User Guide

Babel Buster 2

Models BB2-6010-GW, SPX-GW, SP-GW
Modbus RTU/TCP Non-Mapping Gateway
Rev. 1.0 – Dec. 2015

BB2-6010-GW, SPX-GW, SP-GW User Guide Contents

1. Introduction

1.1 How to Use This Guide

This user guide provides background information on how the gateway works, and an overview of the configuration process. There are several sections for groups of tabs found in the web interface in the gateway which is accessed by opening a web browser and browsing to the IP address of the device.

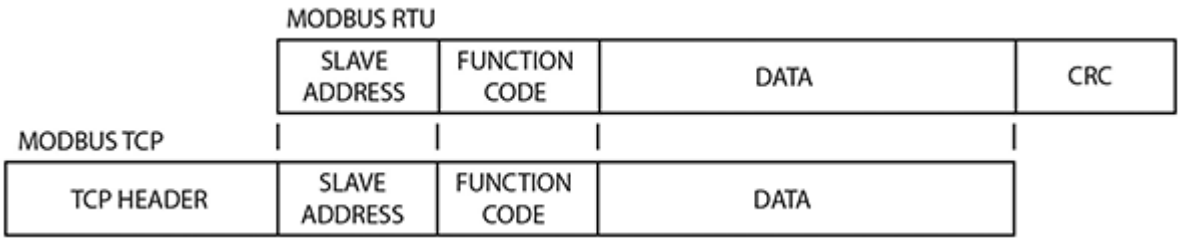
You should at least read the overview sections to gain an understanding of how the gateway functions. You can use the remaining sections as reference material to look up as needed. There is a "Quick Help" section at the bottom of each web page in the gateway which is generally sufficient for quick reference in setting up the gateway.

Throughout this user guide, screen shots taken from a Babel Buster BB2-6010-GW are used to illustrate. However, the same instructions apply to Babel Buster SPX-GW and Babel Buster SP-GW with each available screen looking nearly identical.

1.2 Overview of Gateway Devices

The Babel Buster BB2-6010-GW, Babel Buster SPX-GW, and Babel Buster SP-GW are non-mapping Modbus gateways used to simply forward Modbus RTU requests and responses to Modbus TCP, and vice versa. Most Control Solutions gateways involve mapping, and the gateway itself contains registers or objects which hold copies of data found in other devices. This intermediate data buffering is what allows access to the same data from multiple protocols. The non-mapping gateway discussed here does not contain any of its own registers. It simply forwards whatever request it receives to the other side and simply repackages and retransmites exactly the same request (regardless of whether it was a correct request).

The process of "repackaging" the Modbus request or response is illustrated below. The core of a Modbus data packet is the same for RTU and TCP. It contains a slave address (or unit number), a function code, and some data. The "data" is most often a starting register number, register count, and register data (if writing).



If the data packet is being sent via Modbus RTU, the first character transmitted is the slave address, and the last two characters are a CRC type checksum. If the data packet is being sent via Modbus TCP, there is a TCP header at the beginning of the packet, and the last byte of that packet is the same slave address or unit number that would have been sent via RTU. The RTU checksum is not included because Ethernet has

its own checksum that covers the entire Ethernet transmission.

The process of translating RTU to TCP or vice versa is simply a matter of adding or subtracting TCP header and RTU checksum. The only configuration required in this type of gateway is to create an association between RTU slave addresses and TCP IP addresses.

1.3 Important Safety Notice

Proper system design is required for reliable and safe operation of distributed control systems incorporating any Control Solutions product. It is extremely important for the user and system designer to consider the effects of loss of power, loss of communications, and failure of components in the design of any monitoring or control application. This is especially important where the potential for property damage, personal injury, or loss of life may exist. By using ANY Control Solutions, Inc., product, the user has agreed to assume all risk and responsibility for proper system design as well as any consequence for improper system design.

1.4 Warranty

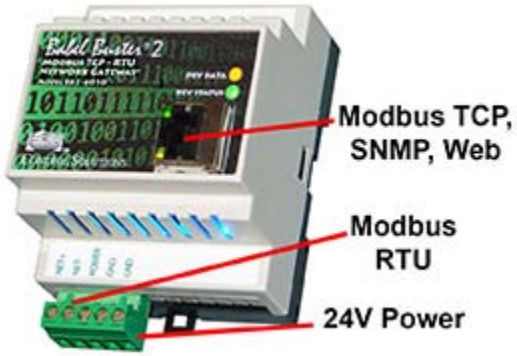
This software and documentation is provided "as is," without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of fitness or merchantability for a particular purpose. Control Solutions may make improvements and/or changes in this documentation or in the product(s) and/or the program(s) described in this documentation at any time. This product could include software bugs, technical inaccuracies, typographical errors, and the like. Changes are periodically made to the information herein; these changes may be incorporated in new editions of the software.

