2024

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MUNRO
INSTRUMENTS

WIND SPEED & DIRECTION

Regular measurement of wind speed and direction is an essential requirement of meteorological stations. This information is used for general forecasting and to make longer term weather predictions.

Elsewhere, knowledge of wind speed and direction is vital for airports, marine authorities, civil engineers, agriculturists, sport and outdoor event promoters and tour operators (among others).

As one of the earliest manufacturers of the Robinson Cup Anemometer (1870), Munro Instruments has maintained a special interest in the field of wind speed and direction. Our equipment is highly durable and provides an absolute assurance of accuracy

MU-IM150/IM147 IN-LINE **CUP ANEMOMETER & WIND DIRECTION VANE**

Product Description

The MU-IM147 is a dual in-line unit comprising an MU-IM124 Cup Anemometer & MU-IM145 Wind Direction Vane. It transmits wind speed and wind direction measurements to remote dial indicators and displays.
The MU-IM147 can be used with the following display modules:

- Up to 6 x MU-IM124A Wind Speed Dial Indicators
- Up to 6 x MU-IM125A Wind Direction Dial Indicators
- 150/DAS Digital Graphical Recorder
- A suitable data logger (4-20 mA output)

The sensor itself is extremely robust and has an expected lifetime of several decades It is particularly suited to coastal and cyclonic areas. The wind speed range is 0-180 knots.
It is a near-identical model to our acclaimed MU-IM146 and is used around the world by meteorological offices, airports, shipping terminals, offshore rigs, bridges etc.

Technical Specifications

Start Threshold	3±1 Knots
Speed Range	0-180 Knots
Speed Accuracy	Below 40 Knots ±1 Knot, Above 41 Knots ±2 Knots
Direction Range	0-360°
Direction Accuracy	±1°
Operating Temp.	-40°C to+ 100°C
Operating Humidity	98% non-condensing
Combined Height	840 mm
Fin Tip Axis	790 mm
Fixing	2 inches BSP internal
Weight	16.25kg

MU-IM124
CUP GENERATOR ANEMOMETER

Product Description

Requiring no external power source, the MU-IM124 Cup Anemometer generates an output signal that is directly proportional to the wind speed. Each MU-IM124 can drive up to six MU-IM124A Wind Speed Dial Indicators. It can also be used as part of a complete MU-IM147 system.
Constructed from non-ferrous materials resistant to corrosion in salt-laden and high humidity atmospheres

Technical Specifications

Start Threshold	3±1 Knots
Speed Range	0-180 Knots
Speed Accuracy	Below 40 Knots ±1 Knot, Above 41
Fixing	±2 Knots
Weight	4.2Kg

MU-IM145
WIND DIRECTION VANE ENCODER

Product Description

The MU-IM145 Wind Direction Vane is a sensitive, reliable unit of robust construction, which transmits wind direction measurements to a high degree of accuracy. It can drive up to six MU-IM125A Wind Direction Dial Indicators using an external AC supply. It can also be used as part of a complete MU-IM147 system.
Constructed from non-ferrous materials resistant to corrosion in salt-laden and high humidity atmospheres able to withstand a near-miss lighting strike

Technical Specifications

Start Threshold	3±1 Knots
Direction Range	0-360°
Direction Accuracy	±1°
Weight	12Kg

12102
3 CUP ANEMOMETER

Product Description

The 3-Cup Anemometer measure horizontal wind speed. This Wind Speed Instrument is sufficiently sensitive for detailed wind speed studies yet rugged enough to remain exposed for extended periods with minimum maintenance.
The 3-Cup Anemometer has light-weight hemispherical cups made from injection molded UV resistant polypropylene. The standard anemometer employs a DC tach-generator coupled to the cup wheel shaft. Cup wheel rotation produces a DC voltage which is directly proportional to wind speed.
The anemometer uses low torque stainless steel precision grade ball bearings for low starting threshold.
The 3-Cup Anemometer is supplied with a single mounting bracket which threads onto 3/4" standard pipe.
Electrical connections are made via a connector at the bottom of the instruments. A variety of devices are available for signal conditioning, display, and recording.

Initial Check-Out:
The instrument is fully calibrated & inspected before shipment, however when unpacked they should be examined for any signs of shipping damage and checked for proper operation before installation. Refer to the accompanying exploded view drawings to identify parts.
Remove the plastic nut from the cup wheel shaft and install the cup wheel. Replace the nut and thumb-tighten. The cup wheel should easily rotate with little friction.
Before installation connect the instrument to an indicator or translator and check for proper wind speed calibration. To check wind speed remove the cup wheel and drive the shaft with a calibration motor. Additional details appear in the CALIBRATION section of this manual.

Installation:
Proper instrument placement is very important. Eddies from trees, buildings, or other structures can greatly influence wind speed observations. To get meaningful data, locate the instrument well above or upwind from any obstructions. As a general rule, the flow around a structure is disturbed to twice the height of the structure upwind, six times the height downwind, and up to twice the height of the structure above ground. For some applications it may not be practical or necessary to meet these requirements. Install the instruments as follows:

- **Mount the instrument**
  - The 3-Cup Anemometer is supplied with a mounting bracket which threads onto a vertical, threaded 3/4" pipe.
- **Check anemometer**
  - Connect cable to 3-Cup Anemometer and monitor output.
  - Rotate anemometer shaft. Check output for activity and proper polarity.

12102

Technical Specifications

WIND SPEED	
Range	0 to 50 m/s (112 mph) Gust Survival to 60 m/s (134 mph)
Sensor	3 Cup Anemometer (100cm per revolution), 17cm Diameter Cup Wheel Assembly, 63mm Diameter Hemispherical Cups
Dynamic Response	2.3m (7.5 ft) cup wheel distance constant
Threshold Sensitivity	0.5 m/s (1.0 mph) tach-generator
Transducer Excitation Requirement	Anemometer generator is self-powered
Transducer Output	Analog DC voltage from tach-generator. 1800 rpm (2400 mV) = 28.6 m/s (63.9 mph)
GENERAL	
Operating Temperature	-50 to +50°C (-58 to +120°F)

03002-L

WIND SENTRY SET

Product Description

The 03002, measures wind speed and direction with a three-cup anemometer and a wind vane mounted on a small crossarm. It interfaces directly with your MUNRO data loggers, so no signal conditioning is required.

Benefits and Features:

- Compatible with most of our data loggers
- Designed for continuous, long-term, unattended operation in adverse conditions
- Small size, simplicity, & rugged construction provide a quality instrument for a modest price
- Ideal for wind profile studies
- Compatible with the LLAC4 4-channel Low-Level AC-Conversion Module, which increases the number of anemometers one data logger can measure
- Our version uses shielded bearings, which lowers the anemometer's starting threshold
- Compatible with the CWS900-series interfaces, allowing it to be used in a wireless sensor network.

Detailed Description:

The 03002 uses a cup wheel assembly to measure wind speed. Rotation of the cup wheel produces an ac sine wave that is directly proportional to wind speed. The frequency of the ac signal is measured by a data logger pulse count channel, then converted to engineering units (mph, m/s, knots). Our version uses shielded bearings, which lowers the anemometer's threshold. Wind direction is sensed by a potentiometer. With the precision excitation voltage from the data logger applied to the potentiometer element, the output signal is an analog voltage that is directly proportional to the azimuth angle of the wind direction.

