DATAWAVE

Wireless Bridge Analog & Digital I/O

USERS MANUAL

R02

Contents

Overview

The ADIO Wireless Bridge is configurable Analog or Digital input and output wireless transmission device. It is designed measure and replicate Analog or Digital I/O signals and wirelessly transmit those signals to a second ADIO Wireless Bridge device. Alternatively, it can be used in conjunction with the RS-232, RS-485 or USB Wireless Bridges to measure and transmit data back to a serial host device. In this mode it can act as a medium to be a wireless data logger.

The ADIO Wireless Bridge has a five pin screw terminal block for the four channels and a micro USB port for radio and device configuration specific to the ADIO Wireless Bridge. Data is also available on the micro USB port. By default, the ADIO Wireless Bridge is configured to measure up to four 0-10V Analog inputs. Inputs can also be configured for Digital inputs (3.3V and 5V tolerant) or for 4-20mA inputs. The four channels can also be configured as 0-10V Analog outputs or as Digital signal outputs.

Specifications

Absolute Maximum Ratings

		MIN	MAX	UNIT
VDC	Supply Voltage	6.5	36	V
V_I	Input Voltage on any I/O	-0.3	10.5	V
I_O	Output Current		1	mA
I_{IN}	4-20mA Input current	0	21	mA

Recommended Operating Conditions

		MIN	MAX	UNIT
VDC	Supply Voltage	7	30	V
V_{IH}	Digital High-level input voltage V		2.1	V
V_{IL}	Digital Low-level input voltage V	0.8		V
I_{IN}	Current Loop input	0	20	mA
A_{IN}	Analog input voltage range	0	10.1	V
Accuracy	Input to Output accuracy over temperature	0.50		%
Tsample	Signal Sample rate	30 min	50ms	

Performance

	24LP	24HP	09SX
OVER-THE-AIR DATA RATE	250 Kbps	250 Kbps	Low: 10Kbps Mid: 110Kbps High: 250Kbps
INDOOR/URBAN RANGE	Up to 200ft.	Up to 300ft.	Up to 1000ft.
OUTDOOR/ RF LINE-OF-SITE RANGE	Up to 4000ft.	Up to 2 miles	Up to 10 miles
TRANSMIT POWER	6.3 mW	63 mW	1 Watt
RECEIVE SENSITIVITY	-101 dBm	-101 dBm	Low: -113 dBm Mid: -106 dBm High: -103 dBm

Table 1. General Performance Specifications

Power Requirements

	24LP	24HP	09SX
INPUT VOLTAGE	7-30VDC	7-30VDC	7-30VDC
TRANSMIT CURRENT	12mA @ 12V	40mA @ 12V	270mA @ 12V
RECEIVE CURRENT	12mA @ 12V	12mA @ 12V	17mA @ 12V

