



WeatherMaster™ Software User Manual



WeatherMaster™

User Manual

Version 5.0.4

All specifications subject to change without notice.

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Welcome

Welcome to the Columbia Weather Systems family of users and congratulations on your purchase of WeatherMaster software.

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Introduction

Features

- Compatible with Capricorn 2000/2000EX, Capricorn FLX, Pegasus, Orion, Vela, Magellan, Magellan MX, Pulsar LX (Pulsar with MicroServer), Weather MicroServer and CWS Web XML data.
- Collects data from single or multiple weather stations connected to separate COM ports on the computer, or through network connection.
- Displays data using multiple HTML pages.
- Automatically updates a web page for each station using an HTML template.
- Automatically generates a data export file to upload to an FTP server for each station.
- Displays trend chart, daily statistics, monthly statistics and latest measurements for each station.
- Allows historical data to be viewed in trend, and daily/monthly statistics pages.
- Emails detailed weather report.
- Provides flexible alarm conditions for individual stations.
- Allows multiple alarm conditions and notifications.
- Alarm notifications include popup, email, and relay control.
- Allows for user defined wind direction offset
- Interfaces with ALOHA software*.
- Stores data in an SQL Database.
- Allows for flexible data export from database.
- Uploads weather data to Weather Underground
- Captures serial data to a CSV file

* Area Locations of Hazardous Atmospheres Software

Installation

Software Installation

Insert the “credit card” USB Drive into a USB port on the computer. Open the USB Drive folder and double click on the SetupWM.exe file to start the installation.

Follow the on-screen instructions to complete the installation.

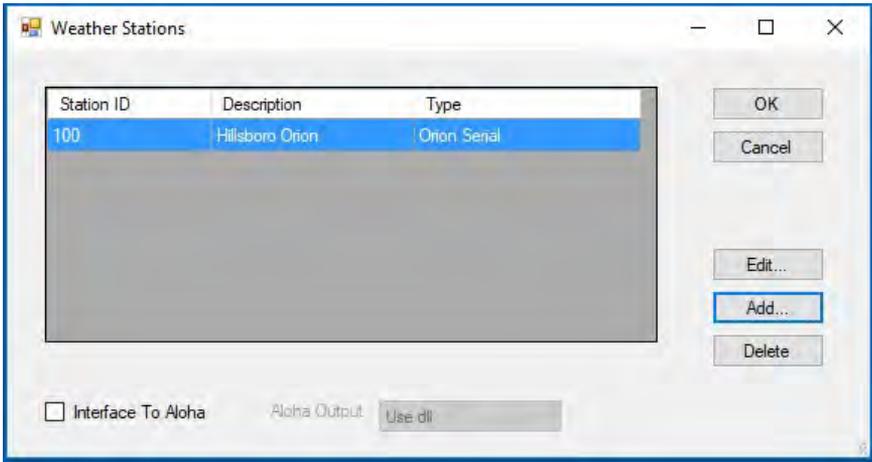
The minimum computer requirements for WeatherMaster software are:

- Windows 7 or 10 operating system
- Intel Core i3 or equivalent
- 4MB Memory
- 500MB Hard Drive
- Serial port or USB to Serial Converter

Configuration

Weather Stations

From the Configuration menu, select Weather Stations.



Adding a new station

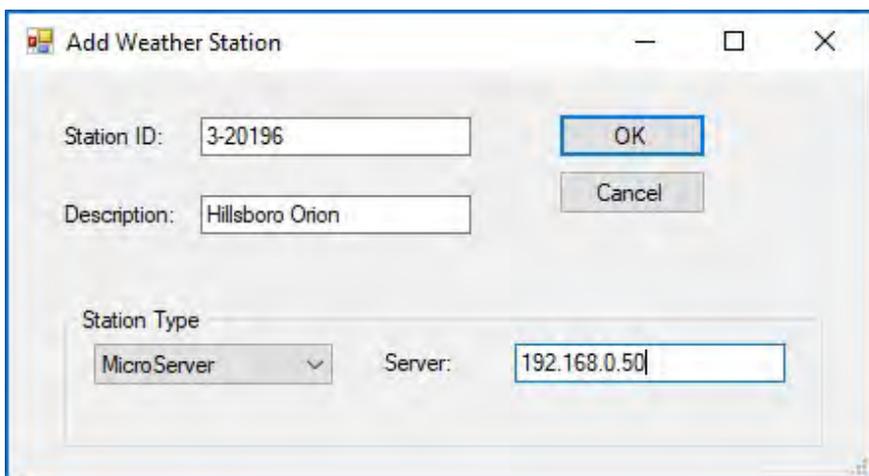
To add a new station, select the Add button in the Weather Stations dialog.

MicroServer, Web XML, and File XML Site Station Types

The MicroServer station communicates with WeatherMaster via the Ethernet network using XML data.

The Web XML station communicates with WeatherMaster via the Internet using XML data which is exported to the Internet by the MicroServer every 15 seconds.

The File XML station communicates with WeatherMaster via the Network using XML data which is exported to the Internet by the MicroServer every 15 seconds.



The screenshot shows a window titled "Add Weather Station" with standard window controls (minimize, maximize, close). The window contains the following fields and controls:

- Station ID:** A text box containing "3-20196".
- Description:** A text box containing "Hillsboro Orion".
- Station Type:** A dropdown menu with "MicroServer" selected.
- Server:** A text box containing "192.168.0.50".
- Buttons:** "OK" and "Cancel" buttons are located to the right of the input fields.

Station ID:

For the MicroServer station, enter the serial number of the MicroServer.

For Web and File XML stations, enter 100 as the serial number. If adding more than one station, increment the serial number.

Description:

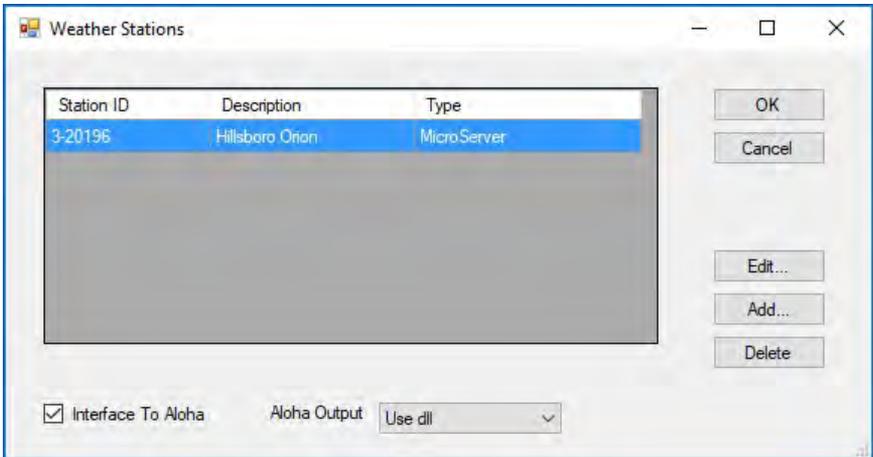
Enter a description for the weather station location, such as Main Street, Hillsboro, North Runway, Command Center or any other description desired.

Station Type:

For **MicroServer stations**, enter the MicroServer IP address (found on the side of the MicroServer enclosure).

For **Web XML stations**, enter the web address and xml file name, e.g. www.columbiaweather.com/commandcenter.xml.

For **File XML stations**, enter the path and XML file name, e.g. `C:\Documents and Settings\weather.xml`



Check “Interface to Aloha” to interface WeatherMaster with ALOHA (Area Locations of Hazardous Atmospheres) software. If there are multiple weather stations communicating with the software, only the first station defined will communicate with ALOHA software.

WeatherMaster communicates directly with ALOHA software using the NOAA_32.DLL library file.

WeatherMaster can also output the ALOHA SAM data over a serial com port. This feature is used by other third-party software that expects the ALOHA SAM data over a serial com port.

Use the Add button to add more stations as required.

Click OK when finished to save changes.

Click Cancel to close the dialog without saving changes.

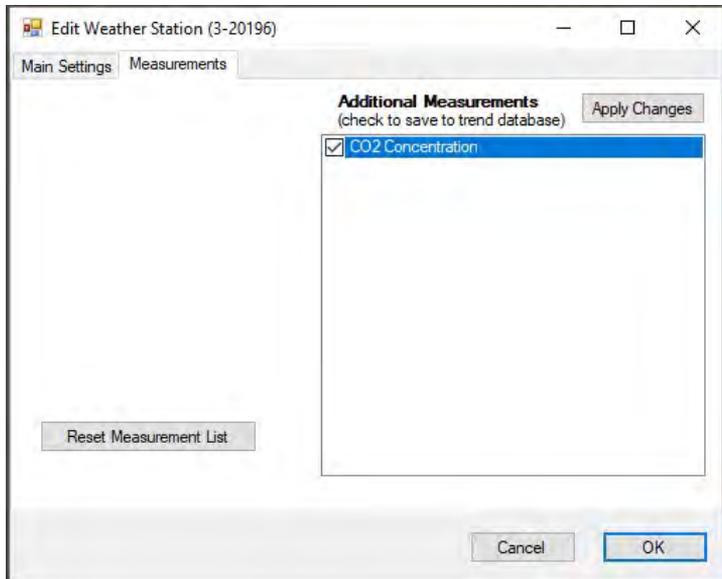
Reset Measurements List

If the Selected Measurements list is changed in the MicroServer then WeatherMaster can be updated to reflect this change.



To update WeatherMaster with the new measurements click Edit from the Configuration/Weather Stations screen.

On the Measurements tab click Reset Measurement List.



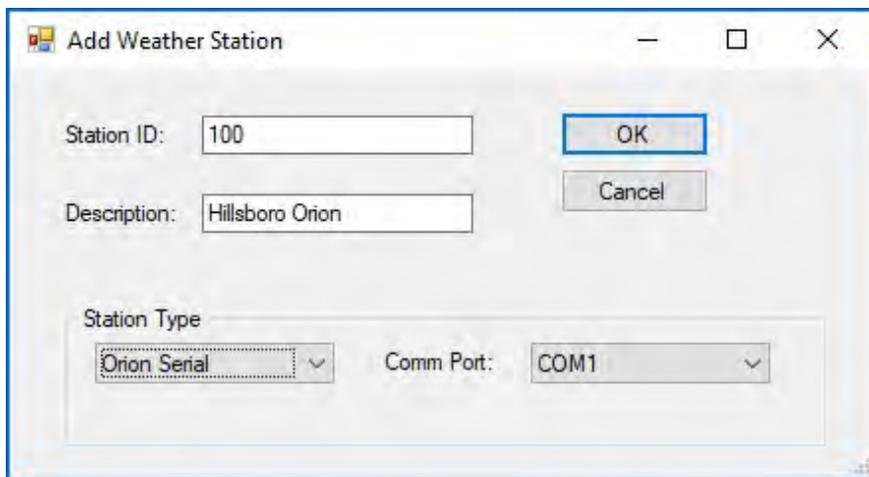
If any custom sensors have been added to the MicroServer they can be saved to the database by checking the corresponding measurement under Additional Measurements.

Click Apply Changes to save the changes.

Orion, Magellan, Magellan MX and Capricorn FLX Station Types

The Orion, Magellan, Magellan MX and Capricorn FLX weather stations communicate with WeatherMaster via an RS-232 serial communication port (Comm. Port).

If the computer does not have a built-in serial port, a USB to Serial converter can be used to create a virtual serial port.



The screenshot shows a Windows-style dialog box titled "Add Weather Station". It features a title bar with a Windows logo, the text "Add Weather Station", and standard window controls (minimize, maximize, close). The main area contains two text input fields: "Station ID" with the value "100" and "Description" with the value "Hillsboro Orion". To the right of these fields are "OK" and "Cancel" buttons. Below the text fields is a "Station Type" section with a dropdown menu showing "Orion Serial" and a "Comm Port" section with a dropdown menu showing "COM1".

