



X317

Web-Enabled Analog Output Module

USERS MANUAL

Revision 1.2

For models: X-317

Five Analog Output Channels • Voltage or Current Output



- ▶ Motor Speed Control
- ▶ Valve Position
- ▶ HVAC
- ▶ Hydraulic Actuators

CONTROL by **WEB**™
www.ControlByWeb.com

a division of Xytronix Research & Design, Inc.
located in Nibley, Utah, USA

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X-317 User Manual Revisions	
Revision	Description
1.0	Initial release
1.1	Minor grammatical cleanup
1.2	Changed Modbus addressing

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Section 1: Introduction

The X-317™ is a web-enabled analog output module with five output channels. It combines many of the features found on other ControlByWeb products and adds new capabilities to the product line. Each channel can be programmed to output a voltage or current. The analog outputs are similar to that of a Programmable Logic Controller (PLC). However, unlike a PLC, the X-317 is designed for web-based applications from the ground up. No add-on software or hardware is required. The X-317 can be fully configured, programmed and tested using its built-in web server. The web setup pages are intuitive and easy to use and do not require special programming skills.

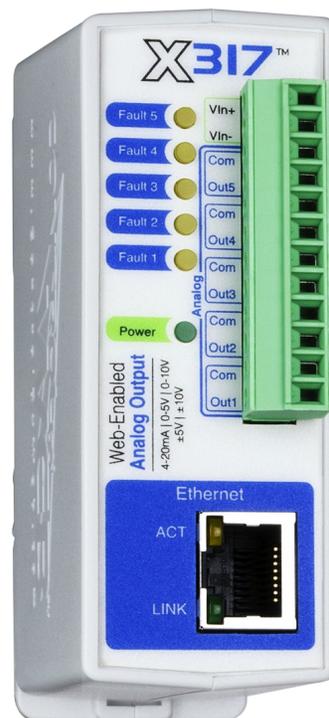
The X-317 can be used as a stand-alone device. For example, you could set the speed of conveyor or the position of a HVAC damper by accessing the X-317's internal web page. The X-317 can also operate as a peripheral for other devices such as a programmable logic controller (PLC) or the X-600M™.

The X-317 has five precision 16-bit digital to analog converters (DACs). Each channel can be programmed for 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA ranges. The voltage and current outputs for each channel are on a single connector terminal, thus reducing the number of connector terminals from three to two.

Most industrial analog applications require isolation between the power supply and analog outputs. The X-317 has a built in DC-DC converter for providing isolated power to the outputs. No external isolated back plane power is needed.

The built-in web setup pages allow the name and settings for each channel to be configured. You can configure the range of a setting to be in engineering units. For example, an input value of 0 to 100% can be scaled and processed for an output range of 4 to 20mA to control a damper motor.

As with other ControlByWeb products, the X-317 supports a number of Ethernet protocols with its built-in server, including HTTP, Modbus/TCP, and XML.



1.1 Features

1.1.1 X-317™ Features:

- Five separate analog output channels
- 0-5V, 0-10V, ±5V, ±10V, 4-20mA output ranges
- Outputs are software configured, independently programmable and scalable
- Built in isolated DC-DC converter
- Wide power supply range (9-28VDC)
- No special software or device drivers required
- Built-in password protected Web server for browser-based setup and control.
- Built-in web page for setting the outputs
- XML and Modbus/TCP communications
- Static or DHCP IP address configuration
- Advanced functionality through BASIC scripts
- DIN-Rail Mountable.
- LED alarm indicators.
- Removable connector for wiring connections

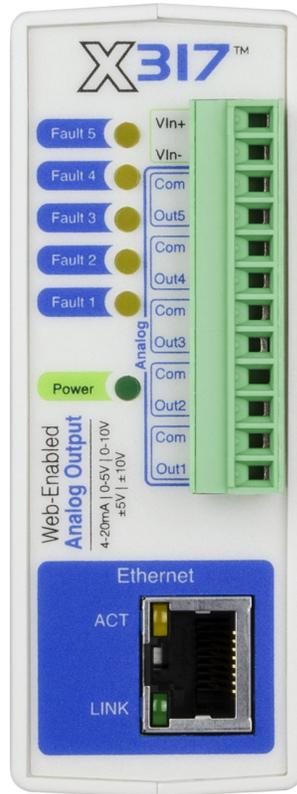
1.1.2 Digital to Analog Converter

The X-317 accepts output settings in familiar engineering units such as V, M, Ft, KPH, %. Internally the X-317 automatically scales the output settings before setting the digital to analog converter. This allows the user to control the output device using familiar and descriptive engineering units.

The internal calculations are made with a linear slope and offset equation ($Y=mX+b$). With the default settings, the input and output have a 1 to 1 relationship. For example, with the default settings, setting the output to 2.0 will result in the analog output being 2.0Volts. When the X-317 is controlled via ModBus/TCP from a PLC or other device it may be convenient to leave the default settings undisturbed so that no data scaling is done in the X-317 and any math or other calculations are done in the PLC or controlling device.

If you wish the X-317 to scale and process the output settings, you can access the **Analog Outputs** tab in the **Setup** menu to change the output settings. For example, you may wish to control a damper motor and have the display and settings with values of 0 to 100%. When properly configured, the X-317 will scale a setting of 0% to generate a 4.0mA output, and a setting of 100% to generate a 20.0mA output.

1.2 Connectors & Indicators



Connections & Indicators

I/O Connector

The 12-pin terminal connector is used to provide power to the module and connect the Analog Outputs.

Network Connector

The Ethernet connector is a standard, 8-position modular receptacle.

Module Power Indicator

The green Power LED indicator is illuminated whenever the module is powered.

I/O Indicators

The four, yellow LEDs indicate the output alarms.

Alarm Condition	Yellow LED's
Power Up	All four yellow LEDs are momentarily illuminated All four yellow LEDs remain illuminated if any internal errors are detected
Current Mode	Open circuit or compliance voltage violation (current source is saturated)
Over Temperature	Die temperature is over +142°C

Ethernet Indicators

The green LINK LED is illuminated when the module is properly connected to an Ethernet network and is ready to communicate. Network communications will only occur if this LED is illuminated. The ACT LED flashes amber when activity is detected on the network.

1.3 Accessing the X-317

Standard Access Using a Web Browser

The X-317™ has a built-in web server that provides simple web pages that can be accessed directly using a standard web browser. This allows users to access the unit with NO SPECIAL SOFTWARE installed on their computer. This is ideal for applications that require a quick, simple solution that does not need to be accessible to more than a few people. This configuration is simple to setup, simple to use, and can be accessed from any computer.

*Note: Network routers may need to be configured to allow access from computers outside of the local network (see **Appendix C: Accessing the X-317 Over The Internet**).*

1.4 Part Numbers and Accessories

Device	Description	Part Number
X-317	Analog Output Module	X-317
Spare Connector	12-position, screw terminal connector	X-1803675

Section 2: Installation and Connections

Installation consists of mounting the X-317, connecting it to an Ethernet network, providing power, wiring the analog outputs, and configuring via a web browser.

2.1 Installation Guidelines

- This unit must be installed by qualified personnel. In the case of line-voltage connections, a licensed electrician should be employed.
- This unit must not be installed in unprotected outdoor locations.
- This unit must not be used for medical, life saving purposes, or for any purpose where its failure could cause serious injury or the loss of life.
- This unit must not be used in any way where its function or failure could cause significant loss or property damage
- Do not use to directly control motors or other actuators not equipped with limit switches or other safeguards to protect from equipment or wiring failures.

2.2 Security Notes

The X-317 does not employ a general purpose computer operating system and does not have features such as telnet, FTP, SSH, nor uncontrolled open ports. This means it is unlikely for someone to 'break in' to the X-317 and access other devices on your local network. The simplicity of the X-317 makes it an inherently secure device. Nevertheless, as with any device installed on a network, appropriate security precautions should be observed.

If the X-317 is installed on the Internet, it is recommended that passwords be enabled for the **Control Page**. Passwords should be at least 8 characters in length and use a combination of upper and lower case letters and numbers. For additional security, a firewall may be used to limit access to selected IP addresses. Another option may be to set up a Virtual Private Network (VPN) between the network where the X-317 resides and the client machine (web browser, another, ControlByWeb™ product, etc.).

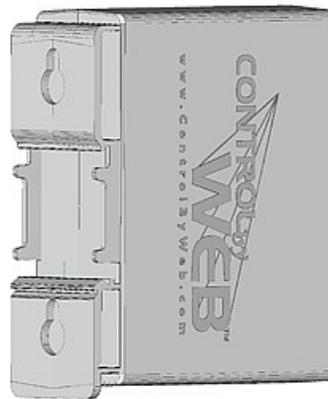
2.3 Connection Speed

This ControlByWeb™ product supports connection to **10 Mbps** and **100 Mbps** networks. Although 100Mbps networks are faster, the amount of data transferred to and from this device is very minimal and little, if any, performance increase will be gained by setting it to **100 Mbps**. There are advantages, however, to operate this device at **10 Mbps**. At **10 Mbps**, less power is required, the unit runs cooler, and the lifetime of the product will be extended.

Any changes to the Ethernet settings will require removing and re-applying power to the X-317.

2.4 Mounting

The X-317 can be mounted to a standard (35mm by 7.55mm) DIN-Rail. The X-317 should be located in a clean, dry location where it is protected from the elements. Ventilation is recommended for installations where ambient air temperatures are expected to be high. See *Appendix J: Mechanical Information* for additional mechanical details.



Attach the X-317 to the DIN-Rail by hooking the top hook on the back of the enclosure to the DIN-Rail and then snap the bottom hook into place. To remove the X-317 from the DIN-Rail, use a flat-head screwdriver. Insert the screw driver into the notch in the release tab and pry against the enclosure to release the bottom hook.

2.5 Making Connections

A removable terminal connector is provided for the wiring connections. The correct wiring procedure is as follows:

1. Make sure power is turned off.
2. Remove the terminal connector from the X-317 and make wiring connections to the terminals. This technique avoids stressing the internal components while torquing the screws.
3. Reconnect the terminal connector.
4. Apply power.

- Make sure wires are properly attached to the terminals and that the terminals are tight!
- Do not route signal cables in the same conduit or raceway with AC power lines feeding motors, solenoids or other electrically noisy loads. Long cable runs are susceptible to EMI and interference, keep cable runs as short as possible
- It is recommended that the load (device to be controlled) not be connected to the X-317™ until after the X-317™ has been configured and tested. By doing this, wiring and configuration mistakes will not cause the load device to turn on unexpectedly.

12-pin Connector	
Pin	Description
Vin+	Power Supply +VDC +9 to 28 VDC DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE.
Vin-	VDC- (Ground) power supply input.
Com	Analog Ground: Common ground for analog outputs (Isolated from Vin-)
Aout5	Analog Output 5, 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA
Com	Analog Ground: Common ground for analog outputs (Isolated from Vin-)
Aout4	Analog Output 4, 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA
Com	Analog Ground: Common ground for analog outputs (Isolated from Vin-)
Aout3	Analog Output 3, 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA
Com	Analog Ground: Common ground for analog outputs (Isolated from Vin-)
Aout2	Analog Output 2, 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA
Com	Analog Ground: Common ground for analog outputs (Isolated from Vin-)
Aout1	Analog Output 1, 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 4-20mA

2.5.1 Power Supply Connections

The X-317™ requires power for its internal logic circuits. Connect a 9-28 VDC power supply to the Vin+ and Vin- terminals. Note that a regulated power supply is recommended, such as a wall-mount AC-DC adapter. Verify that the adapter is rated for the operating current of the X-317 (See **Appendix F: Specifications** for current requirements.) Multiple X-317 units may be connected to a single power supply by connecting the power supply input terminals in parallel. The power supply must have a high enough current rating to power all units connected.

2.5.2 Analog Output Connections

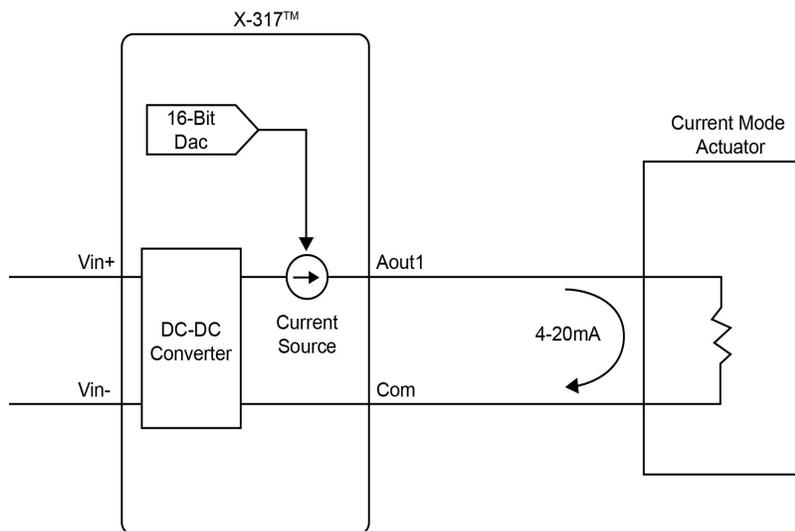
The analog outputs can be individually programmed to function as 0-5V, 0-10V, ±5V, ±10V, 4-20mA outputs.

Voltage Output Connections

Many variable frequency drives (VFD), servos and other actuators are controlled by a variable voltage. To use these devices the **Aout** and **Com** outputs are connected directly to the device to be controlled. A connection must be made to the **Com** terminal. Internally the **Vin-** and **Com** pins are isolated by the DC-DC converter. The maximum output current for voltage outputs is 10mA per channel. The five **Com** pins are internally connected together.

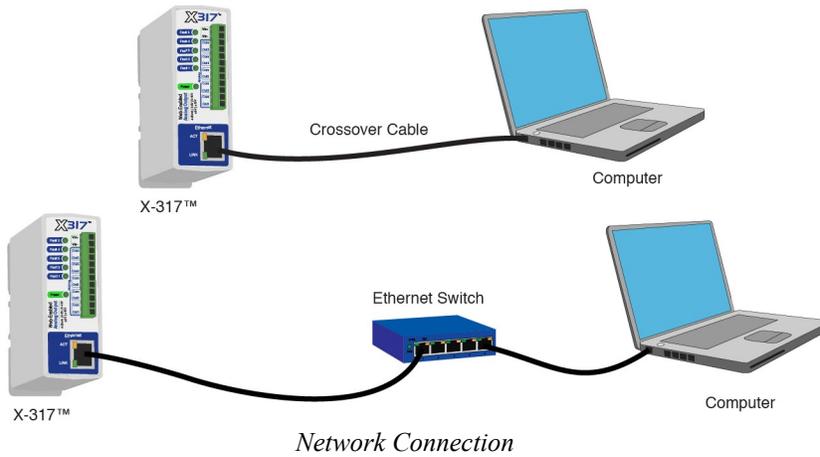
Current Output connections

Some actuators are designed to respond to a change of DC current instead of the voltage levels. To use these devices the **Aout** and **Com** outputs are connected directly to the device to be controlled. Power for the current loop is provided by the X-317. The X-317 employs an internal current source for controlling the output current. The current source saturates at 11.5V. As such the resistance of your output current loop must not be more than 575 ohms ($575\text{ohm} \times 0.02\text{A} = 11.5\text{V}$). This includes the input resistance of the actuator and any wiring in the current loop. If the current loop is open or the loop resistance is too high the respective yellow fault LED will be illuminated and the web page display will show the output value as **xx.xx**.

