The P9243-GB-EVK Evaluation Board demonstrates the features of the P9243-GB 15W Wireless Power Transmitter (TX) with a fixed frequency. It is intended to evaluate the functionality and performance of the P9243-GB when combined with a Qi power receiver in a wireless charging system. The P9243-GB-EVK offers the flexibility to select parameters, such as Q-factor threshold, LED pattern, power loss FOD threshold, and external temperature sensing function. The printed circuit board (PCB) has four layers, and can be used with the user's WPC-1.2.4 compliant receiver.

The high-efficiency, turnkey reference design is supported by comprehensive digital resources to significantly expedite the design-in effort and enable rapid prototyping.

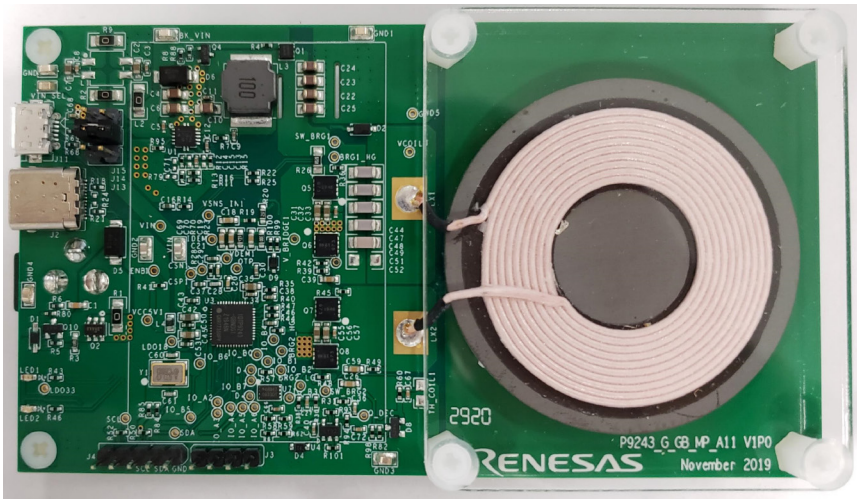
## Kit Contents

- P9243-GB-EVK Evaluation Board
- Adaptor: 18V/1.38A

## Features

- Power transfer up to 15W at receiver side
- Wide input voltage range: 5V to 19V
- WPC-1.2.4 compatible, MP-A11 coil configuration
- Supports system parameters configuration using GUI
- Integrated drivers for external power MOSFETs
- Embedded 32-bit ARM® Cortex®-M0 processor (trademark of ARM, Ltd.)
- Simultaneous voltage and current demodulation scheme for WPC communication
- Integrated current sense amplifier
- Supports accurate 127.7kHz frequency operation
- Feedback control for external input step-down regulator
- Dedicated remote temperature sensing
- User-programmable power transfer LED indicators
- User-programmable foreign objects detection (FOD)
- WPC EPP-based Q-factor detection
- Active-LOW enable pin for electrical on/off
- Over-current and over-temperature protection
- Supports I2C interface
- Four-layer PCB assembled with test points and coil fixture
- -40°C to +85°C ambient operating temperature range
- 48-VFQFPN (6 × 6 mm) RoHS-compliant package

## Evaluation Board




18V/1.38A AC Adapter (Not to scale)

© 2021 Renesas Electronics Corporation

# Contents

# List of Figures



# List of Tables

© 2021 Renesas Electronics Corporation

# Setup

## Required or Recommended User Equipment

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

- P9415-R-EVK Receiver Evaluation Board or any WPC-1.2.4 compliant receiver.
- 18V/1.38A power supply or QC3.0 provided by the user.
- REA USB-to-I2C Dongle (sold separately).

## Software Installation, Dongle Connectivity, and FLASH Programming with GUI

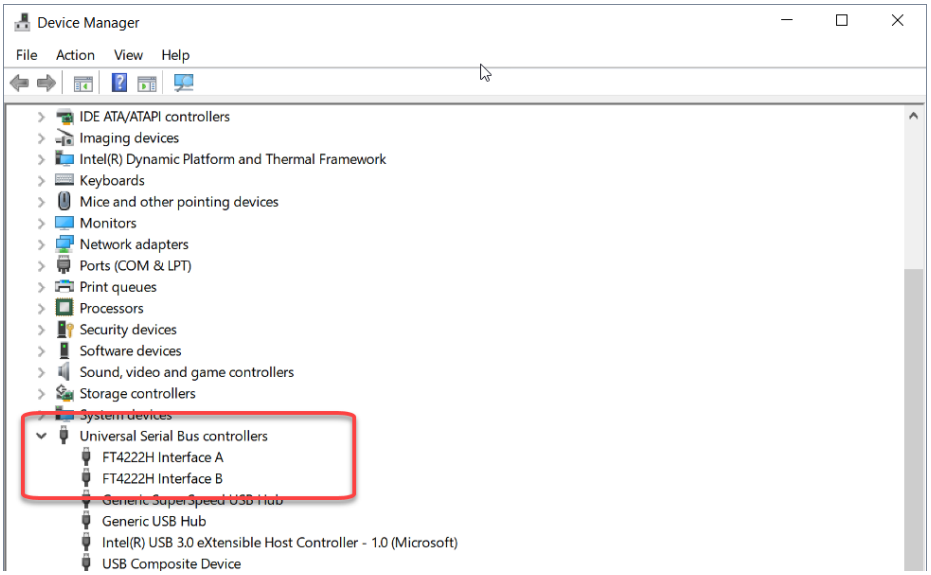
Visit the P9243-GB-EVK webpage and download the latest version of the P9243-GB Wireless Power Pro GUI, USB drivers, and the *P9243-GB A11a Configuration Flash HEX File*. The software provides an intuitive graphical user interface for reading and writing to P9243-GB SRAM registers and generate custom user configurations for the external Flash.

### 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 the “Universal Serial Bus controllers” section. “FT4222H Interface A” and “FT4222H Interface B” should appear in this section as shown in Figure 1.
5. Download and extract the P9243-GB Wireless Power Pro GUI *SWR* compressed file. To launch GUI, click the “Renesas Wireless Power P9243-GB” Application.

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

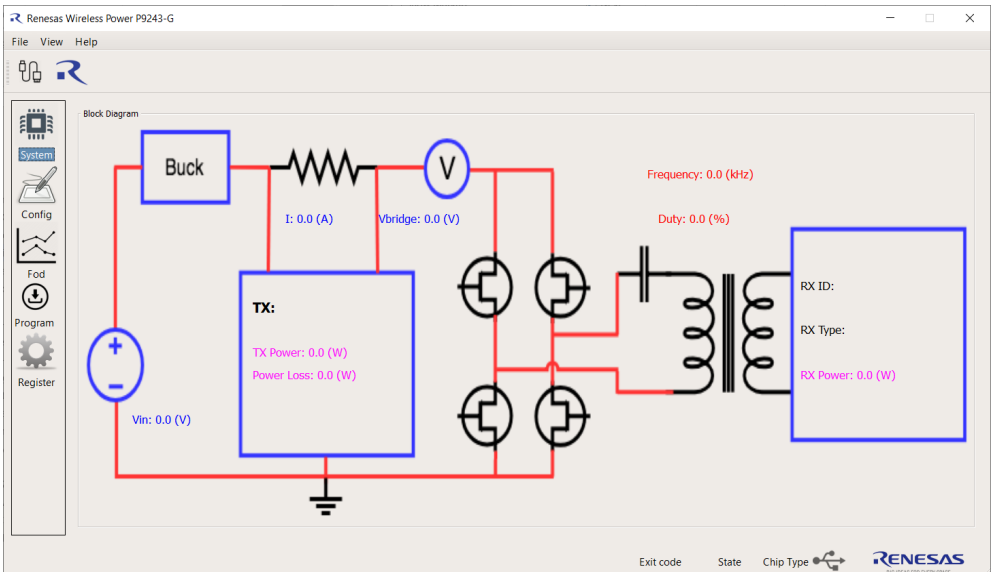


## Dongle Connectivity

Follow these procedures to establish GUI connectivity to the P9243-GB-EVK:

1. Launch the GUI program – Renesas Wireless Power P9243-GB. The initial screen of the GUI is shown in Figure 2.

Figure 2. System Tab of GUI




2. Set up the P9243-GB Evaluation Board by plugging the 5V adapter into J11 (Micro-USB connector) or the user's power supply into VIN (see Figure 4).
3. Connect the USB-to-I2C dongle to the computer and launch the P9243-GB Wireless Power Pro GUI. Once the dongle is detected, the message "Dongle Detected" will appear on the GUI. If the message does not appear, unplug and plug the USB cable at the user's computer.
4. Connect the USB-to-I2C dongle header to J4 of P9243-GB-EVK as shown in Figure 3.

Figure 3. Connecting the Dongle and Verifying GUI Connectivity

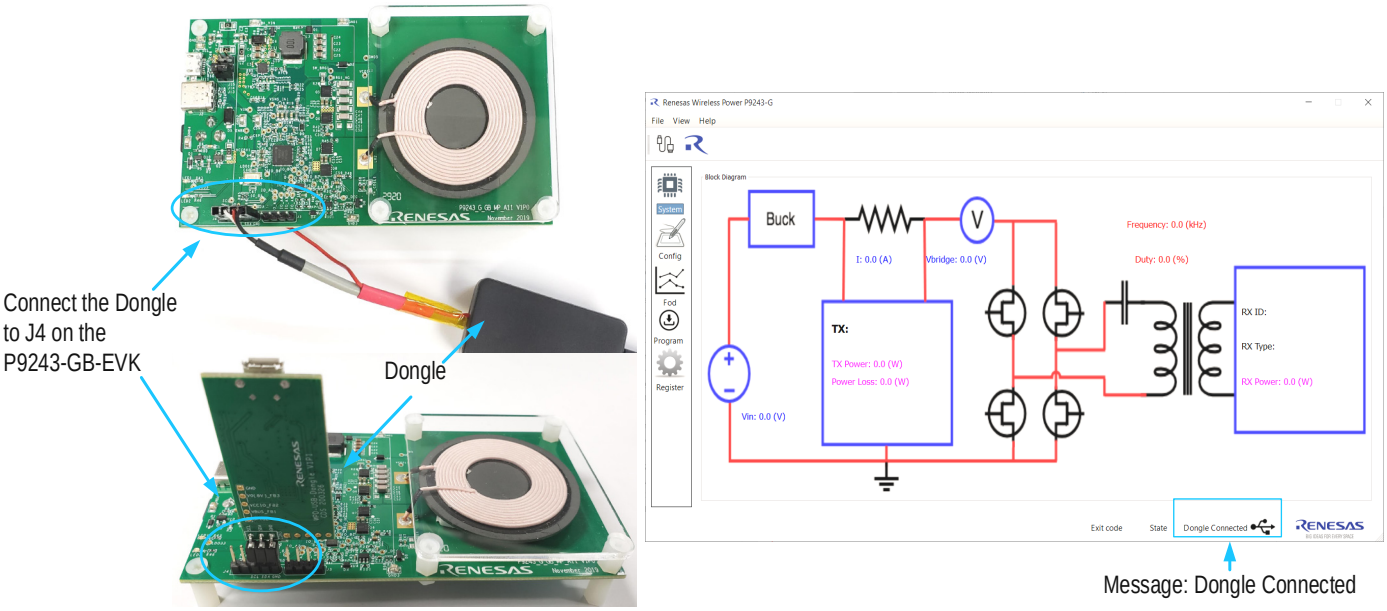
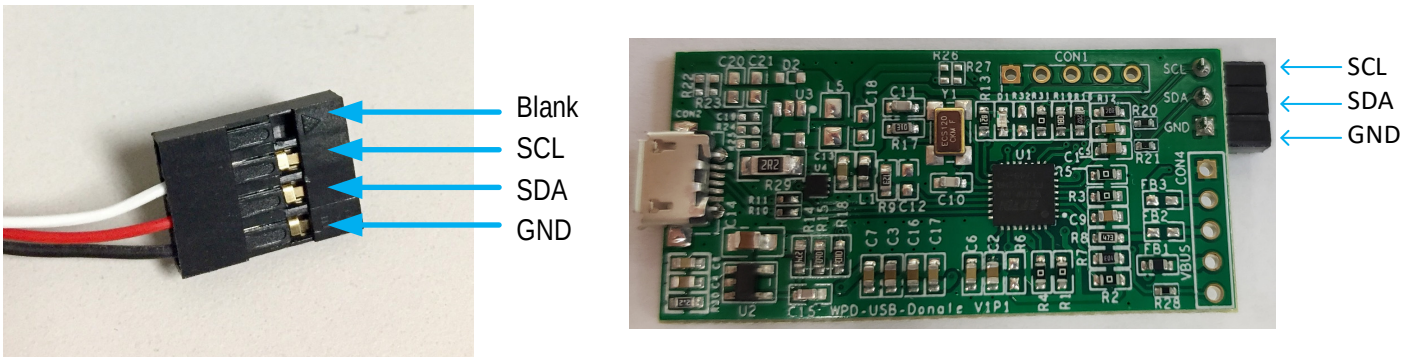


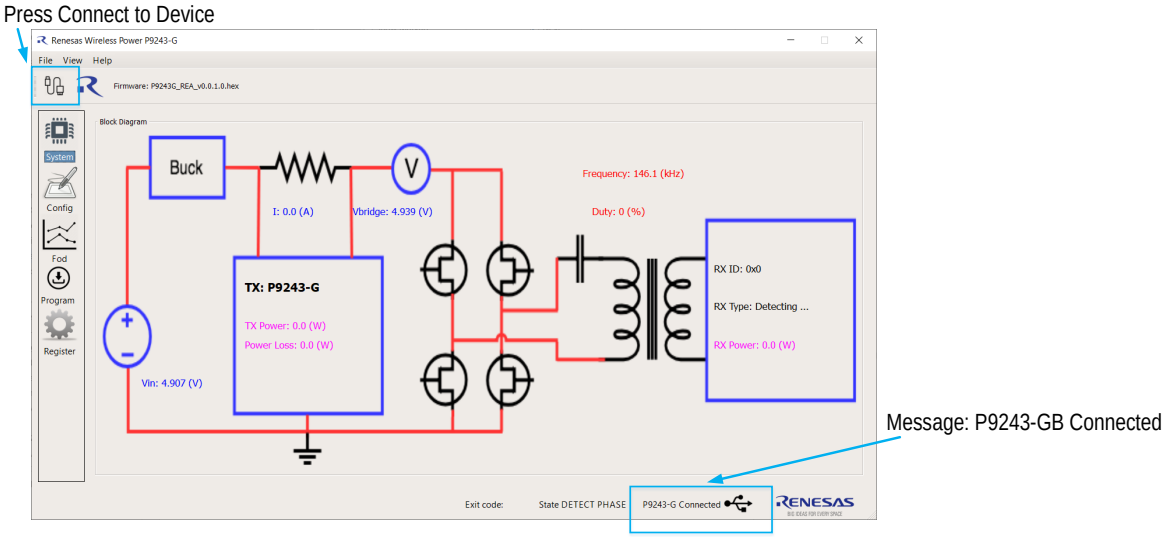
Figure 4. USB-to-I2C Dongle Header of “USB-FTDI-V2-1” (FTDI) Dongle and “WPD-USB-Dongle”




5. Press the “Connect to Device” button in the P9243-GB Wireless Pro GUI to connect to P9243-GB-EVK. Once P9243-GB-EVK is recognized, the message “P9243-GB Connected” will appear (see Figure 5).

