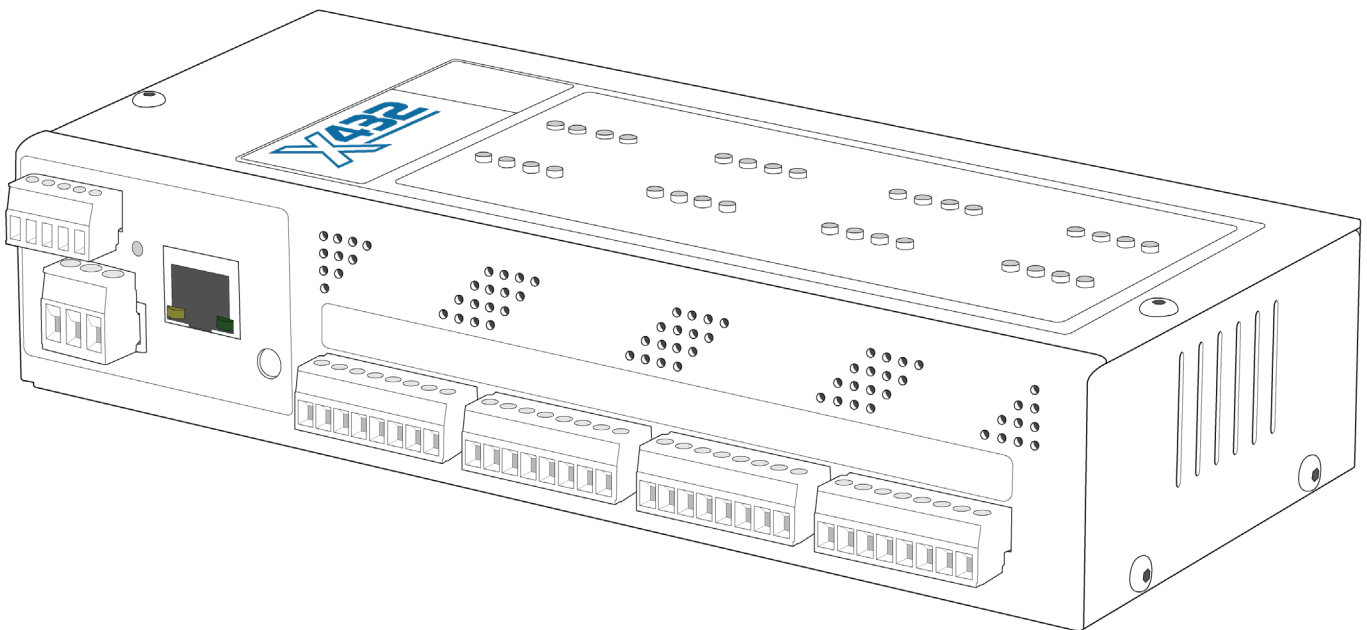


X432

Users Manual

X-432 (X-432)



CONTROL by
WEB™

www.ControlByWeb.com

a division of....

Xytronix Research & Design, Inc.
Nibley, Utah, USA

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Limitation

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

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FCC Statement

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

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

Warning

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

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

Notice

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

Installation Guidelines (Read Before Installing)

- This unit must be installed by qualified personnel.
- 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.

Security Notes

X-432™ does not employ a general purpose computer operating system and does not have features, such as telnet, FTP, SSH, nor uncontrolled open ports. This means it is unlikely for someone to 'break in' to X-432™ and access other devices on your local network. The simplicity of X-432™ makes it an inherently secure device. Nevertheless, as with any device installed on a network, appropriate security precautions should be observed.

If X-432™ is installed on the Internet, it is recommended that passwords be enabled for the **Control Page**. Passwords should be at least 8 characters in length and use a combination of upper and lower case letters and numbers. For additional security, a firewall may be used to limit access to selected IP addresses. Another option may be to set up a Virtual Private Network (VPN) between the network where X-432™ resides and the client machine (web browser, another, ControlByWeb™ product, etc.).

Final Installation Notes

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

Any changes to the Ethernet settings will require a removing and re-applying power to X-432™.

Section 1: Introduction

X-432™ is a multi-function web-enabled module for control and monitoring. The X-432™ includes sixteen dry-contact relays, sixteen optically-isolated digital inputs, two digital inputs (inputs 17 and 18), four analog inputs and 1-wire bus with support for up to 4 temperature/humidity sensors. It can be controlled and/or monitored over any IP network including private networks, IP-based industrial control networks, and the Internet. Users can operate the X-432™ using a web browser, or custom applications can be written to control the X-432™ from a computer, PLC, or other automation controller. In addition, custom control scripts can be written and executed using BASIC programming language.

Other outstanding features of other ControlByWeb products are also included, such as email notification, BASIC scripting, scheduling, and logging. The X-432™ can also control up to 16 remote relays and can graph logged data with any HTML 5 compliant web browser.

The X-432™ supports a number of protocols, including HTTP, XML, Modbus/TCP, SNMP, SMTP, NTP, and Remote Services.



Figure 1.1 - Product Image

1.1 X-432™ Features

Relay Outputs (16)

Control relays with a web browser, timers, input changes, or programmable logic. The relays are isolated from all other circuitry in the device and from each other.

Optically-Isolated Digital Inputs (16)

View state of inputs with a web browser. Inputs are optically isolated and can be used for 28 volt industrial sensors. Use inputs to control relays, trigger email messages.

Digital Inputs (2)

Two discrete, 5V digital inputs (inputs 17 and 18). These inputs are considered “On” when asserted low, and can also be used as counters.

One-Wire bus (connect up to sixteen temperature/humidity sensors)

Monitor temperature and/or humidity sensors - control relays or trigger email messages based upon temperature and humidity values.

Analog Inputs (4)

Monitor analog inputs. Control relays or trigger email messages based upon the analog reading. Each analog input has a 0 to 5 volt range, and offers 12 bits of resolution.

Remote Relays

Control relays on other ControlByWeb products.

Real-time Clock

Manual or NTP capability.

Task Manager

Program up to 50 Scheduled and 50 Conditional events based on specified conditions. Automatically switch from weekday to weekend or holiday schedules.

Logging

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

Graphing

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

Email Notification

Send email alerts based on any sensor or input conditions, such as temperature, time, digital inputs, analog inputs, and more. Send text messages (using a wireless carrier's email bridge).

BASIC Script

Additional flexibility is provided through custom scripts using a BASIC interpreter.

Built-in Web Server

All configuration is done through the built-in, password protected web server.

1.2 Applications

X-432™ was designed to meet a broad range of industrial applications. It works very well as a standalone device that can be controlled using a web browser, or as a convenient way to add I/O to a computer. It can easily be configured using simple menus and drop-down lists, or it can run simple BASIC scripts. Many of its features such as scheduling, logging, input state monitoring, and the ability to control up to 32 relays (16 internal and 16 remote relays on other devices) make the X-432™ a very powerful, yet simple controller.

You can use the X-432™ to control motors, lights, coils, pumps, valves, bells, etc. You can also use it to monitor alarms sensors, switches, fluid level switches, battery voltage, temperature, humidity, and much more. A few example applications include:

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

1.3 X-432™ Models Available

Part Number	Power Supply Requirements
X-432-I	9-28VDC

1.3.1 Optional Accessories

Accessory	Description	Part Number
DIN-Rail Power Supply	Output : 24V DC, 1.75Amp Input Voltage: 100-240V AC, Input Frequency: 45-66 Hz	2092992
Temperature Sensor	Digital temperature sensor with 3-foot wire leads. Note: Leads may be extended	X-DTS-S3C
Temperature Sensor (Wall Mount)	Digital temperature sensor housed in vented plastic enclosure	X-DTS-WMX
Temperature/Humidity Sensor (Wall Mount)	Digital temperature and humidity sensor housed in vented plastic enclosure	X-DTHS-WMX
DIN Rail Mounting Clips	Removable mounting clips to attach the X-432 to a DIN rail.	DRC-12C

1.4 Connectors & Indicators

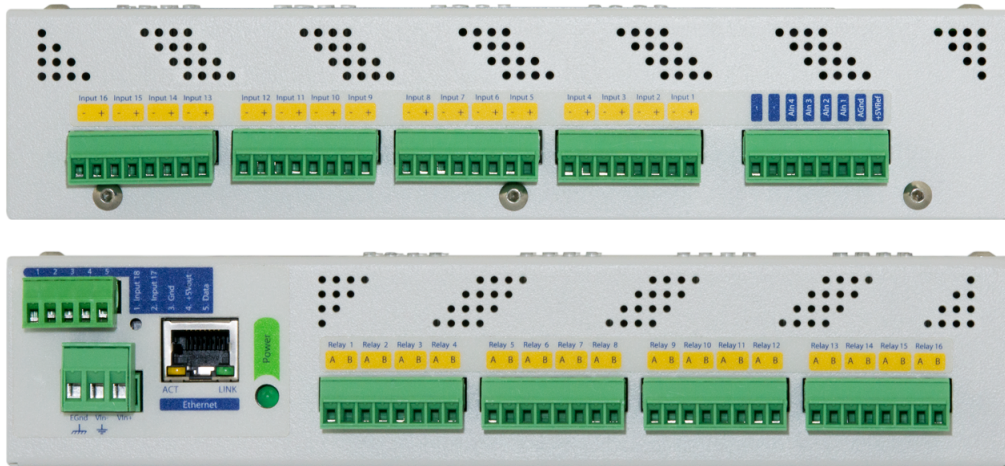


Figure 1.4a - Connections & Indicators

I/O Connectors

X-432™ has nine 8-position removable screw terminal connectors, one 5-position removable screw terminal connector, one 3-position removable screw terminal connectors and an Ethernet connector.

These connectors are used to connect relay contacts, digital inputs, analog inputs, power and network.

Network Connector

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

Module Power Indicator

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

Relay Indicators

Sixteen green LEDs illuminate when the corresponding relays are energized (when a relay is energized, the common and normally open contacts are closed).

Optically-Isolated Digital Input Indicators

Sixteen green LEDs illuminate when a voltage is applied to the corresponding optically-isolated digital inputs.

Ethernet Indicators

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

1.5 Accessing X-432™

Standard Access Using a Web Browser

X-432™ has a built-in web server that provides simple web pages that can be accessed directly using a standard web browser. This allows users to access the unit with NO SPECIAL SOFTWARE installed on their computer. This is ideal for applications that require a quick, simple solution that does not need to be accessible to more than a few people. This configuration is simple to setup, simple to use, and can be accessed from just about any computer or smart phone.

