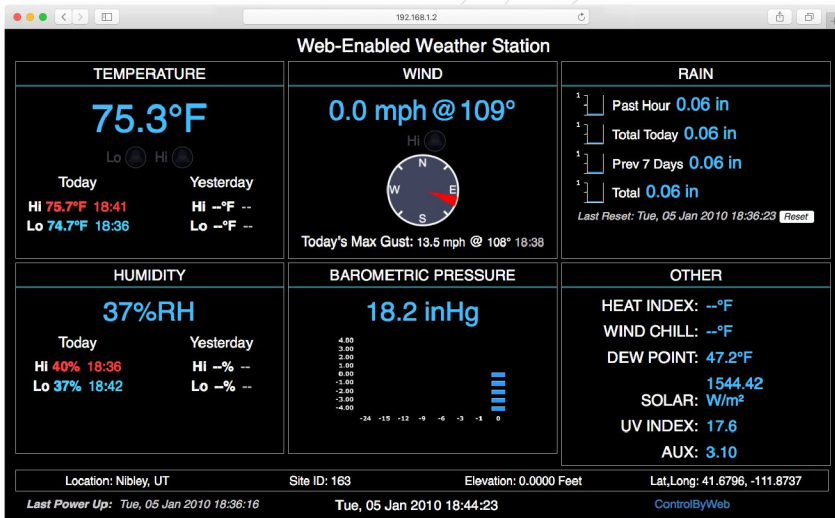


X422

Davis Sensor Suite Controller USERS MANUAL

Rev 1.2



CONTROL by
WEB
www.ControlByWeb.com

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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

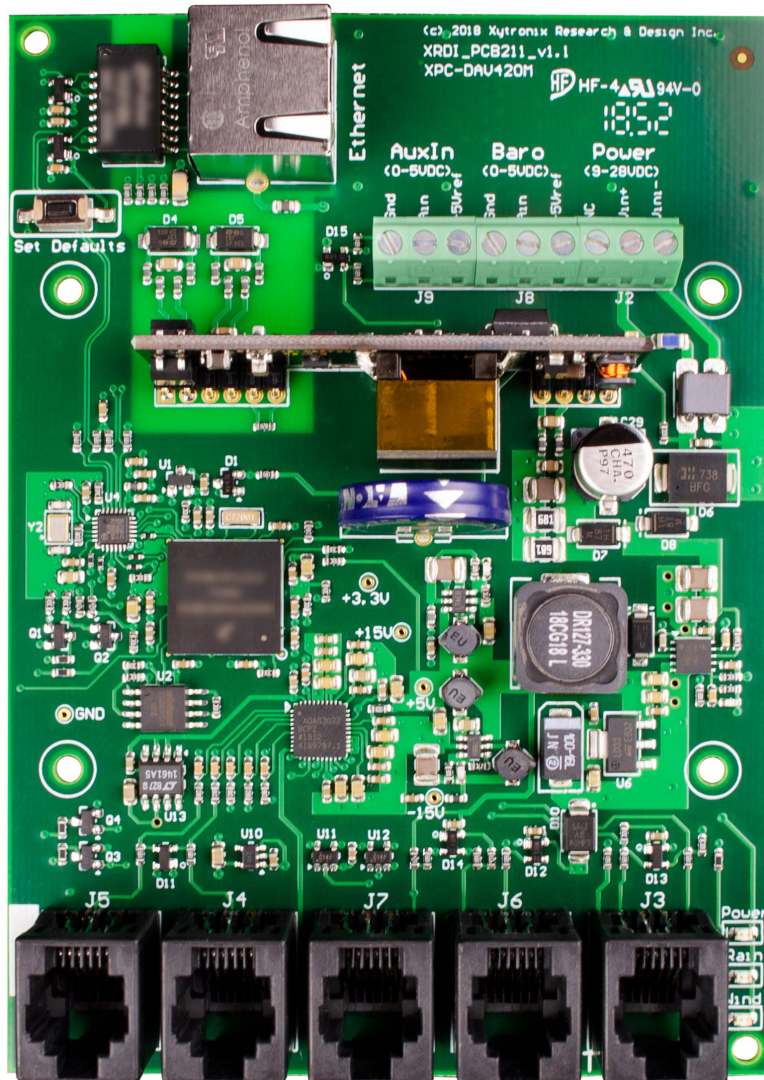
X-422™ does not employ a general purpose computer operating system and does not have features such as telnet, FTP, SSH, nor uncontrolled open ports. This means it is not possible for someone to 'break in' to the X-422 and access other devices on your local network. The simplicity of the X-422 makes it an inherently secure device. Nevertheless, as with any device installed on a network, appropriate security precautions should be observed.

If the X-422 is installed on the Internet, it is recommended that passwords be enabled for the **Weather Monitor Page**. Passwords should be at least 8 characters in length and use a combination of upper and lower case letters and numbers. For additional security, a firewall may be used to limit access to selected IP addresses. Another option may be to set up a Virtual Private Network (VPN) between the network where the X-422 resides and the client machine (web browser, another, ControlByWeb™ product, etc.).

Section 1: Introduction

The X-422™ is an advanced meteorological monitoring system controller designed specifically to be used with a Davis Instruments Integrated Sensor Suite (ISS). The X-422 reads all of the sensors in the ISS (wind speed, wind direction, temperature, humidity, rain, etc) and provides current measurements to users in real time as well as historical measurements through a beautifully formatted web page or mobile app. The web server is built-into the X-422 which makes this a reliable, stand-alone solution with no cloud-services required (however the X-422 can work with cloud services as well).

The X-422 mounts directly inside the ISS housing and seamlessly connects directly to all of the meteorological sensors which are provided in the sensor suite. It's connected to a local area network (LAN) using a wired Ethernet connection. The wired Ethernet connection also provides power to the X-422 and all of the sensors in this ISS using Power Over Ethernet (POE).



With proper configuration of Ethernet gateways, the X-422™ can be viewed through an Internet connection at remote locations.

In addition to standard weather information, users can leverage the sophistication of the X-422 for some of the following functions:

- Data logging.
- Password-protected interface.
- Automatic time synchronization through NTP service.
- Publish weather data to public weather sites such as Citizen Weather Observer or Weather Underground.

1.1 X-422 Features

Installs Directly Into Davis Integrated Weather Sensor Suite

Seamlessly mounts into the Davis 6322C Integrated Sensor Suite for clean installation.

Power Over Ethernet

Controller and sensors are powered using standard 802.3af Power Over Ethernet which simplifies installation requirements. External DC power input provided (9-28VDC input) for non-POE installations.

Quick Connect to 6322C Sensors

Connect the sensors provided in the Davis 6322 including temperature/humidity sensors, wind speed/direction sensors, and rain sensor

Quick Connect to Optional UV and Solar Radiation Sensors

The X-422 provides RJ-11 jacks for easy connection of optional UV and Solar Radiation sensors.

Barometric Pressure Input

Terminals are provided to connect an analog barometric pressure sensor.

Auxiliary Sensor Input

The X-422 provides terminals for an additional analog sensor if needed.

1.2 X-422 Models Available

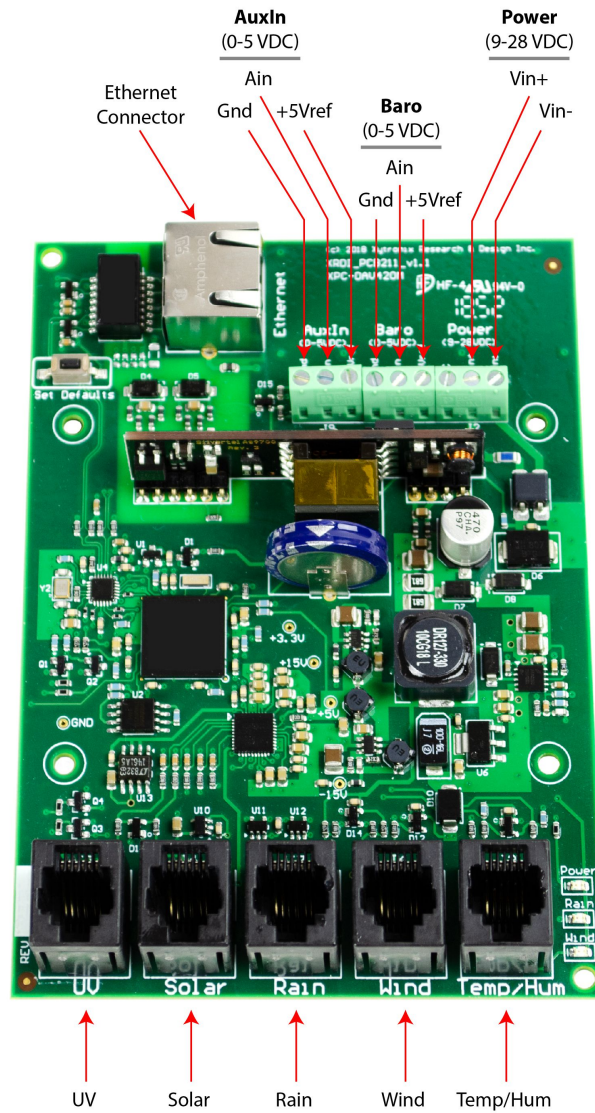
X-422 is currently available in one model.

X-422-E	Web-Enabled Davis Sensor Suite Controller
---------	---

1.2.1 Optional Accessories

Accessory	Description	Part Number
Davis Instruments Integrated Sensor Suite	Meteorological sensor station which includes wind direction, wind speed, precipitation, temperature, and humidity sensors. The X-422 mounts inside this suite. The X-422 is sold separately, however it may purchased as a pre-mounted kit.	DAVIS-6322C
Davis Solar Radiation Sensor	Measures solar radiation and solar energy.	DAVIS-6450
Davis UV Sensor	Measures the sunburning portion of the UV spectrum	DAVIS-6490
Sensor Mounting Shelf	Mounting shelf for the Davis UV and Solar Radiation sensors	DAVIS-6673
Mounting Tripod	Used to mount the integrated sensor suite	DAVIS-7716
Rain Collector Heater & Cone	Rain collector heater to prevent freezing. Note that this unit requires external power.	DAVIS-7721
Daytime Fan-Aspirated Radiation Shielding Kit	Circulates air through temperature and humidity sensors.	DAVIS-7747

1.3 Connectors & Indicators



Network Connector

The Ethernet connector is a standard 8-position modular receptacle and is used to connect the module to the ethernet network. If this is connected to an 802.3af compatible Ethernet switch or POE power injector, power will be provided to the module and sensors through the Ethernet connection.

Power Connector

This is a terminal connector for connection to a DC power supply to provide power to the module and attached sensors. When used, the applied DC power should be within the range of 9V minimum to 28V maximum. This is only required if the module is not connected to an 802.3af Power Over Ethernet (POE) power source such as a POE Ethernet Switch or power injector.

Rain, Wind, and Temp/Humidity Connectors

These RJ-11 modular connectors are used to connect all of the sensors included in the Davis 6322C sensor suite. This includes rain, wind direction, wind speed, temperature, and humidity.

UV Connector

This RJ-11 modular connector can be used to connect an optional UV sensor.

Solar Radiation Connector

This RJ-11 modular connector can be used to connect an optional solar radiation sensor.

Baro Connector

An analog barometric pressure sensor can be connected through these terminals. The barometric pressure sensor should provide a 0-5V analog output.

Aux Input Connector

An additional analog sensor can be connected to these terminals. The analog sensor should product a 0-5V output (or a 4-20mA output can be used by adding a resistor across these terminals).

Module Power Indicator

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

Rain Indicator

The green LED indicator labeled Rain illuminates momentarily each time the rain collector tips. This indicates that 0.01 inches (0.254mm) of rain was measured. This LED is useful for verifying connections and proper operation of the rain sensor. For diagnostic purposes the user can carefully move the sensor back and fourth and confirm that the LED turns on and off (be sure NOT to touch the reed switch).

Wind Indicator

The green LED indicator labeled Wind flashes as the wind speed sensor (anemometer) rotates. As the rotation speed increases the frequency of the flashing increases as well. This indicator is useful for verifying proper connection and operation of the wind speed sensor.

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 amber when activity is detected on the network.

1.4 Accessing the X-422

Standard Access Using a Web Browser

The X-422 has a built-in web server which provides simple web pages that can be accessed directly using a standard web browser. This allows users to access the unit with NO SPECIAL SOFTWARE installed on their computer. This is ideal for applications that require a quick, simple solution that does not need to be accessible to more than a few people. This configuration is simple to setup, simple to use, and can be accessed from any computer.

Note: Network routers may need to be configured to allow access from computers outside of the local network (see **Appendix C: Accessing X-422 Over the Internet**).

Section 2: Installation and Setup

*****NOTE:** *Installation instructions in this manual are for the X-422 module ONLY. Instructions for the installation of the Davis sensor suite and other sensors is provided in their respective installation manuals.*

Installation consists of mounting the X-422 inside the sensor suite and connecting the sensors to the module, installing the sensor suite as per the sensor suite instructions, connecting it to an POE Ethernet network, and configuring via a web browser.

2.1 Mounting the X-422 Inside the Sensor Suite

The X-422 can be purchased as a separate controller board or it may be purchased from ControlByWeb pre-mounted inside a sensor suite. If the module was purchased as a pre-mounted kit, skip to section 2.2.



2.1.1 Step 1, Unplug Sensors and Remove Internal White Cover

Remove internal white cover by removing the four screws that hold it in place.



2.1.2 Step 2, Remove Original Circuit Board

Remove the screws that hold the circuit board in place and remove the circuit board.



2.1.3 Step 3, Install X-422 Circuit Board

Install the X-422 circuit board in place of the original circuit board and secure in place using the screws that were removed in the previous step. Sensors may be connected to the board at this time.



2.1.4 Step 4, Re-Install the internal cover and connect

Install the X-422 circuit board in place of the original circuit board and secure in place using the screws that were removed in the previous step.



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 X-422, THE SENSORS CONNECTED TO IT, OR BOTH.

1. Make sure power is turned off (disconnect Ethernet connector if powered using POE).
2. Connect all sensors.
3. Apply power (connect Ethernet connector if powered using POE).

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

Terminal Connector Pinout (Right to Left)		
Connection	Terminal	Description
Power	Vin-	DC Power supply input - (ground) (required only when not powered using POE) VDC- (Ground) power supply input.
Power	Vin+	DC Power supply input +(required only when not powered using POE) 9-28 VDC DO NOT EXCEED MAXIMUM POWER SUPPLY VOLTAGE
	NC	No connection to this terminal.
Barometric Pressure	+5Vref	Analog Input 2.
Barometric Pressure	Ain	Analog Input 3.
Barometric Pressure	Gnd	Analog Input 4.
Aux In (0-5VDC)	+5Vref	+5 VDC reference output for analog sensors.
Aux In (0-5VDC)	Ain	Analog Ground for Analog inputs.
Aux In (0-5VDC)	Gnd	Digital Ground for 5V Out return used with Outputs, Inputs, Frequency inputs, and digital Temperature/ Humidity sensors.

