INSTRUCTION MANUAL

WXT520 Weather Transmitter

Revision: 9/15

Limited Warranty

"Products manufactured by CSI are warranted by CSI to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified in the corresponding product manual. (Product manuals are available for review online at *www.campbellsci.com*.) Products not manufactured by CSI, but that are resold by CSI, are warranted only to the limits extended by the original manufacturer. Batteries, fine-wire thermocouples, desiccant, and other consumables have no warranty. CSI's obligation under this warranty is limited to repairing or replacing (at CSI's option) defective Products, which shall be the sole and exclusive remedy under this warranty. The Customer assumes all costs of removing, reinstalling, and shipping defective Products to CSI. CSI will return such Products by surface carrier prepaid within the continental United States of America. To all other locations, CSI will return such Products best way CIP (port of entry) per Incoterms ® 2010. This warranty shall not apply to any Products which have been subjected to modification, misuse, neglect, improper service, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied. The warranty for installation services performed by CSI such as programming to customer specifications, electrical connections to Products manufactured by CSI, and Product specific training, is part of CSI's product warranty. **CSI EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**. **CSI hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the Products, whether express, implied or statutory, other than those expressly provided herein.**"

Assistance

Products may not be returned without prior authorization. The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit *www.campbellsci.com* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an application engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our web site at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC**. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com or by telephoning (435) 227-9000 (USA). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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WXT520 Weather Transmitter

1. Introduction

The WXT520 Weather Transmitter, manufactured by Vaisala, measures wind speed and direction, precipitation, barometric pressure, temperature, and relative humidity—all in a single device that has no moving parts. The WXT520's SDI-12 signal can be measured by any of our SDI-12 equipped dataloggers. The WXT520 is about the size of our larger Gill radiation shield, making it ideal for use with our CR200(X)-series dataloggers in applications requiring quick, short-term deployment. However, the WXT520 is not intended for weather stations that require research-grade performance.

Before installing the sensor, please study

- Section 2, *Precautions* ***(p. 1)***
- Section 3, *Initial Inspection* ***(p. 1)***

2. Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- Although the WXT520 is rugged, it should be handled as precision scientific instrument.

3. Initial Inspection

- Upon receipt of the WXT520, inspect the packaging and contents for damage. File damage claims with the shipping company.

4. Overview

4.1 Wind Speed and Direction

The WXT520's wind sensor consists of three equally spaced transducers that produce ultrasonic signals. Wind speed and direction are determined by measuring the time it takes for the ultrasonic signal of one transducer to travel to the other transducers. Wind direction is not calculated when the wind speed drops below 0.05 m/s. In this case, the last calculated direction output remains until wind speed increases. The computed wind speeds are independent of altitude, temperature, and humidity. The WXT520 is preconfigured to provide the minimum, average, and maximum values for both wind speed and direction. Default wind speed units are m/s.

4.2 Precipitation

The WXT520 uses the RAINCAP® Sensor to measure accumulated rainfall, rain intensity, and rain duration. Precipitation is measured one raindrop at a time. Whenever a raindrop hits the precipitation sensor, an electrical signal is produced that is proportional to the volume of the drop.

The sensor is also capable of distinguishing hail stones from raindrops. The measured rain and hail parameters are cumulative amounts of rain or hail, rain or hail intensity, and the duration of a shower.

4.3 Barometric Pressure, Temperature, and Relative Humidity

The WXT520 has a PTU module that contains a capacitive silicon BAROCAP® sensor for barometric pressure measurements, a capacitive ceramic THERMOCAP® sensor for air temperature measurements, and a capacitive thin film polymer HUMICAP® sensor for relative humidity measurements. The PTU is housed in a naturally aspirated radiation shield that protects the PTU and reflects solar radiation. Default units are °Celsius for temperature and hPa for barometric pressure.

