

X-300

User's Manual

Revision 1.2 July 30, 2009

daq data acquisition series **3**

Web Enabled
Thermostat
Thermometer
Alarm/Logger



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

a division of...
Xytronix Research & Design, Inc.
North Logan, Utah, USA

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

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FCC Statement

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

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

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which 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.

Installation Guidelines (Read Before Installing)

- Do not open the X-300™ enclosure. This could damage the unit or cause personal harm and will void the warranty.
- This unit must be installed by qualified personnel. When using as a thermostat, this unit must be installed by a qualified HVAC technician.
- This unit must not be installed directly outdoors.
- This unit must not be used for medical, life saving purposes, or for any purpose where its failure could cause serious injury or the loss of life.
- This unit must not be used in any way where its function or failure could cause significant loss or property damage.

Notes about security:

By design, X-300™ is very secure. It does not support terminal or file transfer programs such as telnet, FTP, ssh, etc. This means that it is not possible for someone to 'break in' to X-300™ and access other devices on your local network. The simplicity of X-300™ makes it a very secure device. As with any device to be installed on a network, there are some security precautions that should be observed. If X-300™ is installed on the Internet, it is recommended that passwords be enabled for the **Control Page**. Make sure secure passwords are used. Passwords should be at least 8 characters in length and should be a combination of upper case letters, lower case letters, and numbers. Don't use passwords that would be easy to guess. For additional security, a firewall may be used to limit access only to selected IP addresses. Another option may be to set up a Virtual Private Network (VPN) between the network where X-300™ resides and the client machine (web browser, another ControlByWeb™ product, etc.).

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

Section 1: Introduction

1.1 Overview

The X-300™ is a powerful web-based instrument for remote temperature measurement, logging, and alarming. In addition, the X-300™ can function as a full-featured single stage thermostat.

Features:

- Web-Based Temperature Monitoring with Email Alerts and Alarms
- Can be used as a stand-alone web-based programmable thermostat with advanced features such as seven day scheduling.
- Simple drop-down list configuration
- Web-browser based; no software required.
- Can be used with up to 8 sensors in monitor mode (2 in thermostat mode).
- Three, 3-Amp relays (automatic or manual control)
- Field Re programmable, users can install firmware updates when available.
- Built-In Real Time Clock for logging and scheduled temperature changes
- Capacitor power backup keeps time for days during power failure.
- Data Logging
- Configure manually or with DHCP.
- Supports Simple Network Management Protocol (SNMP)
- Supports Modbus/TCP
- Remote Services options allows X-300™ to initiate connection to external servers
- Internal temperature and voltage monitoring for diagnostics.
- Supports BASIC scripts for advanced configuration
- Wide operating temperature range.
- Removable terminal connector for convenient wiring.
- Compact, DIN-Rail mountable enclosure

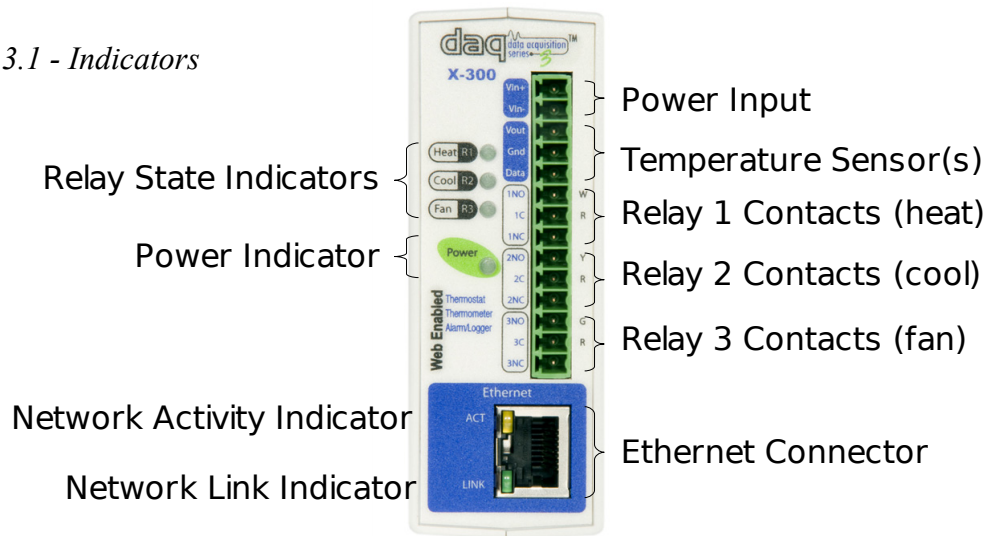
1.2 X-300™ Models Available

Three models are available. The only difference between these three models is the power supply requirement. Note that some models may be available only by special order.

Model Number	Power Supply Requirement
X-300-5	5VDC (regulated power supply required)
X-300-I	9-28VDC
X-300-E	Power Over Ethernet (802.3af) or 5VDC

1.3 Connectors & Indicators

Figure 1.3.1 - Indicators



1.3.1 Connectors

Power, temperature sensors, and relay contact connections are made through a removable 14-pin terminal connector.

Power is required for the X-300™ to operate. Power can be applied to the terminal connector, or for POE models it may be applied through the Ethernet connector (using the 802.3af POE standard).

The temperature sensors all connect to the terminal connector through the same three terminals. The sensors are identified using a unique address so separate terminals for each sensor are not necessary. When multiple sensors are connected, they can be physically connected to the terminals or daisy-chained. See the Application Configuration section for more details.

The terminal connector provides access to the “form C” relay contacts (Common, Normally Open, and Normally Closed). The relay contacts are “dry” contacts and are directly connected (internally) to the terminal connector. The contacts are completely isolated from all other circuits and from each other. For the greatest flexibility, there is no internal voltage, fuse, or protection circuitry connected to the relay contacts.

The Ethernet connector is used for the network connection. This must be connected to a 10Mbps or 100Mbps Ethernet network.

1.3.2 Indicators

Five LED indicators show status information as described below.

The power LED (green) illuminates whenever power is correctly applied to the unit.

Three relay status indicators (yellow) illuminate whenever the corresponding relay is energized. When a relay is energized (LED is on), electrical continuity exists between the common (C) and normally open (NO) terminals, and there is no electrical continuity between the common (C) and normally closed (NC) terminals. When a relay is NOT energized (LED is off), electrical continuity exists between the common (C) and normally closed (NC) terminals, and there is no electrical continuity between the common (C) and normally open (NO) terminals.

The Link indicator (green) is located on the Ethernet connector. When this is illuminated, it indicates that the X-300™ is correctly (physically) connected with the network. This indicator is normally always on and must be on before any communications with the X-300™ can occur.

The Activity (ACT) indicator (yellow) flashes when the X-300™ detects activity on the network.

Note that the LINK and ACT indicators are also used to indicate that the X-300™ is in a special mode called the boot-loader mode. This mode is used only for upgrading firmware or resetting the unit to factory defaults. When the X-300™ is in this mode, both the LINK and ACT indicators will simultaneously flash. See Appendix B for details.

1.4 Options for Accessing the X-300™

The X-300™ is a flexible, self-contained instrument and requires NO COMPUTER to operate. It can be used as a single stand-alone device or as part of a large system. It can be accessed directly from a computer or indirectly through a large server. It can be accessed using a web browser, or using custom software.

1.4.1 Basic Access Using A Web Browser

The X-300™ has a built-in web server and provides simple web pages that can be accessed using a standard web browser. This allows users to access the unit with NO SPECIAL SOFTWARE installed on their computer. This is ideal for basic applications that require a quick, simple solution that does not need to be accessible to more than a few people. This configuration is simple to setup, simple to use, and can be accessed from any computer without the installation of software. Note that computers that are not on the local network may only access the X-300™ if the local network router is setup to allow this.

1.4.2 Accessing X-300™ with Custom Software or Third Party Applications

The X-300™ provides a programming interface that allows applications running on a computer to have full access to it. Custom applications can send commands to the X-300™ for monitoring and control. Custom applications can be used to provide a custom user interface, provide access to multiple units in a single screen, automation, logging, etc. The benefit of using custom software to access the X-300™ is that flexibility is almost unlimited.

1.4.3 Using an external Web Server

Rather than accessing X-300™ directly from a computer, an external web server can be used. The term “external” web server is used here to mean a separate web server (such as Apache or IIS) that is not the web server built into the X-300™. In this scenario, users access custom web pages that reside on the external web server and the external web server communicates with the X-300™. Users would not communicate directly with the X-300™.

Using an external web server to provide a custom user interface is beneficial because multiple X-300™ devices (or other ControlByWeb™ products) can be integrated into a single control page or set of pages so they appear as part of a larger system rather than individual devices. In other words, the user may not be aware that he/she is using multiple X-300™ devices, but rather the user sees a custom control page that shows the temperature in every room in a building. 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 X-300™ and other ControlByWeb™ devices. The first approach is for the external server to create a TCP connection whenever it needs to access the X-300™. In this case, the external server opens the connection, sends commands and/or reads the device, and closes the connection. The second approach is for the X-300™ to initiate a connection. Using the “Remote Services” settings under the **Advanced Network** tab in the setup pages, the X-300™ can be configured 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.

Each of the two approaches is appropriate for different applications. The first approach is ideal when the the web server and all of the X-300™ devices are on the same network (without routers between them). In this case, the server can communicate with the X-300™ devices directly and security concerns are minimal because data never has to leave the local network. When the server and the X-300™ devices are on different networks, the first approach can still be used, but routers that are installed between them must be configured to allow appropriate access. For companies that own or control the networks where all of these devices are installed this is not a problem. Anytime a public network is used (the Internet), however, security precautions should be implemented.

The second approach described above uses “Remote Services” features and is ideal for installations where the server and the X-300™ devices are installed on different networks. This is especially useful when each X-300™ is installed on a separate private network. An example is used to illustrate the use of this approach...

"XYZ resort is a 4-star condominium resort with 310 privately owned condominiums. When the condominium owners are not using their condominium, ABC company offers the service of renting out the condominium. Since each condominium is privately owned, each condominium has independent utilities and each has its own Internet connection. To keep costs down, ABC company installed an X-300™ in each condominium unit with one relay in series with the in-room thermostat and another relay in parallel. This allows them to monitor temperatures, and to override the air-conditioner when condominiums are vacant. To simplify things even further, ABC company wrote a custom computer application that communicates with all of the X-300™ devices, and to automatically turn off the cooling systems when the condominiums are not being used. Since ABC company doesn't own or control any of the network connections inside each condominium, they use the “Remote Services” settings in the X-300™ to connect to their computer that has the cooling system control software. By using the “Remote Services” configuration, the X-300™ initiates a TCP connection over the Internet with their control computer. Since the X-300™ initiates the connection, the control computer doesn't have to know the IP address of the X-300™. This means that the X-300™ can be installed in each condominium using DHCP to obtain a dynamic IP address. In addition, no special router configuration is required in each condominium unit. This makes the network installation of the X-300™ very simple for ABC company, and since no incoming ports need to be opened up in each condominium owners router, security is not compromised."

See the description of the **Advanced Network** tab in chapter 2.5 for more information.

1.5 Application Examples

This section briefly describes some of the applications for the X-300™, illustrates connections for those applications, and provides key configuration settings. Before installing the X-300™, please read Section 2: Installation and Setup. Note that some of the examples below require that temperature sensors be mounted in harsh locations such as outdoors or in water. For those applications, appropriate sensors that are encapsulated in thermal wells or properly protected should be used.

1.5.1 Temperature Monitoring, Logging, and Alarming

The X-300™ can be used as a simple web-enabled thermometer for conveniently viewing temperatures on a computer or web-enabled mobile telephone. This is useful for viewing the temperatures of living spaces, outdoors, refrigeration systems, tanks, pipes, etc. In addition to simple viewing, temperatures can be logged to internal memory and the unit can be configured to send email alerts (or indirectly, text messages) when preset temperature thresholds are crossed. In this and any configuration, the X-300™ can communicate directly with a custom computer application which can read the temperature data from the X-300™ for process control or other functionality.

1.5.1.1 Single Sensor

Applications:

- Thermometer,
- Temperature monitoring of living spaces, outdoors, refrigeration systems, etc
- Email alert alarms
- Ethernet based data acquisition systems

Connection (Figure 1.2):

Provide power, network and temperature sensor.

Software Configuration:

Mode: *Temperature Monitor*

Settings: Under **Sensors** setup tab:

Set **Sensor** to *Sensor 1*

Set **Sensor Address** to address of connected temperature sensor

Power Supply
(5 VDC or 9-28 VDC)

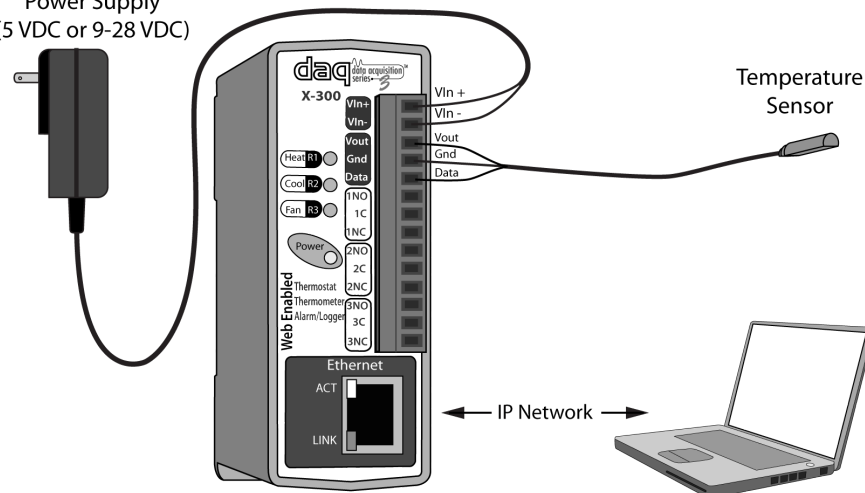


Figure 1.2 – Temperature Monitoring with Single Sensor

1.5.1.2 Multiple Sensors

Applications:

Multiple Thermometers
 Temperature monitoring of living spaces, outdoors, refrigeration systems, etc.
 Email alert alarms
 Ethernet based data acquisition systems

Connection (Figure 1.3):

Provide power, network and temperature sensors. See section 2.2.4 for notes about connecting multiple sensors.

Software Configuration:

Mode: Temperature Monitor

Settings: Connect first temperature sensor.

Under **Sensors** setup tab:

Set **Sensor** to Sensor 1

Set **Sensor Address** to address of connected temperature sensor

Connect second sensor.

Set **Sensor** to Sensor 2

Set **Sensor Address** to new address that appears under the list.

Repeat for all sensors.

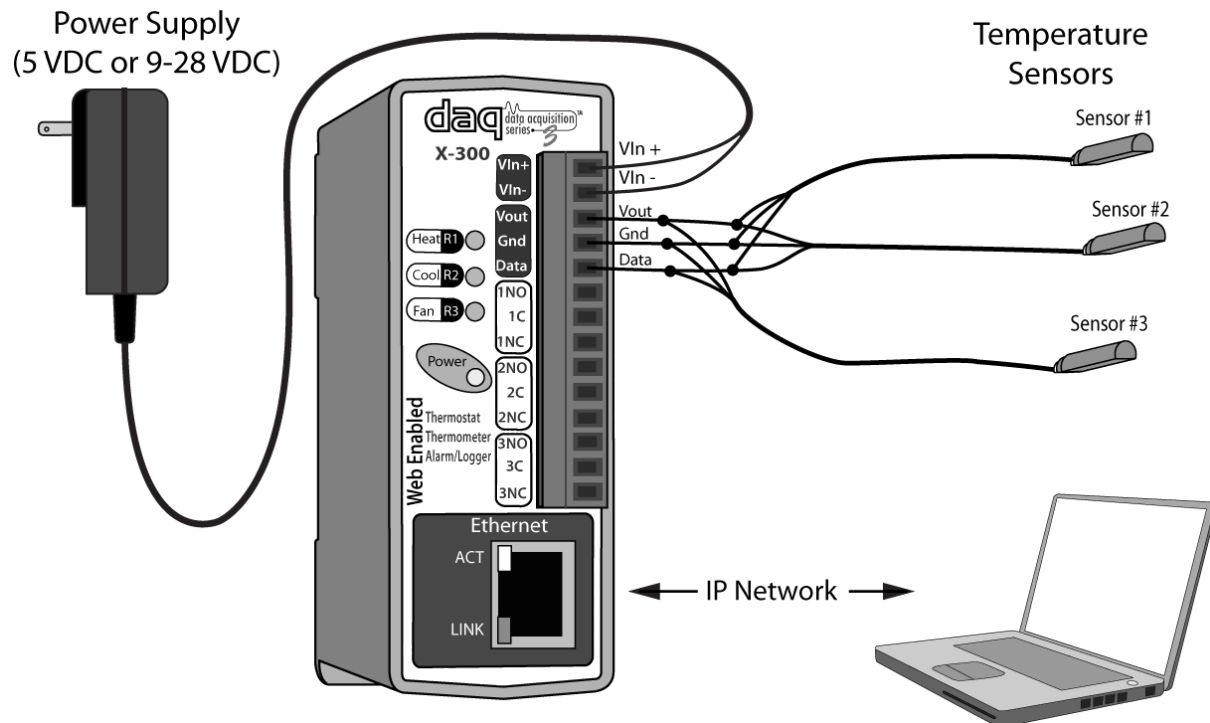


Figure 1.3 – Temperature Monitoring with Multiple Sensors

1.5.1.3 Temperature Monitoring with Alarm

This example illustrates how the X-300™ can be used to monitor temperatures, plus provide an alarm for extreme temperatures. The alarm illustrated is a bell, however this could be any audio device, a visual indicator such as a light in a control panel or flashing alert lamp, or a functional device such as a fan, heater, valve, etc.

Applications:

- Refrigeration system high temperature alarm
- Freezing pipe alarm
- HVAC system failure alarm

Connection (Figure 1.4):

Provide power, network and temperature sensor. Connect alarm (bell, light, etc) to relay contacts.

Basic Configuration:

Mode: Temperature Monitor

Settings: See section 1.5.1.1/2 for connecting temperature sensors.

Under **Sensors** tab in setup pages;

Set **Alarm 1** to desired temperature where relay should turn on.

Specify High or Low value for **Alarm 1**.

Set **Deadband** to appropriate value.

Set **Relay 1 Action** to Turn On when Alarm 1.

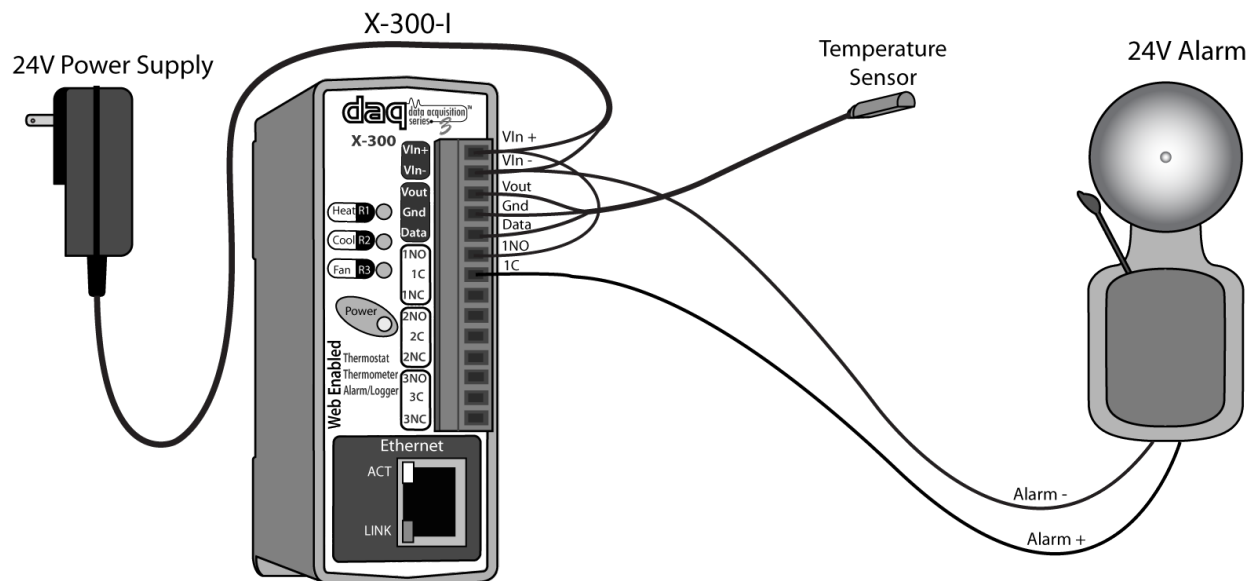


Figure 1.4 – Temperature Monitoring with Alarm

1.5.1.4 Temperature Monitoring with Remote Alarm

This example illustrates how the X-300™ can be used to monitor temperatures, plus provide an alarm for extreme temperatures. This is similar to the example described in the last section, but differs in that the alarm indicator (bell, light, etc.) is located at another location.

Applications:

- Refrigeration system high temperature alarm
- Freezing pipe alarm
- HVAC system failure alarm

Connection (Figure 1.5):

Provide power, network and temperature sensor. In addition, a WebRelay™ (or WebRelay-Dual™, WebRelay-Quad™, etc) is setup at a remote location. Connect alarm (bell, light, etc) to relay contacts of the remote WebRelay.

Software configuration:

Mode: Temperature Monitor

Settings: See section 1.5.1.1/2 for connecting temperature sensors

Under **Sensors** tab in the X-300™ setup pages;

Set **Alarm 1** to desired temperature where alarm should turn on.

Specify **High** or **Low** value for **Alarm 1**.

Set **Deadband** to appropriate value.

Set **Remote Relay 1 Action** to Turn On when Alarm 1.

Under **Relays** tab in the X-300™ setup pages:

Set **Relay** field to Remote Relay 1.

Set **Remote Relay Description**, **IP Address**, **TCP Port**, **Password**, **Relay #**, and **Periodic State Interval** corresponding to the Remote Device.

Set remote device settings as required.

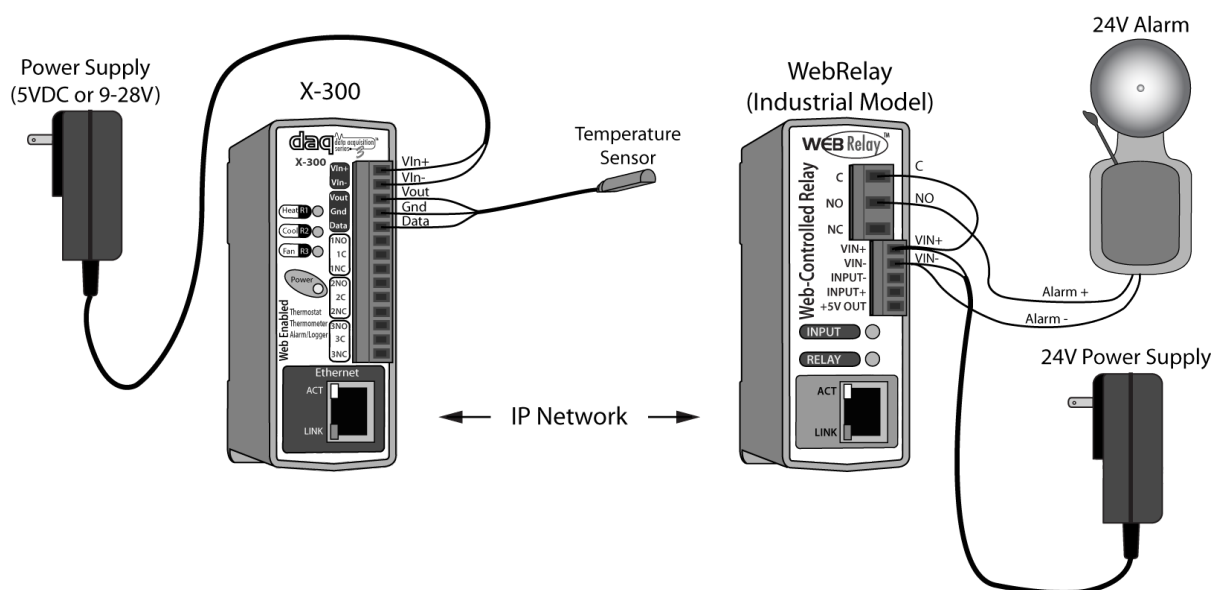


Figure 1.5 – Temperature Monitoring with Remote Alarm

1.5.2 Stand-Alone Thermostat

The X-300™ can be used as a thermostat to control HVAC (Heating, Ventilation, and Air Conditioning) systems. Although it doesn't have a local display or buttons, many users will find it to be more convenient to view and adjust temperatures using a web browser due to the prevalence of computers and web-enabled telephones in today's modern society. This can allow users to access the thermostat from anywhere in the building; or from anywhere over the Internet if desired. This is also useful for applications where thermostat control should be limited and not available to everyone who has physical access to the thermostat.

