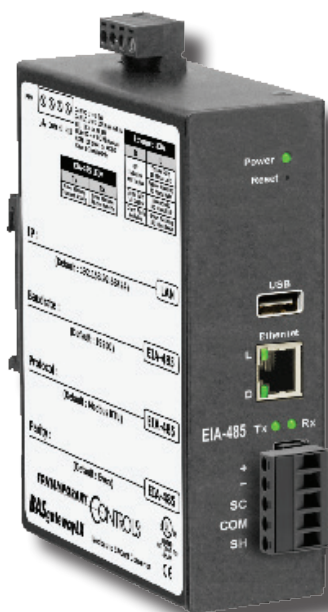# application
NOTE

Using the BASgatewayLX with a Rockwell MicroLogix PLC

In many applications that utilize a PLC it is desirable for the building automation system to have access to the data in the PLC. Some processes, such as compressors and water treatment utilize PLC controls as a normal control platform instead of building controllers. To implement the process in a building automation controller would require a redesign of the entire control system including the cost of programming and debugging of the new system. In the case of OEM's who utilize Rockwell's line of MicroLogix controllers the solution to get the data to the building automation system is resolved by using the Modbus capability of the MicroLogix PLC. By using the 1763-NC01 cable connected to channel 0 of the PLC and connecting it to the RS485 port of the BASgatewayLX, BACnet IP client controllers can read and write data in the PLC.

Rockwell MicroLogix 1100 PLC

1763-NC01
RS-485 cable. 30cm, 8-pin mini DIN to 6-pin terminal block. Use on Communication Channel 0 to provide daisy chain connection for DH-485 and Modbus RTU Master/Slave networks.

BASgatewayLX

BASautomation®

CONTEMPORARY CONTROLS®

Wiring

The BASgatewayLX 485 serial port is connected to the 1763-NC01 cable using the following connections.

- **BASgatewayLX + (Plus Terminal) is connected to 1763 B terminal**

- **BASgatewayLX - (Negative Terminal) is connected to 1763 A terminal**

- **BASgatewayLX SC Terminal is connected to 1763 GND terminal**

See **Figure 1.** at right

DTE Device
(MicroLogix 1100
Channel 0)
8-Pin

7	TXD
4	RXD
2	GND
1	B (+)
8	A (-)
5	N.C.
6	CTS
3	RTS

Figure 1.

Configuring the MicroLogix PLC

Channel configuration, the General tab

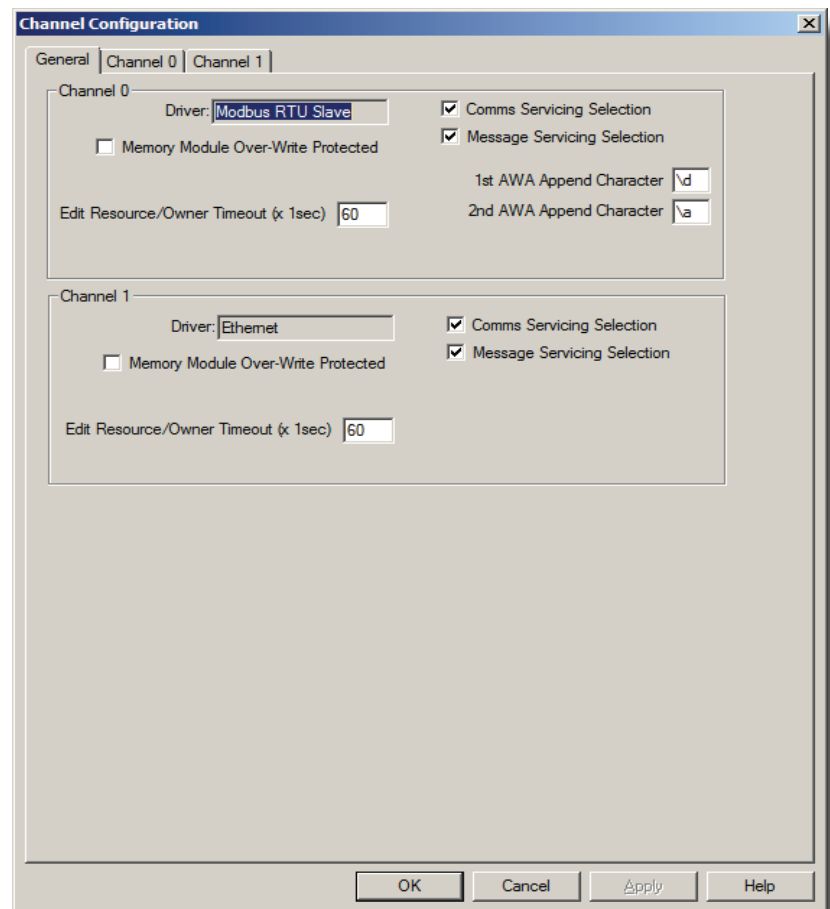Please set up the general tab as shown in **Figure 2.** in the window.