2. Connecting the Gateway for the First Time

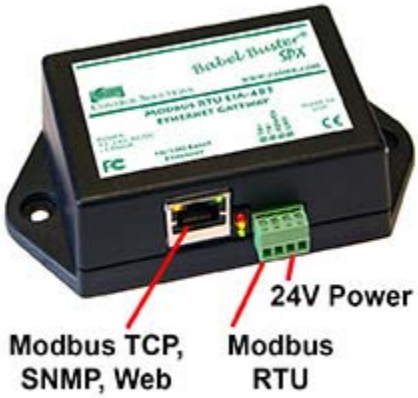
Follow these steps to make the initial connection to the BB2-6010-GW.

(a) Connect power.

Babel Buster BB2-6010-GW: Apply +12 to +24VDC or 24VAC to the terminal marked “POWER”, and common or ground the the terminal marked “GND”.



Babel Buster SPX-GW: Apply +12 to +24VDC or 24VAC to the terminal marked “POWER”, and common or ground the the terminal marked “GND”.



Babel Buster SP-GW: Plug power adapter into power connector marked "Power".

(b) Connect a CAT5 cable between the RJ-45 jack on the gateway, and your network switch or hub. You cannot connect directly to your PC unless you use a “crossover” cable.

(c) Apply power.

BB2-6010-GW: A blue LED inside the case should light indicating power is present. SPX-GW: A green LED inside the case close to the RJ45 connector should light indicating power is present. SP-GW: The LED next to the power connector should light red for a time (but will go out after bootup since this single LED doubles as communication indicator).

All models: If the link LED on the RJ45 jack is not on, check your Ethernet cable connections. Both link and activity LEDs on the RJ45 jack will be on solid for a short time during boot-up. The entire bootup process will take 1-2 minutes, during which time you will not be able to connect with a browser.

Ethernet link LED is the yellow LED integrated into the CAT5 connector on BB2-6010 and SPX, and green on SP. Ethernet activity LED is the green LED integrated into the CAT5 connector on BB2-6010 and SPX, and yellow on SP (SP is reverse of other two).

(d) The default IP address as shipped is 10.0.0.101. If your PC is not already on the 10.0.0.0 domain, you will need to add a route on your PC (XP only). Do this by opening a command prompt. First type “ipconfig” and note the IP address listed. This is your PC’s IP address. Now type the command

```
route add 10.0.0.0 mask 255.255.255.0 1.2.3.4
```

but substitute your PC’s IP address for 1.2.3.4.

This generally works, but if this fails, you will need to temporarily change your computer’s IP address to a fixed address that starts with 10.0.0. and ends with anything but 101.

Gateway Settings | Local Settings

Click on any tab above to log in.

Hardware Guide

Model BB2-6010-GW
v1.04

Quick Help

Click any tab above to log in. If you are not already logged in, you will be asked for your user name and password. You will need these in order to log in.