03002-L

Technical Specifications

Applications	General (Rain with light snow. Little or no riming or blowing sand. No salt spray)
Sensor	3-cup anemometer and vane
Measurement Description	Wind speed and direction
Operating Temperature Range	-50° to +50°C (assuming non-riming conditions)
Height	32 cm (12.6 in.)
Crossarm Length	40 cm (15.7 in.) between instruments (center-to-center)
Mounting Diameter	34 mm (1.34 in.); mounts on standard 1-in. IPS pipe
WIND SPEED (ANEMOMETER)	
Range	0 to 50 m/s (0 to 112 mph)
Gust Survival	60 m/s (134 mph)
Sensor	12-cm diameter cup wheel assembly, 40-mm diameter hemispherical cups
Accuracy	±0.5 m/s (1.1 mph)
Turning Factor	75 cm (2.5 ft)
Distance Constant	2.3 m (7.5 ft) 63% recovery
Starting Threshold	0.5 m/s (1.1 mph)
Transducer	**Stationary coil (1300 ohm nominal resistance)**
Transducer Output	AC sine-wave signal induced by rotating magnet on cup wheel shaft 100mV peak-to-peak at 60 rpm (6 V peak-to-peak at 3600 rpm)
Output Frequency	1 cycle per cup wheel revolution (0.75 m/s per Hz)
Cup Wheel Diameter	12 cm (4.7 in.)
Weight	113 g (4 oz)
WIND DIRECTION (VANE)	
Mechanical Range	360°
Electrical Range	352° (8° open)
Settling Time	20 ms
Sensor	Balanced vane; 16 cm turning radius
Accuracy	±5°
Damping Ratio	0.2
Delay Distance	0.5 m (1.6 ft) 50% recovery
Starting Threshold	0.8 m/s (1.8 mph) with 10° displacement 1.8 m/s (4 mph) with 5° displacement
Transducer	Precision conductive plastic potentiometer (10 kohm resistance) 1.0% linearity Life expectancy is 50 million revolutions. Rated 1 W at 40°C, 0 W at 125°C.
Transducer Excitation	Requires regulated dc voltage. (15 Vdc maximum)
Transducer Output	Analog dc voltage proportional to wind direction angle with regulated excitation voltage supplied by the data logger
Vane Length	22 cm (8.7 in.)
Weight	170 g (6 oz)

WINDSONIC
WIND SPEED & DIRECTION SENSOR

Product Description

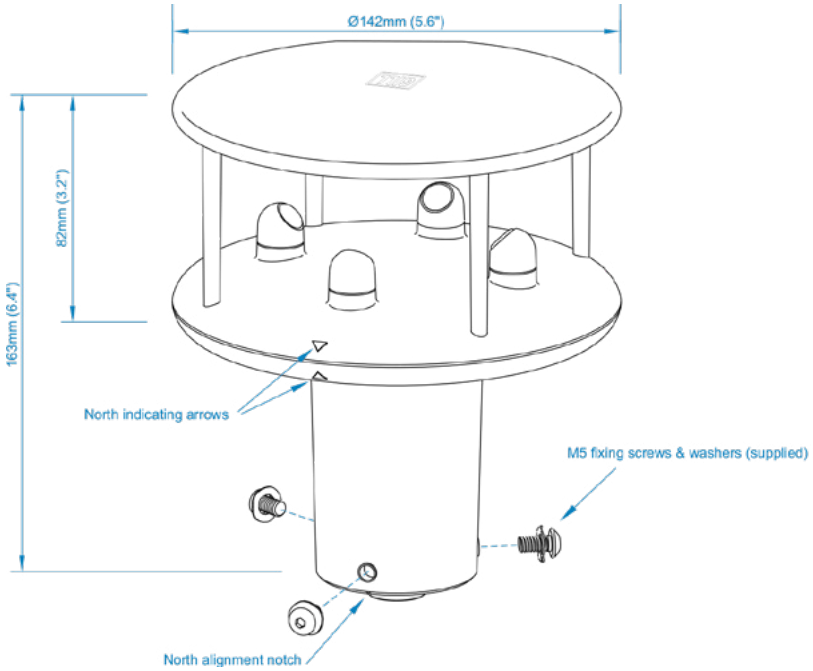
The MUNRO WindSonic is a low-cost anemometer, which utilises proven ultrasonic technology to provide wind speed & direction data via one serial or two analogue outputs.
To confirm correct operation, outputs are transmitted together with an instrument status code.
With a robust, corrosion-free polycarbonate housing, this small, lightweight wind sensor is recommended for use in harsh environmental conditions and is particularly suited to marine & offshore (ships, data buoys) & land based installations. The WindSonic has no moving parts, offering maintenance-free operation in a wide range of applications.

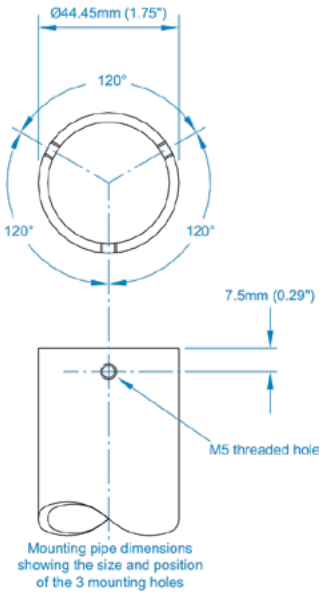
Features

- Wind Speed & Direction Sensor.
- 0-60m/s (116 knots) Wind Speed.
- 0-360º Wind Direction.
- NMEA output.
- Low Power consumption.
- Fast Start-up.
- Solid-state – maintenance-free.
- Corrosion Free.

Applications

- Remote weather monitoring stations.
- Building controls. • Data buoys. • Marine vessels.
- Small airports & helipads. • Road & rail tunnels
- Environmental field sites. • Ports & harbours.
- Mobile weather monitoring vehicles.
- Coastal weather monitoring stations.





Technical Specifications

WINDSONIC

WIND SPEED	
Range	0 - 60 m/s (116 knots)
Accuracy	±2% @12 m/s
Resolution	0.01 m/s (0.02 knots)
Response Time	0.25 seconds
Threshold	0.01 m/s
DIRECTION	
Range	0 - 360° (No dead band)
Accuracy	±2° @12 m/s
Resolution	1°
Response Time	0.25 seconds
MEASUREMENT	
Ultrasonic Output Rate	0.25, 0.5, 1, 2 or 4 Hz
Parameters	Wind Speed & Direction or U and V (vectors)
Units of Measure	m/s, knots, mph, kph, ft/min
OUTPUTS	
Option 1	RS232
Option 2	RS232 + RS422 + RS485*** + NMEA*
Option 3	RS232 + RS422 + RS485*** + NMEA* 0-5 V or, 0-20mA or 4-20mA
Option 4	SDI-12 (refer to manual or separate data-sheet for technical spec.)
Baud Rate	2400 to 38400
Anemometer Status	Supplied as part of standard message
POWER REQUIREMENT	
Anemometer	5-30 VDC Option 1 & 2 7-30 VDC Option 3 9-30 VDC Option 4
Current Drain	Dependent on option selected e.g. < 2mA @ 12V (SDI-12) to 44mA @ 12V (4-20mA) Refer to manual for further advice Start up time < 5 seconds
MECHANICAL	
External Construction	LURAN S KR 2861/1C ASA/PC
Size	142mm x 163mm
Weight	0.5kg
ENVIRONMENTAL	
Protection Class	IP66
Operating Temperature	-35°C to +70°C
Storage Temperature	-40°C to +80°C
Operating Humidity	< 5% to 100% RH
Precipitation	300mm/hr
EMC	EN 61326: 1998
OPERATIONAL	
MTBF	15 years
Warranty	2 years
Factory Calibration	Traceable to National Standards
ACCESSORIES	
Wind Software	Display / Logging**
Pipe Mounting (optional)	44.45mm (1.75 in) diameter
Cables (optional)	Available to match output options
Display (optional)	See MUNRO Display datasheet

