SILICON LABS MGM210PB22 Module Radio Board User Manual

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The BRD4308D Wireless Gecko Radio Board contains a Wireless Gecko module, which integrates Silicon Labs' EFR32MG22 Wireless Gecko SoC into a small form factor module. The fully certified module contains all components (a high-performance transceiver, an energy efficient 32-bit MCU, crystals, RF passives, and antenna) required for a system-level implementation of Zigbee®, Thread® Bluetooth® and multi-protocol (ZigBee + Bluetooth) networks operating in the 2.4 GHz band with 10 dBm output power.

The BRD4308D Wireless Gecko Radio Board plugs into the Wireless Starter Kit Mainboard, which is included with the Wireless Gecko Starter Kit and gives access to display, buttons, and additional features from expansion boards. With the supporting Simplicity Studio suite of tools, developers can take advantage of graphical wireless application development, mesh networking debug and packet trace, and visual energy profiling and optimization.

This document contains a brief introduction and description of the BRD4308D Radio Board features, focusing on the RF performance.

RADIO BOARD FEATURES

- Wireless Module: MGM210PB22JIA2
  - CPU core: ARM Cortex®-M33
  - Flash/RAM memory: 1024 kB/96 kB
  - Secure Vault
  - Operation frequency: 2.4 GHz
  - Transmit power: 10 dBm
  - Integrated chip antenna, RF matching network, crystals, and decoupling
- UFL connector for conducted tests

Contents

Introduction

The BRD4308D Radio Boards provide a development platform (together with the Wireless Starter Kit Mainboard) for the Silicon Labs Wireless Gecko modules.

By carrying the MGM210PB22 module, the BRD4308D Radio Board is designed to operate in the 2400-2483.5 MHz with the maximum of 10 dBm output power.

To develop and/or evaluate the MGM210PB22 module, the BRD4308D Radio Board can be connected to the Wireless Starter Kit Mainboard to get access to display, buttons, and additional features from expansion boards (EXP boards).

Radio Board Connector

Introduction

The board-to-board connector scheme allows access to all MGM210PB22 GPIO pins as well as the RESETn signal. For more information on the functions of the available pins, see the MGM210PB22 data sheet.

Radio Board Connector Pin Associations

The figure below shows the mapping between the connector and the MGM210PB22 pins and their function on the Wireless Starter Kit Mainboard.