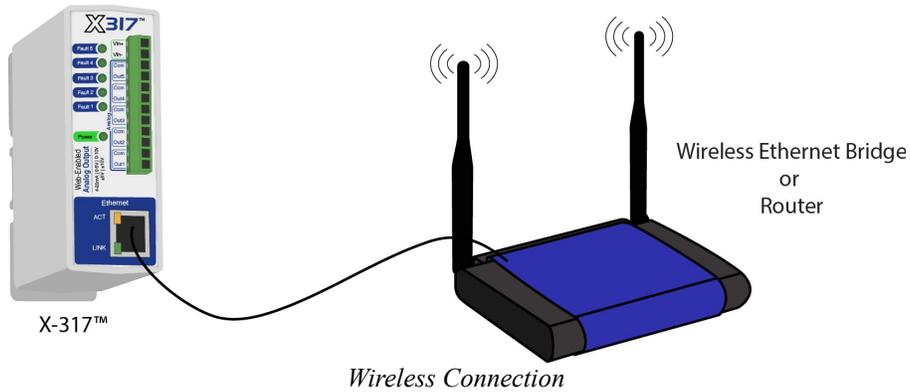


2.5.3 Network Connection

Connect the Ethernet port to a 10 Base-T or 10/100 Base-T Ethernet connection. This typically connects to an Ethernet hub, switch, or router. For configuration, the X-317 may be connected directly to the Ethernet port on a computer using a “crossover” cable. Otherwise, for connection through a hub or router, a standard “straight-through” cable should be used.



The X-317 can be used on a wireless network by connecting through an Ethernet bridge or a wireless router.



Note: The wireless Ethernet bridge or router must be properly configured for the wireless network. Refer to the installation instructions for the wireless device.

2.6 Establishing Communications for Setup

In order to configure the X-317 with the web browser interface, the X-317 must be connected to an Ethernet computer network. This can be done by one of two methods:

Method 1– Temporarily change the IP address of a connected computer to the match the default IP address used by the X-317.

-or-

Method 2 – Assign a temporary IP address to the X-317 to work on an existing network.

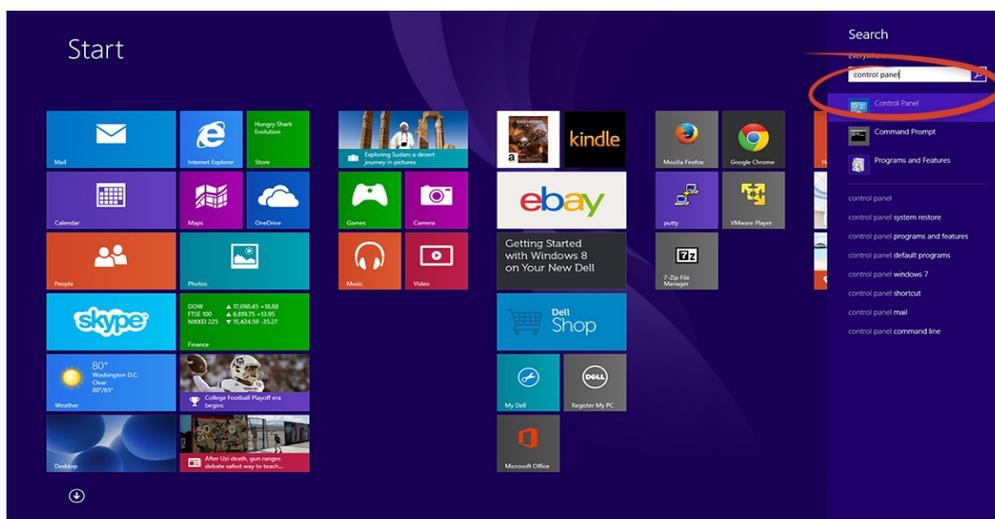
Note: If multiple ControlByWeb™ products are used on the same network, install one at a time and set the IP address of each unit before connecting the next unit to the network. This avoids having multiple devices being installed on the network with the same factory default IP address at the same time. If this approach is used, be sure to clear the arp cache after disconnecting each unit (arp -d).

2.6.1 Method 1: Assign a Temporary IP Address to Configuration Computer

By default, the X-317 comes from the factory with an IP address of 192.168.1.2. Communication with the X-317 may be established by assigning an IP address to the configuration computer so that it is on the same network as the X-317 (for example, the configuration computer could be assigned to 192.168.1.50)

The following example is for those running the Windows-8 operating system:

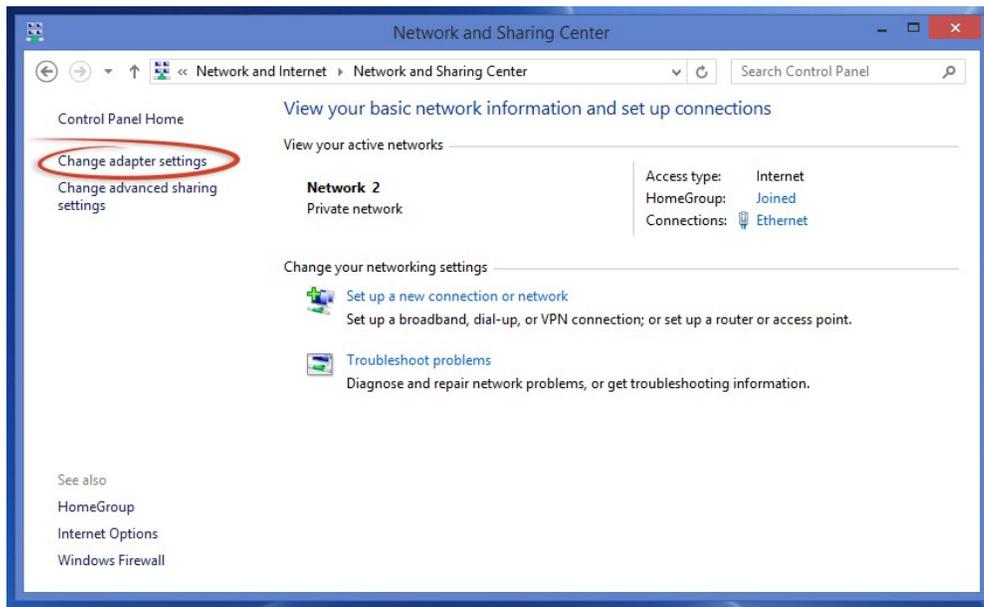
1. Apply Power, wait 15 seconds for the X-317 to become operational, and then connect the Ethernet cable.
2. Open the Windows 8 start screen.
3. Type “**Control Panel**” and press enter (the search box opens automatically when you begin typing).



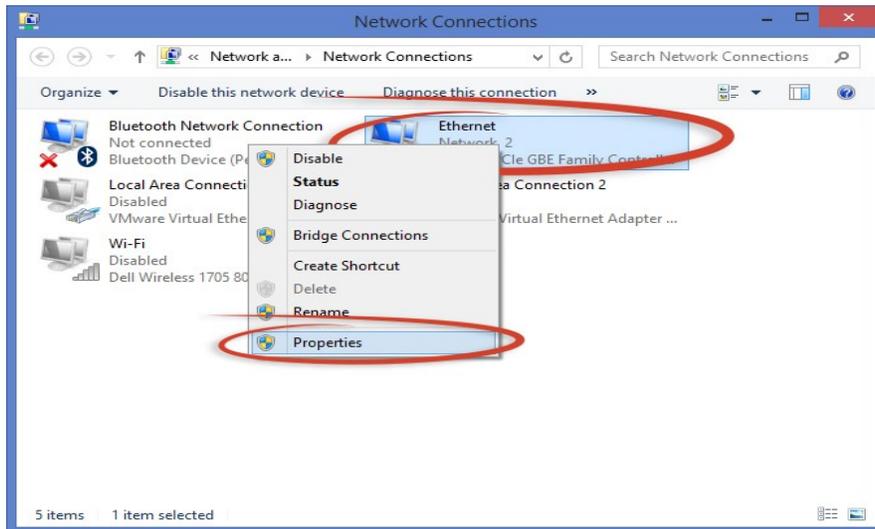
4. Select **View network status and tasks**.



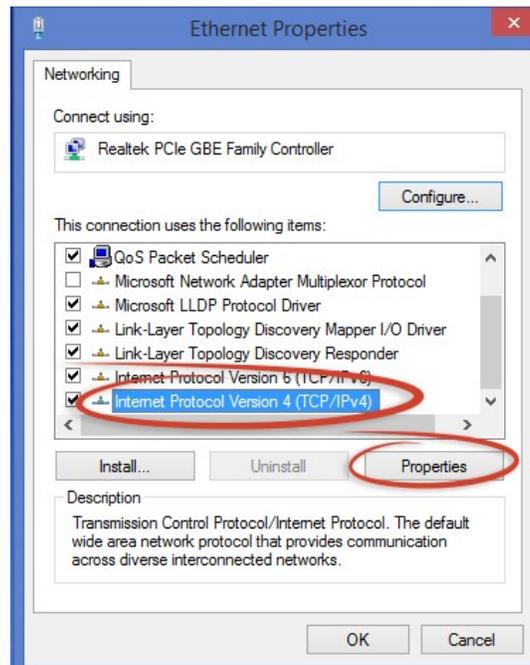
5. Select **Change adapter settings**



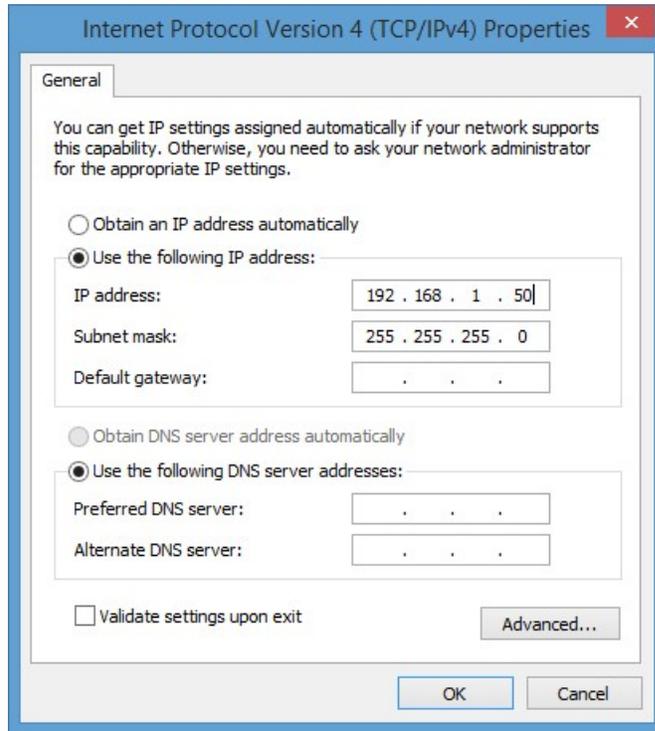
6. Your machine may have more than one Internet connection shown. Right-click on the adapter for your connection to the internet. A drop down box will appear, choose **Properties** to view/edit the settings for this internet connection.



7. Select **Internet Protocol Version 4 (TCP/IPv4)** and then click the **Properties** button.



- If “Use the following IP address” is already selected, the computer has been setup with a static IP address. Record these values so that the current IP address of the computer can be restored once the IP address of the X-317 has been successfully changed.



Select the radio button labeled **"Use the following IP address"** and type in the IP address:

192.168.1.50

Type in the subnet mask:

255.255.255.0

No need to change the default gateway field. Click **OK** to accept the new settings.

- Open the setup pages by entering the following URL in the address bar of a web browser:

`http://{ipaddress}/setup.html`

(For example: `http://192.168.1.2/setup.html`)

If the setup pages are not accessible, verify that the X-317 is powered on and that the LINK light is illuminated. Check all network connections and settings.

Another way to check communications is to ping the X-317 from the command prompt by typing:

```
ping [ipaddress] (e.g. ping 192.168.1.2)
```

2.6.2 Method 2: Assign a Temporary IP address to the X-317

This option (arping) is used to TEMPORARILY assign an IP address to the X-317 without the need to change the IP address of the configuration computer. The X-317 will use this IP address as long as power is maintained. Once power is lost, the X-317 will use the IP address assigned in the setup page and not the temporary address assigned here. Make sure that the X-317 and the configuration computer are connected to the same network. Since ARP is non-routable, this will not work through routers or gateways.

Microsoft Windows Instructions

1. Open a Command Prompt (select START, then RUN, then type "cmd").

Note: For Vista, 7, 8, and 8.1, the Command Prompt should be run as administrator (select Start, then type "cmd" and right click on "cmd" and select "Run as administrator").

2. Type:

```
arp -s {new IP address} {serial number of the X-317 }
```

Note: IP address format is xxx.xxx.xxx.xxx. The serial number can be found on a label on the module board. The format is ss-ss-ss-ss-ss-ss.

For example, to set the X-317 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

```
arp -s 10.10.10.40 00-0c-c8-01-00-01
```

3. Next, type:

```
ping -l 102 {new IP address}
```

For example, if the new IP address is 10.10.10.40, the following command would be used:

```
ping -l 102 10.10.10.40
```

4. Proceed with the X-317 setup in section 4.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional devices. This is necessary because each unit has the same default IP address, but a different unit serial number (MAC address). Clearing the arp table can be done by typing `arp -d` in the command prompt window.

Linux/Unix Instructions

1. Open a terminal and change to root user (su -, then enter root password).

2. Type:

```
arp -s {new IP address} {serial number of the X-317 }
```

Note: IP address format is xxx.xxx.xxx.xxx. The serial number can be found on a label on the module board. The format is ss:ss:ss:ss:ss:ss.

For example, to set the X-317 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

```
arp -s 10.10.10.40 00:0c:c8:01:00:01
```

3. Next, type:

```
ping -s 102 {new IP address}
```

For example, if the new IP address is 10.10.10.40, the following command would be used:

```
ping -s 102 10.10.10.40
```

4. Proceed with the X-317 setup in section 4.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional devices. This is necessary because each unit has the same default IP address, but a different unit serial number (MAC address). Clearing the arp table can be done by typing `sudo arp -d -a` in the command prompt window.

Mac OS X Instructions

1. Open a terminal.

Note: The terminal is in the "Utilities" directory, which is in the "Applications" directory.

2. Type:

```
sudo arp -s {new IP address} {serial number of the X-317 }
```

Administrator password may be required.

Note: IP address format is xxx.xxx.xxx.xxx. The serial number can be found on the label on the module board. The format is ss:ss:ss:ss:ss:ss.

For example, to set the X-317 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

```
sudo arp -s 10.10.10.40 00:0c:c8:01:00:01
```

3. Next, type:

```
ping -s 102 {new IP address}
```

For example, if the new IP address is 10.10.10.40, the following command would be used:

```
ping -s 102 10.10.10.40
```

4. Proceed with the X-317 setup in section 4.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional devices. This is necessary because each unit has the same default IP address, but a different unit serial number (MAC address). Clearing the arp table can be done by typing `sudo arp -d -a` in the command prompt window.