*Note: Network routers may need to be configured to allow access from computers outside of the local network (see **Appendix C: Accessing X-432™ Over The Internet**).*

Section 2: Installation and Setup

Installation consists of mounting the X-432™, connecting it to an Ethernet network, providing power, and configuring via a web browser, wiring the relays, digital inputs, analog inputs and temperature and/or humidity sensors.

2.1 Mounting

X-432™ can sit on a shelf or be mounted to a wall or DIN Rail (35mm by 7.55mm). It should be mounted in a clean, dry location where it is protected from the elements. Ventilation is recommend for installations where ambient air temperatures are expected to be high

See **Appendix J: Mechanical Information** for additional mechanical details.

2.1.1 Shelf Installation

When sitting the X-432™ on a shelf, attach the self-adhesive rubber feet to the bottom of the X-432™, and place on a shelf or flat surface.

2.1.2 Wall Mounting

Omit/remove the rubber feet, attach the wall mount bracket (shown below) to the side of the X-432™ by using two #6 screws. Mount the X-432™ to a wall by using two additional #6 screws. Repeat steps for additional wall mount.



Wall mount brackets



2.1.3 DIN-Rail Mounting

Attach a wall mount bracket (shown above) to the side of the X-432™ by using two #6 screws. Attach the DIN-Rail mounting clips [Part number DRC-12C sold separately] to the wall mount bracket by using two additional #6 screws (pictured below). Repeat for the additional DIN-Rail clip.



An X-432™ mounted to a DIN-Rail using wall mount brackets and DIN-Rail mounting clips



DIN-Rail Mounting Clips

2.2 Connection

CAUTION: MAKE SURE POWER IS SHUT OFF BEFORE WIRING!

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

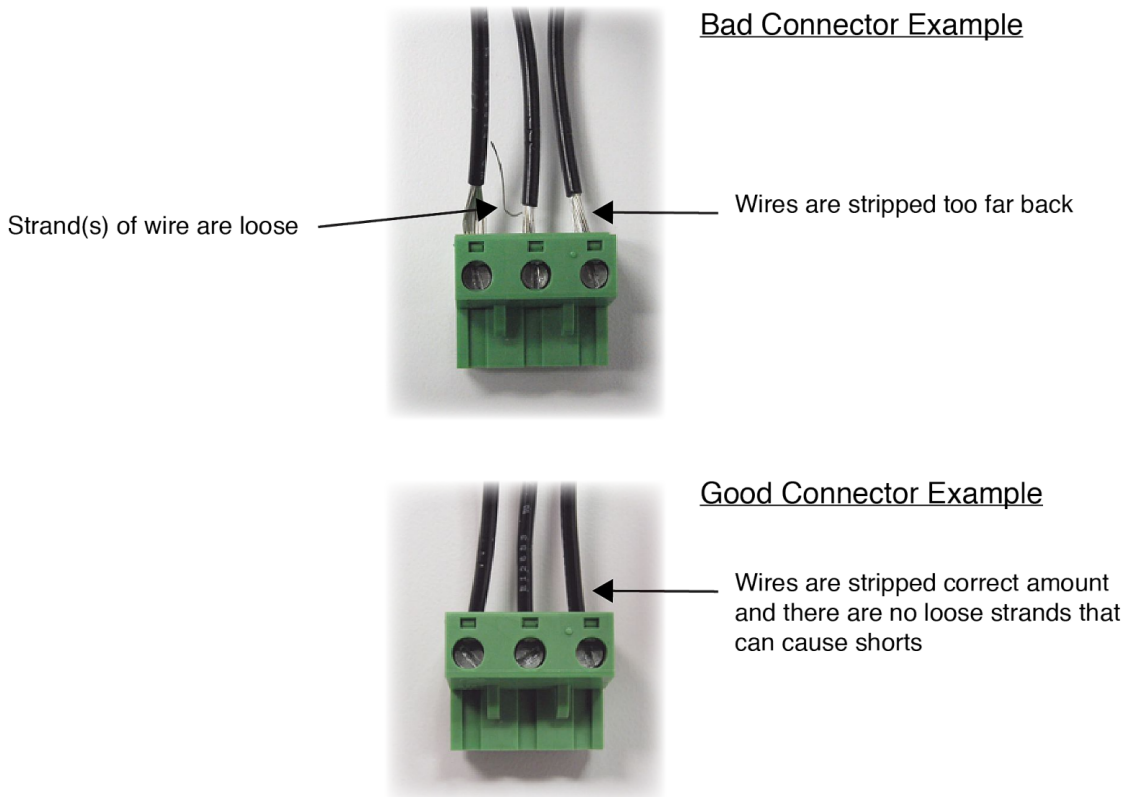
MIS-WIRING OR MIS-CONFIGURATION COULD CAUSE PERMANENT DAMAGE TO THE X-432™, THE EQUIPMENT TO WHICH IT IS CONNECTED, OR BOTH.

Removable terminal connectors are provided for simple wiring. The correct wiring procedure is as follows:

1. Make sure power is turned off.
2. Remove the terminal connector from the X-432™ and make wiring connections to the terminals.
3. Reconnect the terminal connector.
4. Apply power.

It is recommended that the load (device to be controlled) not be connected to the X-432™ until after the X-432™ 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!



2.2.1 Power Supply Connection

3-pin Connector Pinout	
Pin	Description
Vin+	Power Supply VDC+ 9-28 VDC for model X-432-I DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE.
Vin-	VDC- (Ground) power supply input.
Egnd	Earth ground Important Note: Connect this to Earth ground.

X-432™ requires power for its internal logic circuits. Connect a 9-28 VDC power supply to the Vin+ and Vin- terminals. Note that a regulated power supply is recommended. Verify that the power supply is rated for the operating current of X-432™ (See **Appendix H: Specifications** for current requirements.)

Multiple X-432™ 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: Specifications** for current requirements.)

2.2.2 Relay Connection

The relay contacts are internally connected directly to the terminal connectors. Four relays are connected to each 8-pin connector. A Common contact (A) and Normally Open contact (B) are provided for each relay. The relay contacts may be wired in series with the power source for the load (device to be controlled) as long as the load does not exceed the maximum current and voltage rating of the relay contacts.

For loads greater than 2 Amps, an external interposer relay should be used. The illustration below (Figure 2.2a) shows how a 20-Amp motor can be controlled using an external relay. In the example, the X-432™ controls the external relay and the external relay controls the load.

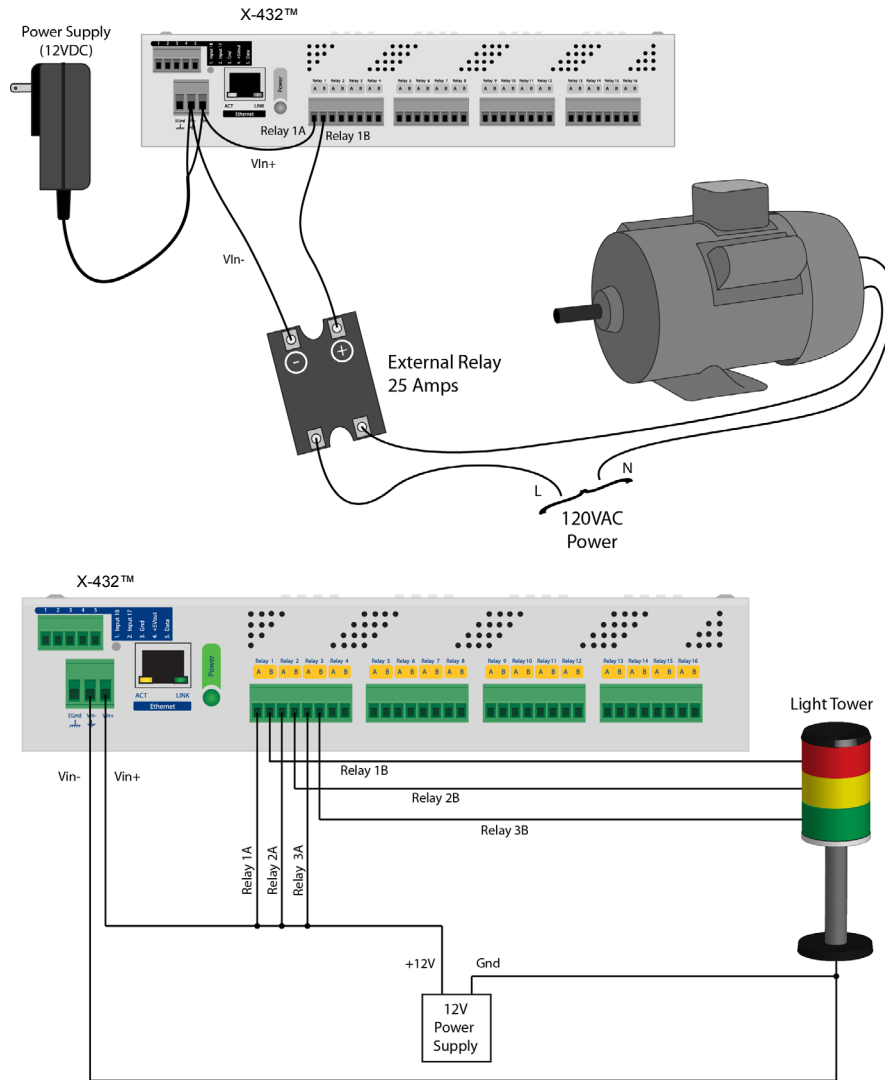


Figure 2.2a - External Relay Connections / Figure 2.2b-High Side Switch Wiring

When mechanical relays switch inductive loads such as motors, transformers, relays, etc., the current will arc across the internal relay contacts each time the contacts open. Over time, this causes wear on the relay contacts which can shorten their life span. When switching an inductive load, it is recommended that relay contact protection devices are used. Note that the X-432™ does include an internal MOV (40V) across its relay contacts, which offers some protection. Additional relay contact protection may be required. Below is an example of relay contact protection for a DC circuit (Figure 2.2c) and an AC circuit (Figure 2.2d). For component values required to provide sufficient contact protection for your application, refer to appropriate references.