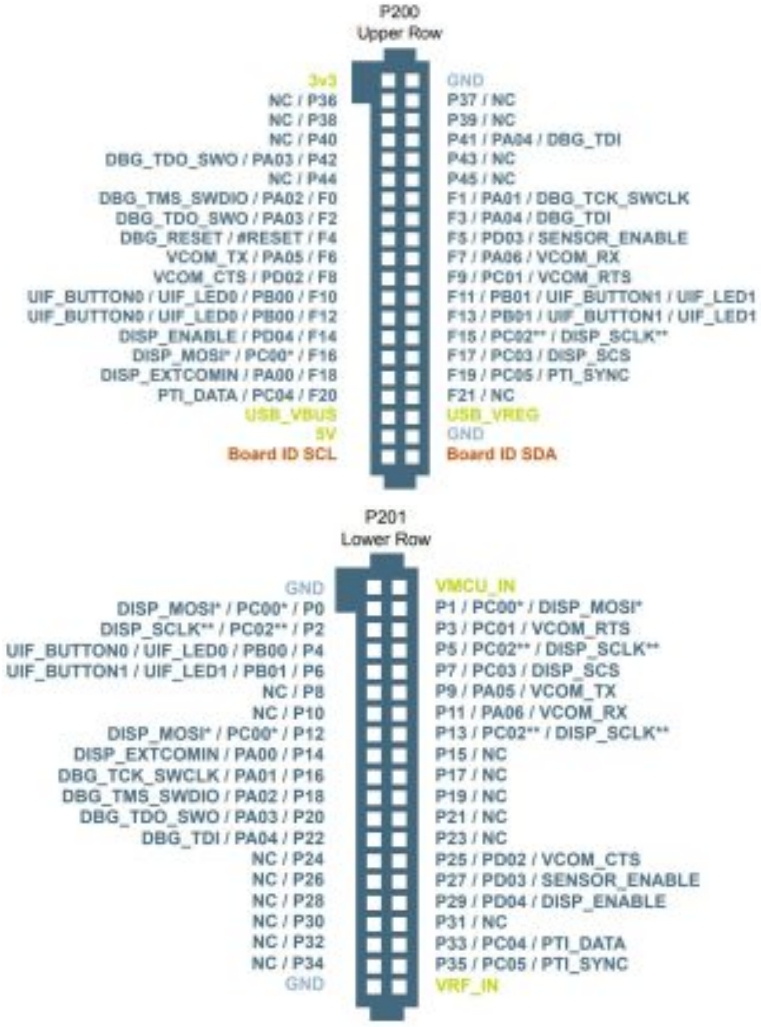

Figure 2.1. BRD4308D Radio Board Connector Pin Mapping

Radio Board Block Summary

Introduction

This section introduces the blocks of the BRD4308D Radio Board.

Radio Board Block Diagram

The block diagram of the BRD4308D Radio Board is shown in the figure below

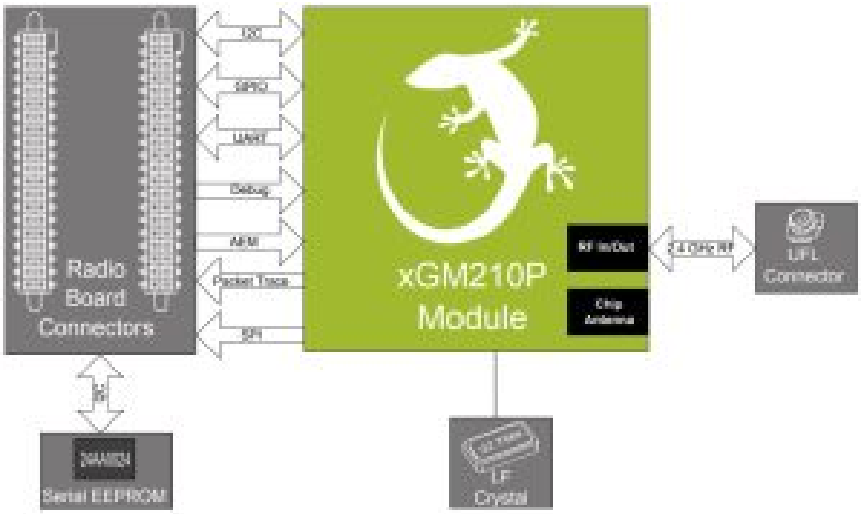

Figure 3.1. BRD4308D Block Diagram

Radio Board Block Description

Wireless Module
The MGM210PB22JIA2 module incorporated on the BRD4308D Wireless Gecko Radio Board features a 32-bit Cortex®-M33 core, 1024 kB of flash memory, 96 kB of RAM, crystals, and a 2.4 GHz band transceiver with RF passives and integrated antenna output power up to 10 dBm. For additional information on the MGM210PB22JIA2, refer to the MGM210P data sheet.

Radio Board Connectors
Two dual-row, 0.05” pitch polarized connectors make up the BRD4308D Radio Board interface to the Wireless Starter Kit Mainboard.

For more information on the pin mapping between the MGM210PB22JIA2 and the Radio Board Connector, refer to section 2.2 Radio Board Connector Pin Associations.

LF Crystal Oscillator (LFXO)
The BRD4308D Radio Board has a crystal mounted. For details regarding the crystal configuration, refer to application note AN0016.2: Oscillator Design Considerations.

Serial EEPROM
The BRD4308D Radio Board is equipped with a serial I2C EEPROM for board identification and to store additional board-related information.

Mechanical Details

The BRD4308D Radio Board is illustrated in the figures below.