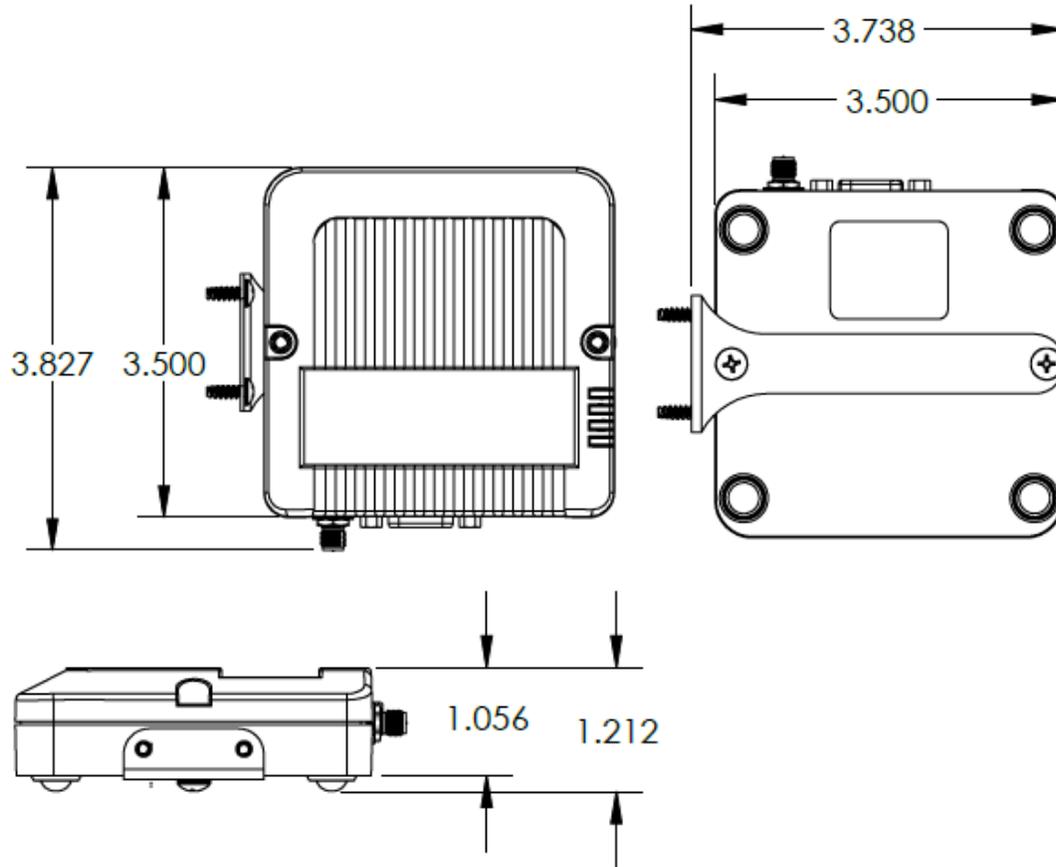**Table 2. Power Requirements**

Mechanical

Fig. 1 Mechanical Dimensions

The mechanical dimensions for the Wireless Bridge are shown in Figure 1. The mechanical dimensions are shown with the optional DIN rail mount bracket which is not included with the standard part number. Mechanical data for the antenna is not shown.

Pinout and Wiring

The uses a five pin screw terminal for I/O signals. Pin 5 is ground. Figures 2 & 3 show the connectors and pinout for the ADIO Wireless Bridge.

SCREW TERMINAL ADIO PINOUT		
PIN	Name	Direction
1	Channel 1	Default Input
2	Channel 2	Default Input
3	Channel 3	Default Input
4	Channel 4	Default Input
5	Ground (GND)	Signal Ground

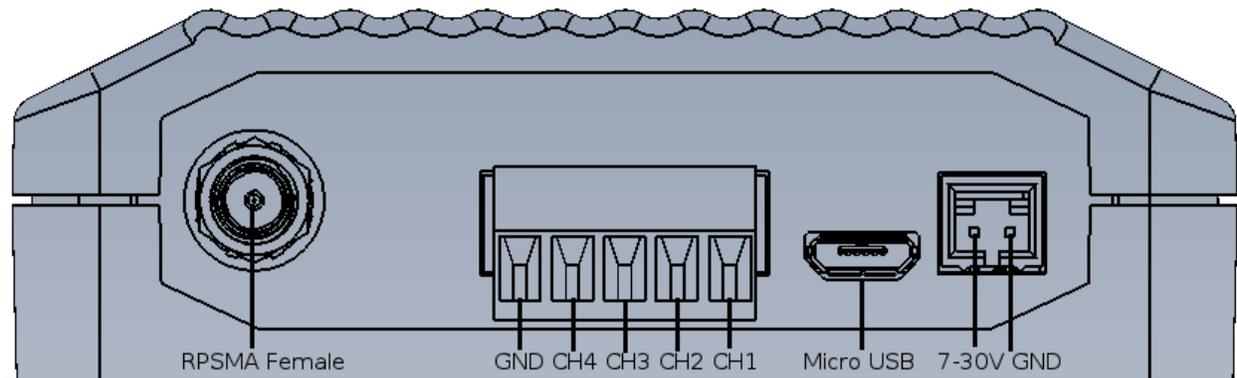**Fig 2. Screw Terminal Pinout**

Fig 3. Wireless Bridge Connectors and Pins

Operation

Standard Operation

The ADIO Wireless Bridge is intended to measure Analog or Digital Input data lines and wirelessly transmit those signal levels to a second ADIO Wireless Bridge to output the measured signal levels. By default, any data sent into one device is broadcast and received by all other Wireless Bridge devices within range. The ADIO uses channel tokens to control which devices respond to the data. Additional addressing can be used to isolate communication between specific devices or to create unique networks.

The Wireless Bridge device is equipped with a micro USB connector. When the micro USB connector is plugged into a USB host device such as a computer, the Wireless Bridge enumerates as two standard serial COM ports. One port is a data port and can send and receive data. The second COM port is the device's information port.

The Wireless Bridge uses standard composite device drivers are preinstalled in Windows 10 and MAC computers. Drivers will need to be installed for Windows 7 machines. While not every machine will

enumerate exactly the same, as a general rule the lower numbered COM port is for Wireless Bridge configuration. The higher numbered COM port can be used to transmit or receive data over the USB port.

LED Indication

The wireless bridge has four LEDS for indication. The Blue Power LED is lit any time the Wireless Bridge is properly powered. A green TX LED and a yellow RX LEDs indicate activity on the serial port of the device. They do not necessarily reflect all activity that may be occurring over the air as they will only blink when a properly addressed data packet is received. The Special function LED is lit when the USB port is in use.