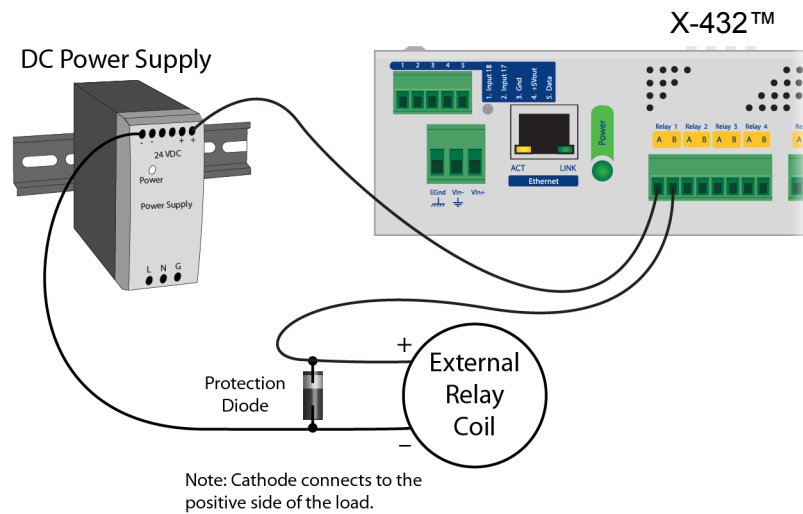


Figure 2.2c - DC Contact Protection

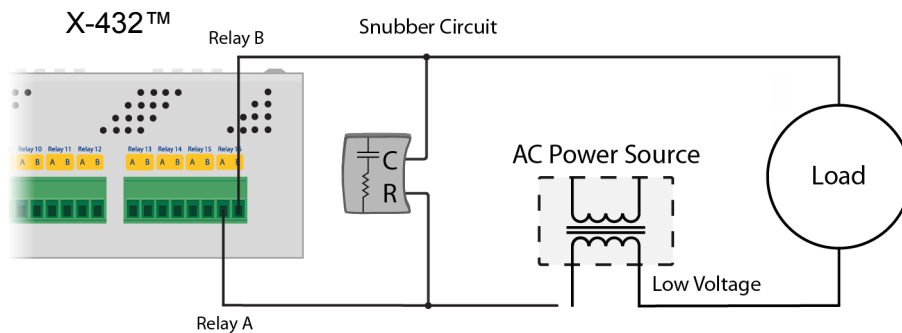


Figure 2.2d - AC Contact Protection

2.2.3 Optically-Isolated Input Connections

Internally each input connects directly to an opto-isolator. There are four optically isolated inputs connected to each 8-pin connector. The optically-isolated inputs can be used to control the internal relays, control remote relays (over the network), or simply to monitor the state of a discrete device. To use these inputs, connect a DC control voltage directly to the input and ground, and set up the function of the input using the configuration pages. A current limiting resistor is provided internally, so no external resistors are required as long as the maximum input voltage is not exceeded. If an AC signal, or a signal greater than the rated input voltage needs to be detected by the X-432™, use a signal conditioner to convert the signal to a DC signal within the input range.

Connecting “dry contacts” to the optically-isolated inputs:

Figure 2.2e illustrates how a dry contact switch can be connected to the input (or inputs) of the X-432™. One side of the contact is connected to Vout, and the other side is connected to In+. When the contact is closed, it applies 5V to the input terminals.

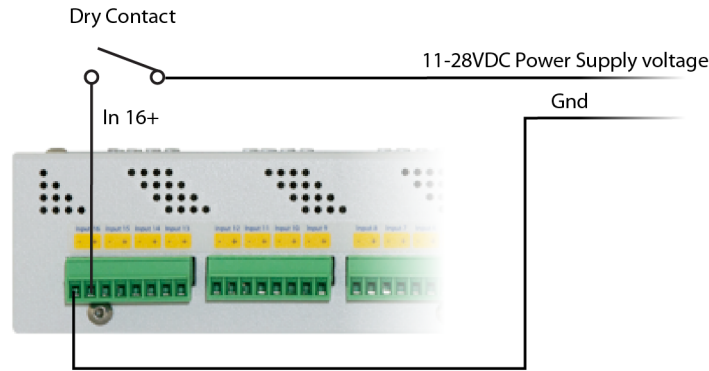


Figure 2.2e - Connecting Dry Contacts to the X-432™

Connecting voltages to the optically-isolated inputs:

AC Inputs:

If an AC signal voltage needs to be detected, use a signal conditioner to convert the AC signal to a DC voltage within the input range. An AC signal conditioner can be made using a diode (or bridge rectifier) and a capacitor. Prepackaged signal converters are available as accessories at industrial automation distributors. A simple voltage converter module manufactured by www.redlion.net is shown below. These are available in two input voltage ranges that cover the spectrum from 4-270VAC/DC. These devices have a MOSFET output (solid state DC contact closure) which is compatible with the X-310 input. The converter module accepts AC (50/60 Hz) or DC voltages at input cycles up to 30 Hz. The converter provides isolation between the input and output using an opto-isolator. You must provide a voltage source for the input of the X-432 as shown in the example below:

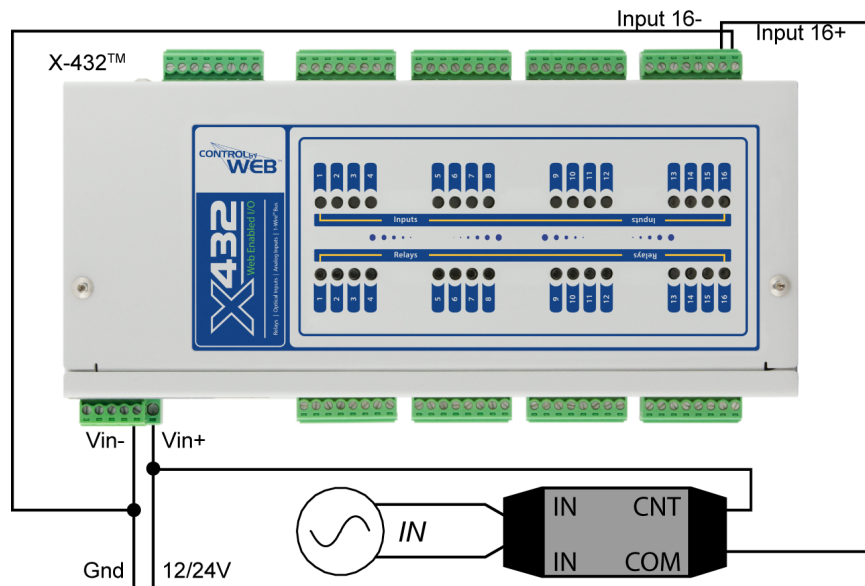


Figure 2.2f - AC Input on the X-432™

DC Inputs:

With DC inputs, no external components are required as long as the maximum input voltage is not exceeded (See Specifications). A DC voltage can be reduced with an external resistor of the appropriate value and power rating to reduce the input current.

The formulas to calculate external resistor values are provided below:

X-432-I with a **11-26VDC** input range has an internal 3K ohm resistor. The forward voltage drop of the photo-coupler is approximately 1.2V and works well with an input current of 10mA.

$$R = (V_{in} - 1.2) / 0.01 - 3000$$

Where:

- R = External resistor value required
- V_{in} = Desired input voltage
- 1.2V = forward voltage drop of the LED in the photo coupler
- .01A = workable LED current
- 3000ohm = Internal resistor

For example:

To connect a 48VDC signal voltage to the X-432™ with a 11-26VDC input range:

$$R = ((48 - 1.2) / 0.01) - 3000 = 1680 \text{ Ohms (use a 1600 ohm resistor)}$$

Check the power dissipated by the resistor:

$P = I \times I \times R$, The resistor must be at least $.01 \times .01 \times 1600 = 0.16$ Watts, so use a 1/2 Watt resistor

2.2.4 Temperature/Humidity Sensor and Counter Input Connection

5-pin Connector Pinout	
Pin	Description
1. Input 18	5V Counter Input
2. Input 17	5V Counter Input
3. Gnd	Ground connection for Discrete Inputs.
4. +5Vout	This output voltage is used to provide power for the digital temperature/humidity sensors
5. Data	Temperature/Humidity Data. This is the data line connection for the digital temperature/humidity sensors.

The 5-pin connector is used to connect temperature and humidity sensors, as well as to connect low voltage sensors. Inputs 17 and 18 found on the 5-pin connector can also be used as counters.

Temperature or humidity sensors can be used for monitoring environmental conditions. The digital sensors use a one-wire data bus, which allows up to four sensors to share the same terminals (+5V, Ground, Data). Every sensor on the one-wire bus is assigned a unique serial number when it is manufactured. That number is used to address the device during communication.

The sensors have three wires; the wire color is show in the table below.



Figure 2.2g - Temperature Sensor

Sensor Wire Color	Connection
Red	5V Out
Black	Gnd
Blue, White, Yellow	Data

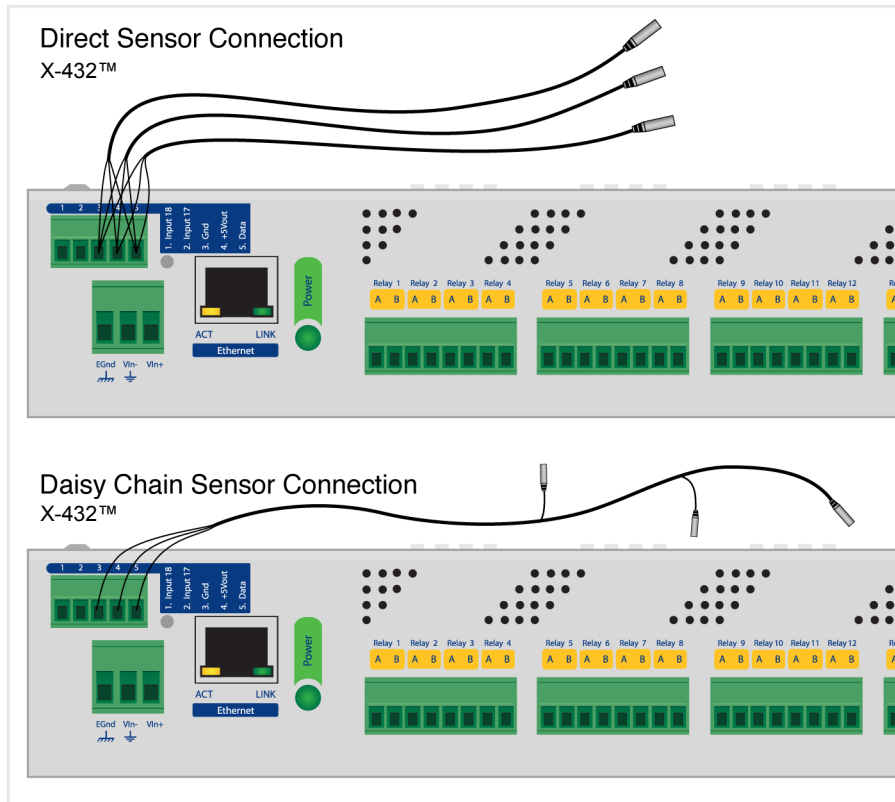


Figure 2.2h - Direct Connection (Star) and Daisy Chain Connection(Linear)

Multiple sensors can be connected in two ways: directly connected to the unit (star topology) or “daisy chained” (linear topology) as shown in Figure 2.2g. Many factors will determine the maximum length of the cable. Some of these factors include, but are not limited to, the type of cable used, the number of sensors, ambient electromagnetic noise, and sensor network topology. Combined cable lengths to all sensors of 600 ft using Cat 5e cable have been successful. However, due to the uniqueness of installation environments, results may vary. Please test in the desired environment before permanent installation.

