



# UG310: XBee3™ Expansion Kit User's Guide

The XBee3 Expansion Kit is an excellent way to explore and evaluate the XBee3™ LTE-M cellular module which allows you to add low-power long range wireless connectivity to your EFM32/ EFR32 embedded application.

The XBee3™ LTE-M cellular module is an easy to use cellular module. The XBee3 Expansion Kit easily integrates and brings LTE-M connectivity to compatible Silicon Labs Wireless and MCU Starter Kits through the expansion header.



## XBEE EXPANSION BOARD FEATURES

- EXP connector for interfacing Silicon Labs MCU and Wireless Starter Kits
- 2x10-pin socket supporting XBee™ and XBee Pro™ through-hole modules
- XBee module can be powered by (W)STK supply rail or on-board DC-DC regulator
- U-blox CAM-M8Q GNSS receiver supporting GPS and GLONASS

## SOFTWARE SUPPORT

- Software examples for the EFM32GG11 Starter Kit are available in Simplicity Studio™

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## 1. Introduction

This user guide covers the usage of the Silicon Labs XBee™ EXP board together with the XBee3™ LTE-M cellular module. The XBee™ EXP board is designed to be compatible with all XBee™ through-hole modules offering a wide array of wireless connectivity options, such as Zigbee, Wi-Fi, 3G and LTE cellular to name a few.

Software examples demonstrating how to use the XBee3™ LTE-M EXP kit with the EFM32GG11 Starter Kit are available through Simplicity Studio™.

## 2. Hardware Overview

### 2.1 Hardware Layout

The layout of the XBee3 Expansion Kit is shown in the figure below.

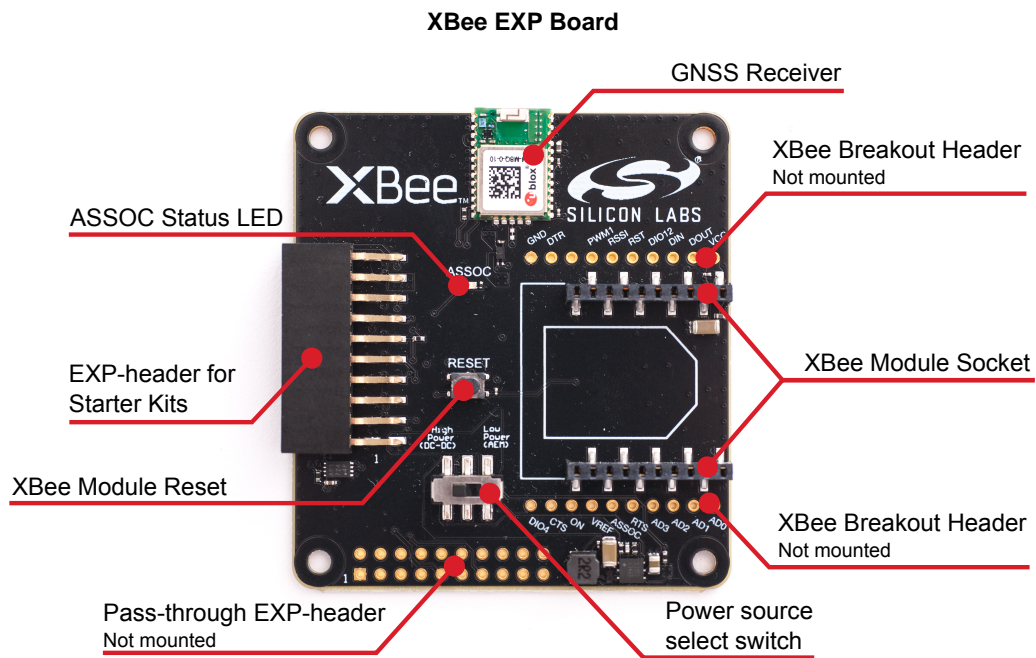


Figure 2.1. XBee3 Expansion Kit Hardware Layout

### 3. Connectors

This chapter gives an overview of the XBee3 Expansion Kit connectivity and power connections.

