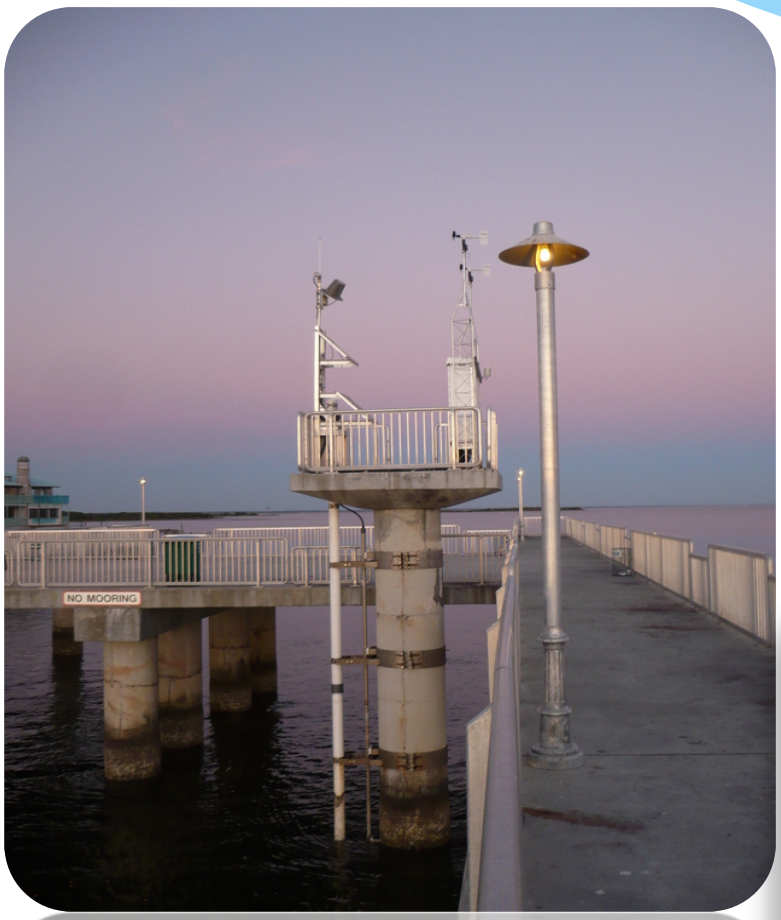
Aquatrak® Model 9002
Tide and Meteorological Station



Whether you want to measure your local tide and meteorological conditions, develop a regional or national network of stations or participate in a worldwide network of information, the Model 9002 Tide and Meteorological Station can be adapted to your specific requirements. These Tide and Automatic Weather Stations include sensors of the highest quality to ensure the data you receive is of the highest accuracy and reliability.

The Model 9002 measures the following:

- **Data Logger**
- **Tide Gauge (ocean level)**
- **Anemometer (direction, speed)**
- **Temperature (air and water)**
- **Humidity**
- **Barometric Pressure**
- **Rainfall**
- **Solar Radiation (Pyranometer)**
- **Water quality (temperature, conductivity, pH, water level)**

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Datalogger

The Model 9002 uses a measurement and control datalogger that is a powerful core component for your data-acquisition system. This data logger uses faster communications, low power requirements, built in USB, compact size, and improved analog input accuracy and resolution. This data logger also uses the universal (U) terminal—an ingenious way for allowing virtually any sensor (analog, digital, or smart) to be connected to any U terminal. This data logger also is capable of doing static vibrating-wire measurements.