Section 3: Example Applications

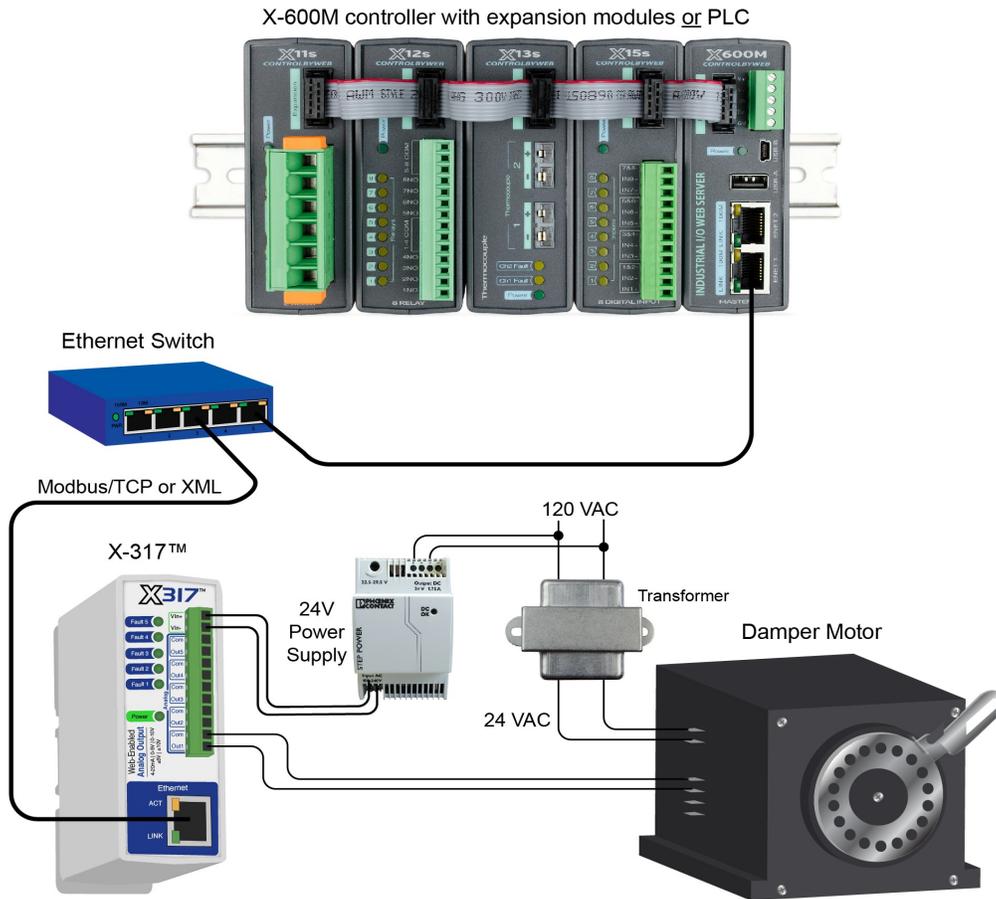
The X-317 was designed to meet a broad range of industrial and scientific applications including:

Process Control

The X-317 may be suitable for process control applications where a PLC is typically used or to augment PLC capabilities. In some applications, not only is the X-317 more economical than a PLC, the ease of programming reduces deployment and maintenance costs. The Modbus/TCP interface can be used to control and monitor the X-317 analog outputs.

With PLC's and many industrial controls, the wiring connections to the actuators are typically run to a central control cabinet. In a large facility the wiring runs can be long and expensive. If the facility already has an Ethernet infrastructure you can install an X-317 near the actuator(s) and eliminate any direct wiring to the controls. By using existing Ethernet infrastructure, the X-317 can be installed in other buildings and remote locations which would be unworkable with direct connections. With the X-317 there is no need for a Remote Terminal Unit (RTU) or other Modbus devices to control the actuator.

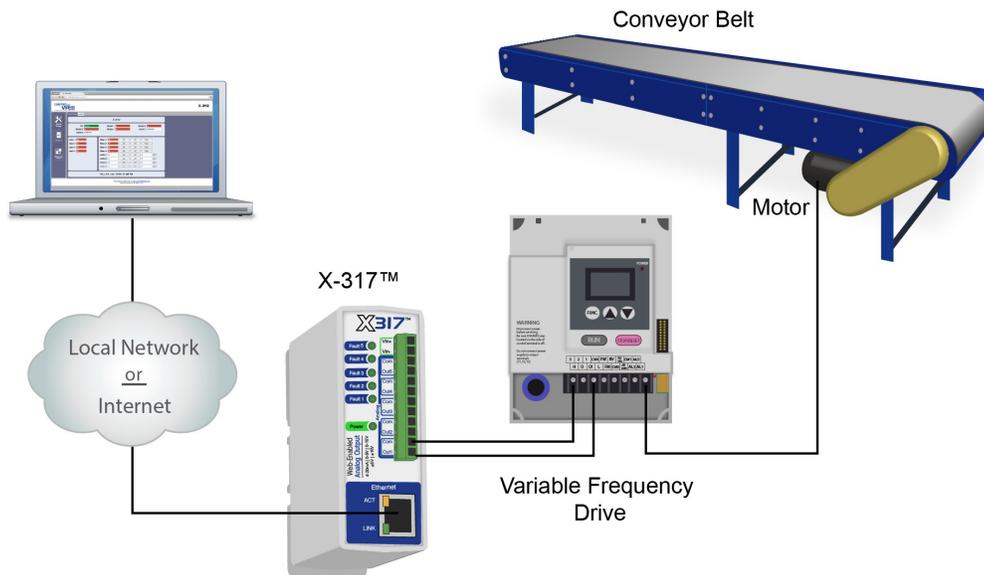
The illustration below shows an example using the X-317 to control a damper motor. In this example the actuator accepts a 2-10V signal to control the actuator arm. When the X-317 is commissioned, it is configured by naming one of the outputs *Intake_Air* and the user range is set to 0-100%. The output range is set to 2-10V such that when the user sets *Intake_Air* = 0 the output is 2.0V and when *Intake_Air* = 100 the output is 10.0V.



Control a damper motor via Modbus or XML

Manual Control

You can manually control a device over the internet without using a PLC or other complicated interface. With the X-317 you can access its internal web page and manually control the outputs. The example below shows how to control a conveyor motor from a web page without using SCADA software or a PLC.



Control the speed of a conveyor from a web page (or smart phone)

Section 4: Configuration and Setup

4.1 X-317 Setup Pages

The X-317 is configured using a web browser. To access the setup pages, enter the following URL in the address bar of a web browser:

```
http://{ipaddress}/setup.html
```

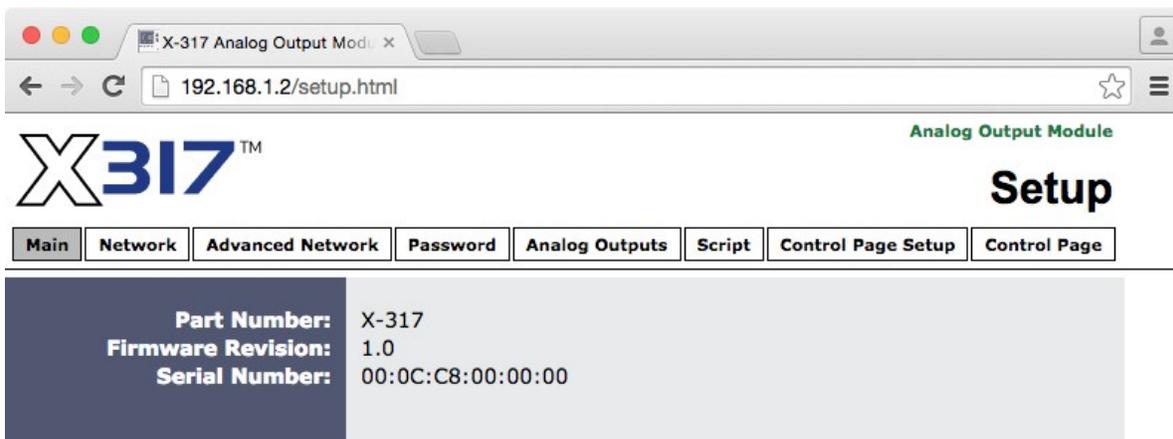
For example, using the default IP address, enter:

```
http://192.168.1.2/setup.html
```

After the page is requested, a password prompt will appear. Enter the username and password. The default username is `admin` and the default password is `webrelay` (password is case sensitive).

4.1.1 Main Tab

This is the initial page that is displayed when `setup.html` is entered into the address bar of the browser. It displays model and serial number information.



For product support go to www.ControlByWeb.com
Xytronix Research & Design, Inc.

Part Number

This is the full model number of the X-317.

Firmware Revision

This is the current product revision of the unit's firmware.

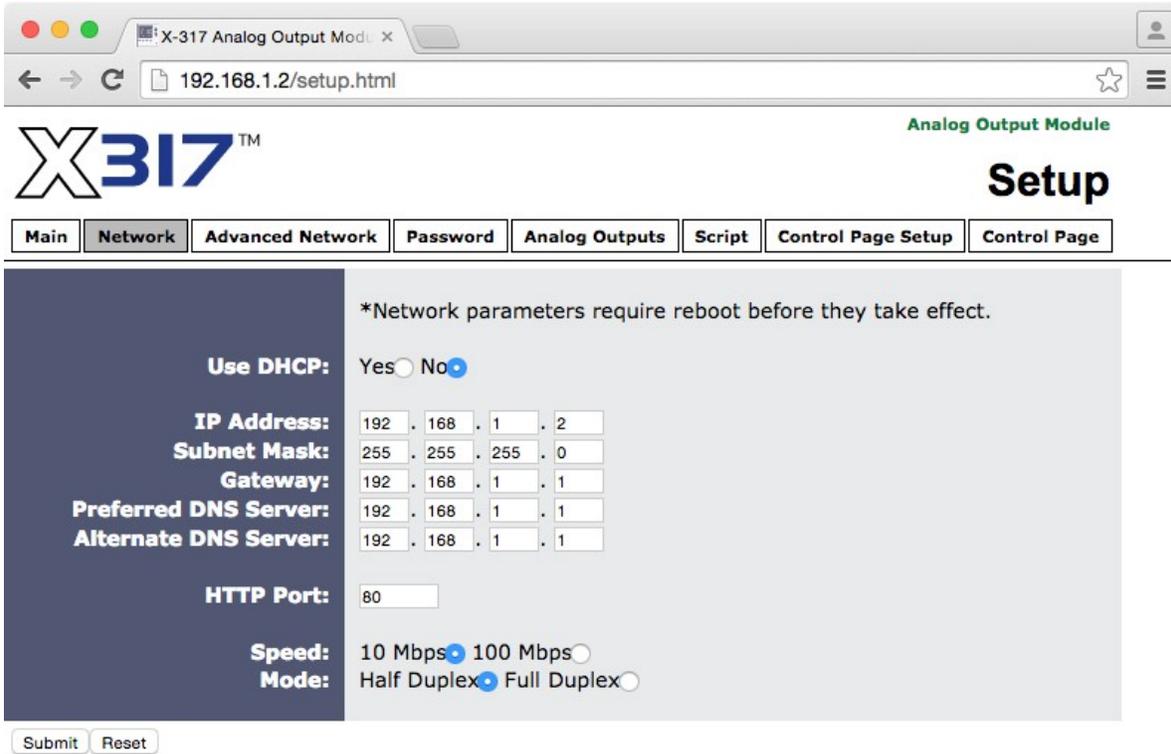
Serial Number

This is the serial number of this unit. The serial number is also the MAC address of the unit.

4.1.2 Network Tab

The network parameters are set on this page.

*Note: The X-317 must be power-cycled (power disconnected, then reconnected) before network settings take effect. Only the settings on the **Network** tab require power-cycling before taking effect.*



Use DHCP

This option allows DHCP to be enabled or disabled. If this option is set to **Yes**, the X-317 will wait for an IP address from a DHCP server each time it is powered. The default setting is **No** (this is recommended for most installations). If DHCP is set to **Yes**, the Network page must be submitted and the X-317 must be rebooted before an IP address will be assigned. Once the X-317 is assigned an IP address by the DHCP, the new IP address can be found through the clients list kept by the DHCP server. For most instances, this is found on the local gateway or router.

Brief Notes About DHCP

All devices on an IP network require an IP address. This is a unique address that identifies each device on the network. DHCP (Dynamic Host Control Protocol) is a mechanism that automatically assigns an IP address to a computer (or other devices) when it is connected to a network. This eliminates the need to manually enter the IP address. When a computer is connected to the network, another device on the network called a DHCP server detects the presence of the computer and dynamically assigns the IP address to that computer. On many small networks, the DHCP server is built into the router.

DHCP works well for "client" devices such as computers, but is not ideal for servers. This is because servers usually don't initiate communications with other devices, but rather they wait for a request from "clients." To make this request, the client must know the IP address of the server. If a server gets its IP address dynamically, the IP address may not always be the same so client devices may not be able to find the server. For this reason, servers usually use an IP address that is fixed and

does not change. The X-317 is a server and manual IP address assignment is usually recommended.

IP Address

Enter the IP address for the X-317 in this field. The IP address is specific to the network where the X-317 will be installed, and must be obtained from the network administrator. For more information on IP addresses and remotely accessing the X-317 over the Internet, see **Appendix C: Accessing the X-317 Remotely Over the Internet**. The default setting for this field is 192.168.1.2.

Subnet Mask

The subnet mask defines the size of the local network. This must be obtained from the network administrator. For additional information about sub-netting and IP networking, many tutorials are available on the Internet. The default setting for this field is 255.255.255.0.

Gateway

This specifies the IP address of the gateway router. This must be obtained from the network administrator. The default setting for this field is 192.168.1.1.

Preferred DNS Server

The IP address of the Primary DNS server is specified here. When DNS services are required, this is the address that will be used. The default setting for this field is 192.168.1.1. This field is only required when **Remote Services** is used:

Alternate DNS Server

This field is used to specify the IP address of a Secondary DNS server. This is used when the X-317 requires DNS services and the preferred DNS server is not available. The default setting for this field is 192.168.1.1.

HTTP Port

The TCP port used for HTTP communications (web browser, XML, get commands) with the X-317 is specified here. The default setting for this field is 80, which is the standard HTTP port. It is recommended that the port be left unchanged unless the user has an understanding of TCP/IP and ports. For more information on TCP ports and IP addressing see **Appendix C: Accessing the X-317 Remotely Over the Internet**.

Speed

This option sets the data rate (clock rate) of the Ethernet port. Either **10 Mbps** or **100 Mbps** can be selected. The **100 Mbps** option offers faster communications but the amount of data to and from the X-317 is so small that users will not likely notice much (if any) difference. When the X-317 is set to **10 Mbps**, it draws less power and runs a little cooler, which may translate into a longer product life. The default setting for this field is **10 Mbps**. IT IS RECOMMENDED THAT THIS SETTING BE LEFT AT **10Mbps** UNLESS THE USER HAS A SPECIFIC REASON TO USE **100Mbps**.

Mode

This option allows the Ethernet port to be set to **Half Duplex** or **Full Duplex**. Legacy Ethernet operates in **Half Duplex** mode which means that devices can either send data or receive data, but not both at the same time. **Full Duplex** means that devices can send and receive data at the same time. The default setting for this field is **Half Duplex**.

4.1.3 Advanced Network Tab

Note: These settings are not used for most installations.

The screenshot shows a web browser window with the URL 192.168.1.2/setup.html. The page title is 'X317™ Analog Output Module Setup'. The 'Advanced Network' tab is selected. The configuration fields are as follows:

- Modbus Enabled:** Yes No
- Modbus Port:** 502
- Remote Services Enabled:** Yes No
- Server Name/IP Address:** [Empty text box]
- Server Port:** 8000
- Connection String:** [00:0C:C8:00:00:00]:ControlByWeb,X-317
- Connection Interval:** 1 Minutes
- IP Filter Range 1:** 0 . 0 . 0 . 0 / 255 . 255 . 255 . 255
- IP Filter Range 2:** 0 . 0 . 0 . 0 / 0 . 0 . 0 . 0

Buttons: Submit, Reset

Modbus Enabled

The X-317 can support Modbus/TCP. Modbus is a messaging structure protocol used in industrial manufacturing control and automation. It is an open protocol and offers interoperability with software and devices from other manufacturers. This is enabled by selecting **Yes** in this field. The default setting for this field is **No**. (See **5.3 Modbus Operation** for more information on using the X-317 on a Modbus network.)

