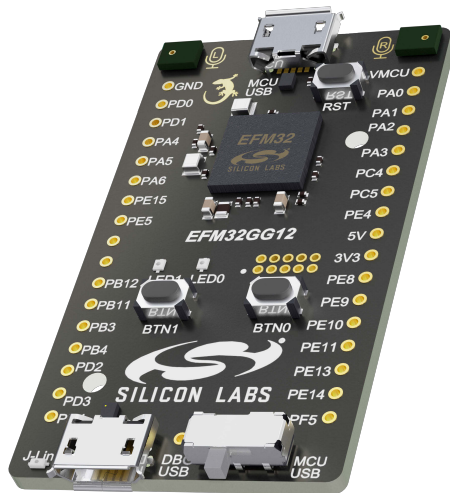


UG371: Thunderboard EFM32GG12 User's Guide



The Thunderboard EFM32GG12 is a low cost, small form factor development and evaluation platform for the EFM32GG12™ Giant Gecko Microcontroller.

The Thunderboard contains an EFM32 MCU together with an on-board SEGGER J-Link debugger for easy debugging through the USB Micro-B debugging connector. Most of the EFM32GG12 I/Os are routed to breakout pads on the sides of the board making it easy to expand on the board features and evaluate the EFM32GG12 Giant Gecko's features with custom hardware.



TARGET DEVICE

- EFM32 Giant Gecko Microcontroller (EFM32GG12B810F1024GM64-A-QFN64)
- CPU: 32-bit ARM® Cortex-M4® with FPU
- Memory: 1024 kB flash and 192 kB RAM
- USB feature set

KIT FEATURES

- PDM stereo microphones
- Out-of-box PDM software example
- USB connectivity
- SEGGER J-Link on-board debugger
- Virtual COM port
- User RGB LEDs and pushbuttons
- 34-pin 2.54 mm breakout pads
- Optional Mini-Simplicity connector for Advanced Energy Monitoring using external Silicon Labs debugger

SOFTWARE SUPPORT

- Simplicity Studio™

Table of Contents

1. Introduction	3
1.1 Kit Contents	3
1.2 Getting Started	3
1.3 Kit Hardware Layout	3
2. Electrical Specifications	4
2.1 Absolute Maximum Ratings	4
3. Hardware	5
3.1 Block Diagram	5
3.2 Power Supply	6
3.2.1 Self-Powered Mode	6
3.2.2 Bus-Powered Mode	6
3.3 Universal Serial Bus	7
3.4 Push Buttons and RGB LEDs	7
3.5 PDM Stereo Microphones	8
3.6 On-board Debugger	8
3.7 EFM32GG12 Reset	9
3.8 Connectors	10
3.8.1 Breakout Pads	11
3.8.2 Mini Simplicity Connector	12
3.8.3 EFM32 USB Micro-B Connector	12
3.8.4 Debug USB Micro-B Connector	12
4. Debugging	13
4.1 On-board Debugger Considerations	13
4.2 Virtual COM Port	14
4.3 Mini Simplicity Connector	14
5. Kit Configuration and Upgrades	15
5.1 Firmware Upgrades	15
6. Schematics, Assembly Drawings, and BOM	16
7. Kit Revision History and Errata	17
7.1 Revision History	17
7.2 Errata	17
8. Board Revision History and Errata	18
8.1 Revision History	18
8.2 Errata	18
9. Document Revision History	19

1. Introduction

The Thunderboard EFM32GG12 (OPN: SLTB009A) is an excellent starting point to get familiar with the EFM32GG12 Giant Gecko Microcontrollers. The Thunderboard contains an EFM32 MCU together with an on-board SEGGER J-Link debugger for easy programming and debugging through the USB Micro-B debug connector. The debugger also provides a USB virtual COM port for serial connection to the target application.

Most of the EFM32GG12 I/Os are routed to breakout pads on the sides of the board making it easy to expand on the board features and evaluate the EFM32GG12 Giant Gecko's features with custom hardware.

1.1 Kit Contents

The following items are included in the box:

- 1x Thunderboard EFM32GG12 board (BRD2207A)
- 1x Micro USB 2.0 to USB A male cable

1.2 Getting Started

Detailed instructions for how to get started with your new Thunderboard EFM32GG12 can be found on the Silicon Labs web pages:

<https://www.silabs.com/support/getting-started/thunderboard>

1.3 Kit Hardware Layout

The layout of the Thunderboard EFM32GG12 is shown below.

