User Guide

Babel Buster SPX

Model SPX-B
BACnet Modbus Gateway
Rev. 1.4 – March 2019

SPX-B User Guide Contents

1. Introduction

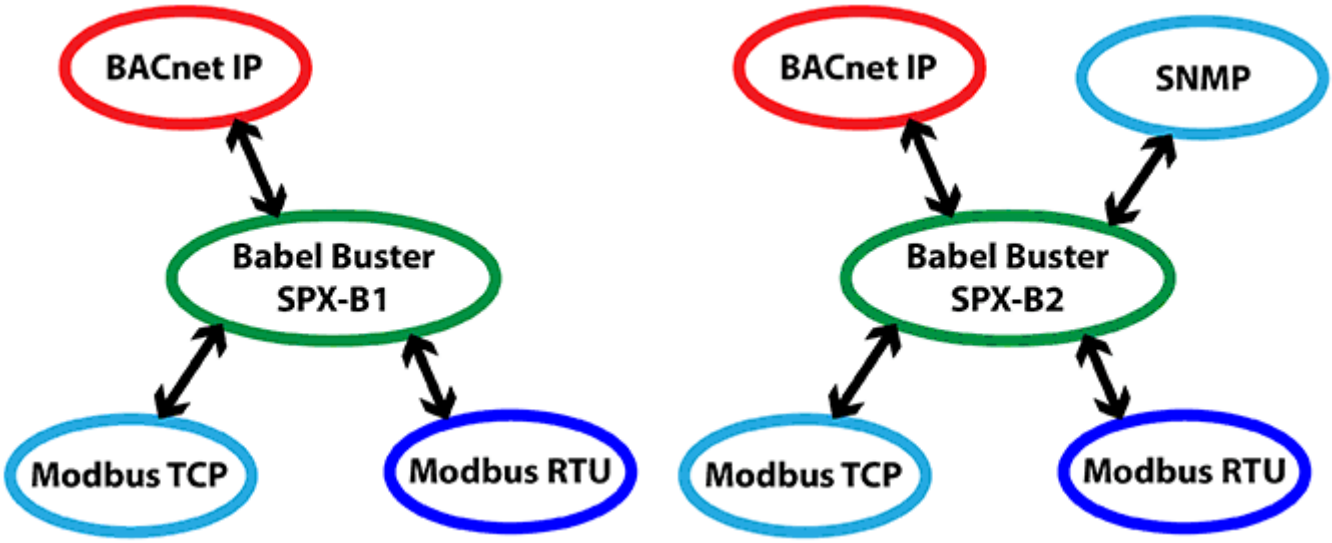
1.1 How to Use This Guide

The first few sections of this user guide provide background information on how the gateway works, and an overview of the configuration process. The next several sections are guides for each of the 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.

1.2 Overview of Gateway Devices

The Babel Buster SPX-B is a BACnet to Modbus gateway. It may be used as BACnet IP client and server, Modbus TCP client and server, and Modbus RTU master or slave. The SPX-B2 may also be used as SNMP client and server. The SPX-B-06, -07, and -08 models add gateway capability for specific types of WiFi sensors (see section 16, 17, 18).



The most common application for the SPX-B is interfacing a Modbus RTU device to a BACnet IP network. The SPX-B will automatically poll the Modbus RTU device, and store the content if its registers in BACnet objects you assign. The BACnet system may then use standard BACnet services such as Read Property to access the content of the Modbus registers. The SPX-B will also accept COV subscriptions such that other devices will receive a COV notification when the content of a Modbus register changes.

The SPX-B can be also configured as a Modbus RTU slave. This is useful when a PLC wants to write data to the SPX-B, thereby making the PLC's data available as BACnet object properties.

The SPX-B can be configured as a BACnet IP client. This means the SPX-B will be reading and writing properties in other BACnet devices, storing copies of their object's Present Value in the SPX-B. The stored values may later be accessed by Modbus or SNMP.

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 SPX-B for the First Time

Follow these steps to make the initial connection to the SPX-B.

(a) Connect power. Apply +12 to +24VDC or 24VAC to the terminal marked “POWER”, and common or ground the the terminal marked “GND”.

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

(c) Apply power. A blue LED inside the case should light indicating power is present. If the yellow LED on the RJ45 jack is not on, check your Ethernet cable connections. Both green and yellow LEDs on the RJ45 jack will be on solid for a 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.

(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. 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

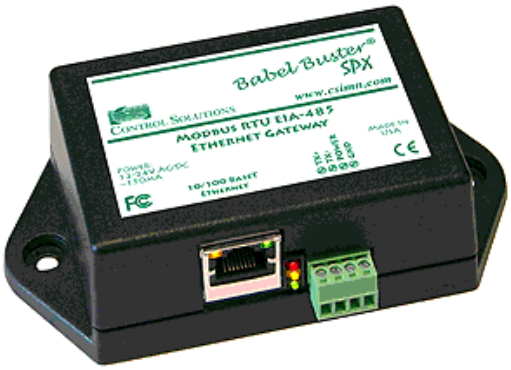
```
route add 10.0.0.0 mask 255.255.255.0 1.2.3.4
```

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.

Data Objects | Modbus | BACnet | System Setup

Click on any tab above to log in.



BACnet Object Property Summary

Hardware Guide

System Capacity Summary

Modbus Slave Register Mapping

Trouble Shooting

Modbus Notes

Model SPX-B1
v2.40.6-10x

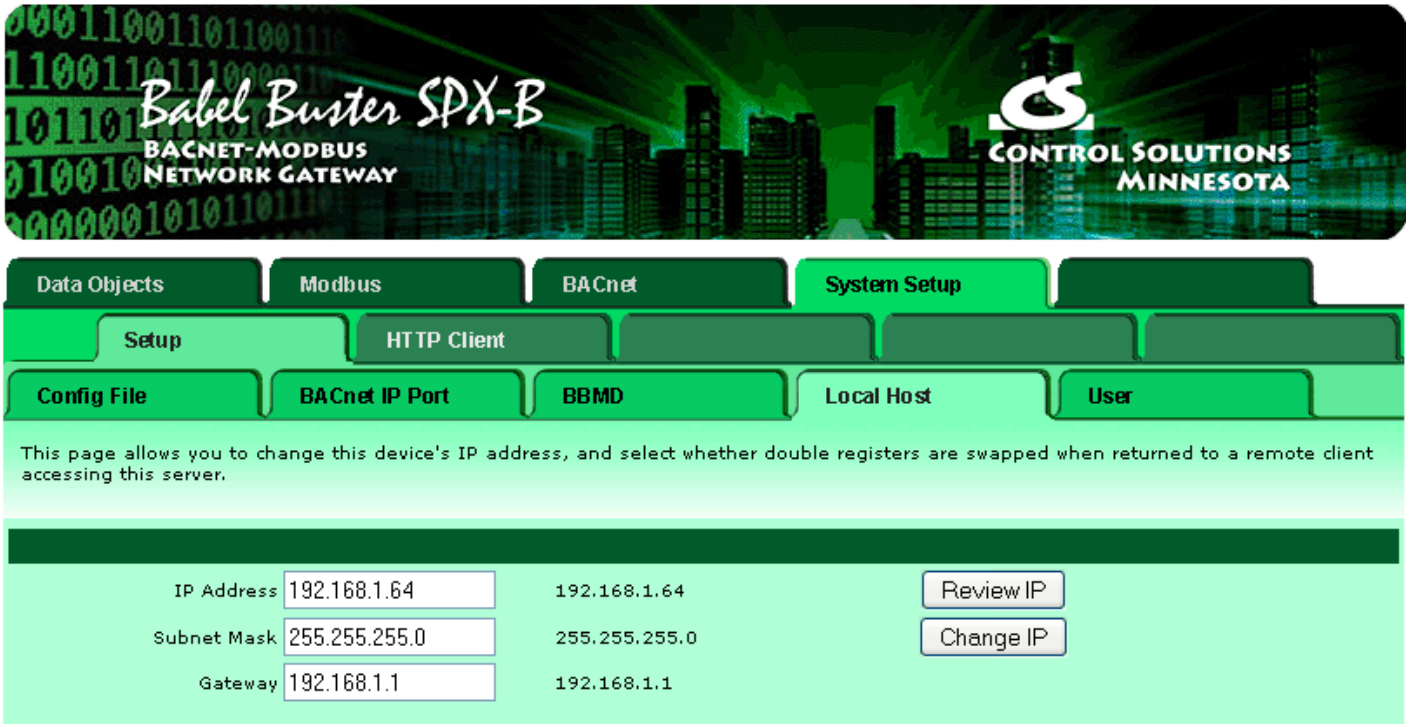
Quick Help

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.

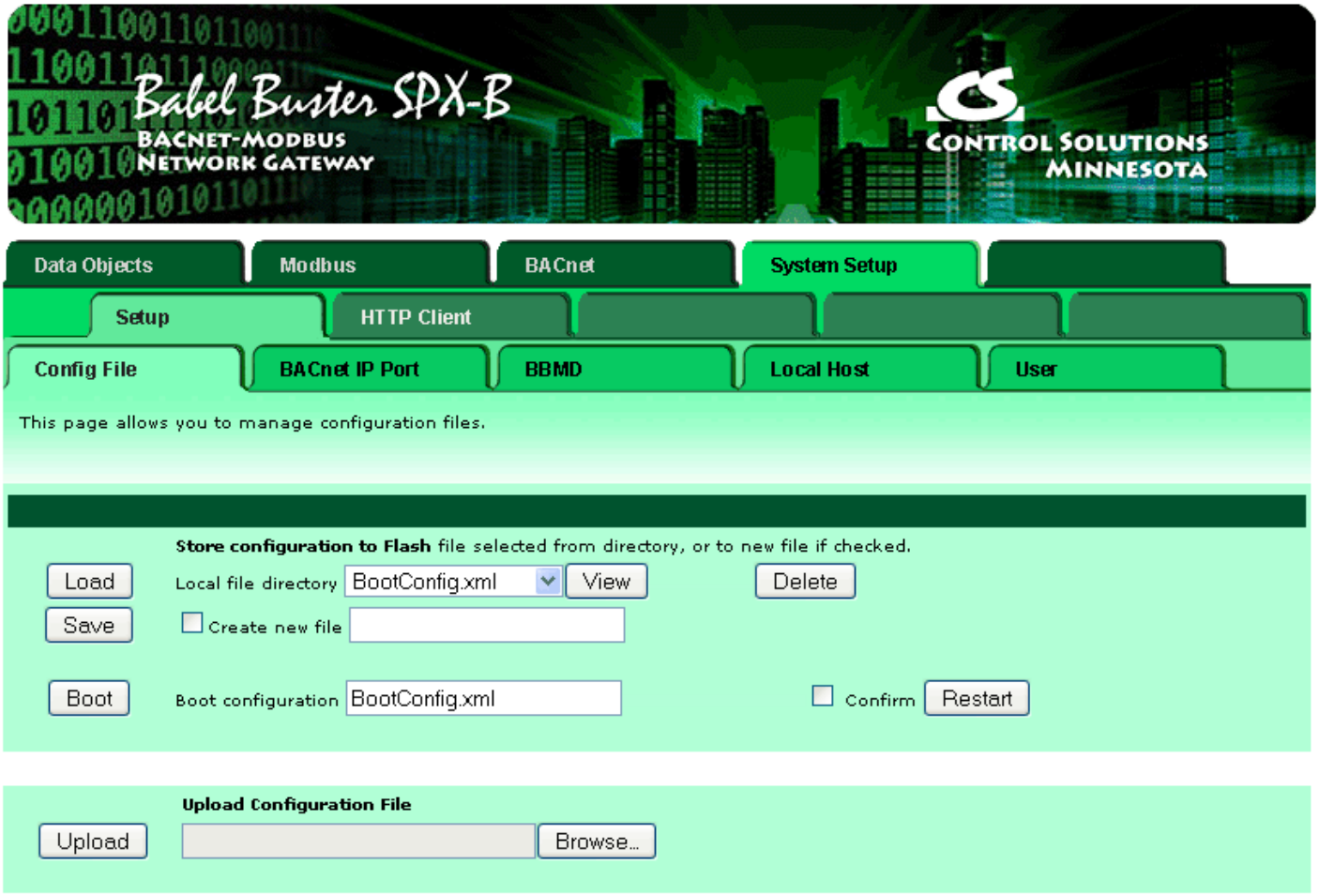
To log out, simply close your browser. IMPORTANT: If you have made configuration changes that you want to save permanently, go to the System->Setup->Config File page and click "save". Changes made by clicking "update" are only temporary until you save changes

(e) Open your browser, and enter “http://10.0.0.101/” in the address window. You should see a page with the “Babel Buster SPX-B” header shown above. 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 should log in as “root” if you will be changing the IP address.



(g) To can change the IP address of the SPX-B, go to the Local Host 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. Minimum SPX-B Gateway Setup

The SPX-B requires only minimal configuration to be useful in its simplest form. First, you must assign a device instance to the SPX-B, and you do this via the BACnet IP Port page. You may leave all other settings at their default. You could leave the device instance at its default as well. The only real requirement is that you do not duplicate device instances.

The number of each type of available object is indicated here. Initially, there will be

only 10 AI's and 1 each of the other object types. There is a pool of objects that may be shared among the different object types. The number of objects available is displayed at the "System Capacities" link on the home page of the device. The number will range from 300 to 1000 depending on model.

The number displayed next to the input window is the object count that has been requested and will take effect upon the next restart. To request a different number, enter that number and click Save. Restart (or power cycle) the device to make the new object allocations take effect.

The check box for "allow fault self-reset without ack" means object reliability code and fault status will return to normal automatically after recovery from a communication fault such as "no response" (reply timed out). If this box is not checked, a BACnet client must read the reliability code to acknowledge the problem before the status will be reset. If the box is checked, fault indications will simply go away when the fault goes away.

The check box for "enable BBMD" is used to enable the BBMD feature of the device. When enabled, additional configuration on the BBMD tab should also be set up.

4. Using the SPX-B as a BACnet Server

The SPX-B contains a set of BACnet objects whose only purpose is to store copies of data obtained from other devices. This copy of data may then be queried by different devices, or written to different devices by the SPX-B client functions.

The collection of objects includes Analog, Binary, and Multi-State types of objects, and includes Input, (commandable) Output, and (writeable) Value types of each of those objects. The SPX-B also contains a Device object which is shared with router functions. All of the remaining objects noted here are not used by routing functions.

Data may be placed in the local objects by other devices writing to the SPX-B, or by the SPX-B querying other devices. When the SPX-B is configured to query other devices, these operations are defined by “read maps” and “write maps” associated with the respective client function (e.g. BACnet client, Modbus TCP client, SNMP client).

The following pages illustrate the Analog Input object pages and the Binary Output object pages. The remaining object pages found in the SPX-B are virtually identical, and are not replicated here.

Each object page initially comes up as a table of object data. Click on the object number in the left-hand column to expand the view of that object and access the windows that let you locall force values, assign units or names, etc.

Data Objects | Modbus | BACnet | System Setup

Analog | Binary | Multi-State

Input Objects | Output Objects | Value Objects

This page displays data as presently found in the local objects maintained by this device.

Analog Input Objects Showing objects from 1 Refresh < Prev Next >

Object	Object Name	Out of Service	Present Value	Reliability	Status	Units
1	Volts	N	121.298	0	0,0,0,0	no_units
2	Amps	N	2.19448	0	0,0,0,0	no_units
3	Hertz	N	60.0112	0	0,0,0,0	no_units
4	Watts	N	263.053	0	0,0,0,0	no_units
5	Temperature	N	76.7660	0	0,0,0,0	no_units
6	Humidity	N	80.8409	0	0,0,0,0	no_units
7	Rack Temp	N	98.8300	0	0,0,0,0	no_units
8	Analog Input 8	N	0.00000	0	0,0,0,0	no_units
9	Analog Input 9	N	0.00000	0	0,0,0,0	no_units
10	Analog Input 10	N	0.00000	0	0,0,0,0	no_units
11	Analog Input 11	N	0.00000	0	0,0,0,0	no_units
12	Analog Input 12	N	0.00000	0	0,0,0,0	no_units
13	Analog Input 13	N	0.00000	0	0,0,0,0	no_units
14	Analog Input 14	N	0.00000	0	0,0,0,0	no_units
15	Analog Input 15	N	0.00000	0	0,0,0,0	no_units

The object name, units, value, and status are shown for a list of objects starting with the number entered at the top of the page. Click Prev/Next to scroll through the list. Click on the object number in the first column to change name, units, COV, and out-of-service state.

The source of data for an Analog Input object will be reading the remote Modbus register via the map indicated by the Device Link. The Modbus device will be polled at the rate specified by the Read Map.

Out of Service means polling of the Modbus register will stop. While out of service, the present value may be written by the BACnet client. Data may be forced via this web page at any time, but will be overwritten by the next Modbus poll unless the object is out of service.

Reliability codes may be any of the following (7010-01):
64: Modbus client, no response
65: Modbus client, crc error
66: Modbus exception, illegal function code
67: Modbus exception, illegal data address

68: Modbus exception, illegal data value
69-79: Modbus exception, code+65, rarely used
80: Local device, configuration property fault
81: Faulty Modbus packet
82: BACnet IP client, device timeout
83: BACnet IP client, error returned by server

Reliability codes may be any of the following (7010-02):
80: Local device, configuration property fault
81: Faulty packet
82: BACnet IP client, device timeout
83: BACnet IP client, error returned by server
84: SNMP client, no response from agent
85: SNMP client, unable to parse data
86: SNMP client, reply does not match request

Status flags A,B,C,D indicate the following, 0 meaning not true, 1 meaning true:
A = in alarm
B = fault
C = overridden
D = out of service

Device link will indicate BAC or TCP, followed by R for read or W for write, and a number which is the rule number in the table of read or write rules for mapping external devices or objects to this BACnet object. The designation R means read from external device, and W means write to external device.

Click on the AI map number to get to the expanded view of the AI object as illustrated below.

The object name, units, value, and status are shown for the object number entered at the top of the page. Click Prev/Next to scroll through the list. Click Refresh to update the page, or Update to accept changes.

The object name may be changed here. BACnet units may be selected. Initial COV increment may be entered. When any of these are changed, be sure to save the updated configuration by clicking Save on the Config File page under System Setup.

The object may be set Out of Service by checking that box and clicking Update. The present value may be changed by entering a value, checking Force, and clicking Update.

The source of data for an Analog Input object will be reading the remote Modbus register via the map indicated by the Device Link. The Modbus device will be polled at the rate specified by the Read Map.

Out of Service means polling of the Modbus register will stop. While out of service, the present value may be written by the BACnet client. Data may be forced via this web page at any time, but will be overwritten by the next Modbus poll unless the object is out of service.

The Binary Output Object page is illustrated below.

Data Objects | Modbus | BACnet | System Setup

Analog | Binary | Multi-State

Input Objects | Output Objects | Value Objects

This page displays data as presently found in the local registers maintained by this device.

Binary Output Objects Showing objects from 1 Update < Prev Next >

Object	Object Name	Out of Service	Present Value	Reliability	Status	Text
1	Relay 1 Out	N	Active	0	0,0,0,0	Contact Closed
2	Binary Output 2	N	Inactive	0	0,0,0,0	
3	Binary Output 3	N	Inactive	0	0,0,0,0	
4	Binary Output 4	N	Inactive	0	0,0,0,0	
5	Binary Output 5	N	Inactive	0	0,0,0,0	
6	Binary Output 6	N	Inactive	0	0,0,0,0	
7	Binary Output 7	N	Inactive	0	0,0,0,0	
8	Binary Output 8	N	Inactive	0	0,0,0,0	
9	Binary Output 9	N	Inactive	0	0,0,0,0	
10	Binary Output 10	N	Inactive	0	0,0,0,0	

The object name, value, and status are shown for a list of objects starting with the number entered at the top of the page. Click Prev/Next to scroll through the list. Click on the object number in the first column to change name or out-of-service state.

The destination of data for a Binary Output object will be writing the remote Modbus register via the map indicated by the Device Link. The Modbus device will be updated upon change of source data and/or periodically as defined by the Write Map.

The Binary Output object is commandable, meaning the BACnet client must write both a value and a priority level for that value. The highest level value will be the one written to the Modbus register. If all values are relinquished, the relinquish default value will be written to the Modbus register.

Out of service means the Modbus register will not be written. Values written by the BACnet client will be retained, but only applied when this object is placed back in service. At that time, the highest priority value will be written to the Modbus register.

Click on the object number in the left-hand column to get to the expanded view of the Binary Output object:

The object name, units, value, and status are shown for the object number entered at the top of the page. Click Prev/Next to scroll through the list. Click Refresh to update the page, or Update to accept changes.

The object name may be changed here. State text may be entered. When any of these are changed, be sure to save the updated configuration by clicking Save on the Config File page under System Setup.

The destination of data for a Binary Output object will be writing the remote Modbus register via the map indicated by the Device Link. The Modbus device will be updated upon change of source data and/or periodically as defined by the Write Map.

The Binary Output object is commandable, meaning the BACnet client must write both a value and a priority level for that value. The highest level value will be the one written to the Modbus register. If all values are relinquished, the relinquish default value will be written to the Modbus register.

To set an output object manually from this page, check the Force box, enter a value in the Present Value window, and select a priority level to assign to your forced value. Then click Update. To return a given priority level to NULL, simply type the word NULL in the Present Value window, check Force, and click Update.

Out of service means the Modbus register will not be written. Values written by the BACnet client will be retained, but only applied when this object is placed back in service. At that time, the highest priority value will be written to the Modbus register.

5. Configuring SPX-B as a Modbus RTU Master

The SPX-B can be a Modbus RTU master or slave. As a master you can read Modbus data from, or write Modbus data to, other Modbus slaves. The SPX-B will periodically poll the other Modbus devices according to register maps you set up. To read from a remote Modbus device, configure a Read Map. To write to a remote Modbus device, configure Write Map.

Data read from a remote device is stored in a local register when received. Data written to a remote device is taken from a local register when sent. The local registers are the same collection of registers that are accessible to other masters when operating as slave, and accessible to other Modbus TCP devices as a collection of holding registers.

5.1 Modbus RTU Device Configuration

Modbus device configuration for RTU really consists of port configuration, and includes setting the slave address if the SPX-B is functioning as Modbus slave.

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. 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.

If your slave/server device only supports function codes 5 and 6 for writing, check the Use FC 5/6 box. The default function codes are 15 and 16, which are most widely used. If you check the box, you should also enter a "starting at" unit # or slave address. This allows supporting both types of devices at the same time provided you assign slave addresses in two non-overlapping groups. (These settings do not apply if the SPX-B is the slave.)

The double register swap on this page only applies when the local device (the gateway you are configuring here) is functioning as a Modbus RTU slave.

The term "swapped" only applies to double or float formats. Modbus registers are, by definition, 16 bits of data per register. Access to 32-bit data, either 32-bit integer ("double"), or IEEE 754 floating point ("float"), is supported by the use of two consecutive registers. Modbus protocol is inherently "big endian", therefore, Modbus by the Module defaults to having the high order register first for double and float. If the low order register comes first on the device being accessed, check the "swapped" box.

If you have "swapped" turned around, you will quickly recognize it. If floating point data is reversed, a 1.0 becomes 2.2779508e-41, which simply rounds to zero. The pattern is not as predictable as the 1.0 example would suggest. A floating point 1.1 becomes negative 107609184. If 32-bit integer data is reversed, 1 becomes 65536.

5.2 Modbus RTU Master Read Maps

Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only read data from remote devices. Go to the RTU Write Map to write data to those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

For each remote register to be read, enter the register type, format, number, and remote unit (slave address).

