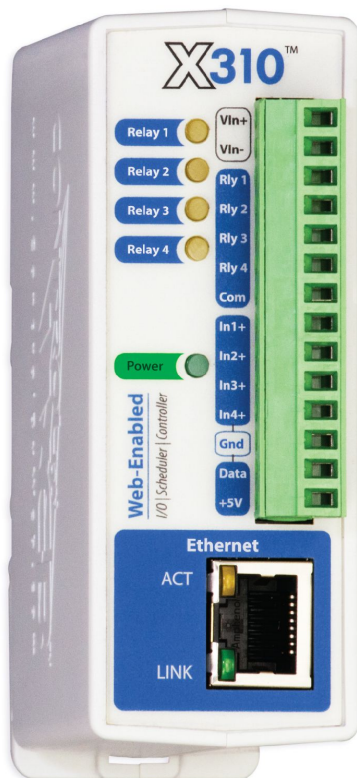# X310™ Users Manual

Revision 1.1
For Models: X-310S-I
X-310S-E

- 4 Relays
- 4 Digital Inputs
- 1-Wire Bus for Temp/Humidity
- 2 Digital Counters
- Built-in Web Server (HTTP/HTTPS)
- Control up to 16 Remote Relays
- Monitor Supply Voltage
- Email Notifications (SSL Supported)
- BASIC Scripting
- Scheduling
- Logging
- HTML 5 Compliant

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X-310S User Manual Revisions	
Revision	**Description**
1.0	Initial release. This manual is based on the X-310 with changes for new hardware and software enhancements. Added encrypted email, ethernet auto-negotiation, moved several sections from the Appendix to new *Section 5: Auxiliary Operations*, upgraded warranty, changed communications setup to Windows 8. Added water leak sensor example, new illustrations and other examples.
1.1	Corrected Modbus counter input data-size type

Table of Contents

Section 1: Introduction

The X-310S™ is a multifunction web-enabled module for control and monitoring. The X-310S has four internal relays, four digital inputs, two pulse counters, and a 1-wire bus which supports up to four temperature/humidity sensors. It can be controlled and/or monitored over any IP network including private networks, IP-based industrial control networks, and the Internet. Users can operate the X-310S using a web browser, the CBW Mobile app, or custom applications can be written to control the X-310S from a computer, PLC, or other automation controller. The X-310S has a built-in BASIC interpreter for custom applications not provided by the normal control functions. The module is powered by an external wall transformer (9-28 VDC), solar panel, or other DC power source. The model X-310S-E is powered over the twisted pair Ethernet cable.

Other features are also included such as, email notification, scheduling, and logging. The X-310S can control up to 16 remote relays, graph logged data with any HTML 5 compliant web browser, send encrypted emails and monitor its power supply voltage.

The X-310S supports a number of Ethernet protocols with it's built-in servers, including HTTP/HTTPS, Modbus/TCP, SNMP, NTP, and XML.

The X-310S is identical to the X-310 but has additional features and capabilities for encryption and remote services. Specifically the X-310S can send encrypted emails. In addition, the X-310S can be configured to automatically connect to ControlByWeb.cloud. This feature allows internet access to an X-310S which is installed behind a network router, without the need to setup port forwarding in the router. This also allows easy installation using DHCP without the need to assign a specific IP address. Since the connection from the X-310S is outgoing, rather than incoming, the local router on the network where X-310S resides doesn't need to be configured to forward ports. This simplifies the installation since the router configuration is not modified. The screen images throughout this manual are for the X-310S version. The settings however, are generally identical to the X-310 with the exception of the encryption and remote services settings.
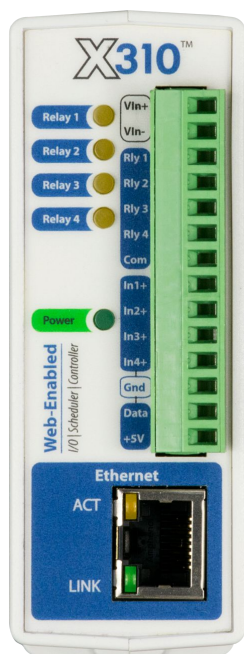
1.1 Features

- ➢ Built-in web server for configuration and remote monitoring (HTTPS supported).

- ➢ Four built-in relays.

- ➢ Four digital inputs. Use the inputs to control relays or trigger email messages.

- ➢ Two pulse counters.

- ➢ "1-wire" port for connecting up to 4 digital temperature and/or humidity sensors.

- ➢ Temperature sensors are accurate to +/-0.5°C from -10°C to +85°C. Air or submersible temperature probes available, sensors are interchangeable and need no calibration.

- ➢ Powered from a 9 to 24V DC power adapter. The power supply voltage is monitored internally and can be monitored and logged. The model X-310S-E is an Ethernet powered device (PD).

- ➢ Sensor/Input status can control relays on other ControlByWeb devices.

- ➢ Configurable logging of the input, temperature, humidity and relay states.

- ➢ Real-time clock with manual or NTP time sync.

- ➢ Send email alerts (up to 3 addresses) based on any sensor or input conditions.

- ➢ Send encrypted emails.

- ➢ Auxiliary protocols including XML, *Modbus/TCP* and *Remote Services.*

- ➢ Custom scrips using the built-in BASIC interpreter provide additional flexibility.

- ➢ Ethernet auto-negotiation automatically selects speed, duplex mode and works with straight or crossover cables.

- ➢ Simple and easy to use.

- ➢ 5-year warranty.

Relay Outputs (4)

The X-310S has four internal relays to operate indicator lights, interposer relays, and other low voltage devices. Control the relays with a web browser, timers, input changes, or programmable logic. The relay contacts are normally open with the common terminals tied together. The screw terminals are internally connected directly to the relays with no internal fuse or other over-current protection. The relay contacts are isolated from all other circuits.

Digital Inputs (4)

The X-310S has four digital inputs The inputs have a photo-coupler circuit, however, the photo couplers are tied to the Gnd terminal of the X-310S and are not isolated. View state of inputs with a web browser. Use the inputs to control relays, trigger email messages, or use first two inputs as pulse counters.

Remote Relays (16)

Control up to 16 relays on other ControlByWeb products.

1-Wire Sensor Bus

The X-310S has a "1-wire" port for connecting up to four digital temperature and humidity sensors. The sensors are available in several configurations, are interchangeable and require no calibration. The sensors require three connections for communications and power (+5V, Gnd, Data). Control relays or trigger email messages based upon temperature and humidity values.

Power Supply

The X-310S employs a modern switch-mode power supply which works from 9 to 28VDC. With this type of power supply, the current draw <u>decreases</u> as the voltage increases. The model X-310S-E is an Ethernet powered device (PD) and receives power along with data on the twisted pair Ethernet cable. The X-310S-E can accept backup power on the Vin+ and Vin- terminals. The power supply voltage (Vin+) is monitored internally and can be displayed, logged, used to control local/remote relays and configured to send email notifications.

Real-time Clock

Manual or NTP capability.

Event Scheduler

Program up to 100 periodic control events based on time and date conditions.

Logging

Configurable logging of inputs, temperature, humidity, Vin+, and relay states. System logging of device operating parameters and events, such as power reset and NTP requests.

Graphing

Logged data can be graphed directly by any HTML 5 compatible web browser.

Email Notification

Send email alerts based on any sensor or input conditions, such as temperature, time, digital inputs, power supply levels, and more. Send text messages to a cell phone through a wireless carrier's email bridge. The X-310S supports encrypted emails.

BASIC Script

The X-310S has a built-in BASIC interpreter for custom applications not provided by the normal built in setups.

Web Server and Protocols

All configurable through the built-in, password protected, TLS enabled web server. Additional interface options include XML, Modbus/TCP, and SNMP IP address configuration can be either static or DHCP.

1.2 Applications

The X-310S was designed to meet a broad range of industrial applications. It works well as a stand-alone device that can be controlled using a web browser, or as a convenient way to add I/O to a computer or existing system. It can easily be configured using its menus and drop-down lists, or it can run a simple BASIC script. Many of its features such as scheduling, logging, input state monitoring, and the ability to control up to 20 relays (4 internal and 16 remote relays on other devices) make the X-310S a powerful, yet simple controller.

Use the X-310S to control motors, lights, coils, pumps, valves, bells, etc. Use it to monitor alarms sensors, switches, fluid level switches, battery voltage, temperature, humidity, and much more. A few example applications include:

- Bell Controller
- I/O Extender
- Industrial Thermostat
- Solar Energy Controller
- Process Controller

1.3   Part Numbers and Accessories

The X-310S is currently available in two different models.

Part Number	Power Supply Requirements
X-310S-I	9-28VDC
X-310S-E	Power Over Ethernet and/or 9-28VDC

1.3.1   Optional Accessories

Accessory	Description	Part Number
Power Supply	Regulated, DIN-rail / wall mount 24V DC, 1.75Amp, 100-240V AC Input	2868648
Power Supply	Regulated, plug in 12V DC, 1.5Amp,100-240V AC Input	PS12VW1.5-B
Temperature Sensor	Digital temperature sensor with 12 inch wire leads. Note: Leads may be extended	X-DTS-U
Temperature Sensor	Digital temperature sensor with 3 foot wire leads (housed in submersible stainless steel probe)	X-DTS-S3C
Temperature Sensor	Digital temperature sensor with 32 foot wire leads (housed in submersible stainless steel probe)	X-DTS-S32C
Temperature Sensor (Wall Mount)	Digital temperature sensor housed in vented plastic enclosure	X-DTS-WM
Temperature/Humidity Sensor (Wall Mount)	Digital temperature and humidity sensor housed in vented plastic enclosure	X-DTHS-WM
Water Leak Sensor	Water leak sensor	GRI-2605
Spare Connector	14-Pin Connector Plug	X-TERM14A

1.4   Security Notes

The X-310S is a dedicated device and does not employ a general purpose computer operating system (i.e. Windows, Linux etc.) It does not have features such as telnet, FTP, SSH, nor uncontrolled open ports. This means it is extremely difficult if not impossible for someone to 'break in' to the X-310S and access other devices on your local network. The simplicity of the X-310S makes it an inherently secure device. Nevertheless, as with any device installed on a network, appropriate security precautions should be observed. Where security is concerned, access to the device should be limited to using encrypted connections to the web server server using HTTPS. Unencrypted access can be disabled in the Network setup page.

It is recommended that passwords be enabled for the *Control Page and Setup Pages*. 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.

1.5   Connectors & Indicators

I/O Connector

The X-310S has a 14-position removable screw terminal connector for making connections to the power source, relays, digital inputs and temperature/humidity sensors.

Pin	Description
Vin+	Power Supply VDC+ (9-28 VDC) DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE.
Vin-	VDC- (Ground) power supply input.
1NO	Relay 1 Normally Open Contact
2NO	Relay 2 Normally Open Contact
3NO	Relay 3 Normally Open Contact
4NO	Relay 4 Normally Open Contact
C	Relay 1,2,3, and 4 Common Contact
In1+	Positive side of the digital input 1.
In2+	Positive side of the digital input 2.
In3+	Positive side of the digital input 3.
In4+	Positive side of the digital input 4.
Gnd	Ground connection for 5VDC output, digital inputs and the 1-wire sensor(s)
Data	Temperature/Humidity Data Input. Data connection for the digital temperature and humidity sensor(s) (1-Wire bus).
+5V Out	This output voltage is used to provide power for the digital temperature/humidity sensor(s).

Network Connector

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

Power Indicator

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

Relay Indicators

Four yellow LEDs illuminate when the corresponding relay is energized. When a relay is energized, the common and normally open contacts are closed. All four relays share the same common connection.

Ethernet Indicators

The LINK LED is illuminated green 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 yellow when activity is detected on the network.

1.6   Accessing the X-310S using a Web Browser

The X-310S 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 just about any computer or smart phone.

Note: Network routers may need to be configured to allow access from computers outside of the local network (see Appendix C: Accessing the X-310S Over The Internet).
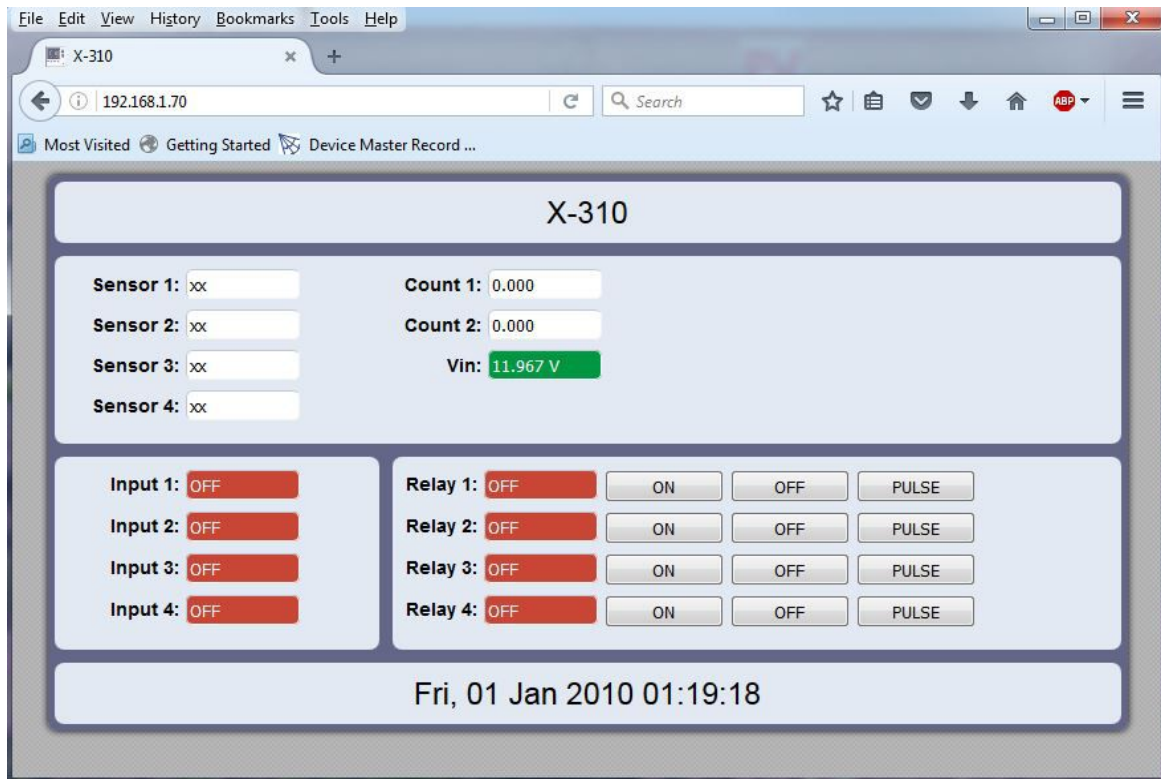
Section 2: Installation and Connections

Installation consists of mounting the X-310S and connecting it to an Ethernet network, providing power, connecting the relays, digital inputs, and temperature and/or humidity sensors. The installation is completed by configuring the module using a web browser.

2.1   Installation Guidelines

- This unit must be installed by qualified personnel.

- 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.

- The X-310S 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 H: Mechanical Information* for additional mechanical details.

2.1.1   Wall Mounting

Mount the X-310S to a wall by using two #8 screws. Attach the screws to the wall vertically spaced exactly 2.5 inches apart. The head of the screw should be about 1/10 inch away from the wall.

2.1.2   DIN-Rail Mounting

The X-310S can be mounted to a standard (35mm by 7.55mm) DIN-Rail. Attach the X-310S 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-310S 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.
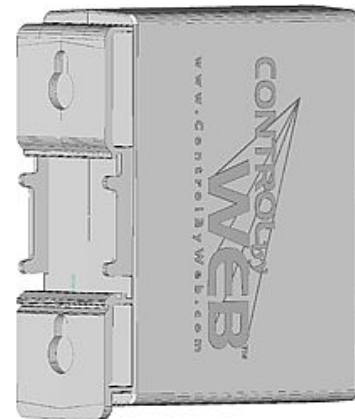
2.2 Making Connections

CAUTION: Make sure the power is shut off before making connections

CAUTION: This unit should be installed by a qualified technician.

CAUTION: Miswiring or misconfiguration could cause permanent damage to the X-310S, the equipment to which it is connected, or both.

A removable terminal connector is provided for making the power connections. To help protect the X-310S from mechanical stress remove the terminal connector before making the connections.

1. Make sure power is turned off.

2. Remove the terminal connector from the X-310S 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.

It is recommended that any load (device to be controlled) not be connected until after the X-310S has been configured and tested. By doing this, wiring and configuration mistakes will not cause the load device to turn on unexpectedly. Make certain the wires are properly inserted into to the terminals and that the screws are tight.

Connector Specifications:

Type:	14-position, removable, 3.81 mm pitch
Connection wire:	Use wire rated for 75ºC (min) for connections to the terminal blocks
Stripping Length:	7mm
Connection capacity:	1.5mm^2 stranded, 1.5mm^2 solid
Conductor minimum:	30AWG (UL/CUL)
Conductor maximum:	14 AWG (UL/CUL)
Conductor Type:	Copper
Tightening torque:	0.22 Nm (min), 0.25 Nm (max)

2.2.1 Power Supply Connections

The X-310S requires power for its internal logic circuits. Connect a 9-28 VDC power supply to the +Vin and Vin- (Gnd) terminals. 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-310S (See *Appendix D: Specifications* for the current requirements.) Multiple X-310S 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.

The model X-310S-E is normally powered from a Power Sourcing Equipment (PSE) device which passes DC power along with data on the twisted pair Ethernet cabling. This allows a single cable to provide both the data connection and DC power. With the X-310S-E no connections are needed to the Vin+ and Vin- terminals. The Vin+ and Vin- terminals however, can be used as a backup power source. The X-310S-E has an internal "diode or" circuit between the Vin+ terminal and the internal Powered Device (PD) circuits. If a power supply is connected to the Vin+ terminal, the X-310S-E will draw power from the PSE if the input voltage is less than 12.0V, and from the Vin+ terminal if the input voltage is greater than 12.0V. If the PSE power fails, the X-310S-E will draw all power from the Vin+ terminal.

2.3   Relay Connections (Control a device over an IP network)

The relay contacts are internally connected directly to the terminal connector. A Normally Open contact is provided for each relay. All relays share the same Common contact. The relay contacts may be wired in series with the power source for the load (device to be controlled) as long as the load does not exceed the maximum current and voltage rating of the relay contacts. When connecting multiple relays, make sure the common for all loads can be connected together without causing damage or a short circuit.

For loads greater than 1 Amp, an external interposer relay should be used. The illustration below shows how a 15-Amp motor can be controlled using an external relay. In the example, the X-310S controls the external relay and the external relay controls the load.
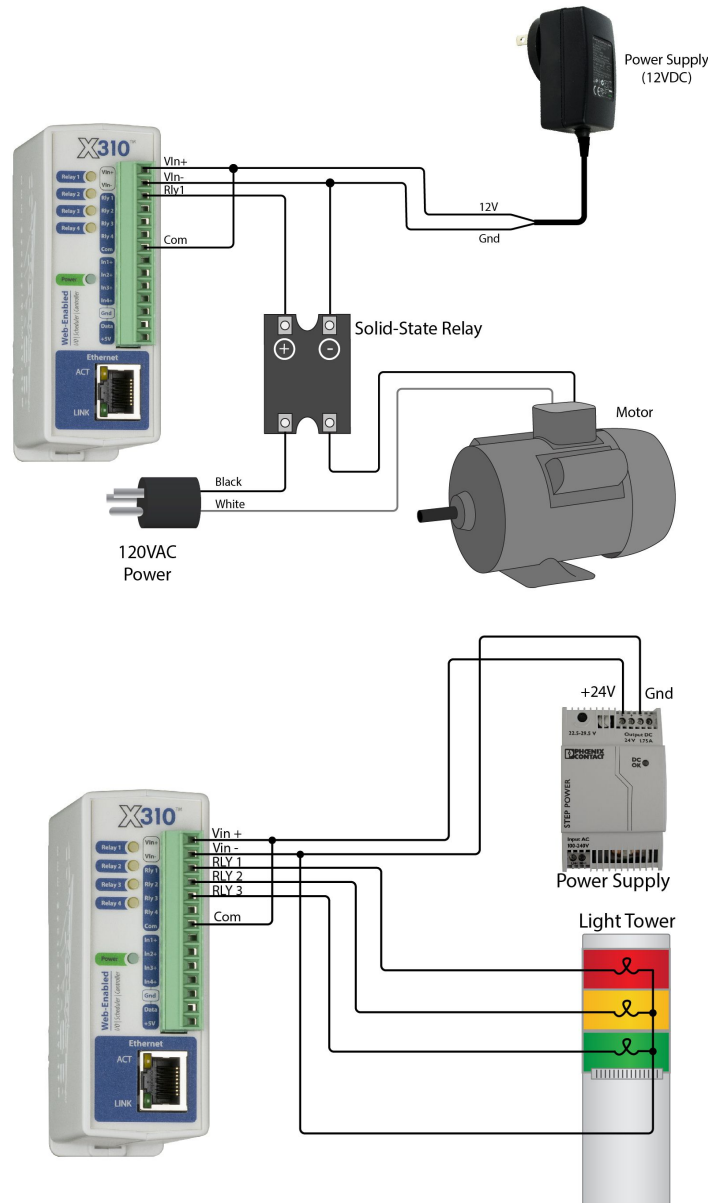
When mechanical relays switch inductive loads such as motors, transformers, relays, etc., the current will arc across the internal relay contacts each time the contacts open. Over time, this causes wear on the relay contacts which can shorten their life span. When switching an inductive load, it is recommended that relay contact protection devices are used. Note that the X-310S does not provide relay contact protection in order to provide the greatest versatility and because appropriate protection differs for various loads. Below is an example of relay contact protection for a DC circuit and an AC circuit. For component values required to provide sufficient contact protection for your application, refer to appropriate references.
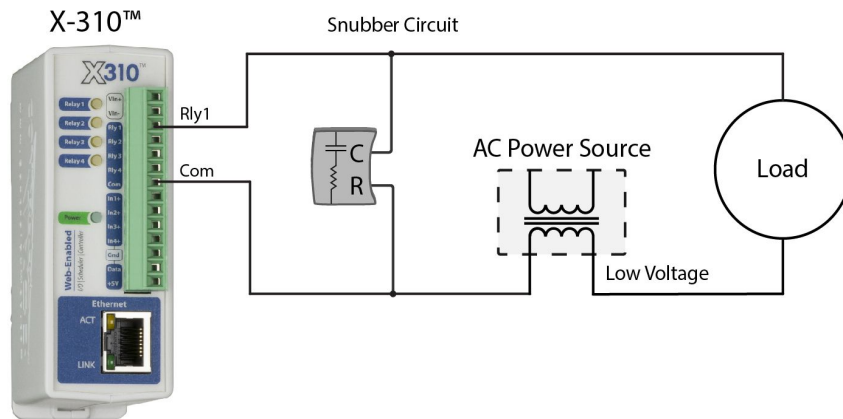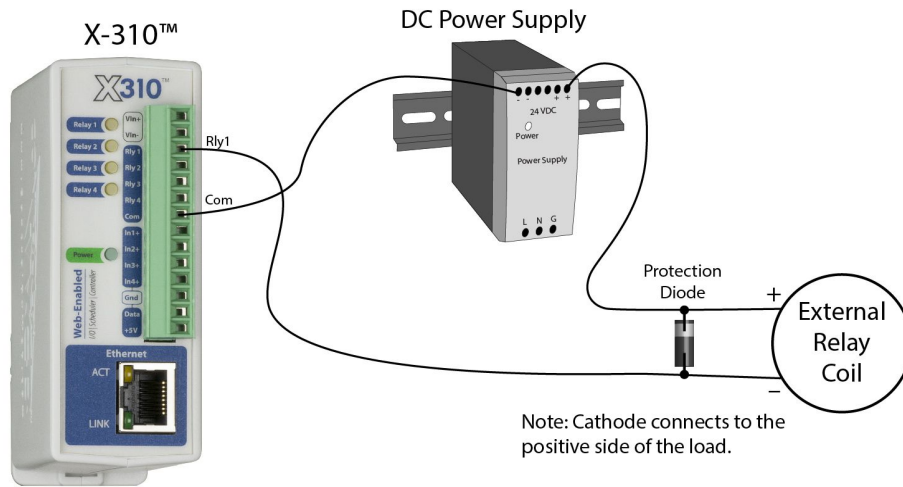
2.4   Temperature & Humidity Sensor Connections

The X-310S has a "1-wire" port which supports up to four digital temperature and/or humidity sensors. The four temperature sensors can be a mix of local sensors or wireless sensors, such as the XW-110, which can push temperature data to the X-310S through an IP network.

The sensors share the same three connections for communications and power (+5V, Ground, Data). Every sensor on the bus is assigned a unique serial number when it is manufactured. That number is used to address the sensor during communication.

Temperature Sensor
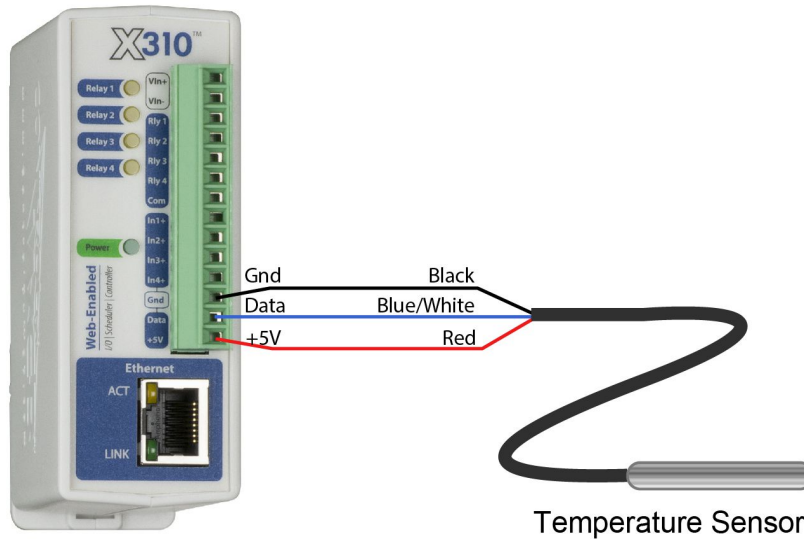
The digital temperature sensors are interchangeable and require no calibration. The sensors range is -67°F to +257°F (-55°C to +125°C) The sensors accuracy is +/-0.5°C (-10°C to +85°C). The temperature sensor is available in several configurations. The encapsulated version has a stainless steel probe and can be used in unprotected outdoor locations. The basic sensor is used in protected locations. The temperature sensors have three wires as shown below.

