

UG310: LTE-M Expansion Kit User's Guide

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

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

To get started with the LTE-M Expansion Kit go to <http://www.silabs.com/start-efm32-xbee>.



LTE-M EXP BOARD FEATURES

- EXP connector for interfacing Silicon Labs MCU and Wireless Starter Kits
- 2x10-pin socket supporting Digi XBee™ and Digi XBee Pro™ through-hole modules
- Digi 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 LTE-M EXP Board together with the Digi XBee3 LTE-M cellular module. The LTE-M EXP Board is designed to be compatible with all Digi 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 LTE-M Expansion Kit with the EFM32GG11 Starter Kit are available through Simplicity Studio™.

For more information about the Digi XBee modules see <https://www.digi.com/xbee>.

Not Recommended for New Designs

2. Hardware Overview

2.1 Hardware Layout

The layout of the LTE-M Expansion Kit is shown in the figure below.

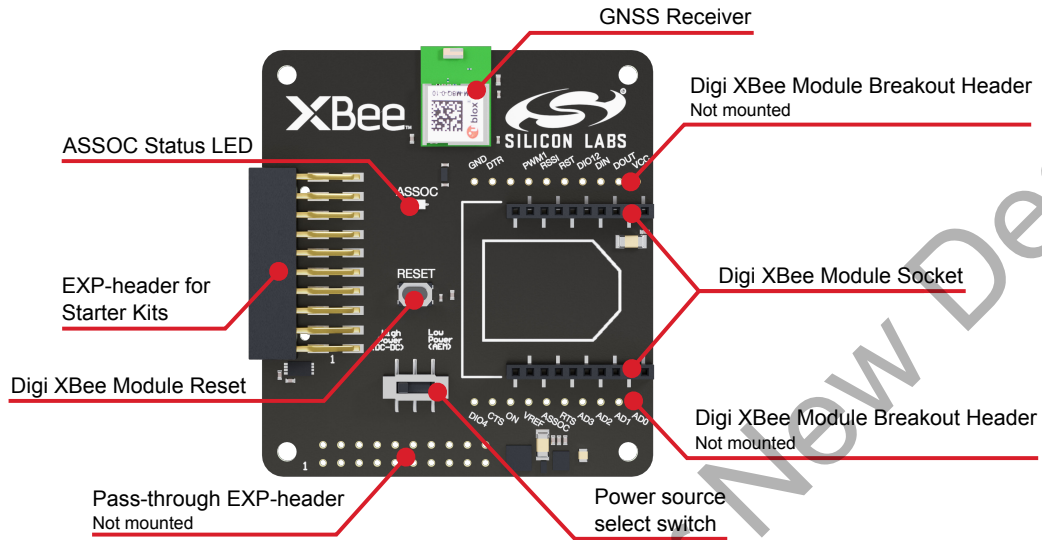


Figure 2.1. LTE-M Expansion Kit Hardware Layout

3. Connectors

This chapter gives an overview of the LTE-M Expansion Kit connectivity and power connections.