2.2.1 Power Supply Connection

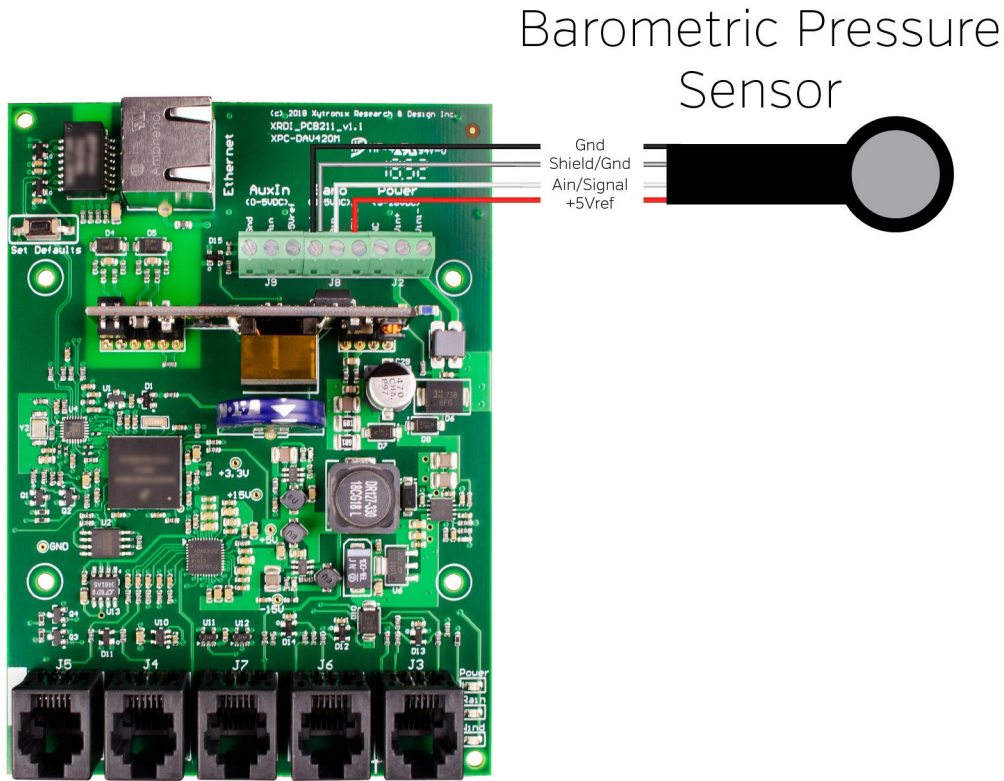
The X-422 requires power for its internal logic circuits and external sensors. For simplicity, the X-422 is designed to be powered using a standard 802.3af POE Ethernet connection. This is accomplished by connecting the X-422 Ethernet connector to a POE switch or a POE injector. If POE is not used to power the module, connect a 9-28 VDC power supply to the Vin+ and Vin- terminals.

2.2.2 Davis Sensor Connections

The X-422 circuit board provides five, RJ11 modular connectors labeled Temp/Hum, Wind, Rain, Solar, and UV. These connectors can be connected directly to Davis Instruments sensors. The Temperature/Humidity, Wind Speed/Wind Direction, and Rain sensors come standard with the 6322C sensor suite. The other two connectors labeled UV and Solar can be connected to Davis UV and Solar Radiation sensors which are purchased separately.

2.2.3 Barometric Pressure and Auxiliary Input Connections

The X-422 provides two additional analog inputs. One is designated as barometric pressure input and the other is an auxiliary input for another analog sensor of choice. Both inputs are connected through three terminal connectors. The three terminals include a +5V reference voltage output, 0-5V analog input, and a ground. Typical connections to these inputs are shown below:



2.2.4 Network Connection

Connect the Ethernet port to a 10 Base-T or 10/100 Base-T Ethernet connection. This typically connects to an 802.3af POE Ethernet switch or to a stand-alone POE power injector.

2.3 Establishing Communications for Setup

In order to configure the X-422 with the web browser interface, the X-422 and computer must be addressed on the same network. This can be done by one of two methods:

Method 1 – Assign a temporary IP address to the X-422 to work on an existing network.

-or-

Method 2 – Temporarily change the IP address of a connected computer to the match the default IP address used by the X-422.

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

2.3.1 Method 1: Assign a Temporary IP address to X-422

This option is used to TEMPORARILY assign an IP address to the X-422 without the need to change the IP address of the configuration computer. The X-422 will use this IP address as long as power is maintained. Once power is lost, the X-422 will use the IP address assigned in the setup page and not the temporary address assigned here.

Make sure that the X-422 and the configuration computer are connected to the same network.

This will not work through routers or gateways.

Microsoft Windows Instructions

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

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

2. Type:

```
arp -s {new IP address} {serial number of X-422 }
```

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

For example, to set X-422 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

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

3. Next, type:

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

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

```
ping -l 102 10.10.10.40
```

4. Proceed with the X-422 setup in section 2.4.

Once setup is complete, it may be necessary to clear the 'arp' cache to configure additional

WebRelays. This is necessary because each unit has the same default IP address, but a different unit serial number (MAC address). Clearing the arp table can be done by typing `arp -d` in the command prompt window.

Linux/Unix Instructions

1. Open a terminal and change to root user (su -, then enter root password).
2. Type: `arp -s {new IP address} {serial number of X-422 }`

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

For example, to set X-422 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

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

3. Next, type:

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

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

```
ping -s 102 10.10.10.40
```

4. Proceed with X-422 setup in section 2.4.

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

Mac OS X Instructions

1. Open a terminal.

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

2. Type:

```
sudo arp -s {new IP address} {serial number of X-422 }
```

Administrator password may be required.

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

For example, to set a X-422 (with serial number 00-0C-C8-01-00-01) to 10.10.10.40 the following command would be used:

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

3. Next, type:

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

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

```
ping -s 102 10.10.10.40
```

4. Proceed with X-422 setup in section 2.4.

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

2.3.2 Method 2: Assign a Temporary IP Address to Configuration Computer

If the foregoing option above is not used, you can use this option to communicate with the X-422. By default, the X-422 comes from the factory with an IP address of 192.168.1.2. Communications with the X-422 may be established by assigning an IP address to the configuration computer that is on the same network as the X-422 (for example, the configuration computer could be assigned to 192.168.1.50)

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

1. Windows XP – Open the control panel by clicking on the start menu and then on Control Panel.

Windows Vista/7 – Select the Windows Icon (Start Menu) and enter `ncpa.cpl` into the search bar and press Enter (Figure 2.3a).

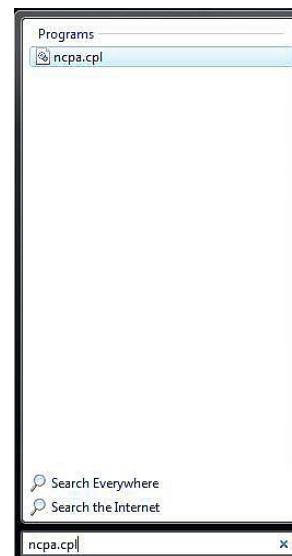


Figure 2.3a- Vista/7 Start Menu

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.

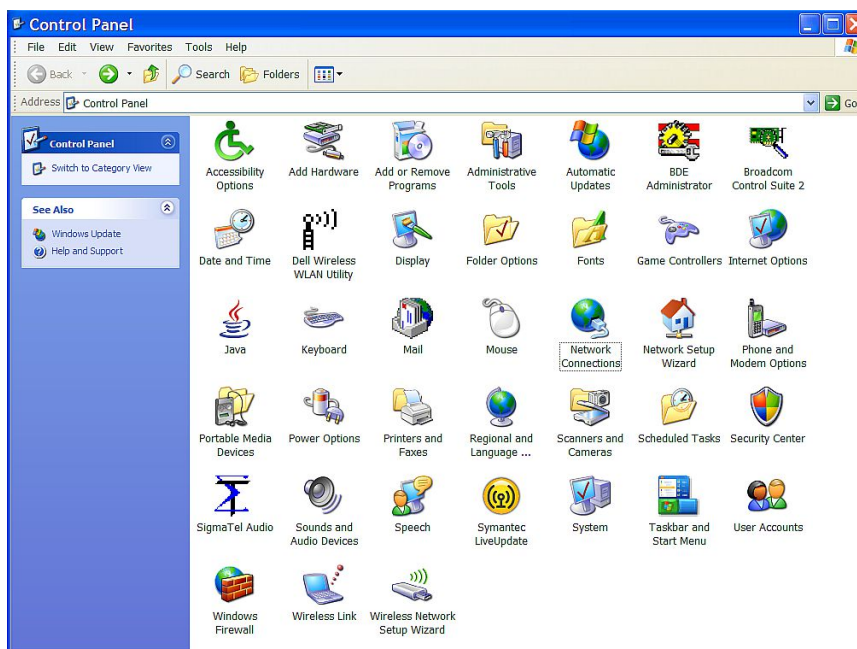


Figure 2.3b- Control Panel

2. Double click on the icon labeled Network Connections. The Network Connections window will open (Figure 2.3c).

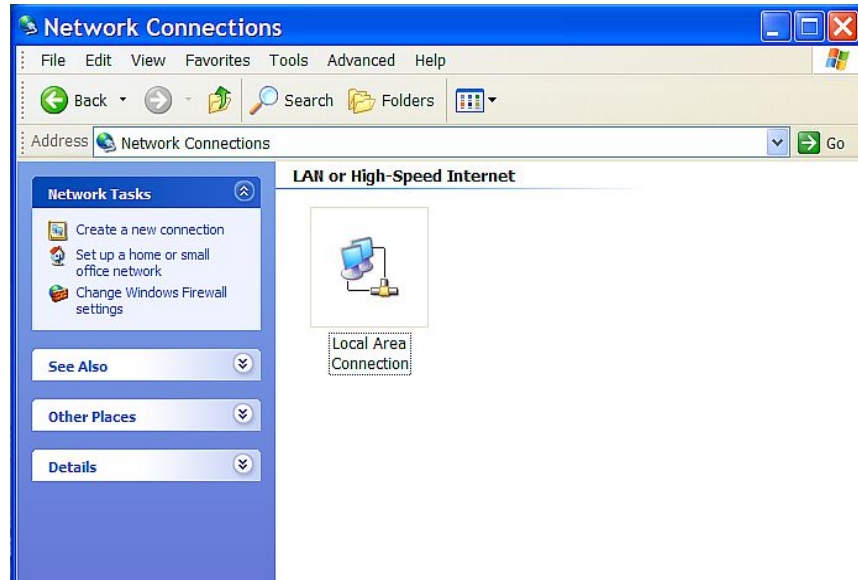


Figure 2.3c- Network Connection

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 (Figure 2.3d).

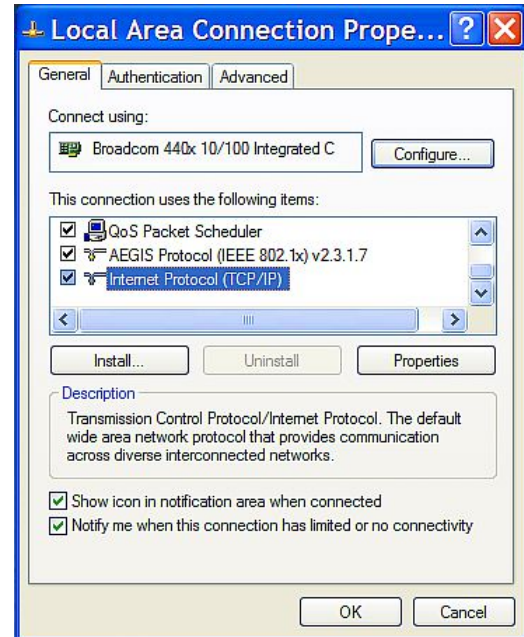


Figure 2.3d- Local Area Connection Properties

4. In the Local Area Connection Properties window in the Connection Uses box, scroll down and highlight "Internet Protocol (TCP/IPv4)." Click the button labeled Properties. The Internet Protocol (TCP/IPv4) Properties menu appears (Figure 2.3e).

Note: If "Use the following IP address" is already selected, the computer has been set up with a static IP address. Record these values so that the IP address of the computer can be restored once the IP address of X-422 has been successfully changed.

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

192.168.1.50

6. Type in the subnet mask:

255.255.255.0

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

7. Open the setup pages as described in section 2.4. If the setup pages are not accessible, verify that X-422 is powered on and that the LINK light is illuminated. Check all network connections and settings.

Another way to check communications is to ping X-422 from the command prompt by typing ping X-422 IP address.

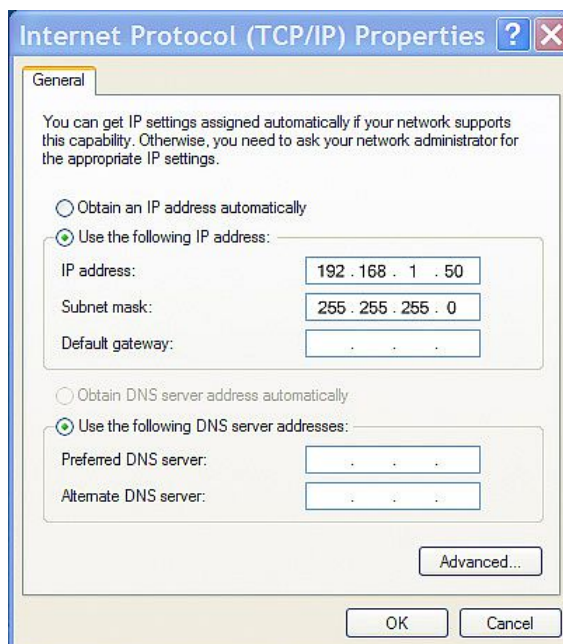


Figure 2.3e- TCP/IP Properties

2.4 General Settings Tab

The X-422 is configured using a web browser. To access the setup pages, enter the following URL in the address bar of a web browser:

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

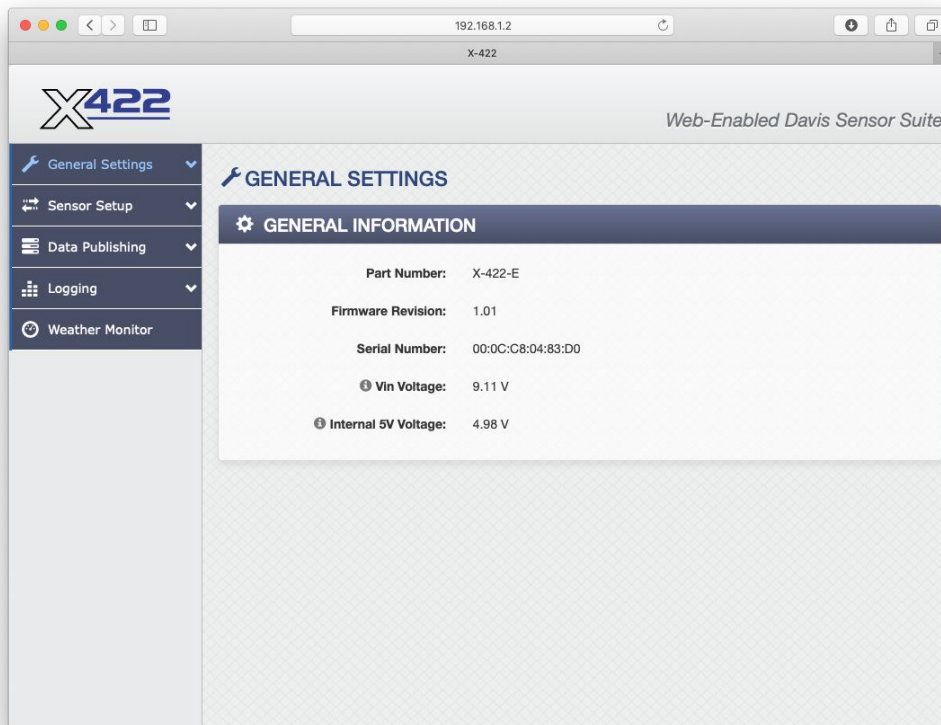
For example, using the default IP address, enter:

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

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

2.4.1 General Information

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



Part Number

This is the full model number of the X-422.

Firmware Revision

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

Serial Number

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

Vin Voltage:

This displays the voltage applied to the Vin terminals. If the unit is powered by POE, it will indicate POE.

Internal 5V Voltage:

Internally, the unit operates on a 5 VDC power supply. This internal voltage is measured and displayed here. It should be within the range of 4.75V to 5.25V.

Note: *The values in these fields are only updated when the webpage is refreshed.*

2.4.2 Network

The network parameters are set on this page.

