

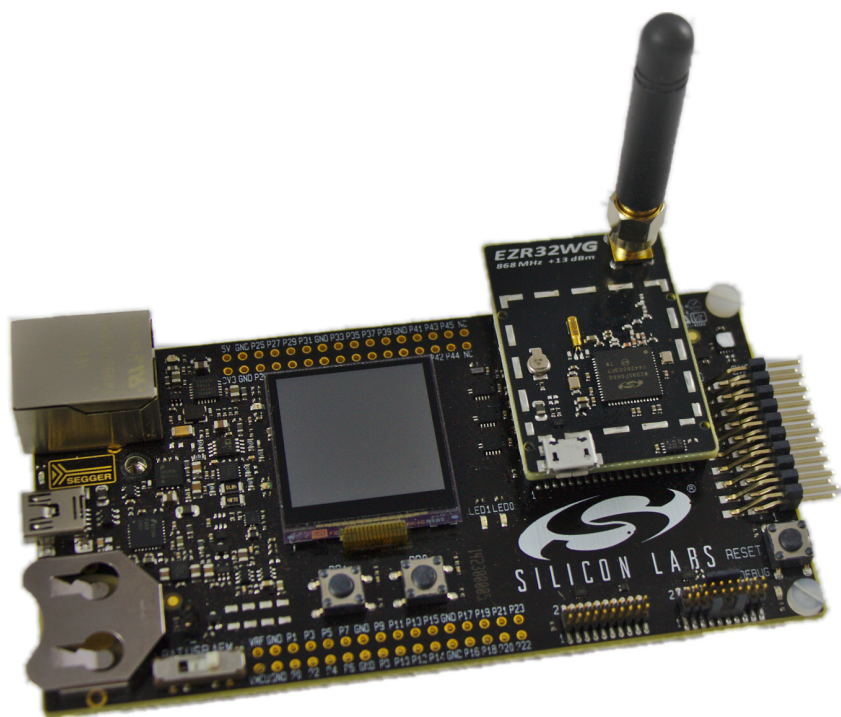
# User Manual

## EZR32WG 490MHz Wireless Starter Kit



The WSTK6223 is an excellent starting point to get familiar with the EZR32 Wonder Gecko Wireless Microcontrollers.

The Wireless Starter Kit Mainboard contains sensors and peripherals demonstrating some of the Wireless MCU's many capabilities. The kit provides all necessary tools for developing a Silicon Labs wireless application.



### KIT FEATURES

- Ethernet and USB connectivity
- Advanced Energy Monitoring
- Packet Trace Interface support
- SEGGER J-Link OB debugger
- Debug Multiplexer supporting external hardware as well as radio board
- Silicon Labs' Si7021 Relative Humidity and Temperature sensor
- Ultra Low power 128x128 pixel Memory LCD
- LEDs / Pushbuttons / Reset button
- 20pin 2.54mm header for expansion boards
- Breakout pads for direct access to all radio I/O pins
- Power sources including USB and CR2032 coin cell holder.

### ORDERING INFO

- SLWSTK6223A

### RADIO BOARD FEATURES

- EZR32WG330F256R63G MCU with 256 kB Flash and 32 kB RAM.
- SMA antenna connector
- USB Micro-B connector
- Backup domain capacitor

### SOFTWARE SUPPORT

- Simplicity Studio
- Simplicity Profiler
- Simplicity Network Analyzer
- Extensive example set for radio
- Kit Board Support Package

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## 1. Introduction

### 1.1 Description

The idea behind the WSTK6223 is to provide a complete development platform for Silicon Labs EZR32 Wonder Gecko Wireless Micro-controllers. The core of the WSTK6223 is the Wireless Starter Kit (WSTK) Mainboard (BRD4001) which feature an on-board J-Link debugger, an Advanced Energy Monitor for real-time current and voltage monitoring, a Virtual COM port interface, and access to the Packet Trace Interface (PTI). The WSTK Mainboard is paired with an EZR32 Wonder Gecko radio board that plugs directly into the mainboard. The radio board feature the EZR32 Wonder Gecko itself and the RF interface. All debug functionality, including AEM, VCOM and PTI, can also be used towards an external target instead of the included radio board. To further enhance the WSTK usability, the WSTK Mainboard contains sensors and peripherals demonstrating some of the Wireless MCU's many capabilities.

### 1.2 Kit Content

The following items are contained in the box:

- 2x BRD4001A Wireless Starter Kit Mainboards
- 2x BRD4505B EZR32 Wonder Gecko 490 MHz WSTK Radio Boards
- 2x 490 MHz antennas with SMA connector
- 2x CR2032 Lithium batteries
- 2x USB Type A <-> USB Mini-B cables
- 2x USB Type A <-> USB Micro-B cables

Figure 1.1 WSTK6223 Kit Content on page 1 shows the kit content.

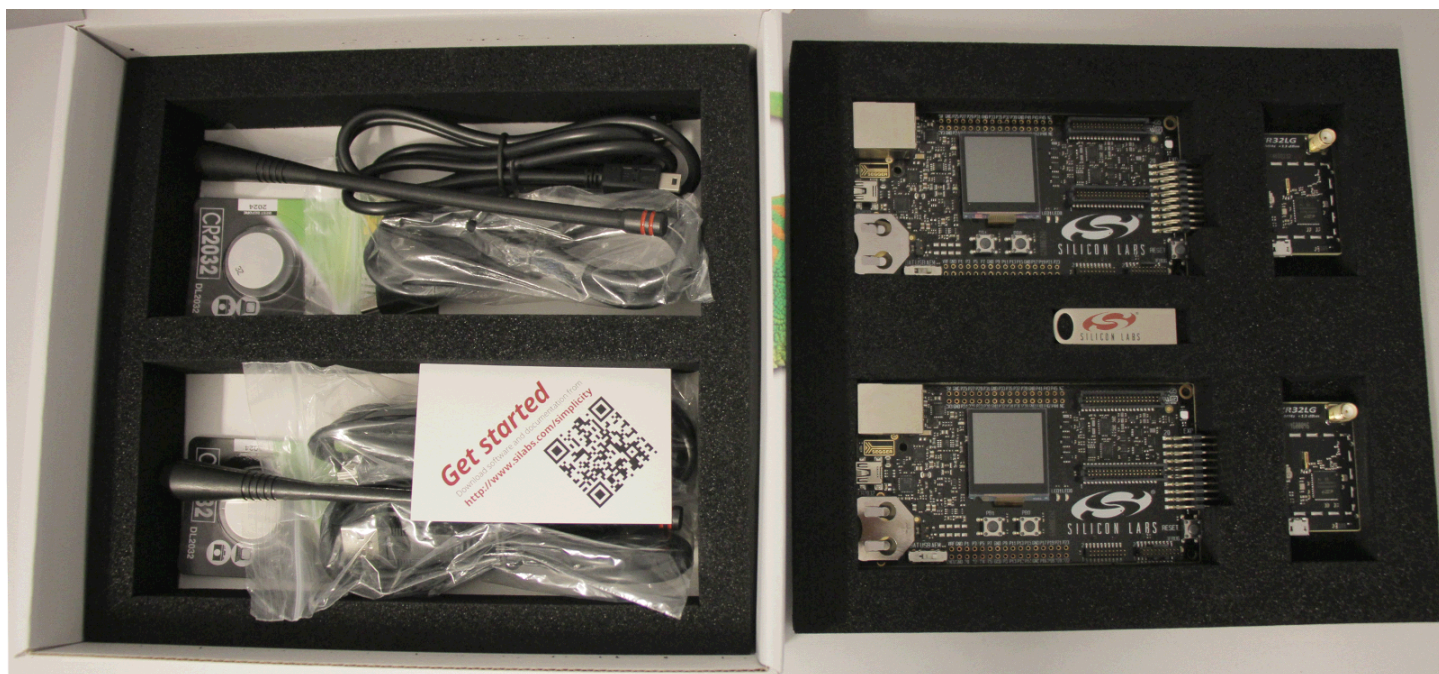


Figure 1.1. WSTK6223 Kit Content

### 1.3 Getting Started

Detailed instructions for how to get started with your new WSTK6223 can be found on the Silicon Labs Simplicity web pages:

<http://www.silabs.com/simplicity>

## 2. Kit Block Diagram

An overview of the EZR32WG 490MHz Wireless Starter Kit is shown in the figure below.

