WatchDog®

Sprayer Station
CANbus Compatible

PRODUCT MANUAL

Item # 3349SSHCB

Spectrum®
Technologies, Inc.

Contents

This manual will familiarize you with the features and operation of your new WatchDog Sprayer Station. Please read this manual thoroughly before using your instrument. For customer support, or to place an order, call Spectrum Technologies, Inc. at
(800) 248-8873 or (815) 436-4440
between 7:30 am and 5:30 p.m. CST
FAX (815) 436-4460
e-mail: info@specmeters.com
www.specmeters.com

Introduction

Thank you for purchasing the WatchDog Sprayer Station. The Sprayer Station is designed to provide an accurate indication and record of the environmental conditions around a vehicle, whether it is stationary or in motion. It allows for real-time measurement of weather data before, during, and after a field operation.

Specifications

Wind Resolution - Speed:	0.1 mph (0.2 km/h); Direction 1°
Wind Speed Range:	0 to 90 mph (0 to 145 km/h)
Wind Speed Accuracy:	< 12 mph (19 km/h): ±1.1 mph (1.7 km/h) + 10%; > 12 mph (19 km/n): ±2.3 mph (3.7 km/h) or ± 5%
Wind Direction Accuracy	4 to 11 mph (6 to 18 km/h): ±5°; > 12 mph (19 km/h): ±2°
Operating Temperature	-13° to 131ºF (-25ºC to 55ºC)
Temperature Accuracy	±2.0ºF (±1.1ºC) with wind above 4.6 mph (7.4 km/h)
Barometric Pressure Range	24 to 33 in-Hg (800 to 1100 hPa)
" " Accuracy	±0.029 in-Hg (± 1 hPa)
Relative Humidity Range	10 to 95%
Relative Humidity Accuracy	±4% with wind above 4.6 mph (7.4 km/h)
Power Supply Voltage	9 to 40 VDC; Current: <70 mA

Installing the Station

Choosing the Mounting Location

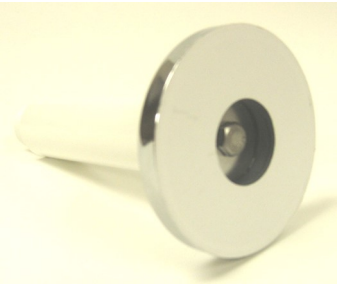
The Sensor Unit must be mounted in "clear air"—away from obstructions in any direction that will interfere with air flowing through the unit. Ideally, this would be on the roof of the cab or the tank. If the Sensor Unit is not the highest point, be sure to mount it far enough from any obstruction so there is no interference with the air flow.

Because the Sensor Unit has an electronic compass, it should be at least 3' (1 m) away from strong magnetic fields from equipment such as radio transmitters. Because it has a GPS, be sure it is as far as possible from high-powered transmitting antennas to avoid mutual interfer-

ence. Similarly, mount the Sensor Unit far enough from an existing GPS unit to avoid interference, and to keep the Sensor Unit from blocking the GPS unit's view of the sky.

The Sensor Unit must be installed vertically—NOT tilted to one side. Tilting the unit will introduce an error in the compass reading.

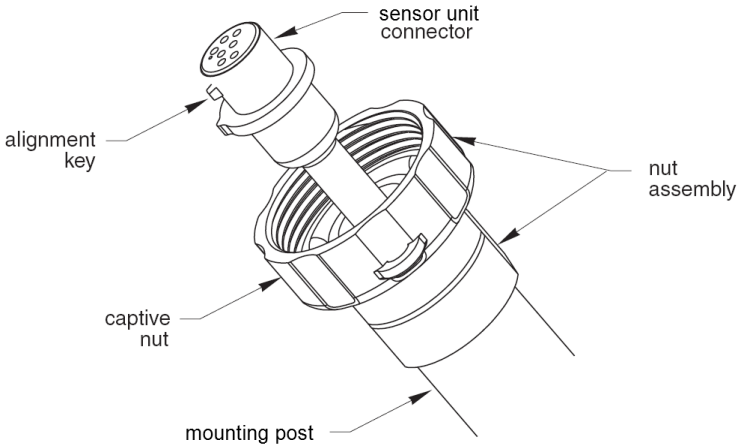
If you are using the magnetic mount, remember that you must have a steel surface to attract the magnet. With a fiberglass roof, this usually requires applying an adhesive steel plate, as is used to provide a mounting point for GPS units. The magnetic mount can also be removed, and a standard ¼" bolt used to attach the mounting post to the vehicle.