Sensor Wire Color	Connection
Red	+5V
Black	Gnd
Blue, White, Yellow	Data
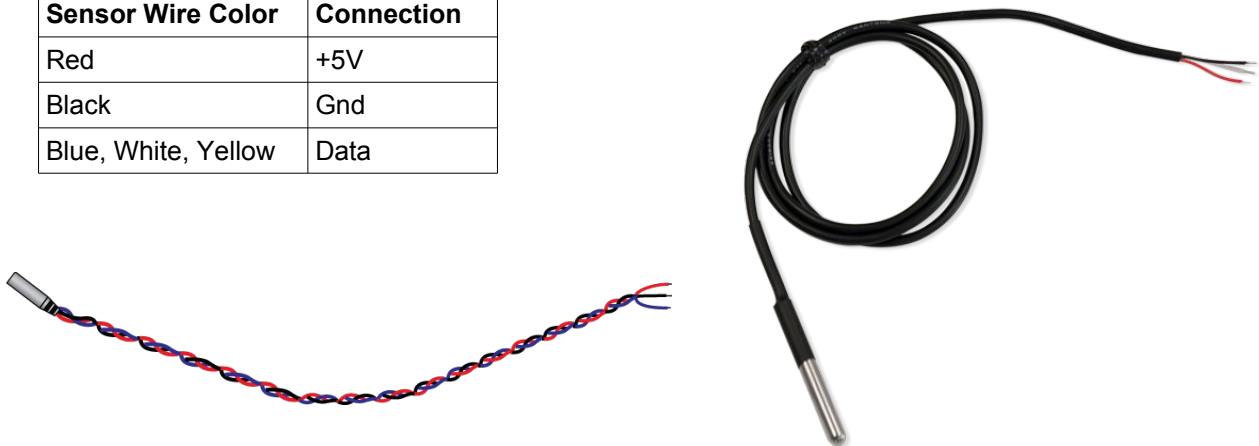
Multiple sensors can be connected in two ways: directly connected (star topology) or "daisy chained" (linear topology). Many factors can determine the maximum length of the cable, including the sensor network topology, the type of cable used, the number of sensors and ambient electromagnetic noise. Combined cable lengths to all sensors of 600 ft using Cat 5e cable have been successful. However, due to the uniqueness of installation environments, results may vary. Please test in the desired environment before making a permanent installation.

The following are general recommendations that will maximize sensor runs and minimize problems. Cat 5 and Cat 5e network cable has proven to be an effective and low-cost solution for long runs. Other cable types can be used, but cable capacitance generally limits the length. The illustration shows the recommended connection using Cat 5 network cable. Connect all unused conductors to ground.

Recommended connections using Cat 5 cable
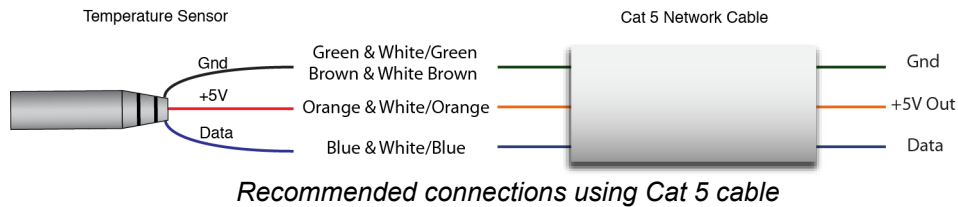
A linear (daisy chain) topology will minimize signal reflections, providing a more reliable connection and will allow longer cable length than a star topology.

The 1-wire bus is "single-ended" and has no intrinsic noise protection. It is susceptible to interference if the cable is routed near power lines, fluorescent fixtures, motors or other noise sources. Keep the cable wiring short and avoid routing it near other electrical equipment.
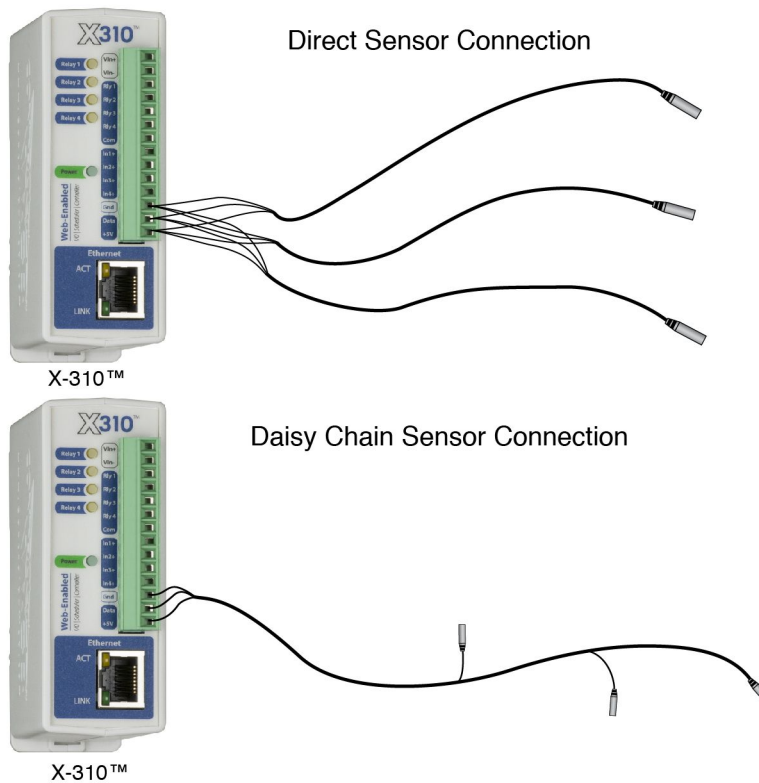
2.5   Digital Input Connections

The digital inputs can be used to control the internal relays, control remote relays (over the network), or simply to monitor the state of a discrete device. To use these inputs, connect a DC control voltage directly to the input and ground, and set up the function of the input using the configuration pages. A current limiting resistor is provided internally, so no external resistors are required as long as the maximum input voltage is not exceeded. If an AC signal, or a signal greater than the rated input voltage needs to be detected by the X-310S, use a signal conditioner to convert the signal to a DC signal within the input range. With the X-310S, the digital inputs are not isolated and share a common ground with the power connection.

2.5.1   DC Input Connections

Each digital input is connected internally through a current-limiting resistor directly to a photo-coupler circuit. The photo couplers are tied to the Gnd terminal of the X-310S and are not isolated. No external resistor is necessary as long as the input signal is within the proper range *(See Appendix D: Specifications)*. A DC voltage can be reduced with an external resistor of the appropriate value and power rating to reduce the input current.

The digital input has an internal 3K ohm resistor. The forward voltage drop of the photo-coupler is approximately 1.2V and works well with an input current of 9mA. Use the following formula to determine the resistor value needed for other voltage ranges:

$R = ((V_{in} - 1.2)/0.009) - 3000$

Where:

- R = External resistor value required

- V_{in} = Desired input voltage

- 1.2V = forward voltage drop of the LED in the photo coupler

- .009A = workable LED current

- 3000 ohm = Internal resistor

For example:

To connect a 48VDC signal voltage to the X-310S:

$R = ((48 - 1.2)/0.009) - 3000 = 2200$ ohms

Check the power dissipated by the resistor:

$P = I \times I \times R$, The resistor must be at least $.009 \times .009 \times 2200 = 0.18$ Watts, so use a 1/2 Watt resistor.

2.5.2 Switch Closure Connections

The X-310S can sense the state of a switch-closure sensor. Sensors with switch-closure outputs include push buttons, magnetic door alarm switches, micro-switches, or any device which has a relay, switch closure or open collector output. The X-310S can be configured for the alarm to be active when the switch is either open or closed.

The illustration below shows an example of using the X-310S to monitor the status of a gate or door over an IP network. The status of the device is detected with a switch. These types of sensors are called "dry contacts" in that the sensor output is a bare switch with no power source. In this example the voltage source for the switch is provided via the +5V output.
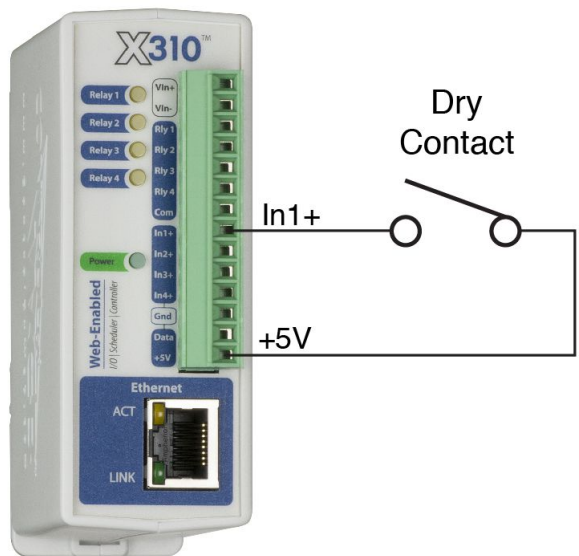
2.5.3 Water Leak Sensor Connections

A GRI-2605 water leak detector can be directly connected to the X-310S. The sensor detects the presence of water or other conductive liquids. The sensor has 4-wires which are connected as shown below. The GRI-2605 has an internal relay whose contacts (green & white wires) are closed when the sensor is dry. When the sensor is dry the digital input will be "On". When water is detected the relay contacts open and the digital input will be Off. With the connections shown the sensor is a supervised alarm circuit such that if a wire is disconnected or the sensor fails, an alarm will be generated. The X-310S can be programmed to activate its relay, activate a relay at a remote location, and send an e-mail warning when a water leak is detected. After installation test the sensor with a damp sponge or wet towel.
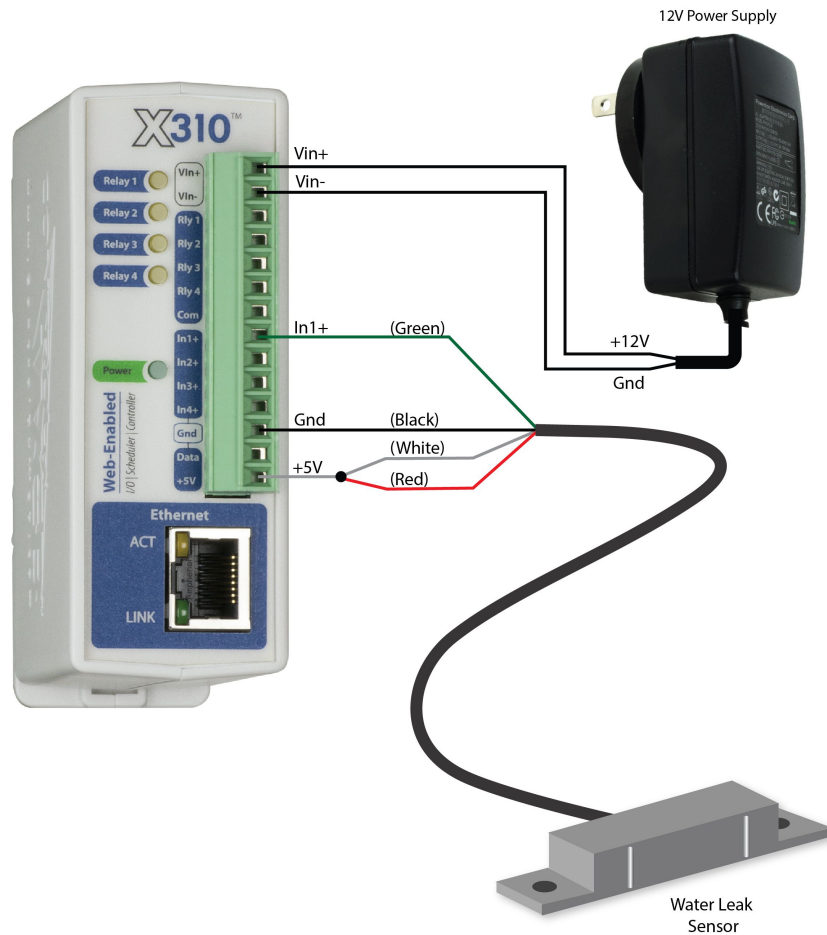
2.5.4 AC Input Connections

If an AC signal voltage needs to be detected, use a signal conditioner to convert the AC signal to a DC voltage within the input range. An AC signal conditioner can be made using a diode (or bridge rectifier) and a capacitor. Prepackaged signal converters are available as accessories at industrial automation distributors. A simple voltage converter module (RedLion VCM10000 or VCM20000) is shown below. These are available in two input voltage ranges that cover the spectrum from 4-270VAC/DC. These devices have a MOSFET output (solid state DC contact closure) which is compatible with the X-310S input. The converter module accepts AC (50/60 Hz) or DC voltages with an input pulse rate up to 30 Hz. The converter provides isolation between the input and output using an opto-isolator. You must provide a voltage source for the converter circuit as shown in the example below:
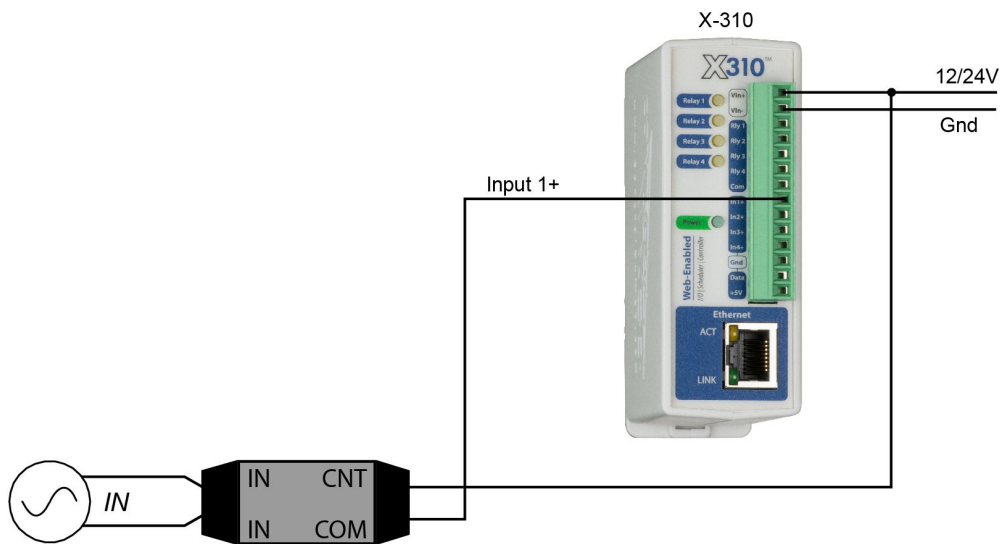
2.5.5 Network Connection
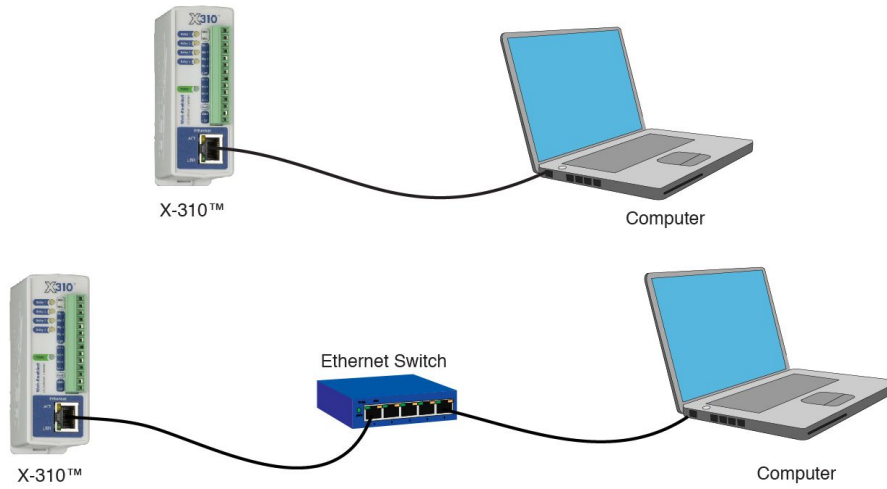
Connect the Ethernet port to a standard 10/100/1000 Base-T Ethernet connection. The X-310S typically connects to an Ethernet switch, or router. For configuration, X-310S may be connected directly to the Ethernet port on a computer or through a switch or router. The X-310S supports auto negotiation and will work with either crossover or straight-thru cables. The X-310S can be used on a wireless network by connecting through an Ethernet bridge or a wireless router.
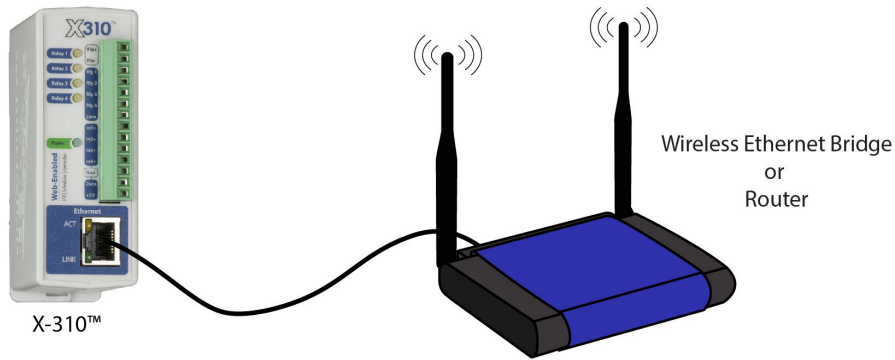
Note: The wireless Ethernet bridge or router must be properly configured for the wireless network. Refer to the installation instructions for the wireless device.

2.6 Establishing Communications for Setup

In order to configure the X-310S with the web browser interface, the X-310S 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-310S.

-or-

Method 2 – Assign a temporary IP address to the X-310S 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-310S comes from the factory with an IP address of 192.168.1.2. Communication with the X-310S may be established by assigning an IP address to the configuration computer so that it is on the same network as the X-310S (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-310S 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).
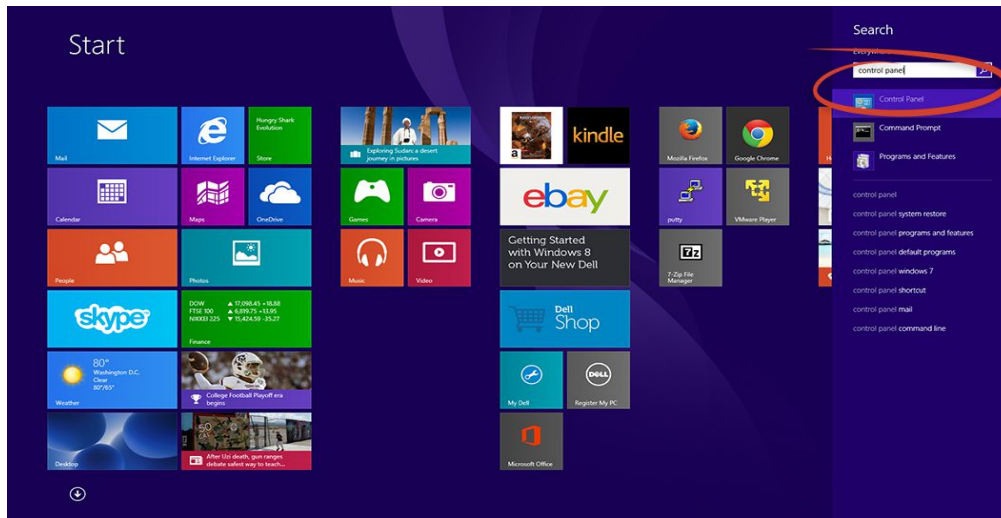
4. Select *View network status and tasks.*
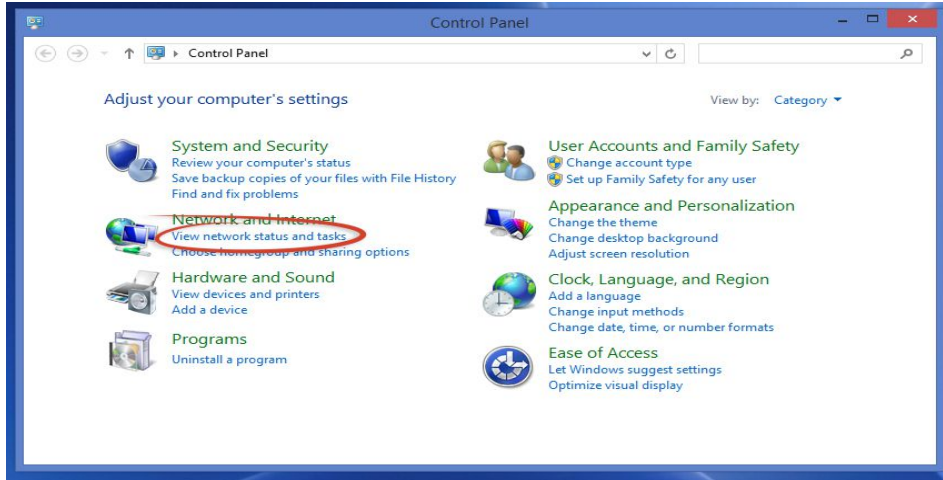
5. Select *Change adapter settings*
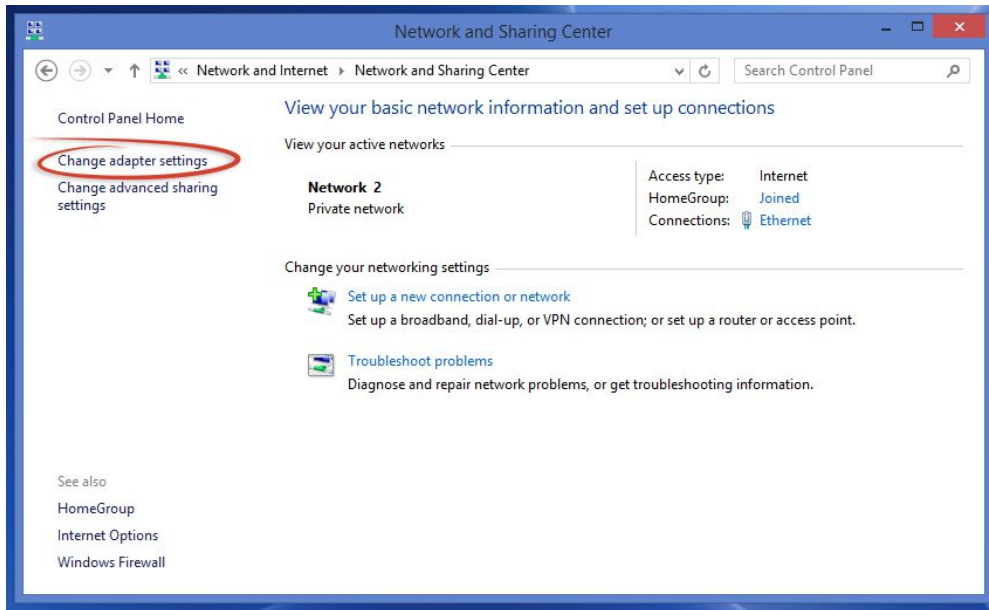
6. Your machine may have more than one Internet connection shown. Right-click on the adapter for your connection to the internet. A drop-down box will appear, choose *Properties* to view/edit the settings for this internet connection.
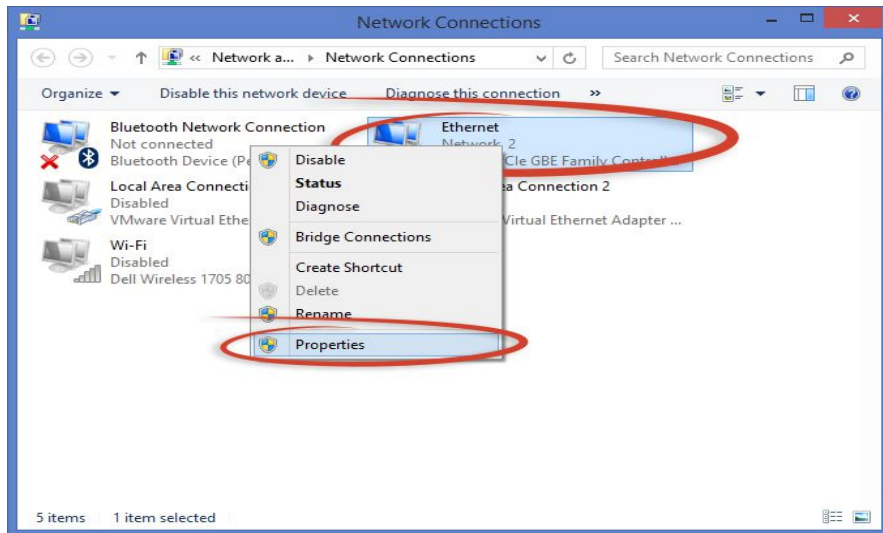
7. Select *Internet Protocol Version 4 (TCP/IPV4)* and then click the *Properties* button.
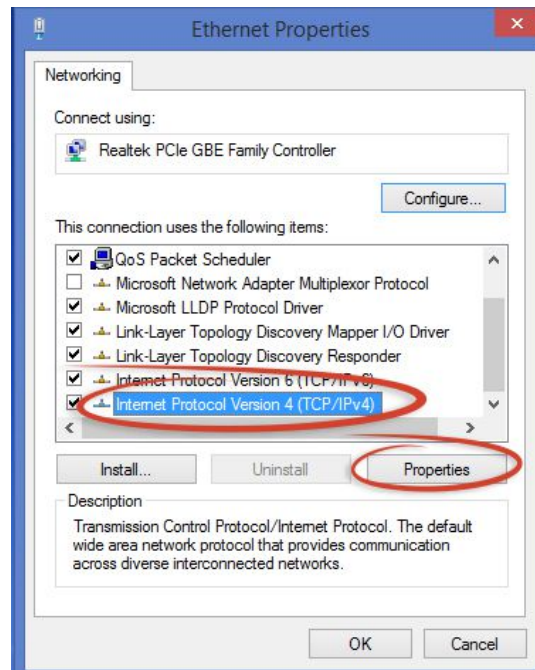
8. If "Use the following IP address" is already selected, the computer has been setup with a static IP address. Record these values so that the current IP address of the computer can be restored once the IP address of the X-310S has been successfully changed.

```
Internet Protocol Version 4 (TCP/IPv4) Properties         ✕

General

You can get IP settings assigned automatically if your network supports
this capability. Otherwise, you need to ask your network administrator
for the appropriate IP settings.

○ Obtain an IP address automatically
◉ Use the following IP address:
IP address:              192 . 168 . 1  . 50
Subnet mask:             255 . 255 . 255 .  0
Default gateway:              .   .

○ Obtain DNS server address automatically
◉ Use the following DNS server addresses:
Preferred DNS server:         .   .
Alternate DNS server:         .   .

☐ Validate settings upon exit              Advanced...

                              OK         Cancel
```

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.