As a stand-alone thermostat, users can view a **Control Page** (web page) that appears as a professional grade thermostat. The **Control Page** displays the current indoor temperature, the set temperature, the outdoor temperature (if outdoor sensor is connected), the high and low outdoor temperatures for current day and the day before (also if outdoor sensor is connected), and other basic information. Using the **Control Page**, the user can adjust the set temperature as desired.

The X-300™ also offers some advanced features such as seven day scheduling and logging. With logging enabled, users can track exactly how long the HVAC system must run to maintain a given set temperature. They can log both indoor and outdoor temperatures to see the full picture. With this information, users can make adjustments to the set temperatures to save energy, if desired.

1.5.2.1 Stand-Alone Thermostat for Heat-Only System

Applications:

Thermostat for single-stage heating systems.

Connection (Figure 1.6):

Provide power, network, and indoor temperature sensor. Outdoor temperature sensor is optional. The heating system is connected to the common and normally open contacts of relay 1. Whenever relay 1 is turned on, the thermostat calls for heat. If a separate fan connection is required, it should be connected to relay 3.

Software configuration:

Mode: Thermostat

Settings: Under **Thermostat Setup** tab:

Set **Indoor Air Sensor** to corresponding temperature sensor.

Set **Outdoor Sensor** to corresponding sensor as needed.

Set **Fan On With Heat** as required. To determine if this option is required, see section 2.6.1.

On **Thermostat View** page:

Set **HEAT MODE** to Heat.

Set **FAN MODE** to Auto.

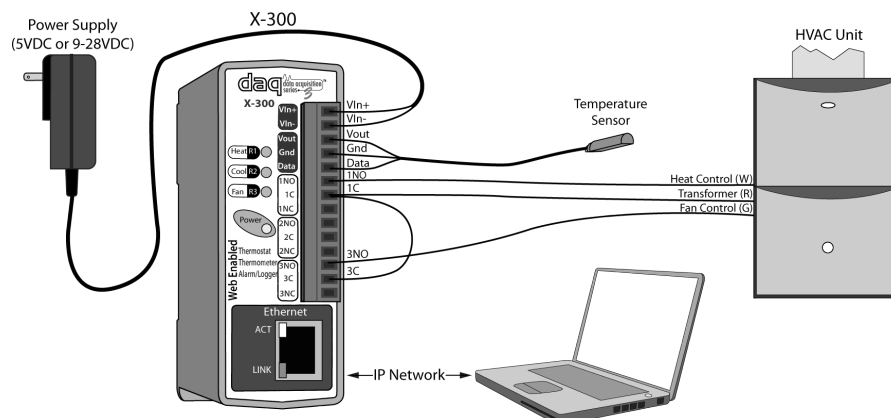


Figure 1.6 – Stand-Alone Thermostat for Heat-Only System

1.5.2.2 Stand-Alone Thermostat for Cool-Only System

Applications:

Thermostat for single-stage cooling systems.

Connection (Figure 1.7):

Provide power, network and indoor temperature sensor. Outdoor temperature sensor is optional. The cooling system is connected to the common and normally open contacts of relay 2 and the fan is connected to the common and normally open contacts of relay 3. Whenever relay 2 and 3 are turned on, the thermostat calls for cool and fan.

Software configuration:

Mode: Thermostat

Settings: Under **Thermostat Setup** tab:

Set **Indoor Air Sensor** to corresponding temperature sensor.

Set **Outdoor Sensor** to corresponding sensor as needed.

On **Thermostat View** page:

Set **HEAT MODE** to Cool.

Set **FAN MODE** to Auto.

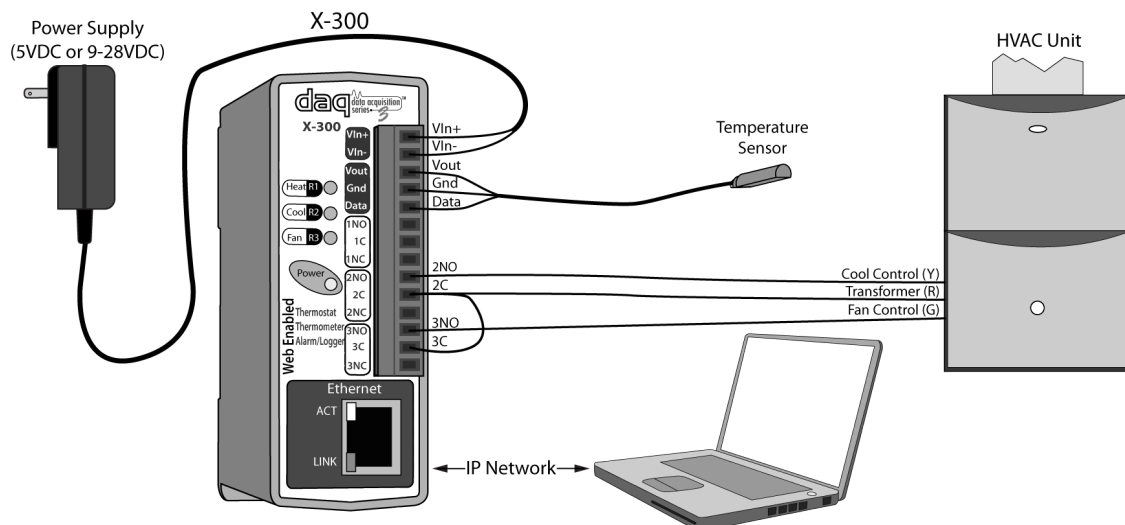


Figure 1.7 – Stand-Alone Thermostat for Cool-Only System

1.5.2.3 Stand-Alone Thermostat for Heat/Cool System

Applications:

Thermostat for single-stage heating and cooling systems.

Connection (Figure 1.8):

Provide power, network and indoor temperature sensor. Outdoor temperature sensor is optional. The heating system is connected to the common and normally open contacts of relay 1. The cooling system is connected to the common and normally open contacts of relay 2 and the fan is connected to the common and normally open contacts of relay 3.

Software configuration:

Mode: Thermostat

Settings: Under **Thermostat Setup** tab:

Set **Indoor Air Sensor** to corresponding temperature sensor.

Set **Outdoor Sensor** to corresponding sensor as needed.

Set **Fan On With Heat** as required. To determine if this option is required, see section 2.6.1.

On **Thermostat View** page:

Set **HEAT MODE** to Auto.

Set **FAN MODE** to Auto.

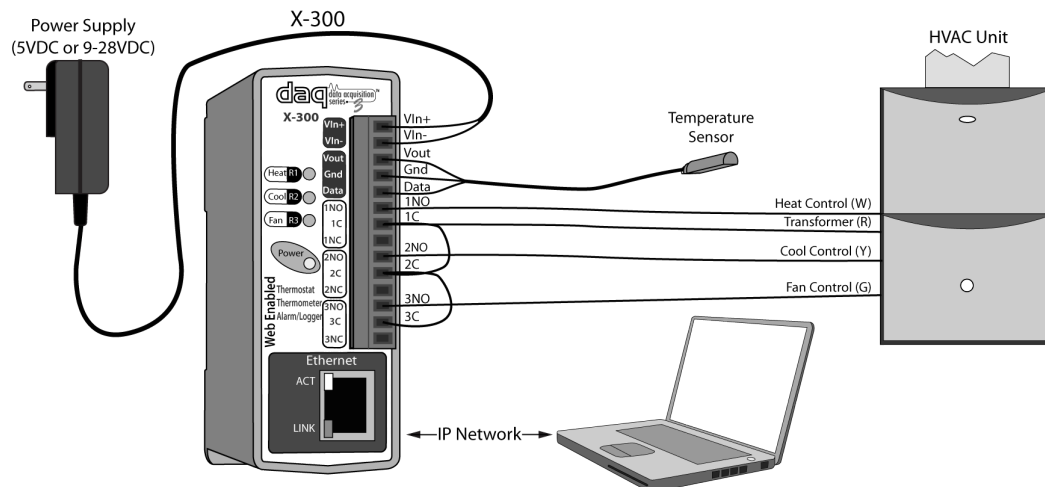


Figure 1.8 – Stand-Alone Thermostat for Heat/Cool System

1.5.2.4 Stand-Alone Thermostat for Heat/Cool System with Separate Transformers

Many HVAC systems use a single transformer for both heat and cool. In some cases, however, the heating system and cooling system are isolated and use separate transformers for each system. The X-300™ relay contacts are internally isolated so connection to separate systems is safe.

Applications:

Thermostat for single-stage heating and cooling systems.

Connection (Figure 1.9):

Provide power, network and indoor temperature sensor. Outdoor temperature sensor is optional. The heating system is connected to the common and normally open contacts of relay 1. The cooling system is connected to the common and normally open contacts of relay 2 and the fan is connected to the common and normally open contacts of relay 3. Note that a separate red wire is used for the heating system and the cooling system. The fan is typically tied to the transformer of the cooling system, but this should be verified with the HVAC equipment instruction manual.

Software configuration:

Mode: Thermostat

Settings: Under **Thermostat Setup** tab:

Set **Indoor Air Sensor** to corresponding temperature sensor.

Set **Outdoor Sensor** to corresponding sensor as needed.

Set **Fan On With Heat** as required. To determine if this option is required, see section 2.6.1.

On **Thermostat View** page:

Set **HEAT MODE** to Auto.

Set **FAN MODE** to Auto.

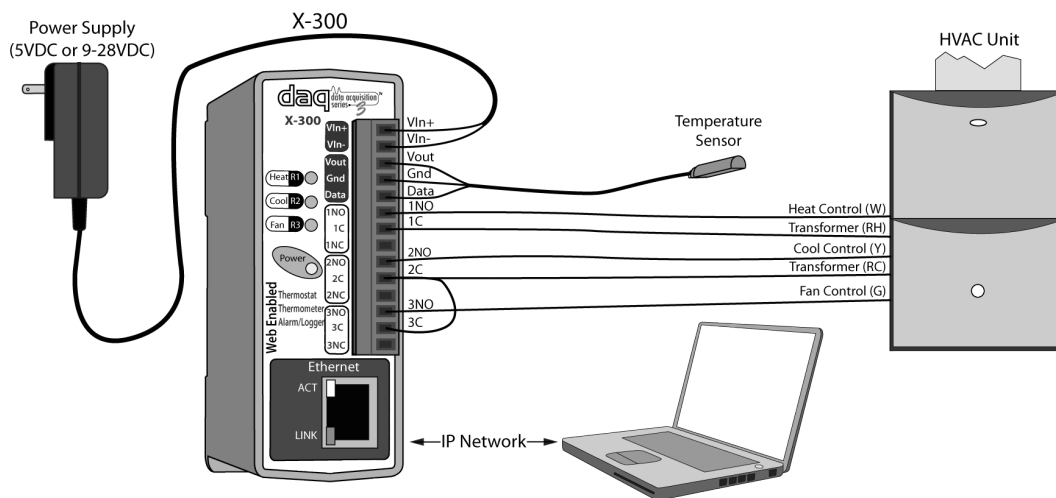


Figure 1.9 – Stand-Alone Thermostat for Heat/Cool System with Separate Transformers

1.5.3 Using X-300™ with Another Thermostat

In situations where losing local control of the thermostat is not desirable, the X-300™ can be used in conjunction with another thermostat (local thermostat). In this case, the X-300™ does not control the local thermostat, but over-rides it when desired. Some typical applications are described in the following sub-sections. Note that the following applications do not use the Thermostat mode.

1.5.3.1 Using X-300™ with Another Thermostat (X-300™ Holds Minimum Temperature plus Thermostat Over-ride)

The X-300™ can be used to take control of the temperature when a building is not occupied. When the building is occupied, the X-300™ enables the local thermostat to be in control of the heating system. When the building is not occupied, users can remotely disable the local thermostat and enable the X-300™. In this case, the X-300™ is configured to maintain a lower temperature. This saves energy and prevents pipes from freezing.

Applications:

Vacation homes and spaces that are not always occupied.

Connection (Figure 1.10/11):

Provide power, network and indoor temperature sensor. The white wire (heat) of the HVAC system is connected to the Common contact of relay 3. The NC of relay 3 is connected to the local thermostat (white wire connection). The normally open of relay 3 is connected to the normally open contact of relay 1. The Common contact of relay 1 is connected to the red wire. Relay 3 is used to select which thermostat has control of the heat. When the X-300™ has control of the heat, relay 1 is used to control the temperature.

Software configuration:

Mode: Temperature Monitor

Settings: Under the **Sensors** tab:

Connect and setup temperature sensors.

Enter temperature set point into **Alarm 1** field (low temperature setting when not occupied)

Specify **Alarm 1** to a Low alarm.

Set **Relay 1 Action** to Turn On when Alarm 1

Under **Relays** tab:

Set **Relay** to Relay 1

Label **On Status Text** as HEAT ON and **Off Status Text** as HEAT OFF.

Set **Relay** to Relay 3

Label **On Button Label** as X-300 and **Off Button Label** as Local.

Label **On Status Text** as X-300 and **Off Status Text** as Local.

Under **Control Page Setup** tab:

Check the following for Display Temperature/State: Sensor1, Relay1, Relay3 (Uncheck all others).

Check the following for Display On/Off Buttons: Relay3 (Uncheck all others)

Uncheck everything under Display Pulse Button.

Figure 1.10 – Using X-300™ with Another Thermostat (X-300™ Holds Minimum Temperature plus Thermostat Over-ride) (schematic view)

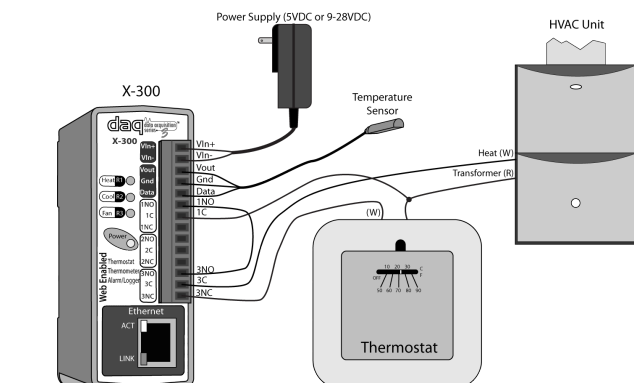
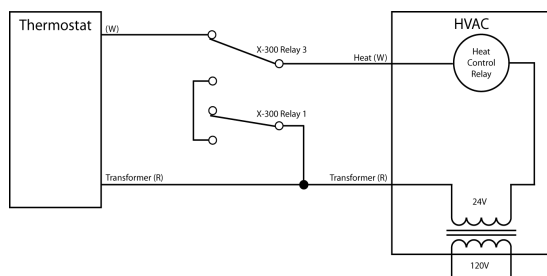


Figure 1.11 – Using X-300™ with Another Thermostat (X-300™ Holds Minimum Temperature plus Thermostat Over-ride) (wiring view)

1.5.3.2 Using X-300™ with Another Thermostat (X-300™ Controls Minimum and Maximum Temperature, Local Thermostat Can Adjust Temperature within Range)

The X-300™ can be used to limit minimum and maximum temperatures within a living space. This provides a way for landlords to monitor temperatures within a rented space and limit settings within reason. WARNING: THERE MAY BE LAWS AND RESTRICTIONS REGARDING LIMITING TEMPERATURE SETTINGS IN RENTED SPACES.

Note that this diagram assumes that the thermostat either is battery powered, or requires no power. If your thermostat requires power from the transformer, the following diagram may cause you to lose all programmed settings within the thermostat. To avoid this, the Heat and Cool would need to be controlled by separate relays within the X-300™. (Setup is similar to section 1.5.3.3)

Applications:

Rental apartments

Connection (Figure 1.12/13):

Provide power, network and indoor temperature sensor. The heat and cool relays are wired in series with the local thermostat.

Software configuration:

Mode: *Temperature Monitor*

Settings: Under **Sensors** tab:

Enter upper limiting temperature into **Alarm 1** field.

Set **Alarm 1** to High alarm

Enter lower limiting temperature into **Alarm 2** field.

Set **Alarm 2** to Low alarm

Set **Relay 1 Action** to Turn On when **Alarm 1**.

Set **Relay 1 Action** to Turn On when **Alarm 2**.

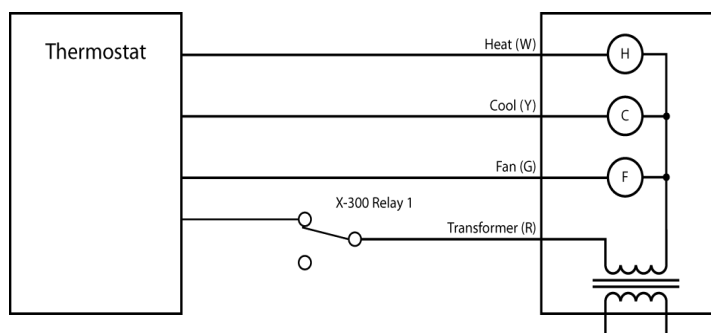
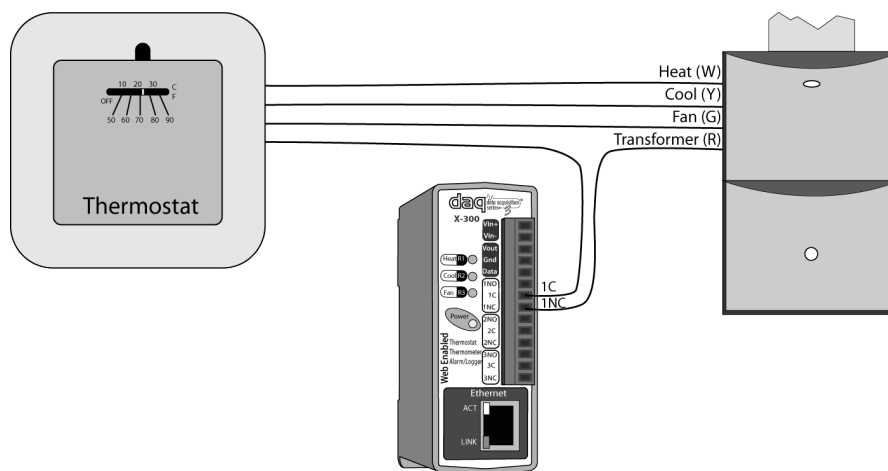


Figure 1.12 – Using X-300™ with Another Thermostat (X-300™ Controls Minimum and Maximum Temperature, Local Thermostat Can Adjust Temperature within Range) (schematic view)

Figure 1.13 – Using X-300™ with Another Thermostat (X-300™ Controls Minimum and Maximum Temperature, Local Thermostat Can Adjust Temperature within Range) (wiring view)



1.5.3.3 Using X-300™ with Another Thermostat (X-300™ Disables Cooling System when space is not occupied)

The X-300™ can be used to enable and disable cooling systems when buildings are not occupied.

Applications:

Vacation homes that are not always occupied.

Connection (Figure 1.14/15):

Provide power, network and indoor temperature sensor. Relay 2 is wired in series with the cooling system.

Software configuration:

Mode: Temperature Monitor

Settings: Under the **Sensors** tab:

Enter temperature set point into **Alarm 1** field.

Set **Alarm 1** to High alarm

Set **Relay 2 Action** to Turn On when Alarm 1.

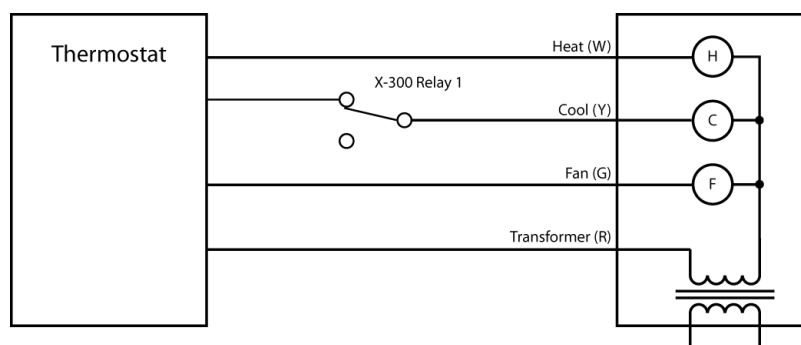


Figure 1.14- Using X-300™ with Another Thermostat (X-300™ Disables Cooling System when space is not occupied) (schematic view)

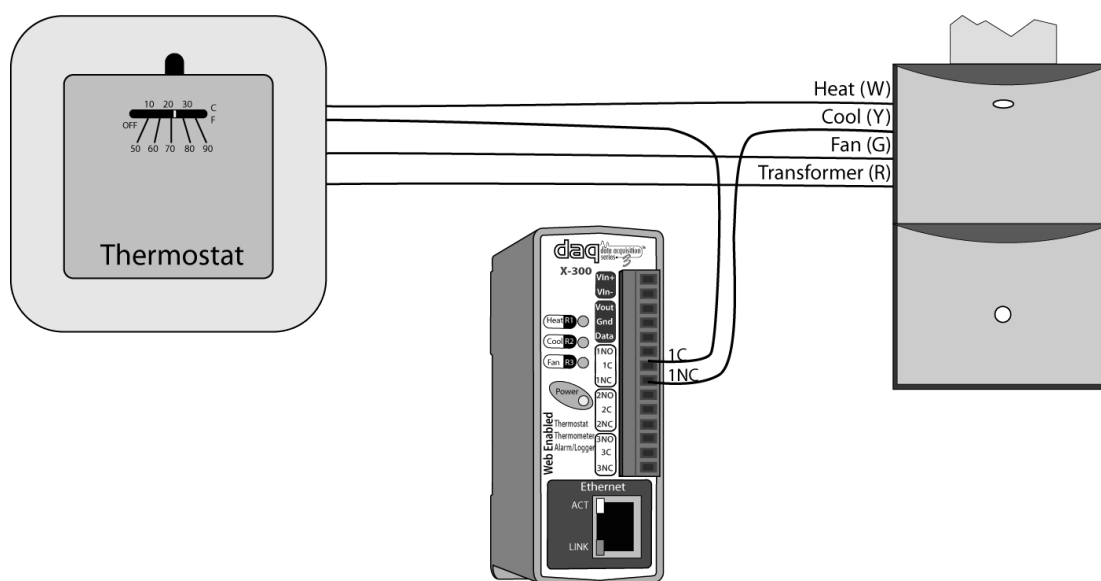


Figure 1.15 - Using X-300™ with Another Thermostat (X-300™ Disables Cooling System when space is not occupied) (wiring view)

Section 2: Installation and Setup

Installation consists of mounting the X-300™, placing and connecting Digital Temperature Sensors, connecting to an IP network, providing power, configuring via a web browser, and wiring relay contacts to devices that will be controlled.

2.1 Mounting

The X-300™ can be wall mounted or DIN rail mounted. It should be mounted in a clean, dry location where it is protected from the elements. Ventilation is recommended for installations where ambient air temperature is expected to be high.

2.1.1 Wall Mounting

Mount the X-300™ to a wall by using two #8 screws. Attach the screws to the wall vertically spaced exactly 2.5 inches (6.35 cm) apart. The head of the screws should be about 1/10 inch (2.5mm) away from the wall. See Appendix C for mechanical details.



Figure 2.1 – Wall Mounting

2.1.2 DIN-Rail Mounting

The X-300™ can be mounted to a standard (35mm by 7.55mm) DIN rail. Attach the X-300™ 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. Remove the X-300™ from DIN rail using a flat-head screwdriver. Insert the screwdriver into the notch in the release tab and pry against the enclosure to release the bottom hook.

