

Weather Station

Operating Instructions



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Weather Station Operating instructions:

The Weather Station is a fixed mount weather sensor device which can be affixed to the exterior of a greenhouse, a house, a trailer, etc. It uses a trio of sensors to calculate Density Altitude and Air Density, and additional sensors to measure wind qualities and rainfall. These sensors are comprised of for barometric pressure sensor, temperature sensor, relative humidity sensor, wind direction sensor, wind speed sensor, and a tipping bucket rainfall sensor. The Weather Station uses high performance sensors to obtain accurate readings and uses sophisticated digital filtering techniques to ensure stable high quality readings. With this device, you are using 21st century technology. The possible applications for the Weather Station are many, such as general weather measurement, agricultural monitoring, small airports, race track and emergency mobile weather monitoring.

Operation:

The Weather Station is a polled serial peripheral device. You can connect the COM port on the Weather Station to a desktop computer and collect the data using the Weather Station Software. You can also use other programs to take readings from the Weather Station, such as HyperTerminal. **Set the serial link parameters in the program for 19200 baud, 8 data bits, no parity, and 1 stop bit.** The Weather Station is also easy to interface to third party or custom software. The interface commands are all single ASCII characters. All responses to the commands are formatted in ASCII, and can be requested as individual numbers or as traditional readings with unit descriptors attached.

Sensors:

- ❑ **The Barometer (BP)** is a 16 PSIA sensor, which has a linear output from 0.2Volts at complete vacuum to 4.7 Volts at 16PSIA (a little higher than the barometric pressure at sea level (14.7 PSIA)). The calibration “O” command will allow you to adjust the barometer to the local altitude so your barometric pressure readings will match that of the local news channel. To request a barometric pressure reading from Weather Station use the “B” command for barometric pressure numbers only, or the “b” command for barometric pressure with descriptors.
- ❑ **The Air Temperature (AT)**, is a linear temperature sensor with a range from 32.0° F to 212.0° F (0.0° C to 100.0° C). It is capable of sensing outside that range with diminished accuracy. The “T” command will request the temperature in Fahrenheit from the Weather Station. Using the “t” command will request the temperature response and will include descriptors. If you want to sense temperatures above 150° F it is recommended that you use a remote temperature sensor.
- ❑ **The Relative Humidity (RH)** sensor reading is measured in a percentage from 0.0 to 100.0 percent. 0.0 being as dry as the scale gets and 100.0 being as moist as the scale gets. Relative Humidity is relative to temperature. The temperature of the air determines the amount of water vapor the air can hold. This is called Saturated Water Vapor Pressure and is expressed as a pressure in inches of mercury. Relative Humidity is the percentage of the Saturated Water Vapor Pressure that the air is currently holding. The command to request relative humidity from the Weather Station is “H”, or “h” to include the descriptors.
- ❑ **The Wind Direction Sensor (WD)** reading is measured in degrees from 0 to 360. North (depending on the orientation of the sensor physically) is 0 or 260. As the scale increases from zero it is rotating to the east, so 90 degrees is due east, 180 degrees is due south and 270 is due west (**See the Calibration Section**). The Weather Station will return a heading number with descriptors when the "Y" command is sent, and will return wind heading numbers only when a "W" is sent.
- ❑ **The Wind Speed Sensor (WS)** reading is measured relative to time. When you measure 1 tick per second the wind speed is 2.5 miles per hour. If you wait 10 seconds and measure 10 ticks the wind speed is still 2.5 miles per hour. The wind speed is physically measured in a tick which is 1 revolution of the anemometer rotor. The Weather Station uses a counter to accumulate the ticks in a register. Every time the wind speed command is issued the Weather Station will transmit the number of ticks in the wind speed counter register and then clear that register. The command to request the wind speed from the Weather Station is "w" with descriptors and "W" for numbers only.

- **The Rainfall Sensor (RF)** reading is measured in tips. Each tip of the bucket signifies 0.01 inches of rainfall. The number of tip is stored in the rainfall counter register. The counter will continue to accumulate tips in this register until the rainfall command is sent to the Weather Station, then the Weather Station will transmit the number of tips and then clear the rainfall counter register. The command to request rainfall tips from the Weather Station is "r" with descriptors and "R" for numbers only.