9. 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-310S 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-310S 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-310S

This option (arping) is used to TEMPORARILY assign an IP address to the X-310S without the need to change the IP address of the configuration computer. The X-310S will use this IP address as long as power is maintained. Once power is lost, the X-310S will use the IP address assigned in the setup page and not the temporary address assigned here. Make sure that the X-310S 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-310S }
   ```

   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-310S (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-310S setup in *Section 3*.

   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-310S }
   ```

   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-310S (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-310S setup in *Section 3*.

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-310S }
```

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-310S (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-310S setup in *Section 3*.

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: Web Server and Setup Pages

The internal web server presents two classes of web pages; *Setup* pages and *Control* pages. *Setup* pages are used by an installer to provision and configure the X-310S. The *Control* page allows the relays to be controlled and displays temperature and digital input status information.

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

To access the *control* page, enter the following URL in the address bar of a web browser:

    http://192.168.1.2

To access any web pages over an encrypted connection replace http with https. For example:

https://192.168.1.2/setup.html

https://192.168.1.2

Before any setup page submission, the browser will request a username and password. The default username is `admin` and the default password is `webrelay` (password is case sensitive).

The setup pages are divided into two sections: General Settings and I/O Setup. A third section is for monitoring and controlling the device. To access the general settings setup pages choose *General Settings* on the menu bar on the left side of the setup screen When using the setup pages, you must click the *Submit* button at the bottom of a page if you have made changes to a setting on the page.

3.1.1 Information Tab

This is the initial page that is displayed when setup.html is entered into the address bar of the browser. It displays the part number, firmware revision, and serial number of the unit. It also allows the user to select the desired temperature units.
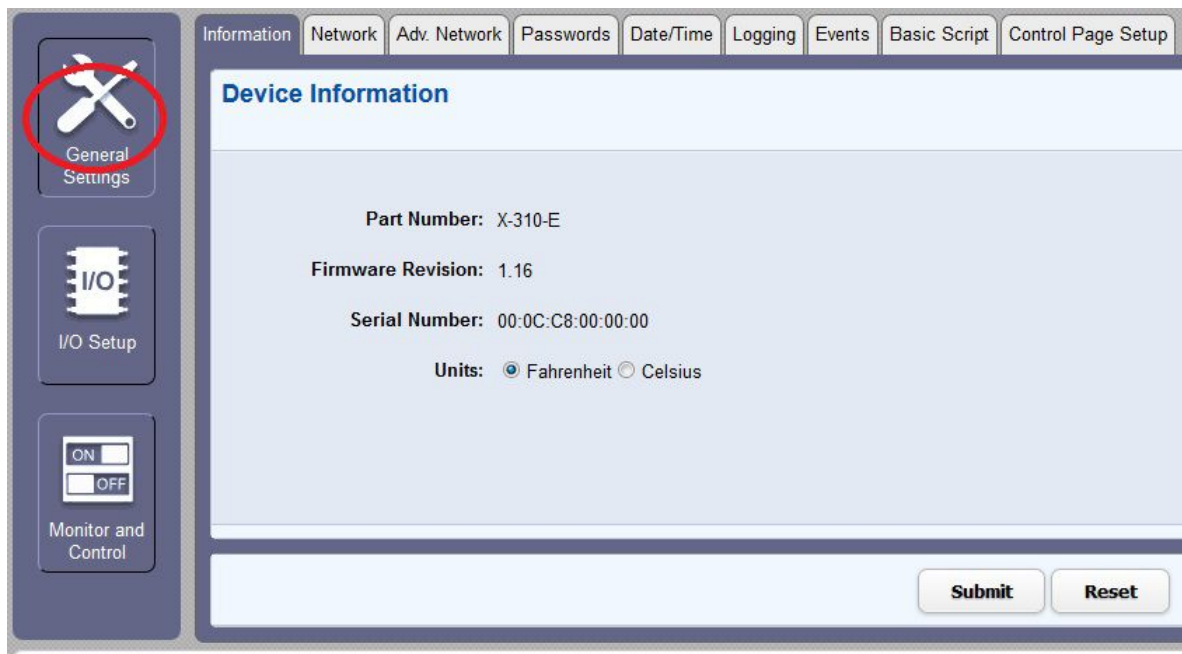
Part Number

This displays the full model number of the module.

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.

Units

This global setting allows the user to select between the temperature units of *Fahrenheit* and *Celsius*. All settings entered and displayed on subsequent pages will be in the units selected.

3.1.2 Network Tab

The network parameters are set on this page.

Note: X-310S must be power-cycled (power disconnected, then reconnected) before new network settings take effect.

Use DHCP

This option allows DHCP to be enabled or disabled. If this option is set to *Yes,* X-310S 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 X-310S must be rebooted before an IP address will be assigned. Once X-310S is assigned an IP address by the DHCP, the new IP address can be found through the list of clients kept by the DHCP server. For most instances, the DHCP server is in 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-310S is a server and manual IP address assignment is usually recommended.

IP Address

Enter the IP address for X-310S in this field. The IP address is specific to the network where X-310S will be installed, and must be obtained from the network administrator. For more information on IP addresses and remotely accessing X-310S over the Internet, see *Appendix C: Accessing the X-310S 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 can 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 can 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 the following options are used:

> *Remote Services* (when server is specified by name and not IP address).

> *Sync time clock with remote NTP server* (when server name is specified by name and not IP address).

> *Mail Server* (when server name is specified by name and not IP address).

Alternate DNS Server

This field is used to specify the IP address of a Secondary DNS server. This is used when X-310S requires DNS services and the preferred DNS server is not available. The default setting for this field is 192.168.1.1.

HTTP Port Enabled

This option enables or disables access to the web server without encryption. For high security applications the HTTP port should be disabled to limit access to encrypted connections on the HTTPS port.

HTTP Port

The TCP port used for unencrypted HTTP communications with X-310S 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-310S Over the Internet*.

HTTPS Port

The TCP port used for encrypted HTTPS communications. It is recommended not to change this port. When requesting a web page using https://192.168.1.2/setup.html, the web browser will automatically use port 443. If this port is changed to 9000 for example, the https port will have to be specified in the request https://192.168.1.2:9000/setup.html.

Upload/View SSL Certificate

By default, the X-310S comes with a previously generated SSL Certificate that is used for encrypted HTTP communications. The default SSL Certificate can be replaced by clicking on this link, choosing the new Certificate file (PEM format), and uploading the file.

Upload/View RSA Key File

By default, the X-310S comes with a previously generated RAS Key that is used for encrypted HTTP communications. The default RSA Key can be replaced by clicking on this link, choosing the new Key file (PEM format), and uploading the file.

EMAIL

Connection Security

Select the security method used for sending email. There are a couple of methods used to securely transmit email messages. STARTTLS and SSL/TLS. When STARTTLS is chosen, encryption will begin after the X-310S makes a connection to the SMTP server. When SSL/TLS is chosen, the connection to the server will be securely negotiated with the SMTP server from the beginning. Both methods are secure. STARTTLS generally requires the use of port 587 and SSL/TLS generally requires the use of port 465. No security method is also an option, and still supported by some SMTP servers. This method generally uses port 25.

Authentication Method

This options specified if a username and password is required to send email through the SMTP server. If enabled, username and password options will appear.

Email Server Name/IP (SMTP)

The name of the SMTP (Simple Mail Transfer Protocol) mail server (for example mail.example.com) or the IP address of the mail server (for example 192.10.10.10) should be entered in this field. There is no default setting for this field.

Note: If the server name is entered and not the IP address, the address of a DNS server will be required in the DNS field.

Email Server Port

This field is used to specify the SMTP Mail Server Port. The default setting is 25, which is the standard SMTP port. This port will generally be different if a connection security method is chosen.

User Name (If Required)

If the SMTP mail server requires authentication, the user name must be entered here. There is no default setting for this field.

Password (If Required)

If the SMTP mail server requires authentication, the password must be entered here. There is no default setting for this field.

Return Email

X-310S will not receive email messages, but when X-310S sends email messages, it must include a return email address. This field is used to specify the return email address. Note that although X-310S will send email messages with any email address specified in this field, some email filters (spam filters) will not allow messages through that include an invalid email address. There is no default setting for this field.

Email 1 to Email 3

Enter the email addresses of up to three recipients for alarm messages in these fields. There are no default settings for these fields.

Email Message

Choose either "Control Page Content" or "Trigger Only" email formats. When "Control Page Content" is selected, all visible fields in the control page will be included in the email message to be sent out; however if "Trigger Only" is selected, the email content will only be a brief description of what triggered the email message.

MTU Setting Notes: To change the MTU, manually enter the advSetup.html (case sensitive) page into the address bar. (http://192.168.1.2/advSetup.html). This new setup page will have a text box that will allow the MTU to be changed. The valid range is 256 to 1476 bytes. MTU is a network parameter that stands for Maximum Transmission Unit. This defines the max size, in bytes, of the TCP packets sent out from the device. This normally can be left alone, but there are some circumstances where it might be beneficial to change it. One of these circumstances is when the device is to be used over a VPN (virtual private network). VPN's add extra information to TCP packets, if the new packets are too big to physically travel across the network (greater than about 1500 bytes) then the packets will be split up. This causes problems for some firewalls and those firewalls will just discard the packets. To fix this, the MTU can be adjusted until the TCP packets do not get split up.

SEND Test Email

Pressing this button attempts to send a test email using the currently configured network and email settings. Failure to send a test email will be logged in the system log along with a description of what might have caused the failure.

3.1.3 Advanced Network Tab
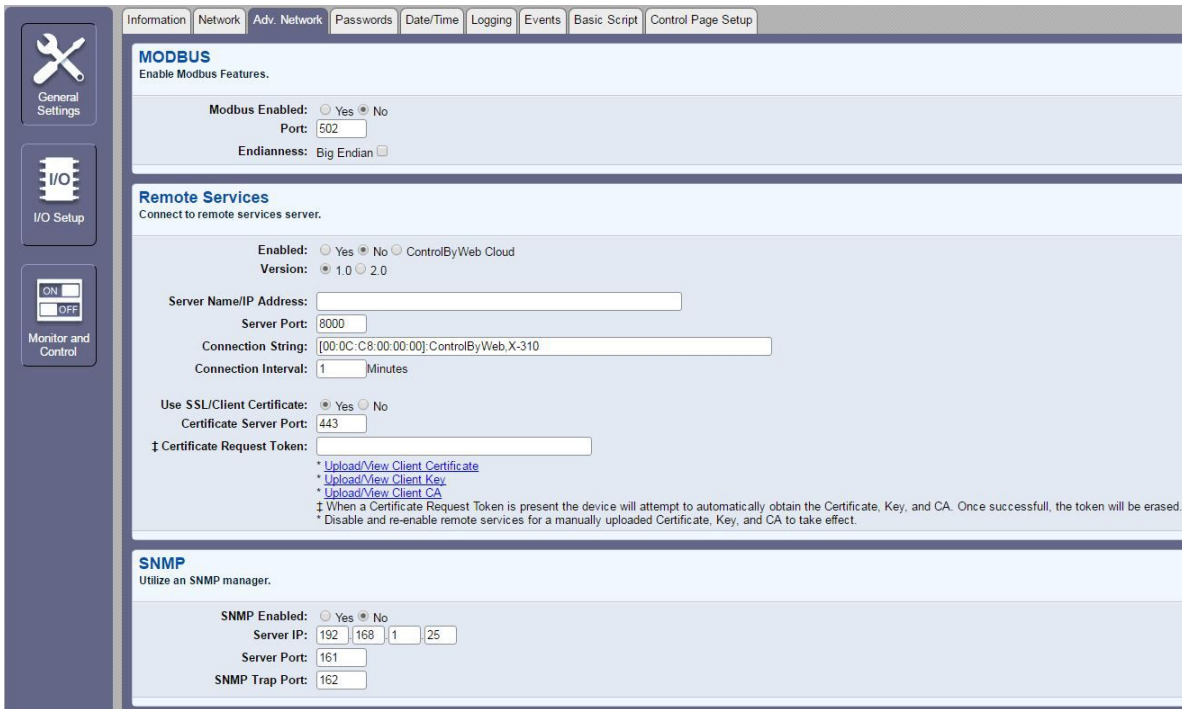
Modbus Enabled

X-310S 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 *3.4 Modbus Operation* for more information on using X-310S on a Modbus network.)

Note: Modbus communications are disabled whenever the Control Password is enabled as Modbus does not have support for Passwords.

Modbus Port

This specifies the port used for Modbus/TCP communications with X-310S. 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.

Endianness

32-bit data is treated as two individual 16-bit words using IEEE 754 floating point format. Floating point format is used for sensor, and pulse counter as well as for setting output pulse duration.

If the checkbox is set, the X-310S will use big-endian architecture, and the most significant 16-bit word (big end) is sent first. If the box is cleared, then the X-310S will use little-endian architecture, and the least significant word (little end) is sent first. The default setting for this box is *unchecked,* use little-endian.

For example, in little-endian format, a 32-bit floating point number represented by '1234 ABCD' is sent as 'ABCD 1234'.

REMOTE SERVICES

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 X-310S will immediately attempt to make a connection with a custom remote server (power cycle not required). Once a connection is established, the connection will remain until it is disconnected by the remote server. Proper connection with the remote server can be verified by viewing the system status log file *(see Section 5.6: Log Files)*. The default setting for this field is *No*. The other option is *ControlByWeb Cloud*. This option will cause the X-310S to connect to the ControlByWeb.cloud service. Most users should leave this setting at its default. (See *Remote Services* at the end of this section for more information.)

The *ControlByWeb Cloud* setting allows internet access to an X-310S which is installed behind a network router, without the need to setup port forwarding in the router. This also allows easy installation using DHCP without the need to assign a specific IP address.

Version

This field specifies the version of the remote services protocol to use. Version 1 of the protocol sends the connection string after successfully connecting to the remote server and then periodically per the connection interval specified. Version 2 of the protocol sends a fixed header of information containing the mac address, model number, and update interval, followed by the connection string and then immediately sends the state.xml file of the devices. Version 2 of the protocol requires the remote server to reply to the initial connection string with a 3 byte packet containing the text "ACK". If the "ACK" is not received within 10 seconds of sending the initial connection string, the X-310S will close the connection. Version 2 continues to send the connection string and the state.xml file periodically per the connection interval specified.

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 [<`Serial Number`>]:ControlByWeb,X-310S.

Connection Interval

This field specifies the periodic interval in which X-310S attempts to connect to the remote server, or if X-310S is already connected, it is the interval in which X-310S 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.

Use SSL/Client Certificate

This option enables encryption of the remote services connection with the remote services server as well as authentication of the X-310S to the server by a client certificate and key. Custom certificates and keys can be loaded into the X-310S for this purpose. (See *Remote Services* at the end of this section for more information.) If *Yes* is selected the following options appear:

Certificate Server Port

The certificate server is a server that has been configured to deliver the Client Certificate, Key, and CA when requested by the X-310S. For the X-310S to request a Certificate, Key, and CA from the certificate server, it must have a previously issued Certificate Request Token. The field specifies what port the Certificate Server listens on. The server is found at the same host name as the remote services server. (See *Remote Services* at the end of this section for more information.)

Certificate Request Token

When the X-310S has a valid Certificate Request Token entered, it will automatically attempt to request and download it's Client Certificate, Key, and CA. Once successful, the token will be erased and the X-310S will stop it's requests. (See *Remote Services* at the end of this section for more information.)

Upload/View Client Certificate

Allow uploading of a custom client certificates that can be used with custom remote services servers for device authentication.

Upload/View Client Key

Allow uploading of a custom client key that can be used with custom remote services servers for device authentication.

Upload/View Client CA

Allow uploading of a custom CA that has been used to generate the custom client certificate and key. The X-310S will use this certificate to verify that the server it has connected to is in fact the server that it expects to connect to.

SNMP

SNMP Enabled

When this option is set to *Yes*, X-310S will support SNMP. The default setting for this option is *No*. (See *SNMP* at the end of this section for more information.)

SNMP Server IP

When SNMP is used, this field is used to specify the IP address of the SNMP manager. The default setting for this field is 192.168.1.25.

SNMP Server Port

When SNMP is used, this field is used to specify the SNMP port that X-310S listens on. The default setting for this field is 161.

SNMP Trap Port

When SNMP is used, this field is used to specify the SNMP Trap port of the SNMP manager. The default setting for this field is 162.

Remote Services Notes: 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 X-310S and other ControlByWeb products. Users access X-310S 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 X-310S). This has two main benefits. First, the web server does not need to know the IP address of X-310S. This means that X-310S can get its IP address dynamically from a DHCP server, simplifying the installation. Second, since the connection from X-310S is outgoing, rather than incoming, the local router on the network where X-310S resides doesn't need to be configured to forward ports. This 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 the Remote Services see *Section 5.4: External Server and Remote Services.*

SNMP Notes: Simple Network Management Protocol (SNMP) is used to manage and administer network devices. X-310S supports SNMP V1.0 and can be configured here. Using SNMP, the I/O states of X-310S can be read as well as some basic information about the device. See *Section 5.3: SNMP Requests* for information about how to request information from X-310S using an SNMP manager, as well as where to find MIB files for X-310S.

Note: The read and write community strings used for SNMP are actually the Control Password found on the Password setup tab. If the Control Password is disabled, then X-310S does not check for the community string when issued a Get or GetNext request from the SNMP manager.

3.1.4 Password Tab

X-310S requires a password to log into the setup pages. The password can be changed on this page. Additionally, a password can be enabled for the *Control Page*.

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: the username required for accessing the setup pages is `admin` (all lower case). The default Setup Password is `webrelay` (all lower case).

Re-enter Setup Password

When the Setup Password is changed, it must be entered twice for verification. If the password is not entered identically in both fields, the password will not be changed.

<u>CONTROL PASSWORD</u>

Enable Control Password

The *Control Page* can be viewed without entering a password. For security purposes, a password can be required to access 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*.

Note: Since Modbus has no provision for passing passwords, Modbus will be disabled if the control page password is enabled.

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: The X-310S requires a password, but does not require a user name to access the *Control Page.* However, some browsers require a user name. 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 for verification. If the password is not entered identically in both fields, the password will not be changed.

3.1.5 Date/Time Tab

The X-310S uses the time of day for scheduled events, such as turning the Relays *ON* or *OFF* at scheduled times and for logging (a time stamp is included with each logged event). The time is stored and displayed in 24-hour time format. The X-310S has a capacitor-backed real-time-clock circuit that will keep track of time for several days in the event of a power failure.
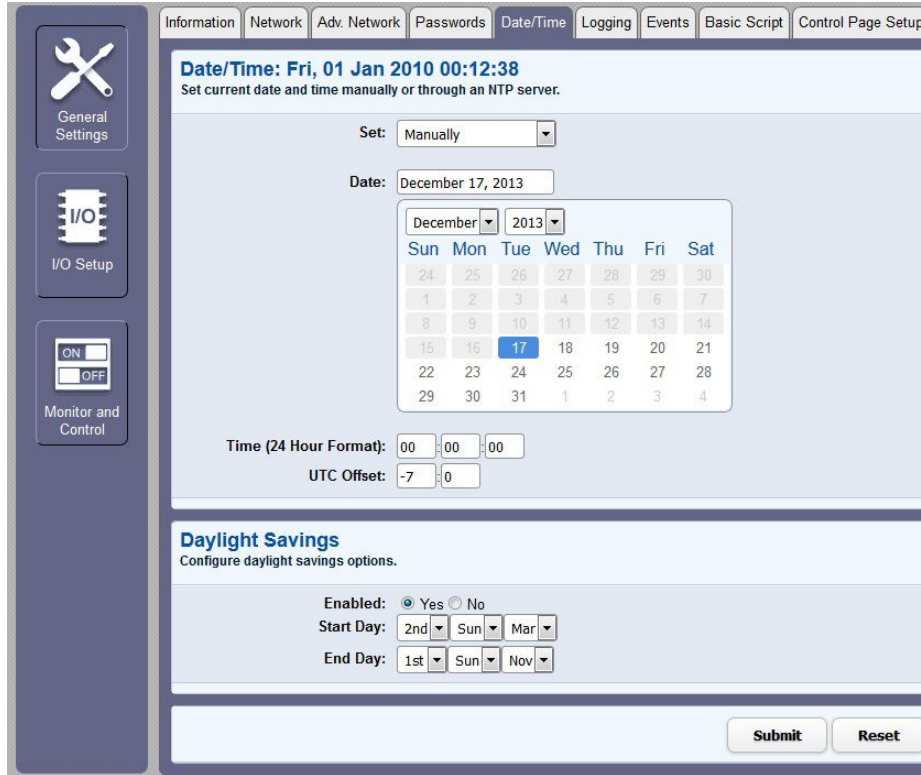
Date/Time

This is the current date and time stored in X-310S. The time is stored and displayed in 24-hour format.

Set Time

This drop-down list offers two options for setting the time: *Manually* or *Sync with NTP server*.

The options that follow this field will change based upon how this option is set.

> *Manually:* requires the user to enter the time and date.

> *Sync with NTP server:* allows the user to set the clock automatically by using an NTP (Network Time Protocol) server.

MANUAL TIME CONFIGURATION

Date

The current date is entered by first selecting the correct month and year, using the drop down boxes. Once the current month and year are displayed, select the correct day, which will then be highlighted in the calendar.

Time (24 Hour Format)

Enter the time as HH:MM:SS. (HH represents hours in 24-hour format [00-23], MM represents minutes [00-59], SS represents seconds [00-59].)

NTP TIME CONFIGURATION

Server Name/IP Address

This field is used to specify the name or IP address of the NTP server. If a name is specified, a working DNS server address must be entered into the Network settings. If the IP address is specified, it should be entered in the following format aaa.bbb.ccc.ddd where each of the letters represents a number between 0 and 255. This field can be up to 40 characters. There is no default value for this field.

Many NTP Internet servers are available. In addition, many desktop computers will function as an NTP server (both Mac and PC). If a desktop computer is used, firewall settings may need to be adjusted to allow for NTP communications on port 123.

Public NTP servers can be found at www.pool.ntp.org. Some of these are listed below.

> US Servers (http://www.pool.ntp.org/zone/us):
> 0.us.pool.ntp.org
> 1.us.pool.ntp.org
> 2.us.pool.ntp.org
> 3.us.pool.ntp.org
>
> North America (http://www.pool.ntp.org/zone/north-america):
> 0.north-america.pool.ntp.org
> 1.north-america.pool.ntp.org

2.north-america.pool.ntp.org
3.north-america.pool.ntp.org

Europe (http://www.pool.ntp.org/zone/europe):
0.europe.pool.ntp.org
1.europe.pool.ntp.org
2.europe.pool.ntp.org
3.europe.pool.ntp.org

Australia (http://www.pool.ntp.org/zone/au):
0.au.pool.ntp.org
1.au.pool.ntp.org
2.au.pool.ntp.org
3.au.pool.ntp.org

South America (http://www.pool.ntp.org/zone/south-america):
0.south-america.pool.ntp.org
1.south-america.pool.ntp.org
2.south-america.pool.ntp.org
3.south-america.pool.ntp.org

Africa (http://www.pool.ntp.org/zone/africa):
1.africa.pool.ntp.org
1.pool.ntp.org
3.pool.ntp.org

Sync With Server

This option allows the user to specify how often the time on X-310S will be synchronized with the time server. When the submit button on this page is pressed, X-310S will immediately synchronize with the time server. If Daily, Weekly, or Monthly options are selected, X-310S will thereafter re-synchronize with the time server at the period interval specified starting at 12:00 AM (00:00).

The exact time the NTP Request occurs is 12:00 AM (00:00) plus the minute equivalent of the last two digits in the models serial number. For example, if the last two digits in the model's serial number were -09, the NTP Request will occur 9 minutes after 12:00 AM. The default value of this setting is Once (the unit will immediately sync with the NTP server, but will not automatically sync again).

Sync on Power Up

When this option is set to *Yes*, X-310S will be synchronized with the time server each time it is powered.

Note: If X-310S will lose power on a frequent basis, it may be beneficial to set this option to *No;* some servers are configured to dis-allow access from client devices that excessively request their services. The default value of this setting is *No.*

UTC Offset

Time servers return the current time in Universal Time (GMT). It is common for many servers and data loggers to use GMT as their official time, even when they are not located within the GMT time zone. The default value for this field is -7 (Mountain Standard Time). For convenience, the time can be converted to local standard time by entering the offset here. This manual cannot include the UTC Offset for all parts of the world, but the offset for GMT time and the four major US Time zones are listed here.

GMT Time: 0
Eastern Standard Time: -5
Central Standard Time: -6
Mountain Standard Time: -7
Pacific Standard Time: -8

DAYLIGHT SAVINGS

In many parts of the United States and in some other countries, the time is shifted forward by one hour during the summer months. This is an effort to conserve energy by making the daylight last longer into the evening hours. If this option is set to *Yes,* the time on X-310S will automatically be shifted forward by one hour between the hours of 12:00 AM – 5:00 PM on the Daylight Savings Start date set below, and it will shift back to standard time between the hours of 12:00 AM – 5:00 PM on the Daylight Savings End date set below. The time change is made at a random time within the previously mentioned, five-hour time frame, in order to prevent multiple devices from simultaneously requesting a time and overwhelming the NTP server. The default setting is *Yes.*

Note: Enabling the daylight savings time adjustment, scheduled events will be adjusted for the new time. Logged data includes a time stamp based upon the current time in the device, so it is possible to duplicate log times in the spring and miss log times in the fall. To avoid confusion, many servers and data loggers are set to remain on GMT time and do not shift for daylight savings.

Daylight Savings Start Day

This is the date that daylight savings will start. Note that on this date, between the hours of 12:00 AM – 5:00 PM, the current time will be shifted forward by one hour (i.e. the time will jump from 12:02 AM [00:02] to 1:02 AM [01:02]). By default this is set to the 2nd Sunday in March which is the date used in the United States.

Daylight Savings End Day

This is the date that daylight savings will end. On this date, between the hours of 12:00 AM – 5:00 PM, the current time will be shifted backward by one hour (i.e. time will jump from 12:02 AM [00:02] to 11:02 PM [23:02] the day before). By default this is set to the 1st Sunday in November which is the date used in the U.S.

3.1.6 Logging Tab

X-310S can be configured to record data such as changes in I/O state, sensor data, and events. Both periodic and event-based logging are supported. The logged data is stored in internal nonvolatile memory and can be retrieved by entering the command http://{X-310S IP address}/log.txt. For more information on logging, see *Section 5.6: Log Files.*

The log is stored in non-volatile, flash memory using a circular buffer (old data is over written). 512 kB of memory space is reserved for logging. Log entries are composed of the following components, 8-byte header, and 4 bytes for each log feature selected, except relays and inputs, which add two bytes regardless of how many are logged. A log of Vin 1 (4 bytes) and 4 digital inputs (1 byte) will occupy 13 bytes per entry.

Note: Changing the log settings will erase the current log file.
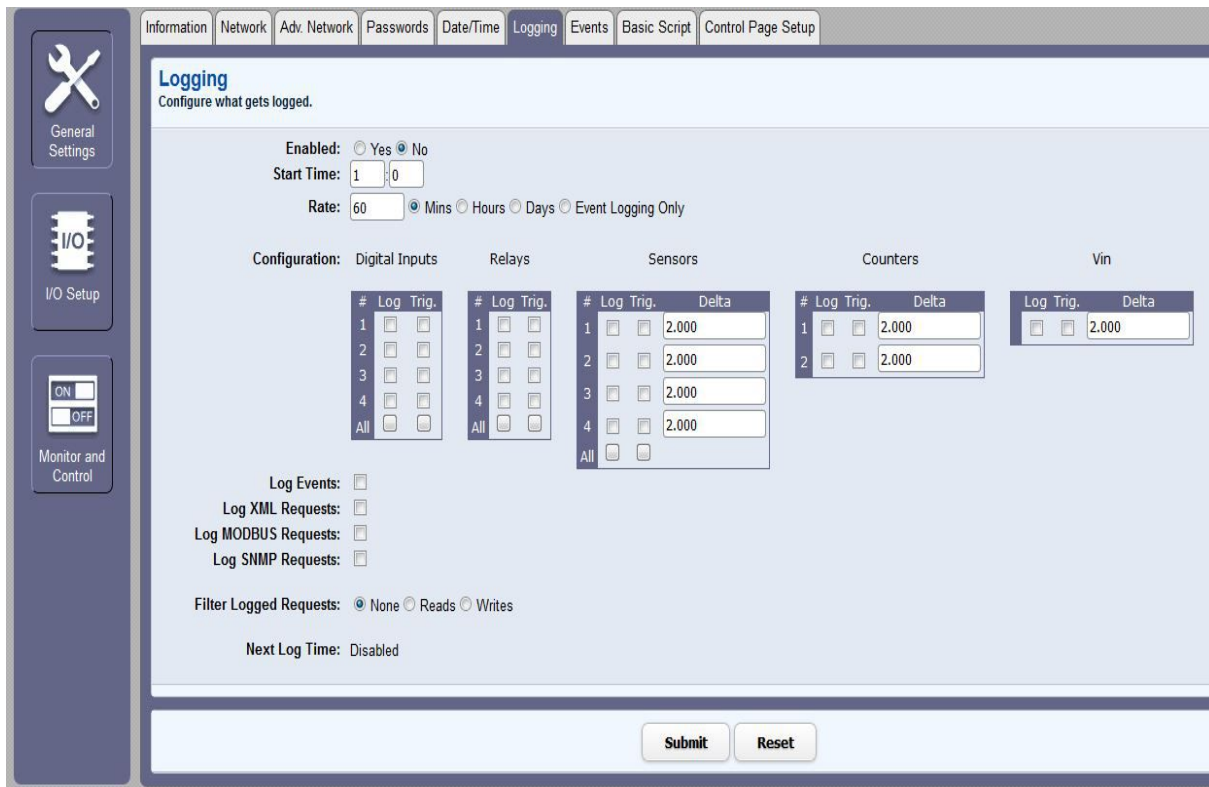
Logging Enabled

When this option is set to *Yes*, X-310S will record data as configured on this page. The default setting for this option is *No*.

Note: This option controls data logging, but not system logging. System logging is always enabled.

Note: Logging of the Pulse Counter 1 or 2 will reduce the maximum counter rate to 10 Hz. Enabling other options can lower this rate even more.

Start Time

If a logging interval is specified (periodic logging rather than event logging), logging will occur relative to this start time. For example, if the start time is 01:00 and the logging rate is 6 hours, logging will occur at 01:00, 07:00, 13:00, and 19:00. Start time is specified in 24-hour time format. The default setting for this

field is 01:00.

Logging Rate

This field is used to specify the time period of logging. A numerical value is entered into the text field, and the unit of time is selected using the adjacent radio buttons. The range of values in this field is 1-20864. Time units are *Minutes, Hours*, and *Days*. Periodic logging can be disabled by selecting the Event Logging Only radio button.

Logging Configuration

This section is used to select which inputs, relays, pulse counters, sensors, Vin and events get logged and which events trigger logging. There are five configuration tables. The first column in each table identifies the elements to be logged. The second column is used to specify which events can cause a log entry to be created. The last column is used to specify the Trigger Delta for the corresponding counters and sensors.

When relays are selected as an *Event Trigger*, logging will occur whenever the selected relay is turned *ON* or *OFF*. When inputs are selected as an *Event Trigger*, logging will occur whenever the input state changes. When pulse counters, sensors and Vin are selected as an *Event Trigger*, logging will occur whenever the input or sensor changes by the trigger delta.

The following *Log/Event Trigger* options are available:

- Inputs (1-4)
- Relays (1-4)
- Sensors (1-6)
- Pulse Counters (1-2)
- Vin
- Events
- XML Requests
- MODBUS Requests
- SNMP Requests

Note: Logging activity will lower the highest possible pulse counter rates.

Sensor Trigger Delta

X-310S can be configured to log data when the count, voltage, temperature, or humidity measured by a sensor changes by the amount specified in this field. This can be set from 1.0 to 9999 units, in 0.1 increments. The default setting for these fields is shown below.

Sensor	Trigger Delta
Counters	2
Vin	2.0 V
Temperature	2º
Humidity	2%

Filter Logged Requests

When logging is enabled for XML Requests, Modbus Requests, or SNMP Requests, the user can filter out *Reads* (such as reading the Digital I/O states via an XML request) or *Writes* (such as changing the output state via an XML command).

On the *Control Page Setup* tab, the user can specify the refresh rate of the Control Page. Each time the page is refreshed, an XML request is sent and logged as a Read. Since the default refresh rate is 3 seconds, the log file can get cluttered by many XML request logs. By filtering out *Reads,* refresh requests will not be shown in the log. Likewise, by selecting *Writes,* any log created by changing the state of the output will not be shown in the log file. The default selection is *None.*

Next Log Time

This field displays the next periodic log time. If logging is disabled, the next log time will indicate "Disabled." If logging is enabled, but periodic logging is disabled (by selecting *Event Logging Only*) the next log time will indicate "Event Logging Only."

Note: This information is updated only when the page is refreshed.

3.1.7 Events Scheduler Tab

Events can be programmed to turn the Relays *ON* and *OFF* at specific times. Up to 100 events can be created. Each event can occur one time or multiple times.

A list of all scheduled events and information about each event is displayed in a table. Events can be sorted according to each column, in ascending or descending order. The following columns are displayed:

- **Events Scheduler: On/Off**: Turns scheduled events *ON* or *OFF. ON* is selected by default.
- **Current Date/Time**: Displays the current date and time.
- **Event #**: The number and name of events that are listed.
- **Schd #**: The schedule where the event is located (0 is the default schedule).
- **Start Date/Time**: The start date and time (24-hour) of the event.
- **Period**: The time between the start of successive events.
- **Count**: The number of times the event will occur.
- **Action**: What action the outputs or schedule will take
- **Act #(s)**: Which of the outputs or schedules, if any, will be affected by the event.
- **Value**: If an output pulse event is programmed, the Pulse Duration will be displayed. If a set extVar(s) event is programmed, the new extVar value is displayed.
- **Next Occurrence**: The date and time of the event's next occurrence will be displayed. If the event has already occurred, the event will be listed as "Inactive" here.

The events are color coded to indicate their status.

- Gray – Event has not been set up.
- Green – Events are active and will occur sometime in the future.
- Red – Events have been temporarily disabled by the disable event action.
- Yellow – Events have already occurred and are not scheduled to happen in the future.

Configuration of events is accomplished by clicking on the appropriate event, which causes the following setup screen to be displayed.
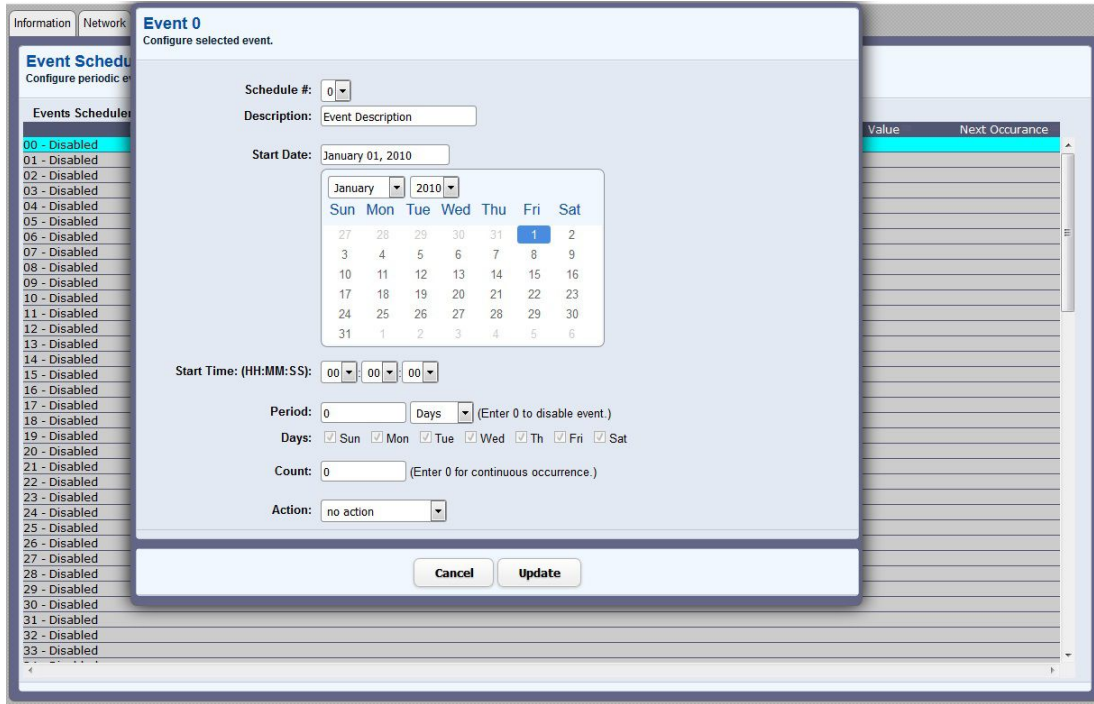
The heading displays the current date and time as specified in the *Date/Time* tab.

Schedule

X-310S can be setup to use multiple schedules. The master event schedule is schedule 0. (See *Schedules* below for more information.)

Description

Text entered here is used to name and describe each event. Default text is "Event Description".

Start Date

This field is used to enter the start date of the event. The date is entered by first selecting the desired month and year, using the drop down boxes. Once the current month and year are displayed, click the day in the calendar.

Start Time (HH:MM:SS)

The start time of the event is entered in the drop-down menus as HH:MM:SS (HH represents hours in 24-hour format [00-23], MM represents minutes [00-59], SS represents seconds [00-59]). Default setting is 00:00:00.

Period

When events are configured to occur more than one time (any entry other than 1 in the Count below), the period field specifies the time between the beginning of events. This time can be specified in *Seconds, Minutes, Hours, Days,* or *Weeks* by selecting the appropriate option in the drop-down menu. Default settings is 0 Days. Note that selecting 0 will disable the event.

Days

When a **Period** of one day is selected, the day(s) on which that event will occur can be specified by

marking the appropriate check boxes.

Count

The number of times the event will occur is specified. The default text is `0`. Note that entering 0 in this field will cause the event to occur continuously.

Action

This drop-down menu specifies which action will take place when the event occurs. The following options may be selected

*no action***:** When this option is selected, nothing will happen when event occurs.

turn relay(s) on: This option causes the relay(s) specified in the Affected Relays(s) field to turn *ON* when the event occurs.

*turn relays(s) off***:** This option causes the relays(s) specified in the Affected Relays(s) field to turn *OFF* when the event occurs.

*pulse relays(s)***:** This option causes the relays(s) specified in the Affected Relays(s) field to turn *ON* when the event occurs, and then turn *OFF* after the Pulse Duration time (specified below) expires.

*toggle relays(s)***:** This option causes the relays(s) specified in the Affected Relay(s) field to change states.

*change schedules***:** This option causes the schedule(s) specified in the Affected field to be enabled or disabled. (See *Schedules* at the end of this section for more information).

*set extVar(s)***:** External variables provide a way for scripts written in BASIC to interact with users, and for scripts to execute as a result of event occurrences. This option sets the extvar(s) specified in the Affected External Variables field to a specified value when the event occurs.

Affected Relay(s), Affected Schedules, Affected External Variables

Depending on the Action selected in the Action field, another field will appear with 4 check boxes. This field selects which relays, schedules, or external variables are affected by the action.

Pulse Duration

If the Output Action has been set to P*ulse Output(s)*, the *Pulse Duration* is set in this field. The time is specified in seconds and can range from 0.1 seconds to 86400 seconds in 0.1 second increments. The default time is 1.5 seconds.

ExtVar(s) Value

If the Action has been set to the Set ExtVar(s) action, then the new value for the extVar(s) is specified here.

Schedules

Events can be assigned to one of five schedules. The schedules are useful for creating complex events that vary with calendar dates, such as work shift alarms. Schedule 0 is always active, it cannot be disabled. Other schedules can be enabled and disabled by schedule events. Multiple schedules may be active at one time. The following is an example of how schedules and events might be used.

Schedule 0 Event – Communication device is enabled daily at 8 pm and disabled at 6 am, Monday through Friday. (The web interface could be used to disable the system for any authorized exceptions.)

Field Name	Event 1	Event 2	Application Description
Schedule #	0	0	Schedule 0 cannot be disabled by other events.
Description	SCADA ON	SCADA OFF	User description of event.
Start Date	Current Day	Current Day	Set to current or previous day.
Start Time	20:00:00	06:00:00	Start time in 24 hr format.
Period	1 Days	1 Days	Event occurs daily.
Days	M-F	M-F	Security system is disabled during work hours and remains on over weekend.
Count	0	0	Event is always in effect, set to zero.
Action	turn output on	turn output off	Security system is controlled through Output 1.
Affected	1	1	Output 1 receives the Action
Pulse Duration	n/a	n/a	The value is ignored except for a pulse action.

Schedule 1 and 2 Events – Radio transmission reports triggered at 8 am and 5 pm Monday through Friday, during winter months but, shifts to 6 am start time during summer.

Field Name	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Schedule #	1	1	0	2	2	0
Description	Summer AM Report	Summer AM Report	End Summer	Winter AM Report	Winter AM Report	End Winter
Start Date	30 May	30 May	01 Sep	01 Sep	1 Sep	30 May
Start Time	08:00:00	17:00:00	00:00:00	06:00:00	03:00:00	00:00:00
Period	1 Days	1 Days	365 Days	1 Days	1 Days	365 Days
Days	M-F	M-F	All	M-F	M-F	All
Count	0	0	0	0	0	0
Action	pulse output	pulse output	change schedules	pulse output	pulse output	change schedules
Affected	1	1	2	1	1	1
Pulse Duration	3	3	n/a	3	3	n/a

In the above example, the Affected row applies to Outputs. When an output action is selected, or when a change schedule action is selected. The security system example could also be changed to schedules 1 and 2, allowing for different hours of operation for summer and winter schedules. Additional lunch or break bells could also be added to schedules 1 and 2 or added in schedules 3 and 4. Events 5 and 8 enable and disable schedules. Event 5 would enable schedule 2, and disable schedules 1,3,4. Event 8 would enable schedule 1, and disable schedules 2,3,4. Additional equipment could be controlled by event schedules such as lighting, compressors, and magnetic door locks.

3.1.8 Script Tab

X-310S can run simple custom programs written in a modified version of BASIC. This page is used to load and execute these programs. Before it can be loaded to the X-310S, a script must first be prepared as a .txt file. The file must then be uploaded to X-310S via the *Basic Script* tab. The maximum size of script that can be uploaded to the device is 4K bytes. Information on writing a basic program for X-310S can be found in *Section 5.8: 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 X-310S. 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 X-310S, click the 'Choose File' button, find the .txt file previously created, 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.

3.1.9 Example Script

The following is an example script which monitors a door switch. An alarm sounds after a door has been open for 10 seconds and turns off if the door is closed. It includes a test to exit the timer if the input turns off before 10 seconds has elapsed. This helps insure that the alarm will only turn on if the door has been open for 10 seconds.