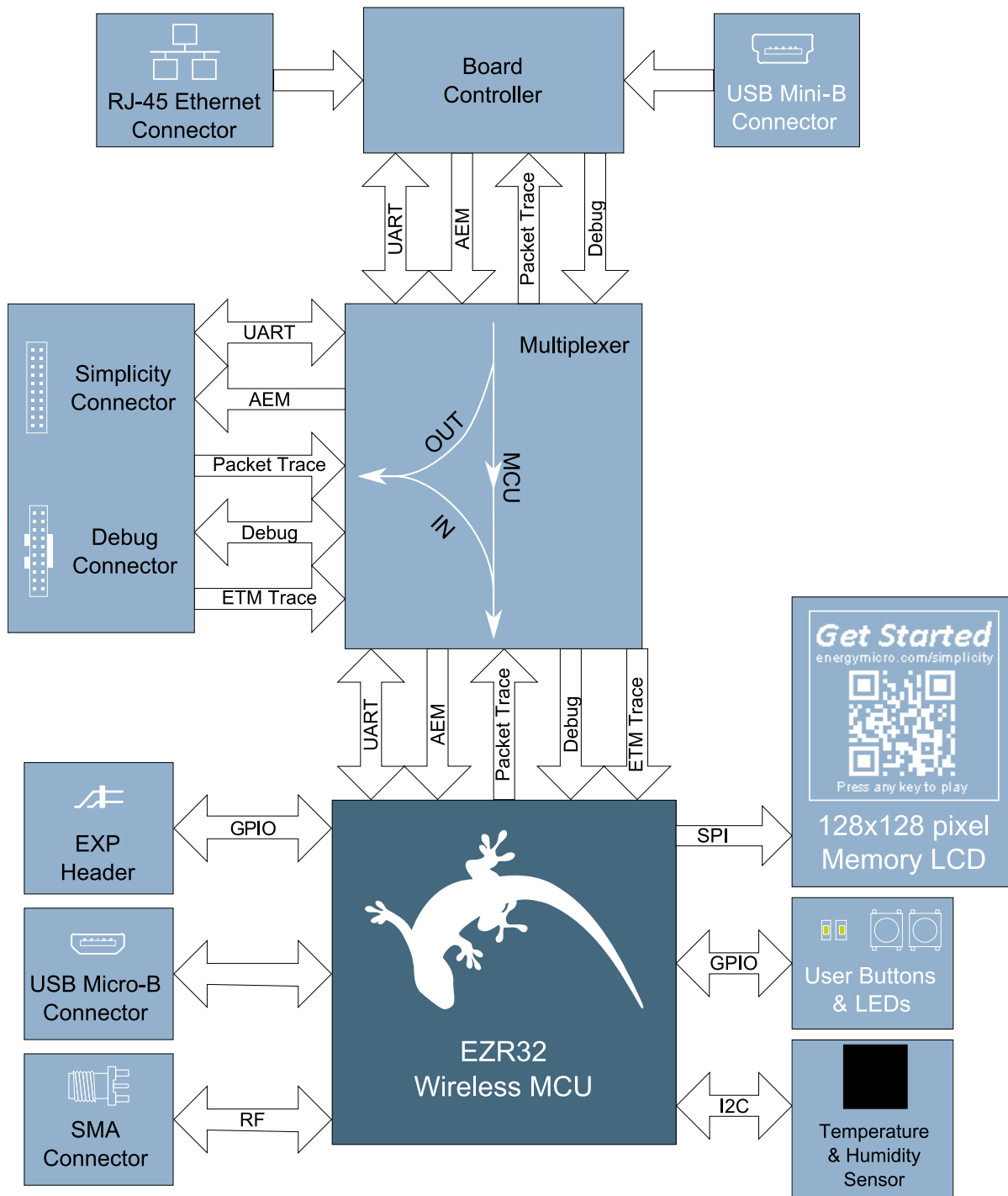
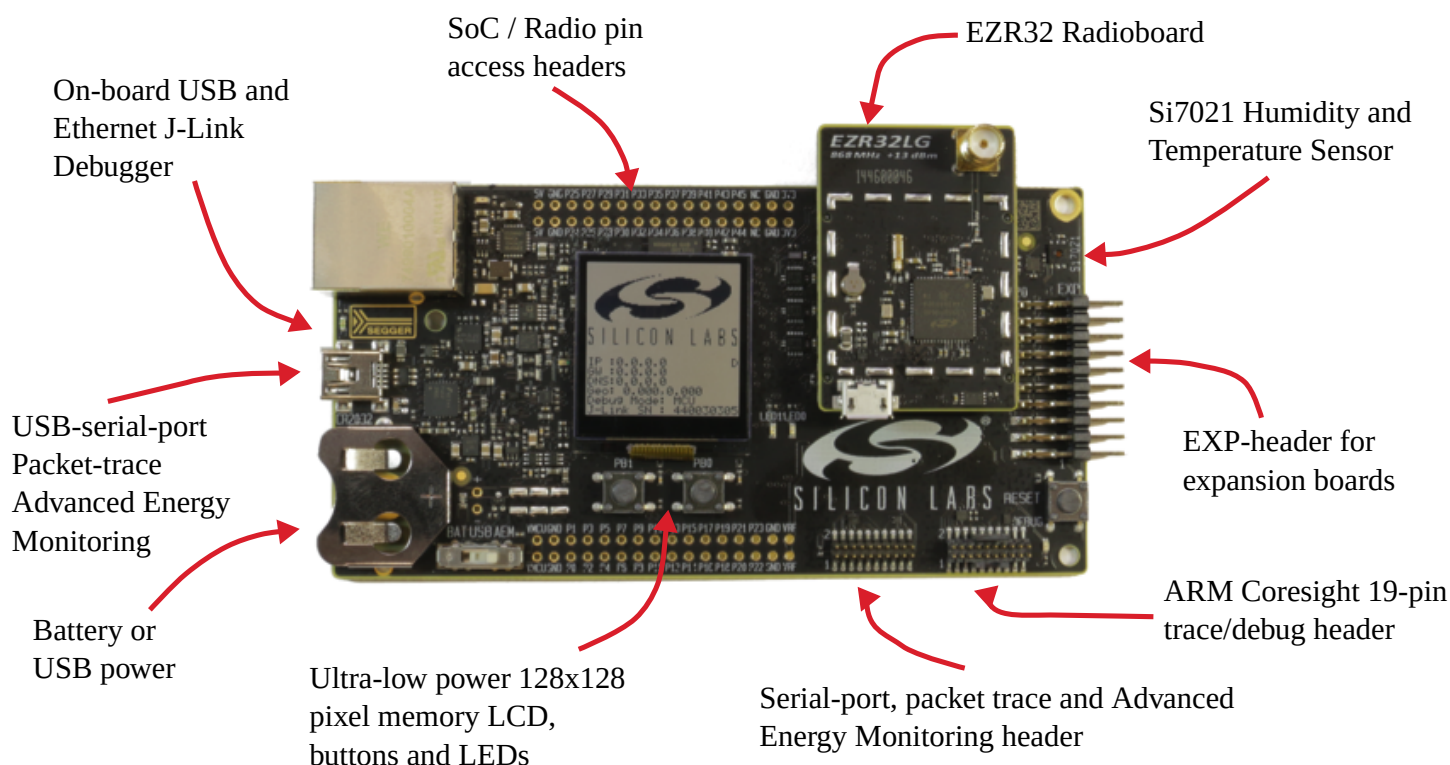


Figure 2.1. WSTK6223 Block Diagram

### 3. Kit Hardware Layout

The layout of the EZR32WG 490MHz Wireless Starter Kit is shown below.



**Figure 3.1. WSTK6223 hardware layout**

The kit consists of two BRD4001 Wireless Starter Kit Mainboards paired with two BRD4505B plug-in radio boards with the following specifications:

- Wireless MCU: EZR32WG330F256R63G
- CPU core: ARM Cortex-M4
- Flash memory: 256 kB
- RAM: 32 kB
- Sub-GHz transceiver integrated in the Wireless MCU: EZRadioPRO
- Operation frequency: 490 MHz
- Transmit power: 20 dBm
- Single antenna connector both for transmit and receive
- Crystals for LFXO and HFXO: 32.768kHz and 48 MHz.
- Crystal for RF: 30 MHz
- Backup Power Domain Capacitor
- Full speed USB 2.0 (12 Mbps)



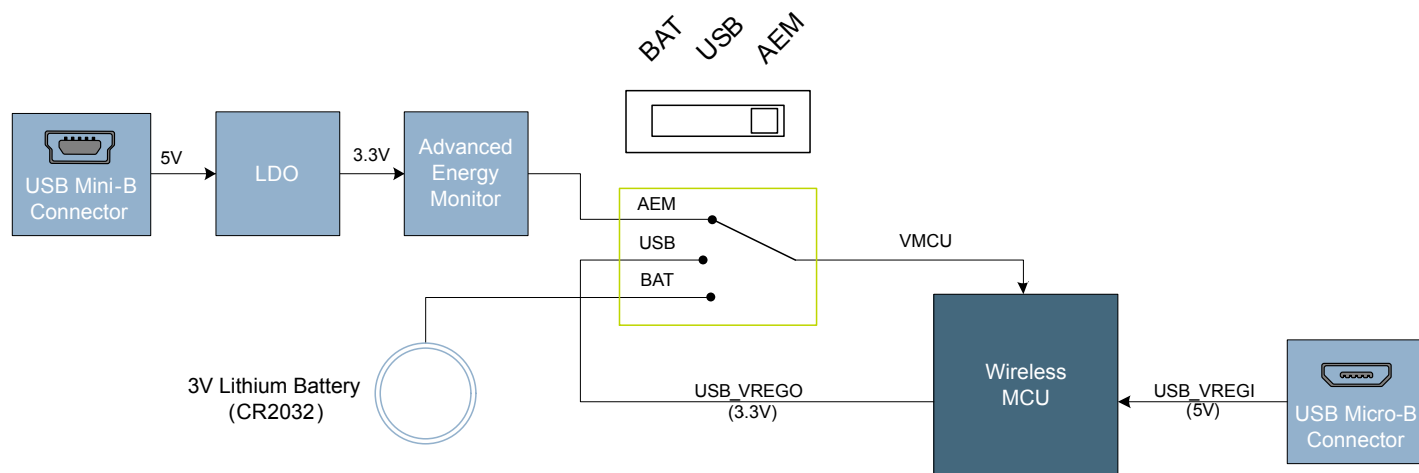
## 4. Power Supply and Reset

### 4.1 MCU Power Selection

The EZR32 Wonder Gecko MCU on the WSTK6223 is designed to be powered by three different sources:

- Through the on-board debugger.
- Through the EZR32's own USB regulator.
- By a 3V Battery.