- **The Battery (BT)** fuel gauge will tell you how much life is left in the optional internal battery. When a new fully charged battery is installed, the gauge will read 100 percent. The recommended time to recharge the battery is at 25 percent; however the unit will continue working down to 0 percent on the fuel gauge, with diminished accuracy. To request the battery power level use the "P" command for numbers only or use "p" to get the battery level with descriptors.

- **Air Density** is a computed reading which is dependant on the three atmospheric sensors in the Weather Station. It is the density of the air expressed in pounds per cubic foot. The algorithm for the Air Density conversion is the same algorithm which pilots use to calculate required power level for takeoff. To request the Air Density from the Weather Station use the "D" for a numbers only and a "d" for the Air Density number with descriptors.

- **Density Altitude** is your apparent altitude with respect to the Air Density. As the air density gets lower the apparent altitude gets higher. This is not very noticeable with human senses, but your air-based machine's performance will notice it. As the altitude gets higher the density of the air gets lower and the available oxygen gets lower. With less oxygen available to an engine, which depends on oxygen to burn fuel, will produce less power. Density Altitude is expressed in feet above sea level. This compound algorithm uses all three atmospheric sensors and the Air Density algorithm to produce Density Altitude. To request Density Altitude from the Weather Station use the "C" command for numbers only and "c" command for numbers and descriptors.

Command Set:

For simple demonstration purposes you can use Hyper Terminal to communicate with the Weather Station. Using Hyper Terminal, setup the com port to communicate with the Weather Station. **The settings for the com port are: 19200 baud, 8 data bits, 1 stop bit, no parity and no flow control.** This is the easiest way to become familiar with the Weather Station's command set. If you are creating a custom piece software to interface with the Weather Station it is recommended that you first start with Hyper Terminal to familiarize yourself with it's nuances.

The Weather Station uses the ASCII communication set to make programming a user interface and communicating with the device as easy as possible. The serial port wires are kept to a minimum in order to keep the interconnect simple and easy to use,. There are only transmit, receive, and ground. Because there are no hardware handshaking signals. It is important to include the correct delay before trying to read data from the Weather Station. In the communication sequence the host would transmit a single ASCII character command; wait for a variable amount of time, then read the data from the Weather Station. The amount of delay is varies based upon the amount of data there is to be read back. For example, if we were to write a command such as “**T**” the amount of delay would be short because we are only reading back 5 bytes - the temperature. However, if we were to write the command “**?**”, we would have to delay about 300 milliseconds while we are waiting for the list of command variables to upload from the Weather Station. The host computer initiates all communications with the Weather Station. There should never be any un-requested data coming from the Weather Station. Lower case commands generally return readings with descriptor while upper case commands generally return readings with no variables.

The following is a “conversation” between a host computer and the Weather Station;

Hyper Terminal sends “**X**” (wake up, delays 10 milliseconds)
Hyper Terminal sends “**T**” (transmit temperature, delays 70 milliseconds)
Weather Station sends “079.7” (response to temperature query)
Hyper Terminal sends “**H**” (transmit humidity, delays 70 milliseconds)
Weather Station sends “039.2” (response to humidity query)
Hyper Terminal sends “**B**” (transmit barometer, delays 70 milliseconds)
Weather Station sends “29.79” (response to barometer query)
Hyper Terminal sends “**N**” (transmit nap command)

The following table describes what each ASCII command does, the amount of delay it needs, and the format it is transmitted as;

Command Set Table: (ms=milliseconds)