   Note: To disconnect: Under the File Drop-down menu → disconnect.

Figure 5. P9243-GB-EVK Successfully Connected to GUI

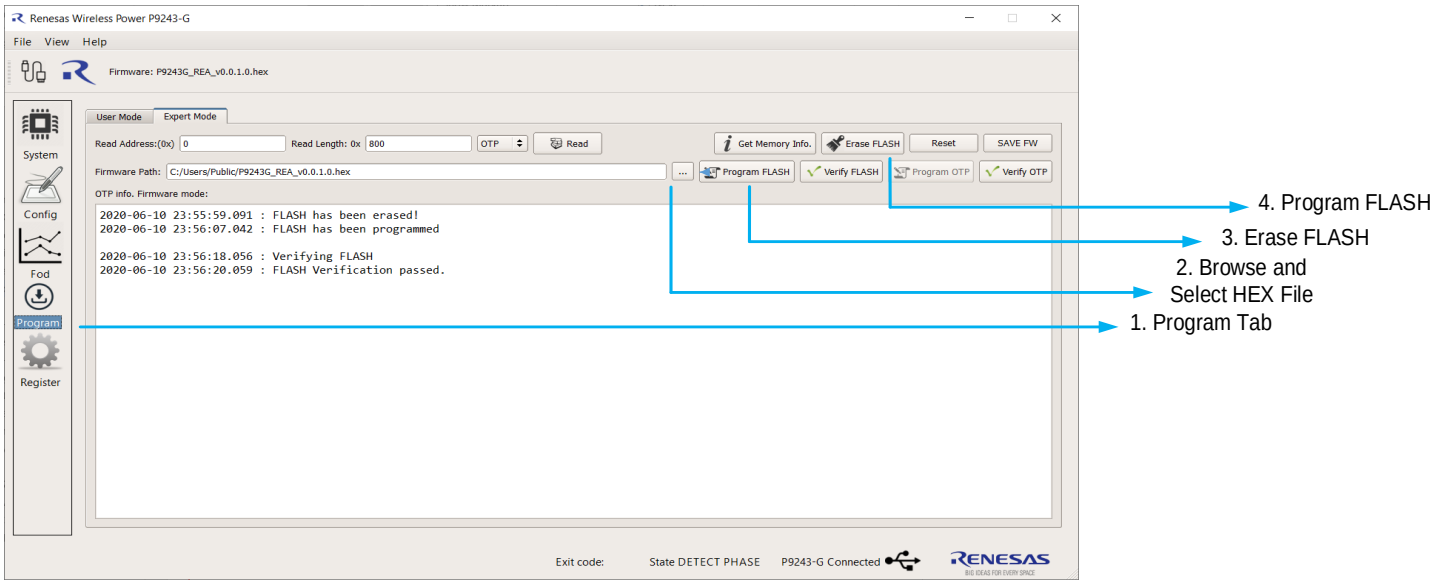



## Using GUI to Write to FLASH

To update the P9243-GB-EVK firmware, follow these steps and refer to Figure 6:

1. Enter the Program Tab of the GUI by Press Program.
2. Browse and select the firmware Hex file in Firmware Path.
3. Press Erase FLASH and accept the prompted messages.
4. Press Program FLASH and accept the prompted messages.
5. (Optional) Power cycle the P9243-GB, then press Verify FLASH and accept the prompted messages.

Figure 6. FLASH Programming Procedure

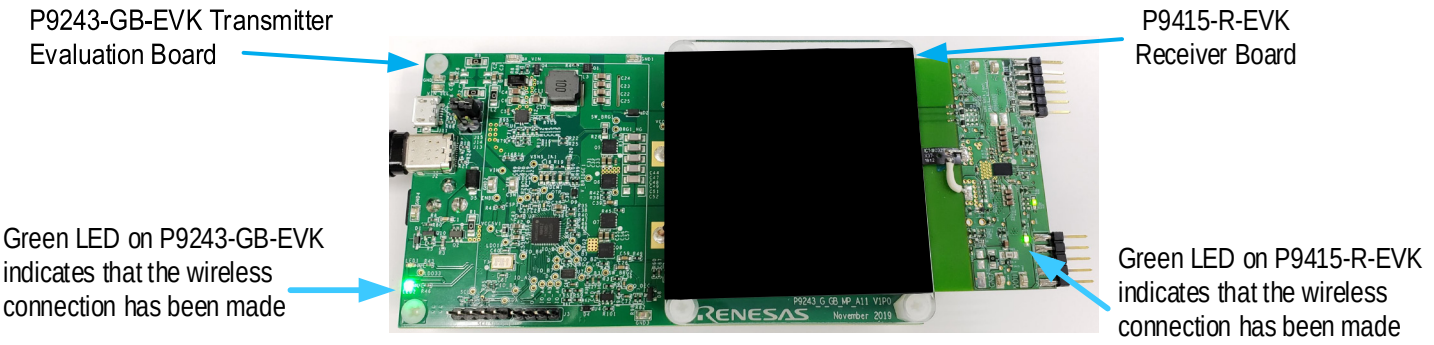



## Kit Hardware Connections

Follow these procedures to set up the kit as shown on Figure 7.

1. Set up the P9243-GB-EVK Evaluation Board by plugging the 5V/2A adapter or the user's power supply into J11 (Micro-USB connector). Refer to Figure 8.
2. If using the P9415-R-EVK Evaluation Board as the receiver, connect wires to the VOUT and GND test points on the P9415-R-EVK receiver to allow measuring the output voltage and applying a load.
3. Place the P9415-R-EVK or the user's receiver on the transmitter (TX) pad with the components facing up as shown on Figure 7.
4. Verify that the two green LEDs identified in Figure 7 are illuminated indicating that coupling has been established.

Figure 7. Evaluation Kit Connections using the P9415-R-EVK Receiver Evaluation Board

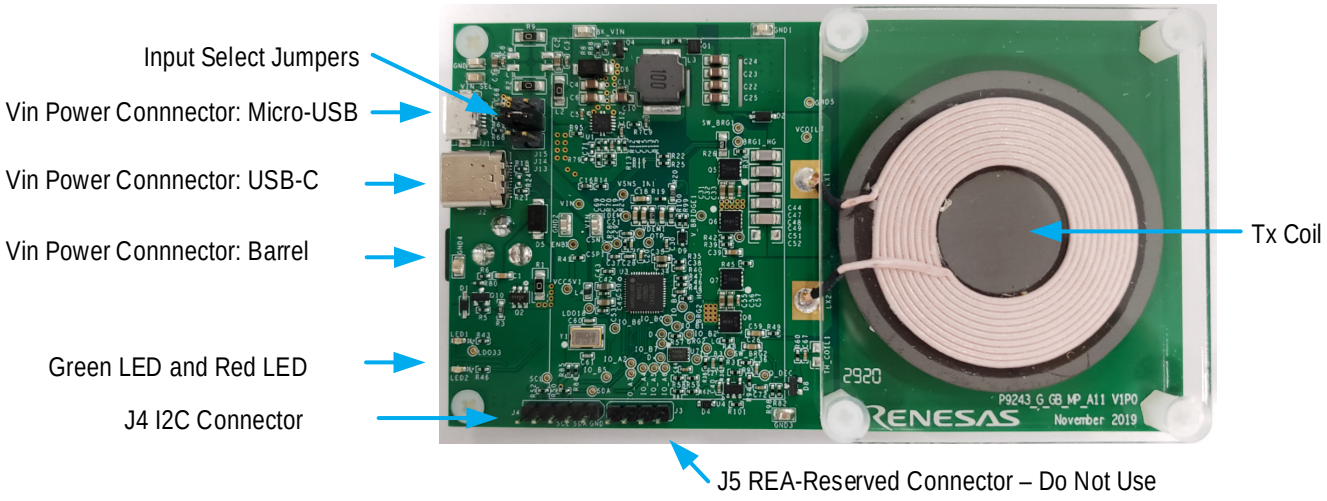


# Usage Guide

The P9243-GB-EVK firmware provides great flexibility to customize operating parameters for custom applications. Default values of the P9243-GB-EVK operating parameters, such as Digital Ping Frequency, FOD parameters, coil over-temperature sensing, and over current limit, are configurable in the firmware and are loaded from the external Flash memory. Based on the end application, the P9243-GB operating parameters can be configured by either writing to internal SRAM registers via the I2C interface, or by creating a new user configuration HEX file that can be generated within the P9243-GB Wireless Power Pro GUI. Once the new user configuration HEX file is generated, the Flash memory can be erased and reprogramed with the P9243-GB Wireless Power Pro GUI. To customize the P9243-GB-EVK's operating parameters in real-time, use the P9243-GB Wireless Power Pro GUI software along with the USB-to-I2C dongle connected to J4 Header. For any production usages, consult with Renesas before finalizing firmware.

## Overview of the P9243-GB-EVK

Figure 8. P9243-GB-EVK V1.0 Evaluation Board Features




## Programming Interface

The P9243-GB has a pre-programmed bootloader that must be used in conjunction with an external flash memory that contains control firmware.

The master P9243-GB accesses the slave external memory using a standard SPI interface (SCLK, MISO, MOSI, and $\overline{SS}$ pins) to upload the firmware from the flash memory into the P9243-GB internal SRAM. This architecture allows the user to change the firmware in the external flash to meet application-specific requirements. Renesas also provides firmware to implement standard WPC coil configurations, such as the A11a addendum.

The P9243-GB Wireless Power Pro GUI can be used for programming the external flash file. The W25X20CLUXIG is the recommended external flash memory. Smaller memory sizes in the W25X family can be used depending on the total firmware size. For recommended flash memories, please consult Renesas.

© 2021 Renesas Electronics Corporation

# Overview of the P9243-GB Wireless Power Pro GUI

## System (Block Diagram) Tab

The System tab of the P9243-GB Wireless Power Pro GUI offers a dynamic visual block diagram to expand the knowledge base of the wireless power system. This tab provides real-time information of input voltage, input current, transmitted power, power level of the receiver received, power loss, operating frequency, operating duty, receiver identification number, and power contract type.

## Config (Configuration) Tab

The Config Tab of P9243-GB Wireless Power Pro GUI offers users the flexibility to change operating parameters. Operating parameters, such as Digital Ping Frequency/Duty, Operating Frequency/Duty limits, Rx Detection Sensitivity to lower quiescent currents in standby, over-current sensing thresholds, LED1/2 patterns in specific events, Coil over-temperature sensing thresholds, Q-Factor threshold adjustments, and Error mode alarm timer, can be configured in real-time. For more a detailed list of configurable parameters, open the P9243-GB Wireless Power Pro GUI. Once the settings are configured to the user's preference, a new configuration HEX file can be generated. The user must press Configure to RAM before generating a new HEX file.

### Digital Ping Voltage and Operating Frequency Adjustment

The P9243-GB converges all popular wireless charging protocols including WPC Baseline Power Profile (BPP), Extended Power Profile (EPP), up to 7.5W charging for iPhones, and Android proprietary fast charging modes. Depending on the type and capability of the power supply, the P9243-GB may operate in different modes. To support 7.5W charging for iPhone, Digital Ping Frequency and Max Operating Frequency must remain at 127.7kHz in High Voltage mode only. It is not recommended to keep Low Voltage's Digital Ping Frequency and Max Operating Frequency at 127.7kHz.

### Low Voltage and High Voltage Parameter Adjustment

The P9243-GB separates overlapped parameters into two separate modes: low voltage and high voltage. Low voltage parameters are automatically loaded when the DC source is in the 5V sector. When operating in 5V sector, EPP mode is disabled. Additionally, a few selective parameters are in further split into four sectors: 5V, 9V, 12V, and 16V. High-voltage parameters are automatically loaded when the DC source is above the 5V sector.

### WPC Max Voltage Tuning Adjustment

This parameter is applicable to EPP mode only. These adjustable parameters should be tuned according to WPC1.2.4 defined specification in Maximum Voltage (WPC1.2.4 Section 5.4.10) and Over Voltage Protection (WPC1.2.4 Section 5.4.11).

Once the P9243-GB recognizes a fast load dump, the bridge firmware protection will be triggered, whereby the bridge voltage will immediately be fold-back. Once triggered, the PWM control for step-down regulator will quickly jump to the target buck duty. The buck duty controls the bridge voltage via GPIO_B7.

### Q-Factor Adjustment

This parameter is applicable to EPP mode only. Prior to each digital ping, the P9243-GB detects and measures the coil's quality factor (Q-factor). If an EPP receiver is present, the transmitter compares its own measured Q-factor with the reference Q-factor provided by the EPP receiver. If the difference is considerably large, the P9243-GB will identify this situation as a WPC-defined FOD being present and cannot move on to the Power Transfer Phase for the purpose of system protection. To aid in recognition of devices placed upon the coil pad surface, it is recommended to set Digital Ping Interval to at least 10 and Analog Ping Interval to at least 80ms. The defaults can be defined based on test. Based on sample test, a typical example of an adjusted threshold and its trend line is shown in Figure 9.