Station ID:

For Orion Serial, Magellan Serial and Magellan MX Serial enter 100 as the serial number. If adding more than one station, increment the serial number.

For Capricorn FLX stations, enter the Control Module serial number.

Description:

Enter a description for the weather station location, such as Main Street, Hillsboro, North Runway, Command Center or any other description desired.

Station Type:

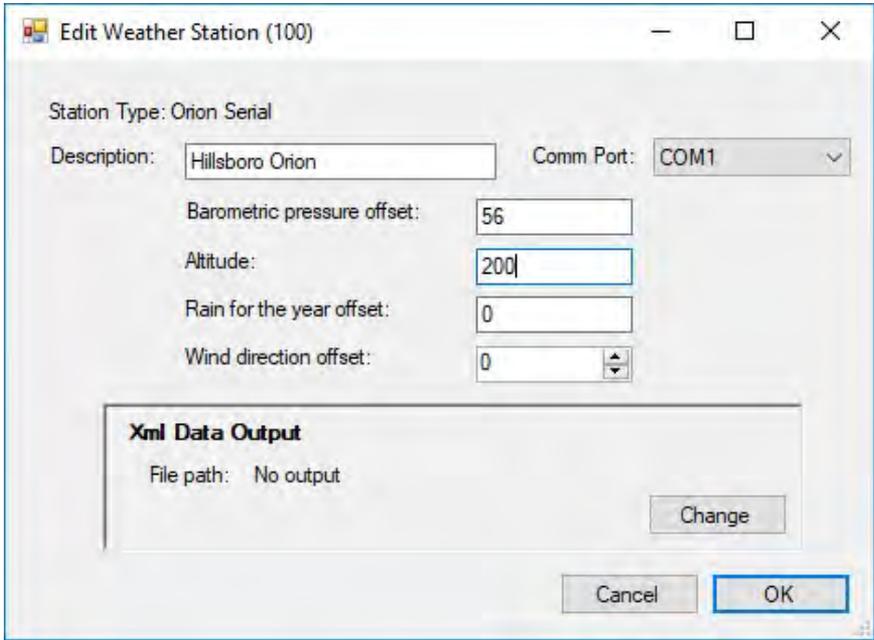
Select the appropriate station type: Orion Serial, Magellan Serial, Magellan MX Serial or Capricorn FLX. For Vela weather stations, select the Magellan Serial setting.

Select the Comm. Port the station is connected to from the drop-down list.

Click OK.

Station Settings

To edit the station settings click Edit from Weather Station dialog.



The screenshot shows a Windows-style dialog box titled "Edit Weather Station (100)". The "Station Type" is "Orion Serial". The "Description" field contains "Hillsboro Orion" and the "Comm Port" dropdown is set to "COM1". Below these are four input fields: "Barometric pressure offset" (56), "Altitude" (200), "Rain for the year offset" (0), and "Wind direction offset" (0). A section titled "Xml Data Output" shows "File path: No output" with a "Change" button. At the bottom are "Cancel" and "OK" buttons.

Location description and port settings can be edited.

Barometric Pressure Offset: is the barometric pressure calibration offset. For example: 56 pressure offset will increase the barometric pressure reading by 0.56 in Hg.

Altitude: is the elevation of the site being monitored. 0 ft is the default value set at the factory. This value should be changed to reflect the correct altitude of the site. The altitude setting will affect the barometric pressure reading. An increase of 10 feet will increase the pressure reading by 0.01 in Hg.

Rain for the year offset: is used to correct the rainfall amount for the year.

Wind Direction Offset: Allows the user to enter a degree offset to change the wind direction value. This feature is useful for vehicle or boat mounted systems. The offset is added to the actual wind direction value. For example, if the sensor output is 45° and the offset is 10°, then WeatherMaster will display 55° for the wind direction value.

For the Magellan MX501 click Sensors and check Solar Radiation.

Capricorn/Pegasus Station Type

Select the Edit button from the Weather Station dialog to change the station configuration.

The screenshot shows the 'Edit Weather Station (655)' dialog box with the following settings:

- Station Type: Capricorn Serial
- Description: Hillsboro Capricorn
- Comm Port: COM3
- Evapotranspiration crop factor: 1
- Degree day reference temperature: 0
- Season start month: March
- Season start day of month: 1
- Wind direction offset: 0
- Xml Data Output: File path: No output (Change button)
- Buttons: Cancel, OK

Location description and port settings can be edited.

If using evapotranspiration, enter the appropriate crop factor. Crop factor 1 is for a reference crop of Alfalfa.

Evapotranspiration is calculated using the 1982 Kimberly-Penman formula as applied in the U.S. Bureau of Reclamation's Pacific Northwest AgriMet Program.

Note: In order to correctly calculate evapotranspiration, the following sensors must be installed in the system:

- Air temperature
- Wind speed and direction
- Relative humidity
- Solar radiation

If using Degree-Day, enter the reference temperature to be used in the calculations. The Degree-Day reference temperature must be entered in degrees F.

Degree-Day = Average Temperature – Reference Temperature

Reference temperature varies from one application to another.

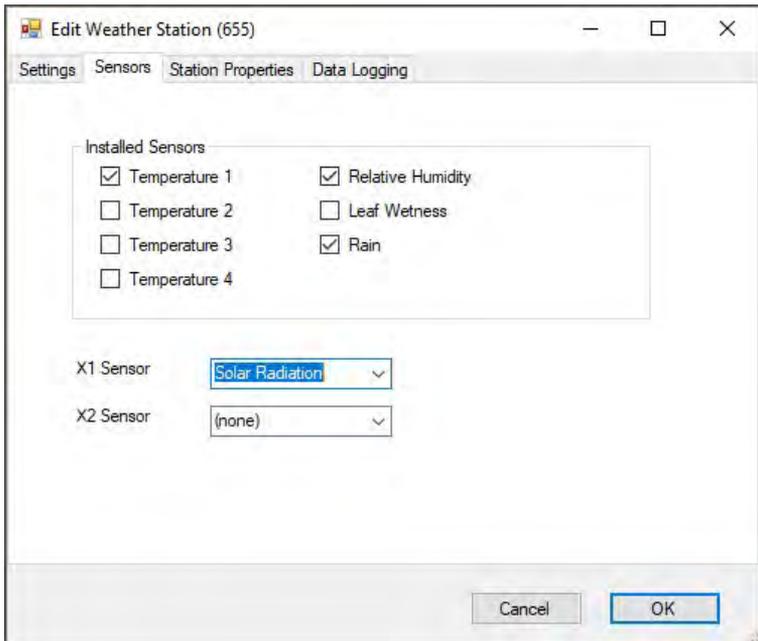
Enter the start date for Degree-Day accumulation.

Degree-Day accumulation for the season (from the start date) is displayed in the Temperature/Rain and Daily Statistics screens.

Wind Direction Offset: Allows the user to enter a degree offset to change the wind direction value. This feature is useful for vehicle or boat mounted systems. The offset is added to the actual wind direction value. For example, if the sensor output is 45° and the offset is 10°, then WeatherMaster will display 55° for the wind direction value.

Sensors

In the Edit Weather Station dialog, select the Sensors tab.



Select the sensors that are installed in the weather station.

If temperature 1 is not selected, then wind chill, dew point and heat index will not be displayed.

If relative humidity is not selected, then dew point, and heat index will not be displayed

Note: Wind speed, wind direction, and barometric pressure are always enabled in the software.

Define the sensors connected to multi-purpose channels, X1 and X2. These channels are only available with the Capricorn 2000MP and Capricorn 2000EX. Normally solar radiation is connected to X1 and soil moisture is connected to X2. If there aren't any sensors connected to these channels, X1 and X2 sensor entries should be left blank.

Reset Sensors: Click on this button to re-initialize Temperature 1 sensor. This feature is only applicable for weather stations with a single temperature sensor.

Station Properties

In the Edit Weather Station dialog, select the Station Properties tab.

Edit Weather Station (655)

Settings Sensors **Station Properties** Data Logging

Note: Station Properties are stored at the Capricorn Weather Station.

T1 Offset:	<input type="text" value="0"/>	Pressure Offset:	<input type="text" value="56"/>
T2 Offset:	<input type="text" value="0"/>	Altitude:	<input type="text" value="0"/>
T3 Offset:	<input type="text" value="0"/>	Hi/Lo Interval:	<input type="text" value="24 hours"/>
T4 Offset:	<input type="text" value="0"/>	Logging Interval:	<input type="text" value="15 minutes"/>

The dialog will display all sensor calibration offsets and internal settings of the weather station. These settings are pre-configured at the factory.

To change any of these settings, simply highlight the desired value and type in the new value.

T1 through T4 Offsets: are the temperature calibration offsets found on the temperature probe cables in Capricorn or Pegasus weather stations. For the Orion weather station, T1 is the only relevant temperature offset. This offset can be used to adjust the temperature reading if desired.

Pressure Offset: is the barometric pressure calibration offset. For example: 56 pressure offset will increase the barometric pressure reading by 0.56 in Hg.

Altitude: is the elevation of the site being monitored. 0 ft is the default value set at the factory. This value should be changed to reflect the correct altitude of the site. The altitude setting will affect the barometric pressure reading. An increase of 10 feet will increase the pressure reading by 0.01 in Hg.

Hi/Lo Interval: This setting determines how often a high (maximum) and low (minimum) record is stored in the data log of the Control Module.

Logging Interval: This setting determines how often a current value record of all sensors is stored in the data log of the Control Module.

Select Save to Weather Station to save the changes without exiting the dialog.

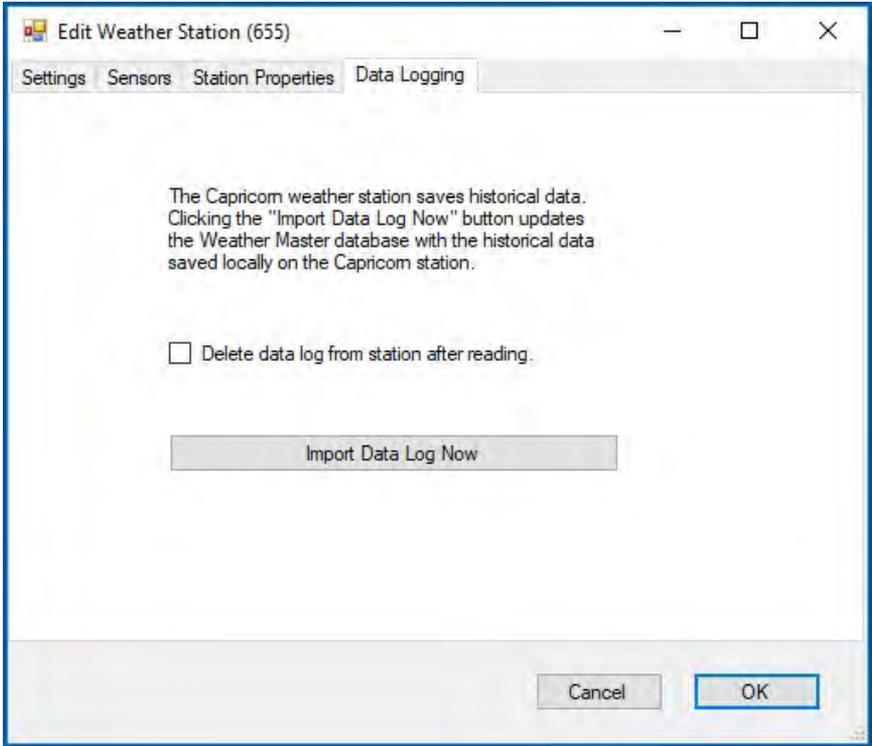
After changing the settings, select OK and the software will send the new values to the Control Module.

