UG465: BGM220 Explorer Kit User's Guide

The BGM220 Explorer Kit is an ultra-low cost, small form factor development and evaluation platform for the BGM220P Wireless Gecko Bluetooth® Module.

The BGM220 Explorer Kit is focused on rapid prototyping and concept creation of IoT applications. It is designed around the BGM220P Module, based on the EFR32BG22 System-on-Chip, which is an ideal device family for developing energy-friendly connected IoT applications.

The kit features a USB interface, an on-board SEGGER J-Link debugger, one user-LED and button, and support for hardware add-on boards via a mikroBus socket and a Qwiic connector. The hardware add-on support allows developers to create and prototype applications using a virtually endless combination of off-the-shelf boards from mikroE, sparkfun, AdaFruit, and Seeed Studios.

TARGET DEVICE

- BGM220P Wireless Gecko Bluetooth® Module (BGM220PC22HNA)
- High performance 2.4 GHz radio
- 32-bit ARM® Cortex®-M33 with 76.8 MHz maximum operating frequency
- 512 kB flash and 32 kB RAM

KIT FEATURES

- User LED and push button
- 20-pin 2.54 mm breakout pads
- mikroBUS™ socket
- Qwiic® connector
- SEGGER J-Link on-board debugger
- Virtual COM port
- Packet Trace Interface (PTI)
- USB-powered.

SOFTWARE SUPPORT

- Simplicity Studio™

ORDERING INFORMATION

- BGM220-EK4314A

Table of Contents

1. Introduction

The BGM220 Explorer Kit has been designed to inspire customers to make IoT devices with the Silicon Labs BGM220P Wireless Gecko Bluetooth® Module. The kit includes a mikroBUS™ socket and Qwiic® connector, allowing users to add features to the kit with a large selection of off-the-shelf boards.

Programming the BGM220 Explorer Kit is easily done using a USB Micro-B cable and the on-board J-Link debugger. A USB virtual COM port provides a serial connection to the target application, and the Packet Trace Interface (PTI) offers invaluable debug information about transmitted and received packets in wireless links. The BGM220 Explorer Kit is supported in Simplicity Studio™ and a Board Support Package (BSP) is provided to give application developers a flying start.

Connecting external hardware to the BGM220 Explorer Kit can be done using the 20 breakout pads which present peripherals from the BGM220P Wireless Gecko such as I^2C, SPI, UART and GPIOs. The mikroBUS socket allows inserting mikroBUS add-on boards which interface with the BGM220P through SPI, UART or I^2C. The Qwiic connector can be used to connect hardware from the Qwiic Connect System through I^2C.

1.1 Kit Contents

The following items are included in the box:
- 1x BGM220 Explorer Kit board (BRD4314A)

1.2 Getting Started

Detailed instructions for how to get started with your new BGM220 Explorer Kit can be found on the Silicon Labs web pages:

silabs.com/start-bgm220ek

1.3 Hardware Content

The following key hardware elements are included on the BGM220 Explorer Kit:
- BGM220P Wireless Gecko Module with 76.8 MHz operating frequency, 2.4 GHz ceramic antenna for wireless transmission, 512 kB kB flash, and 32 kB RAM
- One LED and one push button
- On-board SEGGER J-Link debugger for easy programming and debugging, which includes a USB virtual COM port and Packet Trace Interface (PTI)
- MikroBUS™ socket for connecting click boards™ and other mikroBUS add-on boards
- Qwiic® connector for connecting Qwiic Connect System hardware
- Breakout pads for GPIO access and connection to external hardware
- Reset button