Selecting the power source is done with the slide switch in the lower left corner of the board. Figure [Figure 4.1 WSTK6223 Power Switch](#) on page 4 shows how the different power sources can be selected with the slide switch.



**Figure 4.1. WSTK6223 Power Switch**

With the switch in the *DBG* position, an on-board low noise LDO with a fixed output voltage of 3.3V is used to power the MCU. This LDO is again powered from the "J-Link" USB cable. The Advanced Energy Monitor is now also connected in series, allowing accurate high speed current measurements and energy debugging/profiling.

With the switch in the *USB* position, the integrated linear regulator in the EZR32 Wonder Gecko MCU is used to power the rest of the chip as well as the USB PHY. This allows a USB device application where the MCU acts as a bus powered device.

Finally, with the switch in the *BAT* position, a 20mm coin cell battery in the CR2032 socket can be used to power the device.

**Note:**

The Advanced Energy Monitor can only measure the current consumption of the EZR32 when the power selection switch is in the *DBG* position.

### 4.2 Board Controller Power

The Board Controller is responsible for important features such as the debugger and the Advanced Energy Monitor, and is powered exclusively through the USB port in the top left corner of the board. This part of the kit resides on a separate power domain, so a different power source can be selected for the MCU while retaining debugging functionality. This power domain is also isolated to prevent current leakage from the MCU power domain when power to the Board Controller is removed.

### 4.3 Backup Power Domain

The kit contains a backup capacitor that can be used together with the EZR32 Wonder Gecko's backup power domain. In this case, all other power sources are removed from the kit, and only a small part of the EZR32 runs off the capacitor. It is also possible to enter backup mode while the Board Controller is powered by selecting either *BAT* or *USB* with no battery in the socket or USB cable in the connector.

#### 4.4 MCU Reset

The EZR32 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.

#### 4.5 Board Controller Reset

The Board Controller can be reset by removing and re-inserting the J-Link USB cable. Removing the Board Controller USB cable will not reset the EZR32, but whenever the Board Controller is powered up again, it will issue a RESET to the EZR32 through the on-board debugger.



## 5. Peripherals

The starter kit has a set of peripherals that showcase some of the features of the EZR32 Wonder Gecko Wireless Microcontroller.

Be aware that most EZR32 I/O routed to peripherals are also routed to the breakout pads. This must be taken into consideration when using the breakout pads for your application.

### 5.1 Push Buttons and LEDs

The kit has two user push buttons marked PB0 and PB1. They are connected to the EZR32, and are debounced by RC filters with a time constant of 1ms. The buttons are connected to pins PC8 and PC9.

In addition to the two push buttons, the kit also features two yellow LEDs marked *LED0* and *LED1*, that are controlled by GPIO pins on the EZR32. The LEDs are connected to pins PC10 and PC11 in an active-high configuration.

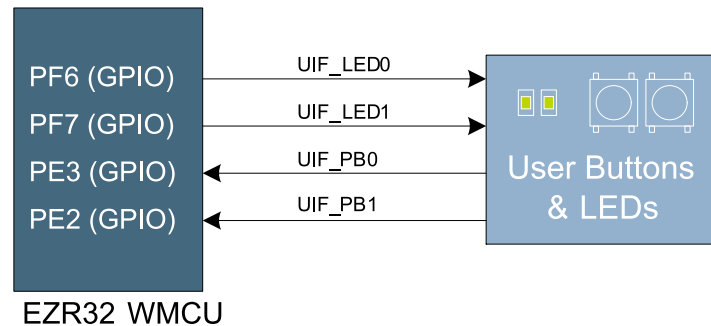


Figure 5.1. Buttons/LEDs

## 5.2 Memory LCD-TFT Display

A 1.28-inch SHARP Memory LCD-TFT has been added to the board to enable interactive applications to be developed. The display has a high resolution of 128 by 128 pixels, and consumes very little power. It is a reflective monochrome display, so each pixel can only be light or dark, and no backlight is needed in normal daylight conditions.

The display interface consists of an SPI-compatible serial interface and some extra control signals. Data is sent to the display one line (128 bits) at a time.

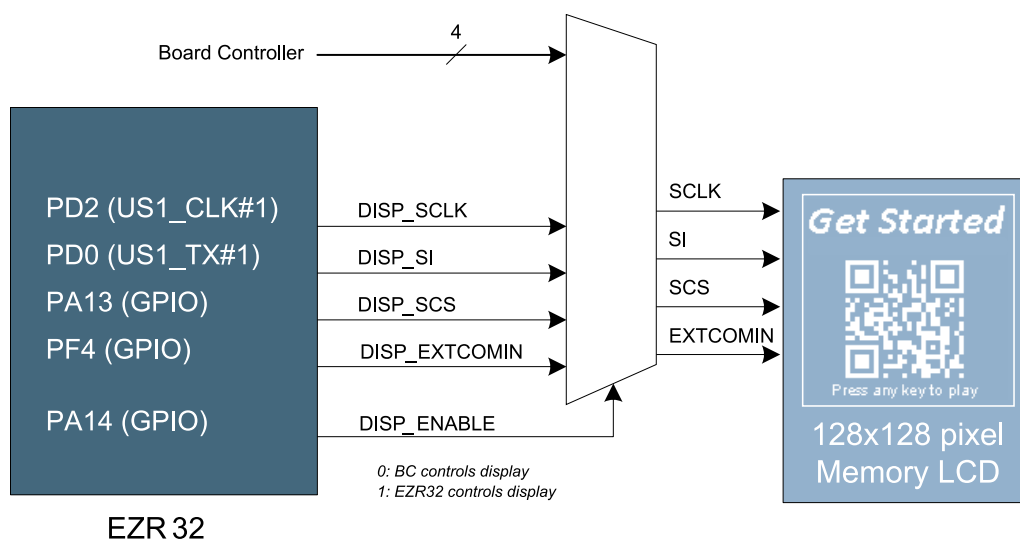
The Memory LCD-TFT display is shared with the kit Board Controller, allowing the Board Controller application to display useful information when the user application is not using the display. The user application always controls ownership of the display with EFM\_DISP\_SELECT (PA8):

- 0: The Board Controller has control of the display
- 1: The user application (EZR32) has control of the display

EFM\_DISP\_PWR (PA10) enables power to the display, and must be set high in order to use the display. Data is clocked in on EFM\_DISP\_MOSI (PD7) when EFM\_DISP\_CS (PE11) is high, and the clock is sent on EFM\_DISP\_SCLK (PC15). The maximum supported clock speed is 1.1 MHz.

EFM\_DISP\_COM (PE10) is the "COM Inversion" line. It must be pulsed periodically to prevent static build-up in the display itself. Please refer to the display application information for details on driving the display:

<http://www.sharpmemorylcd.com/1-28-inch-memory-lcd.html>



**Figure 5.2. 128x128 pixel Memory LCD**

## 5.3 Backup Domain Capacitor

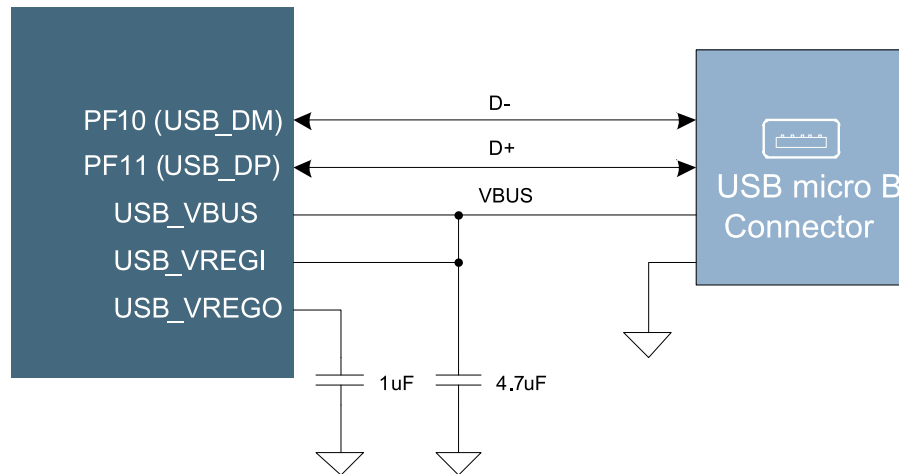
A small super capacitor is provided to evaluate the EZR32 Wonder Gecko MCU's backup power domain. The capacitor has a nominal value of 33 mF, and is connected with a 100 ohm series resistor to the BU\_VIN pin of the EZR32.