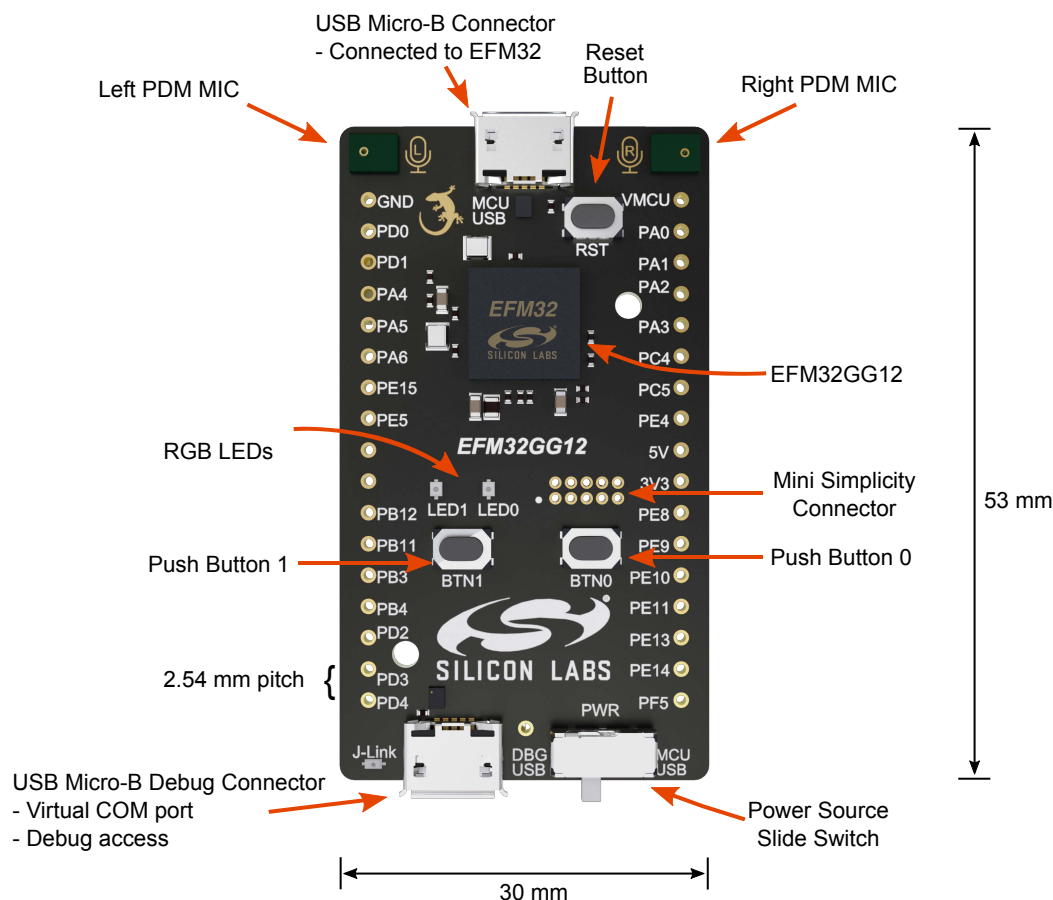


Figure 1.1. Thunderboard EFM32GG12 Hardware Layout

2. Electrical Specifications

2.1 Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Input voltage on EFM32 USB connector	0		+5.5	V
Input voltage on debug USB connector	0		+5.5	V
VMCU max voltage (if applied through some external means)	0		+3.6	V
LDO output current			300	mA
Voltage on any I/O breakout pad	-0.3		VMCU+0.3	V
Current per I/O pin (sink)			50	mA
Current per I/O pin (source)			50	mA
Current for all I/O pins (sink)			200	mA
Current for all I/O pins (source)			200	mA

3. Hardware

3.1 Block Diagram

An overview of the Thunderboard EFM32GG12 is illustrated in the figure below.

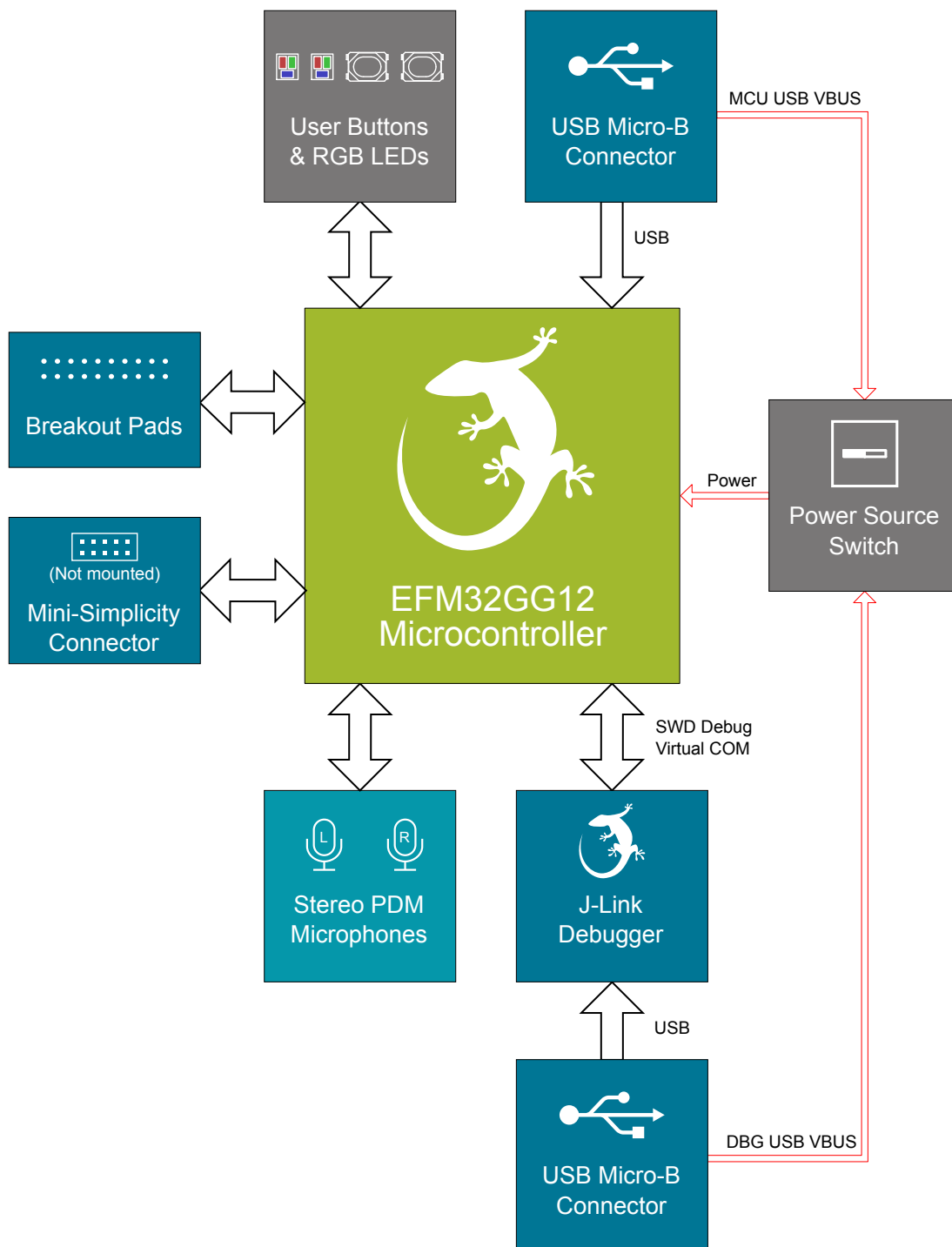


Figure 3.1. Kit Block Diagram

3.2 Power Supply

The Thunderboard EFM32GG12 can be either bus-powered or self-powered depending on the position of the slide switch marked "PWR" located in the lower right corner of the board. Both these modes are explained in detail below.

