**X-418 Features**

- Built-in web server (HTTPS supported).
- Eight analog inputs, programmable, 16-bit.
- Control I/O on other ControlByWeb devices.
- Control/Logic Task Builder for custom control with no scripting necessary.
- Configurable logging of all I/O, both local and remote.
- Real-time clock with manual or NTP time sync.
- Send encrypted email alerts (up to 8 addresses).
- Custom BASIC scripts.
- Simple and easy to use.
- 5-year warranty.
<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Initial release</td>
</tr>
<tr>
<td>1.1</td>
<td>Updated features, corrected errors and typos.</td>
</tr>
</tbody>
</table>
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Section 1: Introduction

Overview

The X-418™ is a web-enabled, industrial analog input module. It features an eight-channel, 16-bit, analog data acquisition system.

It can be controlled and/or monitored over any TCP/IP network including private networks, IP-based industrial control networks, and the Internet.

Built-in Web Server

Users can operate the X-418 using a web browser, the CBW Mobile app, or custom applications written for a computer, PLC, or other automation controller. The built-in web server means users can access the X-418 directly as a self-contained, stand-alone unit. No gateways, cloud servers, or external services are required. The X-418 can be used, however, with our ControlByWeb.cloud cloud service if desired which simplifies network setup.

Simple/Advanced Logic

The X-418's built-in interface allows you to create custom "Tasks" for simple and advanced control logic, without the need for scripting. Easily create scheduled, combinational, or sequential tasks. The X-418 also has a built-in BASIC interpreter for more advanced or custom applications.

Security

The X-418 supports TLS V1.2 encryption. Specifically the X-418 supports HTTPS connections, can send encrypted emails, can communicate with remote devices using TLS, and send logged data to FTP servers over an encrypted connection.

Cloud Services (not required)

In addition, the X-418 can be configured to automatically connect to ControlByWeb.cloud, ControlByWeb’s cloud service. This feature is not required, but does simplify the configuration process and internet access to an X-418 installed behind a network router by eliminating manual configuration of the device and port forwarding setup on routers. The options to use the X-418 as a stand alone device or through a cloud server makes it very powerful and very flexible.

More detailed features of the X-418 are listed below. (Specifications are located towards the end of the manual.)

Analog Inputs

The X-418 features an eight-channel, 16-bit, analog data acquisition system. Each channel is configurable for single-ended or differential inputs. Programmable voltage ranges include; ±1.28V, ±2.56V, ±5.12V and ±10.24V. Four of the channels can be configured for 4-20mA operation. The 4-20mA mode enables a precision internal shunt resistor and configures the A/D for ±5V operation. This feature allows direct connection to 0-20mA current loop transducers. Use with industrial sensors, wind direction sensors, pyranometers, pressure transducers, and much more.

For applications where digital inputs are needed, the analog inputs can be configured as pseudo digital inputs with a boolean (true/false) state. The input voltage is compared to a fixed threshold to determine a true/false state. The input is considered “true” when the voltage rises above 3.5V and “false” when it falls below 1.5V.
Remote I/O
The X-418 can be configured to monitor and control I/O from other ControlByWeb devices. I/O on other devices is referred to as “Remote I/O”. Remote I/O can be used by the X-418 for any function and works the same as “local I/O” which is the I/O that is physically part of the X-418. The X-418 can control and monitor up to 100 I/O points total (including both local and remote I/O). The I/O can be on a single remote device or it can be spread out between up to 32 remote devices.

Real-time Clock
Manual or NTP capability.

Control/Logic Task Builder
Easily program up to 50 Scheduled task, 50 Conditional tasks, and 20 Override Schedules.

User Permissions
The X-418 supports three types of users that provide different levels of access to the device's settings and Control Pages. Each user type has a unique password and is configured by the administrator in the setup pages.

Logging
Configurable logging of local and remote I/O, Vin, and Register values. 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-418 also supports encrypted emails using either implicit or explicit TLS (STARTTLS).

BASIC Script
The X-418 has a built-in BASIC interpreter for custom applications not possible through the built-in Task Builder.

Web Server and Protocols
All built-in services and protocols are configurable through the built-in web pages which are password protected, and TLS enabled (HTTP/HTTPS). Other supported protocols include Modbus/TCP, and SNMP V1, V2 & V3.
The X-418 IP address configuration can be either static or set through DHCP.

Power Supply
The X-418 employs a modern switch-mode power supply which works from 9 to 28VDC. With this type of power supply, the current draw decreases as the voltage increases. The model X-418-E is an Ethernet powered device (PD) and receives power along with data on the twisted-pair Ethernet cable. The X-418-E can also accept power on the Vin+ and Gnd terminals. The power supply voltage (Vin+) is monitored internally and can be displayed, logged, used to control a relay (from a remote device) and configured to send email/text notifications.
1.1 Applications

The X-418 is designed to meet a broad range of industrial applications. It works well as a stand-alone device that can be monitored using a web browser, or as a convenient way to add analog inputs to a computer or existing control/monitoring system. Many of the X-418’s features such as scheduling/tasks, logging, input state monitoring, and the ability to control and monitor both local and remote I/O make the X-418 a powerful, yet simple controller.

Use the X-418 to monitor sensors, switches, fluid level, battery voltage, temperature, humidity, and much more from both local and remote I/O.

The X-418 can control up to 100 local and remote I/O. The X-418’s local I/O count towards the 100 I/O total. Some local I/O cannot be added/removed such as the analog inputs.

You could, for example, configure the X-418 to monitor 90 remote I/O along with the 10 non-configurable local I/O. Or, you could add 16 local registers, and 16 local timers and have 58 remote I/O remaining.

The X-418 can be operated using a web browser through the built-in, customizable Control Page, or by sending Modbus/TCP requests and/or SNMP requests. Custom applications can also be written to communicate with the device using any of the aforementioned protocols (HTTP, MODBUS, SNMP).

A few example applications include:

- I/O Extender
- Monitor wind speed, wind direction, temperature and humidity
- Process Controller
- Monitor fluid level from your office
- Monitor temperature and water level with your smart phone
1.2 Part Numbers and Accessories

The X-418 is currently available in two different models:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Power Supply Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-418-I</td>
<td>9-28VDC</td>
</tr>
<tr>
<td>X-418-E</td>
<td>Power Over Ethernet and/or 9-28VDC</td>
</tr>
</tbody>
</table>

1.2.1 Optional Accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>Regulated, DIN-rail / wall mount 24V DC, 1.75Amp, 100-240V AC Input</td>
<td>2868648</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Regulated, plug in 12V DC, 1.5Amp, 100-240V AC Input</td>
<td>PS12VV1.5-B</td>
</tr>
<tr>
<td>Spare Connector</td>
<td>14-Pin Connector Plug</td>
<td>X-TERM14A</td>
</tr>
</tbody>
</table>

1.3 Security Notes

The X-418 is a dedicated device and does not employ a general purpose computer operating system (i.e. Windows, Linux etc.) It does not have terminal access such as telnet, SSH, nor uncontrolled open ports. This means it is extremely difficult, if not impossible, for someone to 'break in' to the X-418 and access other devices on your local network. The simplicity of the X-418 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 X-418 should be limited to using encrypted connections to the web server using HTTPS. Unencrypted access can be disabled in the Network setup page.

It is recommended that passwords be enabled for the Administrators, Managers, and perhaps Users. Passwords should be at least 8 characters in length and use a combination of upper and lower case letters and numbers. For additional security, the X-418 includes an IP filter and can be used in conjunction with an external firewall to further limit access to selected IP addresses.

The X-418's firmware can be upgraded, but not over the internet. By design, a firmware upgrade requires physical access to the device.
1.4 Connectors & Indicators

I/O Connector
The X-418 has a 14-position removable screw terminal connector for making connections to the power source and analog inputs.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vin+</td>
<td>Power Supply VDC+ (9-28 VDC)</td>
</tr>
<tr>
<td></td>
<td>DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE.</td>
</tr>
<tr>
<td>Gnd</td>
<td>Vin- (Ground) power supply input.</td>
</tr>
<tr>
<td>Vref</td>
<td>+5.0 Reference output</td>
</tr>
<tr>
<td>Agnd</td>
<td>Analog ground for analog inputs</td>
</tr>
<tr>
<td>Ain1</td>
<td>Analog Input 1+</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V and 0-20mA</td>
</tr>
<tr>
<td>Ain2</td>
<td>Analog Input 2+ (single-ended mode) or</td>
</tr>
<tr>
<td></td>
<td>Analog Input 1- (differential mode)</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V and 0-20mA</td>
</tr>
<tr>
<td>Ain3</td>
<td>Analog Input 3+</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V and 0-20mA</td>
</tr>
<tr>
<td>Ain4</td>
<td>Analog Input 4+ (single-ended mode) or</td>
</tr>
<tr>
<td></td>
<td>Analog Input 3- (differential mode)</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V and 0-20mA</td>
</tr>
<tr>
<td>Agnd</td>
<td>Analog ground for analog inputs</td>
</tr>
<tr>
<td>Ain5</td>
<td>Analog Input 5+</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V</td>
</tr>
<tr>
<td>Ain6</td>
<td>Analog Input 6+ (single-ended mode) or</td>
</tr>
<tr>
<td></td>
<td>Analog Input 5- (differential mode)</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V</td>
</tr>
<tr>
<td>Ain7</td>
<td>Analog Input 7+</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V</td>
</tr>
<tr>
<td>Ain8</td>
<td>Analog Input 8+ (single-ended mode) or</td>
</tr>
<tr>
<td></td>
<td>Analog Input 7- (differential mode)</td>
</tr>
<tr>
<td></td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V</td>
</tr>
<tr>
<td>Agnd</td>
<td>Analog ground for analog inputs</td>
</tr>
</tbody>
</table>
**Network Connector**
The Ethernet connector is a standard, 8-position modular receptacle for RJ-45 connectors. The Ethernet port supports auto-negotiation and automatically selects the speed, duplex mode and works with straight or crossover cables.

**Power Indicator**
The green Power LED indicator is illuminated whenever the device is powered.

**Ethernet Indicators**
The LINK LED is illuminated green when the device 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.
1.5 Accessing the X-418 using a Web Browser

The X-418 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 device 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 Device Over the Internet.)
Section 2: Installation and Connections

Installation consists of mounting the X-418, connecting it to an Ethernet network, providing power and connecting the local I/O to other accessories/sensors. The installation is completed by configuring the device’s settings using a web browser.

2.1 Installation Guidelines

- This device must be installed by qualified personnel.
- This device must not be installed in unprotected outdoor locations. This device 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.
- This device 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 device 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.
- If this device is used in a manner not specified by Xytronix, the protection provided by the equipment may be impaired.
- CAUTION: Miswiring or misconfiguration could cause permanent damage to the device, the equipment to which it is connected, or both.
- CAUTION: Make sure the power is shut off before making connections

Wall Mounting

Mount the X-418 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.

DIN-Rail Mounting

The X-418 can be mounted to a standard (35mm by 7.55mm) DIN-Rail. Attach the X-418 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-418 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

A removable terminal connector is provided for making the power connections. To help protect the X-418 from mechanical stress:

1. Make sure power is turned off and
2. Remove the terminal connector from the X-418 and make wiring connections to the terminals.
3. Reconnect the terminal connector and apply power.

See Appendix D: Specifications for wire size, temperature rating and torque requirements for making connections to the terminal blocks.
2.2.1 Power Supply Connections

The X-418 requires power for its internal logic circuits. Connect a 9-28 VDC power supply to the +Vin and 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 this device (See Appendix D: Specifications for the current requirements.)

Multiple X-418 devices may be connected to a single power supply by connecting the power supply input terminals in parallel. The power supply must have an ample current rating to power all units connected.

The model X-418-E is normally powered from either a POE Power Injector or POE Ethernet Switch 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-418-E, no connections are needed to the Vin+ and Gnd terminals. The Vin+ and Gnd terminals, however, can be used as a backup power source. The X-418-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-418 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-418-E will draw all power from the Vin+ terminal.

2.2.2 Analog Input Connections

The X-418 features a high performance, 8-channel, 16-bit analog data acquisition system. The inputs are high impedance (>500 Meg ohms.) Each channel is configurable for single-ended or differential operation. Programmable voltage ranges include: ±1.28V, ±2.56V, ±5.12V and ±10.24V and ±20.48V (differential). Four of the channels can be configured for 0-20mA input operation. The input mode and voltage range is configured in the web-based setup pages. The analog inputs work with industrial sensors, wind direction sensors, pyranometers, pressure transducers, and much more. The input impedance is very high and if an input is left unconnected, the voltage measurement will float and drift. The analog inputs can be configured to send an email, log, or control a remote relay (over the network using peer-to-peer communication).

Single-Ended Mode

The analog data acquisition system can accept bipolar input signals. Single-ended signals are referenced to the AGnd terminals. Each channel can be independently programmed with a ±1.28V, ±2.56V, ±5.12V, ±10.24V voltage range. Do not share the sensor ground connection with the power supply input terminal. Consider how the sensor(s) are powered, arrange the sensor connections so no current flows in the ground reference connections between the X-418 and your sensor(s).

Differential Mode

Differential sensors have two outputs that reference each other instead of ground. The differential mode uses two analog inputs instead of one. For example, if Channel 1 is selected for differential operation, the differential signals are connected to Channel 1 and 2. If Channel 3 is selected for differential operation, the differential signals are connected to Channel 3 and 4, and so on.

Differential mode supports input ranges of up to ±20.48V. However, the absolute input voltages must be less than ±10V. For example, if Input 1 is configured for differential operation and Input1 = +10V and Input2 = -10V, the measurement will read +20V. On the other hand, if Input1 = -10V and Input2 = +10V, the measurement will read -20V. With differential connections, a ground connection is still required between the X-418 and your sensor to maintain the two input voltages within the common mode voltage range (-10V < Vin < +10V) of the X-418.

4-20mA Mode

Some industrial sensors output a current instead of voltage levels. Normally, a shunt resistor is needed to measure the current. With the X-418, the 4-20mA mode enables an internal precision 200-ohm shunt
resistor (0.1%, 25ppm) and automatically configures the A/D for ±5V operation. This feature allows direct connection to 0-20mA current loop transducers. At 20mA, the maximum loop voltage across the X-418 is 4.0 Volts (.020 x 200 = 4.0V). With this setting, the voltage-to-current calculation \((\text{Vin}/200)*1000\) is automatically made so the measurement is in units of mA.

**Pseudo Digital Inputs**

For applications where digital inputs are needed, specific analog inputs can be configured as a pseudo digital input with a boolean (true/false) state. The input voltage is compared to a fixed threshold to determine a true/false state. The input is considered “true” when the voltage rises above 3.5V and “false” when it falls below 1.5V.

When an analog input is configured as a digital input, the input can be configured to send an email, control a remote relay (over the network), or monitor the state of a discrete device.
2.2.3 Network Connection

Connect the Ethernet port to a standard 10/100/1000 Base-T Ethernet connection. The X-418 typically connects to an Ethernet switch, or router. For configuration, the X-418 may be connected directly to the Ethernet port on a computer or through a switch or router. The X-418 supports auto negotiation and will work with either crossover or straight-thru cables. It can be also 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.
2.3 Establishing Communications for Setup

In order to configure the X-418 with its built-in web interface, the X-418 must be connected to an Ethernet network. This can be done by one of two methods:

**Method 1** – Temporarily change the IP address of a connected computer to be compatible (same subnet) with the default IP address used by the X-418.

*Note: If multiple ControlByWeb™ devices 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 (run 'arp -d' from an administrative command prompt).*

-or-

**Method 2** – Assign a temporary IP address to the X-418 to work on an existing network.

2.3.1 Method 1: Assign a Temporary IP Address to the Configuration Computer

By default, the X-418 comes from the factory with an IP address of 192.168.1.2. Communication with the X-418 may be established by assigning an IP address to the configuration computer so that it is on the same logical (and physical) network as the X-418 (for example, the configuration computer could be assigned to an IP address of: 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-418 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-418 has been successfully changed.