Benefits and Features :

- Powerfully versatile, multi-tool of data acquisition
- U terminals configurable to what you want them to be: analog or digital, input, or output
- Surge ESD and over-voltage protection on all terminals
- Flexible power input from solar panel, dc power supply, 12 V battery, USB
- Onboard communication options include Ethernet , Wi-Fi, and spread spectrum radios
- Wiring made easy through removable terminal block
- MicroSD card drive for extended memory requirements
- Serial sensors support with RS-232 and RS-485 native

General Specifications:

***CPU**: 32 bit with hardware FPU, running at 100 MHz*
***Internal Memory**: 4 MB SRAM for data storage, 6 MB flash for OS, 1 MB serial flash (CPU) for program files*
***MicroSD Drive** for extended data storage up to 16 GB*
***Clock Accuracy**: ±3 min per year, optional GPS correction to 10 µs*
***USB micro B** for direct connection to PC (limited power source during configuration), 2.0 full speed, 12 Mbps*
***10/100 Ethernet RJ45** for LAN connection*
***Battery Terminal Pair** for regulated 12 V power input or rechargeable 12 V VRLA for UPS mode*
***Charge Terminal Pair** for 16 to 32 V from dc power converter or 12 or 24 V solar panel*
***Two Switched 12 V Terminals** for powering sensors or communication devices, 1100 mA @ 20°C Continuous 12 V Terminal*

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Datalogger

General Specifications:

***Twelve Universal (U) Terminals**: U terminals are software configurable for analog or digital functions*

Analog functions consist of:

Analog inputs: 12 single-ended or 6 differential with ±5000 mV, ±1000 mV, ±200 mV ranges 24 bit ADC
Analog outputs: ±2.5 V or ±2.5 mA ranges for bridge measurements 12 bit DAC
Static frequency-analyzed vibrating wire: terminal pair both excites to 12 V p-p and 100 Hz to 6.5 kHz and reads vibrating- wire transducers using our patented spectral-analysis technology (VSPECTTM)
Thermistor: completion resistor internal 5 kΩ
Period average: up to 200 kHz, amplitude dependent

Digital I/O functions consist of 5 V or 3.3 V logic levels for:

General status/control
Voltage source: 5 V, 3.3 V, 20 mA @ 3.5 V
Low level ac: up to 20 kHz, amplitude dependent
Switch closure (150 Hz) or high frequency counter (1 MHz)
Pulse width modulation
Interrupts and timer input
SDI-12 and SDM
Serial asynchronous communication Tx/Rx pairs

***Four Control (C) Terminals**: C terminals are software configurable for digital functions*

Digital I/O functions consist of 5 or 3.3 V logic levels for:

RS-232/RS-485: half or full duplex
General status/control
Voltage source 5 V, 3.3 V: 10 mA @ 3.5 V
Switch closure (150 Hz) or high frequency counter (1 MHz)
Pulse width modulation
Interrupts and timer input
SDI-12 and SDM
Serial asynchronous communication Tx/Rx pairs

***Best Analog Accuracy:** ±(0.04% of reading + 2 µV), 0° to 40°C*
***Best Effective Resolution**: 50 nV (±200 mV range, differential measurement, input reversal, 5 Hz fN1)*
***Operating Temperature Range**: -55° to +85°C*
***Weight**: 0.42 kg (0.92 lb)*
***Dimensions**: 20.3 x 10.2 x 6.1 cm (8.0 x 4.0 x 2.4 in)*

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Water Level

Technology

Unique patented means of ratio metric time comparisons of sequential sonic/pressure pulses, Environmentally protected within a small diameter ranging tube. Aquatrak instruments **reliably provide performance unequalled in the indus**try.

Accuracy

Self-calibrated measurement correction for ambient temperature, pressure, and gas density within the calibrated range(s); yields accuracy of better than ±3mm.

Reliability

Non-mechanical implementation with no bushings, bearings, gears, floats, or immersed active elements. Aquatrak sensors have a field-proven reliability record of better than 1,000,000 hours MTBF

Versatility

The all-digital water level Sensor with internal microcomputer relieves the host system of level measurement routines. RS-232 and SDI-12 interfaces make it compatible with commonly-used data loggers, computers, controllers, and modems.

Product Enhancements

The Aquatrak water level continues the tradition of accuracy and reliability of its predecessors. Added capabilities and features include:

- Repackaged as a single integrated unit. The controller is now in the sensor head.
- Reduced power consumption.
- Optional three external temperature probes.
- Concurrent Measurements.

Battery Powered, +12 VDC

The sensor is designed for continuous long-term unattended operation; it draws less than 9ma operating current and less than 7 ma quiescent.