3.2.1 Self-Powered Mode

When the "PWR" slide switch is in the "DBG USB" position, the Thunderboard EFM32GG12 is set up in self-powered mode with its internal regulator disabled. In this configuration, the EFM32GG12 and the VMCU net are powered by an on-board regulator which draws power from the USB Micro-B debugging connector. The low-dropout regulator has a total output current capacity of 300 mA, where some of it is being used to power the on-board debugger through the 3V3 net.

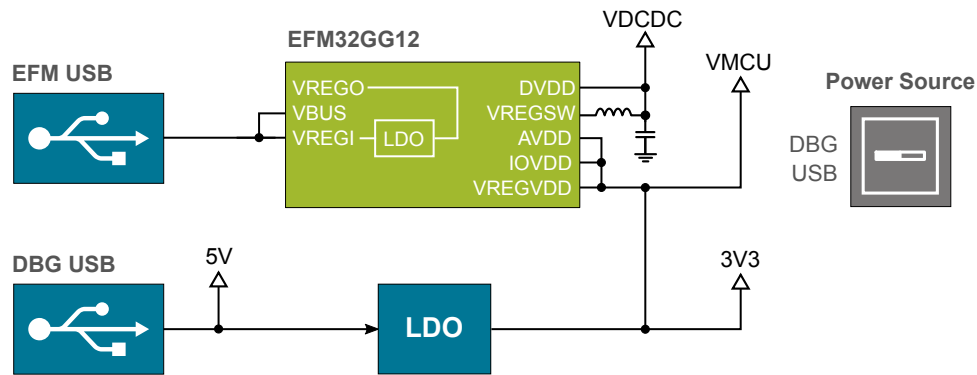


Figure 3.2. Self-powered Mode

3.2.2 Bus-Powered Mode

When the "PWR" slide switch is in the "MCU USB" position, the EFM32GG12 is set up in bus-powered mode. In this configuration, the EFM32GG12 and the VMCU net are powered by the EFM32's internal 5V-to-3.3 V regulator. The input of the internal regulator (VREGI) is connected to the VBUS line of the USB Micro-B connector that connects to the EFM32GG12's USB peripheral.

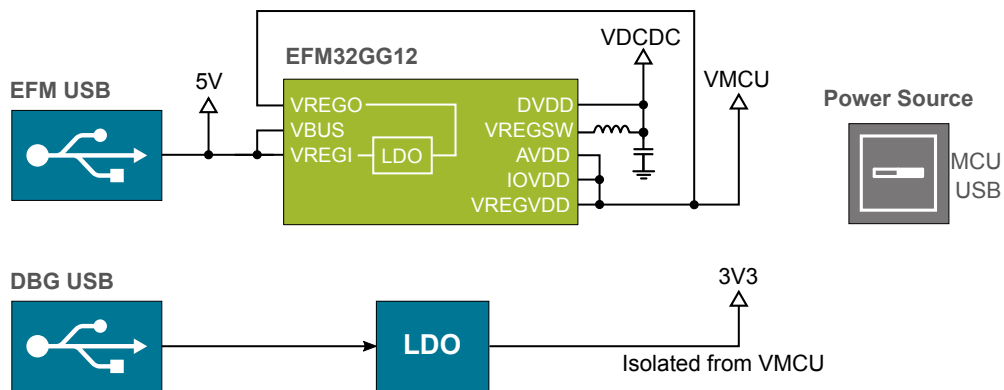


Figure 3.3. Bus-powered Mode

3.3 Universal Serial Bus

The Thunderboard EFM32GG12 board is equipped with a USB Micro-B connector interfacing the EFM32GG12's USB peripheral. The figure below shows how the USB lines are connected to the MCU. USB_D+ and USB_D- connects to USB_DP and USB_DM, respectively. In addition, 5 V from VBUS is connected to the USB_VREGI and USB_VBUS pins. These provide power to the EFM32GG12's internal LDO regulator which again powers the USB PHY inside the chip. The output of the LDO is output on the USB_VREGO pin. When the power selector switch is set in the "MCU USB" position, USB_VREGO is connected to the VMCU net which powers the chip and all the peripherals in the target voltage domain. For more information, see Section 3.2 Power Supply.

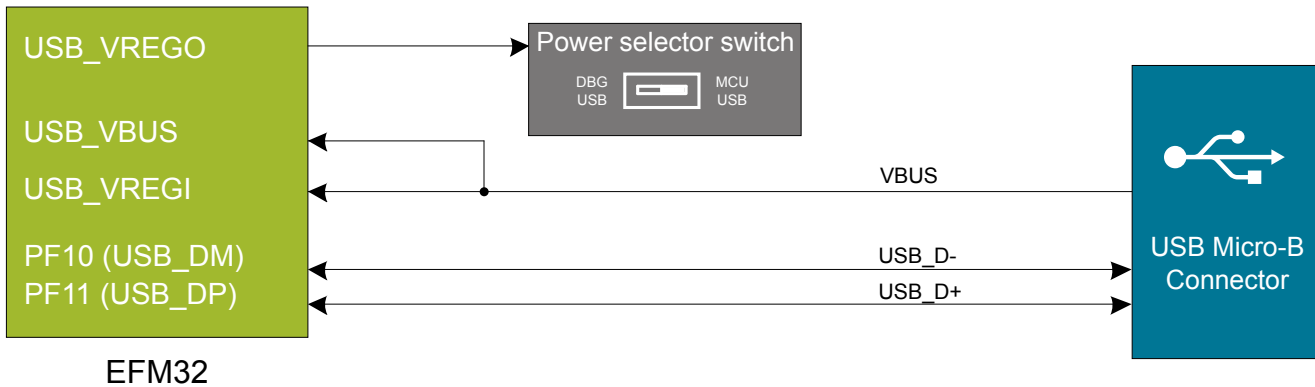


Figure 3.4. Universal Serial Bus

3.4 Push Buttons and RGB LEDs

The kit has two user push buttons marked BTN0 and BTN1. They are connected directly to the EFM32GG12 and are debounced by RC filters with a time constant of 1 ms. The buttons are connected to pins PD5 and PD8.

