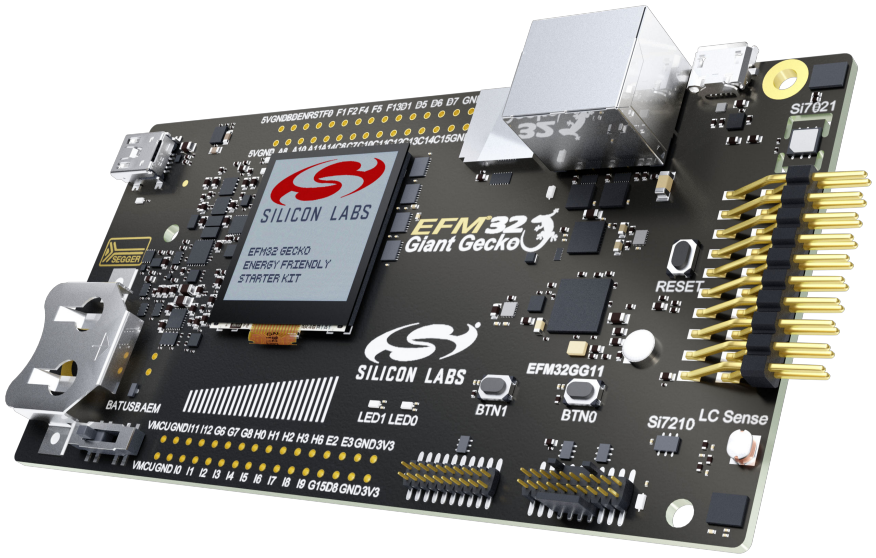
UG287: EFM32 Giant Gecko GG11 Starter Kit User's Guide

The SLSTK3701A Starter Kit is an excellent starting point to get familiar with the EFM32™ Giant Gecko GG11 Microcontroller.

The Starter Kit contains sensors and peripherals demonstrating some of the Giant Gecko GG11's many capabilities. The kit provides all necessary tools for developing an EFM32 Giant Gecko GG11 application.



TARGET DEVICE

- EFM32 Giant Gecko GG11 Microcontroller (EFM32GG11B820F2048GL192)
- CPU: 32-bit ARM® Cortex-M4® with FPU
- Memory: 2048 kB flash and 512 kB RAM

KIT FEATURES

- USB connectivity
- Advanced Energy Monitor
- SEGGER J-Link on-board debugger
- Debug Multiplexer supporting external hardware as well as on-board MCU
- Silicon Labs Si7021 Relative Humidity and Temperature sensor
- User LEDs / Pushbuttons
- Ultra low power 128x128 pixel color Memory LCD
- Inductive LC sensor
- Silicon Labs Si7210 Hall-Effect Sensor
- Digital Stereo Microphones
- Micro-SD Slot
- 32 Mbit QSPI flash memory
- Ethernet connectivity
- Capacitive Touch Slider
- 20-pin 2.54 mm header for expansion boards
- Breakout pads for direct access to I/O pins
- Power sources include USB and CR2032 coin cell battery.

SOFTWARE SUPPORT

- Simplicity Studio™
- IAR Embedded Workbench

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1. Introduction

1.1 Description

The SLSTK3701A is an excellent starting point to get familiar with the EFM32 Giant Gecko GG11 Microcontrollers. The kit contains sensors and peripherals demonstrating some of the EFM32 Giant Gecko GG11's many capabilities. The kit can also serve as a starting point for application development.

In addition to supporting application development on the starter kit itself, the board is also a fully featured debugger and energy monitoring tool that can be used with external applications.

1.2 Features

- EFM32 Giant Gecko GG11 Microcontroller
  - 2048 kB Flash
  - 512 kB RAM
  - BGA192 package
- Advanced Energy Monitoring system for precise current and voltage tracking
- Integrated Segger J-Link USB debugger/emulator with the possiblity to debug external Silicon Labs devices
- 20 pin expansion header
- Breakout pads for easy access to I/O pins
- Power sources include USB and CR2032 battery
- Silicon Labs Si7021 Relative Humidity and Temperature Sensor
- Silicon Labs Si7210 Hall-Effect sensor
- Ultra low power 128x128 pixel Color Memory-LCD
- Digital stereo MEMS microphones
- USB Micro-AB connector supporting both host and device mode USB applications
- 10/100Base-TX ethernet PHY and RJ-45 jack
- Micro-SD slot supporting SD memory cards and SDIO expansion cards
- 32 Mbit QSPI serial flash supporting execute-in-place (XIP)
- 2 push buttons and 2 RGB LEDs connected to EFM32 for user interaction
- LC tank circuit for inductive proximity sensing of metallic objects
- Backup battery
- 4-segment capacitive touch slider
- Crystals for LFXO and HFXO: 32.768 kHz and 50.000 MHz.

1.3 Getting Started

Detailed instructions for how to get started with your new SLSTK3701A can be found on the Silicon Labs web pages:

http://www.silabs.com/start-efm32gg1

2. Kit Block Diagram

An overview of the EFM32 Giant Gecko GG11 Starter Kit is shown in the figure below.

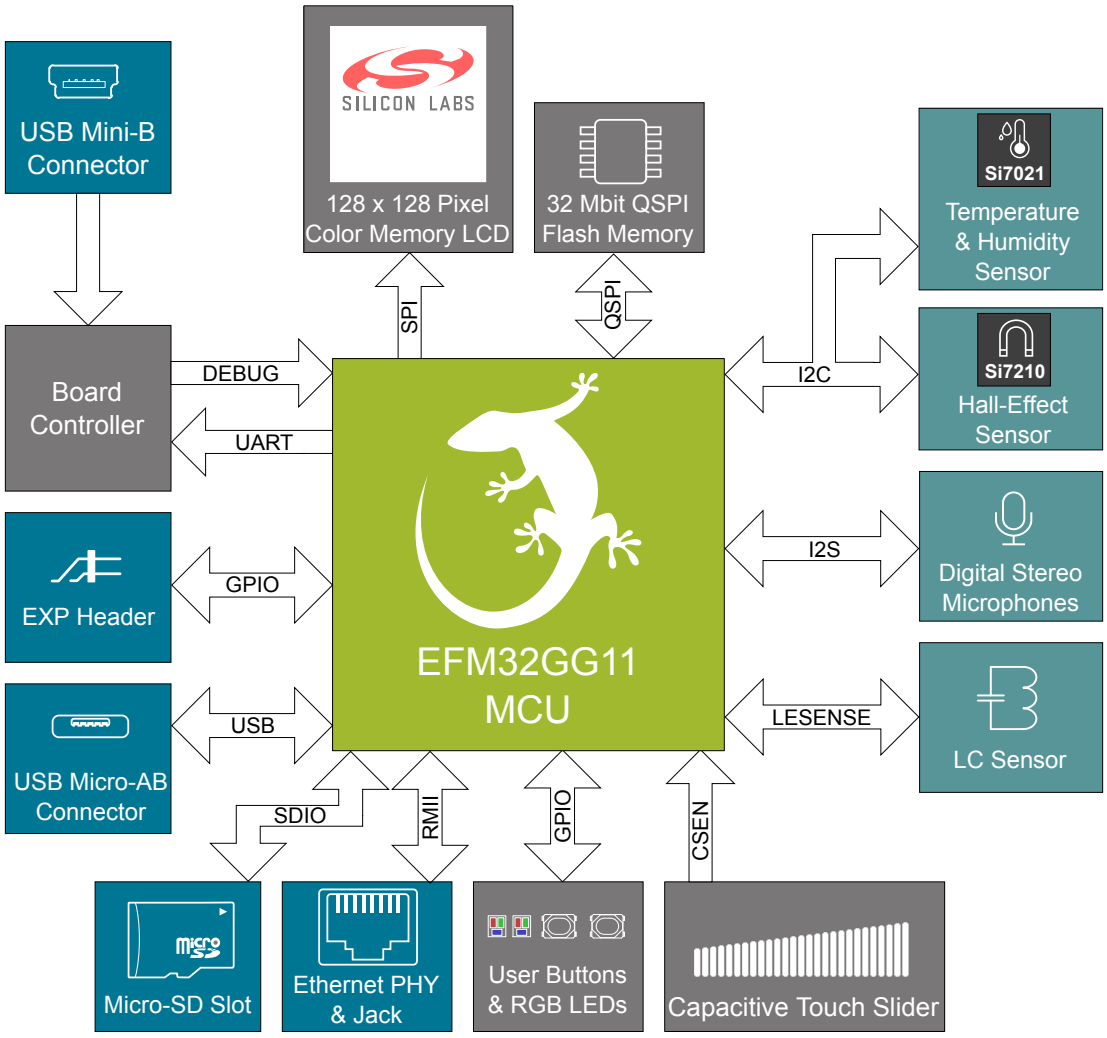


Figure 2.1. Kit Block Diagram

3. Kit Hardware Layout

The layout of the EFM32 Giant Gecko GG11 Starter Kit is shown below.

