

2: Parallax XBee Adapter Boards


The XBee module is a 20 pin DIP package with a pitch of 2 mm (0.079 in) between pins. With typical breadboard and solder board hole spacing of 2.54 mm (0.1 in) the XBee requires an adapter for use with these boards. The XBee is a 3.3 V device. Direct interfacing with the Propeller chip can be done through direct connections. Interfacing with the BASIC Stamp and other 5 V controllers requires line conditioning between the controller's 5 V output and the XBee's 3.3 V input pins. The XBee's 3.3 V output can directly drive the 5 V input logic of the controllers. Additionally, a 3.3 V supply is required to power the XBee. Finally, to access the XBee from the PC for communications or configuration, a means of serial interfacing the computer is needed, such as using USB and a serial interface IC. Parallax has developed a series of interface boards for the XBee for ease of physical interfacing, signal conditioning, power supply requirements and computer connectivity.

BASIC Stamp, SX and other 5 V Controllers

The BASIC Stamp and other 5 V controllers need an adapter that:

- Uses the 5 V supply available to provide regulated to 3.3 V for the XBee supply power.
- Conditions the 5 V logic output to 3.3 V for input to the XBee.
- The Parallax XBee 5V/3.3V Adapter Board and the XBee SIP Adapter Board provide both these functions while providing pin headers suitable to 2.54 mm (0.1 in) breadboards and solder boards. They contain a 3.3V voltage regulator and a 5V to 3.3V logic buffer.

XBee 5V/3.3V Adapter Board

 This section pertains to the XBee 5V/3.3V Adapter Board Rev A. A Rev B board is in development, that will have I/O buffering and LED configurations similar to the XBee SIP Adapter discussed in the next. Schematics for both board revisions are included in Appendix A.

The XBee 5V/3.3V Adapter board in Figure 2-1 has two 11-pin headers with 2 buffered inputs to the XBee: DIN (Data into XBee for transmission) and RTS (for flow-control). The XBee's Reset pin is connected through a diode to allow the controller to bring it low but not high. It also allows direct connections to all other XBee I/O pins. The board has 4 LEDs to indicate Power, Association status, RSSI (Received Signal Strength Indication) and Sleep status. The board uses a 3.3 V regulator for power to the XBee from the BASIC Stamp's 5 V Vdd supply.

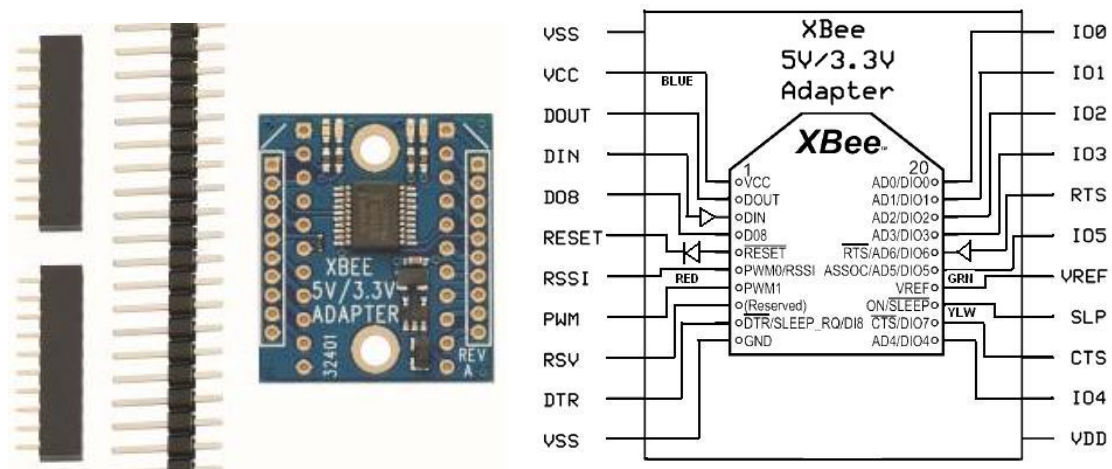


Figure 2-1: XBee 5V/3.3V Adapter Board (unassembled) & I/O Conditioning

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I/O Connections: Connections to the directly connected I/O pins should be performed with an understanding of use and signal conditioning needed. See Chapter 6 for more information.