Figure 2.

CONTEMPORARY CONTROLS®

Configuring the MicroLogix PLC

Channel configuration, Channel 0

In the window shown below **Figure 3.** it is important to select the driver as Modbus RTU, the node address can be any address from 1 to 246. If multiple PLC's are communicating to a single BASgatewayLX then each node address must be unique. The baud rate and parity must match the selection in the Configure tab (Modbus section) of the BASgatewayLX. If there are multiple PLC's the baud and parity must be identical for all units. Stop bits =1 and Databits =8.

Modbus Data Table File Numbers

The Modbus data table allows defining the files from the PLC that will be available during Modbus polling. In **Figure 3.** the Coils (0XXXX) table is file 51 (a binary file) and these on/off status will be available to the BACnet system as BI (binary input) if they are set up in the BASgatewayLX as read only or as BO (binary output) if they are set up in the BASgatewayLX as read/write. In like manner the Holding Register (4XXXX) in this example file 50 (an integer file) is available to the BACnet device as object instances AI (analog input) a read only object or a AO (analog output) a read/write object instance.

The BACnet/IP based controller can read the on/off status of read/write object instances and can also write to them to change on to off and vice versa. Similarly the AI are read only from the BACnet/Ip controller, while the AO is read/write.

The most important selection in the Protocol Control Box is to have the Control Line selection at "No Handshaking (485 Network)". Intercharacter Timeout and Pre Transmit delay can be left at 0 and modified if required as the application gets on line.
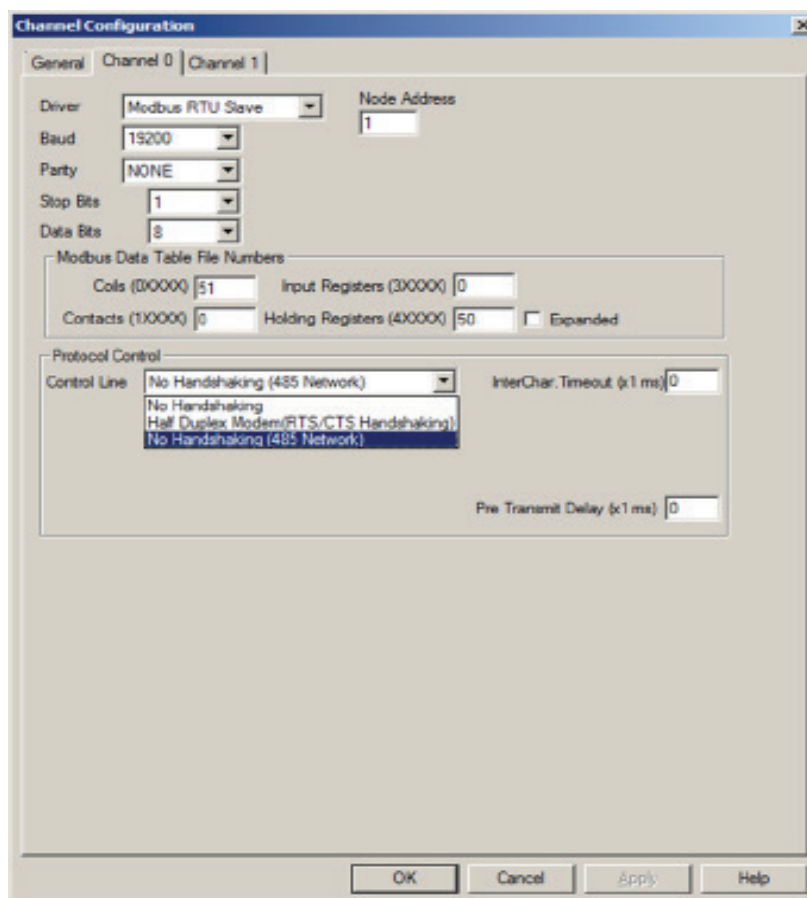

Figure 3.