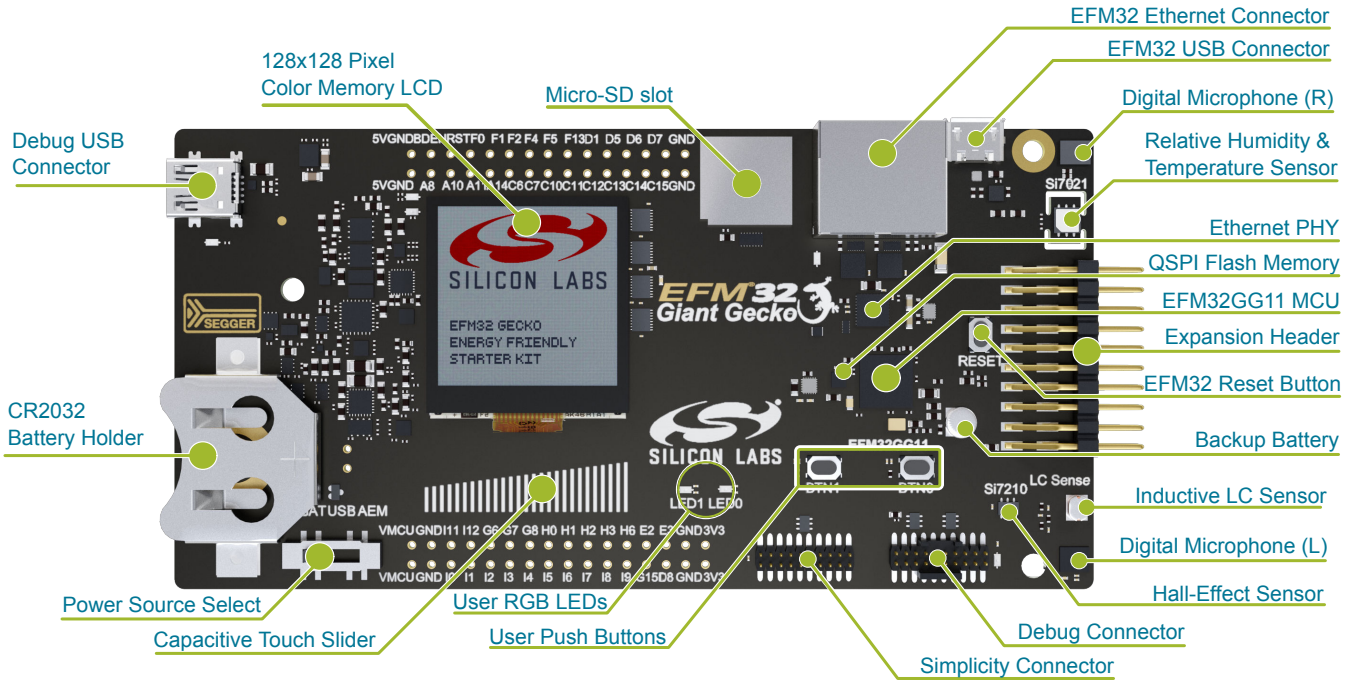


Figure 3.1. SLSTK3701A Hardware Layout

4. Connectors

4.1 Breakout Pads

Most of the EFM32's GPIO pins are available on two pin header rows at the top and bottom edges of the board. These have a standard 2.54 mm pitch, and pin headers can be soldered in if required. In addition to the I/O pins, connections to the different power rails and ground are also provided. Note that some of the pins are used for kit peripherals or features, and may not be available for a custom application without trade-offs.

The figure below shows the pinout of these "breakout pads", as well as the pinout of the "Expansion Header" situated on the right-hand side of the board. The expansion header is further explained in the next section. The breakout pad connections are also printed in silk screen next to each pin for easy reference.

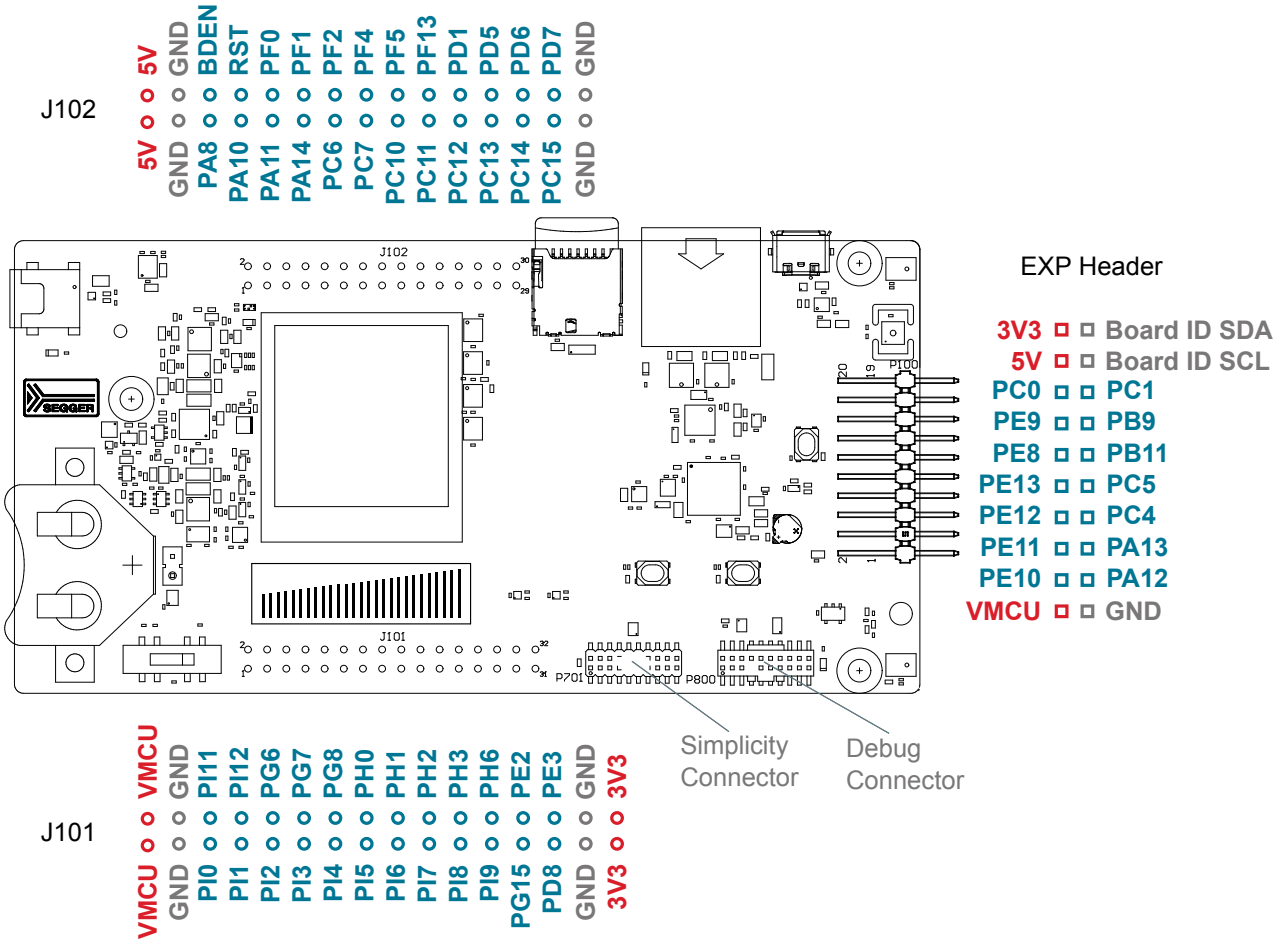


Figure 4.1. Breakout Pads and Expansion Header

The table below shows the connections of each pin of the breakout pads. They also show which kit peripherals or features are connected to the different pins.

Table 4.1. Bottom Row (J101) Pinout

Pin	EFM32 I/O pin	Shared feature		Pin	EFM32 I/O pin	Shared feature
1	VMCU	EFM32 voltage domain (measured by AEM)		2	VMCU	EFM32 voltage domain (measured by AEM)
3	GND	Ground		4	GND	Ground
5	PI0			6	PI11	
7	PI1			8	PI12	

Pin	EFM32 I/O pin	Shared feature		Pin	EFM32 I/O pin	Shared feature
9	PI2			10	PG6	
11	PI3			12	PG7	
13	PI4	SENSOR_I2C_SDA		14	PG8	
15	PI5	SENSOR_I2C_SCL		16	PH0	
17	PI6			18	PH1	
19	PI7			20	PH2	
21	PI8			22	PH3	
23	PI9			24	PH6	
25	PG15	ETH_INTERRUPT		26	PE2	
27	PD8	BU_VIN		28	PE3	
29	GND	Ground		30	GND	Ground
31	3V3	Board controller supply		32	3V3	Board controller supply

Table 4.2. Top Row (J102) Pinout

Pin	EFM32 I/O pin	Shared feature		Pin	EFM32 I/O pin	Shared feature
1	5V	Board USB voltage		2	5V	Board USB voltage
3	GND	Ground		4	GND	Ground
5	PA8			6	BDEN	BOD_ENABLE
7	PA10			8	RST	DEBUG_RESET
9	PA11	DISP_COM		10	PF0	DEBUG_TCK_SWCLK
11	PA14	DISP_MOSI		12	PF1	DEBUG_TMS_SWDIO
13	PC6	DEBUG_TRACECLK		14	PF2	DEBUG_TDO_SWO
15	PC7	DEBUG_TRACED0		16	PF4	USB_OC_FAULT
17	PC10			18	PF5	DEBUG_TDI / USB_VBUSEN
19	PC11			20	PF13	
21	PC12			22	PD1	OPA1_OUT
23	PC13			24	PD5	DEBUG_TRACED3
25	PC14	DISP_CS		26	PD6	OPA1_P
27	PC15	DISP_CLK		28	PD7	OPA1_N
29	GND	Ground		30	GND	Ground

4.2 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 EFM32 Giant Gecko GG11's features. Additionally, the VMCU, 3V3 and 5V power rails are also exported.

The connector follows a standard which ensures that commonly used peripherals such as an SPI, a UART and an I2C bus are available on fixed locations in the connector. The rest of the pins are used for general purpose I/O. This allows the definition of expansion boards that can plug into a number of different Silicon Labs starter kits.