The following are general recommendations that will maximize sensor runs and minimize problems. Cat 5 and Cat 5e network cable has proven to be an effective and low-cost solution for long runs. Other cable types can be used, but cable capacitance may limit the length. Figure 2.2h shows the recommended connection using Cat 5 network cable. Connect all unused conductors to ground.

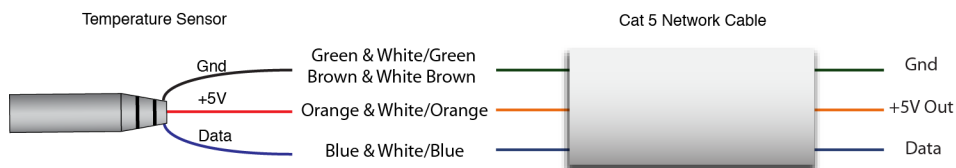


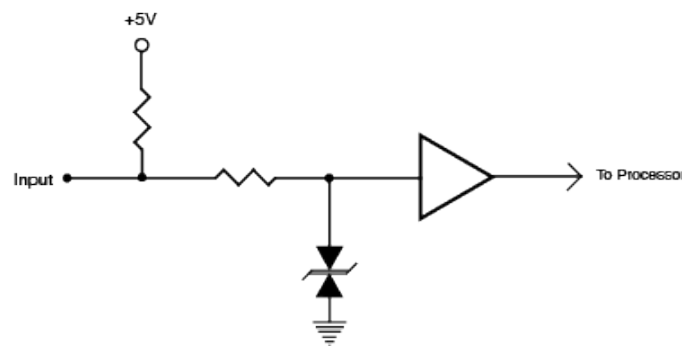
Figure 2.2i - Recommended connection using Cat 5 cable

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

Appropriate strain relief should be used at the X-432™ and other connections that may be subjected to vibration, movement, or repeated handling.

- Avoid sensor runs adjacent to industrial equipment power cables. These cables can have the potential for high voltage spikes that may induce noise on the sensor signals. Similarly, avoid running sensor cables near any radio transmission antennas or coaxial feed-lines.
- Protect any electrical connections with appropriate weather shielding.
- Due to the broad range of applications and environments where the X-432™ may be employed, successful installations of long sensor runs may vary significantly.

Two counter inputs (inputs 17 and 18) are provided which can be connected to dry contact sensors or switches. Sensors can be used for monitoring alarm conditions such as access or thresholds. Alternatively, you can also control outlets by connecting switches to these inputs, and configuring them to control the outlets. Each input can also function as a counter (*for configuration see section 2.5.4*).



Connect one terminal of the sensor or switch to the input terminal (Input 17 or Input 18) on X-432™. Connect the other terminal to the ground terminal on X-432™. When contacts are closed the input is connected to ground and the input is considered to be “ON” (*see figure 2.2e*).

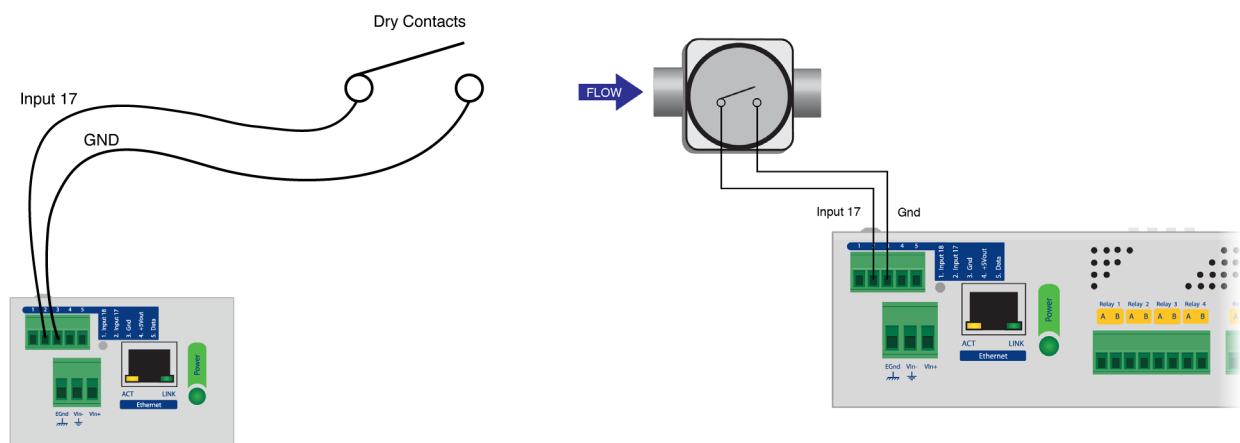


Figure 2.2k - Input Connection

Figure 2.2l - Recommended connection using Cat 5 cable

2.2.5 Network Connection

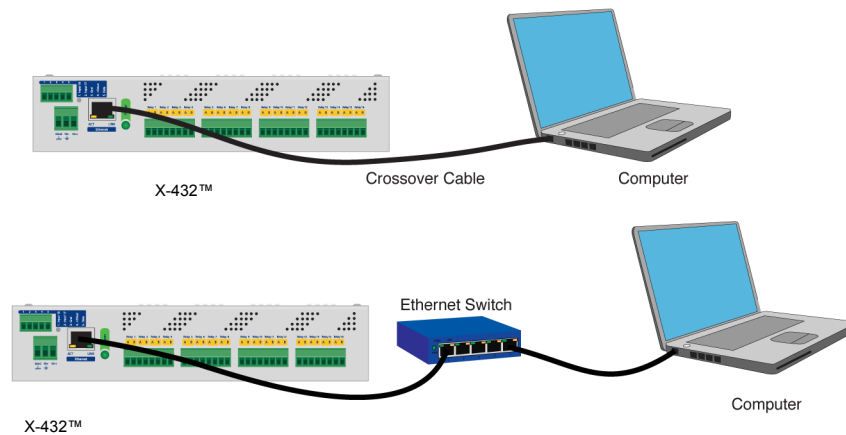


Figure 2.2m - Network Connection

Connect the Ethernet port to a 10 Base-T, 10/100 Base-T, or 10/100/1000 Base-T Ethernet connection. This typically connects to an Ethernet hub, switch, or router. For configuration, X-432™ may be connected directly to the Ethernet port on a computer using a “crossover” cable. Otherwise, for connection through a hub or router, a standard “straight-through” cable should be used. X-432™ can be used on a wireless network by connecting through an Ethernet bridge or a wireless router.

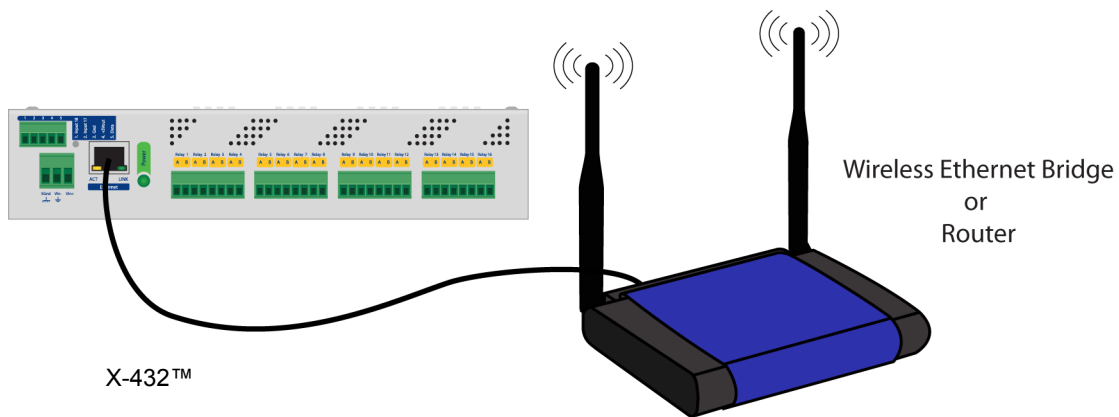


Figure 2.2n - Wireless Connection

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

2.3 Establishing Communications for Setup

The X-432™ is set up using a web browser. The first task is to establish communications between a computer and the X-432™ so that the browser-based configuration can begin. To do this, the computer and the X-432™ 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 the X-432™ so that they are on the same network. The first (Option 1) is to change the IP address of the X-432™ to an address that is on the same network as the computer. The second (Option 2) is to change the IP address of the computer to an address that is on the same network that the X-432™ is set to by default.

