



Digi XBee® Application Note

Migration from XBee S1 (Freescale MC1312 based) 802.15.4 module to XBee S2C (Silabs EM357 based) 802.15.4 module

As of May 2016, Digi has updated and ported its XBee 802.15.4 firmware from the XBee S1 hardware based on the Freescale MC131212 SoC to the XBee S2C hardware based on the SiLabs EM357 SoC. While basic functionality and communication are similar and fully compatible, there are some differences to consider. This newer platform provides several major advantages over the existing platform and will be described in this guide along with other migration considerations

The XBee hardware platforms across all of our protocols are footprint compatible, so there is no need for customers to change board layouts. One important consideration that is important to note is this hardware platform is identical to that used in the XBee ZigBee modules, meaning it is now possible for customers to load either; ZigBee, 802.15.4, or DigiMesh protocols as a firmware update for maximum flexibility.

What's New

The XBee/XBee-PRO S2C 802.15.4 introduces some new features such as:

- Addition of SMT form factor
- Addition of OTA Firmware updates
- Better Range and sensitivity
- Lower Power draw
- Higher throughput capacity
- Addition of SPI support
- Addition of ATNP command to get the RF payload size.
- Capable of firmware migration to DigiMesh™ or ZigBee® protocols and vice-versa.
- Coordinator can simultaneously buffer up to five indirect messages for sleeping end devices compared with two on XBee S1.

Specification Considerations

XBee S1 802.15.4 to XBee S2C 802.15.4

Specifications	Legacy XBee S1 802.15.4	New XBee S2C 802.15.4	Comments
Indoor/Urban Range	up to 100 ft. (30 m)	Up to 200 ft. (60 m)	Improved
Outdoor RF line-of-sight Range	up to 300 ft. (120 m)	Up to 4000 ft. (1200 m)	Improved
Throughput capacity	60kbps	83 kbps	Improved
Transmit Power Output	1mW (+0dBm)	6.3mW (+8dBm), Boost mode 3.1mW (+5dBm), Normal mode Channel 26 max power is -4dBm	Improved on channels 11-25

Specifications	Legacy XBee S1 802.15.4	New XBee S2C 802.15.4	Comments
Receive Sensitivity	-92 dBm	-102 dBm, Boost mode -100 dBm, Normal mode	Improved
Supply Voltage	2.8 - 3.4 V	2.7 - 3.6 V	Larger voltage range
Operating Current (Transmit)	45 mA (0 dBm)	45mA (+8 dBm, Boost mode) 33mA (+5 dBm, Normal mode)	Improved on normal mode.
Operating Current (Receive)	50mA	31mA (Boost mode) 28mA (Normal mode)	Improved
Power-down Current	<10µA @ 25°C	< 1µA @ 25°C	Improved
Channels	12 to 24	12 to 24	No change
SPI	Not Supported	5 Mbps maximum (burst)	Added SPI interface
UART	111 kbps	250 kbps	Improved
Regulatory Approvals (Regions)	North America, Europe, Australia, Japan, Brazil	North America, Europe	Contact Sales for more information.
FCC ID	OUR-XBEE	MCQ-S2CTH	Customer will need to change the label on their end product to show the appropriate FCC ID for the XBee (S2C) 802.15.4
Industry Canada (IC) ID	4214A-XBEE	1846A-S2CTH	