Data Formats and Baud Rates

Since the ADIO Wireless Bridge only communicates with a computer through the micro USB COM port, baud rate is not a parameter that needs changed for most use cases. The default baud rate and data format is 9600 baud, 8 data bits, no parity and one stop bit. The baud rate and data format can be adjusted by adjusting the BD and NB parameter of the radio module (See the Changing the Baud Rate section). Baud rates can be set from 1200 to 115200 bps. If the data of the sending or receiving devices do not correspond with the data settings of the Wireless Bridge then the output data will be appear garbled.

Communicating with the Wireless Bridge

The Wireless Bridge device can be connected to a computer through the micro USB port. Figure 4 shows the device manager view of an example connected device. Note that a single device shows up as two separate COM ports. In Figure 6, the COM ports are COM43 & COM44. The COM port numbers will vary from machine to machine depending on what COM port device drivers have been previously installed.
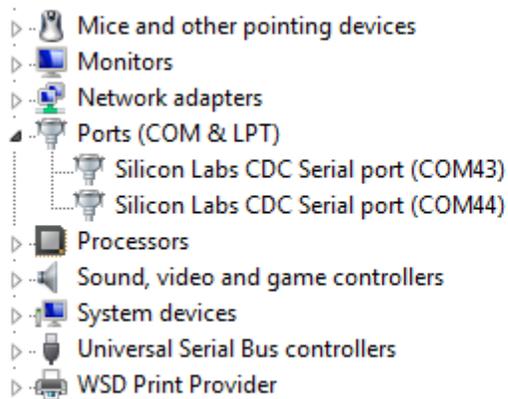

Fig. 4 Example COM port Device Manager View

COM ports can be opened with any terminal program. Putty, Tera term and X-CTU may all be used to send data and communicate with the Wireless Bridge. Links to some terminal programs can be found on the Datawave website.

Once a COM port has been opened, pressing the ENTER key can determine which port is the *data* terminal and which port is the *information* terminal. If a command prompt appears, than that port is the *information* terminal. The command prompt for the ADIO Wireless Bridge indicates the Wireless Bridge type and appears similar to the text below.

ADIO>

Typing 'help' at the command prompt will display the list of available commands as shown in Figure 5. Any data typed into the data terminal window will result in the data being transmitted. This can be confirmed by watching the TX LED blink when data is sent.
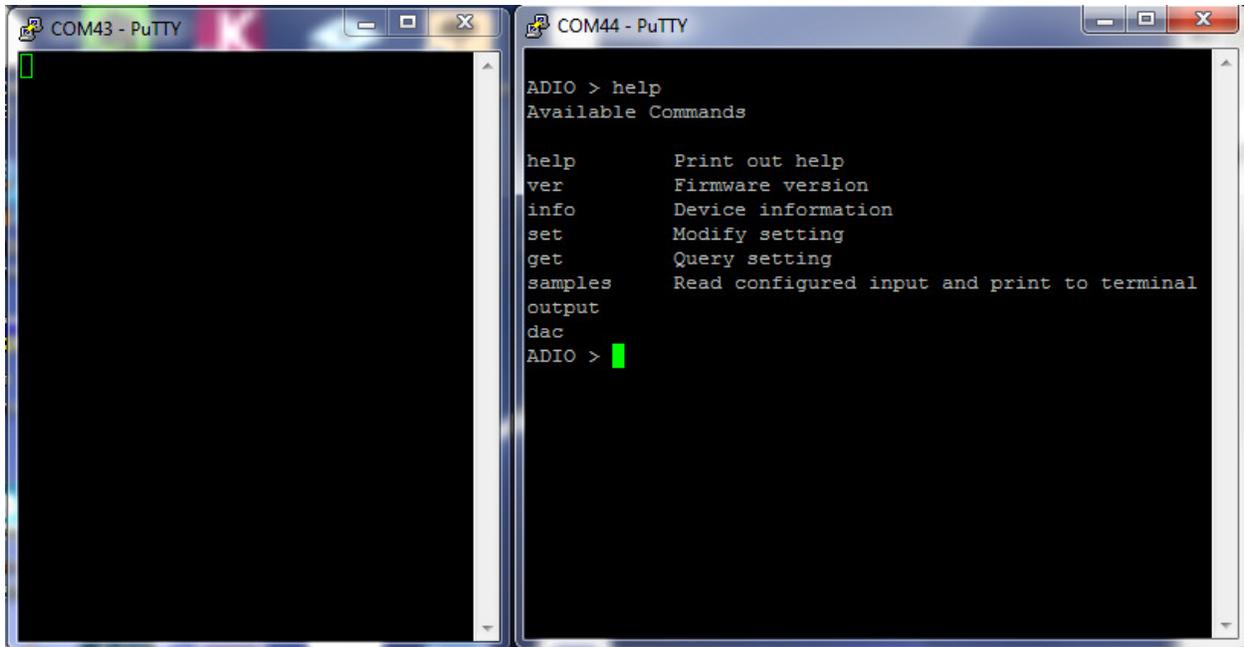
Fig. 5 Data and Information Terminals