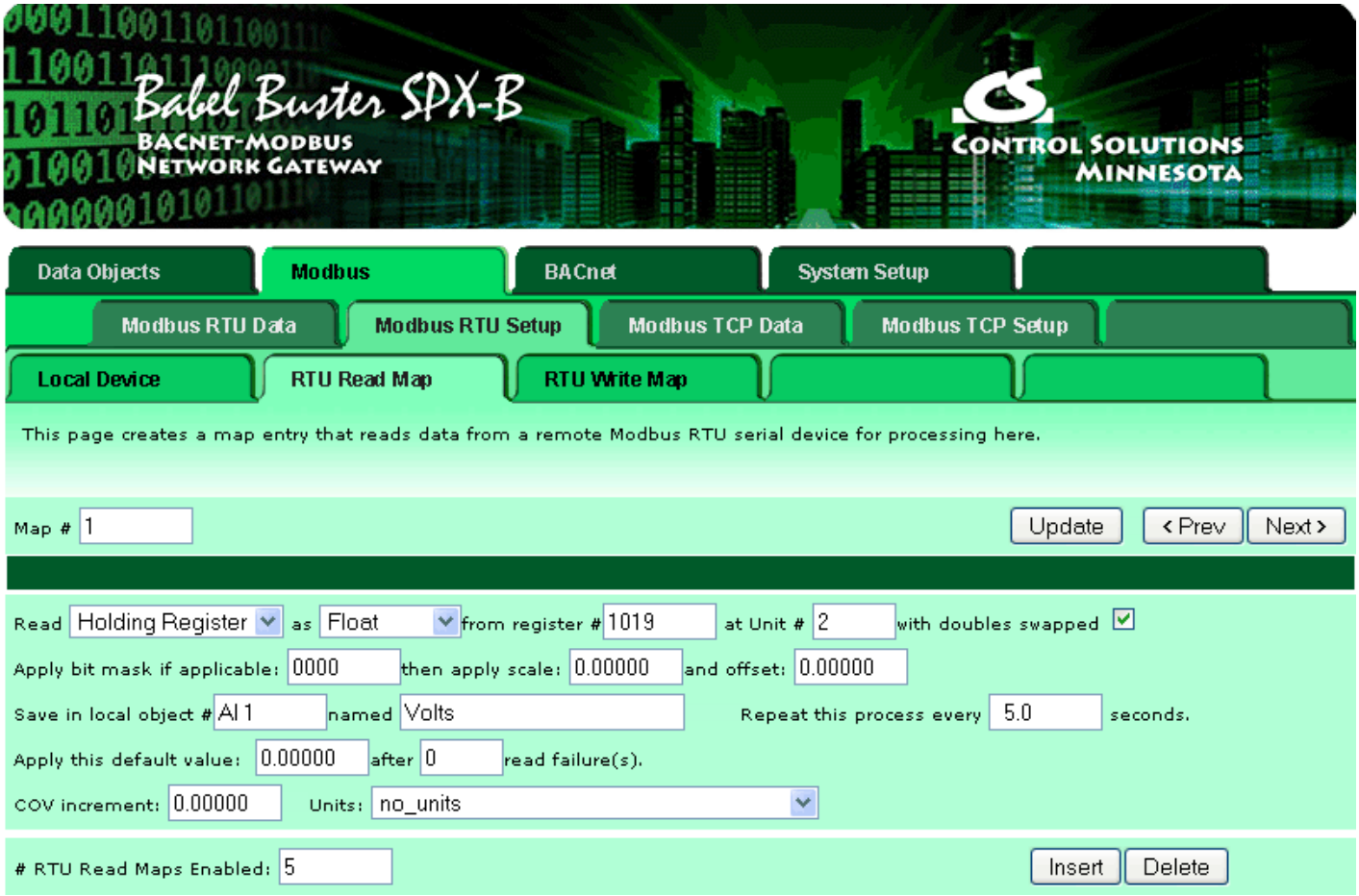
When the remote register is read, the data will be multiplied by the scale factor and written to the local register number given. The name is optional and used only for

display purposes.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local register numbers are 1-999 for integer values, and 1001-1999 accessed as register pairs for floating point. If you try to enter an even number above 1001, you will get an error message. All floating point register pairs start on odd boundaries. All local registers are accessed via Modbus as holding registers.

Click on the map number in the left column of the tabular read map page (above) to get the expanded view of one read map at a time (below).



Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

For each remote register to be read, enter the register type, format, number, and remote unit (slave address).

When the remote register is read, data may be manipulated before being written to the local register. If a bit mask is entered (in hexadecimal), and the remote register type is signed or unsigned (16-bit data), the mask will be bit-wise logical AND-ed with

the data, and the retained bits will be right justified in the result. The result will then be multiplied by the scale factor. The offset is then added and this final result is written to the local register number given. The name is optional and used only for display purposes.

The periodic poll time determines how often the remote register will be read. This number, if nonzero, will override the default poll time given in the Devices page for the remote device being read.

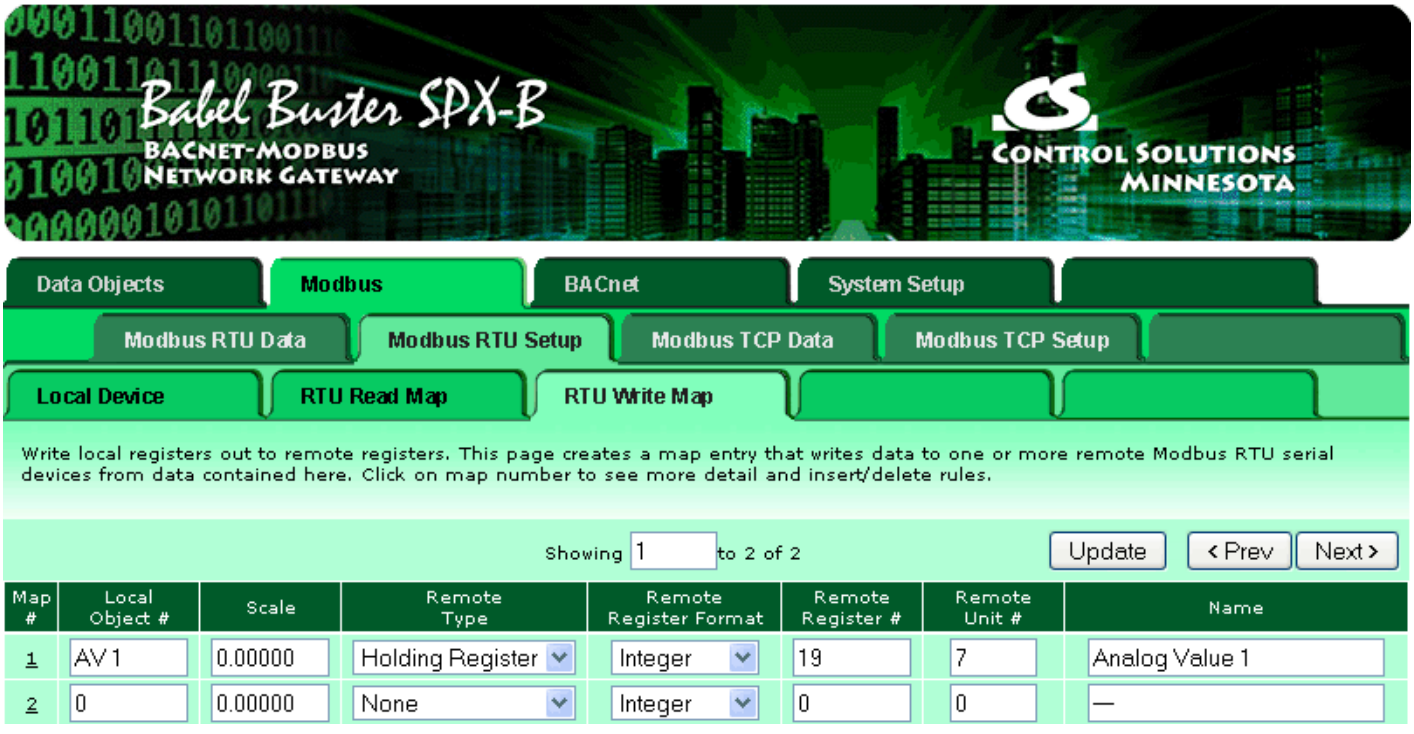
The default value will be stored into the local register after the given number of read failures if the fail count is non-zero. Setting the count to zero will disable the default, and the object will retain the most recent value obtained.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to define any rule presently having zero for a source object or "none" for remote type.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.

5.3 Modbus RTU Master Write Maps



Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only write data to remote devices. Go to the Client Read Map to read data from those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

Data from the local register given will be multiplied by the scale factor before being written. For each remote register to be written, enter the register type, format, number, and remote unit (slave address).

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local register numbers are 1-999 for integer values, and 1001-1999 accessed as register pairs for floating point. If you try to enter an even number above 1001, you will get an error message. All floating point register pairs start on odd boundaries. All local registers are accessed via Modbus as holding registers.

Click on the map number in the left column of the tabular write map page (above) to get the expanded view of one write map at a time (below).

Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

The local register data may be written periodically, or when it changes, or both. To send upon change (send on delta), check the first box and enter the amount by which the local register must change before being written to the remote device. To guarantee that the remote register will be written at least occasionally even if the data does not change, check the second box and enter some amount of time. This time period will be referred to as the "maximum quiet time".

Data from the local register may be manipulated before being written to the remote register. The local data is first multiplied by the scale factor. The offset is then added to it. If a bit mask is entered, and the remote register type is signed or unsigned (16-bit data), the mask will be bit-wise logical AND-ed with the data. The mask is right justified, then AND-ed with the data. The result is then left shifted back to the original position of the mask. In other words, the least significant bits of the original data will be stuffed at the position marked by the mask.

After the scaling and masking, the bit fill will be logically OR-ed into the result, but

only if the mask was nonzero and was used. Both mask and fill are entered in hexadecimal.

Multiple local registers may be packed into a single remote register. To accomplish this, define two or more rules in sequence with the same remote destination. If the destination is the same, data types are 16-bit (integer or unsigned), bit masks are nonzero, and the rules are sequential, the results of all qualifying rules will be OR-ed together before being sent to the remote destination.

For the remote register to be written, enter the register type, format, number, and remote unit (slave address).

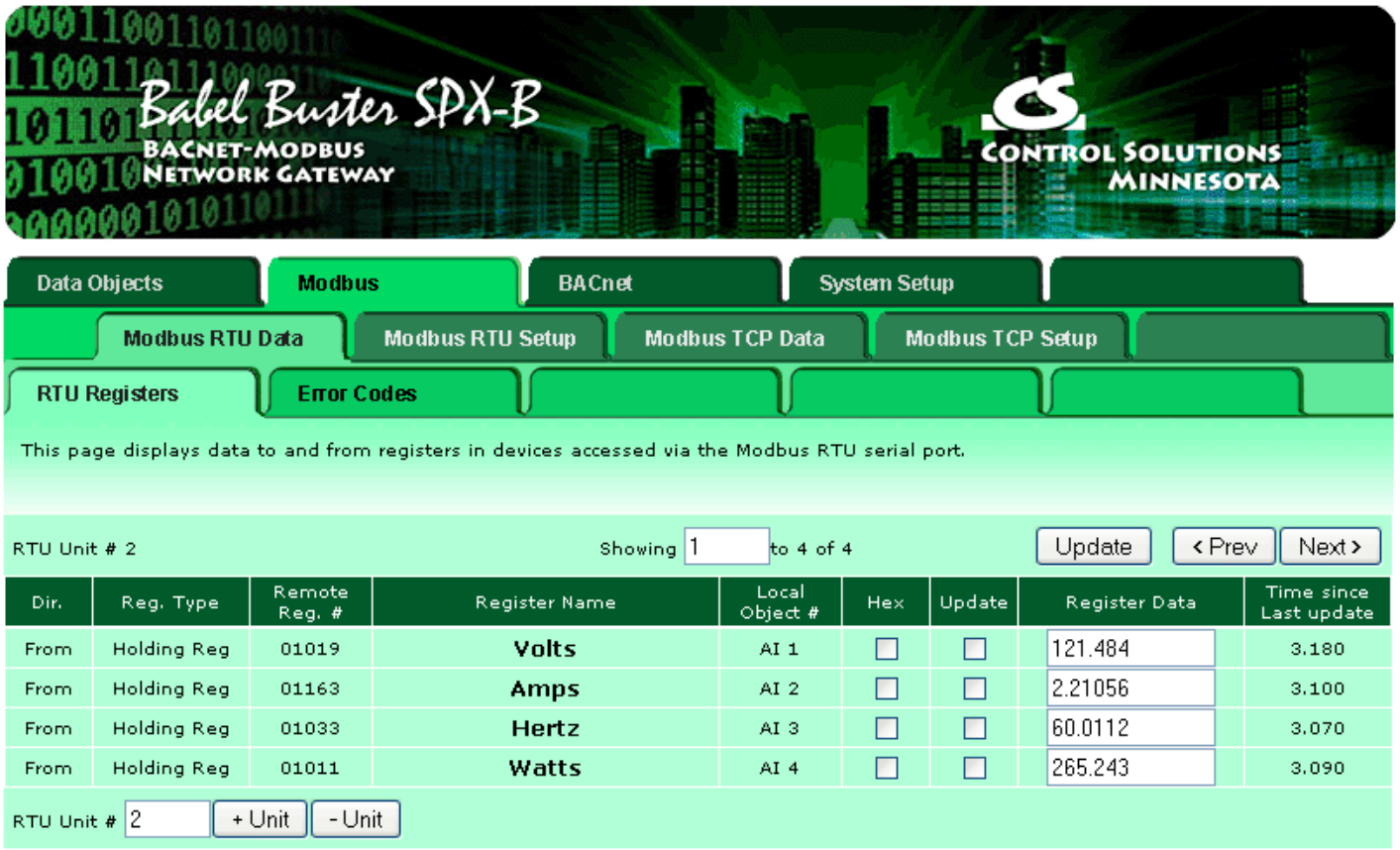
The repeat time may determine how often the remote register will be written. If send on delta and maximum quiet time are not checked above, clicking the "at least" button will establish a periodic update time. If send on delta is used and you wish to limit the network traffic in the event changes are frequent, click the "no more than" button and enter the minumum time that should elapse before another write to the remote device.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to define any rule presently having zero for a source register or "none" for remote type.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.

5.4 Modbus RTU Master Data Displayed Per Slave



The values of Modbus registers that have been read from remote RTU serial devices is displayed here. One remote unit at a time is displayed. To display a different unit, change the RTU Unit #.

Simply click the Update button to view the most recent data. Enter a new value and check the Update box if the value should be changed when you click the Update button. Check the Hex box if you wish to view or enter values in hexadecimal (not recommended for floating point).

Click Update to view the most recent data values. Click "Prev" or "Next" to scroll through the list of registers. You may also enter a number in the "Showing" box to jump directly to a given register when Update is clicked.

5.5 Modbus RTU Errors

Data Objects | Modbus | BACnet | System Setup

Modbus RTU Data | Modbus RTU Setup | Modbus TCP Data | Modbus TCP Setup

RTU Registers | Error Codes

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 -->	Read Error	Offending Read Map #	Reset -->	Write Error	Offending Write Map #	Reset -->	Total Messages	No Responses	CRC Errors	Exceptions
1	☐	0/0	0	☐	0/0	0	☐	0	0	0	0
2	☐	0/0	0	☐	0/0	0	☐	3744	0	0	0
3	☐	0/0	0	☐	0/0	0	☐	0	0	0	0
4	☐	0/0	0	☐	0/0	0	☐	0	0	0	0
5	☐	0/0	0	☐	0/0	0	☐	0	0	0	0
6	☐	0/0	0	☐	0/0	0	☐	0	0	0	0
7	☐	0/0	0	☐	5/0	1	☐	32	32	0	0
8	☐	0/0	0	☐	0/0	0	☐	0	0	0	0

The first occurrence of read and write errors are shown along with the map number that was being processed when the error occurred. Check the reset box and click update to clear it and possibly show the next error if there are more than one active error conditions.

A total count of all errors is also shown. This total is the sum of errors for all maps for this device. Check the reset box and click update to reset the counts. Click Update to view the most recent data values.

Error code indications of A/B indicate the following errors with the first number:
1 = Transaction ID out of sync
2 = Exception code returned by remote device
3 = Function code mismatch (bad packet)
4 = Inusfficient data (bad packet)
5 = No response from remote device, timed out
6 = CRC error in received packet

When A is code 2 indicating an exception code was returned, B indicates the exception as follows:
1 = Illegal function code
2 = Illegal data address (the requested register does not exist in the device)
3 = Illegal data value

6. Configuring SPX-B as a Modbus TCP Client

The SPX-B can be a Modbus client or server. As a client (master) you can read Modbus data from, or write Modbus data to, other Modbus servers (slaves). The SPX-B will periodically poll the other Modbus devices according to register maps you set up. The Modbus server (slave) devices that you will read/write are defined on the Devices page. To read from a remote Modbus device, configure a Read Map. To write to a remote Modbus device, configure Write Map.

Data read from a remote device is stored in a local data object when received. Data written to a remote device is taken from a local data object when sent. The local data objects are the same collection of objects that are accessible to other clients via the server map, and accessible to other BACnet devices via MS/TP or BACnet IP.

6.1 Modbus TCP Device Configuration

The Modbus Devices page is illustrated above. Device number simply shows you where you are on the device list. Click "next" and "prev" to scroll through the list.

Remote Modbus/TCP devices to be accessed by this device are specified here. Enter the IP address of the remote device, a name to reference in other pages, a unit number, poll rate, and check "swapped" if appropriate. Then click "update".

If your slave/server device only supports function codes 5 and 6 for writing, check the Use FC 5/6 box. The default function codes are 15 and 16, which are most widely used.

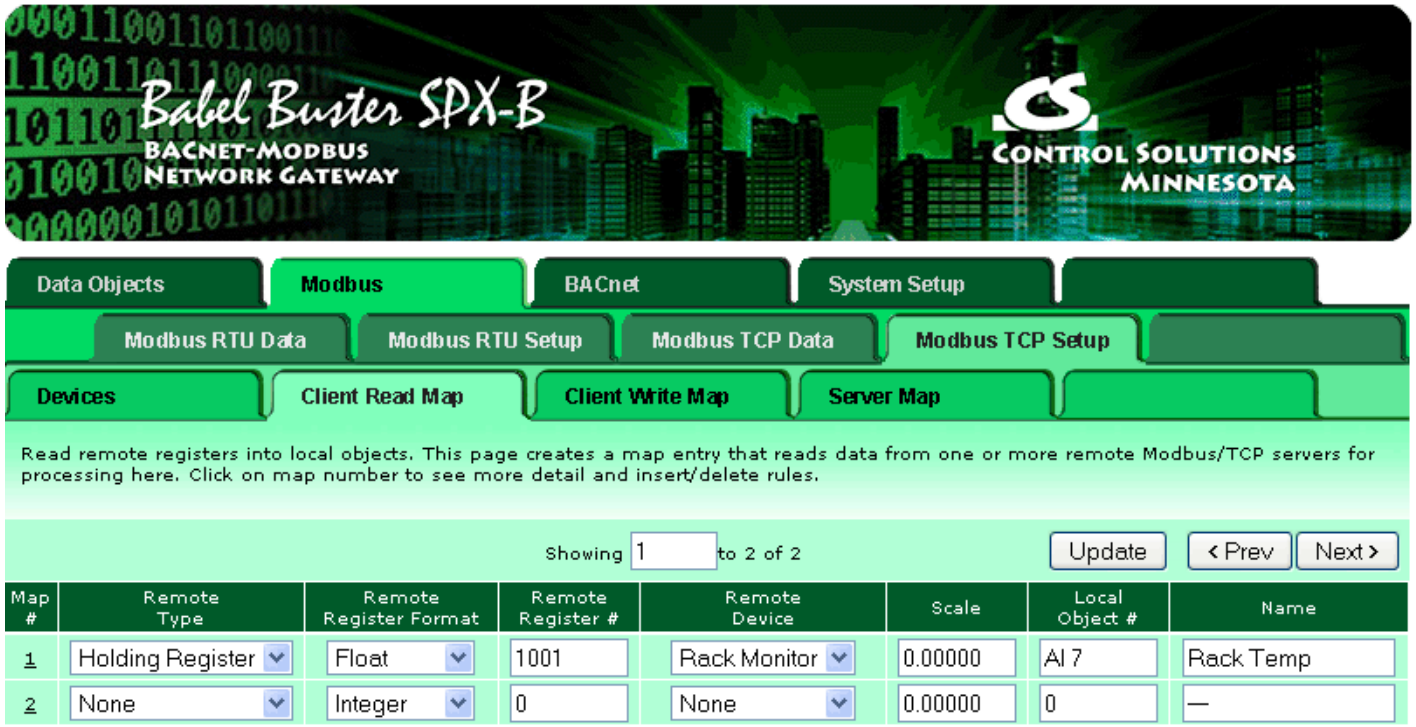
The term "swapped" only applies to double or float formats. Modbus registers are, by definition, 16 bits of data per register. Access to 32-bit data, either 32-bit integer ("double"), or IEEE 754 floating point ("float"), is supported by the use of two consecutive registers. Modbus protocol is inherently "big endian", therefore, Modbus by the Module defaults to having the high order register first for double and float. If the low order register comes first on the device being accessed, check the "swapped" box.

If you have "swapped" turned around, you will quickly recognize it. If floating point data is reversed, a 1.0 becomes 2.2779508e-41, which simply rounds to zero. The pattern is not as predictable as the 1.0 example would suggest. A floating point 1.1 becomes negative 107609184. If 32-bit integer data is reversed, 1 becomes 65536.

Connection status will show a non-zero error code if there is a socket error. Possible errors include:

5 = Connection failed, unable to bind (usually means remote device not connected or not reachable)
81 = Connection in progress (means unsuccessful connect attempt, still trying)
95 = Network is unreachable
97 = Connection aborted
98 = Connection reset by peer
103 = Connection timed out
104 = Connection refused
107 = Host is unreachable

6.2 Modbus TCP Client Read Maps



Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only read data from remote devices. Go to the Client Write Map to write data to those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

For each remote register to be read, enter the register type, format, number, and location (device). The names in the device list are defined in the Devices page.

When the remote register is read, the data will be multiplied by the scale factor and written to the local object number given. The name is optional and used only for display purposes.