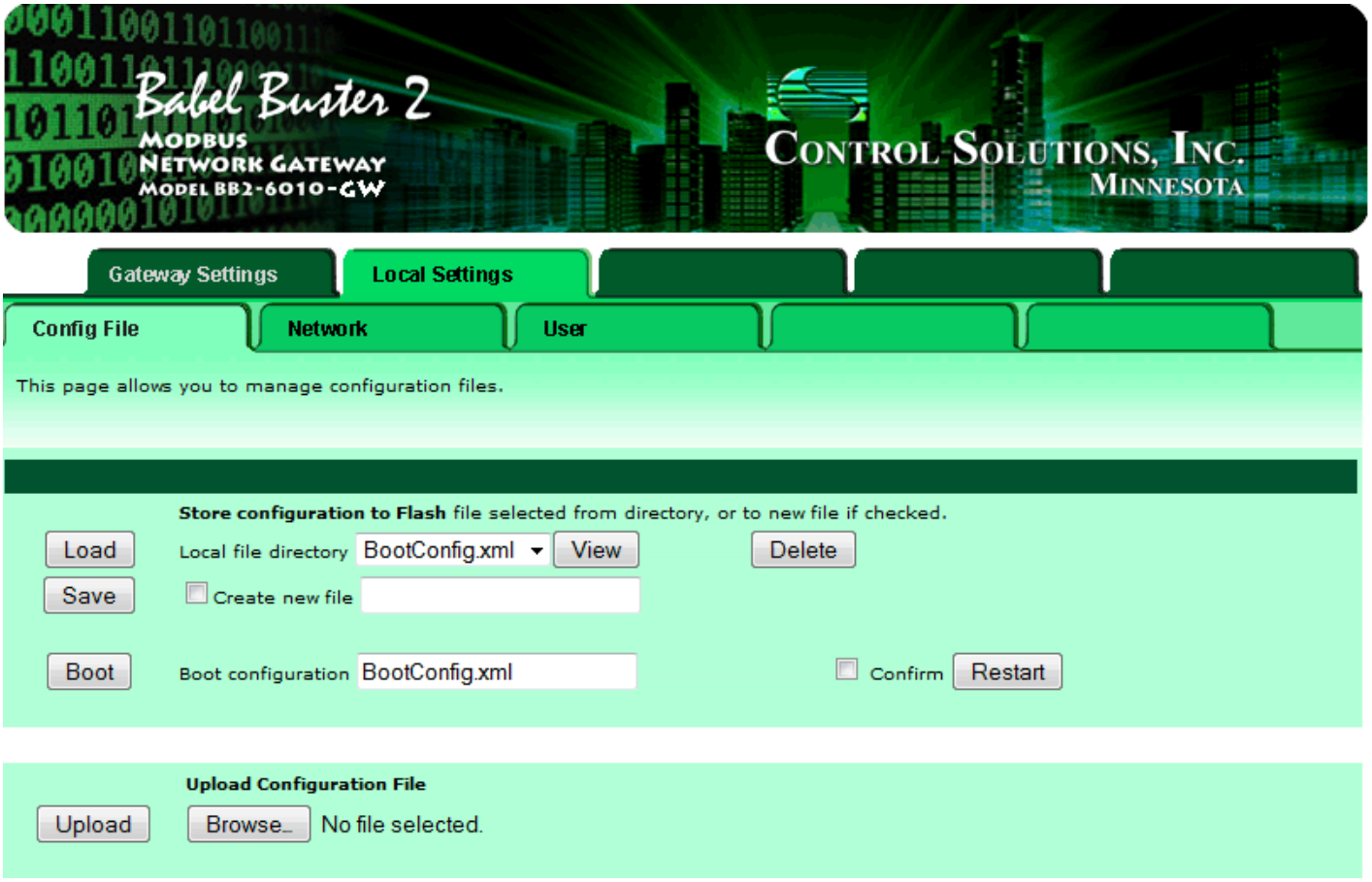
To log out, simply close your browser. IMPORTANT: If you have made configuration changes that you want to save permanently, go to the System->Setup->Config File page and click "save". Changes made by clicking "update" are only temporary until you save changes permanently in your configuration file.

(e) Open your browser, and enter “http://10.0.0.101/” in the address window. You should see a page with the “Babel Buster BB2-6010” header shown above (or as applicable by model). From this point, you will find help on each page in the web site contained within the product.

(f) When you click on any of the page tabs such as System Setup, you will be asked for a user name and password. The default login is user name “system” with password “admin”. You can also log in as “root” using password “buster”. You must log in as “root” if you will be changing the IP address.

(g) To can change the IP address of the gateway, go to the Network page under System :: Setup. The following page should appear. Change the IP address, and subnet mask and gateway if applicable. Click Change IP to save the changes. The process of programming this into Flash takes around half a minute. The new IP address only takes effect following the next system restart or power cycle.

(h) Most changes are stored in an XML configuration file in the device's Flash file system. Only a few are stored differently, and the IP address is one of those. Normally, clicking Update on any configuration page only stores that configuration information to a temporary RAM copy of the configuration file. To make your changes other than IP address permanent, you must click Save on the Config File page (System :: Setup :: Config File).



3. Configuring Gateway

The gateway is configured based on which side is Modbus master. If your Modbus TCP master wants to get data from Modbus RTU slaves, then configure the gateway with Modbus TCP as master. If your Modbus RTU master wants to get data from Modbus TCP slaves, then configure the gateway with Modbus RTU as master.

Regardless of which side is master, one setting that is always required is setting the IP address of the gateway itself. This was already mentioned in the previous section, but for purposes of reiterating the steps required to configure the gateway, set the IP address from the Network page as shown here.

3.1 Configuring Gateway with Modbus TCP as Master

If Modbus TCP is master, then from the perspective of your slave RTU devices, the RTU port on this gateway must also be master. Select master simply by clicking the "Iam the RTU Master" button.

Select baud rate and parity from the drop down list. Click either Master or Slave buttons to select type of operation. Enter timing parameters or address as applicable. Click update to register your changes.