5. Specifications

5.1 Wind Speed

Measurement Range:	0 to 60 m s^{-1}
Accuracy:	±0.3 m s^{-1} or ±3% whichever is greater (0 to 35 m s^{1}); ±5% (36 to 60 m s^{-1})
Response Time:	0.25 s

5.2 Wind Direction

Measurement Range:	0° to 360°
Accuracy:	±3°
Output Resolution:	1°

5.3 Precipitation

Rainfall:	cumulative accumulation after latest automatic or manual reset.
Accuracy:	5% (Due to the nature of the phenomenon, deviations caused by spatial variations may exist in precipitation readings, especially in short time scale. The accuracy specification does not include possible wind induced error.)
Collecting Area:	60 cm^2
Output Resolution:	0.01 mm (0.001 in)
Rain Duration:	counting each ten second increment when droplet detected.
Rain Intensity:	one minute running average in ten second steps.
Rainfall Intensity Range:	0 to 200 mm hr^{-1} (broader range possible with reduced accuracy)

5.4 Barometric Pressure

Measurement Range:	600 to 1100 hPa (mbar)
Accuracy:	±0.5 hPa @ 0 to 30 °C; ±1 hPa @ –52 to 60 °C
Output Resolution:	0.1 hPa

5.5 Air Temperature

Measurement Range:	–52 to 60 °C
Accuracy:	±0.3 °C @ 20 °C
Output Resolution:	0.1 °C

5.6 Relative Humidity

Measurement Range:	0 to 100% RH
Accuracy:	±3% RH @ 0 to 90% RH; ±5% RH @ 90 to 100% RH
Output Resolution:	0.1% RH

5.7 Assembly

Compatible Dataloggers:	CR200(X)-series, CR800, CR850, CR6, CR1000, CR3000, CR5000, CR510, CR10(X), CR23X
Electromagnetic Compatibility:	Complies with EMC standard EN61326-1; IEC standards: IEC 60945/61000-4-4, IEC 60945/61000-4-2
Input Voltage:	5 to 30 Vdc
Typical Current Drain @ 12 Vdc:	3 mA with default measuring intervals; 0.1 mA (SDI-12 standby)
Output:	SDI-12 as configured by Campbell Scientific; RS-292 and RS-485 also available
Operating Range:	–52 to 60 °C; 0 to 100% RH
Dimensions:	24.0 cm (9.4 in) height, 12.0 cm (4.7 in) diameter
Weight:	650 g (1.43 lb)

6. Installation

6.1 Mounting to a Campbell Scientific Crossarm

The WXT520 is mounted to a CM202, CM204, or CM206 crossarm using the 18311 mounting tube, which is shipped with the WXT520.

The 18311 mounting tube fits in the bottom of the WXT520, and is fastened to a crossarm via the CM220 Mounting Kit. Alternatively, the 17953 1-in. x 1-in. NU-RAIL fitting can be used instead of the CM220 for mounting to a crossarm.

6.2 IP66 Mounting Device

Campbell Scientific offers the 25299 mounting kit that provides better protection from water intrusion. When using the 25299, the WXT520's IP classification is increased from IP65 to IP66.

To attach the 25299 to the WXT520, place the L-shaped tabs into the notches on the bottom of the WXT520 (see FIGURE 6-1). Turn the WXT520 until the mount is locked into place. Once the 25299 is in place, the WXT520 is mounted to a mast or crossarm using the method described in Section 6.1, *Mounting to a Campbell Scientific Crossarm* ***(p. 3)***.

FIGURE 6-1. Optional WXT520 IP66 Mounting Kit

6.3 Bird Spike Kit

The 25300 Bird Spike device is fastened on top of the WXT520 using the set screw provided (see FIGURE 6-2). This device is used to discourage birds from roosting on the WXT520. It consists of a metallic band with spikes pointing upward. The spike's shape and location ensure minimal interference of wind and rain measurements.

NOTES

(1) The spikes are designed not to hurt the birds.

(2) While the use of this device does discourage interference from birds, absolute protection cannot be guaranteed.

(3) When this device is attached, snow may be more prone to accumulate on the head of the WXT520. In addition, the snow may melt away more slowly during periods of thaw.