Note: Modbus communications are disabled whenever the Control Password is enabled.

Modbus Port

This specifies the port used for Modbus/TCP communications with the X-317. By default this is set to port 502 which is the standard Modbus port. It can be set within the range of 0 to 65535.

Remote Services Enabled

This option enables or disables Remote Services. If **Yes** is selected, Remote Services will be enabled as soon as the submit button is pressed and the X-317 will immediately attempt to make a connection with the remote server (power cycle not required). Once a connection is established, the connection will remain until it is disconnected by the remote server. The default setting for this field is **No**. Most users should leave this setting at its default. (See **Remote Services** at the end of this section for more information.)

Server Name/IP Address

Specify the name or IP address of the Remote Services server here. If the IP address is specified,

enter it in this format aaa.bbb.ccc.ddd. For numbers that are less than 100, preceding zeros should not be included (for example, enter 80 rather than 080). This field can be up to 40 characters long and has no default setting.

Server Port

Enter the TCP port used for the Remote Services server. This can be set within the range of 0-65535. The default setting for this field is 8000.

Connection String

This text is sent to the Remote Services server when the connection is established. This string should include any information required by the server at connection. For example, it may include an ID number, customer number, password, etc. The format is entirely dependent upon the server requirements. This field can be up to 80 characters long. Default text is provided only as an example placeholder. The default text is [`<serialNumber>`]:ControlByWeb, X-317.

Connection Interval

This field specifies the periodic interval in which the X-317 attempts to connect to the remote server, or if the X-317 is already connected, it is the interval in which the X-317 sends the connection string. This field can be set within the range of 1 to 34452 minutes. The default setting for this field is 1 minute.

IP Filter Range 1 and IP Filter Range 2

For additional security, the X-317 has a simple built-in firewall. If desired, the X-317 can be configured to only allow access to client devices (computers, servers, other X-317 devices, etc) with certain IP addresses. Two IP address ranges are provided and only client devices with addresses that fall within those two ranges will be allowed access. Devices with IP addresses that fall outside of those ranges will not receive any response from the X-317. The following are examples.

To allow access from any device (this is the default setting):

IP Filter Range 1:	0.0.0.0 255.255.255.255
IP Filter Range 2:	0.0.0.0 0.0.0.0

To limit access to only one device (address 192.168.1.33):

IP Filter Range 1:	192.168.1.33 192.168.1.33
IP Filter Range 2:	0.0.0.0 0.0.0.0

To limit access to only devices on the local network and one device on the internet (address 10.143.100.32):

IP Filter Range 1:	192.168.1.0 192.168.1.255
IP Filter Range 2:	10.143.100.32 10.143.100.32

Note: The address specified for the Remote Services server (if applicable) is automatically allowed through the firewall no matter how this is set.

Remote Services

Remote Services initiates an outgoing connection to a server at a remote location. This can be used in an environment where a web server on the Internet provides a custom web page to the X-317 and other ControlByWeb products. Users access the X-317 through the web server rather than communicating directly with it. This method is sometimes referred to as “web services” and allows programmers to create powerful, custom web pages to multiple devices using the web programming languages of their choice.

Remote Services initiates the connection to the external web server (rather than the web server initiating communications to the X-317). This has two main benefits. First, the web server does not need to know the IP address of the X-317. This means that the X-317 can get its IP address dynamically from a DHCP server, simplifying the installation. Second, since the connection from the X-317 is outgoing, rather than incoming, the local router on the network where the X-317 resides doesn't need to be configured to forward sockets. This also simplifies the installation. Since the router configuration is not modified, the risk of compromising security on the local network is eliminated. For more information about Remote Services see Appendix E: External Server and Remote Services.

4.1.4 Password Tab

The X-317 requires a password to log into the setup pages. The password can be changed on this page. Additionally, the installer can enable the requirement for a **Control Page** password.

Setup Password

The Setup Password, which is required to access the setup pages, can be modified by entering a new password here. Passwords that are 8 characters or longer (up to 13 characters can be entered in this field) with both alphabetic and numeric characters are recommended. For security purposes, the password will not be displayed as it is entered. Note that the username required for accessing the setup pages is `admin` (all lower case). The default Setup Password is `webrelay` (also all lower case).

Re-enter Setup Password

When the Setup Password is changed, it must be entered twice. One time in the previous field and a second time in this field. If the password is not entered identically in both fields, the password will not be changed.

Enable Control Password

The **Control Page** can be viewed without entering a password. For security purposes, a password can be required for access to the **Control Page**. When this field is set to **Yes**, a password will be required to view the **Control Page**. The default setting for this field is **No**.

Control Password

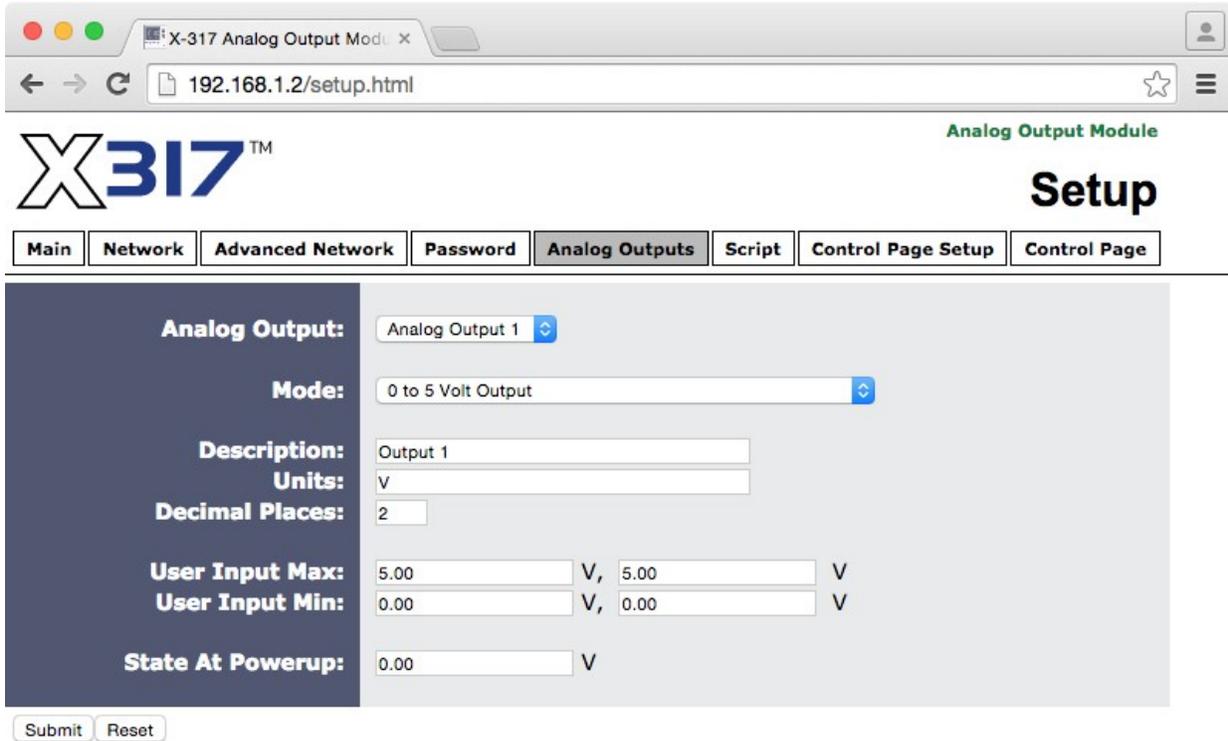
When the Enable Control Password option above is set to **Yes**, this field is used to specify the password which will be required to access the **Control Page**. Passwords that are 8 characters or longer with both alphabetic and numeric characters are recommended. For security purposes, the password will not be displayed as it is entered. Note that the X-317 requires a password, but does not require a user name to access the **Control Page**. However, some browsers require that a user name be entered. In this instance enter none as the user name. The default Control Password is `webrelay`.

Re-enter Control Password

When the Control Password is changed, it must be entered twice. One time in the previous field, and a second time in this field. If the password is not entered identically in both fields, the password will not be changed.

4.1.5 Analog Outputs Tab

This page provides configuration options for each of the five analog outputs. After making selections for a particular output channel you must click the *Submit* button to save your work before selecting another channel for further edits.



Analog Output

This drop down menu is used to select the specific output channel for which the options below will apply. Choose between channels 1 to 5.

Mode

Choose the desired output range for the selected analog output channel. Available selections include 0-5V, 0-10V, ±5V, ±10V and 0-20mA. This setting will be determined by the input range of your actuator to be controlled. In general choose the setting with the best dynamic range. For example, for an actuator with a +2 to +10V input, select the 0-10V output range. For this example, selecting ±10V would waste one half of the available dynamic range and have less resolution.

Description

This text field is used to describe the function of the selected output channel. The text appears to the left of the corresponding output status on the **Control Page**. Up to 24 characters may be entered in this field. The default text is *Output #*. You will want to change the description to a more useful value such as *“conveyor speed”* or *“damper position”*.

Units

This text field sets the engineering units for the selected analog output channel. These values appear with the corresponding analog outputs on the **Control Page**. You will want to change the units to V, M, Ft, KPH, % or other descriptive units. These text field settings help make the **Control**

Page display descriptive and easy to use. The units settings are for display only and are not used in the calculations for setting the digital to analog converter.

Decimal Places

This setting determines how many digits are shown to the right of the decimal point for the data values shown on the **Control Page**. This setting controls only how the data is displayed and does not affect the calculations for setting the digital to analog converter.

User Input Max & User Input Min

The analog output settings are made in user friendly engineering units such as V, M, Ft, KPH, %. Internally the X-317 automatically scales the output settings with a linear $Y=mX+b$ function before setting the digital to analog converter. The default settings are $m=1$ and $b=0$ which provide no scaling and a 1 to 1 output relationship. For example, with the default settings, setting the output to 2.0 will result in the analog output being 2.0Volts. When the X-317 is controlled via ModBus/TCP from a PLC or other device it may be convenient to leave the default settings undisturbed such that no data scaling is done in the X-317 and any math or other calculations are done in the PLC or controlling device.

If you wish the X-317 to scale and process the output settings, use the *User Input Max* and *User Input Min* fields to provide information for the internal calculations. The X-317 automatically computes the slope and offset settings with the data entered. The settings are made by entering two data points (X1,Y1) and (X2,Y2). The slope is calculated as $(Y2-Y1/X2-X1)$. The Y1 and Y2 output values must be within the range selected by the **Mode** setting (0-5V, 0-10V, $\pm 5V$, $\pm 10V$ and 4-20mA). The input format is:

User Input Max: X2, Y2
User Input Min: X1, Y1

For example, a conveyor motor is to be controlled by a 4-20mA loop with 4mA=10fpm and 20mA=50fpm. Make the following settings to control the conveyor in units of feet per minute (fpm).

User Input Max: 50fpm, 20mA
User Input Min: 10fpm, 4mA

With these settings, setting the analog output to 10fpm will cause the digital to analog converter to output 4.0mA and a setting of 50fpm will result in a 20mA output. Setting the analog output to a value between 10fpm and 50fpm will result in a proportional output between 4mA and 20mA.

With another example, a damper motor is to be controlled by a 2 to 10V signal with 2V=closed and 10V=open. Make the following settings to control the damper position in units of % open.

User Input Max: 100%,10V
User Input Min: 0%, 2V

Note the data scaling can process a negative slope. To reverse the operation of the damper motor in the example above, make the following settings:

User Input Max: 100%, 2V
User Input Min: 0%, 10V

After making these settings (and clicking the *submit* button), go to the **Control Page Setup** tab and click the *Display Raw Analog Outputs* box. Then go to the **Control Page** and experiment with your settings. Set the output to the max and min engineering values and make certain the digital to analog converter outputs the expected values.

To restore the default settings so that no data scaling is done set the *User Input Max* to the maximum D/A output voltage and the *User Input Min* to the minimum D/A output voltage. Make the user input and the D/A output values the same for both data points as shown in the table below:

Settings for no data scaling (1:1)									
Mode	Settings								
0V to 5V	<table border="0"> <tr> <td><input type="text" value="5.00"/></td> <td>V,</td> <td><input type="text" value="5.00"/></td> <td>V</td> </tr> <tr> <td><input type="text" value="0.00"/></td> <td>V,</td> <td><input type="text" value="0.00"/></td> <td>V</td> </tr> </table>	<input type="text" value="5.00"/>	V,	<input type="text" value="5.00"/>	V	<input type="text" value="0.00"/>	V,	<input type="text" value="0.00"/>	V
<input type="text" value="5.00"/>	V,	<input type="text" value="5.00"/>	V						
<input type="text" value="0.00"/>	V,	<input type="text" value="0.00"/>	V						
0V to 10V	<table border="0"> <tr> <td><input type="text" value="10"/></td> <td>V,</td> <td><input type="text" value="10"/></td> <td>V</td> </tr> <tr> <td><input type="text" value="0"/></td> <td>V,</td> <td><input type="text" value="0"/></td> <td>V</td> </tr> </table>	<input type="text" value="10"/>	V,	<input type="text" value="10"/>	V	<input type="text" value="0"/>	V,	<input type="text" value="0"/>	V
<input type="text" value="10"/>	V,	<input type="text" value="10"/>	V						
<input type="text" value="0"/>	V,	<input type="text" value="0"/>	V						
-5V to +5V	<table border="0"> <tr> <td><input type="text" value="5"/></td> <td>V,</td> <td><input type="text" value="5"/></td> <td>V</td> </tr> <tr> <td><input type="text" value="-5"/></td> <td>V,</td> <td><input type="text" value="-5"/></td> <td>V</td> </tr> </table>	<input type="text" value="5"/>	V,	<input type="text" value="5"/>	V	<input type="text" value="-5"/>	V,	<input type="text" value="-5"/>	V
<input type="text" value="5"/>	V,	<input type="text" value="5"/>	V						
<input type="text" value="-5"/>	V,	<input type="text" value="-5"/>	V						
-10V to +10V	<table border="0"> <tr> <td><input type="text" value="10"/></td> <td>V,</td> <td><input type="text" value="10"/></td> <td>V</td> </tr> <tr> <td><input type="text" value="-10"/></td> <td>V,</td> <td><input type="text" value="-10"/></td> <td>V</td> </tr> </table>	<input type="text" value="10"/>	V,	<input type="text" value="10"/>	V	<input type="text" value="-10"/>	V,	<input type="text" value="-10"/>	V
<input type="text" value="10"/>	V,	<input type="text" value="10"/>	V						
<input type="text" value="-10"/>	V,	<input type="text" value="-10"/>	V						
4mA to 10mA	<table border="0"> <tr> <td><input type="text" value="20"/></td> <td>mA,</td> <td><input type="text" value="20"/></td> <td>mA</td> </tr> <tr> <td><input type="text" value="4"/></td> <td>mA,</td> <td><input type="text" value="4"/></td> <td>mA</td> </tr> </table>	<input type="text" value="20"/>	mA,	<input type="text" value="20"/>	mA	<input type="text" value="4"/>	mA,	<input type="text" value="4"/>	mA
<input type="text" value="20"/>	mA,	<input type="text" value="20"/>	mA						
<input type="text" value="4"/>	mA,	<input type="text" value="4"/>	mA						