Common Configurations and Use Cases
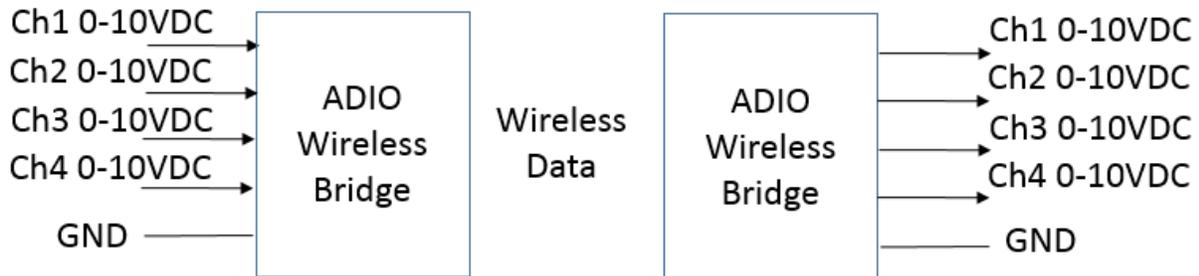
Analog Signal Bridge

Fig. 6 Typical 4 Channel Analog input to Analog Output Signal Bridge

A common configuration for the ADIO Wireless Bridge is as an Analog signal bridge. By default the ADIO Wireless Bridge is configured to accept 0-10V analog inputs. By configuring a second Wireless Bridge for Analog outputs the analog input voltages on the transmitting radio will appear at the outputs on the receiving radio. Not all channels need to be the same type. Each channel can be configured as an analog input, analog output, 4-20mA input, Digital input or a Digital output. For simplicity, Figure 6 shows one radio with all Analog inputs and a second device with all Analog outputs.

Devices use channel tokens to determine if signals should be replicated and output. For I/O line passing to occur, one channel must be an input and the corresponding channel must be set to be an output. The channel token values must also match. It is possible to have a single input driving the signal outputs on multiple radios.

To set up the Wireless Bridge for Analog I/O line passing:

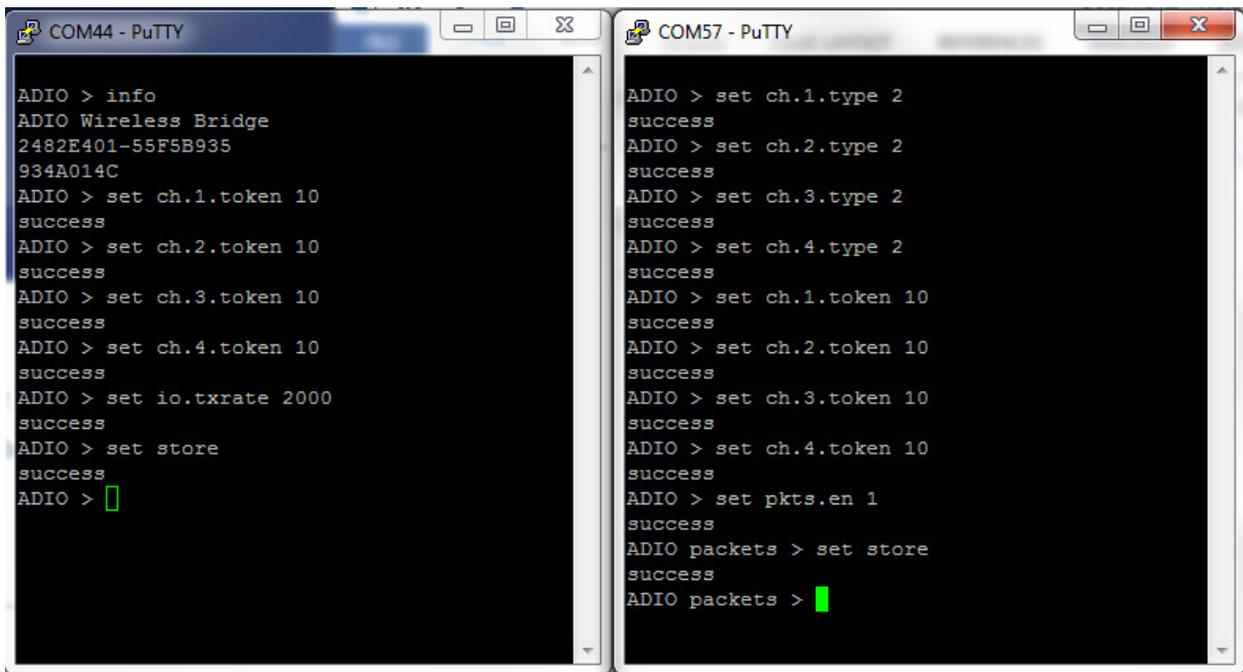For any radio with Analog *inputs:*

1. Set the channel token value for each channel that will be used. This value can be different for each channel or it can be the same, but a value set in channel 1 will not enable a different channel. To set a channel token at the command prompt type:
   ADIO> set ch.X.token YYYY where "X" is the channel number 1-4 and "YYY" is any value from 0 up to 4 million.

2. Set the io.txrate value in milliseconds.
3. Use set store to save the configuration.

For the radio with Analog *outputs:*

1. Set the channel type
2. Set the channel token value to match the value of the input channel token.
3. Set pkts.en parameter to 1.
4. Optional: Use set store to save the configuration

Example:

Figure 7 shows a setup for two radios. COM44 is the information COM port of Radio A and COM57 is the information COM port of Radio B. In this example, Radio A is the input radio and Radio B is the output radio. The same value was used for the channel tokens on all channels in this example. The channel types on Radio B were set to analog outputs (type 2) and the pkts.en command was set to 1.

Fig. 7 Typical 4 Channel Analog input to Analog Output Signal Bridge

Digital Signal Bridge

This is similar to the analog signal bridge except that the outputs will transition when the inputs cross logic voltage thresholds. The High input voltage threshold is 2.1V and the low threshold is 0.8V. By default the high output voltage is 3.3V but this can be adjusted with the chX.lvl.dovolts command. See the ADIO command reference table for details. For digital I/O line passing the following setup should occur. Optional parameters are noted.

Input radio:

1. Set the ch.X.type to 3
2. Set the ch.X.token value
3. Optional: Set ch.chX.cd if you want the radio to transmit only on an input signal change. Also set cd.rate if this parameter is used.
4. Set the io.txrate parameter if change detect is not used
5. Optional: Use set store to save settings to non-volatile memory.

Output radio:

1. Set the ch.X.type to 4
2. Set the ch.X.token value
3. Set the pkts.en command to 1.
4. Optional: set default starting voltage, timeout and output voltage level if desired.
5. Optional: Use set store to save settings to non-volatile memory.

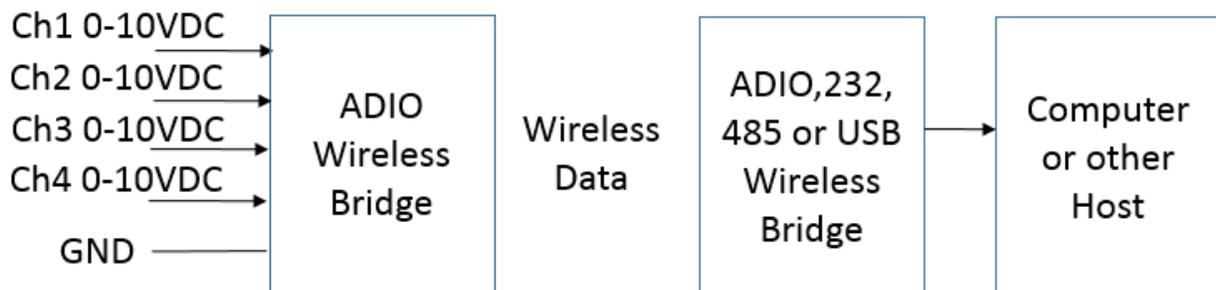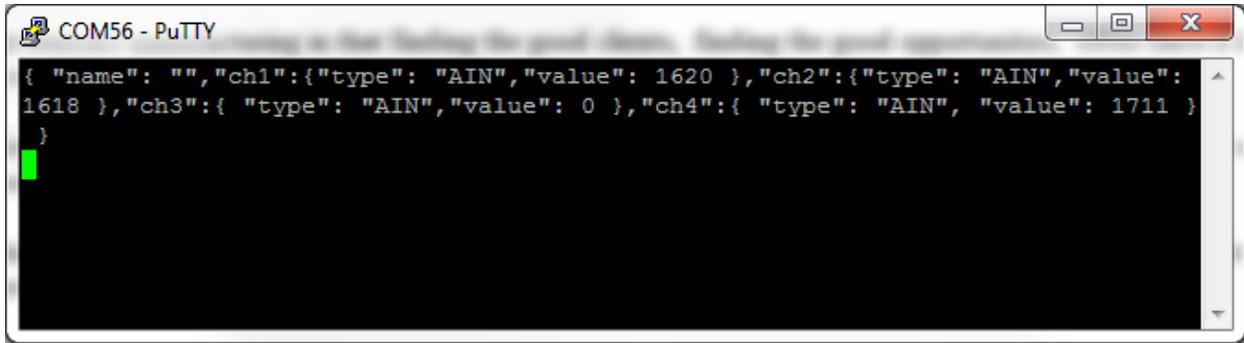## Wireless Data Collector