Once you have decided on a location, note which direction you want the cable to travel. At this time, you may wish to mark the front of the mounting post (the side which will be pointing toward the front of the vehicle).

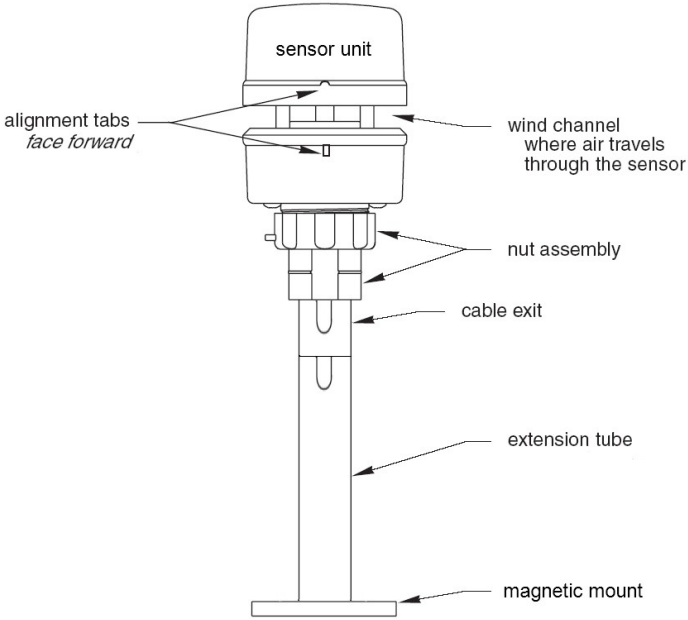
Assembling the Sensor Unit, Cable, and Mount

1. Gather the Sensor Unit, Mounting Post, and Cable Assembly.
2. With the nut assembly on the cable near the Sensor Unit connector, slide the cable into the cable exit slot at the top of the Mounting Tube. Leave several inches of cable topped by the connector above the nut assembly.
3. Screw the nut assembly onto the top of the Mounting Tube. Hand-tighten only. Do not over-tighten. Caution: If you want to use a thread lock, use plumber's tape. Do not use a liquid thread lock as it may weaken the plastic, causing it to swell and crack.



4. Remove the protective cover from the connector, and the warning label from the bottom of the Sensor Unit. Plug the 7-pin connector into the Sensor Unit. The alignment key on the connector fits into a notch in the base of the Sensor Unit.
5. Be sure the alignment tabs on the Sensor Unit are facing forward and parallel to the centerline of the vehicle. Remember to orient the front of the Mounting Post forward as well, so the cable will exit in the correct direction. Slide the captive nut upward and screw it onto the base of the Sensor Unit. Hand-tighten only. Do not over-tighten. Be

careful NOT to rotate the Sensor Unit or loosen the nut assembly from the antenna mount/extension tube. Double check to be sure the alignment tabs are still facing forward.



Alignment

Please note that, for clarity, the above diagram shows the sensor alignment tabs and the cable exit both facing forward, it is uncommon for the cable to run forward from the sensor. It would usually run to the rear or one of the sides, and the cable exit should be aligned accordingly. The sensor itself must face forward.

Temporary Mount

For temporary mounting of the Sprayer Station, slip the cable through an open door or window. Caution: do not damage the cable when closing the door or window. For doors, avoid the area near the hinges as well as near the latch. Both areas exert extremely high forces on the cable.

Replacing the Humidity Sensor

The humidity sensor on item 3349SSHCB can be replaced with sensor item number 3349H.

To replace the sensor, use a Phillips screwdriver to unscrew the two screws and pull off the old sensor and replace with the new sensor.

How the Sprayer Station Works

About the Ultrasonic Wind Sensor

The ultrasonic wind sensor (an ultrasonic anemometer) measures apparent wind speed and direction. The Sprayer Station contains four ultrasonic transducers, visible through the four holes in the top of the sensor's wind channel. These transducers operate in pairs—one transducer injects a pulse into the air, and the other (directly opposite to it) listens for the arrival of that pulse. Each pulse bounces off the metal plate at the bottom of the wind channel and is carried by the wind to arrive at the opposing transducer a short time later.