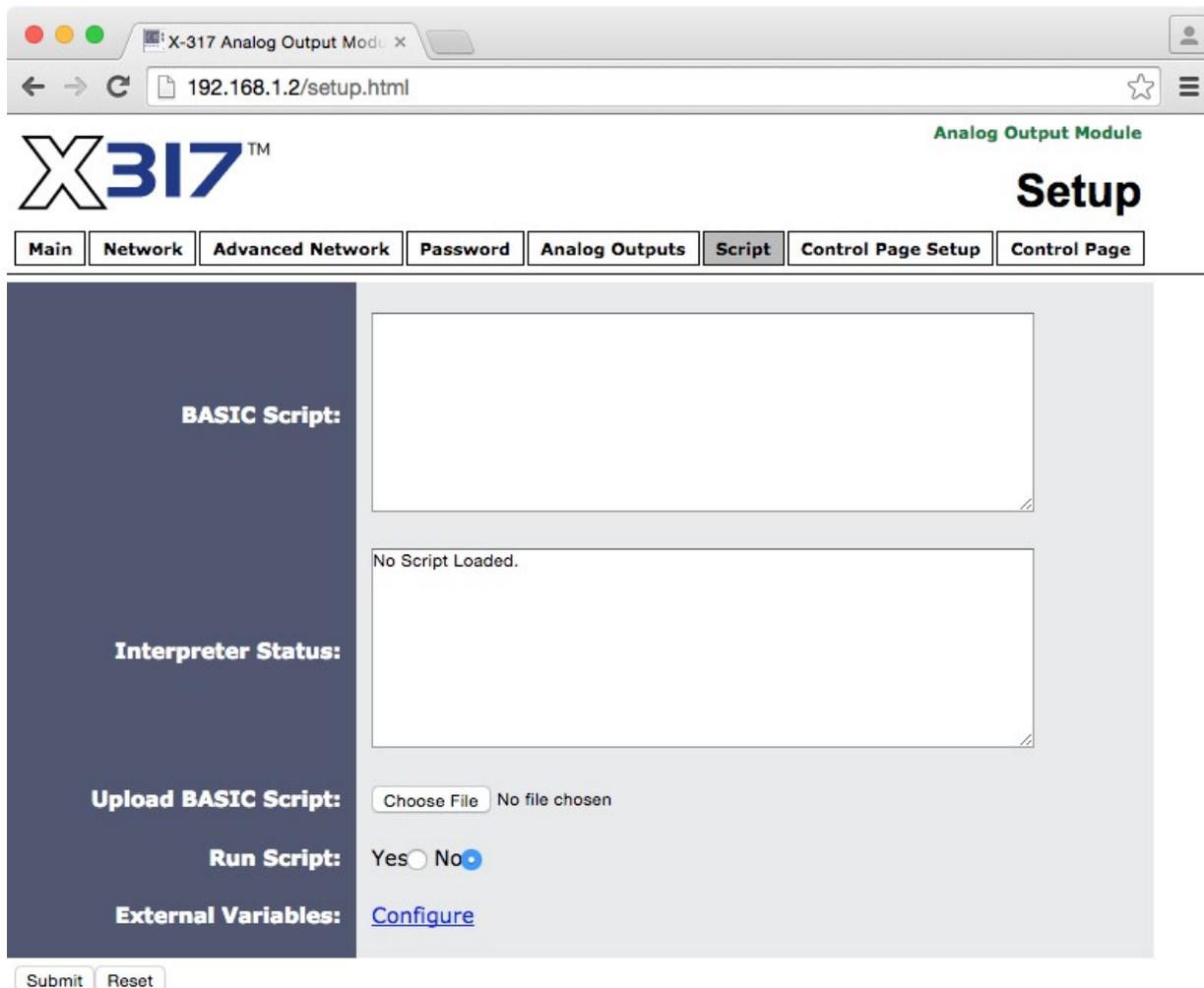
State at Power Up

This setting sets the analog output value when the X-317 is powered up. This value is not processed or scaled and must be within the output range of the digital to analog converter as specified by the **Mode**. This value remains in effect until the output is subsequently updated via the control web page, XML or Modbus communications. The default values are 0.0V if the **Mode** is set to one of the voltage ranges and 4.0mA if **Mode** is set to 4-20mA.

4.1.6 Script Tab

The X-317 can be used to run simple custom programs written in a language similar to BASIC. This page is used to load and execute these programs. Before it can be loaded to the X-317, a script must first be written as a .txt file. The file must then be uploaded to the X-317. The maximum size of script that can be uploaded to the device is 2K bytes. Information on writing a basic program for the X-317 can be found in **Appendix D: Basic Scripts**.

Note: An ASCII standard text file format should be used, such as Windows Notepad, Programmer's Notepad, vi, or other text editor that output the file as a .txt. Rich Text Format (.rtf) used by Microsoft WordPad is NOT compatible.



BASIC Script

This field displays the .txt file that is uploaded to the X-317. Text displayed in this screen cannot be edited. In order to edit any script, it must be rewritten in the .txt file and uploaded to the unit again.

Interpreter Status

This field displays whether the program is continuing to run, has stopped or finished, or if there are errors contained in the script. If there are errors in the script, the line on which the error occurred is displayed.

Upload BASIC Script

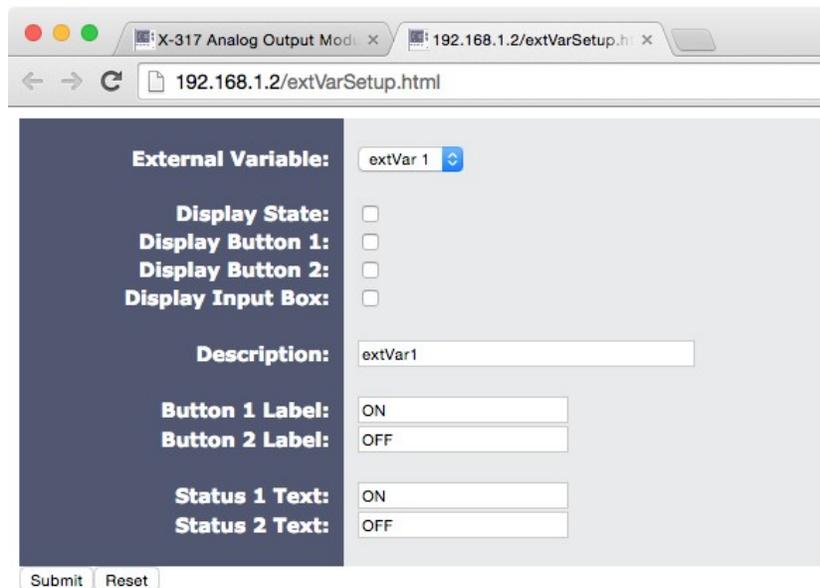
This field displays the script selected to be uploaded to the device. To upload a script to the X-317, click the 'Choose File' button, find the .txt file previously written, and select 'Open.' The location of the file should appear in the neighboring field. To upload the script to the unit, select 'Submit.'

Run Script

This option selects whether or not the selected script will be run after it has been uploaded. The Submit button must be clicked to run the script.

External Variables

External Variables are variables that can be used in BASIC scripts. They are called External Variables because their values can be changed externally to the BASIC script using XML requests, or through the **Control Page**. This allows basic scripts to react to user input. These variables are considered to be floating point numbers, just like other variables in the BASIC script. The following page is displayed when configuring External Variables:



External Variable

This drop down menu offers the option to configure each of the four External Variables.

Display State

Checking this box will display the state of the selected External Variable on the **Control Page**.

Display Button 1

Checking this box will display a button on the **Control Page**. Clicking this button on the **Control Page** will set the extVar to value 1.

Display Button 2

Checking this box will display a button on the **Control Page**. Clicking this button will set the extVar to value 0.

Display Input Box

Checking this box will display an input box on the **Control Page**. Entering a value on the **Control Page** in this field and clicking Set, will set the selected extVar to the new value. Values entered can be either positive or negative numbers.

Description

Text entered here will be displayed in the left column of the control page. Up to 24 characters may be entered here. The default text is `extVar#`.

Button 1 Label

This text field is used to describe the function of button 1 of the selected `extVar`. The text also appears to the right of the corresponding `extVar` status. Up to 14 characters may be entered here. By default, this text is **ON** for a value of 1.

Button 2 Label

This text field is used to describe the function of button 2 of the selected `extVar`. The text also appears to the right of the corresponding `extVar` status. Up to 14 characters may be entered here. By default, this text is **OFF** with a value of 0.

Status 1 Text

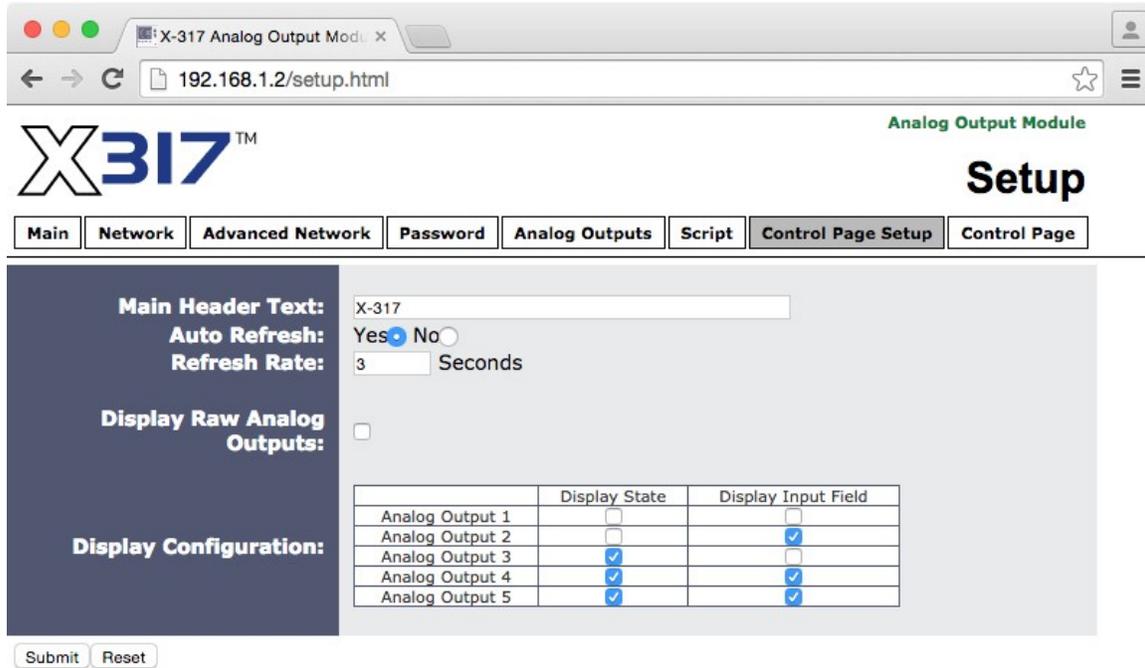
The text in this field specifies the text that will be displayed when the `extVar` is value 1, with a gray background. The text also appears in the status column on the **Control Page**. Up to 14 characters may be entered here. By default the text is `ON`.

Status 2 Text

The text in this field specifies the text that will be displayed when the `extVar` is value 0, with a gray background. The text also appears in the status column on the **Control Page**. Note that if the `extVar` is any other value than 1 or 0, the value will be displayed in the same column, with a gray background. Up to 14 characters may be entered here. By default the text is **OFF**.

4.1.7 Control Page Setup Tab

The **Control Page Setup** page is used mainly to make settings that affect how the **Control Page** is displayed and how often it will refresh, etc.



Main Header Text

The text entered here appears at the top of the **Control Page**. This field can be up to 40 characters in length. The default text is **X-317**. You will want to set the name to something descriptive for your application such as “Upper Floor HVAC”.

Auto Refresh

The Auto Refresh Page option will cause the **Control Page** to continually update its contents by setting a timer in the web page that causes it to be reloaded at a specified time interval. When set to **Yes**, the web page will be refreshed at the time interval specified in the Refresh Rate setting. When set to **NO**, the web page will need to be manually refreshed to show the current status of the unit in the control page.

Refresh Rate

When the Auto Refresh Page option is set to **Yes**, this field specifies the time interval in seconds that the page will be refreshed. It can be set from 1 to 32 seconds.

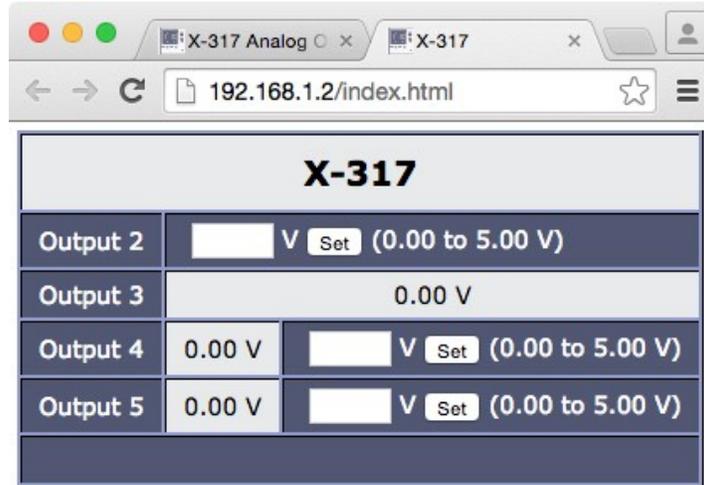
Display Raw Analog Outputs

To keep things simple, the **Control Page** normally displays only the “user units” output settings. In cases while debugging, testing or experimenting you may want the user to also see the actual output values of the Digital to Analog converter after being processed by the $Y=mX+b$ equation. Click the *Display Raw Analog Outputs* box if you want the user to see more detailed engineering information. If the *Display Raw Analog Outputs* box is checked the Display Configurations setting options (below) are suppressed and the inputs, outputs and set fields for all five channels are unconditionally shown. In addition the external variables used by Basic scripts are also shown for debugging and testing.

Display Configurations:

These settings affect the user **Control Page** format. Certain settings omit the “set” box to prevent specific channels from be changed via the **Control Page**. For the check box settings in the example above the following control page will be shown:

- Analog-1: Analog value not displayed, edit box is not displayed (suppressed)
- Analog-2: Analog value not displayed, edit box is displayed
- Analog-3: Analog value displayed, edit box is not displayed
- Analog-4: Analog value displayed, edit box is displayed
- Analog-5: Analog value displayed, edit box is displayed



Control Page if *Display Raw Analog Outputs* box NOT checked

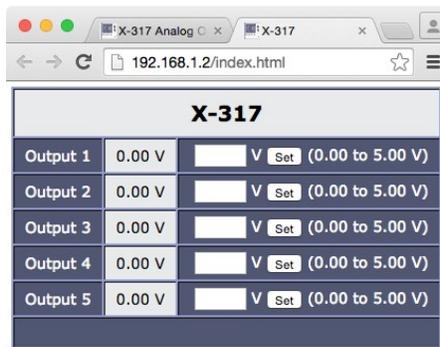
Section 5: Operation

The X-317 can be operated using a web browser, by sending text commands to an XML status/control page, and/or by sending Modbus/TCP requests.