The figure below shows the pin assignment of the expansion header for the EFM32 Giant Gecko GG11 Starter Kit. Because of limitations in the number of available GPIO pins, some of the expansion header pins are shared with kit features.

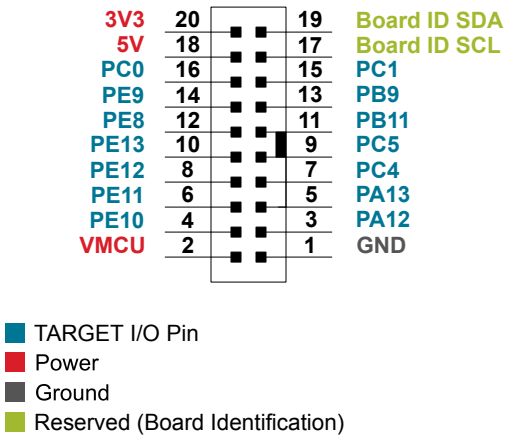


Figure 4.2. Expansion Header

Table 4.3. EXP Header Pinout

Pin	Connection	EXP Header function	Shared feature	Peripheral mapping
20	3V3	Board controller supply		
18	5V	Board controller USB voltage		
16	PC0	I2C_SDA	CAN0_RX #0	I2C0_SDA #4
14	PE9	UART_RX	SDIO_DAT2 #0	USART5_RX #0
12	PE8	UART_TX	SDIO_DAT3 #0	USART5_TX #0
10	PE13	SPI_CS	SDIO_CLK #0	USART0_CS #0
8	PE12	SPI_SCLK	SDIO_CMD #0	USART0_CLK #0
6	PE11	SPI_MISO	SDIO_DAT0 #0	USART0_RX #0
4	PE10	SPI_MOSI	SDIO_DAT1 #0	USART0_TX #0
2	VMCU	EFM32 voltage domain, included in AEM measurements.		
19	BOARD_ID_SDA	Connected to Board Controller for identification of add-on boards.		
17	BOARD_ID_SCL	Connected to Board Controller for identification of add-on boards.		
15	PC1	I2C_SCL	CAN0_TX #0	I2C0_SCL #4
13	PB9	GPIO		
11	PB11	DAC_OUT		VDAC0_OUT0
9	PC5	I2C_SCL	SDIO_WP #1	I2C1_SCL #0

Pin	Connection	EXP Header function	Shared feature	Peripheral mapping
7	PC4	I2C_SDA	SDIO_CD #1	I2C1_SDA #0
5	PA13	CAN_TX	PCNT1_S1IN #5	CAN1_TX #5
3	PA12	CAN_RX	PCNT1_S0IN #5	CAN1_RX #5
1	GND	Ground		

4.3 Debug Connector (DBG)

The Debug Connector serves a dual purpose, depending on the "debug mode", which can be set up using Simplicity Studio. In the "Debug IN" mode this connector allows an external debug emulator to be used with the on-board EFM32. In the "Debug OUT" mode this connector allows the kit to be used as a debugger towards an external target. In the "Debug MCU" (default) mode this connector is isolated from the debug interface of both the Board Controller and the on-board target device.

Because this connector is automatically switched to support the different operating modes, it is only available when the Board Controller is powered (J-Link USB cable connected). If debug access to the target device is required when the Board Controller is unpowered, this should be done by connecting directly to the appropriate breakout pins.

The pinout of the connector follows that of the standard ARM Cortex Debug+ETM 19-pin connector. The pinout is described in detail below. Note that when using the on-board debugger to debug an mcu on an external board, JTAG and ETM functionality is only available if the target device supports it.

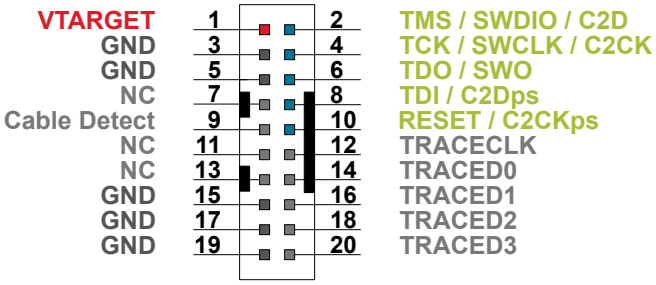


Figure 4.3. Debug Connector

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. Some cables have a small plug that prevent them from being used when this pin is present. If this is the case, remove the plug, or use a standard 2x10 1.27 mm straight cable instead.

Table 4.4. Debug Connector Pin Descriptions

Pin number(s)	Function	Note
1	VTARGET	Target reference voltage. Used for shifting logical signal levels between target and debugger.
2	TMS / SDWIO / C2D	JTAG test mode select, Serial Wire data or C2 data
4	TCK / SWCLK / C2CK	JTAG test clock, Serial Wire clock or C2 clock
6	TDO/SWO	JTAG test data out or Serial Wire Output
8	TDI / C2Dps	JTAG test data in, or C2D "pin sharing" function
10	RESET / C2CKps	Target device reset, or C2CK "pin sharing" function
12	TRACECLK	ETM Trace Clock
14	TRACED0	ETM Trace Data 0
16	TRACED1	ETM Trace Data 1
18	TRACED2	ETM Trace Data 2
20	TRACED3	ETM Trace Data 3
9	Cable detect	Connect to ground
11, 13	NC	Not connected
3, 5, 15, 17, 19	GND	

4.4 Simplicity Connector

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

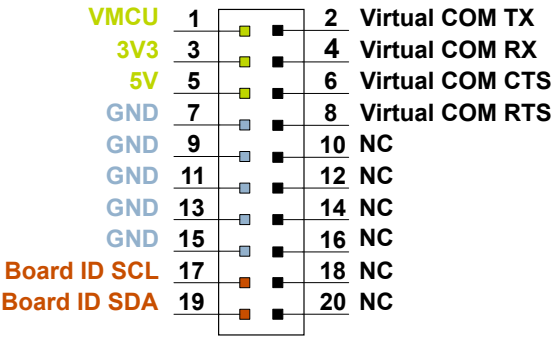


Figure 4.4. Simplicity Connector

The signal names in the figure and the pin description table are referenced from the board controller. This means that VCOM_TX should be connected to the RX pin on the external target, VCOM_RX to the target's TX pin, VCOM_CTS to the target's RTS pin and VCOM_RTS to the target's CTS pin.

Note: 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, put the on-board MCU in its lowest energy mode to minimize its impact on the measurements.

Table 4.5. Simplicity Connector Pin Descriptions

Pin number(s)	Function	Description
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	Virtual COM Tx
4	VCOM_RX	Virtual COM Rx
6	VCOM_CTS	Virtual COM CTS
8	VCOM_RTS	Virtual COM RTS
17	EXT_ID_SCL	Board ID SCL
19	EXT_ID_SDA	Board ID SDA
10, 12, 14, 16, 18, 20	NC	Not connected
7, 9, 11, 13, 15	GND	Ground

5. Power Supply and Reset

5.1 MCU Power Selection

The EFM32 on the Starter Kit can be powered by one of these sources:

- The debug USB cable; or
- the EFM32's own USB regulator; or
- a 3 V coin cell battery.

The power source for the MCU is selected with the slide switch in the lower left corner of the Starter Kit. Figure 5.1 Power Switch on page 13 shows how the different power sources can be selected with the slide switch.

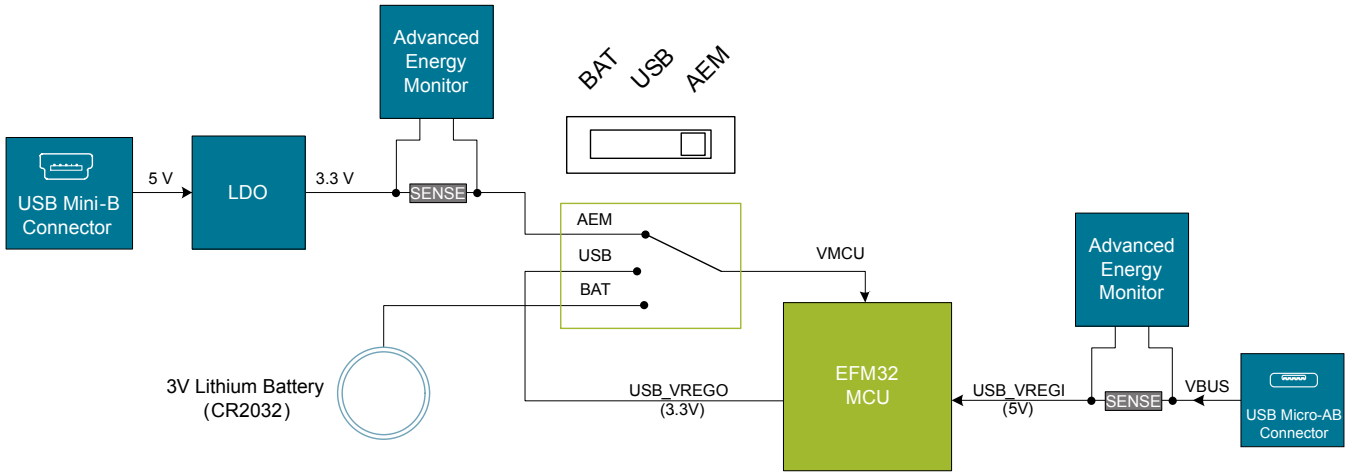


Figure 5.1. Power Switch

With the switch in the **AEM** position, a low noise 3.3 V LDO on the Starter Kit is used to power the EFM32. This LDO is again powered from the debug USB cable. The Advanced Energy Monitor is now 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 EFM32 Giant Gecko GG11 MCU is used to power the rest of the chip as well as the USB PHY with the cable connected to the target USB connector. This allows a USB device application where the MCU acts as a bus powered device. With the switch in this position, the secondary AEM channel is automatically selected to allow accurate measurements of the current consumption of the whole application running on USB power.

