

# XBee

## Wireless Communication



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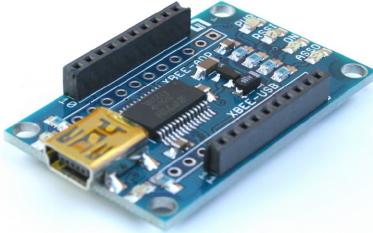
[www.digi.com/xbee/](http://www.digi.com/xbee/)



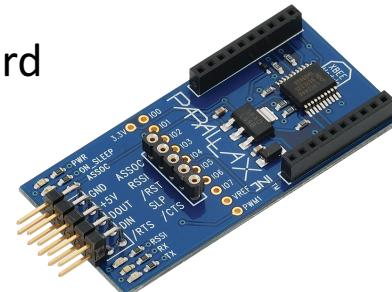
# XBee - Wireless Communication



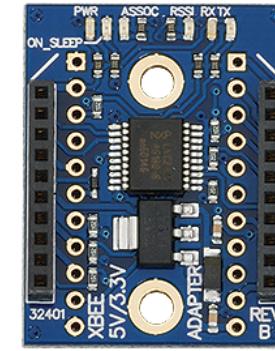
XBee Module



XBee USB Adapter Board



XBee SIP Adapter Board



XBee 5V/3.3V Adapter Board

Arduino Tutorial: Let's make XBee talk!:

<http://www.norwegiancreations.com/2013/10/arduino-tutorial-1-lets-make-xbee-talk/>

Making Things Talk, 2nd Edition (eBook available at Safari Books Online):

<http://proquest.safaribooksonline.com/book/hardware-and-gadgets/9781449314668>

Exploring XBees and XCTU:

[https://learn.sparkfun.com/tutorials/exploring-xbees-and-xctu? \\_ga=1.116328385.696451024.1434708629](https://learn.sparkfun.com/tutorials/exploring-xbees-and-xctu?_ga=1.116328385.696451024.1434708629)

# What is XBee?

XBees are hugely popular wireless transceivers for a number of reasons.

They're flexible – they send and receive data over a serial port, which means they're compatible with both computers and microcontrollers (like Arduino).

They are highly configurable – you can have meshed networks with dozens of XBees, or just a pair swapping data.

You can use them to remotely control your robot, or arrange them all over your house to monitor temperatures or lighting conditions in every room.

# XBee



- XBee is the brand name from Digi International for a family of form factor compatible radio modules.
- XBee modules are tiny blue chips that can communicate wirelessly with each other
- These modules use the IEEE 802.15.4 networking protocol for fast point-to-multipoint or peer-to-peer networking.
- XBee uses the Zigbee standard and adds to it and wraps it up in their own neat little package.  
<http://www.zigbee.org/>.
- Most of the XBee modules operate at 2.4GHz

<https://en.wikipedia.org/wiki/XBee>

[https://www.sparkfun.com/pages/xbee\\_guide](https://www.sparkfun.com/pages/xbee_guide)

# Wireless Communication

- Wi-Fi (IEEE 802.11)
- Bluetooth (IEEE 802.15.1)
- XBee/ZigBee (IEEE 802.15.4)
- etc.

# XBee Hardware

You need 2 things:

1. XBee Modules, lots of different types exists
2. XBee Adapter Boards:
  - XBee USB Adapter
  - XBee SIP Adapter
  - XBee 5V/3.3V Adapter
  - Arduino Wireless SD Shield (with XBee connector)

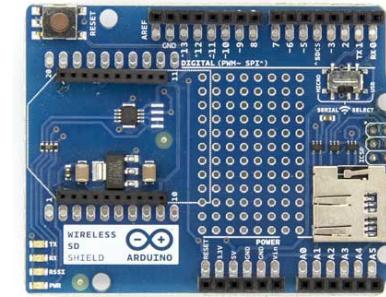
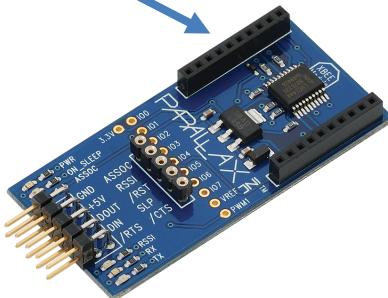
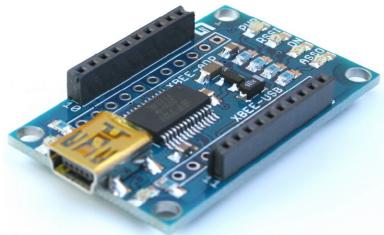
More about these devices on the next slides...