Selecting Cancel will close the dialog without any changes taking effect.

Please refer to the Weather Station User Manual for more information about calibration and settings values.

Data Logging

To import data from a Capricorn or Pegasus weather station select the Data Logging tab in the Edit Weather Station dialog.



Check Delete data log after reading if you want to delete the data log from the Control Module. Otherwise leave it unchecked.

Note: If the Control Module is also connected to other devices such as a modem or other computers, deleting the data log will prevent the other devices from accessing the data.

Downloading a full data log will take about 1 to 2 minutes. The downloaded data will be incorporated into the software database.

To change the data log recording intervals, please refer to the Station Properties section above.

Click on Import Data Log Now to import the data log from the Capricorn/Pegasus Control Module.

When the import is completed, the software will display a window with the number of records imported. Click OK to close.

Capricorn FLX Station Type

Select the Edit button from the Weather Station dialog to change the station configuration.

Edit Weather Station (100)

Main Settings | Sensors

Station Type: Capricorn FLX Serial

Description: Hillsboro Capricorn FLX Comm Port: COM4

Barometric pressure offset: 0

Altitude: 0

Rain for the year offset: 0

Wind direction offset: 0

Xml Data Output

File path: No output Change

Cancel OK

Location description and port settings can be edited.

Barometric Pressure Offset: is the barometric pressure calibration offset. For example: 0.02 pressure offset will increase the barometric pressure reading by 0.02 in Hg.

Altitude: is the elevation of the site being monitored. 0 ft is the default value set at the factory. This value should be changed to reflect the correct altitude of the site. The altitude setting will affect the barometric pressure reading. An increase of 10 feet will increase the pressure reading by 0.01 in Hg.

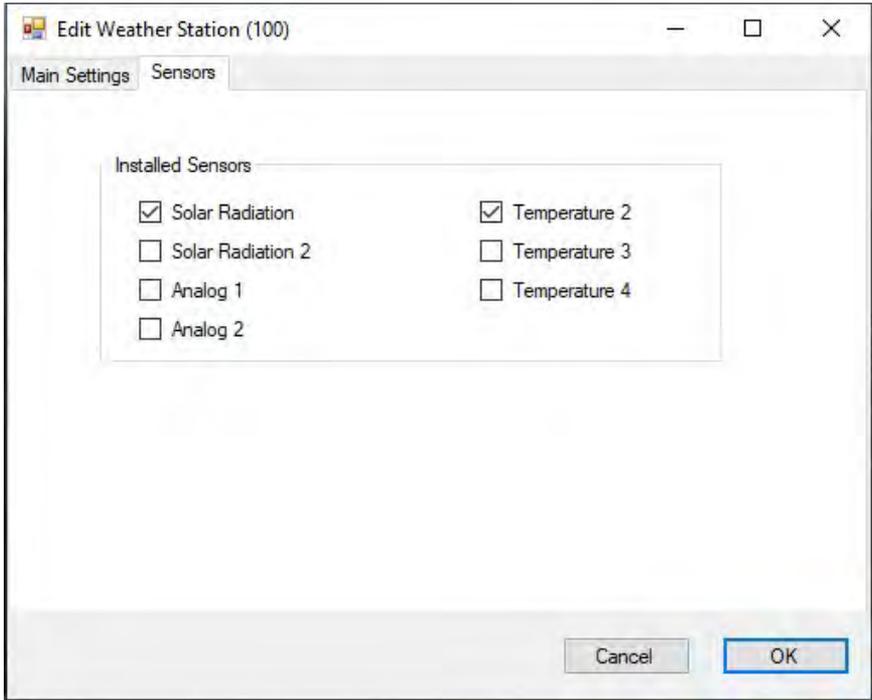
Rain for the year offset: is used to correct the rainfall amount for the year.

Wind Direction Offset: Allows the user to enter a degree offset to change the wind direction value. This feature is useful for vehicle or boat mounted systems. The offset is added to the actual wind direction value.

For example, if the sensor output is 45° and the offset is 10°, then WeatherMaster will display 55° for the wind direction value.

Sensors

In the Edit Weather Station dialog, select the Sensors tab.

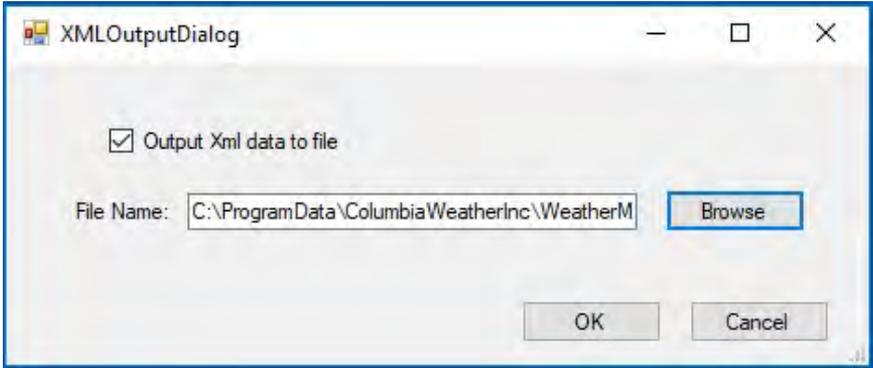


Select the sensors that are installed in the weather station.

XML Output

WeatherMaster is able to output the current weather data in an XML file format. Updates every 8 seconds.

In the Edit Weather Station dialog (any station type), click on the Change button in the XML Data Output box.



Check “Output XML data to file” box to enable the feature.

Browse and select the location and enter a file name.

The XML File will reflect the parameters available for the station type selected and it has the following format:

```
<oriondata station=""><meas name="time-of-day" updateTS="2018/12/04 15:13:01">2018/12/04 15:13:01
</meas><meas name="inst-wind-speed" updateTS="2018/12/04 15:13:01">7.2</meas>
<meas name="inst-wind-dir" updateTS="2018/12/04 15:13:01">30</meas>
<meas name="rel-humidity" updateTS="2018/12/04 15:13:01">45</meas>
<meas name="barom-press" updateTS="2018/12/04 15:13:01">30.14</meas>
<meas name="temp" updateTS="2018/12/04 15:13:01">45.6</meas>
<meas name="wind-chill" updateTS="2018/12/04 15:13:01">41.8</meas>
<meas name="heat-index" updateTS="2018/12/04 15:13:01">46.0</meas>
<meas name="dew-point" updateTS="2018/12/04 15:13:01">25.5</meas>
<meas name="degree-day" updateTS="2018/12/04 15:13:01">6141.4</meas>
<meas name="rain-today" updateTS="2018/12/04 15:13:01">0.000</meas>
<meas name="rain-this-week" updateTS="2018/12/04 15:13:01">0.002</meas>
<meas name="rain-this-month" updateTS="2018/12/04 15:13:01">0.032</meas>
<meas name="rain-this-year" updateTS="2018/12/04 15:13:01">19.337</meas>
<meas name="rain-rate" updateTS="2018/12/04 15:13:01">0.00</meas>
<meas name="density-altitude" updateTS="2018/12/04 15:13:01">-817</meas>
```

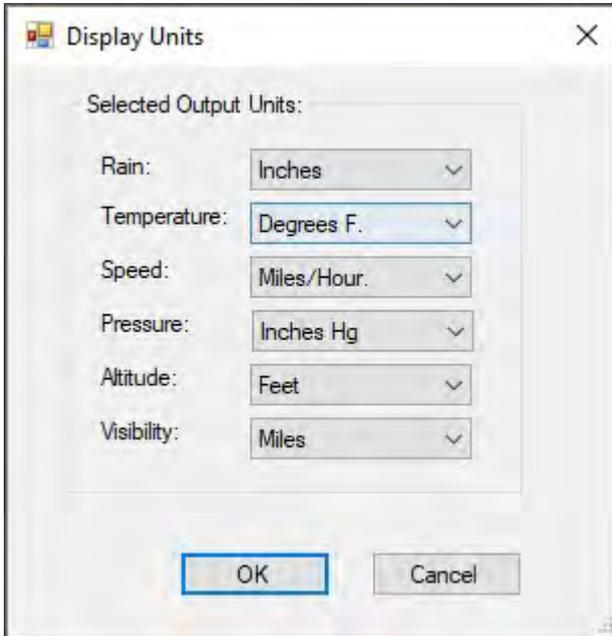
```
<meas name="2min-rolling-avg-wind-speed" updateTS="2018/12/04 15:13:01">5.4</meas>
<meas name="2min-rolling-avg-wind-speed_2" updateTS="2018/12/04 15:13:01">0.0</meas>
<meas name="2min-rolling-avg-wind-dir" updateTS="2018/12/04 15:13:01">49</meas>
<meas name="2min-rolling-avg-wind-dir_2" updateTS="2018/12/04 15:13:01">0</meas>
<meas name="10min-rolling-avg-wind-speed" updateTS="2018/12/04 15:13:01">4.1</meas>
<meas name="10min-rolling-avg-wind-speed_2" updateTS="2018/12/04 15:13:01">0.0</meas>
<meas name="10min-rolling-avg-wind-dir" updateTS="2018/12/04 15:13:01">45</meas>
<meas name="10min-rolling-avg-wind-dir_2" updateTS="2018/12/04 15:13:01">0</meas>
<meas name="windrun" updateTS="2018/12/04 15:12:48">49.00</meas>
<meas name="vmean-windrun" updateTS="2018/12/04 15:12:48">3.71</meas>
<meas name="vmean-winddir" updateTS="2018/12/04 15:12:48">239</meas>
<meas name="vmean-winddirstddev" updateTS="2018/12/04 15:12:48">40</meas>
<meas name="2min-gust-windspeed" updateTS="2018/12/04 15:13:01">12.6</meas>
<meas name="2min-gust-windspeed_2" updateTS="2018/12/04 15:13:01">0.0</meas>
<meas name="2min-gust-winddir" updateTS="2018/12/04 15:13:01">2</meas>
<meas name="2min-gust-winddir_2" updateTS="2018/12/04 15:13:01">0</meas>
<meas name="10min-peak-windspeed" updateTS="2018/12/04 15:13:01">12.6</meas>
<meas name="10min-winddir-atpeak" updateTS="2018/12/04 15:13:01">2</meas>
<meas name="60min-peak-windspeed" updateTS="2018/12/04 15:13:01">12.9</meas>
<meas name="60min-winddir-atpeak" updateTS="2018/12/04 15:13:01">49</meas>
<meas name="solar-radiation" updateTS="2018/12/04 15:13:01">0</meas>
<meas name="raw-barom-pressure" updateTS="2018/12/04 15:13:01">29.92</meas>
<meas name="raw-inst-wind-dir" updateTS="2018/12/04 15:13:01">30</meas>
<meas name="wet-bulb-globe-temp" updateTS="2018/12/04 15:13:01">50.1</meas>
<meas name="saturated-vapor-pressure" updateTS="2018/12/04 15:13:01">0.31</meas>
<meas name="vapor-pressure" updateTS="2018/12/04 15:13:01">0.14</meas>
<meas name="dry-air-pressure" updateTS="2018/12/04 15:13:01">29.78</meas>
<meas name="dry-air-density" updateTS="2018/12/04 15:13:01">0.0782</meas>
<meas name="absolute-humidity" updateTS="2018/12/04 15:13:01">0.0002</meas>
<meas name="air-density-ratio" updateTS="2018/12/04 15:13:01">1</meas>
<meas name="adjusted-altitude" updateTS="2018/12/04 15:13:01">-702</meas>
<meas name="SAE-correction-factor" updateTS="2018/12/04 15:13:01">0.95</meas>
<meas name="wet-air-density" updateTS="2018/12/04 15:13:01">0.0784</meas>
<meas name="wet-bulb-temp" updateTS="2018/12/04 15:13:01">36.6</meas>
<meas name="hail-rate" updateTS="2018/12/04 15:13:01">0</meas>
<meas name="hail-today" updateTS="2018/12/04 15:13:01">0</meas>
</oriondata>
```

Display Units

Select Options>Units

Units of Measurements

To set the unit of measurement, select Units from the Options menu list.