Fig. 8 Wireless Analog Data Collector

The other Datawave Wireless Bridge products can receive and process data from the ADIO Wireless Bridge. Figure 8 shows the typical architecture for this scenario. The ADIO Wireless Bridge can transmit the status of the Input channels at an interval specified by the io.txrate command. With the pkts.en command set to 1, the receiving radios output the data in JSON (default) or simple text format. Figure 9 shows an example output packet. In Figure 9, the name field is blank and all the channels of the transmitting radio are set to analog inputs (AIN). The voltage value of each channel is shown in millivolts.

Fig. 9 Example JSON Packet Output

ADIO Command Reference Table

Main command	Function Command Name	Command Description	Default Value	Value Range
help		Displays list of main commands	NA	No parameters
info		Displays device serial number	NA	No parameters
sample		Outputs sample inputs in mV to the information port	NA	No parameters
set & get	chX.lvl.dovolts	Determines the Digital output voltage level. Parameter is in millivolts. ch.1, ch.2, ch.3 & ch.4	3300(3.3V)	0-10000 mV
	ch.X.lvl.def	Determines the starting default voltage level as well as the return level for signal timeout.	0	0-10000 mV
	ch.X.lvl.tmo	If a radio packet is not received, the output channel will return to the value set in ch.X.lvl.def. The io.txrate should be set shorter than this timeout value if used.	0	0-1800000ms
	ch.X.token	Sets the channel communications token. In order for I/O line passing, channel tokens *must* match for a specific channel to be set for I/O line passing. ch.1, ch.2, ch.3 & ch.4 Example: set ch.1.token 6	0 (Not enabled)	0 – 4 million
	ch.X.type	Sets the IO function type ch.1, ch.2, ch.3, ch.4 0 = off 1 = Analog input 0-10V 2 = Analog output 0-10V 3 = Digital Input 4 = Digital ouput 5 = 4-20mA input Example set ch.2.type 3 (sets channel 2 to a digital input).	1	0-5
	ch.X.cd	Change detect parameter. When enabled with a value of 1, 2 or 3 the Wireless Bridge will send a transmission when a change on a Digital input is detected. 50ms maximum rate. 0 = off 1 = rising edge 2 = falling edge 3 = both	0	0-3
	cd.rate	Change detect sampling rate. Sets the timing for the samples to be detected. Only used for digital inputs.	0	50 – 1800000ms
	defaults	Restores factory default settings.	NA	No parameters

Main command	Function Command Name	Command Description	Default Value	Value Range
	io.txrate	Sets the sample and RF transmission rate. This command must be enabled for I/O line passing	0	50 – 1800000 ms
	io.dataout	Sets the output data format to either text or JSON format. Text = 0, JSON = 1.	1	0 or 1
	io.name	Allows for a user settable string of up to 20 characters. Zeros are sent for all characters that are not set	0	Any 20 characters
	pkts.en	Enables JSON output format when used with an ADIO Wireless Bridge when en = 1	0	0 or 1
	store	Stores settings to non-volatile memory.	NA	No parameters
	uart.rate	Changes the host to internal radio baud rate. This command should be used in conjunction with changing the radio baud rate.	9600	1200 - 115200
ver		Displays loaded firmware version	NA	No parameters

Fig 10. List of ADIO Wireless Bridge Commands

Figure 10 shows a list of commands available to set with the ADIO Wireless Bridge. As with other Wireless Bridge devices, networking modes can be set by using the commands available on the internal Digi XBee radio module. Channel tokens can isolate I/O line passing, but additional network commands can be used to further isolate different networks of devices. Common Networking commands are listed below.

ID – Controls the network identification number

CH – Channel (Frequency) of the XBee radio.

DH & DL – Sets the destination address. For point-to-point mode DH & DL on Radio A should be set to the SH & SL values of Radio B and vice versa.

See the XBee S2C manual and X-CTU program for complete details.