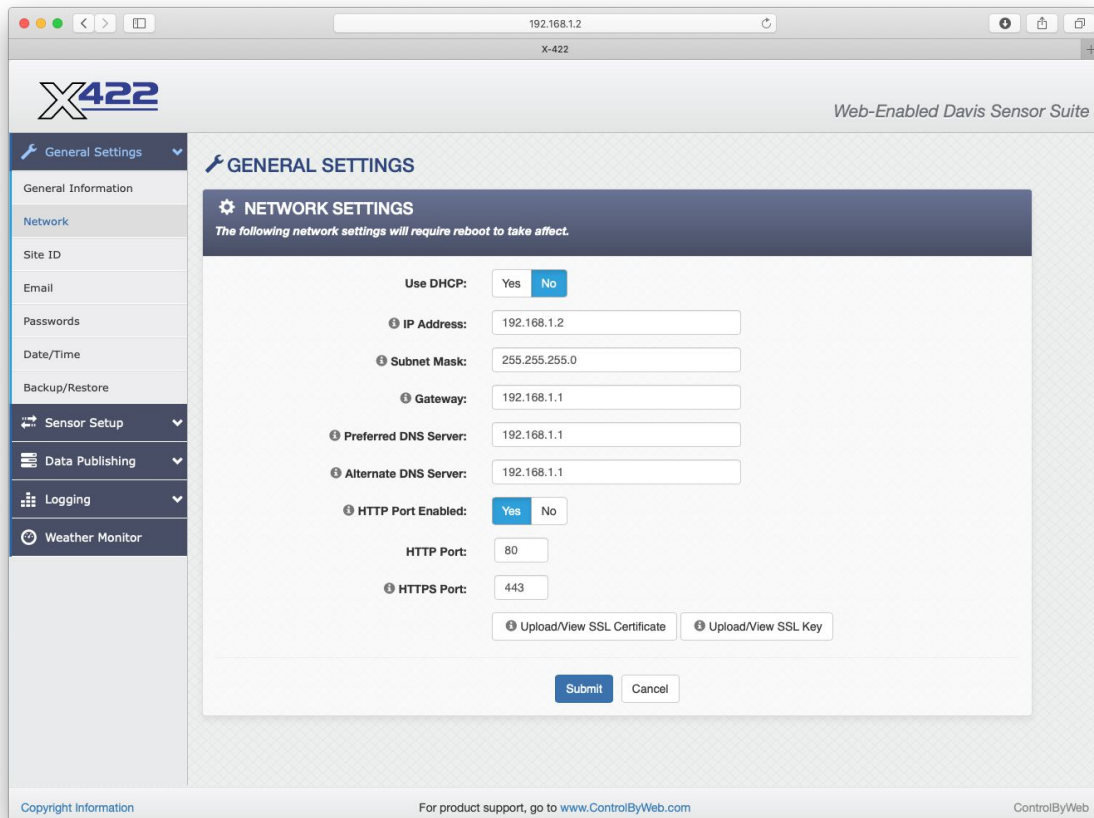


Figure 2.4b - Network Tab

Note: The X-422 must be power-cycled (power disconnected, then reconnected) before network settings take effect. Only the settings on the **Network** tab require power-cycling before taking effect.

Use DHCP

This option allows DHCP to be enabled or disabled. If this option is set to **Yes**, X-422 will wait for an IP address from a DHCP server each time it is powered. If DHCP is set to **Yes**, the Network page must be submitted and X-422 must be rebooted before an IP address will be assigned. Once X-422 is assigned an IP address by the DHCP, the new IP address can be found through the list of clients kept by the DHCP server. For most instances, this is found on the local gateway or router. The default setting is **No** (this is recommended for most installations).

Brief Notes About DHCP

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

server is built into the router.

DHCP works well for "client" devices such as computers, but is not ideal for servers. This is because servers usually don't initiate communications with other devices, but rather they wait for a request from "clients." To make this request, the client must know the IP address of the server. If a server gets its IP address dynamically, the IP address may not always be the same so client devices may not be able to find the server. For this reason, servers usually use an IP address that is fixed and does not change. The X-422 is a server and manual IP address assignment is usually recommended.

IP Address

Enter the IP address for the X-422 in this field. The IP address is specific to the network where the X-422 will be installed, and must be obtained from the network administrator. For more information on IP addresses and remotely accessing the X-422 over the Internet, see **Appendix C: Accessing the X-422 Remotely Over the Internet**. The default setting for this field is 192.168.1.2.

Subnet Mask

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

Gateway

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

Preferred DNS Server

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

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

Alternate DNS Server

This field is used to specify the IP address of a Secondary DNS server. This is used when the X-422 requires DNS services and the preferred DNS server is not available. The default setting for this field is 192.168.1.1

HTTP Port Enabled

By default this option is set to Yes which means the X-422 can be accessed through the HTTP port without encryption (HTTP not HTTPS). By changing this option to No, the HTTP port is disabled and users must access the X-422 through using encrypted HTTPS only

HTTP Port

The TCP port used for HTTP communications (web browser, xml, get commands) with the X-422 is specified here. The default setting for this field is 80, which is the standard HTTP port. It is recommended that the port be left unchanged, unless the user has an understanding of TCP/IP and ports. For more information on TCP ports and IP addressing see Appendix C: Accessing X-422 Over the Internet

HTTPS Port

When users connect to the X-422 using encrypted HTTPS protocol, this is the port that is used. The

default setting for this field is 443, which is the standard HTTPS port.

Upload/View SSL Certificate

By default, the module comes with a previously generated SSL Certificate that is used for encrypted HTTP communications. The default SSL Certificate can be replaced by clicking on this link, choosing the new Certificate file (PEM format), and uploading the file. SSL Certificates are preserved, even when resetting defaults and updating firmware.

Note: Supports 1024-bit and 2048-bit encryption.

Upload/View SSL Key File

By default, the module comes with a previously generated SSL Key that is used for encrypted HTTP communications. The default SSL Key can be replaced by clicking on this link, choosing the new Key file (PEM PKCS#1 format), and uploading the file. SSL Keys are preserved if the firmware is updated or the module is reset to its default settings.

There are various programs that can be used to generate self-signed certificates and keys. When generating the key, the program must either generate the key in PKCS#1 format, or provide a way to convert it to the PKCS#1 format in order for the module to use it.

One such program is openssl. Newer versions of openssl generate keys using the PKCS#8 format. Older versions generated keys using the PKCS#1 format. A visual inspection of the key file can be a good indicator of the format of the key. PKCS#1 keys start with "-----BEGIN RSA PRIVATE KEY-----". PKCS#8 keys start with "-----BEGIN PRIVATE KEY-----". The following command can be used to generate a key and certificate for use with the module:

```
openssl req -newkey rsa:1024 -nodes -keyout domain.key -x509 -days 365 -out domain.crt
```

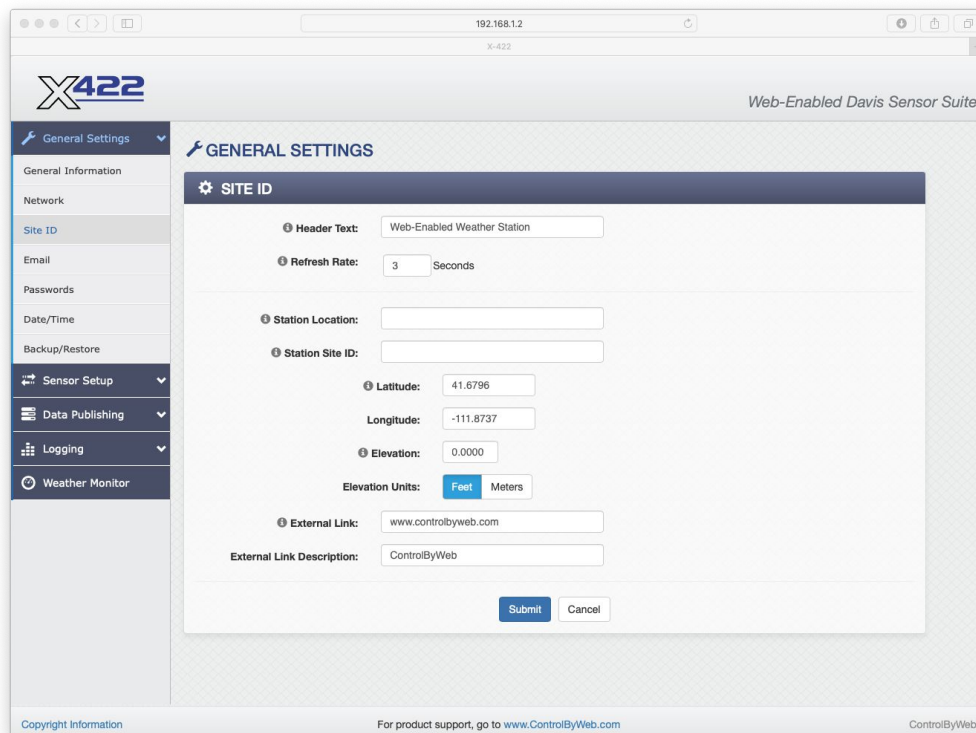
If the format of the key is PKCS#8, the following command will convert it to PKCS#1:

```
openssl rsa -in domain.key -out domain_PKCS1.key
```

After executing the previous commands a key named domain_PKCS1.key and certificate named domain.crt will exist.

2.4.3 Site ID

This page is used to provide detailed information about the site where X-422 is installed, as well as **Status Page** configuration settings.



The screenshot shows a web browser window displaying the X-422 configuration interface. The page title is "X-422" and the subtitle is "Web-Enabled Davis Sensor Suite". The browser address bar shows "192.168.1.2". The left sidebar contains a navigation menu with the following items: General Settings (selected), General Information, Network, Site ID, Email, Passwords, Date/Time, Backup/Restore, Sensor Setup, Data Publishing, Logging, and Weather Monitor. The main content area is titled "GENERAL SETTINGS" and features a "SITE ID" configuration panel. The panel includes the following fields and options:

- Header Text:** Web-Enabled Weather Station
- Refresh Rate:** 3 Seconds
- Station Location:** (empty text field)
- Station Site ID:** (empty text field)
- Latitude:** 41.6796
- Longitude:** -111.8737
- Elevation:** 0.0000
- Elevation Units:** Feet (selected), Meters
- External Link:** www.controlbyweb.com
- External Link Description:** ControlByWeb

At the bottom of the panel are "Submit" and "Cancel" buttons. The footer of the page contains "Copyright Information", "For product support, go to www.ControlByWeb.com", and the "ControlByWeb" logo.

Header Text

This text field is used to describe the site where X-422 is installed. It is also the name that appears at the top of the **Status Page** and in email notifications. This field can be up to 40 characters long. The default text for the description is `MET Station`.

Refresh Rate

This field specifies how often the **Status Page** will update its contents. The web page will be refreshed automatically at the time interval specified. It can be set from 1 to 32 seconds. The default setting is 3 seconds.

Station Location

This text field is used to describe the location where X-422 is installed. This field can be up to 40 characters long. There is no default text for this field.

Station Site ID

This field specifies the Site ID. It can be up to 20 characters long. This field is blank by default.

Latitude

This field specifies the latitude coordinate of X-422 in decimal degrees. It is included with data uploaded to remote weather services. Positive latitudes are north of the equator, negative latitudes are south of the equator.

Longitude

This field specifies the longitude coordinate of X-422 in decimal degrees. It is included with data

uploaded to remote weather services. Positive longitudes are east of the Prime Meridian, negative longitudes are west of the Prime Meridian.

Elevation

This is the elevation of where X-422 is installed. The site elevation is used when adjusting the barometric pressure reading to sea level, and is included with data uploaded to remote weather services.

Elevation Units

Select the units used (Feet or Meters) for the Elevation field described above.

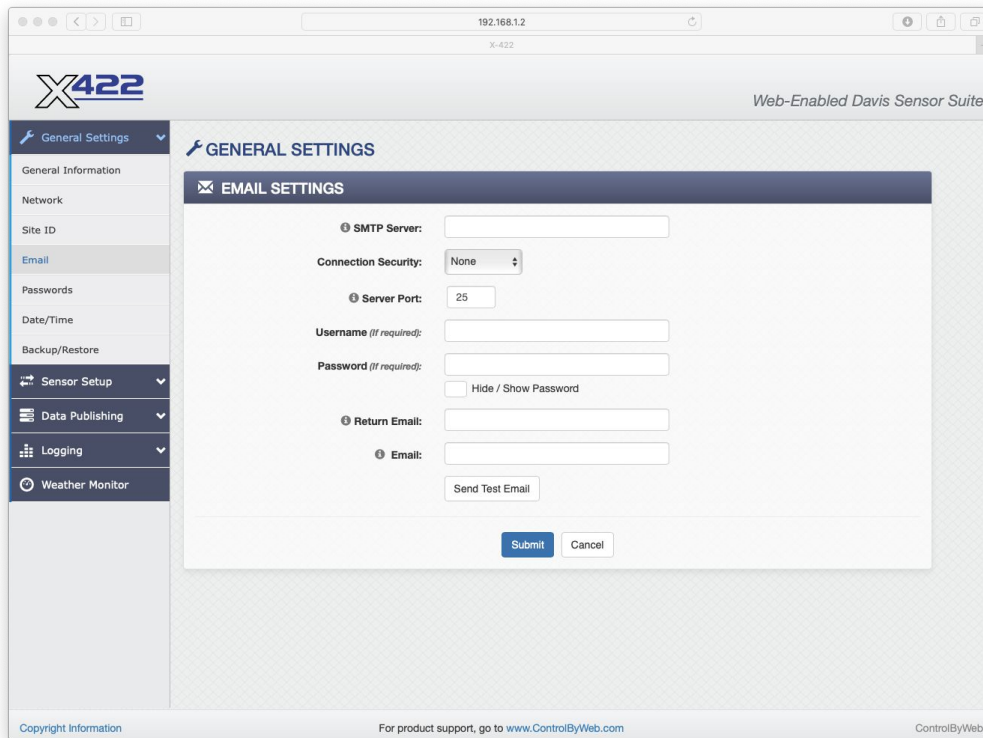
External Link

A link can be added to the Weather Monitor page which links to another website or webpage. This text field is used to enter the URL for the external link. Up to 96 characters can be entered into this field. The default external link address is www.controlbyweb.com.

External Link Description

The text entered in this field is displayed on the Weather Monitor page for the external link above. In other words, when users click on this text it will take them to the link above. The default description is ControlByWeb.

2.4.4 Email



The screenshot shows a web browser window displaying the X-422 Web-Enabled Davis Sensor Suite interface. The browser address bar shows the URL 192.168.1.2. The page title is "X-422" and the subtitle is "Web-Enabled Davis Sensor Suite". The interface features a navigation menu on the left with options: General Settings (selected), General Information, Network, Site ID, Email (highlighted), Passwords, Date/Time, Backup/Restore, Sensor Setup, Data Publishing, Logging, and Weather Monitor. The main content area is titled "GENERAL SETTINGS" and contains an "EMAIL SETTINGS" section. This section includes the following fields and controls:

- SMTP Server:** A text input field.
- Connection Security:** A dropdown menu currently set to "None".
- Server Port:** A text input field containing the value "25".
- Username (if required):** A text input field.
- Password (if required):** A text input field with a "Hide / Show Password" toggle.
- Return Email:** A text input field.
- Email:** A text input field.
- Send Test Email:** A button.
- Submit** and **Cancel** buttons at the bottom of the form.

At the bottom of the page, there is a footer with "Copyright Information", "For product support, go to www.ControlByWeb.com", and the "ControlByWeb" logo.

SMTP Server (Email Server)

The name of the SMTP (Simple Mail Transfer Protocol) mail server (for example mail.example.com) or the IP address of the mail server (for example 192.10.10.10) should be entered in this field. There

is no default setting for this field.

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

Connection Security

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

Server Port

This field is used to specify the SMTP Mail Server Port. The default setting is 25, which is the standard SMTP port.

Username (If Required)

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

Password (If Required)

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

Return Email

The X-422 will not receive email messages, but when the X-422 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-422 will send email messages with any email address specified in this field, some email filters (spam filters) will not allow messages through that include an invalid email address. There is no default setting for this field.

Email

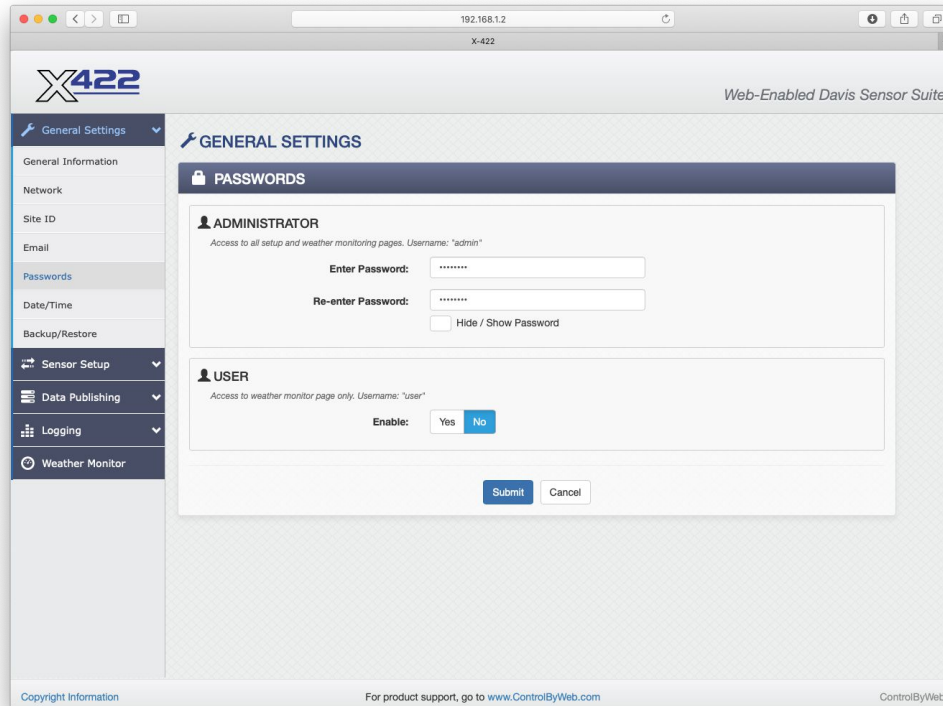
Enter the email addresses of up to five recipients for alarm messages in these fields. There are no default settings for these fields.