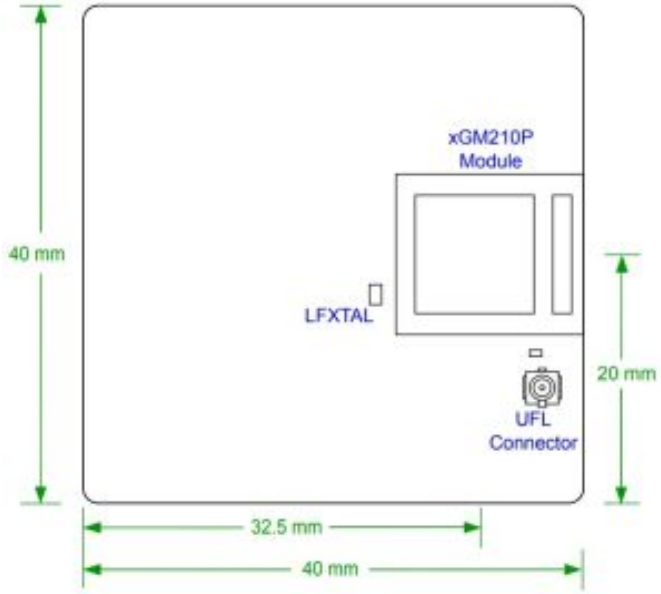

Figure 4.1. BRD4308D Top View

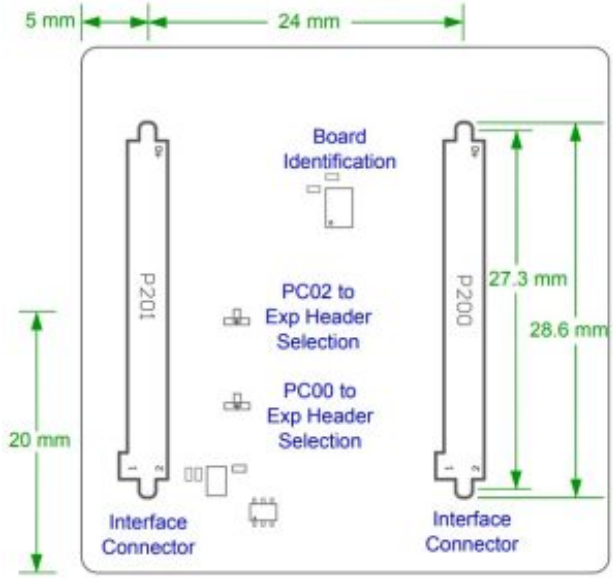

Figure 4.2. BRD4308D Bottom View

EMC Compliance

Introduction

Compliance of the fundamental and harmonic levels of the BRD4308D Radio Board is tested against the following standards:

- 2.4 GHz:
  - ETSI EN 300-328
  - FCC 15.247

EMC Regulations for 2.4 GHz

ETSI EN 300-328 Emission Limits for the 2400-2483.5 MHz Band

Based on ETSI EN 300-328, the allowed maximum fundamental power for the 2400-2483.5 MHz band is 20 dBm EIRP. For the unwanted emissions in the 1 GHz to 12.75 GHz domain, the specific limit is -30 dBm EIRP.

FCC15.247 Emission Limits for the 2400-2483.5 MHz Band

FCC 15.247 allows conducted output power up to 1 W (30 dBm) in the 2400-2483.5 MHz band. For spurious

emissions, the limit is -20 dBc based on either conducted or radiated measurement, if the emission is not in a restricted band. The restricted bands are specified in FCC 15.205. In these bands, the spurious emission levels must meet the levels set out in FCC 15.209. In the range from 960 MHz to the frequency of the 5th harmonic, it is defined as 0.5 mV/m at 3 m distance which equals to -41.2 dBm in EIRP.

If operating in the 2400-2483.5 MHz band, the 2nd, 3rd, and 5th harmonics can fall into restricted bands. As a result, for those harmonics the -41.2 dBm limit should be applied. For the 4th harmonic the -20 dBc limit should be applied.