XBee Module

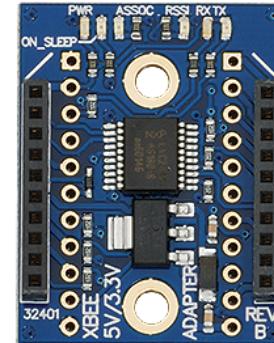
# XBee Hardware



XBee Adapter Boards



Arduino Wireless SD Shield

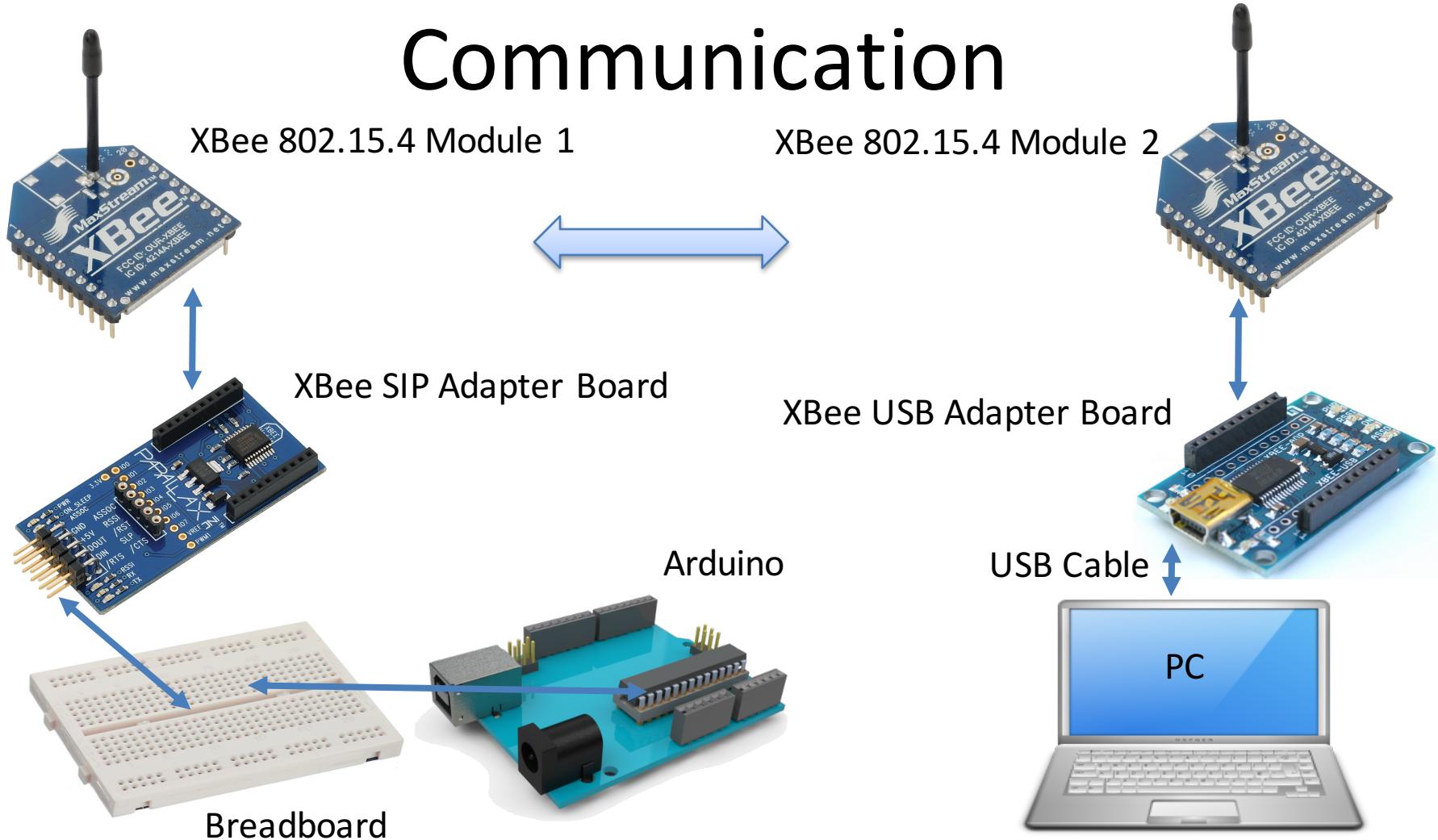


XBee USB Adapter Board

XBee SIP Adapter Board

XBee 5V/3.3V Adapter Board

# Communication



# XBee 802.15.4 modules (“Series 1”)

- XBee Series 1 (also called XBee 802.15.4) - These are the easiest to work with, they don't need to be configured, although they can benefit from it.
- Because they are easy to work with, you should start with these.
- For point to point communication these modules work as well as the Series 2 but without all the work.

# XBee Modules vs. XBee Pro Modules

- There are a few difference between the regular XBees and the XBee Pros.
- The Pros are a bit longer, use more power and cost more money. That's pretty much it.
- The greater power means longer range (1 mile instead of 300ft) so if you need the range or like to spend more money, then use the Pros, otherwise stick with the regular models.
- You can mix and match these on the same network.

# XBee Modules vs. XBee Pro Modules

Specification	XBee	XBee-Pro
Supply Voltage	2.8 VDC – 3.4 VDC	2.8 VDC – 3.4 VDC
RF Power	0 dBm, 1 mW	18 dBm, 63 mW
Outdoor Distance (LOS)	300 ft (90 m)	1 mile (1.6 km)
Indoor Distance	100 ft (30 m)	300 ft (90 m)
Current Draw, Receive	45 mA	50 mA
Current Draw, Transmit	50 mA	215 mA
Current Draw, Sleep	< 10 µA	<10 µA
RF Data Throughput	250 kbps	250 kbps
Operating Frequency, Channels	2.4 GHz, 16 Channels	2.4 GHz, 12 Channels
Receiver Sensitivity	-92 dBm	-100 dBm

# XBee 802.15.4 Modules

The 802.15.4 XBee modules provide two friendly modes of communication—a simple serial method of transmit/receive or a framed mode providing advanced features.



XBees are ready to use out of the package, or they can be configured through the X-CTU utility or from your microcontroller.

These modules can communicate point to point, from one point to a PC, or in a mesh network.