Durability

The sensor and controller electronics are integrated into a single unit and are enclosed and sealed in a durable shock resistant PVC housing.

Economical

The lightweight sensor and range tube assembly is easily mounted at any angle from which the tube is immersed to the lowest significant level with minimal site preparation. Sensor to Data Collection Platform separation up to 1,000 feet can be accommodated.

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Water Level

A SMART INSTRUMENT

The Aquatrak water level Sensor calculates the true average level even in the presence of waves and surging liquid surfaces. The Sensor can be configured via its communication ports for virtually any site-unique conditions. The sample rates, number of samples averaged, and data requested are selectable. Continuous measurements or exclusive data sets without outlier bias are standard operating modes.

WAVES AND SEA STATE

The US NOS standard averaging algorithm is used to determine the standard deviation for each data set. This value may be used in post processing to determine the average wave height during the sample period.

General Specifications:

Measurement	
Dynamic Range	
Standard	*35 feet (10 meters)*
Optional	*50 feet (15 meters)*
Special	*75 feet (23 meters)*
Rate of Change	*±10 feet (±3 m/sec)*
Units	*English or Metric*
Resolution	*0.0033 feet (1 mm)*
Rate Proportionate	*1.2 – 2.4 per sec*
Sample Rate Averaged over 2 to 255 Samples	*1.0 per sec*
Interval	*Host Determined*
Electrical	
Input Voltage	*12.5 ±2 volts DC*
Operating Current	*9 ma*
Quiescent Current	*7 ma*
Environmental	
Operating Temperature	*-40 to +55 °C*
Storage Temperature	*-55 to +60 °C*
Humidity	*0to 100%*

Accuracy	
Calibration	
Standard	*±0.025%*
Optional	*±0.01%*
Nonlinearity	*±0.02%*
Precision Repeatability	*±0.01%*
Stability, Drift	*1 year 0*
Temperature Drift	*<1 ppm/°C*
ASCII Serial Communication	
Selectable Baud Rate (RS-232)	*300 to 9600*
Format	*Serial ASCII*
RS-232	*N-8-1*
SDI-12 (1200 Baud only)	*E-7-1*
Physical	
Sensor Assembly	
Diameter	*3.25 in (8.25 cm)*
Height	*9 in (22.8 cm)*
Weight	*2.5 lb (1.14 kg)*
Shipping Weight (1 Carton)	*5 lb (2.3 kg)*

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Anemometer

The Model 9002 uses the next generation 2D Ultrasonic Anemometer. The sensor offers high performance and low power consumption in a compact size. It is ideal for the most demanding wind sensing applications.

The sensor features durable, corrosion-resistant construction with sensitive ultrasonic transducers secured in a streamlined molded frame. The anemometer is fully wind tunnel tested and calibrated to provide accurate wind measurement over a wide operating range. The standard sensor includes many useful output options. Analog voltage outputs are provided for wind speed and wind direction. 4-20 mA current signals are available for each channel and are well suited for long cable runs or for industrial settings where noise immunity is important. A variety of serial output formats are also available. These include ASCII text, and NMEA formats. The sensor installs on readily available 1 inch (IPS) pipe. Wiring connections are made in a convenient weatherproof junction box; special mounting adapters, connectors and cables are not required.

General Specifications:

***Wind Speed**: 0 to 75 m/s (0 to 156 mph)*
Resolution: 0.01 m/s
Threshold: <0.01 m/s
Accuracy: ± 2% ± 0.1m/s (30 m/s), ± 3% (75 m/s)
Response Time: < 0.25 seconds

***Wind Direction**: 0 to 360 degrees*
Resolution: 0.1 degree
Threshold: < 0.01 m/s
Accuracy: ± 2 degrees
Response Time: < 0.25 seconds

***Serial Output**: RS-232 or RS-485*
Formats: ASCII, ASCII polled, RMYT, NMEA
Baud: 1200, 4800, 9600, 38400
Units: m/s, MPH, Knots, Km/hr
Wind Format: Speed & Direction or U & V
Status Indicator: Standard with ASCII & NMEA