2.3.1 Option 1: Assign a temporary IP address to the X-432™

This option is used to TEMPORARILY assign an IP address to the X-432™ without the need to change the IP address of the configuration computer. Note that the X-432™ will only use this IP address as long as power is maintained. Once power is lost and restored, the X-432™ 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-432™ and the configuration computer are connected to the same network. This will not work through routers or gateways.
2. Assign the address as follows:

Windows:

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

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

Type:

```
arp -s {new IP address} {serial number of the X-432™ }
```

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

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

For example, to set the X-432™ (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-432™ }
```

*Note: IP address format is xxx.xxx.xxx.xxx
Serial number format is ss:ss:ss:ss:ss:ss*

For example, to set the X-432™ (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: The terminal is in the “Utilities” directory, which is in the “Applications” directory.

Type:

```
sudo arp -s {new IP address} {serial number of the X-432™ }
```

*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 a the X-432™ (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-432™. By default, the X-432™ comes from the factory with an IP address of 192.168.1.2. Communications with the X-432™ may be established by assigning an IP address to the configuration computer that is on the same network as the X-432™ (for example, the configuration computer could be assigned to 192.168.1.50)

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

Step 1: Open the control panel by clicking on the start menu and then clicking on Control Panel (Figure 2.3a).

Note: The control panel shown (Figure 2.3b) is in “Classic View.” If the control panel is in “Category View,” select the “Classic View” option before proceeding.

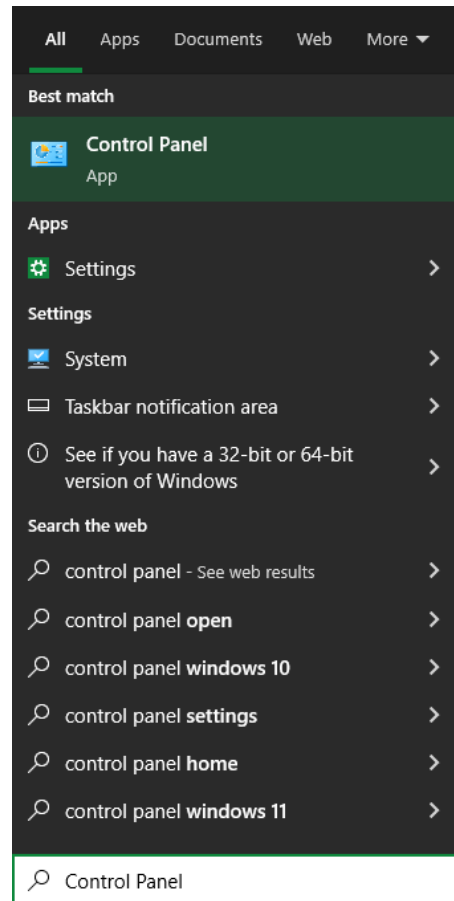


Figure 2.3a - Start Menu

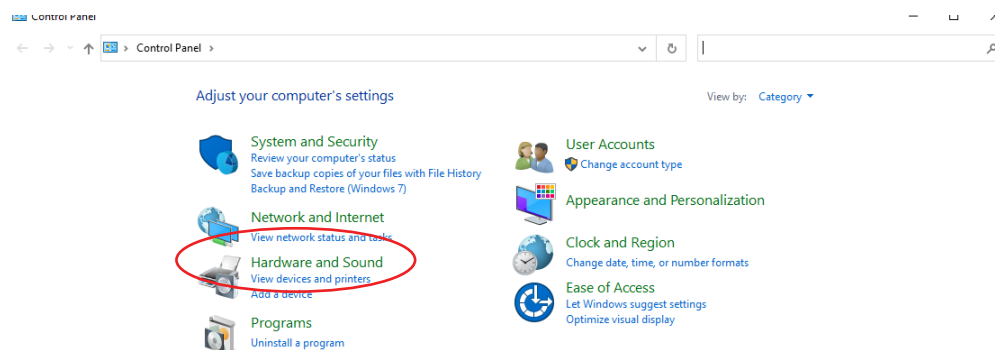


Figure 2.3b - Control Panel

Step 2: Double click on the icon labeled Network Sharing Center. The window shown below will pop-up.

Note: To access the Network Connections folder in Windows Vista, select the Windows Icon (Start Menu) and enter `nca.cpl` into the search bar and press Enter.

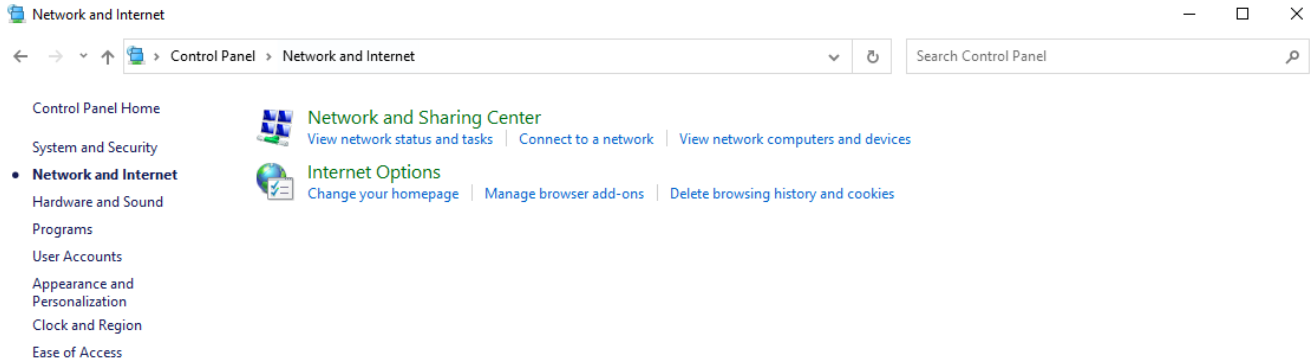


Figure 2.3c - Network and Internet

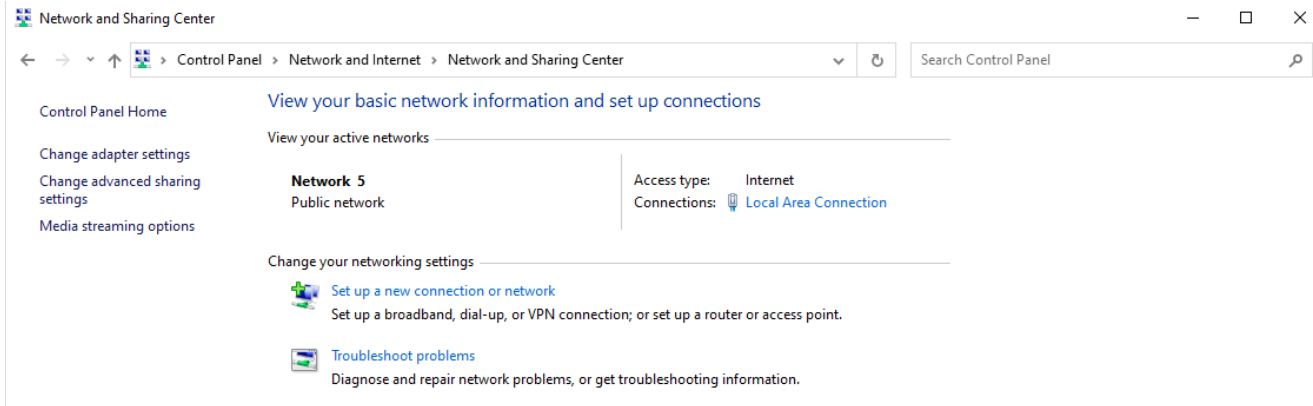


Figure 2.3d - Network and Sharing Center

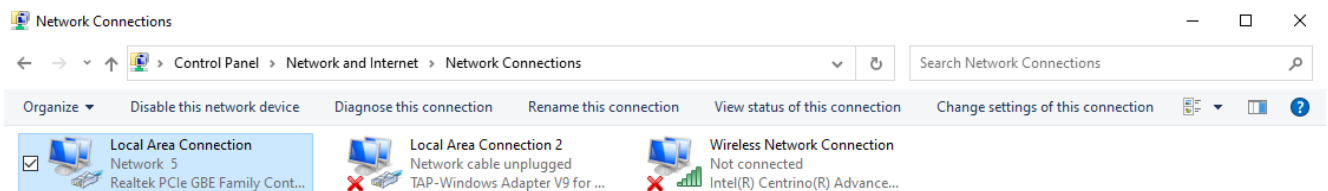


Figure 2.3e - Network Connection

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 “Internet Protocol (TCP/IP),” then click the button labeled “Properties.”

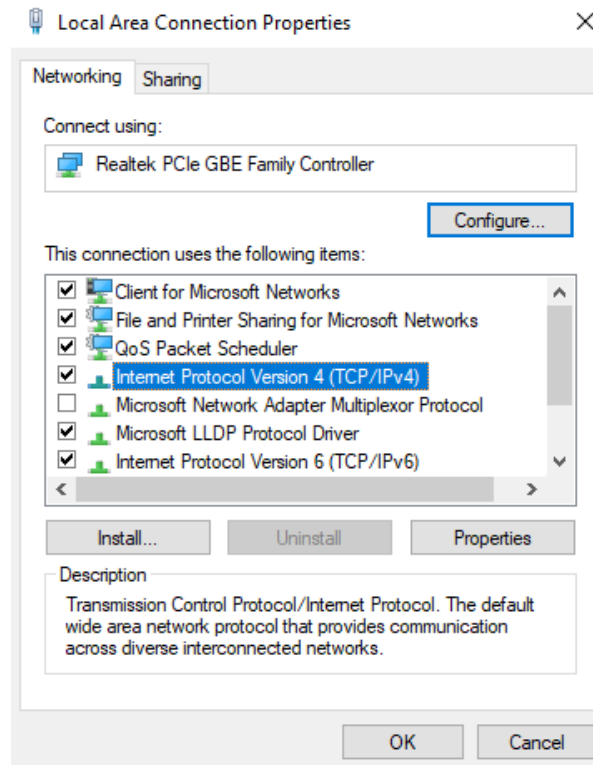


Figure 2.3f - Local Area Connection

Step 4: The following “Internet Protocol (TCP/IP)” Properties menu appears:

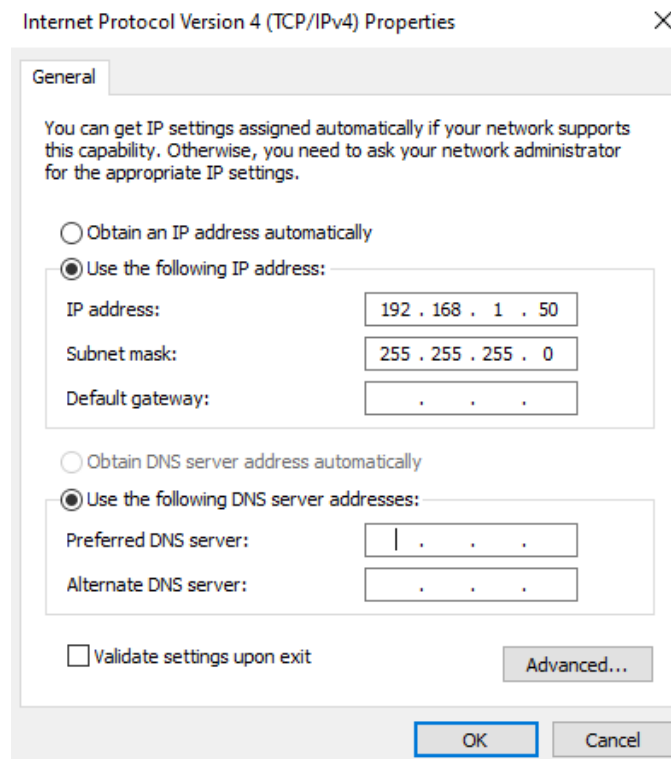


Figure 2.3g - TCP/IP Properties

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

Note: If “Use the following IP address” is already selected, the values need to be recorded, then reentered once the IP address of the X-432™ is successfully changed.

2.3.3 Open Configuration Web Page

Once the network is set up, open the setup page as described in section 2.4. If the setup pages are not accessible, verify that the X-432™ is powered on and that the LINK light is illuminated. Check all network connections and settings. Another way to check communications is to ping the X-432™ (from the command prompt by typing `ping {X-432 IP address}`).

Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, X-432™ may be restored to its original factory default settings.

1. Remove the DC power from the unit. This will also turn off the Output(s).
2. Use a thin, non-conductive object (such as a toothpick) to press and hold the small button located on the side of the unit, next to the Ethernet port. When the object is inserted, a tactile feedback can be felt as the button is depressed.

CAUTION: DO NOT USE METAL OBJECTS FOR THIS FUNCTION.

3. While depressing the button, the green and yellow network LEDs will flash, apply power and wait for about 10 seconds before releasing the button. All settings will be back to the original factory defaults. log.txt and syslog.txt are retained.
4. Refer to **Section 2.3 Establishing Communications for Setup** to begin reconfiguration of the device.

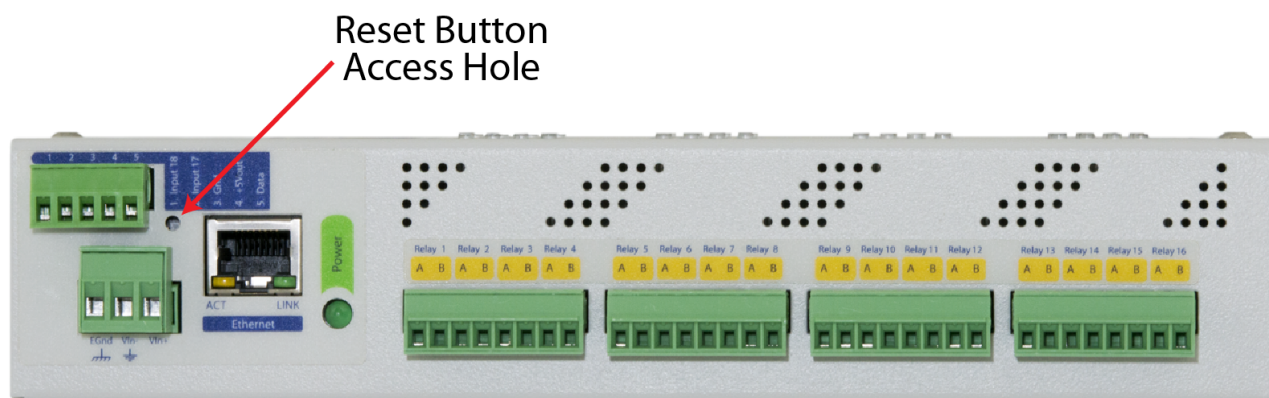


Figure Appendix A.1 - Restore Factory Defaults

Appendix B: Installing New Firmware

From time to time, updates are made to the module's firmware. As an industrial device and unlike many consumer products, firmware updates are recommended only on an as-needed basis. The firmware can be updated in the field. The procedure for updating the firmware is outlined below. Please note that it is important that this procedure is followed precisely.

Requirements

The firmware update software requires Windows 7/8/10.

Setup

1. Updating firmware will not automatically save settings, scripts, etc. Before proceeding with the firmware update, please back up all settings files and Basic scripts.
2. Contact technical support if a firmware update is needed and a download link will be provided. Only a module's image can be installed on the module, so make sure the correct image is being downloaded.
3. bootloader.exe will connect to the module using default IP address 192.168.1.2, not the address currently assigned to the module. After the update, all settings will be lost and the device will return to its default IP address of 192.168.1.2.
Configure the PC to the same subnet as the IP address 192.168.1.2, such as 192.168.1.10. For instructions on doing this see *Section Establishing Communications for Setup*.

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

4. Open the bootloader.exe utility on the computer by double clicking on the downloaded file.
5. Within the ControlByWeb™ Programmer utility programmer, select File, then Open. Specify the firmware image downloaded from the ControlByWeb™ web site.

Device Upgrade Procedure

Carefully follow the following steps to put the module into bootloader mode and perform the upgrade:

1. Remove DC power from the module.
2. Using a small, non-conductive tool, press and hold the reset button.
3. While holding the reset button, apply power to the module. The LINK and ACT lights will flash. Continue to hold the reset button for the next step.
