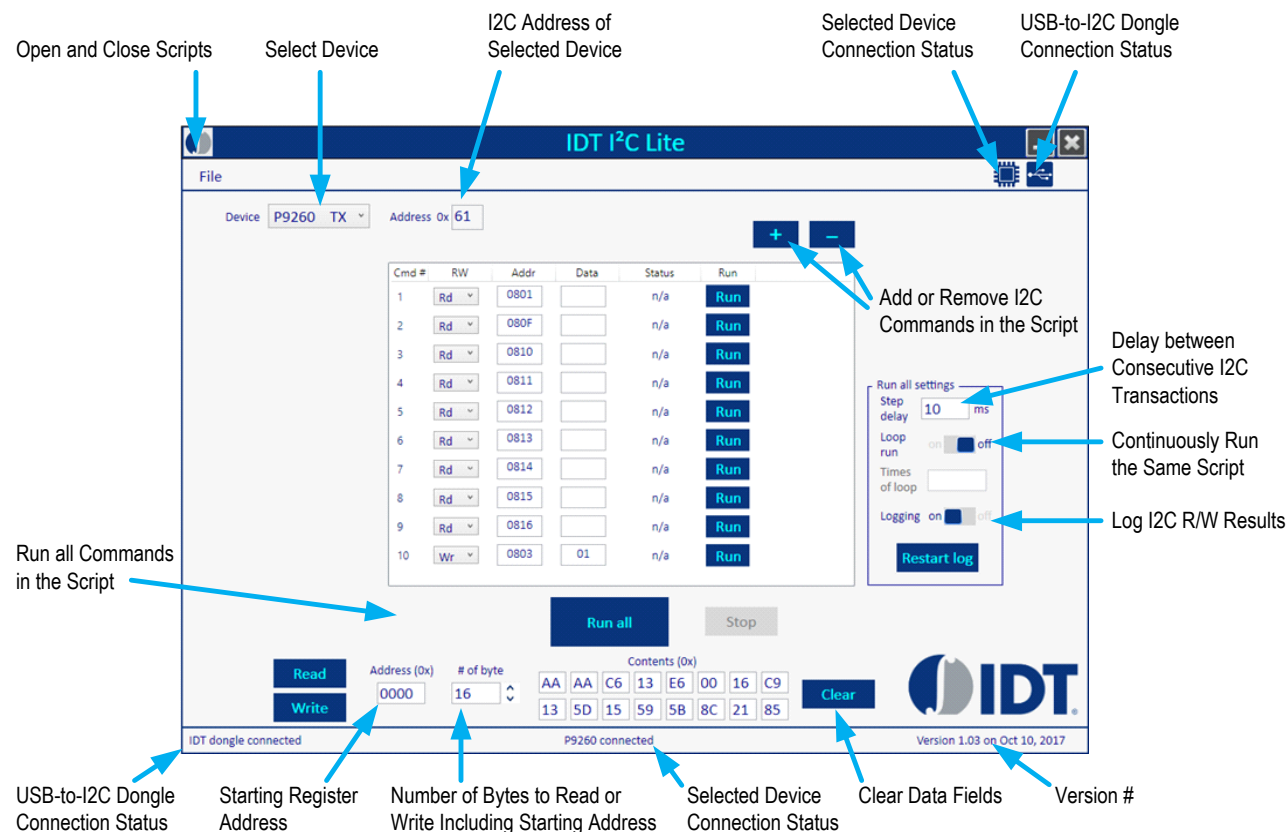
To send the data from the P9221-R3 to the P9242-R3, the external microcontroller (MCU) on the receiver loads data into the user outgoing data registers of the P9221-R3 and triggers the communication by writing to the *Command* register of the P9221-R3 via the I2C bus. The P9242-R3 receives the data and interrupts the external MCU on the transmitter pad. The external MCU on the transmitter pad reads the user incoming data registers via the I2C bus after it receives the interrupt. More details on the data transfer algorithm are in the P9221-R3 and P9242-R3 datasheets.