IMPORTANT: Set timeout to something long enough for the device(s). If too short, the gateway will not wait long enough for a response from the Modbus slave device, and the result will be a lot of "no response" errors from the device even though the device is perfectly functional.

Once you have made all of the appropriate settings on this page, you must go to the Config File page and click Save to retain these settings past the next power cycle. Refer to the previous section to see where to find the Config File page.

Configuring the non-mapping gateway with Modbus TCP as master is very simple. You set up the ports and that is all. You do not need to do anything on the TCP Device Map page - that is for configuring in the opposite direction.

3.2 Configuring Gateway with Modbus RTU as Master

If your Modbus RTU master wants to view one or more Modbus TCP devices as slaves, then from the perspective of your RTU master, this gateway must be configured as an RTU slave. Make that selection by clicking "I am one or more RTU Slaves". You must also select the baud rate that your Modbus RTU master is using, as well as parity and whether 2 stop bits are required.

When Modbus RTU is master, you need to tell this gateway what IP address is mapped to which RTU slave address. If there is a one to one correlation between RTU slave address and Modbus TCP address, enter them as illustrated below. Here we see RTU slave addresses 1 through 3 corresponding to three different IP addresses.

The first and last slave address incoming in this example simple mean that RTU slave addresses "1 through 1" correspond to the first IP address on the list, and unit number 1 will be transmitted as unit or slave ID in the TCP packet. The RTU slave addresses "2 through 2" mean RTU slave address 2 will translate to the second IP address, but its unit number will be sent as 1. If all of the Modbus TCP devices expect to see unit number (or slave address) of 1, this mapping is how we instruct the gateway to translate the slave address. Often a Modbus TCP device will disregard the unit number and it doesn't care what number you send.

Gateway Settings | Local Settings

TCP Device Map | Serial Port | Diagnostics

This page sets up mapping of RTU slave addresses to Modbus TCP IP addresses that are used when this gateway is set to be a Modbus RTU slave. In this mode, the gateway can map multiple Modbus TCP devices to RTU addresses.

Update

Socket	First Slave Address Incoming	Last Slave Address Incoming	IP Address	First Slave Address Outgoing	Connection Status
1	1	1	192.168.1.109	1	0
2	2	2	192.168.1.101	1	0
3	3	3	192.168.1.68	1	0
4	0	0	0.0.0.0	0	---

There are instances where a Modbus TCP device contains several unit numbers at the same IP address. This is common in a multi-channel device where unit specifies channel number. Since RTU does not have the luxury of this sort of multi-layer addressing, your RTU master will need a way of seeing each channel as a separate RTU slave address. The non-mapping gateway can do this for you. We say "non-mapping" because there is no register or object mapping common to other gateways. But RTU slave addresses are being mapped, so in that sense, the non-mapping gateway is still doing some form of mapping.

The example below shows RTU slave addresses 1 through 5 being sent to the first IP address in the list, and unit numbers on the TCP side will be sent as 1 through 5, corresponding to RTU slave addresses 1 through 5. The second line shows RTU slave addresses 6 through 10 being sent to the second IP address on the list, and unit numbers on the TCP side will be sent as 1 through 5 corresponding to RTU slave addresses 6 through 10.

Gateway Settings | Local Settings

TCP Device Map | Serial Port | Diagnostics

This page sets up mapping of RTU slave addresses to Modbus TCP IP addresses that are used when this gateway is set to be a Modbus RTU slave. In this mode, the gateway can map multiple Modbus TCP devices to RTU addresses.