4. While holding the reset button, press the Upload Firmware button at the bottom of the ControlByWeb™ Programmer window. After the programming process begins, the reset button can be released.
5. Programming will take approximately 60 seconds, the LINK LED will stop flashing and remain lit. The module will be set to factory defaults with an IP address of 192.168.1.2.
6. Refer to *Section Establishing Communications for Setup* to reconfigure the device. Verify the new version of firmware has been installed by viewing the default setup page with a web browser (<http://192.168.1.2/setup.html>).

Appendix C: Accessing X-432™ Over the Internet

X-432™ can be monitored and/or controlled from a remote location over the Internet. Once X-432™ can be accessed on the local network, almost all of the settings required to provide remote access are in the router and not in X-432™. This guide is not meant to be a tutorial in router setup, but rather to provide a basic overview of remote access. For specific details, the user should refer to the instruction manual for the router on the local network. Users not familiar with basic IP networking should study one or more basic IP networking tutorials before proceeding (many tutorials are available on the Internet).

IP Addresses

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

Every device that is “directly” connected to the Internet uses a “public” IP address. X-432™ can be assigned a public IP address for direct connection to the Internet. Typically, a public IP address would only be assigned to X-432™ when it is the only device on the local network. The IP address would be obtained from an Internet Service Provider (ISP).

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

A Simple Local Area Network

A small Local Area Network (LAN), can be made up of two or more computers or other devices connected to an Ethernet switch. Each device on the network is assigned a unique private IP address. For example, consider a simple network that consists of a computer, an X-432™, and a WebRelay. In this example, the computer is assigned an IP address of 192.168.1.10, X-432™ 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 X-432™ by entering its IP address in the URL line in the browser, <http://192.168.1.25>. Similarly, WebRelay™ can be accessed by entering its unique private IP address in the URL line in the browser, <http://192.168.1.26>.

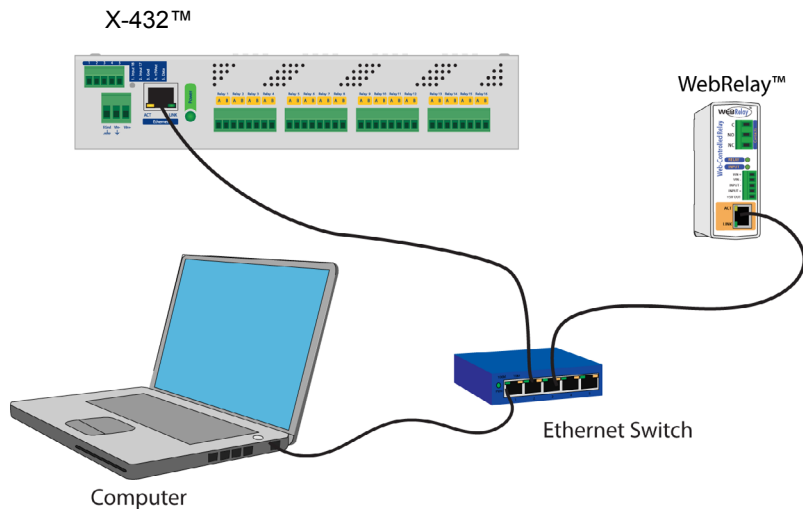


Figure Appendix C.1 - Local Area Network

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).

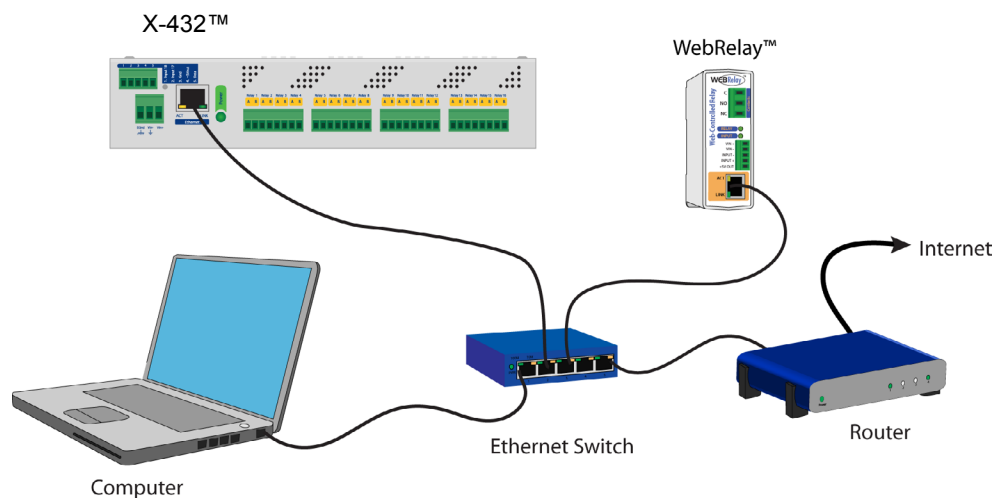


Figure Appendix C.2 - LAN Connected to the Internet

In the example, when a user on the computer needs to access a server on the Internet, the computer sends the request to the router at 192.168.1.1. The router sends the request to the 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 router can be configured to allow outside access to the ControlByWeb devices. All requests from the Internet to any device on the local network must use the public IP address (203.0.113.254). With only a single IP address, TCP ports are used to identify the intended device for the incoming message.

Using the mailing address analogy, the port is similar to a post office box. The IP address specifies the location, and the port specifies the specific recipient. Port numbers can be set to any number between 1 and 65535. However, many port numbers are reserved for specific applications and should be avoided. As a general rule, numbers above 8000 are safe to use. All of the ControlByWeb™ devices come from the factory with the HTTP port set to 80, which is the standard port for HTTP. In the example above, the X-410 HTTP port will be changed to port 8000 and WebRelay™ port will be changed to 8001. Once the ports are changed in the two ControlByWeb™ devices, the router must be set up for port forwarding.

Port forwarding associates the IP address of each local device with an assigned port. In the above example, the address 192.168.1.25 for the X-410 would be associated with port 8000. The address 192.168.1.26 for WebRelay™ would be associated with port 8001. The X-410 would be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-410 in the URL window of the browser, `http://203.0.113.254:8000`. All Internet requests to the router for port 8000 would be forwarded to the X-410. Similarly, all request for port 8001 would be forwarded to WebRelay.

Note: When an HTTP request comes in to the router without the specific port specified (`http://203.0.113.254`), the router will handle this as a port 80 request (default HTTP port). In other words, `http://203.0.113.254` is exactly the same as `http://203.0.113.254:80`.

Router configuration can vary widely. Some routers have the capability of translating the addresses and the ports, which would require no port configuration change on the ControlByWeb device. For example, the router would be configured so that messages sent to `http://203.0.113.254:8000` would be forwarded to `http://203.0.113.254:80`, which is the default HTTP port.

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

The screenshot shows the NETGEAR genie JNR3210 router configuration page. The 'ADVANCED' tab is selected, and the 'Port Forwarding / Port Triggering' section is active. The interface includes a sidebar with navigation options and a main configuration area. The main area shows a table of configured services:

#	Service Name	External Starting Port	External Ending Port	Internal Starting Port	Internal Ending Port	Internal IP address
1	Webrelay	8000	8001	8000	8001	10.0.0.25
2	Webswitch	8002	8002	8002	8002	10.0.0.26

Buttons for 'Edit Service', 'Delete Service', and 'Add Custom Service' are visible below the table.

Figure Appendix C.3 - Port Range Forwarding

Note: Routers will vary, this is an example.

Accessing Setup Pages

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

```
http://(ControlByWeb Device's Local IP Address):(Port Number)/setup.html
```

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

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

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

```
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 device:

```
http://203.0.113.254:8000/setup.html
```

Appendix D: External Server and Remote Services

Note: The following methods are supported by X-432™; however, Xytronix Research & Design, Inc. does not provide or support custom third party applications, or external web servers.