In the Units tab select the desired units for the temperature, wind, pressure, and rainfall parameters.

The temperature unit selection will apply to all temperature readings, wind chill, heat index, dew point, and degree day.

The rainfall unit selection will apply to all rain values and evapotranspiration.

Export Setup

From the Configuration menu, select Auto Setup.

CSV Data Export

To configure WeatherMaster to export text data to a local computer or the Internet, select the CSV Data Export tab from the Export Setup dialog.

Please note the Data Export feature will report in U.S. Customary units.

The screenshot shows the 'Export Setup' dialog box with the 'CSV Data Export' tab selected. The dialog is titled 'Export Setup' and has a close button (X) in the top right corner. Below the title bar, there are two tabs: 'CSV Data Export' (selected) and 'Html Export'. The main content area is titled 'Setup to generate csv files containing weather data'. It contains several options and fields:

- Enable automatic export every minutes. hours. (Data Period)
- Export column names as first line
- Export Destination:
 - Local Computer
 - FTP Host
- Local Path:
 -
 -
- FTP Host (disabled):
 - Host Name:
 - User:
 - Password:
 - Path:
 - Port: Timeout (sec):
 - Passive Transfers (needed for some network configurations)

At the bottom of the dialog, there are three buttons: 'Export CSV Now', 'OK', and 'Cancel'.

Check the Enable Automatic Export box if you want WeatherMaster to automatically export the data. Select the desired export interval. The minimum interval is 5 minutes.

Select the amount of data to be included in the text file by specifying the data period in hours. The minimum data period is one hour and the maximum period is 24 hours.

Check the Export Column Name as First Line box if you would like WeatherMaster to include the column names in the first line.

Select the data destination, local computer or FTP Host (Internet).

If local computer is selected, enter the path of the directory (or folder) where the file will be saved. If the path is left blank, the file will be saved in the program folder.

If FTP Host is selected, enter the FTP connection information. This information can be obtained from the FTP host provider.

Manual Data Export

To manually export text data, click Export CSV Now.

WeatherMaster will start the export process based on the setup in the Data Export dialog.

Data File Format

The first line of the data file may be a comma-delimited list of the field names, in the order represented by the values in each record. This line is optional. The rest of the file consists of comma delimited data records. Below is a sample of an output file with one record.

STATIONNAME,time-of-day,inst-wind-speed,inst-wind-speed_2,inst-wind-dir,rel-humidity,barom-press,barom-press_2,barom-press_3,temp,temp_2,temp_3,temp_4,wind-chill,heat-index,dew-point,rain-today,rain-rate,density-altitude,2min-rolling-avg-wind-speed,2min-rolling-avg-wind-dir,10min-rolling-avg-wind-speed,10min-rolling-avg-wind-dir,2min-gust-windspeed,2min-gust-winddir,60min-peak-windspeed,60min-winddir-atpeak,solar-radiation,solar-radiation_2,visibility,raw-barom-pressure_2,raw-barom-pressure_3,wet-bulb-globe-temp,saturated-vapor-pressure,vapor-pressure,dry-air-pressure,dry-air-density,absolute-humidity,air-density-ratio,wet-air-density,wet-bulb-temp,lux,60min-rolling-avg-wind-speed,60min-rolling-avg-wind-dir,uv-radiation,particle-concent,3sec-rolling-avg-wind-speed,3sec-rolling-avg-wind-dir

W5291,12/5/2018 7:53:27

AM,8.7,0,34,61,30.11,0,0,37.4,0,0,0,31,37,25.1,0,0,-
1347,6.6,9,4.3,43,11.6,355,17.3,11,0,0,0,0,45.4,0.22,0.14,29.75,0.0794,
0.0002,1,0.0796,31.1,0,4.6,46,0,0,7.8,13

One output file is generated for each weather station with the name nnnrh.txt, where nnn is the station ID for the given station.

HTML Export

To configure WeatherMaster to export an HTML file to a local computer or the Internet, select the HTML Export tab from the Export Setup dialog.

Export Setup

CSV Data Export **Html Export**

Setup to generate html files containing weather data

Enable automatic export every minutes.

Export Destination

Local Computer FTP Host

Local Path

C:\ProgramData\ColumbiaWeatherInc\WeatherMa

FTP Host

Host Name:

User:

Password:

Path:

Port: Timeout (sec):

Passive Transfers (needed for some network configurations)

Check the Enable Automatic Export box, if you want WeatherMaster to automatically export the data. Select the desired export interval. The minimum interval is 5 minutes.

Select the amount of data to be included in the text file by specifying the data period in hours. The minimum data period is one hour and the maximum period is 24 hours.

Check the Export Column Name as First Line box if you would like WeatherMaster to include the column names in the first line.

Select the data destination, local computer or FTP Host (Internet).

If local computer is selected, enter the path of the directory (or folder) where the file will be saved. If the path is left blank, the file will be saved in the program folder.

If FTP Host is selected, enter the FTP connection information. This information can be obtained from the FTP host provider.

Manual HTML Export

To manually export the HTML file, click Export HTML Now.

WeatherMaster will start the export process based on the setup in the HTML Export dialog.

HTML Template Format

HTML Export requires customizing the file <sample.html>, which can be found in the directory where WeatherMaster is installed. Sample.html is an HTML file, in which special tags are replaced with the current parameter readings from weather stations. Values will be entered in the units specified in the WeatherMaster Display Options. One output file is generated for each weather station in the form of nnnsample.html, where nnn is the station serial number for the given station. The output files are optionally uploaded to an FTP server.

Parameter	HTML Tag
Date	<#Date Format="mm/dd/yyyy">
Last Sample timestamp	<#Time_of_day>
Wind Speed	<#inst_wind_speed>
Wind Direction	<#inst_wind_dir>
3-sec Wind Speed Average	<#_3sec_gust_wind_speed>
3-sec Wind Direction Average	<#_3sec_gust_wind_dir>
2-min Wind Speed Average	<#_2min_rolling_avg_wind_speed>
2-min Wind Direction Average	<#_2min_rolling_avg_wind_dir>
10-min Wind Speed Average	<#_10min_rolling_avg_wind_speed>
10-min Wind Direction Average	<#_10min_rolling_avg_wind_dir>
10-min Wind Speed Peak	<#_10min_peak_windspeed>

Wind Direction at 10-min Wind Speed Peak	<#_10min_winddir_atpeak>
60-min Wind Speed Peak	<#_60min_peak_windspeed>
Wind Direction at 60-min Wind Speed Peak	<#_60min_winddir_atpeak>
Wind Run	<#windrun>
Vector Mean Wind Speed	<#vmean_windrun>
Vector Mean Wind Direction	<#vmean_winddir>
Vector Mean Wind Direction Standard Deviation	<#vmean_winddirstddev>
Air Temperature	<#temp1>
Temperature 2	<#temp2>
Temperature 3	<#temp3>
Temperature 4	<#temp 4>
Relative Humidity	<#rel_humidity>
Barometric Pressure	<#barom_press>
Raw Barometric Pressure	<#raw_barom_pressure>
Density Altitude	<#density_altitude>
Wind Chill	<#wind_chill>
Heat Index	<#heat_index>
Dew Point	<#dew_point>
Wet Bulb Globe Temperature	<#wet_bulb_globe_temp>
Wet Bulb Temperature	<#wet_bulb_temp>
Degree Day	<#degree_day>
Rain for the Day	<#rain_today>
Rain for the Week	<#rain_this_week>
Rain for the Month	<#rain_this_month>
Rain for the Year	<#rain_this_year>
Rain Rate	<#rain_rate>
Solar Radiation	<#solar_radiation>

Saturated Vapor Pressure	<#saturated_vapor_pressure>
Vapor Pressure	<#vapor_pressure>
Dry Air Pressure	<#dry_air_pressure>
Dry Air Density	<#dry_air_density>
Wet Air Density	<#wet_air_density>
Absolute Humidity	<#absolute_humitiy>
Air Density Ratio	<#air_density_ratio>
Adjusted Altitude	<#adjusted_altitude>
SAE Correction Factor	<#SAE_correction_factor>
Extinction Coefficient	<#extinction_coefficient>
Lux meter	<#lux>
Day/Night	<#day_night>
Wind Speed 2	<#wind_speed_2>
Raw Wind Direction 2	<#raw_wind_dir_2>
3-sec Wind Speed Average 2	<#_3sec_gust_wind_speed_2>
3-sec Wind Direction Avg 2	<#_3sec_gust_wind_dir_2>
2-min Wind Speed Average 2	<#_2min_rolling_avg_wind_speed_2>
2-min Wind Direction Avg 2	<#_2min_rolling_avg_wind_dir_2>
10-min Wind Speed Avg 2	<#_10min_rolling_avg_wind_speed_2>
10-min Wind Direction Avg 2	<#_10min_rolling_avg_wind_dir_2>
10-min Wind Speed Peak 2	<#_10min_peak_windspeed_2>
Wind Direction at 10-min Wind Speed Peak 2	<#_10min_winddir_atpeak_2>
60-min Wind Speed Peak 2	<#_60min_peak_windspeed_2>
Wind Direction at 60-min Wind Speed Peak 2	<#_60min_winddir_atpeak_2>
Soil Moisture	<#soil_moisture>
Leaf Wetness	<#leaf_wetness>
Evapotranspiration	<#et>

Note: Some HTML tags are not available for certain station types.

To have the date or time included, use these tags:

```
<#Date>
```

```
<#Time>
```

You can optionally include a Format="****" parameter in the #Date or #Time tag. The Format string is used to program the exact type of date or time format desired. Here are some samples:

```
<#Date Format="mm/dd/yyyy">
```

```
<#Time Format="tt">
```

The following is a complete list of options for date/time Format strings:

<u>Specifier</u>	<u>Displays</u>
nd	Displays the day as a number without a leading zero (1-31).
dd	Displays the day as a number with a leading zero (01-31).
ddd	Displays the day as an abbreviation (Sun-Sat) using the strings given by the ShortDayNames global variable.
dddd	Displays the day as a full name (Sunday-Saturday) using the strings given by the LongDayNames global variable.
m	Displays the month as a number without a leading zero (1-12). If the m specifier immediately follows an h or hh specifier, the minute rather than the month is displayed.
mm	Displays the month as a number with a leading zero (01-12). If the mm specifier immediately follows an h or hh specifier, the minute rather than the month is displayed.
mmm	Displays the month as an abbreviation (Jan-Dec) using the strings given by the ShortMonthNames global variable.
mmmm	Displays the month as a full name (January-December) using the strings given by the LongMonthNames global variable.
yy	Displays the year as a two-digit number (00-99).
yyyy	Displays the year as a four-digit number (0000-9999).
h	Displays the hour without a leading zero (0-23).
hh	Displays the hour with a leading zero (00-23).
n	Displays the minute without a leading zero (0-59).
nn	Displays the minute with a leading zero (00-59).
s	Displays the second without a leading zero (0-59).
ss	Displays the second with a leading zero (00-59).

am/pm	Uses the 12-hour clock for the preceding h or hh specifier, and displays 'am' for any hour before noon, and 'pm' for any hour after noon. The am/pm specifier can use lower, upper, or mixed case, and the result is displayed accordingly.
a/p	Uses the 12-hour clock for the preceding h or hh specifier, and displays 'a' for any hour before noon, and 'p' for any hour after noon. The a/p specifier can use lower, upper, or mixed case, and the result is displayed accordingly.
/	Displays the date separator character given by the DateSeparator global variable.
:	Displays the time separator character given by the TimeSeparator global variable.