Equation 1

$$(\mathrm{Q}-\mathrm{Threshold}) = (\mathrm{Q}-\mathrm{Rx}) \times \frac{\mathrm{QFOD_{GAIN}}}{100} - \mathrm{QFOD_{OFFSET}}$$

Equation 2

$$(\mathrm{Q}-\mathrm{Factor}) < (\mathrm{Q}-\mathrm{Threshold})$$

Where:

$\mathrm{Q}-\mathrm{Factor}$ = Value of Q returned by P9243

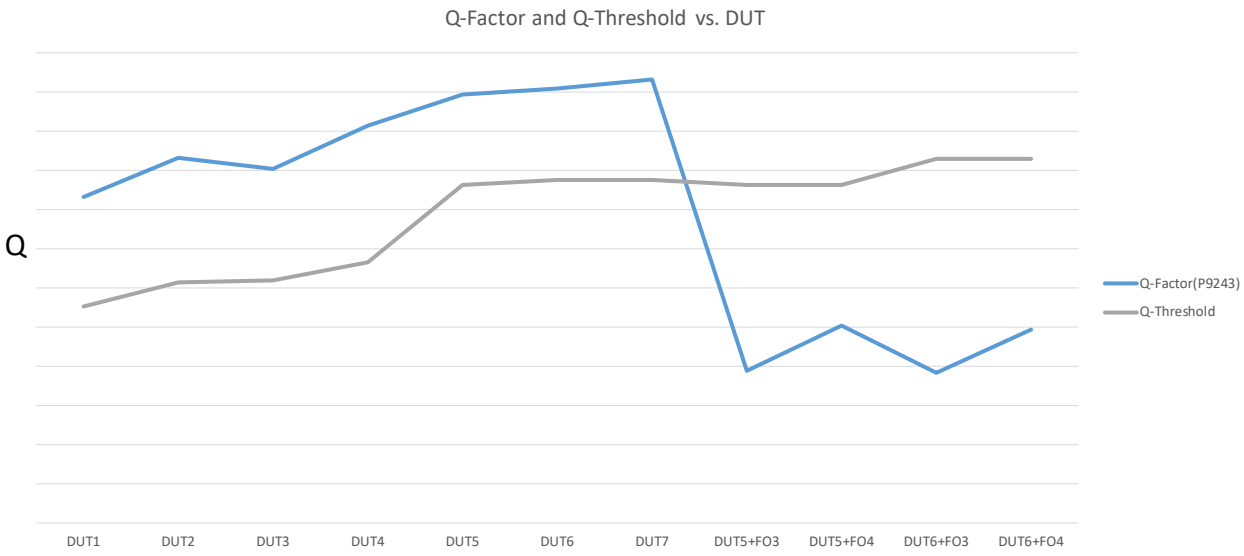
$\mathrm{Q}-\mathrm{Threshold}$ = Calculated Q threshold to trigger QFOD

$\mathrm{Q}-\mathrm{Rx}$ = Reported Q value of Receiver

$\mathrm{QFOD_{GAIN}}$ = Gain used in $\mathrm{Q}-\mathrm{Threshold}$ calculation

$\mathrm{QFOD_{OFFSET}}$ = Offset used in $\mathrm{Q}-\mathrm{Threshold}$ calculation

Figure 9. Sample Q-Factor Test Data




## FOD (Foreign Object Detection) Tab

The FOD tab of the P9243-GB Wireless Power Pro GUI allows users to adjust the FOD thresholds in real-time. Based on experimentation of at least 3 points with and without a foreign object present, a graphic visualization aid is provided to help with the tuning process. The FOD threshold can be automatically generated using the Auto Calculate button, or it can be manually generated using the Manual Adjust button. Once the settings are configured to the user's preference, a new configuration HEX file can be generated. The user must press Configure to RAM before generating a new HEX file.

The P9243-GB separates the FOD parameters into three operating modes: BPP, EPP (5W), and EPP.

### Program (Programming FLASH/OTP) Tab

The Program tab of the P9243-GB Wireless Power Pro GUI allows users to program FLASH and/or OTP memory. The FLASH and/or OTP memory of the P9243-GB-EVK can be verified with a loaded HEX file in the Firmware Path. From an already programmed P9243-GB, the firmware Hex file can also be extracted and saved to a local target.

### Register (Manually Register Read/Write and Logging) Tab

The Register tab of the P9243-GB Wireless Power Pro GUI allows users to manually log registers up to 32 bits to a maximum of 10 registers at any time. Data Rate and Log Display Format is configurable. Manually Read and Write is also offered in this section.

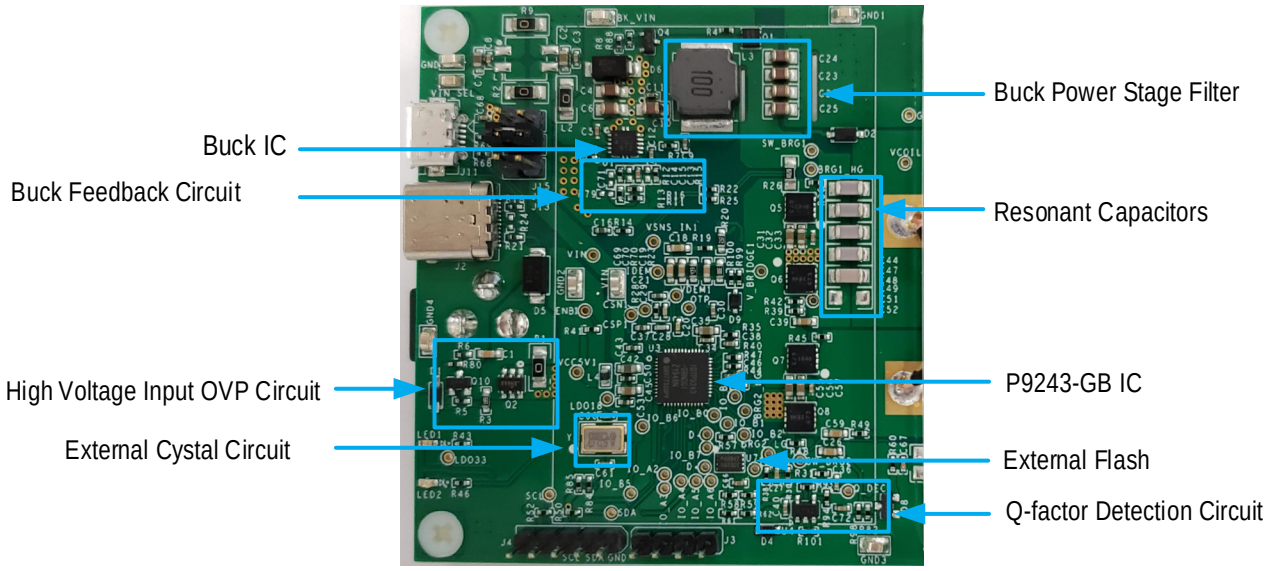
### Generating a New HEX File

It is recommended to complete these steps when generating a HEX file:

1. Program the P9243-GB-EVK with the latest HEX Configuration File from the Renesas website. Start with a golden base hex file first. It is not recommended to daisy-chain the HEX files.
2. Read the defaults before overwriting any parameters by pressing Read Configurations.
3. Enter the desired field value and press Configure to RAM.
4. Confirm acceptance of the desired field value by pressing Read Configurations.
5. Press Generate HEX firmware to create a new HEX file.

Before finalizing firmware for production use, please consult Renesas.

Figure 10. P9243-GB EVB v1.0 Evaluation Board Detail




Note: The P9243-GB has the bootloader and application firmware pre-programmed into the internal one-time programmable (OTP) memory and does not allow users to customize the firmware. The P9243-GB, which is pin-to-pin compatible with the P9243-G, has only a bootloader pre-programmed into the internal OTP memory. Therefore, the P9243-GB must be used in conjunction with an external flash memory. Application firmware is loaded into the external flash for specific system requirements.

The P9243-GB fetches the application firmware from the external flash memory using an SPI interface and executes the code. Users can customize the firmware in external flash and load the new firmware in the flash via the P9243-GB I2C port. The Winbond W25X20CLUXIG is the recommended external flash memory to be used with the P9243-GB.

## External Temperature Sensing – TS

The P9243-GB includes an optional temperature sense input pin, TS, that is used to monitor a remote temperature, such as for a coil or a battery charger. The TS pin voltage can be calculated using Equation 3.

Equation 3

$$V_{TS} = V_{LDO33} \times \frac{NTC}{(NTC + \mathbf{R60})}$$

Where:

NTC Thermistor's resistance (TH_COIL1)

$R_{60}$ Pull-up resistor connected to the 3.3V supply voltage on the P9235A-RB Evaluation Board

The over-temperature shutdown is triggered if the voltage on the TS pin is lower than the threshold. To view default thresholds, launch the P9243-GB Wireless Power Pro GUI. The TH_COIL1 is not populated on the P9243-GB-EVK Evaluation Board.

Figure 11. TH_COIL1, R60, and RC67 Schematic Location

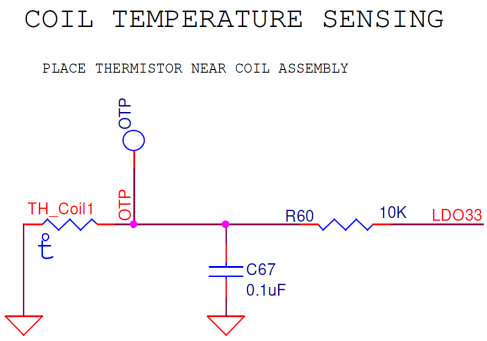
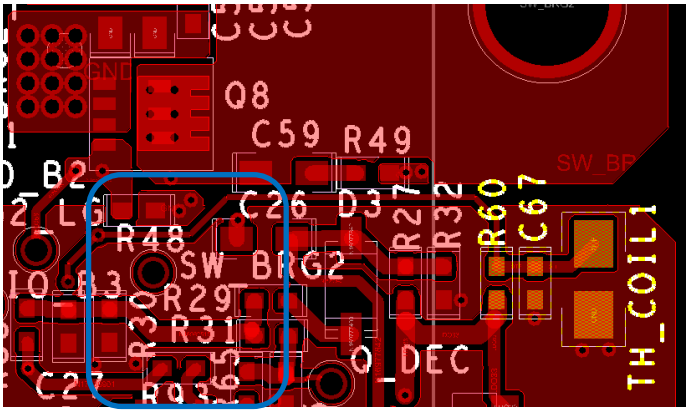



Figure 12. TH_COIL1, R60, and C67 PCB Location



## Control of External Power Stage DC/DC Buck Regulator – GPIO_B4 and GPIO_B7

The P9243-GB is specially designed to support fixed-frequency operation as described in the WPC MP-A11 coil configuration with an external input step-down DC/DC buck regulator. The P9243-GB-EVK uses the on-board DC/DC Buck Regulator IC to adjust the power transfer between the transmitter and receiver. The buck regulator operates at a fixed 500kHz frequency on the board. The buck regulator power stage is designed to accommodate a wide range of input voltages. The feedback loop combined with the external PWM signal are designed for the buck regulator. The resolution of the buck regulator control is approximately 35mV. The buck and external components in the PCB layout should be isolated from any noise generating circuits. For recommended DC/DC buck regulator ICs, please consult Renesas.

For Apple 7.5W charging mode, the P9243-GB supports fixed and precise switching frequency at 127.7kHz, and thus, its bridge input voltage must be adjusted. Another stage of the external buck regulator is added to regulate the input voltage of the full bridge LC circuits. GPIO_B4 is used to enable/disable this external DC/DC buck regulator. GPIO_B7 generates a PWM signal that is applied on top of the feedback pin of the buck regulator through a low-pass filter to fine-tune the output voltage of the buck regulator. The resolution of the buck regulator output depends on the buck IC's internal reference voltage, output voltage range, buck regulator compensation design, and resolution of the PWM signal from GPIO_B7.

Figure 13. Buck Regulator Schematic Location

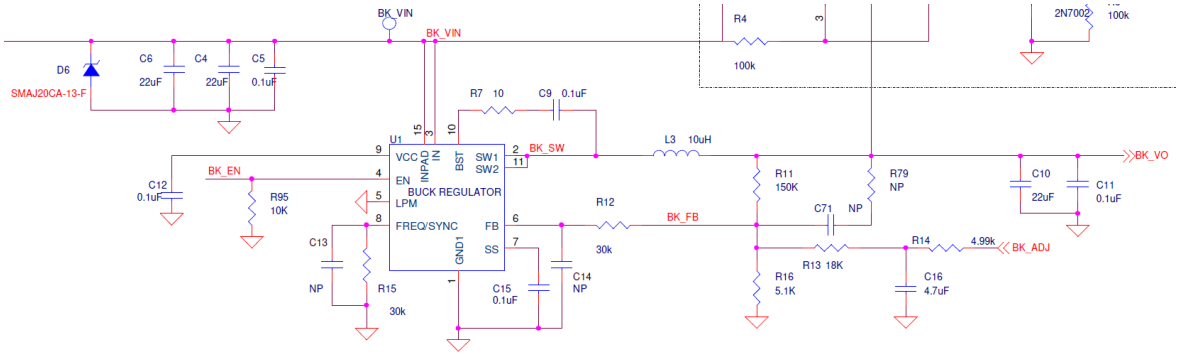
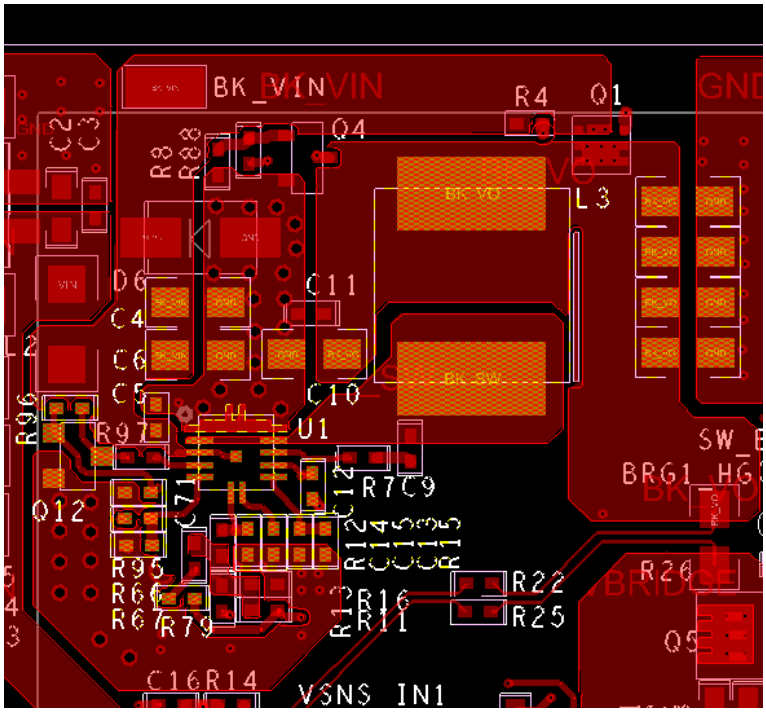



Figure 14. Buck Regulator PCB Location



## Bypass External DC/DC Buck Regulator – GPIO_A4

When the input voltage is 5V only, the P9243-GB operates in the BPP Mode. However, enabling the external power stage buck regulator at this time compromises the efficiency, thermal performance, and maximum power that can be delivered to the receiver. Under such an application scenario, the P9243-GB will disable the external power stage buck regulator and enable another power path for the input voltage (5V) to be directly applied to the DC/AC inverter. GPIO_A4 is used to bypass the external power stage buck regulator. In this mode, the device operates in a mode for a fixed input voltage with variable frequency. The operating frequency range depends on the WPC coil configuration specification.