Configuring the BASgatewayLX for Modbus Communications

Log on to the BASgatewayLX using your web browser. If it is at default the IP address is 192.168.92.68.

Go to the configure tab of the BASgatewayLX and in the center of the page you will configure the Modbus parameters to match your PLC configuration. Other than Baudrate, Protocol, and Parity you can leave all other parameters at default. On the right side of configure web page is an explanation of the Modbus parameters. See **Figure 4.**
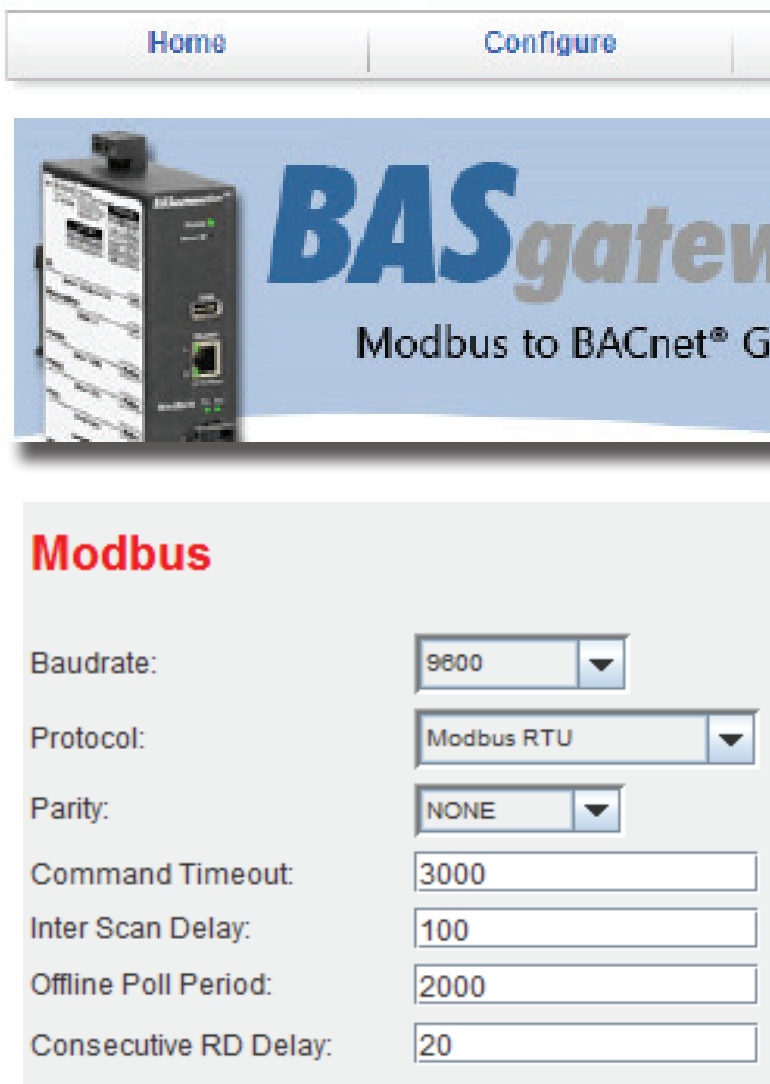

Modbus
All devices on the EIA-485 bus must use the same Baudrate, Protocol and Parity.
Baudrate: Choose a value from 2,400 to 115,200. Default = 19,200.
Protocol: Choose RTU or ASCII. Default = RTU.
Parity: Specify NONE, ODD or EVEN. Default = EVEN.
Command Timeout (ms): Specify how long the Master will await a slave to response (50-3000). Default = 1,000ms. If a device fails to respond, it is put in a queue to be checked every Offline Poll Period.
Inter Scan Delay (ms): Specify the delay between each poll cycle (100-30,000). Default = 2,000ms.
Offline Poll Period (ms): Set how often (2,000-30,000) the Master checks to see if a slave device is back online. Default = 15,000ms.
Consecutive Read Delay (ms): Set the delay (0-1000) before re-accessing of a slave. Default = 10ms.