When there is no wind, the pulse travels at the speed of sound from the sender to the receiver. Whenever the wind is blowing in that direction, the pulse will arrive sooner than if the air is still. Similarly, whenever the wind is blowing in the opposite direction, the pulse will arrive later than if the air is still. The four transducers take turns in sending and receiving pulses to cover all possible wind directions.

A microprocessor within the Sprayer Station then combines the measurements from all four transducers to calculate the resultant wind speed and direction. Throughout this process, the sensor monitors the air temperature, to compensate for the fact that the speed of sound in air changes with temperature.

Understanding True and Apparent Wind

The Sprayer Station has the unique ability to display both true and apparent wind. True wind is the actual motion of the air relative to the earth. Apparent wind is the wind which an observer experiences while moving. It is the result of two motions—the actual motion of the air (the true wind) and the motion of the vehicle. If the vehicle is not moving, then the true and apparent wind will be the same.

There are two components to any wind measurement: speed and direction. By convention, the wind direction is an angle representing the direction from which the wind is blowing.

Consider the case of a vehicle proceeding at a speed of 15 mph in calm air. An observer on board would experience a wind of 15 mph from dead ahead. This apparent wind would be due solely to the motion of the vehicle. If a true wind of 15 mph was blowing from the rear, an observer would experience dead calm—no apparent wind. That is because the vehicle is moving at the same speed and in the same direction as the surrounding air.

Now, consider the more complicated situation of a vehicle proceeding at 15 mph with a true wind of 15 mph blowing from the side. To an observer on board, the apparent wind would be 21.2 mph blowing from an angle 45º off the front.

In order to calculate the true wind speed and direction when on board a moving vehicle, it is necessary to know the apparent wind speed and direction, the speed and course over ground of the vehicle, the compass heading, and the local magnetic variation. Note that heading and course are not the same thing: heading is the direction the vehicle is pointing, while course is the direction the vehicle is traveling. On land, heading and course differ only when the vehicle is stationary. The Sprayer Station can provide true wind speed and direction only if all of the data is available. The speed and course over ground must be provided by a GPS receiver—either built-in or networked. The heading may be provided by either the built-in electronic compass or by an external networked compass.

Because true wind is calculated using the data from several sensors, its accuracy depends on the accuracy of all the raw data used in the calculation. For instance, if the electronic compass is located near iron or a similar magnetic disturbance, the heading will be incorrect, and the true wind calculation will therefore be in error, perhaps by quite a bit. In another example, the speed and course over ground (SOG and COG) provided by the GPS receiver are averaged over time. If the vehicle is performing maneuvers, changing speed and/or direction, then it will take a few seconds for the SOG and COG values to "catch up".

The reported true wind values will therefore also be incorrect until the vehicle reaches a steady-state condition, traveling in a straight line at a constant speed.

Electronic Compass

The Sprayer Station includes a pair of magnetoinductive sensors that measure magnetic field strength in two axes on the horizontal plane of the Sprayer Station. From these measurements, it calculates the resultant magnetic heading angle, thereby providing a built-in electronic compass.

Like all magnetic compasses, the Sprayer Station compass will be affected by any ferrous or magnetic materials in the vicinity, such as metal structures, motors, speakers, etc. It will also be affected by nearby electric fields, such as the wiring for lights. These nearby sources of magnetic interference will distort the magnetic field and produce errors in the compass heading. These errors are known as magnetic deviation.

Although the Sprayer Station compass is a 2-axis device, the earth's magnetic field occurs in three dimensions. That is, part of the earth's magnetic field is oriented in the vertical direction. The closer one's location is to the north or south pole, the stronger this vertical component becomes in comparison to the horizontal components. The effect this has on the Sprayer Station is to introduce an error in the compass reading if the Sprayer Station is tilted from the horizontal plane. Therefore, it is important when installing the Sprayer Station to ensure the support pole is mounted vertically, and not tilted to one side. Also, keep in mind that when your vehicle experiences pitch and roll, the compass heading will be affected accordingly.

Because the compass heading is used in the calculations for true wind, any errors in the compass heading will also produce errors in the reported true wind speed and direction. This is adjusted for in the Sprayer Station by using the GPS-sourced course over ground when the vehicle is moving.