There are no external MCUs on the receiver and transmitter evaluation boards in the WP15WBD-RD Evaluation Kit. Instead the *IDT I2C Lite* software and USB-to-I2C dongles are used to simulate an external MCU. The USB-to-I2C dongle does not have the capability to generate interrupts for the *IDT I2C Lite* software, so it is necessary to poll the *Status* register to check for incoming data or probe the $\overline{\text{INT}}$ test point on the P9242-R3-EVK (IO_B4 test point) using an oscilloscope.

Follow these procedures to transfer the data from the receiver board to the transmitter board:

1. Power up the transmitter and receiver evaluation boards by following the steps in section 1.3.
2. Verify that the green LEDs (identified in Figure 2) on both the transmitter and receiver boards are illuminated indicating that devices are in the power transfer phase. Bi-directional communication is enabled only when the devices are in the power transfer phase.
3. Connect the USB-to-I2C dongle to the computer's USB port and connect the I2C header of the dongle to J1 on the P9221-R3-EVK board as shown in Figure 3. The black wire on the dongle should be on the GND pin of the J1 header.
4. Open the *IDT I2C Lite* GUI by going to the Windows start menu: IDT GUI Application → IDT I2C Lite. Figure 9 shows an overview.

Figure 9. IDT I2C Lite Software Overview



5. Verify the proper USB dongle connection by checking the USB icon status in the top right corner of the GUI. When the USB dongle is properly connected, the USB icon should be bright blue and the bottom left corner should indicate "IDT dongle connected."
6. Select "P9221 RX" from the "Device" drop-down menu in the GUI.
7. Verify that the proper P9221-R3-EVK connection is recognized by the GUI by checking the device icon in the top right corner of the GUI. When the P9221-R3-EVK is properly connected, the selected device icon should be bright blue and the message in the middle of the bottom status bar in the GUI should indicate "P9221 connected."
8. Click "Open Script" from the "File" menu in the top left corner of the GUI, and navigate to the "Send 8 bytes from Rx to Tx" script. This script has all the I2C commands required to send the data from the P9221-R3 to the P9242-R3. The script can be customized by using the "+" and "-" buttons in the GUI.
9. Click the "Run all" button to run all the I2C commands in the script to send the data from the P9221-R3 to the P9242-R3.
10. If using only one computer, gently disconnect the dongle I2C header from the receiver board, and connect the I2C header to J2 of the P9242-R3-EVK transmitter board as shown in Figure 4. The black wire on the dongle should be on the GND pin on the J2 header.
If using two computers, follow the subsequent steps on the second computer to read the data.
11. Select "P9242 TX" from the "Device" drop down menu in the GUI.
12. Verify the proper P9242-R3-EVK connection to GUI by checking the selected device icon in the top right corner of the GUI. When the P9242-R3-EVK is properly connected, the icon should be in bright blue color and the bottom status bar in the GUI should indicate "P9242 connected."
13. Click "Open Script" from the "File" menu in the top left corner of the GUI, and navigate to the "Read 8 bytes of data on Tx" script. This script has all the I2C commands required to read data coming into the P9242-R3. The script can be customized by using the "+" and "-" buttons in the GUI.
14. Click the "Run all" button to run all the I2C commands in the script to read the incoming data in the P9242-R3.
15. Verify that the incoming data on the P9242-R3 matches the P9221-R3 outgoing data.