![Internet Protocol Version 4 (TCP/IPV4) Properties](image)

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-418 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-418 from the command prompt by typing:

ping [ipaddress] (e.g. ping 192.168.1.2)
2.3.2 Method 2: Assign a Temporary IP address to the X-418

This option (arping) is used to TEMPORARILY assign an IP address to the X-418 without the need to change the IP address of the configuration computer. The X-418 will use this IP address as long as power is maintained. Once power is lost, the X-418 will use the IP address assigned in the setup page and not the temporary address assigned here. Make sure that the X-418 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-418 }
   ```

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

3. For example, to set the X-418 (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
   ```

4. 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
   ```

5. Proceed with the X-418’s setup in Section 3.

   Once setup is complete, it may be necessary to clear the ‘arp’ cache to configure additional ControlByWeb devices. This is necessary because each device 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 ControlByWeb device }
   ```

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

   For example, to set the X-418 (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-418's setup in Section 3.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional ControlByWeb devices. This is necessary because each device 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-418 }
   ```

   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 device board. The format is ss:ss:ss:ss:ss:ss.*

3. For example, to set the X-418 (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
   ```

4. 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
   ```

5. Proceed with the device's setup in Section 3.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional ControlByWeb devices. This is necessary because each device 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-418. The Control page allows the local and remote I/O to be monitored and controlled.

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 accessing any setup page, the browser will request a username and password. The X-418 supports various levels of user authentication with different permissions to the setup pages. For a description of Administrators, Managers and Users see General Settings Tab > PASSWORDS. The Administrator username is admin and the default password is webrelay (password is case sensitive).

The setup pages are divided into six sections. Sections with a ▼ symbol can be expanded to reveal other related settings. 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 Setup Strategy

To configure the X-418, follow these basic steps (each of these steps will be discussed in more detail in the next section):

Step 1: Edit the Network settings to make the X-418 accessible on your network (IP address, gateway and DNS Server IP addresses, etc.). The device must be power cycled for these settings to take effect. Also setup any email addresses that will be needed for alarms and messages.

Step 2: Name and configure the I/O resources (i.e., relays, inputs, registers, timers, etc.) under the I/O Setup menu.

Step 3: Define any control logic (tasks) or Basic scripts under the Control/Logic menu. Finally, setup and configure the Control Page under Monitor & Control to show the information and control buttons needed for your specific application.

Step 4: View and test the Control Page where you can monitor your local and remote I/O and experiment with any buttons or controls. Also test for proper operation of email/text messages and alarms.
3.2 General Settings Tab

The General Settings tab is a collection of menus for configuring the IP network settings, email server settings, device configuration backup and restore features, etc.

3.2.1 General Settings Tab > GENERAL INFORMATION

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. The optional latitude and longitude settings are used for calculating sunrise and sunset times for Scheduled Tasks. A global setting selects the temperature units. *(Used for remote temperature sensors.)*

**Part Number**
This displays the full model number of the X-418.

**Firmware Revision**
This is the current product revision of the device's firmware.

**Serial Number**
This is the serial number of the X-418. The serial number is also the MAC address.

**Vin Voltage**
This is the voltage on the +Vin power input terminal. If the X-418 is powered from a battery, this value will show the battery voltage. With the X-418-E model, the power is provided over the Ethernet cable and the Vin+ monitor will show "POE" unless a voltage of at least 9VDC is supplied on Vin+.

**Internal 5V Voltage**
This diagnostic displays the voltage of the internal 5V power rail. It should be 5.0V ±.25V.

**Latitude & Longitude**
The optional latitude and longitude settings are used for calculating sunrise and sunset times for Scheduled Tasks.

**Temperature Units**
This global setting sets the temperature units of Fahrenheit, Celsius, or Kelvin for all temperature sensors, both local and remote *(Some ControlByWeb devices do not have a 1-Wire bus for local temperature sensors; however, they do support remote 1-Wire sensors).*
3.2.2 General Settings Tab > NETWORK SETTINGS

The network parameters are set on this page. Configure the network settings to make the X-418 accessible on your network. The X-418 must be power-cycled (power disconnected, then reconnected) before new network settings take effect.

Use DHCP (Dynamic Host Control Protocol)

This option allows DHCP to be enabled or disabled. If this option is set to Yes, the X-418 will request an IP address from the DHCP server each time it is powered on. The default setting is No (this is recommended for most installations). If DHCP is set to Yes, the Network page must be submitted and the X-418 must be rebooted before an IP address will be assigned. Once the X-418 is assigned an IP address by the DHCP server, the new IP address can be found through the list of clients kept by the DHCP server.

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 is a mechanism that automatically assigns an IP address to a computer (or other device) 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 or device and dynamically assigns an IP address. 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-418 is a server and manual IP address assignment is usually
recommended.

**IP Address**

Enter the IP address for the X-418 in this field. The IP address is specific to the network where the X-418 will be installed, and must be obtained from the network administrator. For more information on IP addresses and remotely accessing the X-418 over the Internet, see Appendix C: Accessing the Device 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:

<table>
<thead>
<tr>
<th>Remote Services</th>
<th>When server is specified by name and not IP address.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync time clock with remote NTP server</td>
<td>When server name is specified by name and not IP address.</td>
</tr>
<tr>
<td>Email Server</td>
<td>When server name is specified by name and not IP address.</td>
</tr>
<tr>
<td>SNMP Manager</td>
<td>When the server for receiving traps and notifications is specified by name and not an IP address.</td>
</tr>
<tr>
<td>Remote Devices</td>
<td>When remote device (such as for use as a remote relay) is specified by name and not IP address</td>
</tr>
</tbody>
</table>

**Alternate DNS Server**

This field is used to specify the IP address of a Secondary DNS server. This is used when the X-418 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 only encrypted connections on the HTTPS port.

**HTTP Port**

The TCP port used for unencrypted HTTP communications with the X-418 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 Device 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](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](https://192.168.1.2:9000/setup.html)

**MTU**

MTU is the Maximum Transmission Unit network parameter. This defines the max size, in bytes, of the TCP packets sent out from the device. The valid range is 256 to 1476 bytes. 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 discard the packets. To fix this, the MTU can be adjusted until the TCP packets do not get split up.

**Upload/View SSL Certificate**

By default, the X-418 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. SSL Certificates are preserved through resetting defaults and updating firmware.

**Upload/View SSL Key File**

By default, the X-418 comes with a previously generated SSL Key that is used for encrypted HTTP communications. The default SSL Key can be replaced by clicking on this link, choosing the new Key file (PEM format), and uploading the file. SSL Keys are preserved if the firmware is updated or the X-418 is reset to its default settings.
3.2.3 General Settings Tab > ADVANCED NETWORK SETTINGS

MODBUS
MODBUS/TCP Service can be enabled or disabled. Modbus is a messaging structure protocol used in industrial 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 Section Modbus/TCP for more information on using the X-418 on a Modbus network.)

Note: Modbus communications are disabled whenever the User password is enabled because Modbus/TCP does not provide a mechanism for password protection.

The X-418 functions as a Modbus slave. Host devices, such as PLCs, open a connection with the X-418 on port 502 and then sends requests to read or set I/O states, or sensor values. When the X-418 receives a command, it performs the desired function and returns a response.

Modbus Port
This specifies the port used for Modbus/TCP communications with the X-418. By default this is set to port 502 which is the standard Modbus port. It can be set within the range of 1 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 all analog sensors, both local and remote. If Big is selected, the X-418 will use big-endian architecture, and the most significant 16-bit word (big end) is sent first. If Little is selected, then the X-418 will use little-endian architecture, and the least significant 16-bit word (little end) is sent first. The default setting is Little (little-endian). For example, in little-endian format, a 32-bit floating point number represented by '1234 ABCD' is sent as 'ABCD 1234'.

Modbus Address Table
The X-418 has a default Modbus address table with addresses for the local I/O and Vin. As resources such as Registers, and remote I/O are added, additional Modbus addresses are automatically created. Use this tool to view the current Modbus address assignments. The addresses are assigned when the I/O is added and cannot be customized except by deleting the I/O
and changing the order in which they are added.

To interpret the Modbus Address Table, find the I/O resource in the left-most column. Then follow the line across to the column of interest. All I/O resources have a corresponding holding register pair for reading the values. This holding register address is listed in the I/O column of the table and is interpreted as a IEEE-754 floating-point value. The number in the cell is the Modbus address for the given data type (or starting address in the case of floating point numbers). On the X-418, all holding registers are read and written as pairs. This is because Modbus registers are 16-bits wide and the data types for reading the registers are floating point and require 32-bits. The number listed in the table is the starting address and the corresponding register immediately follows it.

This example table shows the Modbus addresses of the I/O resources and a configured register.

![Modbus Address Table](image)

This image shows Modbus address examples for the X-418. Other products tables will differ depending on the device’s I/O.
Remote Services

Remote Services allows internet access to an X-418 device which is installed behind a network router, without the need to setup port forwarding in the router.

This can be used in an environment where a web server on the Internet provides a custom web page to the X-418 and other ControlByWeb devices. Users access the X-418 through the remote services 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 control and monitor multiple X-418s using the web programming languages of their choice.

Remote Services has two main benefits:

First, the web server does not need to know the IP address of the X-418. This means that the X-418 can get its IP address dynamically from a DHCP server, simplifying the installation.

Second, since the connection from the X-418 is outgoing, rather than incoming, the local router on the network where the X-418 resides does not 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 Using an External Web Server.

Enable

Remote Services can be enabled or disabled. If Yes is selected, Remote Services will be enabled as soon as the Submit button is pressed and the X-418 will immediately attempt to make a connection with the remote server (power cycle not required). Once a connection is established, the connection will remain until it is disconnected by the remote server. By default, Remote Services is configured to connect to the ControlByWeb.cloud service. The default setting for this field is No.

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, the default setting is: devices.controlbyweb.cloud

Server Port

Enter the TCP port used for the Remote Services server. This can be set within the range of 1-65535. 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 for 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. By default this field is left blank, as the ControlByWeb cloud service does not use it.

**Connection Interval**
This field specifies the periodic interval in which the X-418 attempts to connect to the remote server, or if the X-418 is already connected, it is the interval in which it sends the connection string followed by the current state of the device. This field can be set within the range of 1 to 60 minutes. The default setting for this field is 1 minute.

**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-418. These certificates and key are required for the X-418 to connect to the cloud service. This field specifies the port used to communicate with that server.

**Certificate Request Token**
When the X-418 has a valid Certificate Request Token entered, it will automatically attempt to request and download its Client Certificate, Key, and CA. Once successful, the token will be erased and the X-418 will stop its requests. (See *Remote Services* at the end of this section for more information.) It will then be able to authenticate and connect to the cloud service securely.

**Upload/View Client Certificate**
Uploads a client certificate that will be used for authenticating the X-418 to the cloud service.

**Upload/View Client Key**
Uploads a client key that will be used for encrypting the X-418's communications with the cloud service.

**Upload/View Client CA**
Uploads a CA that has been used to generate the client certificate and key. The X-418 will use this certificate to verify that the server it has connected to is the server that it expects to connect to.
SNMP AGENT
The SNMP agent is the server running on the X-418 responsible for receiving SNMP requests and returning SNMP responses. SNMP Managers are remote servers that the X-418 can send SNMP Trap and Notification messages to. The Agent is always enabled when SNMP is enabled. The SNMP Managers can be enabled/disabled separately. When using SNMP V3, the X-418 supports the User-based Security Model (USM).

SNMP Enabled
SNMP (Simple Network Management Protocol) can be enabled or disabled. The default setting for this option is No. (See SNMP at the end of this section for more information.)

SNMP Version
The X-418 supports versions V1, V2c, and V3. This option allows choosing what version of SNMP will be used, and will determine what SNMP options are presented. The X-418 will only respond to SNMP requests that use the selected SNMP version.

Agent Settings:

Agent Port
When SNMP is used, this field is used to specify the SNMP port that the X-418's SNMP Agent listens on. The default setting for this field is 161.

Agent Read Community
The read community string is used for SNMP V1 and V2c requests. It is required to read I/O on the device using SNMP V1 or V2c.

Agent Write Community
The write community string is used for SNMP V1 and V2c requests. It is required to write I/O on the device using SNMP V1 or V2c.

Notification Retries
When sending notifications, this field defines how many attempts the X-418 will make to send the notification to the SNMP Managers. Notifications differ from Traps in that a response is expected back from the SNMP Manager.

Notification Timeout
When sending Notifications, this field defines how many seconds the X-418 waits for a response to a previously sent notification before attempting to send the notification again.
Manager Settings:

Manager Enable
An SNMP Manager is the server intended to receive traps and notifications from the X-418. The X-418 supports sending traps and notifications to two different SNMP managers. The default setting is No.

Manager Hostname/IP
This field is used to specify the hostname or IP address of the SNMP manager. The default setting for this field is 192.168.1.15

Manager Port
This field is used to specify the SNMP Trap or notification port of the SNMP manager. The default setting for this field is 162.

Manager 1 Community
This field is used to defined the Trap/Notification community string used by the SNMP Manager for SNMP V1 and V2c. The SNMP manager will not accept the Trap/Notification without a correct community string.

MIB File
This button generates the Management Information Base (MIB) used for managing the entities in a communication network associated with the SNMP protocol. The file will be automatically generated and downloaded. This file will change as the I/O configured on the device changes.

SNMP V3 Security Settings:
The following settings appear when the SNMP version is set to Version 3. These settings configure the authentication and privacy protocols used by SNMP V3 User-based Security Model (USM). The Agent, and both SNMP Managers each have their own set of USM settings. When SNMP V3 is selected, the community string settings disappear and are not used. They are replaced by the following settings.

Username
This field defines the security username.

Auth Protocol
This field defines the authentication protocol used: None, MD5, SHA, SHA224, SHA256.

Auth Password
This field defines the authentication password.

Priv Protocol
This field defines the privacy protocol used: None, DES, AES128, AES192, AES256.

Priv Password
This field defines the privacy password used.

SNMP Notes: Simple Network Management Protocol (SNMP) is used to manage and administer network devices. The X-418 supports SNMP V1, V2c, and V3 and can be configured here. Using SNMP, the I/O states of the X-418 can be read as well as some basic information about the X-418. See Section Error: Reference source not found for information about how to request information from the X-418 using an SNMP manager.
IP Filtering

IP filtering can be enabled or disabled. IP filtering is used to restrict incoming network connections to only specific IP addresses. If a connection comes in to the X-418 that is not in the range of allowable IP addresses, the connection is terminated. The IP filter only applies to incoming connections and not to outbound connections such as those to DNS servers. The X-418 allows for two different ranges to be defined. If one of the ranges is not needed, the IP address in each of the three fields for a given filter must be 0.0.0.0. IP filter settings only take effect after the X-418 is power-cycled.

Filter Subnet Mask
This is the subnet mask that is applied first. If the IP address does not fit within this subnet, the connection will be terminated. This subnet mask is applied to the Filter 1 Range's first IP address (the start address).

Filter Range
The range of IP addresses within the defined subnet mask that are allowed to communicate with the X-418. The first field is the start address, the second field is the end address.
3.2.4 General Settings Tab > EMAIL SETTINGS

**Email Notification Description**

The X-418 can be configured to send messages to up to eight email addresses when certain events occur. Events that can trigger email messages include local and remote I/O changes, Vin changes, and commands sent from a BASIC script.

**Note:** *Messages will vary depending on the ControlByWeb device (X-410, X-418, X-420, etc.).*

When an email message is sent, it looks similar to this (I/O will vary depending on the ControlByWeb device).