Figure 4.

Checking out Communication Between the BASgatewayLX and the MicroLogix PLC

You have now wired and configured the PLC and BASgatewayLX to be able to communicate. The best way to do this is to use the Modbus Utility tab in the BASgatewayLX. How to use the utility is presented on the right hand portion of the web page. See **Figure 5**.

Enter the Modbus slave ID, and then the register number you wish to read. In our example we will read holding register 40001. To do this notice the 4X holding register radio button is selected and the register number is 1. Press the read button and a value should appear (assuming you have a non 0 value). You will also see the status as SUCCESS.

If you obtain a different message the issue must be resolved before proper communication can be established. You can also observe the Transmit and Receive light on the 485 port of the BASgatewayLX. Every time you press the READ button you should see the Transmit light illuminate for a short period of time. If you are wired properly the Receive light will illuminate for a short period of time.

Figure 5.

About This Page

This page is a Modbus TCP client (Java applet) and is excellent for verifying BASgatewayLX communication to Modbus devices. You can view coils and read/write registers via a web browser.

The five fields are:

Connect Status: When your PC connects to the BASgatewayLX, it first displays "Connected to target" then awaits a register access.
Slave Address: (1 by default.) Enter the address of a device to access.
Register Number: (1 by default.) Enter only the 3 least significant digits of the register address to access. The 2 most significant digits are automatically added and depend on whether you click the **Read** or **Write** button.
Value: This reads or writes values for the register in the **Register Number** field. When writing a value, match the number format of the selected radio button or an error appears in this field.
Status: If you read or write a register successfully, "Success" appears here and **Value** shows the result. If a register access is unsuccessful, the error is reported in the **Value** field.

More Information...

Modbus Communications Help

The MicroLogix PLC does have a status screen. The link layer error code is the best way to try and determine the source of the communications problem. Do a Google search on the Link Layer Error code for help. **Figure 6.** below.
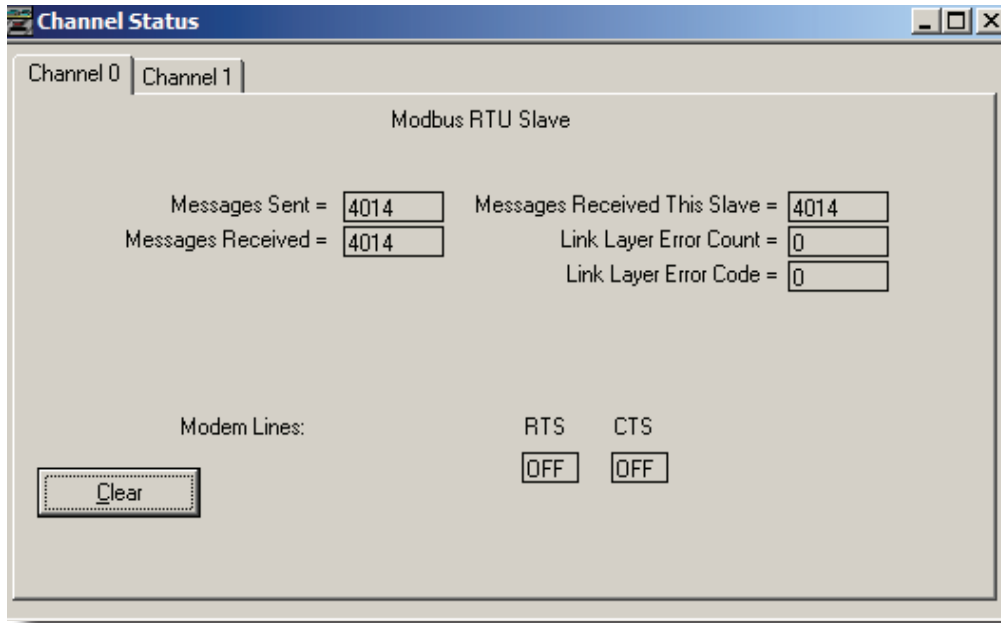

Figure. 6

CONTEMPORARY CONTROLS

Converting the PLC Variables to BACnet/IP Object Instances

The next step is to upload a Modbus profile into the BASgatewayLX so that it can poll the Modbus variables that are being provided from the PLC data file. This polling file connects the PLC variable into a BACnet/IP object instance. The polling file is a csv file. Shown below is the csv file opened in an excel spreadsheet. A complete description of the meaning of each column is available at:

http://www.ccontrols.com/pdf/AN-BASGTWY0B.pdf.