3.2 Transferring Data from the Transmitter to the Receiver

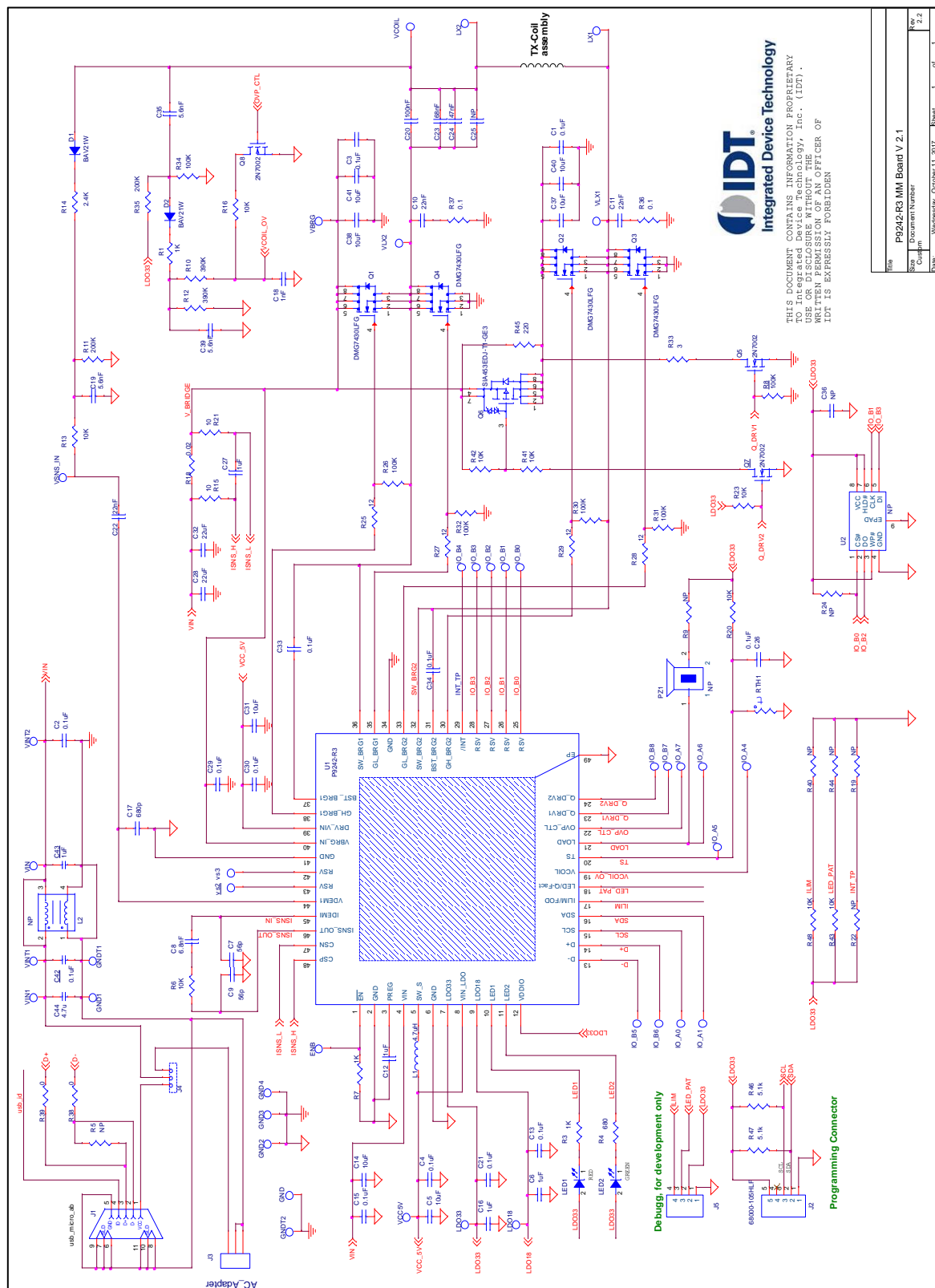
To send the data from the P9242-R3 to the P9221-R3, the external microcontroller (MCU) on the transmitter loads data into the user outgoing data registers of the P9242-R3 and triggers the communication by writing to the *Command* register of the P242-R3 via the I2C bus. The P9221-R3 receives the data and interrupts the external MCU on the receiver board. The external MCU on the receiver board reads the user incoming data registers via the I2C bus after it receives the interrupt. More details on the data transfer algorithm are in the P9221-R3 and P9242-R3 datasheets.