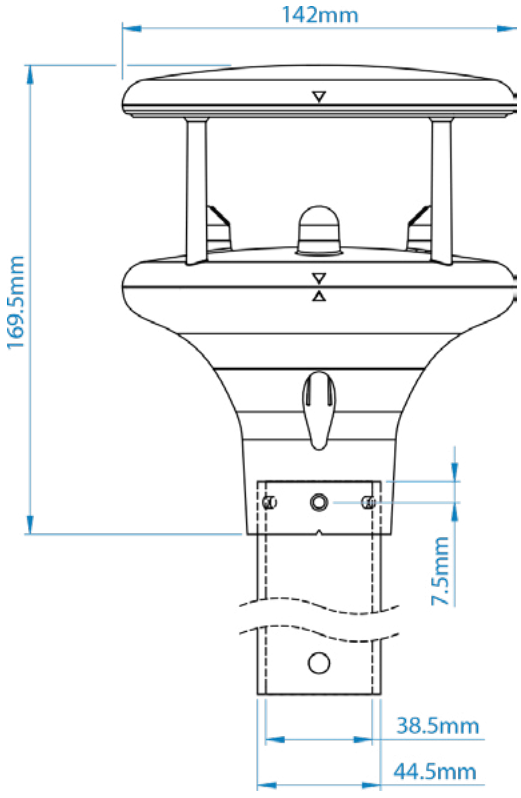
GMX200
WIND SPEED & DIRECTION SENSOR

Product Description

The MUNRO range of compact weather stations is designed and manufactured by MUNRO Instruments. MUNRO products use reliable, high quality instruments to provide accurate meteorological information in a wide variety of applications.

Features:

Wind speed and direction measurements are provided via an ultrasonic sensor and the addition of an electronic compass provides apparent wind measurements. Average speed and direction together with WMO averages and gust data is also provided. Add GPS (optional) to provide true wind and other features.



Wind:
- Wind speed & direction
- Apparent and true wind (with GPS)
- WMO wind averages and gust
- Compass
- GPS (optional) gives height above sea level, latitude and longitude.

GPS (Option):
- Height above sea level m
- MSL pressure
- Sunrise/sunset
- Position of the sun
- Twilight
- Solar Noon

Parameters:
- Wind speed m/s, km/hr, mph, kts, ft/min
- Wind direction
- True/apparent wind
- Angle of Tilt
- Outputs, RS232, 422, 485 (ASCII), SDI-12, NMEA, MODBUS, Analogue (option).

GMX200

All Models Feature:
- Quality Measurements
- Lightweight and Robust
- Low Power Mode
- Free of Charge Software
- Proven Reliability

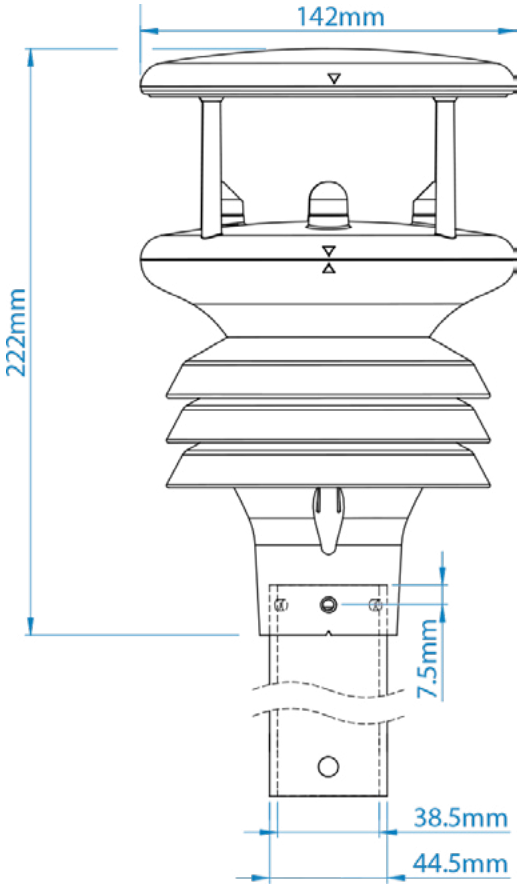
Application:
- Building and Industrial Controls
- Authorities
- Transport • Coastal.

Technical Specifications

WIND SPEED	
Range	0.01 m/s to 60 m/s
Accuracy	±3% to 40 m/s, ±5% to 60 m/s
Resolution	0.01 m/s
Starting Threshold	0.01 m/s
Sampling Rate	1Hz
Units	m/s, km/hr, mph, kts, ft/min
WIND DIRECTION	
Range	0 - 360°
Accuracy	±3% to 40 m/s, ±5% to 60 m/s
Resolution	1°
Starting Threshold	0.05 m/s
Sampling Rate	1 Hz
Units	Degrees
OUTPUTS	
Output rate	1 /s, 1 /min, 1 /hr
Digital Comms Modes	Serial RS232, RS422, NMEA, RS485, MODBUS, SDI-12, ASCII
Analogue Outputs	optional Available via device separate optional device
POWER	
Power Supply	5-30 VDC
Power(Nominal) 12VDC	25mA continuous high mode. 0.7 mA eco-power mode (1 hour polled)
ENVIRONMENTAL CONDITIONS	
Protection Class	IP66
Operating Temperature Range	-35°C to +70°C
EMC Standard	BS EN 61326-2-1:2013 FCC, CFR Title 47, Part 15, Subpart device B, Class A digital device
CE Marketing / RoHS compliant	YES
Weight	0.5Kg
Origin	UK

GMX500
COMPACT WEATHER STATION

The Munro range of compact weather stations is designed and manufactured by Munro Instruments. Munro products use reliable, high quality instruments to provide accurate meteorological information in a wide variety of applications.



Features:

Temperature, humidity, pressure. A combined instrument mounted inside three double louvered, naturally aspirated radiation shields with no moving parts. The results are high performance across each measurement over long periods of time.

Wind. Wind speed and direction measurements are provided via an ultrasonic sensor and the addition of an electronic compass provides apparent wind measurements. Average speed and direction together with WMO averages and gust data is also provided. Add GPS (optional) to provide true wind and other features.

Temperature, Humidity & Pressure:

- Air Pressure / Temperature
- Relative / Absolute humidity
- Naturally aspirated UV stable radiation shield
- Protection against wind-blown precipitation/dust.

Wind:

- Wind speed & direction
- Apparent and true wind (with GPS)
- WMO wind averages and gust
- Compass

GPS (Option):

- Height above sea level m
- Sunrise/sunset
- Position of the sun
- Twilight
- Solar Noon
- MSL pressure.

GMX500

Parameters:
- Temperature °C/°F/°K
- Relative humidity % RH
- Barometric pressure hPa, mbar, mm, Hg, In Hg
- Wet bulb temperature °C/°F/°K
- Absolute humidity g/m³
- Air density kg/m3
- Wind speed m/s, km/hr, mph, kts, ft/min
- Wind direction °
- Wind chill °C/°F/°K
- True/apparent wind
- Angle of Tilt
- Outputs, RS232, 422, 485 (ASCII), SDI-12, NMEA, MODBUS, Analogue (option).

All Models Feature:
- Quality Measurements
- Lightweight and Robust
- Low Power Mode
- Free of Charge Software
- Proven Reliability
- Compact Integrated Design
- Real Time Output
- Easy Installation
- Customer Support.

Application:
- Building and Industrial Controls
- Authorities • Transport
- Coastal • Agricultural
- Safety • Educational
- Commercial • Energy.