LED Indication: The connected Tx and Rx LEDs do not show RF data transmitted and received, but data transmitted to and received from the XBee (data in and data out of XBee). In many cases this will be data sent and received via RF but not always.

Figure 2-2 shows typical connections to the 5V/3.3V SIP adapter for communications, power and optional LEDs to indicate data transmitted to and received by the BASIC Stamp. The XBee, when configured properly, can use the RTS input to wait for a low signal from the BASIC Stamp before sending data to the controller. This allows buffering of received data until the BASIC Stamp is ready to receive.



CAUTION!

VCC may be used as a 3.3V supply output, but the FAN2500S33X regulator used on the adapter is only rated at 100mA continuous, 300mA peak current..

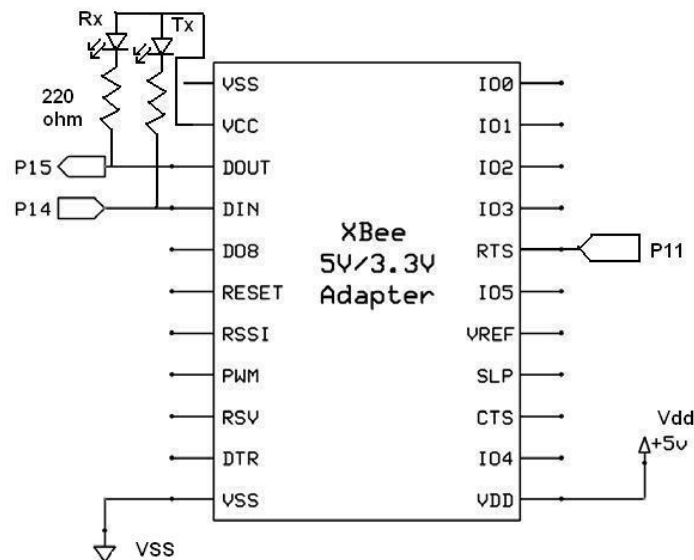


Figure 2-2: Typical Connections to XBee 5V/3.3V Adapter with Tx/Rx LEDs

The LEDs on the adapter board itself indicate:

- **Yellow:** ON/Not Sleeping: This will typically be on unless you configure the XBee for one of the low-power sleep modes.
- **Blue:** Power – Indicated 3.3V power available.
- **Green:** Associate – This LED will typically be blinking unless using the associate mode of joining a network (not covered in this tutorial) or by changing the pin configuration covered later.
- **Red:** RSSI indicator - The XBee PWM output indicated strength of received RF signal. This LED will light for several seconds anytime the XBee receives RF data addressed to it. A slight dimming at low power levels may be noticeable.

XBee SIP Adapter Board

The XBee SIP Adapter Board has features similar to the 5V/3.3V Adapter, but conditions more I/O and provides on-board Tx and Rx LEDs. As shown in Figure 2-3, the adapter has 5 V to 3.3 V buffering for the following inputs: DIN, RTS, DTR/Sleep_RQ. From the XBee, the following outputs are also buffered from 3.3 V to 3.3 V for protection but not level change: DOUT, CTS, ASSOC, and RSSI. Reset once again uses a diode to allow the controller to bring the input low. A solderable header (not shown in drawing) allows direct connections to AD/DIO0 to AD/DIO7 and a connection for 3.3V.