You can download a copy of this profile from our website at:

http://www.ccontrols.com/support/basgatewaylx_profiles.htm

And select the Modbus Device Profile in the Micrologic row.

If you prefer you can create this profile by typing all the info by hand. Just one row will work fine, but you must adhere to the EXACT format shown below in **Figure 7.**

Visit http://www.ccontrols.com/video/basgatewaylxconfig.htm to see how to load the configuration and add a device profile for polling. You will also learn how to monitor the values for your PLC.

When developing a profile for a PLC there are no "canned" profiles. For a electric meter the voltage of phase A would always be in 40001 for a specific model. In like manner 40002 and 40003 would contain the voltage in phase B and C respectively. But in you PLC application the value in 40001 is what you transfer to it from the PLC data file. So it could be anything you want it to be. Contemporary Controls is always willing to build the profile you need. But you will have to define it before we can build it.

If you prefer to build your own Modbus profile we offer an excel worksheet that helps you define the required data and then via a single button press builds the csv file. It is available at:

http://www.ccontrols.com/support/basgatewaylx_profiles.htm

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Micrologix_Test_File_a																
2	YES	0	Register 40001	10	X400001	16 Bit Unsigned Integer	ANALOG_INPUT	1	NO_UNITS	Not Defined	None	0	1	0	1	1	0
3	YES	0	Register 40002	10	X400002	16 Bit Unsigned Integer	ANALOG_INPUT	2	NO_UNITS	Not Defined	None	0	1	0	1	1	0
4	YES	0	Register 40003	10	X400003	16 Bit Unsigned Integer	ANALOG_INPUT	3	NO_UNITS	Not Defined	None	0	1	0	1	1	0
5	YES	0	Register 40004	10	X400004	16 Bit Unsigned Integer	ANALOG_OUTPUT	4	NO_UNITS	Not Defined	None	0	1	0	1	1	0
6	YES	0	Register 40005	10	X400005	16 Bit Unsigned Integer	ANALOG_OUTPUT	5	NO_UNITS	Not Defined	None	0	1	0	1	1	0
7																	

Figure 7.

BDT – Or How to Prove Your Design to the Building Contractor

You now have the data from the PLC into the BASgatewayLX. The next and final step is to prove to yourself and the Building automation contractor that the PLC data is available as BACnet/IP data. Contemporary Controls offers a free utility called BDT (BACnet Discovery Tool). This tool will let you view the PLC data as BACnet data. This is a great way to verify your design with everyone involved in the project. The free BDT software is available at http://www.ccontrols.com/sd/index.htm

Your computer needs to be connected to the BASgatewayLX Ethernet port.