Send Test Email

This button causes the X-422 to send a test message to the email address above using the currently configured network and email settings.

2.4.5 Password Tab

X-422 requires a password to log into the setup pages. The password can be changed on this page. Additionally, a password can be enabled for the **Weather Monitor** page.



Administrator & User Passwords

Passwords require 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 username required for accessing the setup pages is `admin` (all lower case). The default password is `webrelay` (also all lower case). Up to 13 characters can be entered in this field.

Enter Password

The Setup Password, which is required to access the setup pages, can be modified by entering a new password here.

Re-enter Password

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

Enable User Password

The **Weather Monitor** page can be viewed without entering a password. For security purposes, a password can be required for access to the **Weather Monitor**. When this field is set to **Yes**, a password will be required to view the **Weather Monitor** page and password fields will be displayed on this page so the password can be set. The default setting for this field is **No**.

2.4.6 Date/Time

The X-422 uses the time for logging (a time stamp is included with each logged event). The time is stored and displayed in 24-hour time format. The X-422 has a capacitor-backed, real-time-clock circuit that will keep track of time for several days in the event of a power failure.

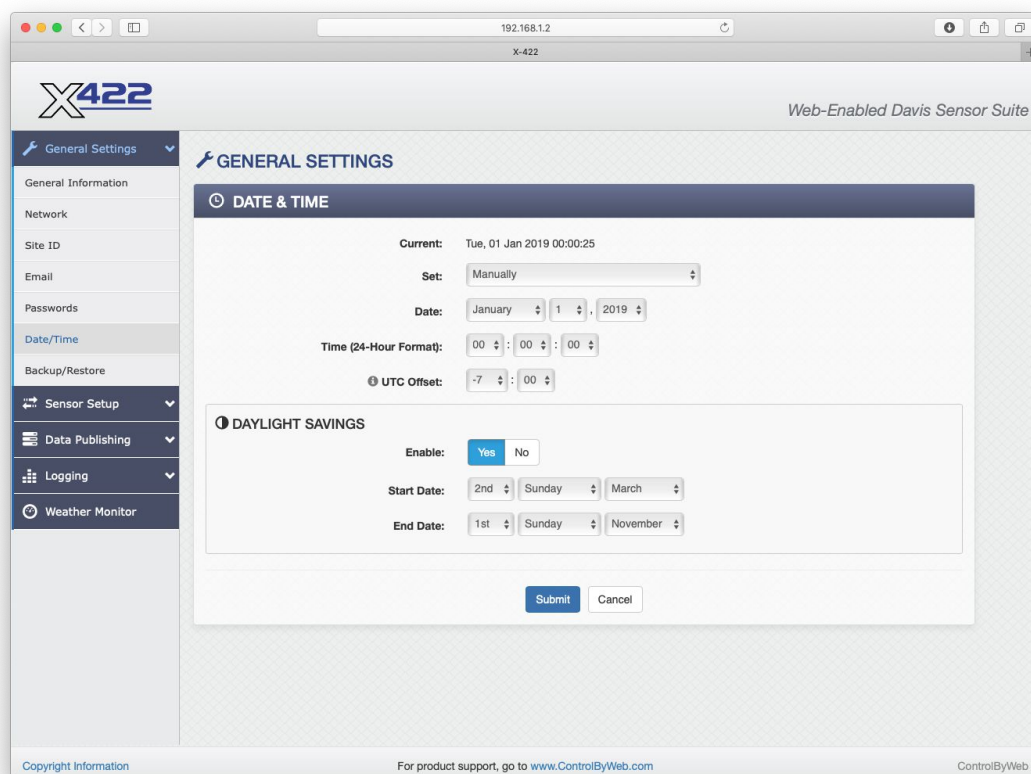


Figure 2.4e - Date/Time Tab - Set Time Manually

Current Date/Time

This is the current date and time stored in X-422. The time is stored and displayed in 24-hour format.

Set

This drop-down list offers two options for setting the time: **Manually** or **Sync with NTP server**. The options that follow this field will change based upon how this option is set.

- **Manually** requires the user to enter the time and date.
- **Sync with NTP server** allows the user to set the clock automatically by using an NTP (Network Time Protocol) server. This option will only work when a valid NTP server address and other network settings are entered.

Manual Time Configuration

The screenshot shows the 'DATE & TIME' configuration page in the X-422 Web-Enabled Davis Sensor Suite. The page is accessed via a browser at 192.168.1.2. The left sidebar contains navigation options: General Settings (selected), General Information, Network, Site ID, Email, Passwords, Date/Time, Backup/Restore, Sensor Setup, Data Publishing, Logging, and Weather Monitor. The main content area is titled 'GENERAL SETTINGS' and 'DATE & TIME'. It displays the current date and time as 'Tue, 01 Jan 2019 00:00:53'. The 'Set' dropdown is set to 'Sync with NTP server'. Below this are fields for 'NTP Host Name', 'NTP Sync Interval' (set to 'Once'), 'Sync On Powerup' (set to 'Yes'), and 'UTC Offset' (set to '-7:00'). A 'DAYLIGHT SAVINGS' section includes an 'Enable' checkbox (checked), 'Start Date' (2nd Sunday of March), and 'End Date' (1st Sunday of November). 'Submit' and 'Cancel' buttons are at the bottom. The footer contains copyright information, a support link to www.ControlByWeb.com, and the ControlByWeb logo.

Date

The current date is entered by first selecting the correct month and year, using the left and right arrows at the 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, select the correct day, which will then be highlighted.

Time (24 Hour Format)

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

UTC Offset

When the time is configured manually, the device still needs to know the time zone in order to calculate the UTC time used when uploading data to remote weather services. The default value for this field is -7 (Mountain Standard Time). 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

NTP Time Configuration

The screenshot shows the X422 Web-Enabled Davis Sensor Suite interface. The browser address bar shows 192.168.1.2. The page title is X-422. The main content area is titled 'GENERAL SETTINGS' and 'DATE & TIME'. The current time is Tue, 01 Jan 2019 00:00:53. The 'Set' dropdown is set to 'Sync with NTP server'. The 'NTP Host Name' field is empty. The 'NTP Sync Interval' dropdown is set to 'Once'. The 'Sync On Powerup' radio buttons are set to 'Yes'. The 'UTC Offset' is set to -7:00. The 'DAYLIGHT SAVINGS' section has 'Enable' set to 'Yes', 'Start Date' set to 2nd Sunday March, and 'End Date' set to 1st Sunday November. There are 'Submit' and 'Cancel' buttons at the bottom of the form.

NTP Host Name

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

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

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

US Servers (<http://www.pool.ntp.org/zone/us>):

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

North America (<http://www.pool.ntp.org/zone/north-america>):

- 0.north-america.pool.ntp.org
- 1.north-america.pool.ntp.org
- 2.north-america.pool.ntp.org

3.north-america.pool.ntp.org

Europe (<http://www.pool.ntp.org/zone/europe>):

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

Australia (<http://www.pool.ntp.org/zone/au>):

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

South America (<http://www.pool.ntp.org/zone/south-america>):

0.south-america.pool.ntp.org
1.south-america.pool.ntp.org
2.south-america.pool.ntp.org
3.south-america.pool.ntp.org

Africa (<http://www.pool.ntp.org/zone/africa>):

1.africa.pool.ntp.org
1.pool.ntp.org
3.pool.ntp.org

NTP Sync Interval

This option allows the user to specify how often the time on X-422 will be synchronized with the time server. When the submit button on this page is pressed, X-422 will immediately synchronize with the time server. If Daily, Weekly, or Monthly options are selected, X-422 will thereafter re-synchronize with the time server at the period interval specified starting at 12:00 AM (00:00).

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

Sync on Power Up

When this option is set to **Yes**, X-422 will be synchronized with the time server each time it is powered.

Note: *If X-422 will lose power on a frequent basis, it may be beneficial to set this option to **No**, as some servers are configured to dis-allow access from client devices that excessively request their services. The default value of this setting is **No**.*

UTC Offset

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

GMT Time: 0
Eastern Standard Time: -5

Central Standard Time: -6
Mountain Standard Time: -7
Pacific Standard Time: -8

Daylight Savings

In many parts of the United States and in some other countries, the time is shifted forward by one hour during the summer months. This is an effort to conserve energy by making the daylight last longer into the evening hours. If this option is set to **Yes**, the time on X-422 will automatically be shifted forward by one hour between the hours of 12:00 AM – 5:00 PM on the Daylight Savings Start date set below, and it will shift back to standard time between the hours of 12:00 AM – 5:00 PM on the Daylight Savings End date set below. The time change is made at a random time within the previously mentioned, five-hour time frame, in order to prevent several different devices from simultaneously requesting a time and overwhelming the NTP server. The default setting is **Yes**.

Note: 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 when daylight savings time adjustment is enabled. To avoid confusion, many servers and data loggers are set to remain on GMT time and do not shift for daylight savings.

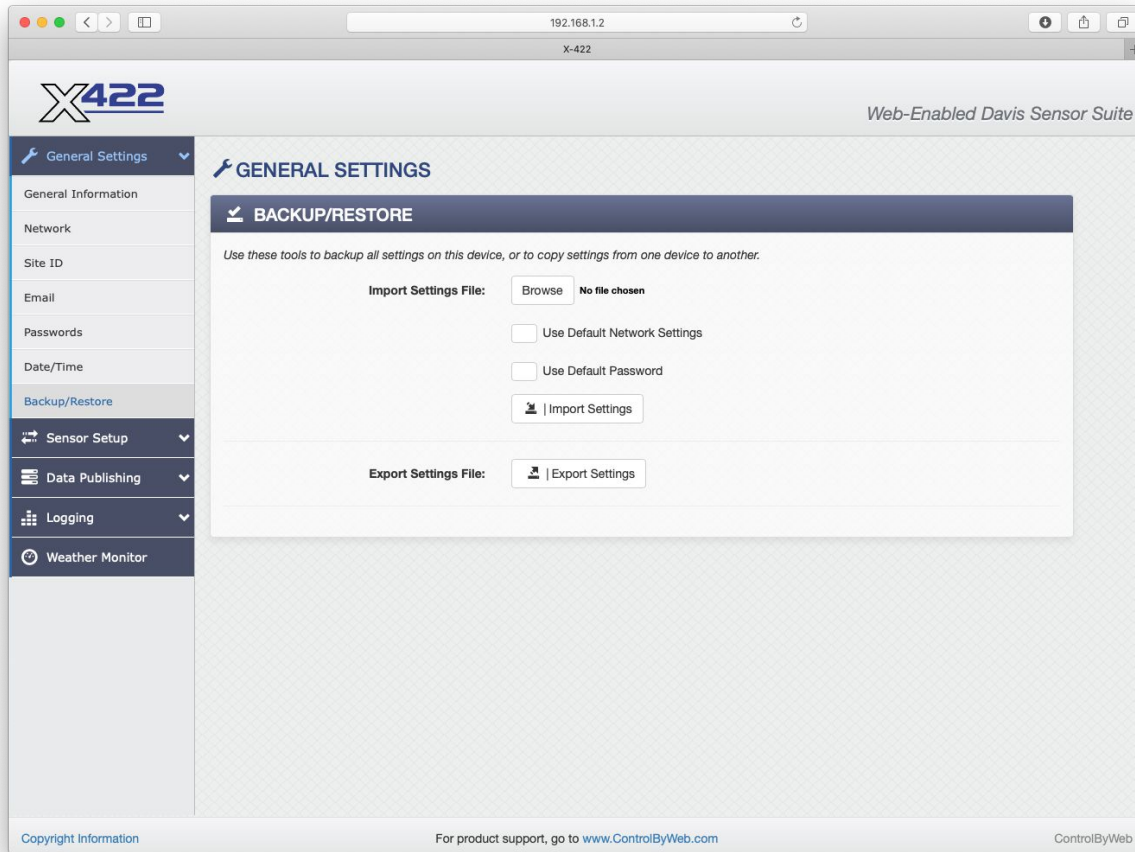
Daylight Savings Start Date

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

Daylight Savings End Date

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

2.4.7 Backup/Restore



Import Settings File

To import settings from an external file, first click the *Browse* button and select the desired *settings.txt* file on your computer.

If *Use Default Network Settings* is checked, any network settings in the file are ignored and the network settings are forced to the default state. If *Use Default Password* is checked, the Administrator password in the file is ignored and the Administrator password is forced to the default state.

Click the *Import Settings* button to import (load) the settings from the selected file.

Export Settings File

Click the *Export Settings* button to export all of the current settings to a "settings.txt" file. If desired, the file can be opened and examined with a text editor.

Note that BASIC scripts and SSL Certificates are not included in this settings file and should be saved separately.

2.5 Sensor Setup Tab

2.5.1 Wind

This page provides options for configuring the Wind Speed sensor input.

The screenshot shows the 'WIND SETTINGS' configuration page in the X-422 Web-Enabled Davis Sensor Suite. The interface includes a sidebar with navigation options: General Settings, Sensor Setup, Wind, Rain, Temperature/Humidity, Solar Radiation, Ultraviolet, Barometric Pressure, Aux, Data Publishing, Logging, and Weather Monitor. The main content area is titled 'SENSOR SETUP' and 'WIND SETTINGS'. The configuration options are as follows:

- Averaging Period:** 2 Minutes
- Wind Speed Units:** mph (selected), km/h, m/s, knots
- High Alarm:** 20.0000
- Advanced Settings:** Show/Hide
- Speed Slope (Multiplier):** 2.2500
- Speed Alarm Deadband:** 0.5000
- Direction Slope (Multiplier):** 72.0000
- Direction Offset:** 0.0000

Below these settings are three sections for RUNWAY 1, RUNWAY 2, and RUNWAY 3, each with an 'Enable' toggle set to 'No'. At the bottom of the page are 'Submit' and 'Cancel' buttons. The footer contains copyright information and a link to the ControlByWeb website.

Averaging Period

The Average Period is the length of time used to average the Scaled Value. For example, if the Average Period is set to 5 minutes, X-422 will keep track of the last 150 samples (30 samples/min) and average them over the 5 minute period. If the Average Period is set to zero, no averaging will be used. The Average Period can be set from 0 to 10 minutes. The default Average Period is 2 minutes.

*Note: Wind Direction and Wind Speed share the same average period. Making a change to the average period in **Wind Speed** tab will result to the same change to the Average Period in **Wind Direction** tab.*

*Note: If the Average Period is set to zero, then the **Status Page** will not show a Wind Gust value.*

Wind Speed Units

This option allows you to specify the units of measure for the wind speed sensor. The units selected will be determined by the Slope and Offset used to calibrate the sensor. The following options are available:

- **mph:** miles per hour.
- **km/h:** kilometers per hour.
- **m/s:** meters per second.
- **knots:** knots.

High Alarm

This setting is used to set the trigger point for a high alarm condition. The alarm is triggered when the value at the sensor exceeds the High Alarm Value. The default High Alarm is 20.

Advanced Settings – Show/Hide

Most users will not need to view or change advanced settings, however when "show" is selected advanced settings will be displayed for viewing or modification.