The kit also features two RGB LEDs marked LED0 and LED1, that are controlled by GPIO pins on the EFM32GG12. The LEDs are connected in an active-low configuration, and each color can be PWM controlled using the EFM32GG12's TIMER/WTIMER peripherals to generate a wide variety of colors.

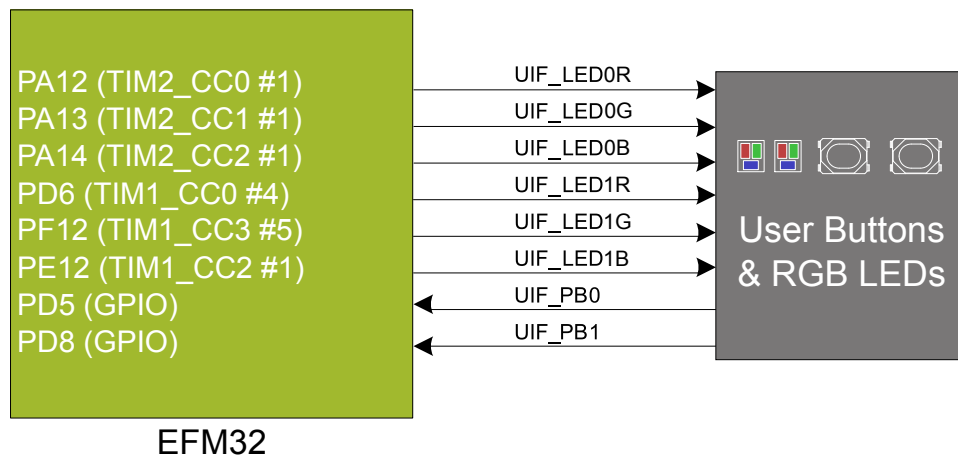


Figure 3.5. Buttons and LEDs

3.5 PDM Stereo Microphones

The Thunderboard EFM32GG12 features two Knowles SPK0641HT4H-1 digital MEMS microphones with PDM output. The microphones are configured to form a stereo sound input device using only a single PDM data line. The clock to the microphones are fed from a pin on EFM32GG12 with PDM clock support. The output from both microphones are connected to the same line and connected to a pin on the EFM32GG12 supporting PDM data input. An isolation switch controlled by the microphone enable signal powers the microphones on and off. Note that the switch allows for free use of the PDM data and clock GPIOs when not in use with the microphones.

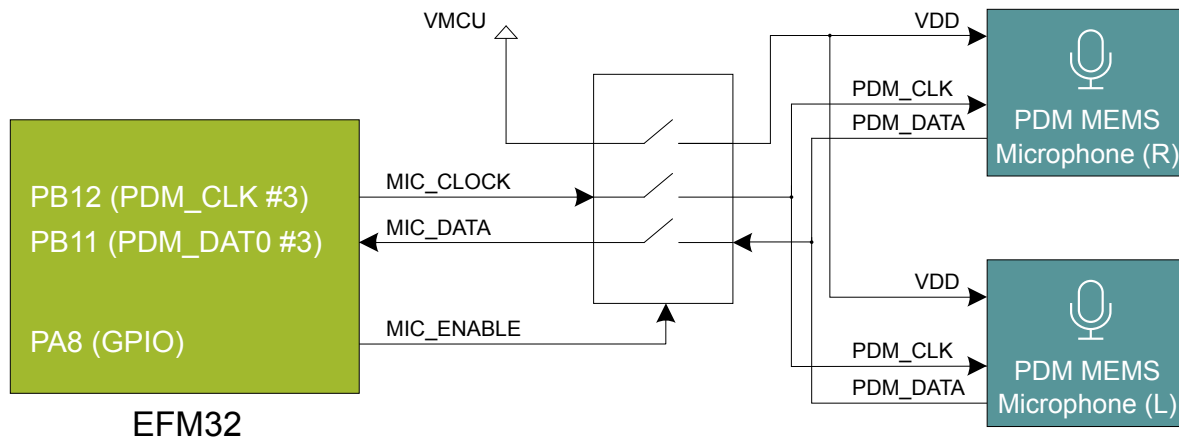


Figure 3.6. Digital Stereo Microphones

3.6 On-board Debugger

The Thunderboard EFM32GG12 contains a microcontroller separate from the EFM32GG12 Giant Gecko that provides the user with an on-board J-Link debugger through the USB micro-B debugging port. This microcontroller is referred to as the "On-board Debugger", and is not programmable by the user.

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.

Figure 3.7 On-Board Debugger Connections on page 8 shows the connections between the target EFM32GG12 device and the on-board debugger. The figure also shows the presence of the Mini Simplicity Connector, and how this is connected to the same I/O pins. Please refer to section 4. Debugging and section 5. Kit Configuration and Upgrades for more details on debugging.