```
X-418

Trigger: Analog Input 3 = 1.00 VAC
Analog Input 1: 4.2 V
Analog Input 2: 2.5 VDC
Analog Input 3: 1.00 VAC
Analog Input 4: 0.001 Amps
Vin: 12.00 V
Time: 09/27/2017 15:30:00
```

**Note:** *The sensor names as well as ON and OFF status text may be customized by the user/installer in the Setup Pages. These same field names are used on the Control Page.*

**Subject Line**

The top line (in this example it reads “X-418”), 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 Monitor & Control Tab > 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 Analog Inputs, Vin, and Sensors**

The remainder of the email message will display the same information shown on the Control Page. Fields not displayed on the Control Page will not be included in the email message. Displayed fields may be configured in the Monitor & Control Tab > CONTROL PAGE SETUP page. Alternatively, the email message can be set to “Full” or “Short” on the Email tab of the Setup pages. Setting the Email Message to “Short” will only include the trigger and the I/O that caused it to show in the email body.

**Important Note:** Notification email messages are limited to 32 I/O. If the Control Page is configured to display more than 32 I/O, email notifications will contain the first 32 I/O that are displayed on the Control Page.

The Email parameters are set on this page.
**SMTP Server**

The name of the SMTP (Simple Mail Transfer Protocol) mail server (i.e., mail.example.com) or the IP address of the mail server (i.e., 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.

**Connection Security**

Select the security method used for sending the email. There are two methods used to securely transmit email messages, STARTTLS and TLS/SSL. When STARTTLS is chosen, encryption will begin after the X-418 makes an unsecured connection to the SMTP server and negotiates TLS. When TLS/SSL 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 TLS/SSL 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.

**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**

The X-418 itself will not receive email messages, but when the X-418 sends email messages, it must include a return email address. This field is used to specify the return email address. Note that although the X-418 will send email messages to 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 8**

Enter the email addresses of up to eight recipients. Email notifications will not be sent until tasks are created to send them.

**Email Message**

Choose either “Full” or “Short” email formats. Full sends email messages with all visible fields on the Control Page. Short sends messages only showing what triggered the email.

**Send Test Email**

This button sends a test email to the first email address in the email list using the currently configured network and email settings. By pressing this button, the settings are automatically submitted, and then a progress window will pop-up and display the result of the test email:

- Success
- Failed DNS Lookup
- No Response from DNS server. Check DNS addresses, Power Cycle Device, etc.
- Failed
- Bad Username/Password
- Missing recipient email address(es)
- Server Address/Hostname does not exist or is misspelled
- Server Address/Hostname is blank
- No Response from SMTP server. Check server address and security/port combination
3.2.5 General Settings Tab > PASSWORDS

The X-418 requires passwords to access specific resources. The passwords can be changed on this page. Passwords must be 6 to 18 characters, both alphabetic and numeric characters are recommended. A hide/show check-box selects if the password will be shown. When a 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.

Administrator

Administrators have access to all Setup, Task, and Control pages. This access privilege is normally used by a system integrator or installer to setup I/O, control logic and user interface. The Administrator username is admin (all lower case). The default password is webrelay (all lower case).

Manager

Managers have access to Tasks and Control pages. This access privilege can be used for example, to allow a door access schedule to be changed for a holiday. A Manager cannot change network settings, I/O, or control logic. The Manager username is manager (all lower case). The default Manager password is webrelay (all lower case). Manager access can be enabled or disabled. When a manager logs into the Setup pages, they will receive a subset of the menu options allowing them to edit Scheduled Tasks and view the Control pages.

User

Users have access privilege to the Control Page only. This access privilege is for users and operators to monitor sensors or control outputs that are on the Control Page. The password access for Users can be enabled or disabled. 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. The User username is user (all lower case). The default User password is webrelay (all lower case).

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

Device PSK

The Device PSK is a pre-shared key used by other ControlByWeb devices when communicating with the X-418 securely. When adding a remote ControlByWeb device to an X-418, that device’s pre-shared key is asked for during the configuration. This is where that PSK is defined. Note that not all ControlByWeb devices support use of PSK.

The PSK is a 32-byte hexadecimal key with valid characters being a-f and 0-9. Anything can be used as the devices PSK as long as it is 32 bytes long and contain only valid characters. The Generate PSK button can be used to request the X-418 to generate a secure, random PSK. This is the preferred way to generate the PSK. Once generated, a new PSK need not be generated unless the old one has been compromised. A new PSK is generated when the device is reset to factory defaults.
3.2.6 General Settings Tab > DATE & TIME

The X-418 uses the time of day for scheduled events, such as turning local/remote I/O on or off at scheduled times, and for logging other local/remote I/O (a time stamp is included with each logged event). The time is stored and displayed in 24-hour time format. The X-418 has a capacitor-backed, real-time-clock circuit that will sustain the time for several days in the event of a power failure.

Current
This is the current date and time maintained in the X-418. The time is stored and displayed in 24-hour format.

Set:
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.

<table>
<thead>
<tr>
<th>Manually</th>
<th>Requires the user to enter the time and date.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync with NTP server</td>
<td>Allows the user to set the clock automatically by using an NTP (Network Time Protocol) server.</td>
</tr>
</tbody>
</table>
Manual Time Configuration

Date
The current date is entered by selecting the month, day, and year using the drop-down boxes.

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].)

UTC Offset
World time zones are defined as an offset from 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: -5:00
- Central Standard Time: -6:00
- Mountain Standard Time: -7:00
- Pacific Standard Time: -8:00

SYNC With NTP Server

NTP Host Name
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 aaaa.bbbb.cccc.dddd 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 UDP port 123.

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

  0.us.pool.ntp.org
  1.us.pool.ntp.org
  2.us.pool.ntp.org
  3.us.pool.ntp.org

  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

**NTP Sync Interval**

This option allows the user to specify how often the time on the X-418 will be synchronized with the time server. When the Submit button on this page is pressed, the X-418 will immediately synchronize with the time server. If Daily, Weekly, or Monthly options are selected, the X-418 will thereafter re-synchronize with the time server at the period interval specified starting at 12:00 AM (00:00).

To prevent multiple ControlByWeb devices from overwhelming the NTP server at power on, the exact time the NTP Request occurs is 12:00 AM (00:00) plus the minute equivalent of the last two digits in the model's 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, the X-418 will be synchronized with the time server each time it is powered.

*Note: If the X-418 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.*

**Daylight Savings**

*Enable*

Daylight Savings can be enabled or disabled. The default setting is Yes.

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 the X-418 will automatically be shifted forward by one hour between the hours of 12:00 AM – 5:00 AM 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 AM 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.
**Note:** When daylight savings time adjustment is enabled, Scheduled Tasks will be adjusted for the new time. Logged data includes a time stamp based upon the current time in the device followed by DST when the device is in daylight savings and STD when it is not. 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 Date/Time**
This is the date and time that daylight savings will start. Note that on this date, between the hours of 12:00 AM – 5:00 AM, 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 Date/Time**
This is the date and time that daylight savings will end. On this date, between the hours of 12:00 AM – 5:00 AM, 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.
3.2.7 General Settings Tab > **BACKUP/RESTORE**

Use these tools to backup the settings (excluding scripts and SSL Certificates) on this device, or to copy settings from one device to another. This is useful for “cloning” or copying devices, or to maintain a backup copy of the settings.

**Import Settings File**

To import settings from an external file, first click the *Browse* button and select the desired `settings.txt` file on your computer. If *Use Default Network Settings* is checked, any network settings in the file are ignored and the network settings are forced to the default state. If *Use Default Password* is checked, the Administrator password in the file is ignored and the Administrator password is forced to the default state. Click the *Import Settings* button to import (load) the settings from the selected file.

**Export Settings File**

Click the *Export Settings* button to export all of the current settings to a “settings.txt” file. If desired, the file can be opened and examined with a text editor. Note that BASIC scripts and SSL Certificates are not included in this settings file and should be saved separately.
3.3 Remote Devices Tab

The X-418 can monitor and control the I/O of up to 32 other ControlByWeb devices. This feature can be used to implement a distributed control system. With distributed control, intelligent control devices, such as the X-418 are placed in close proximity to the sensors, relays, motors and valves that are to be monitored and controlled. The control devices are connected together into a control system with Ethernet communication. No central control cabinet is needed with long wire runs to the sensors, relays, motors and valves in your facility. With Ethernet communication, the control system can accommodate applications with long distances between the devices being monitored and controlled. Each device in the system implements a portion of the control application.

To access I/O on remote devices, first add the remote device to this device list, then add and configure the I/O under the I/O Setup tab. Remote devices appear in the table on the remote devices tab and can be created, edited or deleted as needed.

You can add a remote device to the X-418 in two ways:

1. **Automatically**: Click Find Devices – This will look for other X-400 Series devices (X-410, X-418, etc.) on the network and allow you to automatically add them to the X-418.

2. **Manually**: Click Add Remote Device. Depending on the Model selected in the pull down ▼ list, the available settings will change to accommodate the capabilities of the remote device. For example, only certain devices can support encrypted communications.
**Device Name**
This text field allows setting a descriptive device name that will be referenced throughout the setup pages. Up to 24 characters may be entered in this field. The default text is “Device 1”. Set the name to a descriptive value such as “Warehouse Lights”.

**Model**
Click the ▼ symbol and choose from the list of supported remote devices. When changing the device type of a previously configured device, only I/O compatible device types will be enabled.

**Serial Number**
The serial number of the remote device is entered here. The serial number is only required for X-400 series devices. The default value is 000CC8000000

**IP Address/Hostname**
The IP address or hostname of the remote device. Up to 61 characters may be entered in this field.

**Port**
The TCP port number of the remote device. This must match the port (HTTP port) set in the remote device. The valid range is 1 to 65535. The default port number is 80. If TLS PSK Encryption is selected (see below), the default port number is 443.

**Security Configuration**
Select either Unencrypted or TLS PSK Encryption. When both devices are on the same local network unencrypted communication is usually acceptable. When devices communicate across the Internet, encrypted communication is recommended. Performance with encrypted communication will be slightly slower.

**Device Control Password**
This setting is shown if the security configuration is set to Unencrypted. Enter the password required to access the I/O on the remote device. This password will be the same as the 'User' password on the remote device.

**Device PSK**
This setting is shown if the security configuration is set to TLS PSK Encryption. This is the pre-shared key required to access the I/O on the remote device using encryption. The pre-shared key can be found on the Passwords tab on the remote device.

**Device Admin Password**
Enter the admin password for the remote device. With this password, the X-418 will automatically add itself to the remote device’s Device List. This setting is only shown if the remote device supports this feature. This feature will only work if the remote device is connected to the Ethernet and both the Serial Number and IP address are set (above).
Remote Device Monitor and Control:

Communication with remote ControlByWeb devices uses both event-driven and polled communication models. Remote relay control and output I/O state changes sent to remote devices are event driven. Commands are always sent instantly when a local device needs to control a relay on a remote device. In our Standard communication settings, reading digital input status from remote devices is polled at a periodic rate which is set by the polling interval. The latency of the system as a whole, is determined by the polling interval.

The X-400 series of products introduced a mechanism which allows event-driven communications in both directions. Rather than relying on polling, I/O changes are “pushed” to other devices. This has the advantage of avoiding the latencies of the polling interval, and since the information is pushed, communications can occur through a router or firewall without the need to configure port forwarding. The mechanism is enabled by selecting Instant Send or Instant Receive communications settings. These options will only appear when communicating with devices that support this.

**Standard**
If this check-box is enabled, the remote device is controlled and monitored by sending relay commands when needed and periodically polling its status.

**Poll Interval**
This option appears when “Standard” is checked. It specifies how often the local device reads the state of the remote device.

**Instant Receive**
If this check-box is enabled, the remote device instantly pushes specific I/O changes to the local (this) device. The remote device will push I/O state to the local device periodically and/or when triggers are set up on the remote device to do this. The local device can send relay commands in the response.

**Instant Send**
If this check-box is enabled, the local (this) device instantly pushes specific I/O changes to the remote device. The remote device can send relay commands in response. The local device will push the state of all local I/O to the remote device periodically and/or when triggers are set up with an Action (see Control/Logic Tab > TASK/FUNCTIONS).

**Push Interval**
This option appears when “Instant Send” is selected. It defines the time period that local data is pushed to the remote device.
3.4 I/O Setup Tab

The X-418 supports a total of up to 100 Input/Output (I/O) resources. These can be a mix of local I/O, registers, timers, and Vin. These can also include I/O found on remote devices (relays, analog inputs, digital inputs, etc.). Fixed resources, such as the device's local I/O automatically appear under the I/O Setup tab.

When another ControlByWeb device is added to the X-418, that device's I/O resources (relays, digital inputs, analog inputs, etc.) are also added and they will automatically appear under the I/O Setup tab.

The I/O from the new device can then be added, edited, deleted, or used in control logic using the task builder. For more information about setup options for remote I/O types (relays, analog inputs, digital inputs, etc.), please see that device's users manual.

If an I/O resource is deleted, any dependent task in the Task Builder, or Control Page widget which references that particular I/O is also automatically deleted.

If logging is enabled for the I/O resource which is being deleted, the I/O resource is automatically removed from the logging list and the log file is reset (a warning is shown that the log file is about to be deleted.) The log file is deleted since the log file format is dependent on that I/O being logged. If a remote device is deleted, any dependent I/O resources, Tasks, Control Page widgets, and logs are also automatically deleted.
This page allows configuration of both local and remote analog inputs if remote devices have been configured. There are two tables, one for local analog inputs and one for remote. The analog inputs can be sampled and logged up to 25Hz for short durations. A scheduled or conditional task’s “action” can be used to start and stop logging.

X-400 series devices with local analog inputs feature a high-performance, 16-bit analog data acquisition system. Each analog input can be configured separately:

| **Single Ended** | Single-ended signals are referenced to the Gnd terminals. Each channel can be independently programmed with a ±1.28V, ±2.56V, ±5.12V, ±10.24V voltage range. |
| **Differential** | Differential sensors have two outputs that reference each other instead of ground. The differential mode uses two analog inputs instead of one. For example, if Channel 1 is selected for differential operation, the differential signals are connected to Channel 1 and 2. If Channel 3 is selected for differential operation, the differential signals are connected to Channel 3 and 4, and so on. The differential mode supports input ranges of up to ±20.48V; however, the absolute input voltages must be less than ±10V. For example, if Input1 is configured for differential operation and Input1 = +10V and Input2 = -10V, the measurement will read +20V. On the other hand, if Input1 = -10V and Input2 = +10V, the measurement will read -20V. |
| **4-20mA** | Configured for 0-20mA operation. Some industrial sensors output a current instead of voltage levels. The 4-20mA mode enables an internal precision 200-ohm shunt resistor (0.1%, 25ppm) and automatically configures the A/D for ±5V operation. This feature allows direct connection to 0-20mA current loop transducers. At 20mA, the maximum loop voltage across this device is 4.0 Volts (.020 x 200 = 4.0). With this setting, the voltage to current calculation ((Vin/200)*1000) is automatically made so the measurement is in units of mA. |
| **Digital Input** | For applications where digital inputs are needed, each analog input can be configured as a pseudo digital input with boolean (true/false) states. The input voltage is compared to fixed thresholds to determine a true/false state. The input is considered “true” when the voltage rises above 3.5V and “false” when it falls below 1.5V. If an analog input is configured as a “digital input”, the analog input widget on the Control Page will have appropriate setup options as a digital input. |
Click the respective *Edit* button to configure each analog input. Local analog inputs have some settings that remote analog inputs don't have and vice versa.

**Edit Analog Input Options**

**Input Name**
This text field describes the function of the selected analog input. The label text appears to the left of the corresponding analog input on the *Control Page* and in the email message when email alerts are enabled. When later defining the control logic, logging and other settings, this label appears in the pull-down lists of analog input resources. Up to 27 characters may be entered in this field. The default text is “Analog Input #”. Set the name to a descriptive value such as “Wind Direction”.

**Range Selection**
The analog to digital converter has a programmable gain amplifier (PGA). This setting specifies the full scale range of the analog input. Settings include; ±1.28V, ±2.56V, ±5.12V, ±10.24V.

**Decimal Places**
The number of digits displayed to the right of the decimal point. This does not affect the accuracy of the underlying value.

**Units**
Text entered here will be displayed on the right of the value when shown on the Control Page. This text does not affect the underlying value. Set the units to Volts, mA, mph, etc.

**Slope (Multiplier)**
The analog value can be scaled into engineering units. The X-418 reads the raw value (volts) from the analog-to-digital converter and calculates a new value in engineering units. This scaled value is calculated using the following \(y = mx + b\) formula.

\[
\text{Scaled Value} = \text{Slope} \times \text{RawValue} + \text{Offset}
\]

The calculated scaled value is used for logs, email messages, Control Pages, XML pages, and is 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 \((m=1 \text{ and } y=0)\) the scaled value equals the input voltage.

**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.
Pseudo Digital Input Options
If an analog input is configured as a pseudo digital input, the following options are available:

**Digital Input Name**
This text field describes the function of the selected digital input. The label text appears to the left of the corresponding digital input status on the Control Page and in the email message when email alerts are enabled. When later defining the control logic, logging and other settings, this label appears in the digital input pull-down list.

Up to 27 characters may be entered in this field. The default text is “Digital Input #”. Set the name to a descriptive value such as “Warehouse 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 digital input is On. The digital input is considered “on” when sufficient voltage is applied to the input. Up to 16 characters may be entered in this field. The default text is “On”. Set the status text to a descriptive value such as “Door Open”.

**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 digital input is Off. Up to 16 characters may be entered in this field. The default text is “Off”. Set the status text to a descriptive value such as “Door Closed”.

Remote Analog Input Options

**Device**
The device where the remote analog input is found.

**Device’s Sensor #**
The analog input number on the remote device.
3.4.2 I/O Setup Tab > REGISTERS

Registers are working variables that can be changed externally through the Control Page, XML requests, or the BASIC script. Registers can allow 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. Registers can also hold boolean information where "1"=true and "0"=false. This tab has settings for each of the configured Registers. By default, one register (register1) is pre-defined and is battery-backed such that its value is retained across power loss. Registers appear in tables on the Registers tab and can be created, edited, or deleted as needed. Up to 16 Local Registers can be created. The X-418 can also access remote registers found on other devices.

Register Options

**Register Name**
Text entered here will be displayed in the left column of the control page. Up to 27 characters may be entered here. The default text is “Register 1”. This is also the resource name used in a BASIC script. When later defining the control logic, logging and other settings, this label appears in the pull-down lists of Register resources.

**Decimal Places**
The number of digits displayed to the right of the decimal point. This does not affect the accuracy of the underlying value.

**Units**
Text entered here will be displayed on the right of the value when shown on the control page. This text does not affect the underlying value. Set the units to °F, ft, mph etc.

**Minimum Value**
If this register can be changed externally through the Control Page, XML requests, or the BASIC script it is may be useful to restrict the range of the register value. For example, a thermostat set-point register can be restricted to a minimum value.

**Maximum Value**
If this register can be changed externally through the Control Page, XML requests, or the BASIC script it is may be useful to restrict the range of the register value. For example, a thermostat set-point register can be restricted to a maximum value.
Local Register Options

Power Up State
At power-up the register is set to either an Initial Value (set below) or the Scheduled State. The Scheduled State will cause the Register value to be that defined by any scheduled tasks as if the power was always on.

Remote Register Options

Device
The device where the remote register is found.

Device's Sensor #
The register number on the remote device.
3.4.3 I/O Setup Tab > Vin

The power supply voltage (Vin) to the X-418 is internally measured and can be displayed, logged, or used in logic. This page configures the name for the Vin voltage.

Note: The X-418 can also monitor the power supply voltage of remote devices. For POE devices, the power is provided over the Ethernet cable and the Vin+ monitor will show 0-volts.

![Vin Options](image)

To edit the Vin name, click Edit.

### Vin Options

**Vin Name**

This text field is used to describe the power supply voltage value. 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 27 characters long. Set the name to a descriptive value such as “Power Supply” or “Battery Voltage”.

### Remote Vin Options

**Device**

The device where the remote Vin is found.
3.4.4 I/O Setup Tab > TIMERS

Timers are I/O resources for measuring the time between events/tasks or generating controlled delays. The timers are essentially 24-bit down counters with a one-second resolution. Timers appear in a table on the Timers tab and can be created, edited, or deleted as needed. Up to 16 Timers can be created. The timer's value is accessible to Scheduled and Conditional Tasks, BASIC scripts, Modbus and Control Page widgets. There are no remote timers.

A timer is started via an Action by setting it to a non-zero value. The timer counts downwards and stops when it reaches 0. When the timer reaches zero it generates a "timer expires" event. The "timer expires" events appear in the drop-down list ▼ of available Triggers for Scheduled and Conditional Tasks.

To add a timer, click Add Timer.

**Timer Name**

This text field is used to describe the timer. By default it is set to “Timer #.” This field may be up to 27 characters long. Set the name to a descriptive value such as "Warmup Delay".