Accessing X-432™ with Custom Software or Third Party Applications

X-432™ provides a programming interface that allows applications running on a computer to have full access to it. Custom applications can send commands to X-432™ for monitoring and control. They can also be used to provide a custom user interface, provide access to multiple units in a single screen, and allow for automation, logging, etc.

Using an External Web Server

Rather than accessing X-432™ 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 X-432™. In this scenario, users access custom web pages that reside on the external web server and the external web server communicates with X-432™. This means users would not communicate directly with X-432™.

Using an external web server to provide a custom user interface is beneficial because multiple X-432™ 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 ControlByWeb™ devices, but rather the user sees a custom control page that shows the entire system. In addition, the use of an external web server allows programmers to create custom user interfaces that take advantage of the additional resources typically available on larger web servers, including more memory and various web programming languages.

There are two approaches that an external server can use to communicate with X-432™ and other ControlByWeb™ devices, Direct Server Control and Remote Services.

Direct Server Control

The first approach is for the external server to create a TCP connection whenever it needs to access X-432™. In this case, the external server opens the connection, sends commands and/or reads the device, and closes the connection.

This method is ideal when the web server and all of X-432™ devices are on the same network (without routers between them). In this case, the server can communicate with X-432™ directly and securely since data never has to leave the local network.

When the server and X-432™ are on different networks, routers must be configured to allow appropriate access. If a public network is used, such as the Internet, security precautions should be considered.

Remote Services

The second approach is for X-432™ to initiate a connection using the “Remote Services.” The settings under the Advanced Network tab in the setup pages will enable the X-432™ to open a TCP connection with an external server. Once the connection is open, the external server can send commands and/or read the device. The external server can leave the connection open (so that it never closes) or close the connection.

“Remote Services” is ideal for installations where the server and X-432™ are installed on different networks. This is especially useful when each X-432™ is installed on a separate private network. For example, if the user doesn’t control the network connections where X-432™ is installed, “Remote Services” would initiate a TCP connection over the Internet with the control computer. Since X-432™ initiates the connection, the control computer doesn’t have to know the IP address of X-432™. This means that X-432™ can be installed using DHCP. In addition, no special router configuration is required. This makes the network installation of X-432™ very simple, and since no incoming ports need to be opened in the router, security is not compromised. See the **Advanced Network** Tab for more information.

X-432™ can be configured to establish a connection when triggered by an event, such as an Outlet state changing. This is done by setting the Remote Service/SNMP checkbox in the setup tabs.

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

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

Connection String

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

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

Appendix E: Log Files

X-432™ 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; this 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 under the **Logging** setup tab, and stores real-world data such as temperatures and events such as relay state changes (see section **2.4.6 Logging Tab** for more information). It can be up to 3072K bytes long and is stored using a comma separated value formatting scheme.

Digital Inputs, Relays, Analog Inputs, and Sensors will only be displayed if they are selected in the **Logging** setup tab. The file is read by requesting the log.txt file from X-432™. For example, using the default IP address the following command would be used to request the log file:

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

File format:

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

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)
```

Example:

```
Date Time,Relay 1,Trigger  
07/30/2023 10:30:00,0,I/O: ()  
07/30/2023 11:00:00,1,I/O: ()  
07/30/2023 11:30:00,0,I/O: ()  
07/30/2023 12:00:00,1,I/O: ()
```

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 address bar:

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

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

Note: If the control password is enabled in the setup pages, the password (control password) will be required to access this file.

System log file: syslog.txt

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

File Format:

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

Sample File:

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

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

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

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

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

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

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

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

To erase the file, use:

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

Appendix F: SNMP Requests, Objects and Community Strings

Digital input states, counter inputs states, relay states, analog inputs, temperature/humidity, and some simple network parameters can be retrieved using Simple Network Management Protocol(SNMP). The states of the relays can be changed through SNMP requests. For most cases, using SNMP is as simple as locating the appropriate Management Information Bases (MIB) files and loading them into the SNMP manager software. X-432™ can make use of the following MIB files: RFC1213-MIB and XYTRONIX.mib.

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

SNMP is configured under the **Advanced Network** setup tab. See section **2.4.3 Advanced Network Tab** for more information.

X-432™ supports the following Packet Data Units (PDU):

- GetRequest
- GetNextRequest
- SetRequest
- Trap

Standard Objects

RFC1213 Object	Response
system.sysDescr	X-432
system.sysObjectID	X432
system.sysUpTime	Time in hundredths of seconds since X-432™ was last powered
system.sysName	X-432*

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

Xytronix Objects

X-432™ also supports some special objects that can be found in the XYTRONIX.mib. This MIB can be downloaded from our website.

Read Only Objects:

Optically-Isolated Digital Inputs

Object	Input Type	Response
x432_inputOne	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputTwo	Digital	Value: 0 or 1

Object	Input Type	Response
x432_inputOne	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputTwo	Digital	Value: 0 or 1
x432_inputThree	Digital	Value: 0 or 1
x432_inputFour	Digital	Value: 0 or 1
x432_inputFive	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputSix	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputSeven	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputEight	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputNine	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputTen	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputEleven	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputTwelve	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputThirteen	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputFourteen	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputFifteen	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)
x432_inputSixteen	Digital	Value: 0 or 1 (0 - OFF, 1 - ON)

Digital Inputs

Scaled values are reported.

Object	Response
x432_counterOne	Value: 0.0 (Current count)
x432_counterTwo	Value: 0.0 (Current count)

Analog Inputs

Scaled values are reported.

Object	Response
x432_analogOne	Value: 0.0 (Current analog value)
x432_analogTwo	Value: 0.0 (Current analog value)
x432_analogThree	Value: 0.0 (Current analog value)
x432_analogFour	Value: 0.0 (Current analog value)

Sensors

Object	Response
x432_sensorOne	Value: x.x (Decimal temperature or humidity.)
x432_sensorTwo	Value: x.x (Decimal temperature or humidity.)
x432_sensorThree	Value: x.x (Decimal temperature or humidity.)
x432_sensorFour	Value: x.x (Decimal temperature or humidity.)

Read/Write Objects:

Relays - Read/Write

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

Object	Input Type	Response
x432_relayOne	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayTwo	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayThree	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayFour	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayFive	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relaySix	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relaySeven	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayEight	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayNine	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayTen	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayEleven	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayTwelve	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayThirteen	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayFourteen	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relayFifteen	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE
x432_relaySixteen	Value: 0 or 1	0 - OFF, 1 - ON, 2 - PULSE

TRAPS

X-432™ can send SNMP messages when an input or relay changes state, when a particular Sensor value is reached, or when the supply voltage is out of the desired range. The SNMP Trap must be configured for each Relay, Input, and Sensor in the setup pages. The following Traps are supported:

Relay Traps

A change in state of the relay will cause the X-432™ to send a Trap message.

Object	Description	Value
X432.75	Relay one state change.	0 or 1 (0 - OFF, 1 - ON)
X432.76	Relay two state change.	0 or 1
X432.77	Relay three state change.	0 or 1
X432.78	Relay four state change.	0 or 1
X432.79	Relay five state change.	0 or 1
X432.80	Relay six state change.	0 or 1
X432.81	Relay seven state change.	0 or 1
X432.82	Relay eight state change.	0 or 1

Object	Description	Value
X432.83	Relay nine state change.	0 or 1 (0 - OFF, 1 - ON)
X432.84	Relay ten state change.	0 or 1
X432.85	Relay eleven state change.	0 or 1
X432.86	Relay twelve state change.	0 or 1
X432.87	Relay thirteen state change.	0 or 1
X432.88	Relay fourteen state change.	0 or 1
X432.89	Relay fifteen state change.	0 or 1
X432.90	Relay sixteen state change.	0 or 1

Input Traps

When an input on the X-432™ changes state, a Trap message will be sent.

Object	Description	Value
X432.95	Input one state change.	0 or 1 (0 - OFF, 1 - ON)
X432.96	Input two state change.	0 or 1
X432.97	Input three state change.	0 or 1
X432.98	Input four state change.	0 or 1
X432.99	Input five state change.	0 or 1
X432.100	Input six state change.	0 or 1
X432.101	Input seven state change.	0 or 1
X432.102	Input eight state change.	0 or 1
X432.103	Input nine state change.	0 or 1
X432.104	Input ten state change.	0 or 1
X432.105	Input eleven state change.	0 or 1
X432.106	Input twelve state change.	0 or 1
X432.107	Input thirteen state change.	0 or 1
X432.108	Input fourteen state change.	0 or 1
X432.109	Input fifteen state change.	0 or 1
X432.110	Input sixteen state change.	0 or 1
X432.111	Input seventeen state change.	0 or 1
X432.112	Input eighteen state change.	0 or 1

Analog Traps

An SNMP Trap message can be sent when the analog alarm boundaries are crossed.

Object	Description	Value
X432.120	Analog one alarm.	xxx.x
X432.121	Analog two alarm.	xxx.x
X432.122	Analog three alarm.	xxx.x
X432.123	Analog four alarm.	xxx.x

Sensor Traps

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

Object	Description	Value
X432.65	Sensor one alarm.	xx.x
X432.66	Sensor two alarm.	xx.x
X432.67	Sensor three alarm.	xx.x
X432.68	Sensor four alarm.	xx.x

Password

X-432™ uses the Control Password for both the read and write community strings. If the Control Password is disabled, any object can be read without the need for a correct community string. By default the Control Password is `webrelay`.

Appendix G: BASIC Scripts

BASIC (Beginners All-purpose Symbolic Instruction Code) is a computer programming language that has been in use for many years. The X-432™ has an integrated BASIC interpreter for simple BASIC scripts. This provides a great deal of flexibility by allowing users to customize basic functions of the unit. The interpreter only supports a small subset of the BASIC commands that are available for computers. Some non-standard commands have been added, and some commands may function differently on the X-432™ BASIC interpreter than on other platforms. The following is a short tutorial on the supported BASIC functions.

Contact customer support if further assistance is required.

Structure

A BASIC script is written as a .txt file, which is then uploaded to the device using the Script setup tab. The maximum script size is 2 kbytes. Each line within the script contains a single statement. Line numbers are not used.

Statements are not case sensitive; however, variables are.

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

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

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

Line Format

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

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

The fields in parentheses are optional depending on the statement. Spaces must be used between all statements, numbers, variables, operators, expressions, etc. Multiple spaces are valid. Comments may be inserted, but must begin with an apostrophe. All text on a line after the apostrophe is ignored.

Examples:

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

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

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

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

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

Supported Statements

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

LET

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

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

IF THEN, ELSE, END IF

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

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

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

FOR TO, NEXT

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

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

DO WHILE, LOOP

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

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