XBee S2C Users Manual

https://www.digi.com/pdf/ds_xbee-s2c-802-15-4.pdf

X-CTU Program – Digi's XBee Configuration and Test Utility

https://www.digi.com/products/xbee-rf-solutions/xctu-software/xctu

Changing the Baud Rate

The Wireless Bridge device is made up of two main components:

1. The host processor
2. XBee radio module

The host processor manages the USB interface, the information menu and communication to and from the XBee radio module. Changing the device's baud rate is a two-step process. In order to change the baud rate successfully, the following steps must be followed *in order.*

1. Change the baud rate on the XBee module through the **data** COM port using AT commands or the X-CTU program. Write the parameter to non-volatile memory.
2. Change the Wireless Bridge device baud rate through the **information** COM port using the set uart.rate command. Write to non-volatile memory using the set store command.

Example:

Changing the baud rate from the default 9600 to 115200 bps.

Step 1: Using the X-CTU program, the XBee radio module is discovered on the data port – in this case COM43. The baud rate is changed to 115200. The "Write" button is used to store the setting.
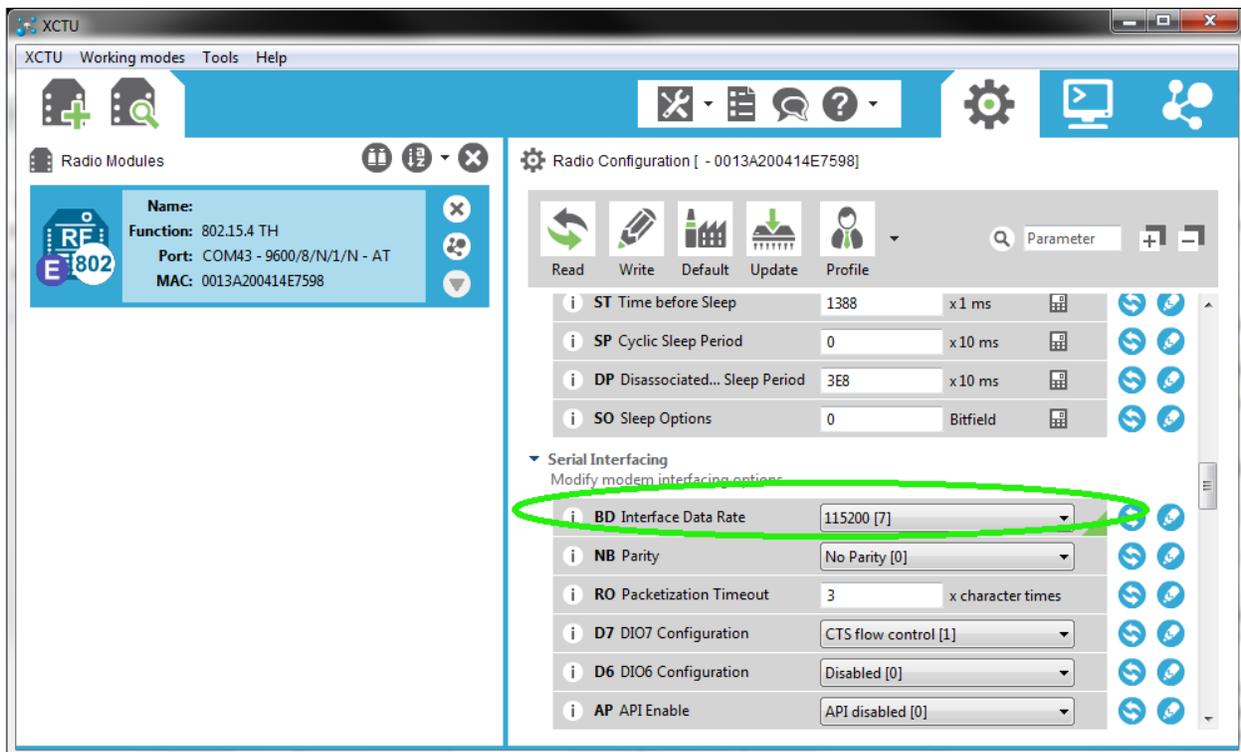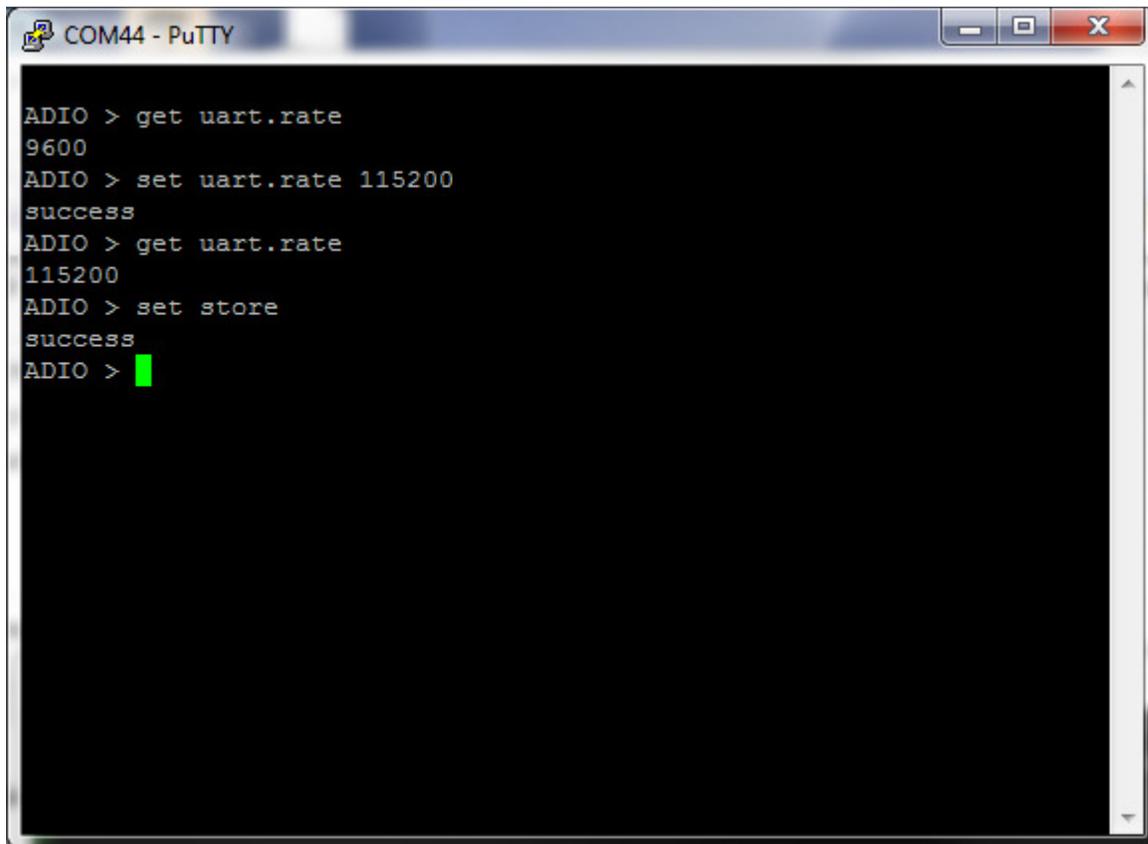