Because of the extremely low power consumption of the EZR32 in backup mode (400nA), the capacitor can power a clock application using the low frequency crystal oscillator (LFXO) for more than 8 hours.

The series resistor allows measuring of the current drawn from the capacitor into the EZR32 device, by simply using a multimeter to measure the voltage across it. Please refer to the schematic and assembly drawings to locate the series resistor.

## 5.4 USB Micro-B Connector

The BRD4505B WSTK Radio Board is equipped with a USB Micro-B connector that is connected directly to the EZR32. The Radio Board supports operation in USB Device mode only, even if the target radio also supports USB Host mode. [Figure 5.3 Radio Board USB Connector on page 8](#) shows how the USB lines are connected to the EZR32.



**Figure 5.3. Radio Board USB Connector**

## 5.5 Si7021 Relative Humidity and Temperature Sensor

The Si7021 I<sup>2</sup>C relative humidity and temperature sensor is a monolithic CMOS IC integrating humidity and temperature sensor elements, an analog-to-digital converter, signal processing, calibration data, and an I<sup>2</sup>C Interface. The patented use of industry-standard, low-K polymeric dielectrics for sensing humidity enables the construction of low-power, monolithic CMOS Sensor ICs with low drift and hysteresis, and excellent long term stability.

The humidity and temperature sensors are factory-calibrated and the calibration data is stored in the on-chip non-volatile memory. This ensures that the sensors are fully interchangeable, with no recalibration or software changes required.

The Si7021 is available in a 3x3 mm DFN package and is reflow solderable. It can be used as a hardware- and software-compatible drop-in upgrade for existing RH/ temperature sensors in 3x3 mm DFN-6 packages, featuring precision sensing over a wider range and lower power consumption. The optional factory-installed cover offers a low profile, convenient means of protecting the sensor during assembly (e.g., reflow soldering) and throughout the life of the product, excluding liquids (hydrophobic/oleophobic) and particulates.

The Si7021 offers an accurate, low-power, factory-calibrated digital solution ideal for measuring humidity, dew-point, and temperature, in applications ranging from HVAC/R and asset tracking to industrial and consumer platforms.

The I<sup>2</sup>C bus used for the Si7021 is shared with the Expansion Header. The temperature sensor is normally isolated from the I<sup>2</sup>C line. To use the sensor, PF8 must be set high. When enabled, the sensor's current consumption is included in the AEM measurements.

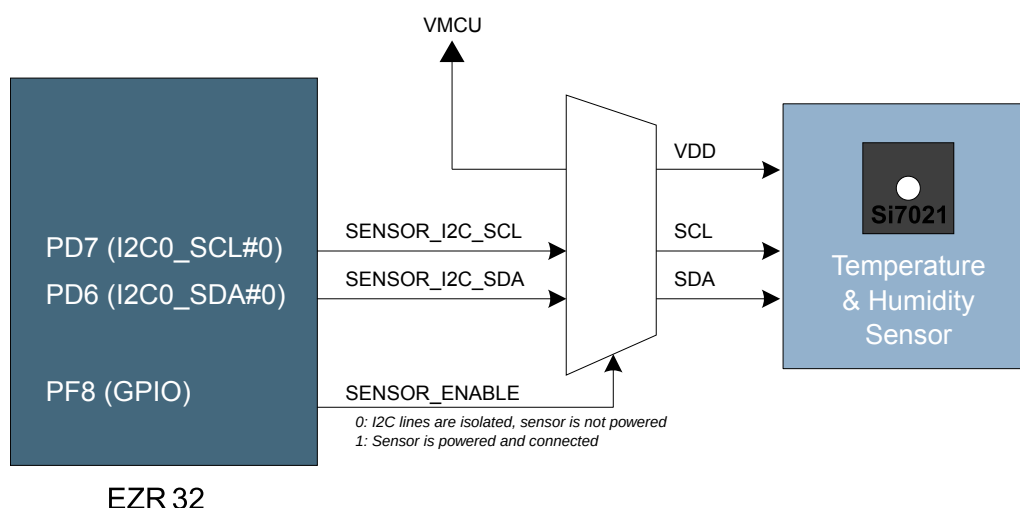


Figure 5.4. Si7021 Relative Humidity and Temperature Sensor

## 6. Advanced Energy Monitor

### 6.1 Introduction

Any embedded developer seeking to make his embedded code spend as little energy as the underlying architecture supports, needs tools to easily and quickly discover inefficiencies in the running application.

This is what the Simplicity Energy Profiler is designed to do. It will in real-time graph and log current as a function of time while correlating this to the actual target application code running on the EZR32. There are multiple features in the profiler software that allows for easy analysis, such as markers and statistics on selected regions of the current graph or aggregate energy usage by different parts of the application.

### 6.2 Advanced Energy Monitor - Theory of operation

The AEM circuitry on the board is capable of measuring current signals in the range of 0.1 $\mu$ A to 150mA, which is close to 123dBs of dynamic range. It can do this while still maintaining approximately 10kHz of current signal bandwidth. This is accomplished through a combination of a highly capable current sense amplifier, multiple gain stages and signal processing within the kit's board controller before the current sense signal is read by a host computer for display and/or storage.

The current sense amplifier measures the voltage drop over a small series resistor, and the gain stage further amplifies this voltage with two different gain settings to obtain two current ranges. The transition between these two ranges occurs around 250  $\mu$ A.

The current signal is combined with the target MCU's Program Counter (PC) sampling by utilizing a feature of the ARM CoreSight debug architecture. The ITM (Instrumentation Trace Macrocell) block can be programmed to sample the MCU's PC at periodic intervals ( 50kHz ) and output these over SWO pin ARM devices. When these two data streams are fused and correlated with the running application's memory map, an accurate statistical profile can be built over time, that shows the energy profile of the running application in real-time.

At kit power-up or on a power-cycle, and automatic AEM calibration is performed. This calibration compensates for any offset errors in the current sense amplifiers.