Sample.html file can be modified/customized by the user to fit the look and feel of an existing web site.

Alarms

WeatherMaster has the capability of setting an unlimited number of alarm conditions with each alarm having one or more notification method.

To view the alarms dialog, select Alarms from the Options menu.

Alarm Conditions

The screenshot shows the 'Alarms' dialog box with the following configuration:

- Weather Station: Hillsboro Orion
- Alarm Conditions: High Winds
- Notifications: Send Email (checked)
- Enabled:
- Recuring Alarm Delay: (none)
- Parameter: Wind Speed (mph)
- Upper Limit: 35
- Lower Limit:

To define an alarm condition, select the Add button under the Alarm Conditions window.



Enter a descriptive name for the alarm and select OK.

The alarm condition name will be listed in the Alarm Conditions window.

Select the name of the parameter.

Define the upper and/or lower limits.

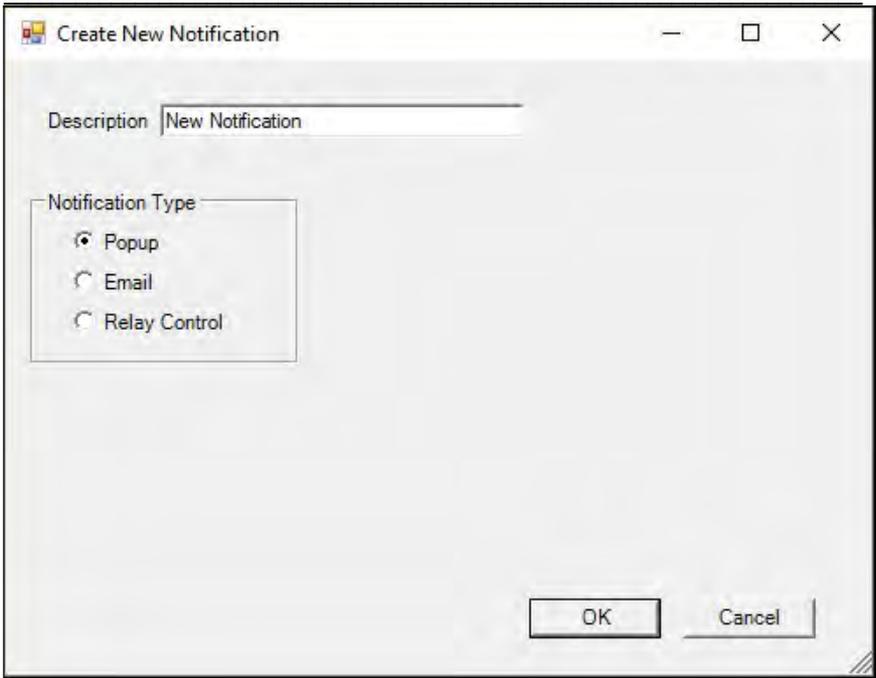
Notifications

WeatherMaster allows an unlimited number of notifications, which can be shared by multiple alarms.

To define a notification, select the Add button at the bottom of the Notifications window.

There are three types of notifications available:

Popup Notification



Enter a descriptive name for this notification and select Popup Only.

A Popup notification will cause the computer to sound a tone when the alarm conditions are met.

Email Notification

Create New Notification

Description:

Notification Type

Popup

Email

Relay Control

Sender Name:

Sender Email:

Subject Line:

Email Address:

Mail Server:

Enter the descriptive name for this notification and select Email.

Enter the Sender Name. This should be the name of the person using WeatherMaster.

Enter the Sender Email. This should be the email address of the person using WeatherMaster.

Enter a subject line that WeatherMaster can use in the email.

Enter the email address of the recipient. This can be the same as the sender's email address, if the sender wishes to be notified.

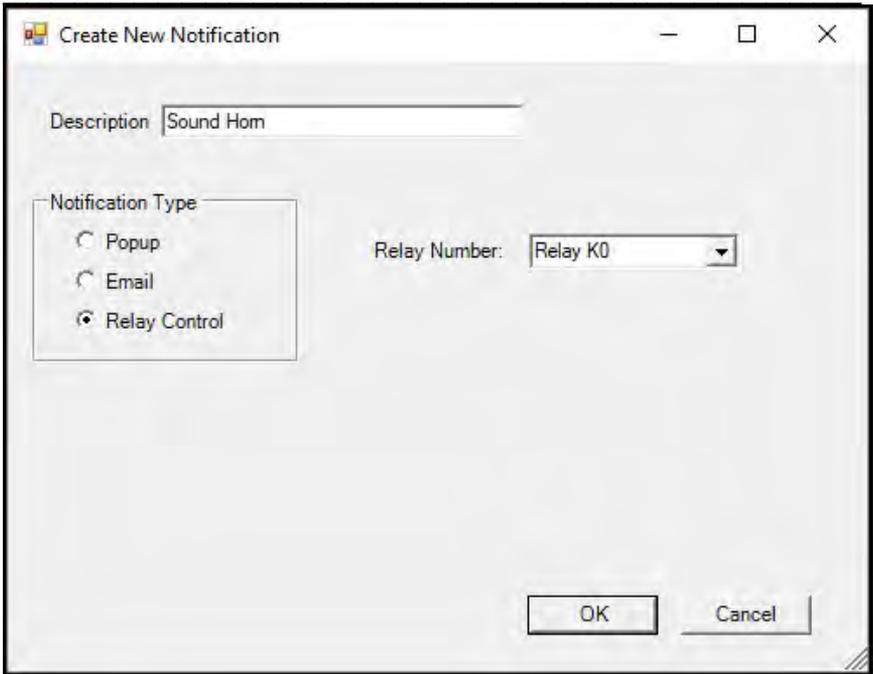
Enter the name of the Mail Server. To get the name of the server:

1. From the Windows Start button, select Settings, then select Control Panel.
2. In the Control Panel window, double click on the Mail icon.
3. Select your email service and click on the Properties button.
4. Select the Servers tab to view the name of the mail server next to the Outgoing Mail (SMTP).

Click OK to close this window and save any changes.

Click Cancel to close the window and discard any edits.

Relay Control Notification



The Relay Control notification feature is available in WeatherMaster with the addition of a USB 4 channel Relay Controller. Please contact Columbia Weather Systems for more information.

Enter a descriptive name for this notification and select Relay Control.

Select the desired relay to activate. Four relays are available, K0 through K3.

Once an alarm condition is met, the selected relay will close momentarily.

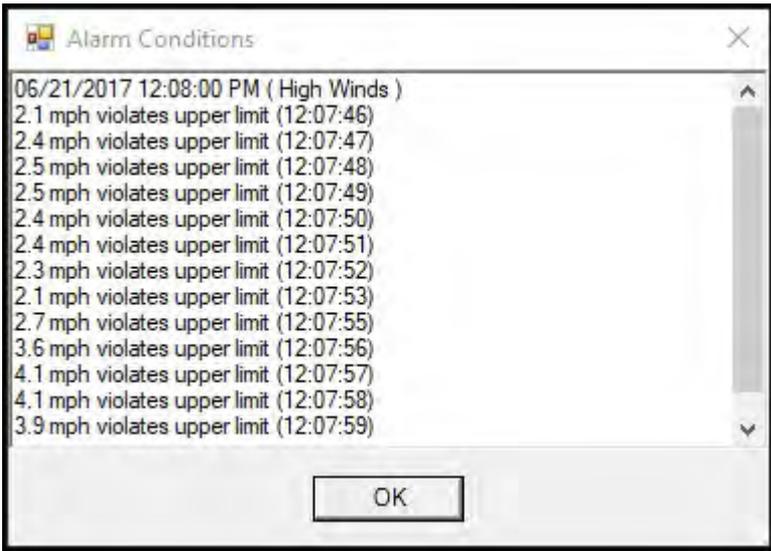
The Relay Controller is designed to activate a secondary latch relay with a user selectable timer.

Click OK to close the Notification window and save any changes.

Click Cancel to close the window and discard any edits.

Alarm Condition

Once an alarm condition has occurred, an Alarm Condition window will appear on the screen with a list of alarms that have occurred listing the date and time, name of the notification, name of the alarm, the value of the parameter and which limit has been violated.



The software will continue to display this screen until the user clicks on the OK button to acknowledge the alarm information.

Email Report

WeatherMaster has the capability of sending an email report at a user selectable interval to multiple email addresses.

The email message can also be sent as a cell phone text message by simply emailing the cell phone. For a cell phone email address, please visit the cell phone service provider's web site.

To view the Email Notification dialog, select Email Report from the Option menu.

The screenshot shows the 'Email Reports' dialog box with the following configuration:

- Selected Weather Station:** Hillsboro Orion
- Enable email report for this station
- Send email report every: 5 minutes
- Sender Name: Robert
- Sender Email: rsmith@columbiaweather.com
- Subject Line: Hillsboro Weather
- Email Address: rsmith@columbiaweather.com
- Outgoing Mail Server: (with 'Configure Outgoing Mail Server' button)
- Use Short Names
- Selected Measurements:**
 - Wind Speed
 - Wind Direction
 - Relative Humidity
 - Barometric Pressure
 - Temperature
 - Temperature 2
 - Wind Chill
 - Heat Index
 - Dew Point
- Report Preview:**

```
Report for WeatherStation: Hillsboro Orion
Wind Speed: 2.6
Wind Direction: 114
Relative Humidity: 44
Temperature: 41.7
Barometric Pressure: 30.08
```

Buttons at the bottom include 'Send Test Email', 'OK', and 'Cancel'.

Select the desired weather station. Use the drop-down if you have multiple weather stations defined in WeatherMaster.

Check the “Enable Email Report for this station”.

Select the email report interval. Minimum interval is 5 minutes.

Enter the sender name, sender email, and subject line.

Enter the recipient's email address. Use a semi colon to separate multiple email addresses.

Enter the outgoing mail server (SMTP) used by the computer. This information can be found in the Control Panel/Mail/Email Account.

Check “Mail server uses authentication” if your email service requires authentication. Enter the user and password required.

Select the measurements to add to the report. The Report Preview will display the selected parameters and their current values.

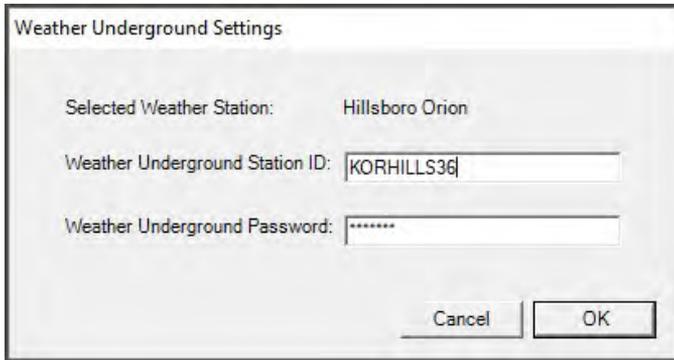
If you are sending the report to a cell phone, you can check the Use Short Names to abbreviate the parameter names. Cell phone text messages have a 150-character limitation.

Use the Send Test Email button to send a test Email Report.

Click OK to apply the changes and close the dialog.

Weather Underground

WeatherMaster can upload the weather data to a Weather Underground account.



The image shows a dialog box titled "Weather Underground Settings". It contains three input fields: "Selected Weather Station" with the value "Hillsboro Orion", "Weather Underground Station ID" with the value "KORHILLS36", and "Weather Underground Password" with a masked password "*****". At the bottom right, there are two buttons: "Cancel" and "OK".