There are no external MCU's on the receiver and transmitter evaluation boards in the WP15WBD-RD Evaluation Kit. Instead, the *IDT I2C Lite* software and USB-to-I2C dongle are used to simulate an external MCU. The USB-to-I2C dongle does not have the capability to generate interrupts for the *IDT I2C Lite* software, so it is necessary to poll the *Data Received Status* register to check for incoming data or probe the interrupt pin on the P9221-R3 (pin 2 on the J1 header on the P9221-R3-EVK board) using an oscilloscope.

Follow these procedures to transfer the data from the transmitter board to the receiver board:

1. Power up the transmitter and receiver evaluation boards by following the steps in section 1.3.
2. Verify that the green LEDs (identified in Figure 2) on both transmitter and receiver boards are illuminated indicating that devices are in the power transfer phase. Bi-directional communication is enabled only when the devices are in the power transfer phase.
3. Connect the USB-to-I2C dongle to the computer's USB port and connect the I2C header of the dongle to J2 on the P9242-R3-EVK board as shown in Figure 4. The black wire on the dongle should be on the GND pin of the J2 header.
4. Open the *IDT I2C Lite* GUI by going to the Windows start menu: IDT GUI Application → IDT I2C Lite. See Figure 9.
5. Verify the proper USB dongle connection by checking the USB icon status in the top right corner of the GUI. When the USB dongle is properly connected, the USB icon should be bright blue and the bottom left corner should indicate "IDT dongle connected."
6. Select "P9242 TX" from the "Device" drop-down menu in the GUI.
7. Verify that the proper P9242-R3-EVK connection is recognized by the GUI by checking the selected device icon in the top right corner of the GUI. When the P9242-R3-EVK evaluation board is properly connected, the icon should be bright blue and the message in the middle of the bottom status bar in the GUI should indicate "P9242 connected."
8. Click "Open Script" from the "File" menu in the top left corner of the GUI, and navigate to the "Send 2 bytes from Tx to Rx" script. This script has all the I2C commands required to send the data from the P9242-R3 to the P9221-R3. The script can be customized by using the "+" and "-" buttons in the GUI.
9. Click the "Run all" button to run all the I2C commands in the script to send the data from the P9242-R3 to the P9221-R3.
10. If using only one computer, gently disconnect the dongle I2C header from the transmitter board, and connect the I2C header to J1 on the P9221-R3-EVK receiver board as shown in Figure 3. The black wire on the dongle should be on the GND pin of the J1 header.
If using two computers, follow the subsequent steps on the second computer to read the data.
11. Select "P9221 RX" from the "Device" drop-down menu in the GUI.
12. Verify the proper P9221-R3-EVK connection to the GUI by checking the selected device icon in the top right corner of the GUI. When the P9221-R3-EVK evaluation board is properly connected, the icon should be bright blue and the bottom status bar in the GUI should indicate "P9221 connected."
13. Click "Open Script" from the "File" menu in the top left corner of the GUI, and navigate to the "Read 2 bytes of data on Rx" script. This script has all the I2C commands required to read data coming into the P9221-R3. The script can be customized by using the "+" and "-" buttons in the GUI.
14. Click the "Run all" button to run all the I2C commands in the script to read the data coming into the P9221-R3.
15. Verify that the incoming data on the P9221-R3 matches the P9242-R3 outgoing data.