```
LOOP
```

Example:

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

LOG

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

*Note that in order to log, logging must be enabled in the **Logging** setup tab. The format is:*

The format is: LOG

EMAIL

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

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

Examples:

EMAIL 'Status email sent to addresses listed under Network tab.

...or...

EMAIL 'Sends state change message to emails setup in I/O tab.

...or...

EMAIL 'Input state change message to emails setup in I/O tab

....or...

EMAIL 'Temp alarm message sent to recipients in the Sensors tab.

MAIL

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 outlets 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)      `outlet variable value to screen
PRINT "(message)"    `outlet '(message)' to screen
```

User-Defined Variables

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

Up to 10 user variables may be initialized. These must be single character, lower case letters.

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

They are always global and stored internally as floating point numbers. Variables are defined using the LET statement.

Examples:

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

Predefined Variables

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

Timer Variables

Six timers are available for use in BASIC scripts.

t0, t1, t2, t3, t4, t5

Timers can be set to any positive integer (or 0) by using the LET statement. As soon as a value is assigned to a timer, it will begin to count down immediately by decrementing one count every 100ms until it reaches zero.

Examples:

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

Relay Variables

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

```

relay1          'relay 1
.
.
relay16         'relay 16
rmt_relay1     'remote relay 1
.
.
rmt_relay3     remote relay 3
.
.
rmt_relay16    'remote relay 16

```

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

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

```

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

```

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

Examples:

```

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

```

Input Variables

The digital input states can be read in BASIC scripts.

```

input1         'digital input 1
input2         'digital input 2
input3         'digital input 3
input4         'digital input 4
.
.
input16        'digital input 16

```

Example:

```

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

```

Analog Variables

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

```
ana1    'analog input 1
...     'ana2, ana3
ana4    'analog input 4
```

Example:

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

Temperature/Humidity Sensor Variables

Each temperature sensor can be read in BASIC scripts.

```
temp1   'temp or humidity sensor 1
temp2   'temp or humidity sensor 2
...
temp4   'temp or humidity sensor 4
```

Example:

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

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

Event Variables

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

Up to five date variables are available.

```
ed1     'event date variable 1
...     'ed2, ed3, ed4
ed5     'event date variable 5
```

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

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

Time variables have a similar naming convention.

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

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

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

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

Example:

```

Let a = 1
Let ed1 = 04/10/2009           '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

```

External Variables

External variables are similar to general purpose variables and can be used in the same manner. The difference between general purpose variables and external variables is that external variables can be accessed by the user through a web browser and modified while the script is running. Scripts can use external variables as a method of retrieving user input.

<i>extvar0</i>	'external variable 1
...	'extvar2, extvar3, extvar4
<i>extvar4</i>	'external variable 5

The following example demonstrates this by creating a script that will turn Output 1 **ON** if extvar1 equals 1 and turn Output 1 **OFF** if extvar1 equals 0.

Example:

```

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

```

External variables can also be used to show numeric values, such as a count down timer. If the extVar is any other value than 1 or 0, the value will be displayed in the Status 2 column, with a gray background. See section **2.4.13 Script Tab** for instructions on configuring external variables for visibility on the **Control Page**.

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

Example:

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

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

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

loop
end
```

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

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

Testing and Debugging:

A copy of the BASIC interpreter for Windows is also available on our website for the use of testing and debugging. The X-432™ will only acknowledge errors as it runs. This means that if a path of the script is not encountered, errors may still exist. The Windows version of the interpreter, however, will check for errors before the script is run.

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

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

MISSING END OF LINE error may be caused by misspelled names or a program that is too long. 1900 bytes of memory is reserved for BASIC scripts. Each text character, space, punctuation mark, tab, or carriage return uses one byte. If the script is too long, the script will be truncated and will not function as desired.

Appendix H: Specifications

Power Requirements:

- Voltage: 9-28VDC
- Max Current: 1.16A Max

10 Mbps Network Speed, 28VDC Applied to Inputs, +5Vout Applied to Analog Inputs

Power Supply	No Relays On No Inputs On	8 Relays On 8 Inputs On	16 Relays On 18 Inputs On
9 VDC	184 mA	567 mA	1.012 A
12 VDC	142 mA	429 mA	734 mA
16 VDC	116 mA	322 mA	540 mA
24 VDC	83 mA	220 mA	363 mA
28 VDC	74 mA	192 mA	316 mA

100 Mbps Network Speed, 28VDC Applied to Inputs, +5Vout Applied to Analog Inputs

Power Supply	No Relays On No Inputs On	8 Relays On 8 Inputs On	16 Relays On 18 Inputs On
9 VDC	282 mA	690 mA	1.161 A
12 VDC	216 mA	504 mA	819 mA
16 VDC	166 mA	377 mA	602 mA
24 VDC	116 mA	261 mA	407 mA
28 VDC	104 mA	227 mA	351 mA

Relay Contacts:

- Number of Relays: 16
- Max Voltage: 30VDC, 30VAC
- Max Current: 2A
- Contact Type: SPST (Form 1A)
- Load Type: General Purpose
- Contact Resistance: < 100 milliohms initial
- Contact Material: AgSnO2
- Electrical Life: 100K operations (Min)
- Mechanical Life: 5M cycles (Min)
- Environmental Rating: Over voltage Category II, Pollution Degree 2
- Relay Modes: ON/OFF or Pulsed
- Pulse Timer Duration: 0.1 to 86,400 Seconds (1-day)

Optically-Isolated Digital Inputs (1-16):

- Number of Inputs: 16
- Voltage Range: 3-26VDC
- Current: 0.6mA @ 3V, 8.2mA @ 26V
- Minimum Hold Time: 20ms
- Input Isolation: 1500V
- Input Functions: Monitor State, Control Relays, Control Remote Relays, Count, High Timer
- Maximum Count: 24-bit
- Max Count Rate: 25Hz Max

Digital Inputs (17 & 18):

- Number of Inputs: 2
- Type: Non-Isolated
- Voltage Range: 0-5VDC
- Current: 47K Pull-Up
- Minimum Hold Time: 20ms
- Input Functions: Monitor State, Control Relays, Control Remote Relays, Count, High Timer
- Maximum Count: 24-bit
- Max Count Rate: 200Hz Max
- Edge Trigger: Rising, Falling or Both

Analog Inputs:

- Number of Inputs: 4
- Type: Single-ended Channels
- Input Range: 0-5VDC
- Resolution: 12-bit
- Reference: 5.00V, 0.04%, 3ppm/C, 50mA Max

Temperature Sensors:

Maximum Number of Sensors: 16

Type: Dallas Semiconductor DS18B20

Temperature Range: -67°F to 257°F (-55°C to +125°C)

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

Sensor Functions: Thermometer, Thermostat, Relay Control, Remote Relay Control,
Email Alerts, SNMP Traps, Temperature Logging

Humidity Type: Xytronix Model X-DTHS-P sensor

Humidity Range: 0-100% RH

Accuracy: $\pm 1.8\%$

Real-Time Clock:

- Manual or NTP(Network Time Protocol) setup
- NTP Sync Period: Once, Daily, Weekly, On Powerup
- Auto Daylight Savings Adjustment
- Battery (capacitor) Power Backup

Capacitor Power Backup:

- Backup Functions: Retain Real-Time Clock, 1 Register, 2 Counters, 16 Relay States
- Backup Duration: 2 weeks minimum

Network:

- Type: 10/100 Base-T Ethernet Port
- Setup: Static or DHCP IP address configuration

Connectors:

- Power: 3-Position, 5.08mm, Removable
- Relays & Inputs: 8-Position, 3.81mm, Removable
- Inputs 17 & 18: 5-Position, 3.81mm, Removable
- Network: 8-pin RJ-45

LED Indicators:

- Number of LEDs: 35
- Power on
- Relay coil energized 1-16
- Optically-Isolated Digital inputs (1-16)
- Network linked
- Network activity

Physical:

- Operating Temperature: -40°F to 150°F (-40°C to 65.5°C)
- Size:
 - 8.725in (221.6mm) wide
 - 1.815in (46.1mm) tall
 - 3.735in (94.9mm) deep (not including connector)
- Weight: 31.3 oz (887.3 grams) with connectors
- Material: Powder-Painted Steel

Protocols:

- HTTP(S), JSON, XML, Modbus TCP/IP, SNMP, Remote Services

Logging:

- Log File Size: 3072K (Max 50688 logs)
- Storage: Nonvolatile Flash
- Buffer Architecture: Circular Buffer
- Log data can be periodically read and stored on a computer

Password Settings:

- Password protection on setup page: Yes
- Password protection on control page: Optional
- Password Encoding: Base 64
- Password Length: 6-18 Characters

Electromagnetic Compliance:

- IEC CISPR 22, CISPR 24
- EU EN55024, EN55022
- FCC 47CFR15 (Class B)

Product Safety Compliance:

- IEC 61010-1



Appendix I: Mechanical Information