<https://www.parallax.com/product/32405>

# XBee 802.15.4 Module (XB24-AWI-001)

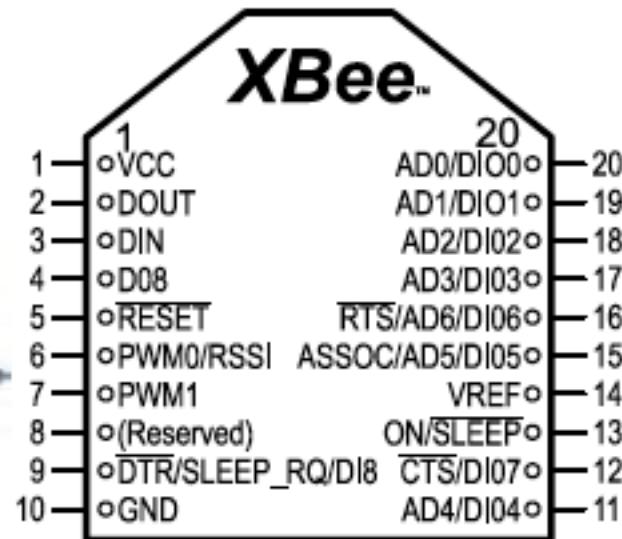


## Key Features:

- Outdoor range up to 300 feet (90 m) line of sight
- Indoor range up to 100 feet (30 m)
- Data rate up to 250 Kbps
- 2.4 GHz frequency band (accepted worldwide)

<https://www.parallax.com/product/32405>

# XBee 802.15.4 Module (XB24-AWI-001)



# XBee 802.15.4 Module (XB24-AWI-001) Pin Overview

DOUT and DIN: These are the pins through which serial data is received by our controller or PC (DOUT) and sent to the XBee (Din).

This data may be either for transmission between XBee modules or for setting and reading configuration information of the XBee.

The default data rate is 9600 baud (bps) using asynchronous serial communications.

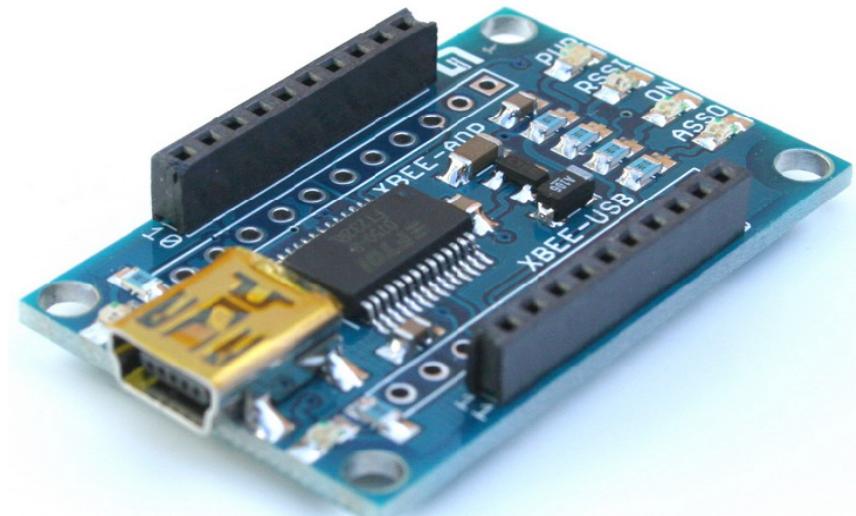
Pin	Name	Type	Function
1	VCC	P	2.8 V to 3.4 V
2	DOUT	O	Serial data output from XBee (received data)
3	DIN	I	Serial data input to XBee (data to transmit)
4	DO8	O	Digital data output 8
5	RESET	I	Reset module (low)
6	PWM0/ RSSI	O O	Pulse Width Modulated output Received Signal Strength Indication as PWM signal
7	PWM1	O	Pulse Width Modulated output
8	(Reserved)		
9	DTR SLEEP_RQ DI8	I I I	Data Terminal Ready: handshaking for firmware updates (low) Sleep Request: A high places XBee in sleep mode when configured Digital Output 8
10	GND	G	Ground (Vss)
11	AD4 DIO4	A IO	Analog to Digital Input 4 Digital Input/Output 4
12	CTS DIO7	O IO	Clear to Send output for controller handshaking (low) Digital Input/Output 7
13	ON/SLEEP	O	Digital output, status indication: High = Awake, Low = Sleep
14	VREF	A	Analog to Digital reference voltage
15	ASSOC AD5 DIO5	O A IO	Associated indication when joining a network Analog to Digital Input 5 Digital Input/Output 5
16	RTS AD6 IO6	I A IO	Ready to Send Handshaking input (Low) Analog to Digital Input 6 Digital Input/Output 6
17-20	AD3-AD0 DIO3-DIO0	A IO	Analog to Digital Input 3 to 0 Digital Input/Output 3 to 0

# XBee Adapter Boards

Why use an Adapter Board?