```
'This example will turn on a relay after an input has been on for 10 seconds

    LET relay1 = 0              'Make sure the relay is off when script starts

    DO                         'Begin main program loop
       IF input1 = 1 THEN      'Checks if input1 is on - Door is open
          CALL delay           'Calls the delay function
          IF input1 = 1 THEN   'After the delay is done,  it will check the door again
             LET relay1 = 1     'Turns the relay on, sounding alarm
          END IF
       ELSE                    'IF input1 is off - door is closed
          LET relay1 = 0        'Turn relay1 off, turning off the alarm after closed door
       END IF                  'End of IF input1 = 1
    LOOP                       'Loop main program
    END                        'End Main Program loop

    SUB delay                  'SUB function
       LET t1 = 100            'Set timer = 10.0 seconds
       DO WHILE t1 > 0         'Loop while timer is counting down to 0.0 seconds.
          IF input1 = 0 THEN   'If the input turns off (door closed), it will exit loop
             LET t1 = 0        'Sets timer to 0 to exit loop
          END IF               'End of IF input1 = 0
       LOOP                    'Loop the DO WHILE statement above
    END SUB                    'End of the SUB routine
```

3.1.10 Control Page Setup Tab

The *Control Page Setup* page is used mainly to set parameters that affect the view of the *Control Page,* how often it will refresh, etc.
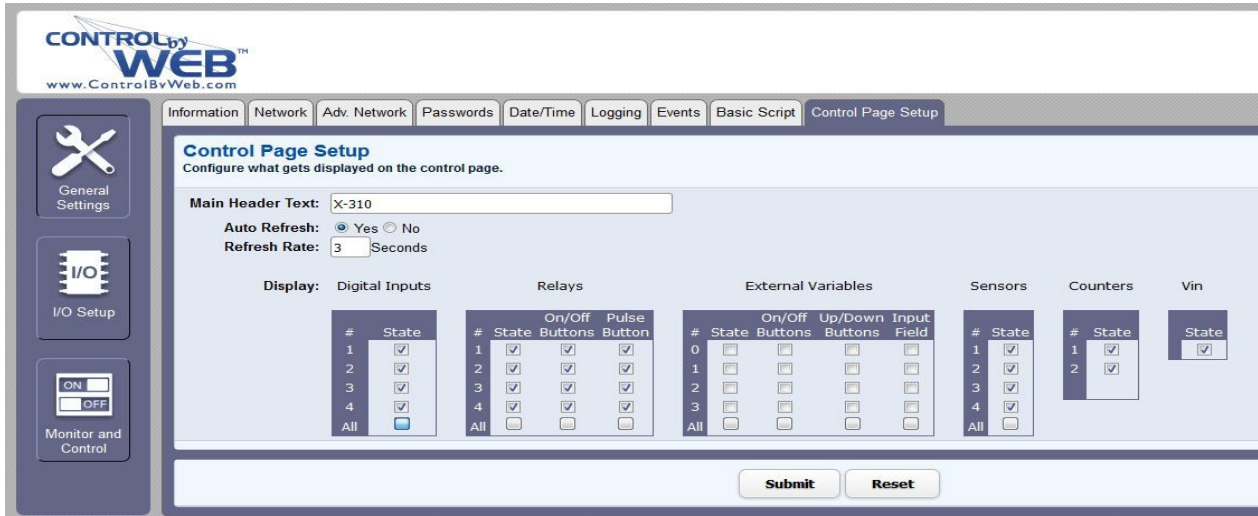
Main Header Text

The text entered here appears at the top of the *Control Page*. It also appears in the header of the email text when the email notification is used. This field can be up to 40 characters in length. The default text is `X-310S`.

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 on 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. The default Refresh Rate is `3` seconds

Display

This section is used to select which inputs, relays, external variables, pulse counters or sensors are displayed on the control page. There are six configuration tables. Some tables, such as the digital inputs table, have one column of check boxes. Each check box determines whether or not the status of the element is displayed. Other tables, such as the relays table, have multiple columns. The first column determines if the relay status is displayed on the control page. Other columns determine what control buttons are displayed on the control page.

Inputs (1-4): Determines if the input status is visible on the control page.

Relays (1-4): Determines if the relay status is visible on the control page. Also, the visibility of On/Off buttons and Pulse buttons can be configured through the check boxes in columns two and three.

External Variables (1-4): Determines if the external variables are visible on the control page. On/Off buttons, Up/Down arrows, and Input boxes can all be enabled/disabled through the check boxes in columns three through five.

Sensors (1-6): Determines the visibility of the sensor readings on the control page.

Pulse Counters (1-2): Determines the visibility of the counter values on the control page.

Vin: Determines whether or not the Vin measurement is displayed on the control page.

3.2   I/O Setup Pages

The second set of setup pages, the I/O Setup pages, are used to configure all the I/O related settings of the device. Choose I/O Setup on the menu bar on the left side of the setup screen.

3.2.1   Digital Input Tab

This page provides configuration options for the four digital inputs built into the X-310S.
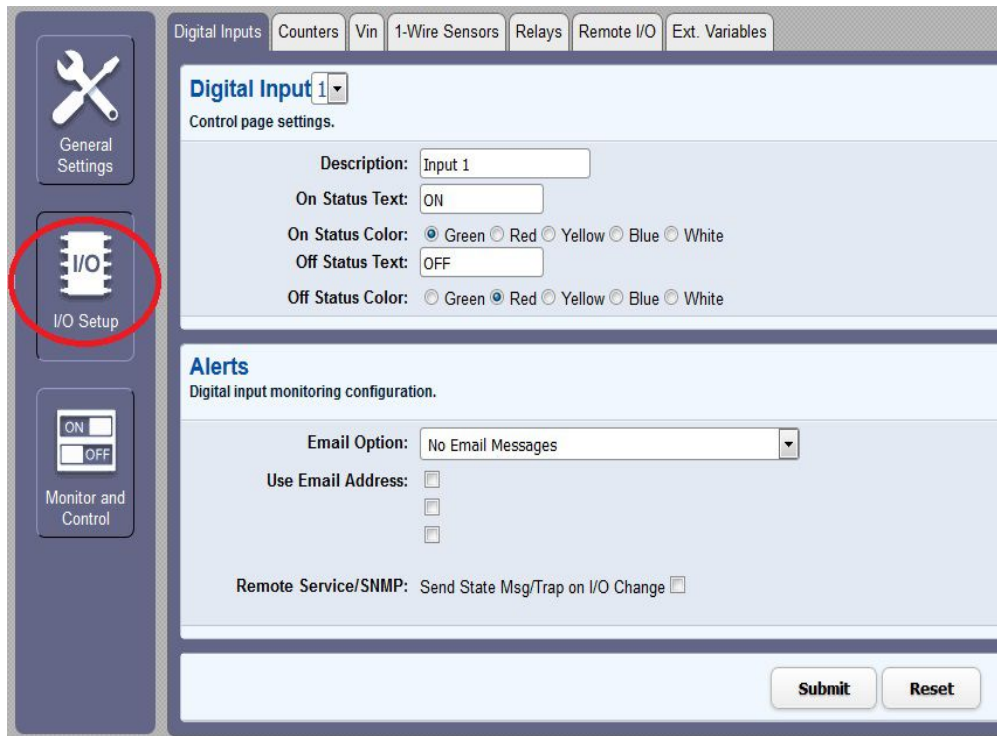
Digital Input #

A drop-down menu is used to select the digital input to configure.

Description

This text field is used to describe the function of the selected input. The text appears to the left of the corresponding input status on the *Control Page,* and in email messages when email alerts are enabled. This field may be up to 9 characters long. The default text is "Input #". Enter a descriptive name such as "*Stockroom Door*".

On Status Text

The text in this field specifies the text that will be displayed in the *Control Page* and in email messages when the input is *ON.* Up to 9 characters may be entered in this field. The default text is "ON". Enter a descriptive status such as "*Door is Open*"

On Status Color

This field specifies the color that will be displayed on the control page when the input is considered On.

Options are Green, Red, Yellow, Blue and White. The default color is Green.

Off Status Text

The text in this field specifies the text that will be displayed in the control page and in email messages when the input is *OFF.* Up to 9 characters may be entered in this field. The default text is "OFF". Enter a descriptive status such as "*Door is Closed*".

Off Status Color

This field specifies the color that will be displayed on the control page when the input is considered Off. Options are Green, Red, Yellow, Blue and White. The default color is Red.

<u>**ALERTS**</u>

Email Option

Simple email messages can be sent in response to input changes. This parameter is used to specify what input changes, if any, will cause email messages to be sent. The default setting for this field is *No Email Messages.*

>***No Email Messages**: No email notifications will be sent due to input changes.

>***Send Email when input on**: Email notifications will be sent when input state changes to *On*.

>***Send Email when input off**: Email notifications will be sent when input state changes to *OFF.*

>***Send Email when input changes state**: Email notifications will be sent when input changes state to *ON* or *OFF.*

Note: Email notification will work only if the email settings are correctly set up in the *Network* setup page.

Use Email Address

If email messages are to be sent out based on input changes, these check boxes specify to which email addresses the message will be sent. The Email addresses specified on the *Network* setup tab will be displayed next to each check box. By default, no boxes are checked.

Remote Service/SNMP

When this box (Send State Msg/Trap on Input Change) is checked, SNMP traps and/or State messages will be sent whenever the input state changes to configured SNMP servers and remote services servers.

3.2.2 Counters Tab

This page provides configuration options for the two counters. Inputs 1 and 2 can be configured to be used as counters, counter one is driven by input one and counter two is driven by input two.
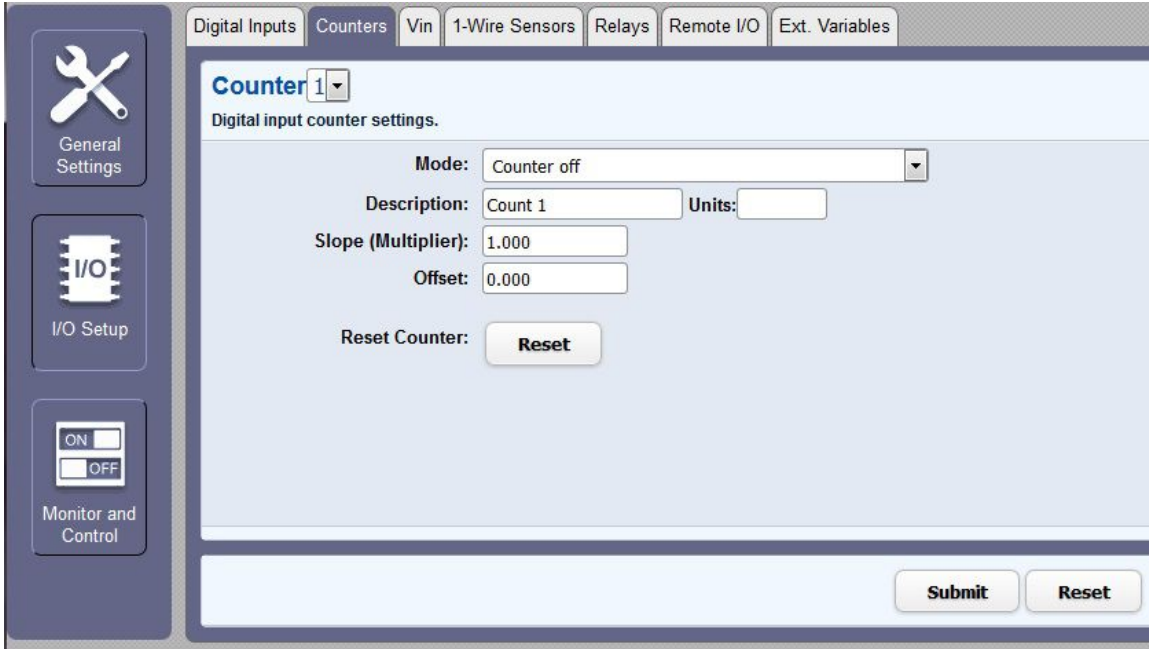
Counter #

A drop-down menu is used to select the counter to configure.

Mode

This settings determines what triggers the counter to increment.

> *Counter off:* No input transitions will be counted.

> *Increment when input on:* The counter will increment each time the input turns on.

> *Increment when input off:* The counter will increment each time the input turns off.

> *Increment when input changes:* The counter will increment each time the input changes on or off.

Note the default setting for this field is *Counter off.*

Description

This text field is used to describe the counter. The text appears to the left of the corresponding counter on the Control Page, and in email messages when email alerts are enabled. This field may be up to 9 characters long. The default text is Count #.

Units

This text field is used to describe the units counted. The text appears to the right of the counter reading. This field may be up to 4 charters long.

Slope (Multiplier)

The counter value can be scaled into engineering units. The X-310S reads the raw value from the counter and calculates a new value in engineering units. This scaled value is calculated using the following y=mX+b formula..

Scaled Value = Slope * Count + Offset

The calculated scaled value is used for trigger logs, email messages, control page, XML page, and returned when Modbus values are read.

The "slope" in the formula above is provided by the user and is entered in this field. When both the slope and offset are set to their default values (m=1 and y=0) the scaled value equals the actual count.

When the counter is set to whole number mode, the slope multiplier is truncated, all digits to the right of the decimal place are ignored.

Offset

The "offset" in the formula above is provided by the user and is entered in this field. The default value for this field is 0.

Reset Counter

This button will reset the counter to zero.

3.2.3 Vin Tab

This page configures how the supply voltage will be monitored. Note: With the X-310S-E the power is provided over the Ethernet cable and the Vin+ monitor will show 0-volts.

Description

This text field is used to describe the supply voltage. By default it is set to "Vin." The text appears to the left of the Vin status on the *Control Page.* This text will also appear in email messages when email alerts are enabled. This field may be up to 9 characters long.

Decimal Places:

This text field is used to specify the number of digits shown on the right of the decimal point on the control page. The minimum number of decimal places shown is 0. The maximum number of decimal places shown is 5. The default for this field is 3.

Alarm 1 Color

The selected color that will be displayed on the Control Page when Alarm 1 is reached. Options are Green, Red, Yellow, Blue and White. The default setting is Green.

Alarm 2 Color

The selected color that will be displayed on the Control Page when Alarm 2 is reached. Options are

Green, Red, Yellow, Blue and White. The default setting is Red.

Normal Color

This field specifies the color that will be displayed on the Control Page when the Vin voltage is in a Normal condition. Options are Green, Red, Yellow, Blue and White. The default setting is White.

<u>**ALARMS**</u>

Alarm 1

This setting is used to set the trigger point for an alarm condition. The number field specifies the value at which the alarm is triggered. The High and Low radio buttons indicate whether the alarm is triggered as a high or low alarm. A high alarm is triggered when the Scaled Value of Vin exceeds the Alarm 1 set point. A low alarm occurs when the Scaled Value of Vin is lower than the alarm set point.

Alarm 2

This is a second alarm trigger that works identical to Alarm 1.

Deadband

The Deadband prevents alarms from triggering excessively when the Vin measurement vacillates around the trigger point. With high alarms, the measurement must fall below the high alarm point minus the deadband before the high alarm will be triggered again. Likewise the deadband on the low alarm requires the measurement to rise above the low alarm point plus the deadband before the low alarm will be triggered again.

For example, if the deadband is set to 0.5 V, and a high alarm occurs at 13 V, the alarm will not trigger until the temperature first drops below 12.5 V (13 V - 0.5 V).

<u>**ALERTS**</u>

Vin Email Option

Simple email messages can be sent in response to alarm conditions. This parameter is used to specify what alarm conditions, if any, will cause email messages to be sent. Email notification will work only if email is correctly setup in the *Network* setup page.

>   ***No Email Messages****:* No email messages will be sent due to alarm conditions.

>   ***Send Email on Alarm 1***: Email notifications will be sent due to Alarm 1 conditions.

>   ***Send Email on Alarm 2***: Email notifications will be sent due to Alarm 2 conditions.

>   ***Send Email on Alarm 1 and Alarm 2***: Email notifications will be sent due to Alarm 1 or Alarm 2 conditions.

> ***Send Email on Alarm 1, Alarm 2, and Normal*:** Email notifications will be sent due to Alarm 1, Alarm 2, or when Normal conditions are regained.

Use Email Address

If email messages are to be sent based on alarm conditions, these check boxes specify to which email addresses the message will be sent. The Email address specified on the *Network setup tab* will be shown next to each check box.

Remote Service/SNMP

This field specifies the action with a remote server due to an alarm condition.

> ***No Action*:** No action is taken.

> ***Send State Msg/Trap*:** An event string will be sent to the remote server.

The second drop-down box specifies the conditions that will cause an alarm trigger. The following alarm conditions are available:

> ***Alarm 1*:** The specified action occurs due to Alarm 1.

> ***Alarm 2*:** The specified action occurs due to Alarm 2.

> ***Alarm 1 or Alarm 2****: The specified action occurs due to Alarm 1 or Alarm 2.*

3.2.4 1-Wire Sensors Tab

This tab is used to configure temperature/humidity sensors and associated alarms. The X-310S will automatically detect whether a temperature or humidity sensor is connected.

Sensor #

Up to four sensors can be connected to the X-310S. This drop-down list selects the sensor to be configured. The fields below are the same for each sensor.

Sensor Description

The text in this field appears to the left of the corresponding temperature/humidity reading on the Control Page. This text also appears in the email status message when email is enabled. This field can be up to 14 characters in length. The default text in this field is "Sensor #".

Sensor Address

Each sensor connected to the X-310S should be associated (or assigned) to a sensor number. This identifies the name, location, and function of the sensor. Every temperature/humidity sensor comes from the factory with a unique, non-changeable address. When the sensors tab is selected (or the Refresh List button is pressed), the X-310S scans the bus for sensors. The addresses of the sensors that are found on the bus are listed in the drop-down list. For each sensor number (Sensor 1... Sensor 3), select the address of the appropriate sensor from the drop-down list.

Selecting sensors is simplest when the sensors are connected to the bus one at a time. The procedure is to start with one sensor and associate it with the appropriate sensor number by selecting the sensor address within the appropriate drop-down list. Submit the page, connect a second sensor, and press the Refresh List button. Associate the second sensor to the appropriate sensor number. Continue this procedure until all sensors are set up.

1-Wire sensors connected to wireless XW-110 device can appear in the sensor address list as well if an XW-110 is configured to push its sensor readings to the X-310S.

Send Diagnostic Emails

When enabled, diagnostic emails will be sent under a couple of circumstances. In the case of 1-Wire sensors directly connected to the X-310S, diagnostic emails will be sent when the sensors cannot be read and are offline (due to a malfunction or disconnect.) A diagnostic email will also be sent if the 1-Wire sensor comes back online. For remote sensors on the XW-110 device, the same diagnostic emails will be sent as sensors are responsive/unresponsive. For XW-110/111 devices, low battery emails will also be sent to inform the user that the batteries need to be changed.

Alarm 1 Color

This field specifies the color that will be displayed on the Control Page when Alarm 1 is reached. Options are Green, Red, Yellow, Blue and White. The default color is Green.

Alarm 2 Color

This field specifies the color that will be displayed on the Control Page when Alarm 2 is reached. Options are Green, Red, Yellow, Blue and White. The default color is Red.

Normal Color

This field specifies the color that will be displayed on the Control Page when the sensor is in a Normal condition. Options are Green, Red, Yellow, Blue and White. The default color is White.

ALARMS

Alarm Offset

The value of the offset will be added to the sensor's reading. Normally this should be set to zero.

Alarm 1

This setting is used to set the trigger point for an alarm condition. The number field specifies the temperature/humidity at which the alarm is triggered. The "High" and "Low" radio buttons indicate whether the alarm is triggered as a high or low alarm. A high alarm is triggered when the sensor reading exceeds the alarm value, and a low alarm occurs when the sensor reading falls below the alarm value. Generally this value will be static, but an external variable can be used as a trigger point for an alarm condition as well. To use an external variable select the desired external variable using the drop-down box. The value of an external variable can be changed by the event scheduler, through a basic script, and directly through the control page.
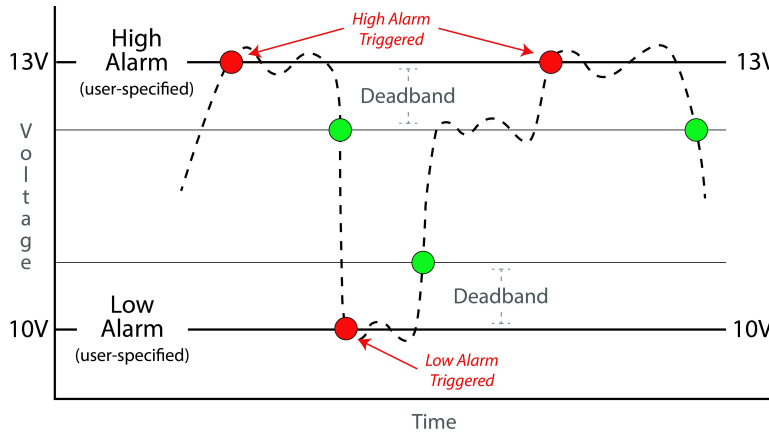
Alarm 2

This is a second alarm trigger that works similar to Alarm 1.

Alarm Deadband

The Deadband prevents alarms from triggering excessively when the sensor measurement vacillates around the trigger point. With high alarms, the measurement must fall below the high alarm point, minus the deadband, before the high alarm will be triggered again. Likewise the deadband on the low alarm requires the measurement to rise above the low alarm point, plus the deadband, before the low alarm will be triggered again.

For example, if the deadband is set to 1 degree, and a high alarm is occurs at 95 degrees, the dead band ensures that once the high alarm is triggered, it won't trigger again until the temperature first drops below 94 degrees (95 – 1).
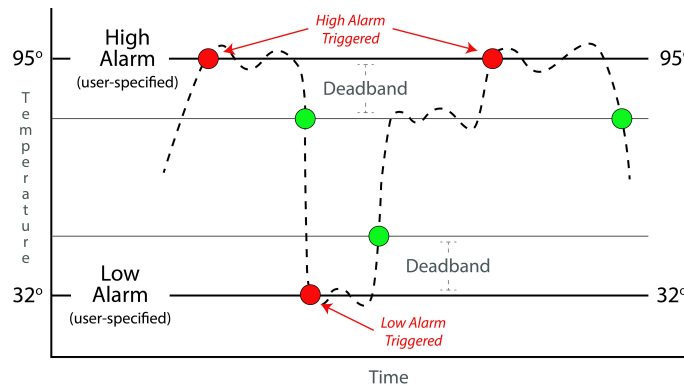
Alarm Delay

The range for the Email/Action Delay is 0 to 3600 seconds. This allows the user to set a time period that the device will wait before triggering an alarm. For example, if sensor 1 is configured to trigger an alarm when the temperature is above 80 degrees and the *Delay* has been set to 20 seconds, then there will be a delay of 20 seconds after the temperature goes above 80 degrees before the alarm is triggered. At the end of the 20 second delay, before the alarm is triggered, the temperature will be checked again, if the temperature has dropped below 80 degrees, no alarm will be triggered.

ALERTS

Email Option

Simple email messages can be sent in response to alarm conditions. This parameter is used to specify what alarm conditions, if any, will cause email messages to be sent. Note that email notifications work only if email is correctly setup in the *Network* setup page.

> *No Email Messages*: No email messages will be sent due to alarm conditions.

> *Send Email on Alarm 1*: Email notifications will be sent due to Alarm 1 conditions.

> *Send Email on Alarm 2*: Email notifications will be sent due to Alarm 2 conditions.

> *Send Email on Alarm 1 and Alarm 2*: Email notifications will be sent due to Alarm 1 or Alarm 2 conditions.

> *Send Email on Alarm 1, Alarm 2, and Normal*: Email notifications will be sent due to Alarm 1, Alarm 2, or when normal conditions are regained.

Use Email Address

If email messages are to be sent out based on alarm conditions, these check boxes specify to which email addresses the message will be sent. The Email address specified on the *Network setup tab* will be shown next to each check box.

Remote Service/SNMP

This field specifies the action with a remote server due to an alarm condition.

>   ***No Action***: No action is taken.

>   ***Send State Msg/Trap***: An event string will be sent to the remote server.

The second drop-down box specifies the conditions that will cause an alarm trigger. The following alarm conditions are available:

>   ***Alarm 1***: The specified action occurs due to Alarm 1.

>   ***Alarm 2***: The specified action occurs due to Alarm 2.

>   ***Alarm 1 or Alarm 2***: The specified action occurs due to Alarm 1 or Alarm 2.

3.2.5 Relay Tab

Relay #

This drop-down menu is used to select the relay to configure.

Relay Description

This text field is used to describe the function of the selected relay. The text appears to the left of the corresponding relay status on the *Control Page* and in the email message when email alerts are enabled. Up to 14 characters may be entered in this field. The default text is "`Relay #`".

On Status Text

The text in this field specifies the text that will be displayed in the *Control Page* and in email messages when the relay is ON. Up to 9 characters may be entered in this field. The default text is "`ON`".

On Status Color

This field specifies the color that will be displayed on the *Control Page* when the relay is considered On. Options are Green, Red, Yellow, Blue and White. The default color is Green.

Off Status Text

The text in this field specifies the text that will be displayed in the *Control Page* and in email messages when the relay is OFF. Up to 9 characters may be entered in this field. The default text is "`OFF`".

Off Status Color

This field specifies the color that will be displayed on the *Control Page* when the relay is considered Off. Options are Green, Red, Yellow, Blue and White. The default color is Red.

On Button Label

The text entered in this field appears in the 'On' button for the corresponding output on the *Control Page*. Up to 9 characters may be entered in this field. The default text is "ON".

Off Button Label

The text entered in this field appears in the 'Off' button for the corresponding output on the *Control Page*. Up to 9 characters may be entered in this field. The default text is "OFF".

Pulse Button Label

The text entered in this field appears in the 'Pulse' button for the corresponding output on the *Control Page*. Up to 9 characters may be entered in this field. The default text is "PULSE".

<u>**ALERTS**</u>

Email Option

Simple email messages can be sent in response to relay state changes. This parameter is used to specify what relay state changes, if any, will cause email messages to be sent. Note that email notification will work only if the email settings are correctly set up in the *Network* setup page. The following options are available:

> ***No Email Messages:*** No email notifications will be sent due to relay state changes.

> ***Send Email when input on:*** Email notifications will be sent when relay state changes to ON.

> ***Send Email when input off:*** Email notifications will be sent when relay state changes to *OFF*.

> ***Send Email when input changes state:*** Email notifications will be sent when relay changes state to *ON* or *OFF*.

Note: The default setting for this field is *No Email Messages*.

Use Email Address

If email messages are to be sent out based on relay state changes, these check boxes specify to which email addresses the message will be sent. The Email addresses specified on the *Network* setup tab will be displayed next to each check box. By default, no boxes are checked.

Remote Service/SNMP

When this box (Send State Msg/Trap on Relay Change) is checked, SNMP traps and/or State messages will be sent whenever the relay state changes. Remote Services or SNMP must be enabled and properly configured for this feature to be effective.

<u>**CONTROL**</u>

Pulse Duration