Applied Emission Limits for the 2.4 GHz Band
The above ETSI limits are applied both for conducted and radiated measurements.

The FCC restricted band limits are radiated limits only. In addition, Silicon Labs applies the same restrictions to the conducted spectrum. By doing so, compliance with the radiated limits can be estimated based on the conducted measurement, by assuming the use of an antenna with 0 dB gain at the fundamental and the harmonic frequencies.

The overall applied limits are shown in the table below. For the harmonics that fall into the FCC restricted bands, the FCC 15.209 limit is applied. ETSI EN 300-328 limit is applied for the rest.

Applied Limits for Spurious Emissions for the 2.4 GHz Band

Harmonic	Frequency	Limit
2nd	4800~4967 MHz	-41.2 dBm
3rd	7200~7450.5 MHz	-41.2 dBm
4th	9600~9934 MHz	-30.0 dBm
5th	12000~12417.5 MHz	-41.2 dBm

RF Performance

Conducted Power Measurements
During measurements, the BRD4308D Radio Board was attached to a Wireless Starter Kit Mainboard which was supplied by USB. The voltage supply for the Radio Board was 3.3 V.

Conducted Measurements in the 2.4 GHz Band
The BRD4308D Radio Board was connected directly to a Spectrum Analyzer through the on-board UFL connector. The RF output of the module was set to the RF2G4_IO2 pin instead of the built-in antenna.

The supply for the module (VDD) was 3.3 V provided by the mainboard; for details, see the BRD4308D schematic. The transceiver was operated in continuous carrier transmission mode. The output power of the radio was set to 10 dBm.

The typical output spectrum is shown in the following figure.

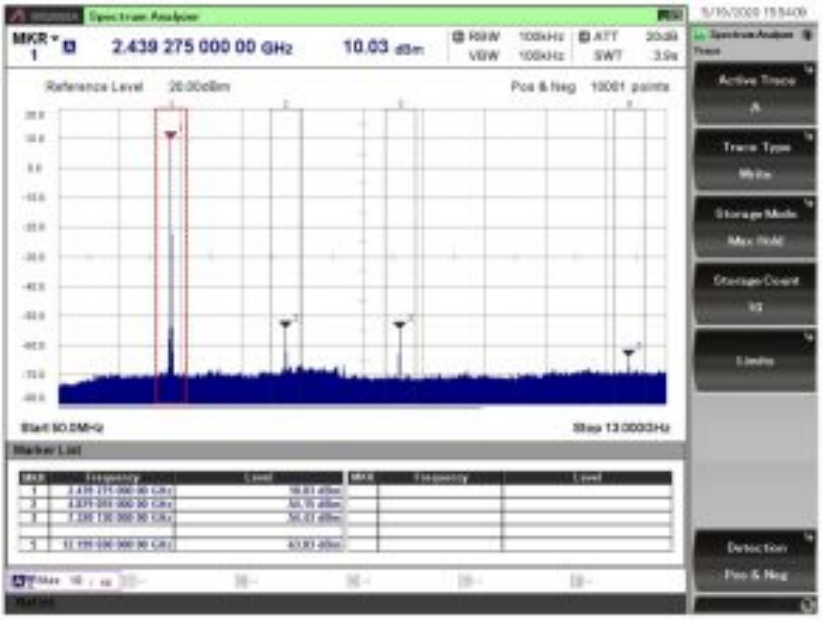

Figure 6.1. Typical Output Spectrum of the BRD4308D

As shown in the figure above, the fundamental is 10 dBm and all of the unwanted emissions are under the applied limits.
Note: The UFL connector introduces approximately 0.3 dB insertion loss.

Radiated Power Measurements
During measurements, the BRD4308D Radio Board was attached to a Wireless Starter Kit Mainboard which was supplied by USB. The voltage supply for the Radio Board was 3.3 V. The radiated power was measured in an antenna chamber by rotating the board 360 degrees with horizontal and vertical reference antenna polarizations in the XY, XZ, and YZ cuts. The measurement planes are illustrated in the figure below.