- The XBee is a 3.3 V device! Your Microcontroller typically runs on 5 V
- Breadboard friendly: Converts XBee 2mm pin spacing to 2.54mm (0.1") pin spacing used on Breadboards
- Adapter Boards: "XBee USB Adapter", "XBee SIP Adapter", "XBee 5V/3.3V Adapter", "Arduino Wireless SD Shield" (with XBee connector)

# XBee USB Adapter Board



**Do NOT connect your hardware to USB or Serial port until AFTER you have installed the software.**



**Step 1:** Download 'Parallax USB Driver Installer'



**Step 2:** Run the installer. Follow the steps provided by the wizard to install your hardware drivers.



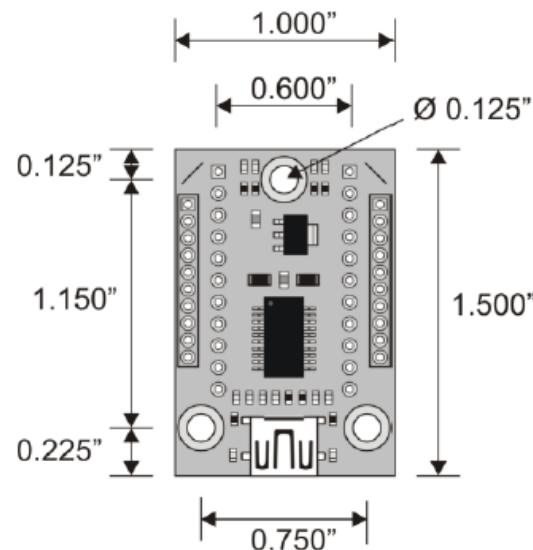
**Step 3:** Connect your hardware.

**Make sure to install Software before you plug in the hardware!**

<https://www.parallax.com/usbdirectors>

<https://www.parallax.com/product/32400>

The XBee USB Adapter Board connects your XBee module to a PC or Microcontroller



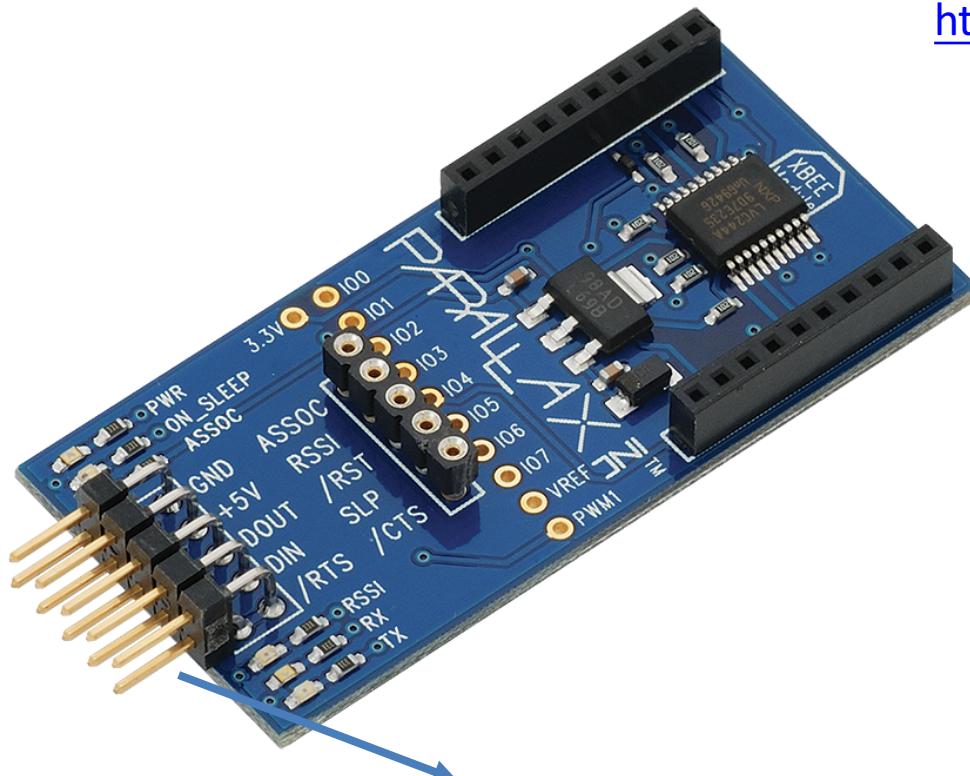
# XBee USB Adapter Board

Note! Take care not to bend any of the XBee pins – be gentle when you're plugging it in. (And be even more careful if you're removing it!)