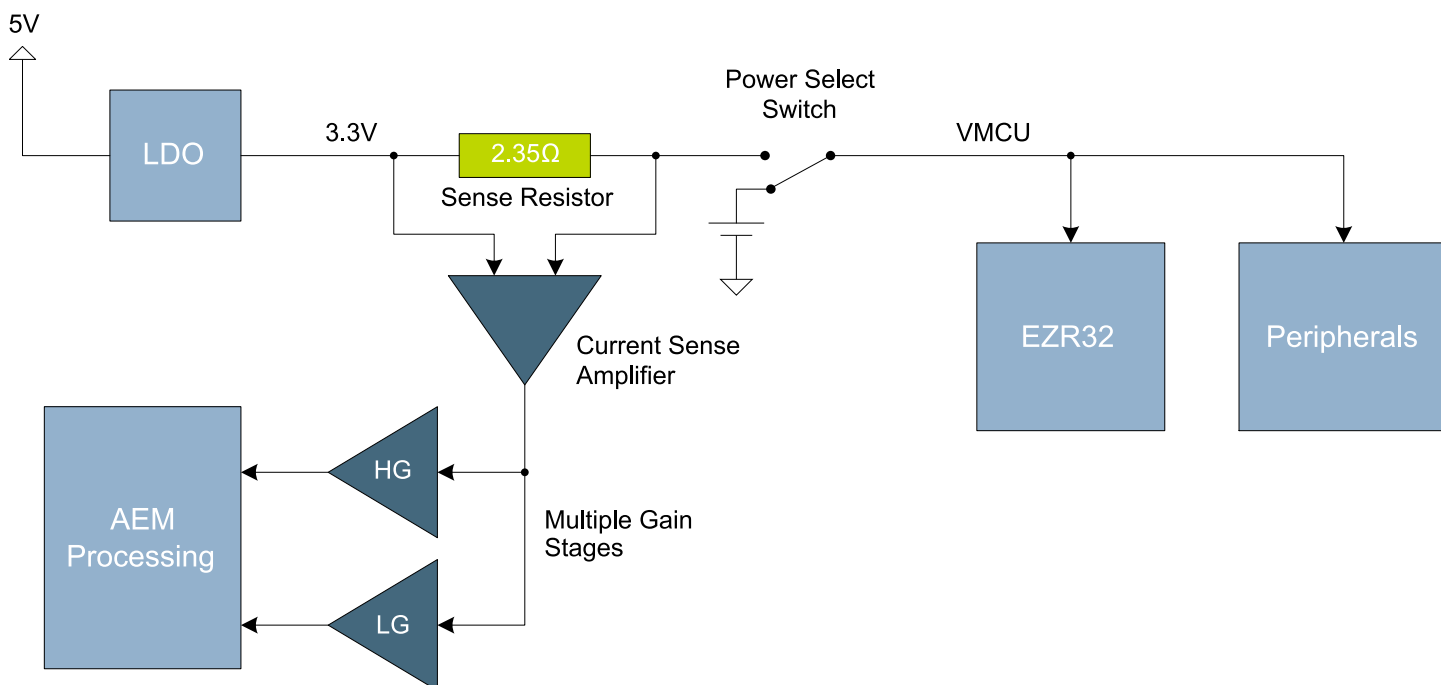


Figure 6.1. Advanced Energy Monitor

### 6.3 AEM accuracy and performance

The Advanced Energy Monitor is capable of measuring currents in the range of 0.1  $\mu\text{A}$  to 95mA. For currents above 250  $\mu\text{A}$ , the AEM is accurate within 0.1 mA. When measuring currents below 250  $\mu\text{A}$ , the accuracy increases to 1  $\mu\text{A}$ . Even though the absolute accuracy is 1  $\mu\text{A}$  in the sub 250  $\mu\text{A}$  range, the AEM is able to detect changes in the current consumption as small as 100 nA.

The AEM current sampling rate is 10000 Hz.

**Note:** The AEM circuitry only works when the kit is powered and the power switch is in the AEM/DBG position.

### 6.4 Usage

The AEM (Advanced Energy Monitor) data is collected by the board controller and can be displayed by the Energy Profiler, available through Simplicity Studio. By using the Energy Profiler, current consumption and voltage can be measured and linked to the actual code running on the EZR32 in realtime.

## 7. Board Controller

The kit contains a board controller that is responsible for performing various board-level tasks, such as handling the debugger and the Advanced Energy Monitor. An interface is provided between the EZR32 and the board controller in the form of a UART connection. The connection is enabled by setting the VCOM\_ENABLE (PA12) line high, and using the lines VCOM\_TX (PB3) and VCOM\_RX (PB4) for communication.

Specific library functions have been provided in the kit Board Support Package that support various requests to be made to the board controller, such as querying AEM voltage or current. To use these functions, the Board Support Package must be installed. See the to find out more.

**Note:**

The board controller is only available when USB power is connected.

### 7.1 VCOM

When enabling virtual serial communication (VCOM), the board controller makes communication possible on the following interfaces:

- Virtual USB COM port using a CDC driver, provided that the kit is connected to a host computer.
- TCP/IP, by connecting to the Wireless Starter Kit on port 4901 using a telnet client.
- Expansion header when enabled by the board controller.

The VCOM functionality can operate in two different modes:

- Transparent mode allows the target to communicate using a regular serial driver. The board controller forwards the raw byte stream to its interfaces.
- BSP-mode is initiated by a BSP call in the target application. This mode enables the target to use all BSP functionality, while having access to VCOM over USB and Ethernet.



## 8. Board Support Package

The Board Support Package (BSP) is a set of C source and header files that enables easy access to, and control over some board specific features. Using the BSP is not required, and the EZR32 is fully usable without the BSP.

The BSP uses EZR32 peripheral USART2, Location 1 (TX pin PB3, RX pin PB4) on baudrate 115200-8-N-1 to communicate with the board controller.

**Note:**

The BSP functionality is only available when the Starter Kit is USB-powered. Using these function calls with USB disconnected will give unpredictable results.

### 8.1 Application Programming Interface

To use the BSP, include the Starter Kit header file, like this:

```
#include "bsp.h"
```

All functions in the BSP are prefixed with `BSP_`. Some functions to control the user LEDs might look like:

```
int BSP_LedClear (int ledNo)
```

Turn off a single LED.

```
int BSP_LedSet (int ledNo)
```

Turn on a single LED.

### 8.2 Example Applications

Under the `kits/EZR32WG_WSTK6223/examples` folder in your base Simplicity installation directory, you will find example programs using the BSP, with corresponding project/Makefiles for supported IDEs.

The *examples* folder also contains examples showing how to use the different peripherals on the WSTK6223.

### 8.3 How to include in your own applications

The easiest way to include the BSP in your application is to create it using the Simplicity IDE.

Alternatively to base your work on the example application that uses the BSP. The following items are recommended for correct configuration:

1. Make sure you define the correct part number (i.e. EZR32WG330F256R63G) as a preprocessor defined symbol
  2. Make sure you define the correct part number (i.e. EZR32WG330F256R63G) for your project file
  3. Add and include the EFM32\_CMSIS-files (`startup_efm32.s`, `system_efm32.c`, `core_cm3.c`) to your project
  4. Add and include *all* BSP package .c-files, with the bsp-prefix to your project
  5. Configure include paths to point at the CMSIS/CM3/CoreSupport and CMSIS/CM3/DeviceSupport/EnergyMicro/EFM32 directories
  6. Configure include paths to point to the `kits/EZR32WG_WSTK6223/bsp` directory
- Make sure you call `"BSP_Init()"` early at startup, and you should be all set.

## 9. Connectors

This chapter gives you an overview of the Wireless Starter Kit Mainboard connectivity. The placement of the connectors can be seen in the figure below.

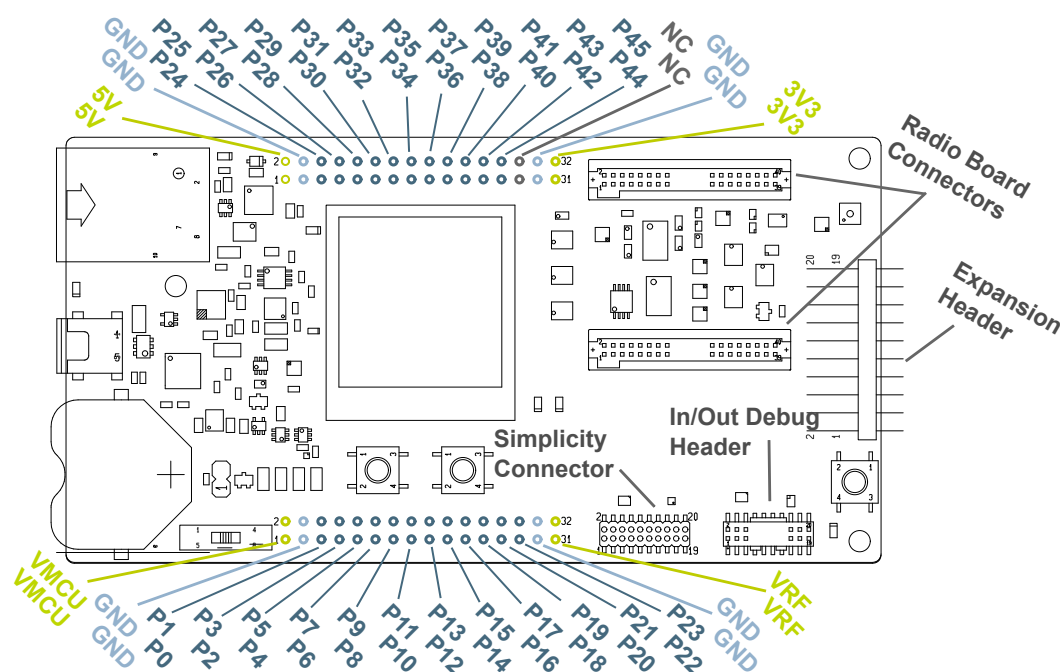


Figure 9.1. Connector layout

### 9.1 Radio Board breakout pads

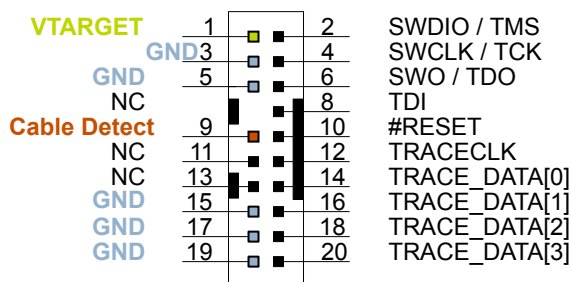
Most of the EZR32's pins are routed out to "breakout pads" at the top and bottom edges of the Wireless Starter Kit Mainboard. A 2.54mm pitch pin header can be soldered on for easy access to the pins. The figure below shows you how the pins of the EZR32 Wonder Gecko Radio Board (BRD4505B (Rev. A00)) maps to the pins indicated on the breakout pads. To see the available functions on each pin we refer you to the EZR32WG330F256R63G reference manual available in Simplicity Studio.