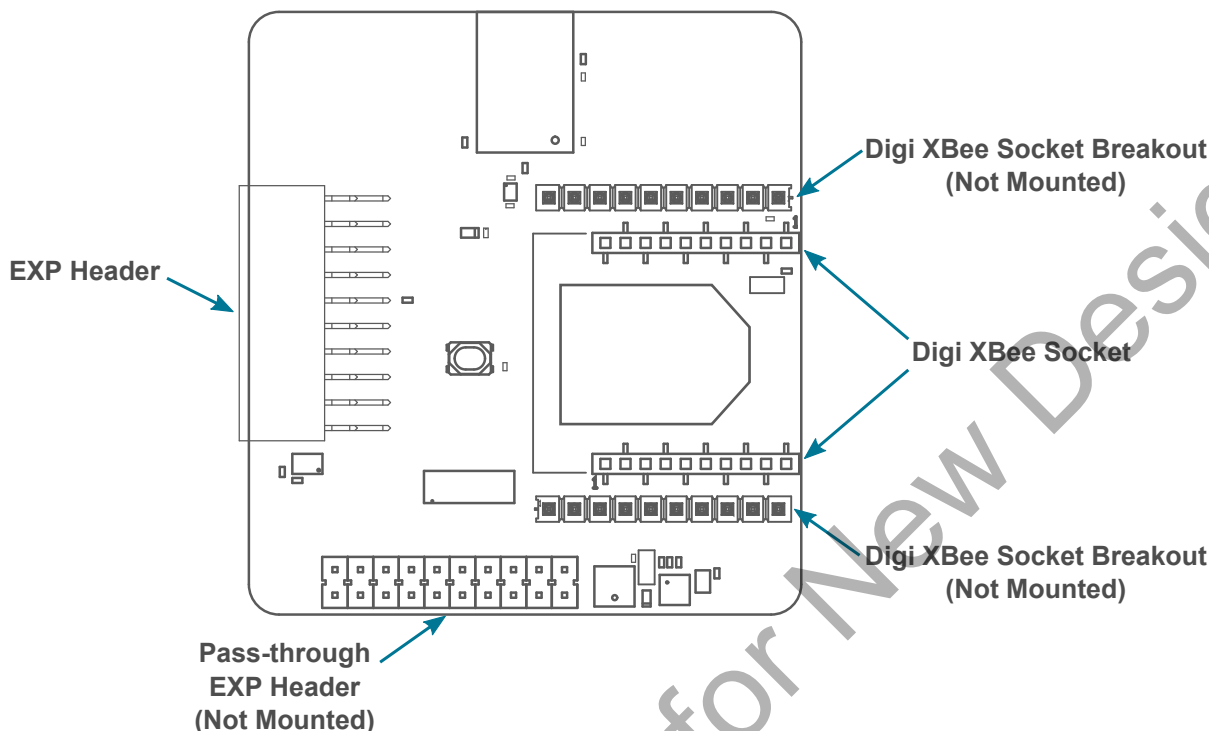
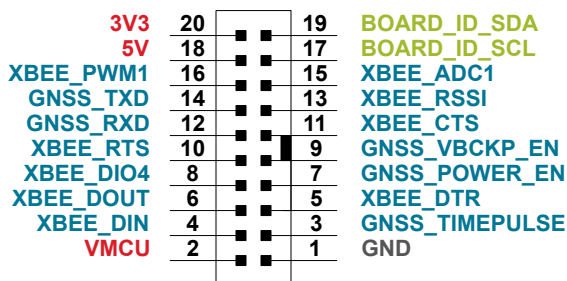


Figure 3.1. LTE-M Expansion Kit Connector Layout

3.1 EXP Header

On the left side of the LTE-M Expansion Kit, a right-angle female 20-pin EXP header is provided to allow connection to one of Silicon Labs' MCU or Wireless Starter Kits. The EXP 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 EXP header. For detailed information regarding the pinout to the EXP header on a specific Starter Kit, consult the accompanying kit user's guide.

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



- LTE-M EXP Board I/O Pin
- Power
- Ground
- Reserved (Board Identification)

Figure 3.2. EXP Header

3.1.1 Pass-through EXP Header

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

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

3.1.2 EXP Header Pinout

The table below shows the pin assignments of the EXP header.

Table 3.1. EXP Header Pinout

Pin	Signal Name	Function
2	VMCU	3.3V Input to low power side of power switch
4	XBEE_DIN	Digi XBee module UART input
6	XBEE_DOUT	Digi XBee module UART output
8	XBEE_DIO4	Digi XBee module digital I/O
10	XBEE_RTS	Digi XBee module UART RTS
12	GNSS_RXD	GNSS receiver UART input
14	GNSS_TXD	GNSS receiver UART output
16	XBEE_PWM1	Digi XBee module PWM output
18	5V	Board 5V supply. Used to supply DC-DC regulator.
20	3V3	Board 3V3 supply. Only used for board identification EEPROM.
1	GND	System ground
3	GNSS_TIMEPULSE	GNSS receiver synchronized timepulse output
5	XBEE_DTR	Digi XBee module UART DTR
7	GNSS_POWER_EN	GNSS receiver main power enable
9	GNSS_VBCKP_EN	GNSS receiver backup power supply
11	XBEE_CTS	Digi XBee module UART CTS
13	XBEE_RSSI	Digi XBee module RSSI output
15	XBEE_ADC1	Digi XBee module analog input
17	BOARD_ID_SCL	Identification of expansion boards.
19	BOARD_ID_SDA	Identification of expansion boards.