Finally, with the switch in the **BAT** position, a 20mm coin cell battery in the CR2032 socket can be used to power the device. With the switch in this position no current measurements are active. This is the recommended switch position when powering the MCU with an external power source.

Note: The Advanced Energy Monitor is automatically recalibrated when switching from **AEM** to **USB** or back, which causes the target EFM32 to lose power for a few seconds.

5.2 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 target device while retaining debugging functionality. This power domain is also isolated to prevent current leakage from the target power domain when power to the Board Controller is removed.

The board controller power domain is not influenced by the position of the power switch.

The kit has been carefully designed to keep the board controller and the target power domains isolated from each other as one of them powers down. This ensures that the target EFM32 device will continue to operate in the **USB** and **BAT** modes.

5.3 EFM32 Reset

The EFM32 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 EFM32 will also be issued during Board Controller boot-up. This means that removing power to the Board Controller (plugging out the J-Link USB cable) will not generate a reset, but plugging the cable back in will, as the Board Controller boots up.

6. Peripherals

The starter kit has a set of peripherals that showcase some of the features of the EFM32.

Be aware that most EFM32 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.

6.1 Push Buttons and RGB LEDs

The kit has two user push buttons marked BTN0 and BTN1. They are connected directly to the EFM32, and are debounced by RC filters with a time constant of 1 ms. The buttons are connected to pins PC8 and PC9.

The kit also features two RGB LEDs marked LED0 and LED1, that are controlled by GPIO pins on the EFM32. The LEDs are connected in an active-low configuration, and each color can be PWM controlled using the EFM32's TIMER/WTIMER peripherals to generate a wide variety of colors.

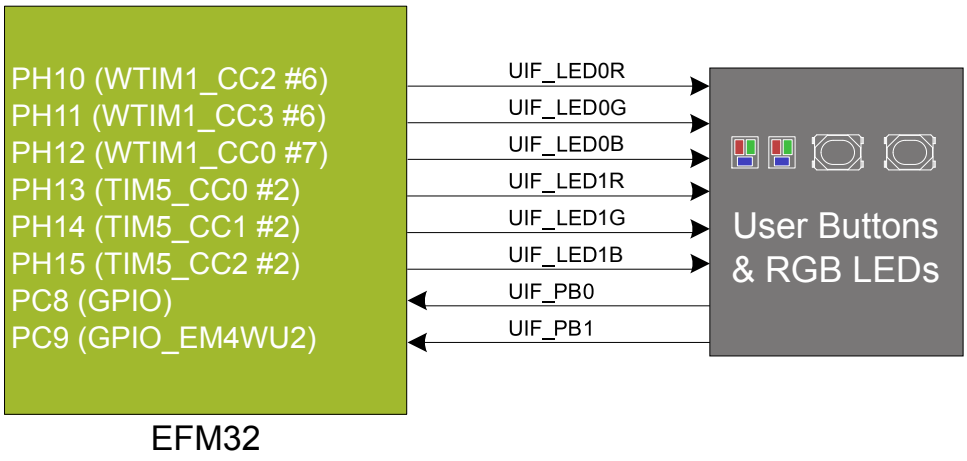


Figure 6.1. Buttons and LEDs

6.2 Memory LCD-TFT Display

A 1.3-inch SHARP Color Memory LCD-TFT is available on the kit to enable development of interactive applications. The display has a high resolution of 128 by 128 pixels, and consumes very little power. It is a reflective three-colors-per-pixel display, so each pixel can have eight different colors (including black and white), and no backlight is needed in normal daylight conditions. Data sent to the display is stored in the pixels on the glass, which means no continous refreshing is required to maintain a static image.

The display interface consists of an SPI-compatible serial interface and some extra control signals. Pixels are not individually addressable, instead data is sent to the display one line (128x3 bits) at a time.

The Color 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 the DISP_ENABLE signal:

- DISP_ENABLE = LOW: The Board Controller has control of the display
- DISP_ENABLE = HIGH: The user application (EFM32) has control of the display

Power to the display is sourced from the target application power domain when the EFM32 controls the display, and from the Board Controller's power domain when the DISP_ENABLE line is low. The display requires 5 volts supply voltage, which is provided by a small switch-mode boost converter. Data is clocked in on DISP_SI when DISP_CS is high, and the clock is sent on DISP_SCLK. The maximum supported clock speed is 1.1 MHz.

DISP_EXTCOMIN 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:

https://www.sharpsma.com

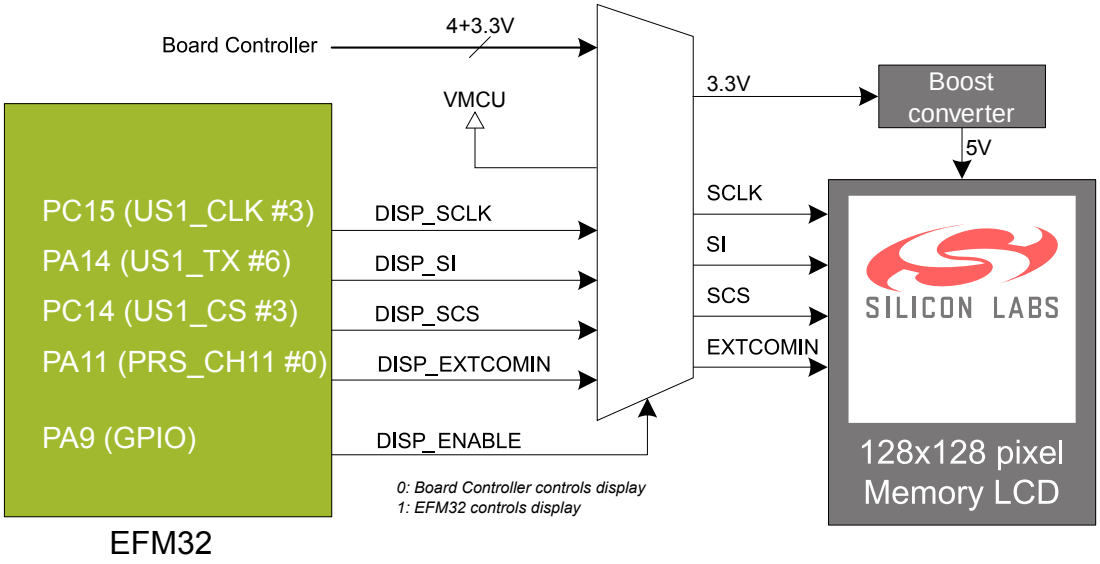


Figure 6.2. 128x128 Pixel Memory LCD

6.3 Capacitive Touch Slider

A touch slider utilizing the capacitive touch capability of the EFM32 is located on the bottom side of the board. It consists of four interleaved pads which are connected to PB6, PB15, PB4 and PA7.

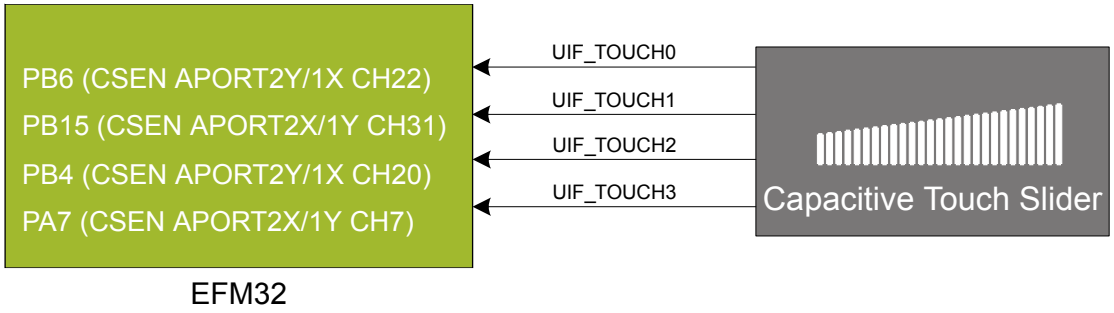


Figure 6.3. Touch Slider

The capacitive touch pads work by sensing changes in the capacitance of the pads when touched by a human finger. Sensing the changes in capacitance is done by setting up the EFM32's analog capacitive sense peripheral (CSEN).

6.4 Si7021 Relative Humidity and Temperature Sensor

The Si7021 I^2C 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^2C 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^2C bus used for the Si7021 is shared with the Si7210 hall-effect sensor. To use the sensor, PB3 must be set high, which also powers the Si7210. When enabled, the sensors' current consumption is included in the AEM measurements.

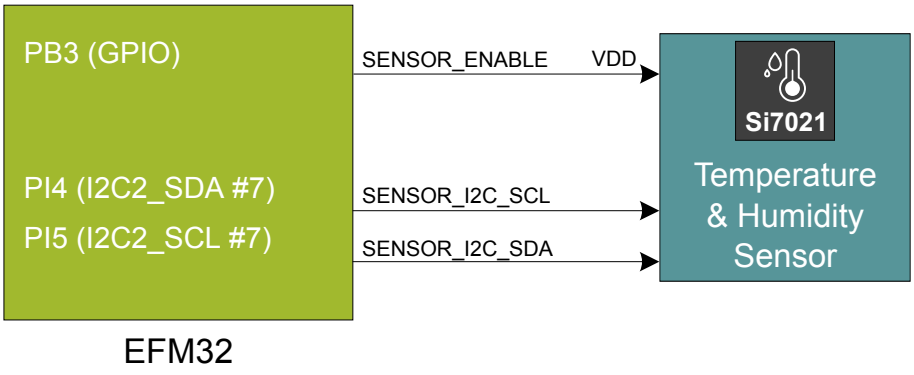


Figure 6.4. Si7021 Relative Humidity and Temperature Sensor

Please refer to the Silicon Labs web pages for more information: http://www.silabs.com/humidity-sensors

6.5 Si7210 Hall-Effect Sensor

The Si7210 family of hall effect sensors from Silicon Labs combines a chopper-stabilized hall element with a low-noise analog amplifier, 13-bit analog-to-digital converter, and an I^2C interface. Leveraging Silicon Labs' proven CMOS design techniques, the Si7210 family incorporates digital signal processing to provide precise compensation for temperature and offset drift.