First create an account by visiting Weather Underground at <https://www.wunderground.com/signup>

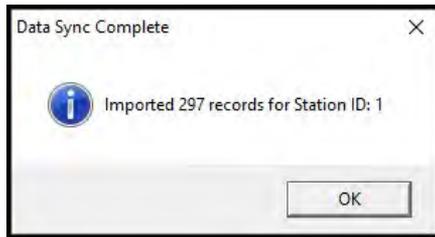
To enable the feature in WeatherMaster click Weather Underground from the Options menu. Enter your Weather Underground Station ID and password.

WeatherMaster uploads the weather data every 5-minutes to Weather Underground.

Data

MicroServer Data Synchronization

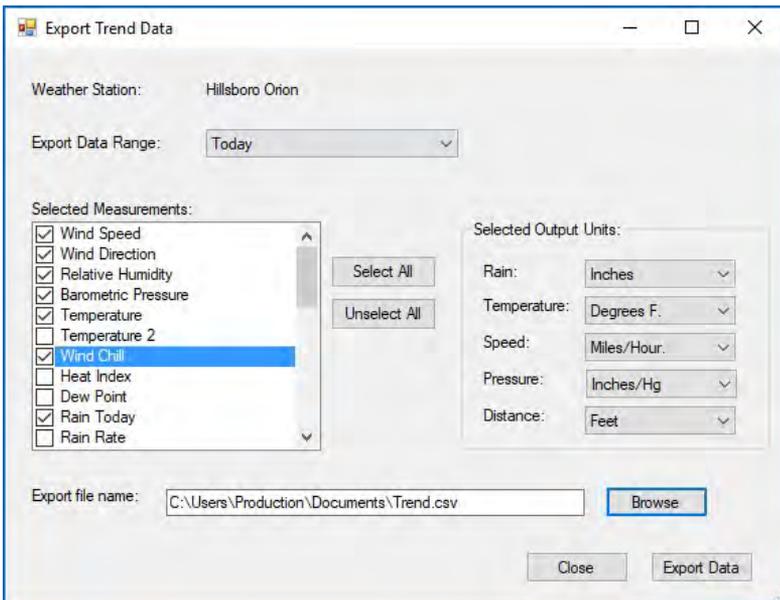
If WeatherMaster software is communicating with a MicroServer, it will automatically synchronize the database with the data log files stored in the MicroServer. If WeatherMaster is closed it will begin the synchronization process (in the background) when WeatherMaster is reopened. When the process is done the following window will appear:



Click OK to close.

Export Trend Data

Select Data/Export Trend Data



Select the Export Data Range. The dialog offers the following predefined data ranges:

Today, Yesterday, Last 2 Days, and Current Month.

You can also select Custom Date Range to define your own date range.

If Custom Date Range is selected, enter the Start and End dates in the new fields on the right side of the dialog.

Select the desired Measurements. Use the Select All button if all measurements are required.

Select the Output Units.

Enter the Export File name and path. Click on the Browse button to choose the folder.

Click on Export Data when ready.

When the export is completed, a window will appear stating:

Successfully exported data from *station name and serial number*.

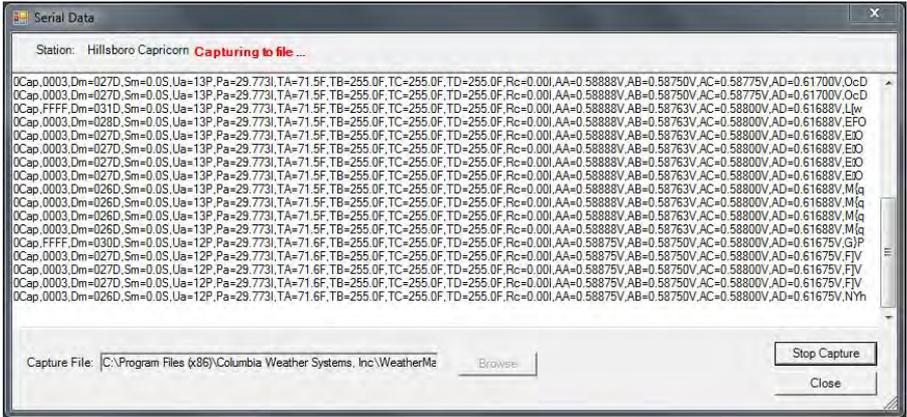
Click OK to close it.

The Export Data Trend dialog will export all the selected parameters in the selected units of measurements in a csv text file.

This file is easily imported in spreadsheet programs.

Capture Serial Data

If WeatherMaster is communicating with the weather station over a serial connection, the sensor data can be captured and saved as a CSV file.



To capture the sensor data click Capture Serial Data under Data.

The sensor data will be displayed once per second for most systems.

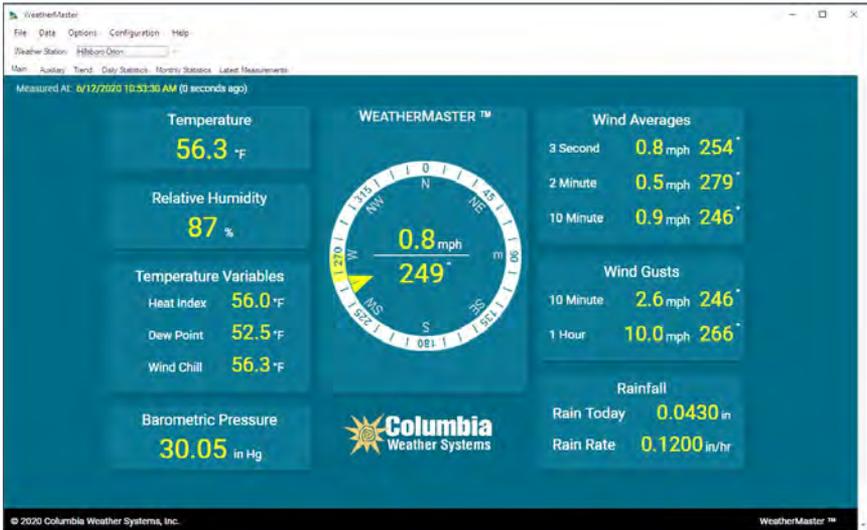
Click Browse to choose where to save the data.

Click Start Capture to save the data to the CSV file.

Click Stop Capture to stop the process.

Operation

Main Screen



The Main screen presents the main parameters clearly, using large text and a graphical wind dial.

The yellow band along the wind dial is a graphical representation of the 30 Second Vector Mean and Standard Deviation Wind Direction.

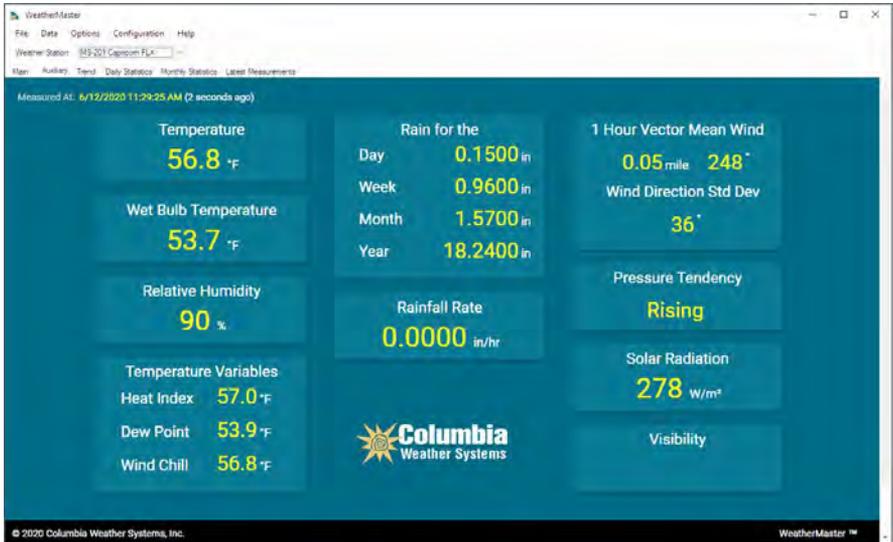
Note: For a MicroServer type station the yellow band only displays with firmware version 2.8.10378 and higher. Also, the 30 Sec Rolling VM Wind Dir and the 30 Sec Rolling Std Dev Wind Dir need to be selected.

Next to the timestamp a counter shows how long-ago data was received in seconds. If data is not received for more than 15 seconds the counter value turns red and continues to count. This counter is displayed on both the Main and Auxiliary tabs. The counter resets when switching between tabs.

This screen is defined using an HTML file that can be customized at the factory.

To print the screen, select Print from the File menu list.

Auxiliary Screen



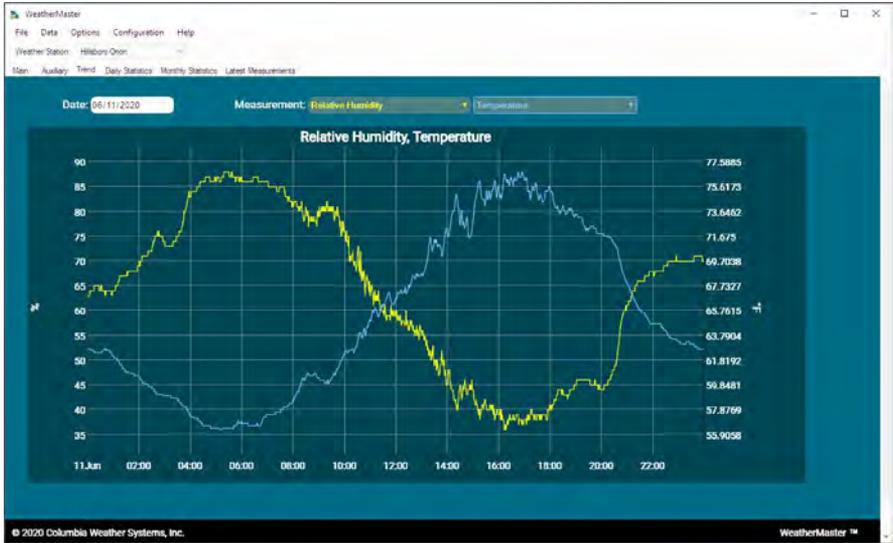
The Auxiliary screen displays the current values for temperature and rain parameters and other auxiliary sensors. The Auxiliary screen also displays the 1 Hour Vector Mean Wind reading for speed and direction including the wind direction standard deviation.

Rain values are displayed for the day, week, month, and year.

Other custom sensor values or parameters can be added to this screen. Please contact the factory for any customization requirements.

To print the screen, select Print from the File menu list.

Trend Screen



The Trend screen displays a 24-hour graph of the selected measurements.

The graph will display the 24-hour data from 12:00 AM to the current time.

The graph is self-scaling based on the data values and the size of the graph window.

To select a measurement, use the drop-down arrow in the Measurement field and select the desired measurement.

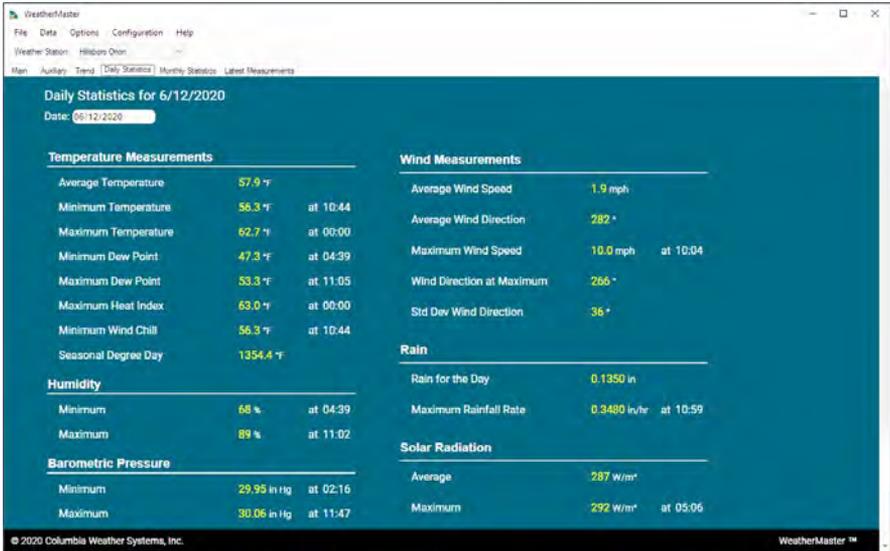
To graph data for another day, use the drop-down arrow in the Date field and select the desired date from the calendar.