| J101                                                        | J102                                                    |
|-------------------------------------------------------------|---------------------------------------------------------|
| VMCU ○ ○ VMCU                                               | 5V ○ ○ 5V                                               |
| GND ○ ○ GND                                                 | GND ○ ○ GND                                             |
| PC6 / P0 ○ ○ P1 / PD0 / DISP_SI                             | BUTTON0 / PE3 / P24 ○ ○ P25 / PF10                      |
| PC7 / P2 ○ ○ P3 / PD1                                       | PF11 / P26 ○ ○ P27 / NC                                 |
| PE0 / P4 ○ ○ P5 / PD2 / DISP_SCLK                           | NC / P28 ○ ○ P29 / NC                                   |
| PE1 / P6 ○ ○ P7 / PD3                                       | PTIO.DAT0 / PA0 / P30 ○ ○ P31 / PA1 / PTIO.SYNC         |
| PB11 / P8 ○ ○ P9 / PD4                                      | RF_GPIO2 / P32 ○ ○ P33 / RF_GPIO3                       |
| PF3 / P10 ○ ○ P11 / PD5                                     | VCOM.RX_MISO / PB4 / P34 ○ ○ P35 / PB5 / VCOM.#CTS_SCLK |
| PD7 / P12 ○ ○ P13 / PD6                                     | VCOM.#RTS_#CS / PB6 / P36 ○ ○ P37 / PF8 / SENSOR_ENABLE |
| DISP_SCS / PA13 / P14 ○ ○ P15 / PA14 / DISP_ENABLE          | VCOM.TX_MOSI / PB3 / P38 ○ ○ P39 / NC                   |
| VCOM_ENABLE / PA12 / P16 ○ ○ P17 / PF6 / LED0               | PF5 / P40 ○ ○ P41 / PD7                                 |
| LED1 / PF7 / P18 ○ ○ P19 / PF2 / DEBUG.TDO_SWO              | PD6 / P42 ○ ○ P43 / PD3                                 |
| DEBUG.TCK_SWCLK / PF0 / P20 ○ ○ P21 / PF1 / DEBUG.TMS_SWDIO | PD4 / P44 ○ ○ P45 / PD5                                 |
| DISP_EXTCOMIN / PF4 / P22 ○ ○ P23 / PE2 / BUTTON1           | NC ○ ○ NC                                               |
| GND ○ ○ GND                                                 | GND ○ ○ GND                                             |
| VRF ○ ○ VRF                                                 | 3V3 ○ ○ 3V3                                             |

Figure 9.2. Radio board pin mapping on breakout pads.

## 9.2 Debug Connector (DBG)

This connector is used for Debug In and Debug Out (see chapter on Debugging). The pinout is described in [Table 9.1 Debug Connector Pinout](#) on page 15.



**Figure 9.3. Debug Connector**

Note that the pin-out matches the pin-out of an ARM Cortex Debug+ETM connector, but these are not fully compatible as pin 7 is physically removed from the Cortex Debug+ETM connector.

**Table 9.1. Debug Connector Pinout**

| Pin number(s)    | Function     | Note                                                                                                        |
|------------------|--------------|-------------------------------------------------------------------------------------------------------------|
| 1                | VTARGET      | Target voltage on the debugged application.                                                                 |
| 2                | TMS/SDWIO    | JTAG TMS or Serial Wire Data I/O                                                                            |
| 4                | TCK/SWCLK    | JTAG TCK or Serial Wire clock                                                                               |
| 6                | TDO/SWO      | JTAG TDO or Serial Wire Output                                                                              |
| 8                | TDI          | JTAG data in                                                                                                |
| 10               | #RESET       | Target MCU reset                                                                                            |
| 12               | TRACECLK     | ETM Trace Clock                                                                                             |
| 14               | TRACEDATA[0] | ETM Trace Data 0                                                                                            |
| 16               | TRACEDATA[1] | ETM Trace Data 1                                                                                            |
| 18               | TRACEDATA[2] | ETM Trace Data 2                                                                                            |
| 20               | TRACEDATA[3] | ETM Trace Data 3                                                                                            |
| 9                | Cable detect | This signal must be pulled to ground by the external debugger or application for cable insertion detection. |
| 11, 13           | NC           | Not connected                                                                                               |
| 3, 5, 15, 17, 19 | GND          |                                                                                                             |

**Note:** The Wireless Starter Kit Mainboard does not have an onboard trace emulator. To have trace functionality an external debugger with such functionality can be connected with Debug In.

**Note:** Although the Debug Connector can support JTAG debugging of external targets, the EZR32-series of devices do not support JTAG.

### 9.3 Simplicity Connector

The Simplicity Connector featured on the Wireless Starter Kit Mainboard enables advanced debugging features such as the AEM, the Virtual COM port and the Packet Trace Interface to be used towards an external target. The pinout is illustrated in the figure below.

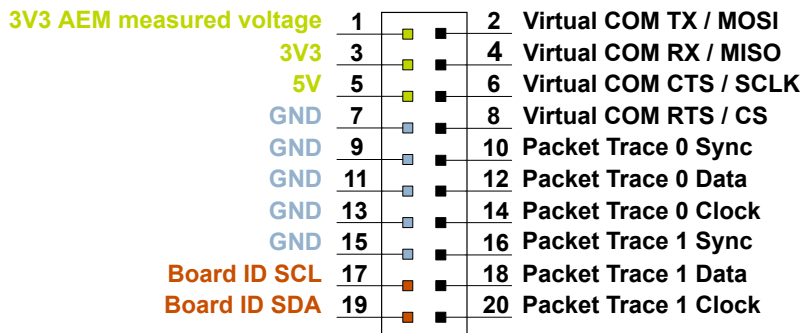


Figure 9.4. Simplicity Header pinout.

Current drawn from the VMCU voltage pin is included in the AEM measurements, while the 3V3 and 5V voltage pins are not. To monitor the current consumption of an external target with the AEM, unplug the WSTK Radio Board from the WSTK Mainboard to avoid that the Radio Board current consumption is added to the measurements.

Table 9.2. Simplicity Header pin descriptions

| Pin number(s)    | Function       | Note                                   |
|------------------|----------------|----------------------------------------|
| 1                | VMCU           | 3.3 V power rail, monitored by the AEM |
| 3                | 3V3            | 3.3 V power rail                       |
| 5                | 5V             | 5 V power rail                         |
| 2                | VCOM_TX_MOSI   | Virtual COM Tx/MOSI                    |
| 4                | VCOM_RX_MISO   | Virtual COM Rx/MISO                    |
| 6                | VCOM_CTS_#SCLK | Virtual COM CTS/SCLK                   |
| 8                | VCOM_#RTS_#CS  | Virtual COM RTS/CS                     |
| 10               | PTI0_SYNC      | Packet Trace 0 Sync                    |
| 12               | PTI0_DATA      | Packet Trace 0 Data                    |
| 14               | PTI0_CLK       | Packet Trace 0 Clock                   |
| 16               | PTI1_SYNC      | Packet Trace 1 Sync                    |
| 18               | PTI1_DATA      | Packet Trace 1 Data                    |
| 20               | PTI1_CLK       | Packet Trace 1 Clock                   |
| 17               | EXT_ID_SCL     | Board ID SCL                           |
| 19               | EXT_ID_SDA     | Board ID SDA                           |
| 7, 9, 11, 13, 15 | GND            |                                        |

## 9.4 Expansion header

On the right hand side of the board an angled 20 pin expansion header is provided to allow connection of peripherals or plugin boards. The connector contains a number of I/O pins that can be used with most of the EZR32 Wonder Gecko's features. Additionally, the VMCU, 3V3 and 5V power rails are also exported.

Figure shows the pin assignment of the expansion header. With a few exceptions, most of the expansion header pins are the same as those on other EFM starter kits.

Some of the chip peripheral functions that are available on the Expansion Header are listed in table [Table 9.3 Some peripheral functions available on Expansion Header on page 17](#).