Load the BDT software into your computer. Double click of the BDT icon and you will open the window below. Press the search button and you will find 2 BACnet devices. In the example below the BASgatewayLX is device instance 2459900, and the PLC can be found at BACnet device instance 2452001. If you had additional PLC Modbus ports each of them would have their own device instance. The BASgatewayLX does virtual routing so each Modbus device is its own BACnet Device ID. **Figure 8.** below.
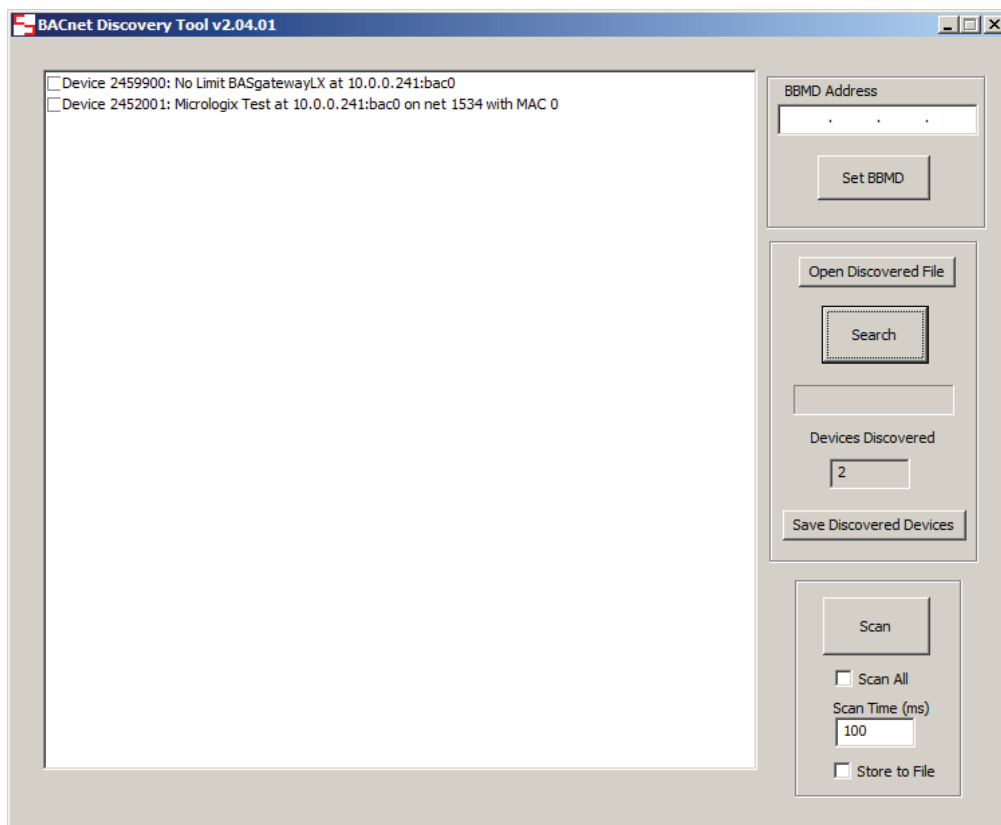

Figure 8.

CONTEMPORARY CONTROLS

BDT – Or How to Prove Your Design to the Building Contractor

Double click on the device and the points will display. Use the check boxes to select the points. See **Figure 9.**
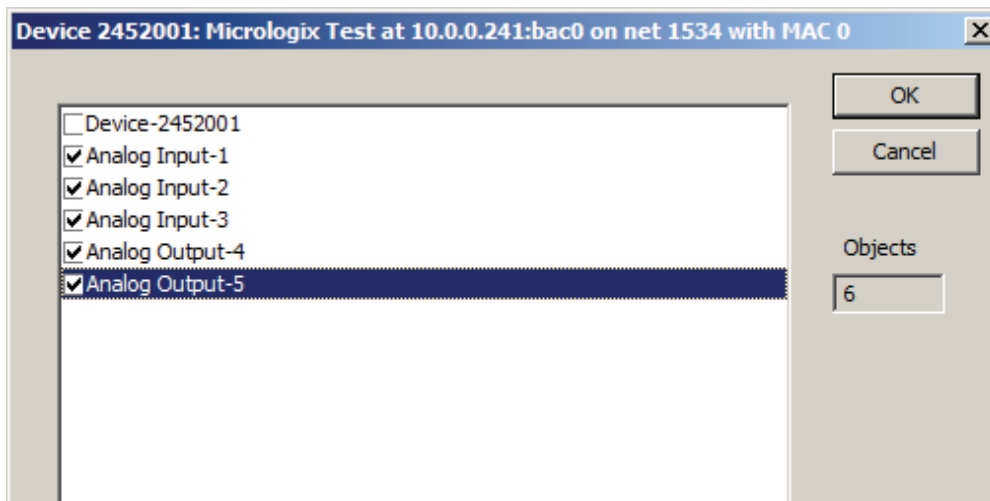

Figure 9.

Click on the scan button to see the results below. You are now reading the PLC data as BACnet data. Success. See **Figure 10.**
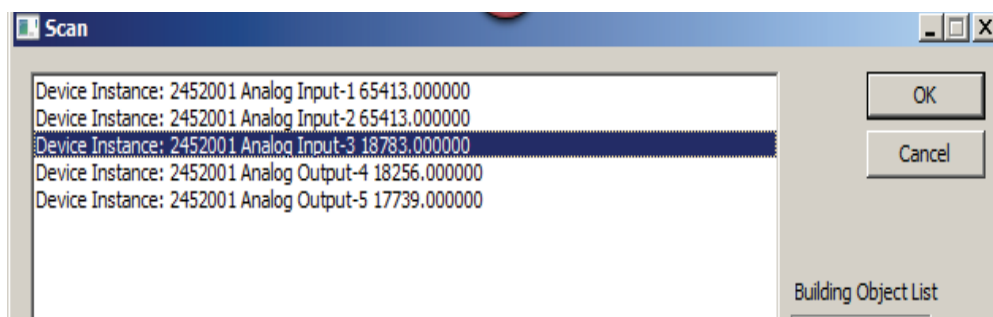

Figure 10.