Command	Delay	Description of command and format	Return Format
a	100ms	Transmit all sensor readings with descriptors	See Below
A	100ms	Transmit all sensor readings with descriptors	See Below
b	100ms	Transmit barometric pressure with descriptors	BPXX.XXIn.Hg.
B	100ms	Transmit barometric pressure without descriptors	XX.XX
c	100ms	Transmit density altitude with descriptors	DAXXXXXFASL
C	100ms	Transmit density altitude without descriptors	XXXXX
d	100ms	Transmit air density with descriptors	ADX.XXXXXF/Ft3
D	100ms	Transmit air density without descriptors	X.XXXXX
h	100ms	Transmit relative humidity with descriptors	RHXXX.X%
H	100ms	Transmit relative humidity without descriptors	XXX.X
l	N/A	Continuous Loop Mode	See Below
L	N/A	Continuous Loop Mode	See Below
n	10ms	Nap Mode (turns off LED)	N/A
N	10ms	Nap Mode (turns off LED)	N/A
o	10ms	Go into calibration mode	See Below
O	10ms	Go into calibration mode	See Below
p	100ms	Transmit battery power level with descriptors	BtXX%
P	100ms	Transmit battery power level with descriptors	XX
q	300ms	Transmit unit information	See Below
Q	300ms	Transmit unit information	See Below
r	100ms	Transmit Rainfall Tips with descriptors	RFXXXXXTicks
R	100ms	Transmit Rainfall Tips without descriptors	XXXXXX
t	100ms	Transmit temperature with descriptors	ATXXX.XF
T	100ms	Transmit temperature without descriptors	XXX.X
w	100ms	Transmit Wind Speed with descriptors	WSXXXXTicks
W	100ms	Transmit Wind Speed without descriptors	XXX
x	10ms	Wake up from Nap Mode	N/A
X	10ms	Wake up from Nap Mode	N/A
y	100ms	Transmit Wind Direction with descriptors	WDXXXDeg
Y	100ms	Transmit Wind Direction without descriptors	XXX
?	300ms	Transmit command list with descriptors	See Below
/	300ms	Transmit command list with descriptors	See Below

Transmit All Sensors Format:

BP=29.46In./Hg. AT=077.4F RH=050.7% BT=100%

Sending a lowercase a or an uppercase A to the Weather Station will solicit the All Sensors response from the Weather Station. This means all air quality sensors and not the wind and rain sensors. The end of line character is a carriage return line feed.

Continuous Loop Mode Format:

BP=29.46In./Hg. AT=077.4F RH=050.7% BT=100%

Sensing a l or L to the Weather Station will activate continuous loop mode. In this mode the unit will continuously transmit this same string of information. The unit is also continuously sampling the sensors so the data transmitted is updated 20 times per second. To exit from loop mode press the l or L again. While the Weather Station is in loop mode the end of line designator is a carriage return, but no line feed so that the unit continuously updates the line it is on. When you terminate the loop mode it will end with 2 carriage returns and 2 line feeds.

Calibrate Mode Format:

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Calibration Routine

+,= to increase barometer

-,_ to decrease barometer

R,r to refresh current readings

H,h to increase thermometer

C,c to decrease thermometer

W,w to increase hygrometer

D,d to decrease hygrometer

S,s to save settings and exit

Z,Z to clear Offsets and exit

Baro 29.46 Temp 077.5 Humi 50.1

barometer offset is 00.00in.Hg

temperature offset is 000

relative humidity offset is 00

In Calibration Mode the Weather Station will transmit a menu of commands and then go into a loop mode. The Weather Station will continuously sample the sensors and transmit the readings as the offset numbers are adjusted. When the desired calibration has been reached send the save command or the zero command. The save command will save the offsets for the sensors and exit calibration mode. The Zero command will change the sensor offset to zeros and exit the calibration mode. As the Weather Station is exiting the calibration mode it will report the offsets.

Unit Information Format:

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Applied Data Sciences Inc.

Built August 18, 2005

in Dallas, Texas, USA

Weather Station Firmware Rev. 1.0

ADS Part Number 0500029

To solicit unit information from the Weather Station send a q or a Q. The Weather Station will return the part number and revision level, as well as copyright data.

Command List Format:

Command Functions:

A,a = All Sensors Display

B,b = Barometric Pressure In.Hg.

C,c = Density Altitude

D,d = Air Density

H,h = Relative Humidity

L,l = Continous Loop Mode

O,o = Offset Adustments/Calibration

P,p = Battery Power Level

Q,q = Device Information

R,r = Rain Fall in Inches

T,t = Temperature in Fahrenheit

W,w = Wind Speed in M.P.H.