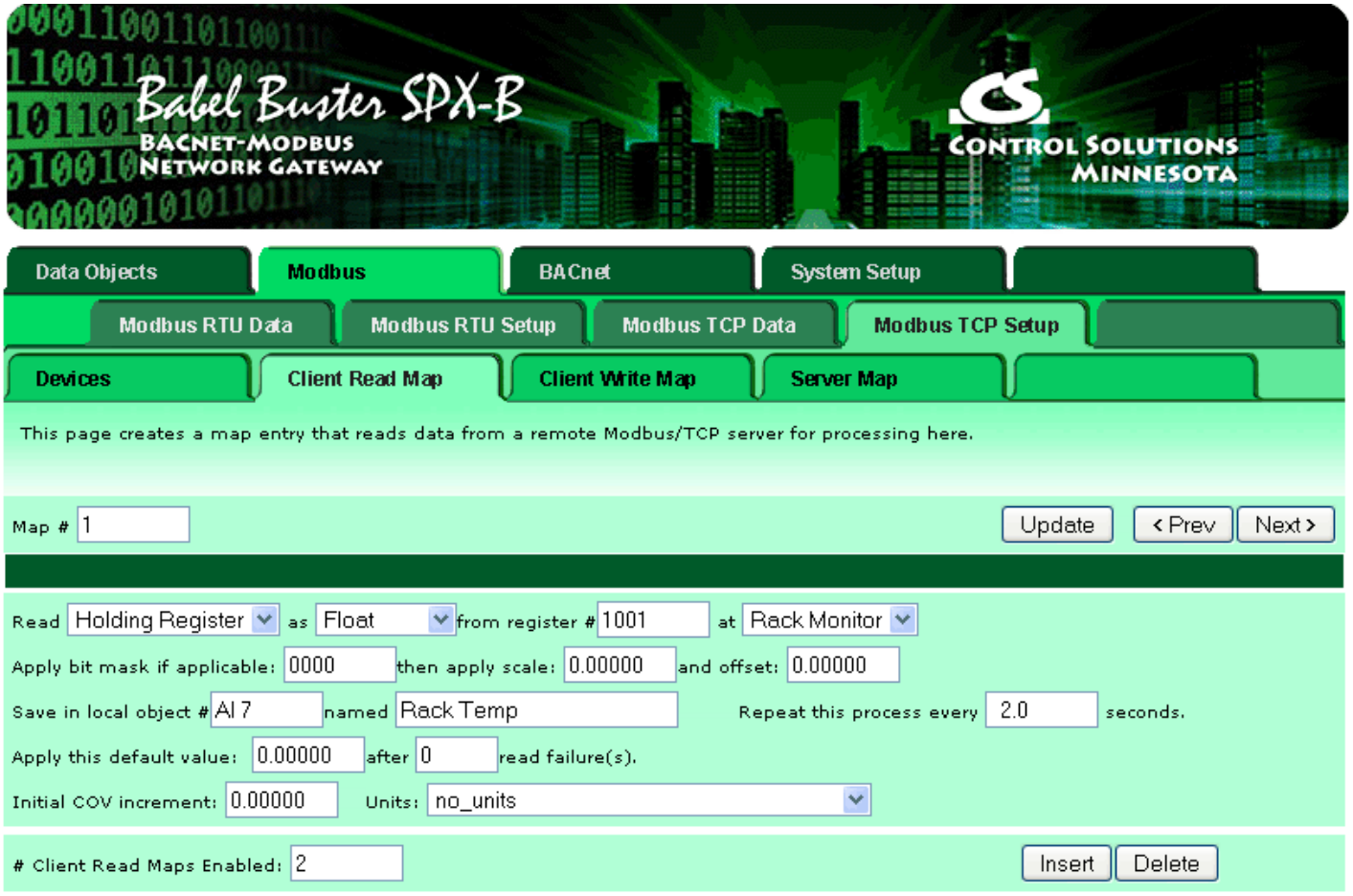
Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n

AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).



Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

For each remote register to be read, enter the register type, format, number, and location (device). The names in the device list are defined in the Devices page.

When the remote register is read, data may be manipulated before being written to the local object. If a bit mask is entered (in hexadecimal), and the remote register type is signed or unsigned (16-bit data), the mask will be bit-wise logical AND-ed with the data, and the retained bits will be right justified in the result. The result will then

be multiplied by the scale factor. The offset is then added and this final result is written to the local object number given. The name is optional and used only for display purposes.

The periodic poll time determines how often the remote register will be read. This number, if nonzero, will override the default poll time given in the Devices page for the remote device being read.

The default value will be stored into the local object after the given number of read failures if the fail count is non-zero. Setting the count to zero will disable the default, and the object will retain the most recent value obtained.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to define any rule presently having zero for a source object or "none" for remote type.

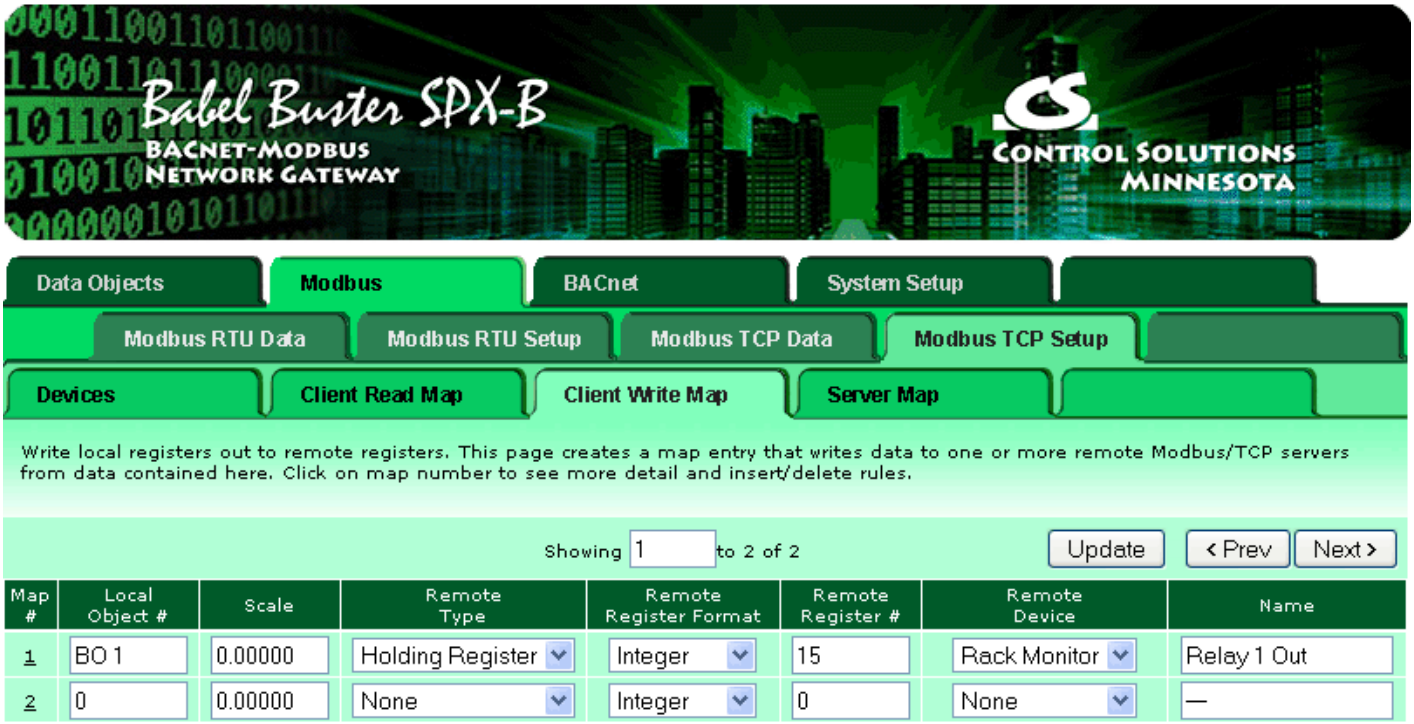
Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

Initial COV increment and period will only apply if a BACnet client subscribes to COV notification from the BACnet object assigned to this Modbus map. These properties may be overwritten by the BACnet client(s) at any time. The values shown here are initial values, not necessarily the current values. (Note: COV increment only applies to Analog objects, all changes are reported for Binary or Multistate objects.)

Units default to no_units, but you may select any of the available BACnetEngineeringUnits values. This value will simply be read by the BACnet client when the units property is requested from the object this Modbus register maps to. The units have no bearing on calculations performed. You must select appropriate scale and offset values to make any required translation between Modbus units and BACnet units. Units are only valid for Analog objects.

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.

6.3 Modbus TCP Client Write Maps



Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only write data to remote devices. Go to the Client Read Map to read data from those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

Data from the local object given will be multiplied by the scale factor before being written. For each remote register to be written, enter the register type, format, number, and location (device). The names in the device list are defined in the Devices page. The name is optional and used only for display purposes.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n

BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).

Rule number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

The local object data may be written periodically, or when it changes, or both. To send upon change (send on delta), check the first box and enter the amount by which the local object must change before being written to the remote device. To guarantee that the remote register will be written at least occasionally even if the data does not change, check the second box and enter some amount of time. This time period will be

referred to as the "maximum quiet time".

Data from the local object may be manipulated before being written to the remote register. The local data is first multiplied by the scale factor. The offset is then added to it. If a bit mask is entered, and the remote register type is signed or unsigned (16-bit data), the mask will be bit-wise logical AND-ed with the data. The mask is right justified, then AND-ed with the data. The result is then left shifted back to the original position of the mask. In other words, the least significant bits of the original data will be stuffed at the position marked by the mask.

After the scaling and masking, the bit fill will be logically OR-ed into the result, but only if the mask was nonzero and was used. Both mask and fill are entered in hexadecimal.

Multiple local objects may be packed into a single remote register. To accomplish this, define two or more rules in sequence with the same remote destination. If the destination is the same, data types are 16-bit (integer or unsigned), bit masks are nonzero, and the rules are sequential, the results of all qualifying rules will be OR-ed together before being sent to the remote destination.

For the remote register to be written, enter the register type, format, number, and location (device). The names in the device list are defined in the Devices page.

The repeat time may determine how often the remote register will be written. If send on delta and maximum quiet time are not checked above, clicking the "at least" button will establish a periodic update time. If send on delta is used and you wish to limit the network traffic in the event changes are frequent, click the "no more than" button and enter the minumum time that should elapse before another write to the remote device.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to define any rule presently having zero for a source register or "none" for remote type.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

Initial COV increment and period will only apply if a BACnet client subscribes to COV notification from the BACnet object assigned to this Modbus map. These properties may be overwritten by the BACnet client(s) at any time. The values shown here are initial values, not necessarily the current values. (Note: COV increment only applies to Analog objects, all changes are reported for Binary or Multistate objects.)

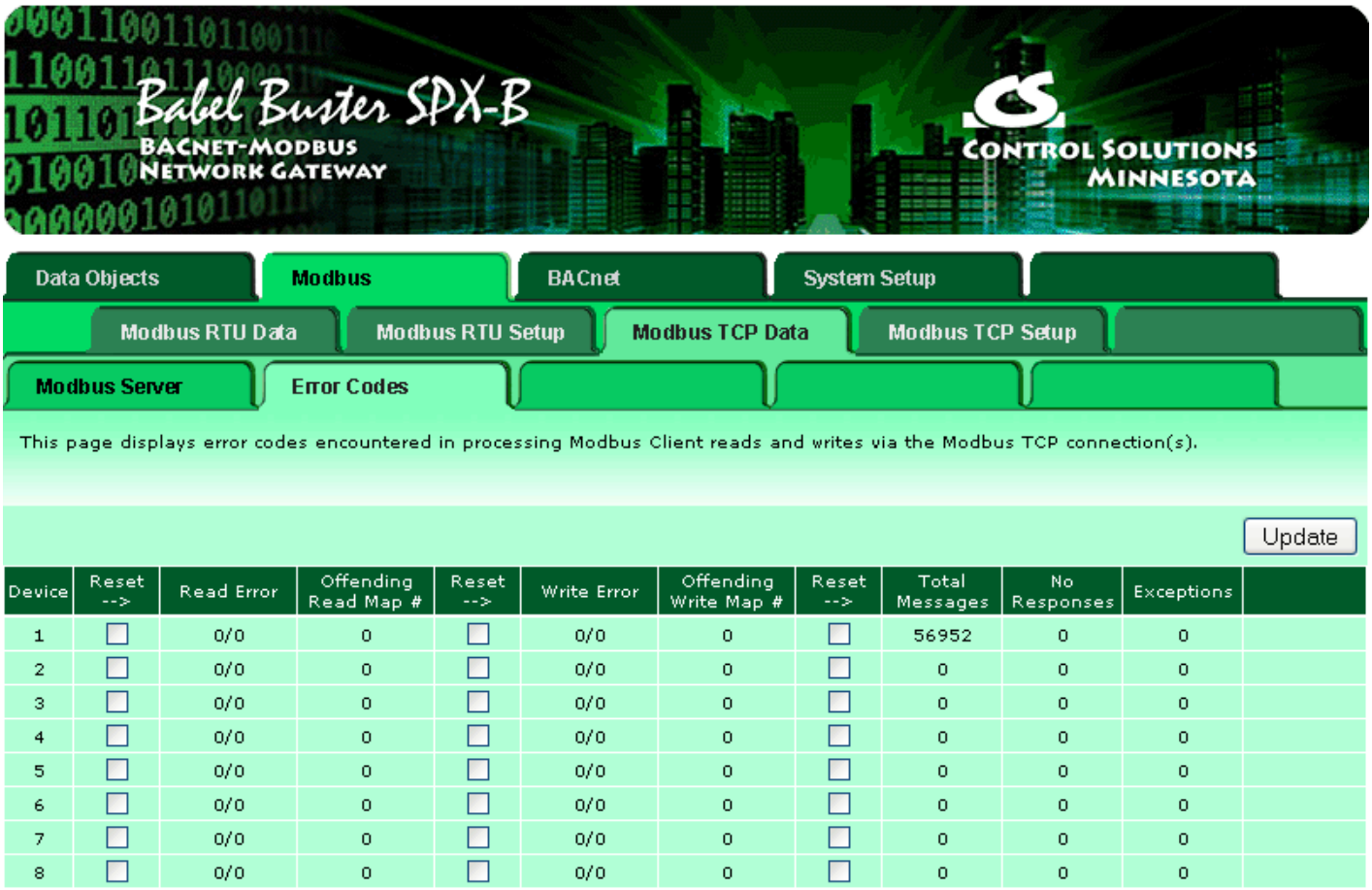
Units default to no_units, but you may select any of the available BACnetEngineeringUnits values. This value will simply be read by the BACnet client

when the units property is requested from the object this Modbus register maps to. The units have no bearing on calculations performed. You must select appropriate scale and offset values to make any required translation between Modbus units and BACnet units. Units are only valid for Analog objects.

Initial Relinquish Default may be set here, but may be overwritten by the BACnet client at any time. This window reflects the initial value, not the current value. (Note: Relinquish Default only applies to commandable Output objects, and does not apply to Input or Value objects.)

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.

6.4 Modbus TCP Errors



Device	Reset -->	Read Error	Offending Read Map #	Reset -->	Write Error	Offending Write Map #	Reset -->	Total Messages	No Responses	Exceptions	
1	☐	0/0	0	☐	0/0	0	☐	56952	0	0	
2	☐	0/0	0	☐	0/0	0	☐	0	0	0	
3	☐	0/0	0	☐	0/0	0	☐	0	0	0	
4	☐	0/0	0	☐	0/0	0	☐	0	0	0	
5	☐	0/0	0	☐	0/0	0	☐	0	0	0	
6	☐	0/0	0	☐	0/0	0	☐	0	0	0	
7	☐	0/0	0	☐	0/0	0	☐	0	0	0	
8	☐	0/0	0	☐	0/0	0	☐	0	0	0	

The first occurrence of read and write errors are shown along with the map number that was being processed when the error occurred. Check the reset box and click update to clear it and possibly show the next error if there are more than one active error conditions.

A total count of all errors is also shown. This total is the sum of errors for all maps for this device. Check the reset box and click update to reset the counts. Click Update to view the most recent data values.

Error code indications of A/B indicate the following errors with the first number:
1 = Transaction ID out of sync
2 = Exception code returned by remote device
3 = Function code mismatch (bad packet)
4 = Inusfficient data (bad packet)
5 = No response from remote device, timed out
6 = CRC error in received packet

When A is code 2 indicating an exception code was returned, B indicates the exception as follows:
1 = Illegal function code
2 = Illegal data address (the requested register does not exist in the device)
3 = Illegal data value

7. Using the SPX-B as a BACnet Client

The BACnet client is used to query other BACnet devices, obtain their Present Value data, and store a copy of that data in the BB2-7030's own local objects. From there, the data may be accessed by Modbus TCP or SNMP devices, or other BACnet devices when application specific reasons make this approach more preferred than direct routing.

7.1. BACnet Device Configuration

Setting up the BACnet client consists of identifying one or more BACnet devices, then listing the objects that should be queried (whether read or written). The client configuration pages are illustrated below.

Device number simply shows you where you are on the device list. Click "next" and "prev" to scroll through the list.

Remote BACnet devices to be accessed by this device are specified here. Enter the Device Instance of the remote device, a name to reference in other pages, a poll rate, default reply timeout, and default write priority. Enter static address if applicable. Then click "update".

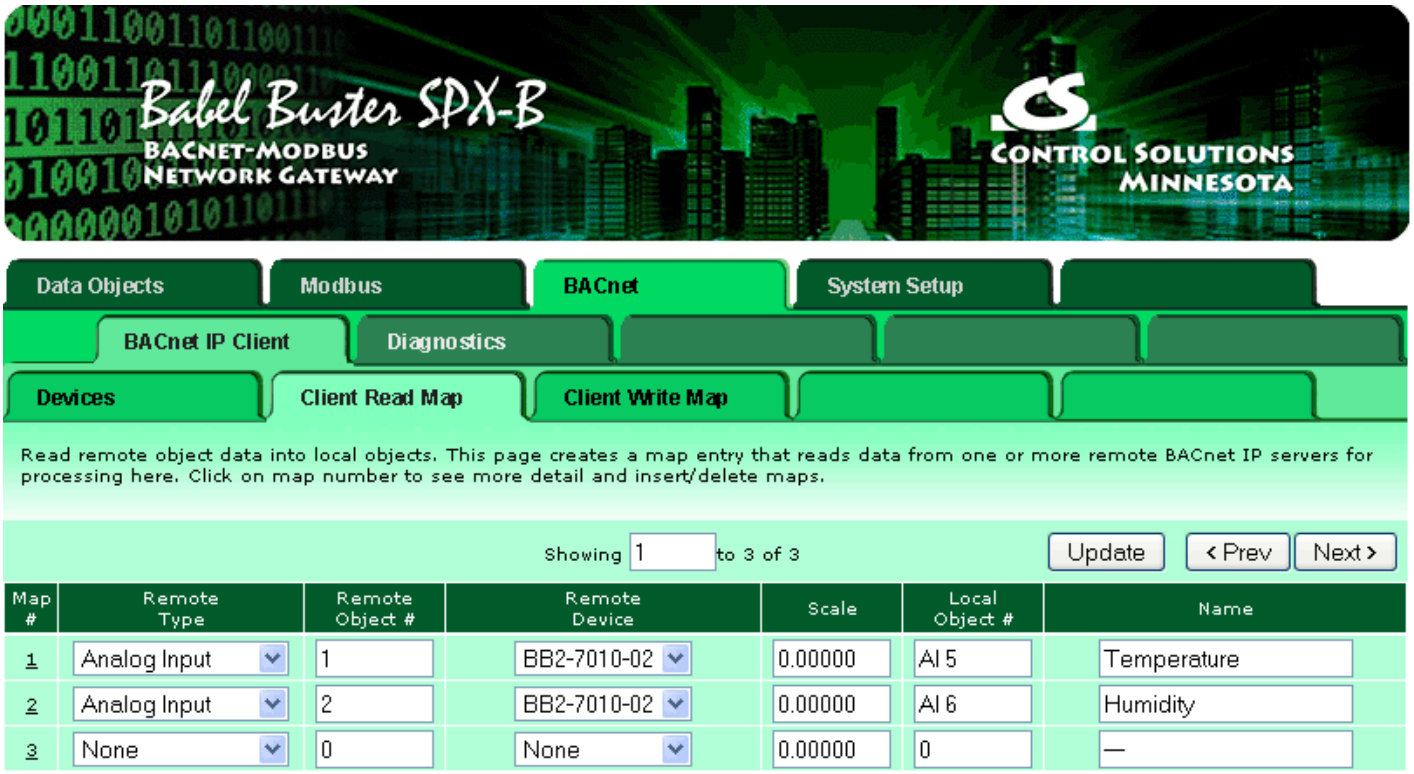
The gateway broadcasts a "who-is" looking for this device when a read or write map wants to use this device. When (if) it responds, its IP address or MS/TP mac address is listed here simply as a diagnostic. Timeouts resulting from inability to reach this device are tabulated on this page as well, and may be cleared by clicking the Clear button. To cause the who-is process to be repeated, click Clear Cache.

BACnet IP or MS/TP slave devices that to not support Who-Is/I-Am can still be supported here. When this is the case, enter the slave device's Mac address in the Static Mac window and check the 'No Who-Is' box. If located on a remote network via a router, enter the network number as DNet. This static entry effectively replies to the implied Who-Is.

To use a fixed static address, enter a single number for MS/TP MAC address. or an IP address optionally including port number. An example of IP address with port number would be 192.168.1.99:47808. The 47808 is the port number, and is separated from the IP address by a colon. Note that 47808 is the default 0xBAC0 port number. If no port number is given, the port configured on the BACnet IP Port page will be used (the SPX-B's own port).

7.2. BACnet Client Read Maps

The client read maps tell the SPX-B which objects to read, from which BACnet devices. Click on the map number to view the full details of the read map.



Map number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Maps entered on this page only read data from remote devices. Go to the Client Write Map to write data to those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of maps is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

For each remote object to be read, enter the object instance and type, and location (device). The names in the device list are defined in the Devices page.

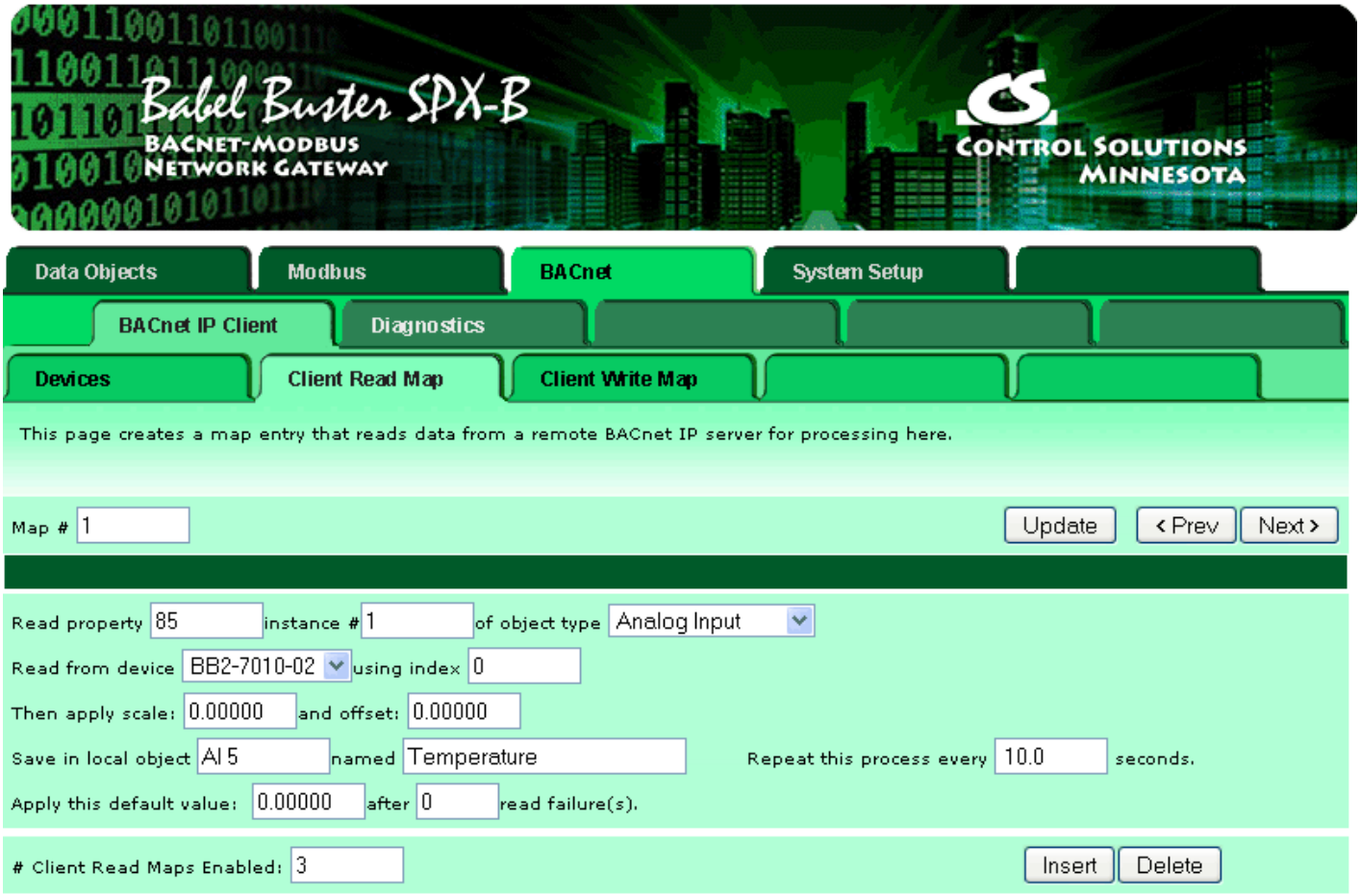
When the remote object is read, data may be manipulated before being written to the local object. The value will be multiplied by the scale factor. The final result is written to the local object number given. The name is optional and used only for display purposes.