3.2 Digi XBee Module Socket

The LTE-M Expansion Kit features two 1x10-pin 2mm pitch connectors for inserting a through-hole Digi 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 Digi XBee module socket, an ASSOC status LED which indicates the wireless connection status of the Digi XBee module, and a reset button connected to the Digi 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 Digi XBee module socket connector.

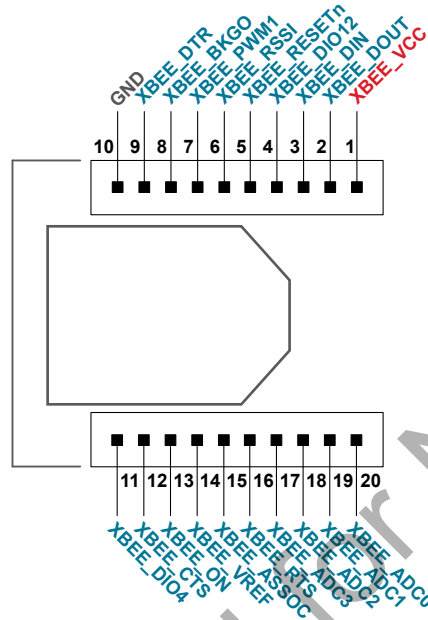


Figure 3.3. Digi XBee Module Socket

3.2.1 Digi XBee Module Socket Pinout

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

Table 3.2. Digi XBee Module Socket Pin Descriptions

Pin Number	Digi XBee Module Signal
Top row	
1	Digi 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 Digi XBee3 LTE-M cellular module can either be powered by the VMCU rail present on the EXP header, or through a DC-DC regulator onboard the LTE-M Expansion Kit. If connected to the VMCU rail of the starter kit, the current consumption of the Digi 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 Digi XBee3 LTE-M cellular module will not be included in any AEM measurements performed by the MCU STK.

A mechanical power switch on the LTE-M 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 Digi XBee3 LTE-M cellular module is connected to the VMCU net on the EXP 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 Digi 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 Digi 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.