GMX500

Technical Specifications

WIND SPEED	
Range	0.01 m/s to 60 m/s
Accuracy	±3% to 40 m/s, ±5% to 60 m/s
Resolution	0.01 m/s
Starting Threshold	0.01 m/s
Sampling Rate	1Hz
Units	m/s, km/hr, mph, kts, ft/min
WIND DIRECTION	
Range	0 - 360°
Accuracy	±3% to 40 m/s, ±5% to 60 m/s
Resolution	1°
Starting Threshold	0.05 m/s
Sampling Rate	1 Hz
Units	Degrees
TEMPERATURE	
Range	-40°C to +70°C
Resolution	0.1
Accuracy	± 0.3°C @ 20°C
Sampling Rate	1 Hz
Units	°C, °F, °K
HUMIDITY	
Range	0-100%
Resolution	1%
Accuracy	± 2% @ 20°C (10%-90% RH)
Sampling Rate	1 Hz
Units	% Rh, g/m³
DEW POINT	
Range	-40°C to +70°C
Resolution	0.1
Accuracy	± 0.3°C @ 20°C
Units	°C, °F, °K
Sampling Rate	1 Hz
PRESSURE	
Range	300 to 1100 hPa
Resolution	0.1 hPa
Accuracy	± 0.5 hPa @ 25°C
Sampling Rate	1 Hz
Units	hPa, mbar, mmHg, inHg
OUTPUTS	
Output rate	1 /s, 1 /min, 1 /hr
Digital Comms Modes	Serial RS232, RS422, NMEA, RS485, MODBUS, SDI-12, ASCII
Analogue Outputs	Available via separate optional device
POWER	
Power Supply	5-30 VDC
Power(Nominal) 12VDC	25mA continuous high mode. 0.7 mA eco-power mode (1 hour polled)
ENVIRONMENTAL CONDITIONS	
IP Rating	IP66
Operating Temperature Range	-35°C to +70°C
EMC Standard	BS EN 61326-2-1:2013 FCC, CFR Title 47, Part 15, Subpart device B, Class A digital device
CE Marketing	YES
RoHS compliant	YES
Weight	0.7Kg
Origin	UK

ATMOS-22
ULTRASONIC WIND SPEED & DIRECTION SENSOR

Product Description

When it comes to measuring wind, trade-offs have always been involved. Cup anemometers cannot measure both wind speed and wind direction (or low wind speeds, for that matter). They are also prone to malfunction since they all contain moving parts. Meanwhile, sonic anemometers have always been too costly. Until now.

The best of both worlds:

The wind-tunnel-tested ATMOS-22 ultrasonic anemometer delivers the best of both worlds. It's accurate at any wind speed because there aren't any moving parts that cause friction or fail. And it's inexpensive, especially when you consider the low-energy design. Accuracy. Dependability. Affordability. You get all three with the ATMOS-22.

Accuracy that will blow you away:

If you want accurate wind profiling, a sonic anemometer is the obvious choice. Designed with canopies in mind, the ATMOS-22 registers even the lowest thresholds of wind speed (0 m/s) with the added ability to detect fine-scale variations within 0.01 m/s resolution. We even installed spikes on flat surfaces to dissipate raindrop energy so transducer signals don't get obstructed. Contrast the ATMOS-22's advanced technology to a cup or propeller wind anemometer. Neither will spin if wind speed is too low. Cup anemometers also do not indicate wind direction, unless you combine them with a wind vane. And both are prone to additional inaccuracies due to worn out moving parts. But with the ATMOS-22, you can accurately measure wind speed anywhere, every time, with total confidence.

ATMOS-22

Technical Specifications

HORIZONTAL WIND SPEED / WIND GUST	
Range	0-30 m/s
Resolution	0.01 m/s
Accuracy	The greater of 0.3 m/s or 3% of measurement
WIND DIRECTION	
Range	0 - 359°
Resolution	1°
Accuracy	NA
Dimensions	10 cm diameter × 16 cm height
Cable length	5 m (custom lengths are available for an additional cost)
Supply voltage (VCC) to GND	Minimum 3.6 VDC Maximum 15.0 VDC
Current drain (during measurement)	Minimum 0.050 mA Typical 0.125 mA Maximum 0.500 mA
Measurement duration	Typical 110 ms Maximum 3,000 ms
Compliance	Manufactured under ISO 9001:2015 EM ISO/IEC 17050:2010 (CE Mark)

81000RE

3-AXIS ULTRASONIC WIND SPEED & DIRECTION

Product Description

The MUNRO Model 81000RE Ultrasonic Anemometer is a 3-axls, no-movingparts wind sensor. It is perfectly suited for applications requiring fast response, high resolution and threedimensional wind measurement.

The sensor features durable corrosion resistant ronstruction with 3 opposing pairs of ultrasonic transducers supported by stainless steel members. The transducers are arranged so that measurements are made through a common volume, A fast1 160 Hz internal sampling raite ensites superior measurement resolution. Output rates from 4 to 32 Hz may be selected. Each 81000RE is individually wind, tunnel tested and calibrated to compensate for wind shadow effects of the support structure.

Model 81000 features four voltage output channels. Serial RS-232 and RS-485 outputs are available as well. For applications requiring synchronized aria. log measurements, Model 81000V includes four voltage input channels fnstead of voltage outputs. Wind, sonic temperature & voltage input data are transmitted serially. For each model, a variety of preset or custom output format options may be select.ed by ltle user. Both models install on standard 1 inch pipe. Wiring connections are housed in a convenient weatherproof junction box.

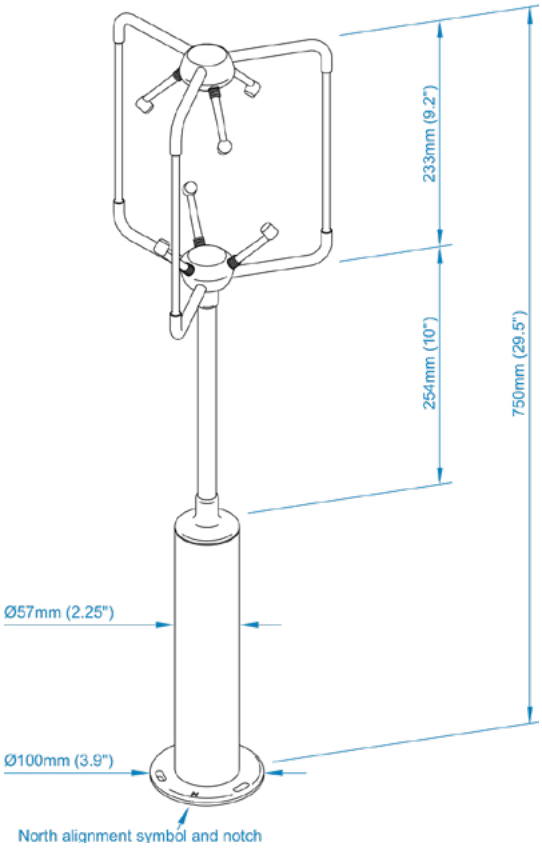
Technical Specifications

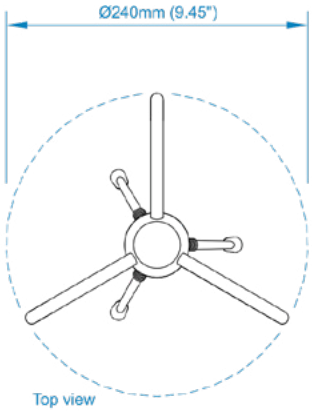
WIND SPEED	
Range	0 to 40 m/s (0 to 90 mph)
Resolution / Threshold:	0.01 m/s
Accuracy	±1% ± 0.05 m/s (0 to 30 m/s) ± 3% (30 to 40 m/s)
WIND DIRECTION	
Range	O to 360°
Elevation Range	± 60°
Resolution	0.1°
Accuracy	± 2° (1 to 30 m/s) ± 5° (30 to 40 m/s)
SPEED OF SOUND	
Range	300 to 360 m/s
Resolution	0.01 m/s
Accuracy	± 0.1% ± 0.05 m/s (0 to 30 m/s)
SONIC TEMPERATURE	
Range	-50 to +50
Resolution	0.01 m/s
Accuracy	± 2°C (0 to 30 m/s)
Serial Output	RS-232 or RS-485 1200 to 38400 baud 4 to 32 Hz (user-Selected) User Programable ASCll output configuration (select from U, V, W, Speed sound, Sonic temperature, 2D speed. 3D speed, Azimuth, Elevation) Units: m/s, cm/s, mph, knots, km/h
Analog Voltage, Outputs	4 voltage outputs, 0 to 5000 mV (select from U, V, W, Sonic temperature or Speed, Azimuth, Elevation, Sonic temperature)