(Note: This text appears to the left of the timer status field on the Control Page. It also appears in the pull-down lists under “Timer” resources when configuring tasks, logging, and other settings.)

**Power Up Value**

At power-up, the timer is set to this value. If the power-up value is something other than 0, the timer will begin to count down once the device is powered.

**Trigger(s)**

Scheduled and Conditional Tasks can start and stop a Timer. Once a timer is added and named in this tab, it will appear in the pull-down list ▼ of available Actions for Scheduled and Conditional Tasks. The Action can be specified to either reset the counter (stop) or to set it to a fixed value (start). Actions that control the timer are shown in the Trigger(s) field. (See example to the right for reference.)
3.5 Control/Logic Tab

The sub-menus under the Control Logic tab define the logic of the X-418. Conditional and Scheduled tasks as well as BASIC scripts are defined under this tab group.

3.5.1 Control/Logic Tab > TASK/FUNCTIONS

“Tasks” are control logic functions that perform specific things, such as turn a remote relay on/off under certain conditions or at certain times. Tasks are assigned a name, configured for a desired function, and saved. Once saved, they appear in tables on the Tasks/Functions tab and can be edited or deleted as needed.

Tasks are configured using settings and pull-down menus to define the logic function without the need to learn boolean or other programming syntax. For more complex logic functions or logic functions not supported by this tab, see Section Control Logic Tab > BASIC SCRIPT.

Up to 50 Scheduled Tasks and 50 Conditional Tasks can be created. Tasks can run once, periodically, or continually depending on its settings. Under the Control/Logic tab, you can observe all of the tasks, their start times, run modes, triggers and actions.

Scheduled tasks run at specific times. They can be configured to happen only one time, or on a repeated schedule.

Normal/Override

The Tasks/Functions tab has a status display which shows the current time of day and whether the Normal or Override schedule is running.

An Override Schedule can temporarily cause certain Scheduled tasks to stop operating (i.e., holidays), and resume normal schedules after the Override Schedule expires.

Up to 20 Override Schedules can be added.

For debug and testing, open the Control Page in another browser window (or another browser) and together with this page you can monitor which tasks are running and what they are doing in response to user input.

See Control Logic Examples Using Tasks/Functions for examples of using Tasks for control logic.

Conditional (boolean) tasks run only if specified conditions are met (e.g., “If an input is ON then turn a relay ON.” -or- “If a temperature sensor is above 32 degrees, send an email alert and turn a relay ON.”).
3.5.1.1 Scheduled Tasks

Scheduled tasks run at a specific time and on specific days of the week (e.g. turn a light on at 08:00 on Monday through Friday – or – start/clear logging at 04:00 on the first day of the month).

Scheduled tasks can also be configured to be conditional based on specified resources.

Each Scheduled task can initiate up to three Actions. Actions are control outputs that “do” something such as: turn a remote relay on or off, send an email, send a SNMP trap, or make a data log.

Scheduled Tasks appear in a table on the Control/Logic Setup tab and can be created, edited, or deleted as needed. Up to 50 Scheduled Tasks can be created.

To add a Scheduled task, click Add Scheduled Task.

Task Name:

This text field is used to describe the task. By default it is set to “Scheduled Task 1”. This field may be up to 24 characters long. Set the name to a descriptive value such as “Unlock Front Door”.

Run Mode:

The Run Mode defines when the scheduled task is active. It has the following options:
- Always: Always active.
- Normal Schedule: Active, unless overridden by an Override schedule.
- Override Schedule: Active only during an Override schedule.
- Off: Never active (disabled).
**Start Date:**
Select the month, day, and year which the scheduled task is to occur for the first time using the drop-down boxes.

**Start Time:**
- **Set:** Select the time of day which the scheduled task is to occur for the first time.
- **Sunrise:** Enter the offset (HH:MM) from sunrise. Choose *Before* or *After* sunrise.
- **Sunset:** Enter the offset (HH:MM) from sunset. Choose *Before* or *After* sunset.

**Note:** *The sunrise and sunset times are automatically calculated based on the latitude and longitude settings made in the General Settings Tab tab.*

**Condition – Scheduled Task (Optional):**
Scheduled tasks can optionally be controlled (enabled) based on an I/O's state (local and remote). In order for I/O to appear in the condition pull-down menu ▼, the I/O must be first added and named in the I/O Setup tab. The scheduled task only runs if the conditional I/O state evaluates as “true” at the scheduled time.

If *None* is selected, no conditional logic will be evaluated when performing the task.

If a **Relay** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON</strong></td>
<td>The scheduled task runs if the relay is On</td>
</tr>
<tr>
<td><strong>OFF</strong></td>
<td>The scheduled task runs if the relay is Off</td>
</tr>
</tbody>
</table>

If a **Digital Input** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON</strong></td>
<td>The scheduled task runs if the input is On</td>
</tr>
<tr>
<td><strong>OFF</strong></td>
<td>The scheduled task runs if the input is Off</td>
</tr>
</tbody>
</table>

If a **Digital Input Counter** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value = X.X</strong></td>
<td>If the Counter value is equal to the setting, the compare is true.</td>
</tr>
<tr>
<td><strong>Value &gt;X.X</strong></td>
<td>If the Counter value is greater than the setting, the compare is true.</td>
</tr>
<tr>
<td><strong>Value &lt; X.X</strong></td>
<td>If the Counter value is less than the setting, the compare is true.</td>
</tr>
</tbody>
</table>

If a **1-Wire Sensor** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value ≥ X.X</strong></td>
<td>If the sensor value is greater than or equal to the setting, the compare is true.</td>
</tr>
<tr>
<td><strong>Value &lt;X.X</strong></td>
<td>If the sensor value is less than the setting, the compare is true.</td>
</tr>
<tr>
<td><strong>Deadband</strong></td>
<td>Hysteresis for the compare</td>
</tr>
</tbody>
</table>

If an **Analog Input** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value ≥ X.X</strong></td>
<td>If the analog input value is greater than or equal to the setting, the compare is true.</td>
</tr>
<tr>
<td><strong>Value &lt; X.X</strong></td>
<td>If the analog input value is less than the setting, the compare is true.</td>
</tr>
</tbody>
</table>
If a pseudo **Digital Input** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>The scheduled task runs if the input is On</td>
</tr>
<tr>
<td>OFF</td>
<td>The scheduled task runs if the input is Off</td>
</tr>
</tbody>
</table>

If a **Register** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value = X.X</td>
<td>If the Register value is equal to the setting, the compare is true.</td>
</tr>
<tr>
<td>Value &gt; X.X</td>
<td>If the Register value is greater than the setting, the compare is true.</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the Register value is less than the setting, the compare is true.</td>
</tr>
<tr>
<td>Deadband</td>
<td>Hysteresis for the compare (see more details below)</td>
</tr>
</tbody>
</table>

If a **Vin** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value ≥ X.X</td>
<td>If the Vin value is greater than or equal to the setting, the compare is true.</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the Vin value is less than the setting, the compare is true.</td>
</tr>
<tr>
<td>Deadband</td>
<td>Hysteresis for the compare (see more details below)</td>
</tr>
</tbody>
</table>

If a **Timer** resource is selected, the trigger is true when the timer expires (reaches 0).

**Deadband**

The **Deadband** settings prevent alarms from triggering excessively when an analog value vacillates around the trigger point.

With high alarms, the value must fall below the high alarm point minus the **Deadband** and then back above the high-alarm point again, before the high alarm will be triggered again.

Likewise the **Deadband** on the low alarm requires the value to rise above the low alarm point plus the Deadband and then back below the low-alarm point again, before the low alarm will be triggered again.

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

**Actions - Scheduled Task**

Up to three actions can be specified for each Scheduled Task. Actions can change the state of local and remote I/O, counters, registers, and other resources. To be available in the task’s action pull-down menus ▼, the resource must be first added and named in the I/O Setup tab.
If *None* is selected, nothing is done when the task runs.

If *Relay* is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>The relay is turned on</td>
</tr>
<tr>
<td>Off</td>
<td>The relay is turned off</td>
</tr>
<tr>
<td>Pulse On</td>
<td>The relay is turned on for the amount of time specified as the pulse time for that relay and then turned off. The pulse time is set for each individual relay in the relay settings under the I/O tab on the device where the relay is physically located. Note: If a new pulse command is set to the relay before the pulse time expires, the pulse timer will be reset to its full value and the relay will remain on until the pulse timer expires.</td>
</tr>
<tr>
<td>Toggle On/Off</td>
<td>The relay changes state to the opposite of its current state.</td>
</tr>
<tr>
<td>Condition-1 I/O Value</td>
<td>The relay is set to the state of the I/O in Condition-1 of the trigger.</td>
</tr>
<tr>
<td>Opposite of Condition-1 I/O Value</td>
<td>The relay is set to the opposite state of the I/O in Condition-1 of the trigger.</td>
</tr>
<tr>
<td>Pulse On (heartbeat mode)</td>
<td>This option is used only for remote relays. While the trigger is true, a continual stream of pulse commands will be sent to the relay. The pulse commands will be sent out at the same rate as the “Poll Interval” which is set for the remote device (under the Remote Devices tab). If the Poll Interval time is less than the pulse time for the relay, the relay will receive pulse commands faster than the pulse timer is allowed to expire, so the relay will remain on until the trigger becomes false or the relay doesn't receive the command due to network failure. This option is useful for “fail safe” applications where it is important to turn the relay off in case of failure.</td>
</tr>
</tbody>
</table>

If *Digital Input Counter* is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>The counter value is logged</td>
</tr>
<tr>
<td>Reset</td>
<td>The counter is reset to 0</td>
</tr>
<tr>
<td>Log &amp; Reset</td>
<td>The counter value is logged, then reset to 0</td>
</tr>
</tbody>
</table>

If *Register* is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set-To</td>
<td>Set the value of the register to a specific value</td>
</tr>
<tr>
<td>Increment By</td>
<td>Increment the register by the specified value</td>
</tr>
<tr>
<td>Decrement By</td>
<td>Decrement the register by the specified value</td>
</tr>
</tbody>
</table>

If *Timer* is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Timer</td>
<td>Set the timer to the specified value</td>
</tr>
</tbody>
</table>
Clear (stop) Timer

Reset the timer to 0, and any actions that depend upon the timer will be cancelled.

If **Log** is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>A data log entry is made of the resources enabled in Logging Tab &gt; LOG I/O</td>
</tr>
<tr>
<td>Reset Log</td>
<td>Clear (Erase) the log file</td>
</tr>
<tr>
<td>Pause Logging</td>
<td>Temporarily pause all logging to the log file.</td>
</tr>
<tr>
<td>Resume Logging</td>
<td>Resume logging after previously pausing it.</td>
</tr>
</tbody>
</table>

If **Email** is selected, an email is sent when the task runs.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send Email To</td>
<td>With the drop down box, select the Email address to use. The address list is configured in the General Settings tab &gt; Email settings tab.</td>
</tr>
</tbody>
</table>

If **SNMP TRAP** is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send SNMP Trap for Cond 1 I/O value</td>
<td>Send SNMP Trap to Configured SNMP Managers for I/O in Condition 1</td>
</tr>
<tr>
<td>Send SNMP Trap for Cond 2 I/O value</td>
<td>Send SNMP Trap to Configured SNMP Managers for I/O in Condition 2</td>
</tr>
<tr>
<td>Send SNMP Trap for Cond 1 and 2 I/O value</td>
<td>Send SNMP Trap to Configured SNMP Managers for I/O in Condition 1 and 2.</td>
</tr>
</tbody>
</table>

If **SNMP NOTIFICATION** is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send SNMP Notification for Cond 1 I/O value</td>
<td>Send SNMP Notification to Configured SNMP Managers for I/O in Condition 1</td>
</tr>
<tr>
<td>Send SNMP Notification for Cond 2 I/O value</td>
<td>Send SNMP Notification to Configured SNMP Managers for I/O in Condition 2</td>
</tr>
<tr>
<td>Send SNMP Notification for Cond 1 and 2 I/O value</td>
<td>Send SNMP Notification to Configured SNMP Managers for I/O in Condition 1 and 2.</td>
</tr>
</tbody>
</table>

If **Remote Services Notification** is selected:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send Device State to Remote Service</td>
<td>The local device state is sent to the remote services server if configured.</td>
</tr>
</tbody>
</table>

If **Push I/O State to Remote Receiver Devices** is selected:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push I/O State to Remote Receiver Devices Action</td>
<td>The state of the X-418 is sent to all remote devices configured to receive such messages.</td>
</tr>
</tbody>
</table>

If **Set I/O Color** is selected, an I/O’s status color can be changed on the Control Page.
**Repeat:** The *Scheduled Task* is repeated:

<table>
<thead>
<tr>
<th>Repeat Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Repeat</td>
<td>Runs only once</td>
</tr>
<tr>
<td>Seconds</td>
<td>Repeats once every X seconds</td>
</tr>
<tr>
<td>Minutes</td>
<td>Repeats once every X minutes</td>
</tr>
<tr>
<td>Hourly</td>
<td>Repeats once every X hours</td>
</tr>
<tr>
<td>Daily</td>
<td>Repeats once every X days</td>
</tr>
<tr>
<td>Weekly</td>
<td>Repeats weekly on the selected days of the week</td>
</tr>
<tr>
<td>Monthly</td>
<td>Repeats monthly either on selected days of the month, or the 1st Sunday, etc.</td>
</tr>
<tr>
<td>Yearly</td>
<td>Repeats yearly on the 1st, 2nd, 4th Day of the Start Date Month, or the 1st, 2nd, 4th day of the Start Date every month that year</td>
</tr>
</tbody>
</table>
3.5.1.2 Conditional Tasks

Conditional tasks occur (run) if certain conditions are met. Conditional tasks are made by comparing specified resources using simple and/or (boolean) logic. For example, if a digital input goes on, turn a relay on.

Conditional tasks can be configured to be active continually or only during specific time periods each day/week.

Each Conditional Task can initiate up to three Actions. Actions are control outputs that “do” something such as turn a relay on or off, send an email, send a SNMP trap or make a data log.

Conditional Tasks are event driven and do not evaluate asynchronously. Their triggers are only evaluated when the conditions of the trigger change state. Conditional Tasks appear in a table on the Control/Logic Setup tab and can be created, edited or deleted as needed. Up to 50 Conditional Tasks can be created.

To add a Conditional Task, click the “Add Conditional Task +” button, and a popup window appears.

Task Name

This text field is used to describe the task. By default it is set to “Conditional Task 1”. This field may be up to 24 characters long. Set the name to a descriptive value such as “High Temp Shutdown”.

Triggers - Conditional Tasks

The “Trigger” section is a boolean logic comparison of two I/O. Triggers ONLY occur when the conditions change to true. The logic operations are event driven, and are not combinational. Conditions must change to false and back to true in order to re-trigger.

Note: To appear as a condition in the task drop-down menus ▼, the I/O must be first added and named in the I/O Setup tab.

The two conditions (arguments) can be evaluated with “AND” or “OR” boolean logic. If both conditions are set to None, the Conditional Task is never evaluated. If one trigger is set to None, only one condition is evaluated for a True or False state.

If a Relay is selected the following logic states are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>The condition is true if the relay is on</td>
</tr>
<tr>
<td>Off</td>
<td>The condition is true if the relay is off</td>
</tr>
<tr>
<td>Changes</td>
<td>The condition is true if the relay changes state</td>
</tr>
</tbody>
</table>

If a Digital Input is selected the following logic states are available:
The condition is true if the digital input is on

The condition is true if the digital input is off

The condition is true if the digital input changes state

If a **Digital Input Counter** is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value = X.X</td>
<td>If the Counter value is equal to the setting, the condition is true</td>
</tr>
<tr>
<td>Value &gt; X.X</td>
<td>If the Counter value is greater than the setting, the condition is true</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the Counter value is less than the setting, the condition is true</td>
</tr>
</tbody>
</table>

If a **1-Wire Sensor** is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value ≥ X.X</td>
<td>If the sensor value is greater than or equal to the setting, the condition is true</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the sensor value is less than the setting, the condition is true</td>
</tr>
<tr>
<td>Deadband</td>
<td>Hysteresis for the comparison</td>
</tr>
</tbody>
</table>

If **Analog Input** is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value ≥ X.X</td>
<td>If the analog input value is greater than or equal to the setting, the condition is true</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the analog input value is less than the setting, the condition is true</td>
</tr>
<tr>
<td>Deadband</td>
<td>Hysteresis for the comparison (see more details below)</td>
</tr>
</tbody>
</table>

If a **Pseudo Digital Input** resource is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>If the pseudo digital input is on, the condition is true</td>
</tr>
<tr>
<td>OFF</td>
<td>If the pseudo digital input is off, the condition is true</td>
</tr>
</tbody>
</table>

If a **Register** is selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value = X.X</td>
<td>If the Register value is equal to the setting, the condition is true</td>
</tr>
<tr>
<td>Value &gt; X.X</td>
<td>If the Register value is greater than the setting, the condition is true</td>
</tr>
<tr>
<td>Value &lt; X.X</td>
<td>If the Register value is less than the setting, the condition is true</td>
</tr>
</tbody>
</table>

If a **Vin** selected, the following conditions are available:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value ≥ X.X</td>
<td>If the Vin value is greater than or equal to the setting, the condition is true</td>
</tr>
</tbody>
</table>
Value <X.X | If the Vin value is less than the setting, the condition is true.
Deadband | Hysteresis for the comparison (see more details below).

If a Timer is selected, the condition is true when the timer expires (reaches 0).

**Deadband**

The Deadband settings prevent alarms from triggering excessively when an analog value vacillates around the trigger point.

With high alarms, the value must fall below the high alarm point minus the Deadband and then back above the high-alarm point again, before the high alarm will be triggered again.

Likewise the Deadband on the low alarm requires the value to rise above the low alarm point plus the Deadband and then back below the low-alarm point again, 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 Deadband ensures that once the high alarm is triggered, it won’t trigger again until the temperature first drops below 94 degrees (95 – 1).

**During – Conditional Tasks**

Conditional tasks can be configured to run continually or during specific days each week.

**Always**

Runs continually.

**Set Time**

Specify the time interval and day(s), when this task will evaluate.

*Note:* If the Start Time begins after the end time (i.e., Start Time: 8:00pm, End Time: 6:00am), then the time interval will start and continue through the end time of the next day.

**Actions – Conditional Tasks**

Up to three actions can be specified for each Conditional Task. Tasks can change the state of a remote relay, counters, registers and other remote I/O. To be available in the task's action pull-down menus ▼, the resource must be first added and named in the I/O Setup tab.

If **None** is selected, nothing is done when the task runs.

If a **Relay** Action is selected the following actions are available:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>The relay is turned on</td>
</tr>
<tr>
<td>Off</td>
<td>The relay is turned off</td>
</tr>
<tr>
<td>Pulse On</td>
<td>The relay is pulsed on (then off)</td>
</tr>
</tbody>
</table>
**Toggle On/Off**  
The relay changes state

**Condition-1 I/O Value**  
The relay is set to the state of condition 1 I/O

**Opposite of Condition-1 I/O Value**  
The relay is set to the opposite state of condition 1 I/O

**Pulse On (heartbeat mode)**  
The relay is pulsed continually over and over while the trigger is true. When the trigger changes to false, the relay will go off. This is useful for remote relays and detecting network drop-outs, etc.

If a **Digital Input Counter** Action is selected, the following actions are available:

- **Log**  
The counter value is logged
- **Reset**  
The counter is reset to 0
- **Log & Reset**  
The counter value is logged, then reset to 0

If **Register** is selected, the following actions are available:

- **Set-To**  
Set the value of the register to a specific value
- **Increment By**  
Increment the register by the specified value
- **Decrement By**  
Decrement the register by the specified value

If **Timer** is selected, the following actions are available:

- **Start Timer**  
Set the timer to the specified value
- **Clear Timer**  
Resets the timer to 0

If **Log** is selected, the following actions are available:

- **Log**  
A data log is made of the resources enabled in Logging Tab > LOG I/O
- **Reset Log**  
Clear (Erase) the log file
- **Pause Logging**  
Temporarily pause all logging to the log file
- **Resume Logging**  
Resume logging after previously pausing it

If **Email** is selected, an email is sent when the task runs.

- **Send Email To**  
With the drop down box, select the Email address to use. The address list is configured in the General Settings Tab > EMAIL SETTINGS tab.
If **SNMP TRAP** is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send SNMP Trap for Cond 1 I/O value</td>
<td>Send SNMP Trap to configured SNMP Managers for I/O in Condition 1</td>
</tr>
<tr>
<td>Send SNMP Trap for Cond 2 I/O value</td>
<td>Send SNMP Trap to configured SNMP Managers for I/O in Condition 2</td>
</tr>
<tr>
<td>Send SNMP Trap for Cond 1 and 2 I/O value</td>
<td>Send SNMP Trap to configured SNMP Managers for I/O in Condition 1 and 2</td>
</tr>
</tbody>
</table>

If **SNMP NOTIFICATION** is selected, the following actions are available:

<table>
<thead>
<tr>
<th>Action Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send SNMP Notification for Cond 1 I/O value</td>
<td>Send SNMP Notification to configured SNMP Managers for I/O in Condition 1</td>
</tr>
<tr>
<td>Send SNMP Notification for Cond 2 I/O value</td>
<td>Send SNMP Notification to configured SNMP Managers for I/O in Condition 2</td>
</tr>
<tr>
<td>Send SNMP Notification for Cond 1 and 2 I/O value</td>
<td>Send SNMP Notification to configured SNMP Managers for I/O in Condition 1 and 2</td>
</tr>
</tbody>
</table>

If **Remote Services Notification** is selected:

<table>
<thead>
<tr>
<th>Action Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send Device State to Remote Service</td>
<td>The local device state is sent to the remote services server if configured.</td>
</tr>
</tbody>
</table>

If **Push I/O State to Remote Receiver Devices** is selected:

<table>
<thead>
<tr>
<th>Action Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push I/O State to Remote Receiver Devices</td>
<td>The state of the X-418 is sent to all remote devices configured to receive such messages.</td>
</tr>
</tbody>
</table>

If **Set I/O Color** is selected, an I/O's status color in the Control Page can be changed.

### 3.5.1.3 Override Schedules

Override Schedules temporarily disable Scheduled Tasks that are set to **Normal Schedule** in the Run Mode column. It enables any Scheduled Tasks that are set to **Override Schedule**. Tasks that are set to **Always** will not be effected by any Override Schedules. Override Schedules are especially helpful for creating holiday schedules. Override Schedules appear in a table on the Control/Logic Setup tab and can be created, edited, or deleted as needed. The X-418 supports up to 20 different override schedules.

A task running on a Normal schedule can be setup by an Administrator (with **Administrator** credentials) and can be used, for example, to open door locks during office hours. Override schedules allow the normal schedule to be temporarily disabled without disturbing the underlying schedule. For example, an employee (with **Manager** credentials) can temporarily change the schedule to accommodate a special holiday without the need to change or adjust the Normal schedule.

An example of this would be the 1st of January. An override schedule could be created that starts 00:00
on January 1st and ends at 23:59 on January 1st. This override schedule would stop normally scheduled tasks from running every year on the 1st of January.

Override schedules are periodic annually (e.g., the event will occur every year at the same time.)

To add an Override Schedule, click Add Override Schedule. Click the Edit button to edit an override schedule, click the “X” button to delete an override schedule.

Name:
This text field is used to describe the override schedule. By default it is set to “Override Schedule 1”. This field may be up to 24 characters long. Set the name to a descriptive value such as “Office Closed”.

Start Day/Time:
Different options will appear depending on the option you choose:

- Choose “On the” to enter a start day of the month, start time, and duration (days) for the override schedule.
- Choose “On” to enter a specific start date and time, and a specific end date and time.
3.5.2 Control Logic Tab > BASIC SCRIPT

The X-418 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-418, a script must first be prepared as a text (.txt) file. The file must then be uploaded to the X-418 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 the X-418 can be found in Section Basic Scripts. See Control Logic Examples Using BASIC Scripts for examples of 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.

Currently Loaded Script
This field displays the .txt file that is uploaded to the X-418. The script (text) displayed on this screen cannot be edited. In order to edit any script, the .txt file must be edited externally and uploaded to the device again.