When X-310S receives a pulse command for the relay (through the web page or through a command), the relay will pulse for the time specified in this field. Note that when a pulse command is sent through the command interface, the command can include a pulse time which will over-ride this value (for that pulse only). The time is specified in seconds and can range from `0.1` seconds to `86400` seconds in 0.1 second increments. The default time is `1.5` seconds.

Relay State at Power up

This drop-down menu lets the user specify the state of each of the relays when the X-310S is powered up. The following options can be selected:

> ***Off (unless overridden by event):*** The relay will be off upon power up. This is the default setting.
>
> ***On (unless overridden by event):*** The relay will be on when power is applied to the X-310S.
>
> ***Last state (unless overridden by event):*** Upon power up, the relay will return to its last state when the X-310S was powered off.

Control Source and #

These drop-down menus specify what input/sensor/relay controls the state of the relay. The following options can be selected:

> ***Digital Input:*** The state of the relay will be controlled by the digital input.
>
> ***Vin:*** The state of the relay will be controlled by Vin.
>
> ***1-Wire Sensor:*** The state of the relay will be controlled by a 1-Wire Sensor (temperature or humidity)
>
> ***Relay:*** The state of the relay will be controlled by the another relay

If you wish to control the relay exclusively from the control page, select one of the above and set the relay action to *No Action*.

Depending on the Control Source selected, the # drop-down menu will change. For example, when Digital Input is selected, the # drop-down menu will have options 1-4. If Vin is selected, the # drop-down menu will only have one option. If a Relay control source is selected then the # drop-down menu will have options 1-4 accept for the number of the relay currently being configured. Relays cannot be configured to control themselves.

Relay Action

These drop-down menus specify what action to take when a criteria is met. The available actions are the same regardless of the control source. The options in this drop-down list change depending on which control source has been selected. The following settings are available.

If *Digital Input* is selected the following Action options are available:

> ***No Action:*** The digital input has no effect on the relay (the W*hen* setting is irrelevant.)
>
> ***Relay Equals Source:*** The relay turns on when the input is on, and off when the input is off.
>
> ***Relay Opposite Source:*** The relay turns off when the input is on, and on when the input is off.
>
> ***Latch On:*** The relay latches on when the input is [on, off, or changes.]
>
> ***Latch Off:*** The relay latches off when the input is [on, off, or changes.]
>
> ***Toggle:*** The relay changes state when the input is [on, off, or changes.]
>
> ***Pulse:*** The relay is pulsed when the input is [on, off, or changes.]

If *Vin* is selected, the following Action options are available:

> ***No Action:*** The Vin has no effect on the relay (the W*hen* setting is irrelevant.)
>
> ***Relay On:*** The relay turns on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Relay Off:*** The relay turns off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Latch On:*** The relay latches on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Latch Off: The relay latches off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Toggle: The relay changes state when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Pulse: The relay is pulsed when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

If *1-Wire Sensor* is selected, choose the sensor number. For each sensor the following Action options are available:

No Action: The sensor has no effect on the relay (the W*hen* setting is irrelevant.)

Relay On: The relay turns on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Relay Off: The relay turns off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Latch On: The relay latches on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Latch Off: The relay latches off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Toggle: The relay changes state when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

Pulse: The relay is pulsed when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

If *Relay* is selected the following Action options are available:

No Action: The control relay has no effect on the relay (the W*hen* setting is irrelevant.)

Relay Equals Source: The relay turns on when the control relay is on, and off when the control relay is off.

Relay Opposite Source: The relay turns off when the control relay is on, and on when the control relay is off.

Latch On: The relay latches on when the control relay is [on, off, or changes.]

Latch Off: The relay latches off when the control relay is [on, off, or changes.]

Toggle: The relay changes state when the control relay is [on, off, or changes.]

Pulse: The relay is pulsed when the control relay is [on, off, or changes.]

3.2.6 Remote I/O Tab

X-310S can be configured to control relays, external variables, and registers on other ControlByWeb devices across the network. These resources are called remote I/O.

Remote I/O #

This option allows you to select which remote resource to configure.

IP Address

The IP address of the remote resource is entered here. The default value is `192.168.1.15`

TCP Port

The TCP port number used to access the remote resource is entered here. This must match the TCP port (HTTP port) set in the remote resource. The valid range is 0 to 65530. The default port number is 80

SSL Encryption:

If the remote I/O is found on another device with encryption support, enabling this feature will allow the X-310S to communicate with the remote device over an encrypted connection. This feature is most useful when the remote device only allows secure connections.

Password

If the remote I/O requires a password for control, the password must be entered here

I/O Type:

This defines what I/O type is being controlled on the remote end. The options are relays, extvars, and registers.

I/O #

The remote relay device may have multiple relays, external variables or registers. This field is used to identify the specific resource to be controlled on the remote device. If the remote device is a single

WebRelay™, this field should be zero. If the remote device has multiple relays, this field should be set to the relay number. For example if relay 2 is to be controlled on another ControlByWeb™ product, the Relay # would be set to 2. This field by be set from 0 to 255.

CONTROL

Control Source and

These drop-down menus specify what input/sensor/relay controls the state of the remote relay, external variable or register. The following options can be selected:

> **Digital Input:** The state of the remote relay will be controlled by a digital input.

> **Vin:** The state of the remote relay will be controlled by Vin.

> **1-Wire Sensor:** The state of the remote relay will be controlled by a 1-Wire Sensor (temperature or humidity)

> **Relay:** The state of the remote relay will be controlled by the state of another relay.

Depending on the Control Source selected, the # drop-down menu will change. For example, when Digital Input is selected, the # drop-down menu will have options 1-4. If Vin is selected, the # drop-down menu will only have one option. If a Relay control source is selected then the # drop-down menu will have options 1-4.

Remote I/O Action

These drop-down menus specify what action to take when a criteria is met. The available actions are the same regardless of the control source. The criteria change depending on what control source has been selected. The following section lists the options available based for each control source selected.

For the Heartbeat Modes, the remote relay is periodically pulsed (periodic state interval) until the selected control source is deactivated. The pulse duration setting is made in the remote device.

If *Digital Input* is selected the following Action options are available:

> **No Action:** The digital input has no effect on the remote I/O. (the W*hen* setting is irrelevant.)

> **I/O Equals Source:** The remote I/O turns on when the input is on, and off when the input is off.

> **I/O Opposite Source:** The remote I/O turns off when the input is on, and on when the input is off.

> **Latch On:** The remote I/O latches on when the input is [on, off, or changes.]

> **Latch Off:** The remote I/O latches off when the input is [on, off, or changes.]

> **Toggle:** The remote I/O changes state when the input is [on, off, or changes.]

> **Pulse:** The remote I/O is pulsed when the input is [on, off, or *changes.]*

> **Pulse (heartbeat mode):** The remote I/O is pulsed continually over and over when the input is on. When the input turns off a message is sent to turn the remote I/O off and no further pulse messages are sent.

If *Vin* is selected, the following Action options are available:

> **No Action:** The Vin has no effect on the remote I/O (the W*hen* setting is irrelevant.)

> **I/O On:** The remote I/O turns on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

> **I/O Off:** The remote I/O turns off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]

> ***Latch On:*** The remote I/O latches on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Latch Off:*** The remote I/O latches off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Toggle****:* The remote I/O changes state when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> **Pulse:** The remote I/O is pulsed when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Pulse* (heartbeat mode):** The remote I/O is pulsed continually over and over when the alarm is on. When the alarm turns off a message is sent to turn the remote I/O off and no further pulse messages are sent.

If *1-Wire Sensor* is selected, choose the sensor number. For each sensor the following Action options are available:

> ***No Action:*** The sensor has no effect on the remote I/O (the W*hen* setting is irrelevant.)
>
> ***I/O Off:*** The remote I/O turns off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***I/O On:*** The remote I/O turns on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Latch On:*** The remote I/O latches on when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Latch Off:*** The remote I/O latches off when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Toggle:*** The remote I/O changes state when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> **Pulse:** The remote I/O is pulsed when [Alarm 1, Alarm 2, Alarm 1 or Alarm 2]
>
> ***Pulse* (heartbeat mode):** The remote I/O is pulsed continually over and over when the alarm is on. When the alarm turns off a message is sent to turn the remote I/O off and no further pulse messages are sent.

If *Relay* is selected the following Action options are available:

> ***No Action:*** The local relay has no effect on the remote I/O (the W*hen* setting is irrelevant.)
>
> ***I/O Equals Source:*** The remote I/O turns on when the internal relay is on, and off when the internal relay is off.
>
> ***I/O Opposite Source:*** The remote I/O turns off when the internal relay is on, and on when the internal relay is off.
>
> ***Latch On:*** The remote I/O latches on when the internal relay is [on, off, or changes.]
>
> ***Latch Off:*** The remote I/O latches off when the internal relay is [on, off, or changes.]
>
> ***Toggle:*** The remote I/O changes state when the internal relay is [on, off, or changes.]
>
> **Pulse:** The remote I/O is pulsed when the internal relay is [on, off, or changes.]
>
> ***Pulse* (heartbeat mode):** The remote I/O is pulsed continually over and over when the internal relay is on. When the internal relay turns off a message is sent to turn the remote I/O off and no further pulse messages are sent.

Periodic State Interval

When the X-310S is configured to control a remote device, a connection is established. If the device does not receive a message for 50 seconds the connection is terminated. In order for the connection to be maintained, a message containing the state of the relay can be sent at a periodic interval. This field sets the time interval at which the message is sent. The default setting is `50` seconds, thus just maintaining the connection. If the connections should not be maintained enter a value of `0`. This field may be set to `0` or `5-50` seconds.

3.2.7 External Variables

External Variables are registers can be changed externally through the *Control Page, XML requests,* or the BASIC script. This allows a BASIC script to react to user input. These variables are considered to be floating point numbers, just like other variables in the BASIC script. This tab has settings for each of the external variables.

External Variable #

This drop-down menu selects the External Variable (1-4) to configure.

Description

Text entered here will be displayed in the left column of the control page. Up to 14 characters may be entered here. The default text is "extVar #".

On Status Text

The text in this field specifies the text that will be displayed when the extVar is value 1. The text also appears in the status column on the *Control Page*. Up to 9 characters may be entered here. By default the text is "ON".

On Status Color

This field specifies the color that will be displayed on the control page when the extVar is considered On. Options are Green, Red, Yellow, Blue and White. The default color is Green.

Off Status Text

The text in this field specifies the text that will be displayed when the extVar is value 0. The text also appears in the status column on the *Control Page.*

If the extVar is any other value than 1 or 0, the value itself will be displayed in the same column. Up to 9 characters may be entered here. By default the text is "OFF".

Off Status Color

This field specifies the color that will be displayed on the control page when the extVar is considered Off.

Options are Green, Red, Yellow, Blue and White. The default color is Red.

On Button Label

This text field is used to describe the function of button 1 of the selected extVar. When the user clicks the On Button, the extVar is set to 1.The text also appears to the right of the corresponding extVar status. Up to 9 characters may be entered here. By default, this text is *"*ON*"*.

Off Button Label

This text field is used to describe the function of button 2 of the selected extVar. When the user clicks button 2, the extVar is set to 0. The text also appears to the right of the corresponding extVar status. Up to 9 characters may be entered here. By default, this text is "OFF".

3.3 Monitor and Control Pages

The third set of setup pages, the Monitor and Control Setup menu, is used to view the control page and log file.

3.3.1 Control Page Tab

The Control Page tab displays the control page that users will see by typing the IP address of the X-310S directly into the web browser address bar (i.e. without entering the setup menus.) A more detailed explanation of the control page can be found in *Section 4.1: Browser Operation*.
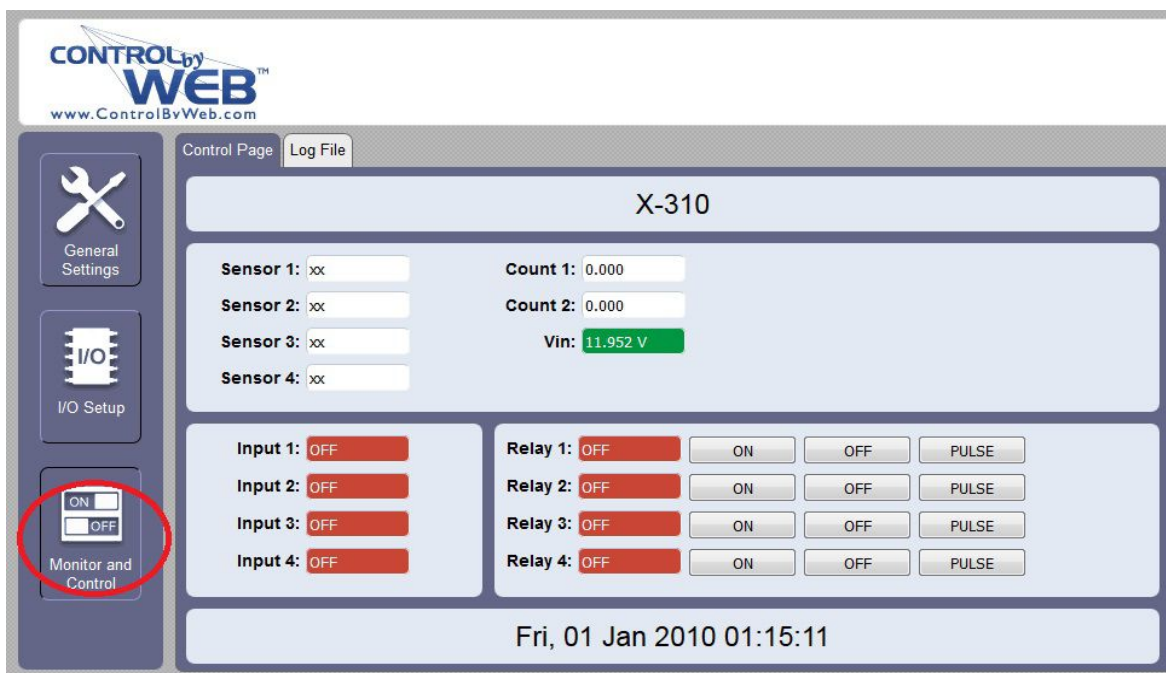
3.3.2 Log File Tab

The Log File Tab shows a formatted version of the log file when logging has been enabled on the Logging setup tab. This contains the same information found when the log.txt file is requested from the device. More details about the log.txt file can be found in *Section 5.6: Log files*.

At the top of the Log File page are two buttons. The *Refresh* button reads the log file from the X-310S and updates the display. It has the same function as navigating to the *Log File tab* for the first time. Depending on the size of the log file, it can take some time for the log file to be fully loaded and formatted.

The *Graph* button opens a popup window that displays a graph of the log file data. The check boxes at the top of the log file data determine what items are graphed. For larger log files, portions of the log file may be chosen to graph. Left clicking on the log data will choose a starting row for the graph, and right clicking on the log data will choose an ending row.
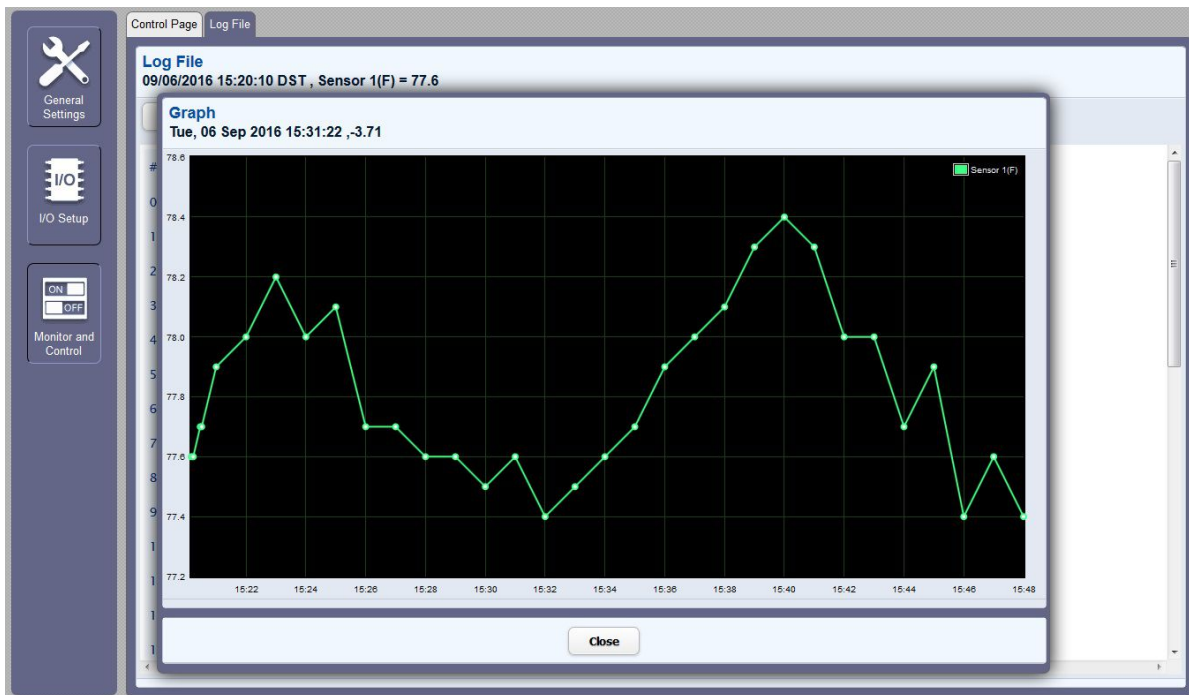
Specific values can be found in the graph by hovering the mouse cursor over the graphed data. The time and value for the location beneath the mouse cursor will appear in the top left corner of the graph popup window. The graph's Key appears in the top right of the graph.

Left clicking on the graph and dragging the mouse to the right or left will select a portion of the graph to zoom in on.

If more complex analysis of the logged data is required, a comma-separated text file can be downloaded and used with a graphing/spreadsheet program. For more details refer to *Section 5.6: Log files*.

Section 4: Control Page

The X-310S can be operated using a web browser, by sending text commands to an XML status/control page, and/or by sending Modbus/TCP requests. The X-310S relays can be controlled using inputs, sensors, other relays, or events. (Using an input or event to control the relays was described in the previous sections of the manual, and will not be described here.)

4.1 Browser Operation

Once the X-310S is set up, users can access the *Control Page* using a web browser. There are two ways to do this. The first is by typing the IP address of the X-310S directly 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 same is true when the default HTTPS port is changed.

The following screen appears when the Control Page is requested from the address bar. The I/O on the control page updates every three seconds. The external variables disabled in this example.
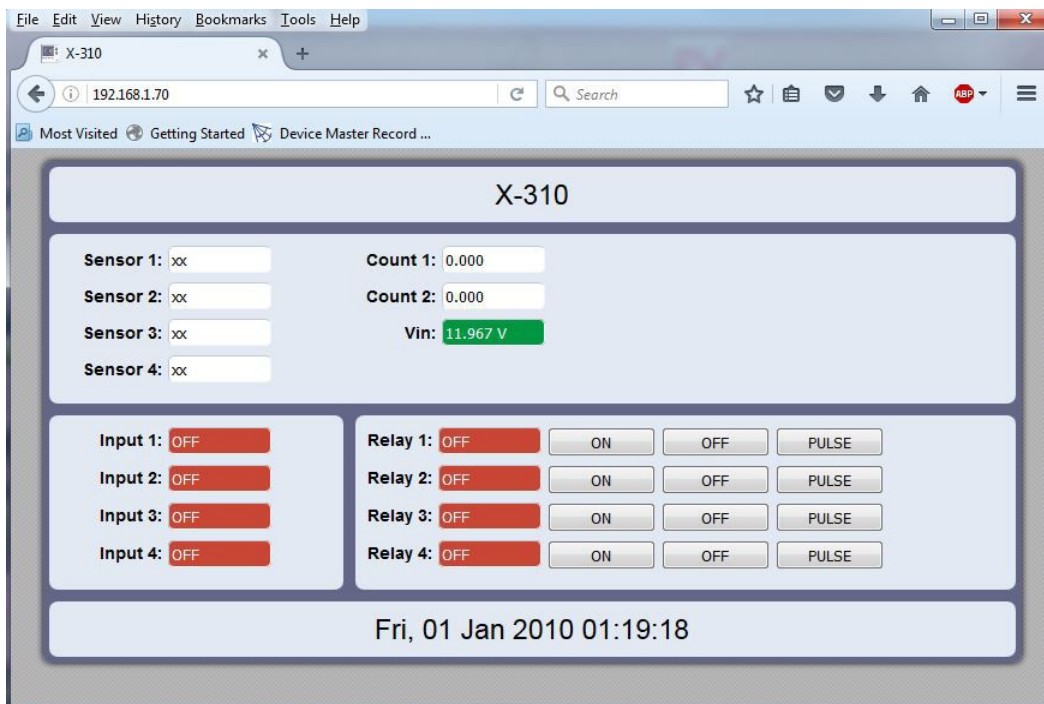
The Control Page is normally what users see and use and it can be highly configured to fit your needs. The *Control Page Setup* tab has check boxes that determine if a specific resource is displayed or not displayed. The device title (text) is also specified in the *Control Page Setup* tab.

Header

Displays the text entered in the Main Header Text field on the *Control Page Setup* tab in the setup pages. This is usually a description of the application such as "Stockroom Freezer".

Vin

This field displays the current Vin+ measurement. This field can be hidden by deselecting the Vin check box on the *Control Page Setup* tab in the setup pages. The voltage will be 0V if the X-310S-E model is powered from the Ethernet cable.

Sensor 1-4

These fields display the current temperature or humidity measured by the associated sensors. Each sensor can be displayed (as shown) or not displayed by checking or clearing the appropriate boxes under the *Control Page Setup* tab in the setup pages. The sensor descriptions (by default reads Sensor 1 through Sensor 4), is specified in the Sensor Description field under the *Sensors* tab in the setup pages.

Count 1-2

A cumulative count of OFF to ON states of the digital inputs is displayed when the Display Counter box is checked.

Input 1 through 4

These rows display the current state of the four digital inputs. Each of these rows can be displayed (as shown) or not displayed by checking or deselecting the appropriate boxes in the *Control Page Setup* tab in the setup pages. The text in the left column (by default reads Input 1, Input 2, etc,) is specified in the Description field in the *Input tab* in the setup pages.

Relay 1 through 4

These rows display the current state of the internal relays and allows the user to change relay state. Each of these rows can be displayed (as shown) or not displayed by checking or deselecting the appropriate boxes in the *Control Page Setup* tab in the setup pages. The text in the left column (by default reads Relay 1, Relay 2, etc.) is specified in the Description field in the *Relays* tab in the setup pages. The state of the relays is shown to the right of the relay description text. By default, the status text will read ON or OFF; however, the status text can be changed in the *Relays* tab. To the right of the relay status, buttons are provided to control the relays. The buttons can be removed when not needed (in the *Control Page Setup* tab) and the text within the buttons can be customized (in the *Relays* tab).

External Variables

These rows display the current state of the four external variables used in the BASIC script. These rows can be displayed (as shown in figure 3.1a) or not displayed (figure 3.1b) by checking or clearing 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* when the extvar is a value of 1 or 0 respectively. To the right of the extvar status, on/off buttons and an input box are provided to control the state/value of the external variable. There is also an option to display up/down buttons that will increment/decrement the extvar when they are pressed or held down. All of these buttons can be enabled/disabled on the *Control Page Setup* tab.

More information on external variables can be found in *Section 5.8: BASIC Scripts.*

Current Time

Displays the current time that is set using the *Date/Time* tab in the setup pages.

4.2   Control Page Tab

The second method of accessing the control page is through the setup pages (http://192.168.1.2/setup.html). Choosing the 'Monitor and Control' button on the left hand side of the setup pages will display the control page shown below. From here the system setup tabs are accessible and the log file can be viewed by selecting the 'Log File' tab at the top (see S*ection 3.3.2: Log File Tab*.)
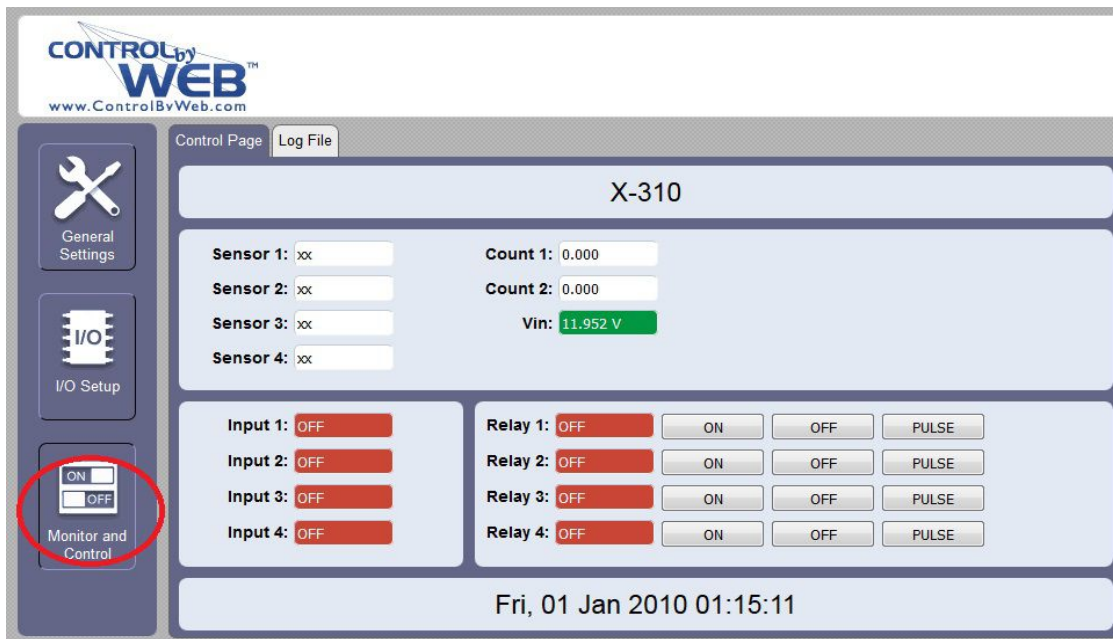
Section 5: Auxiliary Operations

5.1   XML

Custom computer applications may be created to monitor and control the X-310S. This method does not use a web browser. There are three XML pages that can be used to monitor and control the X-310S, state.xml, eventX.xml. and Diagnostics.xml.

Refer to *Section 5.4: External Server and Remote Services* for more information on network configurations when using XML.

5.1.1   state.xml

XML Monitor All Functions

The state of the Relays, Inputs, Counters, Sensors, and Vin 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>
        <input1state>0</input1state>
        <input2state>0</input2state>
        <input3state>0</input3state>
        <input4state>0</input4state>
        <relay1state>1</relay1state>
        <relay2state>0</relay2state>
        <relay3state>0</relay3state>
        <relay4state>0</relay4state>
        <sensor1>x.x</sensor1>
        <sensor2>x.x</sensor2>
        <sensor3>x.x</sensor3>
        <sensor4>x.x</sensor4>
        <s1Alrm>2</s1Alrm>
        <s2Alrm>2</s2Alrm>
        <s3Alrm>2</s3Alrm>
        <s4Alrm>2</s4Alrm>
        <count1>23</count1>
        <count2>23</count2>
        <extvar1>0.00</extvar1>
        <extvar2>0.00</extvar2>
        <extvar3>0.00</extvar3>
        <extvar4>0.00</extvar4>
        <vin>9.577</vin>
        <vinAlrm>1</vinAlrm>
        <serialNumber>00:0C:C8:00:00:00</serialNumber>
        <time>1343647469</time>
</datavalues>
```