Magnetic Variation and True Heading

The earth acts like a giant magnet, with a magnetic north pole and a magnetic south pole. The axis of the magnetic poles is offset approximately 11.5° from the axis of the earth's rotation. Therefore, the earth's magnetic north and south poles are in different locations than the earth's geographic north and south poles. In addition, the earth's magnetic field is non-uniform, and changes over time. Magnetic variation, also known as magnetic declination, is the angle between magnetic north and true (or geographic) north, at the observer's current location.

A magnetic compass measures heading with respect to magnetic north. To convert this magnetic heading to true heading (that is, heading with respect to true north), the magnetic variation must be added to the measured magnetic heading value.

Because magnetic variation changes with location and gradually over time, it is necessary to calculate the magnetic variation using the user's present position and the current date. Therefore it is necessary to have a GPS with a fix in order to provide magnetic variation and heading with respect to true north.

Air Temperature Sensor

The Sprayer Station includes a built-in negative-temperature-coefficient thermistor that measures the ambient air temperature. This NTC thermistor is located in a thermally isolated region of the Sprayer Station housing that is open to the outside air.

Relative Humidity Sensor

The Sprayer Station contains a capacitive cell humidity sensor that measures the relative humidity of the air. Humidity refers to the amount of water vapor in the air. Relative humidity is the percentage of saturation of the water vapor in the air. It is the ratio of the moisture content of the air to the saturated moisture level at the same temperature and pressure.

Barometric Pressure Sensor

The Sprayer Station contains a temperature-compensated, silicon, piezoresistive, pressure sensor. It measures atmospheric pressure for use as a digital barometer

GPS

The Sprayer Station has a built-in Global Positioning System with its own antenna, receiver, and position determining electronics. The GPS receiver receives radio signals from a constellation of orbiting satellites maintained by the U.S. government. By accurately measuring the time it takes for a transmission to travel from each satellite to the receiver, the unit is able to determine the distance between the satellite and the receiver. When the distance is known to three satellites, the unit is able to calculate the latitude and longitude of the receiver. This is known as a 2D (2 dimensional) fix. If the distance is known to four or more satellites, then the unit is additionally able to calculate the altitude of the receiver. This is known as a 3D, or 3 dimensional fix.

On average, the GPS receiver in the Sprayer Station takes approximately one minute to achieve a position fix after power is first applied. This is known as the "time to first fix." The GPS receiver has 16 channels to track satellites, and will use up to 12 satellites in computing a position fix.

The GPS receiver synchronizes itself to the atomic clocks on board each satellite. This allows the GPS receiver to accurately determine the date and time as well.

If the GPS receiver is mounted on a moving vehicle, its changing position over time allows the speed and course over ground to be calculated. The course reported by a GPS is always with respect to true north.

The ability of the Sprayer Station to calculate true wind speed and direction depends on the presence of a GPS fix. If the GPS receiver is not tracking at least three satellites, then the Sprayer Station will be unable to provide true wind data. (Apparent wind data should always be available, regardless of the status of the GPS receiver.)

Warranty

This product is warranted to be free from defects in material or workmanship for one year from the date of purchase. During the warranty period Spectrum will, at its option, either repair or replace products that prove to be defective. This warranty does not cover damage due to improper installation or use, lightning, negligence, accident, or unauthorized modifications, or to incidental or consequential damages beyond the Spectrum product. Before returning a failed unit, you must obtain a Returned Materials Authorization (RMA) from Spectrum. Spectrum is not responsible for any package that is returned without a valid RMA number or for the loss of the package by any shipping company.

CE

This equipment has been manufactured for
Spectrum Technologies, Inc.
12360 S. Industrial Dr. East
Plainfield, IL 60585 USA

The Manufacturer's **DECLARATION OF CONFORMITY** is on file at the above address, and certifies conformity to the following:

Model Number:	3349SS
Description:	WatchDog Sprayer Station
Directive:	EN 60945:1997-EMC Art 3.1b 00/05/CE
	Maritime Navigation and Radiocommunication Equipment and Systems
Clauses:	9.2 Conducted Emissions
	9.3 Radiated Emissions
	10.2 Conducted Low Frequency Interference
	10.3 Conducted Radio Frequency Interference
	10.4 Radiated Interferences
	10.5 Fast Transients of Signal and Control Lines
	10.8 Immunity to Power Supply Failure
	10.9 Immunity to Electrostatic Discharge

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