***Analog Outputs**: 0–5000 mV or 4–20 mA*
Analog Wind Scale: 0–100 m/s
Analog Direction Scale: 0–360 or 0–540 degrees

***Output Update Rate**: 0.1 to 20 Hz*

***Power Requirement**:*
10 to 30 VDC, <20 mA typical

***Environmental**:*
Operating Temperature: -50 to +60 ° C
Protection Class: IP65

***Dimensions**: 29cm high x 11cm wide*
Weight: 0.4 kg (0.9 lb)
Shipping Weight: 1.0 kg (2.2 lb)

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Temperature & Humidity

Temperature and Humidity measurements for the Model 9002 consist of a State-of-the-art HYGROMER® HT-1 sensor that measures relative humidity and temperature, calculates dew point and offers outstanding accuracy, repeatability and excellent long-term stability. This sensor measures both humidity and temperature because temperature is critical to the proper measurement and interpretation of humidity. Problem-free, accurate measurement results from the most stable humidity sensor in the industry combined with our unique HygroClip® digital technology.

General Specifications:

PROBE TYPE	*Meteorological probe*
OPERATING RANGE	*-50…100 °C / 0…100 %rh*
ACCURACY W. ADJUSTMENT PROFILE "STANDARD"	*±0.8 %RH / ±0.1 K, at 10...30 °C* *Adjustment at 23 °C and 10, 35, 80 %RH*
ACCURACY W. ADJUSTMENT PROFILE "HIGH PRECISION"	*±0.5 %RH / ±0.1 K, at 10...30 °C* *at 23 °C and 10, 20, 30, 40, 50, 60, 70, 80, 90 %RH*
POWER SUPPLY / POWER CONSUMPTION	*3.3...5 VDC, Calibration @ 3.3 VDC / ~4.5 mA*
LONG-TERM STABILITY	*<1 %rh / year*
PROBE PROTECTION	*Polycarbonate plastic cage, white*
FILTER CARTRIDGE	*Polyethylene dust filter, white, 40 um*
FILTER TYPE	*Polyethylene, 40 µm*
RESPONSE TIME T 63	*<15 sec.*
ALLOWED WIND SPEED	*20 m/s, with filter*
PSYCHROMETRIC CALCULATIONS	*Dew or frost point*
REPRODUCIBILITY AIRCHIP	*<0.02 %rh / 0.01 K*
PROBE ADJUSTMENT BY SOFTWARE	*1 Point & multipoint %rh & °C*
DEVICE PROTECTION BY PASSWORD	*Yes*
TYPE OF OUTPUT SIGNALS	*2 x 0…1 VDC*
ANALOGUE OUTPUTS SCALEABLE BY THE USER	*Yes*
ANALOG OUTPUT SIGNAL (STANDARD)	*0…1 V = 0…100 %rh; 0…1 V = -40…60 °C*
DIGITAL OUTPUT SIGNAL (STANDARD)	*UART*
COMMUNICATION INTERFACES	*UART*
SERVICE INTERFACE	*UART*
REVERSE VOLTAGE PROTECTION	*Mechanically in the connector*
MAX. CABLE LENGTH	*Up to 5 m with passive cable. Up to 100 m with active cable.*
ENCLOSURE MATERIAL	*Polycarbonate*
FDA/GAMP COMPATIBILITY	*FDA 21 CFR Part 11 and GAMP compatible*
DIMENSIONS	*Ø15 x 108 mm*
WEIGHT	*10 g*

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Barometric Pressure

The Model 9002 utilizes a high accuracy and low power sensor that is accurate and very robust. The sensor includes a separate weatherproof enclosure to ensure long term accuracy and reliability.