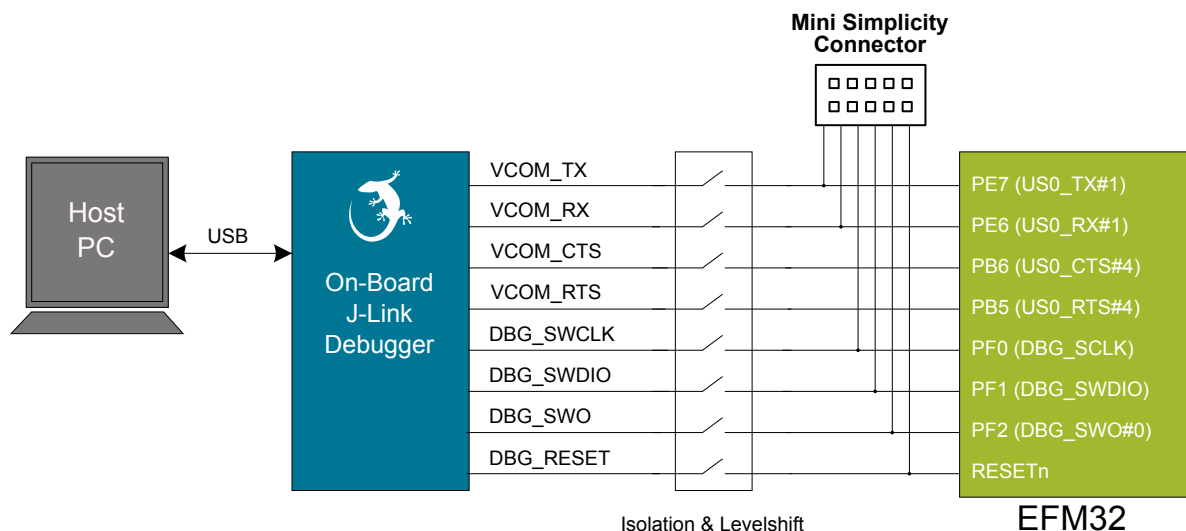


Figure 3.7. On-Board Debugger Connections

3.7 EFM32GG12 Reset

The EFM32GG12 MCU can be reset by a few different sources:

- A user pressing the RESET button
- The on-board debugger pulling the #RESET pin low
- An external debugger pulling the #RESET pin low

In addition to the reset sources mentioned above, a reset to the EFM32GG12 will also be issued during board controller boot-up. This means that removing power to the board controller (unplugging the J-Link USB cable) will not generate a reset, but plugging the cable back in will, as the board controller boots up.

3.8 Connectors

Featured on the Thunderboard EFM32GG12 is a Mini Simplicity connector, two USB Micro-B connectors and 34 breakout pads. Of the breakout pads, 20 follow the Silicon Labs EXP header pinout that provides a fixed feature set across Silicon Labs starter kits. The remaining 14 provide access to unassigned GPIOs.

The placement and pinout of the connectors can be seen in the figure below. See the following sub chapters for additional information on the connectors.

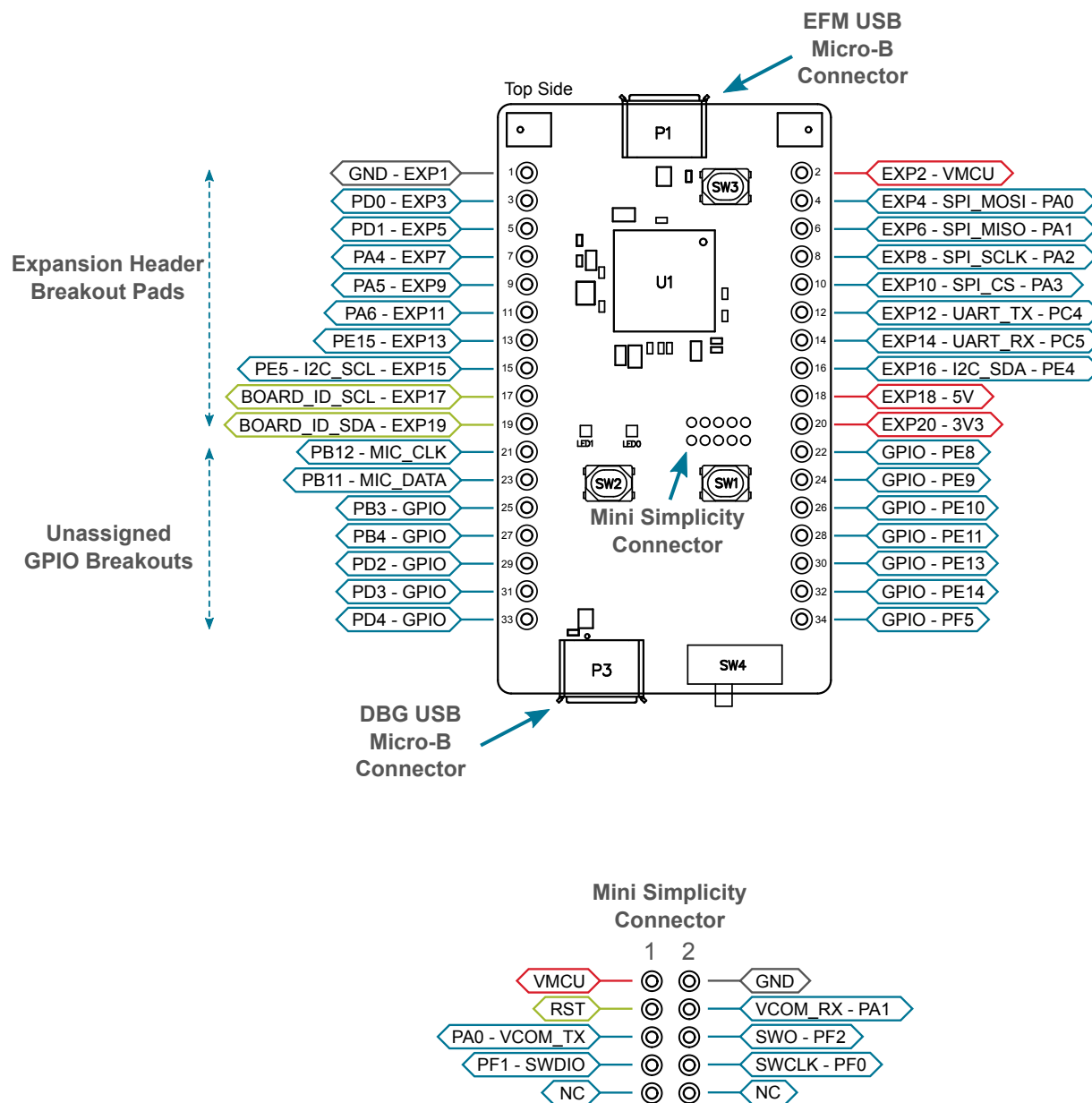


Figure 3.8. Thunderboard EFM32GG12 Connectors

3.8.1 Breakout Pads

The board provides access to a total of 34 breakout pads of which 28 map to I/O pins of EFM32GG12. 17 of these are located along the left side of the board while the remaining 17 are located on the right side of the board. The breakout pads allow access to VMCU (EFM32GG12 power rail), 3.3V (debug LDO regulator), and 5V power rails.