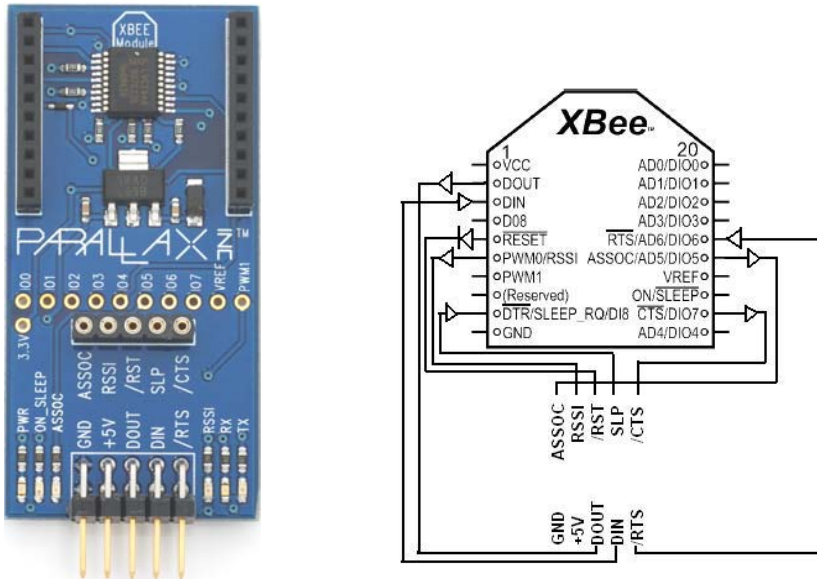


Figure 2-3: XBee SIP Adapter & I/O Conditioning

! **CAUTION!** Connections to the directly connected I/O pins should be performed with an understanding of use and signal conditioning needed. Please see Chapter 6

Figure 2-4 shows a typical connection the adapter to a BASIC Stamp. RTS is once again used for flow control of data from the XBee to the BASIC Stamp.

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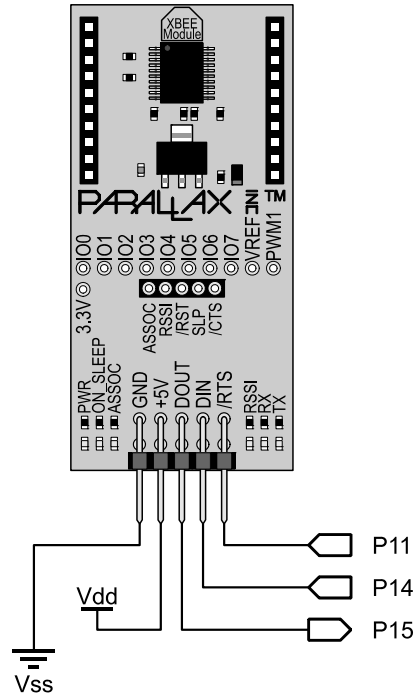


Figure 2-4: Typical Connections to XBee 5V/3.3V SIP Adapter

The LEDs on the adapter board indicate:

- **PWR:** Indicates 3.3V power available.
- **ON_SLEEP:** Will typically be on indicating the unit is awake unless you configure the XBee for one of the low-power sleep modes.
- **ASSOC:** This LED will typically be blinking unless using the associate mode of joining a network (not covered in this tutorial) or by changing the pin configuration covered later.
- **RSSI:** The XBee PWM output indicated strength of received RF signal. This LED will light for several seconds anytime the XBee receives RF data addressed to it. A slight dimming at low power levels may be noticeable.
- **RX:** Indicates data received by the controller from the XBee (DOUT).
- **TX:** Indicates data transmitted by the controller to the XBee (DIN).



LED Indication:

The TX and RX LEDs do not show RF data transmitted and received, but data transmitted to and received from the XBee (data in and data out of XBee). In many cases this will be data sent and received via RF, but not always.

Propeller Chip and other 3.3 V Microcontrollers

The Propeller chip and other 3.3V microcontrollers may use the above two boards as well:

- The Propeller board's 3.3V V_{dd} supply may be supplied to the VCC pin of the XBee 5V/3.3V Adapter board and connecting VSS.
—OR—
- The Propeller board's 5 V supply to the XBee 5V/3.3V Adapter's VDD or the 5 V input of the XBee SIP Adapter and connecting VSS.

The XBee USB Adapter Board (next section) may also be used with USB disconnected:

- By supplying 5 V to the VDD input and connecting VSS.
—OR—
- By supplying 3.3 V to the VCC pin of the USB Adapter Board and connecting VSS.

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Beware of Dueling Power Supplies!

Take care with all boards that two sources of powers are not applied, such as connecting both 5V AND 3.3V supplies. Damaging current will flow between the two sources.

But since both the Propeller chip and the XBee can operate from 3.3 V, all that may be needed is the adapter for 20-pin 2 mm headers of the XBee. The XBee Adapter Board provides this solution. In some mounting situations, no adapter board may be needed.

XBee Adapter Board

This board simply converts the 2 mm pin spacing to 2.54 mm (0.1 in) for use on breadboards and solder boards. Figure 2-5 illustrates the connections for this board.

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Note: VDD on this board is NOT used.

VDD on this board is only included for pin compatibility with the other adapter boards. 3.3 V power is connected at VCC.