Basic Script File
To upload a basic script file to the device, click Basic Script File. A file upload dialog box opens which allows you to choose the file to upload. To upload the script, click Open.

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. Clicking the Refresh Status button will update this field.
**Run Script**

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

**BASIC I/O Tokens**

After I/O resources are added and named, they can be controlled and monitored within BASIC scripts. BASIC scripts must reference I/O resources (relays, temp sensors, digital and analog inputs, etc.) in the form of a token, which is the characters “io” followed by the name of the resource (e.g., io.name). If the resource name has embedded spaces, they must be removed in the io.name token. The first character must be lower case.

For example, if a relay is named “Warehouse Fan”, the fan can be turned on with the BASIC statement “LET io.warehouseFan = 1”. If a resource name is changed, the resource name in the BASIC script must be renamed to match.

The button, “View Basic I/O Tokens” displays a list of all of the I/O resources currently available together with the equivalent token to be used in BASIC scripts to reference the respective I/O resource.

---

This screenshot was taken from the X-410 device. Other ControlByWeb devices will show different I/O Names and Basic I/O Tokens.
3.6 Logging Tab

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-418's IP address}/log.txt. For more information on logging, see Section Log Files.

The X-418 can make up to 30 log entries per second with event-driven logging. Each log entry has a time stamp with millisecond resolution. Two Conditional Task actions are available to pause and resume logging.

The log is stored in non-volatile, flash memory using a circular buffer (oldest data is over written). 512 kB of memory space is reserved for logging. Log entries are composed of the following components, 30-byte header, 16-bytes for relays, 16-bytes for inputs, and 4 bytes for each analog value being logged (counters, 1-Wire sensors, vin, registers, etc). The space allocated for relays and inputs does not change depending on whether any relays or inputs are being logged.

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

3.6.1 Logging Tab > GENERAL LOGGING SETTINGS

Enable Logging
When this option is set to Yes, the X-418 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.

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 Interval 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. Note: If “Event Only” is selected, this setting has no effect.

Interval
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 1-60. Time units are Minutes, Hours, and Days. Select Event Only to disable periodic logging. Note: If “Event Only” is selected, this setting has no effect.

Next Log Time
This field shows when the next periodic log event is scheduled to occur. If logging is disabled, the
next log time will indicate "Disabled." If logging is enabled, but periodic logging is disabled (by selecting Event Only) the next log time will indicate "Event Logging Only."

Note: This information is updated only when the page is refreshed.
3.6.1.1 Logging Tab > LOG I/O

This setup page is used to select which resources are logged, and which resources asynchronously trigger logging.

Whenever a log event (triggered or periodic) occurs, each resource which has its Log check-box enabled will be included in the periodic log. If a resource has its Trigger Log Event check-box enabled, a log will asynchronously occur when that resource changes its state or value.

**Trigger and Delta**

Analog resources log data when the value changes by the amount specified in the Delta fields. The default setting for these fields is shown below.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Trigger Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Inputs</td>
<td>2.0 V</td>
</tr>
<tr>
<td>Vin</td>
<td>2.0 V</td>
</tr>
<tr>
<td>Registers</td>
<td>2</td>
</tr>
</tbody>
</table>
Asynchronous Log Events

<table>
<thead>
<tr>
<th>Digital Inputs or Relays</th>
<th>Logging will occur whenever the state of that I/O changes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Inputs</td>
<td>Logging will occur whenever the voltage changes by the trigger delta.</td>
</tr>
<tr>
<td>Registers</td>
<td>Logging will occur whenever the Register changes by the trigger delta.</td>
</tr>
<tr>
<td>Vin</td>
<td>Logging will occur whenever the Vin voltage changes by the trigger delta.</td>
</tr>
</tbody>
</table>
3.6.1.2 Diagnostic Settings

XML, MODBUS, and SNMP requests received by the X-418 can generate a log entry. Each communication protocol has a check-box to enable logging for that protocol.

Excluding Logged Requests

When logging is enabled for XML Requests, Modbus Requests, or SNMP Requests, you can filter out Reads (such as reading inputs' states via an XML request) or Writes (such as changing the output state via an XML command).

On the Control Page Setup tab, you 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 logged. Likewise, by selecting Writes, write requests will not be logged. The default selection is None.

3.6.1.3 Send Log File

The X-418 can be configured to send its log file to a remote server at a specific time once per day. The file can be emailed and/or uploaded to an FTP server. Only new log entries since the last successful upload, are sent. The log file is not deleted.

Daily Send Time

Select the time each day (24-hour format) the log file is to be sent.

Email Log File

If this check-box is enabled, a log email will be sent daily. The log email will contain entries that are new since the last successfully sent log email. When this box is checked, a drop-down box and Test Log Email button appear. Using the drop-down box, select the email address to send daily log. The address list is configured in General Settings Tab > EMAIL SETTINGS. The Test Log Email button causes the log file to be emailed immediately, without waiting until the daily send time.
**FTP Upload Log File**

If this check-box is enabled, the log file is sent to an FTP server once each day. Only the log entries that are new since the last successfully FTP upload will be sent each day.

*Host Name*

The IP address or hostname of the remote FTP server is entered here. The default value is 192.168.1.15.

*Connection Security*

Choose None, Implicit TLS, or Explicit TLS. The security and port number must be configured to match the FTP server. The None option uses no encryption on the connection. Implicit TLS uses SSL to encrypt the channel before any FTP commands are sent or received. Explicit TLS allows the connection to start unencrypted and then upgrades the connection to encrypted through FTP commands.

*Port*

The TCP port number of the FTP server. This must match the TCP port set in the FTP server. The valid range is 1 to 65535. The default port number is 21.

*User name*

The username for connecting to the FTP server.

*Password*

If the FTP server requires a password, the password is entered here.

*FTP Path/Filename*

When uploading the log file to an FTP server, the FTP server will have a default location where it will place the log file. This field is used to define the filename of the log file stored on the FTP server.
Sub-directories can also be defined here.

The actual filename used for saving the file on the FTP server will be the specified file name with the date and time appended to it. For example log.txt would be log_YYYYMMDDHHMMSS.txt where YYYY is the year, MM is the month, DD is the day of the month, HH is the hour, MM is the minutes, and SS is the seconds. This date and time comes from the X-418, and is the time that the X-418 uploaded the file.

**Test FTP Log**

The *Test FTP Email* button causes the log file to be sent immediately. If nothing is in the log file, no file will be sent. The log information sent when this button is pressed will not be sent again when the button is pressed again or at the daily upload time.
3.7 Monitor & Control Tab

Under this tab there are buttons for viewing and customizing the Control Page as well as graphing the log file.

3.7.1 Monitor & Control Tab > CONTROL PAGE

This button displays the current Control Page. The Control Page is what users typically use to control and monitor I/O on this device. You can access the Control Page either through the setup menu, or directly by entering the IP address of this device into the address bar of a web browser. The Control Page is highly configurable. The Control Page Setup tab determines which resources are shown on the Control Page and how they are presented and displayed.

Here’s an example of a Control Page for the X-418:

![Control Page Example](image1.png)

Here’s an example of a control page with customized resources:

![Control Page Example](image2.png)
If a sensor is disconnected or fails, the data value will be shown as x.xx in yellow.
3.7.2 Monitor & Control Tab > CONTROL PAGE SETUP

The content, format, and presentation of the Control Page is configured on this page. For example, the settings below illustrate the settings for the Control Page shown in the previous section.

After making changes to the header, logo, footer, and control ordering, you must click the Submit button for the changes to take effect.

**Note:** Any browsers currently viewing the Control Page while making changes will need to be refreshed before seeing the new changes. Do this by clicking the refresh button on your browser.

*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 30 characters in length.

**Show Header Logo**

A graphic logo can be displayed in the upper left-hand corner of the Control Page. This setting enables or disables displaying the logo.

**Header Logo**

The ControlByWeb logo is shown by default. To upload a new logo, click Choose New Logo. A file upload dialog box opens, allowing you to browse for the file on your computer. The file must be a *.png format. Click the button to initiate the file upload. The logo file size must be less than 16k bytes. Once a logo has been uploaded, the default ControlByWeb logo will be overwritten. The ControlByWeb logo will not be restored if the device is reset to factory defaults (there is only room for one logo.)

**Footer Text/HTML**

The bottom of the Control Page has a configurable “footer” field. The text entered in this setup box appears as a footer on the Control Page. The text can include HTML hypertext links as shown in the example.

**Refresh Rate**

The Control Page continually updates its contents by setting a timer in the web page that causes it to be reloaded at a specified time interval. The web page content will be refreshed at the time interval specified in this setting. It can be set from 1 to 60 seconds. The default Refresh Rate is 3 seconds. Slower refresh rates will use less network bandwidth.

**Control Page Widgets**

A list of I/O resources that can be added to the Control Page appear next. The “widgets” appear on the Control Page in the same order as the setup list. Resources such as analog inputs automatically appear in this list and can be removed from the Control Page, if desired. For all other I/O (registers, counters, timers, etc.), you must have previously added them in I/O Setup tab before adding them to the Control Page.

To add one or more widgets, click the Add I/O to Control Page button

To edit a widget, click the Edit button

To remove a widget, click the Delete button.

To re-arrange the order of the widgets, click the widget handle and drag the widget to a different row.

When finished, click to Submit at the bottom of the page to save your edits.

To change the name of the resources (analog inputs, registers and Vin) on the Control Page, edit the respective settings in the I/O Setup Tab and change the resource name. While naming each resource, it is good practice to edit the associated status text. For example, for a digital input perhaps name the input “Warehouse Door”, set the On Status Text to “Door is Open” and the Off Status Text to “Door is Closed”.

Some widgets have more setup options than others. Widgets for the analog inputs, Vin and timers can be added but have no options to edit.

Once the I/O has been added, rearrange the I/O by clicking on the icon and dragging to the desired position.
Click *Submit* once you have the finished making changes to the page.

**Add I/O to the Control Page**

To add one or more I/O, click the *Add I/O to Control Page* button. From the list of available I/O resources, check one or more *Add* boxes to add the selected resources to the Control Page.

After adding the desired widgets you can edit the widgets one by one, as needed, for the desired appearance and function. The visual presentation of the labels, buttons and colors can be highly configured. The display options available for the widgets depend on the specific I/O.

**Gap Widgets**

*Gap widgets are cosmetic widgets that allow sections of the Control Page to be separated by a small space. This is useful when grouping similar controls together.*
**Analog Input Widget Editor**

There is no widget editor for analog inputs. The information which will appear on the Control Page will be configured in the I/O Setup tab > Analog Inputs.
Relay Widget Editor

State
Show or Hide the relay state.

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

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

ON Button
Show or Hide the On button.

ON Button Label
The text in this field specifies the text that will be displayed on the ON Button on the Control Page to turn on the relay. Up to 16 characters may be entered in this field. The default text is “On”.

Off Button
Show or Hide the Off button.

OFF Button Label
The text in this field specifies the text that will be displayed on the OFF Button in the Control Page to turn off the relay. Up to 16 characters may be entered in this field. The default text is “Off”.

Toggle Button
Show or Hide the Toggle button.

Toggle Button Label
The text entered in this field appears in the ‘Toggle’ button. Up to 16 characters may be entered in this field. The default text is “Toggle”.

Pulse Button
Show or Hide the Pulse button.

Pulse Button Label
The text entered in this field appears in the ‘Pulse’ button. Up to 16 characters may be entered in this field. The default text is “Pulse”.

**Digital Input Widget Editor**

**State**
Show or Hide the state (value).

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

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

**Input Counter Widget Editor**

**Count/Frequency**
Show or Hide the counter/frequency value.

**Allow reset in control page**
When enabled, the count value on the Control Page may be clicked to reset the counter's value back to 0 after confirmation.

**1-Wire Sensor Widget Editor**

There is no widget editor for 1-Wire sensors. The information which will appear on the Control Page will be configured in the I/O Setup tab > 1-Wire Sensors.
Register Widget Editor

Registers can be changed externally through the Control Page, XML requests, ModBus, 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.

Status:
State
Show or Hide the state (value).

Control Buttons:
There are four different types of control buttons for a register widget, each types has different options:

1. **Type = Increment/Decrement**
   * **Increment Button**
     Show or hide the button
   * **Decrement Button**
     Show or hide the button
   * **Step**
     This setting is the amount the Register will be incremented or decremented when the respective increment/decrement button is clicked. The value can be an integer or floating point number.

2. **Type = Custom Buttons**
   This setting provides up to 4-buttons with custom labels and set-values. Use one or more of these buttons to force a Register to specified fixed values.
   Use these buttons for example, to provide a fan speed control with buttons labeled *High*, *Medium* and *Low* and perhaps with 100%, 50% and 20% for the button set-values.
   * **Button (1-4)**
     Show or Hide the button.
   * **Label (1-4)**
     The text in this field specifies the text that will be displayed in the button. Up to 16 characters may be entered in this field.
   * **Value (1-4)**
     When the user clicks the button, the Register defined in the Widget being edited will be set (forced) to the specified fixed value. The setting can be any integer or floating point value.
3. Control Button Type = Text Box

Use this setting to allow the user to manually change the value of a Register. The input can be an integer or floating point value. The input value can be restricted between minimum and maximum values defined by settings for the Register itself. See Section Error: Reference source not found.

Use this input field for example, to enter a thermostat set-point value.

4. Analog I/O Status Colors

The status colors of analog I/O (analog inputs, 1-Wire sensors, thermocouples, Vin, high-frequency inputs, analog outputs, timers, counters, on timers, total on timers) can be changed by creating Tasks under Control/Logic which set the I/O status colors.

5. Digital Input and Relay Status Colors

The status colors of digital inputs and relays can be configured directly in their respective control page widgets.

3.7.3 Monitor & Control Tab > GRAPH LOG FILE

The data in the log file can be displayed in a graphical format. Use this page to configure and view the graph. With the Start and End settings you can “zoom in” to display the data over a specific time interval. When the Graph is first loaded, the last 24 hours of the log file are downloaded and displayed. Pressing the “Graph Last 24 Hours” button will update the graph with the last 24 hours of the log file. Pressing “Graph Selected Date/Time” will update the graph with the selected range of time in the Start/End drop-down menus. Note: The larger the range of time, the longer it takes to download the log file for graphing.

3.7.3.1 Settings

Select I/O
Select which I/O from the log file is to be graphed. Up to 10 I/O can be graphed at one time.

Start Date & Time
This is the start time for the graph. Select the month, day, year and time of day using the drop-down boxes.

End Date & Time
This is the stop time for the graph. Select the month, day, year and time of day using the drop-down
3.7.3.2 Graph

The graph includes a legend describing the colors and I/O in the top-right corner of the graph. The graph is interactive in that if the mouse is hovered over a specific data-point, it displays the precise value. To zoom in on a specific region of the graph, click and drag to highlight the area of interest. To return to a normal zoom, click the Graph button.

![Graph Image]

---

boxes.
Section 4: Control Page

The Control Page is normally what users see and use and it can be highly configured to fit your needs. The Monitor & Control Tab > CONTROL PAGE SETUP tab has settings that determine what resources are displayed and how they are formatted.

Administrators, Managers and Users have separate access privilege to the Control Page. See General Settings Tab > PASSWORDS for a description of each access privilege.

4.1 Browser Operation

There are two ways users can access the Control Page by using a web browser:

1. Control Page

The first is by typing the IP address of the X-418 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 was 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

To access the X-418 using HTTPS, the user would enter: https://192.168.1.2

If any port is used other than the default HTTPS port 443, the port must also be included in the request. You will usually get a warning when accessing the X-418 over HTTPS, this is because the X-418 is using a default, self-signed SSL certificate.

The I/O on the Control Page updates every three seconds unless the update interval has been changed in the Control Page Setup.

2. Control Page via Setup Page Tabs

The second method of accessing the Control Page is through the Setup Page tabs (http://192.168.1.2/setup.html).

Choose Monitor & Control Tab > CONTROL PAGE.
Section 5: Example Control Scenarios

This section presents various control examples using Scheduled Tasks, Conditional Tasks, and BASIC scripts to solve example applications.

5.1 Control Logic Examples Using Tasks/Functions

The following examples illustrate tasks or functions that can be performed by the X-418. These examples may be used as a tutorial to illustrate how to perform certain functions and can be a good starting point for more advanced logic.

**Important:** When creating tasks that perform actions when something is triggered, the action will not automatically reverse when the trigger goes away. For example, if a trigger turns a remote digital output on when temperature rises above 50 degrees, you must create a second task to turn the digital output off when the temperature falls below 50 degrees.
5.1.1 Send an email if the temperature is less than 33°C between 9:30PM and 10PM each day

In this example the Deadband of 1 degree was used to prevent multiple email messages being sent due to "chatter".

Another email message won't be sent until the temperature rises above 34 degrees (33 plus 1 degree deadband) and then back below 33 degrees.

The "During" section of the task limits the time when the triggers are effective to 9:30 P.M. and 10:00 P.M. every day of the week. Outside this window email messages will not be sent even if the temperature drops below 33 degrees.
5.1.2 Send Email if Input 1 stops toggling

Monitor Pseudo Digital Input 1 for state changes. If Input 1 doesn't change state every 5 seconds or faster an email message will be sent.

This is using two tasks. Task 1 starts (or re-starts) a timer each time the pseudo input changes. Task 2 sends the alert if the timer ever expires.
5.1.3  Send an email message every 24 hours

![Scheduled Task Interface]

- **Task Name:** Email every 24 Hours
- **Run Mode:** Always
- **Start Date:** October 3, 2017
- **Start Time:** 12:00:00
- **Condition:** None (Optional)
- **Set Action 1:** Send Email
  - Send Email To: example@ControlByWeb.com
- **Set Action 2:** None (Optional)
- **Set Action 3:** None (Optional)
- **Set Repeat:** Daily
- **Repeat Every:** 1 Day(s)
- **End Repeat:** Never (Continuous Task)
5.1.4 Network monitor between two X-418 devices (advanced)

In this example we will configure two X-418 devices to share a register. In the example we are using this as a network monitor, but this example illustrates how to share register or I/O states between devices.

One X-418 (we will call X-418_ONE) will be configured to share a register with a second X-418 (we will call X-418_TWO). X-418_ONE will change that register value once every 10 seconds. X-418_TWO will monitor that register value. If X-418_TWO detects no changes to the register for more than 12 seconds it will send an email alert.

Setup X-418_ONE communications with X-418_TWO:

1. Connect both devices to the network and assign IP address to each of them.
2. Open the setup page for X-418_ONE and select "Remote Devices" tab. Click the "Find Devices" button. The other X-418 (X-418_TWO) should appear in the list. If multiple X-418 units are installed on the network you may need to identify it by serial number. Select that X-418 device so the "Add Remote Device" window appears. Within that window...
   - Name the device "X-418_TWO"
   - Select Model X-418 (should already be selected)
   - Serial number should be filled in with correct serial number.
   - IP address should have correct IP address for X-418_TWO and port should be correct.
   - Set up the security options and enter passwords for X-418_TWO
   - In the bottom portion of the window, select "Instant Send"
   - Click "Add Device"

Wait a minute and then you should see X-418_TWO in the Remote Device List and the status should indicate a response time (in milliseconds) from the remote unit (the smaller the response time the better).

Now X-418_ONE is set up to push its I/O state to the remote device. By default it will push the state every 3 seconds (PUSH interval) but we want it to push its state instantly when the register changes so we will set that up in Conditional Tasks.

Setup of X-418_ONE to toggle register and share it with X-418_TWO (add two Conditional Tasks):

1. Open setup page for X-418_ONE (should already be there from above setup)
2. Set up a timer (called Timer 1) with a Power Up value of 8 seconds. This timer will be used to change the register and the Power Up value will cause it to start automatically.
3. Set up a task and call it "Toggle Register to 1". Set the trigger to "Timer 1 Expires AND Register 1 = 0". Set the Actions to "Set Register 1 to 1" and "Start Timer 1 for 10 Seconds" and "Push I/O State To Remote Receiver Device"
4. Set up a task and call it "Toggle Register to 0". Set the trigger to "Timer 1 Expires AND Register 1 = 1". Set the Actions to "Set Register 1 to 0" and "Start Timer 1 for 10 Seconds" and "Push I/O State To Remote Receiver Device"

Setup of X-418_TWO to monitor the register from X-418_ONE and sent alert if the register doesn't change within 12 seconds:

1. Open setup page for X-418_TWO and select Remote Devices tab. You should see X-418_ONE in the list of devices but the name will show as the serial number rather than the name X-
418_ONE. You can click edit and change the name to X-418_ONE. If the X-418_ONE device doesn't appear in the list you will need to add it to the list manually.

2. Once the X-418_ONE device appears as one of the Remote Devices you will need to add its register to the local I/O. Click on I/O Setup, then Registers. At the bottom of the table, click on the button called "Add Remote Register". Add the register "X-418_ONE Register 1" to the list. You should now see this new register listed under "Remote Register".

3. We need a timer to go to I/O Setup and create a timer called "Timer 1". Give it a power up value of 30 seconds to make sure both X-418 units have plenty of time to boot before sending error messages.

4. Now add the logic. Click on "Control/Logic" and create a new Conditional Task. Call this task "Set Timer When 1". Set trigger Condition 1 to "X-418_ONE Register 1 = 1". Set Action 1 to "Start Timer" with a time of 12 Seconds.

5. Add a second Conditional Task. Call this task "Set Timer When 0". Set trigger Condition 1 to "X-418_ONE Register 1 = 0". Set Action 1 to "Start Timer" with a timer of 12 Seconds.

6. Add a third Conditional Task. Call this task "Send Alarm". Set trigger Condition 1 to "Timer 1 Expires". Set Action 1 to "Send Email" and specify the email address where the message should go (if no email addresses appear you will need to set them up first).
5.2 Control Logic Examples Using BASIC Scripts

Most advanced logic tasks can be accomplished using the X-418's Task Builder; however, the X-418 has a BASIC interpreter that can be used for more advanced tasks.

I/O resources are not fixed on the X-418. After registers and other I/O are added, they can be controlled and monitored within BASIC scripts. BASIC scripts must reference I/O resources such as digital I/O in the form of io.name where “name” is the resource name defined for each I/O under the I/O Setup Tab.

If the resource name has embedded spaces, they must be removed in the io.name statement. The first character must be lower case. For example, if a relay is named “Warehouse Fan”, the fan can be turned on with the BASIC statement “LET io.warehouseFan = 1”. If a resource name is changed during development and testing, the resource name in the BASIC script must be renamed to match.

5.2.1 If an analog input is in the alarm state, send an email every hour.