Speed Slope (Multiplier)

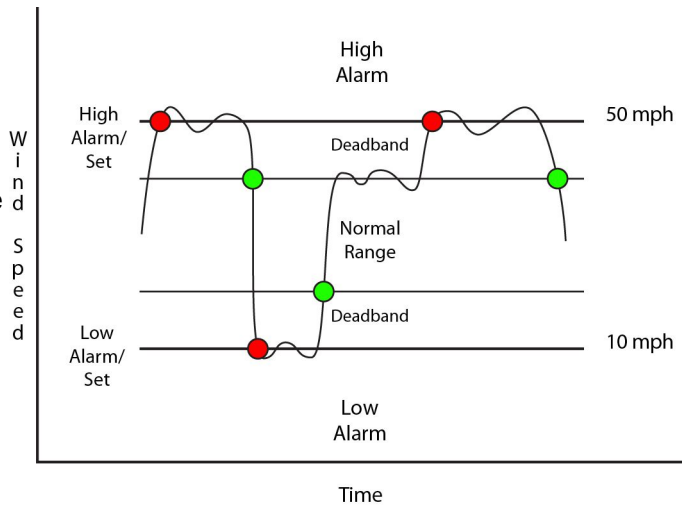
The wind speed slope is multiplied by the raw value that is read from the anemometer. The product of the slope and the raw anemometer value is the wind speed which is given in the units selected above. The slope is automatically set based upon the wind speed units selected.

Speed Alarm Deadband

The Deadband prevents alarms from triggering excessively when the sensor measurement vacillates around the trigger point.

With High Alarms, the measurement must fall below the High Alarm point minus the Deadband before the High Alarm will be triggered again. Likewise the Deadband on the Low Alarm requires the measurement to rise above the low alarm point plus the Deadband before the Low Alarm will be triggered again.

For example, if the Deadband is set to 5 mph, and a High Alarm occurs at 50 mph, the alarm will not trigger again until the wind speed first drops below 45 mph (50 mph - 5 mph), as shown in the figure below. The default Deadband is 0.50.



Direction Slope (Multiplier)

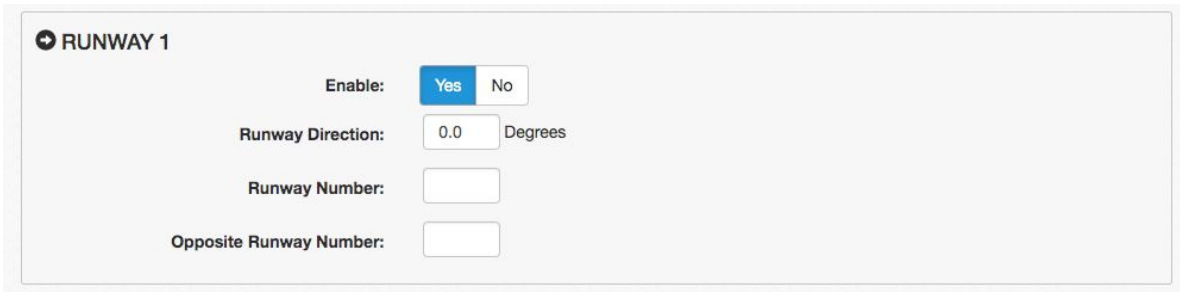
This number is multiplied by the raw value read by the wind direction sensor to provide the wind direction in degrees. The default value is 72.0.

Direction Offset

The "Offset" is used for the "zero" measurement. The default value for this field is 0. When both the slope and offset are set to their default values, the Scaled Value equals the Raw Input.

Runways

When the X-422 is used at an airport up to three runways can be displayed on the wind diagram. This is useful for pilots to visualize the wind direction relative to the runways at the airport.



➔ RUNWAY 1

Enable: Yes No

Runway Direction: Degrees

Runway Number:

Opposite Runway Number:

Enable

When "Yes" is selected, runway settings will be displayed for viewing or modification.

Runway Direction

Enter the direction of the runway (in degrees). This will create a drawing of a runway over the compass view of the wind speed on the Weather Monitor page.

Runway Number

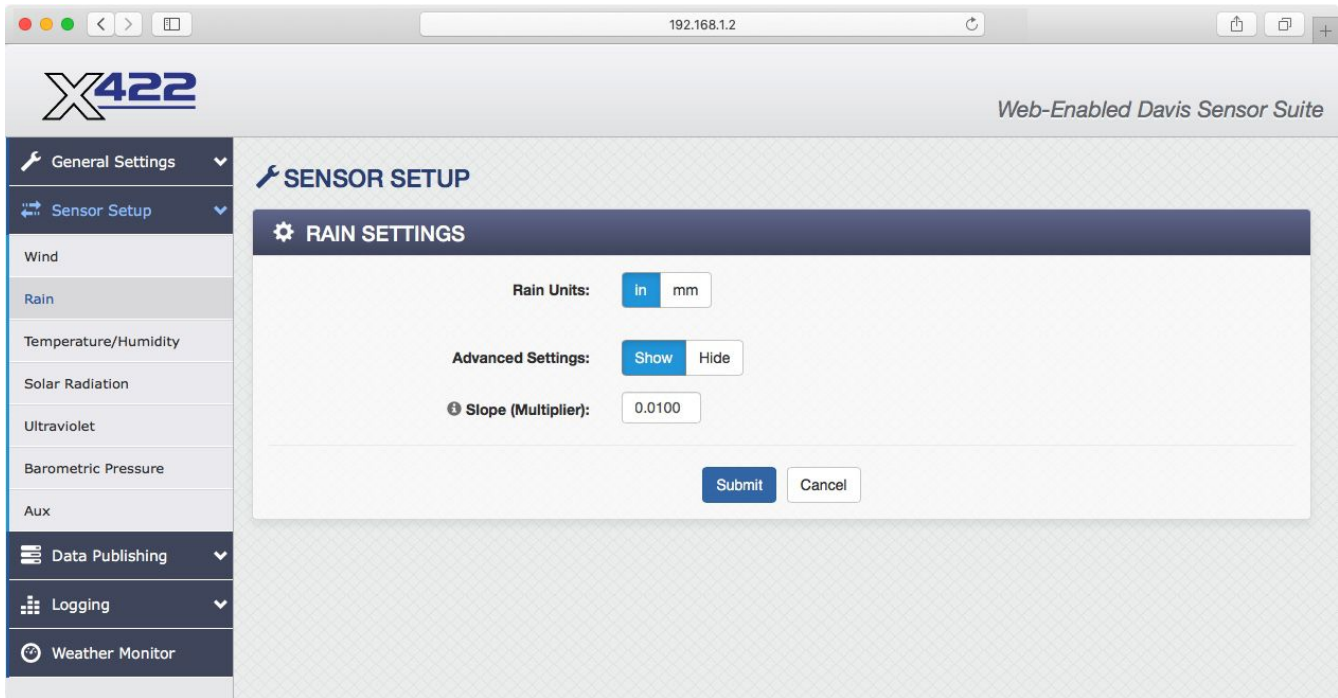
Enter the runway number to be displayed at the end of the runway.

Opposite Runway Number

Enter the runway number to be displayed at the opposite end of the runway.

2.5.2 Rain

This page provides options for configuring the Rain Accumulation sensor input.



Units

This option allows you to specify the units for the rain sensor. Inches or mm can be selected.

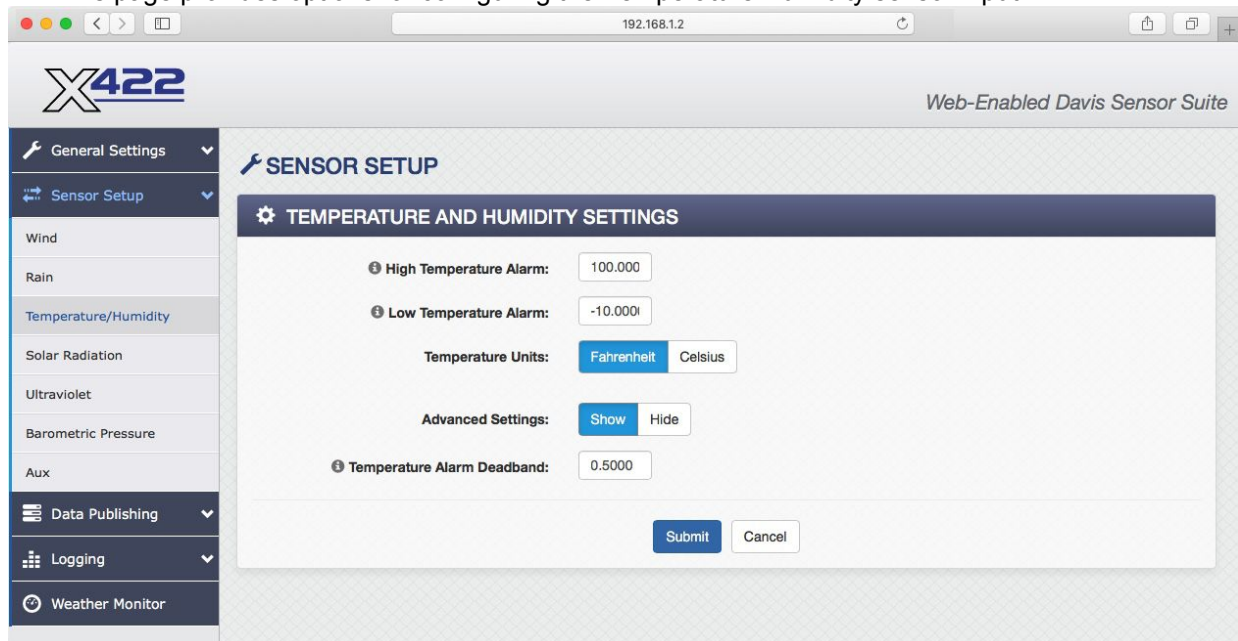
Advanced Settings – Rain

Slope

This value is multiplied by the raw value that is read from the rain sensor to produce the rain measurement. This value is automatically set for the Davis sensors based upon the units selected above.

2.5.3 Temperature/Humidity

This page provides options for configuring the Temperature/Humidity sensor input.



The screenshot shows a web browser window with the URL 192.168.1.2. The page title is "Web-Enabled Davis Sensor Suite". The main content area is titled "SENSOR SETUP" and "TEMPERATURE AND HUMIDITY SETTINGS". The settings are as follows:

Setting	Value
High Temperature Alarm	100.000
Low Temperature Alarm	-10.000
Temperature Units	Fahrenheit (selected), Celsius
Advanced Settings	Show (selected), Hide
Temperature Alarm Deadband	0.5000

Buttons: Submit, Cancel

High Temperature Alarm

This setting is used to set the trigger point for a high alarm condition. The number field specifies the temperature at which the alarm is triggered. An alarm is triggered when the sensor reading exceeds the High Alarm value.

Low Temperature Alarm

This is a Low Alarm trigger that works similar to the High Alarm. The alarm occurs when the sensor reading falls below the Low Alarm Value.

Temperature Units

This option allows you to specify the units of measure for the temperature sensor. The default units for temperature are in Fahrenheit.

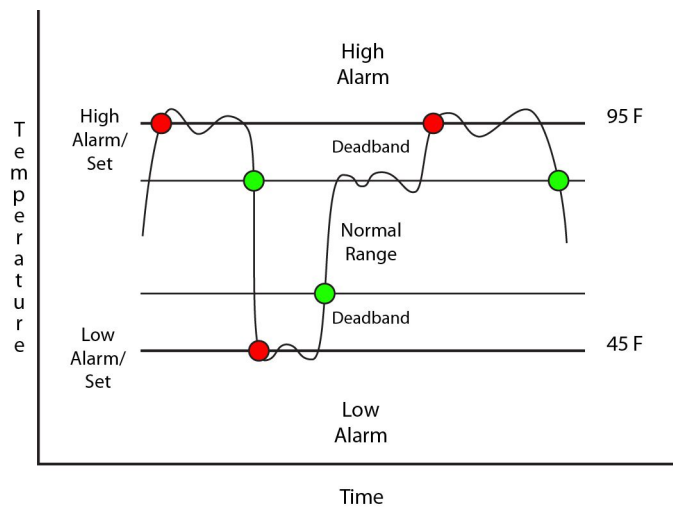
Advanced Settings – Temperature/Humidity

Temperature Alarm Deadband

The Deadband prevents alarms from triggering excessively when the sensor measurement vacillates around the trigger point.

With High Alarms, the measurement must fall below the High Alarm point minus the Deadband before the High Alarm will be triggered again. Likewise, the Deadband on the Low Alarm requires the measurement to rise above the Low Alarm point plus the Deadband before the Low Alarm will be triggered again.

For example, if the Deadband is set to 1 degree, and a High Alarm occurs at 95 degrees, the Deadband ensures that once the High Alarm is triggered, it won't trigger again until the temperature first drops below 94 degrees (95 - 1), as shown in the figure below. The default Deadband is 0.50.



2.5.4 Solar Radiation

This page provides options for configuring the Solar Radiation sensor input. The units used to measure Solar radiation is W/m².

The screenshot shows a web browser window with the URL 192.168.1.2. The page title is 'Web-Enabled Davis Sensor Suite'. The left sidebar contains a menu with 'Sensor Setup' selected. The main content area is titled 'SENSOR SETUP' and 'SOLAR RADIATION SETTINGS'. The settings are as follows:

- Averaging Period:** 60 Minutes
- Show on Weather Monitor:** Show (selected), Hide
- Advanced Settings:** Show (selected), Hide
- Slope (Multiplier):** 598.799
- Offset:** 0.0000

Buttons for 'Submit' and 'Cancel' are located at the bottom right of the settings panel.

Averaging Period

The Average Period is the length of time used to average the Scaled Value. For example, if the Average Period is set to 30 minutes, the X-422 will keep track of the last 30 samples (1 sample/min) and average them over the 30 minute period. If the Average Period is set to zero, no averaging will be used. The Average Period can be set from 0 to 60 minutes. The default average period is 60 minutes.

Show on Weather Monitor

When this option is set to "Show," the solar radiation will be displayed on the Weather Monitor page. If there is no solar radiation sensor connected to the unit it is recommend that this setting be set to "Hide".

Advanced Settings – Solar Radiation

Slope (Multiplier)

In many cases, the inputs must be scaled to represent “real-world” measurements. The X-422 reads the “raw” value from each input, and calculates the number that represents the “real-world” measurement that the user is actually interested in. This real-world value (referred to as the “Scaled Value” in this manual) is calculated using the following linear formula:

$$\text{Scaled Value} = \text{Slope} * \text{Input} + \text{Offset}$$

The Scaled Value is displayed on the **Weather Monitor** page.

“Slope” in the formula above is provided by the user and is entered in this field. The value is used to scale the input to the range of detected condition.

The default value for this field is 598.799, which is the correct setting for the Davis radiation solar

sensor.

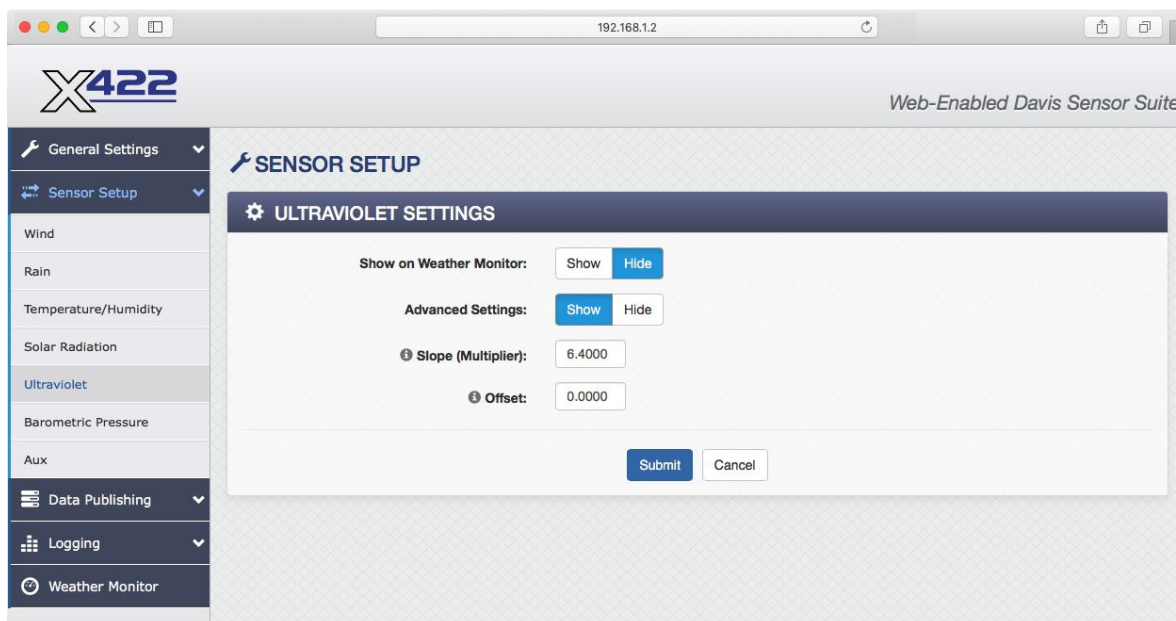
When the Slope is set to 1 and Offset is 0, the Scaled Value equals the Input Value.