1.4 Kit Hardware Layout

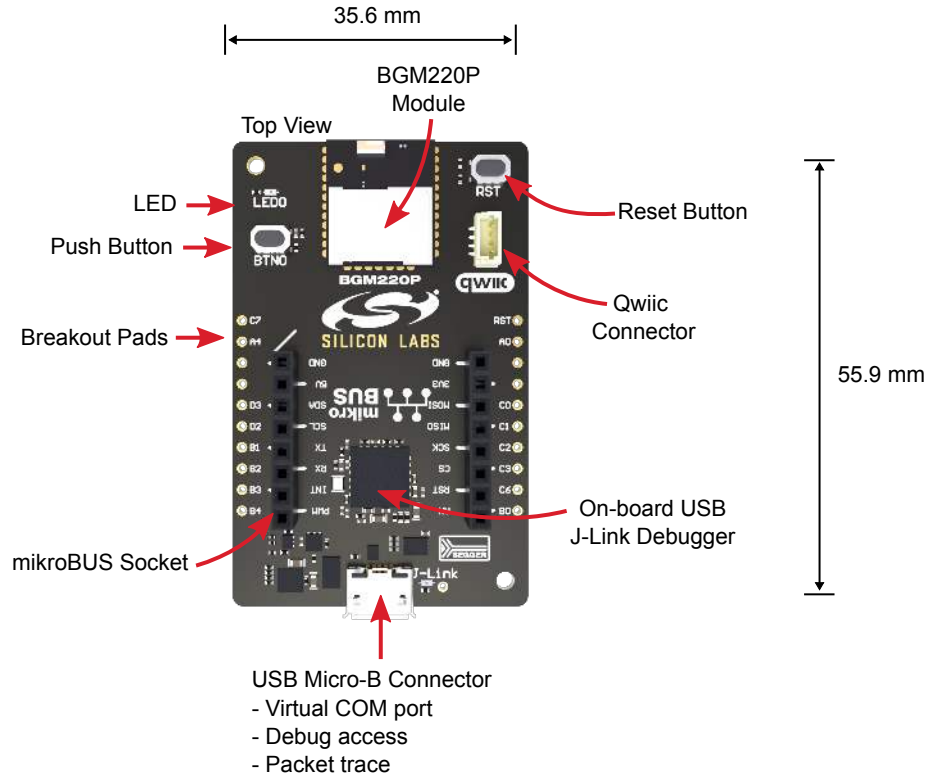The layout of the BGM220 Explorer Kit is shown below.

Figure 1.1.   BGM220 Explorer Kit Hardware Layout

2. Specifications

2.1 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
USB Supply Input Voltage	V_{USB}	-	+5.0	-	V
Supply Input Voltage (VMCU supplied externally)	V_{VMCU}		+3.3[1]		V
Operating Temperature	T_{OP}	-	+20	-	˚C

[1]The typical supply voltage to the BGM220P is 3.0 V, but the maximum voltage is a function of temperature and average lifetime current load. Over a 10-year lifespan, the average lifetime current load should not exceed 60 mA when the supply voltage is 3.3 V. See the BGM220P data sheet for more information.

2.2 Current Consumption

The operating current of the board greatly depends on the application and the amount of external hardware connected. The table below attempts to give some indication of typical current consumptions for the BGM220P and the on-board debugger. Note that the numbers are taken from the data sheets for the devices. For a full overview of the conditions that apply for a specific number from a data sheet, the reader is encouraged to read the specific data sheet.

Table 2.1. Current Consumption

Parameter	Symbol	Condition	Typ	Unit
BGM220P Current Consumption[1]	I_{BGM}	MCU current consumption in EM0 mode with all peripherals disabled (module supply voltage = 3.0 V, VSCALE2, 38.4 MHz crystal, CPU running Prime from flash at 25 ˚C)	28	µA/MHz
		Radio system current consumption in receive mode, active packet reception (VDD = 3.0 V, MCU in EM1 and all MCU peripherals disabled, HCLK = 38.4 MHz, 1Mbit/s, 2GFSK, f = 2.4 GHz at 25 ˚C)	3.8	mA
		Radio system current consumption in transmit mode (VDD = 3.0 V, MCU in EM1 and all MCU peripherals disabled, HCLK = 38.4 MHz, f = 2.4 GHz, CW, 6 dBm output power at 25 ˚C)	8.4	mA
On-board Debugger Sleep Current Consumption [2]	I_{DBG}	On-board debugger current consumption when USB cable is not inserted (EFM32GG12 EM4S mode current consumption)	80	nA

1   From BGM220P data sheet

2   From EFM32GG12 data sheet

3. Hardware

The core of the BGM220 Explorer Kit is the BGM220P Wireless Gecko Bluetooth® Module. Refer to section 1.4 Kit Hardware Layout for placement and layout of the hardware components.