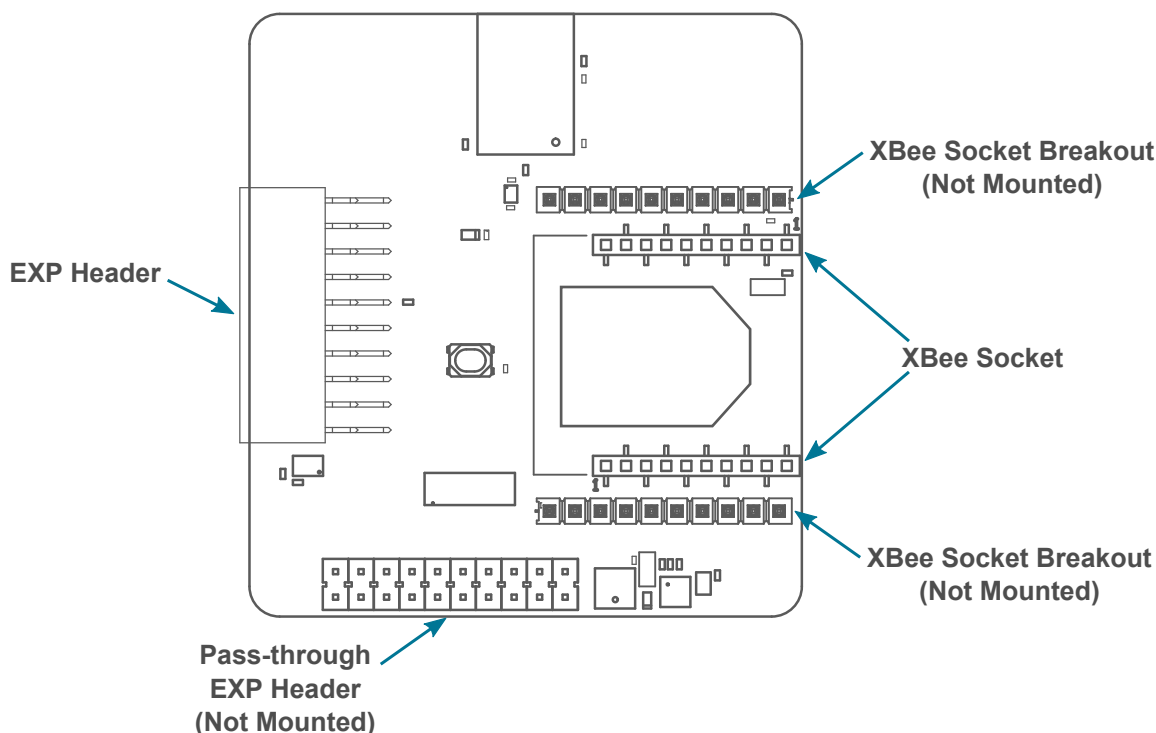


Figure 3.1. XBee3 Expansion Kit Connector Layout

#### 3.1 EXP Header

On the left hand side of the XBee3 Expansion Kit, a right-angle female 20-pin expansion header is provided to allow connection to one of Silicon Labs' MCU or Wireless Starter Kits. The expansion header on the Starter Kits follows a standard which ensures that commonly used peripherals such as an SPI, a UART, and an I2C bus, are available on fixed locations on the connector. Additionally, the VMCU, 3V3 and 5V power rails are also available on the expansion header. For detailed information regarding the pinout to the expansion header on a specific Starter Kit, consult the accompanying kit user's guide.

The figure below shows how the XBee™ module socket and the on-board GNSS receiver are connected to the EXP connector and the peripheral functions that are available.

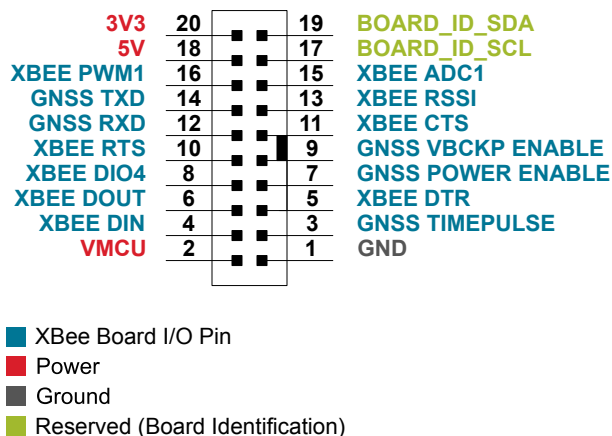


Figure 3.2. Expansion Header

### 3.1.1 Pass-through Expansion Header

The XBee3™ Expansion Kit features a footprint for a secondary expansion header. All signals from the expansion header, including those that are not connected to any features on the XBee3™ Expansion Kit are directly tied to the corresponding pins in the footprint, allowing daisy-chaining of additional expansion boards if a connector is soldered in.