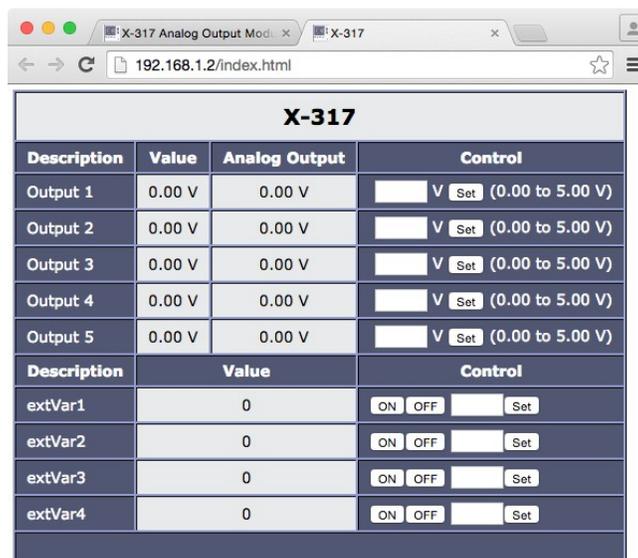
5.1 Browser Operation

Once the X-317 is set up, users can access the Control Page using a web browser by typing the IP address of the X-317 into the web browser address bar. For example, using the default IP address, the user would enter <http://192.168.1.2>. If the IP address is changed from the default, the user must use the new IP address. Note that if any port is used other than the default port 80, the port must also be included in the request. For example, accessing the unit at port 8000 would be as follows: <http://192.168.1.2:8000>.

The screen below appears when the Control Page is selected. In this example the *Display Raw Analog Outputs* box has not been checked in the **Control Page Setup** tab and a simplified display is presented.



For the example below, the *Display Raw Analog Outputs* box has been checked in the **Control Page Setup** tab. With this display additional engineering information is shown.



Header

Displays the text entered in the Main Header Text field on the **Control Page Setup** tab in the setup pages.

Output 1-5

These rows display the current state of the five analog outputs and allow the user to set (change) the output value. The text in the left column (by default reads Output 1, Output 2, etc.) is specified in the Description field in the **Analog Outputs** tab in the setup pages. The current analog output value is shown to the right of the description text. Next, (in this example) the current analog output of the digital to analog converter is shown in units of volts or mA. To the right, a blank data entry box is provided to enter a new output setting. After entering a value, click the **Set** button to make the output change. On the far right the valid range for the setting is shown. If the output value is set above or below the valid range the setting is automatically forced to the max or min value.

The display and set fields are typically configured for descriptive user engineering units such as feet, meters, mph etc. These settings are internally processed with a $Y=mX+b$ equation to generate the actual output of the digital to analog converter. If the *Display Raw Analog Outputs* box has been checked in the **Control Page Setup** tab the actual output of the digital to analog converter is also shown.

External Variables

These rows display the current state of the four external variables. These rows can be displayed (as shown) or not displayed by checking or unchecking the appropriate boxes in the extVar setup page. The text in the left column is specified in the Description field on the extVar setup page. The state of the extVar is shown to the right of the description text. By default the status text will read **ON** or **OFF**. To the right of the extVar status, buttons and an input box are provided to control the state/value of the external variable.

5.2 XML Operation

Custom XML computer applications may be created to monitor and control the X-317. This method does not use a web browser. Diagnostics.xml is available for troubleshooting and system monitoring. With XML, the analog output values are the “user units” values which are subsequently processed by the $Y=mX+b$ equation to drive the digital to analog converter. The XML data values are not the raw output to the digital to analog converter. As such, the values are in easy to use engineering units such as percent (%), feet per minute (fpm) etc as defined in the **Analog Output** tab.

5.2.1 XML Monitoring

The state of the analog outputs can be monitored by sending a request to port 80 (or port specified in setup). This can be demonstrated by entering the following URL into the address bar of a web browser (substituting the IP address as necessary): <http://192.168.1.2/state.xml>

The following state.xml page is returned:

```
<datavalues>
<an1state>0.0000</an1state>
<an2state>0.0000</an2state>
<an3state>0.0000</an3state>
<an4state>0.0000</an4state>
<an5state>0.0000</an5state>
<extvar1>0.00</extvar1>
<extvar2>0.00</extvar2>
<extvar3>0.00</extvar3>
<extvar4>0.00</extvar4>
<serialNumber>00:0C:C8:00:00:78</serialNumber>
<reloadPage>0</reloadPage>
</datavalues>
```

The numbers enclosed by the tags, <tag>, indicate the current analog output value. Values for each tag are described in the table below. XML computer applications will open a TCP/IP socket with the X-317 and send a GET command followed by the state.xml command string.

XML Tags*	Monitor Values
<anXstate>	The current analog output value
<extvarX>	Value of each External Variable.
<serialNumber>	00:00:00:00:00:00, serial number of the X-317.
<reloadPage>	

* 'X' is replaced by the analog channel or extvar number.

5.2.2 XML Control

Commands can be sent to the X-317 to control the analog outputs. Each analog output can be controlled individually. The following are a few examples:

Command	Description
state.xml?an1State=0	Set channel 1 to 0.0
state.xml?an1State=2.5	Set channel 1 to 2.5
state.xml?an2State=50	Set channel 2 to 50
state.xml?an2State=100	Set channel 2 to 100

5.2.3 XML Password

If the Control Password is enabled on the X-317 and the state.xml page is requested through a browser, the user will be prompted for a password. If the XML request is sent from an XML application, the html request will need to contain the password, encoded as Base64. The following is an html request header without the password:

```
GET /state.xml?an1State=1&noReply=1 HTTP/1.1 (Terminated w/ two \r\n.)
```

The following example adds the password:

```
GET /state.xml?an1State=1&noReply=1 HTTP/1.1 (Terminated with \r\n.)  
Authorization: Basic bm9uZTp3ZWJyZWxheQ== (Terminated with two \r\n.)
```

bm9uZTp3ZWJyZWxheQ== is the Base64 encoded version of the user "name:password," where name:password is "none:webrelay".

A utility is provided at <http://www.controlbyweb.com/encoder> to encode the password. Simply type the password into the website and press 'Encode'.

5.2.4 XML Diagnostics

There is a special diagnostics.xml page that can be requested by entering the following in the web browser address bar:

```
http://192.168.1.2/diagnostics.xml
```

The following diagnostics.xml file is returned.

```
<datavalues>
  <devicePowerUpFlag>1</devicePowerUpFlag>
</datavalues>
```

Diagnostic tags are given in the table below.

Tag	Description
<devicePowerUpFlag>	Loss of power to the device is indicated by 1. A value of 1 means the X-317 has lost power at least one time since the flag was set to 0. By default, the flag value is 1. It is not automatically set and will read 1 until it is explicitly set to 0, as described below.

The above flag may be cleared by requesting the diagnostics.xml file along with request parameters.

To clear the device power loss flag:

```
http://192.168.1.2/diagnostics.xml?devicePowerUpFlag=0
```

Note: Requests for the diagnostics.xml file do not require a password.

5.3 Modbus Operation

The X-317 can be controlled and monitored using Modbus/TCP protocol. This provides a standard means of using the X-317 with devices and software from other manufacturers. This section is not a tutorial on Modbus and it is assumed that the reader is already familiar with Modbus. Detailed Modbus information can be found at <http://www.modbus.org>.

Note: Modbus communications are disabled whenever the Control Password is enabled. This is because Modbus/TCP does not provide a mechanism for password protection. Make sure the Control Password is disabled (default) and Modbus functionality is enabled on the Advanced Network.

The X-317 functions as a Modbus slave. Host devices, such as PLCs, open a connection with the X-317 on port 502 (configurable under **Advanced Network** tab) and then send requests to read or set analog channel values. When the X-317 receives a command, it will perform the desired function and return a response.

5.3.1 X-317 Function Code Summary

The X-317 supports the following function codes:

Code Name	Modbus Function	X-317 Address	Data Type
Read Holding Registers	03	0x0510 to 0x0518	32-bit
Write Multiple Registers	16	0x0510 to 0x0518	32-bit

Multiple commands may be sent without closing and re-opening the connection, but if no data is transferred for 50 seconds, the connection will time out and close. To keep the connection open, a read request can be sent periodically.

The X-317 has two TCP sockets available for Modbus/TCP. This allows two connections to be open at one time. Requests for more than two open connections will be rejected. When errors occur, an error code is returned. Most Modbus client software will interpret this code in a human readable form. The code is comprised of the original function code plus 0x80. Each error has a qualifying exception number. The following are the possible exception codes and their meanings:

- 0x01 - Function code not supported (also when Modbus is disabled in the setup pages).
- 0x02 - Incorrect starting address/quantity of registers combination.

The structure of these commands is described in the following sections. In the examples below the Modbus payload portion of the TCP packet is highlighted in blue.

5.3.2 PLC Device Addressing

There are generally two schemes for accessing Modbus devices, The first is by specifying the Modbus function code, memory type, and address. The second, sometimes called PLC addressing, requires only the address.

Modbus protocol uses four different address ranges for discrete inputs, coils, input registers, and holding registers. The function code determines the address range of the message. The following are common function codes and their respective address ranges. With the X-317 only the Holding Registers are supported.

Code Name	Modbus Function	Data Type*	PLC Address Mode 485	PLC Address Mode 584/984
Coils (Read/Write)	01, 05, 15	Discrete	1-1000	1-10000
Discrete Inputs (Read only)	02	Discrete	1001-2000	10001-20000
Registers (Read only)	04	8-64 bits	3001-4000	30001-40000
Holding Registers (Read/Write)	03, 06, 16	8-64 bits	4001-5000	40001-50000

- Data types may be implemented at the discretion of the manufacturer. Address ranges may also overlap. Discrete is a binary or boolean value, 1 or 0.

Function codes, memory types, and addresses can be converted to the PLC addressing equivalent using the table below. To use the table, look up the row corresponding to the Modbus function code. Then take the desired X-317 feature address and add to it the address offset in the PLC address mode column.

{input address} + {PLC address range} = PLC address

For example, to read Analog Output 2, the Modbus function code 03 is used. Adding the address of Output 2, to the address range, 4001, gives a PLC address of 5297. Programming the PLC to read from 5297 will return the value of Analog Output 2.

Code Name	Modbus Function	X-317 Addresses	Data Type	PLC Address Mode 485	PLC Address Mode 584/984
Read Holding Registers	03	0x0510-0x0518 (Channels 1-5)	32-bit	Addr + 4001	Addr + 40001
Write Multiple Registers	16	0x0510-0x0518 (Channels 1-5)	32-bit	Addr + 1	Addr + 1

For 32-bit numbers, two registers must be read starting at the desired address, examples of each are given for the applicable functions. The Write Single Register is not supported because the data values are 32-bit floating point and require 2-registers to be written for each value.

5.3.3 X-317 Modbus Address Table

The table below gives commonly used function code, memory type, data size, and equivalent PLC addresses for accessing the X-317. The data size will be the same regardless of the addressing mode.

	Function Code	Address	Data Size	PLC Address Mode 485	PLC Address Mode 584/984
Read Analog Out 1	03	0x510	32-bit Float	5297	41297
Read Analog Out 2	03	0x512	32-bit Float	5299	41299
Read Analog Out 3	03	0x514	32-bit Float	5301	41301
Read Analog Out 4	03	0x516	32-bit Float	5303	41303
Read Analog Out 5	03	0x518	32-bit Float	5305	41306

5.3.4 Read Holding Registers – Modbus Function Code 03 (0x03)

The Read Holding Registers function is used to read the analog output values. 32-bit values are read from 16-bit register pairs. Consequently, the addresses and registers must be even numbers.

5.3.4.1 Request

Modbus TCP Request Frame Example – Read analog output 1 and 2			
Field Name	Length	Function	Example Data
Transaction Identifier	2 bytes	Synchronization number.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x0005
Unit Identifier	1 byte	Slave Address (0xff if not used)	0xFF
Function Code	1 byte	Read Holding Register	0x03
Start Address	2-bytes	Start Address	0x0510
Quantity of Registers	2 bytes	Quantity of Registers	0x0002

5.3.4.2 Response

Each value is returned as two registers in IEEE 754 floating point formats. The four data bytes are treated as two individual big-endian 16-bit words with the least significant word being sent first. In other words, the 32-bit floating point number represented as '1234 ABCD' is sent as an 'ABCD 1234.'

The device returns a value of 0xFFFFFFFF (NaN) if there isn't a valid reading or when the output is in an alarm condition.

X-317 Response Frame Example – Read Sensor 1 and 2			
Field Name	Length	Function	Example Data
Transaction Identifier	2 bytes	Synchronization number.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x000C
Unit Identifier	1 byte	Slave Address (0xff if not used)	0xFF
Function Code	1 byte	Read Holding Registers	0x03
Byte Count	1 byte	Byte Count	0x08
Analog Out 1	4-bytes	Data Value (0x00000000 – 0xFFFFFFFF)	0x999A41B1
Analog Out 2	4-bytes	Data Value (0x00000000 – 0xFFFFFFFF)	0xB85142D2

5.3.4.3 Errors

Error Response Frame Example			
Field Name	Length	Function	Example Data
Transaction Identifier	2 bytes	Synchronization between messages of server and client.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x0003
Unit Identifier	1 byte	Slave Address (0xFF if not used)	0xFF
Function Code	1 byte	Error code	0x83
Data	1 byte	Exception code 0x01 = function code not supported 0x02 = incorrect starting address or input quantity combination	0x01 or 0x02

5.3.5 Write Multiple Registers (Modbus Function Code 16 (0x10))

The Write Multiple Registers function is used to write (set) the analog output value(s). 32-bit values are written to 16-bit register pairs. Consequently, addresses and registers must be even numbers.

5.3.5.1 Request

Modbus TCP Request Frame Example – Write Analog Channel(s)			
Field Name	Length	Function	Example Data (AnalogOut1)
Transaction Identifier	2 bytes	Synchronization number.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x000B
Unit Identifier	1 byte	Slave Address (0xff if not used)	0xFF
Function Code	1 byte	Write multiple registers	0x10
Start Address	2 bytes	Start Address:	0x0510
Quantity of registers	2 bytes	Quantity of registers:	0x0002
Byte Count	1 byte	Byte count (2 x N)	0x02
Data	N * 2	Register(s) value:	0x800042A2

5.3.5.2 Response

Response Frame Example			
Field Name	Length	Function	Example Data
Transaction Identifier	2 bytes	Synchronization number.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x0006
Unit Identifier	1 byte	Slave Address (0xff if not used)	0xFF
Function Code	1 byte	Write multiple registers	0x10
Starting Address	2-bytes	Starting address	0x0510
Quantity of registers	2-bytes	Quantity of registers	0x0002

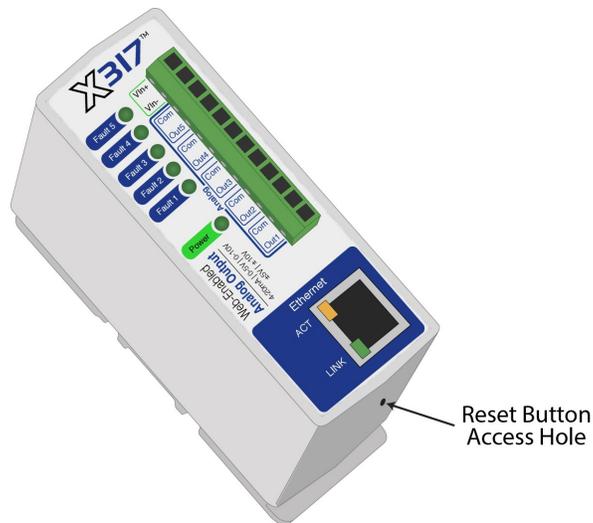
5.3.5.3 Errors

Error Response Frame Example			
Field Name	Length	Function	Example Data
Transaction Identifier	2 bytes	Synchronization between messages of server and client.	0x0001
Protocol Identifier	2 bytes	Zero for Modbus/TCP	0x0000
Message Length	2 bytes	Number of bytes in frame (below)	0x0003
Unit Identifier	1 byte	Slave Address (0xff if not used)	0xFF
Function Code	1 byte	Error code	0x90
Data	1 byte	Exception code 0x01 = function code not supported 0x02 = incorrect starting address or byte count combination	0x01 or 0x02

Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, the X-317 may be restored to its original factory default settings.