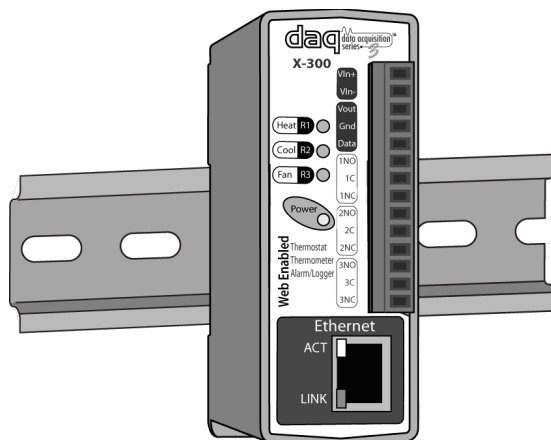


Figure 2.2 – DIN-Rail Mounting

2.2 Connection

CAUTION: MAKE SURE POWER IS SHUT OFF BEFORE WIRING!

CAUTION: THIS UNIT SHOULD BE INSTALLED BY A QUALIFIED TECHNICIAN.

MIS-WIRING OR MIS-CONFIGURATION COULD CAUSE PERMANANT DAMAGE TO THE X-300™ AND/OR THE EQUIPMENT TO WHICH IT IS CONNECTED.

A 14-position removable terminal connector is provided for simple wiring to the X-300™. The correct wiring procedure is as follows;

1. Make sure power is turned off.
2. Remove terminal connector from the X-300™ and make wiring connections to the terminal.
3. Reconnect terminal connector.
4. Apply power.

It is recommended that the load (device to be controlled) not be connected to the X-300™ relay contacts until after the X-300™ has been configured and tested. By doing this, wiring and configuration mistakes will not cause the load device to turn on unexpectedly.

IMPORTANT: MAKE SURE WIRES ARE PROPERLY ATTACHED TO THE TERMINALS AND THAT THE TERMINALS ARE TIGHT!

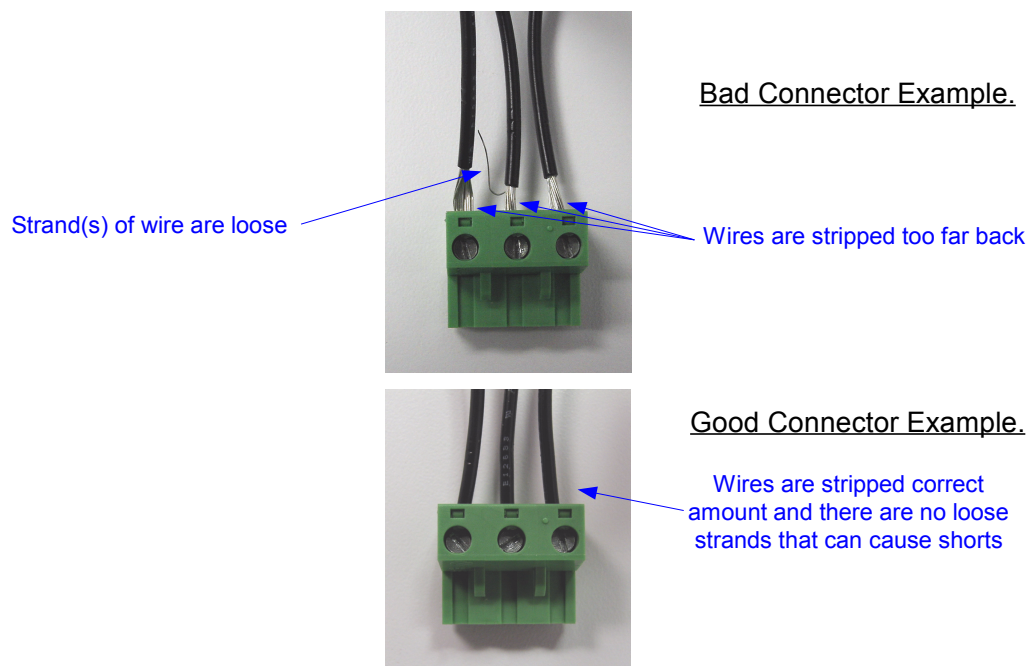


Figure 2.3 – Connection Examples

14-pin connector pin out:

Pin	Description
Vin+	Power supply input +. Connect to the positive side of the appropriate power supply. DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE. <u>Model X-300-5</u> 5VDC Power Supply

Pin	Description
	<u>Model X-300-I</u> 9-28VDC Power supply <u>Model X-300-E</u> Power Over Ethernet model. These units do not require a power supply to be connected to this pin when the unit is connected to an 802.3af compliant network. Alternatively, this model can be powered using a 5VDC power supply.
Vin-	Vin- Negative power supply input.
Vout	+5VDC Out. This output voltage is used to provide power for the digital temperature sensors.
Gnd	Ground connection for 5VDC output. Connect to the digital temperature sensors.
Data	Temperature Data. This is the data line connection for the digital temperature sensors.
1NO (W)	Relay 1 Normally Open (Thermostat heat connection: white wire. When white wire is connected to red wire (by closing relay contact), thermostat calls for heat.)
1C (R, or RH)	Relay 1 Common (HVAC system 24VAC transformer: red wire) (Heat transformer if separate transformers are used)
1NC	Relay 1 Normally Closed
2NO (Y)	Relay 2 Normally Open (Thermostat cool connection: yellow wire. When yellow wire is connected to red wire (by closing relay contact), thermostat calls for cool)
2C (R, or RC)	Relay 2 Common (HVAC system 24VAC transformer: red wire) (Cool transformer if separate transformers are used)
2NC	Relay 2 Normally Closed
3NO (G)	Relay 3 Normally Open (Thermostat fan connection: green wire. When green wire is connected to red wire (by closing relay contact), thermostat forces fan on.)
3C (R, or RC)	Relay 3 Common (HVAC system 24VAC transformer: red wire) (Typically connected to cool transformer if separate transformers are used)
3NC	Relay 3 Normally Closed

HVAC Note: In cases where separate transformers are used for heat and cool, the red wire is for the heat transformer is usually marked as (RH) and the red wire for the cooling transformer is usually marked as (RC). The common terminals on the X-300™ are not internally connected so it will accommodate separate heating and cooling transformers.

2.2.1 Power Supply Connection

The X-300™ requires power for its internal web server and logic circuits. Connect appropriate DC power supply to the Vin+ and Vin- terminals. Alternatively, X-300™ units with the Power Over Ethernet option may be powered through the Ethernet connection instead of using an external power supply.

Multiple X-300™ units may be connected to a single power supply by connecting the power supply input terminals in parallel. The power supply must have a high enough current rating to power all units connected (see Appendix H for specifications and current requirements).

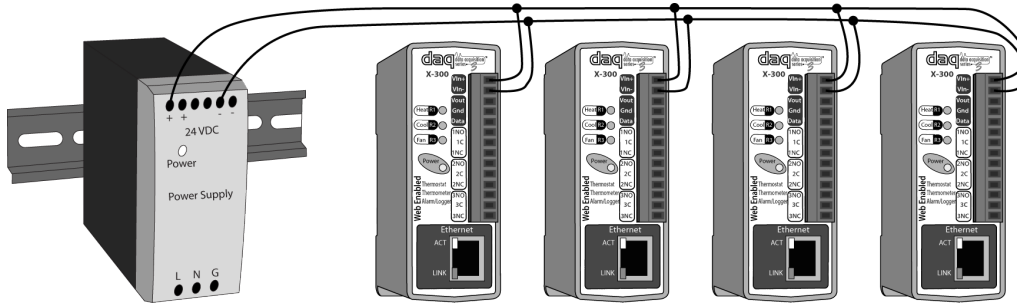


Figure 2.4 – Multiple Unit Power Supply connection

X-300™-E models: (POE)

X-300™ units with the Power Over Ethernet option may be connected to an 802.3af compliant Ethernet port instead of connecting to an external power supply. In this case, the X-300™ is powered through the network port. In 802.3af compliant networks, a 48 Volt power source is injected into the Ethernet line. This power source is provided by an 802.3af compliant hub, switch, or power injector which may be located in a utility closet which could be a distance away from the X-300™. This option is very useful for installations where local power is not available. The power injector may inject the 48 Volt power source through the data lines or the spare lines in the Ethernet cable. **DO NOT USE A POWER INJECTOR THAT APPLIES A VOLTAGE TO BOTH THE DATA LINES AND THE SPARE LINES.**

2.2.2 Network Connection

Connect the Ethernet port to a 10 Base T or 10/100 Base T Ethernet connection. This typically connects to an Ethernet hub, switch, or router. For configuration, the X-300™ may be connected directly to the Ethernet port on a computer using a “crossover” cable. Otherwise, for connection through a hub or router, a standard “straight-thru” cable should be used.

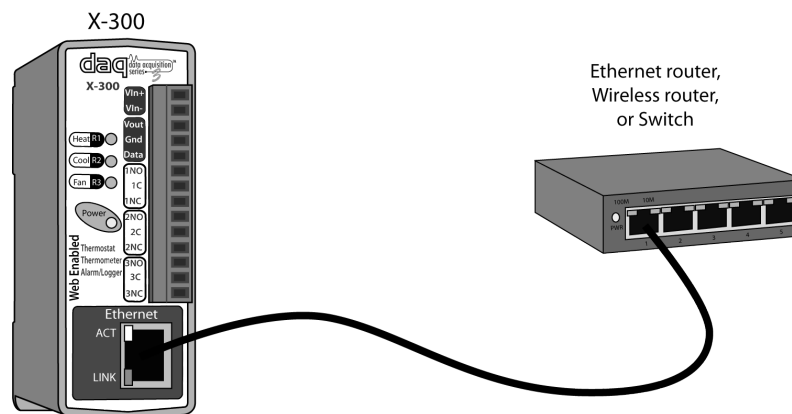


Figure 2.5 - Wired Network Connection

The X-300™ can be used indirectly on a wireless network. This can be done by using a wireless Ethernet bridge or a wireless router. The network connection of the X-300™ is connected to the wireless device and the wireless device makes the connection to the wireless network. Note that wireless Ethernet bridge or router must be properly set up for the wireless network used. Refer to the installation instructions that came with the wireless device.

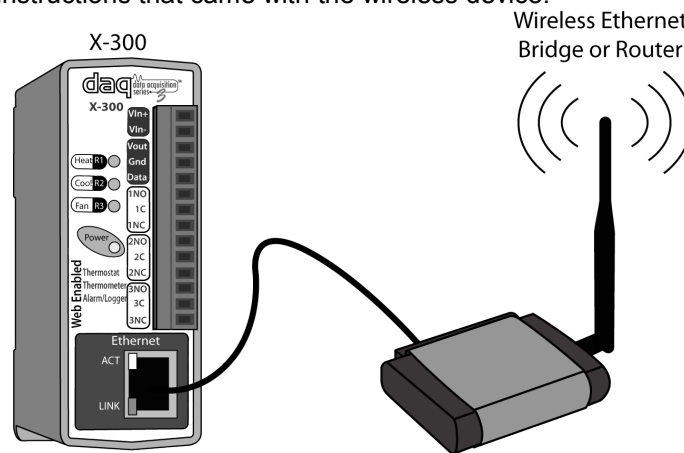


Figure 2.6 – Wireless Network Connection

2.2.3 Relay Connection

Three internal relays are included in the X-300™ that may be used to control external devices such as alarms, signals, motors, heaters, etc. The relays can be configured to control devices based upon temperature measurements or they can simply be turned on and off over the network. In order to provide the X-300™ with the greatest versatility, the relay contacts (Common, Normally Open, and Normally Closed) internally connect directly to the terminal connector with no internal over-current or contact protection. If the power source connected to the relay contacts can deliver more than rated maximum contact current, an external fuse or circuit breaker must be used. The relay contacts may be wired in series with the power source for a device that will be controlled (the load). For loads greater than the maximum relay contact rating, an external relay may be used. The illustration below shows how a 20-Amp motor can be controlled using an external relay. In the example, the X-300™ controls the external relay and the external relay controls the load.

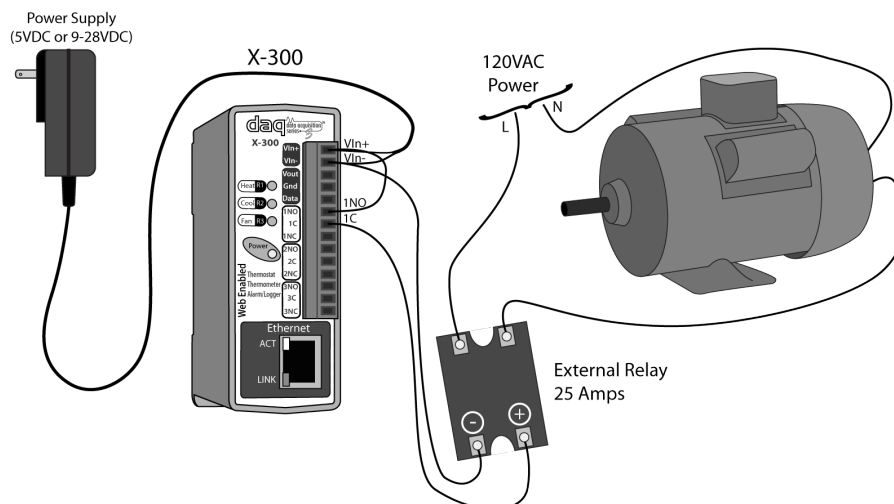


Figure 2.7 - External Relay Connection

When relays switch inductive loads such as motors, transformers, relays, etc., electricity will arc across the internal relay contacts each time the contacts open. Over time, this causes wear on the relay contacts which can shorten their life span. When switching an inductive load, it is

recommended that simple relay contact protection devices are used. Note that the X-300™ does not provide relay contact protection in order to provide the greatest versatility and because appropriate protection differs for various loads. Below is an example of relay contact protection for a DC circuit (Figure 2.8) and an AC circuit (Figure 2.9). For component values required to provide sufficient contact protection for your application, refer to appropriate references.

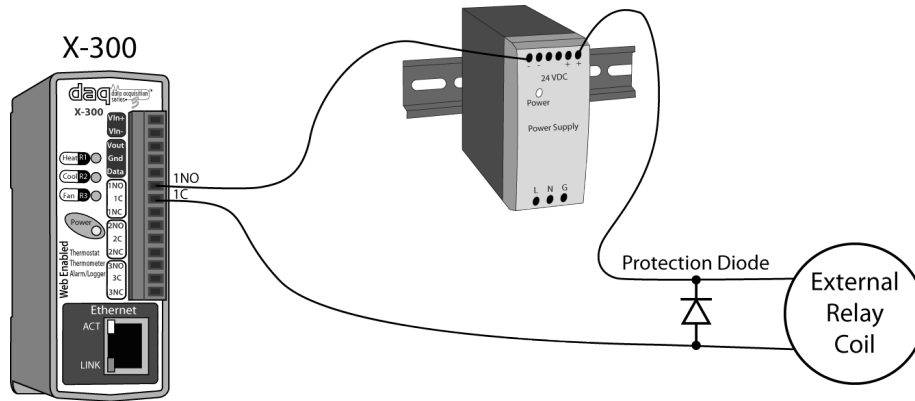


Figure 2.8 - DC Contact Protection

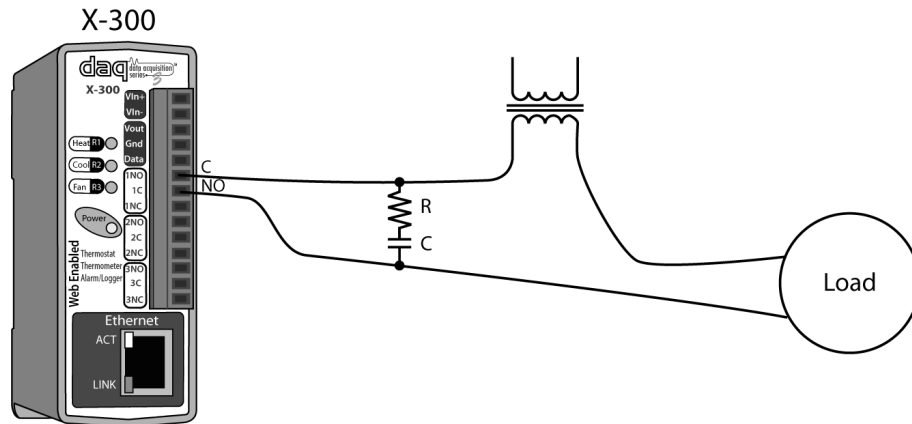


Figure 2.9 - AC Contact Protection

2.2.4 Sensor Connection

The X-300™ requires temperature sensors for data acquisition. One temperature sensor is included with the X-300™ (see Figure 2.10), and additional sensors may be purchased. The sensor is manufactured by Dallas Semiconductor (part number DS18B20). All three lead wires must be connected. The lead wires are 12 inches long, but may be extended. The maximum extension length depends on the number of sensors used, the type of wire, etc. When 1-4 sensors are used, it is safe to extend the sensor leads up to a length of 60 feet. If more sensors are used, the length will be shorter.

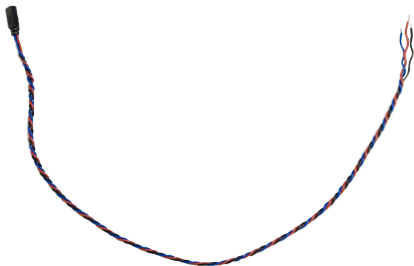


Figure 2.10 – Temperature Sensor

Sensor Wire Color	Connection
Red	Vout
Black	Gnd
Blue (or White)	Data

The temperature sensor measures the temperature and converts the analog measurement to a digital format. The digital information is sent to the unit periodically (approximately every two seconds). Because the information is sent in a digital format, the sensors can be extended without any loss to the information.

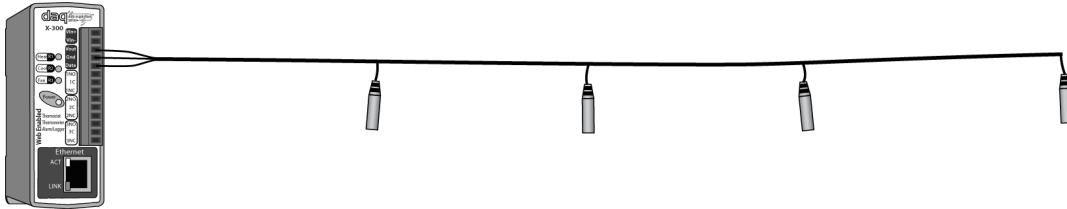


Figure 2.11 – “Daisy Chained” Sensors

A total of eight temperature sensors can be connected to the X-300™ at one time (two if in Thermostat mode). All sensors are connected to the same terminals in the 14-pin connector. Each sensor has a specific address assigned to it, thus allowing the unit to differentiate the sensors and their measurements. Multiple sensors can be connected in two ways. They can all directly connected to the unit, or they can be “daisy chained” as shown in Figures 1.3 and 2.11.

2.3 Establishing Communications for Setup

The X-300™ is set up using a web browser. The first task is to establish communications between a computer and the X-300™ so that the browser-based configuration can begin. To do this, the computer and the X-300™ must be physically connected to the same network and both must have IP addresses on the same network.

There are two ways to set up the computer and X-300™ so that they are on the same network. The first way (Option 1), is to change the IP address of X-300™ to an address that is on the same network as the computer.

The second way (Option 2) is to change the IP address of the computer to an address that is on the same network that X-300™ is set to by default. Use Option 2 for Windows Vista.

2.3.1 Option 1: Assign a temporary IP address to the X-300™

This option is used to TEMPORARILY assign an IP address to X-300™ without the need to change the IP address of the configuration computer. Note that X-300™ will only use this IP address as long as power is maintained. Once power is lost and restored, X-300™ will use the IP address assigned in the setup page and not the temporary address assigned here. This means that once communications are established, the desired IP address should be entered into the **Network** setup tab using the browser.

To assign the temporary IP address...

1. Make sure the X-300™ and the configuration computer are connected to the same physical network. This will not work through routers or gateways.
2. Assign the address as follows...

Windows XP:

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

Note: This option does not work with Windows Vista. For Vista see Section 2.3.2

Type...

```
arp -s {new IP address} {serial number of the X-300 }
```

Note: IP address format is: xxx.xxx.xxx.xxx

Serial number format is: ss-ss-ss-ss-ss-ss

For example, to set an X-300™ (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
```

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
```

Linux/Unix:

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

Type...

```
arp -s {new IP address} {serial number of the X-300 }
```

Note: IP address format is: xxx.xxx.xxx.xxx

Serial number format is: ss:ss:ss:ss:ss:ss

For example, to set an X-300™ (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
```

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
```

Mac OS X

Open a terminal,

Note that the terminal is in the “Utilities” directory which is in the “Applications” directory.

Type...

```
sudo arp -s {new IP address} {serial number the X-300 }
```

Note: Administrator password is required.

IP address format is: xxx.xxx.xxx.xxx

Serial number format is: ss:ss:ss:ss:ss:ss

For example, to set an X-300™ (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
```

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
```

2.3.2 Option 2: Assign a temporary IP address to configuration computer

If the first option above is not used, you can use this option to communicate with the X-300™. By default, the X-300™ comes from the factory with an IP address of 192.168.1.2. Communications with the X-300™ may be established by assigning an IP address to the configuration computer that is on the same network as the X-300™ (for example, the configuration computer could be assigned to 192.168.1.50) .

Instructions for changing the IP address of the computer that will be used for the X-300™ configuration are given here. The following example is for those running the Windows operating system. For setup using other operating systems, refer to the appropriate users manual.

Step 1: Open the control panel by clicking on the start menu and then clicking on Control Panel (Figure 2.12). (Note that control panel shown (Figure 2.13) is in “Classic View”. If control panel is in “Category View” select the “Classic View” option before proceeding.)

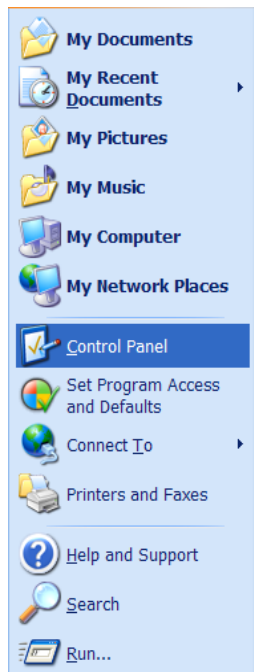


Figure 2.12 – Start Menu

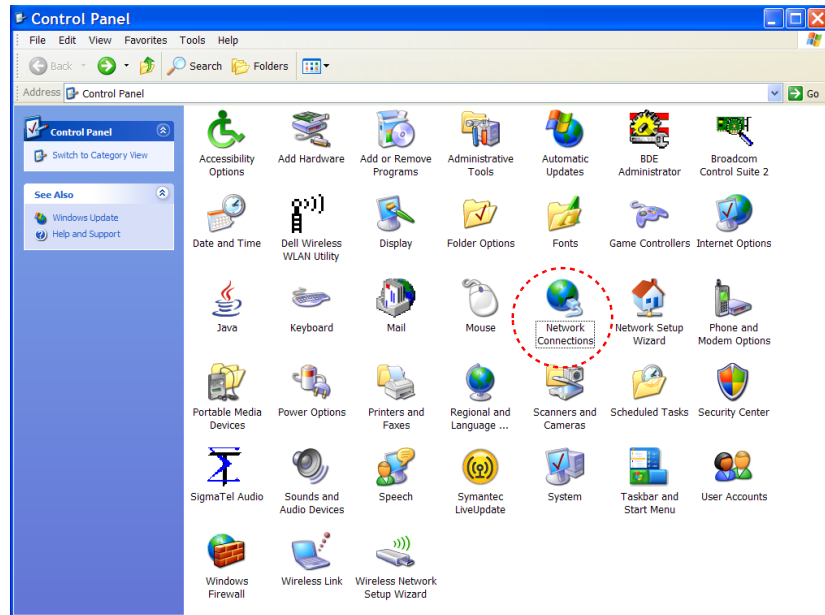


Figure 2.13 – Control Panel

Step 2: Double click on the icon labeled Network Connections. The window in figure 2.14 will pop up.