```
DO
  'If 2.5 < sensor1 < 4.5 then send an email every 1 hour
  IF io.temp1 < 4.5 THEN
    IF io.temp1 > 2.5 THEN
      IF t0 = 0 THEN
        EMAIL
        LET t0 = 36000  '3600 seconds
      END IF
    END IF
  END IF
LOOP
END
```
5.2.2  Monitor 4 doors, send an Email if a door is open more than 5-minutes

Send an email if a door has been open for more than 5 minutes, repeat the email every 5 minutes thereafter while the door is open. Note, we use the digital input mode of the analog inputs for this scenario.

'Send an email alert after a door has been open for more than 5 minutes.
'Continuously set a timer for 5 minutes if the door is closed

'Setting initial timer values
'Using variables a-d allow simple changes to alarm times
LET a = 3000  'Input1 300.0 seconds
LET b = 3000  'Input2 300.0 seconds
LET c = 3000  'Input3 300.0 seconds
LET d = 3000  'Input4 300.0 seconds

LET t1 = a
LET t2 = b
LET t3 = c
LET t4 = d

'Begin main program, sequentially service each door.
DO
  'If door1 is closed, then set timer for 5 minutes.
  'If door1 is open, then send an email and reset timer after timer expires
  'Door 1
  IF io.analogInput1 = 1 THEN
    LET t1 = a
  ELSE
    IF t1 = 0 THEN
      EMAIL io.analogInput1
      LET t1 = a
    END IF
  END IF

  'Door 2
  IF io.analogInput2 = 1 THEN
    LET t2 = b
  ELSE
    IF t2 = 0 THEN
      EMAIL io.analogInput2
      LET b
    END IF
  END IF

  'Door 3
  IF io.analogInput3 = 1 THEN
    LET t3 = c
  ELSE
    IF t3 = 0 THEN
      EMAIL io.analogInput3
      LET t3 = c
    END IF
  END IF

  'Door 4
  IF io.analogInput4 = 1 THEN
    LET t4 = d
  ELSE
    IF t4 = 0 THEN
      EMAIL io.analogInput4
      LET t4 = d
    END IF
  END IF

LOOP
END
5.2.3  Send an email if the AC power fails

Send an email if the AC power (via input1) has been off for 60 seconds. Send a follow-up email when the power is restored. Send the power restored email only if a 'power off' email was previously sent.

Note: A simple AC to 12VDC wall transformer connected to the digital input can be used to detect the loss of AC power.

'Script will send an email after power has been off for a specific amount of time. Will also send an email when power is on only if a 'power off' email has been sent.

LET a = 0  'Power on email sent if true
LET b = 0  'Power off email sent if true

DO
  IF io.input1 = 1 THEN  'If power is on
    LET t1 = 600
    IF a = 0 THEN  'If no 'power on' email has been sent
      IF b = 1 THEN  'If 'power off' email has been sent
        EMAIL io.input1
        LET a = 1  'Set power on email sent flag
      END IF
    END IF
    LET b = 0
  END IF
  IF t1 = 0 THEN  'Once power has been off a specific time
    IF b = 1 THEN
      EMAIL io.input1
      LET b = 1  'Set power off email sent flag
    END IF
  END IF
LOOP
END
5.2.4 Monitor a generator. Send an email if it runs for more than 10 seconds.

Send an email if a generator runs for more than 10 seconds, and every 30 minutes afterward. Send an email when the generator turns off if a 'generator on' email was sent.

'Input1 is used as the source for the generator status
'Input1 = 1 : Generator off
'Input1 = 0 : Generator on

LET a = 0  'Generator on email sent flag
LET t1 = 100  '10.0 seconds

DO

'Generator off
IF io.input1 = 1 THEN
  LET t1 = 100  '10.0 seconds
  IF a = 1 THEN
    EMAIL io.input1  'Email everything okay
    LET a = 0  'Set generator on flag back to false
  END IF
END IF

'Generator on and timer expires
IF t1 = 0 THEN
  EMAIL io.input1  'Email generator on
  LET t1 = 18000  '30 minutes until another email
  LET a = 1  'Generator on email flag
END IF

LOOP
END
Section 6: Auxiliary Operations

6.1 XML

Custom computer applications may be created to monitor and control the X-418. This method does not use a web browser. There are two XML pages that can be used to monitor and control the X-418: state.xml and customState.xml.

All requests to the XML files must be in the form of HTTP GET requests see Section HTTP GET Requests (for custom applications) for details.

See Section External Server and Remote Services for more information on network configurations when using XML.

6.1.1 state.xml

The state.xml page only shows the local I/O on the X-418. The XML tag names on this page are hard-coded and cannot be modified. They represent the I/O type and I/O number on the device. Some values may or may not show depending on the I/O configuration.

Reading state.xml

XML Monitor All Functions

The state of the device's local I/O, Registers, Timers, 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 (this can vary, depending on browser):