FIGURE 6-2. Optional bird spike device

6.4 Wiring Table

TABLE 6-1. Connections to Campbell Scientific Dataloggers		
Wire Color	**Wire Function**	**Datalogger Connection Terminal**
Brown	Power	**12V** or **SW_Battery**
Clear (silver) or Red	Power ground	**G**
Blue	SDI-12 signal	**C, U** configured for SDI-12[1], **C1/SDI-12**, or **SDI-12**
White	SDI-12 signal	**C, U** configured for SDI-12[1], **C1/SDI-12**, or **SDI-12**
Green	Data ground	**G**
Green	Optional heater power (see note)	**12V** or **SW_Battery**
Pink	Optional heater ground (see note)	**G**
Grey		Not used
[1] **U** channels are automatically configured by the measurement instruction.		

NOTE Unless special ordered, the heater will not be operational for WXT520s purchased from Campbell Scientific. Although the heater is not operational, the WXT520 will have a pink and yellow wire. Do not connect the pink and yellow wire unless the heater is operational.

6.5 Commands

Campbell Scientific uses the SDI-12 protocol to communicate with the WXT520. Both "aM!" and "aR!" commands are supported (where "a" is the sensor address). The preferred command is "aR!", since the communication is done in fewer steps. The WXT520 is configured to run continuously so the output is identical. TABLE 6-2 contains the outputs as configured by Campbell Scientific. All outputs are in SI units.

TABLE 6-2. SDI-12 Commands

SDI-12 Command	Command Function	Values Returned
aR! or aM!	Composite Message	Wind Direction Average, Wind Speed Average, Air Temperature, Relative Humidity, Barometric Pressure, Rainfall Amount, Hail Amount
aR1! or aM1!	Wind Message	Wind Direction Minimum, Wind Direction Average, Wind Direction Maximum, Wind Speed Minimum, Wind Speed Average, Wind Speed Maximum
aR2! or aM2!	PTU Message	Air Temperature, Relative Humidity, Barometric Pressure
aR3! or aM3!	Precipitation Message	Rainfall Amount, rainfall Duration, Rainfall Intensity, Hail Amount, Hail Duration, Hail Intensity
aR5! or aM5!	Self Diagnostic Message	Supply Voltage, Internal Reference Voltage

6.6 Programming

6.6.1 CRBasic

Dataloggers that use CRBasic include our CR200(X)-series, CR800, CR850, CR6, CR1000, CR3000, and CR5000. These dataloggers use the **SDI12Recorder()** instruction to read the WXT520.

When using a CR200(X), the **SDI12Recorder()** instruction has the following form:

SDI12Recorder(*Destination, Output String, Multiplier, Offset*)

For the other CRBasic dataloggers, the **SDI12Recorder()** instruction has the following form:

SDI12Recorder(*Destination, SDIPort, SDIAddress, "SDICommand", Multiplier, Offset***)**

6.6.1.1 Example CR1000 Program

Although the following program is for the CR1000, the CR800, CR850, CR6, CR3000, and CR5000 are programmed similarly. This program uses the "aR!" command.

```
'CR1000
Public BattV
Public PTemp_C
Public WXT(7)

Alias WXT(1)=WindDir
Alias WXT(2)=WindSpd
Alias WXT(3)=AirTemp
Alias WXT(4)=RelHumidity
Alias WXT(5)=AirPressure
Alias WXT(6)=Ramount
Alias WXT(7)=Hamount

Units BattV=Volts
Units PTemp_C=Deg C
Units WindDir=Degrees
Units WindSpd=meters/second
Units AirTemp=Deg C
Units RelHumidity=%
Units AirPressure=mbar
Units Ramount=mm
Units Hamount=hits/cm^2

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  WindVector(1,WindSpd,WindDir,FP2,False,900,0,0)
  FieldNames("WindSpd_Mean,WindDir_MeanUnitVector,WindDir_SD1")
  Average(1,AirTemp,FP2,False)
  Sample(1,RelHumidity,FP2)
  Sample(1,AirPressure,IEEE4)
  Totalize(1,Ramount,FP2,False)
  Totalize(1,Hamount,FP2,False)
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan(5,Sec,1,0)
    'Dalogger Battery Voltage measurement 'BattV'
    Battery(BattV)
    'Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C,_60Hz)
    'Reset WXT520 Sensor measurements
    Move(WXT(),7,NaN,1)
    'WXT520 Weather Transmitter measurements 'WindDir', 'WindSpd', 'AirTemp',
    'RelHumidity', 'AirPressure', 'Ramount', and 'Hamount'
    SDI12Recorder(WXT(),1,"0","R!",1,0)
    'Call Data Tables and Store Data
    CallTable Table1
  NextScan
EndProg
```