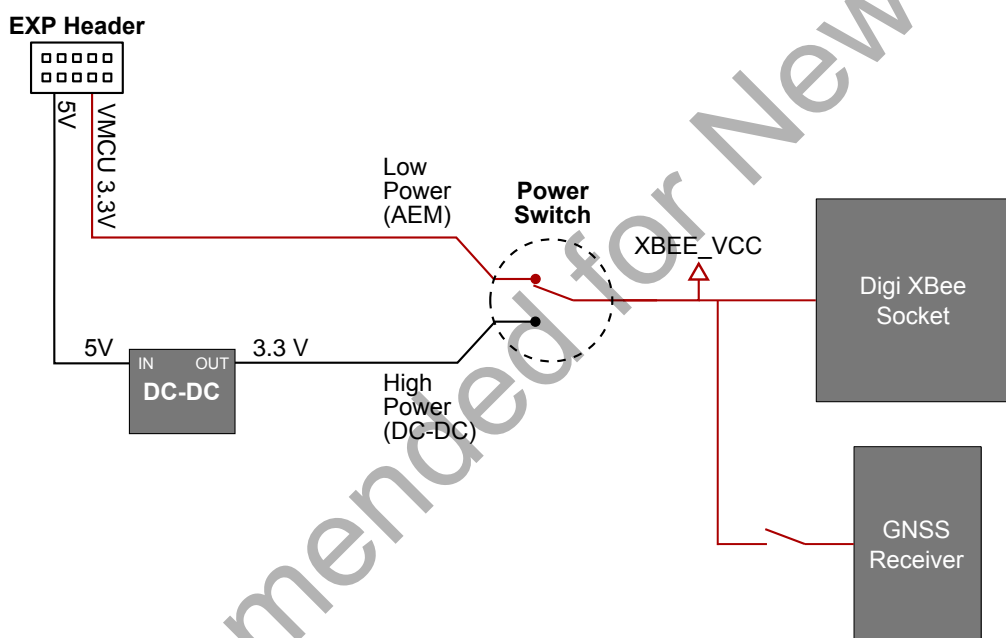


Figure 3.4. LTE-M Expansion Kit Power Topology

4. Using the LTE-M Expansion Kit

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

4.1 Board Identification

The LTE-M 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 Digi XBee module is inserted into the LTE-M EXP Board's Digi XBee module socket.

4.2 Digi XBee3 LTE-M Module

The Digi 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 Digi XBee3 LTE-M module. Refer to the LTE-M Expansion Kit Quick Start Guide for information on how to activate the SIM card.

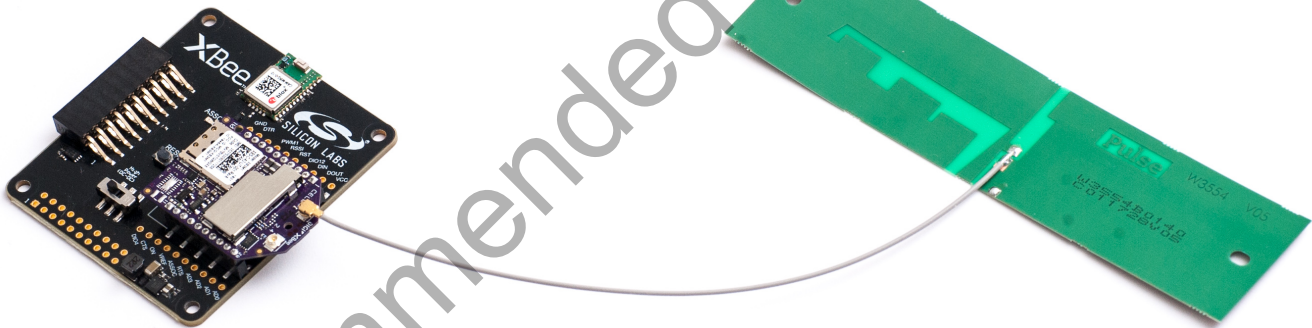


Figure 4.1. LTE-M Expansion Kit assembled for use

4.3 On-Board GNSS Receiver

The LTE-M 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 provides 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:

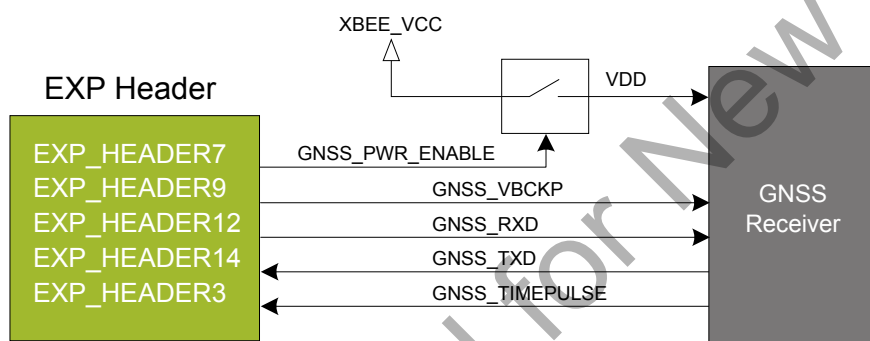


Figure 4.2. On-Board GNSS Receiver Connection Diagram

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 Modes

GNSS_PWR_EN	GNSS_VBCKP	Mode description
LOW	LOW	GNSS receiver powered off
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.

Not Recommended for New Designs

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.

Not Recommended for New Designs

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.

Not Recommended for New Designs

7. Document Revision History

Revision 1.0

October, 2018

- Initial document revision.

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