4.2 P9242-R3-EVK Evaluation Board Schematics V2.1



5. Bill of Materials (BOM)

Table 1. P9221-R3-EVK BOM V2.2

| Item | Quantity | Reference | Value | Description | Part Number | PCB Footprint |
|------|----------|--|---------------|----------------------------------|---------------------|-------------------------------|
| 1 | 16 | AC2T, VDD5V, VPP18, VOSET, TS, SDA, SCL, RPO, RPG, INT, ILIM, GCOM, DEN, ALGY, ALGX, /EN | PTH_TP | Test Pad | | 10MIL_35PAD |
| 2 | 2 | AC2, LC | NP | Test Point | | test_pt_sm_135x70 |
| 3 | 4 | C1, C2, C3, C5 | 100nF/ 50V | CAP CER 0.1UF 50V X5R 0402 | GRM155R61H104KE19D | 0402 |
| 4 | 2 | C6, C14 | 47nF | CAP CER 0.047UF 50V X7R 0402 | C1005X7R1H473K050BB | 0402 |
| 5 | 2 | C7, C15 | NP | CAP CER 0.047UF 50V X7R 0402 | C1005X7R1H473K050BB | 0402 |
| 6 | 2 | C8, C16 | 15nF | CAP CER 0.015UF 50V X7R 0402 | GRM155R71H153KA12J | 0402 |
| 7 | 1 | C9 | 3.3nF | CAP CER 3300PF 50V X7R 0402 | CL05B332KB5NNNC | 0402 |
| 8 | 5 | C10, C11, C21, C22, C33 | 10μF | CAP CER 10UF 25V X5R 0603 | CL10A106MA8NRNC | 0603 |
| 9 | 1 | C12 | NP | CAP CER 10UF 25V X5R 0603 | CL10A106MA8NRNC | 0603 |
| 10 | 1 | C18 | NP | CAP CER 1UF 10V X5R 0402 | GRM155R61A105KE15D | 0402 |
| 11 | 1 | C20 | 1μF | CAP CER 1UF 10V X5R 0402 | GRM155R61A105KE15D | 0402 |
| 12 | 3 | C19, C25, C31 | 0.1μF | CAP CER 0.1UF 10V X5R 0201 | C0603X5R1A104K030BC | 0201 |
| 13 | 1 | C23 | 0.1μF | CAP CER 0.1UF 25V X5R 0201 | CL03A104KA3NNNC | 0201 |
| 14 | 1 | D1 | LED | LED GREEN CLEAR 0603 SMD | 150060GS75000 | 0603_diode |
| 15 | 2 | D6,D7 | 5.1V | DIODE ZENER 5.1V 100MW 0201 | CZRZ5V1B-HF | 0201 |
| 16 | 5 | GND1, VRECT, VOUT, VOSNS, GND | Test Point | TEST POINT PC MINIATURE SMT | 5015 | test_pt_sm_135x70 |
| 17 | 1 | L1 | RX coil | AMOTECH, Rx Power Coil | ASC-504060M22-S00 | 10MIL_35PAD |
| 18 | 1 | J1 | NP | HEADER_1X5_0P1PITCH60P42D | 68002-205HLF | header_1x5_0p1Pitch60 p42d |
| 19 | 1 | RTS | NP | | | NTC2 |
| 20 | 3 | R1, R13, R14 | 5.1kΩ | RES SMD 5.1K OHM 5% 1/16W 0402 | MCR01MRTJ512 | 0402 |
| 21 | 1 | R2 | 36Ω | RES SMD 36 OHM 5% 1/2W 0805 | ERJ-P06J360V | 0805 |
| 22 | 1 | R6 | NP | RES SMD 0.0OHM 1/10W 0402 | ERJ-2GE0R00X | 0402 |
| 23 | 1 | R8 | 0Ω | RES SMD 0.0OHM 1/10W 0402 | ERJ-2GE0R00X | 0402 |
| 24 | 2 | R15, R16 | 10kΩ | RES SMD 10KOHM 1% 1/10W 0603 | RC0603FR-0710KL | 0603 |
| 25 | 10 | R17, R19, R23, R27, R28, R29, R30, R34, R38, R39 | 10kΩ | RES SMD 10K OHM 5% 1/10W 0402 | ERJ-2GEJ103X | 0402 |
| 26 | 3 | R18, R22, ,R33 | NP | RES SMD 10K OHM 5% 1/10W 0402 | ERJ-2GEJ103X | 0402 |
| 27 | 1 | R35 | 0Ω | RES SMD 0.0OHM JUMPER 1/10W 0603 | MCR03EZPJ000 | 0603 |

| Item | Quantity | Reference | Value | Description | Part Number | PCB Footprint |
|------|----------|-----------|----------|--------------------------------|----------------|-----------------------|
| 28 | 1 | U1 | P9221-R3 | Wireless power receiver | P9221-R3 | csp52_2p64x3p94_0p4mm |
| 29 | 1 | U2 | NP | IC EEPROM 128KBIT 400KHZ 8TDFN | 24AA128T-I/MNY | TDFN08 |