6.6.1.2 Example CR200(X) Program

```
'CR200 Series
Public BattV
Public PTemp_C
Public WXT(7)
Dim N

Alias WXT(1)=WindDir
Alias WXT(2)=WindSpd
Alias WXT(3)=AirTemp
Alias WXT(4)=RelHumidity
Alias WXT(5)=AirPressure
Alias WXT(6)=Ramount
Alias WXT(7)=Hamount

Units BattV=Volts
Units PTemp_C=Deg C
Units WindDir=Degrees
Units WindSpd=meters/second
Units AirTemp=Deg C
Units RelHumidity=%
Units AirPressure=mbar
Units Ramount=mm
Units Hamount=hits/cm^2

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min)
  WindVector(WindSpd,WindDir,False,0,0)
  FieldNames("WindSpd_Mean,WindDir_Mean,WindDir_SD1")
  Average(1,AirTemp,False)
  Sample(1,RelHumidity)
  Sample(1,AirPressure)
  Totalize(1,Ramount,False)
  Totalize(1,Hamount,False)
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan(5,Sec)
    'Dalogger Battery Voltage measurement 'BattV'
    Battery(BattV)
    'Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C)
    'Reset WXT520 Sensor measurements
    For N=1 To 7
      WXT(N)=NaN
    Next
    'WXT520 Weather Transmitter measurements 'WindDir', 'WindSpd', 'AirTemp',
    'RelHumidity', 'AirPressure', 'Ramount', and 'Hamount'
    SDI12Recorder(WXT(),"0R!",1,0)
    'Call Data Tables and Store Data
    CallTable Table1
  NextScan
EndProg
```

6.6.2 Edlog Programming

Our CR500, CR510, CR10(X), and CR23X dataloggers are programmed with Edlog.

These dataloggers use Instruction 105 to read the WXT520. Your datalogger manual has a detailed explanation of Instruction 105.

Please note that Edlog only allocates one input location for Instruction 105. Additional input locations need to be inserted manually using the Input Location Editor.

6.6.2.1 CR10X Program

The following example is the portion of a CR10X program that measures the WXT520. A complete program will include output processing instructions.

```
;                                   wind direction                  wind speed
; Get WXT520 Values 1 - 6 (Dn=Wd min, Dm=Wd avg, Dx=Wd max, Sn=Ws min, Sm=Ws avg, Sx=Ws max)

22:  SDI-12 Recorder (P105) ;
   1:   0          SDI-12 Address
   2:   1          Start Measurement (aM1!)      ; corresponds with Wind message Command R1
   3:   2          Port                          ; control port for SDI-12 comms
   4:   15         Loc [ Value1    ]
   5:   1.0        Mult
   6:   0.0        Offset

23:  Excitation with Delay (P22)
   1:   1          Ex Channel
   2:   0          Delay W/Ex (0.01 sec units)
   3:   50         Delay After Ex (0.01 sec units)
   4:   0          mV Excitation

; Get WXT520 Values 7 - 9 (Ta= air temp, Ua= rel humidity, Pa= air pressure)

24:  SDI-12 Recorder (P105)
   1:   0          SDI-12 Address
   2:   2          Start Measurement (aM2!)      ; corresponds with Pressure Humidity and
   3:   2          Port                          Temp Message Command R2
   4:   21         Loc [ Value7    ]
   5:   1.0        Multiplier
   6:   0.0        Offset

25:  Excitation with Delay (P22)
   1:   1          Ex Channel
   2:   0          Delay W/Ex (0.01 sec units)
   3:   50         Delay After Ex (0.01 sec units)
   4:   0          mV Excitation

;                                   rain                            hail
; Get WXT520 Values 10 - 15 (Rc= amount, Rd= duration, Ri= intensity, Hc= amount, Hd= duration, Hi = intensity)

26:  SDI-12 Recorder (P105)
   1:   0          SDI-12 Address
   2:   3          Start Measurement (aM3!)      ; corresponds with Precip Message Command R3
   3:   2          Port
   4:   24         Loc [ Value10   ]
   5:   1.0        Multiplier
   6:   0.0        Offset
```

Appendix A. Configuring the WXT520

NOTE Modifying the default configuration of the WXT520 requires the purchase of a grey configuration cable; contact Campbell Scientific for more information.