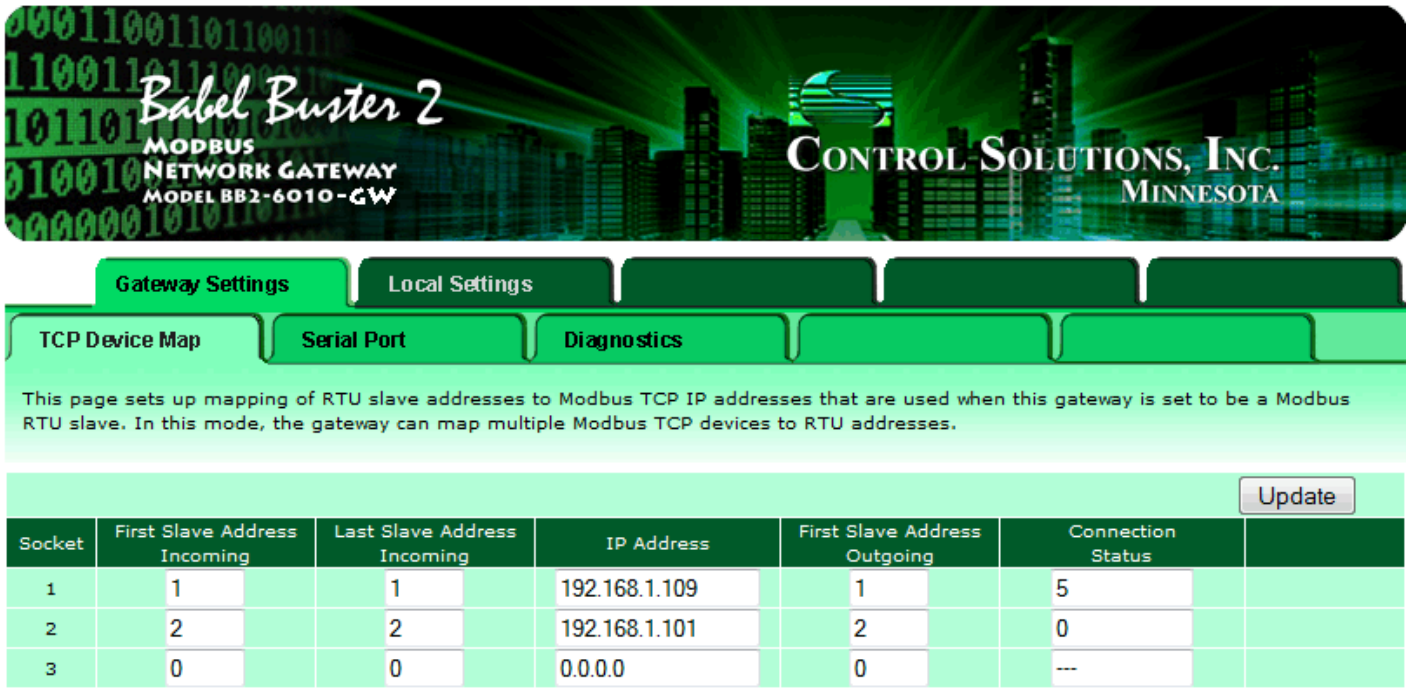
Update

Socket	First Slave Address Incoming	Last Slave Address Incoming	IP Address	First Slave Address Outgoing	Connection Status
1	1	5	192.168.1.109	1	0
2	6	10	192.168.1.101	1	0
3	0	0	0.0.0.0	0	---

IMPORTANT: Once you have set up the serial port and made all of your address entries on the TCP Device Map, you must go to the Config File page and click Save to retain your settings through the next power cycle.

3.3 Error Indications

Errors on the TCP side with RTU as master will be indicated by Connection Status. The most common error will be status code 5, which simply means unable to connect. A Connection Status of zero means no errors detected. However, if the gateway has not received any requests from RTU, then it will not have attempted to connect to TCP yet. Therefore, status is only meaningful if the RTU master is sending requests to the gateway.



Socket	First Slave Address Incoming	Last Slave Address Incoming	IP Address	First Slave Address Outgoing	Connection Status
1	1	1	192.168.1.109	1	5
2	2	2	192.168.1.101	2	0
3	0	0	0.0.0.0	0	---

Errors on the RTU side with TCP as master will be indicated on the Diganostics page illustrated here. A tabulation of errors detected by the gateway will be noted here.

Gateway Settings | Local Settings

TCP Device Map | Serial Port | Diagnostics

This page displays error codes encountered in processing reads and writes via the Modbus RTU serial port.