Table 2. P9242-R3-EVK BOM V2.1

| Item | Quantity | Reference | Value | Description | Part Number | PCB Footprint |
|------|----------|--|--------|---|---------------------|---------------|
| 1 | 12 | C1, C2, C3, C4, C13, C15, C21, C26, C29, C30, C33, C34 | 0.1μF | CAP CER 0.1μF 25V 10% X7R 0402 | C1005X7R1E104K050BB | 0402 |
| 2 | 7 | C5, C14, C31, C37, C38, C40, C41 | 10μF | CAP CER 10μF 25V 20% X5R 0603 | C1608X5R1E106M080AC | 0603 |
| 3 | 4 | C6, C12, C16, C27 | 1μF | CAP CER 1μF 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 | 0.022μF 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 ±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 0.1μF 100V C0G 1206 | C3216C0G2A104K160AC | 1206 |
| 11 | 1 | C22 | 22nF | CAP CER 0.022μF 50V 10% X7R 0402 | GRM155R71H223KA12D | 0402 |
| 12 | 1 | C23 | 68nF | CAP CER 0.068μF 100V NP0 1206 | C3216C0G2A683K160AC | 1206 |
| 13 | 1 | C24 | 47nF | CAP CER 0.047μF 100V NP0 1206 | C3216C0G2A473J115AC | 1206 |
| 14 | 1 | C25 | NP | CAP CER 10000PF 100V C0G 1206 | C3216C0G2A103J115AA | 1206 |
| 15 | 2 | C28, C32 | 22μF | CAP CER 22μF 25V 20% X5R 1206 | GRM31CR61E226KE15L | 1206 |
| 16 | 1 | C36 | 0.1uF | CAP CER 0.1μF 25V 10% X7R 0402 | C1005X7R1E104K050BB | 0402 |
| 17 | 1 | C42 | 0.1μF | 0.10μF 50V Ceramic Capacitor X7R 0603 | GRM188R71H104KA93D | 0603 |
| 18 | 1 | C43 | 1μF | 1μF 25V Ceramic Capacitor X5R 0603 | GRM188R61E105KA12D | 0603 |
| 19 | 1 | C44 | 4.7μF | 4.7μF 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-position header | 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 | NP | 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 | MOSFET | 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 | 1kΩ | RES SMD 1K OHM 5% 1/16W 0402 | RC0402JR-071KL | 0402 |
| 39 | 1 | R4 | 680Ω | 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 | 10kΩ | RES SMD 10K OHM 1% 1/10W 0402 | RC0402FR-0710KL | 0402 |
| 42 | 5 | R8, R26, R30, R31, R32 | 100kΩ | RES SMD 100K OHM 5% 1/10W 0402 | ERJ-2GEJ104X | 0402 |