# XBee SIP Adapter Board

<https://www.parallax.com/product/32402>

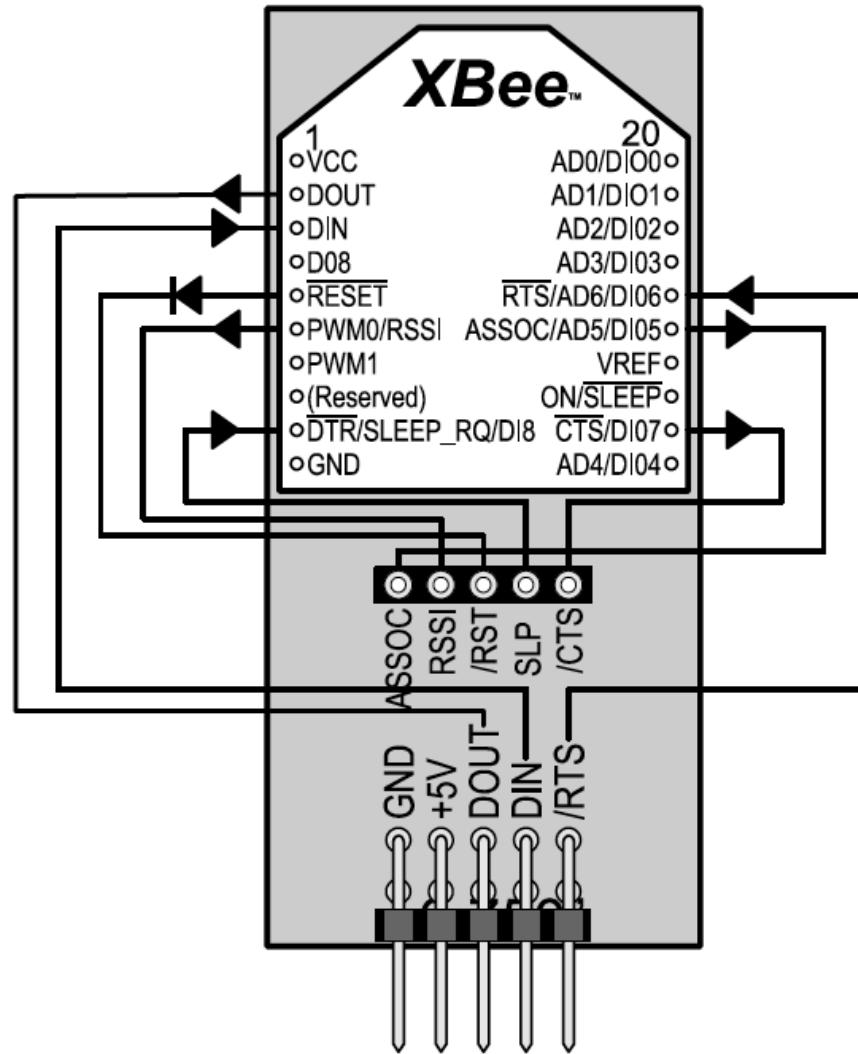
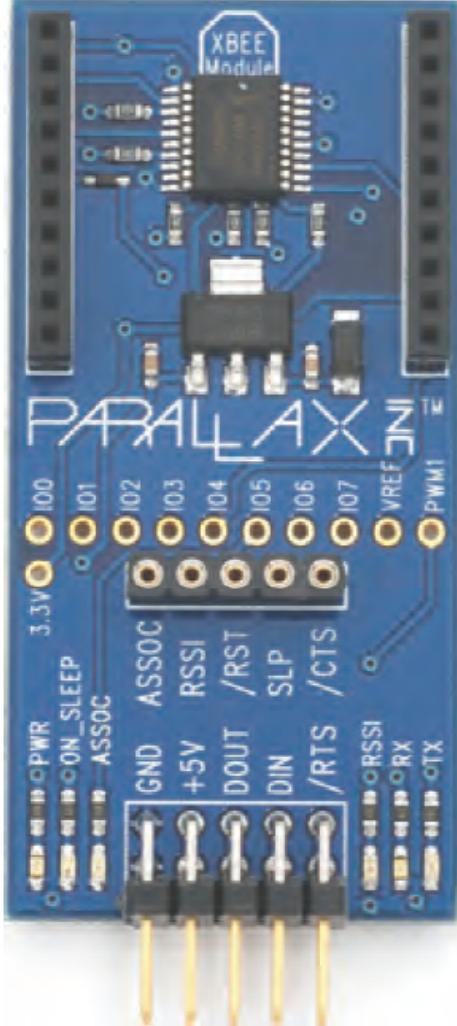


Plug into the Breadboard

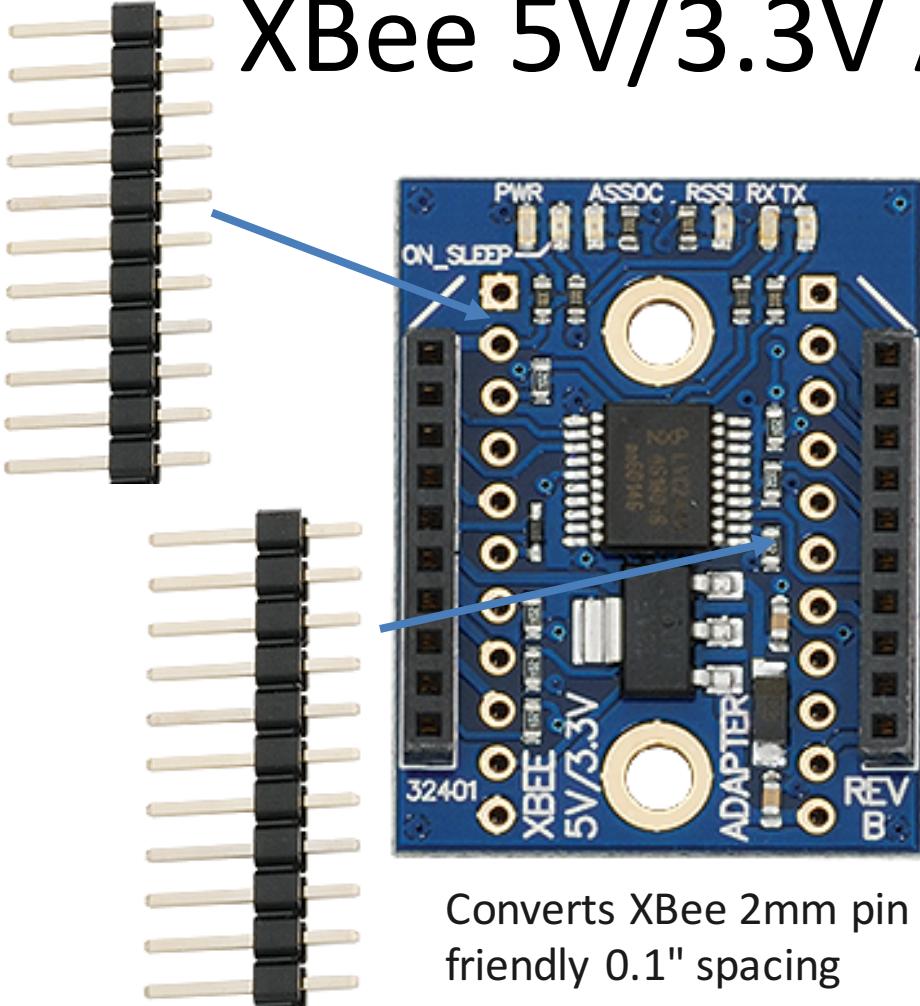
The XBee SIP Adapter is a solution for interfacing a XBee module with microcontroller, such as Arduino or Raspberry Pi.