XBee-PRO S1 802.15.4 to XBee-PRO S2C 802.15.4

Specifications	Legacy XBee-PRO S1 802.15.4	New XBee-PRO S2C 802.15.4	Comments
Indoor/Urban Range	Up to 300 ft (90m)	Up to 300 ft (90m)	No Change
Outdoor RF line-of-sight Range	Up to 2 miles (3200 m)	Up to 2 miles (3200 m)	No Change
Transmit Power Output	63mW (+18 dBm)	63mW (+18 dBm)	No Change
Receive Sensitivity	-100 dBm	-101 dBm	Improved
Supply Voltage	2.8 - 3.4 V	2.7 - 3.6 V	Larger voltage range
Operating Current (Transmit)	250mA @ 3.3V, 18 dBm	120mA @ 3.3 V, 18 dBm	Improved
Operating Current (Receive)	55 mA	31 mA	Improved
Power-down Current	<10µA @ 25°C	< 1µA @ 25°C	Improved
Channels	12 to 24	12 to 24	No change
SPI	Not Supported	5 Mbps maximum (burst)	Added SPI interface
UART	111 kbps	250 kbps	Improved
Regulatory Approvals (Regions)	North America, Australia, Brazil, Others*	North America	Contact Sales for more information.
FCC ID	OUR-XBEEPRO	MCQ-PS2CTH	Customer will need to change the label on their end product to show the appropriate FCC ID for the S2C.
Industry Canada (IC) ID	4214A-XBEEPRO	1846A-PS2CTH	

* Note: An International variant of the XBee-PRO S2C 802.15.4 is not available; the +8dBm XBee should be used instead.

Pin Compatibility

The table below compares the pin features between the Through Hold versions of the legacy and new modules. All legacy features are supported with the exception of AD4, AD5, and VREF, and SPI communication has been added. The new XBee/XBee-PRO S2C 802.15.4 introduces the SPI serial interface to Digi's through-hole and surface mount 802.15.4 radio offering. The table below shows which pins are used for the SPI interface. Please refer to the XBee/XBee-PRO S2C 802.15.4 product manual for more information.

Pin #	XBee/XBee-PRO S1 802.15.4 TH	XBee/XBee-PRO S2C 802.15.4 TH
1	VCC	VCC
2	DOUT	DOUT
3	DIN / nCONFIG	DIN / nCONFIG
4	Not supported	SPI_MISO
5	nRESET	nRESET
6	PWM0 / RSSI	PWM0 / RSSI
7	PWM1	PWM1
8	[RESERVED]	[RESERVED]
9	nDTR / SLEEP_RQ/ DI8	nDTR / SLEEP_RQ / DI8
10	GND	GND
11	AD4 / DIO4	SPI_MOSI / DIO4
12	nCTS / DIO7	nCTS / DIO7
13	ON / nSLEEP	ON_SLEEP
14	VREF	Not supported (Analog reference is internal)
15	ASSOCIATE / AD5 / DIO5	ASSOCIATE / DIO5
16	nRTS / DIO6	nRTS / DIO6
17	AD3 / DIO3	AD3 / DIO3 / SPI_SSEL
18	AD2 / DIO2	AD2 / DIO2 / SPI_CLK
19	AD1 / DIO1	AD1 / DIO1 / SPI_ATTN
20	AD0 / DIO0	AD0 / DIO0

Part Number Migration Guide

The following table shows which XBee/XBee-PRO S2C 802.15.4 module to migrate to depending on which XBee/XBee-PRO S1 802.15.4 module you are currently using.

Legacy Part Number	Description	Migrate To	Description
XBP24-AWI-001	XBee24 PRO-2.4GHz-WIRE	XBP24CAWIT-001	XBee-PRO, S2C, 2.4GHz, 802.15.4, TH, Wire ant
XB24-AWI-001	XBee24 2.4GHz WIRE	XB24CAWIT-001	XBee, S2C, 2.4GHz, 802.15.4, TH, Wire ant
XBP24-API-001	XBee24 PRO-2.4GHz-PCB Ant	XBP24CAPIT-001	XBee-PRO, S2C, 2.4GHz, 802.15.4, TH, PCB ant
XB24-API-001	XBee24, 2.4GHz PCB Ant	XB24CAPIT-001	XBee, S2C, 2.4GHz, 802.15.4, TH, PCB ant
XBP24-AUI-001	XBee24 PRO2.4GHz-RFCON	XBP24CAUIT-001	XBee-PRO, S2C, 2.4GHz, 802.15.4, TH, U.FL
XB24-AUI-001	XBee24 2.4GHz RFCON	XB24CAUIT-001	XBee, S2C, 2.4GHz, 802.15.4, TH, U.FL
XBP24-ASI-001	XBee24 PRO 2.4GHz RPSMA	XBP24CASIT-001	XBee-PRO, S2C 2.4GHz, 802.15.4, TH, RPSMA
XB24-ASI-001	XBee24 2.4GHz RPSMA	XB24CASIT-001	XBee, S2C, 2.4GHz, 802.15.4, TH, RPSMA