1. Remove the DC power from the unit.
2. Use a thin, non-conductive object (such as a toothpick) to press and hold the small button located on the bottom of the unit. When the object is inserted, a tactile feedback can be felt as the button is depressed.
3. While depressing the button, apply power and wait for about 10 seconds before releasing the button. All settings will be back to the original factory defaults.
4. Refer to **Section 2.4 Establishing Communications for Setup** to begin reconfiguration of the device.



Appendix B: Installing New Firmware

From time to time, updates are made to the X-317 firmware. The firmware can be updated in the field. The procedure for updating the firmware is outlined below. Please note that it is important that this procedure is followed precisely.

Requirements

The firmware update software requires Windows XP/Vista/7/8 with the .Net framework installed. The .Net framework is generally installed automatically through Windows update. To install it manually, go to the following address:

<http://www.microsoft.com/downloads/details.aspx?FamilyId=333325FD-AE52-4E35-B531-508D977D32A6&displaylang=en>

Select the Download button. Once you've downloaded the installation file, double click on the installation file to install the framework.

Setup

1. Download the firmware zip file from the ControlByWeb website. Only an X-317 image can be installed on the X-317 so make sure the correct image is being downloaded.
2. bootloader.exe will connect to the X-317 using default IP address 192.168.1.2, not the address currently assigned to the X-317. After the update, all settings will be lost and the device will return to its default IP address of 192.168.1.2.

Configure the PC to the same subnet as the IP address 192.168.1.2, such as 192.168.1.10. For instructions on doing this see section **2.4 Establishing Communications for Setup**.

Note: The IP address of the X-317 will automatically be set to the default 192.168.1.2 during the update process.

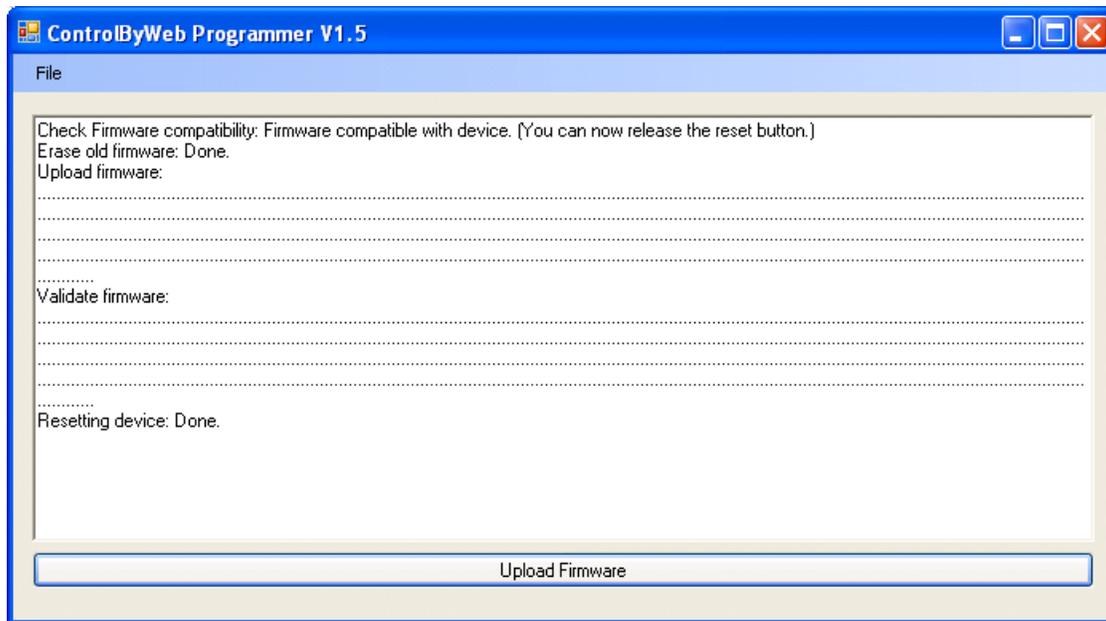
Note: A crossover cable cannot be used during the update procedure, an Ethernet switch will be necessary to properly update the firmware.

3. Open the bootloader.exe utility on the computer by double clicking on the downloaded file (Figure Appendix B.1).
4. Within the ControlByWeb™ Programmer utility programmer, select File, then Open. Specify the firmware image downloaded from the ControlByWeb™ web site.

Device Upgrade Procedure

Carefully follow the following steps to put the X-317 into bootloader mode and perform the upgrade. Make a note of the current settings. The device will be reset to factory defaults after the upgrade.

1. Remove DC power from the X-317.
2. Using a small, non-conductive tool, press and hold the reset button.
3. While holding the reset button, apply power to the X-317. The LINK and ACT lights will flash. Continue to hold the reset button for the next step.
4. While holding the reset button, press the Upload Firmware button at the bottom of the ControlByWeb™ Programmer window. After the programming process begins, the reset button can be released
5. Programming will take approximately 20-30 seconds, the LINK LED will stop flashing and remain lit. The X-317 will be set to factory defaults with an IP address of 192.168.1.2.
6. Refer to section **2.4 Establishing Communication for Setup** to reconfigure the X-317. Verify the new version of firmware has been installed by viewing the default setup page with a web browser (<http://192.168.1.2/setup.html>).



Appendix C: Accessing the X-317 Over the Internet

The X-317 can be monitored and/or controlled from a remote location over the Internet. Once the X-317 can be accessed on the local network, almost all of the settings required to provide remote access are in the router and not in the X-317. This guide is not meant to be a tutorial in router setup, but rather to provide a basic overview of remote access. For specific details, the user should refer to the instruction manual for the router on the local network. Users not familiar with basic IP networking should study one or more basic IP networking tutorials before proceeding (many tutorials are available on the Internet).

IP Addresses

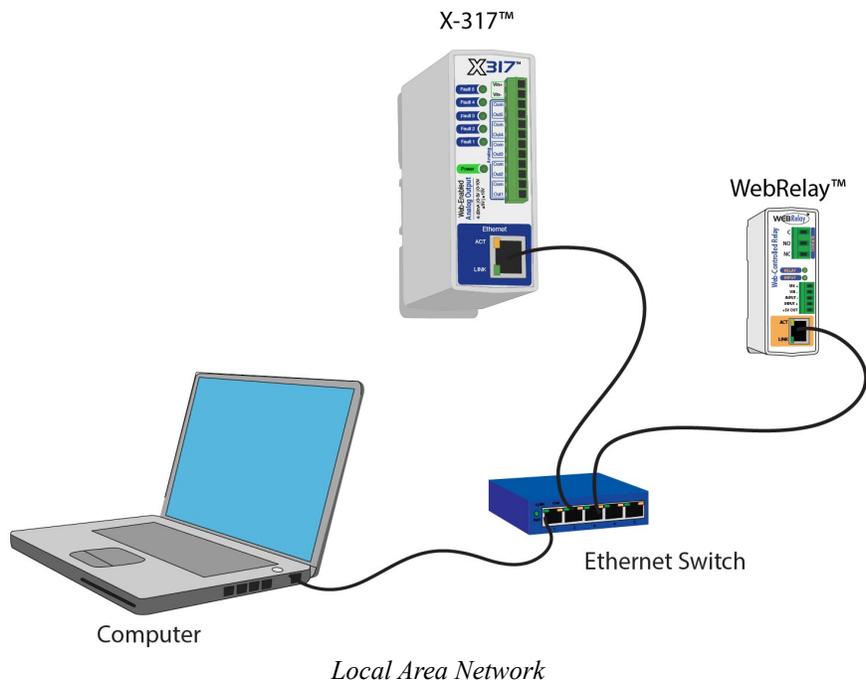
Every device on the Internet is identified by a unique address called an IP (Internet Protocol) address. IP addresses are somewhat similar to mailing addresses in that they identify the precise logical location of the device on the Internet. The IP address identifies the global region down to the network and then the specific device on that network. IP addresses are globally maintained and assigned by an entity called the Internet Assigned Numbers Authority (IANA). IP addresses consist of four sets of numbers that range from 0 to 255 and are separated by a decimal. For example, 192.168.200.167 is an IP address.

Every device that is “directly” connected to the Internet uses a “public” IP address. The X-317 can be assigned a public IP address for direct connection to the Internet. Typically, a public IP address would only be assigned to the X-317 when it is the only device on the local network. The IP address would be obtained from an Internet Service Provider (ISP).

Due to the limited number of public IP addresses, private networks can be set up with “private” IP addresses. These addresses are used within a local network and have no global designation, they are not routed on the Internet. The following address blocks are designated for private networks (where x represents decimal numbers from 0 to 255): 192.168.x.x, 10.x.x.x, and 172.16.x.x.

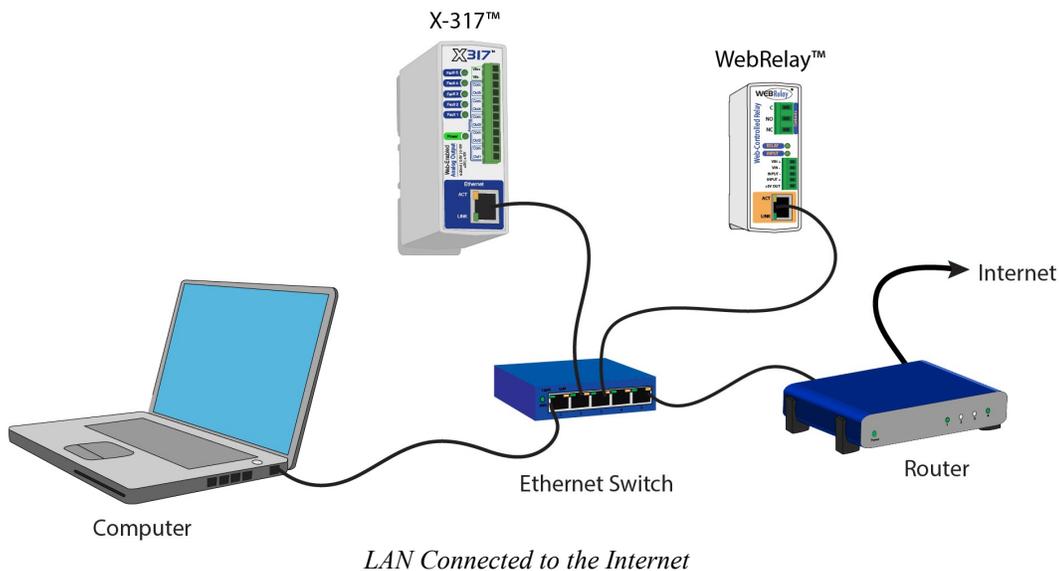
A Simple Local Area Network

A small Local Area Network (LAN), can be made up of two or more computers or other devices connected to an Ethernet switch. Each device on the network is assigned a unique private IP address. For example, consider a simple network that consists of a computer, an X-317, and a WebRelay™. In this example, the computer is assigned an IP address of 192.168.1.10, the X-317 has the IP address of 192.168.1.25 and the WebRelay has an IP address of 192.168.1.26. A person using the computer can access the X-317 by entering its IP address in the URL line in the browser, <http://192.168.1.25>. Similarly, the WebRelay™ can be accessed by entering its unique private IP address in the URL line in the browser, <http://192.168.1.26>.



A Simple LAN connected to the Internet

The LAN in the example above can be connected to the Internet by adding a router and an Internet connection. The router has two network connections. It has an Ethernet network connection to the LAN and another connection to the Internet. Often the Internet connection is called a Wide Area Network (WAN) connection. Each network connection on the router has an IP address. In our example, the IP address on the LAN side of the router has an address of 192.168.1.1. The IP address on the WAN side of the router has an IP address that has been assigned by the Internet Service Provider, such as 266.70.164.97. (This is not a valid IP address because each number cannot be larger than 255 It is used in this example for illustration purposes only.)



In the example, when a user on the computer needs to access a server on the Internet, the computer sends the request to the router at 192.168.1.1. The router sends the request to the ISP server on the Internet. The ISP server does not send the response directly to the computer on the LAN, but to the router at the IP address of 266.70.164.97. The router then forwards the response to the computer. This way, all devices on the LAN share a single public IP address. This is called Network Address Translation (NAT).

Port Forwarding

The router can be configured to allow outside access to the X-317 or the WebRelay™. All requests from the Internet to any device on the local network must use the public IP address (266.70.164.97). With only a single IP address, TCP ports are used to identify the intended device for the incoming message.

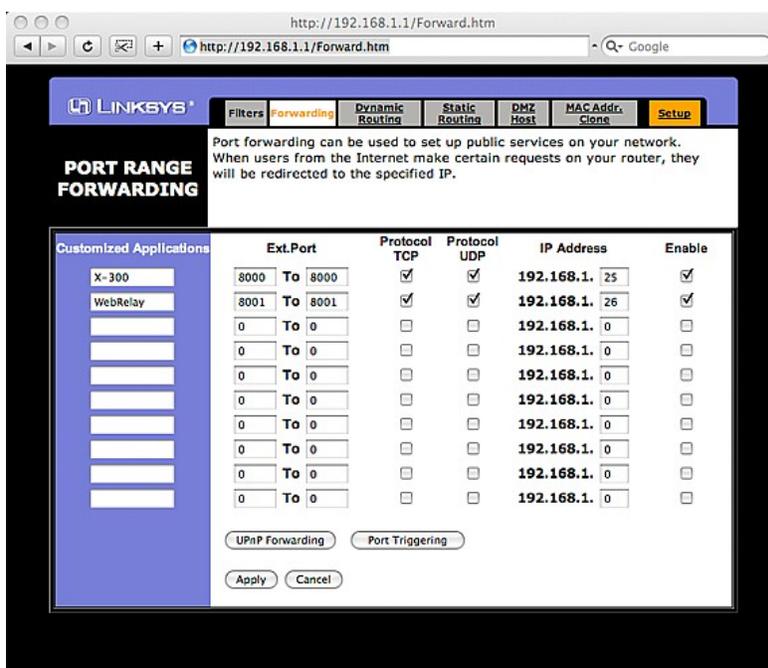
Using the mailing address analogy, the port is similar to a post office box. The IP address specifies the location, and the port specifies the specific recipient. Port numbers can be set to any number between 1 and 65235. However, many port numbers are reserved for specific applications and should be avoided. As a general rule, numbers above 8000 are safe to use. All of the ControlByWeb™ products come from the factory with the HTTP port set to 80, which is the standard port for HTTP. In this example, the X-317 HTTP port will be changed to port 8000 and the WebRelay™ port will be changed to 8001. Once the ports are changed in the two ControlByWeb™ devices, the router must be set up for port forwarding.

Port forwarding associates the IP address of each local device with an assigned port. In this example, the address 192.168.1.25 for the X-317 would be associated with port 8000. The address 192.168.1.26 for the WebRelay™ would be associated with port 8001. The X-317 would be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-317 in the URL window of the browser, `http://266.70.164.97:8000`. All Internet requests to the router for port 8000 would be forwarded to the X-317. Similarly, all request for port 8001 would be forwarded to the WebRelay.

Note: When an HTTP request comes in to the router without the specific port specified (`http://266.70.164.97`), the router will handle this as a port 80 request (default HTTP port). In other words, `http://266.70.164.97` is exactly the same as `http://266.70.164.97:80`.

Router configuration can vary widely. Some routers have the capability of translating the addresses and the ports, which would require no port configuration change on the X-317. For example, the router would be configured so that messages sent to `http://266.70.164.97:8000` would be forwarded to `http://266.70.164.97:80`, which is the default HTTP port.

An example screen shot of a router configuration is given below. This setup allows the two ControlByWeb™ products in the above example to be accessed remotely from the Internet.