Fig. 11 X-CTU Baud Rate Setting

Step 2: On the Wireless Bridge information terminal – COM44 in this example, the set uart.rate 115200 is issued followed by set store.

Fig. 12 Uart Rate Setting Example

Configuring the XBee Module

The ADIO wireless bridge utilizes the Digi XBee module. Consequently, all radio settings can be read or set with Digi AT commands or The Digi X-CTU software. As a general rule the only commands that might need be set are the Networking and Serial Interfacing commands. Any I/O commands or other features are not used. See Digi's website at www.digi.com and the XBee user manual and discussion forums for more information.

Antennas

The Wireless Bridge uses an RP-SMA Female connector. The Wireless Bridge is approved to be used with any 2.1dBi RP-SMA Male antennas that are frequency compatible. Datawave antenna part numbers include

Part Number: ANT-2400-RP-2-A (2.4 GHz for the 24LP & 24HP variants)

Part Number: ANT-900-RP-2-A (900 MHz for the 09SX variant)

Part Numbers and Compatibility

The RS-485 Wireless Bridge comes with three basic options depending on range requirements. The 24LP and 24HP operate at 2.4 GHz and the 09SX operates in the 902-928MHz band. Any 24xx device can transmit and receive data from an 24xx RS-232, USB or ADIO Wireless Bridge. Likewise for the 09SX families.

Orderable Part Numbers	Description
WB-ADIO-24LP-A	2.4 GHz 6.3mW Wireless Bridge RS-485
WB-ADIO-24HP-A	2.4 GHz 63mW Wireless Bridge RS-485
WB-ADIO-09SC-A	900 MHz 1W power Wireless Bridge 485

Certifications

United States (FCC)

The Datawave Wireless Bridges comply with Part 15 of the FCC rules and regulations.
Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

FCC notices

IMPORTANT: The RF device has been certified for remote and base radio applications.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Re-orient or relocate the receiving antenna, Increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or consult the dealer or an experienced radio/TV technician for help.

Parts manufactured by Datawave Wireless meet the specific requirements of the EU directive (Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment) for the following banned substances:

Cadmium (Cd)	Lead (Pb) (per exemption 6)
Mercury (Hg)	Hexavalent Chromium
Polybrominated Biphenyl (PBB)	Polybrominated Diphenyl ether (PBDE)