Selecting "none" for remote type effectively deletes the map even though it will still appear in the list until deleted. Unused maps at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).



Rule number simply tells you where you're at on the list of object maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

For each remote object to be read, enter the object instance and type, and location (device). The names in the device list are defined in the Devices page. Use index value of 0 if no index.

When the remote object is read, data may be manipulated before being written to the local object. The value will be multiplied by the scale factor, then the offset is added.

The final result is written to the local object number given. The name is optional and used only for display purposes.

The periodic poll time determines how often the remote object will be read. This number, if nonzero, will override the default poll time given in the Devices page for the remote device being read.

The default value will be stored into the local object after the given number of read failures if the fail count is non-zero. Setting the count to zero will disable the default, and the object will retain the most recent value obtained.

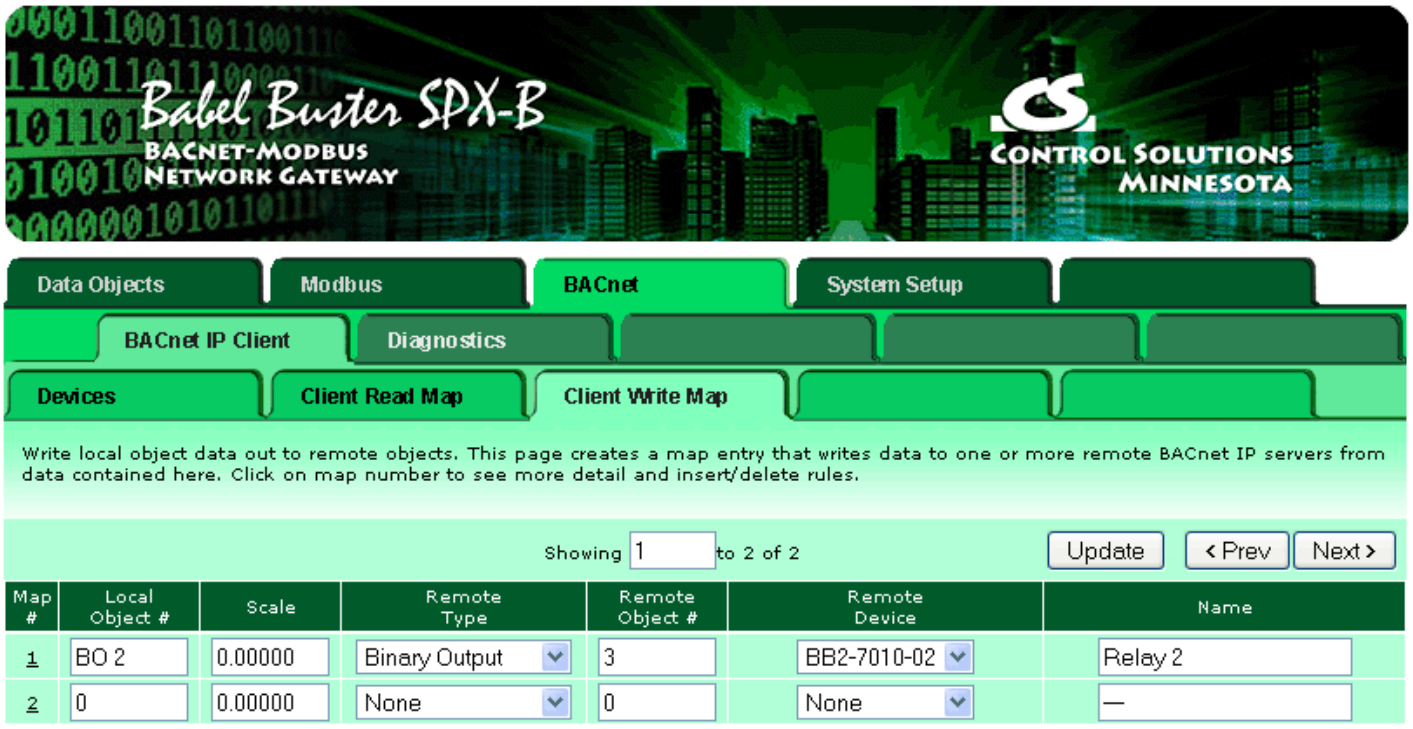
Delete will remove the rule number shown in the "Map #" box. Insert will insert a new map before the map number shown, and is used for placing maps between existing maps. It is not necessary to use Insert to add maps to the bottom of the list or to define any map presently having zero for a source object or "none" for remote type.

Selecting "none" for remote type effectively deletes the map even though it will still appear in the list until deleted. Unused maps at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of maps enabled.

The number of maps enabled simply limits the scope of map review so that you do not have to review a lot of unused maps. If the displayed maps are used up and you need more, increase the enabled number.

7.3. BACnet Client Write Maps

The client read maps tell the SPX-B which objects to write, on which BACnet devices. Click on the map number to view the full details of the write map.



Map number simply tells you where you're at on the list of register maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Maps entered on this page only write data to remote devices. Go to the Client Read Map to read data from those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of maps is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

Data from the local object given will be multiplied by the scale factor before being written. For each remote object to be written, enter the object instance and type, and location (device). The names in the device list are defined in the Devices page. The name is optional and used only for display purposes.

Selecting "none" for remote type effectively deletes the map even though it will still appear in the list until deleted. Unused maps at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).

Rule number simply tells you where you're at on the list of object maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

The local object data may be written periodically, or when it changes, or both. To send upon change (send on delta), check the first box and enter the amount by which the local object must change before being written to the remote device. To guarantee that the remote object will be written at least occasionally even if the data does not change, check the second box and enter some amount of time. This time period will be referred to as the "maximum quiet time".

Data from the local object may be manipulated before being written to the remote register. The local data is first multiplied by the scale factor. The offset is then added to it.

For the remote object to be written, enter the object instance and type, index if applicable (leave at 0 if not), and priority to use of the object being written is commandable. The names in the device list are defined in the Devices page.

The repeat time may determine how often the remote object will be written. If send on

delta and maximum quiet time are not checked above, clicking the "at least" button will establish a periodic update time. If send on delta is used and you wish to limit the network traffic in the event changes are frequent, click the "no more than" button and enter the minumum time that should elapse before another write to the remote device.

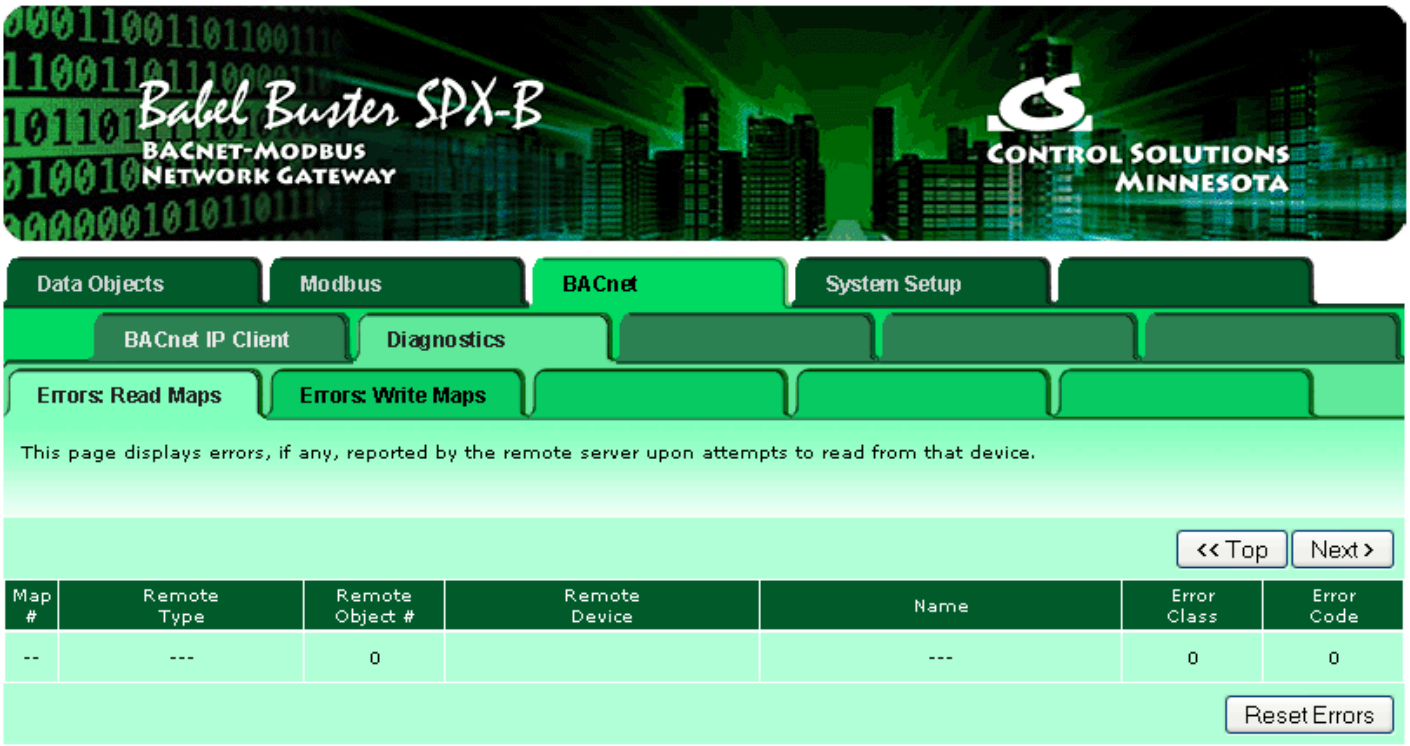
Delete will remove the rule number shown in the "Map #" box. Insert will insert a new map before the map number shown, and is used for placing maps between existing maps. It is not necessary to use Insert to add maps to the bottom of the list or to define any map presently having zero for a source object or "none" for remote type.

Selecting "none" for remote type effectively deletes the map even though it will still appear in the list until deleted. Unused maps at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of maps enabled.

The number of maps enabled simply limits the scope of map review so that you do not have to review a lot of unused maps. If the displayed maps are used up and you need more, increase the enabled number.

7.4. BACnet Errors

If errors are detected in the course of reading or writing other BACnet objects via the client's maps, they will be indicated on the errors pages.



Errors for BACnet IP client read maps are shown on this page. Only those maps with errors to report are listed. Refer to the code and class lists below for interpretation.

Proprietary class 82, code 0, is generated locally indicating a timeout, no response received from remote server. All other codes listed below are returned by the remote server.

0 = ERROR_CLASS_DEVICE
1 = ERROR_CLASS_OBJECT
2 = ERROR_CLASS_PROPERTY
3 = ERROR_CLASS_RESOURCES
4 = ERROR_CLASS_SECURITY
5 = ERROR_CLASS_SERVICES

/* valid for all classes */
0 = ERROR_CODE_OTHER

/* Error Class - Device */
2 = ERROR_CODE_CONFIGURATION_IN_PROGRESS
3 = ERROR_CODE_DEVICE_BUSY
25 = ERROR_CODE_OPERATIONAL_PROBLEM

/* Error Class - Object */
4 = ERROR_CODE_DYNAMIC_CREATION_NOT_SUPPORTED
17 = ERROR_CODE_NO_OBJECTS_OF_SPECIFIED_TYPE
23 = ERROR_CODE_OBJECT_DELETION_NOT_PERMITTED
24 = ERROR_CODE_OBJECT_IDENTIFIER_ALREADY_EXISTS
27 = ERROR_CODE_READ_ACCESS_DENIED
31 = ERROR_CODE_UNKNOWN_OBJECT
36 = ERROR_CODE_UNSUPPORTED_OBJECT_TYPE

/* Error Class - Property */
8 = ERROR_CODE_INCONSISTENT_SELECTION_CRITERION
9 = ERROR_CODE_INVALID_DATA_TYPE
32 = ERROR_CODE_UNKNOWN_PROPERTY
37 = ERROR_CODE_VALUE_OUT_OF_RANGE
40 = ERROR_CODE_WRITE_ACCESS_DENIED
41 = ERROR_CODE_CHARACTER_SET_NOT_SUPPORTED
42 = ERROR_CODE_INVALID_ARRAY_INDEX
44 = ERROR_CODE_NOT_COV_PROPERTY
45 = ERROR_CODE_OPTIONAL_FUNCTIONALITY_NOT_SUPPORTED
47 = ERROR_CODE_DATATYPE_NOT_SUPPORTED
50 = ERROR_CODE_PROPERTY_IS_NOT_AN_ARRAY

/* Error Class - Resources */
18 = ERROR_CODE_NO_SPACE_FOR_OBJECT
19 = ERROR_CODE_NO_SPACE_TO_ADD_LIST_ELEMENT
20 = ERROR_CODE_NO_SPACE_TO_WRITE_PROPERTY

/* Error Class - Security */
1 = ERROR_CODE_AUTHENTICATION_FAILED
6 = ERROR_CODE_INCOMPATIBLE_SECURITY_LEVELS
12 = ERROR_CODE_INVALID_OPERATOR_NAME
15 = ERROR_CODE_KEY_GENERATION_ERROR
26 = ERROR_CODE_PASSWORD_FAILURE
28 = ERROR_CODE_SECURITY_NOT_SUPPORTED
30 = ERROR_CODE_TIMEOUT

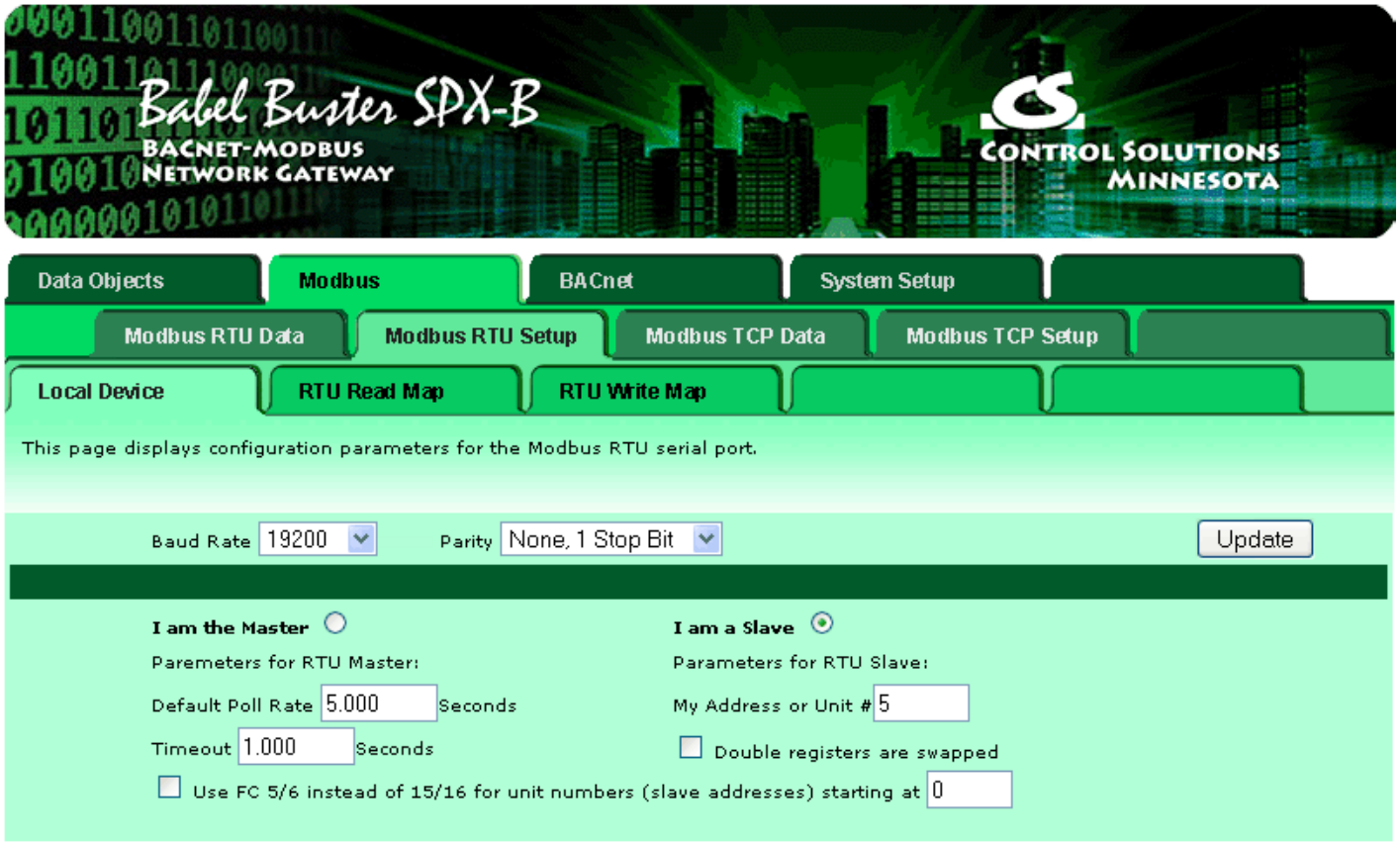
/* Error Class - Services */
5 = ERROR_CODE_FILE_ACCESS_DENIED
7 = ERROR_CODE_INCONSISTENT_PARAMETERS
10 = ERROR_CODE_INVALID_FILE_ACCESS_METHOD
11 = ERROR_CODE_ERROR_CODE_INVALID_FILE_START_POSITION
13 = ERROR_CODE_INVALID_PARAMETER_DATA_TYPE
14 = ERROR_CODE_INVALID_TIME_STAMP
16 = ERROR_CODE_MISSING_REQUIRED_PARAMETER
22 = ERROR_CODE_PROPERTY_IS_NOT_A_LIST
29 = ERROR_CODE_SERVICE_REQUEST_DENIED
43 = ERROR_CODE_COV_SUBSCRIPTION_FAILED
46 = ERROR_CODE_INVALID_CONFIGURATION_DATA
48 = ERROR_CODE_DUPLICATE_NAME
49 = ERROR_CODE_DUPLICATE_OBJECT_ID

8. Configuring SPX-B as a Modbus RTU Slave

The SPX-B can be a Modbus RTU master or slave. As slave, the SPX-B will respond to another Modbus master and return data requested. The various objects in the SPX-B are accessed as holding registers, with register numbers calculated and based on object type and instance.

8.1 Modbus RTU Device Configuration

Modbus device configuration for RTU really consists of port configuration, and includes setting the slave address if the SPX-B is functioning as Modbus slave.



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.

The double register swap on this page only applies when the local device (the gateway

you are configuring here) is functioning as a Modbus RTU slave. If the Modbus master expects least significant data to be in the first (lowest numbered) register, then check the "swap" box.

The term "swapped" only applies to double or float formats. Modbus registers are, by definition, 16 bits of data per register. Access to 32-bit data, either 32-bit integer ("double"), or IEEE 754 floating point ("float"), is supported by the use of two consecutive registers. Modbus protocol is inherently "big endian", therefore, Modbus by the Module defaults to having the high order register first for double and float. If the low order register comes first on the device being accessed, check the "swapped" box.

If you have "swapped" turned around, you will quickly recognize it. If floating point data is reversed, a 1.0 becomes 2.2779508e-41, which simply rounds to zero. The pattern is not as predictable as the 1.0 example would suggest. A floating point 1.1 becomes negative 107609184. If 32-bit integer data is reversed, 1 becomes 65536.

8.2 Modbus RTU Slave Register Mapping

The mappings shown below are used when the SPX-B is treated as a Modbus RTU Slave. All objects are accessed as holding registers. Analog registers MUST be read as a register pair, and will return IEEE754 floating point.

Analog Input Object

Must be read/written as Floating Point (IEEE 754) register pair, most significant register first.

ANALOG INPUT	
Object	Modbus Registers
AI #1	1 (read 1,2 as pair)
AI #2	3 (read 3,4 as pair)
AI #3	5 (read 5,6 as pair)
AI #300	599 (read 599,600 as pair)

Analog Output Object

Must be read/written as Floating Point (IEEE 754) register pair, most significant register first.

ANALOG OUTPUT	
Object	Modbus Registers
AO #1	1001 (read 1001,1002 as pair)
AO #2	1003 (read 1003,1004 as pair)
AO #3	1005 (read 1005,1006 as pair)
AO #100	1199 (read 1199,1200 as pair)

Analog Value Object

Must be read/written as Floating Point (IEEE 754) register pair, most

ANALOG VALUE	
Object	Modbus Registers
AV #1	2001 (read 2001,2002 as pair)

significant register first.

AV #2	2003 (read 2003,2004 as pair)
AV #3	2005 (read 2005,2006 as pair)
AV #100	2199 (read 2199,2200 as pair)

Binary Input Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY INPUT	
Object	Modbus Registers
BI #1	3001
BI #2	3002
BI #3	3003
BI #300	3300

Binary Output Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY OUTPUT	
Object	Modbus Registers
BO #1	4001
BO #2	4002
BO #3	4003
BO #100	4100

Binary Value Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY VALUE	
Object	Modbus Registers
BV #1	5001
BV #2	5002
BV #3	5003
BV #100	5100

Multi-state Input Object

Read/written as single holding register, treated as unsigned 16-bit integer.

MULTI-STATE INPUT	
Object	Modbus Registers
MI #1	13001
MI #2	13002
MI #3	13003
MI #300	13300

Multi-state Output Object

MULTI-STATE OUTPUT	
Object	Modbus Registers

Read/written as single holding register, treated as unsigned 16-bit integer.

MO #1	14001
MO #2	14002
MO #3	14003
MO #100	14100

Multi-state Value Object

Read/written as single holding register, treated as unsigned 16-bit integer.