The numbers enclosed by the tags, `<tag>`, indicate the current state or value monitored by X-310S. Values for each tag are described in the table below.

Custom Computer applications can open a TCP/IP connection with the X-310S and send a `GET` request for the state.xml file to obtain the current state of the X-310S. Parameters can be passed with the GET request to control relays on the X-310S. (See *Section 5.2 HTTP Get Requests* for instructions on using

GET requests to monitor and control the X-310S.)

XML Tags*	Monitor Values
`<inputXstate>`	0=off (voltage not applied to input one) 1=on (voltage applied to input one)
`<relayXstate>`	0=off (coil one off) 1=on (coil one energized)
`<sensorXtemp>`	x.x = Indicates that no digital temperature sensor is attached. 77.3 = Current temperature. H24.9 = Current humidity reading.
`<sXAlarm>`	Current state of the sensor alarms 0 = Normal 1 = Alarm 1 2 = Alarm 2
`<countX>`	The scaled count value (rawCount * multiplier + offset).
`<extvarX>`	Value of each External Variable.
`<vin>`	Scaled internal Vin measurement
`<vinAlrm>`	Current state of the vin alarms 0 = Normal 1 = Alarm 1 condition 2 = Alarm 2 condition
`<serialNumber>`	00:00:00:00:00:00, serial number of X-310S.
`<time>`	Time displayed in "epoch time" (number of seconds since January 1, 1970)

* 'X' is replaced by the input, relay or sensor number.

5.1.2 XML Control

Commands can be sent to the X-310S to control the relays, counters, and external variables.

Relay State Control

Commands are sent using a variable called relayXState (X is replaced by 1 for relay 1, or 2 for relay 2, etc). A few examples of using relayXState are given here.

Command	Description
`state.xml?relay1State=0`	Turn Relay 1 *OFF*
`state.xml?relay1State=1`	Turn Relay 1 *ON*
`state.xml?relay2State=0`	Turn Relay 2 *OFF*
`state.xml?relay2State=1`	Turn Relay 2 *ON*

Pulse Relay

When the pulse command is sent, the output will turn *ON* for the Pulse Duration specified in the *Relay setup page*. It is also possible to send a pulse time command that is different than the configured Pulse Duration. This is done by sending a pulseTime variable. The pulseTime variable does not change the Pulse Duration in the setup page and it is not stored or recorded. The pulseTime variable only changes the duration for the single pulse initiated by that command. In other words, you must issue the pulseTime command for each pulse command that differs from the preset value. For example, if the X-310S is configured for a Pulse Duration of 1.5 seconds. To issue one 1.5 second pulse, three 5 second pulses, and another 1.5 second pulse to relay 1, you would issue the following commands:

Command	Description
state.xml?relay1State=2	Pulse Relay 1 for the preset time (1.5 seconds).
state.xml?relay1State=2&pulseTime1=5	Pulse Relay 1 for 5 seconds.
state.xml?relay1State=2&pulseTime1=5	Pulse Relay 1 for 5 seconds.
state.xml?relay1State=2&pulseTime1=5	Pulse Relay 1 for 5 seconds.
state.xml?relay1State=2	Pulse Relay 1 for the preset time (1.5 seconds).

XML Set Counter

The counter value can be set using the `countx` command:

Command	Description
state.xml?count1=200	Set counter1 to 200.

5.1.3 Message Acknowledgment

By default, when commands are sent to X-310S, the state.xml page is returned. The xml reply can be disabled by adding the `noReply` parameter as follows:

Command	Description
state.xml?relay1State=1&noReply=1	Turn Relay 1 *ON* without returning state
state.xml?relay1State=0&noReply=1	Turn Relay 1 *OFF* without returning state

5.1.4 eventX.xml

The outputs can be configured to turn *ON*, turn *OFF*, or pulse at specified times. Instructions to change the output state at a given time (or periodically) are called events. X-310S supports 100 events, which can be monitored through the eventX.xml page (where X is the event number 0-99). This can be demonstrated by entering the following URL into the address bar of a web browser:

```
http://192.168.1.2/event0.xml
```

The following event.xml page is returned:

```
<event0>
        <active>yes</active>
        <currentTime>11/14/2010 15:14:09</currentTime>
        <nextEvent>11/15/2010 15:15:00</nextEvent>
        <period>1 d</period>
        <count>0</count>
        <relay>1</relay>
        <action>turn relay(s) on</action>
        <pulseDuration>0.5 s</pulseDuration>
</event0>
```

The tags used by X-310S are described below:

Tags*	Description
<eventX>	Event tag where X represents the event number (0-99).
<active>	This field indicates whether or not the event is active. The text `yes` indicates that the event is active and the event will occur at the next event time. The text `no` indicates that the event is inactive and the event will no longer take place.
<currentTime>	This field indicates the current date and time as `MM/DD/YYYY HH:MM:SS` in 24-hour format.

Tags*	Description
`<nextEvent>`	The next time the event is scheduled to occur is given as `MM/DD/YYYY HH:MM:SS`. If an event is inactive, this field will display the date and time as `xx/xx/xxxx xx:xx:xx`.
`<period>`	For events that occur more than one time, this field indicates the period of the event (time between event occurrences). The unit of time is indicated after the value (seconds (s), minutes (m), hours (h), days (d), or weeks (w)). If this field is set to `0`, then the event has been disabled. For example `1d` would be a period of 3 days.
`<count>`	This field indicates the number of remaining times the event will occur. If this field is 0 and the event is active, then the event is always on.
`<relay>`	Event will apply to the relay(s) specified

`<action>`	One of the follow actions is applied to the event.
	        `turn relay(s) on`
	        `turn relay(s) off`
	        `pulse relay(s)`
	        `toggle relay(s)`
	        `set extVar0`
	        `clear extVar0`
	        `change schedules`

`<pulseDuration>`	This field indicates the time (in seconds) that the output will be turned on.

* 'X' is replaced by the I/O number.

5.1.5 Diagnostics.xml

There is a special diagnostics.xml 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>
        <internalTemp>89.3</internalTemp>
        <vin>12.0</vin>
        <memoryPowerUpFlag>1</memoryPowerUpFlag>
        <devicePowerUpFlag>1</devicePowerUpFlag>
        <powerLossCounter>1</powerLossCounter>
</datavalues>
```

Diagnostic tags are given in the table below.

Tag	Description
<internalTemp>	Indicates the internal temperature of the device.
<vin>	Indicates the DC voltage that is applied to the VIn+ and Vin- terminals.
<memoryPowerUpFlag>	Indicates a loss of power to the capacitor-backed real-time clock. A value of 1 indicates that the real-time clock lost power. This should only happen if the device has lost power for several days. There is an internal capacitor that can power the real-time clock for an extended period of time, even if the main power is lost. If the real-time-clock loses power, the time will have to be reset. By default, this will read 1 until it is set to 0.
<devicePowerUpFlag>	Indicates a loss of power to the device. This field can also be set to 0. A value of 1 means the X-310S has lost power at least one time since the flag was set to 0.
<powerLossCounter>	This field is a count of how many times the X-310S has lost main power.

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

To clear the real-time clock power loss flag:
```
http://192.168.1.2/diagnostics.xml?memoryPowerUpFlag=0
```

To clear the device power loss flag:
```
http://192.168.1.2/diagnostics.xml?devicePowerUpFlag=0
```

To clear the powerLossCounter flag:
```
http://192.168.1.2/diagnostics.xml?powerLossCounter=0
```

Resetting of multiple flags may be done at one time by placing & between each request:
```
http://192.168.1.2/diagnostics.xml?memoryPowerUpFlag=0&devicePowerUpFlag=0
```

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

5.2   HTTP GET Requests (for custom applications)

The X-310S has a built-in web server that responds to HTTP GET requests. These GET requests are sent from web browsers when a web page is requested. They are fairly similar to the actual addresses seen in the browser's address bar. The following section describes the HTTP GET protocol and how it can be used to control and monitor the X-310S.

5.2.1   Using GET for Control and Monitoring

No Password

GET requests to the device for XML files.

Example request state.xml:
```
GET /state.xml HTTP/1.1\r\n\r\n
```

Example turn Relay1 On:
```
GET /state.xml?relay1State=1 HTTP/1.1 \r\n\r\n
```

Password Enabled

If the Control Password is enabled on X-310S 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?relay1State=1&noReply=1 HTTP/1.1 (Terminated with two \r\n.)
```

The following example adds the password:
```
GET /state.xml?relay1State=1&noReply=1 HTTP/1.1 (Terminated with one \r\n.)
Authorization: Basic bm9uZTp3ZWJyZWxheQ== (Terminated with two \r\n.)
```

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

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

5.2.2   HTTP GET Event Configuration

Events can be configured using a GET request through http. For example, to configure event 5 to start on November 19, 2010 at 12:00:00 and continue every day, turning Output 1 on, send the following request (using the default IP address):
```
http://192.168.1.2/eventSetup.srv?
e5=1290168000;1;3;0;0;1;4;0;Event5Desc;127;1;
```

The basic format of the request is:

e(event#)=epoch time;period;period units;count;schedule#;action;pulse duration;0;description;days;action#;

Parameter	Description
e5=	**Parameter Name:** Each event has an identifier (0-99). In this case the parameter name is e5. Event 100 would be e99.
1290168000	**Epoch Time:** The number of seconds up to the desired start date since January 1, 1970.
1	**Period:** The period value.
3	**Period Units:** The units of the period, 0-Seconds, 1-Minutes, 2-Hours, 3-Days, 4-Weeks.
0	**Count:** Number of times the event will occur. (0 = continuous)
0	**Schedule #:** The schedule where the event will occur (0-4). 0 = schedule 0, 1= schedule 1, and so forth.
1	**Action:** 0-No Action, 1-Turn output on, 2-Turn output off, 3-Pulse output, 4-Toggle output, 5-change schedules, 7-Set extVar0, 8-Clear extVar0.
4	**Pulse Duration:** Pulse duration when using the pulse output action.
0	**Next Occurrence:** This is a report value only, indicating the next time this event will occur in Epoch Time. When setting an event leave this at 0.
Event5Desc;	**Description:** Text description of the event, up to 20 characters can be entered.
127	**Days:** This number represents which days the event will occur. This value is the base ten version of a binary number where each bit represents one day of the week. Bit 0 is Saturday and Bit 6 is Sunday. See the table below for some common values.
1	**Action #:** This number represents which output will be affected by the event. This value is the base ten version of a binary number where each bit represents the *ON/OFF* state of one output. Bit 0 corresponds to relay/schedule 1, and Bit 3 corresponds with relay/schedule 4.