To advance to the next/previous day, month or year highlight one and press up or down on your keyboard.

To zoom in on an area on the graph, click and drag your mouse. Double-click to resume to normal view.

To print the graph, select Print from the File menu list.

Daily Statistics Screen



The Daily Statistics screen displays averages, minimum and maximum values for several measurements including the time of occurrence for the selected day.

To view the data for another day, use the drop-down arrow in the Date field and select the desired date from the calendar.

To print the screen, select Print from the File menu list.

Monthly Statistics

WeatherMaster
File Data Options Configuration Help
Weather Station: Hillsboro, OR
Main Julian Trend Daily Statistics Monthly Statistics Latest Measurements

Monthly Statistics for June, 2020
Month: Jun 2020

Temperature Measurements		
Average Temperature	59.7 °F	
Minimum Temperature	42.2 °F	at 06-01 05:57
Maximum Temperature	80.2 °F	at 06-02 17:06
Minimum Dew Point	34.2 °F	at 06-02 17:27
Maximum Dew Point	58.6 °F	at 06-09 19:00
Maximum Heat Index	79.0 °F	at 06-10 17:09
Minimum Wind Chill	40.5 °F	at 06-01 05:19

Humidity		
Minimum	19 %	at 06-02 17:27
Maximum	91 %	at 06-01 04:59

Barometric Pressure		
Minimum	29.71 in Hg	at 06-05 14:09
Maximum	30.28 in Hg	at 06-08 11:32

Wind Measurements		
Average Wind Speed	2.2 mph	
Average Wind Direction	266 °	
Maximum Wind Speed	15.9 mph	at 06-07 19:02
Wind Direction at Maximum	277 °	
Std Dev Wind Direction	87 °	

Rain		
Rain for the Month	1.5080 in	
Maximum Rainfall Rate	1.9200 in/hr	at 06-05 19:42

Solar Radiation		
Average	288 W/m ²	
Maximum	294 W/m ²	at 06-02 03:40

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The Monthly Statistics screen displays averages, minimum and maximum values for several measurements including the time of occurrence for the selected day.

To view the data for another month, use the drop-down arrow in the Month field and select the desired month from the calendar.

To print the screen, select Print from the File menu list.

Latest Measurements

Latest Measurements			
Last Sample Timestamp	6/12/2020 11:51:11 AM	Wind Gust Dir - 10-min	264 °
Wind Speed	1.0 mph	Wind Gust Time - 10-min	6/12/2020 11:44:13 AM
Wind Direction	350 °	Wind Gust Speed - 60-min	7.2 mph
Relative Humidity	84 %	Wind Gust Dir - 60-min	264 °
Barometric Pressure	30.06 in Hg	Wind Gust Time - 60-min	6/12/2020 11:44:13 AM
Wind Speed-Peak	1.1 mph	Solar Radiation	287 W/m²
Wind Speed-Avg	1.1 mph	Raw Barometric Pressure	29.84 in Hg
Wind Direction-Avg	346 °	Raw Wind Direction	350 °
Wind Direction at Peak	342 °	Wet Bulb Globe Temperature	62.5 °F
Temperature	56.8 °F	Saturated Vapor Pressure	0.47 in Hg
Wind Chill	56.8 °F	Vapor Pressure	0.39 in Hg
Heat Index	57.0 °F	Dry Air Pressure	29.45 in Hg
Dew Point	51.9 °F	Dry Air Density	0.0757 lb/ft³
Degree Day	1354.4 °F	Absolute Humidity	0.0006 lb/ft³
Rain Today	0.1360 in	Air Density Ratio	1 %
Rain This Week	0.7770 in	Adjusted Altitude	289 ft
Rain This Month	1.5080 in	Wet Air Density	0.0763 lb/ft³
Rain This Year	14.6380 in	Wet Bulb Temperature	52.5 °F
Rain Rate	0.0240 in/hr	Hail Rate	0 in/hr
Density Altitude	135 ft	Hail Today	0 in/hr
Wind Speed - 3-second Avg	1.1 mph	Wind Speed 1 Hr Rolling Average	1.4 mph

The Latest Measurements screen displays the current measurement values in the selected units.

To print the screen, select Print from the File menu list.

ALOHA Software Interface

ALOHA (Area Locations of Hazardous Atmospheres) is software jointly developed by NOAA and EPA. This software is used to model and plot plumes of hazardous gases and chemicals by HazMat and Emergency Management teams.

To predict how a pollutant cloud might disperse in the atmosphere, ALOHA needs information about weather conditions at the release site. WeatherMaster automatically transmits weather data in the ALOHA format every 30 seconds.

WeatherMaster transmits the following data, also called SAM (Station for Atmospheric Measurements):

ID = the station identification number

VS = the vector mean wind speed, averaged over 5 minutes (in meters per second)

WD = the vector mean wind direction, averaged over 5 minutes (in degrees true)

SD = the standard deviation of the wind direction (in degrees)

TA = the mean air temperature, averaged over 5 minutes (in °C)

SP = the instantaneous wind speed (in meters per second)

DI = the instantaneous wind direction (in degrees true)

TI = the instantaneous air temperature (in °C)

B = instantaneous SAM battery voltage (in volts)

CHK = a checksum value

Note: The weather stations do not measure battery voltage and therefore always transmit 0.00 volts for battery voltage.

Interfacing ALOHA to WeatherMaster

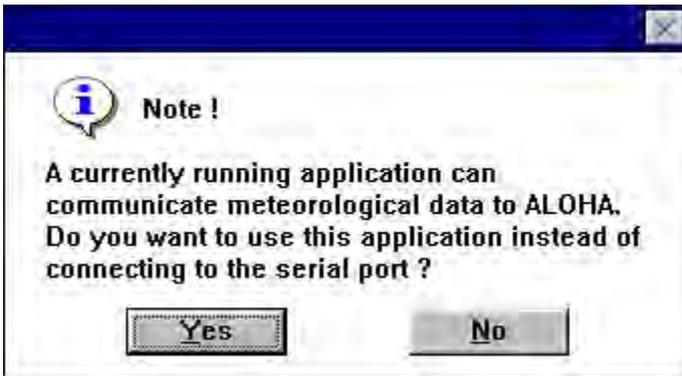
From the Configuration menu list in WeatherMaster, select Configuration.

Check "Interface to ALOHA" to interface WeatherMaster with ALOHA (Area Locations of Hazardous Atmospheres) software.

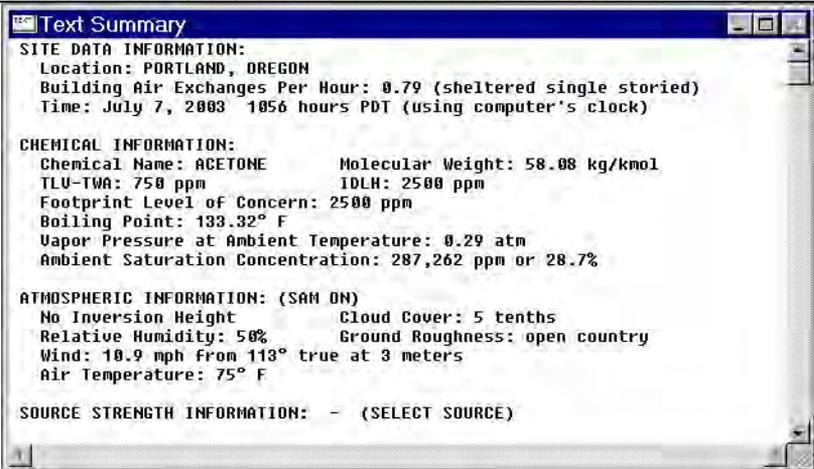
If there is more than one station installed, only the first station can interface with ALOHA.

Use the following procedure to successfully connect ALOHA to WeatherMaster:

1. Close both ALOHA and WeatherMaster (if they are open).
2. Open ALOHA software and click OK at the introductory window.
3. Make sure a site location is defined in ALOHA.
4. Minimize ALOHA window.
5. Open WeatherMaster.
6. After the station properties are read, wait for 30 seconds.
7. In ALOHA, click on Setup/Atmospheric/SAM Station.



8. Click Yes to communicate with the running application.
9. Enter desired information in the "User Input for SAM Unit" window and click OK.
10. Enter desired information in the "Cloud Cover and Humidity" window and click OK.
11. Wait approximately one minute while the software programs interface.
12. ALOHA will display the weather data from WeatherMaster.



13. WeatherMaster will show ALOHA Active in the status bar.

Note: If ALOHA and WeatherMaster are not communicating WeatherMaster will show ALOHA Unavailable in the status bar and ALOHA will ask for a COM port when a SAM Station is selected.

This problem occurs when the NOAA_32.dll file is located somewhere other than the Windows folder. This file should reside only in the Windows folder.

Perform a search to verify that the NOAA_32.dll file only exists in the C:\Windows folder (or equivalent.) If other copies of the NOAA_32.dll are found, simply rename them to NOAA_32.tmp.

Database

WeatherMaster uses a Firebird SQL format database to store weather data.

Data collected from all weather stations is stored in the database on 1-minute intervals.

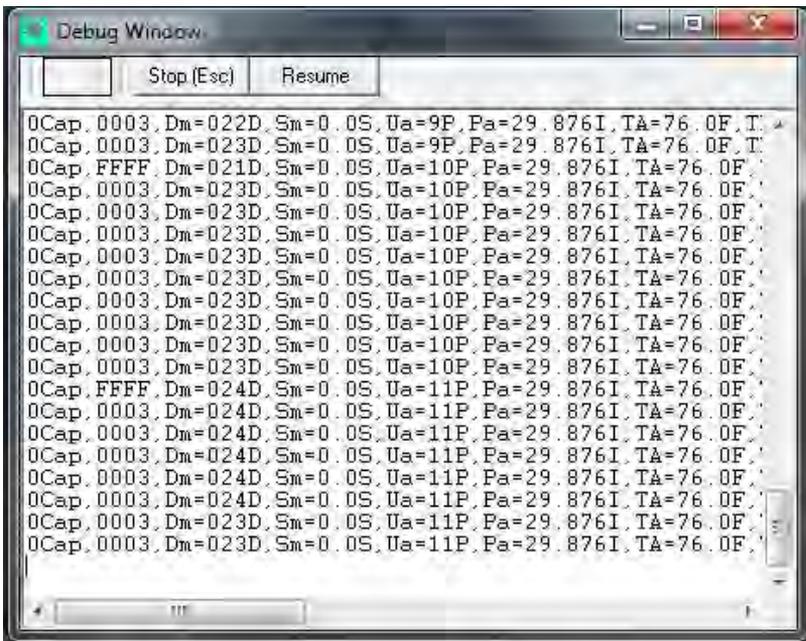
In addition, the software also stores the daily minimum and maximum values, and daily statistics.

To open the database directly, please contact the factory for instructions.

Troubleshooting

Debug Window

To view the communication between the weather station and WeatherMaster, select the Debug menu item from the Help menu list.