Figure 15. Bypass Path Schematic Location

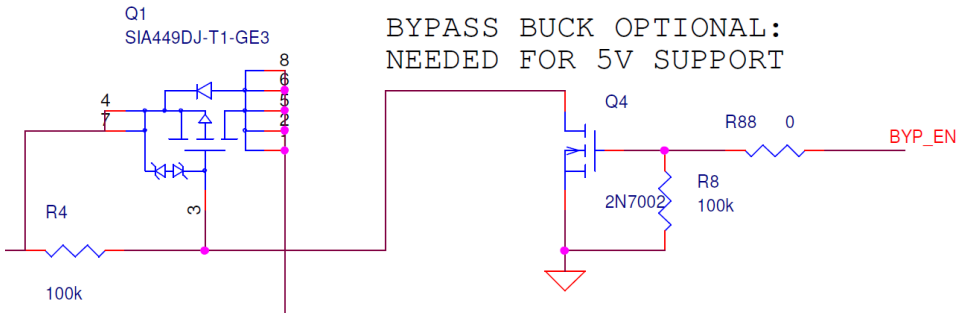
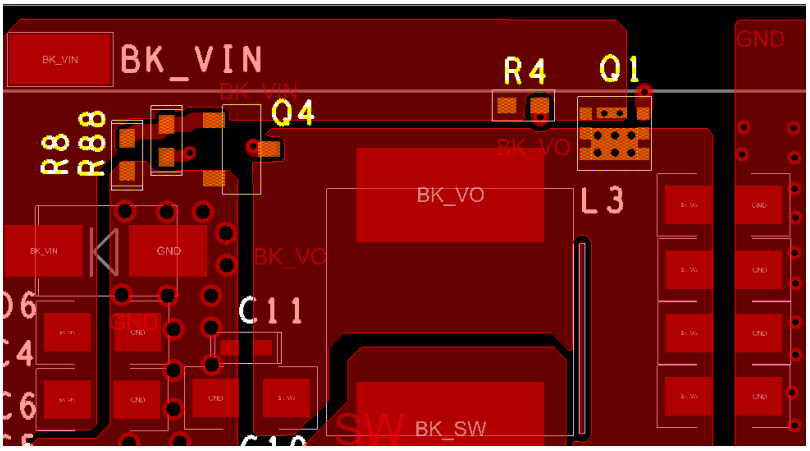



Figure 16. Buck Regulator PCB Location




## External Oscillator – GPIO_B5 and GPIO_B6

To guarantee that the operating frequency is precisely at 127.7kHz under different temperature conditions, the P9243-GB requires an external oscillator to provide accurate frequency operation. The PLL and crystal driver circuits inside the P9243-GB guarantee that the internal clock for the ARM® Cortex®-M0 core is synchronized with the external oscillator frequency.

An external 8MHz crystal must be connected between GPIO_B5 and GPIO_B6.

Table 1. External Oscillator Selection

| Type | Vendor | Part Number | Typical Frequency (MHz) |
|---|---|---|---|
| Crystal Oscillator | ECS Inc. | ECS-80-18-30B-AGN-TR | 8MHz + 30ppm |

© 2021 Renesas Electronics Corporation

Figure 17. External Crystal Schematic Location

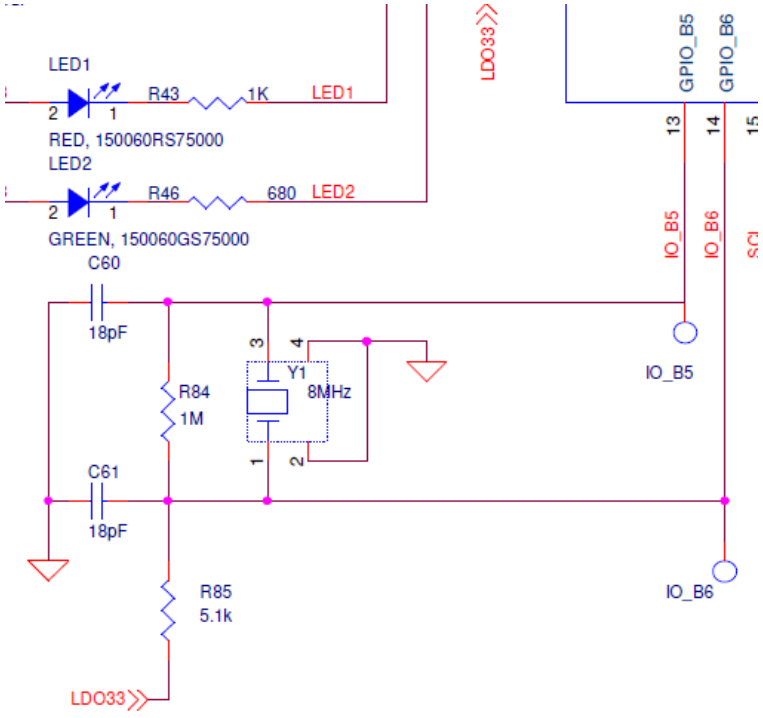
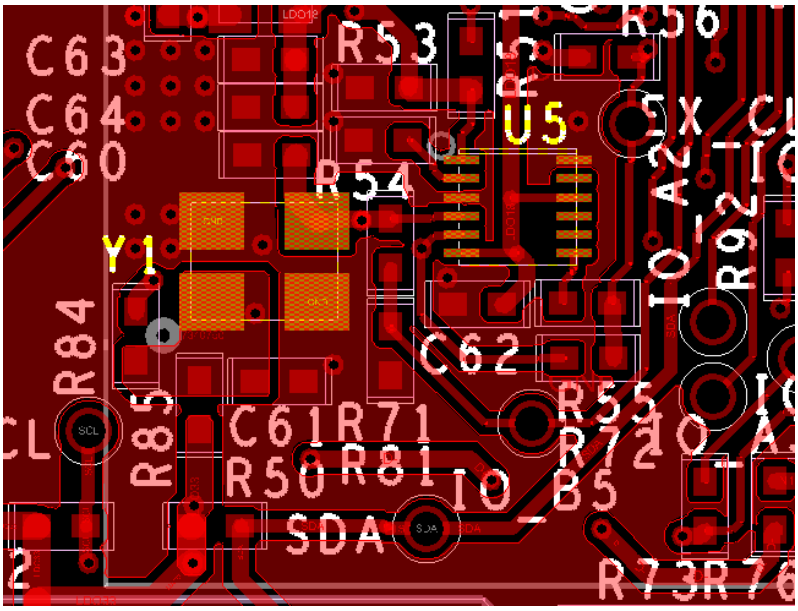



Figure 18. External Crystal PCB Location



## LED Pattern Selection – LED1 and LED2

The P9243-GB uses two LED outputs to indicate power transfer, faults, and operating modes. The LEDs are connected to LED1 and LED2 pins as shown in the typical application schematic. The LED pattern can be modified using the P9243-GB Wireless Power Pro GUI.

There are three states of LED patterns: Charge Complete State, Power Transfer State, and Alarm State. Power Transfer State is triggered upon Power Transfer Phase in System State Register. Alarm State is triggered upon any fault in System Error Register. Charge Complete State is triggered upon receiving either End-Power-Transfer Charge Complete Packet received from Receiver or Charge Status Packet value of 100 received from Receiver.

Once application firmware is boot up, LED2 will be toggle three times at 500 millisecond intervals. The LED pattern for the Boot Up State is not programmable.

## Quality Factor in Digital Ping Phase – QDEC

Before each digital ping, the P9243-GB detects and measures the coil's quality factor (Q-factor). If an EPP receiver is present, the transmitter compares its own measured Q-factor with the reference Q-factor provided by the EPP receiver. If the measured Q-factor is lower than the calculated threshold based on the Receiver's reference Q-factor value, the P9243-GB will identify this situation as a WPC-defined FOD being present and cannot continue on to the Power Transfer Phase for the purpose of system protection. The default Q-factor detection threshold can be adjusted using the P9243-GB Wireless Power Pro GUI.

The method implemented by the P9243-GB to detect the Q-factor is completely based on the nature of the LC resonant circuit. The transmitter LC resonant tank is first charged by a low voltage DC source to ensure that the Rx will not be powered up by using a small amount of energy. Until there is no AC current flowing from the DC source to the LC tank, the DC source voltage will be removed and the LC tank will be shorted. The energy previously stored in the LC resonant tank circulates between the coil and capacitors and generates resonant ringing naturally. The frequency and envelope of the resonant ringing are directly related to the Q-factor. Thus, the Q-factor can be calculated by detecting the envelope of the ringing with the circuit in Figure 19.

The P9243-GB-EVK has implemented the Q-factor detection for WPC EPP receivers. The Q_DEC pin is used to sample the voltage on the coil. Figure 20 shows the Q-factor detection circuits.

Figure 19. Q-factor Detection Schematic Location

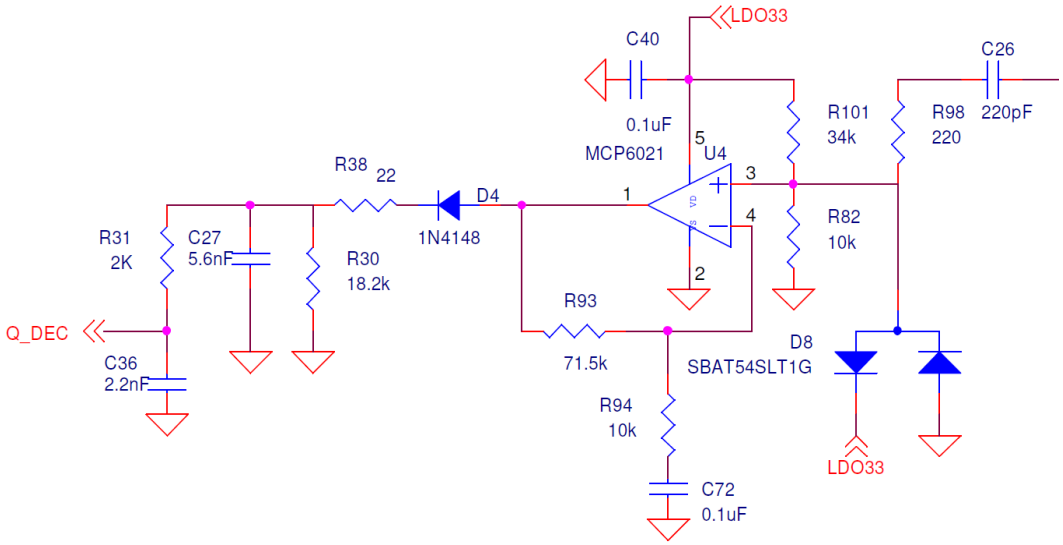
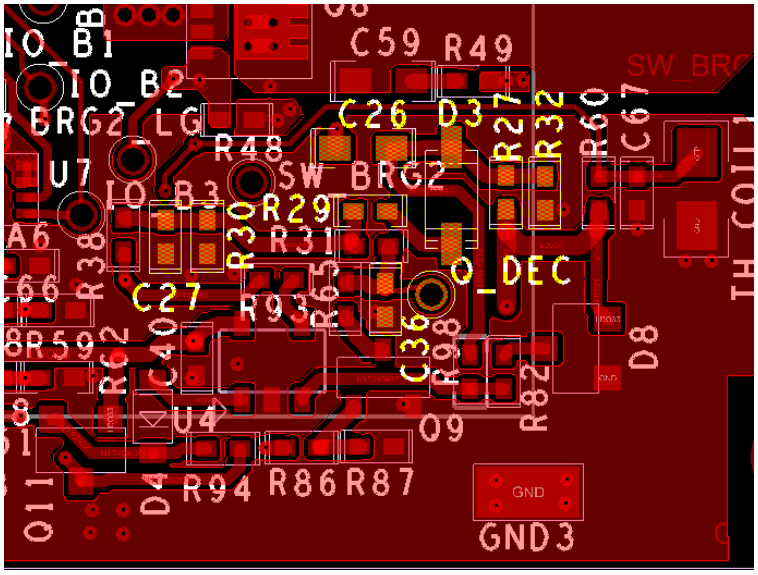


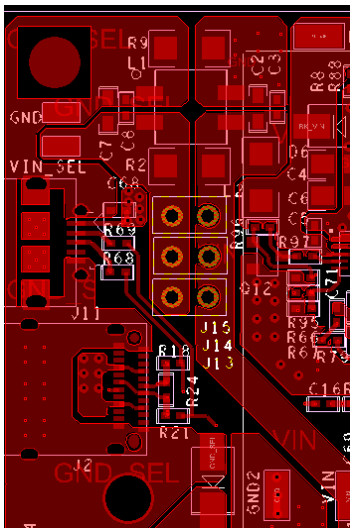
Figure 20. Q-factor PCB Location




## Selection of Input Source and Operation Mode

The P9243-GB-EVK supports different types of AD/DC adaptors and connectors. By selecting the jumpers in Figure 15, the user can select the USB-Micro connector, USB-C connector, or DC jack adaptor.

Figure 21. Input Source Selection Jumpers on the PCB



The P9243-GB-EVK supports a wide range of input DC sources from 5V to 19V. Based on the input source, the P9243-GB-EVK supports different types of receivers. Table 2 lists the P9243-GB-EVK operation modes.

Table 2. P9243-GB-EVK Operation Modes

| Input Voltage/Current Rating | Receiver Supported | Operating Frequency |
|---|---|---|
| 5V/2A | BPP (Bypass External Buck Regulator) | 110k – 148k |
| 9V/1.67A | BPP 5W | 110kHz – 127.7kHz |
| | EPP, up to 8W | |
| | Up to 7.5W charging for iPhones | |
| 12V/2A | BPP 5W | |
| | EPP, up to 10W | |
| | Samsung AFC | |
| | Up to 7.5W charging for iPhones | |
| 15V to 19V/1.8A | BPP 5W | |
| | EPP, up to 15W | |
| | Samsung AFC | |
| | Up to 7.5W charging for iPhones | |

## Transmitter Coil

The MP-A11 coils in Table 3 are recommended to be used with the P9243-GB transmitter for 15W applications for optimum performance. The recommended vendor has been tested and verified.

Table 3. Recommend Coil Manufacturer

| Output Power | Vendor | Part Number | Inductance at 100kHz | Typical DCR at 25ºC |
|---|---|---|---|---|
| 15W | SUNLORD | MQQTC505030S6R3 | 6.3uH | 38mΩ |
| 15W | CYNTEC | WTCL05054F-6R3ABKS-70 | 6.3uH | 38mΩ |

# List of Register for Default Configuration

The P9243-GB uses the standard I2C slave implementation protocol to communicate with a host AP or other I2C peripherals. The communication protocol is implemented using 8 bits for data and 16 bits for addresses. The default slave address of the P9243-GB is $61_{HEX}$. The address of each register is 16 bits. Note that some values require multiple registers and therefore span multiple addresses. For example, the address of the device ID high byte is $0001_{HEX}$ and the low byte address is $0000_{HEX}$.