3.1 Block Diagram

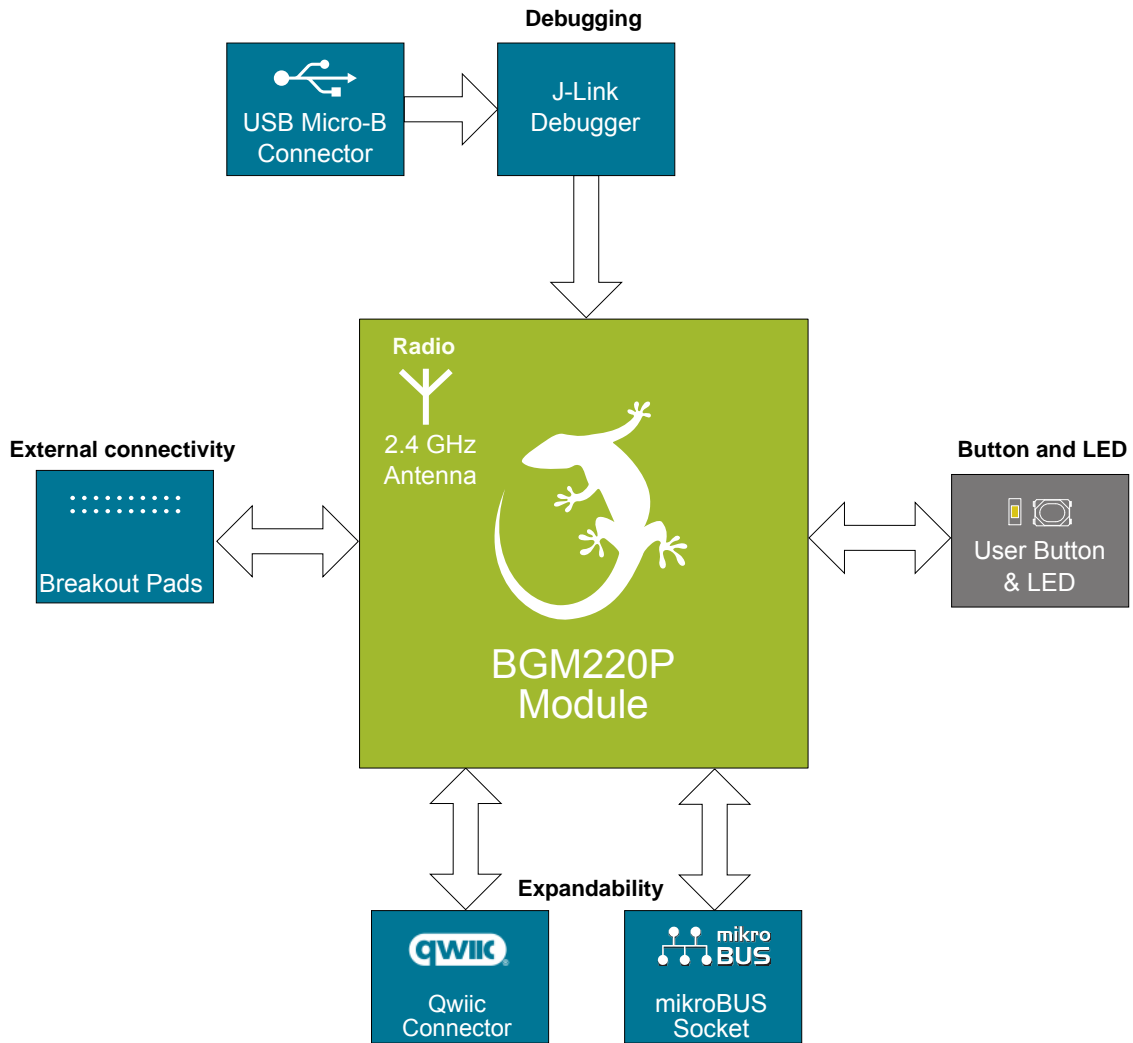An overview of the BGM220 Explorer Kit is illustrated in the figure below.