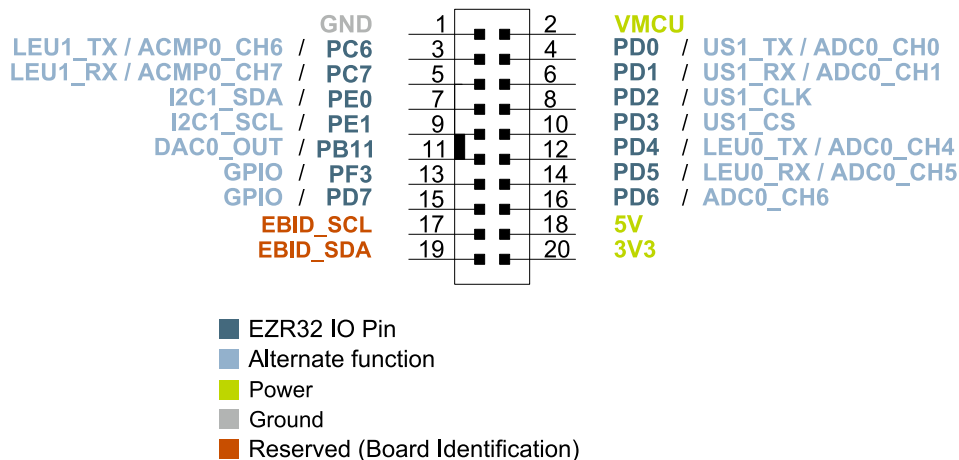


Figure 9.5. Expansion Header

Table 9.3. Some peripheral functions available on Expansion Header

| Peripheral                  | Peripheral pin | MCU Pin | EXP Header pin number |
|-----------------------------|----------------|---------|-----------------------|
| USART/SPI                   | USART1_TX      | PD0     | 4                     |
|                             | USART1_RX      | PD1     | 6                     |
|                             | USART1_CLK     | PD2     | 8                     |
|                             | USART1_CS      | PD3     | 10                    |
| I <sup>2</sup> C            | I2C1_SDA       | PC4     | 7                     |
|                             | I2C1_SCL       | PC5     | 9                     |
| Low Energy UART             | LEUART0_TX     | PD4     | 12                    |
|                             | LEUART0_RX     | PD5     | 14                    |
| Analog to Digital Converter | ADC0_CH0       | PD0     | 4                     |
|                             | ADC0_CH1       | PD1     | 6                     |
|                             | ADC0_CH2       | PD2     | 8                     |
|                             | ADC0_CH3       | PD3     | 10                    |
|                             | ADC0_CH4       | PD4     | 12                    |
|                             | ADC0_CH5       | PD5     | 14                    |
|                             | ADC0_CH6       | PD6     | 16                    |
|                             | ADC0_CH7       | PD7     | 17                    |

| Peripheral                            | Peripheral pin | MCU Pin        | EXP Header pin number |
|---------------------------------------|----------------|----------------|-----------------------|
| Digital to Analog Converter           | DAC0_CH0       | PB11           | 11                    |
|                                       | DAC0_CH1       | PB12           | 13                    |
| Analog Comparator                     | ACMP0_CH0      | PC0            | 3                     |
|                                       | ACMP0_CH3      | PC3            | 5                     |
|                                       | ACMP0_CH4      | PC4            | 7                     |
|                                       | ACMP0_CH5      | PC5            | 9                     |
|                                       | ACMP0_CH6      | PC6            | 15                    |
|                                       | ACMP0_O        | PD6            | 16                    |
|                                       | ACMP1_O        | PD7            | 17                    |
| Operational Amplifier                 | OPAMP_N0       | PC5            | 9                     |
|                                       | OPAMP_P0       | PC4            | 7                     |
|                                       | OPAMP_OUT0     | PB11           | 11                    |
|                                       | OPAMP_N1       | PD7            | 17                    |
|                                       | OPAMP_P1       | PD6            | 16                    |
|                                       | OPAMP_OUT1     | PB12           | 13                    |
|                                       | OPAMP_N2       | PD3            | 10                    |
|                                       | OPAMP_P2       | PD4            | 12                    |
|                                       | OPAMP_OUT2     | PD5, PD0       | 14, 4                 |
| Timer Compare/Capture                 | TIMER0_CC0     | PD1            | 6                     |
|                                       | TIMER0_CC1     | PD2            | 8                     |
|                                       | TIMER0_CC2     | PD3            | 10                    |
|                                       | TIMER1_CC0     | PD6            | 16                    |
|                                       | TIMER1_CC1     | PD7            | 17                    |
|                                       | TIMER1_CC2     | PB11           | 11                    |
| Low Energy Timer                      | LETIM0_OUT0    | PD6, PB11, PC4 | 16, 11, 7             |
|                                       | LETIM0_OUT1    | PD7, PB12, PC5 | 17, 13, 9             |
| Low Energy Sensor Interface (LESENSE) | LES_CH0        | PC0            | 3                     |
|                                       | LES_CH3        | PC3            | 5                     |
|                                       | LES_CH4        | PC4            | 7                     |
|                                       | LES_CH5        | PC5            | 9                     |
|                                       | LES_CH6        | PC6            | 15                    |
|                                       | LES_ALTEX0     | PD6            | 16                    |
|                                       | LES_ALTEX1     | PD7            | 17                    |

| Peripheral                     | Peripheral pin | MCU Pin | EXP Header pin number |
|--------------------------------|----------------|---------|-----------------------|
| Pulse Counter                  | PCNT0_S0IN     | PD6     | 16                    |
|                                | PCNT0_S1IN     | PD7     | 17                    |
|                                | PCNT1_S0IN     | PC4     | 7                     |
|                                | PCNT1_S1IN     | PC5     | 9                     |
|                                | PCNT2_S0IN     | PD0     | 4                     |
|                                | PCNT2_S1IN     | PD1     | 6                     |
| Peripheral Reflex System (PRS) | PRS_CH2        | PC0     | 3                     |

**Note:**

Please note that this table only sums up some of the alternate functions available on the expansion header. Consult the EZR32WG330F256R63G datasheet for a complete list of alternate functions.

## 10. Integrated Development Environments

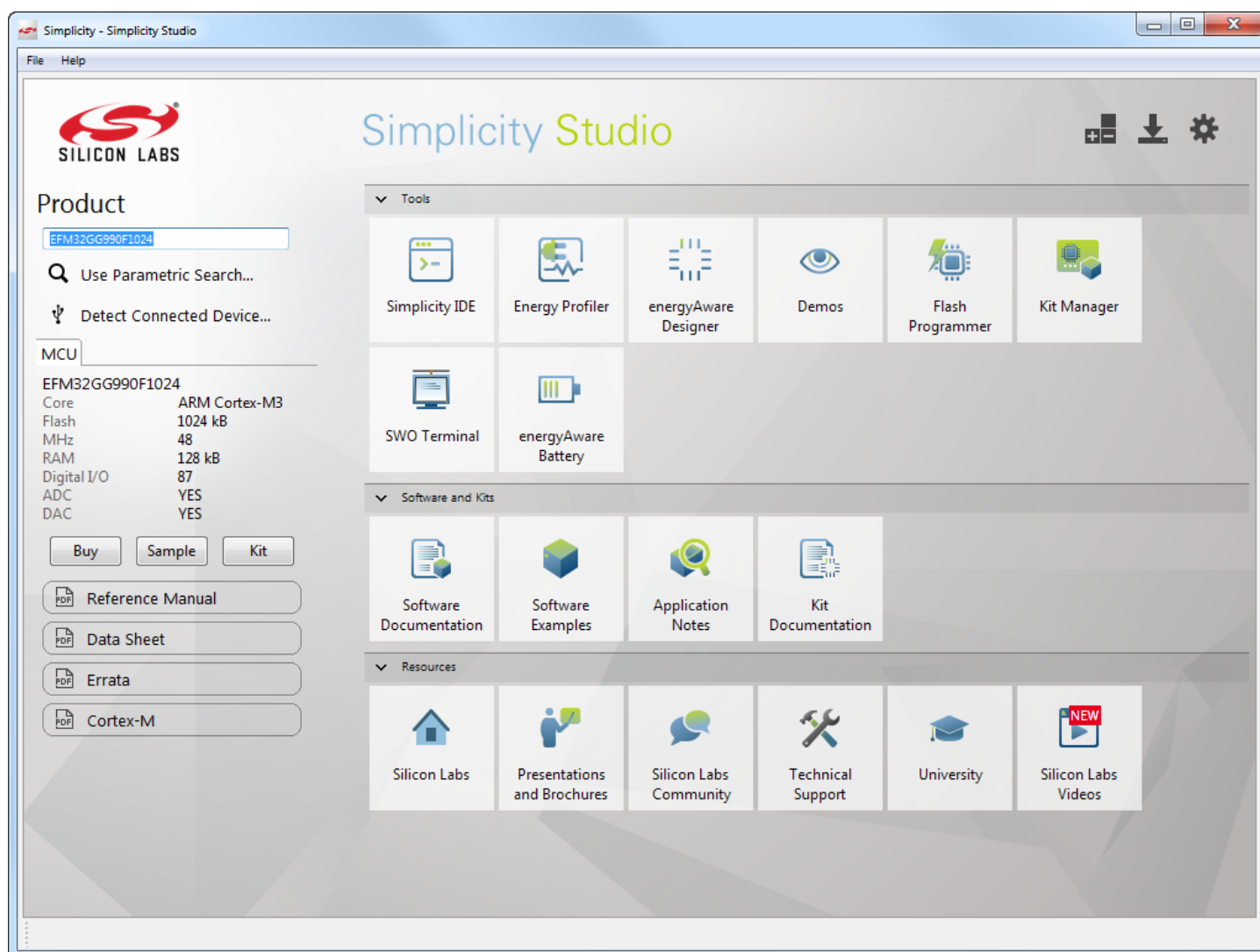


Figure 10.1. Simplicity Studio

Simplicity Studio includes various examples in source form to use with the Starter Kit. To run these examples:

1. Provide power to the board by connecting the DBG USB connector to the PC using the provided USB cable.
2. Move the switch to the AEM position.
3. Click the **[Refresh detected hardware]** button and select the WSTK6223 kit under **[Detected Hardware]**.
4. Click the **[Software Examples]** tile under **[Software and Kits]**.
5. In the wizard, select the WSTK6223 kit and click **[Next]**.
6. Select the desired example or demo from the list and click **[Next]**.
7. Click **[Finish]**.
8. Click the **[Debug]** button in the IDE to build and download the code to the hardware.
9. Follow the instructions at the top of the main example file to set up the hardware as needed.
10. Click the **[Resume]** button to start running the example.