1. Connect one end of the grey Configuration Cable to a COM port on the PC and the other end of the cable to the "Service" connector on the WXT520.

2. Connect a 9 V battery to the Configuration Cable's battery clip. The female contact of the battery clip is (+).

3. On your PC, run Vaisala's WXT Configuration Tool Software and go to the Connection Setup Screen.

4. Enter the settings for each of the Connection Setup Screen's parameters (see FIGURE A-1). The default settings are:
   - Connect using: enter the COM Port in which the Configuration Cable is connected.
   - Bits per second: 19200
   - Parity: 8-N-1

5. Click on the OK button.

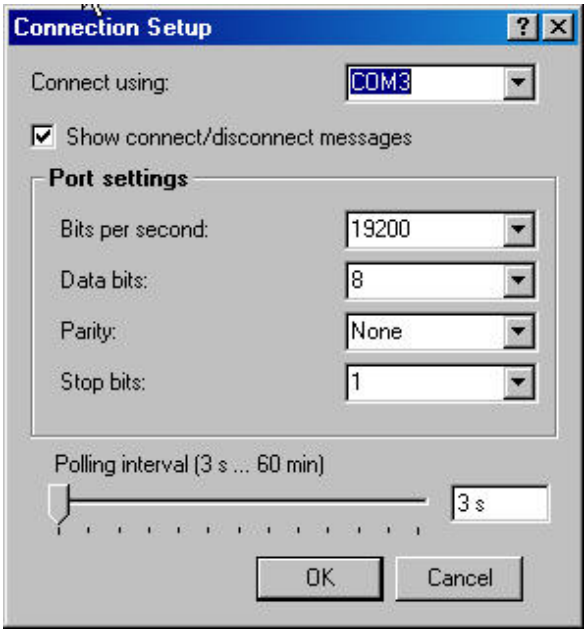

FIGURE A-1. Connection Setup screen

6. Go to the Device Settings Screen and enter the settings for each of the parameters (see FIGURE A-2). Default settings are:
    - Device—Address: 0
    - Heating and self diagnostic—verify Enable Heating is NOT selected.
    - Heating and self diagnostics—Update Interval: 15 s
    - Communication protocol—select SDI-12 v1.3
    - User port settings—Port type: SDI-12, select continuous measurements