The upper 20 of the breakout pads are pinned out similar to the EXP header found on Silicon Labs Starter Kits, which ensures that commonly used peripherals such as SPI, UART and I²C buses are available on fixed locations. The rest of the pins are used for general purpose IO. This allows the definition of expansion boards that can be used in conjunction with a number of different Silicon Labs starter kits.

The pin-routing on the EFM32GG12 is very flexible, so most peripherals can be routed to any pin. However, some pins are shared between the breakout pads and other functions on the Thunderboard EFM32GG12. The table below shows an overview of the breakout pads and functionality that is shared with the kit.

Table 3.1. Expansion Header Pinout

Pin	Connection	EXP Header Function	Shared Feature	Peripheral Mapping
Right Side Breakout Pins				
2	VMCU	EFM32GG12 voltage domain, included in AEM measurements.		
4	PA0	SPI_MOSI		US3_TX #0
6	PA1	SPI_MISO		US3_RX #0
8	PA2	SPI_SCLK		US3_CLK #0
10	PA3	SPI_CS		US3_CS #0
12	PC4	UART_TX		U0_TX #4
14	PC5	UART_RX		U0_RX #4
16	PE4	I2C_SDA		I2C0_SDA #7
18	5V	Board USB voltage		
20	3V3	Board controller supply		
Left Side Breakout Pins				
1	GND	Ground		
3	PD0	CAN_RX		CAN0_RX #2
5	PD1	CAN_TX		CAN0_TX #2
7	PA4	GPIO		
9	PA5	GPIO		
11	PA6	GPIO		
13	PE15	GPIO		
15	PE5	I2C_SCL		I2C0_SCL #7
17	BOARD_ID_SCL	Connected to Board Controller for identification of add-on boards.		
19	BOARD_ID_SDA	Connected to Board Controller for identification of add-on boards.		

Table 3.2. Remaining GPIO breakout pads

Pin	EFM32G G12 I/O pin	Kit peripheral/feature connection	Pin	EFM32G G12 I/O pin	Kit peripheral/feature connection
21	PB12	MIC_CLK (PDM_CLK #3)	22	PE8	GPIO

Pin	EFM32G G12 I/O pin	Kit peripheral/feature connection	Pin	EFM32G G12 I/O pin	Kit peripheral/feature connection
23	PB11	MIC_DATA (PDM_DAT0 #3)	24	PE9	GPIO
25	PB3	GPIO	26	PE10	GPIO
27	PB4	GPIO	28	PE11	GPIO
29	PD2	GPIO	30	PE13	GPIO
31	PD3	GPIO	32	PE14	GPIO
33	PD4	GPIO	34	PF5	GPIO

3.8.2 Mini Simplicity Connector

The Mini Simplicity connector featured on the Thunderboard EFM32GG12 allows the use of an external debugger such as a Silicon Labs Wireless Starter Kit (WSTK) with the board. In addition to providing serial wire debug (SWD) and virtual COM port functionality, the WSTK can also support advanced energy profiling, wireless network analysis and debugging tools. The pinout, which is described in [Table 3.3 Mini Simplicity Connector Pin Descriptions on page 12](#), is referenced from the EFM32GG12.

Table 3.3. Mini Simplicity Connector Pin Descriptions

Pin number	Connection	Function	Description
1	VMCU	VAEM	Target voltage on the debugged application. Supplied and monitored by the AEM when powered by a WSTK with its power selection switch in the "AEM" position.
2	GND	GND	Ground.
3	EFM32GG12 reset pin	DBG_RST	Reset.
4	PE6	VCOM_RX	Virtual COM Rx.
5	PE7	VCOM_TX	Virtual COM Tx.
6	PF2	DBG_SWO	Serial Wire Output.
7	PF1	DBG_SWDIO	Serial Wire Data.
8	PF0	DBG_SWCLK	Serial Wire Clock.
9	NC	NC	Not connected on this board
10	NC	NC	Not connected on this board

3.8.3 EFM32 USB Micro-B Connector

The EFM32 USB port is connected to the Universal Serial Bus (USB0) peripheral on the EFM32GG12. More information is available in [section 3.3 Universal Serial Bus](#).

3.8.4 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 Thunderboard EFM32GG12 contains an on-board fully functional SEGGER J-Link Debugger that interfaces to the target EFM32GG12 SWD debug interface. The debugger allows the user to download code and debug applications running in the target EFM32GG12. Additionally, it also provides a virtual COM port (VCOM) to the host computer that is directly connected to the target device's serial port, for general purpose communication between the running application and the host computer.

An external Silicon Labs debugger can also be used with the board by connecting it to the Mini Simplicity connector. This allows advanced debugging features as described in section 4.3 [Mini Simplicity Connector](#). A Silicon Labs Starter Kit (STK) is a good example of a debugger that can be used with the Thunderboard EFM32GG12 when connected through a debug adapter.

Note: When using an external debugger, the "PWR" slide switch must be placed in the "DBG USB" position, and the debug USB cable must be removed to ensure correct operation.

Figure 4.1 Thunderboard EFM32GG12 Debugging Possibilities on page 13 shows the possible debug options.