### 10.1 IAR Embedded Workbench for ARM

An evaluation version of IAR Embedded Workbench for ARM is included on a CD in the WSTK6223 package. Check the quick start guide for where to find updates, and IAR's own documentation on how to use it. You will find the IAR project file in the

iar

subfolder of each project



## 10.2 Atollic TrueSTUDIO for ARM

See the quick start guide for download details for Atollic TrueSTUDIO for ARM. You will find TrueStudio project files in the

atollic

subfolder of each project.

## 10.3 Rowley Associates - CrossWorks for ARM

See the quick start guide for download details for CrossWorks for ARM. You will find CrossWorks project files in the

rowley

subfolder of each project.

## 10.4 Keil - MDK-ARM

See the quick start guide for download details for evaluation versions of Keil MDK-ARM. The

arm

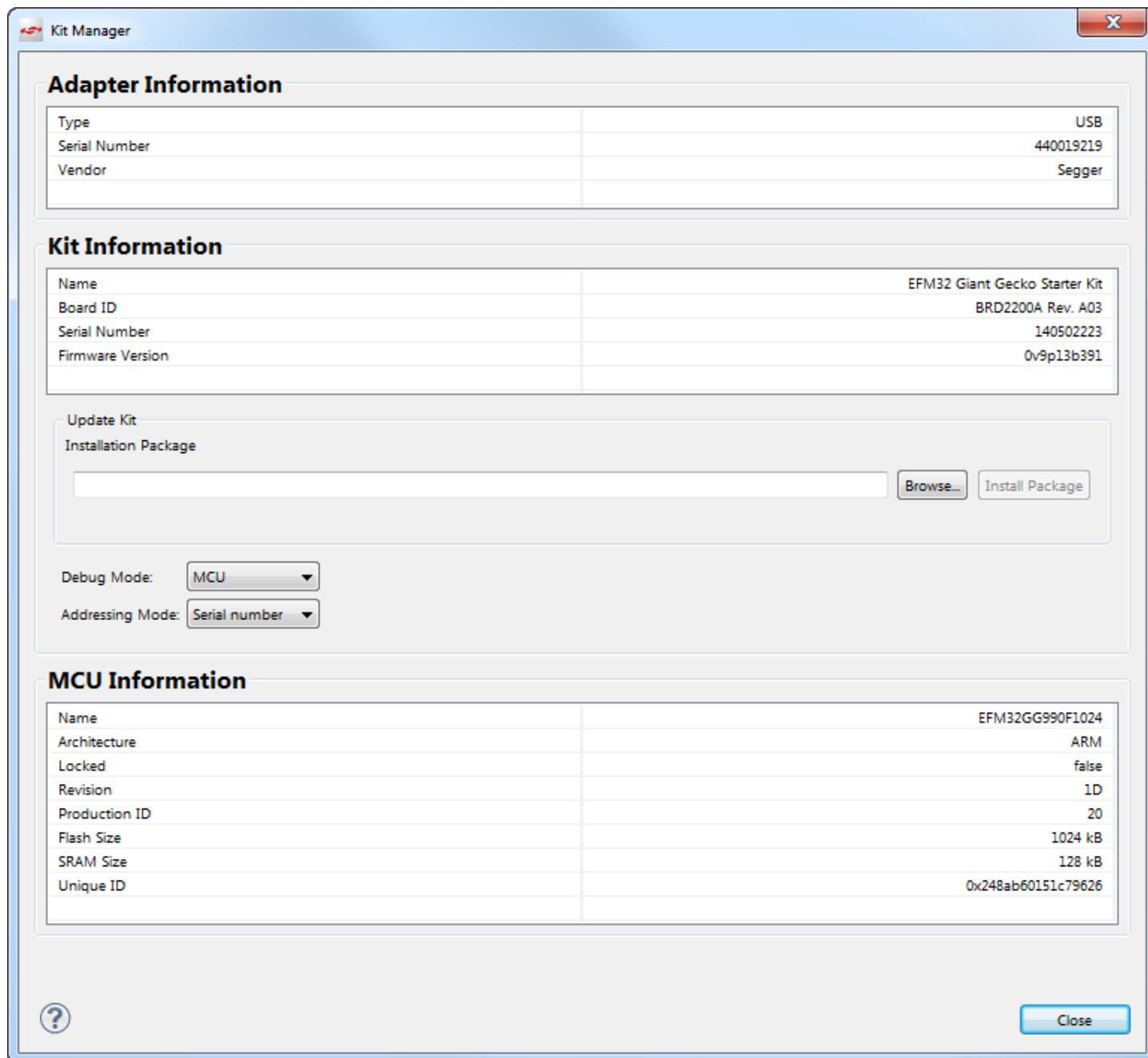
subfolder in each project contains project files for MDK-ARM. Please see the MDK-ARM documentation for usage details.

## 11. Kit Manager and Upgrades

The Kit Manager is a program that comes with Simplicity Studio. It can perform various kit and EZR32 specific tasks.

### 11.1 Kit Manager Operation

This utility gives the ability to program the EZR32, upgrade the kit, lock and unlock devices and more. Some of the features will only work with Energy Micro kits, while other will work with a generic J-Link debugger connected.



The Kit Manager application window displays the following information:

#### Adapter Information

|               |           |
|---------------|-----------|
| Type          | USB       |
| Serial Number | 440019219 |
| Vendor        | Segger    |

#### Kit Information

|                  |                               |
|------------------|-------------------------------|
| Name             | EFM32 Giant Gecko Starter Kit |
| Board ID         | BRD2200A Rev. A03             |
| Serial Number    | 140502223                     |
| Firmware Version | 0v9p13b391                    |

Update Kit

Installation Package

Debug Mode:

Addressing Mode:

#### MCU Information

|               |                    |
|---------------|--------------------|
| Name          | EFM32GG990F1024    |
| Architecture  | ARM                |
| Locked        | false              |
| Revision      | 1D                 |
| Production ID | 20                 |
| Flash Size    | 1024 kB            |
| SRAM Size     | 128 kB             |
| Unique ID     | 0x248ab60151c79626 |

Figure 11.1. Kit Manager

### 11.2 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 Manager for manual upgrades. Click the **[Browse]** button in the **[Update Kit]** section to select the correct file ending in ".emz". Then, click the **[Install Package]** button.

## 12. Schematics, Assembly Drawings and BOM

The schematics, assembly drawings and bill of materials (BOM) for the EZR32WG 490MHz Wireless Starter Kit board are available through Simplicity Studio when the kit documentation package has been installed.

## 13. Kit Revision History and Errata

### 13.1 Revision History

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

# WSTK6223A EZR32 490MHz Wireless Starter Kit

(1P) Part: SLWSTK6223A

(D) Date: 23-02-15



S.nr: 124802042

(Q) Qty: 1



Rev. A01

Figure 13.1. Revision info

Table 13.1. Kit Revision History

| Kit Revision | Released   | Description          |
|--------------|------------|----------------------|
| A01          | 02.02.2015 | Initial kit release. |

### 13.2 Errata

Table 13.2. Kit Errata

| Kit Revision | Problem            | Description                                                                                      |
|--------------|--------------------|--------------------------------------------------------------------------------------------------|
| A00 - A01    | Radio board errata | This kit revision includes a radio board with known errata. See BRD4505B user guide for details. |

## 14. Document Revision History

**Table 14.1. Document Revision History**

| Revision Number | Effective Date | Change Description        |
|-----------------|----------------|---------------------------|
| 1.2             | 19.03.2015     | Kit Errata added.         |
| 1.1             | 23.02.2015     | Minor text revision.      |
| 1.00            | 19.02.2015     | Major updates.            |
| 0.10            | 23.12.2014     | Initial document version. |

## Simplicity Studio

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

[www.silabs.com/simplicity](http://www.silabs.com/simplicity)



**MCU Portfolio**  
[www.silabs.com/mcu](http://www.silabs.com/mcu)



**SW/HW**  
[www.silabs.com/simplicity](http://www.silabs.com/simplicity)



**Quality**  
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**Support and Community**  
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400 West Cesar Chavez  
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USA

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