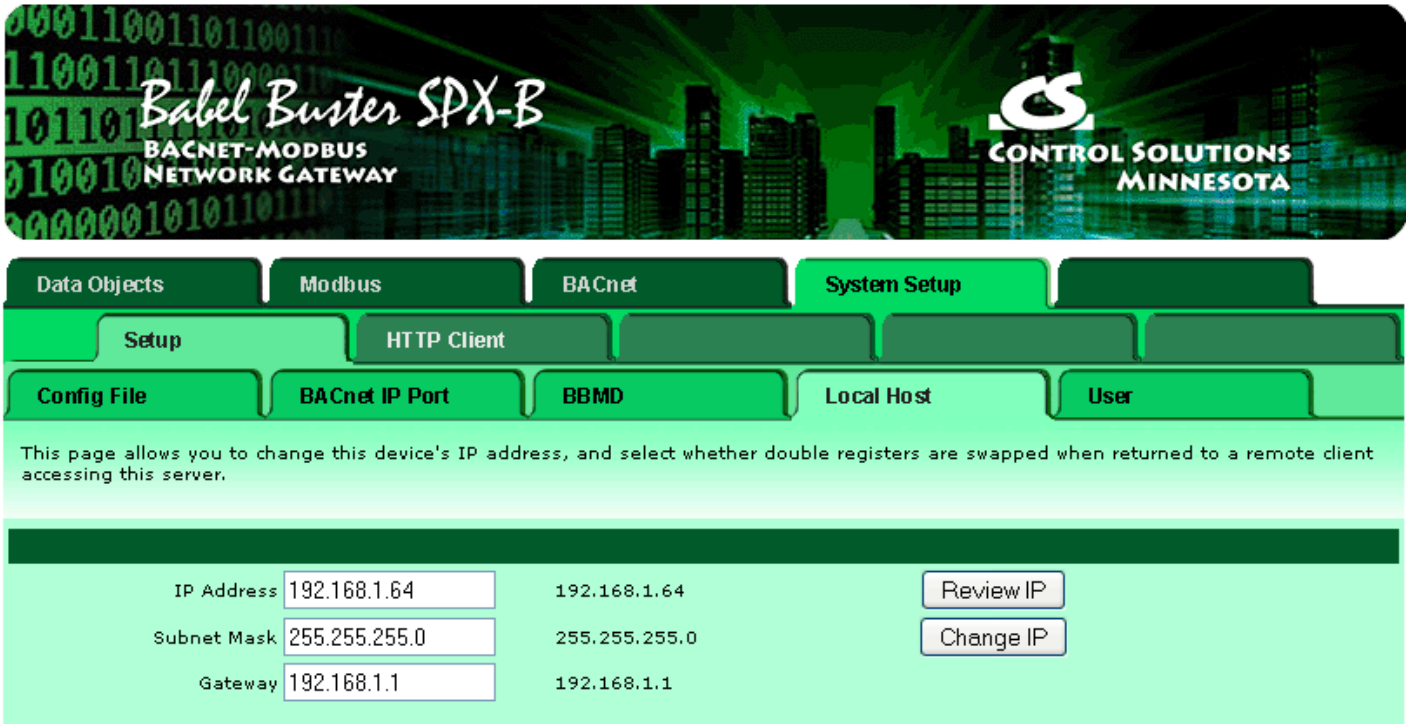
MULTI-STATE VALUE	
Object	Modbus Registers
MV #1	19001
MV #2	19002
MV #3	19003
MV #100	19100

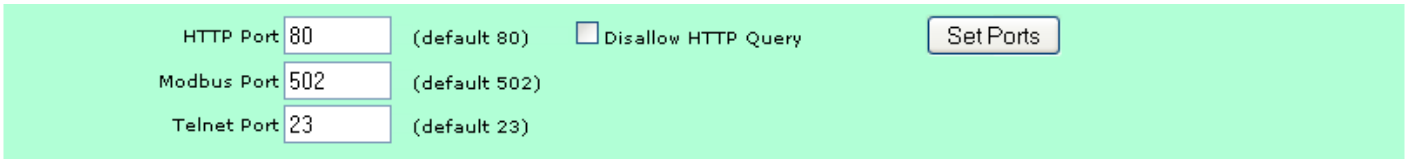
9. Configuring SPX-B as a Modbus TCP Slave

The term “server” is often used to describe the Modbus TCP version of a Modbus slave. A server will provide data when a client asks for it. The concept of master/slave is less significant in Modbus TCP because any TCP device can be both master and slave at the same time, and there can be multiple “masters” on the network. That is in contrast with Modbus RTU where there can be only one master and multiple slaves, and each device must be one or the other.

The Modbus TCP server is simply a collection of registers that may contain data. The source of that data in the case of Babel Buster SPX-B can be any of several possible sources. It may be read from another Modbus device. Another Modbus device could have put it there by writing to the SPX-B. The data could have been received by the BACnet client or BACnet server.

9.1 Modbus TCP Device Configuration





The only local device configuration required for Modbus TCP is to set the IP address of the local device. The standard port for Modbus TCP is 502. This can be changed if necessary.

9.2 Modbus TCP Slave Register Mapping

The mappings shown below are used when the SPX-B is treated as a Modbus RTU Slave. All objects are accessed as holding registers. These mappings are also used when the SPX-B is treated as a Modbus TCP Server (slave). The local register numbers may be accessed as holding registers. In addition, if the Modicon mapping option is turned on (TCP only), binary points can be accessed as coils.

Analog Input Object

Must be read/written as Floating Point (IEEE 754) register pair, most significant register first.

ANALOG INPUT	
Object	Modbus Registers
AI #1	1 (read 1,2 as pair)
AI #2	3 (read 3,4 as pair)
AI #3	5 (read 5,6 as pair)
AI #300	599 (read 599,600 as pair)

Analog Output Object

Must be read/written as Floating Point (IEEE 754) register pair, most significant register first.

ANALOG OUTPUT	
Object	Modbus Registers
AO #1	1001 (read 1001,1002 as pair)
AO #2	1003 (read 1003,1004 as pair)
AO #3	1005 (read 1005,1006 as pair)
AO #100	1199 (read 1199,1200 as pair)

Analog Value Object

Must be read/written as Floating Point (IEEE 754) register pair, most significant register first.

ANALOG VALUE	
Object	Modbus Registers
AV #1	2001 (read 2001,2002 as pair)
AV #2	2003 (read 2003,2004 as pair)
AV #3	2005 (read 2005,2006 as pair)
AV #100	2199 (read 2199,2200 as pair)

Binary Input Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY INPUT	
Object	Modbus Registers
BI #1	3001
BI #2	3002
BI #3	3003
BI #300	3300

Binary Output Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY OUTPUT	
Object	Modbus Registers
BO #1	4001
BO #2	4002
BO #3	4003
BO #100	4100

Binary Value Object

Read/written as a single holding register, any non-zero value written will result in bit set.

BINARY VALUE	
Object	Modbus Registers
BV #1	5001
BV #2	5002
BV #3	5003
BV #100	5100

Multi-state Input Object

Read/written as single holding register, treated as unsigned 16-bit integer.

MULTI-STATE INPUT	
Object	Modbus Registers
MI #1	13001
MI #2	13002
MI #3	13003
MI #300	13300

Multi-state Output Object

Read/written as single holding register, treated as unsigned 16-bit integer.

MULTI-STATE OUTPUT	
Object	Modbus Registers
MO #1	14001
MO #2	14002
MO #3	14003
MO #100	14100

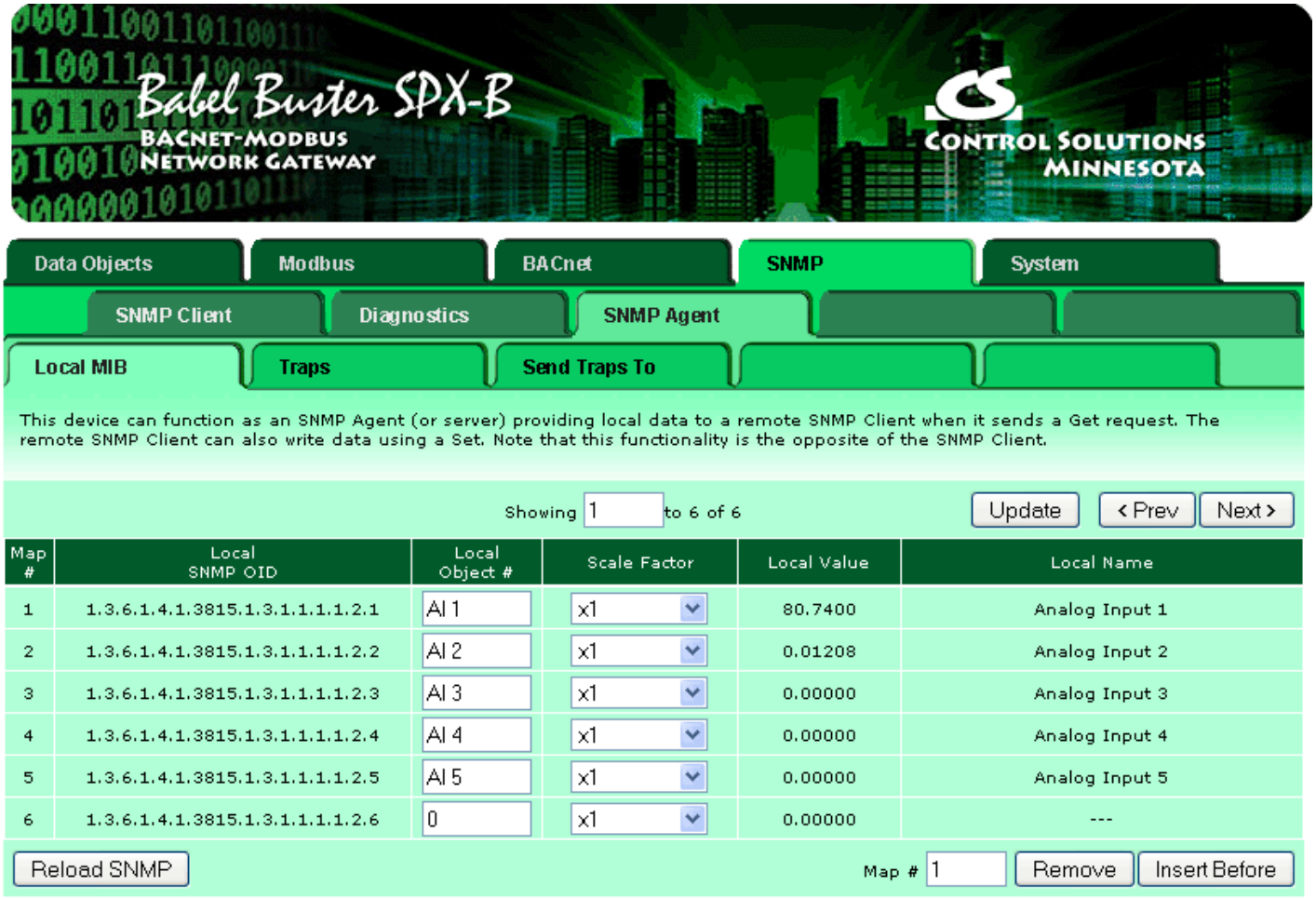
Multi-state Value Object

Read/written as single holding register, treated as unsigned 16-bit integer.

MULTI-STATE VALUE	
Object	Modbus Registers
MV #1	19001
MV #2	19002
MV #3	19003
MV #100	19100

10. Using the SPX-B2 as an SNMP Server (Agent)

The SPX-B2 can act as an SNMP agent or server. You select which BACnet objects are to show up in the MIB, and the MIB is created dynamically as you fill out the list of objects. Once the MIB is created, any standard v1 or v2 SNMP manager can access the data. Integer data is most universally recognized by SNMP. Floating point support is available in the SPX-B; however, floating point is not standardized and you should test compatibility.



IMPORTANT: The definition of Input versus Output object is from the perspective of the BACnet network. Therefore your SNMP client should Write to Input objects to provide input to BACnet, and Read from Output objects to receive output from BACnet. Attempting to write a BACnet Output object from SNMP will not work properly. You must think of your SNMP manager as the physical I/O being accessed

from BACnet. If you want to make your SNMP manager write to an Output object on another BACnet device, use the BACnet client mapping to translate a local Input to remote Output on the BACnet side.

Rule number simply tells you where you're at on the list of the local SNMP Agent's OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

This page enables SNMP Get/Set to objects indicated on the above map list. The available local OID's are assigned automatically. You may select which local BACnet objects are mapped to these OID's. The only data type supported via the internal SNMP Agent is signed integer, therefore you must use scaling to provide real data as integers. This is an inherent limitation of SNMP which does not have any universally accepted method of transmitting floating point data.

Internal data is multiplied by the scale factor when read by your remote SNMP manager (client). Data written by your SNMP client is divided by the scale factor before being stored internally.

For each local object to be accessed by the remote SNMP Client, enter the local object number and scale factor. The local data and object name will be shown for reference. The data returned to the remote SNMP client will be the indicated local value multiplied by the scale factor, then truncated to integer. Enter an object number, then click Update to add the mapping to the list.

Objects are not immediately available when entered in the list above. When you have finished making changes, click the Reload SNMP button to clear and reload the MIB. The MIB is also automatically reloaded every time you restart this device.

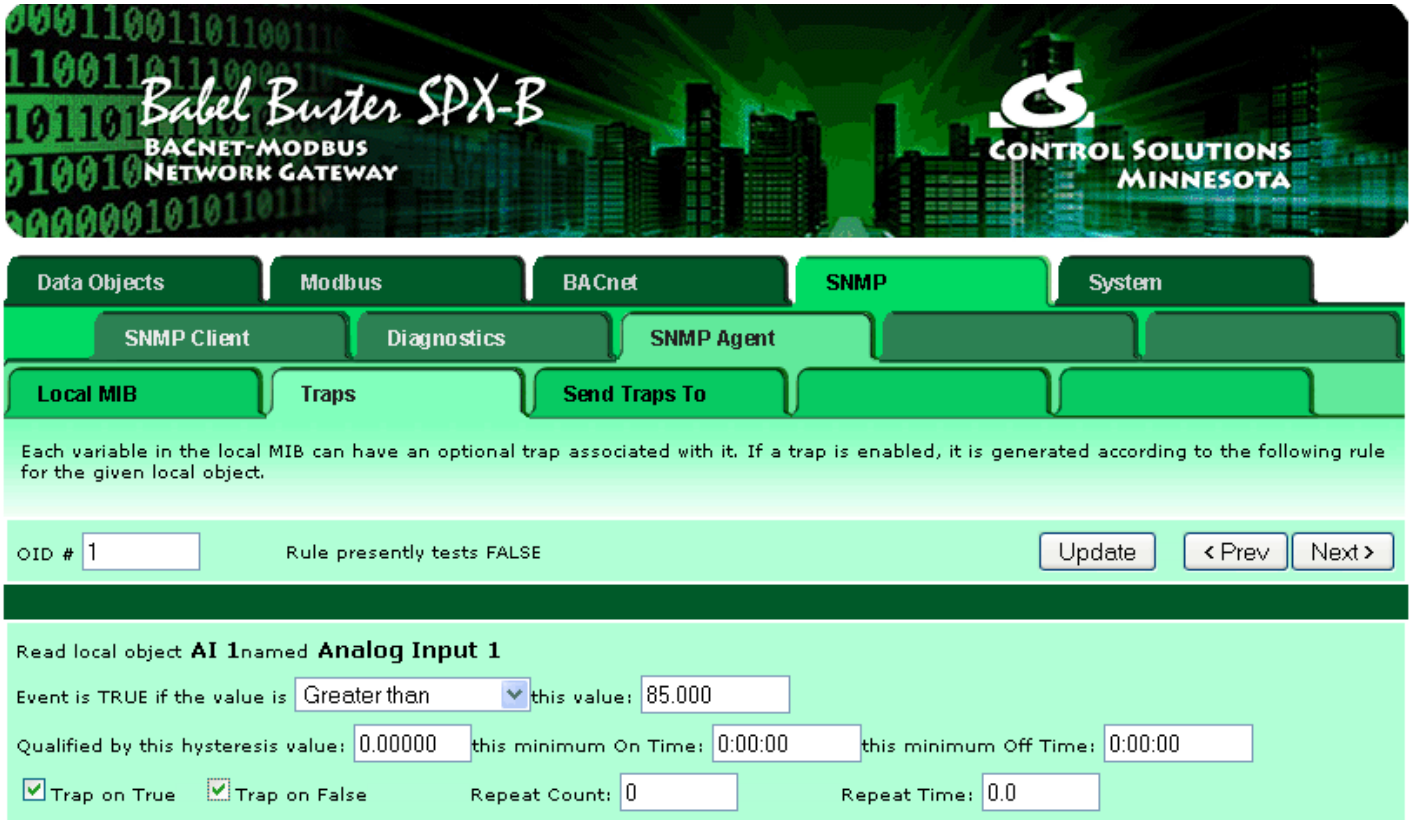
Entering zero (none) for local object effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type,

and these limits may be found on the System Capacities link from the home/index page (click graphic at top).



OID number simply tells you where you're at on the list of the local SNMP Agent's OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update. You cannot proceed to a trap rule for an OID that has not been defined on the Local MIB page.

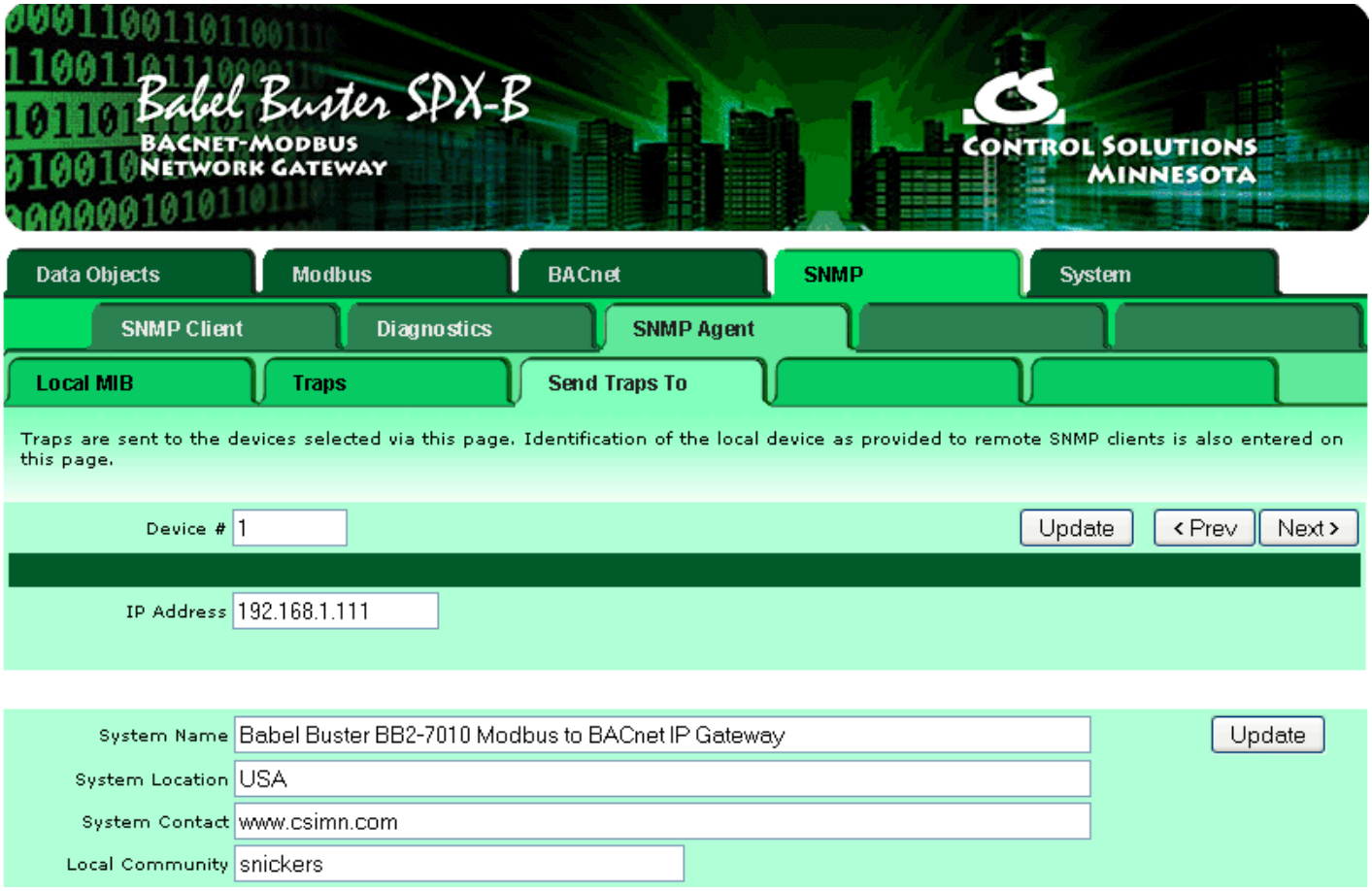
Select a comparison or test, and click the button for your choice of what the local register should be compared to. Then enter either the fixed value for threshold.

Quaifications are optional, and enabled only when values are nonzero. How hysteresis is applied depends on the comparison. For a test that becomes true if greater than, the test will not return to false until the local register is less than the test value by a margin of at least this hysteresis value. If a test becomes true if less than, it will not return to false until the local register is greater than the test value by a margin of at least this hysteresis value.

On time and off time, if specified, determine how long the condition must be true (on time) or false (off time) before the true or false response is actually taken. Times are given in HH:MM:SS format (hours, minutes, seconds).

The repeat count is the number of times the same trap will be sent when triggered. This number of traps will be sent at approximately 100 millisecond intervals. The repeat time is the delay period between re-transmissions of the trap, or series of traps as determined by the repeat count. Repeat time is in seconds. Example: If repeat

count is set to 3, and repeat time is set to 60 seconds, then three trap messages will be sent in a burst and this burst will be repeated once every minute.

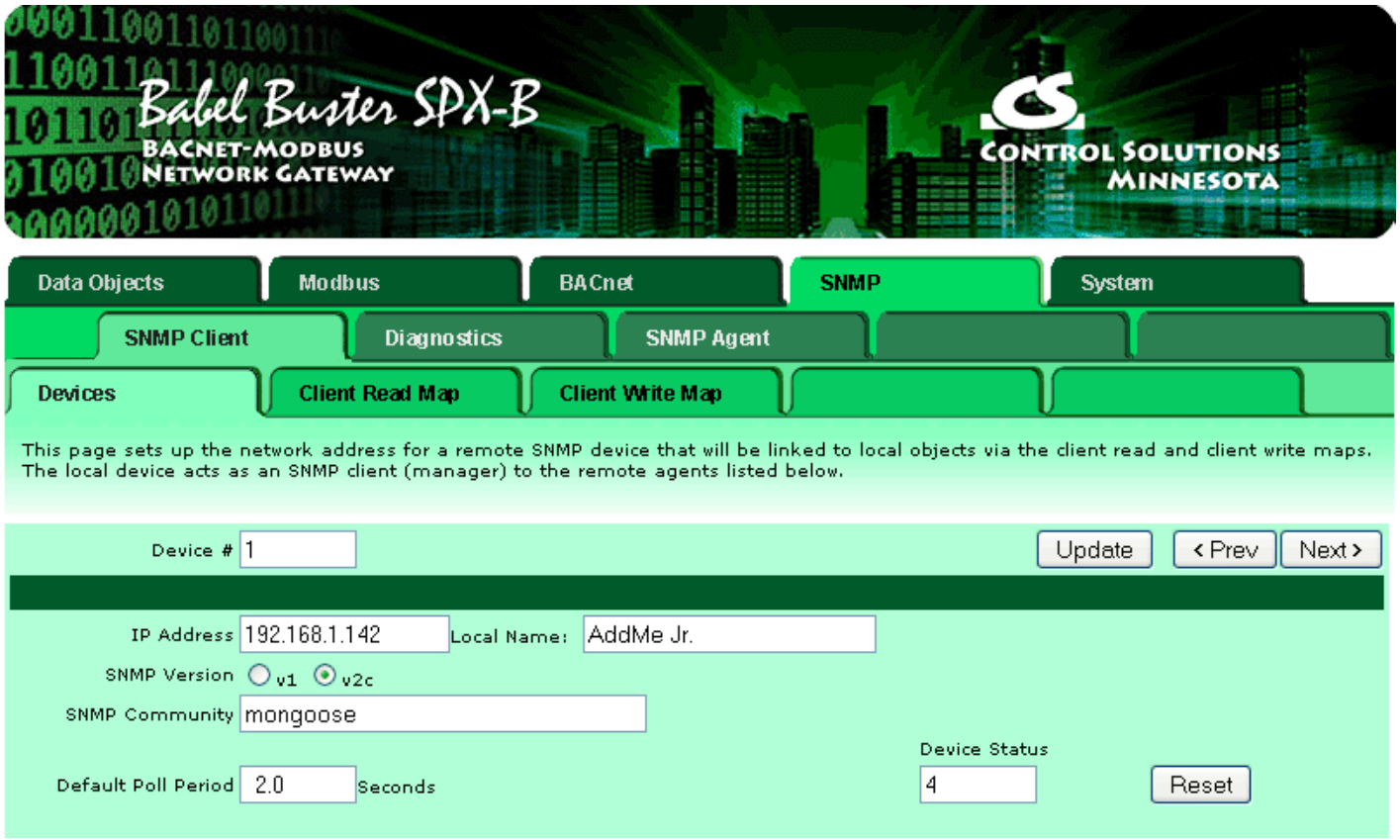


Traps generated by this device will be sent to port 162 on each IP address listed above. The name, location, and contact listed above may be retrieved by the remote SNMP client. The local community is the name that must be used by the remote SNMP client to write to this device. The name "public" is accepted for reading.