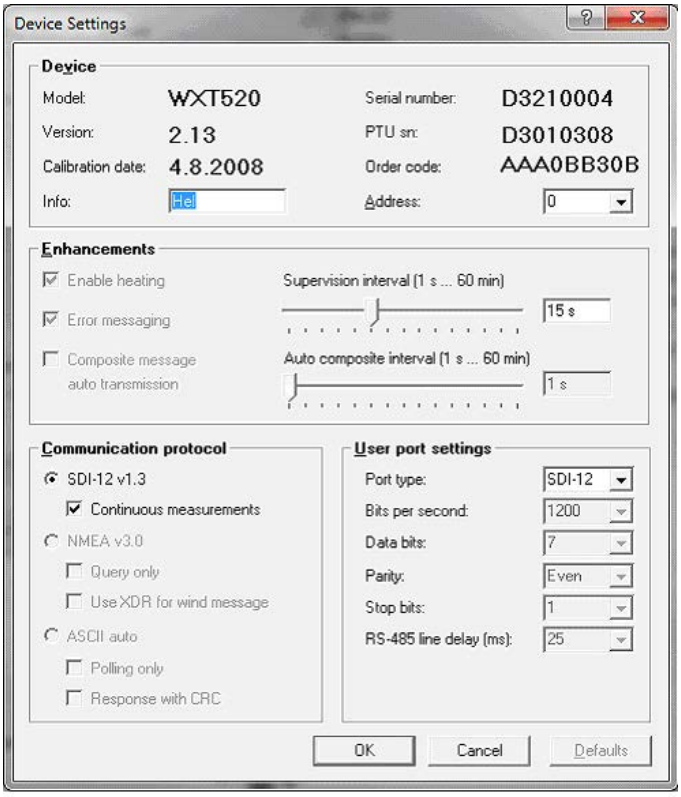

FIGURE A-2. Device Settings screen

7. Click on the OK button.

8. Go to the Sensor Settings Screen (see FIGURE A-3). The default Wind and PTU Update intervals are set to 5 s.

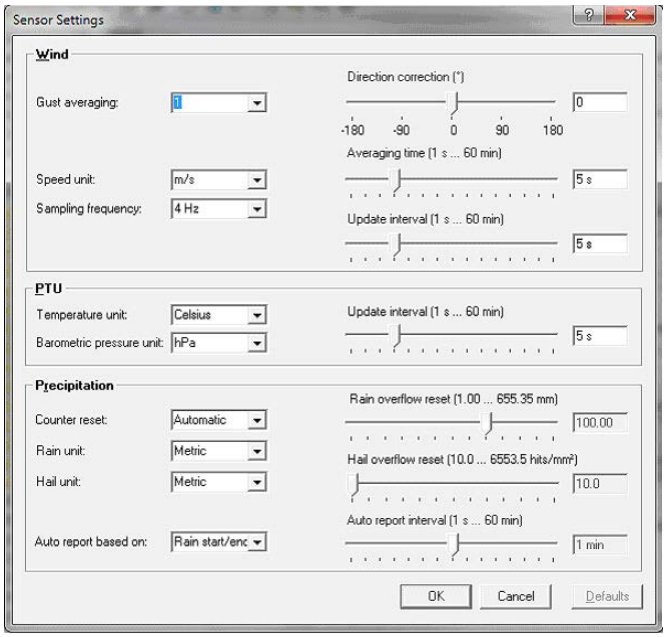

FIGURE A-3. Sensor Settings screen

9. Click on the OK button.

10. Go to the Message Settings Screen and verify that Message Settings are as desired. The default settings are shown in FIGURE A-4.

    Note: Hail accumulation should be checked.

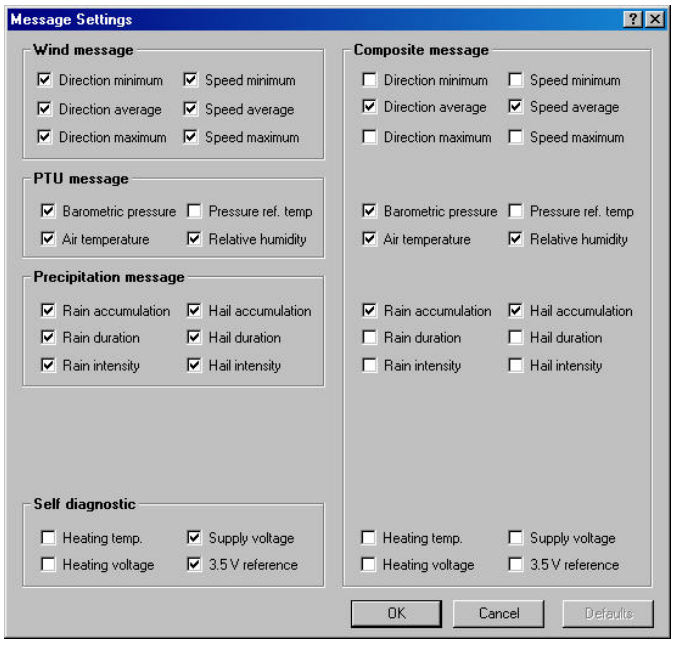

FIGURE A-4. Message Settings screen

11. Click on the OK button.
12. Close the WXT Configuration Tool.
13. Remove the 9 V battery.
14. Disconnect the Configuration Cable.
15. Secure protective service port cap on PTU.

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