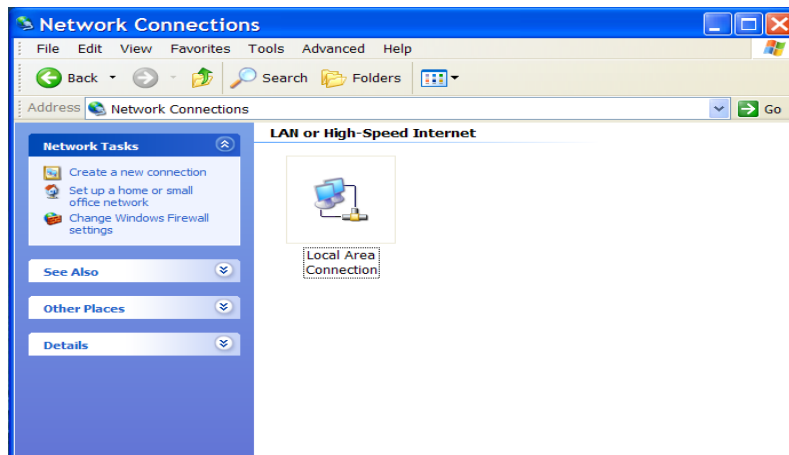
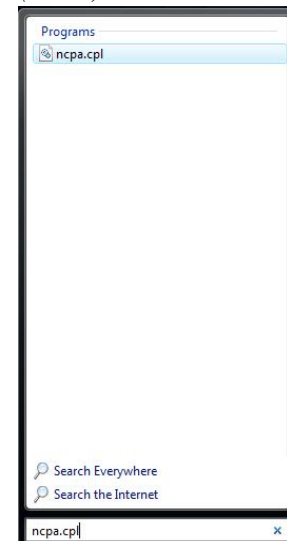


Figure 2.14 – Network Connections Folder

Note: To access the the Network Connections folder in Windows Vista, select the Windows Icon (Start Menu) and enter **ncpa.cpl** into the search bar and press enter (See Figure 2.15).

Figure 2.15– Windows Button (Vista)



Step 3: Right click on the icon labeled Local Area Connection. In the menu that follows select the option at the bottom of the menu labeled Properties. The Local Area Connection Properties window will appear. Scroll down to and highlight the 'Internet Protocol (TCP/IP)', then click the button labeled 'Properties'. (Figure 2.16)

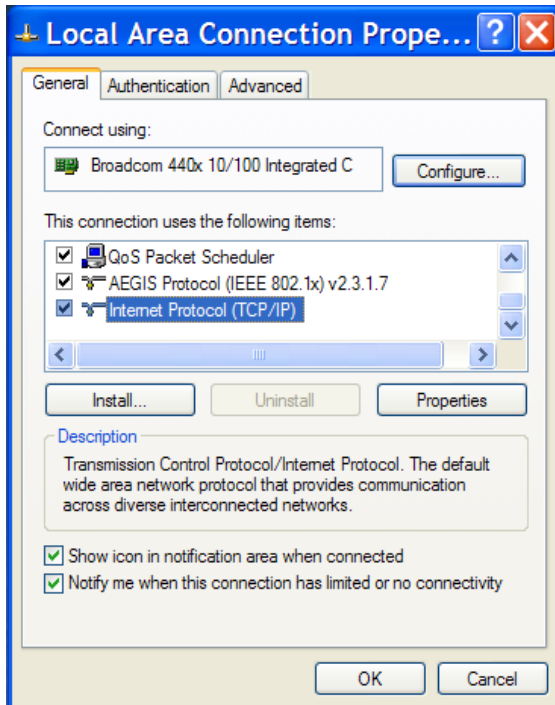


Figure 2.16 – Local Area Connection Properties

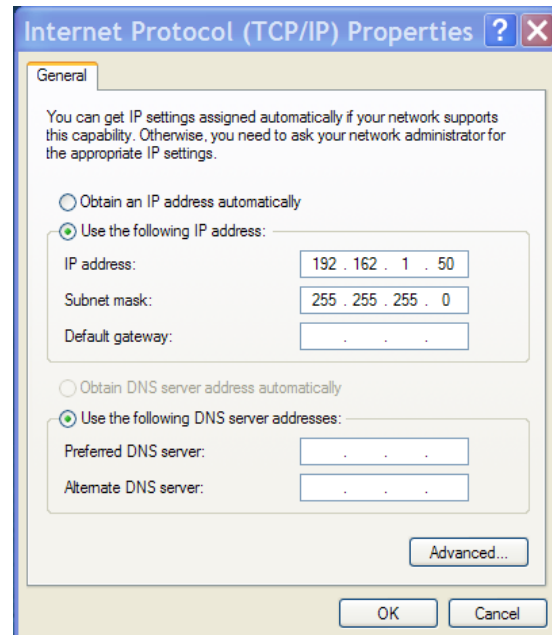


Figure 2.17 – Internet Protocol Properties

Step 4: The following 'Internet Protocol (TCP/IP) Properties' menu appears.

Before making any changes to the network settings (Figure 2.17), write down the current settings so that they can be restored once the X-300™ is configured.

Step 5: Select the radio button labeled "Use the following IP address," and type in the IP address 192.168.1.50. Type in a subnet mask of 255.255.255.0. Leave the default gateway field blank. Click OK to apply the new settings.

2.3.3 Open Configuration Web Page

Once the network is set up, open the setup page as described in section 2.5. If the setup pages are not accessible, verify that the X-300™ is powered on and that the LINK light is illuminated. Check all network connections and settings.

2.4 X-300™ Setup Pages

The X-300™ is configured using a web browser. To access the setup pages, enter the following in the URL in a web browser:

`http://ip-address/setup.html`

For example, using the default address, enter.

`http://192.168.1.2/setup.html`

After the page is requested, a password prompt will appear. Enter the user name and password. Note that the user name is admin and the default password is webrelay (both are case sensitive).

2.4.1 Main Tab

This is the initial page that is displayed when setup.html is entered into the URL line of the browser. It displays model and serial number information about the X-300™, basic diagnostic information, and provides key mode settings.

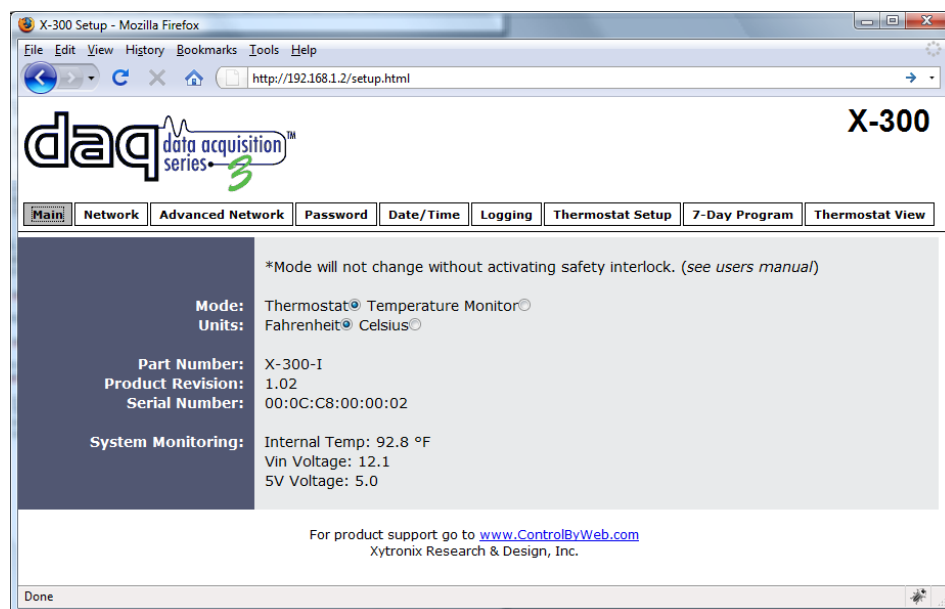


Figure 2.18 – Main Tab

1. **Mode:**

The X-300™ functions as two, very different modules. The mode selection determines the function. The menus, options, and **Control Pages**, are very different for each mode. The default setting is Thermostat. Note that when the mode is changed, the current log file (if enabled) will be erased. A pop up window will warn the user of this before changing.

-Thermostat: This option configures the X-300™ to operate as an advanced, single-state thermostat. In this mode, all settings and features are geared toward using the X-300™ as a thermostat and non-thermostat related features are not included for simplicity.

-Temperature Monitor: This option is ideal for for temperature monitoring, logging, alarming, and control of non HVAC systems. This mode offers the greatest degree of versatility.

IMPORTANT NOTE: HVAC systems can be damaged if both heat and cool relays are turned on at the same time. If the X-300™ is used as a thermostat, the system firmware will not allow both relays to be turned on at the same time. If however, a user changes modes to Temperature Monitor mode, the relays can be turned on in any combination. To prevent errors due to mode changes, a safety interlock has been integrated into the X-300™. The mode will not change without activating the safety interlock.

STEPS TO CHANGE MODES:

1. Activate the safety interlock by briefly pressing the reset button while the unit is powered.
2. Change the mode within 60 seconds after activating the safety interlock. If the mode is not changed within 60 seconds, the mode will not change without repeating step 1.

Note: The reset button is located on the bottom of the unit and can only be pressed by inserting a thin object such as a toothpick straight through the access hole. Care must be taken not to damage the reset button or any other internal components by pressing too hard or inserting the object at an angle and missing the reset switch. Do not use a metal object to access the reset button.



Figure 2.19 – Reset Button Position (illustrated using WebRelay™)

3. **Units:**

The unit of temperature measurement is selected here. All temperatures (displayed, alarm thresholds, etc) used or referenced in the X-300™ will use the unit selected. Either Fahrenheit or Celsius may be selected.

4. **Model:**

This is the full model number of the X-300™.

5. **Product Revision:**

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

6. Serial Number:

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

7. System Monitoring:

***NOTE: The values in these fields are only updated when the web page is refreshed.

Internal Temp: This provides the current temperature inside the X-300™.

Vin Voltage: This is the DC voltage that is applied to the Vin+ and Vin- terminals.

5V Voltage: Internal 5V power supply

2.4.2 Network Tab

The network parameters are set on this page. Note that if multiple ControlByWeb™ products are used on the same network, install one unit 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. It may be necessary to clear the 'arp' cache each time you swap ControlByWeb™ products on the network (this is because each unit has the same default IP address but a different mac address). This is done by typing "arp -d" in the command prompt of a Windows computer ("arp -d -a" as a super user on Apple OSX). Note that the X-300™ must be power-cycled (power disconnected, then reconnected) before network settings take effect. Only the settings on the **Network** tab and some settings on the **Advanced Network** tab require power-cycling before taking effect.

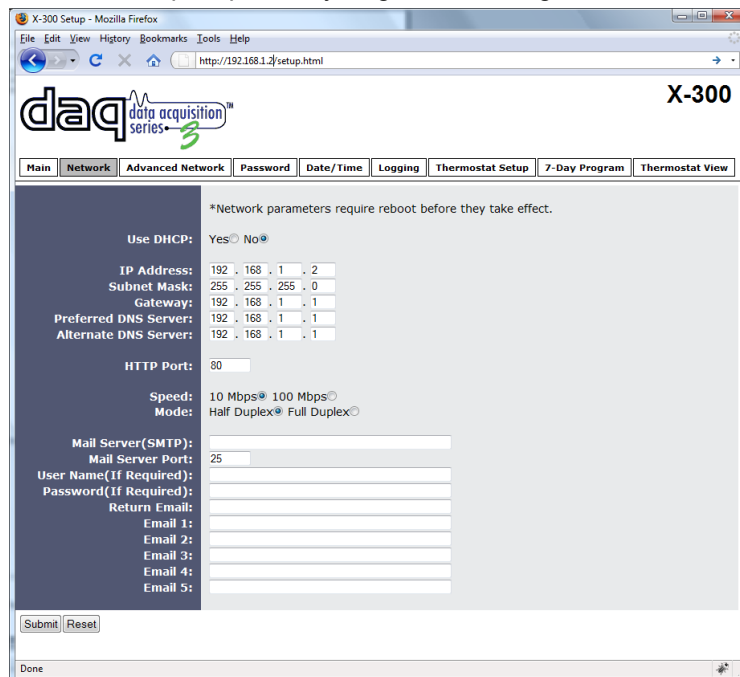


Figure 2.20 – Network Tab

1. Use DHCP:

This option allows DHCP to be enabled or disabled. If this option is set to Yes, the X-300™ will wait for an IP address from a DHCP server each time it is powered. The default setting is No (this is recommended for most installations). If DHCP is set to Yes, the **Network** page must be submitted, and the X-300™ must be rebooted before an IP address will be assigned. Once the X-300™ is assigned an IP address by the DHCP, the new IP address can be found through the clients list kept by the DHCP. For most instances, this is found on the local gateway or router.

Brief notes about DHCP:

All devices on an IP network require an IP address. This is a unique address that

identifies each device on the network. DHCP (Dynamic Host Control Protocol) is a mechanism that automatically assigns an IP address to a computer (or other 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 and dynamically assigns an IP address to that computer. On many small networks, the DHCP server is built into the router.

DHCP works well for “client” devices such as computers, but is not ideal for servers. This is because servers usually don't initiate communications with other devices, but rather, they wait for a request from “clients”. To make this request, the client must know the IP address of the server. If a server gets its IP address dynamically, the IP address may not always be the same so client devices may not be able to find the server. For this reason, servers usually use an IP address that is fixed and does not change. The X-300™ is a server and manual IP address assignment is usually recommended.

2. IP Address:

Enter the IP address for X-300™ in this field.

The IP address is specific to the network where the X-300™ will be installed, and must be obtained from the network administrator. For more information on IP addresses and remotely accessing the X-300™ over the Internet see Appendix B: Accessing the X-300™ Remotely over the Internet. The default setting for this field is *192.168.1.2*.

3. Subnet Mask:

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

4. Gateway:

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

5. Preferred DNS Server:

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

This field is only required when the following options are used:

- Remote Services (when server is specified by name and not IP address).
- Sync time clock with remote NTP server (when server name is specified by name and not IP address).
- Mail Server is used (when server name is specified by name and not IP address).

6. Alternate DNS Server:

This field is used to specify the IP address of a Secondary DNS server. This is used when the X-300™ requires DNS services and the preferred DNS server is not available. The default setting for this field is *192.168.1.1*.

7. HTTP Port:

The TCP port used for HTTP communications (web browser, XML, get commands) with X-300™ is specified here. It is recommended that the port not be changed without an understanding of TCP/IP and ports. For more information on TCP ports and IP addressing see Appendix B: Accessing the X-300™ Remotely over the Internet. The port can be set within the range of *0-65535*. The default setting for this field is *80* which is the standard HTTP port.

8. Speed:

This option sets the data rate (clock rate) of the Ethernet port. Either 10Mbps or 100Mbps can be selected. The 100Mbps option offers faster communications but the amount of data to and from the X-300™ is so small that users will not likely notice much (if any) difference. When the X-300™ is set to 10Mbps, it draws less power and runs a little cooler which translates into a longer product life. IT IS RECOMMENDED THAT THIS SETTING BE LEFT AT 10MBPS UNLESS THE USER HAS A SPECIFIC REASON TO USE 100MBPS. The default setting for this field is 10Mbps.

9. Mode:

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

The remaining fields on this page are required only if the X-300™ is configured to send email messages when alarm conditions occur.

10. Mail Server (SMTP):

The name of the mail server (for example mail.example.com) or the IP address of the mail server (for example. 192.10.10.10) should be entered in this field. Note that if the server name is entered and not the IP address, the address of a DNS server will be required. There is no default setting for this field.

11. Mail Server Port:

The standard port for SMTP is 25 however an alternate port may be entered here. The default setting for this field is 25.

12. 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.

13. Password (If Required):

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

14. Return Email:

The X-300™ will not receive email messages, but when the X-300™ 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-300™ will send email messages with any email address specified in this field, some email filters (spam filters) will not allow messages through that include an invalid email address. There is no default setting for this field.

15. Email 1 to Email 5:

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

2.4.3 Advanced Network Tab

(Note that these settings are not used for most installations. Also note that some settings on this tab require the unit to be power-cycled (power disconnected, then reconnected) before taking effect.)

Figure 2.21 – Advanced Network Tab

Modbus

1. **Modbus Enabled:**

The X-300™ can support Modbus/TCP. For users not familiar with Modbus, Modbus is a messaging structure protocol used in industrial manufacturing control and automation. It is an open protocol and offers interoperability with software and devices from other manufacturers. This is enabled by selecting Yes in this field. Note that Modbus communications are disabled whenever the control password is enabled. The default setting for this field is No.

2. **Modbus Port:**

This specifies the port used for Modbus/TCP communications with the X-300™. By default this is set to port 502 which is the standard Modbus port. It can be set within the range of 0 to 65535. The unit must be power-cycled before the new port number takes effect.

Remote Services

Remote Services initiates an outgoing connection to a server at a remote location. This can be used, for example in an environment where a web server on the Internet provides a custom user interface and users access the X-300™ through the web server rather than communicating directly with the X-300™. This is sometimes referred to as “web services”.

As mentioned earlier in this users manual, using an external web server allows users to access one or many X-300™ units (or other ControlByWeb™ products) through a custom web page. This has the benefits of being able to combine multiple devices seamlessly into a single web page, and it allows programmers to create powerful, custom web pages using the web programming languages of their choice.

Using the Remote Services configuration so that the X-300™ units initiate the connection to the external web server (rather than having the web server initiate communications to the X-300™ units) has two main benefits. First, the web server does not need to know the IP address of the X-300™. This means that the X-300™ can get its IP address dynamically from a DHCP server which simplifies the installation. Second, since the connection from the X-300™ is outgoing, rather than incoming, the local router on the network where the X-300™ resides doesn't need to be configured to forward sockets. This also has the benefit of simplifying the installation. In addition, 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 Appendix E.

3. **Remote Services Enabled:**

This option enables or disables Remote Services. If *Yes* is selected, Remote Services will be enabled as soon as the submit button is pressed and the X-300™ will immediately attempt to make a connection with the remote server. Once a connection is established, the connection will remain until it is dis-connected by the remote server. Proper connection with the remote server can be verified by viewing the system status log file (see Appendix D: Log Files). The default setting for this field is *No*. Note that the unit does not need to be power-cycled after Remote Services settings have been changed.

4. **Server Name/IP Address:**

Specify the name or IP address of the server here. If the IP address is specified, enter it as *aaa.bbb.ccc.ddd*. For numbers that are less than 100, preceding zeros should not be included (for example, enter 80 rather than 080). This field can be up to 40 characters long and has no default setting.

5. **Server Port:**

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

6. **Connection String:**

This text is sent to the server when the connection is established. This string should include any information required by the server at connection. For example, it may include an ID number, customer number, password, etc. The format is entirely dependent upon the server requirements. This field can be up to 80 characters long. Default text is provided only as an example placeholder. The default text is
[<serialAddress>]:ControlByWeb,X-300

7. **Connection Interval:**

This field specifies the periodic interval in which the X-300™ attempts to connect to the remote server, or if the X-300™ is already connected it is the interval which the X-300™ sends the connection string. This field can be set within the range of 1 to 34452 minutes. The default setting for this field is 1 minute.

SNMP

Simple Network Management Protocol (SNMP) is used to manage and administer network devices. X-300™ supports SNMP V1.0 and can be configured here. Using SNMP, the temperature readings and relay states of the X-300™ can be read as well as some basic information about the device. See Appendix F for information about how to request information from the X-300™ using an SNMP manager, as well as where to find MIB files for the X-300™.

Note: The read and write community strings used for SNMP are actually the control password found on the **Password** setup tab (see Section 2.5.4.) If the control password is disabled, then the X-300™ does not check for the community string when issued a Get or Get Next request from the SNMP manager. The X-300™ always requires the write community string when issued a Set request.

8. **SNMP Enabled:**

When this option is set to Yes the X-300™ will support SNMP. The default setting for this option is No.

9. **SNMP Manager IP:**

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

10. **SNMP Port:**

When SNMP is used, this field is used to specify the SNMP port that the X-300™ listens on. The default setting for this field is 161.

11. **SNMP Trap Port:**

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

12. **Send State Msg/Trap On:** (Thermostat Mode Only)

The X-300™ can push messages when one or more relays change state. It can push state messages to a remote services server and/or an SNMP trap. If remote services and/or SNMP is set up, the X-300™ will push messages when one or more of the options below are selected.

-Heat State Change - When this is selected, state information will be sent when heat relay changes state.

-Cool State Change - When this is selected, state information will be sent when cool relay changes state.

-Fan State Change - When this is selected, state information will be sent when fan relay changes state.

Note that this option only appears on the **Advanced Network** tab in Thermostat Mode. In Temperature Monitor mode, similar options appear in the **Relays** setup tab.

2.4.4 Password Tab

The X-300™ requires a password to log into the setup pages. The password can be changed on this page. Additionally, the installer can enable the requirement for a control password.

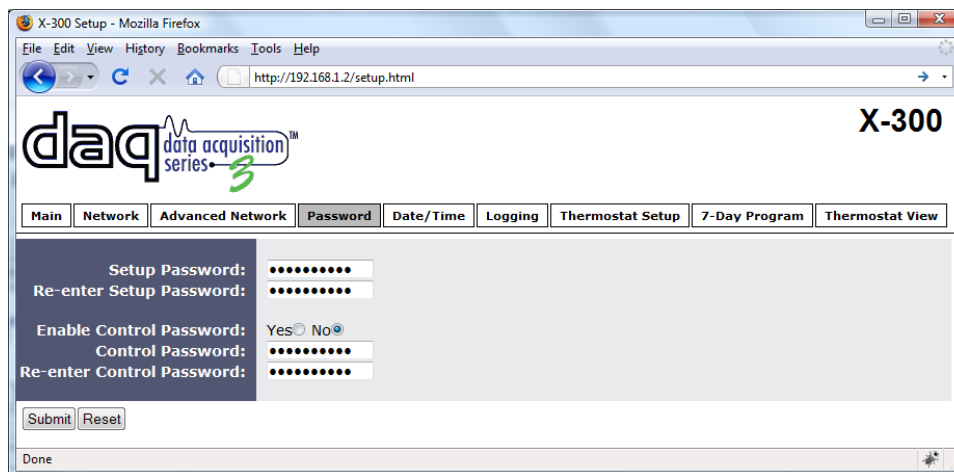


Figure 2.22 – Password Tab

1. Setup Password:

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

2. Re-enter Setup Password:

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

3. Enable Control Password:

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

4. Control Password:

When the Enable Control Password option above is set to Yes, this field is used to specify the password which will be required to access the **Thermostat View/Control Page**. Passwords that are 8 characters or longer with both alphabetic and numeric characters are recommended. For security purposes, the password will not be displayed as it is entered. Note that the X-300™ does not require a user name to access the **Thermostat View/Control Page**, only a password, however some browsers require a user name to be entered. In this instance enter none as the user name. The default control password is *webrelay*.

5. Re-enter Control Password:

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

2.4.5 Date/Time Tab

The X-300™ uses the time for scheduled events (such as changing the temperature settings between daytime and night-time settings) and for logging (a time stamp is included with each logged event). The time is stored and displayed in 24-hour time format. The X-300™ has a capacitor-backed real-time-clock circuit that will keep track of time for several days in event of a power failure.

1. **Current Date/Time:**

This is the current date and time stored in the X-300™. The time is stored and displayed in 24-hour format.

2. **Set Time:**

This drop-down list offers two options - Manually and Sync with NTP server. For each of the two options, the options below this field change.

-Manually is selected when the user needs to manually enter the time and date. When this option is selected parameters 3 & 4 appear.

-Sync with NTP server allows the user to set the clock automatically by using an NTP (Network Time Protocol) server. Many NTP servers are available for use on the Internet. In addition, many desktop computers will function as an NTP server (both Mac and PC). Note that if a desktop computer is used, firewall settings may need to be adjusted allowing for NTP communications (port 123). When this option is selected parameters 5-8 appear.

The screenshot shows the 'X-300 Setup' web interface. The 'Date/Time' tab is active. The 'Current Date/Time' field displays 'Fri, 31 Jul 2009 11:30:22'. The 'Set Time' dropdown menu is set to 'Manually'. Below this, there is a calendar for July 2009. The 'Date' field is currently empty. The 'Time (24 Hour Format)' field shows '11 : 30 : 00'. The 'Daylight Savings' section has 'Yes' selected, with 'Start' set to '2nd Sun Mar' and 'End' set to '1st Sun Nov'. At the bottom, there are 'Submit' and 'Reset' buttons.