Offset

The “Offset” is used for the “zero” measurement. The default value for this field is 0.

2.5.5 Ultraviolet

This page provides configuration options for configuring the ultraviolet sensor input



Show on Weather Monitor

When this option is set to "Show" the measured ultraviolet value will be displayed on the Weather Monitor page. If there is no ultraviolet sensor connected to the unit it is recommend that this setting be set to "Hide".

Advanced Settings – Ultraviolet

Slope (Multiplier)

In many cases, the inputs must be scaled to represent “real-world” measurements. The X-422 reads the “raw” value from each input, and calculates the number that represents the “real-world” measurement that the user is actually interested in. This real-world value (referred to as the “Scaled Value” in this manual) is calculated using the following linear formula:

$$\text{Scaled Value} = \text{Slope} * \text{Input} + \text{Offset}$$

The Scaled Value is displayed on the **Weather Monitor** page.

“Slope” in the formula above is provided by the user and is entered in this field. The value is used to scale the input to the range of detected condition.

The default value for this field is 6.4000, which is the correct setting for the Davis ultraviolet solar sensor.

When the Slope is set to 1 and Offset is 0, the Scaled Value equals the Input Value.

Offset

The “Offset” is used for the “zero” measurement. The default value for this field is 0.

2.5.6 Barometric Pressure Tab

This page provides configuration options for configuring the Barometric Pressure sensor input.

Adjustment:

Depending on the type of sensor and/or the type of barometric pressure reading, the sensor reading may need to be adjusted so that sea level pressure is the indicated value. The default value for this field is *None*.

This drop-down allows you to select the adjustment used for the barometric pressure sensor. The following options are available:

- **None:** No adjustment will be applied to the input value from the sensor
- **Sea Level:** The input value from the sensor will be adjusted to indicate sea level pressure

Pressure Units

This setting allows you to specify the units for the barometric pressure sensor. The following options are available:

- **inHg:** This option is used if you are measuring the barometric pressure in inches of Mercury.
- **mmHg:** This option is used if you are measuring the barometric pressure in millimeters of Mercury.
- **hPa:** This option is used if you are measuring the barometric pressure in hectopascals.
- **mbar:** This option is used if you are measuring the barometric pressure in millibars.

Advanced Settings – Barometric Pressure

Slope (Multiplier)

In many cases, the sensor inputs must be scaled to represent “real-world” measurements. The X-422 reads the “raw” value from each sensor, and calculates the number that represents the “real-world” measurement that the user is actually interested in. This real-world value (referred to as the “Scaled Value” in this manual) is calculated using the following linear formula:

$$\text{Scaled Value} = \text{Slope} * \text{Input} + \text{Offset}$$

The Scaled Value is displayed on the **Weather Monitor** page.

“Slope” in the formula above is provided by the user and is entered in this field. The value is used to scale the input to the range of detected condition.

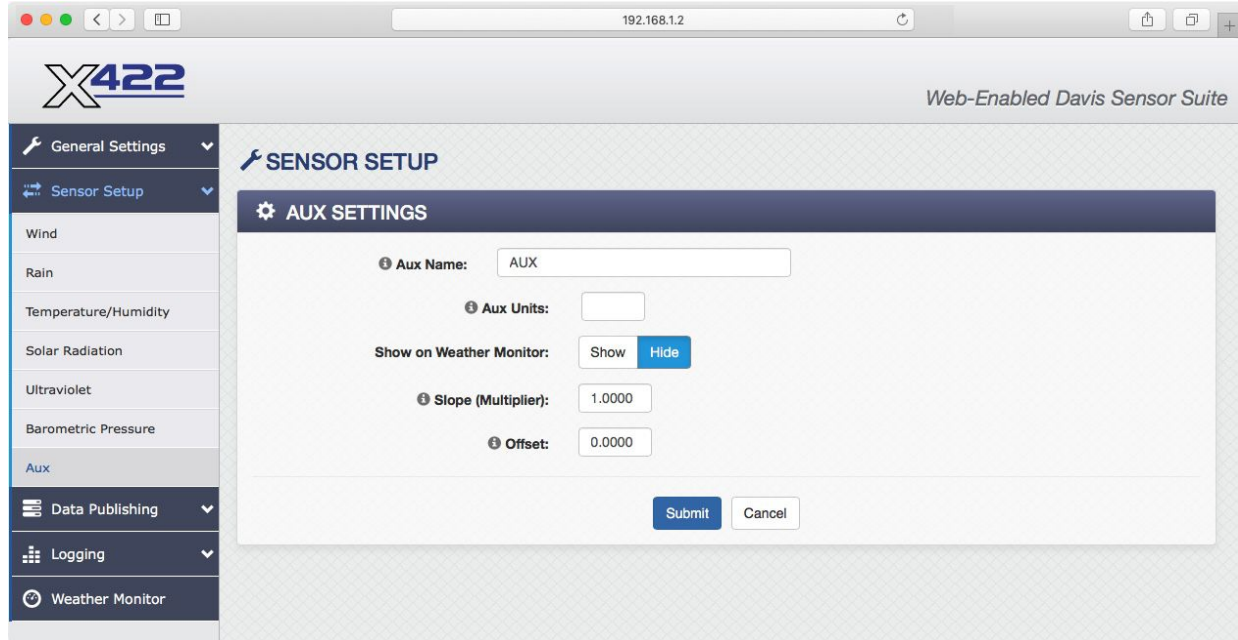
The default value for this field dependent upon the units selected above.

Offset

The “Offset” is used for the “zero” measurement. The default value for this field is dependent upon the units selected above.

2.5.7 AUX

The AUX1 setup page allows you to configure additional sensors that are not listed under the default setup tabs.



Aux Name

This field is used to describe the sensor connected. It can be a maximum of 10 characters long. The default description is `AUX`.

Aux Units

This field allows the user to enter the units that this sensor represents. The text entered in this field will be displayed on the Weather Monitor page to the right of the scaled sensor measurement.

Show on Weather Monitor

When this option is set to "Show" the scaled value will be displayed on the Weather Monitor page. If there is no auxiliary sensor connected to the unit it is recommend that this setting be set to "Hide".

Slope (Multiplier)

In many cases, the inputs must be scaled to represent "real-world" measurements. The X-422 reads the "raw" value from each input, and calculates the number that represents the "real-world" measurement that the user is actually interested in. This real-world value (referred to as the "Scaled Value" in this manual) is calculated using the following linear formula:

$$\text{Scaled Value} = \text{Slope} * \text{Input} + \text{Offset}$$

The Scaled Value is displayed on the **Weather Monitor** page (when Show on Weather Monitor is enabled).

"Slope" in the formula above is provided by the user and is entered in this field. The value is used to scale the input to the range of detected condition.

The default value for this field is 1.0000

When the Slope is set to 1 and Offset is 0, the Scaled Value equals the Input Value.

Offset

The "Offset" is used for the "zero" measurement. The default value for this field is 0.0000

2.5.8 Data Publishing

The screenshot shows a web browser window with the URL 192.168.1.78/setup.html#. The page title is 'Web-Enabled Davis Sensor Suite'. The left sidebar contains navigation options: General Settings, Sensor Setup, Data Publishing (selected), Citizen Weather Observer Program, Weather Underground, Logging, and Weather Monitor. The main content area is titled 'DATA PUBLISHING' and 'CITIZEN WEATHER OBSERVATION PROGRAM (CWOP)'. It displays four steps for configuration:

- Step 1:** Obtain a DW designation number [here](#).
- Step 2:** Enable data publishing and enter DW number. (Submit settings before continuing to Step 3.)
 - Enable Data Publishing: Yes No
 - DW Number:
 - Interval: 5 Minutes
 - Server: cwop.aprs.net
 - Port: 14580
 - Submit Settings
- Step 3:** Send test packet:
- Step 4:** Check [station status](#) to see if data is being received.

At the bottom of the page, there is copyright information, a link to www.ControlByWeb.com for product support, and the text 'ControlByWeb'.

There are four steps to configuring data publishing to the CWOP system:

1 – Obtain a DW number from CWOP by clicking on the 'here' link and following the instructions on the registration form that appears. The DW number will be sent to the email address entered into the registration form.

2- Enabled data publishing and Enter the DW number obtained from Step 1 into the DW Number field of the CWOP setup page. The Server and Port number fields can generally be left at their default values. For a list of other possible servers visit the CWOP website at <http://www.wxqa.com/> . Submit the settings before moving on to step three.

3 – Once data publishing has been enabled and the data publishing settings have been submitted to the device, a test packet can be sent to CWOP. Press the Test button to send a test packet now.

4 – To see if the test packet was received click on 'station status' to be taken to the CWOP status page for this device. For more information on CWOP, visit their website at <http://www.wxqa.com/>.

The screenshot shows a web browser window with the URL 192.168.1.78/setup.html#. The page title is "X422 Web-Enabled Davis Sensor Suite". The left sidebar contains a navigation menu with the following items: General Settings, Sensor Setup, Data Publishing (selected), Citizen Weather Observer Program, Weather Underground, Logging, and Weather Monitor. The main content area is titled "DATA PUBLISHING" and "WEATHER UNDERGROUND". It contains four steps for configuration:

- Step 1:** Register station [here](#).
- Step 2:** Enable data publishing. Enter ID, and Password. (Submit settings before continuing to Step 3.)
 - Enable Data Publishing: Yes No
 - ID:
 - Password:
 - Interval: 5 Minutes
 - Server: weatherstation.wunderg
 - Port: 80
 - Submit Settings
- Step 3:** Send test packet:
- Step 4:** Check [station status](#) to see if data is being received.

At the bottom of the page, there is copyright information, a link to www.ControlByWeb.com for product support, and the text "ControlByWeb".

There are four steps to configuring data publishing to the Weather Underground system.

1 – Obtain an ID number from Weather Underground by clicking on the 'here' link and following the instructions on the registration form that appears.

2- Enabled data publishing and enter the ID number obtained from step one into the ID Number field of the Weather Underground setup page and enable data publishing. Weather Underground also requires a password. This password is the same password used to login to the Weather Underground account created in Step 1. The Server and Port number fields can generally be left at their default values. For a list of other possible servers visit the Weather Underground Upload Protocol website at http://wiki.wunderground.com/index.php/PWS_-_Upload_Protocol. (At the time of writing this manual, there is only one.) Submit the settings before moving on to step three.

3 – Once data publishing has been enabled and the data publishing settings have been submitted to the device, a test packet can be sent to Weather Underground. Press the Test button to send a test packet now.

4 – To see if the test packet was received click on 'station status' to be taken to the Weather Underground status page for this device.

For more information on Weather Underground, visit their website at <http://www.wunderground.com/>.

2.5.9 Logging

The X-422 can be configured to record data such as wind speed and direction, temperature, and solar radiation. The logged data is stored in internal non-volatile memory and can be retrieved by entering the command `http://{X-422 IP address}/log.txt`. For more information on logging, see **Appendix E: Log Files**.

The screenshot shows the X422 web interface for configuring logging. The browser address bar shows 192.168.1.2. The page title is "Web-Enabled Davis Sensor Suite". A left sidebar contains navigation links: General Settings, Sensor Setup, Data Publishing, Logging, Logging Setup, Graph Log File, and Weather Monitor. The main content area is titled "LOGGING" and contains three sections:

- GENERAL LOGGING SETTINGS:** Includes "Enable Logging" (Yes/No), "Interval" (60 Mins/Hours/Days/Event Only), and "Next Log Time" (Disabled).
- LOG SENSORS:** A table with columns for Name, Log, Trigger Log Event, and Delta.
- SEND LOG FILE:** Includes "Daily Send Time (HH:MM)" (23:00), "Email Log File" (Enable), and "FTP Upload Log File" (Enable).

Buttons for "Submit" and "Cancel" are at the bottom of the configuration area. The footer contains copyright information, a support link (www.ControlByWeb.com), and the ControlByWeb logo.

Name	Log	Trigger Log Event	Delta
Wind Speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Wind Direction	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Rain	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Temperature	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Humidity	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Solar Radiation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
UV Index	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Barometric Pressure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2.0000
Aux	<input type="checkbox"/>	<input type="checkbox"/>	2.0000
Wind Gust	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Vin	<input type="checkbox"/>	<input type="checkbox"/>	0.5000

The log is stored in non-volatile flash memory using a circular buffer (old date is over written). 512 kB of memory space is reserved for logging. Log entries are composed of the following components: 8-byte header, and 4 bytes for each log feature selected. A log of Wind Speed (4 bytes) and Humidity (4 bytes) will occupy 16 bytes per entry. Note: Changing the log settings will erase the current log file.

General Logging Settings

Logging Enabled

When this option is set to **Yes**, the X-422 will record data as configured on this page. The default setting for this option is **No**.

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

Interval

This field is used to specify the time period of logging. A numerical value is entered into the text field, and the unit of time is selected using the adjacent radio buttons. Time units are **Minutes**, **Hours**, and **Days**. The range of values in this field is 1 to 20864. The default setting for this field is 60.

Periodic logging can be disabled by selecting the Event Only button.

Next Log Time

This field displays the next periodic log time. If logging is disabled, the Next Log Time will indicate "Disabled."

Log Sensors

This table is used to select which sensors get logged and which events trigger the logging.

Name

Identifies the sensor(s) that can be logged or cause logging events.

Log

Enables/disabled logging of the individual sensor.

Trigger Log Event

When sensors and/or Vin are selected as a *Trigger Log Event*, logging will occur whenever the input or sensor changes by the trigger delta. All sensors can be configured to trigger a log entry to be created. The Wind Gust is the only log option that can trigger logging to occur without a specific delta value. When Wind Gust is configured to trigger logging, any registered wind gust will create a new log entry.

Delta

Specifies the Trigger Delta for the corresponding sensors.

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

Section 3: Operation

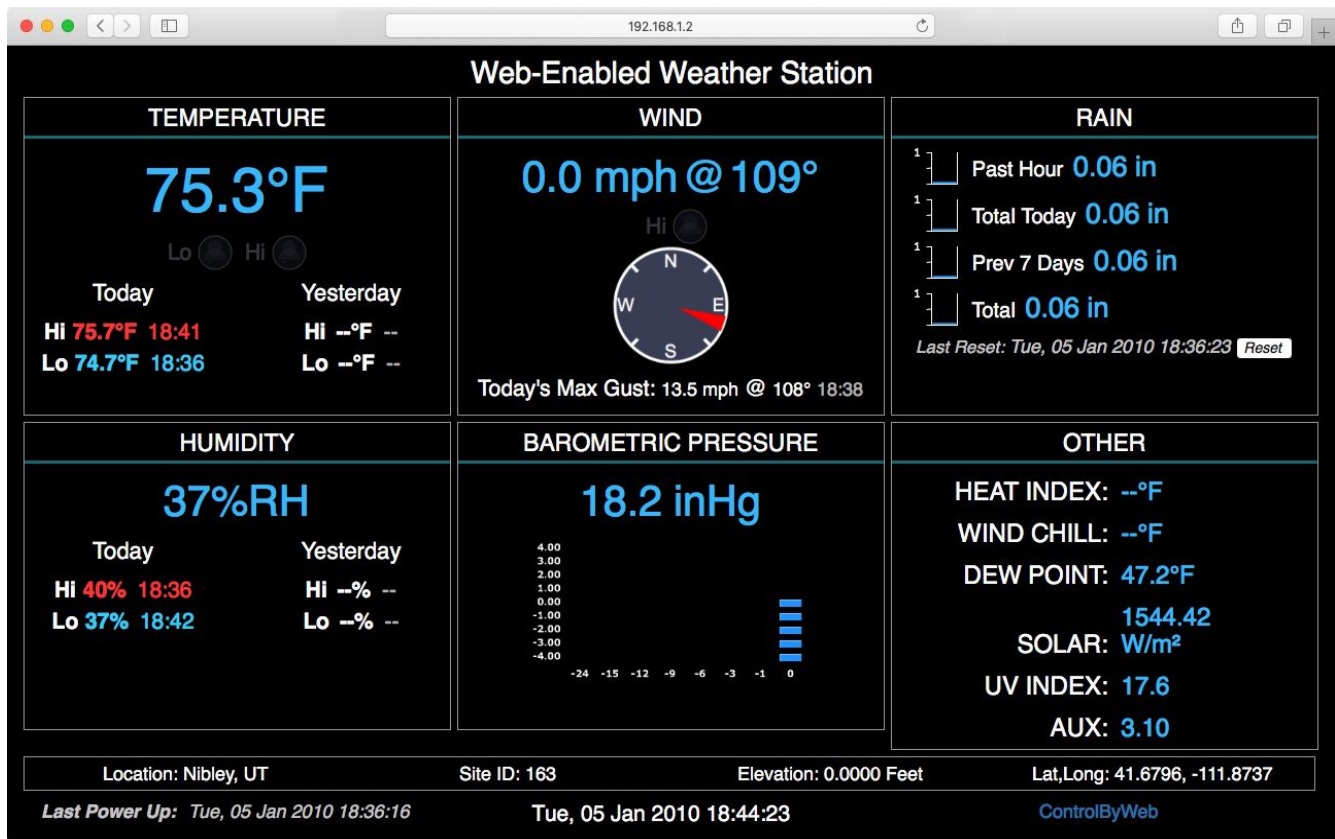
The X-422 can be operated using a web browser, or by sending text commands to an XML status/Weather Monitor Page. The X-422 also allows you to control the outputs using inputs, or alarms.