General Specifications:

Pressure Range	*: 500 to 1100 hPa*
Operating Temperature	*: -40 to +60°C*
Digital Accuracy*	*: 0.2 hPa (25°C) 0.3 hPa (-40 to +60°C)*
Analog Accuracy	*: 0.05% of analog pressure range*
Analog Temperature Dependence	*: 0.0017% of analog pressure range/ °C (25°C reference)*
Long Term Stability	*: 0.2% FS per year*
Update Rate	*: 1.8 Hz max*
Serial Output	*: Full duplex RS-232 9600 baud Polled or continuous ASCII text, NMEA Half duplex RS-485 (61302L only)*
Analog Output	*: 0 to 5000 mV*
Resolution	*: Serial 0.01 hPa Analog 0.025% of analog scale*
Power	*: 7 to 30 VDC , Vout, 2.8 mA – Sleep mode, 1.4 µA*
Dimensions	*: 90 mm (3.6 in) x 60 mm (2.4 in) x 20 mm (0.8 in)*
Weight	*: 44 g (1.5 oz)*

** Defined as ±1 standard deviation from NIST traceable pressure reference. Includes non-linearity, hysteresis, repeatability, and calibration uncertainty.*

*** Defined as ±1 standard deviation from ideal analog output. Total analog output accuracy is the root sum square of digital accuracy, analog accuracy, and analog temperature dependence.*

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Rainfall

The Tipping Bucket Rain Gauge that is part of the Model 9002 is recognized as the world standard for measuring rainfall and precipitation in remote and unattended locations. Based on meteorological specifications from several countries, the gauge offer s an integrated syphon mechanism which delivers high levels of accuracy across a broad range of rainfall intensities. The gauge consists of a collector funnel with leaf filter with an outer enclosure complete with quick release fasteners with the base housing the tipping bucket mechanism. The unit includes a dual output 24V DC reed switch with varistor protection as well as dual rainfall discharge outlets for water collection and/or analysis.

Main Features:

- ❑ *World standard 200mm diameter catch*
- ❑ *Accuracy not affected by rainfall intensity*
- ❑ *Long term stable calibration*
- ❑ *Minimal maintenance required*
- ❑ *Used world-wide in a range of hostile environments*
- ❑ *Resolution The following resolutions are available:*
  - *0.1mm*
  - *0.2mm*
  - *0.5mm*
  - *1.0mm*
  - *0.01 Inch*
- ❑ *Accuracy*
  - *0-250mm per hour ; +/-2%*
  - *250-500mm per hour; +/-3%*
- ❑ *Range 700mm per hour.*
- ❑ *Enclosure Anodised and powder-coated aluminium*
- ❑ *Base Anodised and powder-coated aluminium*
- ❑ *Pivots Ground sapphire pivots with hard stainless steel shaft*
- ❑ *Bucket Material Available in painted brass OR chrome plated ABS*
- ❑ *Dimensions 330mm (H)*
- ❑ *Mass 3 kg.*
- ❑ *Operating Temperature Range -20°C to +70°C*
- ❑ *Humidity 0 -100%*

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Solar Radiation

The Model 9002 utilizes an upward-looking pyranometer that combines a blackbody thermopile detector and acrylic diffuser, and is a significant improvement when compared to the spectral response of silicon-cell pyranometers.

The patented domed shaped sensor head (diffuser and body) facilitate runoff of dew and rain to keep the sensor clean and minimize errors caused by dust blocking the radiation path. The sensor is housed in a rugged anodize aluminum body, and electronics are fully potted.

Calibration in controlled laboratory conditions is traceable to the World Radiometeric Reference in Davos, Switzerland. The upward-looking model is cosine-corrected, with directional errors less than 20 W m-2 at 80° solar zenith angle. Long-term non-stability determined from multiple replicate pyranometers in accelerated aging tests and field conditions is less than 2 % per year.

A 0.2 W heater keeps water (liquid and frozen) off the sensor and minimizes errors caused by dew, frost, rain, and snow blocking the radiation path.