Pin 1 of the secondary expansion header is marked with a 1 in the silkscreen printing.

### 3.1.2 Expansion Header Pinout

The table below shows the pin assignments of the Expansion Header.

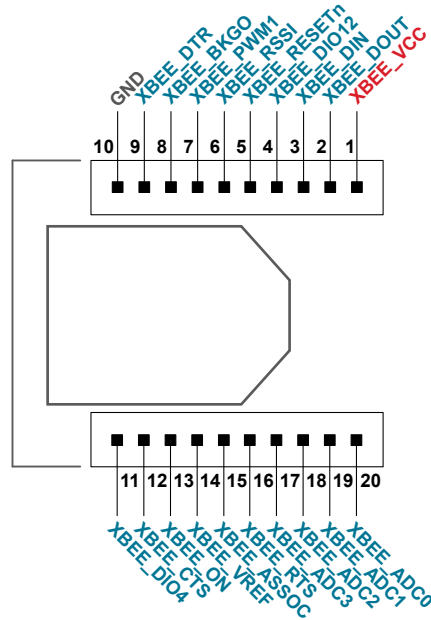
**Table 3.1. Expansion Header Pinout**

Pin	Function
2	VMCU (3.3V Input to low power side of power switch)
4	XBee DIN
6	XBee DOUT
8	XBee DIO4
10	XBee RTS
12	GNSS RXD
14	GNSS TXD
16	XBee PWM1
18	Board 5V supply. Used to supply DC-DC regulator.
20	Board 3V3 supply. Only used for board identification EEPROM.
1	Ground
3	GNSS Timepulse output
5	XBee DTR
7	GNSS Power Enable
9	GNSS Backup Power
11	XBee CTS
13	XBee RSSI
15	XBee ADC1
17	Identification of expansion boards.
19	Identification of expansion boards.

### 3.2 XBee Module Socket

The XBee3™ Expansion Kit features two 1x10-pin 2mm pitch connectors for inserting a through-hole XBee™ wireless module. There are also two unpopulated footprint for 1x10-pin 2.54mm (0.1") pitch pin headers which breaks out the signals of the XBee™ module socket, an ASSOC status LED which indicates the wireless connection status of the XBee™ module, and a reset button connected to the XBee™ module's reset signal input.

The pinout of the socket is illustrated in the figure below. The pinout of the unpopulated breakout headers are identical to the adjacent XBee™ module socket connector.



**Figure 3.3. XBee™ module socket**

### 3.2.1 XBee Module Socket Pinout

The pin assignment of the XBee module socket is given in the table below.

**Table 3.2. XBee Module Socket Pin Descriptions**

Pin Number	XBee module signal
Top row	
1	XBee VCC
2	DOUT (Module UART TXD)
3	DIN (Module UART RXD)
4	DIO12 (Digital IO 12)
5	RESETn
6	RSSI (Module RF Received Signal Strength Indicator output)
7	PWM1 (Module PWM output)
8	Not Connected
9	DTR (Module UART DTR)
10	GND
Bottom row	
11	DIO4 (Digital IO 4)
12	CTS (Module UART CTS)
13	ON (Module status output)
14	VREF
15	ASSOC (Module wireless connection status output)
16	RTS (Module UART RTS)
17	ADC3 (Analog input 3)
18	ADC2 (Analog input 2)
19	ADC1 (Analog input 1)
20	ADC0 (Analog input 0)



### 3.2.2 Power Supply

When connected to a Silicon Labs MCU or Wireless STK, the XBee3™ LTE-M cellular module can either be powered by the VMCU rail present on the Expansion Header, or through an LDO regulator on board the XBee3™ Expansion Kit. If connected to the VMCU rail of the starter kit, the current consumption of the XBee3™ LTE-M cellular module will be included in the starter kit's on-board Advanced Energy Monitor (AEM). The DC-DC regulator draws power from the 5V net, and hence, the power consumption of the XBee3™ LTE-M cellular module will not be included in any AEM measurements performed by the MCU STK.