Note: Using an input or alarm to control the outputs was described throughout previous sections of the manual, and will not be described here.

3.1 Weather Monitor

Once the X-422 is set up, users can access the **Weather Monitor** page using a web browser by typing the IP address of the X-422 into the web browser address bar. For example, using the default IP address, the user would enter `http://192.168.1.2`. If the IP address is changed from the default, the user must use the new IP address. Note that if any port is used other than the default port 80, the port must also be included in the request. For example, accessing the unit at port 8000 would be as follows: `http://192.168.1.2:8000`.

The following screen appears when the **Weather Monitor** is selected:



Temperature

Display of the current temperature, current High and Low temperature values for today, and these values for yesterday. High/Low Alarm status.

Wind Information

Display of the current wind speed, direction, wind gust information, and High/Low Alarm status.

When the wind is 10 knots above the low for the average period, then it is considered a gust and will be reported.

Rain

Displays the rain accumulation data for the past hour, since midnight, Previous 7 days, and a total accumulation. Total values are updated instantly. Hourly and the Total Today are updated every 4 minutes, and the previous 7 days measurements are updated daily.

Rain Counter Reset

This button resets the counters, as well as all rain totals back to zero.

Humidity

Display of the current humidity measurement, current High and Low humidity values for today, and these values for yesterday. High/Low Alarm status.

Barometric Pressure

Display of the current barometric pressure reading, pressure-trend graph for previous 24 hours, and High/Low Alarm status.

Note: The historical information is on the state.xml page, and it loads with the graph every time.

Other

This row displays the calculated values for the Heat Index, Wind Chill, Dew Point based off current wind and temperatures. It also calculates Solar Radiation, UV Index, and data from an auxiliary sensor.

Site Information

Displays detailed information about the meteorological site, including: Location, Site ID, Elevation, and Latitude and Longitude.

Last Power Up

This displays the last time that X-422 was powered on. This information can be useful if the user wants to know whether or not the unit lost power during the time since the page was last viewed.

Date/Time

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

External Link

*Displays a link provided by the user to an external site or webpage. Configurable in the **Status Setup** tab.*

Note: Information about how these values are measured and calculated can be found in **Appendix F: Methods and Calculation Details**.

3.2 XML Operation

Custom XML computer applications may be created to monitor the X-422. This method does not use a web browser. There are three XML pages that can be used to monitor the X-422: state.xml, eventX.xml, and Diagnostics.xml.

3.2.1 State.XML

XML Monitor All Functions

The state of the I/Os, Counters, Rate, Frequency Input, Analog Input, and Sensors can be monitored by sending a request to port 80 (or port specified in setup). This can be demonstrated by entering the following URL into the address bar of a web browser (substituting the IP address as necessary):

```
http://192.168.1.2/state.xml
```

The following state.xml page is returned:

```
<datavalues>
  <windSpd>15.67</windSpd>
  <windDir>327.29</windDir>
  <rainTot>0.36</rainTot>
  <temp>29.13</temp>
  <humidity>34.51</humidity>
  <solarRad>426.48</solarRad>
  <barPressure>30.11</barPressure>
  <uvIndex>17.6</uvIndex>
  <aux1>79.36</aux>
  <rain1h>0.00</rain1h>
  <rainToday>0.00</rainToday>
  <rain7d>0.36</rain7d>
  <rainRst>1262366852</rainRst>
  <tempH>29.38</tempH>
  <tempHTime>1262366852</tempHTime>
  <tempL>23.63</tempL>
  <tempLTime>1262366852</tempLTime>
  <tempHY>27.51</tempHY>
  <tempHYTime>1262280452</tempHYTime>
  <tempLY>25.07</tempLY>
  <tempLYTime>1262280452</tempLYTime>
  <heatIndex>28.28</heatIndex>
  <windChill>--</windChill>
  <dewPoint>11.87</dewPoint>
  <tempAlrm>2</tempAlrm>
  <humidityH>43.73</humidityH>
  <humidityHTime>1262366852</humidityHTime>
  <humidityL>34.40</humidityL>
  <humidityLTime>1262366852</humidityLTime>
  <humidityHY>43.49</humidityHY>
  <humidityHYTime>1262280452</humidityHYTime>
  <humidityLY>36.98</humidityLY>
  <humidityLYTime>1262280452</humidityLYTime>
  <presN1>30.13</presN1>
  <presN3>30.16</presN3>
  <presN6>30.18</presN6>
  <presN9>30.16</presN9>
```

```

<presN12>30.15</presN12>
<presN15>30.13</presN15>
<presN24>30.14</presN24>
<windGust>47.00</windGust>
<windGustDir>121</windGustDir>
<windGustH>30.1</windGustH>
<windGustHTime>1262366852</windGustHTime>
<windGustDirH>214</windGustDirH>
<windAlrm>2</windAlrm>
<powerUp>1262366852 </powerUp>
<utcTime>1262367932</utcTime>
<timezoneOffset>0</timezoneOffset>
<serialNumber>00:0C:C8:00:00:09</serialNumber>
</datavalues>

```

The numbers enclosed by the tags, <tag>, indicate the current state or value monitored by the X-422. Values for each tag are described in the table below.

XML computer applications will open a TCP/IP socket with the X-422 and send a GET command followed by the state.xml command string. (See **Section 3.3** for instructions on using GET.)

XML Tags	Monitor Values
<windSpd>	Indicates the current wind speed.
<windDir>	Indicates the current wind direction.
<rainTot>	Indicates the current rainfall total.
<temp>	Indicates the current temperature measurement. -- = Indicates that no digital temperature sensor is attached. 77.3 = Current temperature.
<humidity>	Indicates the current relative humidity measurement -- = Indicates that no digital humidity sensor is attached. H24.9 = Current humidity reading.
<solarRad>	Indicates the current solar radiation value.
<barPressure>	Indicates the current barometric pressure.
<uvIndex>	Indicates the UV Index
<aux1>	Indicates the current value measured by an auxiliary sensor 1.
<rain1h>	Indicates the total rainfall for the past 1 hour.
<rainToday>	Indicates the total rainfall since midnight.
<rain7d>	Indicates the total rainfall in the last week
<rainRst>	Time that rain total was reset. (number of seconds since January 1, 1970).
<tempH>	Indicates today's current high temperature.
<tempHTime>	Tme of today's high temperature (number of seconds since January 1, 1970)

XML Tags	Monitor Values
<tempL>	Indicates today's current low temperature.
<tempLTime>	Time of today's low temperature (number of seconds since January 1, 1970)
<tempHY>	Indicates yesterday's high temperature.
<tempHYTime>	Time of yesterday's high temperature (number of seconds since January 1, 1970)
<tempLY>	Indicates yesterday's low temperature.
<tempLYTime>	Time of yesterday's low temperature (number of seconds since January 1, 1970)
<heatIndex>	Indicates the calculated heat index value.
<windChill>	Indicates the calculated wind chill value.
<dewPoint>	Indicates the calculated dew point.
<tempAlarm>	Current state of the temperature alarm. 0 = Normal 1 = High 2 = Low
<humidityH>	Indicates today's highest humidity reading.
<humidityHTime>	Time of today's highest humidity reading (number of seconds since January 1, 1970)
<humidityL>	Indicates today's lowest humidity reading.
<humidityLTime>	Time of today's lowest humidity reading (number of seconds since January 1, 1970)
<humidityHY>	Indicates yesterday's highest humidity reading.
<humidityHYTime>	Time of yesterday's highest humidity reading (number of seconds since January 1, 1970)
<humidityLY>	Indicates yesterday's lowest humidity reading.
<humidityLYTime>	Time of yesterday's lowest humidity reading (number of seconds since January 1, 1970)
<presN1>	Indicates the measured barometric pressure last hour.
<presN3>	Indicates the measured barometric pressure three hours prior.
<presN6>	Indicates the measured barometric pressure six hours prior.
<presN9>	Indicates the measured barometric pressure nine hours prior.
<presN12>	Indicates the measured barometric pressure twelve hours prior.
<presN15>	Indicates the measured barometric pressure fifteen hours prior.
<presN24>	Indicates the measured barometric pressure twenty-four hours prior.
<windGust>	Indicates the most recent wind gust speed.

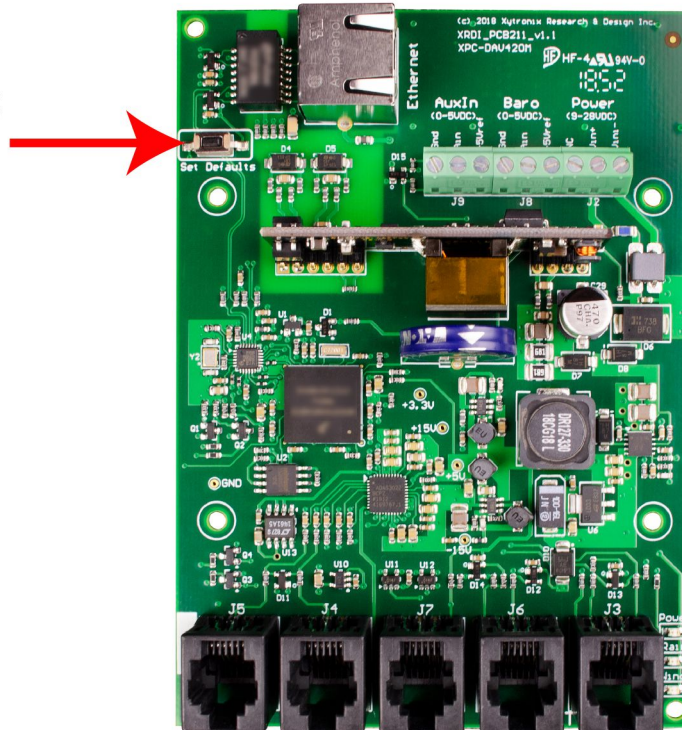
XML Tags	Monitor Values
<windGustDir>	Indicates the most recent wind gust direction.
<windgustH>	Indicates the highest wind gust since midnight.
<windGustHTime>	Time of the highest wind gust (number of seconds since January 1, 1970)
<windGustDirH>	Indicates the direction of the highest wind gust since midnight
<windAlrm>	Current state of the wind speed alarm. 0 = Normal 1 = High 2 = Low
<powerUp>	Time device powered on. (number of seconds since January 1, 1970).
<utcTime>	Current UTC time
<timezoneOffset>	Offset in seconds for the configured timezone.
<serialNumber>	00:00:00:00:00:00, serial number of the X-422.

Appendix A: Restoring Factory Default Settings

In the event that the IP address or passwords are forgotten, the X-422 may be restored to its original factory default settings.

1. Remove the DC power from the unit (disconnect Ethernet cable if POE powered).
2. Locate the Set Defaults button on the X-422 circuit board. Carefully press and hold this button.
3. While depressing the button, apply power and wait for about 10 seconds before releasing the button. All settings will be set 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.

Set Defaults
Button



Appendix B: Installing New Firmware

From time to time, updates are made to the X-422 firmware. The firmware can be updated in the field. The procedure for updating the firmware is outlined below. Please note that it is important that this procedure is followed precisely.

Requirements

The firmware update software requires Windows XP/Vista/7/10 with the .Net framework installed. The .Net framework is generally installed automatically through Windows update. To install it manually, go to the following address:

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

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

Setup

1. Download the firmware zip file from the ControlByWeb website. Only a the X-422 image can be installed on the X-422 so make sure the correct image is being downloaded.
2. bootloader.exe will connect to X-422 using default IP address 192.168.1.2, not the address currently assigned to the X-422. After the update, all settings will be lost and the device will return to its default IP address of 192.168.1.2.

Configure the PC to the same subnet as the IP address 192.168.1.2, such as 192.168.1.10. For instructions on doing this, see section **2.3 Establishing Communications for Setup**.

Note: The IP address of the X-422 will automatically be set to the default 192.168.1.2 during the update process.

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

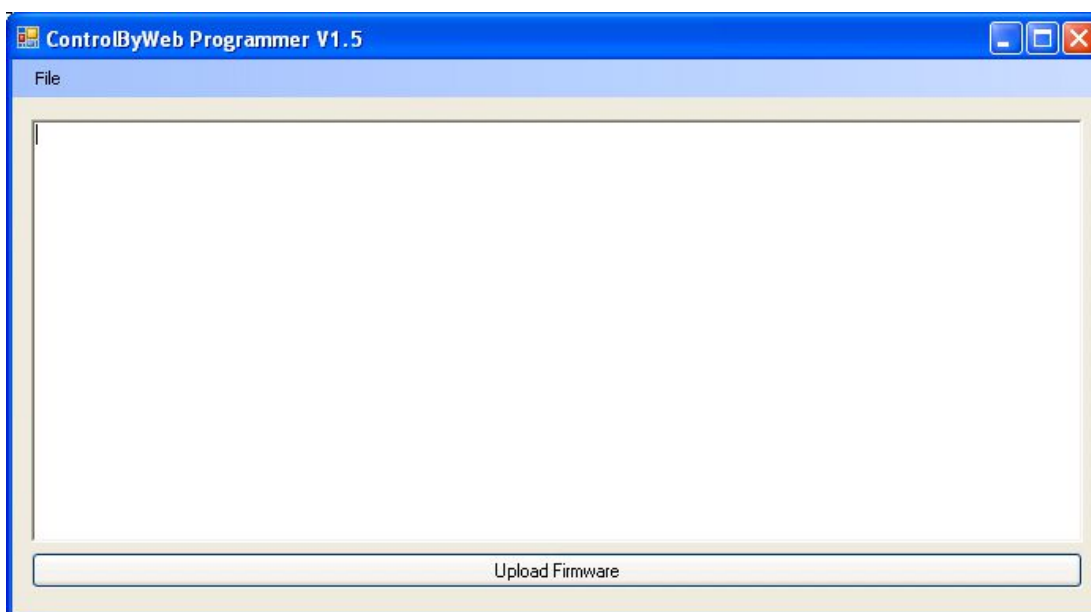


Figure Appendix B.1 - Firmware Update Utility

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

Device Upgrade Procedure

Carefully follow the following steps to put the X-422 into bootloader mode and perform the upgrade:

1. Remove DC power from the X-422.
2. Press and hold the Set Defaults button.
3. While holding the Set Defaults button, apply power to the X-422. The LINK and ACT lights will flash. Continue to hold the reset button for the next step.
4. While holding the Set Defaults button, press the Upload Firmware button at the bottom of the ControlByWeb™ Programmer window. After the programming process begins, the reset button can be released
5. Programming will take approximately 20-30 seconds. The LINK LED will stop flashing and remain lit during this time. The X-422 will be set to factory defaults with an IP address of 192.168.1.2.
6. Refer to section **2.3 Establishing Communication for Setup** to reconfigure the X-422. 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>).