On the left side of the tool bar, WeatherMaster has an indicator bar showing the communication status. If the bar is blank, there is no communication between the weather station and the software. If the bar has a moving blue area, there is a communication stream between the two.

To stop the data stream between the weather station and the software, click on the Stop (Esc) button. In some instances, it might take few seconds for the stoppage to occur. If the data stream does not stop, click on the button again.

To resume the data stream between the weather station and the software, click on the Resume button.

The data displayed will differ from one station type to another.

Incorrect Temperature Readings (Capricorn/Pegasus or Capricorn FLX Only)

When used with Capricorn, Pegasus or Capricorn FLX weather stations, WeatherMaster has the capability of displaying four temperature readings.

If the temperature reading is 255 °F (123.9 °C), the temperature sensor is not installed or has not been properly initialized in the Control Module.

Verify that the temperature sensor is installed, and then perform the temperature sensor initialization procedure.

Please refer to the Capricorn 2000EX, Capricorn FLX or Pegasus Weather Station User Manual for installation/initialization procedure.

User Support Information

Technical Support

Columbia Weather Systems, Inc. offers free technical support to users. Columbia Weather Systems, Inc. reserves the right to revoke this policy at any time and charge a reasonable fee per hour for phone support.

For technical support:

Phone: 1-503-629-0887

Fax: 1-503-629-0898

Email: support@columbiaweather.com

Office hours are 8:30 AM to 4:30 PM Pacific Time, Monday through Friday.

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5285 NE Elam Young Parkway, Suite C100
Hillsboro, OR 97124

503-629-0887

info@columbiaweather.com

Reference

Glossary

Self-Aspirating Radiation Shield

A device used to shield a sensor such as a temperature or humidity probes from direct and indirect radiation and rain while providing access for ventilation.

Barometric Pressure

The pressure exerted by the atmosphere as a consequence of gravitational attraction exerted upon the “column” of air lying directly above the point in question.

Celsius Temperature Scale

A temperature scale with the ice point at 0 degrees and the boiling point of water at 100 degrees.

Dew Point

The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur. When this temperature is below 0°C, it is sometimes called the frost point.

Fahrenheit Temperature Scale

A temperature scale with the ice point at 32 degrees and the boiling point of water at 212 degrees.

Global Radiation

The total of direct solar radiation and diffused sky radiation received by a unit horizontal surface. Global radiation is measured by a pyranometer.

Heat Index

The heat index or apparent temperature is a measure of discomfort due to the combination of heat and humidity. It was developed in 1979 and is based on studies of evaporative skin cooling for combinations of temperature and humidity.

Pyranometer

Measures the combined intensity of incoming direct solar radiation and diffused sky radiation. The pyranometer consists of a radiation-sensing element, which is mounted so that it views the entire sky.

Relative Humidity

Popularly called humidity. The ratio of the actual vapor pressure of the air to the saturation vapor pressure.

Sea Level Pressure

The atmospheric pressure at mean sea level, either directly measured or, most commonly, empirically determined from the observed station pressure.

In regions where the earth's surface pressure is above sea level, it is standard observational practice to reduce the observed surface pressure to the value that would exist at sea level directly below.

Soil Moisture

Moisture in the soil within the zone of aeration present in the soil pores. In some cases, this refers strictly to moisture within the root zone of plants.

Solar Radiation

The total electromagnetic radiation emitted by the sun. 99% of the sun's energy output falls within the wavelength interval from 0.15 microns to 4.0 microns, with peak intensity near 0.47 microns. About one-half of the total energy in the solar beam is contained within the visible spectrum from 0.4 to 0.7 microns, and most of the other half lies near infrared, a small additional portion lying in the ultraviolet.

Wet Bulb Temperature (MicroServer Station Only)

Wet bulb temperature is calculated from ambient temperature (dry bulb) and relative humidity using a recursive formula.

Wet Bulb Globe Temperature (WBGT) (MicroServer Station Only)

The determination of WBGT requires the use of a black globe temperature sensor, relative humidity sensor, and a dry-bulb (ambient) temperature sensor. See below in the Tables and Formulas section.

Wind Chill

That part of the total cooling of a body caused by air motion.

Unit Conversion

Speed

Kilometers per hour = 1.610 x miles per hour

Knots = 0.869 x miles per hour

Meters per second = 0.448 x miles per hour

Feet per second = 1.467 x miles per hour

Temperature

Temperature in °C = $\frac{5}{9}$ (temperature in °F - 32)

Temperature in °F = (1.8 x temperature in °C) + 32

Distance

Millimeters = 25.4 x inches

Centimeters = 2.54 x inches

Pressure

Millibars = 33.86 x inches of mercury

Kilopascals = 3.386 x inches of mercury

Pounds per square inch = 0.49 x inches of mercury

Standard atmospheres = 0.0334 x inches of mercury

Solar Radiation

BTU/foot² minutes = 0.00529 x watts/meter²

Joules/centimeter² minutes = 0.006 x watts/meter²

Mega joules/meter² day = 11.574 x watts/meter²

Langley/minutes = 0.00143 x watts/meter²

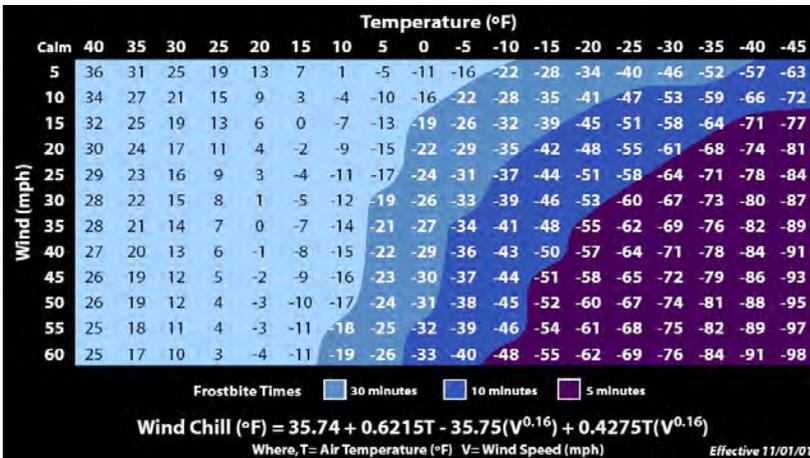
Tables and Formulas

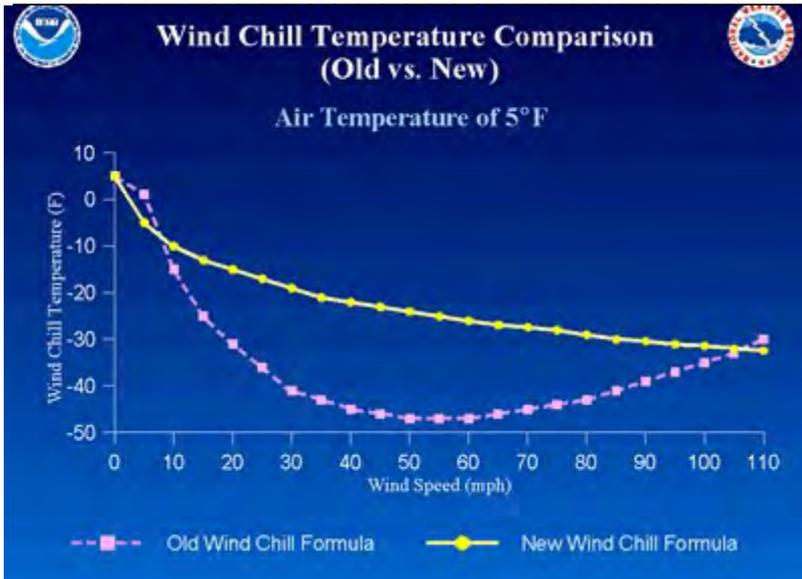
Wind Chill Chart

In 2001, NWS implemented an updated Wind Chill Temperature (WCT) index. The change improves upon the former WCT Index used by the NWS and the Meteorological Services of Canada, which was based on the 1945 Siple and Passel Index.

In the fall of 2000, the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) formed a group consisting of several Federal agencies, MSC, the academic community (Indiana University-Purdue University in Indianapolis (IUPUI), University of Delaware and University of Missouri), and the International Society of Biometeorology to evaluate and improve the windchill formula. The group, chaired by the NWS, is called the Joint Action Group for temperature Indices (JAG/TI). JAG/TI's goal is to upgrade and standardize the index for temperature extremes internationally (e.g. Wind chill Index).

The current formula uses advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures.





Wind Chill Equation

$$WC = 35.74 + 0.6215 T - 35.75(V^{0.16}) + 0.4275 T(V^{0.16})$$

Where:

WC = wind chill temperature in °F

V = wind velocity in mph

T = air temperature in °F

Note: Wind chill Temperature is only defined for temperatures at or below 50 degrees F and wind speeds above 3 mph.

Heat Index

Heat index is calculated using the following formula:

$$HI = -42.379 + 2.04901523 * T + 10.14333127 * RH - .22475541 * T * RH - .00683783 * T * T - .05481717 * RH * RH + .00122874 * T * T * RH + .00085282 * T * RH * RH - .00000199 * T * T * RH * RH$$

Where T is temperature in degrees F and RH is relative humidity in percent.

HI is the heat index expressed as an apparent temperature in degrees F.

Heat Index look up table (printed for reference)

RH	Temperature in °F													
	70	75	80	85	90	95	100	105	110	115	120	125	130	135
0	64	66	73	78	83	87	91	95	99	103	107	111	117	120
5	64	69	74	79	84	88	93	97	102	107	111	116	122	126
10	65	70	75	80	85	90	95	100	105	111	116	123	131	
15	65	71	76	81	86	91	97	102	108	115	123	131		
20	66	72	77	82	87	93	99	105	112	120	130	141		
25	66	72	77	83	88	94	101	109	117	127	139			
30	67	73	78	84	90	96	104	113	123	135	148			
35	67	73	79	85	91	98	107	118	130	143				
40	68	74	79	86	93	101	110	123	137	151				
45	68	74	80	87	95	104	115	129	143					
50	69	75	81	88	96	107	120	135	150					
55	69	75	81	89	98	110	126	142						
60	70	76	82	90	100	114	132	149						
65	70	76	83	91	102	119	138							
70	70	77	84	93	106	124	144							
75	70	77	85	95	109	130	150							
80	71	78	86	97	113	136								
85	71	78	87	99	117	140								
90	71	79	88	102	122	150								
95	71	79	89	105	126									
100	72	80	90	108	131									

Dew Point

$$B = (\ln(RH/100) + ((17.2694 * T) / (237.7 + T))) / 17.2694$$

$$\text{Dew Point in } ^\circ\text{C} = (238.3 * B) / (1 - B)$$

Where:

RH = Relative Humidity

T = Temperature in $^\circ\text{C}$

Ln = Natural logarithm

B = Intermediate variable

Evapotranspiration

The 1982 Kimberly-Penman equation:

$$\lambda ET_x = (\Delta / (\Delta + \gamma)) (R_n - G) + (\gamma / (\Delta + \gamma)) 6.43 W_f (e_s - e_a)$$

The Penman equation is known as a “combination equation” because it combines net radiation (the heat function) and advective energy transfer (the wind function) into one energy balance equation.

Wet Bulb Globe Temperature (WBGT) (MicroServer Station Only)

Equation for WBGT (Outdoors with solar load)

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where:

WBGT = Wet Bulb Globe Temperature Index

NWB = Natural Wet-Bulb Temperature

DB = Dry-Bulb (air) Temperature

GT = Globe Thermometer Temperature

The determination of WBGT requires the use of a black globe temperature sensor, relative humidity sensor, and a dry-bulb (ambient) temperature sensor.



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