Port Range Forwarding

Note: This screen shot is simply an example of a typical router setup page. Routers will vary.

Accessing Setup Pages

After changing ports, the setup pages are accessed on a local network as described below:

```
http://(Local IP Address):(Port Number)/setup.html
```

For example, to access the setup pages when the port is set to 8000, the following command would be used:

```
http://192.168.1.25:8000/setup.html
```

To access the ControlByWeb™ units from the Internet, enter the public IP address of the router plus the port number of the desired device in the following format:

```
http://(Public IP Address of Router):(Port Number of Device)/setup.html
```

Using the example above, the following line would be used to access the setup page of the X-317:

```
http://266.70.164.97:8000/setup.html
```

Appendix D: BASIC Scripts

BASIC (Beginners All-purpose Symbolic Instruction Code) is a computer programming language that has been in use for many years. The X-317 has an integrated BASIC interpreter for simple BASIC scripts. This provides a great deal of flexibility by allowing users to customize basic functions of the unit. The interpreter only supports a small subset of the BASIC commands. Some non-standard commands have been added, and some commands may function differently on the X-317 BASIC interpreter than on other platforms. The following is a short tutorial on the supported BASIC functions.

Contact customer support if further assistance is required.

Structure

A BASIC script is written as a .txt file, which is then uploaded to the device using the **Script** setup tab. The maximum script size is 2K bytes. Each line within the script contains a single statement. Line numbers are not used. Statements are not case sensitive; however, variables are.

IF THEN, FOR loops, and DO loops can only be nested up to 5 times per command. For those not familiar with nesting, the following is an example of nested FOR loops:

```
FOR a = 0 to 100
  FOR b = 0 to 100
    NEXT b
  NEXT a
```

Every program must end with an END statement. Subroutines would then follow after the END statement, if required. The last line of the script should be left blank.

Line Format

Every line follows the same format. The basic format is:

statement (variable) (=, <, >, <=, >=, <>) (expression) (THEN)

The fields in parentheses are optional depending on the statement. Spaces must be used between all statements, numbers, variables, operators, expressions, etc. Multiple spaces are valid.

Comments may be inserted, but must begin with an apostrophe. All text on a line after the apostrophe is ignored.

Examples:

```
LET a=1           'this will return an error because of insufficient spacing
LET a = 1        'this is valid
LET a = 1        'this is valid
```

Only a single variable or literal is allowed on the left side of any operator. The following example is incorrect and will return an error. The error occurs because there is more than a single value to the left of the comparison operator (a + 2 is to the left of =).

```
IF a + 2 = 3 THEN 'this will return an error
```

To fix the above line, replace 'a + 2.' One of the following options may be used:

```
IF a = 1 THEN
...Or...
LET b = a + 2
IF b = 3 THEN
```

Supported Statements

The following are the statements supported by the ControlByWeb™ BASIC interpreter.

LET

The LET statement assigns a variable a value. The format is:

```
LET (variable) = (expression)
```

IF THEN, ELSE, END IF

The IF THEN statement tests the truth of a condition. The ELSE statement defines a second function if the condition is found false. In other words, if the condition is true, then a function is performed. If it is not true, a second function may be performed. The second function may or may not be necessary depending on the application. The IF THEN (ELSE) statement must always be followed with an END IF statement. The format is:

```
IF (variable) (=, <, >, <=, >=, <>) (expression) THEN  
  (Function 1)  
ELSE  
  (Function 2)  
END IF
```

Note: In most BASIC interpreters, 'Function 1' (see above) may be placed after the THEN statement. This interpreter requires 'Function 1' to be put on the following line.

FOR TO, NEXT

The FOR TO statement loops a section of code a predefined number of times. The NEXT statement always follows the section of code to be looped. The format is:

```
FOR (variable) = (expression) TO (expression)  
  (code to be looped)  
NEXT (variable)
```

DO WHILE, LOOP

The DO WHILE statement loops a section of code while a condition is found true. The LOOP statement always follows the section of code to be looped. Note that if the condition is omitted, the code will be looped without end. The format is:

```
DO WHILE (variable) (=, <, >, <=, >=, <>) (expression)  
  (code to be looped)  
LOOP
```

END

The END statement ends the main body of code.

CALL

The CALL statement is found within the main body of code, but requires the interpreter to skip to a subroutine found at the end of the program. After the subroutine is finished, the interpreter returns to the line immediately following the CALL statement. The format is:

```
CALL (name of subroutine)
```

SUB, END SUB

The SUB statement defines the beginning and name of a subroutine. The END SUB statement defines the end of the respective subroutine. Subroutine names can be up to 20 characters long and are case

sensitive. The SUB and END SUB statements always must follow the END statement. The format is:

```
END

*** Subroutines Go Here ***
SUB (name of subroutine)
  (contents of subroutine)
END SUB
SUB (name of subroutine)
  (contents of subroutine)
END SUB
```

REM or '

The REM or apostrophe (') statement designates remarks made by the programmer. The interpreter will disregard any characters on the line following these statements.

PRINT

The PRINT statement relays a variable or message to the display. The PRINT statement is only available for the PC version of the BASIC interpreter. The device will not recognize the command since it does not have an operator display. The format is:

```
PRINT (variable)      'relay variable value to screen
PRINT "(message)"    'relay '(message)' to screen
```

User-Defined Variables

Two types of variables are available for use in the ControlByWeb™ BASIC interpreter, user-defined variables, and predefined variables.

Up to 10 user-defined variables are allowed to be used in scripts. Variables are represented by single, lower-case characters ranging from the letter 'a' to the letter 'j'. They are always global and stored internally as floating point numbers. Variables are defined using the LET statement.

Examples:

```
Let b = 5           'variable b will be set to 5
Let d = b + 2      'variable d will be set to 7
```

Predefined Variables

The following are useful predefined variables for the ControlByWeb™ BASIC interpreter. These are useful for accessing internal values and features states.

Timer Variables

Six timers are available for use in BASIC scripts. They are designated as t0 through t5. Timers can be set to any positive integer (or 0) by using the LET statement. As soon as a value is assigned to a timer, it will begin to count down immediately by decrementing one count every 100ms until it reaches zero.

Examples:

```
Let t3 = 1500      'set timer 3 to 150 seconds
Let t1 = 0         'disable time 1
```

Analog Output Variables

The analog outputs can be set in BASIC scripts. The LET statement is used to set the analog output. Note: the output value is subsequently processed by the $Y=mX+b$ equation to generate the actual output of the digital to analog converter. In the example below the *User Input Max* and *User Input Min* fields of

the **Analog Outputs** tab have been set for a 1 to 1 output relationship (no scaling). This allows the BASIC calculations and output settings to be in engineering units.

For example:

```
Let ana1 = 0           'set analog output 1 to 0.0V
Let ana2 = 2.5         'set analog output 2 to +2.5V
Let ana3 = 10          'set analog output 3 to +10V
Let ana4 = -2.5        'set analog output 4 to -2.5V
Let ana5 = 20          'set analog output 5 to 20.0mA
```

External Variables

There are five external variables, extvar0 through extvar4. External variables are similar to general purpose variables and can be used in the same manner. The difference between general purpose variables and external variables is that external variables can be accessed by the user through a web browser and modified while the script is running. Scripts can use external variables as a method of retrieving user input. The following example demonstrates this by creating a script that will turn Relay 1 **ON** if extvar1 equals 1 and turn Relay 1 **OFF** if extvar1 equals 0.

Example:

```
Do
  If extvar1 = 1 Then
    Let relay1 = 1
  Else
    Let relay1 = 0
  End If
Loop
End
```

Extvar1 can be set and cleared by entering the following requests into a web browser:

```
http://192.168.1.2/state.xml?extvar1=1
http://192.168.1.2/state.xml?extvar1=0
```

Testing and Debugging

A copy of the BASIC interpreter for Windows is also available on our website for the use of testing and debugging. The X-317 will only acknowledge errors as it runs. This means that if a path of the script is not encountered, errors may still exist. The Windows version of the interpreter, however, will check for errors before the script is run.

The PRINT function is available for use with the Windows version of the BASIC interpreter. The interpreter on the device, however, will not recognize this command.

Note: The script will be restarted by submitting any of the setup pages or by power cycling the unit.

Appendix E: External Server and Remote Services

Note: The following methods are supported by the X-317; however, Xytronix Research & Design, Inc. does not provide or support custom third party applications, or external web servers.

Accessing the X-317 with Custom Software or Third Party Applications

Custom applications can send commands to the X-317 for monitoring and control. The application interface can be used to provide a custom user interface, access to multiple units in a single screen, and allow for automation, logging, and other application-specific features.

Using an External Web Server

Rather than accessing the X-317 directly from a computer, an external web server can be used. The term “external” web server is used here to mean a separate web server (such as Apache or IIS) that is not the web server built into the X-317. In this scenario, users access custom web pages that reside on the external web server and the external web server communicates with the X-317.

An external web server can integrate multiple ControlByWeb products into a single control page. In other words, the user may not be aware that he/she is using multiple ControlByWeb™ devices, but rather the user sees an integrated control page for the entire system. In addition, the use of an external web server allows programmers to create custom user interfaces that take advantage of the additional resources typically available on larger web servers, including more memory and various web programming languages.

There are two approaches that an external server can use to communicate with the X-317 and other ControlByWeb™ devices, Direct Server Control and Remote Services.

Direct Server Control

The first approach is for the external server to create a TCP connection whenever it needs to access the X-317. In this case, the external server opens the connection, sends commands and/or reads the device, and closes the connection.

This method is ideal when the web server and all of the X-317 devices are on the same network (without routers between them). In this case, the server can communicate with the X-317 devices directly and securely since data never has to leave the local network.

When the server and the X-317 are on different networks, routers must be configured to allow appropriate access. If a public network is used, such as the Internet, security precautions should be considered.

Remote Services

The second approach is for the X-317 to initiate a connection using the “Remote Services.” The settings under the **Advanced Network** tab in the setup pages will enable the X-317 to open a TCP connection with an external server. Once the connection is open, the external server can send commands and/or read the device. The external server can leave the connection open (so that it never closes) or close the connection.

“Remote Services” is ideal for installations where the server and the X-317 are installed on different networks. This is especially useful when each X-317 is installed on a separate private network. For example, if the user doesn’t control the network connections where the X-317 is installed, “Remote Services” would initiate a TCP connection over the Internet with the control computer. Since the X-317 initiates the connection, the control computer doesn’t have to know the IP address of the X-317. This means that the X-317 can be installed using DHCP. In addition, no special router configuration is required. This makes the network installation of the X-317 very simple, and since no incoming ports

need to be opened in the router, security is not compromised. See section **Advanced Network Tab** for more information..

Connection String

With Remote Services enabled, a connection attempt will be made periodically according to the Connection Interval setting in the **Advanced Network** setup tab. The Connection String is a user-defined character string configured in the **Advanced Network** tab.

The connection string is also sent at the same interval once the connection is open. The external server is responsible for closing the connection when it is done.

Remote Commands

Once the connection is open, the remote server can issue HTTP GET requests to the device for XML files. The X-317 does not support “events” and does not send unsolicited state.xml files.

Request about.html:

```
GET /about.html HTTP/1.1\r\n\r\n
```

Set Analog Output 1 to 50:

```
GET /state.xml?an1State=50 HTTP/1.1\r\n\r\n
```

Appendix F: Specifications

Power Requirements

Input Voltage: 9-28 VDC
 Current: See table below for typical values at 25°C

10 Mbps Network Speed

Power Supply	Outputs = 0V	Outputs = 20mA
9 VDC	210 mA	404 mA
12 VDC	162 mA	298 mA
24 VDC	92 mA	163 mA

100 Mbps Network Speed

Power Supply	Outputs = 0V	Outputs = 20mA
9 VDC	302 mA	498 mA
12 VDC	229 mA	368 mA
24 VDC	126 mA	198 m

Analog Outputs

Number of Channels: 5 (individually configurable)
 Output Ranges: 0-5V, 0-10V, ±5V, ±10V, 4-20mA (software selectable)
 Resolution: 16-bit DAC (0-65535)
 Linearity Error: ±1-count, monotonic DAC

Current Output (Voltage mode): 10mA max (min load = 1K), 30mA max short circuit
 Voltage Output Inaccuracy: ±0.2% FSR, includes offset error, gain error and non-linearity error (-40 to 65°C)
 Max Load Capacitance: 20nF (no load), 5nF (1K load)

Current Output Range: 4-20mA
 Current Output Inaccuracy: ±0.2% FSR, includes offset error, gain error and non-linearity error (-40 to 65°C)
 Output Compliance Voltage: 11.50V min (max loop voltage)

Isolated Power Supply: Internal DC-DC converter
 Isolation: Galvanic, 1500 VAC
 ESD Protection: Integrated 15kV protection (IEC61000-4-2)
 Output Protection: Integrated over-temperature, open-line and short circuit protection
 Output Alarms: Open current loop, high internal temperature

Load Type: Grounded, COM of all 5-channels are connected together
 Output at power up: Programmable

Connector

Type: 12-position, removable, 3.81 mm pitch
 (Replacement part number, Phoenix Contact 1803675)

LED Indicators

Green: Power On
 Yellow: Fault condition, 5ea (channels 1-5), indicate output failure

Network

- 10 Base-T or 100 Base-T Ethernet IPv4
- Setup: Static IP address assignment or DHCP, HTTP port selectable
- Network Connector: 8-pin RJ-45 socket

Memory

- All user settings are stored in nonvolatile memory. Settings will not be lost when power is disconnected.

Communications

- Web Browser, XML, Modbus/TCP

Password Settings

- Password protection on setup page: Yes
- Password protection on control page: Optional
- Password encoding: Base 64
- Max password length: 13 character

Environmental

Environment: Indoor use or NEMA-4 protected location
 Category II, Pollution Degree 2
 Altitude: up to 2000m
 Operating Temperature: -40°C to 65.5°C (-40°F to 150°F)
 Storage Temperature: -40°C to 85°C (-40°F to 185°F)
 Humidity: 5-95%, non-condensing

Mechanical

Size: 1.41 x 3.88 x 3.1 in. (35.7 x 98.5 x 78 mm), (not including connector)
 Weight: 4.8 oz (136 g)

Electromagnetic Compliance

IEC CISPR 22, CISPR 24
 CC 47CFR15 (Class B)
 EN55024 ITE Immunity (2010)
 EN55022 Emissions (2010)



Appendix G: Trademark and Copyright Information

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Appendix H: Warranty

This Xytronix Research & Design, Inc. product has a warranty against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Xytronix Research & Design, Inc. will, at its option, either repair or replace products that prove to be defective. This warranty is extended to the original purchaser of the equipment only.

For warranty service or repair, the product must be properly packaged, and returned to Xytronix Research & Design, Inc. The purchaser shall prepay all charges for shipping to Xytronix Research & Design, Inc., and Xytronix Research & Design, Inc. will pay the shipping charges to return the product to the purchaser as long as the product is shipped within the United States. If the product is shipped outside of the United States, the purchaser shall pay all shipping charges, duties, and taxes.

Limitation

The foregoing warranty shall not apply to defects or damage resulting from improper use or misuse, unauthorized repair, tampering, modification, improper connection, or operation outside the electrical/environmental specifications for the product. Further, the warranty does not cover Acts of God, such as fire, flood, hurricanes, and tornadoes. This warranty does not cover damage to property, equipment, direct, indirect, consequential, or incidental damage (including damage for loss of business profit, business interruption, loss of data, and the like) arising out of the use or misuse of this product.

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Appendix I: FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause interference to radio communications. There is no guarantee, however, that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into a relay on a circuit different from where the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Notice

Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Section 6: J: Mechanical Dimensions