Figure 2.23 – Date/Time Tab (Manually)

The following parameters (3-4) are available when the Set Time is set to Manually

3. **Date:**

This field is used to enter the current date. The date is entered by first selecting the correct month and year by using the left and right arrows on top of the calendar. The single arrows (< and >) change the month and the double arrows (<< and >>) change the year. Once the current month and year are displayed, the date should be entered by moving the mouse pointer over the correct day and clicking the (left) mouse button to highlight that date.

4. Time:

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

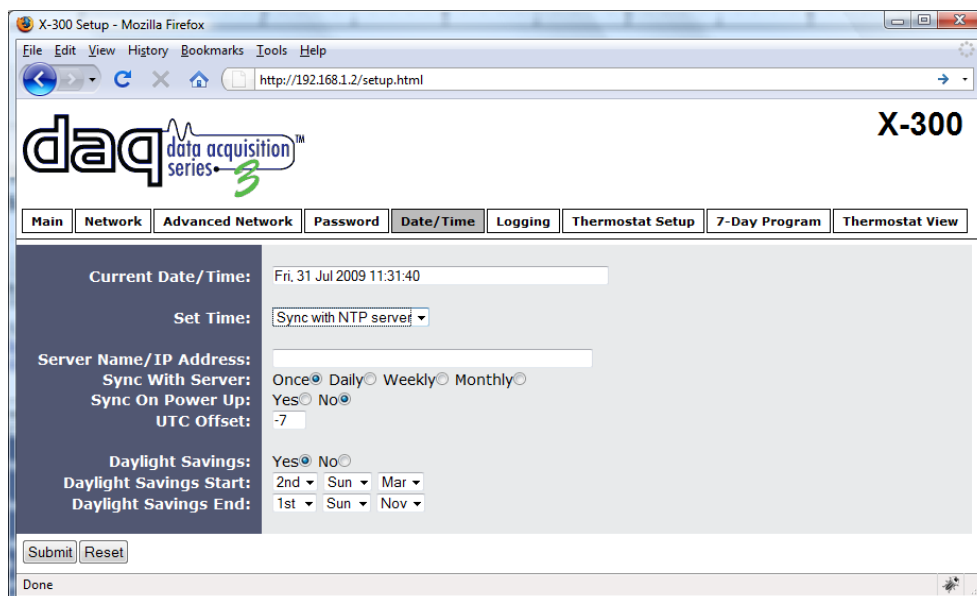


Figure 2.24 – Date/Time Tab (Sync with NTP server)

The following parameters (5-8) are available when Set Time is set to *Sync with NTP server*

5. Server Name/IP Address:

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

6. Sync With Server:

This option allows the user to specify how often the X-300™ time will be synchronized with the time server. When the submit button on this page is pressed, the X-300™ will immediately synchronize with the time server. If *Daily*, *Weekly*, or *Monthly* options are selected, the X-300™ will thereafter re-synchronize with the time server at 12:02 AM at the period interval specified. The default value of this setting is *Once*.

7. Sync on Power Up:

When this option is set to *Yes*, the X-300™ will be synchronized with the time server each time it is powered. Note that if it is expected that the X-300™ will lose power on a frequent basis, it may be beneficial to set this option to *No*; some time servers are configured to dis-allow access from client devices that excessively request their services. The default value of this setting is *No*.

8. UTC Offset:

Time servers return the current time in Universal Time (GMT). It is common for many servers and data loggers to use GMT as their official time, even when they are not located within the GMT time zone. The default value for this field is -7 (Mountain Standard Time).

For convenience, the time can be converted to local standard time by entering the offset here. This manual cannot include the UTC Offset for all parts of the world, but the offset for GMT time and the four major US Time zones are listed here.

GMT Time: 0

Eastern Standard Time: -5

Central Standard Time: -6

Mountain Standard Time: -7

Pacific Standard Time: -8

9. Daylight Savings:

In many parts of the United States and in some other countries, the time is shifted forward by one hour during the summer months. This is an effort to conserve energy by making the daylight last longer into the evening hours. If this option is set to Yes, the time on the X-300™ will automatically be shifted forward by one hour at 12:02 AM (00:02) on the **Daylight Savings Start** date set below, and it will shift back to standard time at 12:02 AM (00:02) on the **Daylight Savings End** date set below.

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

10. Daylight Savings Start:

This is the date that daylight savings will start. Note that on this date, at 12:02 AM (00:02) the current time will be shifted forward by one hour (Time will jump from 12:02 AM to 1:02 AM). By default this is set to the *2nd Sunday in March* which is the date used in the United States.

11. Daylight Savings End:

This is the date that daylight savings will end. Note that on this date, at 12:02 AM (00:02) the current time will be shifted backward by one hour (Time will jump from 12:02 AM to 11:02 PM the day before). By default this is set to the *1st Sunday in November* which is the date used in the United States.

2.4.6 Logging Tab

The X-300™ can be configured to record data such as temperatures and changes in relay state. This can be useful for calculating efficiencies of heating/cooling systems, tracking trends, etc. The logged data is stored in internal non-volatile memory and can be retrieved by entering the command `http://192.168.1.2/log.txt`. The X-300™ can be configured to log on a periodic basis, on events, a temperature delta, or all of the above. For more information on logging, see Appendix D.

The screenshot shows the 'X-300 Setup' web page in a Mozilla Firefox browser window. The address bar shows `http://192.168.1.2/setup.html`. The page has a navigation bar with the following tabs: Main, Network, Advanced Network, Password, Date/Time, **Logging**, Thermostat Setup, 7-Day Program, and Thermostat View. The 'Logging' tab is active, displaying the following configuration options:

- Logging Enabled:** Yes ☐ No ☒
- Start Time:** 01 : 00
- Logging Rate:** 60 Mins ☒ Hours ☐ Days ☐ Event Logging Only ☐
- Sensor Trigger Delta:** 2.0 °F
- Logging Configuration:**

	Log	Event Trigger
Set Temp	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sensor 1/Indoor Air	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sensor 2/Outdoor	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Relay 1/Heat	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Relay 2/Cool	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Relay 3/Fan	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- Next Log Time:** Disabled

At the bottom of the form are 'Submit' and 'Reset' buttons. The browser's status bar at the bottom shows 'Done'.

Figure 2.25 – Logging Tab

1. **Logging Enabled:**

When this option is set to Yes, the X-300™ will record data as configured on this page. Note that this option controls data logging but not system logging. System logging is always enabled. The default setting for this option is No.

2. **Start Time:**

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

3. **Logging Rate:**

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

4. **Sensor Trigger Delta:**

The X-300™ can be configured to log data when the temperature measured by a sensor changes by the amount specified in this field. This can be set from 1.0 to 9.9 degrees in 0.1 degree increments and 10 to 24 degrees in 1 degree increments. The default setting for this field is 2.0 degrees.

5. Logging Configuration:

This table is used to select which sensors and relays get logged, and which events trigger the logging. The table contains a column with a list of the sensors and relays available, a column to select what gets logged, and a column to select which sensor/relay changes will trigger the logging.

When relays are selected as an event trigger, logging will occur whenever the selected relay is turned on or off. When sensors are selected as an event trigger, logging will occur whenever the temperature on the selected sensor changes by the **Sensor Trigger Delta** value.

In Thermostat Mode the following Log/Event trigger options are available...

Set Temp
Sensor1/Indoor Air
Sensor2/Outdoor
Relay1/Heat
Relay2/Cool
Relay3/Fan

In Temperature Monitor mode the following Log/Event trigger options are available...

Sensor1
Sensor2
Sensor3
Sensor4
Sensor5
Sensor6
Sensor7
Sensor8
Relay1
Relay2
Relay3

6. Next Log Time:

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

2.5 Thermostat Setup Pages

The following setup pages are only available when *Thermostat* mode is selected on the **Main** tab.

2.5.1 Thermostat Setup Tab

This tab is used to set up the thermostat functionality.

The screenshot shows a web browser window titled "X-300 Setup" with the address bar displaying "http://192.168.1.2/setup.html". The page features the "daq data acquisition series 3" logo and the "X-300" model name. A navigation bar includes tabs: Main, Network, Advanced Network, Password, Date/Time, Logging, **Thermostat Setup**, 7-Day Program, and Thermostat View. The "Thermostat Setup" tab is active, showing a form with the following fields:

- Main Header Text:** X-300
- Indoor Air Sensor:** 28B4BDA001000064
- Outdoor Sensor:** 0000000000000000
- Refresh Lists:** Button
- Min Cycle Time:** 4 Minutes
- Max Set Temp:** 95.0 °F
- Min Set Temp:** 45.0 °F
- Heat Anticipation:** 0.0 °F
- Cool Anticipation:** 0.0 °F
- Fan On With Heat:** Yes ☐ No ☒
- Notification Email:** On ☐ Off ☒
- High Temp Email:** 99.0 °F
- Low Temp Email:** 5.0 °F
- Filter Change Period:** 60 Days

At the bottom of the form are "Submit" and "Reset" buttons.

Figure 2.26 – Thermostat Setup Tab

1. **Main Header Text:**

The text entered here will be displayed as the header and the title of the **Thermostat View** page. In addition, when email alerts are enabled this text is included in email messages. This text can be up to 40 characters in length. The default text in this field is X-300.

Notes about the temperature sensors

When the X-300™ is installed for use as a thermostat, one or two temperature sensors may be connected. If one sensor is used, it must be mounted in a position where it can accurately measure indoor air temperature. If two sensors are used, one sensor is used for measuring indoor air temperature, and the other for measuring outdoor temperature. The outdoor temperature is displayed for convenience in the **Thermostat View** page.

The following fields are used to identify the location for each of the the sensors. Each sensor has a unique serial number. When sensors are connected to the X-300™, the X-300™ discovers the sensors and lists the serial number for each sensor in the drop down lists below. Select the appropriate sensor for each of the two locations. The typical approach to identifying sensors is as follows. Connect only one sensor. Press the Refresh Lists button to update the drop-down lists. Select the sensor in the appropriate drop-down list. Connect the second sensor. Press the Refresh Lists button. Select the sensor in the appropriate drop-down list. Repeat for the remaining sensor(s).

2. Indoor Air Sensor:

This field is used to identify the indoor air temperature sensor. This sensor is required and should be mounted in a location where it can accurately measure the indoor air temperature.

3. Outdoor Sensor:

This field is used to identify the outdoor sensor. This sensor is used to display outdoor temperature on the **Thermostat View** page. This sensor is optional.

4. Refresh Lists:

When this button is pressed, the X-300™ will re-scan the bus and update the sensor drop-down lists. Any sensors that were added or removed from the bus since the last scan will be added or removed from the drop-down lists.

5. Min Cycle Time:

The time specified in this field (in minutes) is the minimum time that the HVAC system can run or stop. This prevents HVAC run/stop times from being too short. This field can be set within the range of 2 to 15 minutes. Default is 4 minutes.

6. Max Set Temp:

This is the maximum temperature that can be set by the user in the **Thermostat View** page. This can be set between 48 and 127 degrees Fahrenheit. The default value is 95 degrees Fahrenheit.

7. Min Set Temp:

This is the minimum temperature that can be set by the user in the **Thermostat View** page. This can be set between 32 and 124 degrees Fahrenheit. The default value is 45 degrees Fahrenheit. The **Min Set Temp** must always be set to at least 3 degrees lower than the **Max Set Temp**.

8. Heat Anticipation:

When a heating system heats a building, the temperature rises until it reaches the desired temperature and the thermostat shuts off the heat. Due to thermal inertia, the temperature will continue to rise and over-shoot the set temperature after the heat is turned off. The X-300™ can be set to anticipate the overshoot and turn off the heat slightly before the set temperature is reached to reduce the over-shoot. The X-300™ will turn off the call for heat at the set temperature minus the value entered in this field. This value can range from 0 to 20. Default value is 0 (no anticipation).

9. Cool Anticipation:

This works similar to heat anticipation. The X-300™ will turn off the call for cool at the set temperature plus the value entered in this field. This value can range from 0 to 20. Default value is 0 (no anticipation).

10. Fan On With Heat:

Many heating systems will automatically turn on the fan as they heat. Some systems require that the thermostat turn on the fan when it turns on the heat.

Yes – Thermostat turns on the fan when it turns on the heat.

No – Thermostat does not turn on the fan when it turns on the heat (this is the correct setting for most systems). Default setting is *No*.

11. Notification Email:

When this option is set to On, the X-300™ will send email messages to the email recipients listed under the **Network** tab whenever the indoor air temperature exceeds the **High Temp Email** setting, falls below the **Low Temp Email** setting, or when the **Filter Change Period** reaches 0 days. The default setting for this field is *Off*.

12. High Temp Email:

This is the high temperature threshold for sending email messages. When the indoor air temperature reaches this value, notification email messages will be sent if email is properly set up and **Notification Email** setting is set to Yes. The default value for this field is 99.0 degrees Fahrenheit.

13. Low Temp Email:

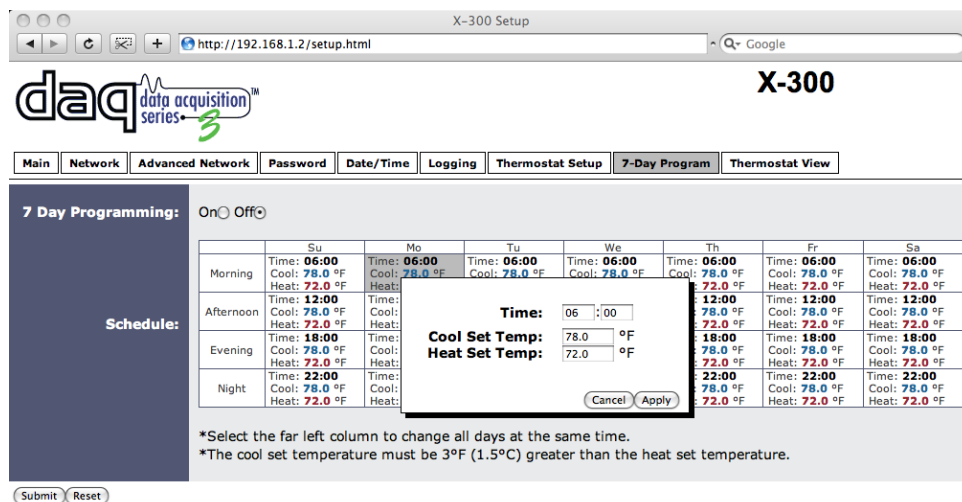
This is the low temperature threshold for sending email messages. When the indoor air temperature falls below this value, notification email messages will be sent if email is properly set up and **Notification Email** settings is set to Yes. The default value for this field is 5.0 degrees Fahrenheit.

14. Filter Change Period:

The X-300™ provides a reminder to change HVAC system filters. The number of days between filter changes is entered here. When this page is submitted, a counter will be set with this value. Each day, the counter will decrement by one. When the counter gets to zero, a filter change notice will appear on the **Thermostat View** page and an email message will be sent (if enabled). Once the filter change period expires, the user can reset the counter on the **Thermostat View** page. Note that each time this page is submitted, the filter change period will be set to the value in this field. The default value for this field is 60 days.

2.5.2 7-Day Program Tab

This tab allows for the setup of a 7-day thermostat program. Here the unit can be programmed to change the set thermostat temperature at specified times during the day and week.



7 Day Programming: On ☐ Off ☐

	Su	Mo	Tu	We	Th	Fr	Sa
Morning	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 06:00 Cool: 78.0 °F Heat: 72.0 °F
Afternoon	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 12:00 Cool: 78.0 °F Heat: 72.0 °F
Evening	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 18:00 Cool: 78.0 °F Heat: 72.0 °F
Night	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F	Time: 22:00 Cool: 78.0 °F Heat: 72.0 °F

Schedule:

Time: 06:00
Cool Set Temp: 78.0 °F
Heat Set Temp: 72.0 °F

Cancel Apply

*Select the far left column to change all days at the same time.
*The cool set temperature must be 3°F (1.5°C) greater than the heat set temperature.

Submit Reset

Figure 2.27 – 7-Day Program Tab

1. 7-Day Programming:

Enables or Disables the set program.

2. Schedule:

This field is used to specify the seven day temperature schedule. Temperatures can be set to change up to four times each day. Note that for each set time, two temperatures (a heat temperature and a cool temperature) can be specified. When the X-300™ is operating in Heat mode, the listed **Heat** set temperature will be used. When the X-300™ is operating in cool mode, the listed **Cool** set temperature will be used. When the X-300™ is operating in automatic mode, it will use the listed **Heat** set temp whenever it heats the building and the listed **Cool** set temp whenever it cools the building. See Section 3.1

(Browser Operation (*Thermostat* Mode)) for details on *Auto* mode. Note that the cool temperature must be set at least 3 degrees Fahrenheit (1.5 degrees Celsius) higher than the heat temperature. To change a setting, click the desired time period from the calendar. A pop up box appears (as shown). Enter the time at which this period will start (in 24 hour time) and temperatures in the option box. Note that to make a change for the entire week at a specified time period, the far left hand column may be selected. Both the option box and **7-Day Program** page must be submitted before settings will take effect.

2.6 Temperature Monitor Mode

The following pages are available only when *Temperature Monitor* mode is selected on the **Main** setup tab.

2.6.1 Sensors Tab

This tab is used to configure temperature sensors and alarms.

Figure 2.28 – Sensors Tab

1. **Sensor:**

Up to eight sensors can be connected up to the X-300™. This drop-down list selects the sensor to configure. The following fields are the same for each temperature sensor.

2. **Sensor Description:**

The text in this field appears to the left of the corresponding temperature reading on the **Control Page**. This text also appears in the email status messages when email is enabled. This field can be up to 24 characters in length. The default text in this field is *Sensor #*.

3. **Sensor Address:**

Each sensor connected to the X-300™ should be associated (or assigned) to a sensor number. This identifies the name, location, and function of the sensors. Every digital

temperature sensor comes from the factory with a unique, non-changeable address. When the **Sensors** tab is selected (or the Refresh List button is pressed), the X-300™ scans the bus for sensors. The address of the sensors that are found on the bus are listed in the drop-down list. For each sensor number (Sensor 1... Sensor 8), select the address of the appropriate sensor in the appropriate drop-down list.

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

4. **Alarm 1:**

This setting is used to set the trigger point for an alarm condition. The number field specifies the temperature at which the alarm is triggered. The High and Low radio buttons indicate whether the alarm is triggered as a high or low alarm. A high alarm is triggered when the temperature at the sensor exceeds the alarm temperature, and a low alarm is occurs when the temperature at the sensor is lower than the alarm temperature.

5. **Alarm 2:**

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

6. **Deadband:**

This option sets the deadband used when evaluating alarm conditions. Deadband prevents alarms or relays from toggling excessively when measured temperature fluctuates quickly around the set point due to normal fluctuations. For example, if the deadband is set to 1 degree, and a high alarm is to occur at 95 degrees, the dead band ensures that once the high alarm is triggered, it won't go off until the temperature return below 94 degrees ($95 - 1$). This reduces problems with small fluctuations in temperature readings triggering multiple alarms. The deadband is also used during low alarm conditions. If, for example, a low alarm is to occur at 45 degrees and the dead band is set to 1 degree, then once the low alarm is triggered, it won't go off until the temperature returns higher than 46 degrees ($45 + 1$). Figure 2.29 illustrates the use of deadband in high, low, and normal conditions. The default for this field is 0.5 degrees Fahrenheit.

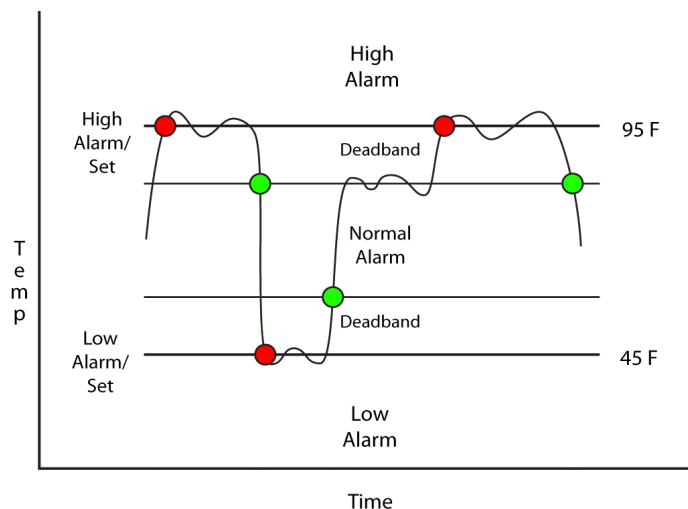


Figure 2.29 – Deadband Illustration

7. Email Option:

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

- No Email Messages: No email messages will be sent due to alarm conditions.
- Send Email on Alarm 1: Email notifications will be sent due to **Alarm 1** conditions.
- Send Email on Alarm 2: Email notifications will be sent due to **Alarm 2** conditions.
- Send Email on Alarm 1 and Alarm 2: Email notifications will be sent due to **Alarm 1** or **Alarm 2** conditions.
- Send Email on Alarm 1, Alarm 2, and Normal: Email notifications will be sent due to **Alarm 1**, **Alarm 2**, or when Normal conditions are regained.

8. Use Email Address:

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

9. Relay 1 Action:

This field is used to set the action Relay 1 takes due to an alarm condition. The first drop down box specifies the action. The following Actions are available:

- No Action: No action is taken by the relay.
- Turn On: Turns the relay on due to an alarm condition. The relay will turn off when alarm conditions are no longer met.
- Turn Off: Turns the relay off due to an alarm condition. The relay will turn on when alarm conditions are no longer met.
- Pulse: Pulses the relay for a specified amount of time due to an alarm condition.
- Latch On: Turns on the relay due to an alarm condition. Once the relay is on it will stay on (unaffected by alarm conditions) until it is turned off via the web by a user or the X-300™ is powered off. This option is useful for alarming functions.
- Latch Off: Turns off the relay due to an alarm condition. Once the relay is off it will stay off (unaffected by alarm conditions) until it is turned on via the web by a user or the X-300™ is powered off. This option is useful for alarming functions.

The second drop down box specifies the conditions that will cause the action previously specified. The following alarm conditions are available:

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

10. Relay 2 Action:

This field is identical to **Relay 1 Action** except it controls relay 2.

11. Relay 3 Action:

This field is identical to **Relay 1 Action** except it controls relay 3.

12. Remote Relay 1 Action:

The X-300™ can be configured to control relays in other ControlByWeb™ products that are located at a remote location on the network (see Section 2.6.2 for more information). The same actions for local relays also apply to remotely controlled relays. This field determines the action taken by Remote Relay 1 due to an alarm condition. The following actions are available:

- No Action: No action is taken by the relay.
- Turn On: Turns the relay on due to an alarm condition. The relay will turn off when alarm conditions are no longer met.
- Turn Off: Turns the relay off due to an alarm condition. The relay will turn on when alarm conditions are no longer met.
- Pulse: Pulses the relay for a specified amount of time due to an alarm condition.
- Latch On: Turns on the relay due to an alarm condition. Once the relay is on it will stay on (unaffected by alarm conditions) until it is turned off via the web by a user or the X-300™ is powered off. This option is useful for alarming functions.
- Latch Off: Turns off the relay due to an alarm condition. Once the relay is off it will stay off (unaffected by alarm conditions) until it is turned on via the web by a user or the X-300™ is powered off. This option is useful for alarming functions.

The second drop down box specifies the conditions that will cause the action previously specified.

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

13. **Remote Relay 2 Action:**

This field is identical to **Remote Relay 1 Action** except it controls remote relay 2.

14. **Remote Relay 3 Action:**

This field is identical to **Remote Relay 1 Action** except it controls remote relay 3.

15. **Remote Service/SNMP:**

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

- No Action: No action is taken.
- Send State Msg/Trap: An event string will be sent to the remote server. For more information regarding the event string or other commands, see Appendix E: Remote Services Commands and Events.

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

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

2.6.2 Relays Tab

This page provides configuration options for the three relays built into the X-300™, and up to three remote relays across the network. The remote relays can be any ControlByWeb™ product that has relays.

