



Skill Badge Requirements: Digi XBee

Created by Adam Kemp



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Overview

For years, Digi's XBee line has provided the Maker World with an easy to use wireless serial/IO bridge. Each XBee shares a common footprint (with exception to the XBee SMT) between series 1 & 2 while offering a wide range of power and antenna options. The user also has the ability to configure the network type to meet the needs of almost any project.



Instructions for completion:

Record the section, item number and requirement before each response on your notepaper. This will assist your instructor when evaluating the completion of the requirements.

Example (from Solar Requirements):

2.1 Measure and calculate the surface area (A_{eff}) of the solar cell supplied by your instructor.

- I calculated the surface area (A_{eff}) of my solar cell to be 2 square inches, with the dimensions of 2in x 1in.

Section 1: XBee Hardware

Product	Product	Certification	Frequency	Power/Range	Max Line of Sight Range	Transmit Power	Receiver Sensitivity	Form Factor	MSRP	QTY/Min	Programmable	Functions
XBEE 484.31	XBee 484.31	US, CA, EU, JP	4.8 GHz	Low-power mode to 100mW	400 ft / 120m	-10 to +15 dBm	-75 to -97 dBm	Through-hole	\$12.00	1000	Yes	50
XBEE PRO 802.15.4	XBee PRO 802.15.4	US, CA, EU, JP	4.8 GHz	Low-power, low-power multi-rate	300 ft / 90m	0 dBm	-85 dBm	Through-hole	\$12.00	1000	Yes	51
	XBee PRO 802.15.4	US, CA, EU, JP	4.8 GHz	Extended-range multi-rate	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51
XBee PRO ZigBee 2.4	XBee PRO ZigBee 2.4	US, CA, EU, JP	2.4 GHz	Low-power multi-rate for ZigBee	1 mile / 1.6 km	0 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51B
	XBee PRO ZigBee 2.4	EU	868 MHz	Low-power multi-rate for ZigBee	1 mile / 1.6 km	0 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51C
XBee PRO Flex	XBee PRO Flex 484.31	US, CA, EU, JP	4.8 GHz	Software-configurable, low-power and extended-range	400 ft / 120m	-10 to +15 dBm	-75 to -97 dBm	Through-hole	\$12.00	1000	Yes	51D
	XBee PRO Flex 802.15.4	US, CA, EU, JP	4.8 GHz	Software-configurable, low-power and extended-range	300 ft / 90m	0 dBm	-85 dBm	Through-hole	\$12.00	1000	Yes	51E
	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51F
	XBee PRO Flex 868	US, CA, EU, JP	868 MHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51G
XBee PRO Flex 2.4	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51H
	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51I
	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51J
XBee PRO Flex 2.4	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51K
	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51L
	XBee PRO Flex 2.4	US, CA, EU, JP	2.4 GHz	Software-configurable, low-power and extended-range	1 mile / 1.6 km	-10 dBm	-100 dBm	Through-hole	\$12.00	1000	Yes	51M

This section focuses on establishing an understanding of the types of XBee modules and their hardware

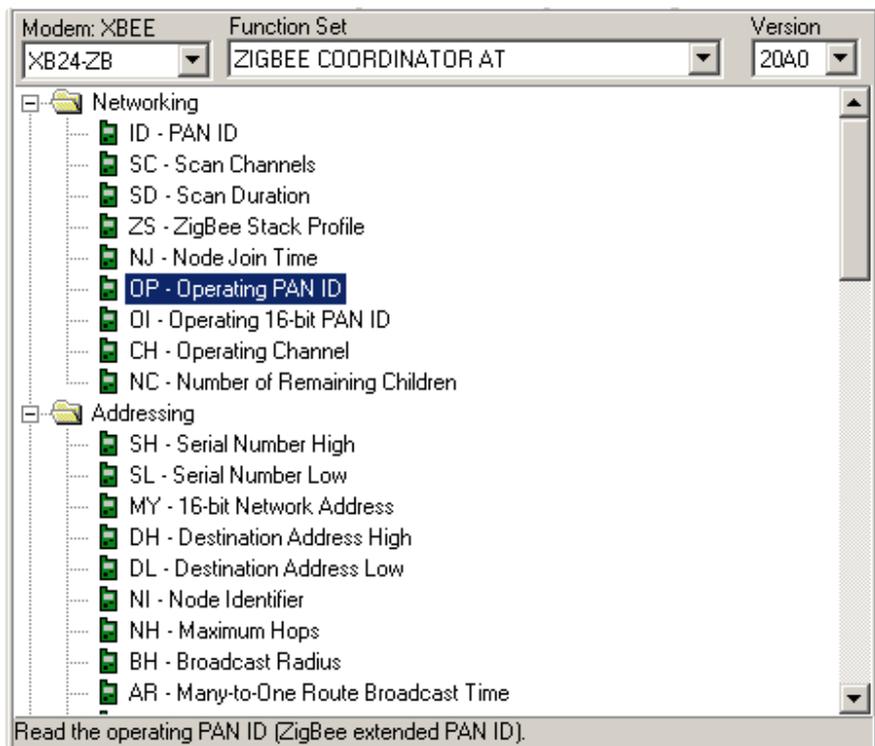
Do EACH of the following and submit to your instructor:

- Describe the general idea behind producing a wireless data connection between two devices
- Identify and describe the differences between the series 1 & 2 XBee modules
- Identify and describe the differences between the low-power and PRO modules
- Identify and describe the available antenna options and their individual benefits
- Identify and describe the methods for configuring a module
 - Be sure to include the use of X-CTU and an explanation of the AT command set

Do EACH of the following and submit to your instructor:

- Identify and describe XBee's operating voltage
 - Describe why this voltage is important to know when interfacing with devices, such as Arduino
 - Identify and describe a method for interfacing an XBee with a microcontroller, such as Arduino
- Identify and describe the issues concerning sharing serial TX/RX lines between your microcontroller and other devices (i.e. the problem with Arduino sharing TX/RX lines with the USB to Serial converter and an XBee)

Section 2: The Wireless Data Connection



This section focuses on the different methods of producing a wireless data connection

Do EACH of the following and submit to your instructor:

1. Identify and describe XBee's three primary network topologies
 1. Provide instances where these topologies could be used
2. Identify and describe the format in which data is sent between XBee modules
 1. How might you optimize your data packets to reduce size and simplify interpretation
2. Identify and describe the supported baud rates
 1. Provide advantages of using a lower rate over a higher
 2. Provide advantages of using a higher rate over a lower
3. Identify and describe the different "Function Sets" the XBee can be configured for
 1. How do these differ between the series 1 & 2 modules

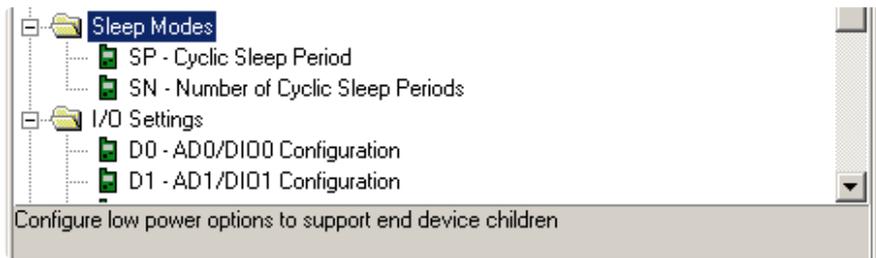
Do ONE of the following and submit to your instructor:

1. Using a pair of XBee series 1 modules, produce a point to point network and demonstrate successful bi-directional communication
 1. Complete a range test inside of a building and record your results
 2. Complete a range test outside with a clear line of sight and record your results
 3. Detail the factors, both hardware and structural, that affect the range of your connection
4. Using a pair of XBee series 2 modules, produce a point to point network and demonstrate successful bi-directional communication
 1. Complete a range test inside of a building and record your results
 2. Complete a range test outside with a clear line of sight and record your results
 3. Detail the factors, both hardware and structural, that affects the range of your connection

Do ONE of the following and submit to your instructor:

1. Using a pair of XBee series 1 modules, reconfigure the modules to a higher baud-rate, produce a point to point network, and successfully transfer data
 1. Replicate the previous range test inside of a building and record your results
 2. Replicate the previous range test outside with a clear line of sight and record your results
 3. Detail the effect of baud-rate on range
4. Using a pair of XBee series 2 modules, reconfigure the modules to a higher baud-rate, produce a point to point network, and successfully transfer data
 1. Replicate the previous range test inside of a building and record your results
 2. Replicate the previous range test outside with a clear line of sight and record your results
 3. Detail the effect of baud-rate on range

Section 3: Power Options



This section focuses on the production of a simple wireless sensor network

Do EACH of the following and submit to your instructor:

1. Identify and describe the different sleep options for the series 1 & 2 modules
2. Identify and describe the difference between hardware controlled and software controlled sleep
3. Use a multimeter to measure and describe the power consumption of a sleeping XBee
 1. Explain and describe the discrepancy between your measured number and the number provided by Digi

Section 4: Establishing a Network



This section focuses on the production of a simple wireless sensor network

Do EACH of the following and submit to your instructor:

1. Identify and describe a method for passing and interpreting a data stream between a remote device and the host
 2. Identify and describe the benefits of data integrity checking and when it should be used
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Section 5: Demonstration



This section focuses on the demonstration of a properly configured XBee network and its interface to a microcontroller of your choice.

Do ONE of the following and submit to your instructor:

1. Using a microcontroller of your choice, produce a peer to peer XBee network that samples a remote temperature sensor when requested by the operator
 1. Describe the method for passing your request
 2. Describe the method for interpreting the data
3. Using a microcontroller of your choice, construct a remotely controlled device (i.e. model car, quadcopter, robot) that demonstrated bi-directional communication
 1. Describe the method for passing your control values
 2. Describe the method for interpreting the data being transmitted from your remote device

Certificate of Completion



This certificate is awarded to

*For successful completion of
requirements to earn the*

Digi XBee Skill Badge

Issued by: _____ *Date:* _____