The 13-bit magnetic field strength can be read through the I^2C interface at any time. The Si7210 also features an output pin which can provide a digital alert when the measured field is above or below a programmable threshold value.

Applications for the Si7210 include mechanical position sensing in consumer, industrial and automotive applications, reed switch replacement, fluid level measurement, speed sensing and control knobs and switches.

The I^2C bus used for the Si7210 is shared with the Si7021 relative humidity and temperature sensor. To use the sensor, PB3 must be set high, which also powers the Si7021. When enabled, the sensors' current consumption is included in the AEM measurements.

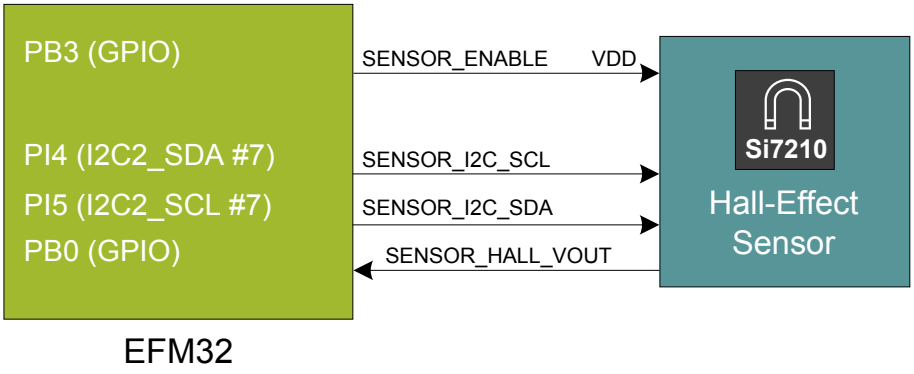


Figure 6.5. Si7210 Hall-Effect Sensor

Please refer to the Si7210 datasheet for more information.

6.6 LC Sensor

In the bottom right corner of the board there is an inductive-capacitive sensor for demonstrating the low energy sensor interface (LESENSE). The LESENSE peripheral uses the voltage digital-to-analog converter (VDAC) to set up an oscillating current through the inductor, and then uses the analog comparator (ACMP) to measure the oscillation decay time. The oscillation decay time will be affected by the presence of metal objects within a few millimeters of the inductor.

The LC sensor can be used for implementing a sensor that wakes up the EFM32 from sleep when a metal object comes close to the inductor, which again can be used as a utility meter pulse counter, door alarm switch, position indicator or other applications where one wants to sense the presence of a metal object.

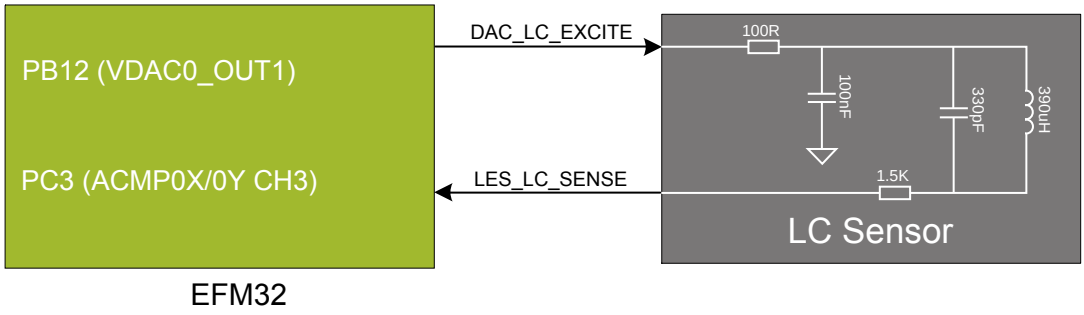


Figure 6.6. LC Metal Sensor

For more information about usage and theory of operation of the LC sensor, please refer to application note AN0029 Low Energy Sensor Interface - Inductive Sense

6.7 Digital Stereo Microphones

The EFM32 Giant Gecko GG11 Starter Kit features two Knowles SPK0838HT4H-B digital MEMS microphones with PDM output configured to form a stereo sound input device. The output from both microphones is connected to a PDM to I2S codec which again is connected to a USART peripheral with I2S support on the EFM32.

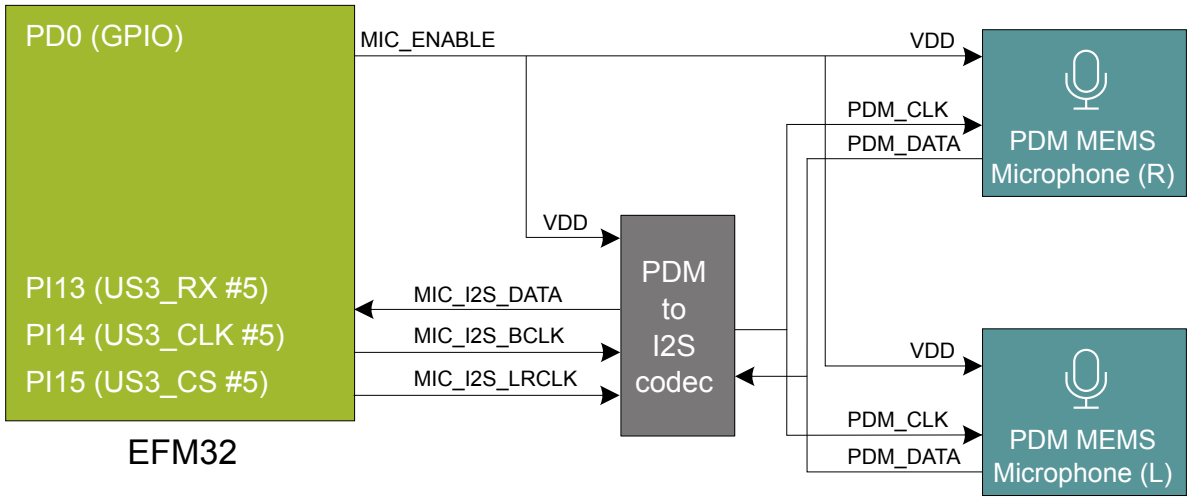


Figure 6.7. Digital Stereo Microphones

6.8 USB Micro-AB Connector

The SLSTK3701A board is equipped with a USB Micro-AB connector interfacing with the EFM32's USB peripheral. This allows the development and evaluation of applications using USB in both host and device mode. For host mode, the board can supply 5V power to the USB VBUS if the board itself has been powered using the debug-USB connector. The VBUS power switch also provides an overcurrent flag which can be read in order to detect if a connected device draws too much current.

The secondary AEM channel (see chapter on Advanced Energy Monitoring) is placed between the USB connector and the EFM32, and allows monitoring of the current sourced from the USB cable when developing a bus-powered USB application. The AEM circuit includes an input filter and a sense resistor on the VBUS line, which could potentially influence USB compliance testing. If it is required, the AEM circuit can be bypassed by removing some components and shorting a footprint on the PCB. More details about this can be found in the schematic.

The secondary AEM channel will only measure current consumption when the power selector switch is set to the "USB" position.

The EFM32 has an internal LDO regulator that powers the USB PHY inside the chip. 5 V from VBUS is applied to the USB_VREGI pin, and the output is decoupled on the USB_VREGO pin. When the power select switch is set to the *USB* position, USB_VREGO is connected to the VMCU net, which powers the chip and all peripherals in the target voltage domain. When the J-Link USB cable is inserted, it is possible to monitor the current that supplies the USB PHY, the EFM32 device and all user peripherals on the board.