You typically plug the Adapter board into a Breadboard

# XBee SIP Adapter Board



# XBee 5V/3.3V Adapter Board

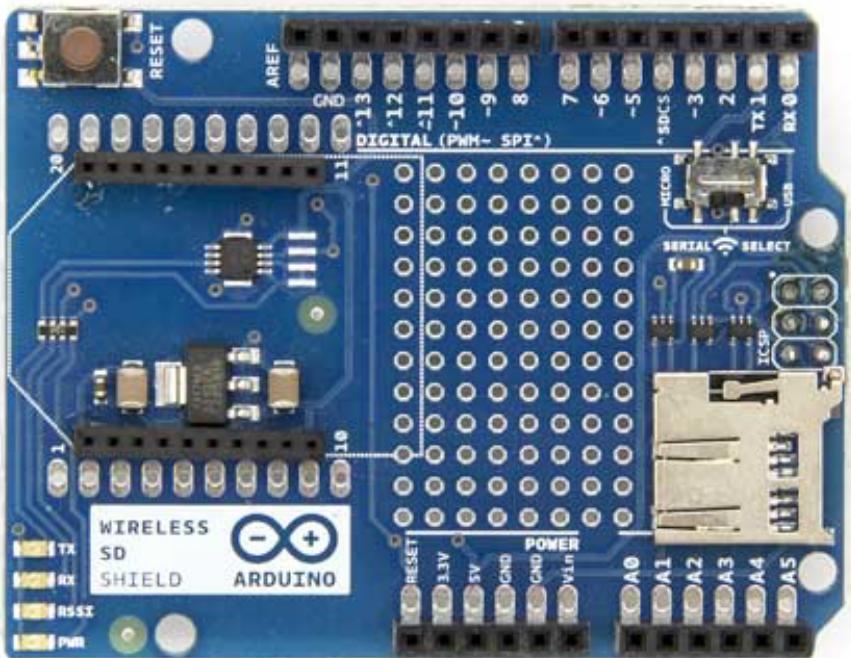


The XBee 5V/3.3V Adapter is a solution for interfacing a XBee module with microcontroller, such as Arduino or Raspberry Pi. You typically plug the Adapter board into a Breadboard

Insert the two 11-pin SIP headers into the bottom of the adapter board as shown and solder them in place from the top.

Converts XBee 2mm pin spacing to breadboard friendly 0.1" spacing

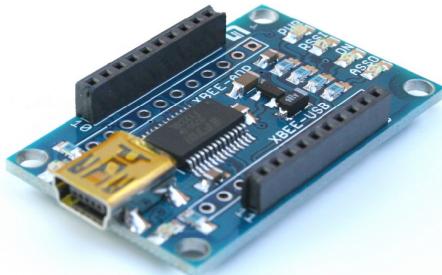
# Arduino Wireless SD Shield



- The Wireless SD shield allows an Arduino board to communicate wirelessly using a wireless module. It is based on the Xbee modules from Digi, but can use any module with the same footprint.
- The module can communicate up to 100 feet indoors or 300 feet outdoors (with line-of-sight).

<https://www.arduino.cc/en/Main/ArduinoWirelessShield>

# PC Configuration, Diagnostics & Test Tool



Connect The XBee USB Adapter Board connects your XBee module to a PC or Microcontroller