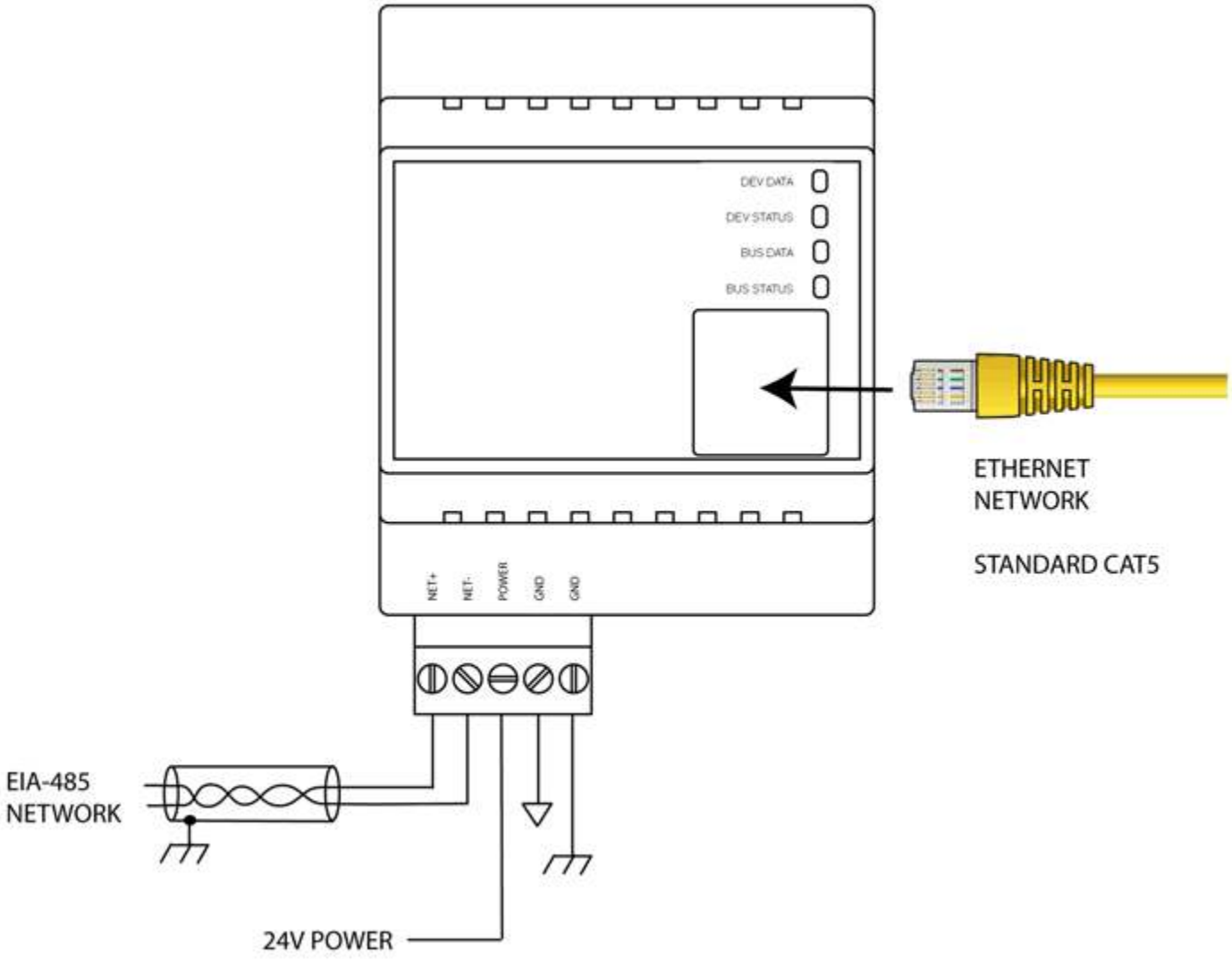
Showing devices from 1 Update < Prev Next >

Unit #		Reset -->	Total Messages	No Responses	CRC Errors	Exceptions	
1		☐	121	0	0	0	
2		☐	226	0	0	21	
3		☐	411	0	0	0	
4		☐	0	0	0	0	