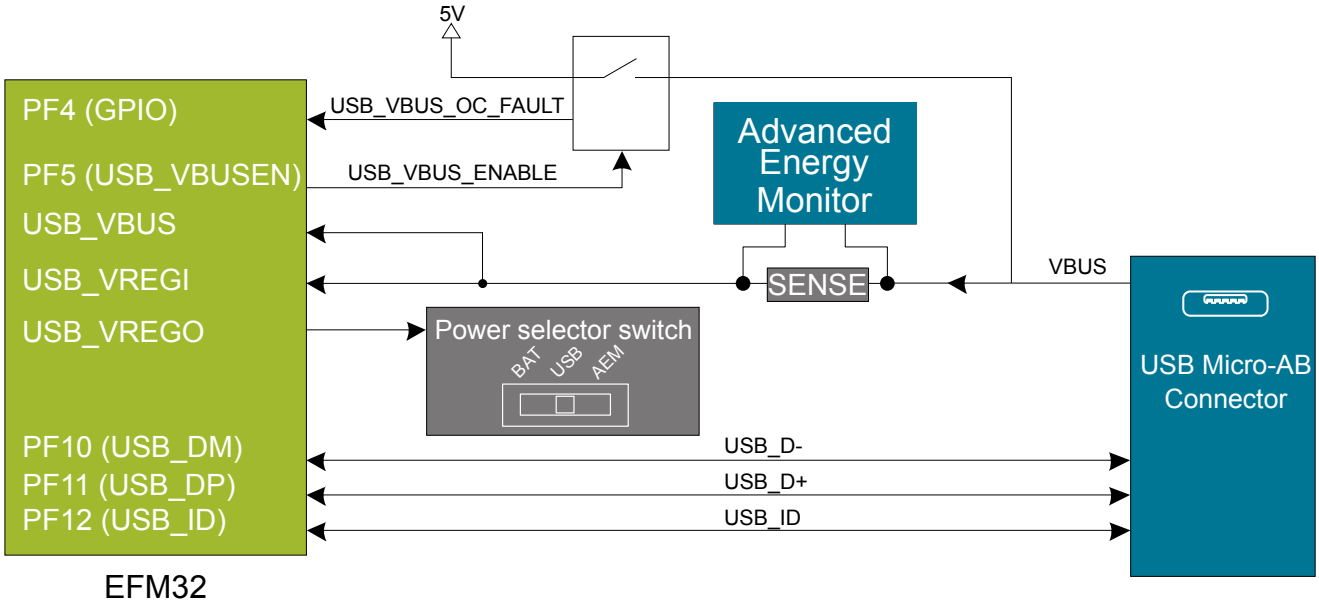


Figure 6.8. USB Connector And Power Supply

6.9 QSPI Flash Memory

The EFM32 Giant Gecko GG11 Starter Kit features a Macronix MX25R 32 Mbit external NOR flash memory connected to the EFM32's Quad SPI (QSPI) peripheral. The external flash is memory mapped in both code space and user space, and can be used for data storage or for storing program code that can be executed directly from flash due to the QSPI peripheral's execute-in-place (XIP) support.

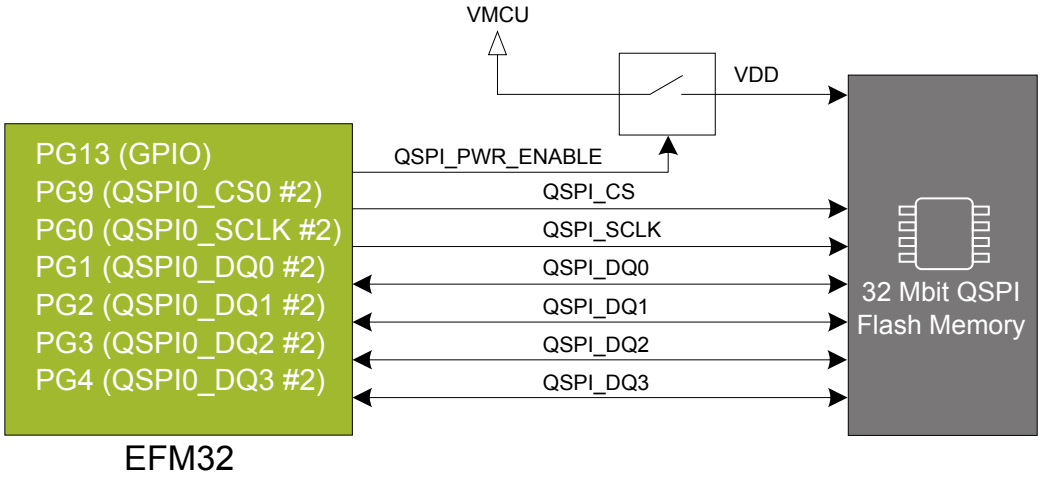


Figure 6.9. QSPI Flash Memory

6.10 Micro-SD Slot

The micro-SD slot is connected to the EFM32's SDIO peripheral. The SDIO peripheral supports both SD memory cards as well as SDIO devices with a micro-SD form factor. The micro-SD slot has an active low card detect switch.

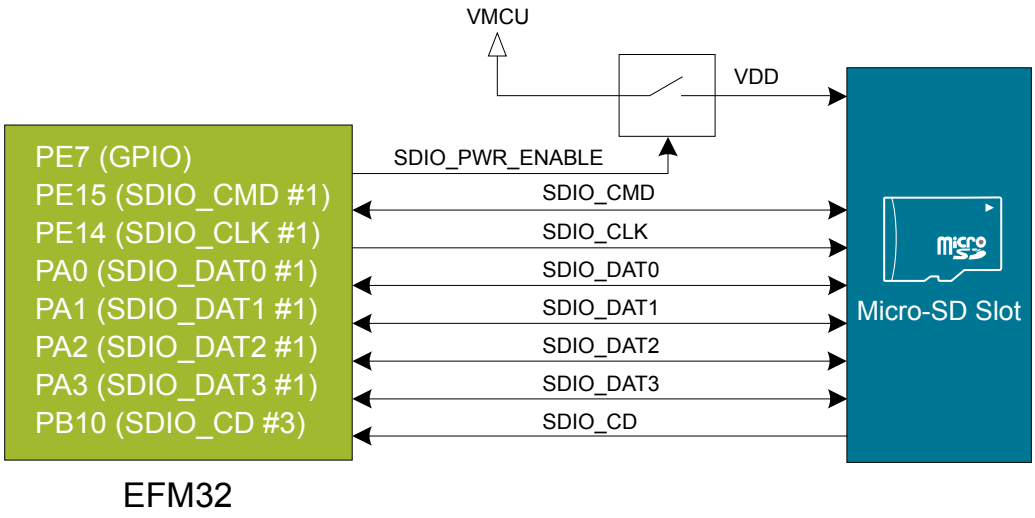


Figure 6.10. Micro-SD Slot

6.11 10/100Base-TX Ethernet

The EFM32 Giant Gecko GG11 features an ethernet MAC peripheral (ETH) supporting 10 and 100 Mbit/s transfer speeds. The SLSTK3701A provides the hardware required to communicate with other ethernet devices using standard twisted pair cables, including a Microchip KSZ8091-RNDCA PHY transceiver, magnetics and an RJ-45 ethernet jack.

Note: due to the power supply requirements of the PHY transceiver, it is not possible to utilize ethernet connectivity while powering the kit from a CR2032 lithium battery. Refer to the KSZ8091-RNDCA datasheet for detailed electrical specifications including current consumption in different scenarios.

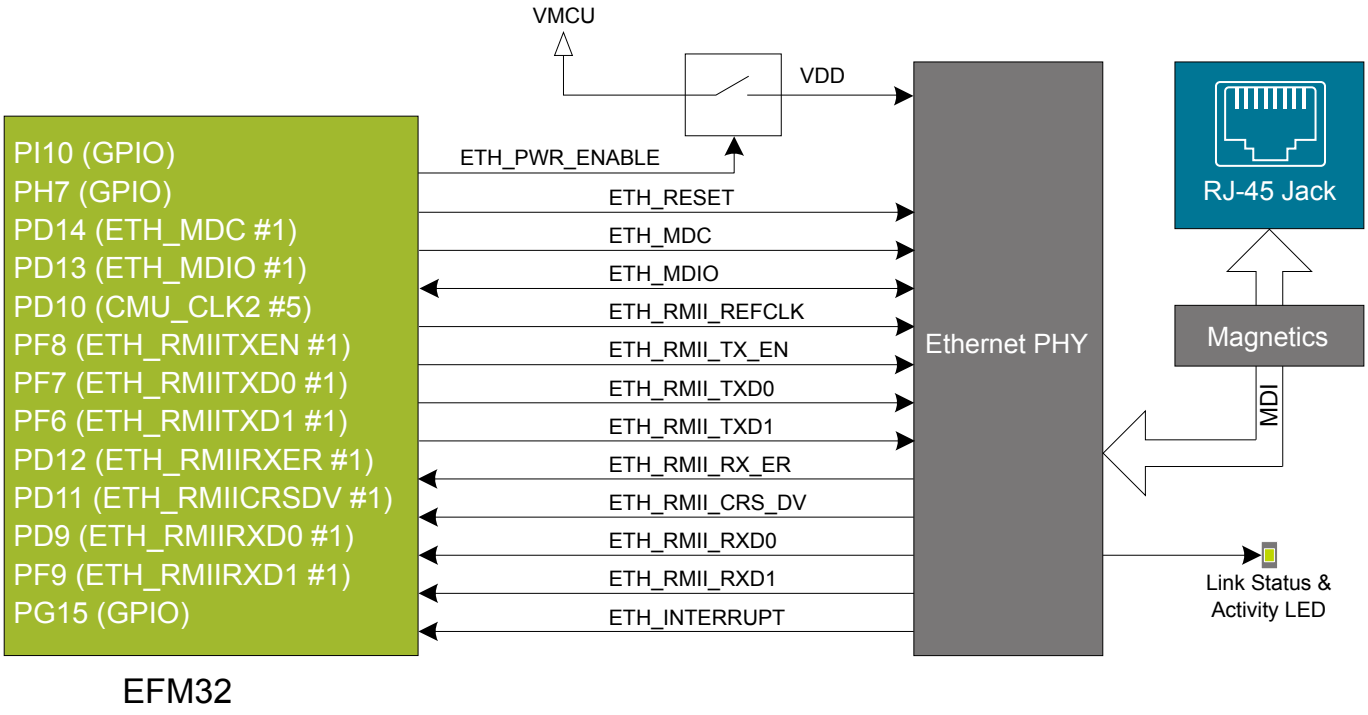


Figure 6.11. Ethernet Interface

6.12 Virtual COM Port

An asynchronous serial connection to the board controller is provided for application data transfer between a host PC and the target EFM32. This eliminates the need for an external serial port adapter.