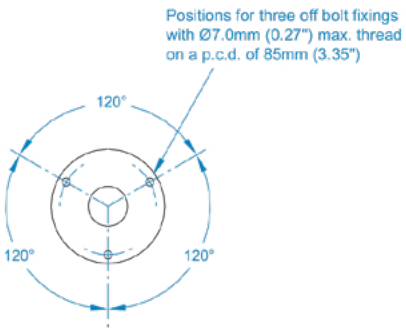
WINDMASTER
3-AXIS UITRASONIC WIND SPEED & DIRECTION

Product Description

The MUNRO WindMaster is a precision anemometer offering three-axis wind measurement data.
This instrument will monitor wind speeds of 0-50m/s and provides sonic temperature, speed of sound and U, V & W vector outputs at 20Hz (32Hz optional). This anemometer is of aluminium/carbon fibre construction & is ideal for the understanding of turbulent flows, surface energy balance and scalar fluxes. Each WindMaster can be calibrated with an optional MUNRO wind tunnel test to provide optimum performance.
This 3D sonic anemometer is ideally suited to the measurement of air turbulence around bridges, buildings, wind turbine sites, building ventilation control systems, meteorological & flux measurement sites.







WINDMASTER

Pipe Mount 34mm diameter option with Terminal Strip junction Box.

Features:

- Precision 3-axis sonic anemometer
- 20Hz output rate
- 0-50m/s wind speed
- 0-359° wind direction
- U, V, W vector outputs
- Sonic temperature output
- Aluminium/Carbon fibre construction
- Optional custom calibration.

Typical Applications:

• Power Lines • Bridges • Viaducts • Building ventilation control systems • Measurement Masts • Skyscrapers • Wind Turbine Test Sites • Meteorological & Flux measurement sites.

Technical Specifications

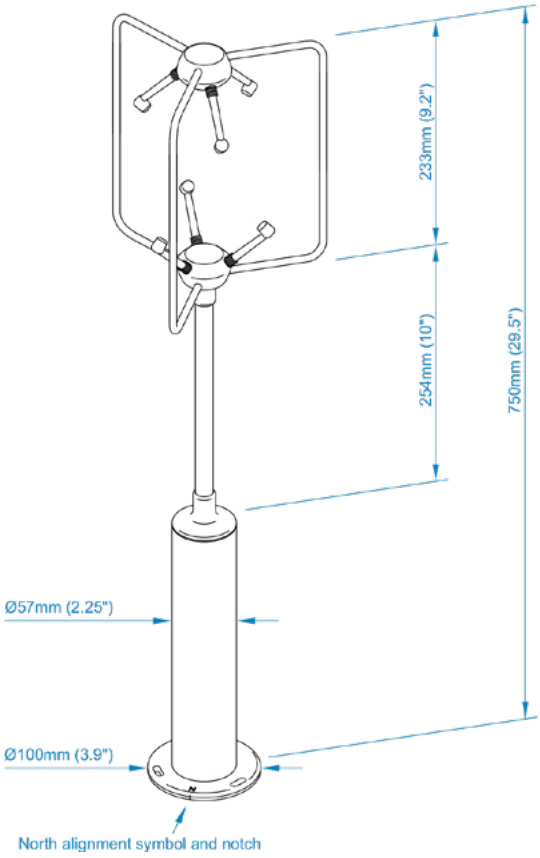
WIND SPEED	
Range	0-50 m/s
Resolution	0.01 m/s
Accuracy	<1.5% RMS @12 m/s <1% RMS @12 m/s (Custom)
WIND DIRECTION	
Range	0 - 359°
Resolution	0.1°
Accuracy	2° @12 m/s 0.5° @12 m/s (Custom)
SONIC TEMPERATURE	
Range	-40°C to +70°C
Resolution	0.01°C
Accuracy	-20°C to +30°C within ±2°C of ambient temperature
SPEED OF SOUND	
Range	300-370 m/s
Resolution	0.01 m/s
Accuracy	< ±0.5% @ 20°C
MEASUREMENT	
Internal sample rate	20 Hz or 32 Hz
Output Parameters	1, 2, 4, 8, 10, 16, 20 & 32 (Option) Hz
Units of Measure	m/s, mph, kph, knots, ft/min
Formats	UVW or Polar
DIGITAL OUTPUT	
Communication	RS232, 422, 485, Binary
Baud Rates	2400 - 57600
Format	ASCII
ANALOGUE OUTPUTS - OPTIONAL	
Resolution 12 bits or 14 bits	4 channels available
Selectable Range	User selectable full scale wind speed
Output type	0-20mA, 4-20mA, 0-5 V, ±2.5 V, ±5 V
ANALOGUE INPUTS - OPTIONAL	
Resolution 12 bits or 14 bits	Up to 4 single ended or 2 differential
Input Type	±5 V
POWER REQUIREMENT	
Anemometer	9-30 VDC (55mA @ 12 VDC)
MECHANICAL	
Weight / Size	1.0kg / 750mm x 240mm

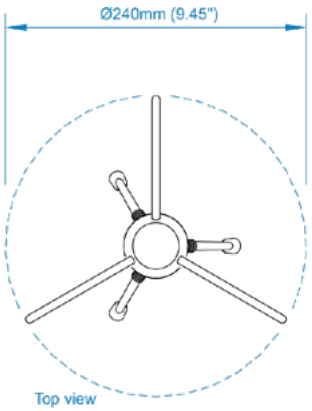
WINDMASTER-PRO
3-AXIS UITRASONIC WIND SPEED & DIRECTION

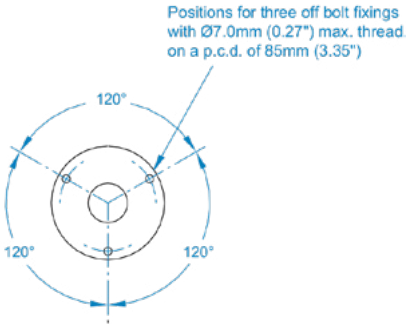
Product Description

The MUNRO WindMaster Pro is a precision anemometer offering three-axis wind measurement data. This instrument will monitor wind speeds of 0-65m/s and provides sonic temperature, speed of sound and U, V & W vector outputs at 32Hz as standard. The unit also features improved vertical (W) resolution and speed of sound accuracy and less distortion due to wind loading. Each WindMaster Pro can be calibrated with an optional MUNRO wind tunnel test to provide optimum performance. Optional analogue inputs and outputs plus a PRT are available with 14 bit resolution.

This anemometer is of stainless steel external construction & is particularly suitable for precision wind measurement applications requiring 3-axis data involving high wind speeds.







WINDMASTER-PRO

Key Features:

- Precision 3-axis sonic anemometer
- 32Hz output rate
- 0-65m/s wind speed
- 0-360° wind direction
- U, V, W vector outputs
- Sonic temperature output
- Stainless steel construction
- Optional custom calibration.

Typical Applications:

- Meteorological Systems
- Flux Systems
- Structural Safety
- Wind Profiling
- Marine Research
- Wind Turbine Site Survey.