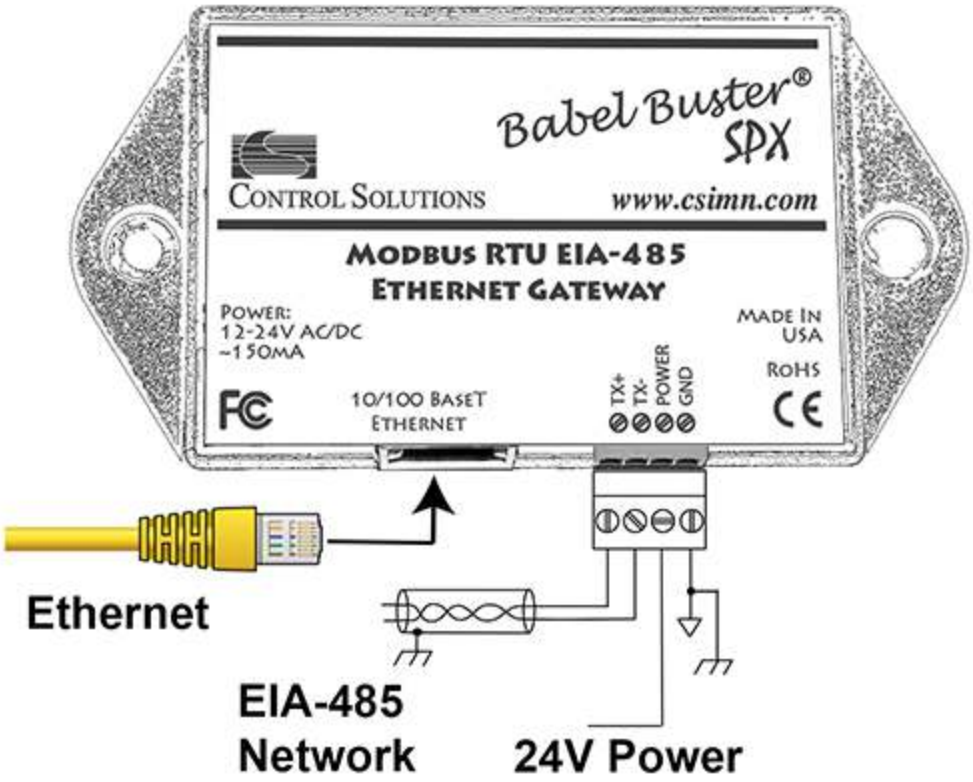
Appendix A Hardware Details

A.1 Wiring

Wiring for the Babel Buster BB2-6010 is illustrated below.



Wiring for the Babel Buster SPX is illustrated below (see section A.4 for SP).



Wire the gateway as illustrated. Follow all conventional standards for wiring of EIA-485 networks when connecting the Modbus RTU EIA-485 (RS485) network. This includes use and termination of shield, termination of the network, and grounding.

IMPORTANT: Although EIA-485 (RS485) is thought of as a 2-wire network, you MUST include a third conductor connected to GND or common at each device so that all devices are operating at close to the same ground potential. Proper grounding of equipment should ensure proper operation without the third conductor; however, proper grounding often cannot be relied upon. If large common mode voltages are present, you may even need to insert optically isolated repeaters between EIA-485 devices.

Use standard CAT5 cables for Ethernet connections. Use control wire as applicable for local electrical codes for connecting the 24V (AC or DC) power supply.

Note that in addition to connecting power supply common to a GND terminal, you must also connect a GND terminal to earth ground in order to ensure proper ESD protection.

A.2 Front Panel LED Indicators

Power-up LED behavior for BB2-6010: Following a server boot-up delay, all LEDs on front panel will turn on yellow or red for half a second, then all will turn on green for half a second. Then they will proceed to indicate as normally defined for the indicators.

Power-up LED behavior for SPX: Following a server boot-up delay, all LEDs will turn on briefly, then proceed to indicate as normally defined for the indicators.

Power-up LED behavior for SP: The single power/status LED will light up red and remain on until server boot-up.

Babel Buster BB2-6010 and SPX request/reply LEDs reflect RTU traffic while the Ethernet activity LED will indicate TCP traffic. To see TCP errors, one needs to look at the Errors page in the web UI.

Babel Buster SP: Since there is only one LED available, it simply indicates Modbus traffic. To see either TCP or RTU errors, one needs to look at the Errors pages in the web UI.

Babel Buster BB2-6010 LEDs indicate as follows (LEDs are bi-color):

DEV DATA	Flashes yellow each time a request is sent when operating as Modbus Master, or each time a request is received when operating as Modbus Slave.
DEV STATUS	Operating as Modbus Master, flashes green each time a good response is received, or red when an error code is received, the request times out, or there is a flaw in the response such as CRC error. Operating as Modbus Slave, flashes green each time a good response is sent, or red if an exception code is sent (meaning the received request resulted in an error).

Babel Buster SPX LEDs indicate as follows:

Yellow	Flashes each time a request is sent when operating as Modbus Master, or each time a request is received when operating as Modbus Slave.
Green	Operating as Modbus Master, flashes each time a good response is received. Operating as Modbus Slave, flashes green each time a good response is sent.
Red	Operating as Modbus Master, flashes when an error code is received, the request times out, or there is a flaw in the response such as CRC error.

	Operating as Modbus Slave, flashes if an exception code is sent (meaning the received request resulted in an error).

Ethernet link LED is the yellow LED integrated into the CAT5 connector on BB2-6010 and SPX, and green on SP. Ethernet activity LED is the green LED integrated into the CAT5 connector on BB2-6010 and SPX, and yellow on SP (SP is reverse of other two).