Figure 6.2. Illustration of Reference Planes with a Radio Board Plugged into the Wireless Starter Kit Mainboard

Note: The radiated measurement results presented in this document were recorded in an unlicensed antenna chamber. Also, the radiated power levels may change depending on the actual application (PCB size, used antenna, and so on). Therefore, the absolute levels and margins of the final application are recommended to be verified in a licensed EMC testhouse.

Radiated Measurements in the 2.4 GHz Band
The supply for the module (VDD) was 3.3 V provided by the mainboard; for details, see the BRD4308D schematic. The RF output of the module was set to the built-in antenna. The transceiver was operated in continuous carrier transmission mode. The output power of the radio was set to 10 dBm based on the conducted measurement.

The fundamental was set to the frequency where the maximum antenna gain was measured. The results are shown in the table below.

Note: The frequency in which the antenna gain has its maximum value can vary between modules due to the technological spreading of the passive RF components and the antenna.

Maximums of the Measured Radiated Powers in EIRP [dBm]

Frequency (2440 MHz)	EIRP [dBm]	Orientation	Margin [dB]	Limit in EIRP [dBm]
Fund	11.6	XY/H	18.4	30.0
2nd	<-50*	-/-	>10	-41.2
3rd	-44.4	XZ/H	3.3	-41.2
4th	<-50*	-/-	>20	-30.0
5th	-42.7	XY/V	1.5	-41.2
* Signal level is below the Spectrum Analyzer noise floor.				

As shown in the table above, due to the antenna gain, the fundamental is slightly higher than the output power based the conducted measurement. The harmonics are below the applied limits.

Antenna Pattern Measurements
The measured normalized antenna patterns are shown in the following figures.

Figure 6.3. Normalized Antenna Pattern of the BRD4308D with the Wireless Starter Kit Mainboard

EMC Compliance Recommendations

Recommendations for 2.4 GHz ETSI EN 300-328 Compliance
As shown in section 6.2 Radiated Power Measurements, the power of the fundamental frequency of the BRD4308D Wireless Gecko Radio Board with 10 dBm output is compliant with the 20 dBm limit of the ETSI EN 300-328 regulation in both the conducted and radiated measurements. The harmonic emissions are under the -30 dBm limit with large margin.

Recommendations for 2.4 GHz FCC 15.247 Compliance
As shown in section 6.2 Radiated Power Measurements, the power of the fundamental frequency of the

BRD4308D Wireless Gecko Radio Board with 10 dBm output is compliant with the 30 dBm limit of the FCC 15.247 regulation. The harmonic emissions are under the applied limits.

Board Revision History

The board revision is laser engraved in the Board Info field on the bottom side of the PCB, as outlined in the figure below. The revision printed on the silkscreen is the PCB revision.

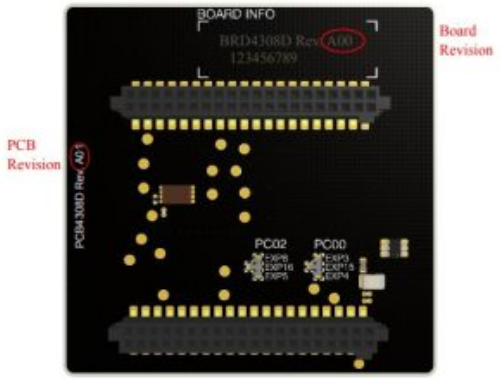

Figure 8.1. Revision Info

Table 8.1. BRD4308D Radio Board Revision History

Board Revision	Description
A00	Initial production release based on BRD4308B Rev. A02. New module OPN.

Errata

There are no known errata at present.

Document Revision History

Revision 1.0
Aug, 2020

- Initial document release.

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Silicon Laboratories Inc.
400 West Cesar Chavez
Austin, TX 78701
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