General Specifications:

Sensitivity (variable from sensor to sensor, typical values listed) : *0.057 mV per Wm^{-2}*
Calibration Factor (reciprocal of sensitivity)(variable from sensor to sensor, typical values listed) : *17.5 Wm^{-2} per mV*
Calibration Uncertainty : *± 5 %*
Output Range : *0 to 114 mV & 0 to 300 Wm^{-2}*
Measurement Range : *0 to 2000 Wm^{-2} (net shortwave radiation)*
Measurement Repeatability : *Less than 1 %*
Long-term Drift : *Less than 2 % per year*
Non-linearity : *Less than 1 %*
Detector Response Time : *0.5 s*
Field of View : *180° & 150°*
Spectral Range (50 % points) : *385 nm to 2105 nm*
Directional (Cosine) Response : *Less than 30 Wm^{-2} at 80° solar zenith Less*
Temperature Response : *Less than 5 % from -15 to 45 C*
Zero Offset A : *Less than 5 Wm^{-2}; Less than 10 Wm^{-2} (heated)*
Zero Offset B : *Less than 5 Wm^{-2}*
Uncertainty with Daily Total : *Less than 5 %*
Operating Environment : *-50 to 50 C; 0 to 100 % relative humidity*
Heater : *780 Ω, 15.4 mA current drain and 185 mW power requirement at 12 V DC*
Dimensions : *28.7 mm height, 23.5 mm diameter*
Mass : *90 g & 100 g*
Cable : *5m of four conductor, shielded, twisted-pair wire; additional cable available in multiples of 5 m; santoprene rubber jacket (high water resistance, high UV stability, flexibility in cold conditions); pigtail lead wires*

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Water Quality

The Model 9002 includes a water quality sensor that measure water level, ensuring redundancy for the water level gauge above, water temperature, conductivity and pH. This sensor provides high levels of accuracy and reliability.

General Specifications:

- ***Level***
  Scale: 2 bar (relative pressure)
  Level: 0.000/20.000 m
  Resolution of data: 0.001 m
  Zero adjustment: 2.000 m | 0.000 m
  Sensitivity of sensor: 65.0/135.0 % | 100.0 %
- ***Temperature***
  Scale: -5.00/+55.00 °C
  Resolution: 0.01 °C
  Zero: ±2.00 °C | 0.00 °C
  Manual temperature: -5.00/55.00 °C | 20.00 °C
- ***Conductivity***
  Sensor: Cell K=1.00
  Scale: 6.000/60.000 mS | 6.000 mS
  Autoranging: On/Off | On
  Scale: 6.000 mS
  - *Resolution: 0.001 mS*
  - *Zero : ±0.600 mS | 0.000 mS*

  Scale: 60.000 mS
  - *Resolution: 0.001 mS*
  - *Zero: ±6.000 mS | 0.000 mS*

  Sensitivity: 60.0/160.0 % | 100.0 %
  ATC coefficient: 0.00/3.50 %/°C | 2.10 %/°C
  Temperature reference: 10/30 °C | 20 °C
  Calibration solution auto recognized:
  - 1.000mS/2.000mS/10.00mS/20.00mS
- ***pH***
  Scale pH: -2.000/16.000 pH
  Resolution: 0.001 pH
  Zero: ±2.000 pH | 0.000
  pH Sensitivity: 80.0/110.0 % | 100.0 %
  Buffer solution auto recognized:
  - *BDH 4.00 pH/7.00 pH/9.00 pH*
- ***General parameter***
  Filter Response time continuous acq. : 1"/60" | 10"
  ID number 0/32 | 0
  Serial interface
  - *Type: RS485 isolated*
  - *Connecting distance: 4000' (1300 m)*
  - *Probes in network: up to 16*
  - *Speed: 1200/2400/4800/9600/19200 baud | 2400 baud*
  - *Length: 8 bit*
  - *Bit of stop: 1*
  - *Parity: None*
  - *Supported protocols ASCII B&C Electronics protocol Modbus (RTU) protocol (Function 03)*
- ***Power***
  External
  Voltage: 9/14 Volt
  Current: 35/20 mA
- ***Material in contact with liquids***
  PVC Body
  O-Ring in NBR (Acrylat Nitrile)
  Sensors in PVC, stainless steel, glass, graphite
- ***Connecting cable***
  Type: SZ928
  External: polyurethane
  Internal tubing for pressure compensation: 1x2 mm
- ***Weight***
  Probe: 800 g appox Cable: 2000 g

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