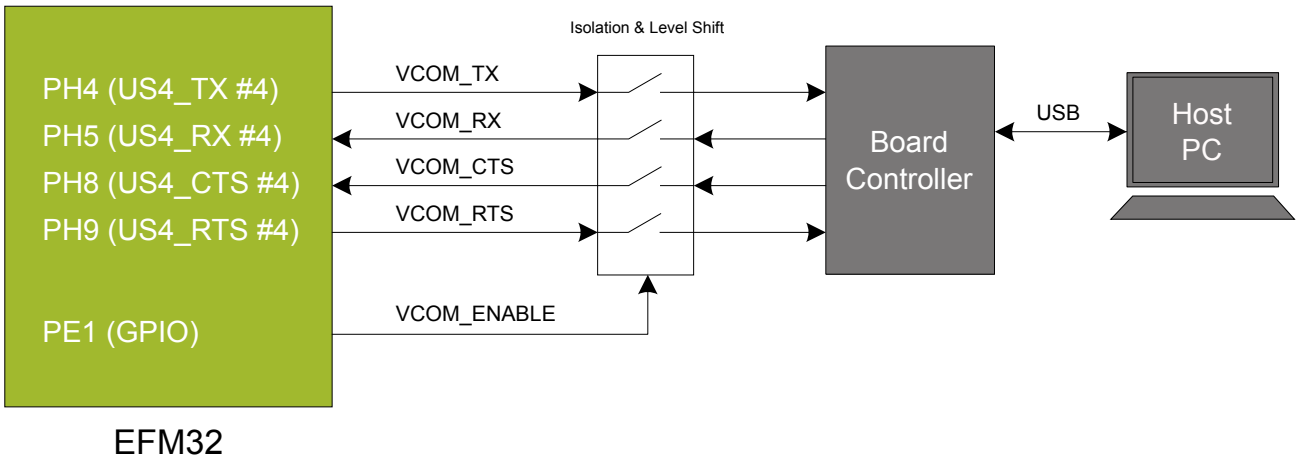


Figure 6.12. Virtual COM Port Interface

The Virtual COM port consists of a physical UART between the target device and the board controller, and a logical function in the board controller that makes the serial port available to the host PC over USB. The UART interface consists of four pins and an enable signal.

Table 6.1. Virtual COM Port Interface Pins

Signal	Description
VCOM_TX	Transmit data from the EFM32 to the board controller
VCOM_RX	Receive data from the board controller to the EFM32
VCOM_CTS	Clear to Send hardware flow control input, asserted by the board controller when it is ready to receive more data
VCOM_RTS	Request to Send hardware flow control output, asserted by the EFM32 when it is ready to receive more data
VCOM_ENABLE	Enables the VCOM interface, allowing data to pass through to the board controller.

Note: The VCOM port is only available when the board controller is powered, which requires the J-Link USB cable to be inserted.

7. Advanced Energy Monitor

7.1 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 EFM32 in realtime.

7.2 Theory of Operation

The Advanced Energy Monitor (AEM) circuitry on the board is capable of measuring current signals in the range of 0.1 µA to 95 mA, which is a dynamic range of alomst 120 dB. 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 µA.

The current signal is combined with the target processor'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 (50 kHz) 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, 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.

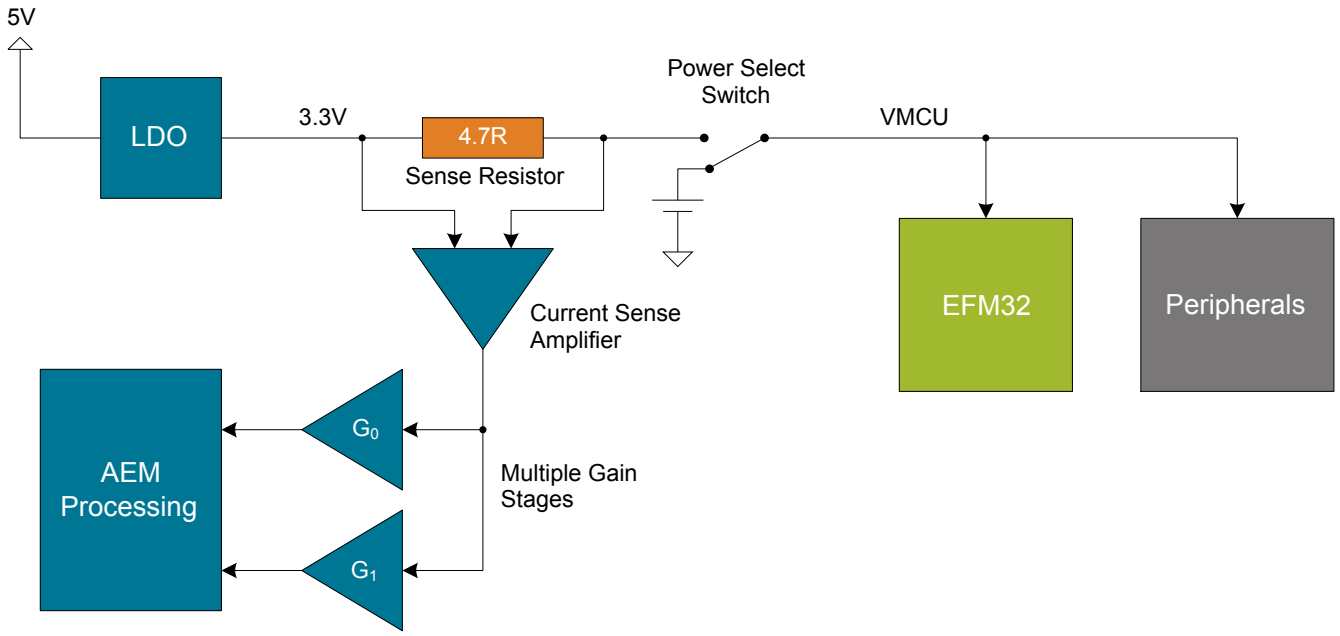


Figure 7.1. Advanced Energy Monitor

7.3 Secondary AEM Channel

The EFM32 Giant Gecko GG11 Starter Kit contains a secondary AEM channel in addition to the default one. This secondary channel has a sense resistor on the USB VBUS line connected to the EFM32's USB regulator input, and allows energy monitoring of a bus powered USB application, showcasing the EFM32 Giant Gecko GG11's low energy USB peripheral.

In order to use the secondary AEM channel, the power switch must be set to the "USB" position so that the EFM32 is configured as a bus powered device with the internal USB LDO regulator powering the device's VDD rail. The board controller monitors the switch position, and performs an automatic switch-over and calibration when the USB position is selected and a valid voltage is present on the VBUS rail. Both the current and the voltage measurement will now show the VBUS supply instead of the normal 3.3 V supply.

Please note that the recalibration that occures when switching between the "USB" and "AEM" modes on the power switch causes the target EFM32 to lose power for a few seconds.

7.4 Accuracy and Performance

The Advanced Energy Monitor is capable of measuring currents in the range of 0.1 µA to 95 mA. For currents above 250 µA, the AEM is accurate within 0.1 mA. When measuring currents below 250 µA, the accuracy increases to 1 µA. Even though the absolute accuracy is 1 µA in the sub 250 µA range, the AEM is able to detect changes in the current consumption as small as 100 nA. The AEM produces 6250 current samples per second.

8. On-Board Debugger

The Starter Kit contains an integrated debugger, which can be used to download code and debug the EFM32. In addition to programming the EFM32 on the kit, the debugger can also be used to program and debug external Silicon Labs EFM32, EFM8, EZR32 and EFR32 devices.

The debugger supports three different debug interfaces used with Silicon Labs devices:

- Serial Wire Debug, which is used with all EFM32, EFR32 and EZR32 devices
- JTAG, which can be used with EFR32 and some EFM32 devices
- C2 Debug, which is used with EFM8 devices

In order for debugging to work properly, make sure you have the appropriate debug interface selected that works with your device. The debug connector on the board supports all three of these modes.

8.1 Debug Modes

Programming external devices is done by connecting to a target board through the provided Debug IN/OUT Connector, and by setting the debug mode to [**Out**]. The same connector can also be used to connect an external debugger to the EFM32 MCU on the kit, by setting debug mode to [**In**].

Selecting the active debug mode is done in Simplicity Studio.

Debug MCU: In this mode the on-board debugger is connected to the EFM32 on the kit.

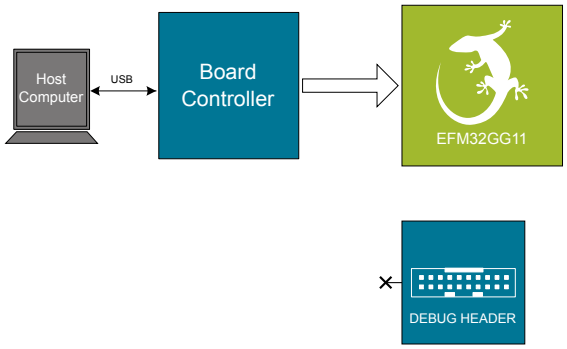


Figure 8.1. Debug MCU

Debug OUT: In this mode, the on-board debugger can be used to debug a supported Silicon Labs device mounted on a custom board.

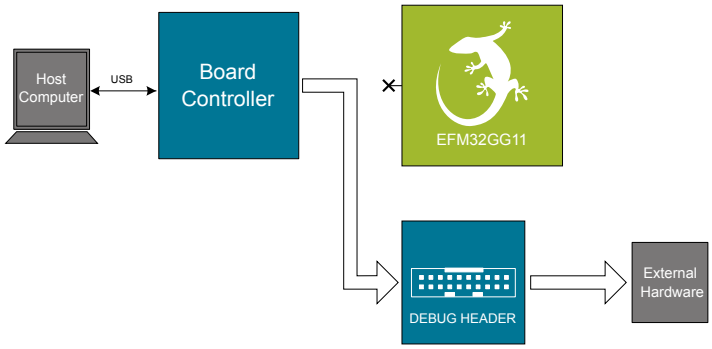


Figure 8.2. Debug OUT

Debug IN: In this mode, the on-board debugger is disconnected, and an external debugger can be connected to debug the EFM32 on the kit.