11. Using the SPX-B2 as an SNMP Client (Manager)

The SPX-B2 has the ability to be an SNMP client. In “master/slave” terms, this would be the master. Configuring the SNMP client starts with defining one or more SNMP devices that will be queried. Then, like the other possible client functions in the SPX-B2, you set up read and write maps. A “read map” will use SNMP Get to query the device, and a “write map” will use SNMP Set to write to the device.

The SNMP Client configuration pages are illustrated below along with a summary of how to use them.



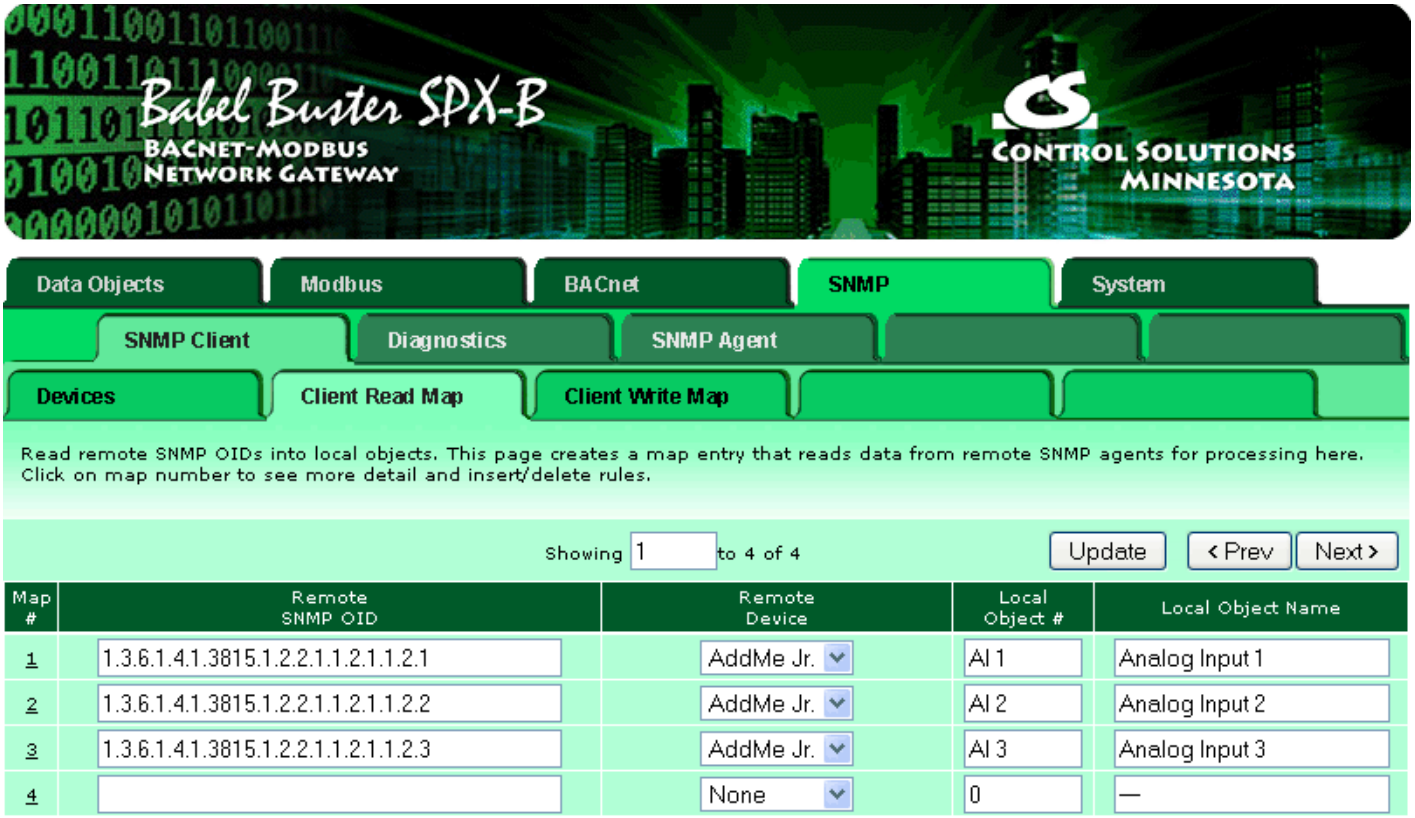
Device number simply shows you where you are on the device list. Click "next" and "prev" to scroll through the list.

Remote SNMP devices to be accessed by this device are specified here. Enter the IP address of the remote device, a name to reference in other pages, and a default poll rate. Then click "update".

This gateway expects to access SNMP devices via the standard port 161.

Connection status will show a non-zero error code if there is a socket error. Possible errors include:

5 = Connection failed, unable to bind (usually means remote device not connected or not reachable)
81 = Connection in progress (means unsuccessful connect attempt, still trying)
95 = Network is unreachable
97 = Connection aborted
98 = Connection reset by peer
103 = Connection timed out
104 = Connection refused
107 = Host is unreachable



Rule number simply tells you where you're at on the list of OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only read data from remote devices. Go to the Client Write Map to write data to those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

For each remote OID to be read, enter the full SNMP OID and location (device). The names in the device list are defined in the Devices page.

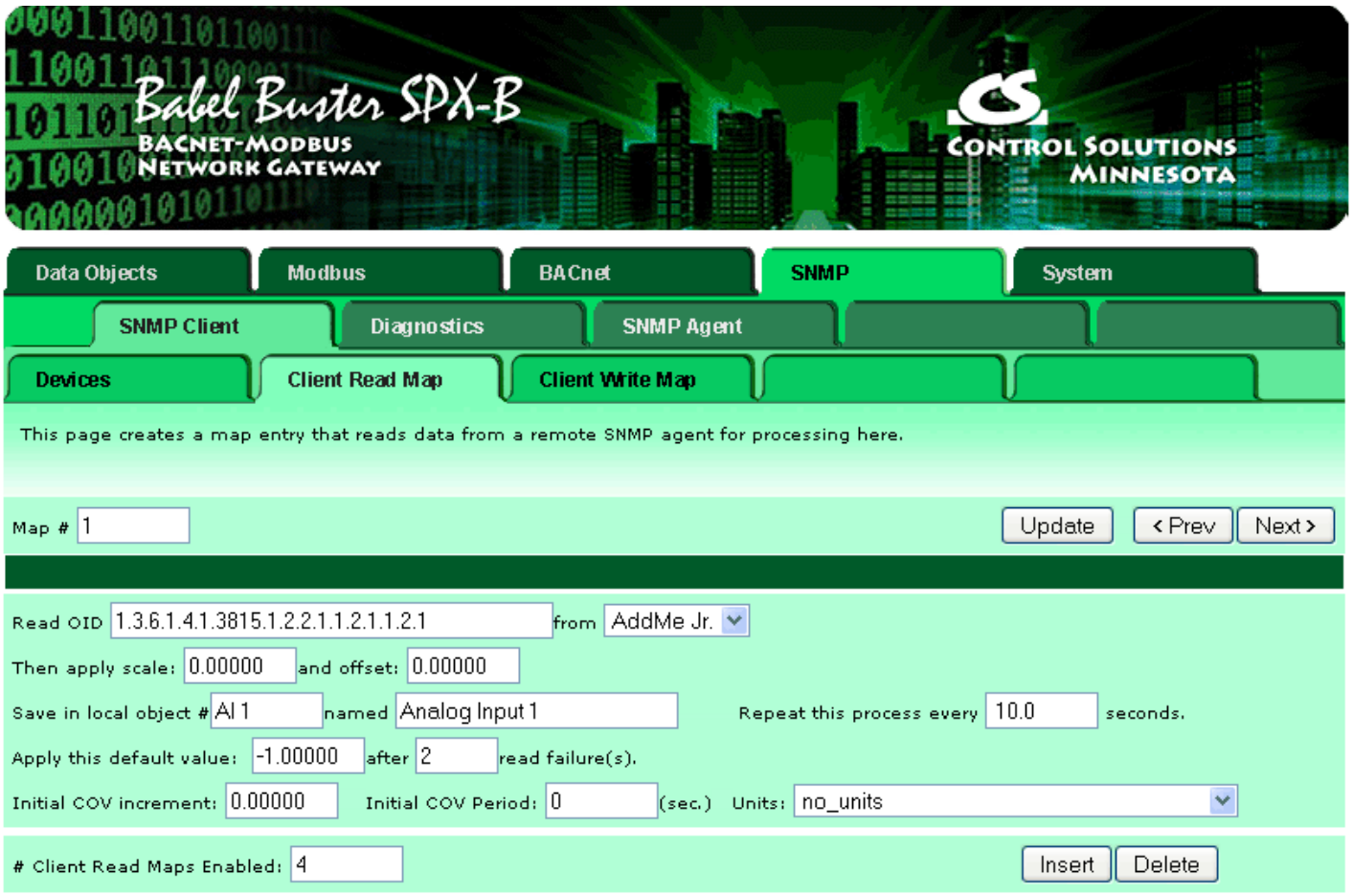
The object name is optional and used only for display purposes, but is also returned as the object name to the remote BACnet client.

Entering zero (none) for local object effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).



Rule number simply tells you where you're at on the list of OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

For each remote OID to be read, enter the full OID and location (device). The names in the device list are defined in the Devices page.

When the remote OID is read, data may be manipulated before being written to the local object. The result will be multiplied by the scale factor if any non-zero scale factor is given. The offset is then added and this final result is written to the local object number given. The name is optional and used only for display purposes (but will also be returned as the object name to the BACnet client).

The periodic poll time determines how often the remote OID will be read. This number, if nonzero, will override the default poll time given in the Devices page for the remote device being read.

The default value will be stored into the local object after the given number of read failures if the fail count is non-zero. Setting the count to zero will disable the default, and the object will retain the most recent value obtained.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to

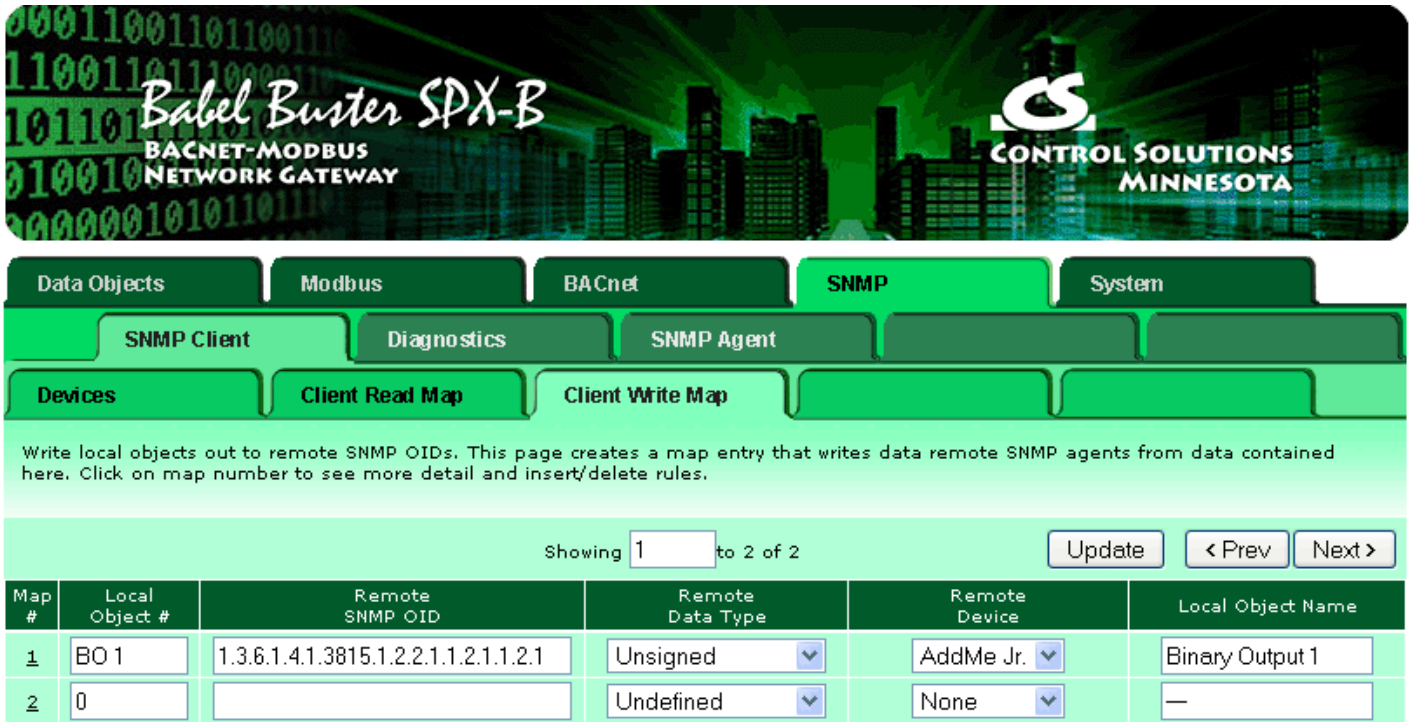
define any rule presently having zero for a source object or "none" for remote type.

Entering zero (for none) for local object effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

Initial COV increment and period will only apply if a BACnet client subscribes to COV notification from the BACnet object assigned to this SNMP client map. These properties may be overwritten by the BACnet client(s) at any time. The values shown here are initial values, not necessarily the current values. (Note: COV increment only applies to Analog objects, all changes are reported for Binary or Multistate objects.)

Units default to no_units, but you may select any of the available BACnetEngineeringUnits values. This value will simply be read by the BACnet client when the units property is requested from the object this OID maps to. The units have no bearing on calculations performed. You must select appropriate scale and offset values to make any required translation between SNMP units and BACnet units. Units are only valid for Analog objects.

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.



Rule number simply tells you where you're at on the list of OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Showing" box, then click Update.

Rules entered on this page only write data to remote devices. Go to the Client Read

Map to read data from those devices. The full parameter set is different for read versus write.

An abbreviated version of a list of rules is shown on this page. Any of the parameters shown may be changed here and registered by clicking the Update button. To view and/or modify the complete set of parameters, click on the map number in the left most column.

Data from the local object given will be multiplied by the scale factor before being written. For each remote OID to be written, enter the register type, format, number, and location (device). The names in the device list are defined in the Devices page. The name is optional and used only for display purposes.

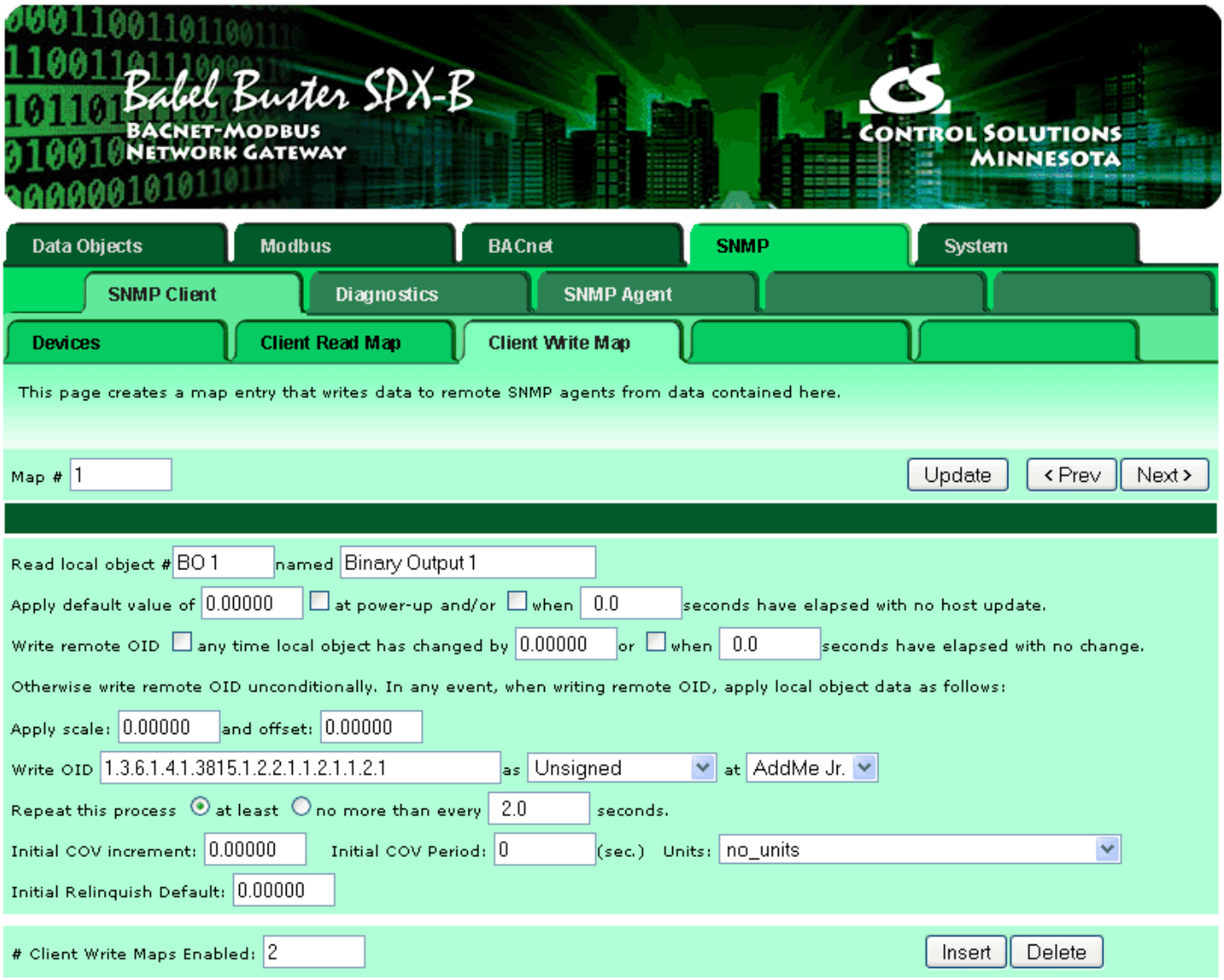
Important note about data type: SNMP does not have a universally accepted representation for floating point. The most commonly used means of representing real data is scaled integers, and this method is supported by SPX-B. IEEE 754 is not recognized as an SNMP standard and is not used. X.690 defines an encoding for real data, but it is inefficient and little used. A common recommendation is to use ASCII string representation of floating point data, and this method is supported by SPX-B (Octet String Num). Another known but application specific implementation is the ASN OPAQUE FLOAT used in netsnmp applications. This method is also supported by SPX-B but should be tested to confirm compatibility.

Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type.

Local Object is internally a coded number consisting of BACnet object type multiplied by 1000, then added to the object number starting from #1. These are translated into abbreviations that are easy to interpret on the web page as follows:

AI n = Analog Input #n
AO n = Analog Output #n
AV n = Analog Value #n
BI n = Binary Input #n
BO n = Binary Output #n
BV n = Binary Value #n
MI n = Multi-state Input #n
MO n = Multi-state Output #n
MV n = Multi-state Value #n

Object numbers start at #1. The maximum available number varies by object type, and these limits may be found on the System Capacities link from the home/index page (click graphic at top).



Rule number simply tells you where you're at on the list of OID maps. Click "next" and "prev" to scroll through the list. To advance directly to a specific map, enter the desired number in the "Map #" box, then click Update.

The local object data may be written periodically, or when it changes, or both. To send upon change (send on delta), check the first box and enter the amount by which the local object must change before being written to the remote device. To guarantee that the remote OID will be written at least occasionally even if the data does not change, check the second box and enter some amount of time. This time period will be referred to as the "maximum quiet time".

Data from the local object may be manipulated before being written to the remote OID. The local data is first multiplied by the scale factor. The offset is then added to it. The data is then sent to the remote SNMP agent. Enter the full OID to be written, the SNMP ASN data type to be written (select from list), and the location (device). The names in the device list are defined in the Devices page.

Important note about data type: SNMP does not have a universally accepted representation for floating point. The most commonly used means of representing real

data is scaled integers, and this method is supported by SPX-B. IEEE 754 is not recognized as an SNMP standard and is not used. X.690 defines an encoding for real data, but it is inefficient and little used. A common recommendation is to use ASCII string representation of floating point data, and this method is supported by SPX-B (Octet String Num). Another known but application specific implementation is the ASN OPAQUE FLOAT used in netsnmp applications. This method is also supported by SPX-B but should be tested to confirm compatibility.

The repeat time may determine how often the remote OID will be written. If send on delta and maximum quiet time are not checked above, clicking the "at least" button will establish a periodic update time. If send on delta is used and you wish to limit the network traffic in the event changes are frequent, click the "no more than" button and enter the minumum time that should elapse before another write to the remote device.

Delete will remove the rule number shown in the "Map #" box. Insert will insert a new rule before the rule number shown, and is used for placing rules between existing rules. It is not necessary to use Insert to add rules to the bottom of the list or to define any rule presently having zero/none for a source object.

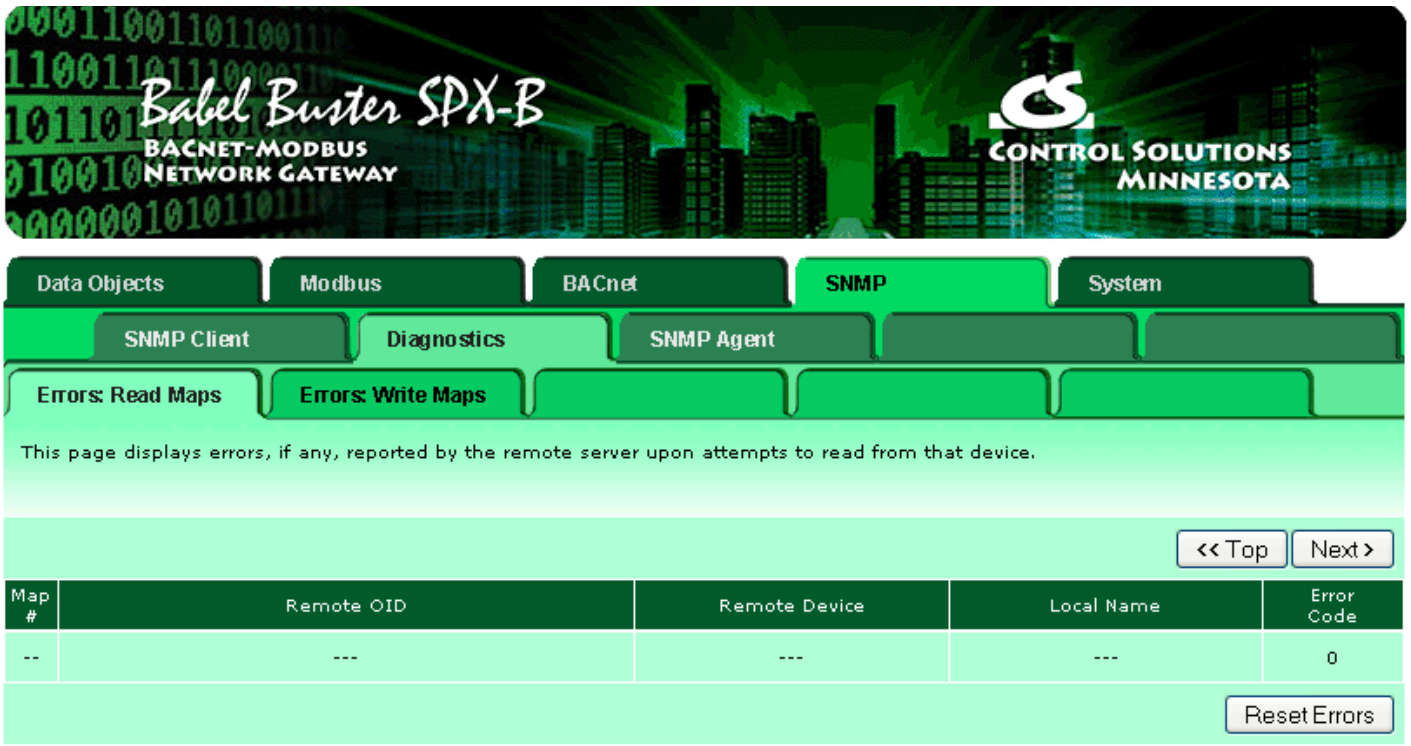
Selecting "none" for remote type effectively deletes the rule even though it will still appear in the list until deleted. Unused rules at the end of the list will always show none as the type. If you wish to prevent these from being displayed, reduce the number of rules enabled.