The following tables list address locations, field names, available operations (R or RW), default values, and functional descriptions of internally accessible SRAM registers contained within the P9243-GB. The registers are loaded each time the device is powered and cannot be changed except by new firmware programmed into the external Flash device. The SRAM registers are available to make setting changes after the device is powered. These changes are reset to default when the power is cycled or the device is reset. Below are the commonly used SRAM registers for the system configuration or debug.

## Identification Registers

Table 4. Read Register – Device ID Register

| Address and Bit | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0000_{HEX}$ | Device_ID [15:0] | R | $9243_{HEX}$ | Device ID. |

Table 5. Read Register – Firmware Revision

| Address and Bit | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0540_{HEX}$ | Customer_Code [7:0] | R | - | Customer code. |
| $0541_{HEX}$ | Project_Code [7:0] | R | - | Project code. |
| $0542_{HEX}$ | FW_Major_Rev [7:0] | R | - | Major firmware revision. |
| $0543_{HEX}$ | FW_Minor_Rev [7:0] | R | - | Minor firmware revision. |
| $0544_{HEX}$ | Month_Code [7:0] | R | - | Month firmware revision. |
| $0545_{HEX}$ | Day_Code [7:0] | R | - | Day firmware revision. |
| $0546_{HEX}$ | Year_Code [7:0] | R | - | Year firmware revision. |

© 2021 Renesas Electronics Corporation

## State and Status Registers

Table 6. Read Register – System State

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0707_{HEX}$ | System State [7:0] | R | – | $0_{DEC}$ = Detection Phase<br>$1_{DEC}$ = Selection Phase<br>$2_{DEC}$ = Ping Phase<br>$3_{DEC}$ = ID Phase<br>$5_{DEC}$ = Configuration Phase<br>$6_{DEC}$ = Negotiation Phase<br>$7_{DEC}$ = Calibration Phase<br>$8_{DEC}$ = Power Transfer Phase<br>$9_{DEC}$ = Renegotiation Phase<br>$10_{DEC}$ = Remove Power |

Table 7. Read Register – System Error Code

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0614_{HEX}$ | System Error [31:0] | R | – | BIT0 = *End Power Transfer* command from receiver<br>BIT6 = Signal strength<br>BIT7 = WPC packager timeout<br>BIT8 = Control Error Packet timeout<br>BIT9 = Received Power Packet timeout<br>BIT10 = Over-current protection during the Digital Ping Phase<br>BIT11 = Over-voltage<br>BIT12 = Under-voltage<br>BIT13 = FOD in power transfer<br>BIT14 = Over-temperature<br>BIT17 = Over-current<br>BIT21 = Buck error<br>BIT22 = Q-factor FOD |

## System Read-Only Registers

### Table 8. Read Register – Input Current

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0664_{HEX}$ | Bridge_input_current [15:0] | R | – | Input current ADC reading in mA. |

### Table 9. Read Register – Input Voltage

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0668_{HEX}$ | Input_voltage [15:0] | R | – | Coil voltage ADC reading in mV. |

### Table 10. Read Register – Operating Frequency

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0632_{HEX}$ | Freq_Cnt [15:0] | R | – | Operating frequency count. Operating frequency changes based on the CEP packets from the receiver. $f_{OP} = \frac{106667}{FREQ\_CNT[15:0] - 2}$ |

### Table 11. Read Register – Transmitter Duty Cycle

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $05CF_{HEX}$ | Transmitter_Duty [7:0] | R | – | Transmitter duty cycle. Duty cycle changes based on the CEP packets from the receiver. $D(\%) = \frac{FREQ\_CNT[7:0]}{510}$ |

### Table 12. Read Register – Receiver Reported Q-Factor Value

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $083D_{HEX}$ | Reported_Q [7:0] | R | – | Reported Q value of Receiver. |

### Table 13. Read Register – Measured Q Factor Value

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $050A_{HEX}$ | Q_factor [7:0] | R | – | Measured Q value of Transmitter. |

© 2021 Renesas Electronics Corporation

Table 14. Read Register – Threshold Q Factor Value

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $050A_{HEX}$ | Q_threshold [7:0] | R | – | Calculated Q threshold value to trigger QFOD. QFOD alarm triggers when Q_Factor < Q_Threshold. Gain and Offset can be adjusted using the Configuration Registers. $\text{Q\_threshold} = \frac{\text{Reported\_Q} \times \text{Gain}}{100} + \text{Offset}$ |

Table 15. Read Register – Potential Power

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $083E_{HEX}$ | Potential_Power [7:0] | R | – | Transmitter potential power in W. |

Table 16. Read Register – Transmitter Power

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0880_{HEX}$ | Tx_Power [31:0] | R | – | Power transmitted in mW. |

Table 17. Read Register – Received Power

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0884_{HEX}$ | Rx_Power [31:0] | R | – | Received Power in mW from the RPP packet received from the Receiver. |

Table 18. Read Register – FOD Threshold

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $088C_{HEX}$ | FOD_Threshold [15:0] | R | – | Gain and Offset values change based on the RPP packet received from the Receiver. Value is in mW. FOD alarm triggers when FOD Threshold < Power Loss. $\text{FOD Threshold} = (\text{GAIN} \times \text{RPP})/100 + \text{OFFSET}$ |

Table 19. Read Register – Remote Temperature Sensing Voltage

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $06A4_{HEX}$ | Thermistor pin voltage [15:0] | R | – | Thermistor raw ADC reading. Value in ADC count. |

© 2021 Renesas Electronics Corporation

Table 20. Read Register – Adaptor Type

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $070E_{HEX}$ | Adaptor Type [7:0] | R | – | $0_{DEC}$ = None<br>$1_{DEC}$ = USB SDP<br>$2_{DEC}$ = USB DCP<br>$3_{DEC}$ = USB CDP<br>$5_{DEC}$ = QC 2.0<br>$6_{DEC}$ = QC 3.0<br>$7_{DEC}$ = Reserved<br>$8_{DEC}$ = Adaptor Detect Error<br>$9_{DEC}$ = QC 27W<br>$10_{DEC}$ = Reserved<br>$11_{DEC}$ = USB FCP<br>$12_{DEC}$ = USB SCP<br>$13_{DEC}$ = Reserved |

Table 21. Read/Write Register – Rx Manufacture ID

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0892_{HEX}$ | RX_Manufacture_ID [7:0] | R | – | RX WPC Manufacturer code (PRMC ID). The code is assigned by WPC to each company producing compliant products. |

Table 22. Read/Write Register – Rx Type

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0893_{HEX}$ | RX_Type [7:0] | R | – | Displays the Rx Power Profile Type Flag.<br>$0_{DEC}$ = BPP<br>$1_{DEC}$ = EPP (5W)<br>$2_{DEC}$ = EPP<br>$3_{DEC}$ = AFC<br>$4_{DEC}$ = iOS |

Table 23. Read/Write Register – Charge Status Packet

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0718_{HEX}$ | Charge_Status [7:0] | R | – | Displays the data value of the Charge Status Packet from Receiver.<br>View LED pattern registers for defaults.<br>$100_{DEC}$ = LED pattern is change to Charge Complete State.<br>Others = LED pattern is changed to Power Transfer State. |

## Configuration Registers

Default values can be configured using the P9243-GB Wireless Pro GUI. Visit the P9243-GB-EVK webpage and download the latest version of the P9243-GB Wireless Power Pro GUI, USB drivers, and the P9243-GB A11a Configuration Flash HEX File. The software provides an intuitive GUI for reading and writing to P9243-GB SRAM registers and for generating custom user configurations for the external Flash. Launch the P9243-GB Wireless Power Pro GUI to view more. The following registers are commonly used for system configuration or debug.

Table 24. Read/Write Register – Tx Manufacture ID Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0918_{HEX}$ | TX_Manufacture_ID [15:0] | R/W | 0x0050 | TX WPC Manufacturer code (PRMC ID). The code is assigned by WPC to each company producing compliant products. |

Table 25. Read/Write Register – Over Current Threshold Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $08F4_{HEX}$ | OVP_5V [15:0] | R/W | 2500 | Over current protection (OCP) threshold in mA for 5V Vin. |
| $08F6_{HEX}$ | OVP_9V [15:0] | R/W | 2500 | Over current protection (OCP) threshold in mA for 9V Vin. |
| $08F8_{HEX}$ | OVP_12V [15:0] | R/W | 1800 | Over current protection (OCP) threshold in mA for 12V Vin. |
| $08FA_{HEX}$ | OVP_16V [15:0] | R/W | 1800 | Over current protection (OCP) threshold in mA for 16V Vin. |

Table 26. Read/Write Register – Low Voltage and Over Voltage Threshold Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $091E_{HEX}$ | LVP_5V [15:0] | R/W | 4200 | Low voltage protection (LVP) threshold in mV for 5V Vin. |
| $0920_{HEX}$ | OVP_5V [15:0] | R/W | 6500 | Over voltage protection (OVP) threshold in mV for 5V Vin. |
| $0922_{HEX}$ | LVP_9V [15:0] | R/W | 8400 | Low voltage protection (LVP) threshold in mV for 9V Vin. |
| $0924_{HEX}$ | OVP_9V [15:0] | R/W | 9600 | Over voltage protection (OVP) threshold in mV for 9V Vin. |
| $0926_{HEX}$ | LVP_12V [15:0] | R/W | 8400 | Low voltage protection (LVP) threshold in mV for 12V Vin. |
| $0928_{HEX}$ | OVP_12V [15:0] | R/W | 13200 | Over voltage protection (OVP) threshold in mV for 12V Vin. |
| $092A_{HEX}$ | LVP_16V [15:0] | R/W | 14000 | Low voltage protection (LVP) threshold in mV for 16V Vin. |
| $092C_{HEX}$ | OVP_16V [15:0] | R/W | 19700 | Over voltage protection (OVP) threshold in mV for 16V Vin. |

Table 27. Read/Write Register – Over Temperature Threshold Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0930_{HEX}$ | OTP_Recovery [15:0] | R/W | – | Over temperature protection (OTP) recovery threshold. Thermistor voltage needs to go above this value to restart the normal operation. Value in ADC count. |
| $0932_{HEX}$ | OTP_Trigger [15:0] | R/W | – | Over temperature protection (OTP) trigger threshold. Thermistor voltage needs to go below this value to trigger OTP. Value in ADC count. |

© 2021 Renesas Electronics Corporation

Table 28. Read/Write Register – WPC Tuning Threshold Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $096A_{HEX}$ | WPC_Coil_Current_thd [15:0] | R/W | 180 | Coil Current Threshold for WPC Maximum Voltage Test. Value in mA. Used for WPC conformance. |
| $096C_{HEX}$ | WPC_LD_BuckDuty [15:0] | R/W | 775 | Controls the VBRG fold back after a load dump occurs for WPC Maximum Voltage test. Used for WPC conformance. $\text{Duty Cycle}[\%] = (1067 - \text{value})/1067$ For example, $\frac{1067-775}{1067} = 27.37\%$ |

Table 29. Read/Write Register – FOD Region Select Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $08C0_{HEX}$ | FOD_Pwr_EPP_0 [15:0] | R/W | 6200 | Extended Power Profile (>5W). Threshold that separates region 0 and region 1 for FOD Protection in mW. |
| $08C2_{HEX}$ | FOD_Pwr_EPP_1 [15:0] | R/W | 11700 | Extended Power Profile (>5W). Threshold that separates region 2 and region 3 for FOD Protection in mW. |
| $08C4_{HEX}$ | FOD_Pwr_BPP_0 [15:0] | R/W | 2000 | Baseline Power Profile. Threshold that separates region 0 and region 1 for FOD Protection in mW. |
| $08C6_{HEX}$ | FOD_Pwr_BPP_1 [15:0] | R/W | 5900 | Baseline Power Profile. Threshold that separates region 2 and region 3 for FOD Protection in mW. |
| $08C8_{HEX}$ | FOD_Pwr_EPP_LP_0 [15:0] | R/W | 2400 | Extended Power Profile (5W). Threshold that separates region 0 and region 1 for FOD Protection in mW. |
| $08CA_{HEX}$ | FOD_Pwr_EPP_LP_1 [15:0] | R/W | 4500 | Extended Power Profile (5W). Threshold that separates region 2 and region 3 for FOD Protection in mW. |

Table 30. Read/Write Register – FOD Gain Select Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $08CC_{HEX}$ | FOD_G_EPP_0 [15:0] | R/W | 2 | Extended Power Profile (>5W). Gain used in FOD threshold calculation in region 0. |
| $08CE_{HEX}$ | FOD_G_EPP_1 [15:0] | R/W | 5 | Extended Power Profile (>5W). Gain used in FOD threshold calculation in region 1. |
| $08D0_{HEX}$ | FOD_G_EPP_2 [15:0] | R/W | 11 | Extended Power Profile (>5W). Gain used in FOD threshold calculation in region 2. |
| $08D2_{HEX}$ | FOD_G_BPP_0 [15:0] | R/W | 5 | Baseline Power Profile. Gain used in FOD threshold calculation in region 0. |
| $08D4_{HEX}$ | FOD_G_BPP_1 [15:0] | R/W | 8 | Baseline Power Profile. Gain used in FOD threshold calculation in region 1. |
| $08D6_{HEX}$ | FOD_G_BPP_2 [15:0] | R/W | 7 | Baseline Power Profile. Gain used in FOD threshold calculation in region 2. |
| $08D8_{HEX}$ | FOD_G_EPP_LP_0 [15:0] | R/W | 25 | Extended Power Profile (5W). Gain used in FOD threshold calculation in region 0. |
| $08DA_{HEX}$ | FOD_G_EPP_LP_1 [15:0] | R/W | 25 | Extended Power Profile (5W). Gain used in FOD threshold calculation in region 1. |
| $08DC_{HEX}$ | FOD_G_EPP_LP_2 [15:0] | R/W | 25 | Extended Power Profile (5W). Gain used in FOD threshold calculation in region 2. |