5.2.3   Common Base Ten Values for Event Days

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Base 10 Value
Bit 6	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**	--
1	1	1	1	1	1	1	**127**
0	1	1	1	1	1	0	**62**
0	1	0	1	0	1	0	**42**
0	0	1	0	1	0	0	**20**
0	0	0	0	0	0	1	**1**

5.3   SNMP Requests, Objects and Community Strings

Input states, Relay states, Vin, Temperature/Humidity, and some simple network parameters can be retrieved using Simple Network Management Protocol(SNMP). The states of the relays can be changed through SNMP requests. For most cases, using SNMP is as simple as locating the appropriate Management Information Bases (MIB) files and loading them into the SNMP manager software. X-310S can make use of the following MIB files: RFC1213-MIB and XYTRONIX.mib.

Note: As additional ControlByWeb products are introduced, the Xytronix MIB file will remain reverse compatible, older MIB files can be overwritten.

SNMP is configured under the *Advanced Network* setup tab. See S*ection 3.1.3: Advanced Network Tab* for more information.

X-310S supports the following Packet Data Units (PDU):

- GetRequest
- GetNextRequest
- SetRequest
- Trap

5.3.1   Standard Objects

X-310S supports several standard RFC1213 objects that usually come with SNMP management software. If not, an Internet search for RFC1213-MIB will turn up multiple links.

RFC1213 Object	Response
`system.sysDescr`	X-310S DAQ Module
`system.sysObjectID`	X310
`system.sysUpTime`	Time in hundredths of seconds since X-310S was last powered.
`system.sysName`	X-310S*

*The sysName is customizable under the **Control Page Setup** tab.

5.3.2   Xytronix Objects

X-310S also supports some special objects that can be found in the XYTRONIX.mib. This MIB can be downloaded from our website.

Read Only Objects:

Inputs

Object	Input Type	Response
`x310_inputOne`	Digital	Value: 0 or 1 (0 – OFF, 1 – ON)
`x310_inputTwo`	Digital	Value: 0 or 1
`x310_inputThree`	Digital	Value: 0 or 1
`x310_inputFour`	Digital	Value: 0 or 1

Counters

Scaled values are reported.

Object	Response
x310_counterOne	Value: 0.0 (Current count)
x310_counterTwo	Value: 0.0 (Current count)

Vin

Scaled values are reported.

Object	Response
x310_Vin	Value: 0.0 (Current analog value)

Sensors

Object	Response
x310_sensorOne	Value: x.x (Decimal temperature or humidity.)
x310_sensorTwo	Value: x.x (Decimal temperature or humidity.)
x310_sensorThree	Value: x.x (Decimal temperature or humidity.)
x310_sensorFour	Value: x.x (Decimal temperature or humidity.)

Read/Write Objects:

Relays – Read/Write

A Get request will return the current state. A Set request of 0 or 1 will turn the Relay *ON* or *OFF*. A Set request of 2 will pulse the Relay for the time configured in the setup page.

Object	Response	Set Value
x310_relayOne	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x310_relayTwo	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x310_relayThree	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x310_relayFour	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE

5.3.3 TRAPS

X-310S can send SNMP messages when an input or relay changes state, when a particular Sensor value is reached, or when the supply voltage is out of the desired range. The SNMP Trap must be configured for each Relay, Input, and Sensor in the setup pages. The following Traps are supported:

Relay Traps

A change in state of the relay will cause the X-310S to send a Trap message.

Object	Description	Value
X310.75	Relay one state change.	0 or 1 (0 – OFF, 1 – ON)
X310.76	Relay two state change.	0 or 1
X310.77	Relay three state change.	0 or 1
X310.78	Relay four state change.	0 or 1

Input Traps

When an input on the X-310S changes state, a Trap message will be sent.

Object	Description	Value
X320.95	Input one state change.	0 or 1 (0 – OFF, 1 – ON)
X320.96	Input two state change.	0 or 1
X320.97	Input three state change.	0 or 1
X320.98	Input four state change.	0 or 1

Vin Traps

Alarm thresholds can be configured to monitor the supply voltage. An SNMP Trap message can be sent when the boundaries are crossed. See S*ection 3.2.3: Vin Tab* for more information on configuring Vin alarms. Vin trap values are given with one decimal place.

Object	Description	Value
X310.180	Vin alarm	xxx.x

Sensor Traps

Two alarm thresholds can be configured for each sensor. An SNMP Trap message can be sent when the temperature boundaries are crossed. See **2.3.9 Sensor Tab** for more information on configuring the sensor alarms.

Object	Description	Value
X320.65	Sensor one alarm.	xx.x
X320.66	Sensor two alarm.	xx.x
X320.67	Sensor three alarm.	xx.x
X320.68	Sensor four alarm.	xx.x

5.3.4 Password

X-310S uses the Control Password for both the read and write community strings. If the Control Password is disabled, any object can be read without the need for a correct community string. By default the Control Password is webrelay.

5.4   External Server and Remote Services

Note: The following methods are supported by the X-310S; however, Xytronix Research & Design, Inc. does not provide or support custom third-party applications, or external web servers.

5.4.1   Accessing the X-310S with custom software or third party applications

Custom applications can send commands to the X-310S for monitoring and control functions using XML. (See S*ection 5.1: XML Operation* for more information.) 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.

5.4.2   Using an External Web Server

Rather than accessing the X-310S 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-310S. In this scenario, users access custom web pages that reside on the external web server and the external web server communicates with the X-310S.

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-310S and other ControlByWeb™ devices, *Direct Server Control* and *Remote Services*.

5.4.3   Direct Server Control

The first approach is for the external server to create a TCP connection whenever it needs to access the X-310S. 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-310S devices are on the same network (without routers between them). In this case, the server can communicate with the X-310S devices directly and securely since data never has to leave the local network.

When the server and the X-310S 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.

5.4.4   Remote Services

The second approach is for the X-310S to initiate a connection using the *Remote Services*. The settings under the *Advanced Network* tab in the setup pages will enable the X-310S 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-310S are installed on different networks. This is especially useful when each X-310S is installed on a separate private network. For example, if the user doesn't control the network connections where the X-310S is installed, *Remote Services* would initiate a TCP connection over the Internet with the control computer. Since the X-310S initiates the connection, the control computer doesn't have to know the IP address of the X-310S. This

means that the X-310S can be installed using DHCP. In addition, no special router configuration is required. This makes the network installation of the X-310S very simple, and since no incoming ports need to be opened in the router, security is not compromised. See S*ection 3.1.3: Advanced Network Ta*b for more information.

The X-310S can be configured to establish a connection when triggered by an event, such as an I/O state changing. This is done by setting the *Remote Service* checkbox in the I/O setup tabs.

When an event occurs and a connection is open, the state.xml file is sent.

If a connection is not open and *Remote Services* is enabled, a connection will be established by sending the connection string. Once the connection is established, state.xml will be sent.

5.4.5 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.

If version 2 of the Remote Services protocol is enabled, the state.xml file will be sent immediately after the connection string in order to push the status of the device to the remote server. A three-character "ACK" response is expected in return to the initial connection string after a TCP/IP connection is established. If the "ACK" is not received within 10 seconds, the X-310S will close the connection.

5.5   Email Notification

5.5.1   Email Notification Description

The X-310S can be configured to send messages to three email addresses when certain events occur. Events that can trigger email messages include relay/input state changes, Vin changes, temperature/humidity changes, and commands sent from a BASIC script.

When an email message is sent, it looks similar to this:

```
X-310

Trigger: Relay 1 ON

Relay 1: ON
Relay 2: OFF
Relay 3: OFF
Relay 4: OFF
Input 1: OFF
Input 2: OFF
Input 3: OFF
Input 4: OFF
Vin: 12.00 V
Sensor 1: 76.2° F
Sensor 2: 73.7° F
Sensor 3: 32.0° F
Sensor 4: 84.5° F
Count 1: 5.00
Count 2: 0.00
```

Note: Relays, Inputs, Count, and Sensor names as well as ON and OFF status text may be customized by the user (installer) in the setup pages. The same field names are used on the Control Page.

Subject Line

The top line (that reads "X-310S"), appears in the subject line of the email message. This is the same text that appears as the header on the *Control Page*. It is set in the *Main Header Text* field under the *Control Page Setup* tab.

Trigger

The first line displayed in the body of the message shows the event that triggered the message. The text "Trigger" will always appear and cannot be changed. The remaining text includes the trigger name, and what caused the trigger. The text that describes the trigger and its current state are configured in the setup pages as described below.

Current Status of the Digital Inputs, Relays, Vin, and Sensors

The remainder of the email message will display the same information shown on the *Control Page*. Fields not displayed in the *Control Page* will not be included in the email message. Displayed fields may be configured in the *Control Page Setup* page.

5.5.2   Email Notification Setup

Email notification requires that the following fields are properly configured. See *Section 3.1.2* for a description of each field.

Network Tab

IP Address
Subnet Mask
Gateway
Preferred DNS Server (this is required if Mail Server is entered by name and not by IP address)
Alt DNS Server
Mail Server (SMTP)
User Name (If Required)
Password (If Required)
Return Email
Email 1
Email 2
Email 3

Note: The X-310S must be power-cycled (power disconnected, then reconnected) before network settings take effect.

Email triggers can be generated within a BASIC script (See *Section 5.8: BASIC Scripts*), or can be explicitly defined for each Relay, Input, Vin, and sensor under the *Relay, Input, Vin,* and *Sensors* tabs.

The email options and recipients for each Relay, Input, Vin, and Sensor are configured separately. Select the the Email Option and the check box for the desired email recipient for each Relay, Input, Vin, and Sensor.

Once the email settings are entered, the email functionality can be tested by entering the following command:

```
http://IP address/state.xml?testEmail=1
```

For example, using the default IP address, enter:

```
http://192.168.1.2/state.xml?testEmail=1
```

This will cause an email message to be sent immediately. If the messages don't get through, the system log file may have some clues to assist in diagnosing the problem (http://192.168.1.2/syslog.txt). See *Section 5.6: Log Files* for additional Logging Information.

5.6 Log Files

The X-310S logs information to two different log files; log.txt and syslog.txt. Both log files are text files and are stored in nonvolatile memory; this data will not be lost due to power failure and is also not cleared when restoring factory defaults. The log files are stored in circular buffers which write from the beginning of the allocated memory space to the end and then repeat from the beginning (over-writing the original data). The nonvolatile memory is divided into 4K byte sectors. Each time data gets erased to make room for new data, a full sector (4K bytes) is erased at one time.

Data Log File – log.txt

This log file is user-configurable under the *Logging setup tab,* and stores real-world data such as temperatures and events such as relay state changes (see Section *3.1.6: Logging Tab* for more information). It can be up to 512K bytes long and is stored using a comma-separated value formatting scheme.

Inputs, Relays, Counters, Vin, and Sensors will only be displayed if they are selected in the *Logging setup tab*. The file is read by requesting the log.txt file from X-310S. For example, using the default IP address the following command would be used to request the log file:

```
http://192.168.1.2/log.txt
```

File Format:

```
MM/DD/YYYY HH:MM:SS, Input 1-4, Relay 1-4, Counters 1-2, Vin, Sensors 1-4,
Trigger: Source
```

Date and Time Format:

MM – Month (1-12)
DD – Day (1-31)
YYYY – Year (1970 - 2106)
HH – Hour in 24 hour time (0 -23)
MM – Minutes (0-59)
SS – Seconds (0-59)

Sample File:
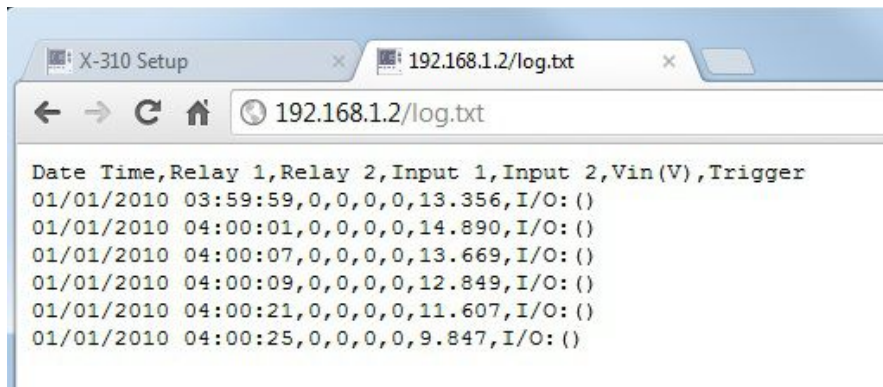
The file can then be saved using the 'Save As...' option under the 'File' menu of the web browser. If the

---

TCP port has been changed (not port 80), the port will be required to read the file. For example, using the default IP address, and port 8000, the log file would be read as follows:

```
http://192.168.1.2:8000/log.txt
```

The log.txt file may be erased with the following command:

```
http://192.168.1.2/log.txt?erase=1
```

After erasing the file, it might be necessary to refresh the page.

Note: If the Control Password is enabled in the setup pages, the password will be required to access the log file.

System Log File – syslog.txt

The syslog file records various system events, which can be used for diagnostics and troubleshooting purposes.

File Format:

```
MM/DD/YYYY HH:MM:SS, (category to which message applies): (message)
```

Sample File:

```
01/02/2010 04:08:13 DEVICE: Power Up.
01/01/2010 00:41:05 DEVICE: Reset factory defaults.
```

Listed below is a description of messages that a user may see:

Category	Message	Description
DEVICE	Power Up	Device has been properly powered.
	Initialize	Device is ready.
	Reset Factory Defaults	Device has been reset to factory defaults.
EMAIL	Failed DNS Lookup	Unable to lookup mail server due to an incorrect DNS setting.
	Bad Username	Email was not sent due to an incorrect user name.
	Bad Password	Email was not sent due to an incorrect password.
	Authentication Required	A user name and password are required by the mail server.
	No Response	No response from SMTP server.
CLOCK	RTC Reset	Real Time Clock has been reset.
NTP SERVER	Request Attempt	Device attempting to connect to NTP Server.
	Failed DNS Lookup	Unable to lookup NTP server name due to an incorrect DNS setting.
	Success	Device successfully connected to NTP Server.
REMOTE SERVER	Failed DNS Lookup	Unable to lookup Remote Server due to an incorrect DNS setting.
	Connection Attempt Started	Connection port with Remote Server has been opened.
	Connection Closed	Connection port with the Remote Server has been closed.
DHCP	Address Acquired	IP address request successful, and IP address assigned.
	Lease Renewal	IP address assigned to device was renewed.
MAIN_MCU	New Firmware Loaded	New firmware has been loaded to the device.

This file is read by requesting the syslog.txt file. For example, using the default IP address the following command would be used:

```
http://192.168.1.2/syslog.txt
```

Note: The setup user name and password are required to access this file.

If the TCP port has been changed (not port 80), the port will be required to read the file. For example, using the default IP address, and port 8000, the log file would be read as follows:

```
http://192.168.1.2:8000/syslog.txt
```

To erase the file, use:

```
http://192.168.1.2/syslog.txt?erase=1
```

5.7   Modbus/TCP

The X-310S can be controlled and monitored using Modbus/TCP protocol. This provides a standard means of using the X-310S 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-310S functions as a Modbus slave. Host devices, such as PLCs, open a connection with the X-310S on port 502 (configurable under *Advanced Network* tab) and then send requests to read or set relay states, read input states, or sensor values. When the X-310S receives a command, it will perform the desired function and return a response.

The following sections provide an overview and explanation of Modbus operation.

5.7.1   X-310S Function Code Summary

The X-310S supports the following function codes:

Code Name	Modbus Function	X-310S Feature	X-310S Start Address	
			Hexadecimal	**Decimal**
Read Coils	01	Relays 1-4	0x0000-0x0003	0-3
Read Discrete Inputs	02	Inputs 1-4	0x0000-0x0003	0-3
Read Analog Inputs	03	Vin	0x0010	16
Read Sensors	03	Sensors 1-4	0x0110-0x0116	272-278
Read Counters	03	Counters 1-2	0x0210-0x0212	528-530
Write Single Coil	05	Relay 1-4	0x0000-0x0003	0-1
Write Multiple Coils	15	Relay 1-4	0x0000-0x0003	0-1
Pulse Coils	16	Relay 1-4	0x0310-0x0317	784-791
Set Counter	16	Counters 1-2	0x0210-0x0211	528-530

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-310S 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. For example, an error during the read coils function 0x01 would return 0x81. 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 output combination.

5.7.2 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.

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 over lap. 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-310S™ feature address and add to it the address offset in the PLC address mode column.
>   *Input Address + PLC Base Address = PLC Address*

For example, to read discrete Input 2
>   Input Address   1
>   PLC Base address 1001
>   PLC Address   1002

Programming the PLC to read from 1002 will return the value of Input 2.

Code Name	Modbus Function	X-310S Addresses	Data Type	PLC Address Mode 485	PLC Address Mode 584/984
Read Coils	01	0-3 (Relays 1-4)	Discrete	Addr + 1	Addr + 1
Read Discrete Inputs	02	0-3 (Inputs 1-4)	Discrete	Addr + 1001	Addr + 10001
Read Holding Registers	03	16 (Vin)	32-bit float	Addr + 4001	Addr + 40001
		272-278 (Sensors 1-4)	32-bit float	Addr + 4001	Addr + 40001
		528-530 (Counters 1-2)	32-bit int	Addr + 4001	Addr + 40001
Write Coils	05	0-3 (Relays 1-4)	Discrete	Addr + 1	Addr + 1
Write Multiple Coils	15	0-3 (Relays 1-4)	Discrete	Addr + 1	Addr + 1
Write Multiple Registers	16	528-530 (Counters 1-2)	32-bit int	Addr + 4001	Addr + 40001
		784-791 (Relays 1-4)	32-bit float	Addr + 4001	Addr + 40001

For 32-bit numbers, two registers must be read starting at the desired address, examples of each are given for the applicable functions.

5.7.3 X-310S Full Address Table

The table below gives commonly used function codes, memory types, data sizes, and equivalent PLC addresses for accessing the X-310S. The data size will be the same regardless of the addressing mode.

	Function Code	Address (Decimal)	Data Size	PLC Address Mode 485	PLC Address Mode 584/984
Read Relay 1	01	0	Discrete	1	1
Read Relay 2	01	1	Discrete	2	2
Read Relay 3	01	2	Discrete	3	3
Read Relay 4	01	3	Discrete	4	4
Write Relay 1	05	0	Discrete	1	1
Write Relay 2	05	1	Discrete	2	2
Write Relay 3	05	2	Discrete	3	3
Write Relay 4	05	3	Discrete	4	4
Read Input 1 State	02	0	Discrete	1001	10001
Read Input 2 State	02	1	Discrete	1002	10002
Read Input 3 State	02	2	Discrete	1003	10003
Read Input 4 State	02	3	Discrete	1004	10004
Read Vin	03	16	32-bit Float	4017	40017
Read Sensor 1	03	272	32-bit Float	4273	40273
Read Sensor 2	03	274	32-bit Float	4275	40275
Read Sensor 3	03	276	32-bit Float	4277	40277
Read Sensor 4	03	278	32-bit Float	4279	40279
Read Counter 1	03	528	32-bit Float	4529	40529
Read Counter 2	03	530	32-bit Float	4531	40531
Write Multiple Relays	15	0	8-bit	1	1
Set Counters	16	528	32-bit int	4529	40529
Pulse Relays	16	784	32-bit Float	4785	40785

5.7.4 Read Coils - Modbus Function Code 01 (0x01)

Read the state of the relays.

Request

Start Address: 0x0000 (coil 1) to 0x0001 (coil 2)
Coil Quantity: 0x0001 (1 coil) to 0x0002 (2 coils)
Both Outputs may be read at the same time by specifying the correct starting address and quantity of coils to be read.

Response

The X-310S will respond to the request with a data field of one byte, each bit representing the coil status. A '1' indicates the Output is *ON*. A '0' indicates that the Output is *OFF*.

Bit zero of the return value will be the state of the coil corresponding to the start address. For example, if a start address of 0x0001 is used, bit zero will be the status of Relay 2.

<table>
<tr><th colspan="8">Coil State Byte</th></tr>
<tr><th>Bit 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>Bit 0</th></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>Relay 4</td><td>Relay 3</td><td>Relay 2</td><td>Relay 1</td></tr>
</table>

Errors

The sum of the start address and coil count cannot exceed the maximum coil count or an error response will be returned.

The following are possible error responses:

Coil Read Error Function Code (1 byte): 0x81

Exception Codes (1 byte):   0x01 – Function code not supported.
                                 0x02 – Incorrect combination of start address and quantity of Relays

5.7.5   Read Discrete Inputs – Modbus Function Code 02 (0x02)

This function returns the state of the digital inputs.

Request

Start Address: 0x0000 (input1) to 0x0003 (Input 4)
Input Quantity: 0x0001 to 0x0004

The sum of the starting address and the quantity of coils must not be greater than 0x0004. For example, if you want to read 0x0002, both inputs, then the start address must be 0x0000. To read the second input only the start address is 0x0001 with a quantity of 0x0001.

Response

The inputs states are indicated by bits one and two of the status byte. A 1 indicates that the input is switched high *ON*. A 0 indicates that the input switched low *OFF*. Bit zero of the return value will be the state of the coil corresponding to the start address. For example, if a start address of 0x0001 is used, bit zero will be the status of input 2.

When reading all 4 inputs, the following table shows the bit positions.

Discrete Input State Byte							
Bit 7	6	5	4	3	2	1	Bit 0
X	X	x	x	Input 4	Input 3	Input 2	Input 1

Errors

Input Read Error Function Code (1 Byte): 0x82

Exception codes (1 Byte):   0x01 – Function not supported.
                                 0x02 – Incorrect combination of start address and input quantity.

5.7.6 Read Sensors – Modbus Function Code 03 (0x03)

The Read Holding Registers function is used for the counters, vin, temperature and humidity sensors.

Request

32-bit sensor values are read from 16-bit register pairs. Consequently, senors addresses and registers must be even numbers.

Vin Start Addresses

Start Address: 0x0010 (Vin)
Input Quantity: 0x0002

Temperature and Humidity Sensor Start Addresses

Start Address: 0x0110 (Sensor Input1) to 0x0116 (Sensor Input 4)
Input Quantity: 0x0002 to 0x0008

Counter Input Start Addresses

Start Address: 0x0210 (Counter 1) to 0x0212 (Counter 2)
Input Quantity: 0x0002 to 0x0004

Response

32-bit floating-point values are returned, either as little-endian or big-endian numbers, depending on the configuration in the *Advanced Network tab*.

With little-endian ordering, a temperature reading of sensor 1 (0x0110) would return 0x800042A2. The least significant word would be 8000 hex and the most significant word would be 42A2. This hexadecimal value converts to a temperature reading of 81.25 degrees.
If a temperature or humidity sensor is not installed, a value of 0xFFFFFFFF (NaN) is returned. Other inputs will show measured values of the open circuits.

Errors

Sensor Read Error Function Code (1 byte): 0x83

Exception Codes (1 byte):   0x01 – Function not supported.
                                  0x02 – Incorrect combination of start address and input quantity

5.7.7   Write Single Coil – Modbus Function Code 05 (0x05)

Relays may be controlled one at a time.

Request

Start Address (2 bytes):   0x0000 (Relay 1) – 0x00003 (Relay 4)
Output Value (1 byte):   0x00 (OFF), 0xFF(ON)
Padding (1 byte):   0x00

Response

The response mirrors the requested state, 0x00 or 0xFF.

Errors

Single Coil Write Error Function Code (1 Byte): 0x85

Exception codes (1 Byte):   0x01 – Function not supported.
                                0x02 – Address out of range.
                                0x03 – Padding value.

5.7.8   Write Multiple Coils - Modbus Function Code 15 (0x0F)

One byte can be written to set the state of all relays, each bit representing one relay.

Request

Relay states are controlled by specifying the start address of the first relay to be controlled, the count of the relays to be affected, and the relay state byte.

A relay value of 0xFFFF would be used to turn *ON* all of the relays in the range or 0x0000 to turn them *OFF*. In the above example, the relay value 0xFF would turn relays 1-4 *ON*.

Start Address (2 bytes):   0x0000 (Relays 1) – 0x0003 (Relays 2)
Output Quantity (2 bytes):   0x0001 – 0x0004
Byte Count (1-2 bytes):   0x01
Relay Value (1 bytes):   0x0000 – 0x0003

Relay State Byte							
Bit 7	6	5	4	3	2	1	Bit 0
X	X	X	X	Relay 4	Relay 3	Relay 2	Relay 1

Response

The quantity value is returned.

Errors

Multiple Coil Write Error Function Code (1 Byte): 0x8F

Exception codes (1 Byte):   0x01 – Function not supported.
                                 0x02 – Incorrect combination of start address and Relay quantity
                                 0x03 – Byte count out of range.

5.7.9 Write Multiple Registers – Modbus Function Code 16 (0x10)

The Modbus Write Multiple Registers function can be used to set the counter to a specific value or pulse the relays.

Request

Set Counters

The counter value is specified using a 32-bit integer (not a floating point number).

Start Address (2 bytes):   0x0210 (counter 1) - 0x0212 (counter 2)
Register Quantity (2 bytes):   0x0002 - 0x0004 (2 registers for each counter, even number)
Byte Count (1 byte):   0x04 - 0x08 (Multiples of 4)
Counter Quantity (4 bytes/Counter):   0x00000000 – 0xFFFFFFFF

Pulse Relay

The Modbus Write Multiple Registers function is used to pulse the relay(s) for a specified time. When X-310S receives this command, it immediately turns the appropriate relay(s) *ON* (if not already on) and starts the pulse timer. The relay(s) are selected by writing the pulse time in seconds to the register(s) associated with the desired relay(s).