Figure 3.1. Kit Block Diagram

3.2 Power Supply

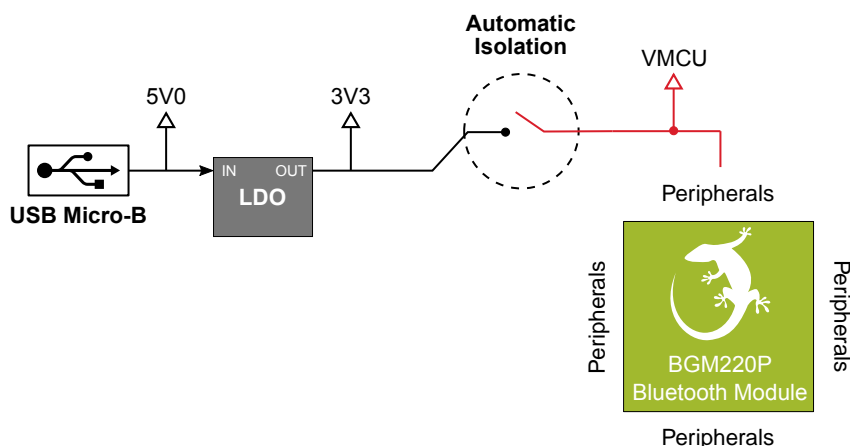The kit is powered by the debug USB cable as illustrated in the figure below.

Figure 3.2. BGM220 Explorer Kit Power Topology

The 5 volt power net on the USB bus is regulated down to 3.3 V using an LDO (low-dropout regulator). An automatic isolation circuit isolates the LDO when the USB cable is not plugged in.

Power can be injected externally on the VMCU net if the USB cable is removed and no other power sources are present on the kit. Failure to follow this guideline can cause power conflicts and damage the LDO.

3.3 BGM220P Reset

The BGM220P can be reset by a few different sources:
 • A user pressing the RESET button.
 • The on-board debugger pulling the #RESET pin low.

3.4 Push Button and LED

The kit has one user push button marked LED0 that is connected to a GPIO on the BGM220P. The button is connected to pin PC07 and it is debounced by an RC filter with a time constant of 1 ms. The logic state of the button is high while the button is not being pressed, and low when the button is pressed.

The kit also features one yellow LED marked LED0 that is controlled by a GPIO pin on the BGM220P. The LED is connected to pin PA04 in an active-high configuration.
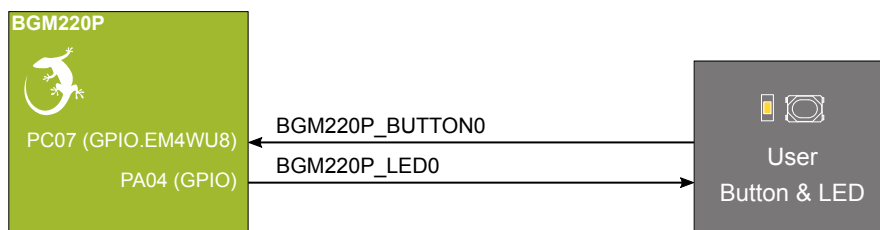
Figure 3.3. Button and LED

3.5 On-board Debugger

The BGM220 Explorer Kit contains a microcontroller separate from the BGM220P Wireless Gecko that provides the user with an on-board J-Link debugger through the USB Micro-B port. This microcontroller is referred to as the "on-board debugger", and is not programmable by the user. When the USB cable is removed, the on-board debugger goes into a very low power shutoff mode (EM4S), consuming around 80 nA typically (EFM32GG12 data sheet number).

In addition to providing code download and debug features, the on-board debugger also presents a virtual COM port for general purpose application serial data transfer. The Packet Trace Interface (PTI) is also supported which offers invaluable debug information about transmitted and received packets in wireless links.