Table 31. Read/Write Register – FOD Offset Select Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $08DE_{HEX}$ | FOD_O_EPP_0 [15:0] | R/W | 800 | Extended Power Profile (>5W). Offset used in FOD threshold calculation in region 0 in mW. This register is signed. |
| $08E0_{HEX}$ | FOD_O_EPP_1 [15:0] | R/W | 650 | Extended Power Profile (>5W). Offset used in FOD threshold calculation in region 1 in mW. This register is signed. |
| $08E2_{HEX}$ | FOD_O _EPP_2 [15:0] | R/W | -56 | Extended Power Profile (>5W). Offset used in FOD threshold calculation in region 2 in mW. This register is signed. |
| $08E4_{HEX}$ | FOD_O_BPP_0 [15:0] | R/W | 630 | Baseline Power Profile. Offset used in FOD threshold calculation in region 0 in mW. This register is signed. |
| $08E6_{HEX}$ | FOD_O_BPP_1 [15:0] | R/W | 575 | Baseline Power Profile. Offset used in FOD threshold calculation in region 1 in mW. This register is signed. |
| $08E8_{HEX}$ | FOD_O _BPP_2 [15:0] | R/W | 625 | Baseline Power Profile. Offset used in FOD threshold calculation in region 2 in mW. This register is signed. |
| $08EA_{HEX}$ | FOD_O_EPP_LP_0 [15:0] | R/W | 460 | Extended Power Profile (5W). Offset used in FOD threshold calculation in region 0 in mW. This register is signed. |
| $08EC_{HEX}$ | FOD_O _EPP_LP_1 [15:0] | R/W | 470 | Extended Power Profile (5W). Offset used in FOD threshold calculation in region 1 in mW. This register is signed. |
| $08EE_{HEX}$ | FOD_O _EPP_LP_2 [15:0] | R/W | 470 | Extended Power Profile (5W). Offset used in FOD threshold calculation in region 2 in mW. This register is signed. |

© 2021 Renesas Electronics Corporation

Table 32. Read/Write Register – FOD Disable Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $08F4_{HEX}$ | FOD_Enable [7:0] | R/W | 1 | Disables FOD Protection. To be used only in development stage. Do not disable in final production.<br>$0_{DEC}$ = FOD Disabled<br>$1_{DEC}$ = FOD Enabled |

Table 33. Read/Write Register – LED Pattern Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0900_{HEX}$ | FC_Red_LED_ON [15:0] | R/W | 0 | Red LED on time in Charge Complete State. Value in ms. |
| $0902_{HEX}$ | FC_Red_LED_OFF [15:0] | R/W | 0 | Red LED off time in Charge Complete State. Value in ms. |
| $0904_{HEX}$ | FC_Green_LED_ON [15:0] | R/W | 500 | Green LED on time in Charge Complete State. Value in ms. |
| $0906_{HEX}$ | FC_Green_LED_OFF [15:0] | R/W | 500 | Green LED off time in Charge Complete State. Value in ms. |
| $0908_{HEX}$ | Chg_Red_LED_ON [15:0] | R/W | 0 | Red LED on time in Power Transfer State. Value in ms. |
| $090A_{HEX}$ | Chg_Red_LED_OFF[15:0] | R/W | 0 | Red LED off time in Power Transfer State. Value in ms. |
| $090C_{HEX}$ | Chg_Green_LED_ON [15:0] | R/W | 1000 | Green LED on time in Power Transfer State. Value in ms. |
| $090E_{HEX}$ | Chg_Green_LED_OFF [15:0] | R/W | 0 | Green LED off time in Power Transfer State. Value in ms. |
| $0910_{HEX}$ | Err_Red_LED_ON [15:0] | R/W | 200 | Red LED on time in Alarm State. Value in ms. |
| $0912_{HEX}$ | Err_Red_LED_OFF [15:0] | R/W | 200 | Red LED off time in Alarm State. Value in ms. |
| $0914_{HEX}$ | Err_Green_LED_ON [15:0] | R/W | 0 | Green LED on time in Alarm State. Value in ms. |
| $0916_{HEX}$ | Err_Green_LED_OFF [15:0] | R/W | 0 | Green LED off time in Alarm State. Value in ms. |

Table 34. Read/Write Register – Sleep Timer Adjust

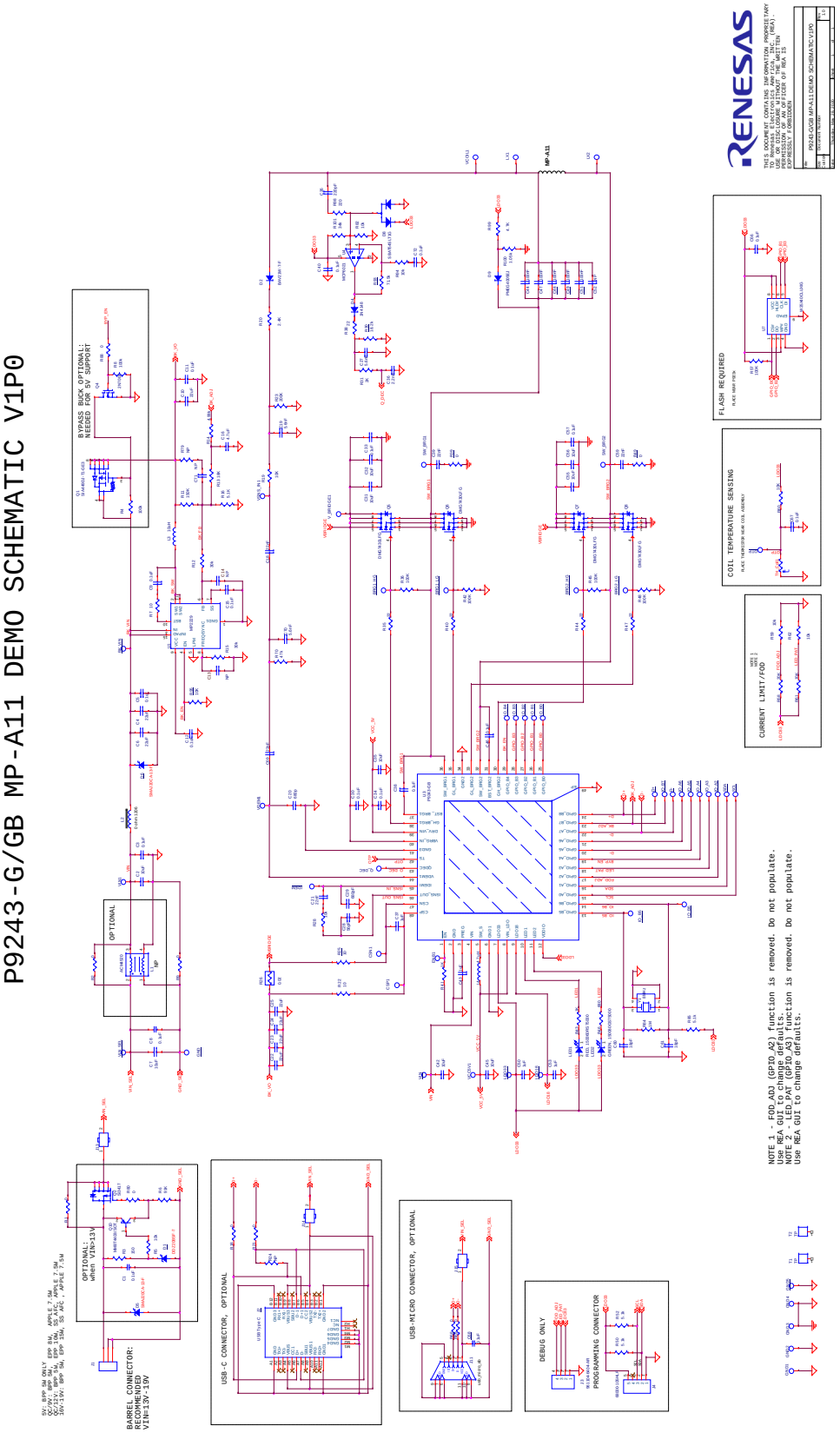
| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $091A_{HEX}$ | Chg_Complete_Timer [15:0] | R/W | 60 | Sleep timer for which transmitter turns off when it receives a Charge Complete End of Power Transfer (EPT) packet. Value in seconds. |
| $091C_{HEX}$ | Error_Timer [15:0] | R/W | 60 | Sleep timer for which transmitter turns off when in Alarm State. Value in seconds. |

Table 35. Read/Write Register – Q-Factor Adjust

| Address and Bits | Register Field Name | R/W | Default | Function and Description |
|---|---|---|---|---|
| $0943_{HEX}$ | Q_Threshold_Gain [7:0] | R/W | 34 | Gain for Q-factor threshold calculation |
| $0944_{HEX}$ | Q_Threshold_Offset [7:0] | R/W | 45 | Offset for Q-factor threshold calculation |
| $0946_{HEX}$ | Q_Vbridge_adjust [15:0] | R/W | 2500 | Bridge voltage in mV adjust during Q measurement. Bridge voltages lower than 1500mV is not recommended. |

© 2021 Renesas Electronics Corporation

# P9243-GB EVB Application Schematic v1.0



# Bill of Materials (BOM)

Table 3. P9243-GB-EVK BOM

| Item | QTY | Reference | Description | Value | PCB Footprint | Part Number |
|---|---|---|---|---|---|---|
| 1 | 8 | VIN1,GND1,GND2,GND3,GND4,VIN_SEL,GND,BK_VIN | TEST POINT PC MINIATURE SMT | TP | test_pt_sm_135x70 | 5015 |
| 2 | 38 | V_BRIDGE1,VSNS_IN1,VDEM1,VCOIL1,SW_BRG1,IO_B1,ENB1,CSP1,CSN1,BRG1_LG,BRG1_HG,SW_BRG2,IO_B2,IO_A2,BRG2_LG,BRG2_HG,IO_B3,IO_A3,IO_B4,IO_A4,IO_B5,IO_A5,GND5,IO_B6,IO_A6,IO_B7,LDO18,LDO33,VCC5V1,VIN,SDA,SCL,Q_DEC,OTP,IO_B0,IDEM,D-,D+ | 30 GAUGE WIRE PAD | PTH_TP | TEST_PT30DPAD | NP |
| 3 | 1 | C1 | CAP CER 0.1UF 25V X7R 0603 | 0.1uF | 603 | CC0603KRX7R8BB104 |
| 4 | 9 | C2,C7,C31,C32,C35,C42,C45,C55,C56 | CAP CER 10UF 25V X5R 0603 | 10uF | 603 | C1608X5R1E106M080AC |
| 5 | 18 | C3,C5,C8,C9,C11,C12,C15,C30,C33,C34,C38,C40,C46,C57,C66,C67,C68,C72 | CAP CER 0.1UF 25V X7R 0402 | 0.1uF | 402 | CC0402KRX7R8BB104 |
| 6 | 7 | C4,C6,C10,C22,C23,C24,C25 | CAP CER 22UF 25V X5R 0805 | 22uF | 805 | GRM21BR61E226ME44L |
| 7 | 4 | C13,C14,R24,C71 | NP | NP | 402 | NP |
| 8 | 1 | C16 | CAP CER 4.7UF 16V X5R 0402 | 4.7uF | 402 | CL05A475MO5NUNC |
| 9 | 2 | C18,C69 | CAP CER 0.022UF 50V X7R 0603 | 22nF | 603 | GCJ188R71H223KA01D |
| 10 | 2 | C19,C70 | CAP CER 5600PF 50V X7R 0603 | 5.6nF | 603 | CC0603KRX7R9BB562 |
| 11 | 1 | C20 | CAP CER 680PF 50V X7R 0402 | 680p | 402 | CL05B681KB5NNNC |
| 12 | 1 | C21 | CAP CER 0.022UF 25V X7R 0402 | 22nF | 402 | GRM155R71E223JA61D |
| 13 | 1 | C26 | CAP CER 220PF 50V X7R 0603 | 220pF | 603 | CC0603JRX7R9BB221 |
| 14 | 1 | C27 | CAP CER 5600PF 16V X7R 0402 | 5.6nF | 402 | CC0402KRX7R7BB562 |
| 15 | 1 | C28 | CAP CER 56PF 50V C0G/NP0 0402 | 56pF | 402 | CL05C560JB5NNNC |
| 16 | 1 | C29 | CAP CER 680PF 50V X7R 0402 | 680pF | 402 | CL05B681KB5NNNC |
| 17 | 1 | C36 | CAP CER 2200PF 10V X7R 0402 | 2.2nF | 402 | CC0402KRX7R6BB222 |
| 18 | 4 | C37,C43,C50,C53 | CAP CER 1UF 25V X5R 0402 | 1uF | 402 | CGB2A1X5R1E105M033BC |
| 19 | 2 | C39,C59 | CAP CER 0.022UF 50V X7R 0603 | 22nF | 603 | CL10B223KB8NNNC |

© 2021 Renesas Electronics Corporation

| Item | QTY | Reference | Description | Value | PCB Footprint | Part Number |
|---|---|---|---|---|---|---|
| 20 | 5 | C44,C47,C48,C49,C51 | CAP CER 100nF 100V C0G 1206 | 100nF | 1206 | C3216C0G2A104K160AC |
| 21 | 1 | C52 | NP | NP | 1206 | NP |
| 22 | 2 | C60,C61 | CAP CER 18pF 50V 5% C0G/NP0 0402 | 18pF | 402 | GRM1555C1H180JA01D |
| 23 | 1 | D1 | DIODE ZENER 20V 500MW SOD323F | DDZ20BSF-7 | sod123 | DDZ20BSF-7 |
| 24 | 1 | D2 | DIODE GEN PURP 200V 200MA SOD123 | BAV21W-7-F | sod123 | BAV21W-7-F |
| 25 | 1 | D4 | DIODE GEN PURP 75V 150MA SOD323 | 1N4148 | sod-323 | 1N4148WX-TP |
| 26 | 2 | D5,D6 | TVS DIODE 20V 32.4V SMA | SMAJ20CA-13-F | SMAJ20CA | SMAJ20CA-13-F |
| 27 | 1 | D8 | DIODE ARRAY SCHOTTKY 30V SOT23-3 | SBAT54SLT1G | SOT-23 | SBAT54SLT1G |
| 28 | 1 | D9 | SHTKY DIODE PURP 200V 500MA | PMEG4005EJ | SOD323F | PMEG4005EJ |
| 29 | 1 | J1 | CONN PWR JACK 2.5X5.5MM SOLDER | AC_Adapter | CONN_POWER_JACK5_5MM | PJ-002AH |
| 30 | 1 | J2 | CONN RCP USB3.1 TYPEC 24P SMD RA | USB Type C | USB-C12401610E4 | 12401610E4#2A |
| 31 | 1 | J3 | 4 Positions Header, Unshrouded Connector 0.100" (2.54mm) Through Hole Gold or Gold, GXT™ | 961104-6404-AR | sip-4 | 961104-6404-AR |
| 32 | 1 | J4 | BERGSTIK II .100" SR STRAIGHT | 68000-105HLF | sip5 | 68000-105HLF |
| 33 | 1 | J11 | CONN RCPT USB2.0 MICRO AB SMD RA | ZX62D-AB-5P8(30) | usb_micro_ab | ZX62D-AB-5P8(30) |
| 34 | 3 | J13,J14,J15 | CONN HEADER VERT 2POS 2.54MM | JMP | sip2 | 68000-102HLF |
| 35 | 1 | LED1 | LED RED CLEAR 0603 SMD | RED, 150060RS75000 | 0603_diode | 150060RS75000 |
| 36 | 1 | LED2 | LED GREEN CLEAR 0603 SMD | GREEN, 150060GS75000 | 0603_diode | 150060GS75000 |
| 37 | 2 | LX1,LX2 | 30 GAUGE WIRE PAD | PTH_TP | TP_TXCoil | NP |
| 38 | 1 | L1 | Common mode EMI choke | ACM4520 | EMI_TDK_ACM4520L | ACM4520-901-2P-T-000 |
| 39 | 1 | L2 | RES SMD 0 OHM JUMPER 1/4W 1206 | Zero ohm | 0 ohm 1206 | RC1206JR-070RL |
| 40 | 1 | L3 | 29mOhm, 3.6A inductor | 10uH | 5x5-10x10 | SWPA8040S100MT |
| 41 | 1 | L4 | FIXED IND 4.7UH 620MA 550 MOHM | 4.7uH | L0603 | LQM18PN4R7MFRL |