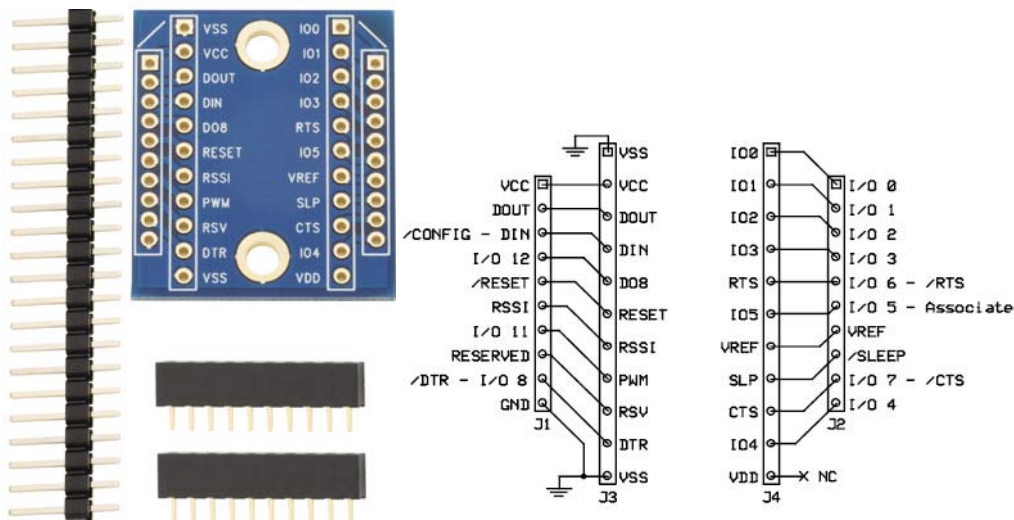


Figure 2-5: XBee Adapter Board (un-assembled) and Connections

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This board has no LEDs. LEDs for communications indication, RSSI, Association and Sleep modes may be optionally connected as shown in Figure 2-6 (some chapters use these LEDs for experiments).

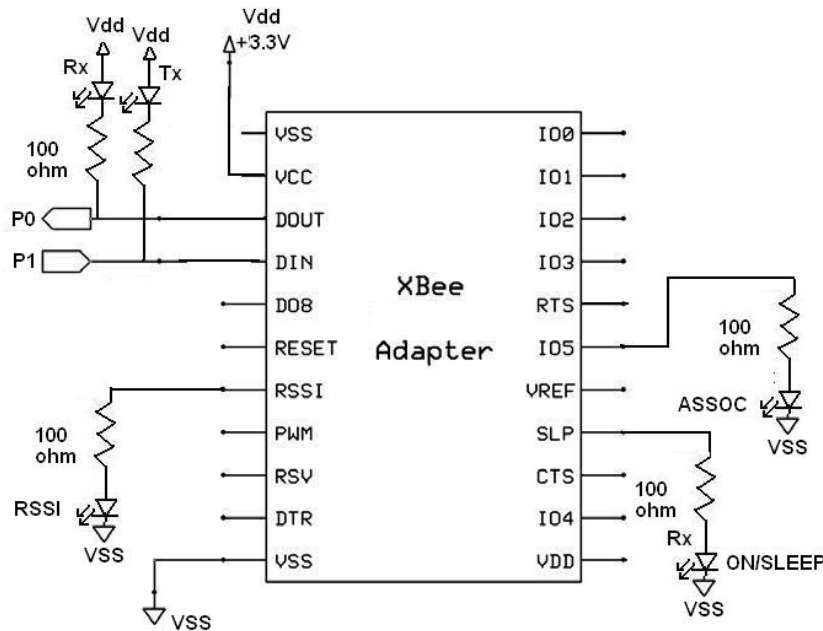


Figure 2-6: Propeller to XBee Adapter with Optional LEDs

Direct PC Interfacing with USB

Just as a microcontroller can communicate serially to the XBee, so can a personal computer. While any terminal program, such as Parallax Serial Terminal, HyperTerminal[®] or the BASIC Stamp Editor's Debug Terminal can send and receive serial data, the X-CTU software from Digi International may be used as a serial terminal, for configuration changes, testing RSSI levels and to download different firmware to the XBee with the right interface.