Initial COV increment and period will only apply if a BACnet client subscribes to COV notification from the BACnet object assigned to this Modbus map. These properties may be overwritten by the BACnet client(s) at any time. The values shown here are initial values, not necessarily the current values. (Note: COV increment only applies to Analog objects, all changes are reported for Binary or Multistate objects.)

Units default to no_units, but you may select any of the available BACnetEngineeringUnits values. This value will simply be read by the BACnet client when the units property is requested from the object this OID maps to. The units have no bearing on calculations performed. You must select appropriate scale and offset values to make any required translation between SNMP units and BACnet units. Units are only valid for Analog objects.

Initial Relinquish Default may be set here, but may be overwritten by the BACnet client at any time. This window reflects the initial value, not the current value. (Note: Relinquish Default only applies to commandable Output objects, and does not apply to Input or Value objects.)

The number of rules enabled simply limits the scope of rule review so that you do not have to review a lot of unused rules. If the displayed rules are used up and you need more, increase the enabled number.



Errors for SNMP client read maps are shown on this page. Only those maps with errors to report are listed. Refer to the code and class lists below for interpretation.

Common error codes for the SNMP client are as follows:

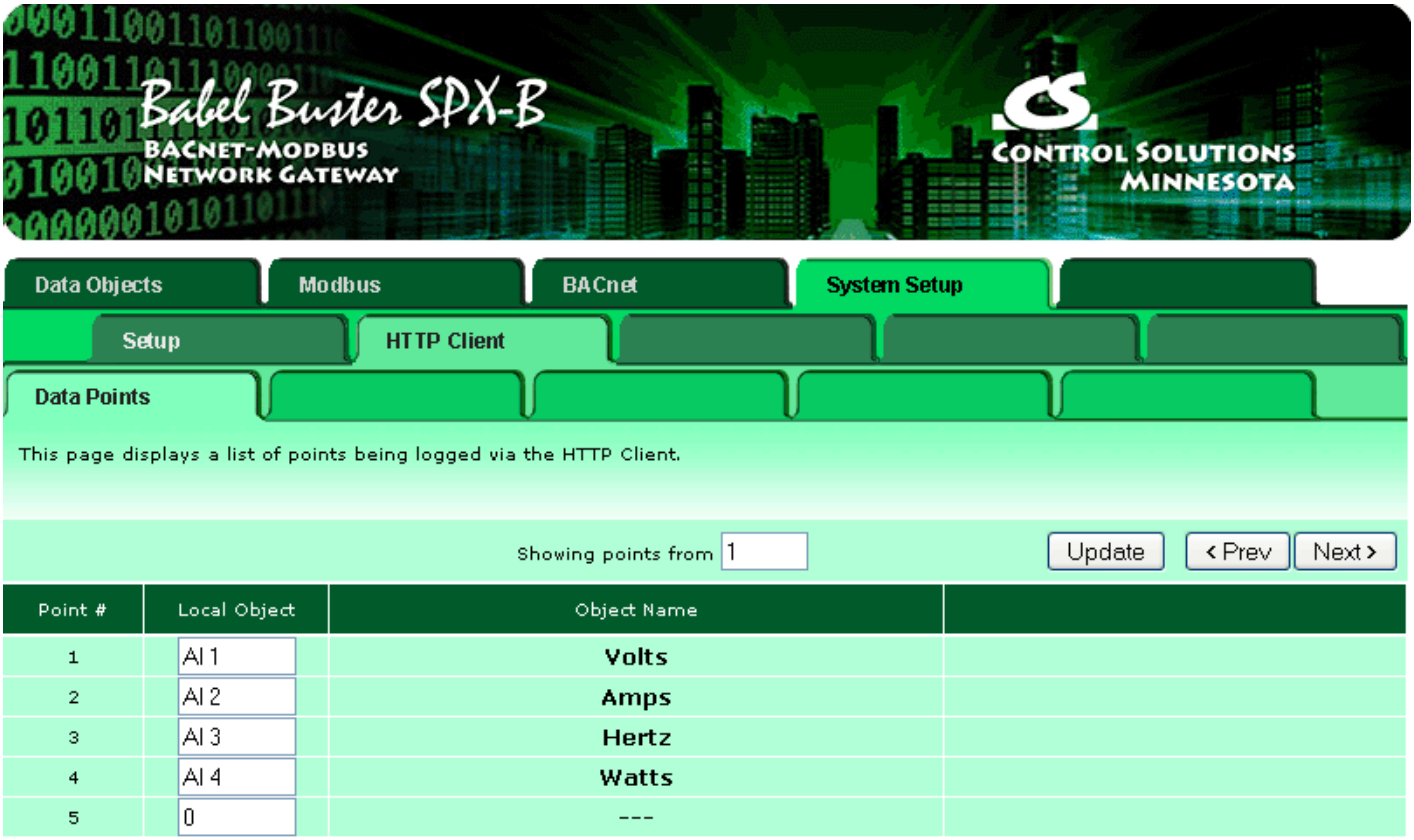
9 = No response from remote Agent (server)
10 = Unable to interpret data
11 = Reply does not match request

Other error codes are possible but improbable. Codes in the 80-120 range indicate socket errors; however, because SNMP uses UDP/IP, which is "connectionless", socket errors would indicate something internal is seriously broken.

12. HTTP Client

The Babel Buster SPX-B1 can function as an HTTP Client to push data to a specially programmed remote server such as the web portal you find at www.logmydata.com. You may develop your own web server for this purpose. Contact Control Solutions via support ticket for guidance on developing such a web server application.

Once you have access to a web server application ready to receive data, you simply list the objects you wish to send to the server in the list illustrated below.



There are additional settings that need to be configured on the Local Network page if the HTTP Client is used. This is the only time these settings need to be configured. You will need to provide the IP address(es) of your DNS Server(s). You will need to provide the URL of the web server that is to receive data, and the web page that the data is to be submitted to. The Client ID uniquely identifies this device when you have more than one reporting to the same web portal. The minimum additional settings are illustrated below.

Data Objects | Modbus | BACnet | System Setup

Setup | HTTP Client

Config File | BACnet IP Port | BBMD | Local Host | User

This page allows you to change this device's IP address, and select whether double registers are swapped when returned to a remote client accessing this server.

IP Address	192.168.1.64	192.168.1.64	Review IP
Subnet Mask	255.255.255.0	255.255.255.0	Change IP
Gateway	192.168.1.1	192.168.1.1	
Static DNS1	68.87.77.130	68.87.77.130	Set DNS
Static DNS2	68.87.72.130	68.87.72.130	
Proxy Server			Set Proxy
Proxy Port	0		
HTTP Port	80	(default 80) ☐ Disallow HTTP Query	Set Ports
Modbus Port	502	(default 502)	
Telnet Port	23	(default 23)	
Client Update Host	logmydata.net	☑ Enable	Update
Log Page	/ireport.php		
Log Parameters		(optional)	
Configuration Page			
Update Timeout	60	Client ID 900064	HTTP Port 80

Uptime 1,02:29:30

13. BBMD Configuration

BBMD stands for BACnet Broadcast Management Device. Messages such as "Who-Is" and "I-Am" are broadcast. Most routers, however, to not pass broadcast messages along. The BBMD solves this problem by explicitly directing broadcast messages to a specific IP address.

A Broadcast Distribution Table (BDT) defines a list of IP addresses that the BBMD should send broadcast messages to. It is important to note that a BBMD only forwards broadcast messages. It does not do full routing. If you are attempting to connect two networks across a NAT router, you must get a full BACnet Router to accomplish this. For this reason, the BDT has limited usefulness when only BBMD is present. The SPX-B only includes BBMD, not full routing. Use the BB2-7030 if you need full routing.

If you have a remote SPX-B that needs to connect via router, including NAT router, to a local network, use Foreign Device Registration. There will typically be a master device, such as operator station or other front end, that includes BBMD. The IP address of this device is the one that should be given as the BBMD address for foreign device registration.

Broadcast distribution will result in device discover, but you will not be able to read/write properties in the remote device without full routing. Foreign device registration does result in being able to fully communicate with the foreign device from the local network.

The screen shot below shows a SPX-B that has successfully registered with a BBMD at the IP address shown.

Data Objects | Modbus | BACnet | System Setup

Setup | HTTP Client

Config File | BACnet IP Port | BBMD | Local Host | User

This page displays BACnet IP port settings.

Broadcast Distribution Table Edit Refresh

Broadcast Address:Port	Broadcast Mask
192.168.1.191:47808	FFFFFF00

Foreign Device Table Refresh

Local Device's Registration as a Foreign Device at Remote Location

BBMD Time To Live (seconds) 600 (Zero disables foreign registration) Save

BBMD IP Address, Port 173.11.32.82 47808 **BBMD is registered.**

Foreign Devices Registered Locally	Time to Live
---	---

14. Object Properties

14.1 Data Object Properties (Analog, Binary, Multi-state)

The following properties are found in the Analog, Binary, and Multi-state types of Input, Output, and Value objects. Some properties apply only to certain object types as noted where applicable.

Property	Encoding
Object_Identifier (75)	BACnetObjectIdentifier
Object_Name (77) (W)	CharacterString “Analog Input *n*”
Object_Type (79)	BACnetObjectType ENUMERATED: analog-input (0) analog-output (1) analog-value (2) binary-input (3) binary-output (4) binary-value (5) device (8) multi-state-input (13) multi-state-output (14) multi-state-value (19)
Present_Value (85) (W)	REAL (analog objects) ENUMERATED (binary objects) Unsigned (multi-state objets) (no index) (priority required when writing commandable objects) (input objects writeable only when out of service)
Status_Flags (111)	BACnetStatusFlags BIT STRING: fault(1), out-of-service(3)
Event_State (36)	BACnetEventState ENUMERATED: normal(0), fault(1)

Reliability (103)	BACnetReliability ENUMERATED: normal(0) *Vendor specific:* no response (64) crc error (65) exception, illegal function code (66) exception, illegal data address (67) exception, illegal data value (68) exception, code+65, rarely used (69..79) configuration property fault (80) exception, code not recognized (81) BACnet client read/write timeout (82) BACnet client received error response from slave (83) SNMP client received no response from agent (84) SNMP client unable to parse data (85) SNMP client reply does not match request (86)
Out_Of_Service (81) (W)	BOOLEAN
COV_Increment (22) (W)	REAL (analog objects only)
Priority_Array (87)	BACnetPriorityArray (commandable objects only) SEQUENCE SIZE (16) OF BACnetPriorityValue REAL (each element, analog output objects) ENUMERATED (each element, binary output objects) Unsigned (each element, multi-state output objects)
Relinquish_Default (104) (W)	REAL (analog objects) ENUMERATED (binary objects) Unsigned (multi-state objets)
Polarity (84)	BACnetPolarity (binary objects only) ENUMERATED: normal(0)
Number_Of_States (74)	Unsigned (multi-state objects only)
Units (117)	BACnetEngineeringUnits (analog objects only)

14.2 Device Object Properties

The following properties are found in the Device object of the SPX-B. In addition to standard Device properties.

Property	Encoding
Object_Identifier (75)	BACnetObjectIdentifier

Object_Name (77)	CharacterString
Object_Type (79)	BACnetObjectType ENUMERATED: device (8)
System_Status (112)	BACnetDeviceStatus
Vendor_Name (121)	CharacterString
Vendor_Identifier (120)	Unsigned16 (should always return 208)
Model_Name (70)	CharacterString
Fimrware_Revision (44)	CharacterString
Application_Software_Version (12)	CharacterString
Protocol_Version (98)	Unsigned
Protocol_Revision (139)	Unsigned
Protocol_Services_Supported (97)	BACnetServicesSupported
Protocol_Object_Types_Supported (96)	BACnetObjectTypesSupported
Object_List (76)	BACnetARRAY[N] of BACnetObjectIdentifier
Max_APDU_Length_Accepted (62)	Unsigned
Segmentation_Supported (107)	BACnetSegmentation
APDU_Timeout (11)	Unsigned
Number_Of_APDU_Retries (73)	Unsigned
Device_Address_Binding (30)	List of BACnetAddressBinding
Database_Revision (155)	Unsigned

15. Trouble Shooting

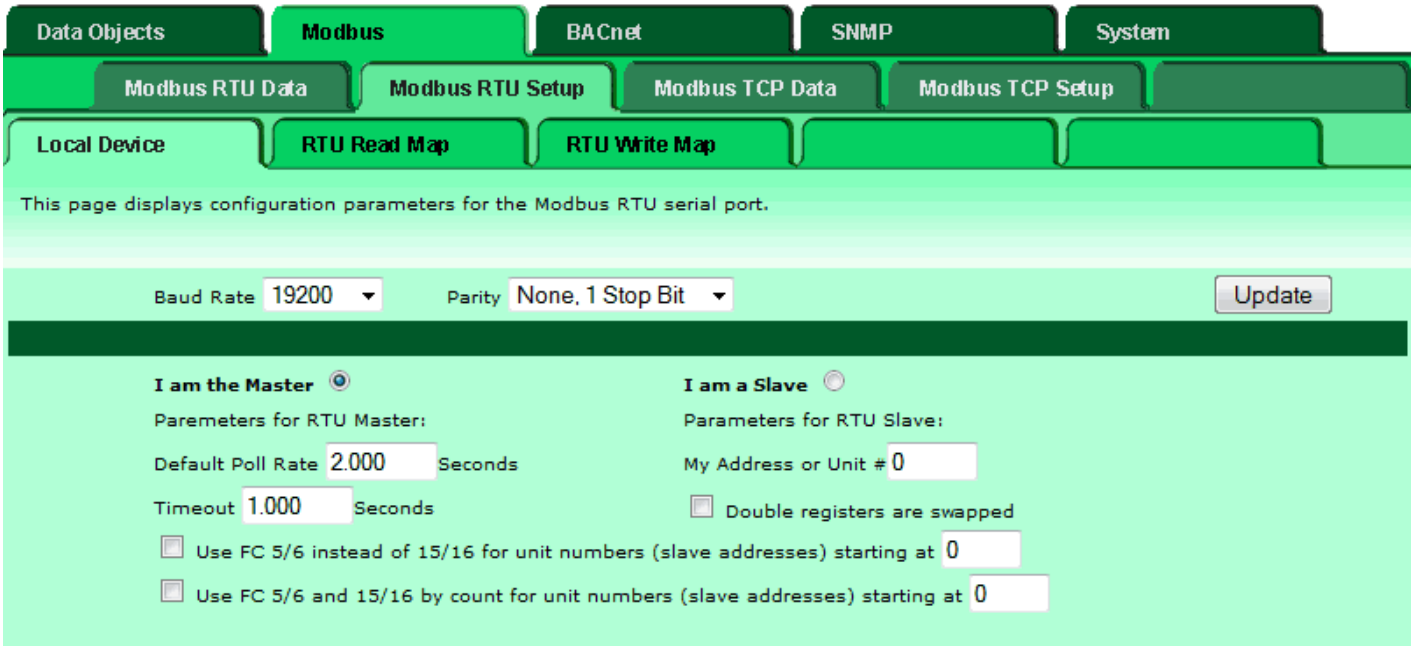
The following discussion focuses on Modbus Master functionality. Troubleshooting for the BACnet or SNMP clients will be very similar and you should be able to use the examples here to help trouble shoot.

15.1 Modbus RTU Trouble Shooting

This discussion assumes you want the Babel Buster SPX-B to be the Modbus Master (most common use). Let's review the setup procedure for a single Modbus read map. We suggest starting with one register. Once you get that working, proceed to fill up the table.

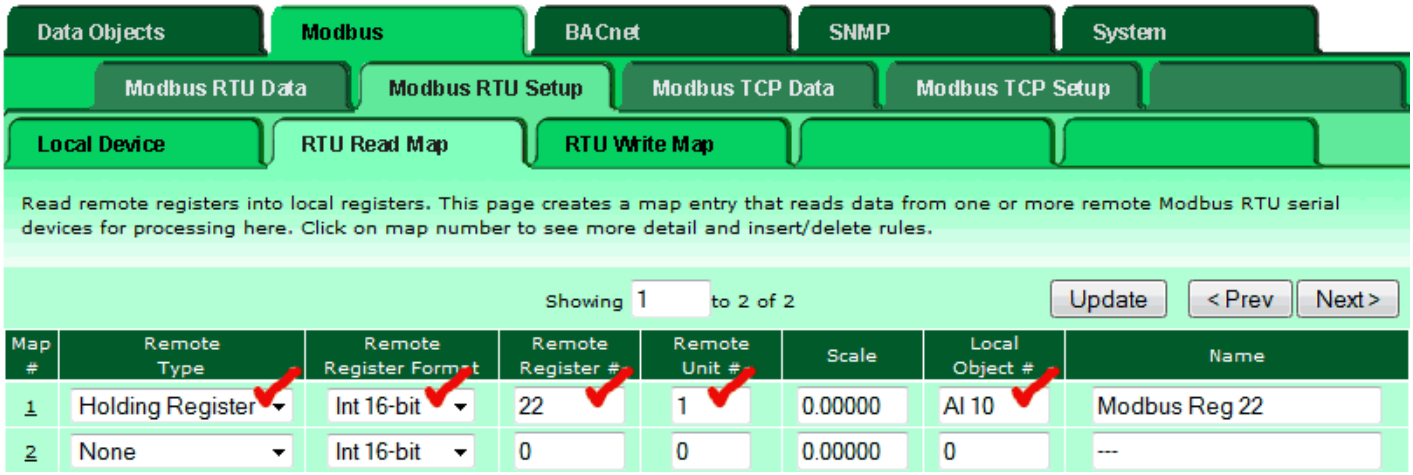
First, go to the Local Device page and make sure you have the baud rate set, and parity (if any) selected. If you do not know what baud rate your Modbus device is set to, consult that manufacturers documentation before proceeding.

Make sure the Master button is clicked. Start with a liberally slow timeout, like 0.5 second just to be rather certain you do not have timeout problems. It is rare to see a piece of working equipment take longer than half a second to respond to a Modbus master. *Setting the timeout to zero, however, will guarantee failure* since the master will miss every reply by not waiting at all for it.

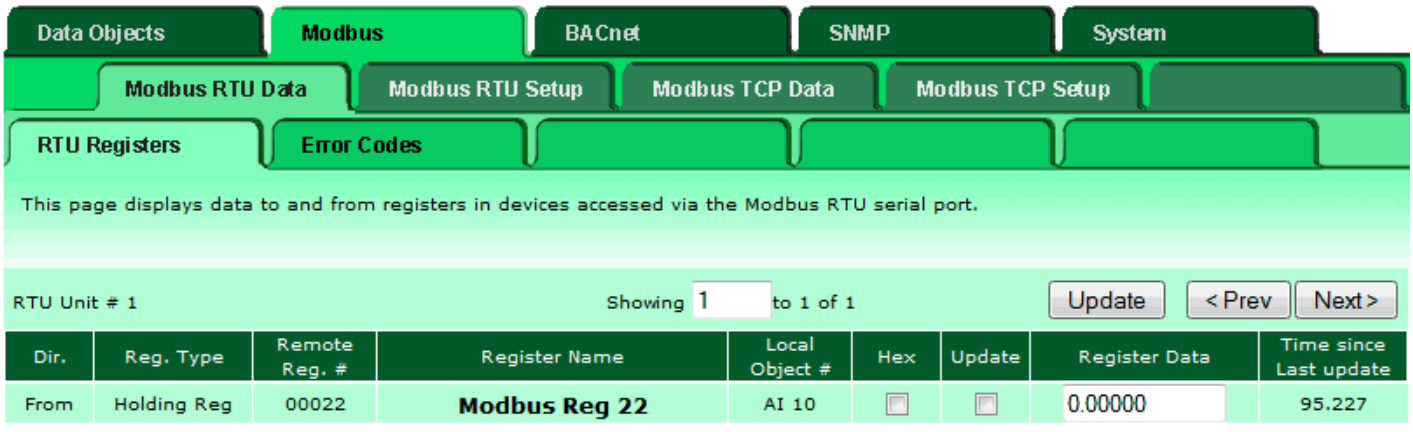


Next, go to the RTU Read Map page (below) . To get started, select a register type and format, a register number, a unit # (aka slave ID or slave address), and a local object number to store the data in. If any of the red check marks shown below are "none" or zero, you will get no action even attempted. Make sure the Unit # (slave ID or slave address) matches whatever you have your Modbus device set to. If you are uncertain what address it is set to, you need to consult the manufacturer's documentation for that equipment before proceeding.

The following example shows the only non-zero entries required (the 5 check marks) to successfully read holding register #22 from unit #1 and store the data in Analog Input #10. Once these (or comparable) entries have been made, click the Update button.

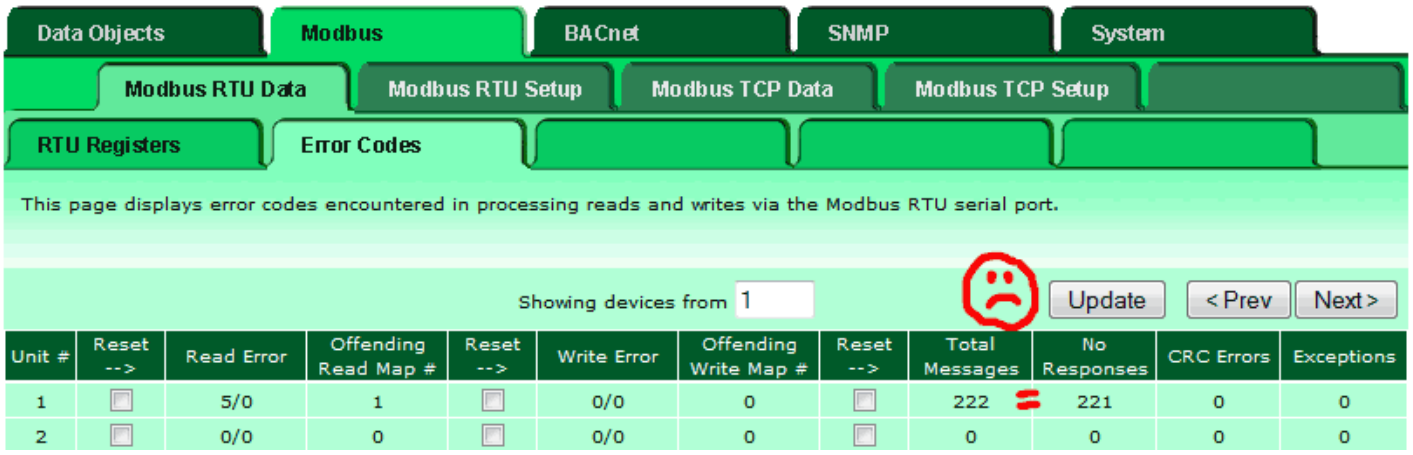


At this point, you can go to the data page (below) and see if you have data showing up. If you get no data, there is a problem. The confirmation that you are probably getting no data is the "time since last update". In this example, we see 95 seconds have elapsed. We are attempting to update every 2 seconds, so obviously data retrieval is not happening.