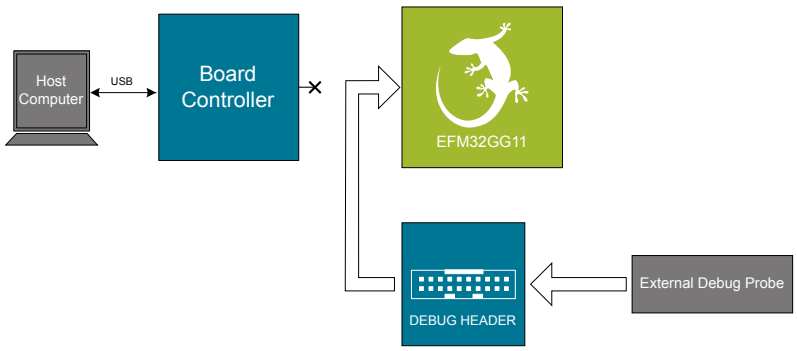


Figure 8.3. Debug IN

Note: For "Debug IN" to work, the kit board controller must be powered through the Debug USB connector.

8.2 Debugging During Battery Operation

When the EFM32 is powered by battery and the J-Link USB is still connected, the on-board debug functionality is available. If the USB power is disconnected, the Debug In mode will stop working.

If debug access is required when the target is running of another energy source, such as a battery, and the board controller is powered down, the user should make direct connections to the GPIO used for debugging. This can be done by connecting to the appropriate pins of the breakout pads. Some Silicon Labs kits provide a dedicated pin header for this purpose.

9. 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.

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.

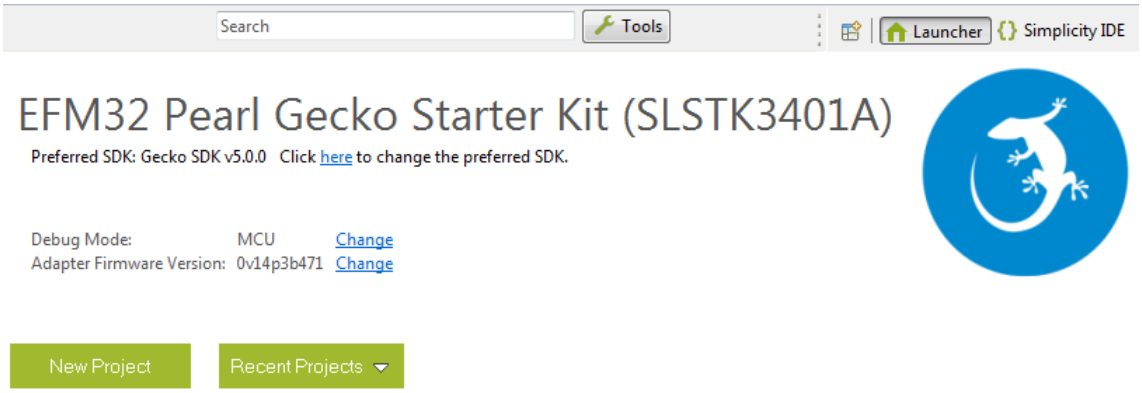


Figure 9.1. Simplicity Studio Kit Information

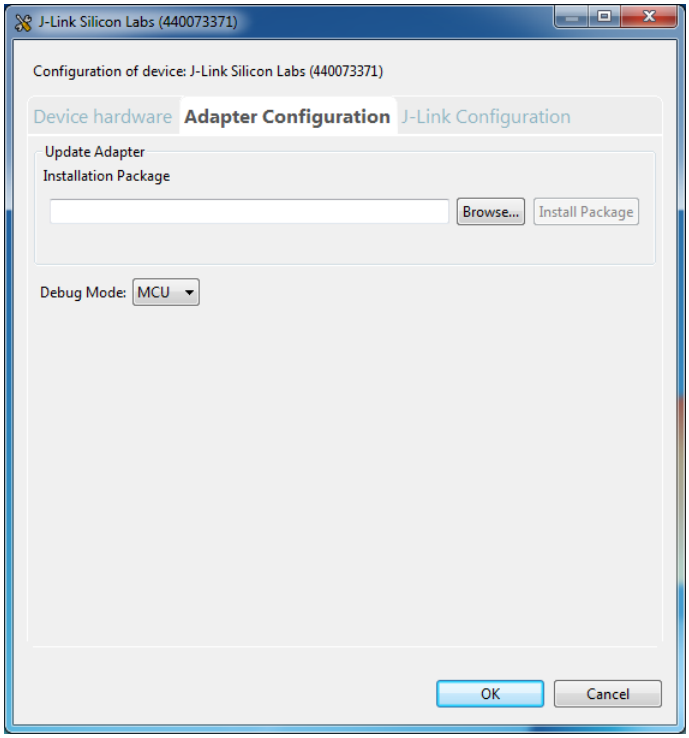


Figure 9.2. Kit Configuration Dialog

9.1 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.

10. 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.

11. Kit Revision History and Errata

11.1 Revision History

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



Figure 11.1. Revision Info

Table 11.1. Kit Revision History

Kit Revision	Released	Description
A00	2017-01-03	Initial Kit Revision.

11.2 Errata

There are no known errata at present.

12. Document Revision History

Revision 1.00

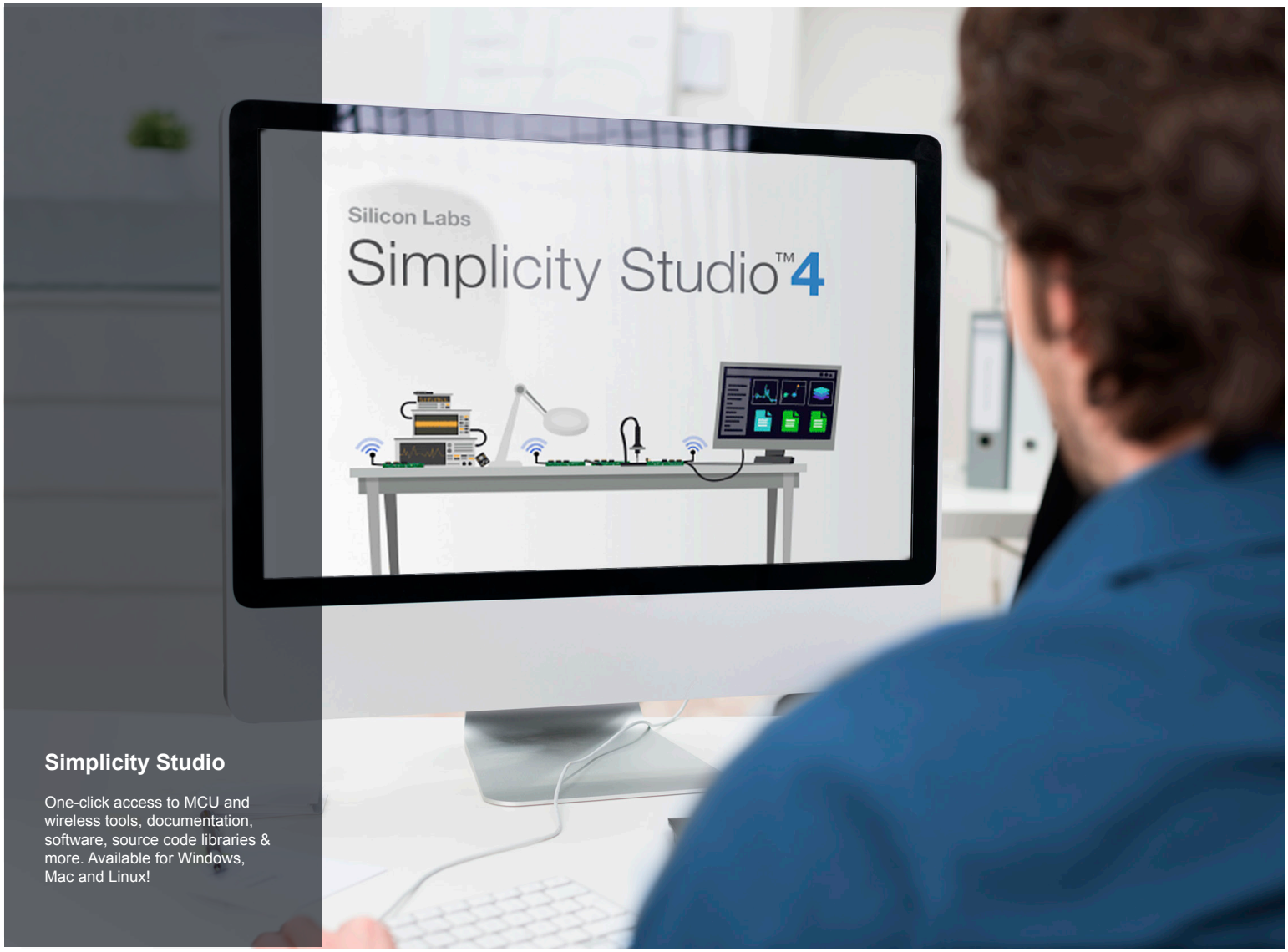
2017-01-13

Initial document version.

Revision 1.10

2017-08-17

Support for Energy Efficient Ethernet has been removed.



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