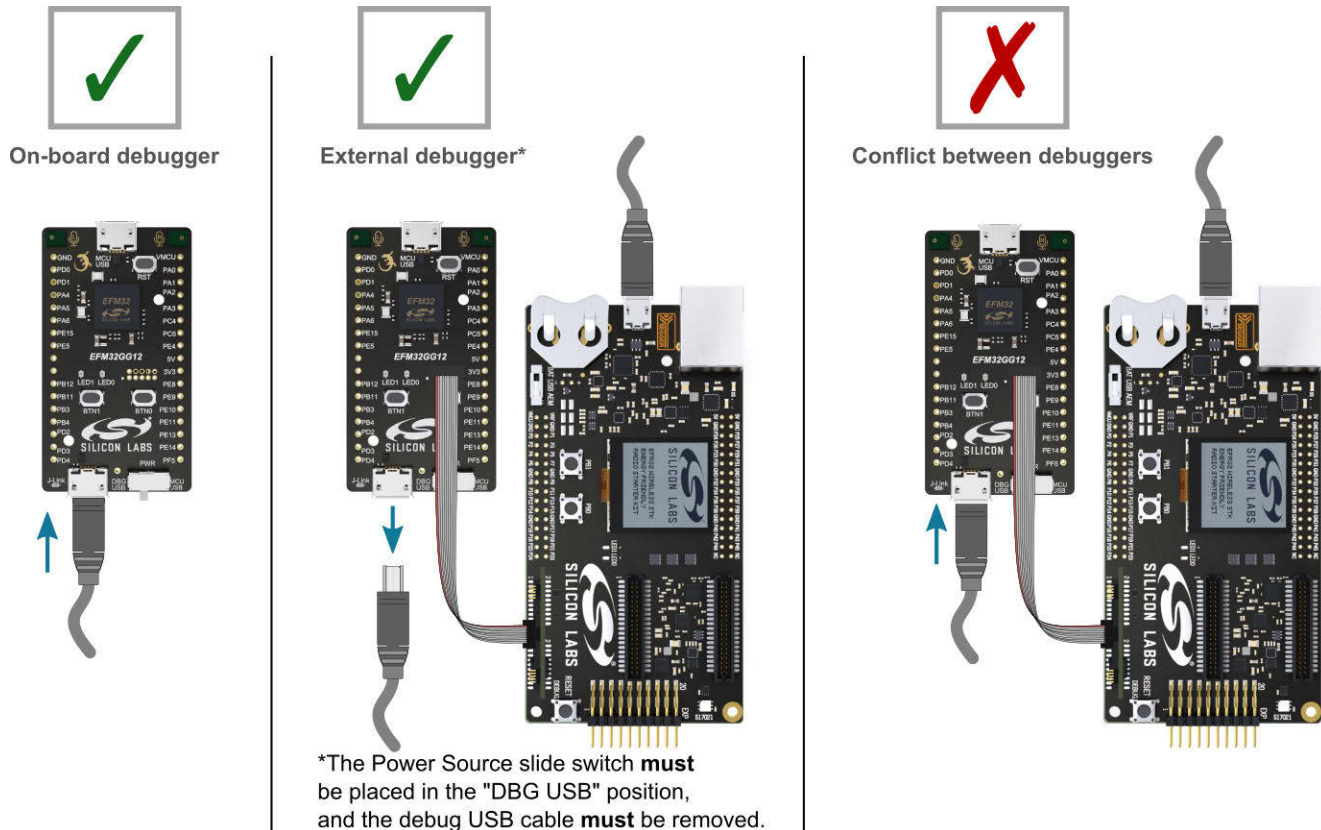


Figure 4.1. Thunderboard EFM32GG12 Debugging Possibilities

4.1 On-board Debugger Considerations

The on-board debugger is a SEGGER J-Link debugger running on an EFM32 Giant Gecko. The debugger is connected to the SWD and VCOM pins of the target EFM32GG12 through a level shift and isolation circuit. When the debug USB cable is inserted, the on-board debugger is automatically active and takes control of the SWD and VCOM interfaces. This means that debugging or communication will *not* work with an external STK connected through the Mini Simplicity connector at the same time.

When the debug USB cable is connected, the target EFM32GG12 voltage domain (VMCU) is used to power parts of the level shift and isolation circuit. Furthermore, depending on the "PWR" slide switch position, the debugger itself may also be powered from the VMCU rail. These considerations should be taken into account when trying to measure the EFM32GG12 current consumption on the kit while using the on-board debugger.

When the debug USB cable is disconnected, the on-board debugger is powered down and the level shift and isolation circuit is put in a partially powered down state, minimizing both leakage current and quiescent current from the target EFM32GG12 voltage domain (VMCU). This means that high performance power measurements of the EFM32GG12 with either Advanced Energy Monitoring or other external hardware should be obtained with the debug USB cable disconnected.

4.2 Virtual COM Port

The virtual COM port is a connection to a UART of the target EFM32GG12, 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. Alternatively, the VCOM port can also be used through the Mini Simplicity Connector with an external WSTK.

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.

Using the VCOM port through the Mini Simplicity Connector with an external WSTK works in a similar way, but requires that the on-board debugger is unplugged. The board controller on the WSTK then makes the data available over USB (CDC) or an IP socket.

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.

4.3 Mini Simplicity Connector

The Mini Simplicity connector is a 10-pin 1.27 mm pitch connector that gives access to advanced debugging features using an external debugger. Debugging with an external debugger such as a Silicon Labs Starter Kit (STK) or Wireless Starter Kit (WSTK) allows:

- Debugging of the target device through the SWD interface
- Communication using the VCOM port
- Advanced Energy Monitor

Please note that the Mini Simplicity Connector *cannot* be used at the same time as the on-board debugger is active (debug USB cable is plugged in). The "Power Source" slide switch must furthermore be placed in the "DBG USB" position, as the Mini Simplicity connector injects a voltage into the target EFM32GG12 voltage domain. For information on how to correctly connect to the kit, see [Figure 4.1 Thunderboard EFM32GG12 Debugging Possibilities on page 13](#). The recommended way to power the board when using the Mini Simplicity Connector is to use the AEM voltage supply of the STK or WSTK. Power-cycling of the board, if necessary, can easily be done by flipping the power switch on the WSTK to "BAT" and back to "AEM".

5. Kit Configuration and Upgrades

The kit configuration dialog in Simplicity Studio allows you to change the J-Link adapter debug mode, upgrade its firmware, and change other configuration settings. To download Simplicity Studio, go to <http://www.silabs.com/simplicity>.

In the main window of the Simplicity Studio's Launcher perspective, the debug mode and firmware version of the selected J-Link adapter is shown. Click the **[Change]** link next to any of them to open the kit configuration dialog.