| Item | QTY | Reference | Description | Value | PCB Footprint | Part Number |
|---|---|---|---|---|---|---|
| 42 | 1 | Q1 | MOSFET P-CH 30V 12A SC70-6 | SIA449DJ-T1-GE3 | sc70_6ld_fet | SIA449DJ-T1-GE3 |
| 43 | 1 | Q2 | P-Channel 30 V , 35mOhm, 15nC MOSFET | Si3417 | SOT-23-6 | Si3417DV-T1-GE3 |
| 44 | 1 | Q4 | N-Channel 60-V (D-S) MOSFET | 2N7002 | SOT23_3 | 2N7002KT1G |
| 45 | 4 | Q5,Q6,Q7,Q8 | MOSFET N-CH 30V 10.5A PWRDI3333 | DMG7430LFG | powerdi3333_8ld_fet | DMG7430LFG-7 |
| 46 | 1 | Q10 | TRANS PNP 40V 0.6A SOT-23 | MMBT4403/SOT | SOT-23 | MMBT4403LT3G |
| 47 | 3 | R1,R2,R9 | RES SMD 0.0 OHM JUMPER 1/4W 1206 | 0 | 1206 | RC1206JR-070R |
| 48 | 1 | R3 | RES SMD 150 OHM 1% 1/10W 0603 | 150 | 603 | RC0603FR-07150RL |
| 49 | 2 | R4,R8 | RES SMD 100K OHM 1% 1/16W 0402 | 100k | 402 | RC0402FR-07100KL |
| 50 | 7 | R5,R19,R59,R60,R61,R82,R94 | RES SMD 10K OHM 1% 1/16W 0402 | 10k | 402 | RC0402FR-0710KL |
| 51 | 1 | R6 | RES SMD 91K OHM 1% 1/16W 0402 | 91K | 402 | RC0402FR-0791K |
| 52 | 2 | R7,R25 | RES SMD 10 OHM 1% 1/16W 0402 | 10 | 402 | RC0402FR-0710RL |
| 53 | 1 | R11 | RES SMD 150K OHM 1% 1/16W 0402 | 150K | 402 | RC0402FR-07150K |
| 54 | 2 | R12,R15 | RES SMD 30K OHM 1% 1/16W 0402 | 30k | 402 | RC0402FR-0730KL |
| 55 | 1 | R13 | RES SMD 18K OHM 1% 1/10W 0402 | 18K | 402 | ERJ-2RKF1802X |
| 56 | 1 | R14 | RES SMD 4.99K OHM 1% 1/16W 0402 | 4.99k | 402 | RC0402FR-074K99L |
| 57 | 4 | R16,R50,R52,R85 | RES SMD 5.1K OHM 1% 1/16W 0402 | 5.1k | 402 | RC1005F512CS |
| 58 | 8 | R18,R21,R39,R49,R68,R69,R80,R88 | RES SMD 0 OHM JUMPER 1/16W 0402 | 0 | 402 | RC0402JR-070RL |
| 59 | 1 | R20 | RES SMD 2.4K OHM 1% 1/10W 0603 | 2.4K | 603 | RC0603FR-072K4L |
| 60 | 1 | R22 | RES SMD 10 OHM 1% 1/16W 0402 | 10 | 402 | RC0402FR-0710RL |
| 61 | 1 | R23 | RES SMD 200K OHM 1% 1/10W 0603 | 200K | 603 | RC1608F204CS |
| 62 | 1 | R26 | RES SMD 0.02 OHM 1% 1/3W 0805 | 0.02 | 805 | UCR10EVHFSR020 |
| 63 | 2 | R28,R62 | RES SMD 10K OHM 1% 1/16W 0402 | 10k | 402 | RC0402FR-0710KP |
| 64 | 1 | R30 | RES SMD 18.2K OHM 1% 1/16W 0402 | 18.2k | 402 | RC0402FR-0718K2L |
| 65 | 1 | R31 | RES SMD 2K OHM 1% 1/16W 0402 | 2K | 402 | RC0402FR-072KL |
| 66 | 4 | R35,R40,R44,R47 | RES SMD 22 OHM 5% 1/10W 0402 | 22 | 402 | ERJ-2GEJ220X |
| 67 | 5 | R36,R42,R45,R48,R57 | RES SMD 100K OHM 5% 1/10W 0402 | 100K | 402 | ERJ-2GEJ104X |

© 2021 Renesas Electronics Corporation

| Item | QTY | Reference | Description | Value | PCB Footprint | Part Number |
|---|---|---|---|---|---|---|
| 68 | 1 | R38 | RES SMD 22 OHM 1% 1/16W 0402 | 22 | 402 | RC0402FR-0722RL |
| 69 | 2 | R41,R43 | RES SMD 1K OHM 5% 1/16W 0402 | 1K | 402 | RC0402JR-071KL |
| 70 | 1 | R46 | RES SMD 680 OHM 5% 1/16W 0402 | 680 | 402 | RC0402JR-07680RL |
| 71 | 1 | R58 | RES SMD 20K OHM 0.1% 1/16W 0402 | 20K | 402 | RT0402BRD0720KL |
| 72 | 1 | R70 | RES SMD 47K OHM 1% 1/10W 0603 | 47k | 603 | RC0603FR-0747KL |
| 73 | 1 | R79 | RES SMD 51k 1% 1/16W 0402 | NP | 402 | RC0402FR-0751KL |
| 74 | 1 | R84 | RES SMD 1M OHM 1% 1/16W 0402 | 1M | 402 | RC0402FR-071ML |
| 75 | 1 | R93 | RES SMD 71.5K OHM 1% 1/16W 0402 | 71.5k | 402 | RC0402FR-0771K5L |
| 76 | 1 | R95 | RES SMD 10K OHM 1% 1/10W 0402 | 10K | 402 | RC0402FR-0710KL |
| 77 | 1 | R98 | RES SMD 220 OHM 1% 1/16W 0402 | 220 | 402 | AC0402FR-07220RL |
| 78 | 1 | R99 | RES SMD 4.7K OHM 1% 1/16W 0402 | 4.7K | 402 | RC0402FR-074K7L |
| 79 | 1 | R100 | RES SMD 1.05K OHM 1% 1/16W 0402 | 1.05k | 402 | RC0402FR-071K05L |
| 80 | 1 | R101 | RES SMD 34K OHM 1% 1/16W 0402 | 34k | 402 | RC0402FR-0734KL |
| 81 | 1 | TH_Coil1 | NTC Thermistor 10k Bead | NP | 805 | NTCLE203E3103JB0 |
| 82 | 1 | T1 | | TP | 8x250unplated | |
| 83 | 1 | T2 | | TP | 8x320unplated | |
| 84 | 1 | U1 | Buck Regulator Chip, QFN-14 (3X3) | MP2229 | MP_2229 | MP2229GQ |
| 85 | 1 | U3 | Medium Power Transmitter | P9243-GB | socketqfn_48_6x6_0p4 | P9243-GB |
| 86 | 1 | U4 | 1.7~5.5V input, 10MHz R2R OPA | MCP6021 | SOT23-5 | MCP6021T-E/OT |
| 87 | 1 | U7 | SPIFLASH 4M-BIT 4KB UNIFORM SECT | W25X40CLUXIG | uson_2x3_8LD | W25X40CLUXIG |
| 88 | 1 | Y1 | 8MHz Crystal Oscillator | 8MHz | ECX-53B | ECS-80-18-30B-AGN-TR |