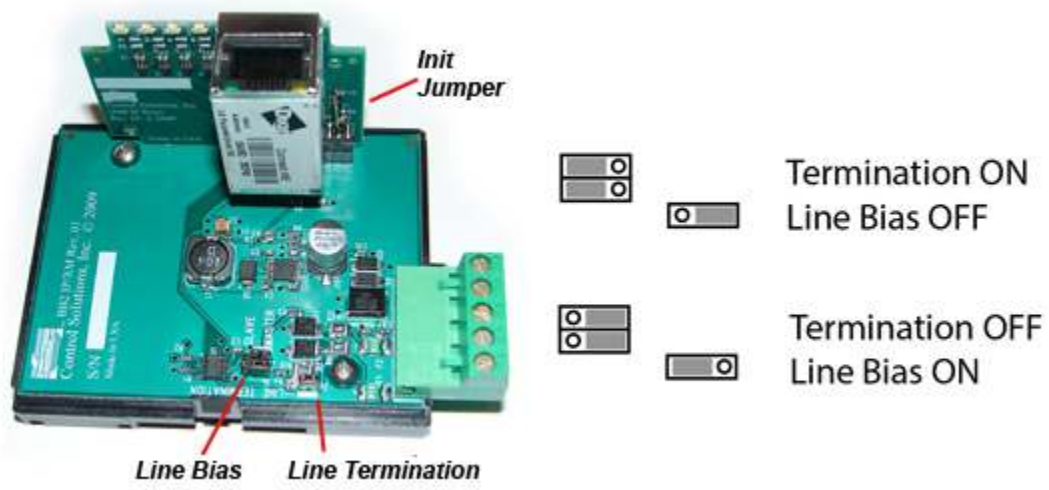
A.3 RS-485 Line Termination & Bias

Enable line termination only when this device is placed at the end of the network. Termination should only be enabled at two points on the network, and these two points must be specifically the end points.

Enable line bias when needed. Line bias should only be enabled at one point on the network, and does not have to be the end point. Line bias holds the line in a known neutral state when no devices are transmitting. Without bias, the transition from offline to online by a transmitter can look like a false start bit and cause loss of communication.

The line conditioning options are enabled when the respective shunt is moved to the position indicated by the white block next to the 3-pin header. Putting the shunt on the opposite 2 pins disables the option, and is simply a place to store the shunt.

Jumper locations for Babel Buster BB2-6010:



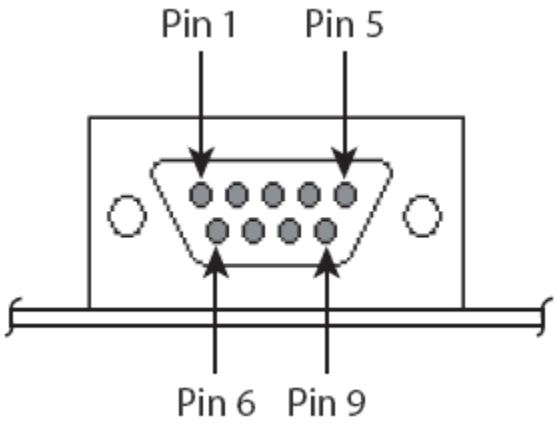
Jumper locations for Babel Buster SPX (see following section for SP):

The "Init" jumper on the server module should only be used when advised by tech support. Installing this jumper prior to power-up causes the server to go into firmware update mode.

A.4 Babel Buster SP DB-9 Connector & DIP Switch

Pin connections are shown below. RS-485 (EIA-485) is by definition 2-wire. Any reference to 4-wire RS-485 is really EIA-422. Babel Buster SP supports EIA-422, but also automatically supports EIA-485 with a simple wiring configuration. Simply connect all the pluses together, and all the minuses together. Connect RXD+ to TXD+ on Babel Buster SP, and that one connection to + on your Modbus device. Do the same with the minus side. Then set the DIP switches for EIA-485 half duplex, termination ON. Although called "2-wire" you really need 3 conductors, 2 wires for signal + and - with a third conductor for ground/common.

If your Modbus device has its RS-485 terminal marked A and B, be aware that about half of the equipment out there has A and B backwards. This is due to the fact that A and B as published by EIA-485 are the reverse of A and B as defined by the RS-485 chip makers. Somewhere along the line they didn't compare notes. There is no harm done in reversing the wires, it simply will not communicate. If you are having trouble communicating, especially if the device terminals are marked A and B, try reversing them.



The above view is the male DB9 as seen looking into the Babel Buster SP. Important: This is **NOT** a PC COM port. Study the wiring table below carefully. Also keep in mind that while Pin 1 is on the left on the male connector, Pin 1 will be on the right looking at the female connector.

DB-9 Pin Assignments			
Pin	**EIA-232**	**EIA-422/485 Full-Duplex**	**EIA-485 Half-Duplex**
1	DCD	CTS-	Not used
2	RXD	RXD+	RXD+
3	TXD	TXD+	TXD+
4	DTR	RTS-	Not used
5	GND	GND	GND
6	DSR	RXD-	RXD-
7	RTS	RTS+	Not used
8	CTS	CTS+	Not used
9	NA	TXD-	TXD-

In addition to connecting wiring as indicated above, you need to change the DIP switch settings to select what type of port you are configuring.