A mechanical power switch on the XBee3 Expansion Kit is used to select between Low Power (AEM) mode and High Power (DC-DC) mode. When the switch is set to Low Power (AEM) mode, the XBee3™ LTE-M cellular module is connected to the VMCU net on the Expansion Header. For most MCU Starter Kits, the regulator supplying the VMCU net is capable of sourcing up to 300 mA, bearing in mind that the MCU is also powered from this net. The EFM32GG11 starter kit and the Wireless Starter Kit main board are able to source up to 800 mA on the VMCU net (provided that the kit's power source is able to supply this much current). When the switch is set to High Power (DC-DC) mode, the XBee3™ LTE-M cellular module is connected to the output of the DC-DC converter, which is able to source up to 2 A (again, limited by the capability of the source powering the starter kit). For applications requiring higher power than what is available from the VMCU net, the power switch should be set to High Power (DC-DC) mode.

The on-board GNSS receiver is powered from the same rail as the XBee3™ LTE-M cellular module through an analog switch that can be controlled by a GPIO pin on the EXP header.

The power topology is illustrated in the figure below.

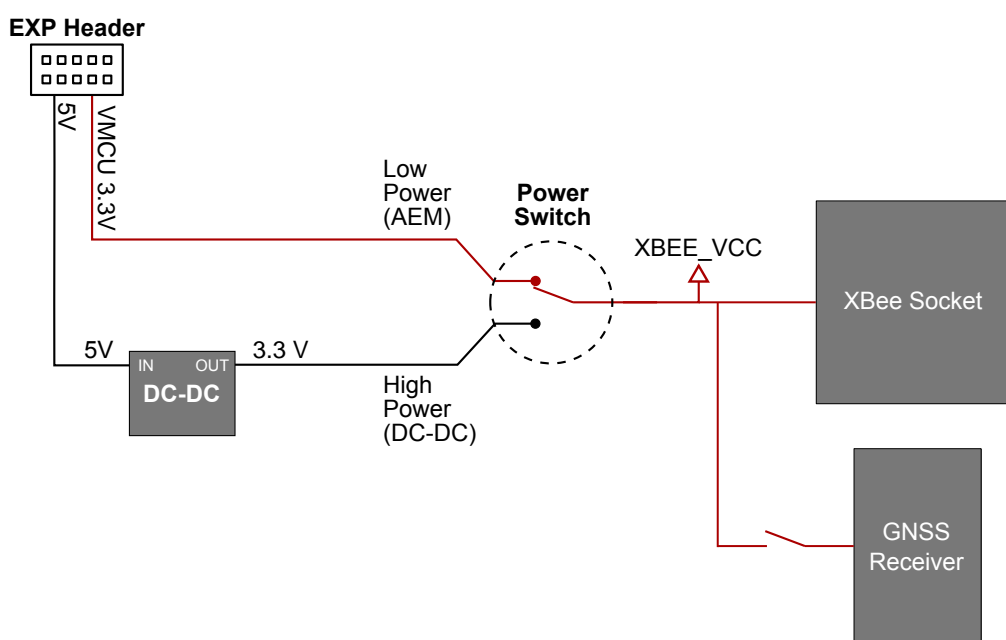


Figure 3.4. XBee3 Expansion Kit Power Topology

## 4. Using the XBee3 LTE-M EXP Kit

The XBee3™ LTE-M cellular module is a wireless module providing cellular connectivity using the low-power LTE-M technology.

### 4.1 Board Identification

The XBee™ EXP board and the starter kit it is connected to are automatically identified by Simplicity Studio when connected to the computer to present the correct documentation and software examples. Note however that Simplicity studio is not able to identify which XBee™ module that is inserted to the XBee EXP board's XBee™ module socket.