# Board Layout

Figure 22. Silkscreen – Top of Board

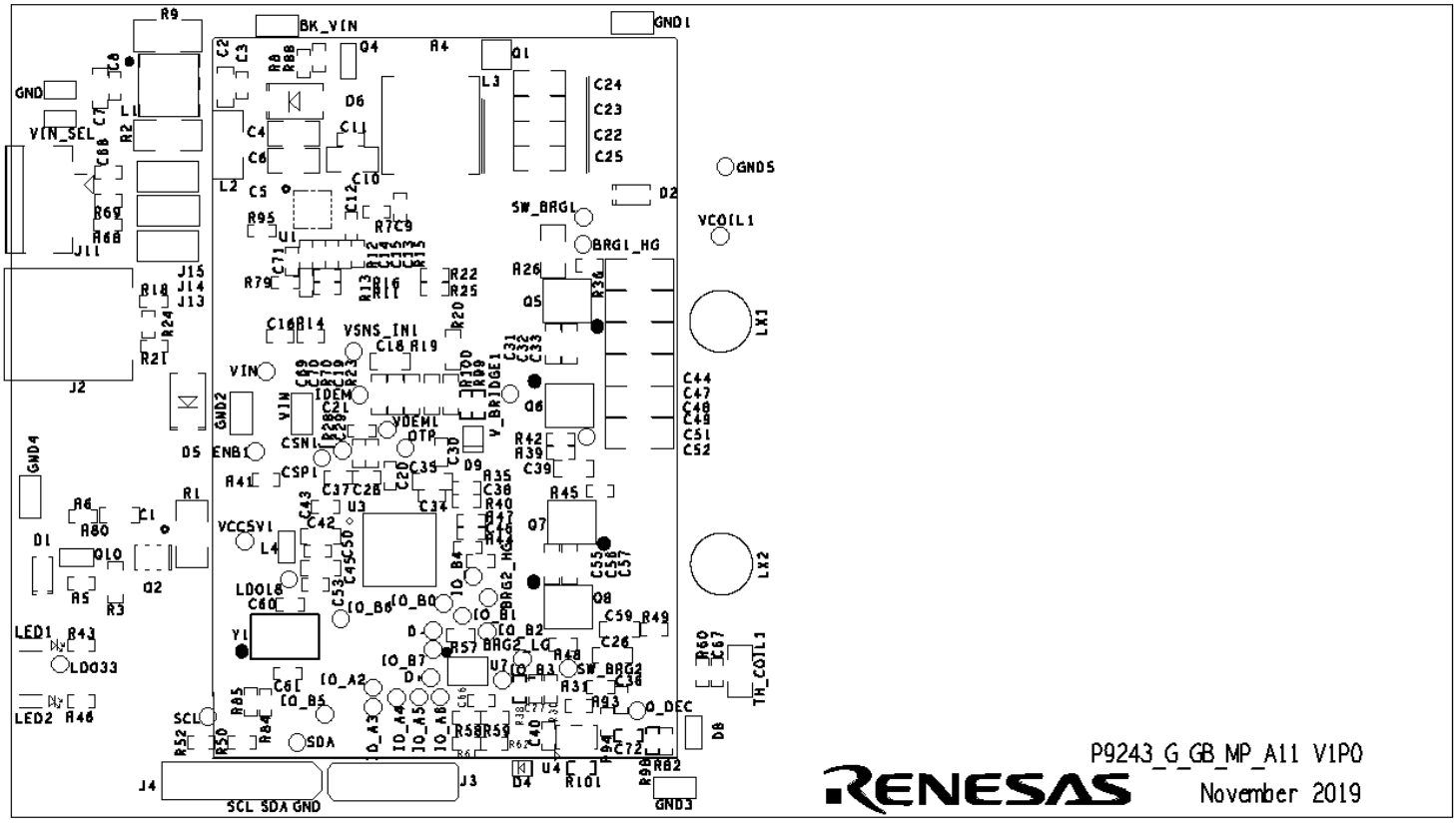


Figure 23. Copper – Top Layer

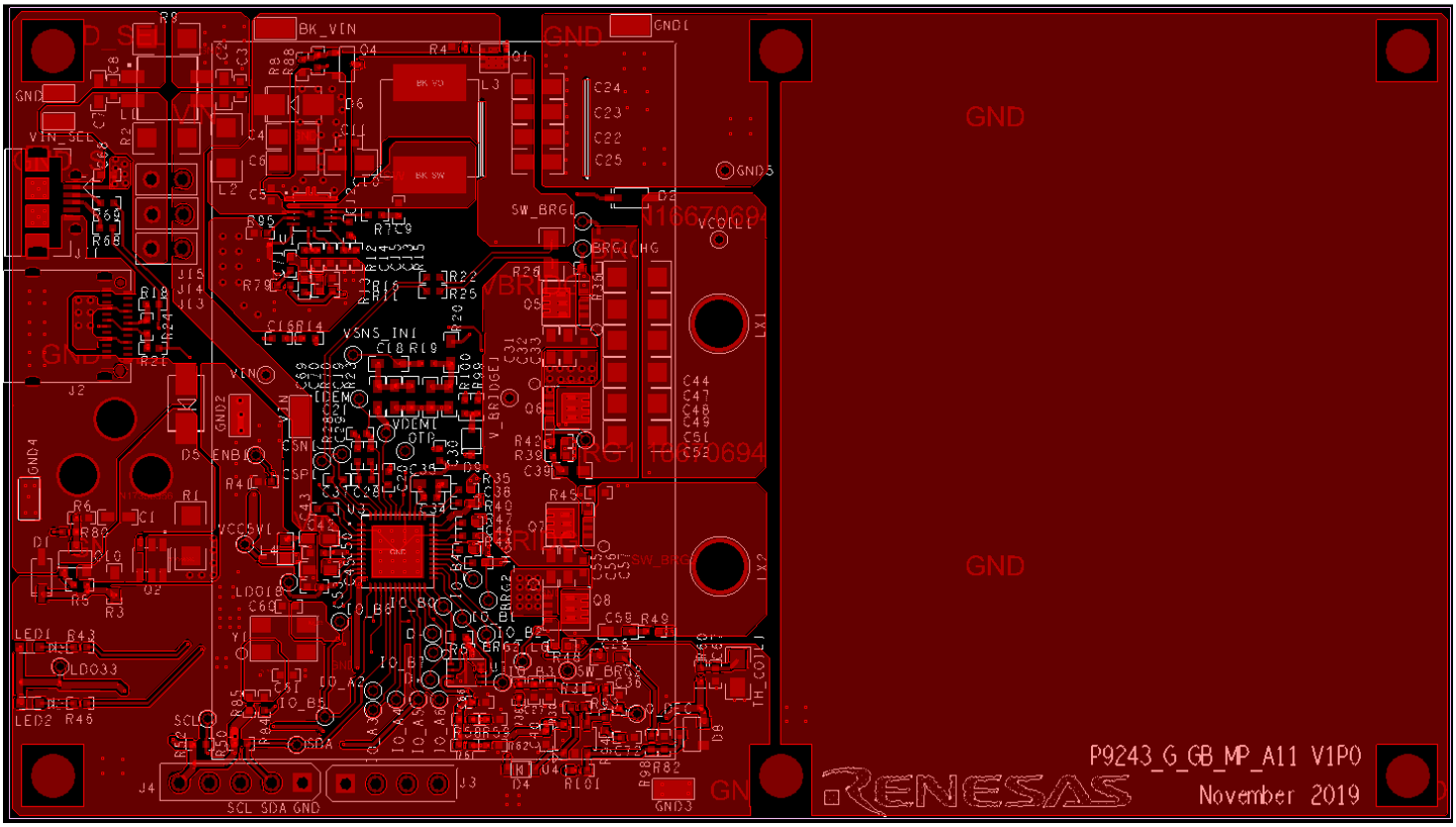


Figure 24. Copper L1 Layer

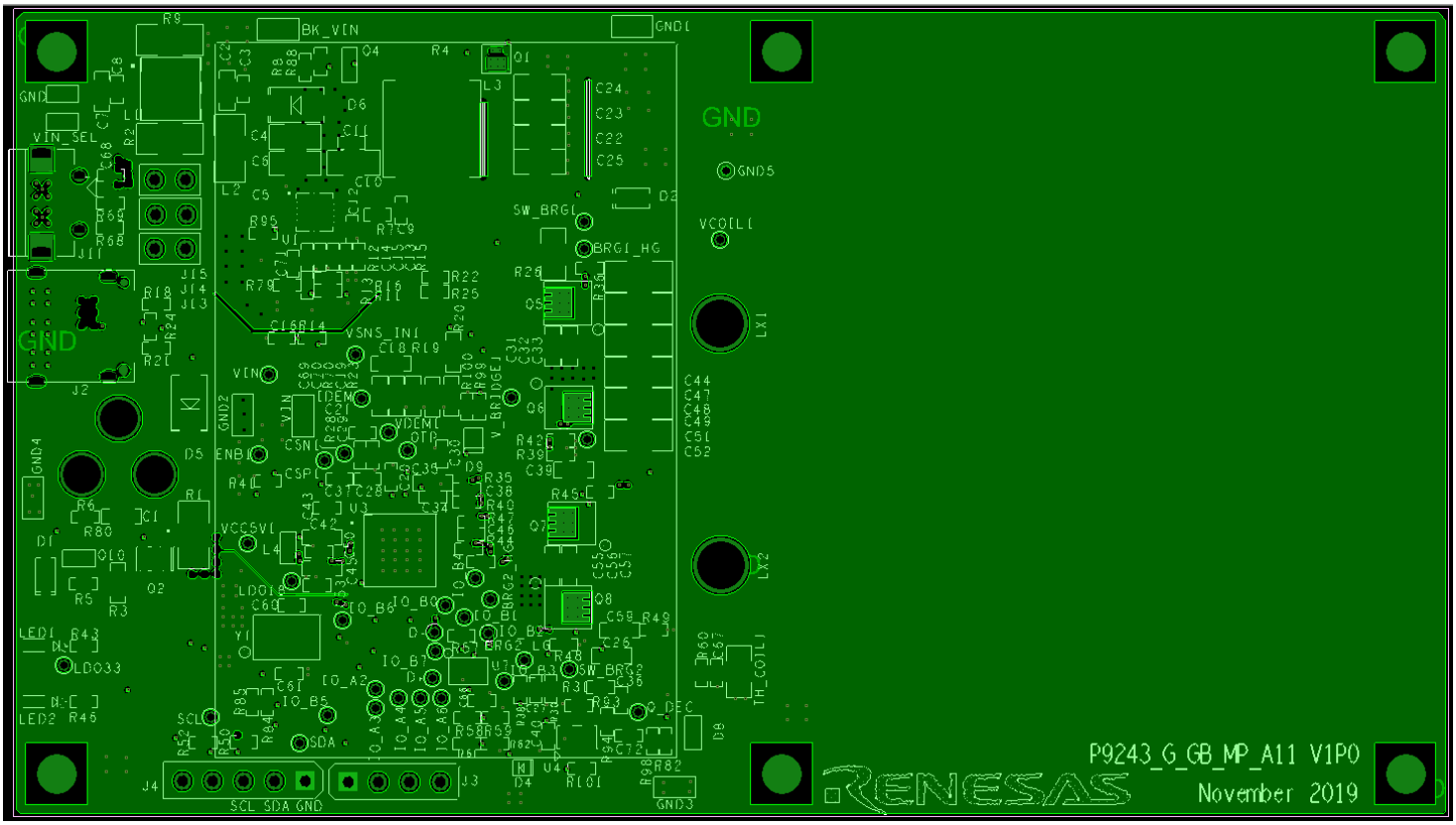


Figure 25. Copper L2 Layer

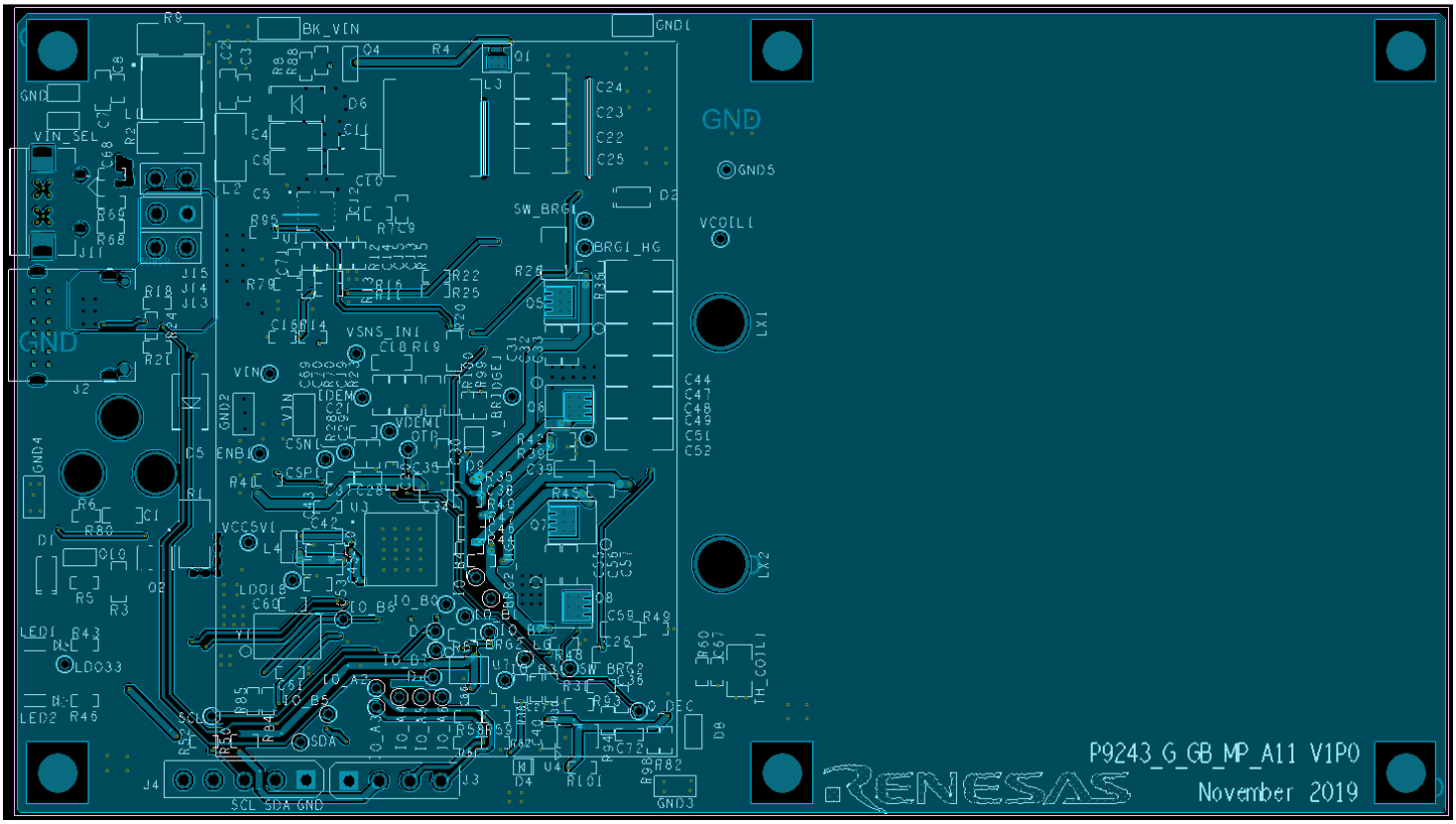
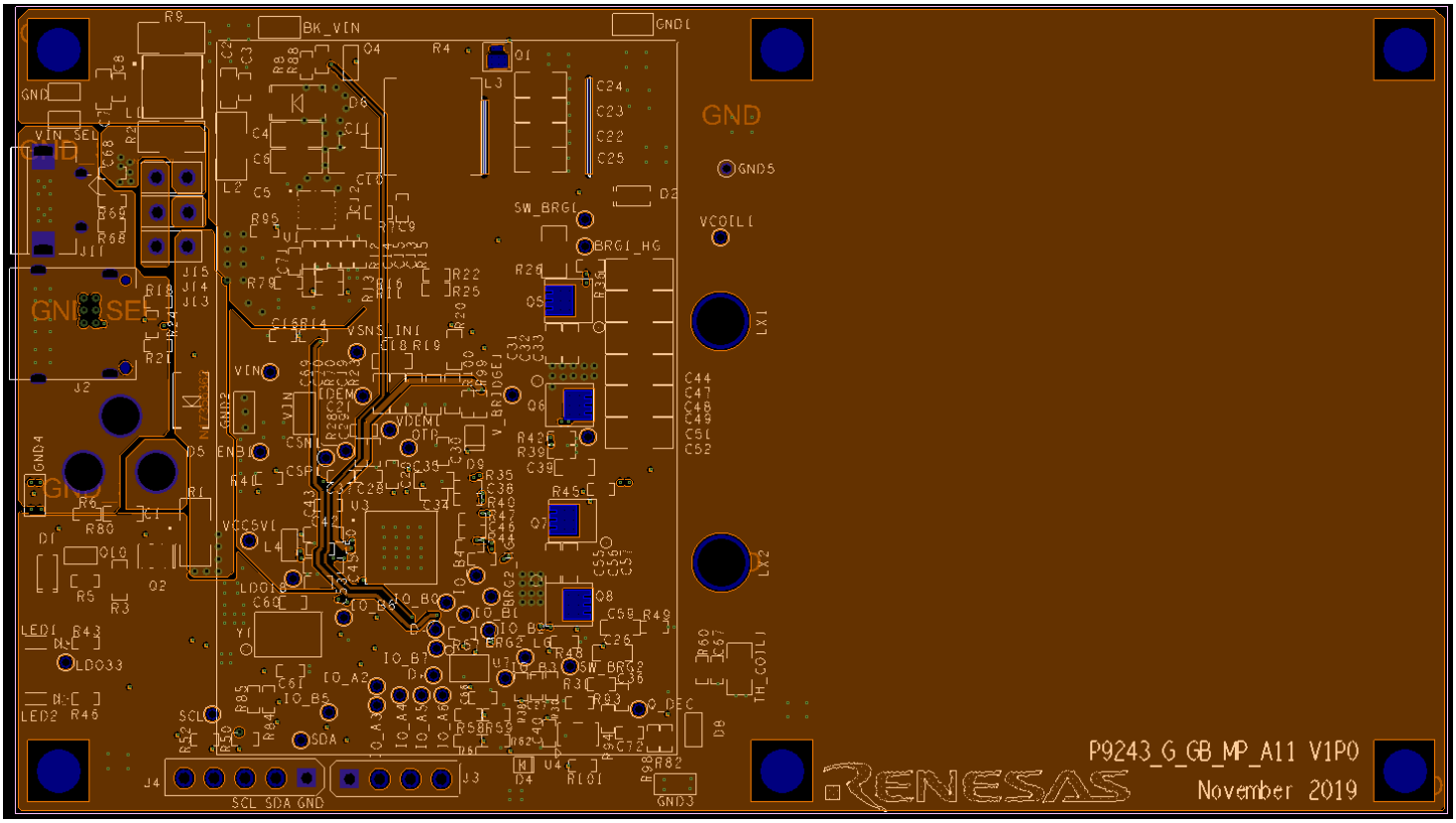


Figure 26. Copper Bottom




# Ordering Information

| Orderable Part Number[a] | Description |
|---|---|
| P9243-GB-EVK | P9243-GB-EVK Evaluation Board |
| WPD-USB-DONGLE | USB-to-I2C dongle (FTDI). It is not included in the P9243-GB-EVK evaluation kit, and must be ordered separately. USB-FTDI-V2.1 and WPD-USB-DONGLE have the same functionality and can be used interchangeably. |

[a] The P9243-GB has only the bootloader firmware pre-programmed into the internal one-time programmable (OTP) memory. The device must be used in conjunction with an external Winbond W25X20CLUXIG flash. For a sizeable business opportunity, the application firmware can also be loaded into the internal one-time programmable (OTP) memory and external flash memory can be removed. For more information, contact the Renesas sales team or your distributor.

© 2021 Renesas Electronics Corporation

# Revision History

| Revision Date | Description of Change |
|---|---|
| February 25, 2021 | ▪ Updated “Control of External Power Stage DC/DC Buck Regulator – GPIO_B4 and GPIO_B7” |
| January 31, 2021 | ▪ Updated “LED Pattern Selection – LED1 and LED2”<br>▪ Updated register information pertain to USB PD as Reserved and register addresses for Sleep Timer Adjust.<br>▪ Added Rx Manufacture ID Register, Rx Type Register, Charge Status Packet Registers, and LED Pattern Selection Information. |
| September 15, 2020 | Initial release. |

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01 Jan 2024)


### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com


### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit www.renesas.com/contact-us/.

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

© 2024 Renesas Electronics Corporation. All rights reserved.