XBee USB Adapter

The XBee USB Adapter, shown in Figure 2-7, provides a serial interface using the FTDI USB serial interface chip (FT232RL) and virtual COM port drivers to emulate a serial COM port. This board provides the following features:

- Send/Receive serial data between the PC and the XBee for communications and configuration.
- Self-powered from USB for 5 V and 3.3 V.
- Incorporates the DTR (Data Terminal Ready) line needed for firmware downloads.
- May be powered from a 5 V source via VDD input or 3.3 V to VCC when operating without USB.

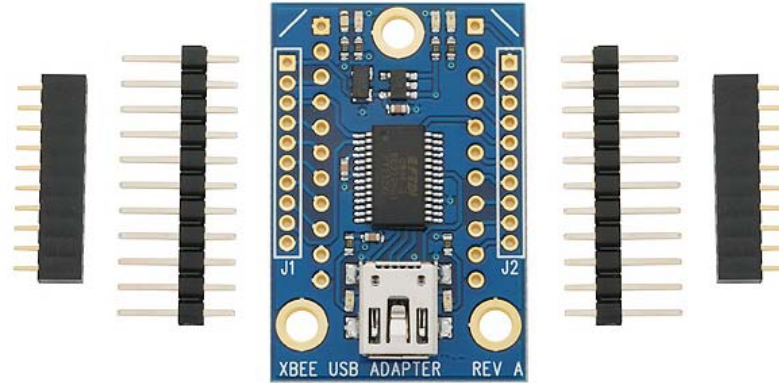


Figure 2-7: XBee USB Adapter Board (un-assembled)

LEDs on the board indicate the following:

- **Green:** ON/Not Sleeping. This will typically be on unless you configure the XBee for one of the low-power sleep modes.
- **Yellow:** Power. Indicates 3.3 V power is available.
- **Red:** Associate. This LED will typically be blinking unless using the associate mode of joining a network (not covered in this tutorial) or by changing the pin configuration covered later.
- **Blue:** RSSI indicator. The XBee PWM output indicated strength of received RF signal. This LED will light for several seconds anytime the XBee receives RF data addressed to it. A slight dimming at low power levels may be noticeable.
- **Red:** USB Transmit
- **Green:** USB Receiver

For use with the PC, simply connect the appropriate USB cable between the PC and the board with an XBee installed. For use with the Propeller, connect per Figure 2-6 as with the XBee Adapter. LEDs may also be added for transmit and receive between the Propeller and XBee.



Beware of Dueling Power Supplies!

Take care with all boards that two sources of powers are not applied, such as connecting both 5V AND 3.3V supplies. Damaging current will flow between the two sources.



3.3 Volt Supply

When connected to USB, the 3.3 V pin may be used to supply power, but current draw should be limited to 40 mA.

Using a Propeller Chip and Serial_Pass_Through.spin

Chapter 4 introduces programming of serial communications. One example program is **Serial_Pass_Through.spin**. This passes serial data between the PC and XBee. A non-USB adapter board and the Propeller can be used for the PC interface. The only function this configuration cannot provide is updating firmware on the XBee.

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Summary

Parallax provides a variety of boards for interfacing the XBee to their 5 V and 3.3 V microcontrollers, as well as a USB interface version for PC communications and configuration of the XBee. In Chapter 3 we will explore basic communications and configuration of the XBee using the PC, the BASIC Stamp, and the Propeller Chip. Table 2-1 is a list of available adapter board options from Parallax.

Table 2-1: Microcontroller Platforms and Adapter Board Options

Processor Platform	Adapter Board Options	Board Stock Code
BASIC Stamp and other 5 V microcontrollers	XBee 5V/3.3V Adapter with 5 V supplied to VDD pin.	32401
	XBee SIP Adapter with 5 V supplied to 5 V pin.	32402
Propeller chip and other 3.3 V microcontrollers	XBee Adapter using 3.3 V supplied to VCC pin	32403
	XBee 5V/3.3V Adapter with ONE of these options: <ul style="list-style-type: none">▪ 5 V supplied to VDD pin▪ 3.3 V supplied to VCC pin	32401
	XBee SIP Adapter with 5 V supplied to 5 V pin.	32402
	XBee USB Adapter with ONE of these options: <ul style="list-style-type: none">▪ 5 V supplied to VDD pin▪ 3.3 V supplied to VCC Pin	32400
PC Interfacing	XBee USB Adapter Board, powered from USB only.	32400
	Interfacing via Propeller using Serial_Pass_Through.spin and any Propeller adapter option per Chapter 4	Any of the above