The figure below shows the connections between the target BGM220P device and the on-board debugger.

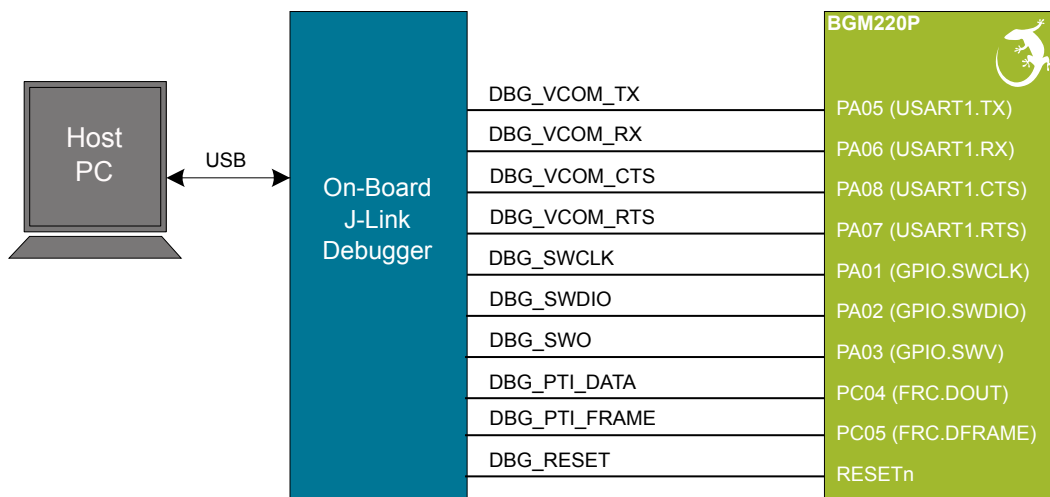Refer to chapter 4. Debugging for more details on debugging.

Figure 3.4. On-Board Debugger Connections

3.6 Connectors

The BGM220 Explorer Kit features a USB Micro-B connector, 20 breakout pads, a mikroBUS connector for connecting mikroBUS add-on boards, and a Qwiic connector for connecting Qwiic Connect System hardware. The connectors are placed on the top side of the board, and their placement and pinout are shown in the figure below. For additional information on the connectors, see the following sub chapters.
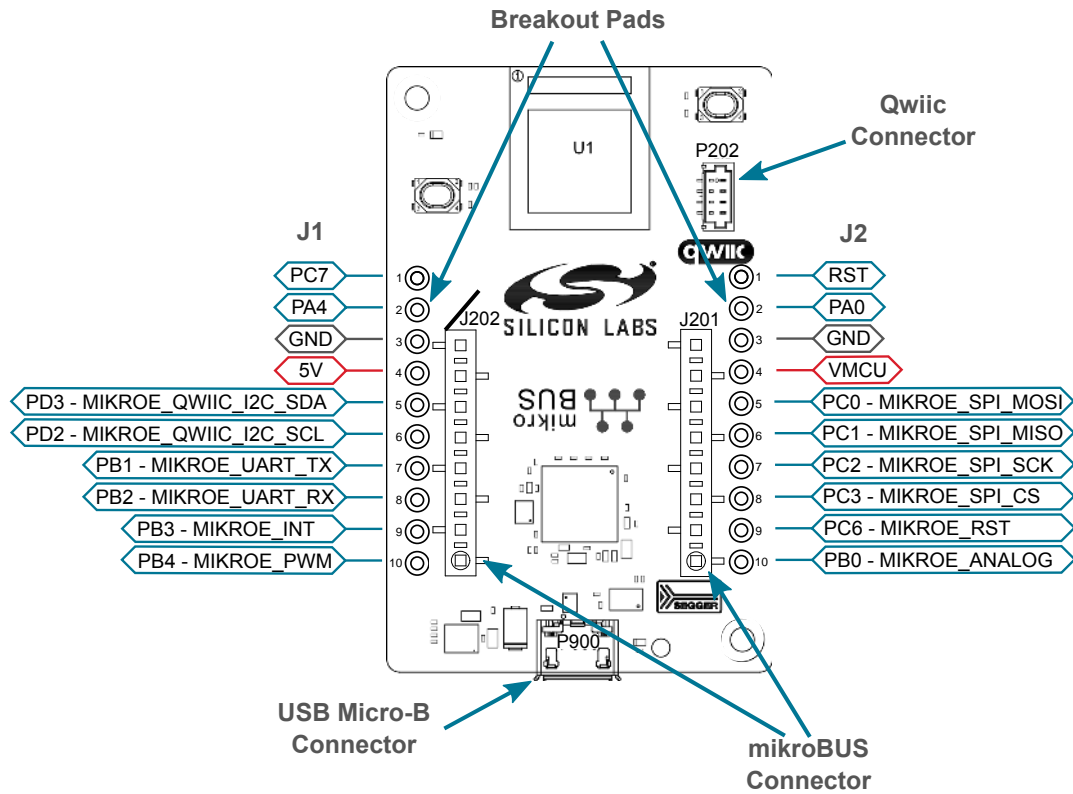