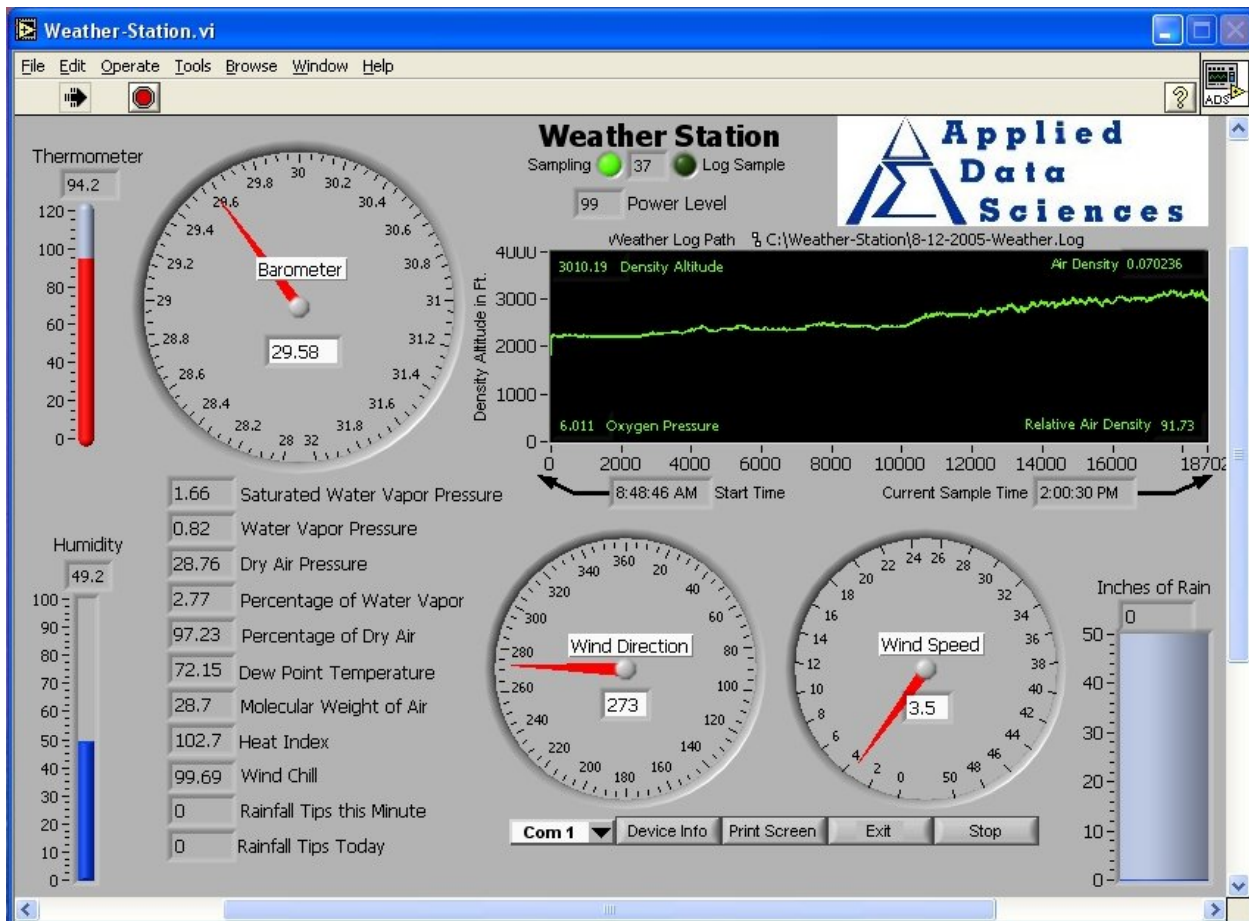
Y,y = Wind Direction in Degrees

?,/ = Help Screen

Send a ? or a / to the Weather Station and it will respond with a list of commands to which it responds.

It is important to not overrun the Weather Station's 2 byte input serial buffer. This buffer is important for the proper functioning of the Weather Station. If this buffer is overrun it will start dropping commands to the unit. When you are writing commands to the unit send only 1 character at a time. Then read the response from the Weather Station before writing the next command character.

Weather Station Terminal Software:



The Weather Station Software is included free with the Weather Station. Its purpose is to be a low cost interface for users who want instant access to the Weather Station. The software runs in a loop, continuously monitoring the Weather Station. As it receives the raw data, it will display the values and also refresh the computed values. The ring control labeled "Serial Port" sets the COM Port under windows using the same COM number as Windows.