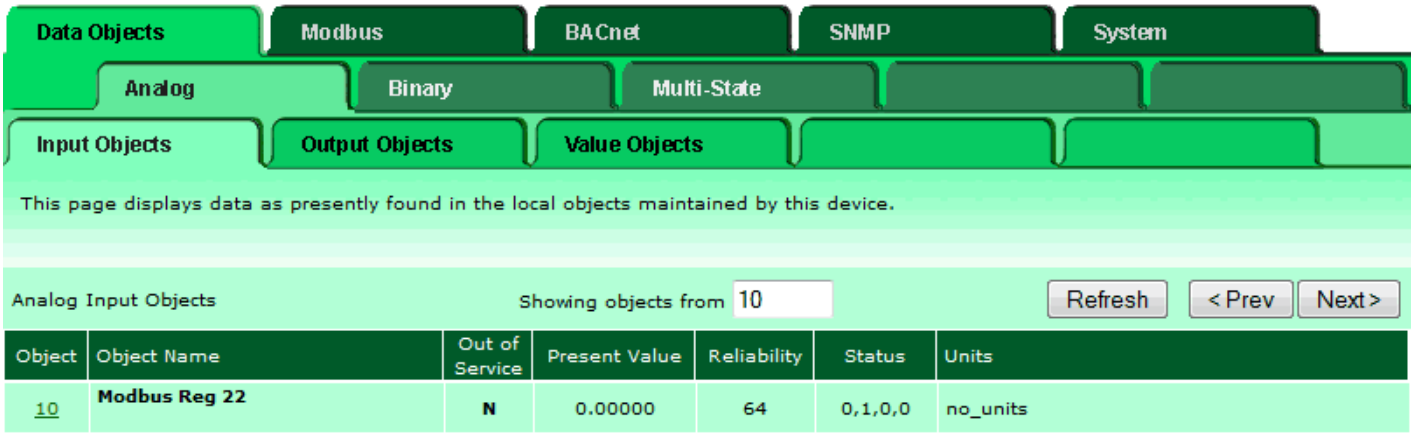
If you are getting no data, check the Error Codes page (below). Here we see that the "No Responses" is about equal to the "Total Messages". This means we are not getting anything back from the Modbus slave. If you are certain all of the above setup is correct, the only conclusion you (or we) can come to at this point is that there is a wiring problem, or the slave is not responding or not configured correctly. Review

wiring information, and check the slave configuration. If you get a high number of CRC errors, this is also an indication of likely wiring problem.

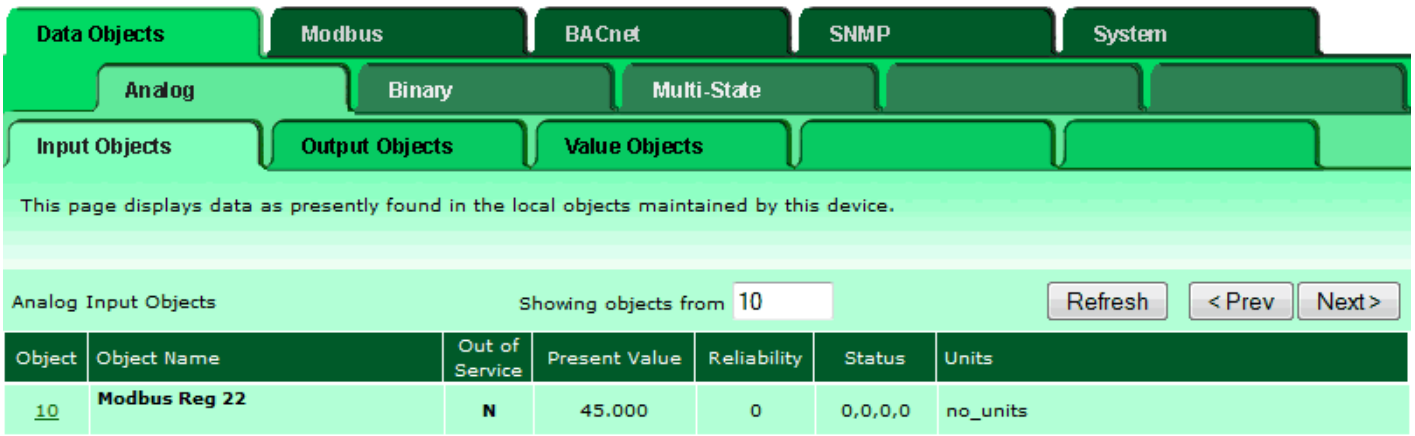


If, instead of No Repsonses, the count you see is Exceptions, this means you are communicating just fine, but the slave is telling you that your request is incorrect. You are asking for a register number that does not exist, using the incorrect register type, etc. Something about configuration is not right if you get Exception errors.

If the Error Codes page is showing a problem, this will also be reflected by the BACnet object reliability code and status bits as illustrated below.



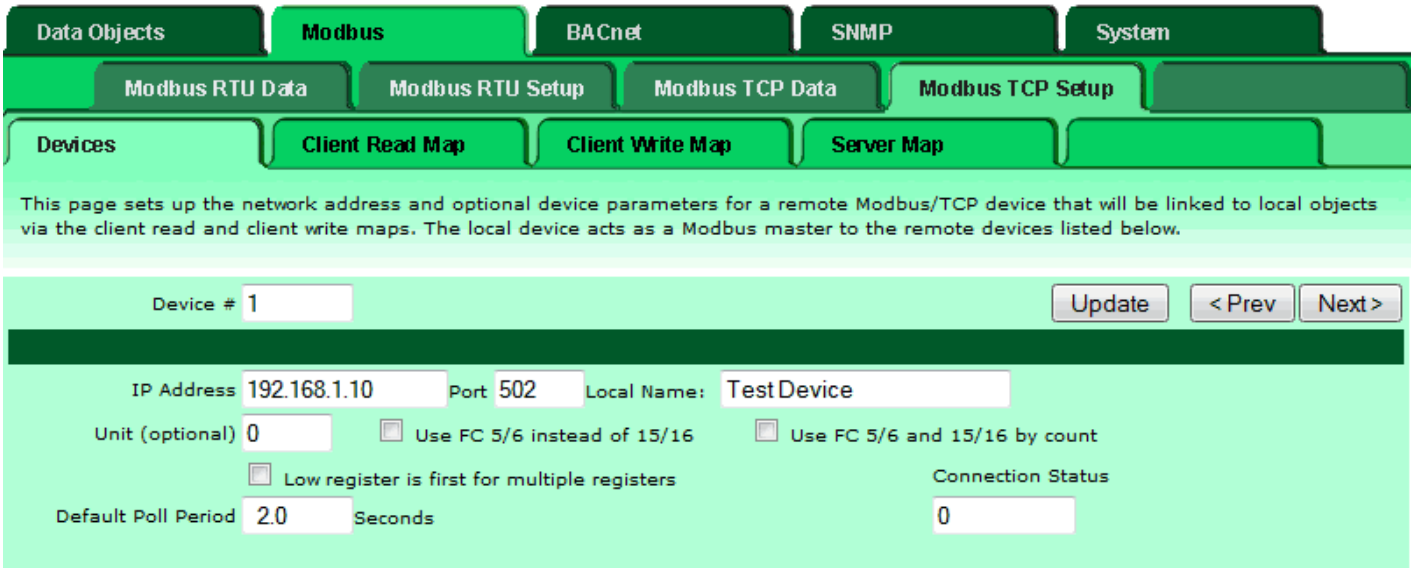
Once the problem is resolved and you are successfully receiving data, the BACnet object will reflect a reliability code of zero and the fault bits will be clear.



15.2 Modbus TCP Trouble Shooting

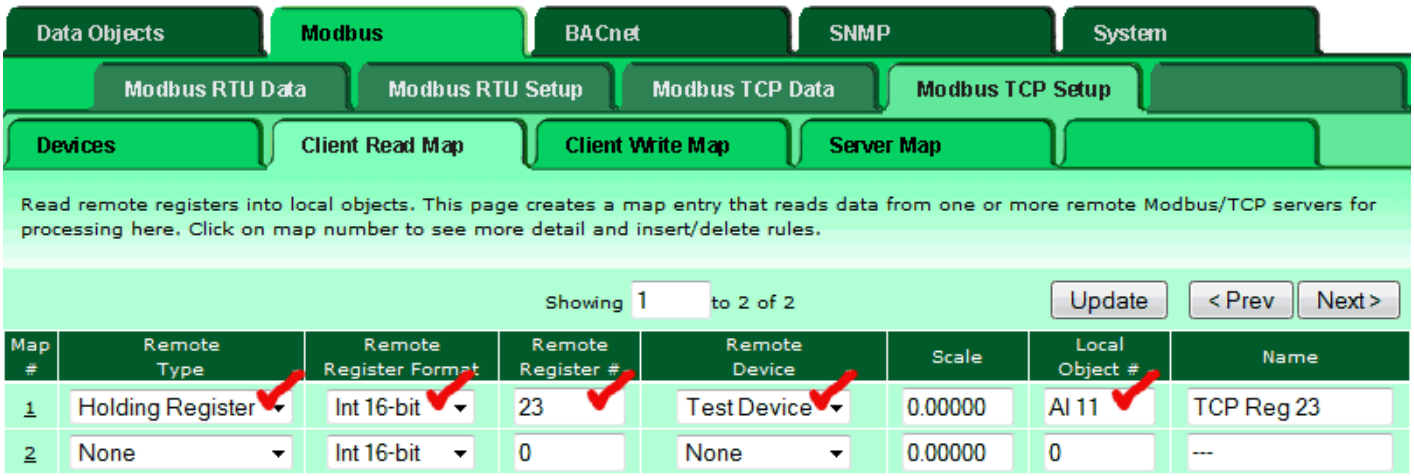
This discussion assumes you want the Babel Buster SPX-B to be the Modbus TCP Master. Let's review the setup procedure for a single Modbus read map. We suggest starting with one register. Once you get that working, proceed to fill up the table.

First, go to the IP Network Devices page and make sure you have the IP of the intended Modbus TCP slave entered, along with a local name by which it will be referenced.

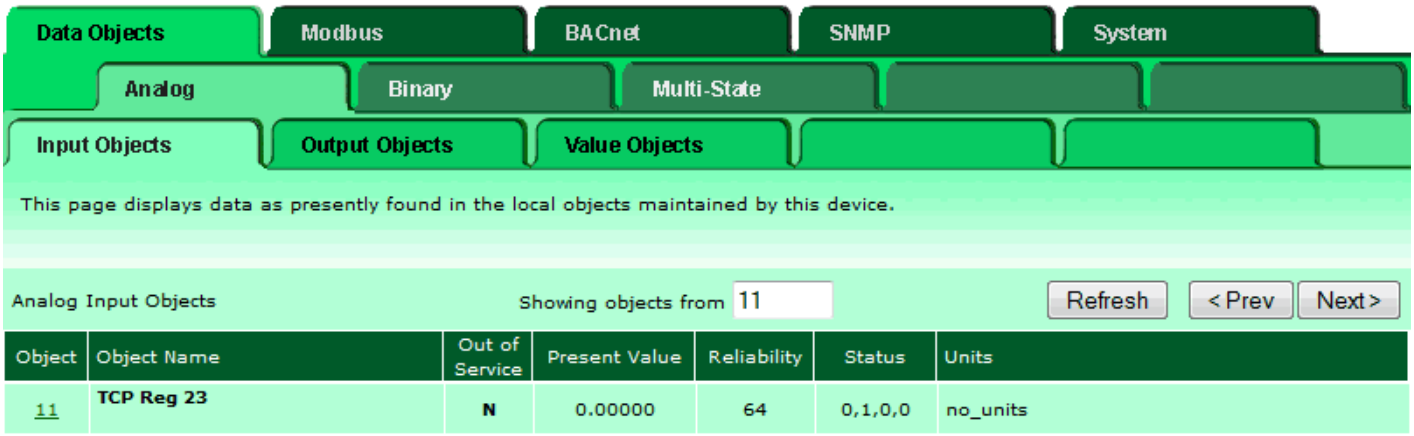


Next, go to the Click Read Map page (below). To get started, select a register type and format, a register number, a device (from list created above), and a local object number to store the data in. If any of the red check marks shown below are "none" or zero, you will get no action even attempted. Make sure the IP address (in the device list) matches whatever you have your Modbus device set to. If you are uncertain what IP address it is set to, you need to consult the manufacturer's documentation for that equipment before proceeding.

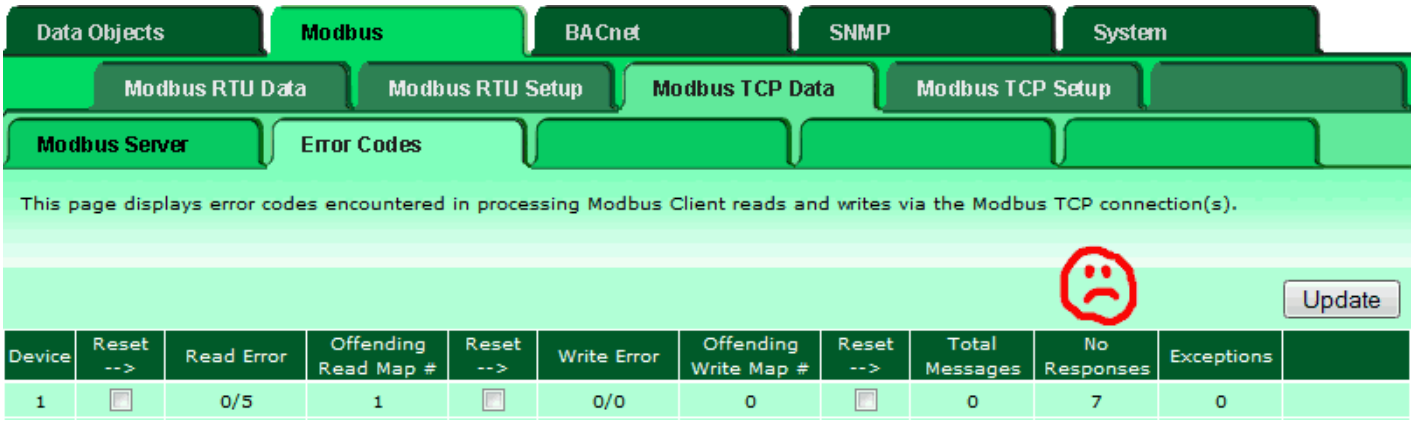
The following example shows the only non-zero entries required (the 5 check marks) to successfully read holding register #23 from "Test Device" and store the data in Analog Input #11. Once these (or comparable) entries have been made, click the Update button.



At this point, you can go to the Data Objects page (below) and see if you have data showing up. If you get no data, there is a problem, and the problem will be further indicated by the BACnet object reliability code being non-zero, and the fault status bit set. The meaning of the various possible reliability codes is listed in the Quick Help section at the bottom of each Data Object page. Code 64 means "no response" from the Modbus device.

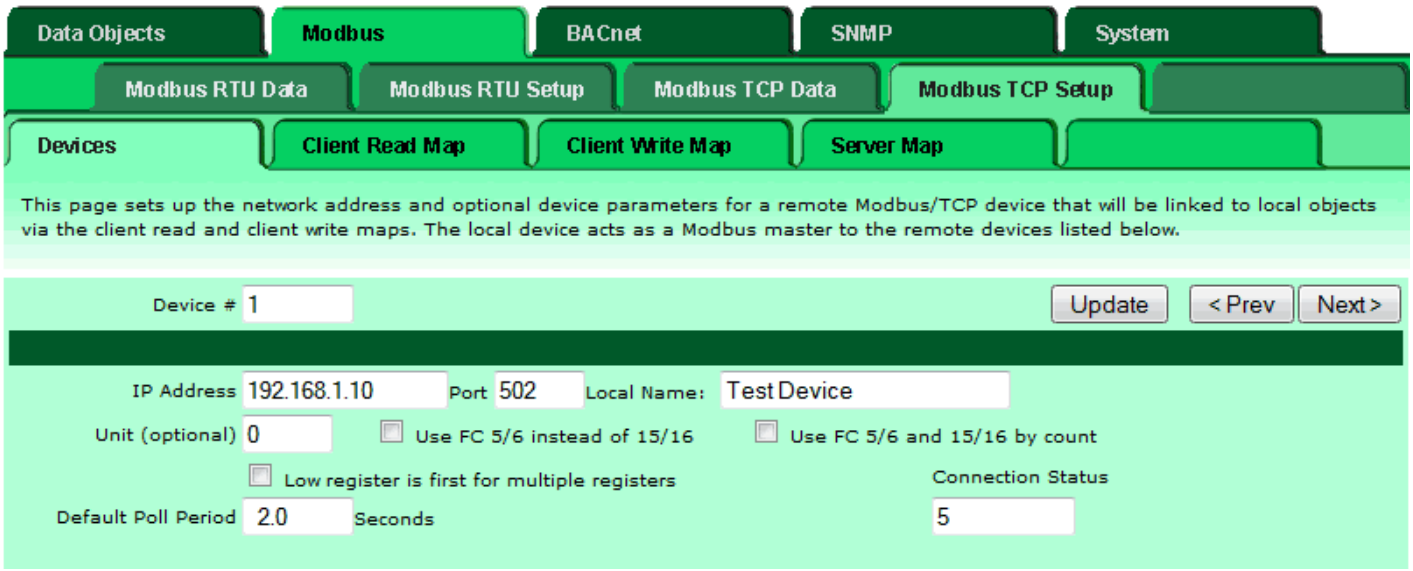


If you are getting no data, check the Error Codes page (below). Here we see that the "No Responses" is some number greater than total messages. Zero total messages means we never succeeded in making a TCP connection.



If you return to the TCP Devices page at this point, you may notice that the

Connection Status is some non-zero value. Status zero means no problem has been detected. A non-zero code means there is a problem with the connection.

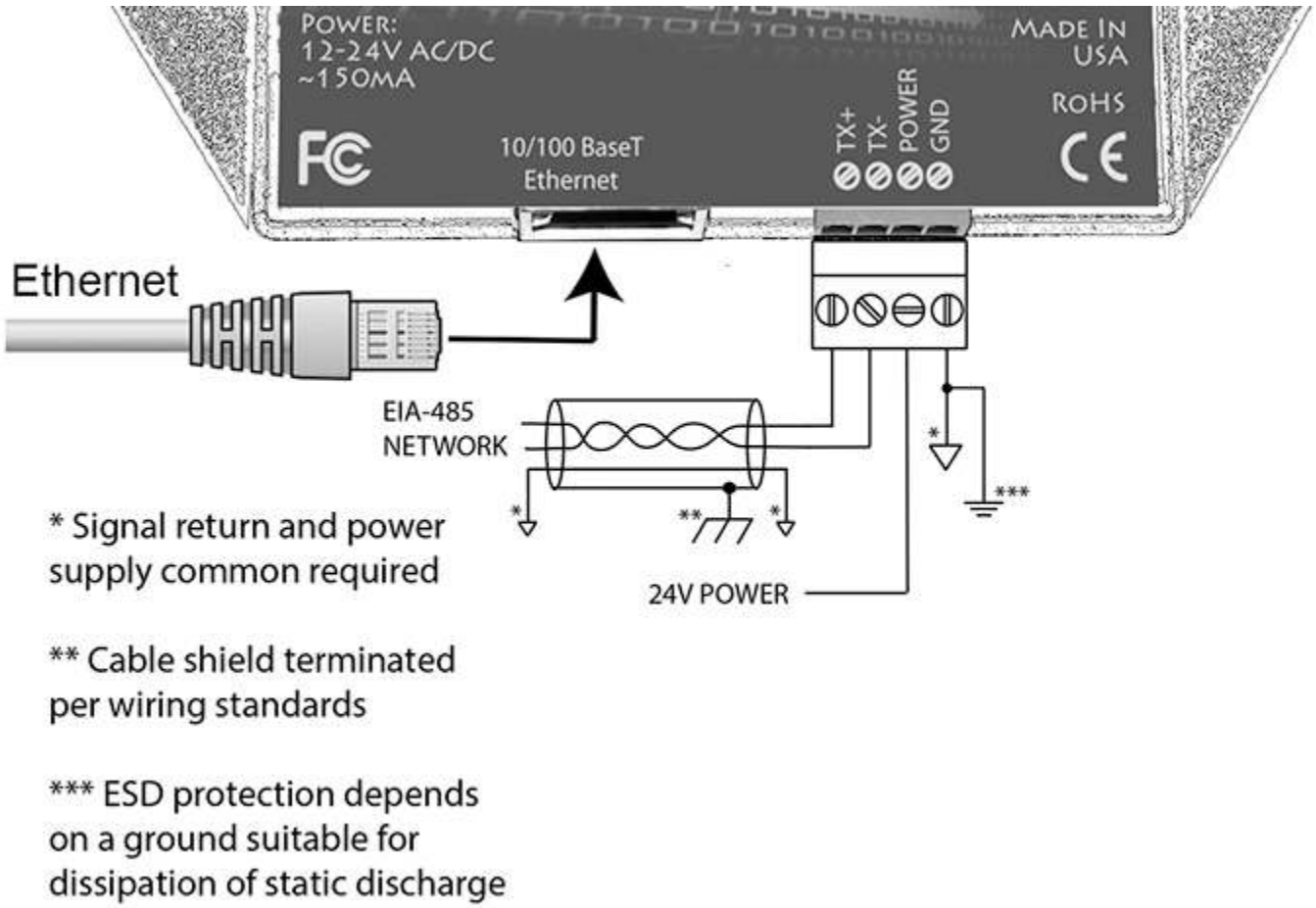


Connection status will show a non-zero error code if there is a socket error. The most common errors include:

5 = Connection failed, unable to bind (usually means remote device not connected or not reachable)
81 = Connection in progress (means unsuccessful connect attempt, still trying)
95 = Network is unreachable
97 = Connection aborted
98 = Connection reset by peer
103 = Connection timed out
104 = Connection refused
107 = Host is unreachable

Appendix A Hardware Details

A.1 Wiring



Wire the SPX-B as illustrated above. 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: All LEDs in between the RJ45 jack and the 4-pin terminal block will turn on for half a second, then off, after fully booted up. Then they will proceed to indicate as normally defined for the indicators.

The LED indicators behave as follows. Normally the reply/request LEDs reflect Modbus RTU activity. If the gateway is being used only for Modbus TCP (as SNMP gateway), then the same LEDs reflect TCP bahavior instead. The LEDs do not attempt to reflect both RTU and TCP activity since that would get confusing. If both RTU and TCP are used, the 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.

Yellow LED	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.
Green LED	Operating as Modbus Master, flashes green each time a good response is received. Operating as Modbus Slave, flashes green each time a good response is sent.
Red LED	Operating as Modbus Master, flashes 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 red if an exception code is sent (meaning the received request resulted in an error).

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.

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.