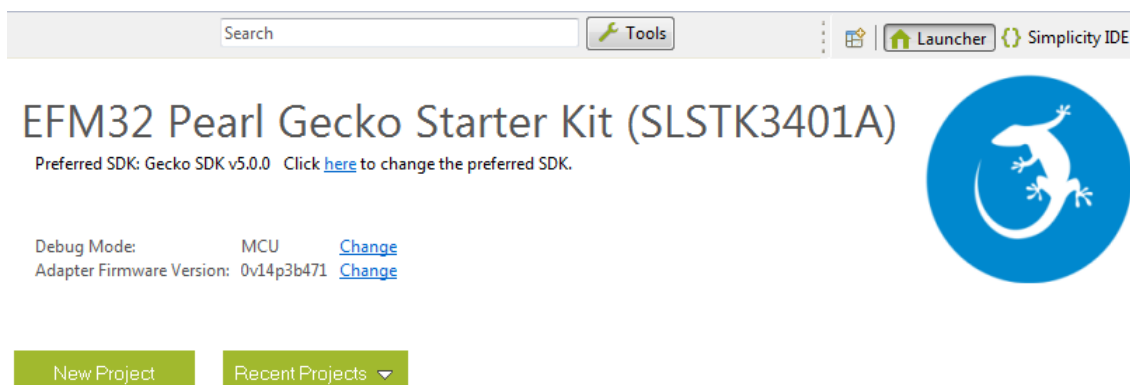


Figure 5.1. Simplicity Studio Kit Information

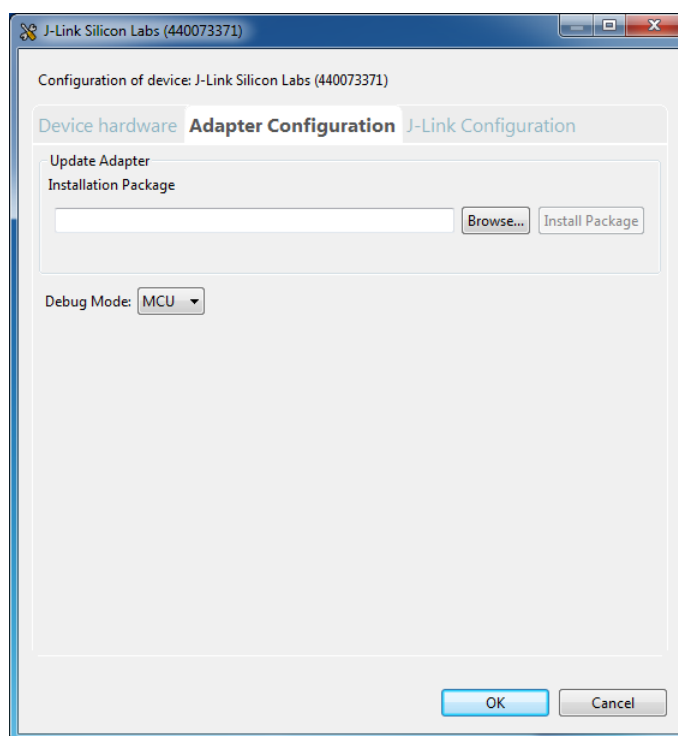


Figure 5.2. Kit Configuration Dialog

5.1 Firmware Upgrades

Upgrading the kit firmware is done through Simplicity Studio. Simplicity Studio will automatically check for new updates on startup.

You can also use the kit configuration dialog for manual upgrades. Click the **[Browse]** button in the **[Update Adapter]** section to select the correct file ending in `.emz`. Then, click the **[Install Package]** button.

6. 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.

7. Kit Revision History and Errata

7.1 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 summarised in [Table 7.1 Kit Revision History on page 17](#).



Figure 7.1. Revision Info

Table 7.1. Kit Revision History

Kit Revision	Released	Description
A01	2019-11-12	New revision to include BRD2207A Rev. A02.
A00	2018-12-12	Initial kit revision, including BRD2207A Rev. A01.

7.2 Errata

There are no known errata at present.

8. Board Revision History and Errata

8.1 Revision History

The board revision can be found laser printed on the board, and the board revision history is summarised in [Table 8.1 Board Revision History on page 18](#).

Table 8.1. Board Revision History

Revision	Released	Description
A02	2019-11-12	Swapped HFXO X1 crystal and changed blue debugger LED7. Updated resistor values in Q2 voltage divider.
A01	2018-12-12	Initial production version.

8.2 Errata

There are no known errata at present.

9. Document Revision History

Revision 1.1

November, 2019

- Added SLTB009A Rev. A01 to kit revision history.
- Added BRD2207A Rev. A02 to board revision history.

Revision 1.0

December, 2018

- Initial document release.

Silicon Labs

Simplicity Studio™4



Simplicity Studio

One-click access to MCU and wireless tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!



IoT Portfolio
www.silabs.com/IoT



SW/HW
www.silabs.com/simplicity



Quality
www.silabs.com/quality



Support and Community
community.silabs.com

Disclaimer

Silicon Labs intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Labs products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Labs reserves the right to make changes without further notice and limitation to product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Silicon Labs shall have no liability for the consequences of use of the information supplied herein. This document does not imply or express copyright licenses granted hereunder to design or fabricate any integrated circuits. The products are not designed or authorized to be used within any Life Support System without the specific written consent of Silicon Labs. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Labs products are not designed or authorized for military applications. Silicon Labs products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons.

Trademark Information

Silicon Laboratories Inc.®, Silicon Laboratories®, Silicon Labs®, SiLabs® and the Silicon Labs logo®, Bluegiga®, Bluegiga Logo®, Clockbuilder®, CMEMS®, DSPLL®, EFM®, EFM32®, EFR®, Ember®, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Ember®, EZLink®, EZRadio®, EZRadioPRO®, Gecko®, ISOModem®, Micrium, Precision32®, ProSLIC®, Simplicity Studio®, SiPHY®, Telegesis, the Telegesis Logo®, USBXpress®, Zentri and others are trademarks or registered trademarks of Silicon Labs. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. All other products or brand names mentioned herein are trademarks of their respective holders.



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

<http://www.silabs.com>