Figure 3.5. BGM220 Explorer Kit Connectors

3.6.1 Breakout Pads

Twenty breakout pads are provided and allow connection of external peripherals. There are 10 pads on the left side of the board, and 10 pads on the right. The breakout pads contain a number of I/O pins that can be used with most of the BGM220P Wireless Gecko's features. Additionally, the VMCU (main board power rail), 3V3 (LDO regulator output), and 5V power rails are also exposed on the pads.

The pin-routing on the Wireless Gecko is very flexible, so most peripherals can be routed to any pin. However, pins may be shared between the breakout pads and other functions on the BGM220 Explorer Kit. The table below includes an overview of the breakout pads and functionality that is shared with the kit.

Table 3.1. Breakout Pads Pinout

Pin	Connection	Shared Feature
Left Side Breakout Pins		
1	PC07	Button
2	PA04	LED
3	GND	Ground
4	5V	Board USB voltage
5	PD03	MikroBUS I2C_SDA, Qwiic I2C_SDA
6	PD02	MikroBUS I2C_SCL, Qwiic I2C_SCL
7	PB01	MikroBUS UART_TX
8	PB02	MikroBUS UART_RX
9	PB03	MikroBUS INT
10	PB04	MikroBUS PWM
Right Side Breakout Pins		
1	RST	BGM220P reset, active low.
2	PA00	
3	GND	Ground
4	VMCU	BGM220P voltage domain
5	PC00	MikroBUS SPI_MOSI
6	PC01	MikroBUS SPI_MISO
7	PC02	MikroBUS SPI_SCK
8	PC03	MikroBUS SPI_CS
9	PC06	MikroBUS RST
10	PB00	MikroBUS Analog

3.6.2 MikroBUS Socket

The BGM220 Explorer Kit features a mikroBUS™ socket compatible with mikroBUS add-on boards. MikroBUS add-on boards can expand the functionality of the kit with peripherals such as sensors and LCDs. Add-on boards follow the mikroBUS socket pin mapping, and communicates with the on-kit BGM220P through UART, SPI or I^{2}C. Several GPIOs are exposed on the mikroBUS socket. MikroBUS add-on boards can be powered by the 5V or VMCU power rails, which are available on the mikroBUS socket.

The pinout of the BGM220P on the kit is made such that all required peripherals are available on the mikroBUS socket. The I^{2}C signals are, however, shared with the Qwiic connector, and all mikroBUS signals are also routed to adjacent breakout pads.