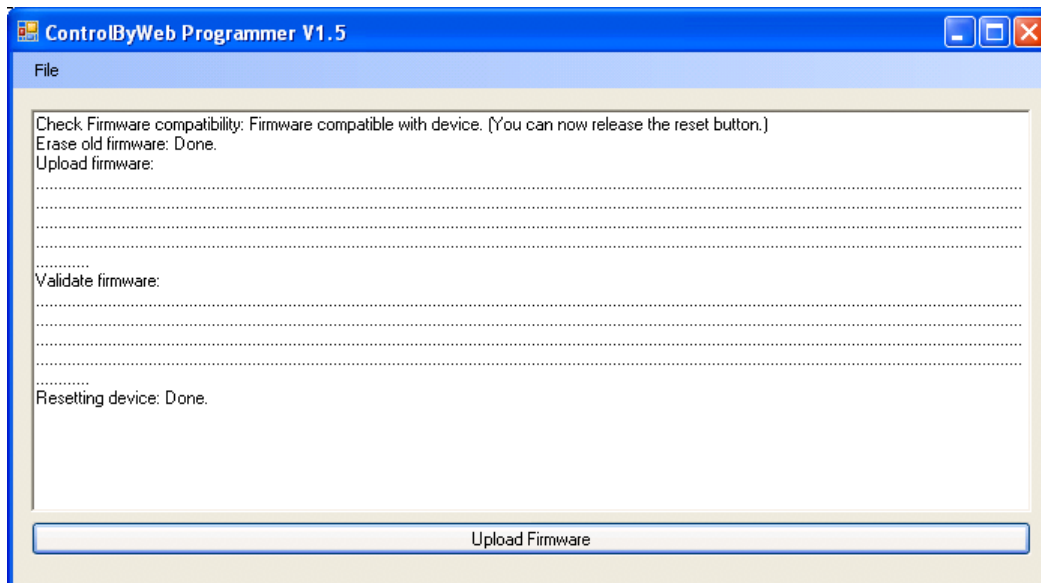


Figure Appendix B.2 - Firmware Update Complete

Appendix C: Accessing X-422 Over the Internet

The X-422 can be monitored and/or controlled from a remote location over the Internet. Once the X-422 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-422. This guide is not meant to be a tutorial in router setup, but rather to provide a basic overview of remote access. For specific details, the user should refer to the instruction manual for the router on the local network. Users not familiar with basic IP networking should study one or more basic IP networking tutorials before proceeding (many tutorials are available on the Internet).

IP Addresses

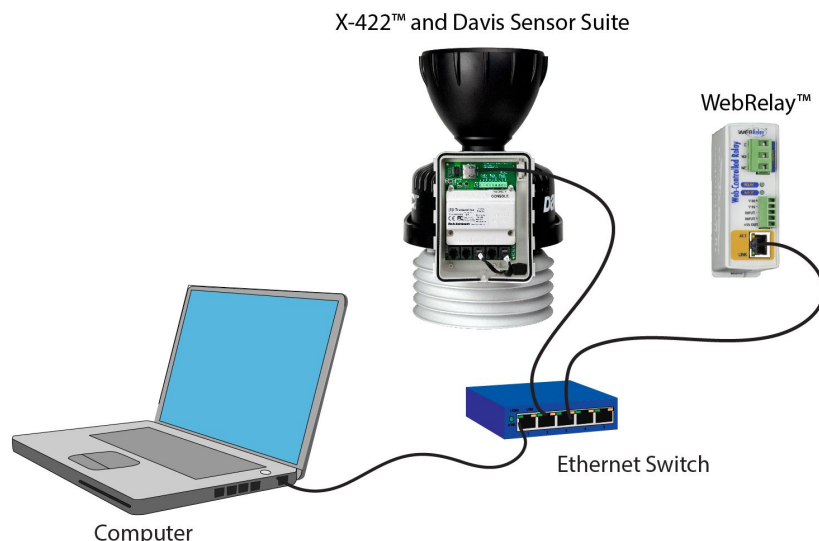
Every device on the Internet is identified by a unique address called an IP (Internet Protocol) address. IP addresses are somewhat similar to mailing addresses in that they identify the precise logical location of the device on the Internet. The IP address identifies the global region down to the network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

Every device that is “directly” connected to the Internet uses a “public” IP address. The X-422 can be assigned a public IP address for direct connection to the Internet. Typically, a public IP address would only be assigned to the X-422 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.

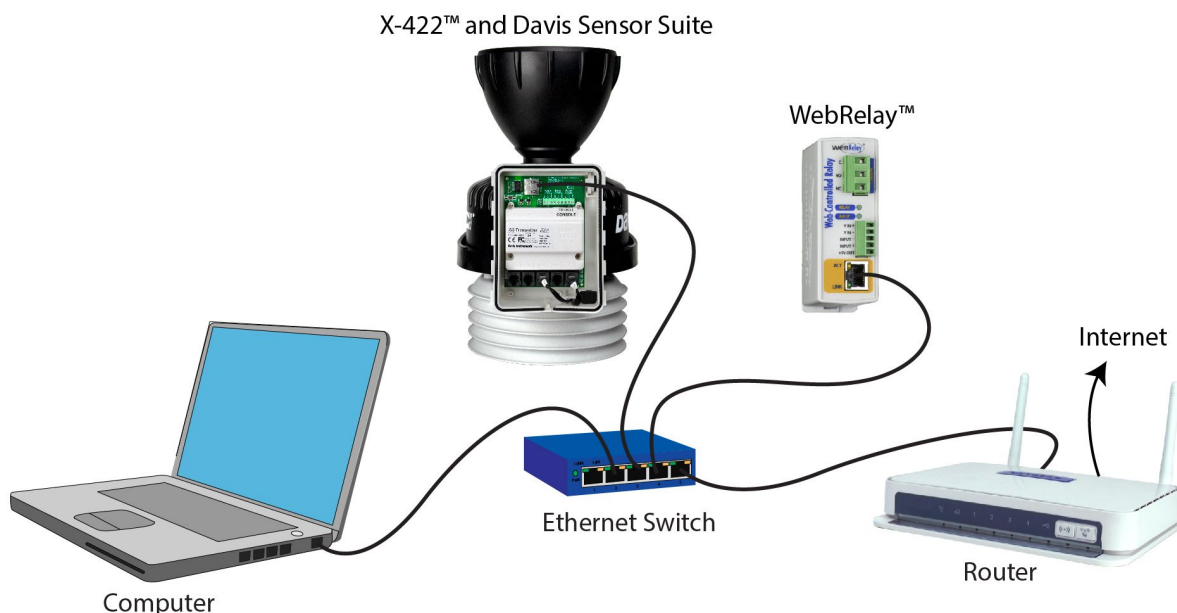
A Simple Local Area Network

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-422, and a WebRelay™. In this example, the computer is assigned an IP address of 192.168.1.10, the X-422 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-422 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>.



A Simple LAN connected to the Internet

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



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

Port Forwarding

The router can be configured to allow outside access to the X-422 and WebRelay™. All requests from the Internet to any device on the local network must use the public IP address (266.70.164.97). With only a single IP address, TCP ports are used to identify the intended device for the incoming message.

Using the mailing address analogy, the port is similar to a post office box. The IP address specifies the location, and the port specifies the specific recipient. Port numbers can be set to any number between 1 and 65235. However, many port numbers are reserved for specific applications and should be avoided. As a general rule, numbers above 8000 are safe to use. All of the ControlByWeb™ products come from the factory with the HTTP port set to 80, which is the standard port for HTTP. In this example, the X-422 HTTP port will be changed to port 8000 and WebRelay™ port will be changed to 8001. Once the ports are changed in the two ControlByWeb™ devices, the router must be set up for port forwarding.

Port forwarding associates the IP address of each local device with an assigned port. In this example, the address 192.168.1.25 for the X-422 would be associated with port 8000. The address 192.168.1.26

for WebRelay™ would be associated with port 8001. The X-422 would be accessed from the Internet by entering the public IP address of the router, plus the port number assigned to the X-422 in the URL window of the browser, <http://266.70.164.97:8000>. All Internet requests to the router for port 8000 would be forwarded to the X-422. Similarly, all request for port 8001 would be forwarded to WebRelay.

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

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

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

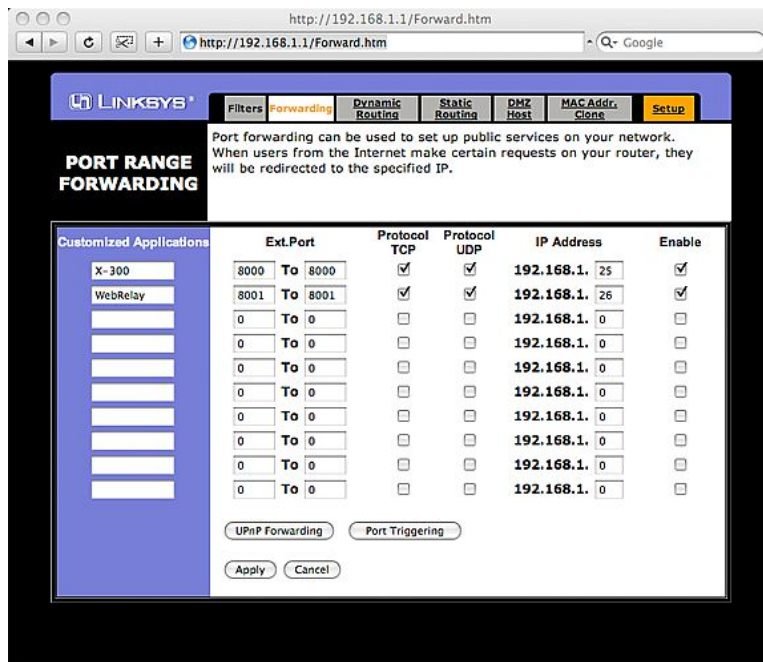


Figure Appendix C.3- Port Range Forwarding

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

Accessing Setup Pages

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

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

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

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

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

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

Using the example above, the following line would be used to access the setup page of X-422:

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

Appendix E: Log Files

The X-422 logs information to two different log files: log.txt and syslog.txt. Both log files are text files and are stored in nonvolatile memory. This data will not be lost due to power failure and is also not cleared when restoring factory defaults. The log files are stored in circular buffers which write from the beginning of the allocated memory space to the end and then repeat from the beginning (over-writing the original data). The nonvolatile memory is divided into 4K byte sectors. Each time data gets erased to make room for new data, a full sector (4K bytes) is erased at one time.

Data Log File – log.txt

This log file is user-configurable under the **Logging** setup tab, and stores real-world data from the sensors connected to X-422(see Logging for more information). It can be up to 512K bytes long and is stored using a comma-separated value formatting scheme.

Measured values will only be displayed if they are selected in the **Logging** setup tab. The file is read by requesting the log.txt file from the X-422. 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:

```
Location: Logan, UT Site ID: 567584321
Elevation: 4457.000 Feet Lat, Long: 41.764, -11.851
Date Time, Wind Speed(mph), Wind Direction(deg), Rain(in), Temperature(°F), Humidity(%RH),
Solar Radiation(W/m²), UV Index, Barometric Pressure(inHg), AUX, Wind Gust(mph), Vin(V), Trigger
```

Date and Time Format:

```
MM – Month (01-12)
DD – Day (01-31)
YYYY – Year (1970 - 2106)
HH – Hour in 24 hour time (00 -23)
MM – Minutes (00-59)
SS – Seconds (00-59)
```

Sample File:

```
Location: Nibley, UT Site ID: 163
Elevation: 0.0000 Feet Lat, Long: 41.6796, -111.8737
Date Time, Wind Speed(mph), Wind Direction(deg), Rain(in), Temperature(°F), Humidity(%RH), Solar
Radiation(W/m²), UV Index, Barometric Pressure(inHg), AUX, Wind Gust(mph), Vin(V), Trigger
01/05/2010 00:57:00 STD,0.0000,351.4647,0.0000,x.x,x.x,0.0000,-0.7963,2.7939,-0.1333,x.x,9.1022,Time:()
01/05/2010 00:58:00 STD,0.0000,351.4590,0.0000,x.x,x.x,0.0000,-0.7923,2.7959,-0.1330,x.x,9.1171,Time:()
```

The file can then be saved using the 'Save As...' option under the 'File' menu of the web browser. If the TCP port has been changed (not port 80), the port will be required to read the file. For example, using the default IP address, and port 8000, the log file would be read as follows:

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

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

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

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

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

System Log File – syslog.txt

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

File Format:

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

Sample File:

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

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

Category	Message	Description
DEVICE	Power Up	Device has been properly powered.
	Initialize	Device is ready.
	Reset Factory Defaults	Device has been reset to factory defaults.
EMAIL	Failed DNS Lookup	Unable to look up 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 look up Remote Server due to an incorrect DNS setting.
	Connection Attempt Started	Connection port with Remote Server has been opened.
	Connection Closed	Connection port with the Remote Server has been closed.
DHCP	Address Acquired	IP address request successful, and IP address assigned.
	Lease Renewal	IP address assigned to device was renewed.
MAIN_MCU	New Firmware Loaded	New firmware has been loaded to the device.
CWOP / WEATHER UNDERGROUND	Error establishing connection.	Could not communicate with the weather service.
	Failed DNS Lookup	Unable to lookup NTP server name due to an incorrect DNS

Category	Message	Description
		setting.
	Server Address/Hostname does not exist or is misspelled	Ensure the "Server" field is correct.
	Server Address/Hostname is blank	Enter in a valid hostname in the "Server" field.

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 J: Specifications

Power Requirements

- Input Voltage: 9-28 VDC or 802.3af POE
- Current: See table below for typical values at 25°C.

100 Mbps Network Speed

Power Supply	Typical Current
9 VDC	155 mA
12 VDC	117 mA
24 VDC	64 mA

I/O Connector

- (1) 9-position, screw terminal strip, 3.81 mm spacing
- (5) RJ-25 connectors for weather station sensors
- (1) RJ-45 connector for Ethernet

Sensors

Auxiliary Input

- Voltage Range: 0-5VDC

Barometric Pressure

- Voltage Range: 0-5VDC

UV / Solar Radiation

- Pin 1: NC
- Pin 2: +3Vref supply
- Pin 3: UV Sensor Input
- Pin 4-5: GND
- PIN 6: NC

Rain

- Pin 1: NC
- Pin 2-3: GND
- Pin 4: Open drain input
- Pin 5: GND
- Pin 6: NC

Wind

- Pin 1: NC
- Pin 2: +5Vref supply
- Pin 3: Wind direction Input
- Pin 4: GND
- Pin 5: Open drain speed input
- Pin 6: NC

Temperature/Humidity

- Sensiron SHT11
- Pin 1: Data
- Pin 2: +3.3V supply
- Pin 3: GND
- Pin 4/5: NC
- Pin 6: Clock

Analog Inputs

- 16-bit conversions
- 0-5VDC input range

Network

- 10 Base-T or 100 Base-T Ethernet IPv4
- Static IP address assignment or DHCP
- HTTP port selectable
- Standard 8-pin RJ-45 Modular Socket
- Supports Web Browser (HTTP), XML, SMTP protocols

5 LED Indicators

- Power On
- Rain
- Wind
- Network Linked
- Network Activity

Real-Time Clock

- Manual or NTP (Network Time Protocol) setup
- NTP Sync Configurable for Once, Daily, Weekly, or On Power-up
- Automatic Daylight Savings Adjustment
- Battery (capacitor) Power Backup

Capacitor Power Backup

- Supports Real-Time Clock
- 2 weeks Minimum Duration

Nonvolatile Memory

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

Environmental

- Operating Temperature: -40°C to 65.5°C (-40°F to 150°F)
- Storage Temperature: -40°C to 85°C (-40°F to 185°F)

Mechanical

- Size: 3.5 x 4.85 x 0.875 in. (88.9 x 123.19 x 22.23 mm)
- Weight: 3.0 oz (84 g)

Logging

- Stored in Nonvolatile Flash
- Circular Buffer
- 512 kB (Up to 42000 log entries)

Password Settings

- Password protection on **Setup Page**
- Optional Password protection on **Status Page**
- Base 64 Password Encoding
- 13 Character, Case-Sensitive Password Length

Electromagnetic Compliance

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

Product Safety Compliance

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