```xml
<datavalues>
  <analogInput1>4.96</analogInput1>
  <analogInput2>4.96</analogInput2>
  <analogInput3>4.97</analogInput3>
  <analogInput4>4.97</analogInput4>
  <analogInput5>4.97</analogInput5>
  <analogInput6>4.97</analogInput6>
  <analogInput7>4.97</analogInput7>
  <analogInput8>4.97</analogInput8>
  <vin>12.2</vin>
  <register1>0</register1>
  <utcTime>1262394580</utcTime>
  <timezoneOffset>-25200</timezoneOffset>
  <serialNumber>00:0C:C8:00:00:00</serialNumber>
</datavalues>
```

The numbers enclosed by the tags, `<tag>`, indicate the current state or value monitored by the X-418. Values for each tag are described in the table below.

Custom computer applications can open a TCP/IP connection with the X-418 and send a GET request for the state.xml file to obtain the current state of the X-418.
**XML Tags**

<table>
<thead>
<tr>
<th>XML Tags*</th>
<th>Monitor Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;analogInput1&gt;</td>
<td>Value of analog input 1</td>
</tr>
<tr>
<td>&lt;analogInput2&gt;</td>
<td>Value of analog input 2</td>
</tr>
<tr>
<td>&lt;analogInput3&gt;</td>
<td>Value of analog input 3</td>
</tr>
<tr>
<td>&lt;analogInput4&gt;</td>
<td>Value of analog input 4</td>
</tr>
<tr>
<td>&lt;analogInput5&gt;</td>
<td>Value of analog input 5</td>
</tr>
<tr>
<td>&lt;analogInput6&gt;</td>
<td>Value of analog input 6</td>
</tr>
<tr>
<td>&lt;analogInput7&gt;</td>
<td>Value of analog input 7</td>
</tr>
<tr>
<td>&lt;analogInput8&gt;</td>
<td>Value of analog input 8</td>
</tr>
<tr>
<td>&lt;vin&gt;</td>
<td>Scaled internal Vin measurement</td>
</tr>
<tr>
<td>&lt;register1&gt;</td>
<td>Value of the register 1</td>
</tr>
<tr>
<td>&lt;utcTime&gt;</td>
<td>Current UTC time expressed in seconds since January 1\textsuperscript{st}, 1970</td>
</tr>
<tr>
<td>&lt;timezoneOffset&gt;</td>
<td>Value to offset utcTime for local time</td>
</tr>
<tr>
<td>&lt;serialNumber&gt;</td>
<td>00:00:00:00:00:00:00:00, serial number of X-418.</td>
</tr>
</tbody>
</table>

**Controlling with state.xml**

Commands can be sent to the X-418 to control the registers. The parameters used differ depending on if state.xml is used or customState.xml is used. State.xml uses the io type names and io numbers when controlling the I/O. CustomState.xml uses the camelcase version of the user configurable name when controlling the I/O. Also, remote I/O can be monitored and controlled using the CustomState.xml. State.xml is only for local I/O on the device. On the X-418, the only local I/O that can be controlled are the register values.

**XML Set Register Values**

The register values can be set using the registerx command:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>state.xml?register1=10.5</td>
<td>Set register1 to 10.5.</td>
</tr>
</tbody>
</table>

**6.1.2 customState.xml**

The customState.xml works very similarly to the state.xml page. The difference is in the customState.xml, the XML tag names are set to a name very similar to the name of the I/O it is associated with. For example, if you were to set the name of 'Register 1' to 'My Register 1' the register would show up in the customState.xml as 'myRegister1'. Using these names allows applications interfacing with the X-418 to use more appropriate names when reading and writing I/O values.

Controlling I/O with the customState.xml is the same as with the state.xml except you may now use the names shown in the XML tags. For example, if you wanted to set a register named 'My Register 1' to the value 10, you would use the following command:

http://192.168.1.2/customState.xml?myRegister1=10

You will need to reference the customState.xml for the exact names to use for each of the configured I/O.
6.2 JSON

This device can also read the current state of the devices I/O through JavaScript Object Notation (JSON). The JSON format may be preferred for some custom applications as some languages provide native methods for processing data in JSON form.

There are two primary files that can be requested from this device in JSON form. The state.json and the customState.json. Each of these files provide the same information as their XML counterparts, but will be formatted with JSON. Additionally, the methods of controlling the I/O will be the same as with the XML pages. Note that all requests to the JSON files must be HTTP GET requests, see Section HTTP GET Requests (for custom applications)

6.3 HTTP GET Requests (for custom applications)

The X-418 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 protocol and how it can be used to control and monitor the X-418. All examples below show the state.xml, but will be the same for customState.xml and the JSON files. It is also assumed that a TCP/IP connection has already been established from the custom application to the device. The following are the messages that should be sent over the TCP/IP connection to control and monitor the device.

6.3.1 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

Example set Register 1 to the value 25:

GET /state.xml?register1=25 HTTP/1.1

Password Enabled

If the User account is enabled on the X-418, and the state.xml page is requested through a browser, the user will be prompted for a password. If the request is sent from custom application, the HTTP request will need to contain the password encoded as Base64.

The following is an html request header without the password:

GET /state.xml?register1=25 HTTP/1.1 (Terminated with two \r\n.)

The following example adds the password:

GET /state.xml?register1=25 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.
### 6.4 SNMP Requests, Objects and Community Strings

All configured I/O and some simple network parameters can be retrieved using Simple Network Management Protocol (SNMP). 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. The X-418 will generate an MIB file, based on its I/O configuration, for use with the SNMP manager software. If the I/O are configured (added/deleted), a new MIB will need to be generated.

SNMP is configured under the Advanced Network setup tab. See Section General Settings Tab > ADVANCED NETWORK SETTINGS for more information.

The X-418 supports the following Packet Data Units (PDU):

- GetRequest
- GetNextRequest
- GetBulkRequest
- SetRequest
- Trap
- Notification

#### 6.4.1 Standard Objects

The X-418 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.

<table>
<thead>
<tr>
<th>RFC1213 Object</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>system.sysDescr</td>
<td>X-418</td>
</tr>
<tr>
<td>system.sysObjectID</td>
<td>X418</td>
</tr>
<tr>
<td>system.sysUpTime</td>
<td>Time in hundredths of seconds since the device was last powered.</td>
</tr>
<tr>
<td>system.sysName</td>
<td>X-418*</td>
</tr>
</tbody>
</table>

*The sysName is customizable under the Control Page Setup tab. It’s the Control Page Header.*

#### 6.4.2 X-418 Objects

All configured I/O on the X-418 can be monitored and controlled through SNMP. The MIB file can be generated for the X-418 by going to General Settings Tab > ADVANCED NETWORK SETTINGS and pressing the button Generate and Download MIB File. This file should be regenerated whenever there are changes made to the I/O.

#### 6.4.3 TRAPS

Send SNMP traps when a relay changes state, when a particular sensor value is reached, or when the supply voltage is out of the desired range. Traps are configured as actions in Conditional and Scheduled tasks. As more I/O are added to the X-418, more I/O will appear in the MIB file.

#### 6.4.4 Notifications

Supports sending of SNMP Notifications when the SNMP version is 2c or 3. Notifications are similar to traps accept they require a response to be sent back from the SNMP manager. Retries will occur if the SNMP manager does not return a response. This makes notifications more reliable than traps.
6.4.5 Community Strings

The X-418 allows customization of both the read and write community strings. The proper community string will be needed for all read and write requests. By default both read and write community strings are `webrelay`. Community strings are only used by SNMP versions 1 and 2c. SNMP version 3 uses a different security mechanism.

6.4.6 SNMP V3 User-Based Security Model

The X-418 supports the SNMP V3 User-Based Security Model (USM). This replaces the community strings “security” of SNMP V1 and 2C. The details of USM can be complicated, but the main thing is that both the X-418’s security settings and the SNMP Manager’s security settings need to match for it to work.

There are two protocols used for USM. The first, authentication protocol, allows the SNMP manager to authenticate the X-418 and vice versa. The second, privacy protocol, allows the SNMP communication to be encrypted. Each protocol has an “algorithm” and a password associated with it. There is also a security username that is shared by both protocols.
6.5 External Server and Remote Services

Note: The following methods are supported by the X-418; however, Xytronix Research & Design, Inc. does not provide or support custom third-party applications, or external web servers.

6.5.1 Accessing the X-418 with custom software or third-party applications

Custom applications can send commands to the X-418 for monitoring and control functions using HTTP requests for XML or JSON files. (See Section XML and JSON 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.

6.5.2 Using an External Web Server

Rather than accessing the X-418 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, IIS, or NGINX) that is not the web server built into the X-418. In this scenario, users access custom web pages that reside on the external web server and the external web server communicates with the X-418.

An external web server can integrate multiple ControlByWeb devices 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-418 and other ControlByWeb™ devices: Direct Server Control, and Remote Services.

Direct Server Control

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

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

Remote Services

The second approach is for the ControlByWeb device to initiate a connection using Remote Services. The settings under the Advanced Network tab in the setup pages will enable the device 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 device are installed on different networks. This is especially useful when each device is installed on a separate private network. For example, if the user doesn't control the network connections where the ControlByWeb device is installed, Remote Services would initiate a TCP connection over the Internet with the control computer.
Since the ControlByWeb device initiates the connection, the control computer doesn't have to know the IP address of the device. This means that the device can be installed using DHCP. In addition, no special router configuration is required. This makes the network installation of the device very simple, and since no incoming ports need to be opened in the router, security is not compromised. See Section General Settings Tab > ADVANCED NETWORK SETTINGS for more information.

The ControlByWeb device can be configured to establish a connection when triggered by an event, such as an I/O state changing. This is done by setting a conditional task with the action being Send Device State to Remote Service.

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 consists of static information about the device, a user-defined character string configured in the Advanced Network tab and ends with sending the state.xml.

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.

A three-character “ACK” response is expected in return to every connection string. If the “ACK” is not received within 10 seconds, the ControlByWeb device will close the connection.

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

The X-418 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 the syslog.txt is 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 tab, and stores real-world data such as relay states, digital/analog input values, and events such as remote I/O state changes (see Section Logging Tab > GENERAL LOGGING SETTINGS for more information). It can be up to 3072K bytes long and is displayed 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 the X-418. 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

Example File Format:


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)
mmm – Milliseconds
DDD – DST When in daylight savings, STD When not in daylight savings time

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

Note: If the User account 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:

01/01/2010 00:41:05 DEVICE: Reset factory defaults.

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

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

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 username 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`
6.7 Modbus/TCP

The X-418 can be controlled and monitored using Modbus/TCP protocol. This provides a standard means of using the X-418 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 User account is enabled. This is because Modbus/TCP does not provide a mechanism for password protection. Make sure the User account is disabled (default) and Modbus functionality is enabled on the Advanced Network.

The X-418 functions as a Modbus slave. Host devices, such as PLCs, open a connection with the X-418 on port 502 (configurable under Advanced Network tab) and then send requests to read or set I/O states, or sensor values. When the X-418 receives a command, it performs the desired function and returns a response.

The X-418 can have additional I/O added and removed that can cause changes to the Modbus address map. For an up-to-date map of I/O on the X-418 to the addresses for Modbus, please select the View Modbus Address Table button from the Setup pages under the Advanced Network tab.

The Modbus Address Table will list all the addresses to be used when accessing I/O on the X-418. It is broken down into three groups: register addresses, coil addresses, and discrete input addresses. Register addresses are used with the modbus register functions. Coil addresses are used with the modbus coil functions, and discrete input addresses are used with modbus discrete input functions.

The following is an example of a Modbus Address Table. Note that while the X-418 might not have all the I/O hardware present in the table, it can have remote I/O for those types.

| IO Name     | IO | Register Addr |  |  |  |  |  |  |  |
|-------------|----|---------------|----|----|----|----|----|----|
|             |    | Pulse Timer   | Counter | On Timer | Total On Timer | IO |  |
| Relay 1     | 0  | 512           | --     | --       | --             | 0  | -- |
| Input 1     | 2  | --            | 1026   | 1538     | 2050           | -- | 1  |
| Analog Input 1 | 4 | --            | --     | --       | --             | -- | -- |
| Vin         | 6  | --            | --     | --       | --             | -- | -- |

The first column in the Modbus Address Table lists the name of the I/O. The seconds column lists the register address for the I/O. All I/O can be read and written as a register using this address and the modbus register functions regardless of the I/O type. Columns 3 through 6 are the register addresses used to access auxiliary functions of relays that have Pulse Timers, and digital inputs that have Counters, On Timers, and Total On Timers. The seventh column contains addresses used to read and write digital I/O and relays using the modbus coil functions. The last column contains addresses used to read digital I/O and inputs using the modbus discrete input functions.

The following sections provide an overview and explanation of the different Modbus functions.
6.7.1 Modbus Function Code Summary

The X-418 supports the following function codes for reading and writing I/O. If the I/O type does not exist on the X-418, the function code is still supported for use with remote I/O of that type.

<table>
<thead>
<tr>
<th>Code Name</th>
<th>Modbus Function</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Coils</td>
<td>01</td>
<td>Read Relays and Digital I/O (Configured as outputs)</td>
</tr>
<tr>
<td>Read Discrete Inputs</td>
<td>02</td>
<td>Read Digital Inputs and Digital I/O (Configured as inputs)</td>
</tr>
<tr>
<td>Read Multiple Registers</td>
<td>03</td>
<td>Read Vin, Sensors, Registers, Counters, Analog Inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(All I/O both Local and Remote)</td>
</tr>
<tr>
<td>Write Single Coil</td>
<td>05</td>
<td>Write Relays and Digital I/O (Configured as outputs)</td>
</tr>
<tr>
<td>Write Multiple Coils</td>
<td>15</td>
<td>Write Digital Inputs and Digital I/O (Configured as outputs)</td>
</tr>
<tr>
<td>Write Multiple Registers</td>
<td>16</td>
<td>Write Digital I/O Pulse Counters, Registers, Counters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(All writable I/O)</td>
</tr>
</tbody>
</table>

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-418 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.

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

Read the state of relays and digital I/O configured as outputs.

Request

Start Address:  Refer to Modbus map in setup pages
Coil Quantity: Refer to Modbus map in setup pages. Multiple Outputs may be read at the same time by specifying the correct starting address and quantity of coils to be read.

Response

The X-418 will respond to the request with a data field of one or more bytes depending on the number of coils read. Each bit represents a 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 the first relay or digital I/O.
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:

<table>
<thead>
<tr>
<th>Coil Read Error Function Code (1 byte):</th>
<th>0x81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exception Codes (1 byte):</td>
<td></td>
</tr>
<tr>
<td>0x01 – Function code not supported.</td>
<td></td>
</tr>
<tr>
<td>0x02 – Incorrect combination of start address and quantity of Digital I/O</td>
<td></td>
</tr>
</tbody>
</table>
6.7.3  Read Discrete Inputs – Modbus Function Code 02 (0x02)

This function returns the state of digital inputs and digital I/O (when configured as inputs).

Request

Start Address:  Refer to Modbus map in setup pages
Input Quantity:  Refer to Modbus map in setup pages. Multiple Inputs may be read at the same time by specifying the correct starting address and quantity of inputs to be read.

Response

The inputs states are indicated by bits in the status byte(s). A 1 indicates that the input is switched ON. A 0 indicates that the input switched OFF. Bit zero of the return value will be the state of the discrete input corresponding to the start address. For example, if a start address of 0x0001 is used, bit zero will be the status of input 2.

<table>
<thead>
<tr>
<th>Discrete Input State Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

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

The Read Holding Registers function is used mainly to read analog I/O such as the analog inputs, registers, counters, and vin. All I/O can be read using this function code. The holding register addresses can be found in the Modbus Address Table in the Advanced Network setup page under Modbus.

**Request**

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

Start Address: Refer to Modbus map in setup pages
Input Quantity: Refer to Modbus map in setup pages. Multiple Registers may be read at the same time by specifying the correct starting address and quantity of registers to be read. The number of registers read must be divisible by 2.

**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 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**

<table>
<thead>
<tr>
<th>Sensor Read Error Function Code (1 byte):</th>
<th>0x83</th>
</tr>
</thead>
</table>
| Exception Codes (1 byte):               | 0x01 – Function not supported.  
                                        | 0x02 – Incorrect combination of start address and input quantity |
6.7.5 Write Single Coil – Modbus Function Code 05 (0x05)

Control digital outputs and relays one at a time.

**Request**

Start Address: Refer to Modbus map in setup pages  
Output Value: 0x00 (Off), 0xFF (On)

**Response**

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

**Errors**

<table>
<thead>
<tr>
<th>Single Coil Write Error Function Code (1 Byte):</th>
<th>0x85</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Exception codes (1 Byte):</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01 – Function not supported.</td>
</tr>
<tr>
<td>0x02 – Address out of range.</td>
</tr>
<tr>
<td>0x03 – Padding value.</td>
</tr>
</tbody>
</table>
6.7.6 Write Multiple Coils - Modbus Function Code 15 (0x0F)

One or more bytes can be written to set the state of multiple digital outputs and relays, each bit representing one digital output or relay.

**Request**

Digital output and relay states are controlled by specifying the start address of the first digital output to be controlled, the number of the digital outputs to be affected, and the digital output state byte(s).

A value of 0xFFFF would be used to turn ON up to 16 digital outputs and relays. A value of 0x0000 would be used to turn them OFF. A value of 0xF0 would turn off the first 4 digital outputs while turning on outputs 5 through 8.

**Start Address (2 bytes):** Refer to Modbus map in setup pages
**Output Quantity (1 byte):** Refer to Modbus map in setup pages
**Byte Count (1 byte):** Refer to Modbus map in setup pages (Output Quantity divided by 8)
**Digital I/O Value (Byte Count bytes):** 0x0000 – 0xFFFF

<table>
<thead>
<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>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Digital I/O 2</td>
<td>Digital I/O 1</td>
</tr>
</tbody>
</table>

**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 Digital I/O quantity
- 0x03 – Byte count out of range
6.7.7 Write Multiple Registers – Modbus Function Code 16 (0x10)

The Modbus Write Multiple Registers function can be used to set the state of writable analog I/O such as registers and analog outputs.

**Request**

Start Address: Refer to Modbus map in setup pages
Input Quantity: Refer to Modbus map in setup pages. Multiple Registers may be written at the same time by specifying the correct starting address and quantity of registers to be read. The number of registers written must be divisible by 2. The values sent are in IEEE 754 floating point format. Also, the endianness configured in the modbus setup pages is taken into account.

In little-endian the value 81.25 would be as follows: 0x800042A2. The least significant word would be 8000 hex and the most significant word would be 42A2. In big-endian, the least significant word would be 0x42A2 and the most significant word would be 0x8000.

**Response**

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

**Errors**

<table>
<thead>
<tr>
<th>Pulse Function code Error (1 Byte):</th>
<th>0x90</th>
</tr>
</thead>
</table>
| Exception codes (1 Byte):          | 0x01 – Feature not supported.  
                                       | 0x02 – Address quantity not an even number. Incorrect combination of start address and register count. |
### 6.8 Basic Scripts

BASIC (Beginners All-purpose Symbolic Instruction Code) is a computer programming language that has been in use for many years. The X-418 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-418’s BASIC interpreter than on other platforms. The following is a short tutorial on the supported BASIC functions.

Example scripts are available at https://www.controlbyweb.com/support/tutorials/basic-script-tutorial.html. Contact customer support if further assistance is required.

#### 6.8.1 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.

#### 6.8.2 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
LET a = 1
LET a  =  1
```