| Item | Quantity | Reference | Value | Description | Part Number | PCB Footprint |
|------|----------|--------------------|---------------|----------------------------------|------------------|----------------------|
| 43 | 1 | R24 | 100K | RES SMD 100K OHM 5% 1/10W 0402 | ERJ-2GEJ104X | 0402 |
| 44 | 1 | R9 | NP | RES SMD 100 OHM 5% 1/10W 0603 | RC0603JR-07100RL | 0603 |
| 45 | 2 | R10, R12 | 390kΩ | RES SMD 390K OHM 5% 1/10W 0603 | ERJ-3GEYJ394V | 0603 |
| 46 | 1 | R14 | 2.4kΩ | RES SMD 2.4K OHM 5% 1/10W 0402 | ERJ-2GEJ242X | 0402 |
| 47 | 2 | R11, R35 | 200kΩ | RES SMD 200K OHM 1% 1/10W 0603 | RC1608F204CS | 0603 |
| 48 | 2 | R15, R21 | 10Ω | RES SMD 10 OHM 1% 1/10W 0402 | ERJ-2RKF10R0X | 0402 |
| 49 | 1 | R18 | 0.02Ω | RES SMD 0.02 OHM 1% 1/8W 0805 | WSL0805R0200FEA | 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 | 12Ω | RES SMD 12 OHM 5% 1/10W 0402 | ERJ-2GEJ120X | 0402 |
| 52 | 1 | R33 | 3Ω | RES SMD 3 OHM 1% 1/8W 0805 | RC0805FR-073RL | 0805 |
| 53 | 1 | R34 | 100kΩ | RES SMD 100K OHM 1% 1/10W 0603 | ERJ-3EKF1003V | 0603 |
| 54 | 2 | R36, R37 | 0.1Ω | RES SMD 0.1 OHM 5% 1/6W 0402 | ERJ-2BSJR10X | 0402 |
| 55 | 2 | R38, R39 | 0Ω | RES SMD 0.0 OHM JUMPER 1/10W | RC0402JR-070RL | 0402 |
| 56 | 1 | R45 | 220Ω | RES SMD 220 OHM 1% 0.4W 0805 | RC1206FR-07220RL | 1206 |
| 57 | 2 | R46, R47 | 5.1kΩ | RES SMD 5.1K OHM 5% 1/16W 0402 | MCR01MRTJ512 | 0402 |
| 58 | 1 | U1[a] | P9242-RB | Transmitter (Bootloader Part) | P9242-RB | socketqfn_48_6x6_0p4 |
| 59 | 1 | U2 | W25X20 CLUXIG | SPIFLASH 2M-BIT 4KB UNIFORM SECT | W25X20CLUXIG TR | uson_2x3_8LD |

[a] The P9242-RB offers a pre-programmed bootloader that must be used in conjunction with an external flash. Bi-directional communications firmware is loaded into the external flash. The firmware can be customized in external flash. There is no functionality difference between the P9242-R3 V2.1 Evaluation board with P9242-R3 IC and the P9242-RB with external flash.

6. Partner Products Information

6.1 Evaluation Kits

Renesas partnered with Würth Elektronik to build a development kit for customers with the same bill of materials and reference designators as the WP15WBD-RK. For more information on the development kit, see the Würth Elektronik [website](#).



6.2 Transmitter Coils

Table 3. Recommended Transmitter Coil Manufactures

| Output Power | Vendor | Part Number | Inductance at 100kHz | DCR at 20°C |
|--------------|---------|---------------------|----------------------|--------------|
| 15W | SUNLORD | SWA53N53H30C11B | 10 μ H | 50m Ω |
| 15W | TDK | WT525225-12F2-MA2-G | 10.6 μ H | 40m Ω |
| 15W | WURTH | 760308103102 | 10 μ H | 55m Ω |

6.3 Receiver Coils

Table 4. Recommended Receiver Coil Manufacturers

| Output Power | Vendor | Part Number | Inductance at 100kHz | ACR at 20°C | Series Resonant Capacitance |
|--------------|---------|-------------------|----------------------|-------------|-----------------------------|
| 15W | AMOTECH | ASC-504060E00-S00 | 8.2μH | 220mΩ | 400nF |
| 15W | TDK | WR424245-13K2-G | 11.2μH | 170mΩ | 300nF |
| 15W | SUNLORD | SWA50R40H06C02B | 8.4μH | 150mΩ | 400nF |
| 15W | WURTH | 760308102207 | 8.0μH | 80mΩ | 400nF |

7. Ordering Information

| Orderable Part Number | Description |
|-----------------------|--|
| WP15WBD-RK | WP15WBD-RK Bi-directional Data Transfer Evaluation Kit including P9242-R3-EVK Transmitter Evaluation Board, P9221-R3-EVK Receiver Evaluation Board, two USB to I2C Dongles, and 12V/2A AC Adapter. |

8. Revision History

| Revision Date | Description of Change |
|-------------------|--|
| April 3, 2020 | <ul style="list-style-type: none"> Added Partner Products Information |
| November 21, 2018 | <ul style="list-style-type: none"> Updated Figure 7 (and added note below figure) and Figure 8 Updated Table 2 |
| October 19, 2017 | Initial release. |

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