The Weather Station will "nap" between samples. You can look at the bottom of the Weather Station to tell the status of the unit. When the unit is napping the LED will be off. If the Weather Station is sampling, the LED will be on. The "Device Info" button will request the unit information from the Weather Station and put it in a pop-up window. The Exit button will close the Weather Station Software and the LabView Runtime Engine. The Stop button will only stop the execution of the program and not close it. The Weather Station Software requests the temperature, humidity and barometric pressure from the Weather Station. The rest of the values that you see on the Weather Station Software are calculated.

Polled readings:

1. Air Temperature (in degrees Fahrenheit)
2. Relative Humidity (as a percentage of saturated water vapor pressure)
3. Barometric Pressure (in inches of mercury)
4. Wind Direction (in degrees North being 0 or 360)
5. Wind Speed (in ticks, which are 1 revolution of the anemometer impeller)
6. Rainfall (in tips of the tipping bucket rainfall sensor)
7. Battery Level (in a percentage of maximum)

Computed readings:

1. Saturated Water Vapor Pressure (in inches of mercury)
2. Water Vapor Pressure (in inches of mercury)
3. Water Vapor Percentage (percentage of air which is water vapor)
4. Dry Air Pressure (in inches of mercury)
5. Dry Air Percentage (percentage of air which is dry air)
6. Dew Point Temperature (temperature where humidity exceeds saturated water vapor pressure and water droplets come out of the solution called air)
7. Molecular Weight (represents weight of single air molecule)
8. Air Density (mass of air computed in weight per volume)
9. Density Altitude (the apparent altitude based on weather conditions)
10. Heat Index (The apparent temperature where humidity make it feel hotter)
11. Wind Chill (The apparent temperature where the wind makes it feel colder)

Weather Station Terminal Software Installation

Insert the CD labeled “Weather Station Software” into your CDROM drive. It should automatically start to install.

If the software does not automatically start to install, go to the CDROM root directory and run a program called setup.exe.

The setup program will prompt you install the software in the C:\Weather-Station directory. It must go there, otherwise it will not be able to find it's configuration file.

The installation program will create a program group for Weather Station and place it on your desktop.

To run the software double click on the Weather Station Icon.

Select the com port using the ring control for the com port.

Weather Station Product Specifications

Processor:	Microchip
Processor Speed:	4 Megahertz
Program Memory:	8192, 14 bit words (14 kilobytes)
Processor RAM:	384 bytes
Processor EEPROM:	256 bytes
Processing Speed:	1 MIPS
Air Density Calculation:	+/- 1% accurate, in Pounds per Cubic foot
Density Altitude Calculation:	+/- 1% accurate, in Feet above sea level
Pressure Sensor:	Fujikura
Pressure Range:	0 PSIA to 16 PSIA
Pressure Resolution:	0.01 inches of mercury
Temperature Sensor:	National
Temperature Range:	32.0° F. to 212.0° F.
Temperature Resolution:	0.1° F
Humidity Sensor:	Honeywell
Humidity Range:	0.0% RH to 100.0%RH
Humidity Resolution:	0.1%
Voltage Requirement:	6Vdc to 12Vdc
Current Requirement:	150 Milliamps
Power Consumption:	750 MilliWatts

Weather Station Limited Manufacturers Warranty

Applied Data Sciences will honor a limited warranty on this product for a period of one year after the purchase date. This warranty covers manufacturer's original parts and workmanship. If this product fails, the manufacturer will repair or replace the unit within the warranty period.

Upgrades are not covered by the warranty, and are treated as purchasing additional parts or software. Out of warranty repair charges are a minimum ½ hour at \$35 per half hour.

Practices that will void the warranty are as follows:

- ❑ Immersing the Weather Station in water.
- ❑ Exposing the Weather Station to microwave radiation.
- ❑ Exposing Weather Station to temperatures above 150°F while in operating mode.
- ❑ Intentional physical damage.

Do not, under any circumstance, put your Weather Station in a hot oven, a microwave oven, a fireplace or a barbecue. The Weather Station is not heat proof and excessive heat will completely destroy it, and will void the warranty. Also, the Weather Station is not waterproof, so Do Not immerse in water or any other liquid, especially flammable liquids.

For Information on repairs, upgrades, or questions contact:

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