BDT – Or How to Prove Your Design to the Building Contractor

If you have any variables that the Building automation controller will be writing data to your PLC you can prove out the functionality by turning off the scan and going to the point screen and double clicking on Analog Output - 4. It will display the screen below. **Figure 11.** below
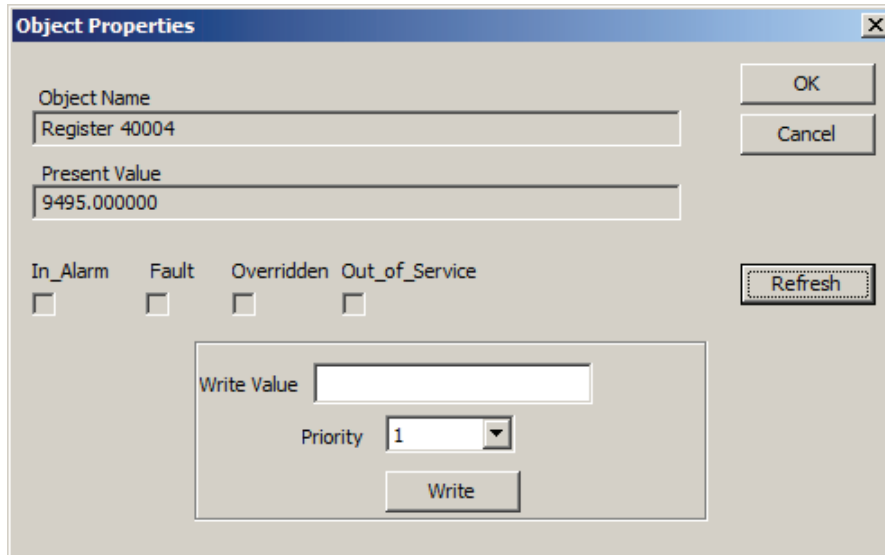

Figure 11.

You can use the Write button to change the data and then press the refresh to view it. The data was originally 9495 and after the write was performed the data is 2344. This is a good way to prove out that the data is flowing from the BASgatewayLX to the proper location in your PLC. **Figure 12.** below
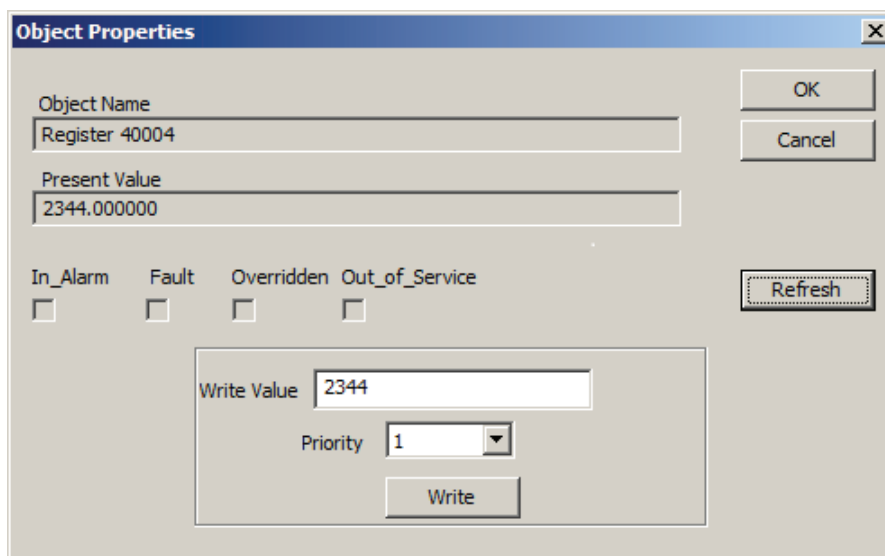

Figure 12.

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