When inserting a mikroBUS add-on board, refer to the orientation notch on the BGM220 Explorer Kit, shown in the figure below, to ensure correct orientation. Add-on boards have a similar notch that needs to be lined up with the one shown below.
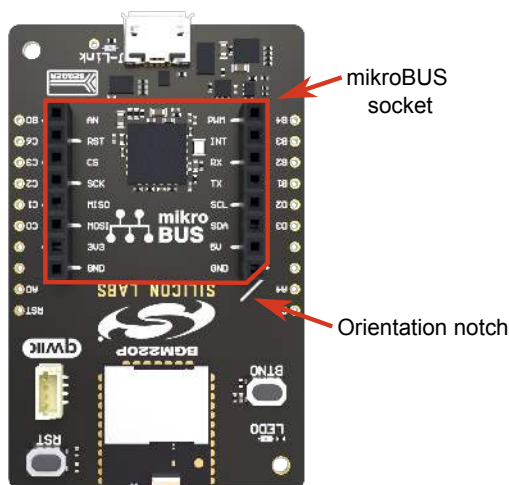
Figure 3.6. mikroBUS Add-on Board Orientation

The table below gives an overview of the mikroBUS socket pin connections to the BGM220P.

Table 3.2. mikroBUS Socket Pinout

mikro-BUS Pin Name	mikroBUS Pin Function	Connection	Shared Feature	Suggested Peripheral Mapping
AN	Analog	PB00	BREAKOUT_RIGHT10	IADC0
RST	Reset	PC06	BREAKOUT_RIGHT9	
CS	SPI Chip Select	PC03	BREAKOUT_RIGHT8	USARTx.CS
SCK	SPI Clock	PC02	BREAKOUT_RIGHT7	USARTx.CLK
MISO	SPI Master Input Slave Output	PC01	BREAKOUT_RIGHT6	USARTx.RX
MOSI	SPI Master Output Slave Input	PC00	BREAKOUT_RIGHT5	USARTx.TX
PWM	PWM output	PB04	BREAKOUT_LEFT10	TIMER0.CCx
INT	Hardware Interrupt	PB03	BREAKOUT_LEFT9	
RX	UART Receive	PB02	BREAKOUT_LEFT8	USARTx.RX
TX	UART Transmit	PB01	BREAKOUT_LEFT7	USARTx.TX
SCL	I2C Clock	PD02	QWIIC_I2C_SCL, BREAKOUT_LEFT6	I2Cx.SCL
SDA	I2C Data	PD03	QWIIC_I2C_SDA, BREAKOUT_LEFT5	I2Cx.SDA

mikro-BUS Pin Name	mikroBUS Pin Function	Connection	Shared Feature	Suggested Peripheral Mapping
3V3	VCC 3.3V power	VMCU	BGM220P voltage domain	
5V	VCC 5V power	5V	Board USB voltage	
GND	Reference Ground	GND	Ground	

3.6.3 Qwiic Connector

The BGM220 Explorer Kit features a Qwiic® connector compatible with Qwiic Connect System hardware. The Qwiic connector provides an easy way to expand the functionality of the BGM220 Explorer Kit with sensors, LCDs, and other peripherals over the I^2C interface. The Qwiic connector is a 4-pin polarized JST connector, which ensures the cable is inserted the right way.

Qwiic Connect System hardware is daisy chain-able as long as each I^2C device in the chain has a unique I^2C address.

Note: The Qwiic I^2C connections on the BGM220 Explorer Kit are shared with the mikroBUS I^2C signals.

The Qwiic connector and its connections to Qwiic cables and the BGM220P are illustrated in the figure below.
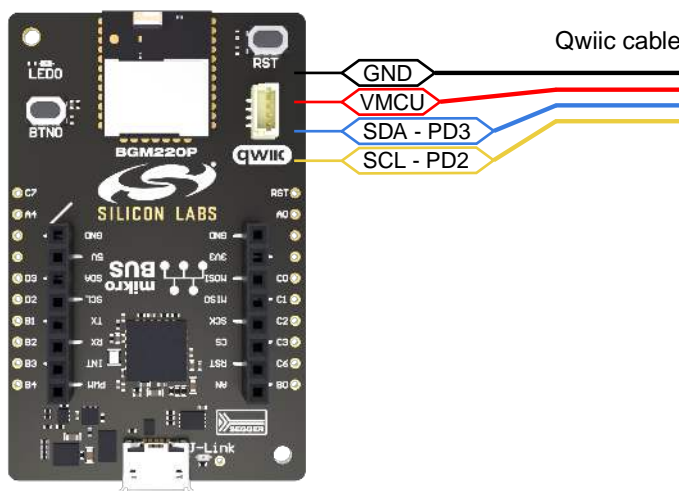
Figure 3.7. Qwiic Connector

The table below gives an overview of the Qwiic connections to the BGM220P.