Use the Digi XCTU Software in order to Configure or run Diagnostics

<http://www.digi.com/support/productdetail?pid=3352&osvid=57&type=utilities>

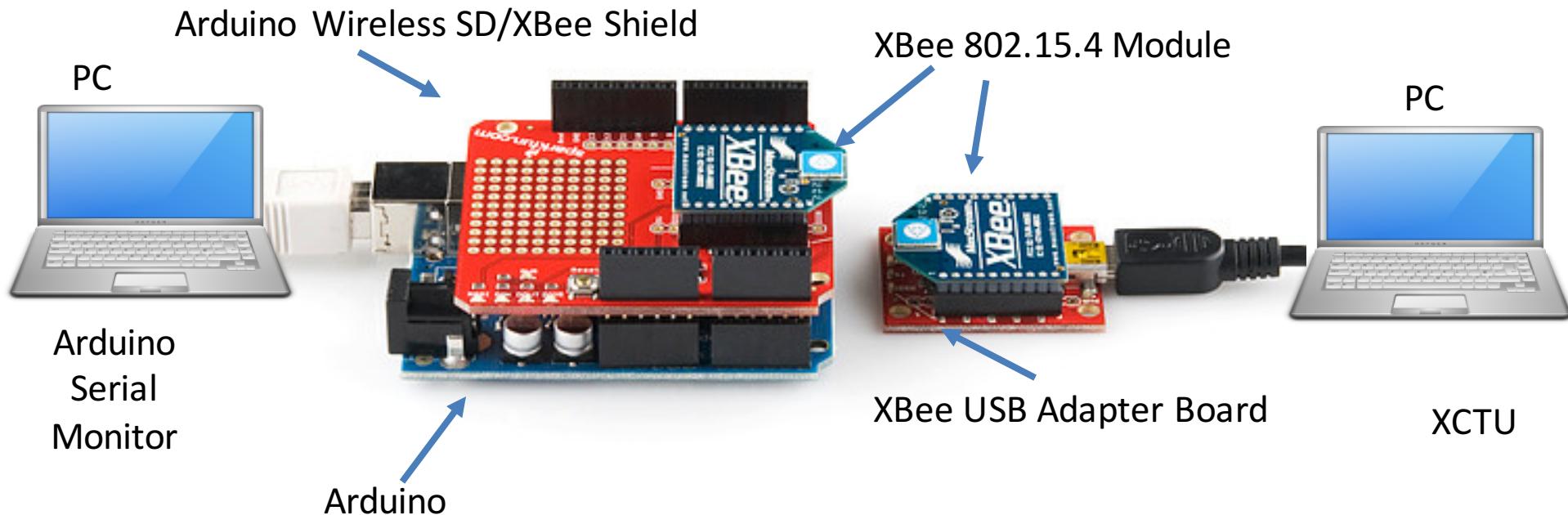
XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. It includes new tools that make it easy to set-up, configure and test XBee RF modules.

<https://docs.digi.com/display/XCTU/XCTU+Overview>

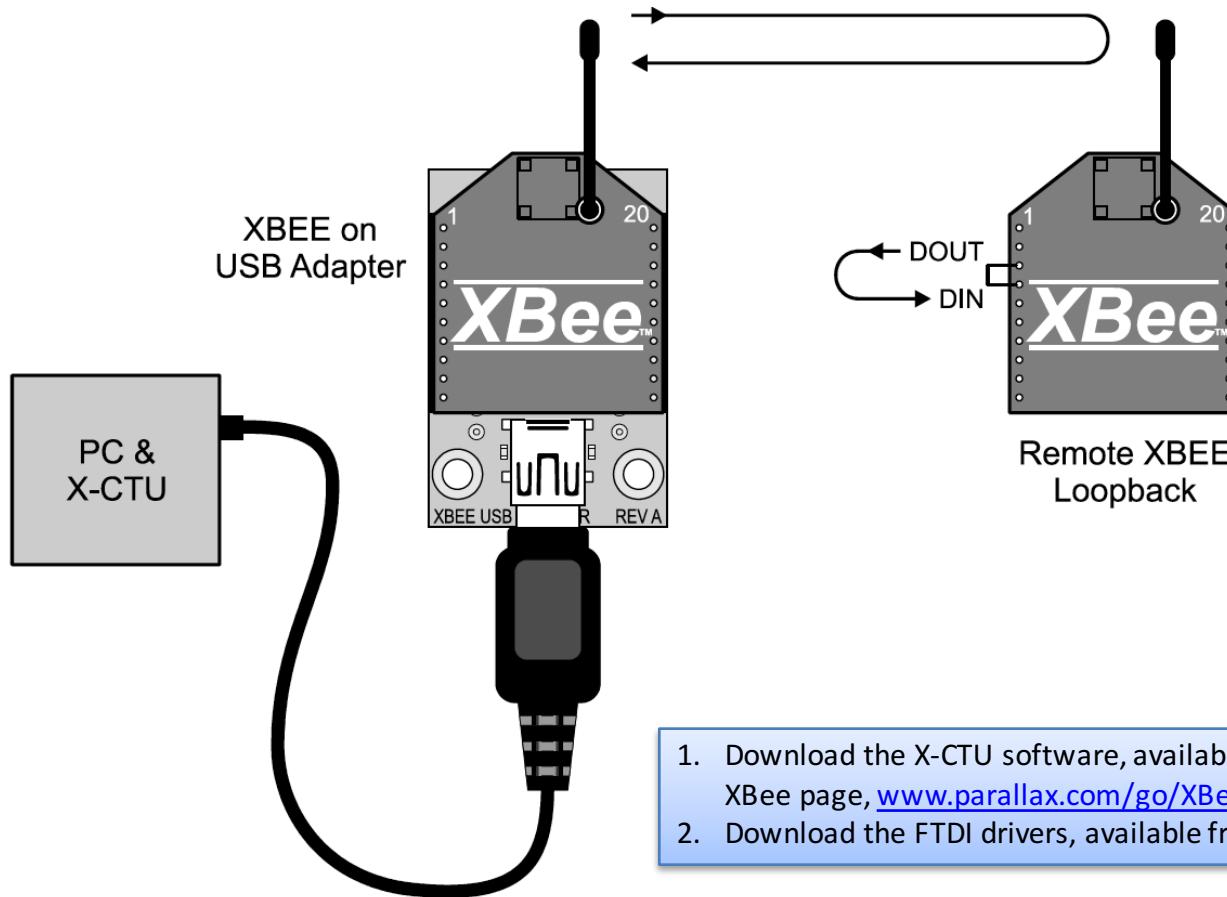
Make sure to install Software before you plug in the hardware!