Technical Specifications

WIND SPEED	
Range	0-65 m/s
Resolution	0.01 m/s
Accuracy	<1.5% RMS @12 m/s <1% RMS @12 m/s (Custom)
WIND DIRECTION	
Range	0 - 360°
Resolution	0.1°
Accuracy	2° @12 m/s 0.5° @12 m/s (Custom)
SONIC TEMPERATURE	
Range	-40°C to +70°C
Resolution	0.01°C
Accuracy	-20°C to +30°C within ±2°C of ambient temperature
SPEED OF SOUND	
Range	300-370 m/s
Resolution	0.01 m/s
Accuracy	< ±0.5% @ 20°C
MEASUREMENT	
Internal sample rate	32 Hz
Output Parameters	1, 2, 4, 8, 10, 16, 20 & 32 Hz
Units of Measure	m/s, mph, kph, knots, ft/min
Formats	UVW or Polar
DIGITAL OUTPUT	
Communication	RS232, 422, 485, Binary
Baud Rates	2400 - 57600
Format	ASCII
ANALOGUE OUTPUTS - OPTIONAL	
Resolution 14 bits	4 channels available
Selectable Range	User selectable full scale wind speed
Output type	0-20mA, 4-20mA, 0-5 V, ±2.5 V, ±5 V
ANALOGUE INPUTS - OPTIONAL	
Resolution 14 bits	Up to 4 single ended or 2 differential plus PRT 100 input
Input Type	±5 V
POWER REQUIREMENT	
Anemometer	9-30 VDC (55mA @ 12 VDC)
MECHANICAL	
Weight / Size	1.7kg / 750mm x 240mm
ENVIRONMENTAL	
Protection Class	IP65
Operating Temp. / Humidity	-40°C to +70°C / < 5% to 100% RH

05103
HIGH PERFORMANCE WIND SENSOR

The Wind Monitor is a high performance, rugged wind sensor. Its simplicity and corrosion-resistant construction make it ideal for a wide range of wind measuring applications.

The MUNRO Model 05103 Wind Monitor measures horizontal wind speed and direction. Originally developed for ocean data buoy use it is rugged and corrosion resistant, yet accurate and light weight. A four-blade helicoid propeller, used to measure wind speed, generates an AC sine wave signal upon rotation. Wind direction is determined by a vane attached to a precision potentiometer inside an internal housing. UV stabilized plastic with stainless steel and anodized aluminum parts are used in the construction of the sensor. Precision grade stainless steel ball bearings with light contacting Teflon seals and a wide temperature grease are used to help exclude contamination. The sensor mounts on a standard 1-inch IPS pipe. A mounting orientation ring is included that engages with the base of the sensor to retain orientation when the sensor is removed for maintenance. Terminations are made in a junction box at the base of the sensor by small clamp-style connectors (no special connectors are required).

The Wind Monitor is also available with 0-5 VDC outputs, Model 05103V, or 4-20 mA outputs, Model 05103L (both models scaled for 0-100 m/s and 0-360°). The 05103L is recommended for use in high noise areas or for installations with long cables, typically 300 meters (1,000 feet) or more, up to several kilometers.

Options:

- 05106 - Marine Wind Monitor
- 05108 - Heavy Duty Wind Monitor
- 05108-45 - Heavy Duty Wind Monitor Alpine
- 05305 - AQ Wind Monitor
- 05501LM - Intrinsically Safe Wind Monitor.

05103

Technical Specifications

Range	Wind speed: 0-100 m/s (224 mph) Azimuth: 360° mechanical, 355° electrical (5° open)
Accuracy	Wind speed: ± 0.3 m/s (0.6 mph) or 1% of reading Wind direction: ± 3°
Threshold*	Propeller: 1.0 m/s (2.2 mph) Vane: 1.1 m/s (2.4 mph)
Dynamic Response*	Propeller distance constant (63% recovery): 2.7 m (8.9 ft) Vane delay distance (50% recovery): 1.3 m (4.3 ft) Damping ratio: 0.3 Damped natural wavelength: 7.4 m (24.3 ft) Undamped natural wavelength: 7.2 m (23.6 ft)
Signal Output	Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 8.8 m/s (19.7 mph) Wind direction: DC voltage from conductive plastic potentiometer – resistance 10K Ω, linearity 0.25%, life expectancy – 50 million revolutions
Power Requirement	Potentiometer excitation: 15 VDC maximum
Operating Temperature	-50 to 50°C
Dimensions	Overall height: 37 cm (14.6 in) Overall length: 55 cm (21.7 in) Propeller: 18 cm (7 in) diameter Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)
Weight	1.0 kg (2.2 lbs)
Shipping weight	2.3 kg (5 lbs)
Model 05103V	Signal outputs: 0-5.00 VDC full scale Power requirement: 8-24 VDC (5 mA @ 12 VDC)
Model 05103L	Signal outputs: 4-20 mA full scale Power requirement: 8-30 VDC (40 mA max.)

*** Nominal values, determined in accordance with ASTM standard procedures.**

CM115
15 FT S.S. TRIPOD WITH GROUNDING AND GUY KIT

Strong, Tilting Mast

The CM115 is a 15-foot instrumentation tripod that supports the attachment of sensors, mounts, solar panels, and environmental enclosures. Constructed from stainless steel, the CM115 is easier to transport to remote locations. The tripod can be deployed in uneven terrain and at varying heights. To facilitate sensor attachment, the tripod mast pivots at the leg junction.

Benefits and Features:

- Strong and lightweight
- Most joints are locked with pins that are simple to insert and remove
- Individually-adjustable legs allow installation over uneven terrain
- Includes grounding kit.

Detailed Description:

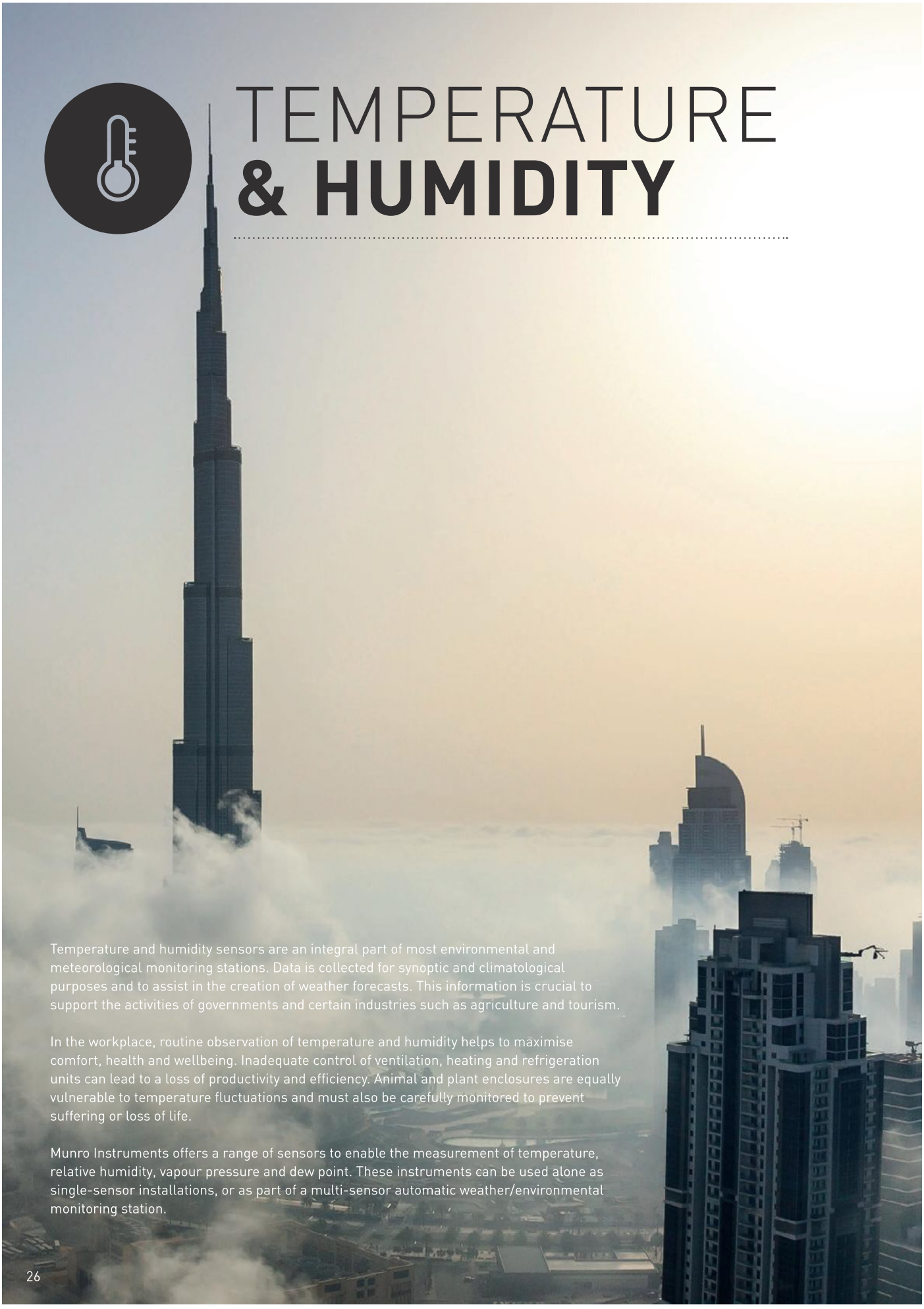
The CM115 is used as a portable instrument mount in a variety of applications. For meteorological applications, tripods augmented with mounts support the attachment of sensors such as wind sets, pyranometers, and temperature/relative humidity probes. Barometers, soil temperature and moisture probes, and rain gages are also used with tripod-based weather stations. For non-meteorological applications, tripods can provide a portable instrument mount for enclosures and a mounting point for antennas. UV-resistant cable ties, grounding kit, and six spikes for the tripod feet are included with the CM115. Two duckbill anchor kits are offered for securing the guy wires (see Ordering Information). Duckbill anchors are not required to use the guy-wire kits. Without them, the guy wires are run from the mast to the feet of the tripod. Duckbill anchors are recommended for areas subjected to higher winds. They allow the guy wires to be anchored at points beyond the feet, thereby increasing the rating of the tripod for higher winds.