The pulse time is specified using floating point format in the register value field and can range from 0.1 seconds to 86400 seconds (1 day). When the pulse time expires, the relay will be turned *OFF*. If a pulse time command is sent with a value greater than 86400, the pulse timer will be set to 86400. If a pulse time command is sent with a value less than 0.1, the pulse timer will be set to 0.1.

If any commands are sent to X-310S (Modbus, XML, SNMP, or HTML) before the pulse timer has expired, the pulse timer will be canceled immediately and the new command will be executed.

IEEE 754 floating point format is used for the pulse time. X-310S may be configured for little-endian or big-endian transmission. The endian-ness is configured in the *Advanced Network* tab. (See *Advanced Network Tab* for more information.)

Start Address (2 bytes):   0x0310 (relay 1) – 0x0316 (relay 4)
Register Quantity (2 bytes):   0x0002 – 0x0008 (2 registers for each relay, even number)
Byte Count (1 byte):   0x04 – 0x10 (Multiples of 4)
Pulse Duration (4 bytes/relay):   0x3DCCCCCC – 0x47A8C000 (big-endian)
                                   0xCCCC3DCC – 0xC00047A8 (little-endian)

Response

The request is acknowledged by responding with the register quantity that was requested.

Errors

Pulse Function code Error (1 Byte):   0x90

Exception codes (1 Byte):   0x01 – Feature not supported.
                                       0x02 – Address quantity not an even number.
                                              Incorrect combination of start address and relay count.

5.8 Basic Scripts

BASIC (Beginners All-purpose Symbolic Instruction Code) is a computer programming language that has been in use for many years. The X-310S has an integrated BASIC interpreter for a simple BASIC script. 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 that are available for larger computers. Some non-standard commands have been added, and some commands may function differently on the X-310S BASIC interpreter than on other platforms. The following is a short tutorial on the supported BASIC functions.

Example scripts are available at http://www.controlbyweb.com/support/sample_code.html. Contact customer support if further assistance is required.

5.8.1 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 4-Kbytes. 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.

5.8.2 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. One space must be used between

all statements, numbers, variables, operators, expressions, etc. Multiple spaces are invalid.

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

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

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
LET b = a + 2
IF b = 3 THEN
```

5.8.3 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

Example:

```
let t0 = 100
do while t0 > 0
    ' wait
loop
```

LOG

The LOG statement causes the device to log data according to the settings specified under the *Logging setup tab*.

Note: In order to log, logging must be enabled in the Logging setup tab.

The format is: LOG

EMAIL

The EMAIL statement causes the device to send an email of the same format as that generated by other status change and alarm conditions. The event that triggered the email is given, followed by the I/O or Sensor that you want to email. The format is:

EMAIL (feature state – relayX, inputX, tempX, vin) 'X represents the feature number such as relay2
Examples:

```
    EMAIL         'Status email sent to addresses listed under Network tab.
...or...
    EMAIL relay2 'Sends state change message to emails setup in I/O tab.
...or...
    EMAIL input1 'Input state change message to emails setup in I/O tab.
...or...
    EMAIL temp2  'Temp alarm message sent to recipients in the Sensors tab.
```

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 displays 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)   'show variable value to screen
PRINT "(message)"   'show '(message)' to screen

5.8.4 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 variables may be initialized. These must be single character, lower case letters.

a, b, c, d, e, f, g, h, i, 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
```

5.8.5 Predefined Variables

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

5.8.5.1 Timer Variables

Six timers are available for use in BASIC scripts.

t0, t1, t2, t3, t4, 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 100 ms until it reaches zero.

Examples:

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

5.8.5.2 Relay Variables

Relay variables are represent the state of the relays and can be used to change the state of the relays. Remote relays can also be controlled, but not read. The following variables are available.

relay1   'relay 1
rmt_relay1   'remote relay 1
rmt_relay2

Note: Commands can be sent to remote relays, but the states of those relays cannot be read. Consequently, remote relays should not be used in safety or security-critical applications.

Relay outputs can be turned ON, turned OFF, pulsed, toggled, or read in BASIC scripts. The LET statement is used to set the output state. The state options available are:

0 – turn relay off
1 – turn relay on
2 – pulse relay
5 – toggle relay

The pulse time is specified in the **Relay** setup tab.

Examples:

```
Let relay1 = 1      'turn on relay 1
Let relay1 = 0      'turn off relay 1
Let relay1 = 2      'pulse relay 1
Let relay1 = 5      'toggle relay 1
Let a = relay2      'read the state of relay 2, state will be 0 or 1
```

5.8.5.3 Input Variables

The digital input states can be read in BASIC scripts.

input1   'digital input 1

Example:

```
Let a = input1     'sets 'a' equal to value of input 1
```

5.8.5.4 Counter Variables

The input counter can be read in BASIC scripts.
count1   'input 1 counter

Example:
```
If count1 > 5000 Then    'If input counter 1 is greater than 5000 then
      Let relay1 = 1     'turn output 2 on
End If
```

5.8.5.5 Analog Variables

The analog input scaled values can be read in BASIC scripts.

ana1   'analog input 1
...   'ana2, ana3
ana4   'analog input 4
Example:

```
If ana1 > 4 Then          'If Analog Input 1 is greater than 4 then
      Let relay1 = 2      'Pulse output 1, otherwise
Else
      Let relay1 = 0      'output1 will be off
End If
```

5.8.5.6 Temperature/Humidity Sensor Variables

Each temperature sensor or humidity sensor can be read in BASIC scripts.

temp1   'temp or humidity sensor 1
temp2   'temp or humidity sensor 2
…
temp4   'temp or humidity sensor 4
Example:

```
If temp2 >= 80 Then       'If temperature sensor reads greater than 80
                          ' degrees, then
  Let relay2 = 1          'Turn on relay 2
End If
```

5.8.5.7 Date and Time Variables

The variables 'time' and 'date' are predefined, read only variables that store the current date and time. They can be used to schedule events and activities, such as sending emails, reading temperature, or setting Outputs. The date uses the mm/dd/yyyy format. Clock time is formatted as hh:mm:ss (24-hour clock).

Example:

```
If date = 01/01/2014 Then
  If time > 12:30:00 Then
    Let relay2 = 1
    Let relay3 = 0
  End If
```

```
End If
```

Note: Current date and time can only be set in the Date/Time tab.

5.8.5.8 Event Variables

Data and time variables can be used to execute script events.

Up to five date variables are available.

> *ed1*   'event date variable 1
> *…*   'ed2, ed3, ed4
> *ed5*   'event date variable 5

The value assigned to event variables should be in the format mm/dd/yyyy. The event date variables store the number of days that have passed since January 1, 1970.

Event time variables may be used in math expressions as well as comparison statements.

Time variables have a similar naming convention.

> *et1*   'event time variable 1
> *...*   ' et2, et3, et4
> *et5*   'event time variable 5

Event time variables are declared in the format hh:mm:ss in 24-hour time. The event time variables store the number of seconds from the beginning of the day.

Event date and event time variables of the same number are linked. If the event time variable is incremented more than the number of seconds in a day (86400 seconds), the variable is reset to 0 and the event date variable is incremented by one. For example, if et3 rolls over to zero, ed3 will be incremented.

The following script example demonstrates defining the event variables and comparing it to the current date and time. Assume current time is April 10, 2010 at 1:30 AM and the event should occur in one hour and every hour thereafter.

Example:

```
Let a = 1
Let ed1 = 04/10/2010            'sets the event date to April 10,
                                '2010.
Let et1 = 02:30:00              'sets the event time to 2:30
Do While a <> 0
  If ed1 >= date Then           'Tests event date versus current date.
    If et1 >= time Then         'Tests event time versus current time.
      Let et1 = et1 + 3600      'Increments the event time by one hour
                                '(in seconds).
      Print "Event"             'Event to occur
    End If
  End If
Loop
End
```

5.8.6   External Variables

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.

> *extvar0*   'external variable 1
> *…*   'extvar2, extvar3
> *extvar3*   'external variable 4

The following example demonstrates this by creating a script that will turn Output 1 ***ON*** if extvar1 equals

1 and turn Output 1 *OFF* if extvar1 equals 0.

Example:

```
Do
  If extvar1 = 1 Then
    Let rmt_relay1 = 1
  Else
    Let rmt_relay1 = 0
  End If
Loop
End
```

External variables can also be used to show numeric values, such as a count-down timer. If the extVar is any other value than 1 or 0, the value will be displayed in the Status 2 column, with a gray background. See *Section 3.1.8: Script Tab* for instructions on configuring external variables for visibility on the *Control Page*.

The following code will show a count down from 10 seconds and automatically restart. The refresh rate must be configured in the *Control Page Setup* in order to see each of the count down values.
Example:

```
let t0 = 10                        'Initialize variables and start timer
let extvar0 = 10

'Main Loop
Do
    if t0 = 0                    'when timer reaches 0 decrement counter
        let extvar0 = extvar0 - 1
        let t0 = 10
    end if

    if extvar0 < 0           'restart when counter reaches zero
        let extvar0 = 10
    end if
loop
end
```

Extvar1 can be set and cleared by entering the following requests into a web browser or by configuring on and off buttons to appear on the *Control Page* for extvar0:

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

5.8.7 Testing and Debugging

A copy of the BASIC interpreter for Windows is available on www.controlbyweb.com/support/utilities.html for testing and debugging. The X-310S 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.

The "MISSING END OF LINE" error may be caused by misspelled names or a program that is too long. 4096 bytes of memory is reserved for BASIC scripts. Each text character, space, punctuation mark, tab, or carriage return uses one byte. If the script is too long, the script will be truncated and will not function as desired.

Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, the X-310S 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.

    CAUTION: Do not use metal objects for this function

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. log.txt and syslog.txt are retained.

4. Refer to *Section 2.6: Establishing Communications for Setup* to begin reconfiguration of the device.

Reset Button
Access Hole
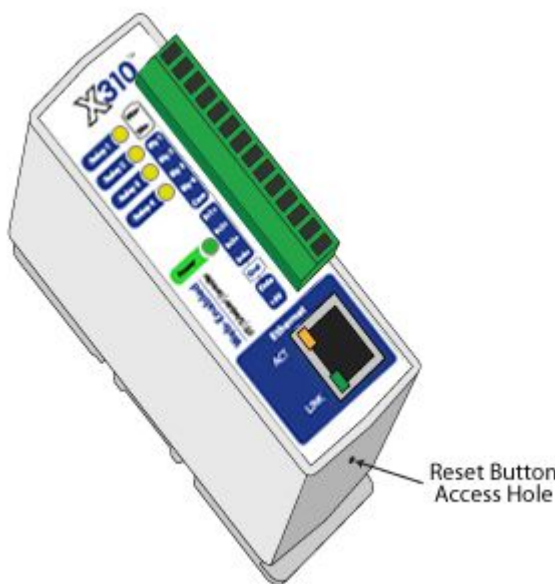
Appendix B: Installing New Firmware

From time to time, updates are made to the X-310S 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 7/8/10 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-310S image can be installed on the X-310S so make sure the correct image is being downloaded.

2. bootloader.exe will connect to the X-310S using default IP address 192.168.1.2, not the address currently assigned to the X-310S. 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 2.6: Establishing Communications for Setup*.

   Note: The IP address of the X-310S will automatically be set to the default 192.168.1.2 during the update process. Since the X-310S supports Auto Negotiation, a crossover cable is not necessary.
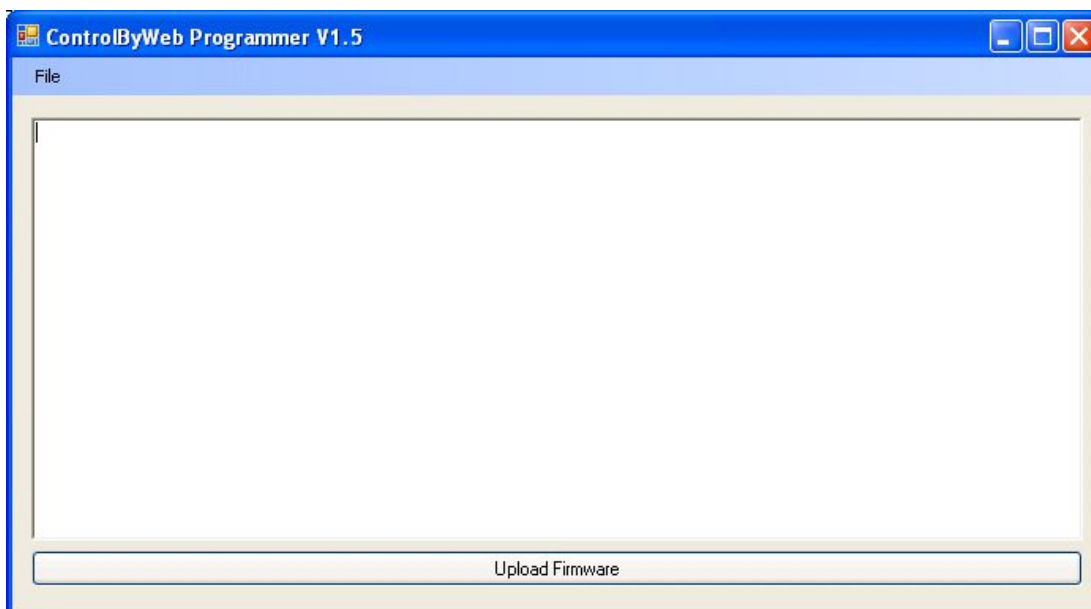

Figure Appendix B.1 - Firmware Update Utility

3. Open the bootloader.exe utility on the computer by double clicking on the downloaded file.

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-310S into bootloader mode and perform the upgrade:

1. Remove DC power from X-310S.

2. Using a small, non-conductive tool, press and hold the reset button.

3. While holding the reset button, apply power to X-310S. 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-310S will be set to factory defaults with an IP address of 192.168.1.2.

6. Refer to S*ection 2.6: Establishing Communication for Setup* to reconfigure the X-310S. 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).
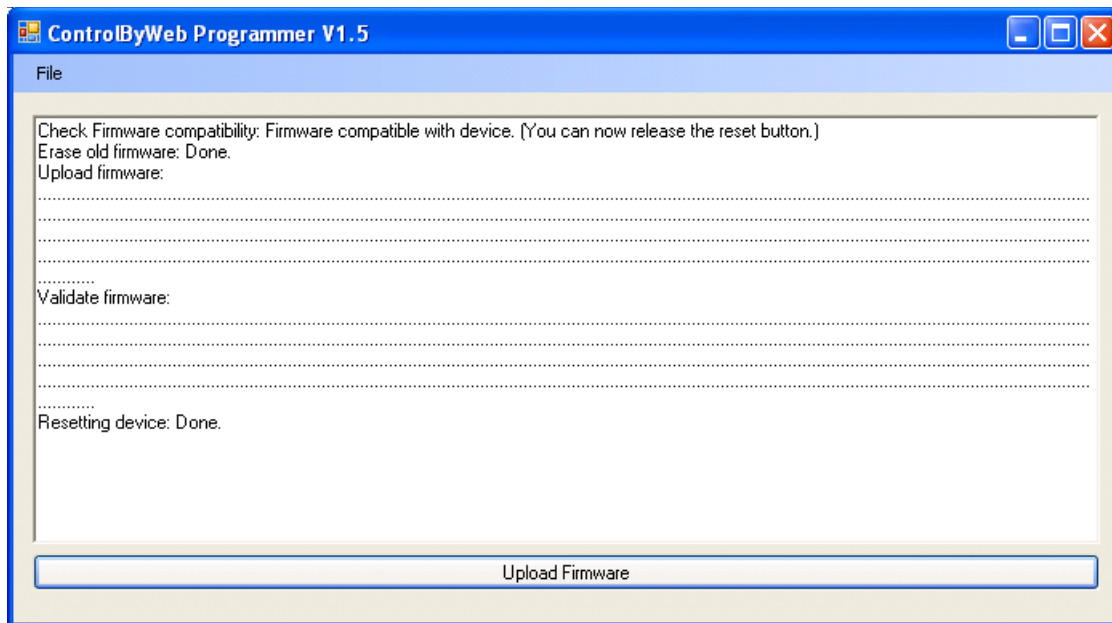
Appendix C: Accessing the X-310S Over the Internet

The X-310S can be monitored and/or controlled from a remote location over the Internet. Once the X-310S 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-310S. 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-310S can be assigned a public IP address for direct connection to the Internet. Typically, a public IP address to would only be assigned to the X-310S 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-310S, and a WebRelay™. In this example, the computer is assigned an IP address of 192.168.1.10, the X-310S has the IP address of 192.168.1.25 and a WebRelay™ has and IP address of 192.168.1.26. A person using the computer can access the X-310S 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.
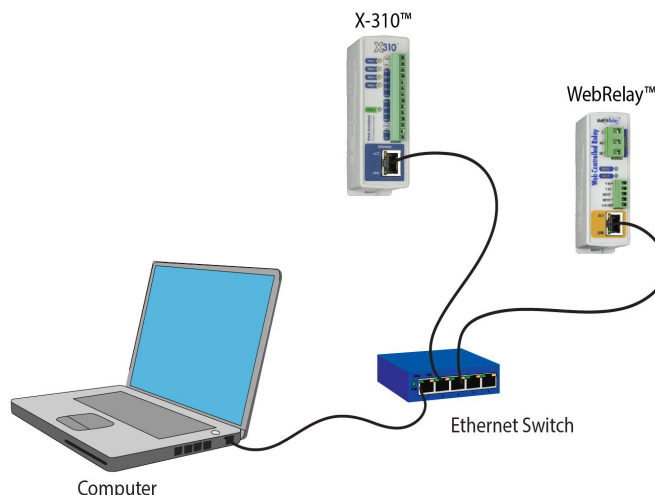
A Simple LAN connected to the Internet

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.)
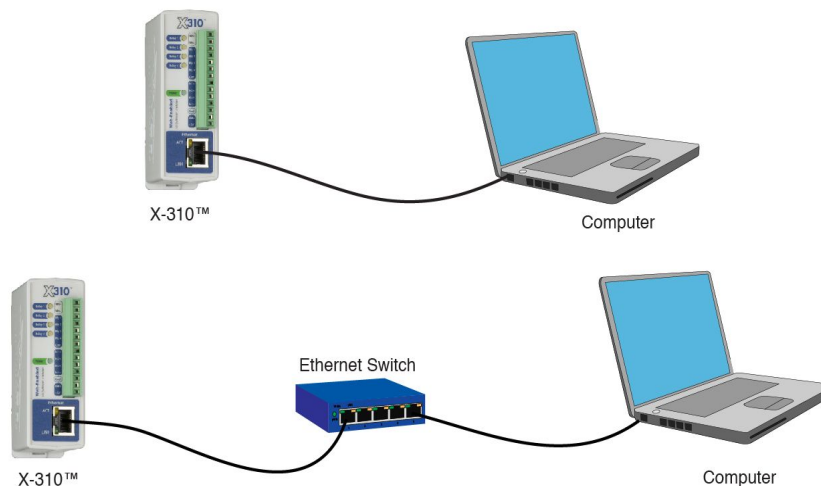
In the example, when a user on the computer needs to access a server on the Internet, the computer sends the request to the router at 192.168.1.1. The router sends the request to the ISP server on the Internet. The ISP server does not send the response directly to the computer on the LAN, but to the 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-310S and 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-310S HTTP port will be changed to port 8000 and 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-310S would be associated with port 8000. The address 192.168.1.26 for WebRelay™ would be associated with port 8001. The X-310S would be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-310S 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-310S. Similarly, all request for port 8001 would be forwarded to 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 WebRelay. 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.
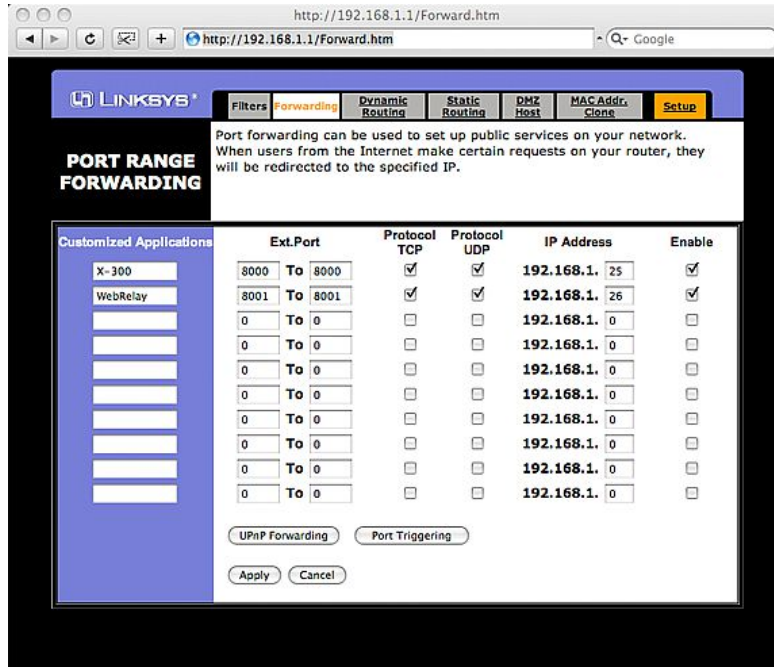
Example of Port Range Forwarding

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-310S:

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

Appendix D: Specifications

Power Requirements

Input Voltage:

Model X-310S-I: 9-28 VDC
Model X-310S-E: Power Over Ethernet <u>or</u> 9-28VDC
                   48V injected into Ethernet Line as per 802.3af specification
                   POE Class 1 (0.44Watt to 3.84Watt range)

Current: See table below for typical values at 25°C.

Power Supply	No Relays On No Inputs On	4 Relays On 4 Inputs On
9 VDC	110 mA	240 mA
12 VDC	85 mA	180 mA
24 VDC	50 mA	100 mA

I/O Connector

14-position, removable terminal strip, 3.81 mm spacing
(Replacement part number, Phoenix Contact 1803691)

Relay Contacts:

Number of relays:	4
Contact Form:	SPST (form A)
Contact Material:	AgNi
Contact Resistance:	milli-ohm max
Internal Relay Mechanical Endurance:	5,000,000 operations min. (under no load)
Internal Relay Electrical Endurance:	100,000 operations average (under rated load)
Max Voltage:	28VAC, 24VDC
Max Current:	1A
Environmental Rating:	Over voltage Category II, Pollution Degree 2
Control Options:	On/Off or Pulsed
Pulse Timer Duration:	100ms to 86400 Seconds (1-day)

Digital Inputs:

Number of inputs:	4
Minimum Pulse Time (high or low):	20mS
Input Current (Iin):	950uA @ 4V, 8.5mA @ 26V
Reverse voltage (Vr):	6V max
Vin:	26V (max)
Vin Hi:	4V (min)
Vin Lo:	1.5V (max)
Input counter:	32-bit

1-Wire Sensor Input

+5Vout Output	5.0V, 100mA max
Maximum number of sensors:	4
Measurement Range:	-55°C-to 125°C (-67°F to 257°F)
Accuracy:	+/-0.5°C from -10°C to +85°C.
Humidity Sensor:	0-100% RH +/- 1.8%
Maximum cable length:	600 feet (180m) maximum combined cable length

Works with digital "1-wire" thermometer or humidity probes
Interchangeable, no calibration needed
Dallas Semiconductor DS18B20 digital 1-wire thermometer
Available in non submersible (air) or submersible versions

Network

10 Base-T or 100 Base-T Ethernet IPv4 (10 Mbit/s or 100 Mbit/s)
Static IP address assignment or DHCP
HTTP port selectable
HTTPS port selectable
Standard 8-pin RJ-45 modular socket, with auto-negotiation
Supports Encrypted Web Browser (HTTP/HTTPS), XML, Modbus/TCP, SNMP protocols

LED Indicators (7)

Power
Relay (1-4)
Network *Linked*
Network *Activity*

Configuration

Celsius/Fahrenheit:	User configurable
Temperature Reports:	Interval
Switch Status Reports:	Interval, on state change, or both
Report Rate:	User configurable

Email alerts

Email Alerts:	Configurable, up to 3 addresses
Encrypted Email Alerts:	Yes
Temperature Alerts:	High or low temperature
Input Status Alerts:	Input on, input off, or input change

Real-Time Clock

Manual or NTP (Network Time Protocol) setup
NTP Sync configurable for once, daily, weekly, or on power-up
Automatic daylight savings adjustment
Battery (capacitor) backup: 2-weeks min, supports real-time clock, external variables, output state

Nonvolatile Memory

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

Logging

Stored in Nonvolatile Flash
Circular Buffer
512-Kbyte (11811 to 32512 log entries depending on configuration)
Unlimited data storage possible through web services.

Password Settings

Password protection on *Setup Page*
Optional Password protection on *Control Page*
Base 64 Password Encoding
Password Length: 13 character (case sensitive)

Scripts

Implement special or custom features with a BASIC script
Max size : 4-Kbytes

Environmental

Operating Temperature: -40ºC to 65.5ºC (-40ºF to 150ºF)
Storage Temperature: -40ºC to 85ºC (-40ºF to 185ºF)

Mechanical

Size: 1.41 x 3.88 x 3.1 in. (35.7 x 98.5 x 78 mm), connector not included
Weight: 5 oz (142 g)

Electromagnetic Compliance

IEC CISPR 22, CISPR 24
EU EN55024, EN55022
X-310S-I: FCC 47CFR15 (Class B)
X-310S-E: FCC 47CFR15 (Class A)

Product Safety Compliance

UL 61010-1 (Electrical Equipment for Measurement, Control, and Laboratory Use)

Appendix E: Trademark and Copyright Information

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Appendix F: Warranty

This Xytronix Research & Design, Inc. product is warrantied against defects in material and workmanship for a period of five years 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, customer must contact Xytronix Research & Design, Inc. technical support (support@ControlByWeb.com) and obtain a Return Authorization number (RA#). Before issuing an RA#, a support technician will work with customer to try to resolve the issue without returning the product. If technician determines that product must be returned for service an RA# will be issued. Next, the product must be properly packaged and returned to Xytronix Research & Design, Inc. with the RA# clearly marked on the package. The purchaser shall prepay all charges for shipping to Xytronix Research & Design, Inc. For warranty repairs of products less than one year old, 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 continental United States. If the product is shipped outside of the continental United States or the product was shipped more than one year earlier, the purchaser shall pay all shipping charges both ways.

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 damage from Acts of God, such as lightning, 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 G: FCC Statement

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

1. This device may not cause harmful interference.
2. 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 against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not in-stalled and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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.

Canadian License-Exempt Radio Apparatus (RSS-GEN)

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Appendix H: Mechanical Dimensions