1. **Relay:**

This field selects the relay for which the options below will apply.

- Relay 1, Relay 2, or Relay 3: Selects the built-in relays.
- Remote Relay 1, Remote Relay 2, or Remote Relay 3: Selects remote relays.

The following screen appears when one of the internal relays is selected (See Figure 2.30).

Figure 2.30 – Relays Tab (Local Relay)

2. **Relay Description:**

This text field is used to describe the function of the selected relay. The text appears to the left of the corresponding relay status on the **Control Page**. This text will also appear in email messages when email alerts are enabled. This field may be up to 30 characters long. The default text is *Relay #*.

3. **On Button Label:**

The text in this field appears in the 'ON' button for the corresponding relay on the **Control Page**. This field may be up to 15 characters long. The default text is *ON*.

4. **Off Button Label:**

The text in this field appears in the 'OFF' button for the corresponding relay on the **Control Page**. This field may be up to 15 characters long. The default text is *OFF*.

5. **Pulse Button Label:**

The text in this field appears in the 'PULSE' button for the corresponding relay on the **Control Page**. This field may be up to 15 characters long. The default text is *PULSE*.

6. **On Status Text:**

The text in this field appears in the status field for the corresponding relay on the **Control Page** when the relay coil is energized. This field may be up to 15 characters long. The default text is *ON*.

7. **Off Status Text:**

The text in this field appears in the status field for the corresponding relay on the **Control Page** when the relay coil is not energized. This field may be up to 15 characters long. The default text is *OFF*.

8. **Pulse Time:**

When the X-300™ receives a pulse command for the relay (through the web page or the command interface), the relay will turn on for the time specified in this field and then turn off. Note that when a pulse command is sent through the command interface, the command can include a pulse time which will over-ride this value (for that pulse only). The time is specified in seconds and can range from 0.1 seconds to 86400 seconds in 0.1 second increments. Default time is 1.5 seconds.

9. Remote Service/SNMP:

When this field (Send State Msg/Trap on Relay Change) is checked, SNMP traps and/or State messages will be sent whenever the relay state changes.

The following screen appears when a Remote Relay is selected (See Figure 2.32)

This page is used to configure network settings and access to remote relays. Relay action and triggers for the remote relays are defined on the **Sensors** tab.

The screenshot shows a web browser window titled "X-300 Setup" with the address bar displaying "http://192.168.1.2/setup.html". The page features the "daq data acquisition series 3" logo and the "X-300" model name. A navigation bar includes tabs: Main, Network, Advanced Network, Password, Date/Time, Logging, Sensors, Relays, Script, Control Page Setup, and Control Page. The "Relays" tab is active, showing a configuration form for "Remote Relay 1". The form includes fields for "Remote Relay Description" (set to "Remote Relay 1"), "IP Address" (192.168.1.15), "TCP Port" (80), "Password" (masked with dots), "Relay #" (0), and "Periodic State Interval" (50 Seconds). "Submit" and "Reset" buttons are at the bottom.

Figure 2.31 – Relays Tab (Remote Relay)

10. Remote Relay Description:

This text field describes the function of the selected remote relay. This text is used for reference purposes only and may be up to 24 characters long.

11. IP Address:

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

12. TCP Port:

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

13. Password:

If the remote relay requires a password for control, the password must be entered here.

14. Relay #:

The remote relay device may have multiple relays. This field is used to identify the specific relay to be controlled on the remote device. If the remote device is a single WebRelay™, this field should be set to zero. If the remote device has multiple relays, this field should be set to the relay number. For example, if relay 2 is to be controlled on another ControlByWeb™ product, the **Relay #** would be set to 2. This field may be set from 0 to 255.

10. Periodic State Interval:

When the X-300™ is configured to control a remote device, a connection is established. If the device does not receive a message for 50 seconds the connection is terminated. In order for the connection to be maintained, a message containing the state of the relay can be sent at a periodic interval. This field sets the time interval at which the message is sent. The default setting is 50 seconds, thus just maintaining the connection. If the connection should not be maintained enter a value of 0. This field may be set to 0 or 10 to 50 seconds.

2.6.3 Script

The X-300™ can be used to run simple custom programs written in a language similar to BASIC. This page is used to load, and execute these programs. Before loading a script to the X-300™, it must first be written as a .txt file. The file must then be uploaded to the X-300™. The maximum size of script that can be uploaded to the device is 2K bytes. Notes on writing a basic program for the X-300™ can be found in Appendix F.

Figure 2.32 – Script Tab

1. **BASIC Script:**

This field displays the .txt file that is uploaded to the X-300™. Text displayed in this screen cannot be edited. In order to edit any script, it must be rewritten in the .txt file and uploaded again to the unit.

2. **Interpreter Status:**

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

3. **Upload BASIC Script:**

This field displays the script selected to be uploaded to the device. To upload a script to the X-300™ click the 'Browse' button, find the .txt file previously written, and select Open. The location of the file should appear in the neighboring field. To upload the script to the unit select Submit.

4. **Run Script:**

This option selects whether or not the selected script will be run after it has been uploaded.

2.6.4 Control Page Setup

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

	Display Temperature/State	Display On/Off Buttons	Display Pulse Button
Sensor1	<input checked="" type="checkbox"/>		
Sensor2	<input checked="" type="checkbox"/>		
Sensor3	<input checked="" type="checkbox"/>		
Sensor4	<input checked="" type="checkbox"/>		
Sensor5	<input checked="" type="checkbox"/>		
Sensor6	<input checked="" type="checkbox"/>		
Sensor7	<input checked="" type="checkbox"/>		
Sensor8	<input checked="" type="checkbox"/>		
Relay1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Relay2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Relay3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 2.33 – Control Page Setup

1. Main Header Text:

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

2. Auto Refresh Page:

Web pages traditionally display static information. The X-300™ **Control Page**, however, displays information that is dynamic. Each time the **Control Page** is loaded to the browser, it displays a snapshot of the current status of the unit. Whenever the state of a sensor changes, the **Control Page** will be obsolete until the page is refreshed. The X-300™ cannot force the web page to be updated when the sensors update. The Auto Refresh Page option will cause the **Control Page** to continually update its contents by setting a timer in the web page that causes it to be reloaded at a specified time interval.

3. Refresh Rate:

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

4. Display Configuration:

This field sets the options that are displayed on the **Control Page**.

-Display Temperature/State: For Sensors 1 through 8 this controls whether the temperature for the specified sensor is displayed. For Relays 1 through 3 this controls whether the state of the relay is displayed.

-Display On/Off Button: When checked, an ON/OFF button is displayed on the **Control Page** for direct user control.

-Display Pulse Button: When checked, a button allowing a user to manually pulse a specified relay is displayed.

Section 3: Operation

Once the X-300™ is set up, users can access the **Control Page** using a web browser. Alternatively, custom applications can be written or third-party software can be used to access and control the X-300™ through its XML interface, using SNMP, or using Modbus/TCP. The **Control Page** is accessed by typing the IP address of the X-300™ into the web browser URL line. For example, using the default IP address, the user would enter; <http://192.168.1.2>. If the IP address is changed from the default, the user must use the new IP address. Note that if any port is used other than 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>.

3.1 Browser Operation (Thermostat Mode)

When the X-300™ is set to Thermostat Mode, the Control Page appears as a high-end digital thermostat. Using this virtual thermostat is very simple. Users must select the operating mode (Heat, Cool, or Auto) and select the desired temperature. Other features are optional. A screen shot of the thermostat Control Page is shown below and a description of the page follows.

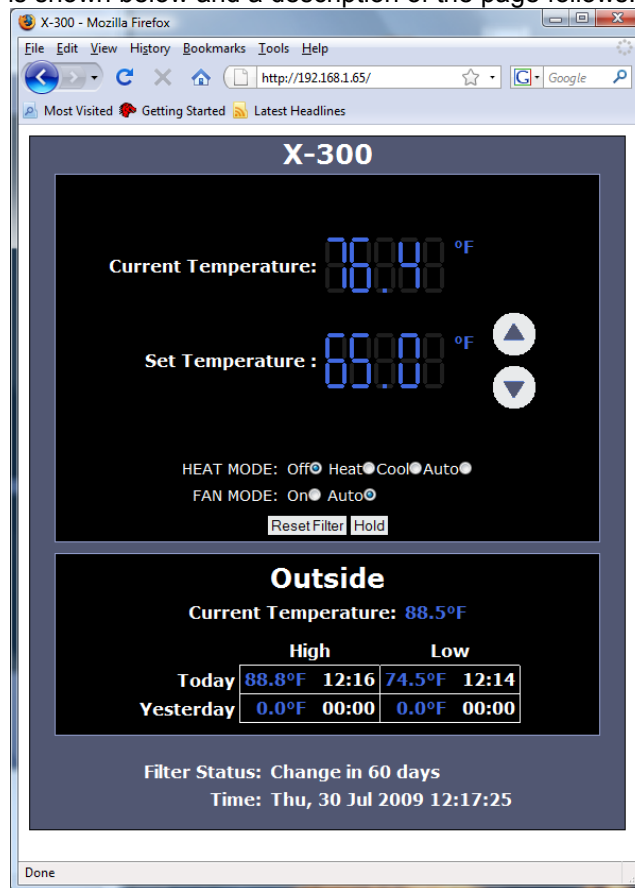


Figure 3.1 – Thermostat Control Page

-The top of the window contains the header text that is entered in the **Main Header Text** field under the **Thermostat Setup** tab in the setup pages.

-**Thermostat status** line. The status line is directly below the **Main Header Text**. This line contains the current state of the thermostat. State is indicated by text that pops up as appropriate. The following indicators may appear on this line.

- HEAT: ON - This indicates that the heat relay is currently on.
- COOL: ON - This indicates that the cool relay is currently on.
- FAN: ON - This indicates that the fan relay is currently on.

7-DAY – This appears when the 7-day programming is enabled
HOLD - This indicates that the thermostat is currently in hold mode (see description of HOLD mode below).
SYNCING - Whenever the set temperature is changed, the new value must be submitted to the X-300™. The value is also returned to the browser to confirm proper setting. During this data transfer process, the text 'SYNCING' appears in the status line.
COMMUNICATIONS ERROR - This indicates that the browser cannot read data from the X-300. This message will automatically disappear when communications are restored (see Figure 3.2 below).

-**Current Temperature:** This indicates the current indoor temperature. If a sensor has not been assigned or the unit cannot communicate with the sensor (but the browser is able to communicate with the X-300™), the temperature will display '-.-'.

-**Set Temperature:** This indicates the desired temperature. The X-300™ will enable heating or cooling until the current temperature equals this temperature. The set temperature can be changed by the user using the up and down arrows located to the right of the set temperature or the set temperature can be changed using the seven-day scheduling.

-**Heat Mode:** These radio buttons set the mode of the X-300™. The three options are described below.

Cool: This mode is used to enable the cooling system. When in this mode, the X-300™ will turn on the cooling system whenever the current temperature is warmer than the set temperature.

Heat: This mode is used to enable the heating system. When in this mode, the X-300™ will turn on the heating system whenever the current temperature is colder than the set temperature.

Auto: In this mode the X-300™ will automatically switch between heating and cooling when necessary to achieve the desired temperature. Auto works as follows...

When the seven day schedule is enabled (and HOLD is not on):

The X-300™ will enable the heating system when the current temperature is below the **Heat** temperature specified for the current time in the seven day schedule. The X-300™ will enable the cooling system when the current temperature is above the **Cool** temperature specified for the current time in the seven day schedule. When the current temperature is between the **Heat** and **Cool** temperatures, the X-300™ will determine if heating or cooling is necessary, based upon recent history.

When the user manually sets the temperature:

The X-300™ will try to hold the temperature at the user set temperature by enabling the heating system or the cooling system as appropriate. Note that to avoid turning on the cooling system when the heating system overshoots (and turning on the heating system when the cooling system overshoots), the X-300™ implements a deadband zone of 3 degrees Fahrenheit.

Note that to prevent alternately switching between heating and cooling due to overshoot, the X-300 implements a deadband zone which requires the temperature to move a minimum of three degrees Fahrenheit away from the set temperature before the mode can change.

Off: This mode disables heating and cooling.

- Fan Mode:** These radio buttons set the fan mode. When the fan mode is set to On, the fan will be on no matter what the current heat/cool/fan state is. When the fan mode is set to Auto, the fan will be turned on only when required for heating or cooling.
- Reset Filter:** When the change filter indicator (see below) is displayed, the user should change the filter. After changing the filter, the user should press this button to reset the filter timer. The filter timer can only be reset when the change filter indicator is displayed.
- Hold:** When the seven-day scheduling feature is enabled, the set temperature will change as according to the preset schedule. This button is used to put the scheduling on hold which temporarily disables the scheduling feature and holds the set temperature at value displayed. When the scheduling is on hold, the word 'HOLD' will appear in the status line at the top of the window. Scheduling is re-enabled by pressing this button once again.

THE FOLLOWING SECTION APPEARS ONLY WHEN THE OUTSIDE TEMPERATURE SENSOR IS CONNECTED.

- Current Temperature:** This is the current outdoor temperature.
- High/Low Temperatures:** The X-300™ tracks the high and low outside temperatures for the current day and yesterday. These temperatures for both days and the times that the temperatures were recorded are displayed in a table.

THE FOLLOWING TWO FIELDS APPEAR AT THE BOTTOM OF THE WINDOW.

- Filter Status:** This field indicates the number of days until the user should change filters in the HVAC system. When the filter timer expires, the text "CHANGE FILTER" appears. The number of days until filter change is set under the **Thermostat Setup** tab in the setup pages.
- Current Date and Time:** The current time and date are displayed here. The time and date are set under the **Date/Time** tab in the setup pages.

The information on this **Thermostat View** page is displayed in real-time and is refreshed every three seconds. If the browser loses communication with the X-300™, data values will not be displayed. When data is displayed, users can trust that it is current and accurate. The figure below shows the display when communications are lost. Notice that all fields are cleared.

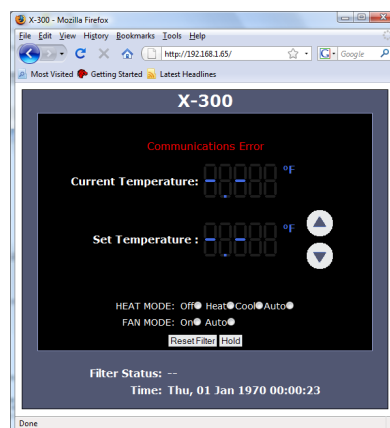


Figure 3.2 – Communications Error Message

3.3 Browser Operation (Temperature Monitor Mode)

When the X-300™ is set to *Temperature Monitor* mode, the **Control Page** appears differently than it does when the X-300™ is set in *Thermostat* mode. A **Control Page** with default settings is shown below.

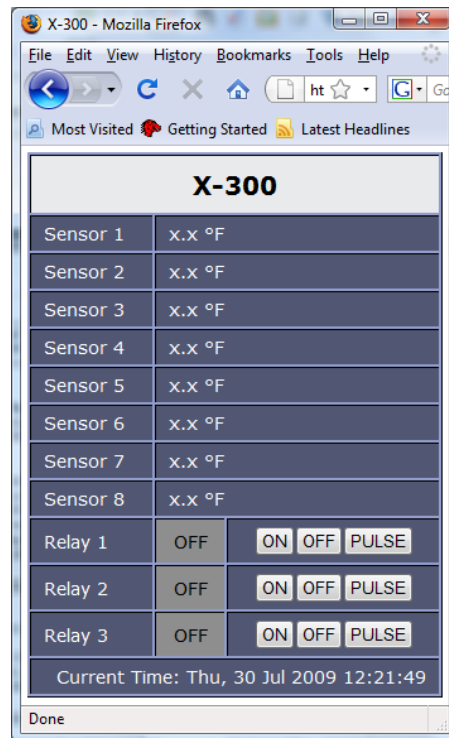


Figure 3.3 – Temperature Monitor Control Page

- The header displays the **Main Header Text** field under the **Control Page Setup** tab in the setup pages.
- Sensor 1 to Sensor 8: These rows display the current temperatures measured by the associated sensors. Each of these rows can be displayed (as shown) or not displayed by checking or unchecking the appropriate boxes under the Control Page Setup tab in the setup pages. The text in the left column (by default reads Sensor 1 through Sensor 8), is specified in the **Sensor Description** field under the **Sensors** tab in the setup pages. Note that if sensors are not configured (sensor addresses selected for each sensor) or are unreadable, the display will read 'x.x' rather than displaying a false numerical value.
- Relay 1 to Relay 3: These rows display the current relay state and allow users to change the relay state. Each of these rows can be displayed (as shown) or not displayed by checking or unchecking the appropriate boxes under the Control Page Setup tab in the setup pages. The text in the left column (by default reads Relay 1, Relay 2, and Relay 3) is specified in the **Relay Description** field under the **Relays** tab in the setup pages. The state of the relays is shown to the right of the relay description text. By default, the status text will read ON or OFF however the status text can be changed under the **Relays** tab. To the right of the relay status, buttons are provided to control the relays. The buttons can be removed when appropriate (under the **Control Page Setup** tab) and the text within the buttons can be customized (under the **Relays** tab).

3.4 XML Operation

Custom computer applications may be created to monitor and control the X-300™ without using a web browser. Monitoring the state of the device is done by sending an HTTP GET request for the file state.xml. This file returns the current status of the device and is different depending on the current mode of the device. The device can also be controlled by passing parameters along with the request for the file state.xml similarly to how an HTML form would send name/value pairs to a server when the submit button is pressed. This can be demonstrated by entering commands into the URL line of a web browser.

To simply request the state of the device, enter: `http://192.168.1.2/state.xml`

To set the set temperature of the device, enter: `http://192.168.1.2/state.xml?setTemp=75.0`

To set the set temperature of the device and turn the fan on, enter:

`http://192.168.1.2/state.xml?setTemp=75.0&fanMode=0`

To turn the first relay on, enter: `http://192.168.1.2/state.xml?relay1State=1`

In response to each request, an XML file will be returned with the current state of the device. The format of the XML file will differ depending on the mode of the X-300™ (Thermostat or Temperature Monitor). Also, some parameters only work in Thermostat mode while others only work in Temperature Monitor mode.

3.4.1 Thermostat Mode

Entering the above address in Thermostat mode will return the following XML page:

```
<datavalues>
  <units>F</units>
  <indoorTemp>x.x</indoorTemp>
  <outdoorTemp>x.x</outdoorTemp>
  <setTemp>65</setTemp>
  <heat>0</heat>
  <cool>0</cool>
  <fan>0</fan>
  <hold>00</hold>
  <minTemp>00:00 300.0</minTemp>
  <maxTemp>00:00 -300.0</maxTemp>
  <minTempY>00:00 0.0</minTempY>
  <maxTempY>00:00 0.0</maxTempY>
  <heatMode>0</heatMode>
  <fanMode>1</fanMode>
  <filtChng>60</filtChng>
  <maxSTemp>85.0</maxSTemp>
  <minSTemp>65.0</minSTemp>
  <mode>6</mode>
  <time>1235406753</time>
  <serialNumber>00:0C:00:00:00:00</serialNumber>
</datavalues>
```

The tags <units>, <indoorTemp>, <wallTemp>, <outdoorTemp>, <setTemp>, <heat>, <cool>, <fan>, <hold>, <minTemp>, <maxTemp>, <heatMode>, <fanMode>, <filtChng>, <maxSTemp>, <minSTemp>, <mode>, and <time> indicate the current state of the X-300™ unit. Values for each are described below.

<units>	F (Degrees Fahrenheit)
	C (Degrees Celsius)

<indoorTemp>	x.x (indicates that no digital temperature sensor is associated with the indoor temperature sensor) 80.1 (temperature reading from digital temperature sensor associated with the indoor temperature sensor)
<outdoorTemp>	x.x (indicates that no digital temperature sensor is associated with the outdoor temperature sensor) 80.1 (temperature reading from digital temperature sensor associated with the outdoor temperature sensor)
<setTemp>	65 (indicates the set temperature)
<heat>	Indicates whether the heat relay is energized (0 = off, 1 = on).
<cool>	Indicates whether cool relay is energized (0 = off, 1 = on)
<fan>	Indicates whether fan relay is energized (0 = off, 1 = on)
<hold>	Indicates whether the <u>Hold</u> or 7-day program is enabled. The first number shows whether hold is enabled and the second number indicates whether the 7-day programming is enabled. (00 = both hold and 7-day program are disabled, 01 = hold is disabled; 7-day program is enabled, 11 = both hold and 7-day program are enabled, 10 = hold is enabled, 7-day program is disabled)
<minTemp>	12:48 80.1 (indicates minimum 24 hour temperature reading [time temp])
<maxTemp>	12:48 80.1 (indicates maximum 24 hour temperature reading [time temp])
<minTempY>	80.1 (indicates minimum temperature reading for yesterday [time temp])
<maxTempY>	80.1 (indicates maximum temperature reading for yesterday [time temp])
<heatMode>	Indicates current HEAT MODE (0 = off, 1 = heat only, 2 = cool only, 3 = auto)
<fanMode>	Indicates current FAN MODE (0 = on, 1 = auto)
<filtChng>	60 (indicates number of days until filter should be changed)
<maxSTemp>	85 (indicates maximum allowable set temperature)
<minSTemp>	65 (displays minimum allowable set temperature)
<mode>	Indicates current Mode (6 = <u>Thermostat</u> mode, 7 = <u>Temperature Monitor</u> mode)
<time>	1235406753 = time displayed in "epoch time" (number of seconds since January 1, 1970)
<serialNumber>	00:0C:00:00:00:00 Serial Number (MAC address) of X-300

In Thermostat mode there are five parameters that can be sent to the X-300™ to control it. The current set temperature, heat mode, fan mode, hold state, and filter change counter can all be set/configured through the use of HTTP GET requests for the file state.xml.

The supported parameters are:

1. setTemp

Set the set temperature. Valid range must be within the min and max set temp values.

Example: <http://192.168.1.2/state.xml?setTemp=75.0>

2. heatMode

Set the heat mode of the X-300™. Possible values are:

- 0 – off
- 1 – heat
- 2 – cool
- 3 – auto

Example: `http://192.168.1.2/state.xml?heatMode=1`

3. hold

Hold the current set temperature. Essentially toggles the 7 day programming on/off.

Possible values are:

- 1 - toggle hold state

Example: `http://192.168.1.2/state.xml?hold=1`

4. fanMode

Change the fan mode. Possible values are:

- 0 - Fan always on
- 1 - Fan works automatically

Example: `http://192.168.1.2/state.xml?fanMode=1`

5. rstFilt

Reset the filter counter to the filter change interval in the setup pages. Possible values are:

- 1 – reset

Example: `http://192.168.1.2/state.xml?rstFilt=1`

Note: This parameter will only reset the filter counter once the counter has reached zero.

These parameters can be sent individually or chained together in one request. The previous parameters, for example, could all be sent in one request as follows:

`http://192.168.1.2/state.xml?setTemp=75&heatMode=1&fanMode=1&hold=1`

Note that when commands are sent to the X-300™, its current state is returned in the form of an XML page. The command can also be sent without having the X-300™ return the XML page. This is accomplished by adding the `noReply` parameter as follows:

`http://192.168.1.2/state.xml?setTemp=75&noReply=1`

Password :

If the control password is enabled in the temperature module and the XML page is requested through a browser, the browser will prompt the user for the password. If the XML request is sent from another application and not a browser, the HTML request will need to contain the password encoded using the base 64 encoding scheme. The HTML request header without the password looks like this:

`GET /state.xml?noReply=1 HTTP/1.1` (Ends with two `\r\n`)

The HTML request header with the password looks like this:

`GET /state.xml?relayState=1&noReply=1 HTTP/1.1` (Ends with one `\r\n`)

`Authorization: Basic bm9uZTp3ZWJyZWxheQ==` (Ends with two `\r\n`)

Where `bm9uZTp3ZWJyZWxheQ==` is the base 64 encoded version of the user name and password `none:webrelay`

A utility is provided at <http://www.ControlByWeb.com/encoder> that can be used to encode the password. The utility is used by simply typing the string username:password into the website and pressing encode.