### 4.2 XBee3 LTE-M Module

The XBee3™ LTE-M module requires an external antenna to enable wireless connectivity. Connect the included patch antenna to the module's u.FL connector labeled 'CELL' and insert the module into the socket as shown in the figure below, before connecting the board to a Silicon Labs MCU or Wireless starter kit.

The kit also includes a SIM card, which needs to be activated before being inserted into the SIM slot of the XBee3™ LTE-M module. Please refer to the XBee3 Expansion Kit Quick Start Guide for information on how to activate the SIM card.

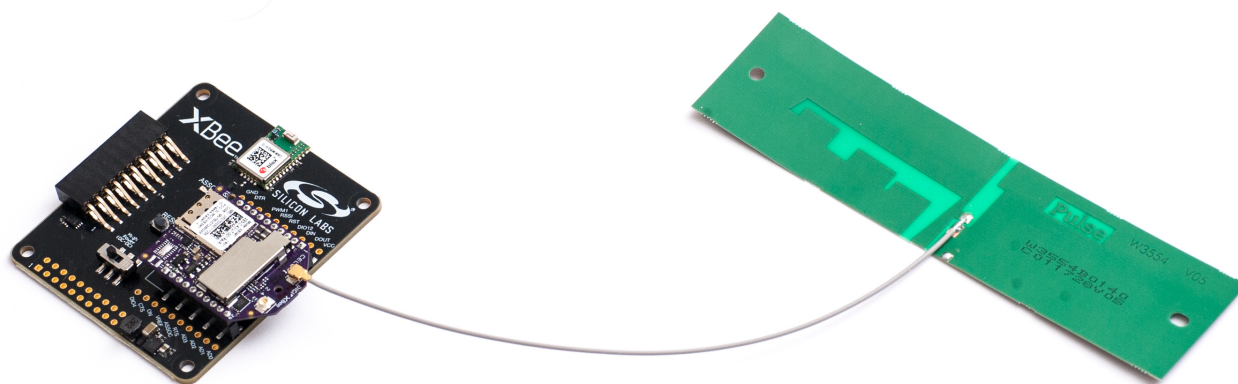


Figure 4.1. XBee3 Expansion Kit assembled for use

### 4.3 On-Board GNSS Receiver

The XBee3 Expansion Kit is equipped with a U-Blox Cam-M8Q Global Navigation Satellite System (GNSS) receiver module that allows the user to retrieve position and time information and use it in their embedded application.

The U-Blox Cam-M8Q can receive signals from both the GPS and GLONASS GNSS constellations, which gives good worldwide coverage. A reasonably clear view of the sky is required to obtain signal reception, meaning the GNSS receiver will work best outdoors. Indoor operation with reduced position accuracy is possible if the receiver has a reasonably clear view of the sky through a glass window, though the reliability will be unpredictable.

The GNSS receiver will output the current time and position (given that a satellite fix has been acquired) as well as satellite fix status over a UART interface using either the NMEA-0183 (default) or proprietary UBX protocol. Configuration commands can be input to the receiver using the same protocols. In addition, the receiver supports input of Differential GPS (DGPS) correction data using the RTCM 10402.3 protocol.

For more information about the GNSS receiver refer to the following documents:

- [U-Blox Cam-M8Q Datasheet](#)
- [U-Blox M8 Receiver Description Including Protocol Specification](#)

The figure below shows how the GNSS receiver is connected to the rest of the board. The table below describes the signals:

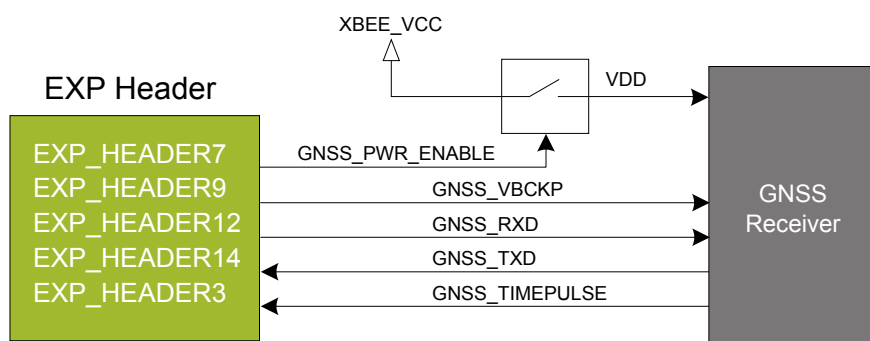


Figure 4.2. On-Board GNSS Receiver Connection Diagram

Table 4.1. GNSS Receiver Signal Descriptions

Signal	Description
GNSS Power Enable	Connects the GNSS receiver's main power input to the same power rail as the XBee module socket
GNSS Backup Power (VBCKP)	GNSS Receiver RAM and RTC backup power supply. Must be high in order to use the GNSS receiver.
GNSS TXD	GNSS Receiver UART output. 9600 bps 8N1 frame format.
GNSS RXD	GNSS Receiver UART input.
GNSS Timepulse	Provides an output pulse at a configurable interval (default: 1 second), synchronized to the received GNSS signal.

The GNSS receiver can be enabled, disabled or kept in sleep mode with RAM powered and RTC running depending on the state of the GNSS\_PWR\_ENABLE and GNSS\_VBCKP pins according to the table below:

Table 4.2. GNSS receiver power mode table

GNSS_PWR_ENABLE	GNSS_VBCKP	Mode description
LOW	LOW	GNSS Receiver powered off

GNSS_PWR_ENABLE	GNSS_VBCKP	Mode description
LOW	HIGH	Sleep mode - GNSS Receiver core, RF frontend and UART interface powered off. RAM and RTC are powered. Time to re-acquire time and position fix is significantly reduced if the VBCKP power has not been removed since the last valid time and position fix. Current consumption at the VBCKP pin in this mode is approx. 15 uA.
HIGH	HIGH	Active mode - GNSS Receiver is active with all features available.
HIGH	LOW	Invalid mode - VBCKP needs to be high whenever the GNSS receiver is powered.

## 5. Schematics, Assembly Drawings, and BOM

Schematics, assembly drawings, and bill of materials (BOM) are available through [Simplicity Studio](#) when the kit documentation package has been installed. They are also available from the Silicon Labs website and kit page.

## 6. Kit Revision History

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

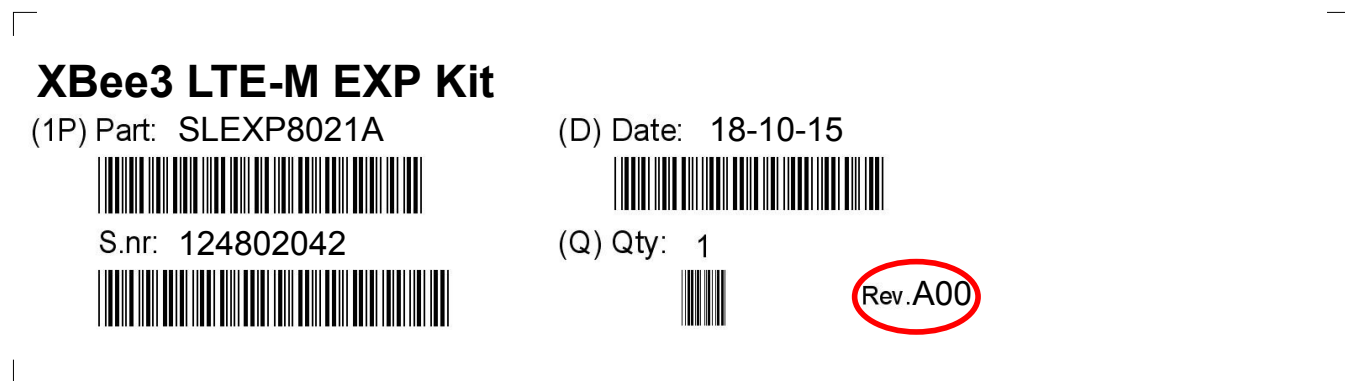


Figure 6.1. Kit Label

### 6.1 SLEXP8021A Revision History

Kit Revision	Released	Description
A00	2018-10-15	Initial release.

## 7. Document Revision History

### Revision 1.0

2018-10-15

- Initial document revision.