Table 3.3. Qwiic Connector Pinout

Qwiic Pin	Connection	Shared Feature	Suggested Peripheral Mapping
Ground	GND	Ground	
3.3V	VMCU	BGM220P voltage domain	
SDA	PD03	MIKROE_I2C_SDA, BREAKOUT_LEFT5	I2Cx.SDA
SCL	PD02	MIKROE_I2C_SCL, BREAKOUT_LEFT6	I2Cx.SCL

3.6.4 Debug USB Micro-B Connector

The debug USB port can be used for uploading code, debugging, and as a Virtual COM port. More information is available in section 4. Debugging.

4. Debugging

The BGM220 Explorer Kit contains an on-board SEGGER J-Link Debugger that interfaces to the target BGM220P using the Serial Wire Debug (SWD) interface. The debugger allows the user to download code and debug applications running in the target BGM220P. Additionally, it also provides a virtual COM port (VCOM) to the host computer that is connected to the target device's serial port, for general purpose communication between the running application and the host computer. The Packet Trace Interface (PTI) is also supported by the on-board debugger, which offers invaluable debug information about transmitted and received packets in wireless links. The on-board debugger is accessible through the USB Micro-B connector.

4.1 On-board Debugger

The on-board debugger is a SEGGER J-Link debugger running on an EFM32 Giant Gecko. The debugger is directly connected to the debug and VCOM pins of the target BGM220P.

When the debug USB cable is inserted, the on-board debugger is automatically active and takes control of the debug and VCOM interfaces. This means that debug and communication will *not* work with an external debugger connected at the same time. The on-board LDO is also activated which then powers the board. When the USB cable is removed, the on-board debugger goes into a very low power shutoff mode (EM4S), consuming around 80 nA typically (EFM32GG12 data sheet number). This means that an application running off batteries will not be affected too much by the on-board debugger power consumption. Since the I/O voltage rail of the debugger remains powered in the battery operated mode, the pins connected to the debug and VCOM interfaces maintain proper isolation and prevent leakage currents.

4.2 Virtual COM Port

The virtual COM port is a connection to a UART of the target BGM220P and allows serial data to be sent and received from the device. The on-board debugger presents this as a virtual COM port on the host computer that shows up when the USB cable is inserted.

Data is transferred between the host computer and the debugger through the USB connection, which emulates a serial port using the USB Communication Device Class (CDC). From the debugger, the data is passed on to the target device through a physical UART connection.

The serial format is 115200 bps, 8 bits, no parity, and 1 stop bit by default. For more information on

Note: Changing the baud rate for the COM port on the PC side does not influence the UART baud rate between the debugger and the target device.

5. Schematics, Assembly Drawings, and BOM

Schematics, assembly drawings, and bill of materials (BOM) are available through Simplicity Studio when the kit documentation package has been installed. They are also available from the kit page on the Silicon Labs website: http://www.silabs.com/

6. Kit Revision History and Errata

6.1 Revision History

The kit revision can be found printed on the box label of the kit, as outlined in the figure below. The kit revision history is summarized in the table below.

Figure 6.1. Revision Info

Table 6.1. Kit Revision History

Kit Revision	Released	Description
A02	22 September 2020	Initial kit version.

6.2 Errata

There are no known errata at present.

7. Board Revision History and Errata

7.1 Revision History

The board revision can be found laser printed on the board, and the board revision history is summarized in the following table.

Table 7.1. Board Revision History

Revision	Released	Description
A02	22 September 2020	Initial version.

7.2 Errata

There are no known errata at present.

8. Document Revision History

Revision 1.0

October 2020

- Initial document release.

Simplicity Studio

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