<https://www.parallax.com/usbdirectors>

# XBee Shield Hookup Guide



# Loopback Test



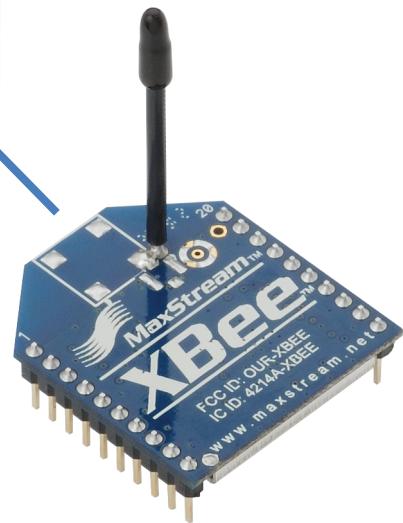
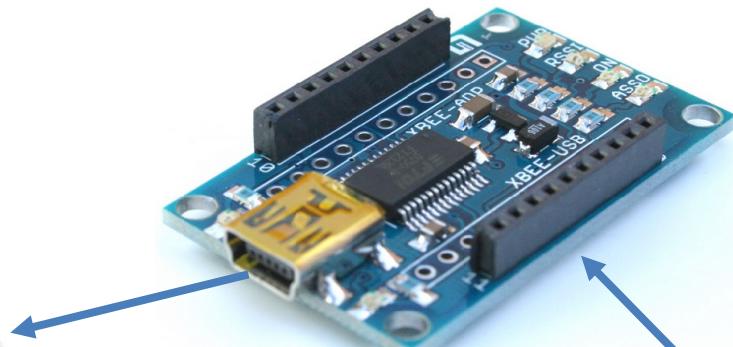
# XBee Examples



<http://examples.digi.com/get-started/basic-xbee-802-15-4-chat/>

# Terminal Programs

PC



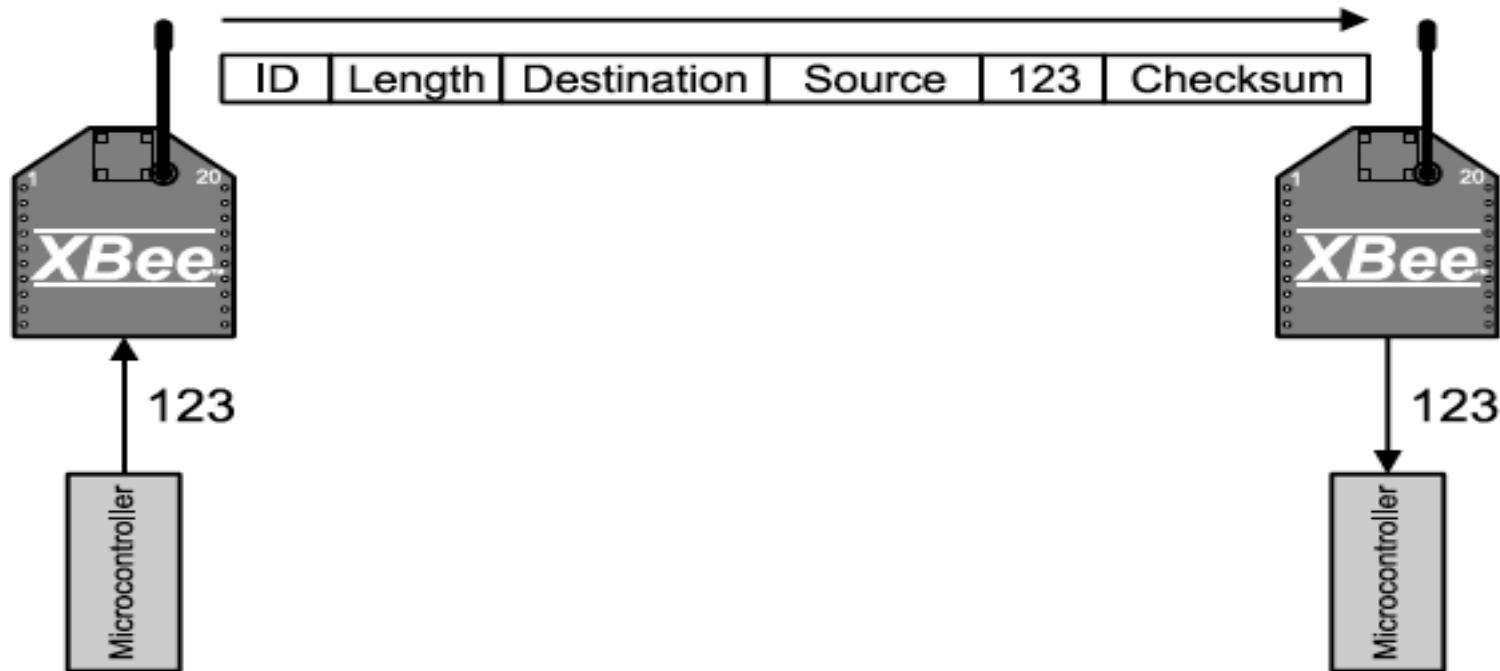
Its handy to use a Terminal Program for Testing

CoolTerm: <http://freeware.the-meiers.org>

PuTTY: <https://en.m.wikipedia.org/wiki/PuTTY#>

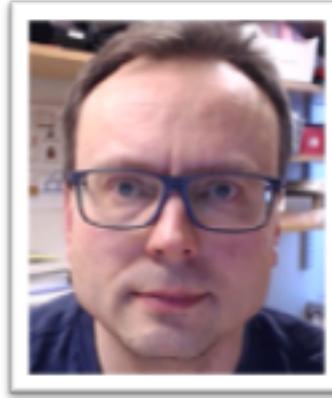
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# XBee Networking





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