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 + b is to the left of =).

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

To fix the above line, replace ‘a + b’. One of the following options may be used:

```
Let c = a + b
IF c = 3 THEN
```
6.8.3 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:

\[
\text{LET (variable) = (expression)}
\]

**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:

\[
\text{IF (variable) (=, <, >, <=, >=, <> (expression) THEN (Function 1) ELSE (Function 2) END IF)
}\]

A special Variable NAN is available to check if I/O values are valid before using them. To check if a 1-Wire temperature sensor value is valid before using it to send an email the following could be used:

\[
\text{IF NAN <> io.oneWireSensor1 Then ' send email ELSE ' do something else END IF}
\]

*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:

\[
\text{FOR (variable) = (expression) TO (expression) (code to be looped) NEXT (variable)}
\]

**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:

\[
\text{DO WHILE (variable) (=, <, >, <=, >=, <> (expression) (code to be looped) LOOP}
\]

If the loop is to continue indefinitely, the format would be:

\[
\text{DO (code to be looped) LOOP}
\]
Example:

```plaintext
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. If an I/O variable is given as a parameter, then the subject line in the email will contain “Variable Name = Variable Value”. If no I/O variable is given, then the subject of the email will be “Basic Script”.

```plaintext
EMAIL (io.digitalIO1, etc)
```

Examples:

```plaintext
   EMAIL
...or...
   EMAIL io.analogInput1
...or...
   EMAIL io.input1
...or...
   EMAIL io.temp2
```

**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:

```plaintext
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:

```plaintext
END

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

6.8.4 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:

\[
\begin{align*}
\text{Let } b &= 5 & \text{ 'variable } b \text{ will be set to } 5 \\
\text{Let } d &= b + 2 & \text{ 'variable } d \text{ will be set to } 7
\end{align*}
\]

6.8.5 Predefined Variables

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

**Timer Variables**

Ten timers are available for use in BASIC scripts.

\[ t0, t1, t2, t3, t4, t5, t6, t7, t8, t9 \]

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:

\[
\begin{align*}
\text{Let } t3 &= 1500 & \text{ 'set timer } 3 \text{ to } 150 \text{ seconds} \\
\text{Let } t1 &= 0 & \text{ 'disable time } 1
\end{align*}
\]

These timers are different than the Timer I/O that can be configured under the I/O setup tab. They are only accessible to the basic script, and their resolution is 100 ms. The Timer I/O can also be accessed from the basic script as io.timer1, etc. These timers have 1 second resolution.

**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:

\[
\begin{align*}
\text{If } \text{date} &= \text{01/01/2014} \text{ Then} \\
&\quad \text{If time} > \text{12:30:00} \text{ Then} \\
&\quad\quad \text{Let io.rmtRelay1} = 1 \\
&\quad\quad \text{Let io.rmtRelay2} = 0 \\
&\quad \text{End If} \\
&\text{End If}
\end{align*}
\]

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

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

Up to ten date variables are available.

```
ed0    'event date variable 0
...    'ed1, ed2, ed3, ed4, ed5, ed6, ed7, ed8,
ed9    'event date variable 9
```

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.

```
et0    'event time variable 0
...    'et1, et2, et3, et4, et5, et6, et7, et8
et9    'event time variable 9
```

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
        If et1 >= time Then
            Let et1 = et1 + 3600
            'Increments the event time by one hour (in seconds).
        'Event to occur would go on this line
    End If
End If
Loop
End
```

6.8.6 **I/O Variables**

The BASIC interpreter has full access to all configured I/O on the X-418. The I/O are treated as variables and can be read and written to the same as other variables. Depending on the ControlByWeb device, the number fixed I/O resources will vary. After I/O is added and defined they can be controlled and monitored within BASIC scripts.

BASIC scripts must reference I/O resources such as digital inputs and relays in the form of io.name where “name” is the resource name defined when the resource was added in the I/O Setup tab. If the resource name has embedded spaces, they must be removed in the io.name statement. For example, if a remote relay is named “Warehouse Fan”, the fan can be turned on with the BASIC statement “LET
io.warehouseFan = 1". If a resource name is changed during development and testing, the resource name in the BASIC script must be renamed to match.

The button on the BASIC setup page displays a list of all of the I/O resources currently available together with the equivalent token to be used in BASIC scripts to reference the respective I/O resource.

### Relay Variables

Relay variables are represent the state of the relays and can be used to change the state of the relays. Remote relays and local relays are read and controlled the same. Below is an example on how to access the relays provided they are at the default names.

- `io.relay1`  
- `io.device1Relay1`  

**Note:** Commands can be sent to remote relays, but the states of those relays cannot be reliably read immediately. 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 io.relay1 = 1`  
  `'turn on relay 1`
- `Let io.relay1 = 0`  
  `'turn off relay 1`
- `Let io.relay1 = 2`  
  `'pulse relay 1`
- `Let io.relay1 = 5`  
  `'toggle relay 1`
- `Let a = io.relay2`  
  `'read the state of relay 2, state will be 0 or 1`

### Digital Input Variables

The digital input states can be read in BASIC scripts. Below is an example assuming the name for input 1 is left at the default.

- `io.digitalInput1`  
  `'digital input 1`

Example:

- `Let a = io.digitalInput1`  
  `'sets 'a' equal to value of input 1`

### Counter Variables

The input counter can be read in BASIC scripts. Below is an example assuming the name for input 1 is left at the default.

- `io.digitalInput1.count`  
  `'input 1 counter`

Example:

- `If io.digitalInput1.count > 5000 Then`  
  `'If input counter 1 is greater than 5000 then`
- `Let io.relay1 = 1`  
  `'turn output 2 on`
- `End If`
**Analog Input Variables**

The analog input scaled values can be read in BASIC scripts. Below is an example assuming the name for analog input 1 is left at the default.

\[ io.analogInput1 \]

Example:

```basic
If io.analogInput1 > 4 Then
    Let io.rmtRelay1 = 2
Else
    Let io.rmtRelay1 = 0
End If
```

**Temperature/Humidity Sensor Variables**

Each temperature sensor or humidity sensor can be read in BASIC scripts. Below is an example assuming the name for the 1-Wire sensor is left at the default.

\[ io.oneWire1 \]

Example:

```basic
If io.oneWire1 >= 80 Then
    Let io.relay2 = 1
End If
```

**Registers**

Registers are similar to general purpose variables and can be used in the same manner. The difference between general purpose variables and registers is that registers can be accessed by the user through a web browser and modified while the script is running. Scripts can use registers as a method of retrieving input from the user or through any of the scheduled or conditional tasks. Below is an example of how to access a register assuming it is at the default name.

\[ io.register1 \]

The following example demonstrates the BASIC script reacting to user input by creating a script that will turn **ON** a remote relay if Register 1 equals 1 and turn **OFF** if a remote relay if Register 1 equals 0.

Example:

```basic
Do
    If io.register1 = 1 Then
        Let io.device1Relay1 = 1
    Else
        Let io.device1Relay1 = 0
    End If
Loop
End
```

Registers can also be used to show numeric values, such as a count-down timer. 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:

```basic
let t0 = 10
let io.register1 = 10

'Initialize variables and start timer

'Main Loop
Do
```

Xytronix Research & Design, Inc.
if t0 = 0
    'when timer reaches 0 decrement counter
    let io.register1 = io.register1 - 1
    let t0 = 10
end if

if io.register1 < 0
    'restart when counter reaches zero
    let io.register1 = 10
end if

loop
end
Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, the X-418 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. While holding the button, you should see both the Link and Activity lights on the Ethernet port flash.
4. Continue holding the button for five seconds before releasing the button. All settings will be back to the original factory defaults. log.txt and syslog.txt are retained.
5. Refer to Section 2.6: Establishing Communications for Setup to begin reconfiguration of the X-418.
Appendix B: Installing New Firmware

From time to time, updates are made to the X-418's firmware. Unlike many consumer products, firmware updates are recommended only on an as-needed basis. 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:


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

Setup

1. Contact technical support if a firmware update is needed and a download link will be provided. Only an X-418's image can be installed on the X-418, so make sure the correct image is being downloaded.

2. bootloader.exe will connect to the X-418 using default IP address 192.168.1.2, not the address currently assigned to the X-418. 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 Establishing Communications for Setup.

   Note: The IP address of the X-418 will automatically be set to the default 192.168.1.2 during the update process. Since the X-418 supports Auto Negotiation, a crossover cable is not necessary.

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-418 into bootloader mode and perform the upgrade:

1. Remove DC power from the X-418.

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

3. While holding the reset button, apply power to the X-418. 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 60 seconds, the LINK LED will stop flashing and remain lit. The X-418 will be set to factory defaults with an IP address of 192.168.1.2.

6. Refer to Section Establishing Communications for Setup to reconfigure the device. 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 Device Over the Internet

The X-418 can be monitored and/or controlled from a remote location over the Internet. Once the X-418 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-418.

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-418 can be assigned a public IP address for direct connection to the Internet. Typically, a public IP address would only be assigned to the X-418 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-410, and a WebRelay™. In this example, the computer is assigned an IP address of 192.168.1.10, the X-410 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-410 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](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 203.0.113.254.

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 203.0.113.254. 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 ControlByWeb devices. All requests from the Internet to any device on the local network must use the public IP address (203.0.113.254). 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 65535. 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™ devices come from the factory with the HTTP port set to 80, which is the standard port for HTTP. In the example above, the X-410 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 the above example, the address 192.168.1.25 for the X-410 would be associated with port 8000. The address 192.168.1.26 for WebRelay™ would be associated with port 8001. The X-410 would be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-410 in the URL window of the browser, http://203.0.113.254:8000. All Internet requests to the router for port 8000 would be forwarded to the X-410. 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://203.0.113.254), the router will handle this as a port 80 request (default HTTP port). In other words, http://203.0.113.254 is exactly the same as http://203.0.113.254:80.

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 ControlByWeb device. For example, the router would be configured so that messages sent to http://203.0.113.254:8000 would be forwarded to http://203.0.113.254:80, which is the default HTTP port.

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

\[ \text{http://(ControlByWeb Device's Local IP Address):(Port Number)/setup.html} \]

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

\[ \text{http://192.168.1.25:8000/setup.html} \]

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

\[ \text{http://(Public IP Address of Router):(Port Number of Device)/setup.html} \]

Using the example above, the following line would be used to access the setup page of the X-410:

\[ \text{http://203.0.113.254:8000/setup.html} \]
Appendix D: Specifications

Power Requirements

Input Voltage:

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model X-418-I</td>
<td>9-28 VDC</td>
</tr>
<tr>
<td>Model X-418-E</td>
<td>Power Over Ethernet and/or 9-28VDC. 48V injected into Ethernet Line as per 802.3af specification. POE Class 1 (0.44Watt to 3.84Watt range)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Input Current</th>
<th>Input Current 4x 4-20mA mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 VDC</td>
<td>134 mA</td>
<td>152 mA</td>
</tr>
<tr>
<td>12 VDC</td>
<td>103 mA</td>
<td>115 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>58 mA</td>
<td>65 mA</td>
</tr>
</tbody>
</table>

I/O Connector

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

Analog Data Acquisition System:

<table>
<thead>
<tr>
<th></th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels:</td>
<td>8</td>
</tr>
<tr>
<td>Resolution:</td>
<td>16-bit, SAR</td>
</tr>
<tr>
<td>Type:</td>
<td>Channels 1-4: Single ended, differential or 4-20mA (0-20mA) Channels 5-8: Single ended or differential Channels 1-8: Pseudo digital input</td>
</tr>
<tr>
<td>Input Range (programmable):</td>
<td>±1.28V, ±2.56V, ±5.12V, ±10.24V, ±20.48V (differential)</td>
</tr>
<tr>
<td>Max Input Voltage Range (Vin):</td>
<td>-12.5V &lt; Vin &lt; +12.5V</td>
</tr>
<tr>
<td>Input Impedance (Zin):</td>
<td>&gt;500Meg Ohm</td>
</tr>
<tr>
<td>Channel Off Leakage:</td>
<td>±0.6nA (typ)</td>
</tr>
<tr>
<td>Input Common Mode Rejection:</td>
<td>&gt;100dB</td>
</tr>
<tr>
<td>Total Unadjusted Error:</td>
<td>-9LSB (min), +9LSB (max)</td>
</tr>
<tr>
<td>Voltage Reference Drift:</td>
<td>±5 ppm/°C</td>
</tr>
<tr>
<td>Internal 0-20mA input shunt:</td>
<td>200.0-ohm, ±0.1%, 25ppm (uses ±5.12V range)</td>
</tr>
<tr>
<td>Logging Rate:</td>
<td>25 Hz</td>
</tr>
<tr>
<td>Sample Rate:</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>
Pseudo Digital Inputs:

<table>
<thead>
<tr>
<th>Number:</th>
<th>Programmable option, channels 1 to 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vih (high-level input voltage):</td>
<td>3.5V</td>
</tr>
<tr>
<td>Vil (low-level input voltage):</td>
<td>1.5V</td>
</tr>
<tr>
<td>Sample Rate:</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>

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

**Supported Protocols:** HTTP, HTTPS, SSL, XML, Modbus TCP/IP, SNMP V1,2C,V3, SMTP

LED Indicators (3)

| Power | Green |
| Network Linked | Green |
| Network Activity | Yellow |

Email Alerts

| Email Addresses: | Configurable, up to 8 addresses |
| Encrypted Email Alerts: | STARTTLS and TLS/SSL |
| Status Alerts: | Analog and digital inputs, etc. |
| Other Alerts: | Alert logic is fully customizable |

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 and 1 register

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
3072-Kbyte (up to 50688 log entries depending on configuration)
Unlimited data storage possible through sending the log through email or FTP services.

Password Settings
Password protection for Administrators (setup pages)
Optional password protection for Managers
Optional password protection for Users (control page)
Base 64 Password Encoding
Password Length: 18 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)
Altitude: up to 2000m
Humidity: 5-95% non-condensing

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

Electromagnetic Compliance
IEC CISPR 22, CISPR 24
EU EN55024, EN55022
X-418-I: FCC 47CFR15 (Class B)
X-418-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.
Appendix H: Product Licensing

The webpages on the X-418 use javascript libraries that contain permissive free software licenses such as MIT and BSD 3-Clause. The licenses and copyrights are included directly in the source for setup.html on the X-418.

The firmware included in this product also contains copyrighted software that is licensed under various permissive free software licenses.

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http://www.apache.org/licenses/LICENSE-2.0

**lwIP** - Copyright (c) 2001-2004 Swedish Institute of Computer Science.
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Appendix I: Mechanical Dimensions

A 3D-CAD model of the X-418 is available at https://www.controlbyweb.com/x418/x-418_3d.stp