CM115

Technical Specifications

Material	304 stainless steel
Vertical Load Limit	45 kg (100 lb)
Mast Sections	2
Base Diameter	2 m (7 ft) with legs extended
Insert Outer Diameter	4.45 cm (1.75 in.)
Height	4.5 m (15.2 ft) with mast insert
Dimensions	15 x 15 x 145 cm (6 x 6 x 57 in.) of collapsed tripod
Shipping Weight	18 kg (40 lb)
MAST	
Outer Diameter	4.8 cm (1.9 in.)
Pipe Size	3.81 cm (1.5 in.) IPS
Length	• 2.8 m (9.3 ft) without insert • 4.1 m (13.3 ft) with insert
WIND LOAD RECOMMENDATION	
Note	This recommendation assumes the guy wire anchors are able to hold at least 1.8 kN (400 lbf)
Sustained Wind	• 90.52 kph (56.25 mph) guyed at feet • 120.7 kph (75 mph) guyed at 60°
Gust Tolerance	• 114.7 kph (71.25 mph) guyed at feet • 152.9 kph (95 mph) guyed at 60°
TOTE BAG	
Diameter	20 cm (8 in.)
Length	152 cm (60 in.)

TEMPERATURE & HUMIDITY



Temperature and humidity sensors are an integral part of most environmental and meteorological monitoring stations. Data is collected for synoptic and climatological purposes and to assist in the creation of weather forecasts. This information is crucial to support the activities of governments and certain industries such as agriculture and tourism.

In the workplace, routine observation of temperature and humidity helps to maximise comfort, health and wellbeing. Inadequate control of ventilation, heating and refrigeration units can lead to a loss of productivity and efficiency. Animal and plant enclosures are equally vulnerable to temperature fluctuations and must also be carefully monitored to prevent suffering or loss of life.

Munro Instruments offers a range of sensors to enable the measurement of temperature, relative humidity, vapour pressure and dew point. These instruments can be used alone as single-sensor installations, or as part of a multi-sensor automatic weather/environmental monitoring station.

HygroVUE5
DIGITAL TEMPERATURE & RELATIVE HUMIDITY SENSOR

Benefits and Features:

- Uses a combined, pre-calibrated digital humidity & temperature element
- Field-changeable element for fast, on-site recalibration
- Digital SDI-12 output, allowing long cables with no added errors
- Simple data logger programming
- Low power consumption
- Wide operating voltage
- Rugged design with potted electronics
- Compact size for smaller radiation shields.

Product Description

The HygroVUE5 Temperature and Relative Humidity Sensor is designed for general meteorological and environmental monitoring applications. It utilizes the SDI-12 communications protocol to communicate with any SDI-12 recorder, simplifying installation and programming. The sensing element is easily changed in the field, reducing downtime and calibration costs. It is the entry-level sensor in the HygroVUE line of relative humidity and temperature sensors.

Technical Specifications

Sensor Element	SHT35 derivative (specially coated for reliability)
Calibration Traceability	NIST and NPL standards
Supply Voltage	7 to 28 Vdc
Warm-up Time	Sensor is normally powered all the time. If power is switched off, allow 1.8 s for sensor to power up.
Main Housing Material	White PET-P
Housing Classification	IP67 (electronics housing)
Sensor Protection	Outer glass-filled polypropylene cap fitted with a stainless-steel mesh dust filter with nominal pore size of < 30 µm. The sensor element is fitted with a PTFE protective film with a filtration efficiency of > 99.99% for particles of 200 nm or larger size.
EMC Compliance	Tested and conforms to IEC61326:2013
Calibration	The sensor element is individually calibrated during manufacture.
Diameter	12.5mm (0.49 in) at sensor tip, max. 16mm (0.63 in) at the cable end
Length	115 mm (4.52 in) sensor only, without cable
MAXIMUM CURRENT DRAIN	
Quiescent	50 µA typical
During Measurement	0.6 mA (takes 0.5 s) typical
TEMPERATURE MEASUREMENT	
Operating Range	-40 to +70°C
Accuracy	±0.4°C(over the range -40 to +70°C) ±0.3°C(over the range -20 to +60°C)
Long-Term Drift	< ±0.03°C per year
Reported Resolution	0.001°C
Repeatability	0.04°C Values are 3 standard deviations of 25 measurements at constant temp.
Response Time	130 s (63% response time in air moving at 1 m/s)

HygroVUE10
DIGITAL TEMP. & RELATIVE HUMIDITY SENSOR WITH M12 CONNECTOR

Product Description

The HygroVUE10 offers a combined temp. and relative humidity element in an advanced digital sensor that is ideal for weather networks. The electronics within the sensor provide accurate measurements, & the sensor is easy to use. The digital SDI-12 output allows a simple connection and measurement by many data logging systems. Another benefit is that this digital output avoids the extra errors associated with measuring analog sensors. A hydrophobic sintered filter prevents dirt and water from entering the cap. The filter is designed to be resistant to wind-driven rain. A secondary PTFE membrane filter is bonded to the surface of the sensor element to prevent finer dust & mold from directly influencing the measurements. Because the sensor housing is designed to withstand permanent exposure to various weather conditions and to fit inside a range of radiation shields (including compact shields), the HygroVUE10 is truly suitable for a wide range of monitoring applications. The HygroVUE10 utilizes a latest-generation, Swiss-made, combined relative humidity and temperature element based on CMOSens technology that offers good measurements, accuracy, and stability. Each element of the HygroVUE10 is individually calibrated with the calibration corrections stored on the chip. You can easily change the sensor element in the field, which reduces your downtime and calibration costs.

Benefits and Features:

- Uses a combined, pre-calibrated digital humidity and temperature element
- Field-changeable element for fast, on-site recalibration
- Digital SDI-12 output, allowing long cables with no added errors
- Simple data logger programming
- Low power consumption
- Wide operating voltage
- Rugged design with potted electronics Standard
- M12 connector with IP67 sealing rating.