3.4.2 Temperature Monitor Mode

To request the current state enter:

<http://192.168.1.2/state.xml>

In Temperature Monitor mode the following XML page will be returned:

```
-<datavalues>
  <units>F</units>
  <sensor1temp>x.x</sensor1temp>
  <sensor2temp>x.x</sensor2temp>
  <sensor3temp>x.x</sensor3temp>
  <sensor4temp>x.x</sensor4temp>
  <sensor5temp>x.x</sensor5temp>
  <sensor6temp>x.x</sensor6temp>
  <sensor7temp>x.x</sensor7temp>
  <sensor8temp>x.x</sensor8temp>
  <relay1state>0</relay1state>
  <relay2state>0</relay2state>
  <relay3state>0</relay3state>
  <mode>7</mode>
</datavalues>
```

The tags <units> , <sensorXtemp> , <relayXstate> , and <mode> indicate the current state of the X-300™ unit. Values for each tag are described below.

<units>	F (Degrees Fahrenheit) C (Degrees Celsius)
<sensorXtemp>	x.x (indicates that no digital temperature sensor is associated with the sensor number) 80.1 (temperature reading from digital temperature sensor associated with the sensor number)
<relayXstate>	Indicates whether relay is energized (0 = off, 1 = on)
<mode>	Indicates current Mode (6 = <u>Thermostat</u> mode, 7 = <u>Temperature Monitor</u> mode)

In Temperature Monitor mode there are six parameters that can be sent to the device to control it. Using these parameters, the relay states can be changed.

The supported parameters are:

1. relay1State
2. relay2State
3. relay3State

Change the state of relays 1 – 3. Possible values are:

- 1 – On
- 0 – Off
- 2 – Pulse
- 5 – Toggle

Example: <http://192.168.1.2/state.xml?relay1State=1>

4. pulseTime1
5. pulseTime2
6. pulseTime3

Used to change the pulse time for a pulse command. Used in conjunction with a relayXState=2 command.

Valid range: 0.1 to 86400 seconds or 0.1 seconds to 1 day.

Example: <http://192.168.1.2/state.xml?relay1State=2&pulseTime1=5>

Note that the PulseTimeX command does not change the pulse time specified in the setup pages, nor is it stored or recorded.

Note that when commands are sent to the X-300™, its current state is returned in the form of an XML page. The command can also be sent without having the X-300™ return the XML page. This is accomplished by adding the noReply parameter as follows:

<http://192.168.1.2/state.xml?setTemp=75&noReply=1>

Password:

If the control password is enabled in the temperature module and the XML page is requested through a browser, the browser will prompt the user for the password. If the XML request is sent from another application and not a browser, the HTML request will need to contain the password encoded using the base 64 encoding scheme. The HTML request header without the password looks like this:

```
GET /state.xml?noReply=1 HTTP/1.1           (Ends with two \r\n)
```

The HTML request header with the password looks like this:

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

Where bm9uZTp3ZWJyZWxheQ== is the base 64 encoded version of the user name and password none:webrelay

A utility is provided at <http://www.ControlByWeb.com/encoder> that can be used to encode the password. The utility is used by simply typing the string username:password into the website and pressing encode.

3.4.3 XML Diagnostics

There is a special XML page that can be requested for diagnostic purposes called diagnostics.xml. A request for this file returns the following:

```
<datavalues>
  <internalTemp>76.6</internalTemp>
  <vin>15.0</vin>
  <fiveVolt>5.0</fiveVolt>
  <memoryPowerUpFlag>1</memoryPowerUpFlag>
  <devicePowerUpFlag>1</devicePowerUpFlag>
  <powerLossCounter>1</powerLossCounter>
</datavalues>
```

The tags <internalTemp>, <vin>, <fiveVolt>, <memoryPowerUpFlag>, <devicePowerUpFlag>, and <powerLossCounter> are helpful parameters when trying to diagnose a problem with the X-300™.

<internalTemp> Indicates the internal temperature of the device

<vin> Indicates the DC voltage that is applied to the Vin+ and Vin- terminals.

<fiveVolt>	Indicates the 5V power supply.
<memoryPowerUpFlag>	Indicates a loss of power to the capacitor backed real time clock. This field can be set to 0. A value of 1 indicates that the real time clock lost power. This should only happen if the device has lost power for several days. There is an internal capacitor that can power the real time clock for an extended period of time even if the main power is lost. If the real time clock loses power, the time will have to be reset. By default this will read 1 until it is set to 0.
<devicePowerUpFlag>	Indicates a loss of power to the device. This field can also be set to 0. A value of 1 means the X-300™ has lost power at least one time since the flag was set to 0.
<powerLossCounter> count	A count of how many times the device has lost power. This field is a count of how many times the X-300™ has lost main power.

In both *Thermostat* mode and *Temperature Monitor* mode the devicePowerUpFlag and memoryPowerUpFlag can be cleared by requesting the file diagnostics.xml and passing parameters along with this request. For example, to clear both flags the following request can be sent to the device:

<http://192.168.1.2/diagnostics.xml?memoryPowerUpFlag=0&devicePowerUpFlag=0>

The powerLossCounter can also be cleared by using the request:

<http://192.168.1.2/diagnostics.xml?powerLossCounter=0>

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

3.5 Modbus Operation

The X-300™ can be controlled (and read) using Modbus/TCP protocol. This provides a standard means of using the temperature module in conjunction with devices and software from other manufacturers. This section contains the information necessary to communicate with the X-300™ using Modbus/TCP. This 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>.

It is important to note that when the control password in the X-300™ is enabled, Modbus/TCP communications are disabled. This is because Modbus/TCP does not provide a mechanism for password protection. Make sure the control password is disabled (default) before using Modbus with the X-300™.

The X-300™ functions as a Modbus server (slave). Client (master) devices open a connection with the temperature module on port 502 (unless another Modbus port is selected) and send commands or requests to read the state of the relays, read the current value of the temperature sensors, or change the relay states. When the X-300™ receives a command, it will perform the desired function and return a response. The following commands are available:

Read Coils (Modbus function 01 (0x01)) - read the status of the relays.
 Read Holding Registers (Modbus Function Code 03 (0x03)) – read temperature values of sensors
 Write Single Coil (Modbus function 05 (0x05)) - change one relay state
 Write Multiple Coils (Modbus Function Code 15 (0x0F)) - change one or more relay states
 Write Multiple Registers (Modbus function 16 (0x10)) - pulse the relay(s)

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. To keep the connection open, a read request can be sent periodically. Two TCP sockets are available for Modbus communications. If two masters each have a socket open (or a single master using two sockets) and a third master attempts to open a socket for Modbus communications, the request to open a third socket will be rejected.

When errors occur, an error code is sent. This code is comprised of the function code sent 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 returned when Modbus is disabled in the setup pages)

0x02 - Incorrect starting address / quantity of outputs combination

3.5.1 Read Coils (Modbus Function Code 01 (0x01))

This function returns the state of the relay coils. 0 denotes that the coil is not energized, 1 denotes that the coil is energized.

Valid Starting Address and Quantity of Coil Combinations

The following gives the starting address range of coils and the number of possible coils to read. Some examples are also shown of using the given addressing and quantities.

Starting Address: 0x00 to 0x02

Quantity: 0x01 to 0x03

Examples:

Starting address 0x00 quantity of coils 0x01 (read relay 1 state only)

Starting address 0x01 quantity of coils 0x01 (read relay 2 state only)

Starting address 0x02 quantity of coils 0x01 (read relay 3 state only)

Starting address 0x00 quantity of coils 0x02 (read relay 1 and 2 state)

Starting address 0x01 quantity of coils 0x02 (read relay 2 and 3 state)

Starting address 0x00 quantity of coils 0x03 (read relay 1, 2, and 3 state)

The response of the unit will be given in a binary value which determines the state of the relays. The following chart gives all possible responses from the unit.

Data Byte (hex)	LS Data Bits (binary)	Relay 3 State	Relay 2 State	Relay 1 State
0x00	000	off	off	off
0x01	001	off	off	on
0x02	010	off	on	off
0x03	011	off	on	on
0x04	100	on	off	off
0x05	101	on	off	on
0x06	110	on	on	off
0x07	111	on	on	on

3.5.2 Read Holding Registers (Modbus Function Code 03 (0x03))

This function is used to read the temperature values of the sensors. One, multiple, or all values can be read at the same time using this function.

Valid Starting Addresses and Quantity of Coil Combinations

Reading these registers requires that the address be in the range of 16 to 30 (0x10 and 0x1E). Also, the address must be evenly divisible by 2. In other words, only address 0x10, 0x12, 0x14, 0x16, 0x18, 0x1A, 0x1C, and 0x1E are valid. Each value is returned as two registers in IEEE 754 floating point format. The four data bytes are treated as two individual big endian 16-bit words with the least significant word being sent first. In other words, the 32 bit floating point number represented as '1234 ABCD' is sent as 'CDAB 3412'. For example, if we were to read two registers starting at address 0x10, and sensor 1 measured the temperature to be 81.25 degrees, then we would get the following value 800042A2. The least significant word would be 8000 hex and the most significant word would be 42A2. Using a conversion utility we could then convert this hexadecimal value into the temperature reading of 81.25 degrees. The following table lists the addresses that correspond to each input.

The device returns a value of 0xffffffff (NaN) if there isn't a valid reading or when the sensor isn't active.

Starting Address: 0x10 to 0x1E

Quantity: 0x02 to 0x10 (must be divisible by 2)

The following chart gives the addresses of each of the temperature sensors.

Sensor	Address
1	0x10
2	0x12
3	0x14
4	0x16
5	0x18
6	0x1A
7	0x1C
8	0x1E

3.5.3 Write Single Coil (Modbus Function Code 05 (0x05))

This command allows to change the state of a single relay coil. The valid addresses and quantities correspond to the relay coils described in section 3.5.1.

Starting Address: 0x00 to 0x02

Quantity: 0x01 to 0x03

3.5.4 Write Multiple Coils (Modbus Function Code 15 (0x0F))

This function allows you to control relays 1, 2, or 3 simultaneously using one command.

Valid starting Address and Quantity of Coil Combinations

Valid starting address can fall in the range of 0x00 and 0x02. The only restriction is that the sum of the starting address and the quantity of coils must not be greater than 0x03. For example, if you want to control two relays, then the starting address can be 0x01 or 0x00. On the other hand, you may want to control the third relay only. This can be achieved by starting at address 0x02 and using a quantity of 0x01.

Starting Address: 0x00 to 0x02

Quantity: 0x01 to 0x03

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

This is used to pulse the relays for a specified time. When the X-300™ receives this command, it immediately turns the relay coil on (if it is not on already on) and starts the pulse timer. The pulse time is specified in the register value field and the time can range from 0.1 seconds to 86400 seconds (1 day). When the pulse time expires, the relay coil will be turned off. If a pulse time command is sent with a value greater than 86400, the pulse timer will be set to 86400. If a pulse time command is sent with a value less than 0.1, the pulse timer will be set to 0.1. If any commands are sent to the X-300™ (commands may be Modbus, XML, HTML) before the pulse timer has expired, the pulse timer will be canceled immediately and the new command will be executed.

Valid Starting Addresses and Quantity of Coil Combinations

Writing to these register requires that the address be in the range of 0x16 and 0x1A. Also, the address must be evenly divisible by 2. In other words, only address 0x16, 0x18 and 0x1A are valid addresses. When the address 0x16 is used, all three relays can be sent pulse times (12 bytes), or just the first relay can be sent a pulse time (4 bytes.) If the address 0x1A is used, only relay 3 will be sent a pulse time (4 bytes.)

Note that the pulse time is provided in IEEE 754 floating point format. The four data bytes are treated as two individual big endian 16-bit words but the least significant word is sent first. In other words, the 32-byte floating point number represented as 'ABCD 1234' is sent as 'CDAB 3412'. In the example shown below, the relay will pulse for 10 seconds. Ten seconds is represented using a floating point number of 41200000. It is transferred as 00004120.

Starting Address: 0x10 to 0x12

Quantity: 0x01 to 0x03

3.6 Special Functions

3.6.1 Email Alerts

Each of the eight sensors on the X-300™ can be configured to send an email message to up to five email addresses when alarm conditions occur. The header, descriptions and temperature units are taken from the entries in the setup pages.

The message is shown below with default text settings. The text shown in bold indicates that it can be changed by the user.

X-300 - Email Notification

Email alert triggered by high alarm from **Sensor 1**: 87.0° F

Sensor 1 Current Temp: 87.4° F

Sensor 2 Current Temp: xx.x

Sensor 3 Current Temp: xx.x

Sensor 4 Current Temp: xx.x

Sensor 5 Current Temp: xx.x

Sensor 6 Current Temp: xx.x

Sensor 7 Current Temp: xx.x

Sensor 8 Current Temp: xx.x

Quite a bit of the text above is shown in bold. These items can be changed by the user using the fields described below from the setup pages.

X-300 – This text is set in the **Main Header Text** field under the **Control Page Setup** tab.

F – The units are set through the radio button field **Units** under the **Main** tab.

Sensor 1-8 – This text is set in the **Sensor Description** field for the selected sensor under the **Sensors** tab.

*Note: The email message will only contain the temperature for sensors that have the Display Temperature/State option selected under the **Control Page Setup** tab.

Email notification requires that the following fields are set. See Section 2 for a description of each field.

Network Tab:

IP Addressing

Netmask

Broadcast

Gateway

DNS Addresses (Only necessary if SMTP server is not listed as an IP address)

Mail Server (SMTP)

Port

Domain

Return Email

Email 1 Address (Email 2,3,4,5 Address are optional)

Sensor Tab:

Email Options

Use Email Address

Thermostat Setup Tab

Notification Email

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

<http://192.168.1.2/state.xml?testEmail=1>

This will cause an email message to be sent immediately. If the message doesn't get through, the system log file may have some clues to assist in diagnosing the problem (<http://192.168.1.2/syslog.txt>).

3.6.2 Alarm Conditions

Diagram 3.4 below shows a visualization a high alarm set point and a low alarm set point when one of the temperature sensors is configured to send out emails or remote messages based on the set points. When the temperature goes above the high alarm set point a high alarm occurs. This high alarm condition remains until the temperature drops below the deadband. The same is true when the temperature falls below the low alarm set point. In this situation the low alarm condition remains until the temperature rises past the deadband. Red dots indicate high and low alarms while the green dots indicate a return to the normal operating condition. Note that relays are only changed when the alarm condition changes. Users can still manually change relays using the web page.

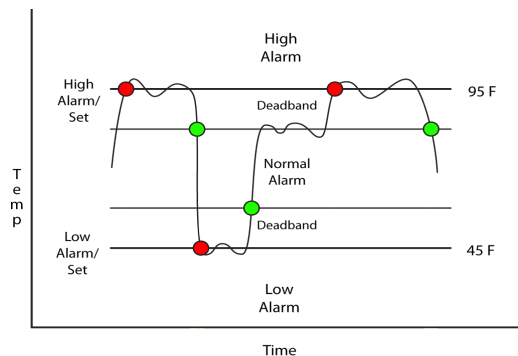


Figure 3.4 – High, Low, and Normal Alarm Diagram

Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, the X-300™ can be restored to its original factory default settings. To do this, first remove the power from the unit. Next, insert a thin object (such as a toothpick) through the small hole in the bottom of the unit to press the small button that is located inside the unit. When the object is inserted, a tactile feedback can be felt as the button is depressed. While holding the button down, apply power and wait for both the link and activity LEDs to blink together repeatedly. Release the button. Now all settings will be back to the original factory defaults. CAUTION: DO NOT USE METAL OBJECTS FOR THIS FUNCTION.



*Figure A – Reset Button Position
(illustrated using WebRelay™)*

Appendix B: Installing New Firmware

From time to time, it may be possible that updates are made to the X-300™ firmware. The X-300™ firmware can be updated in the field. The procedure for updating the firmware is outlined below. Please note that it is important this procedure is followed precisely.

Step 1:

Download the cbwProgrammer_v1.0.exe utility from the ControlByWeb.com web site (located in the x-300/downloads section, note that new versions of the software may be released on occasion so the version portion of the name may change cbwProgrammer_v1.1.exe, cbwProgrammer_v2.0.exe, etc.). Copy the utility to a known location on a computer with a Windows operating system.

(Windows is a registered trademark of Microsoft Corporation in the United States and other countries.)

Step 2:

Download the new firmware image for the X-300™ from the ControlByWeb™ web site (located in the x-300/downloads section on the web site). Note that only an X-300™ image can be installed on an X-300™ so make sure the correct image is being downloaded. Copy this image to the same directory as the cbwProgrammer utility downloaded in step 1.

Step 3:

Connect the computer to the same network as the X-300™. Note that the X-300™ will revert back to the factory default IP address of 192.168.1.2 during the update process. This procedure must be done on a network where 192.168.1.2 is not assigned to another device. Creating a small private network with only the computer and X-300™ is recommended.

Step 4:

Set the IP address of the computer to 192.168.1.10 (or another address that is available on this network between 192.168.1.3 and 192.168.1.254). For instructions on changing the IP address of the computer, see Section 2.4.2 in this manual.

Step 5:

Open the cbwProgrammer utility on the computer by double clicking on the downloaded file (Figure B).

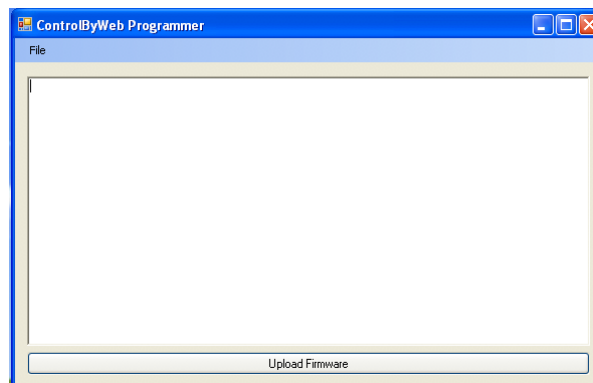


Figure B – Firmware Update Utility

Step 6:

Within the cbwProgrammer utility programmer, select File, then Open. Specify the firmware image downloaded from the ControlByWeb™ web site.

Step 7:

Carefully follow these steps.

- (a) Remove power to the X-300™.
- (b) Press and hold the reset button as described in Appendix A.
- (c) While holding the reset button, apply power to the X-300™. The Link and Act lights will flash. Continue to hold the reset button without releasing for the next step.
- (d) While holding the reset button, press the Upload Firmware button at the bottom of the ControlByWeb™ Programmer window.
- (e) After the programming process begins, the reset button can be released.

Step 8:

Wait for Link LED to turn on such that it is continuously on. This may take up to 10-20 seconds. Programming should be complete. The X-300™ will be set to factory defaults with an IP address of 192.168.1.2. Verify the new version of firmware has been installed by viewing the default setup page with a web browser (<http://192.168.1.2/setup.html>).

Appendix C: Accessing the X-300™ Remotely over the Internet

The X-300™ can be monitored and/or controlled from a remote location over the Internet. If access over the Internet is required, the X-300™ must be set up properly, and the router on the network where the X-300™ is installed must be configured for this. Note that once the X-300™ 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-300™. 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 his/her 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 an 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 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 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. Public IP addresses are addresses described in the paragraph above that identify a specific device on the Internet. The X-300™ can be assigned a public IP address for direct connection to the Internet. Typically, those who are reading this section of the manual would only assign a public IP address to the X-300™ when the X-300™ is the only device on the local network. The IP address would be obtained from the Internet Service Provider (ISP).

Due to the limited number of public IP addresses, private networks can be set up with “private” IP addresses. Private IP addresses are blocks of IP addresses that have been set aside for private use by anyone. These addresses have no global designation and 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-300™, and a WebRelay™. In this example, the computer is assigned an IP address of 192.168.1.10, the X-300™ has the IP address of 192.168.1.25 and a WebRelay™ has an IP address of 192.168.1.26. A person using the computer can access the X-300™ by entering its IP address in the URL line in the browser (<http://192.168.1.25>). The WebRelay™ can be accessed by entering its IP address in the URL line in the browser (<http://192.168.1.26>).

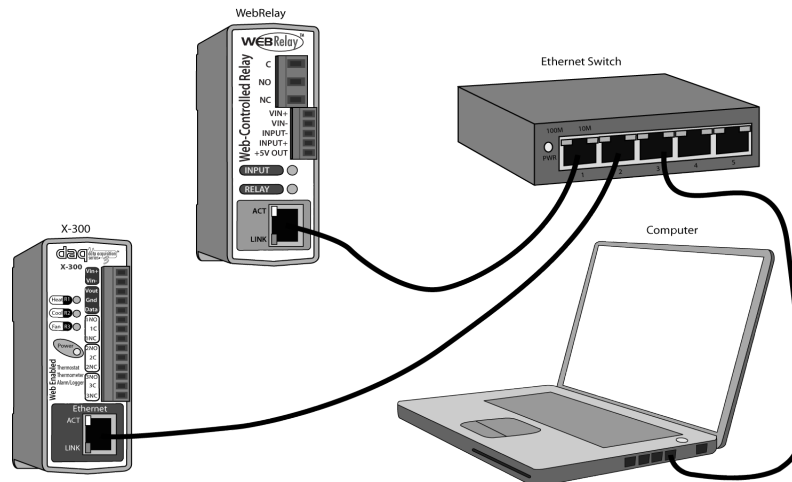


Figure C1 – Simple Local Area Network

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 that connects to the LAN, and it has another connection that connects to the Internet (this is called the WAN or Wide Area Network connection). Each network connection on the router has an IP address. In our example, the IP address on the LAN side of the router has an address of 192.168.1.1. The IP address on the WAN side of the router has an IP address that has been assigned by the Internet Service Provider such as 266.70.164.97 (note that this is not a valid IP address because each number cannot be larger than 255 but it is used in this example for illustration purposes only).

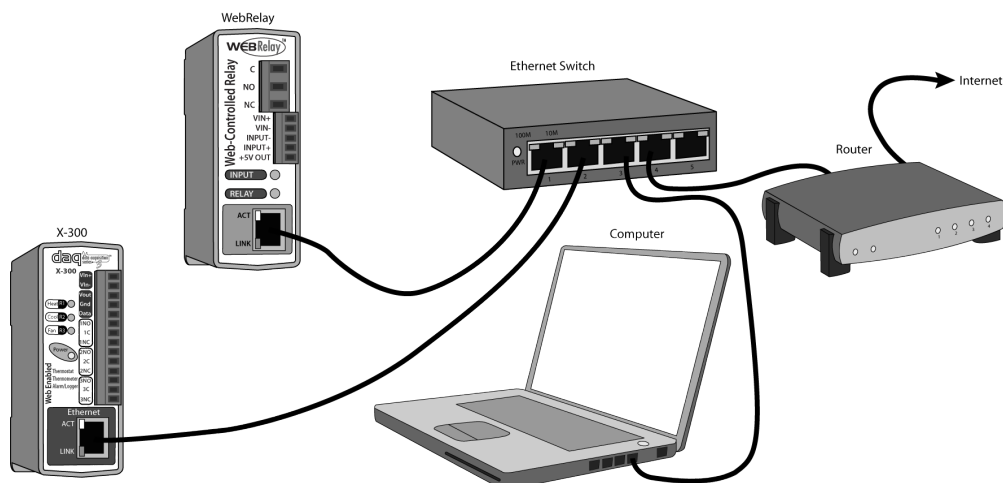


Figure C2 – Simple LAN connected to the Internet

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

Port Forwarding:

The network can be configured to allow outside access to the X-300™ and the WebRelay™. All requests to any device on the network use the public IP address (266.70.164.97). With only a single IP address, TCP ports are used to identify the specific devices the incoming message should be sent to. Using the mailing address analogy, the port is similar to a post office box. The IP address specifies the location, and the port specifies the specific recipient. Port numbers can be set to any number between 1 and 65235 however many port numbers are reserved for specific applications and should be avoided. As a general rule, numbers above 8000 are safe to use. All of the ControlByWeb™ products come from the factory with the HTTP port set to 80 which is the standard port for HTTP. In this example, the X-300™ HTTP port will be changed to port 8000 and the WebRelay™ port will be changed to 8001. Once the ports are changed in the two ControlByWeb™ devices, the router must be set up for port forwarding. The way this is set up is specific to the router, but many routers use a table. Port forwarding setup associates the IP address of each device with the assigned port. In this example, the address 192.168.1.25 (X-300™) would be associated with port 8000. The address 192.168.1.26 (WebRelay™) would be associated with port 8001. By doing this, the X-300™ can be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-300™ in the URL window of the browser. For example, the user would enter `http://266.70.164.97:8000`. When the router receives this request, it would look in it's port forwarding table to find out what to do with a request for port 8000. It would find that it should forward the request to the local address of 192.168.1.25 and then would forward the request. The WebRelay™ could be accessed the same way, except it would use port 8001 (`http://266.70.164.97:8001`).