Surface Mount (SMT) options New to XBee 802.15.4

New	Description
XBP24CAPIS-001	XBee-PRO, S2C, 2.4GHz, 802.15.4, SMT, PCB antenna
XB24CAPIS-001	XBee, S2C 2.4GHz, 802.15.4, SMT, PCB antenna
XBP24CAUIS-001	XBee-PRO, S2C, 2.4GHz, 802.15.4, SMT, u.fl
XB24CAUIS-001	XBee, S2C, 2.4GHz, 802.15.4, SMT, u.fl
XBP24CARIS-001	XBee-PRO, S2C, 802.15.4, SMT, RF PAD
XB24CARIS-001	XBee, S2C, 802.15.4, SMT, RF PAD

Configuration

The XBee/XBee-PRO S1 802.15.4 module was a single purpose hardware platform that supported Digi's proprietary implementation of the IEEE 802.15.4 protocol. However with the XBee/XBee-PRO S2C family of modules we now enable the user to reconfigure the firmware to one of three different, non-compatible protocols for maximum versatility: 802.15.4, ZigBee-Pro (2007 stack) and DigiMesh. Using XCTU you can load the appropriate firmware to fit your current needs within the regulatory guidance of the region of deployment. Please see the user guide for more information.

Limitations of the XBee S2C hardware (In reference to the S1 hardware)

- SM2 is supported but with a different wakeup time For comparison, in SM1 mode, XBee S1 awakens in 10.5 ms, but it awakens in 2.5 ms in SM2 mode. By contrast, SM1 and SM2 both awaken in 6.3 ms on XBee 802.15.4 (S2C). Therefore, SM2 provides no advantages over SM1 and is being deprecated.
- ADC is supported but the XBee S2C 802.15.4 hardware/firmware only supports 4 ADC lines compared with 6 on the XBee S1 hardware.
- Space parity on the UART is not supported by the XBee S2C 802.15.4 firmware/hardware.
- The XBee S2C does not support an external Voltage Reference for ADC, but has an internal reference of 1.2 V.
- In order to provide robust over-the-air compatibility between the S1 and S2C, a **C8** compatibility AT command has been introduced. If you will be operating the XBee S2C 802.15.4 module in a mixed network with S1 XBee modules, you will need to set the **C8** parameter accordingly:
 - Setting **C8 bit 1** will cause the S2C module to transmit packets at a rate that is more compatible with the S1. Data integrity will be improved at the cost of reduced throughput.
 - Setting **C8 bit 2** will cause the S2C module perform directed network discoveries (**ND** command with **NI** string) in a way that is compatible with S1 modules. If this bit is not set, there is a chance that the discovery will time out before the response is heard.

A recap of the key new advantages of the XBee S2C 802.15.4 are:

- Much lower sleep current (Less than 1 uA vs 10 uA on XBee S1)
- Lower current consumption for RX (31 mA vs 50 mA on XBee S1)
- Lower current consumption for TX on PRO (120 mA vs. 250 mA on XBee S1)
- Same current consumption for TX on non-PRO (45 mA), but greater output power (8 dBm)

- Higher throughput capacity (83kbps on XBee S2C compared with 60kbps on XBee S1)
- Addition of the SMT form factor
- Addition of OTA Firmware updates
- Addition of SPI support
- Addition of ATNP command to get the RF payload size.
- Flexible firmware loads

For more information, please see the product user guide.