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

An example screen shot of a router configuration is given below. This setup allows the two ControlByWeb™ products in the above example to be accessed remotely from the Internet. Note that this screen shot is simply an example of a typical router setup page. Routers will vary.

Customized Applications	Ext. Port	Protocol	IP Address	Enable
X-300	8000 To 8000	TCP	192.168.1.25	<input checked="" type="checkbox"/>
WebRelay	8001 To 8001	TCP	192.168.1.26	<input checked="" type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>
	0 To 0	TCP	192.168.1.0	<input type="checkbox"/>

Figure C3 – General Port Forwarding Router Page

Accessing Setup Pages:

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

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

For example, To access the X-300™ in the setup page above, the following command would be used.

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

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

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

Using the example above, the following line would be used to access the setup page of the X-300™.

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

Appendix D: Log Files

The X-300™ logs information to two different log files; log.txt and syslog.txt. Both log files are text files and are stored in non-volatile memory and data will not be lost due to power failure. 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 non-volatile 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 and stores real-world data such as temperatures and events such as relay contact changes. It can be up to 200K bytes long, and is stored using a comma separated value formatting scheme.

File format:

MM/DD/YYYY HH:MM:SS, sensor1, sensor2, sensor3, sensor4, sensor5, sensor6, sensor7, sensor8,
relay1, relay2, relay3

Date and time of event;

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)

Sensor1 to Sensor8 and Relay1 to Relay3 will be displayed only if they are selected in the log setup. Thus, in *Thermostat* mode only two sensors are logged. The set temperature replaces sensor1, and the indoor temp and outdoor temp replace sensor2 and sensor3, respectively, in the format above.

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

`http://192.168.1.2/log.txt`

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`

To erase the file, use the following parameter in the in the address bar:

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

After erasing the file, it might be necessary to refresh the page. Note that if the control password is enabled in the setup pages, the password (control password) will be required to access this file.

System log file: syslog.txt

*****The setup password is required to access this file.**

This log file records various system events which can be used for diagnostics and troubleshooting purposes. This file can be up to 16K bytes long.

File format:

MM/DD/YYYY HH:MM:SS (*Internal Temp*), (*Vin Voltage*), (*5V Voltage*) (category to which message applies): (message).

Date and time of event;

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)

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`

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`

Appendix E: Remote Services Commands and Events

When remote services is enabled, a connection attempt will be made periodically according to the Connection Interval setting. If a connection has already been established, the connection string will be sent periodically according to the connection interval. The remote end is responsible for closing the connection when it is done.

Connection String:

The connection string is sent whenever a connection is made. The connection string is a user defined string that is configurable in the **Remote Services** tab. The string is also sent periodically if a connection has been established according to the Connection Interval setting.

Commands:

All commands are one word all uppercase. The complete command will always end with a carriage return line feed to indicate the end of the command. Most responses (exceptions being log files and the state.xml file) will be a one word, uppercase response ending with a carriage return line feed. If the command does not exist then a "DNE\r\n" (Does Not Exist) will be returned in response. If the command is in the wrong format a "BADCMD\r\n" (Bad Command) will be returned.

GET

- get a file from the device.
- files: state.xml, log.txt, syslog.txt
- Example: "GET log.txt\r\n"
- Returns the file beginning with a header defining the file.

HTTP/1.0 200 OK
 Cache-control: no-cache
 Content-type: text/xml
 Content-length: 419\r\n\r\n

NOOP

- send the NOOP command which does nothing but receive a NOOP response.
- Example: "NOOP\r\n"
- Returns "NOOP\r\n"

ERASE

- cause a log file to be erased
- files: log.txt, syslog.txt
- Example: "ERASE syslog.txt\r\n"
- Returns "ERASE_ACK\r\n"

SET

- set the state of a relay
- Example: "SET relay1=1\r\n" - turn on relay 1
- Returns "SET_ACK relay1=1\r\n" - acknowledgment that relay 1 is 'on'
- Example: "SET relay2=0\r\n" - turn off relay 2
- Returns "SET_ACK relay2=0\r\n" - acknowledgment that relay 2 is 'off'
- Example: "SET setTemp=80.0\r\n" - set the set temperature to 80.0
- Returns "SET_ACK setTemp=80.0\r\n" - the set temperature
- Example: "SET heatMode=0\r\n" - turn heat mode to off (0 = off, 1 = heat, 2 = cool, 3 = auto)
- Returns "SET_ACK heatMode=0\r\n" - the heat mode
- Example: "SET fan=1\r\n" - set the fan mode to auto (0 = on, 1 = auto)
- Returns "SET_ACK fan=1\r\n" - fan mode
- Example: "SET hold=1\r\n" - toggle hold (1 = toggle hold)
- Returns "SET_ACK hold=1\r\n" - hold on (0 = hold off, 1 = hold on)

Events:

When an event occurs a connection will be established if one does not already exist and the event message will be sent following the connection id string. If a connection already exists then the event message will be sent without the Connection String. Event messages come in the following format:

<event>(event description)\r\n

Example: Relay 2 changes state and is configured to send an event message. There is already a connection.

<event>relay2\r\n

Example: Relay 1 changes state and is configured to send an event message. There isn't a connection established.

(Connection String)<event>relay2\r\n

Note that to find the state of the device after an event has occurred, request the 'state.xml' page (see Section 3.3)

Appendix F: SNMP Requests, Objects and Community Strings

Using SNMP some simple network parameters, relay states, and temperature readings of the sensors connected to the X-300™ can be retrieved. The states of the relays can also be changed through SNMP SET requests when the device is configured correctly. For most cases, using SNMP is as simple as locating the appropriate MIB files and loading them into the SNMP manager software. Once the MIB files have been loaded, information from the X-300™ can be accessed. The X-300™ can make use of the following MIB files: RFC1213-MIB, and XYTRONIX_V1_0.mib. Note: As new MIB file become available with support for other products, the older MIB files can be safely overwritten.

The X-300™ supports the following requests:

GET, GET NEXT, WALK, and SET

The X-300™ also supports a few objects found in MIB for network management of TCP/IP-based internets. The MIB for these objects usually comes with SNMP manager software. If it does not, a search for RFC1213-MIB will turn up multiple links for this MIB. The following objects are supported from this MIB. All of them are read only.

iso.org.dod.internet.mgmt.mib-2.system.sysDescr
Returns the Octet String: X300 - Thermostat/Temperature Controller

iso.org.dod.internet.mgmt.mib-2.system.sysObjectID
Returns the object id of the X-300™: 1.3.6.1.4.1.30586.10

iso.org.dod.internet.mgmt.mib-2.system.sysUpTime
Returns the time (in hundredths of a second) since the X-300™ has been running.

iso.org.dod.internet.mgmt.mib-2.system.sysName
Returns the name of the device: X-300

The X-300™ also supports some special objects that can be found in the MIB XYTRONIX_V1_0.mib. This MIB can be downloaded from our website. The following objects are supported from this MIB. Some are read only, others have read/write capability.

Read Only Objects: iso.org.odo.internet.private.enterprises.XYTRONIX.X300.1.0 through iso.org.odo.internet.private.enterprises.XYTRONIX.X300.8.0
Returns an Octet String indicating the temperature reading of sensor 1 through 8. If the temperature is invalid or there is no sensor configured, this will read x.x.

iso.org.odo.internet.private.enterprises.XYTRONIX.X300.16.0
Returns an Octet String indicating the temperature reading of the indoor sensor. If the temperature is invalid or there is no sensor configured, this will read x.x.

iso.org.odo.internet.private.enterprises.XYTRONIX.X300.17.0
Returns an Octet String indicating the temperature reading of the outdoor sensor. If the temperature is invalid or there is no sensor configured, this will read x.x.

Read/Write Objects: iso.org.odo.internet.private.enterprises.XYTRONIX.X300.11.0 through iso.org.odo.internet.private.enterprises.XYTRONIX.X300.13.0
Returns an Octet String indicating the current relay state for relays 1 through 3. A 1 means the relay is on. A 0 means the relay is off. Writing to these objects can change the states of the relays when the device is in Temperature Monitor mode. Writing a 1 turns the relay on while writing a 0 turns the relay off.

The X-300™ also has the capability to send information to the SNMP manager as a result of alarm conditions through the use of TRAPS. The following TRAPS are supported.

iso.org.odo.internet.private.enterprises.XYTRONIX.X300.65 through
iso.org.odo.internet.private.enterprises.XYTRONIX.X300.72

These traps occur as a result of an alarm condition that has been configured in the **Sensors** setup tab. These traps will send an Octet String indicating the temperature reading of the sensor that triggered the alarm.

iso.org.odo.internet.private.enterprises.XYTRONIX.X300.75 through
iso.org.odo.internet.private.enterprises.XYTRONIX.X300.77

These traps occur as a result of the relays changing states. They are configured on the **Advanced Network** setup page in *Thermostat* mode, and on the **Relays** setup tab in *Temperature Monitor* mode. These traps will send an Octet String indicating the new state of the relay. A 1 indicates the relay is on and a 0 indicates the relay is off.

Community Strings:

The X-300™ uses the control password for both the read and write community strings. If the control password is disabled, any object can be read without the need for a correct community string. The write community string is required regardless of whether or not the control password has been enabled. By default the control password is webrelay.

Appendix G: BASIC Script

BASIC (Beginners All-purpose Symbolic Instruction Code) is a computer programming language that has been in use for many years. This ControlByWeb™ product has an integrated BASIC interpreter for simple BASIC scripts. This provides a great deal of flexibility by allowing users to customize basic functions of the unit. Note that the interpreter only supports a small subset of the BASIC commands that are available for computers. Note also, that some non-standard commands have been added, and some commands may function differently on the ControlByWeb™ BASIC interpreter than on other platforms. The following is a short tutorial on the supported BASIC functions. This tutorial is not meant as a tutorial for using the BASIC programming language and it assumes that the user has already had some experience with programming. For more information on programming in BASIC, tutorials can be found over the Internet.

Structure:

A BASIC script is written as a .txt file, which is then uploaded to the device using the **Script** setup tab. The maximum script size is 2K bytes. Each line within the script contains a single statement. Line numbers are not used. Statements are not case sensitive, however, variables are. IF THEN, FOR loops, and DO loops can only be nested up to 5 times per command. For those not familiar with nesting the following is an example of nested FOR loops.

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

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

Line Format:

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

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

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

Examples:

```

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

```

Only a single variable 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 variable to the left of the comparison operator (a + 2 is to the left of =).

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

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

```

IF a = 1 THEN
or
LET b = a + 2
IF b = 3 THEN

```

Supported Statements:

The following are the statements supported by the ControlByWeb™ BASIC interpreter, a short description of the statements and their formats.

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

LET (variable) = (expression)

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

```

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

```

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

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

```

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

```

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

```

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

```

LOG - The LOG statement causes the device to log data according to the settings specified under the **Logging** setup tab. Note that 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. The format is:

EMAIL (corresponding temperature sensor variable)

The temperature sensor assigned governs the email settings used when sending the email. For example if the code stated:

EMAIL temp3

The unit would send an email triggered by temperature sensor 3 to the email addresses selected under the Sensor 3 settings in the **Sensors** setup tab. The email contains the temperatures on all sensors, and specifies which sensor triggered the email.

END - The END statement ends the main body of code.

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

CALL (name of subroutine)

SUB, END SUB - The SUB statement defines the beginning and name of a subroutine. The END SUB statement defines the end of the respective subroutine. Subroutine names can be up to 20 characters long and are case sensitive. The SUB and END SUB statements always must follow the END statement. The format is:

END

SUB (name of subroutine)

(contents of subroutine)

END SUB

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

PRINT - The PRINT statement outputs a variable or message (if contained within quotation marks). Note that the PRINT statement is only available for the PC version of the BASIC interpreter. The device will not recognize the command. The format is:

PRINT (variable) 'output variable value to screen

PRINT "(message)" 'output '(message)' to screen

Variables:

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

User Defined Variables:

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

Examples:

Let b = 5 'variable b will be set to 5

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

The following are useful predefined variables for the ControlByWeb™ BASIC interpreter. Note that some models may not contain digital inputs, analog inputs and/or relays and thus would not have digital input, analog input and/or relay variables.

Timer Variables:

Six timers are available for use in BASIC scripts. They are designated as t0 through t5. Timers can be set to any positive integer (or 0) by using the LET statement. As soon as a value is

assigned to a timer, it will begin to count down immediately by decrementing one count every 100ms until it reaches zero.

Examples:

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

Relay Variables:

The internal relays can be turned on, turned off, pulsed, toggled, or read in BASIC scripts. The LET statement is used to set the relay state. The state options available are 0 (turn relay off), 1 (turn relay on), 2 (pulse relay), and 5 (toggle relay). Note that the relay pulse time is specified in the **Relays** setup tab. Relays are designated as relay1, relay2, relay3, etc.

Examples:

```
Let relay1 = 1      'turn on relay 1
Let relay3 = 0      'turn off relay 3
Let relay1 = 2      'pulse relay 1
Let relay3 = 5      'toggle relay 3
Let a = relay2      'read the state of relay 2, state will be 0 or 1
```

Remote Relay Variables:

Remote relays can be turned on, turned off, pulsed, or toggled in BASIC scripts. Note: remote relays cannot be read (they will always return 0). In order for a remote relay to be used, it must first be set up using the Remote Relay settings in the **Relays** setup tab. The LET statement is used to set the remote relay's state. The states available for remote relays are the same as the internal relays. The relay pulse time is likewise specified in the **Relays** setup tab. The remote relays are designated as rmt_relay1, rmt_relay2, rmt_relay3, etc.

Examples:

```
Let rmt_relay2 = 1  'turn on remote relay 2
Let rmt_relay1 = 0  'turn off remote relay 1
Let rmt_relay2 = 2  'pulse remote relay 2
Let rmt_relay3 = 5  'toggle remote relay 3
```

Note: The remote relay states can only be changed as fast as the remote device can be updated. If the state is changed faster than the device can be updated, only the last state change will occur.

Digital Input Variables:

The input states can be read in BASIC scripts. The inputs are designated as input1, input2, input3, etc.

Example:

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

Analog Input Variables:

The analog inputs can be read in BASIC scripts. The inputs are designated as ana1, ana2, ana3, etc.

Example:

```
Let b = ana1        'sets 'b' equal to value of analog input 1
```

Temperature Sensor Variables:

Each temperature sensor can be read in BASIC scripts. The temperature sensors are designated as temp1, temp2, temp3, etc.

Example:

```

If temp 2 >= 80 Then      'If temperature sensor reads greater than 80
                           degrees, then
    Let relay2 = 1        'Turn on relay 2
End If
LET c = temp3 + 15        'set user variable 'c' equal to the value on temp3 + 15

```

Event Variables:

Actions can be configured to occur at specified days and times. Five events may be configured for the unit. This is done by setting the day and time of the event and then comparing it to the current date and time. Note that the current date and time must be set in the **Date/Time** setup tab. The event date variables are designated ed1 to ed5. They are set using the LET command and setting the desired event date variable equal to the date the event should occur in the format mm/dd/yyyy. The event time variables are designated et1 to et5. They are likewise set using the LET command and setting the corresponding event time variable equal to the event time in the format hh:mm:ss in 24 hour time. The event date variables store the number of days that have passed since January 1, 1970. The event time variables store the number of seconds from the beginning of the day. If the event time variable is incremented more than the number of seconds in a day (86400 seconds), the counter is reset to 0 and the event date variable is incremented by one. The variables 'time' and 'date' are predefined variables that store the current date and time and can only be read. They can then be used to compare the event date and times. The following example demonstrates defining the event variables and comparing it to the current date and time. Assume current time is April 10, 2009 at 1:30 AM and the event should occur in one hour and every hour thereafter.

Example:

```

Let a = 1
Let ed1 = 04/10/2009      'sets the event date to April 10, 2009.
Let et1 = 02:30:00        'sets the event time to 2:30
Do While a <> 0
  If ed1 >= date Then      'Tests event date versus current date.
    If et1 >= time Then    'Tests event time versus current time.
      Let et1 = et1 + 3600 'Increments the event time by one hour (in
                           ' seconds).
      Print "Event"       'Event to occur
    End If
  End If
End If
Loop
End

```

Examples:

The following are a few examples of general applications that could be adapted for more specific use.

1. Application: If any one of three sensors exceeds a temperature of 80.5 degrees, relay 1 will be triggered. Note that relay 1 will not turn off until the script is manually restarted.

```

LET relay1 = 0           'Relay 1 is set to the off position
DO                      'The IF THEN statements are looped continuously
    IF temp1 > 80.5 THEN 'Tests temperature sensor 1
        LET relay1 = 1   'Turns on Relay 1
    END IF
    IF temp2 > 80.5 then  'Tests temperature sensor 2
        LET relay1 = 1   'Turns on Relay 1
    END IF
    IF temp3 > 80.5 THEN  'Tests temperature sensor 3
        LET relay1 = 1   'Turns on Relay 1
    END IF
LOOP
END

```

2. Application: If temperature sensor 1 is above 80.5, relay 1 is turned on. If temperature sensor 1 is below 65, relay 2 is turned on. Note that the relays will turn off as soon as conditions return to between 65 and 80.5 degrees.

```

DO                      'The IF THEN statements are looped continuously
    IF temp1 > 80.5 THEN 'Tests if sensor 1 is greater than 80.5 degrees
        LET relay1 = 1   'Turns on Relay 1 if condition is true
    ELSE
        LET relay1 = 0   'Turns off Relay 1 if condition is false
    END IF
    IF temp1 < 65 THEN   'Tests if sensor 1 is less than 65 degrees
        LET relay2 = 1   'Turns on Relay 2 if condition is true
    ELSE
        LET relay2 = 0   'Turns off Relay 2 if condition is false
    END IF
LOOP
END

```

3. Application: Relay 1 is triggered if sensor 1 is above 32 degrees for 10 minutes. It will check every 5 minutes to see if sensor 1 has dropped below 32. If the sensor has dropped below 32 degrees before the 10 minutes are up, the relay will not be triggered. In addition to the relay being triggered, we also want to log the time at which the relay is triggered and send an email notification.

```

DO                      'Loops statements continuously
    DO WHILE temp1 > 32 'Loops IF THEN statements if sensor 1 is greater than
32                      ' degrees
    CALL delay          'Waits 5 minutes
    IF temp1 > 32 THEN  'If sensor 1 is still greater than 32 degrees, then
        CALL delay      'Waits another 5 minutes

```

```

        IF temp1 > 32 THEN 'If sensor 1 is still greater than 32 degrees, then
            LET relay1 = 1 'Triggers relay 1
            LOG           'Logs according to selected log settings
            EMAIL temp1   'Sends an email notification from sensor 1
        END IF
    END IF
LOOP
    'If sensor 1 drops below 32 degrees before 10 minutes are up,
    '    then the program restarts because the IF statement
    '    failed
END

SUB delay
    'Subroutine delays script by 5 minutes
LET t1 = 3000
DO WHILE t1 <> 0
LOOP
END SUB

```

Testing and Debugging:

Note that a copy of the BASIC interpreter for Windows is also available on our website for the use of testing and debugging. The device will only acknowledge errors as it runs. This means that if a path of the script is not encountered, errors may still exist. The Windows version of the interpreter, however, will check for errors before the script is run. Note also that the PRINT function is available for use with the Windows version of the BASIC interpreter. The interpreter on the device, however, will not recognize this command.

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

Appendix H: Specifications

Power Requirements:

Voltage Input:

Model X-300-5 : 5VDC \pm 5%

Model X-300-I : 9-28VDC

Model X-300-E : Power Over Ethernet (48V injected into Ethernet line as per 802.3af specification)
POE Class 1 (0.44Watt to 3.84Watt range) or 5VDC \pm 5%

Current Draw (typical):

Network Speed (# of energized relays)	5 VDC (-5 Model)	9 VDC (-I Model)	12 VDC (-I Model)	24 VDC (-I Model)	28 VDC (-I Model)
10 Mbps (No Relays)	0.184 A	0.118 A	0.089 A	0.048 A	0.043 A
10 Mbps (3 Relays)	0.407 A	0.287 A	0.217 A	0.111 A	0.099 A
100 Mbps (No Relays)	0.314 A	0.201 A	0.151 A	0.081 A	0.071 A
100 Mbps (3 Relays)	0.530 A	0.378 A	0.281 A	0.145 A	0.125 A

*note that the X-300-E will draw the same current as the X-300-5 when powered with a 5VDC power supply.

Temperature Sensors:

"1-Wire" Digital Thermometer (Dallas Semiconductor part DS18B20)

Temperature Range: -55°C to $+125^{\circ}\text{C}$ (-67°F to $+257^{\circ}\text{F}$)

Accuracy: $\pm 0.5^{\circ}\text{C}$ from -10°C to $+85^{\circ}\text{C}$

Maximum number of Sensors: 8 in *Temperature Monitor* mode 2 in *Thermostat* mode

Maximum Distance from X-300 to Sensors: 120 feet with one sensor. 60 feet with four sensors. Short distances with 8 sensors.

Temperature Sensor Functions:

Thermometer, Thermostat, Relay Control, Remote Relay Control, Email Alarms, SNMP Traps, Temperature Logging

Relay Contacts:

Contact Form: SPDT (form c)

Contact Material: AgSnO₂

Contact Resistance: 100 m Ω max.

Max Voltage: 28VAC, 24VDC

Max Current: 3A

Relay Control Options: ON/OFF or Pulsed

Pulse Timer Duration: 100ms to 86400 Seconds (1 day)

Real-Time Clock:

Time Setup: Manually or with NTP (Network Time Protocol) server

NTP Synchronization Period: User specified (once, daily, weekly, monthly, and/or on power-up)

Automatic Daylight Savings Adjustment: Yes

Battery Backup: Internal capacitor backup maintains time for several days

Logging:

Number of Log Files: 2 (System log and Data log)

Log Storage: Nonvolatile Flash Memory

Buffer Architecture: Circular Buffer

Data Logging Type: Selectable Event and/or Periodic

System Logging Type: Event

Data Log File Size: 200K bytes (approx 4655 logs)

System Log File Size: 16K bytes

Operating Modes:

Temperature Monitor - used for temperature monitoring, alarming, discrete relay control, advanced functions.

Thermostat - advanced single-stage HVAC system controller.

Advanced Features:

BASIC interpreter

Remote services

Network: 10/100 Base-T Ethernet

Network Setup: Static IP address assignment or DHCP, HTTP port selectable

Protocols Supported: HTTP, Modbus/TCP, SNMP, SMTP, plus proprietary Remote Services

Internal Monitoring: Vin Voltage, 5V, internal temperature

Connectors:

Power/Sensors/Relays: 14-position, removable terminal strip, 3.81mm terminal spacing
(Replacement part number, Phoenix Contact 1803691)

Network: 8-pin RJ-45 socket

LED Indicators: 6

- Power Indicator
- Relay coil engaged (Relay 1, Relay 2, Relay 3)
- Network linked
- Network activity

Physical:

Operating Temperature: -30° to 65°C (-22°-149°F)

Size: 1.41in (35.7mm) wide X 3.88in (98.5mm) tall X 3.1 in(78.0mm) deep

Weight: 5.5oz (156 grams)

Enclosure Material: Lexan 940 (UL94 V0 flame rated)

Password Settings:

Password protection on setup page: Yes

Password protection on control page: Optional

Password Encoding: Base 64

Max setup password length: 13 characters

Max control password length: 13 characters

Regulatory Compliance:

Electromagnetic Compliance:

IEC CISPR 22, CISPR 24

FCC 47CFR15 (-I and -5 Models class B, POE Model Class A)

EU EN55024, EN55022

Product Safety:

IEC 60950-1 / EN 60950-1



Appendix I: Mechanical Information