HygroVUE10

Technical Specifications

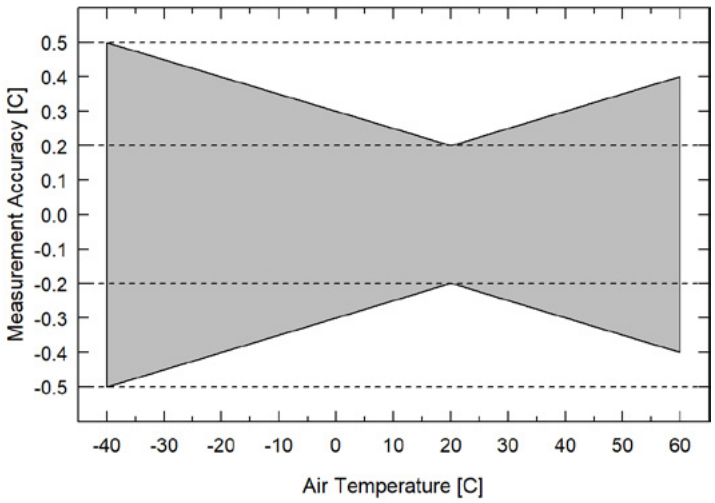
Sensor Element	SHT35 modified by MUNRO
Communication Standard	SDI-12 V1.4 (responds to a subset of commands)
Supply Voltage	7 to 28 Vdc
EMC Compliance	Tested and conforms to IEC61326:2013.
Standard Operating Temp. Range	-40° to +70°C
Main Housing Material	UV stable, white PET-P
Electronics Sealing Classification	IP67
Sensor Protection	Outer glass-filled polypropylene cap fitted with a stainless-steel mesh dust filter with nominal pore size of < 30 µm. The sensor element has a PTFE protective film with a filtration efficiency of > 99.99% for particles of 200nm or larger size
Sensor Connector	M12, male, 4-pole, A-coded
Cable	Polyurethane sheathed, screened cable, nominal diameter 4.8 mm
Field-Replaceable Chip or Recalibrate	Field-replaceable chip
Sensor Cap Diameter	12.5 mm
Body Diameter at Connector	18 mm
Length	180 mm without cable fitted
Sensor Body Weight	50 g
Weight	250 g with 5 m cable
RELATIVE HUMIDITY	
Measurement Range	0 to 100% RH
Accuracy	±2% (at 25°C, over the range 80 to 100% RH) -NOTE- The accuracy figures quoted are the 95% confidence limits relative to factory standards. ±1.5% (at 25°C, over the range 0 to 80% RH)
Short-Term Hysteresis	< ±1% RH
Additional Errors at Other Temp.	< ±1% RH (over -40° to +60°C)
Long-Term Stability	±0.5% per year (maximum drift in clean air conditions)
Reported Resolution	0.001% RH
Repeatability	0.05% RH (3σ noise level)
Response Time with Filter	< 20 s (63% response time in still air)
AIR TEMPERATURE	
Measurement Range	-40°C to +70°C
Note	The accuracy figures quoted are the 95% confidence limits relative to factory standards.
Accuracy	±0.1°C (over the range 20 to 60°C) ±0.2°C (over the range -40 to +70°C)
Long-Term Drift	< 0.03°C per year
Reported Resolution	0.001°C
Repeatability	0.04°C (3σ noise level)
Response Time with Filter	< 130 s (63% response time in air moving at 1 m/s)
Calibration Traceability	NIST and NPL standards
Quiescent / During Measurement	50 µA / 0.6 mA (takes 0.5 s)

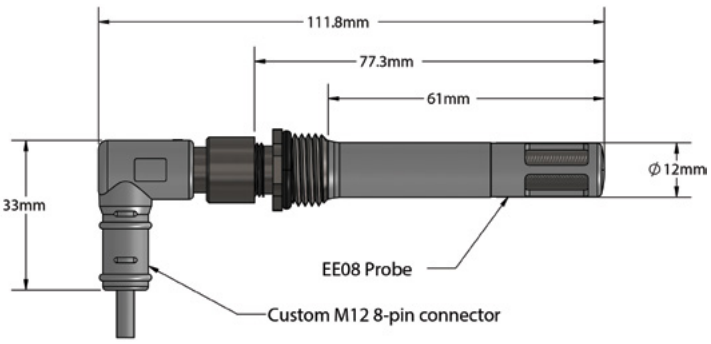
EE08
HIGH ACCURACY AIR TEMPERATURE & RELATIVE HUMIDITY PROBE

Aerodynamic Shape:

The Apogee EE08-SS is a customized version of the EE08 probe made by Austrian manufacturer E + E Elektronik. After years of evaluation, the EE08-SS has emerged as our sensor of choice over more expensive probes for accuracy, stability, and durability. The Apogee EE08-SS features an improved right angle, IP67 rated, stainless-steel M12 connector; heat-reflective white cabling; and a more durable, metal-grid dust filter. These features added by Apogee only slightly increase the price over the base model from E + E, but greatly improve the performance and reduce the maintenance of the probe, especially when used with a fan-aspirated radiation shield like the Apogee TS-100.

Accuracy Over Measurement Range:





EE08

Typical Applications:

- Meteorology & Weather stations
- Hatcheries & incubators
- Climatic chambers & green houses
- Storage rooms
- Artificial snow machines
- Battery operated devices.

Technical Specifications

Input Voltage	7 to 30 V DC
Current Draw	Less than 1.3 mA
Start-up Time	2 s
Housing	Polycarbonate, IP65
Filter	Stainless steel wire mesh, 30 micron pore size
Connector	M12, IP67
Dimensions	83 mm length, 12 mm diameter
Mass with 5 m Cable	270 g
Operating Environment	-40 to 80°C; 0 to 100 % relative humidity
Cable	M12 connector (IP67 rating) to interface to sensor housing, 5m of four conductor, shielded, twisted-pair wire (10m & 20m cables also available), white TPR jacket (high water resistance, high UV stability, flexibility in cold conditions), pigtail lead wires
TEMPERATURE MEASUREMENT	
Sensor	PT1000 (Class A)
Measurement Range	-40 to 60°C
Output Signal Range	0 to 2.5 V DC
Slope	0.04 C per mV
Intercept	-40°C
Accuracy at 20°C	± 0.2°C
Long-term Stability	Less than 0.1°C per year
Time Constant	Less than 30 s
Accuracy Over Measurement Range	See graph above
RELATIVE HUMIDITY MEASUREMENT	
Sensor	Capacitance Chip
Measurement Range	0 to 100 %
Output Signal Range	0 to 2.5 V DC
Slope	0.04 % per mV
Intercept	0.00 %
Accuracy at 20°C	± 2 % from 0 to 90 %; ± 3 % from 90 to 100 %
Temperature Response	Less than -0.05 % per C
Long-term Stability	Less than 1 % per year
Time Constant	Less than 30 s

ATMOS-14
SENSOR TEMPERATURE/ RELETIVE HUMIDITY/ BAROMETRIC PRESSURE/ VAPOR PRESSURE

Microclimate measurement made simple:
If you're doing a microclimate or evapotranspiration study, you may need up to four extra sensors to get important measurements that will benchmark your data. Not to mention you have to face the hassle of getting all those sensors integrated into your system. What you need is something simpler. With this in mind, we engineered the ATMOS-14 to be four sensors in one-air temperature, relative humidity, barometric pressure, and vapor pressure. And best of all, it's plug and play with our data logger.

Plug it in, and walk away:
Despite its minimalist design, the ATMOS-14 provides maximum value. While other sensors require wiring and programming, the ATMOS-14 simply plugs into the (It's also compatible with third-party data loggers). There's no having to figure out complicated instructions. Just mount the sensor on your data logger mast, plug it in, and walk away.

Measures a lot. Requires very little effort:
The ATMOS-14 is low-maintenance. It gives accurate vapor pressure and RH without a lot of cleaning. Plus it's weatherproof, meaning it will last a long time in the field. Another helpful feature is the compact shape that fits into tight spaces, leaving room on a mast for other sensors.

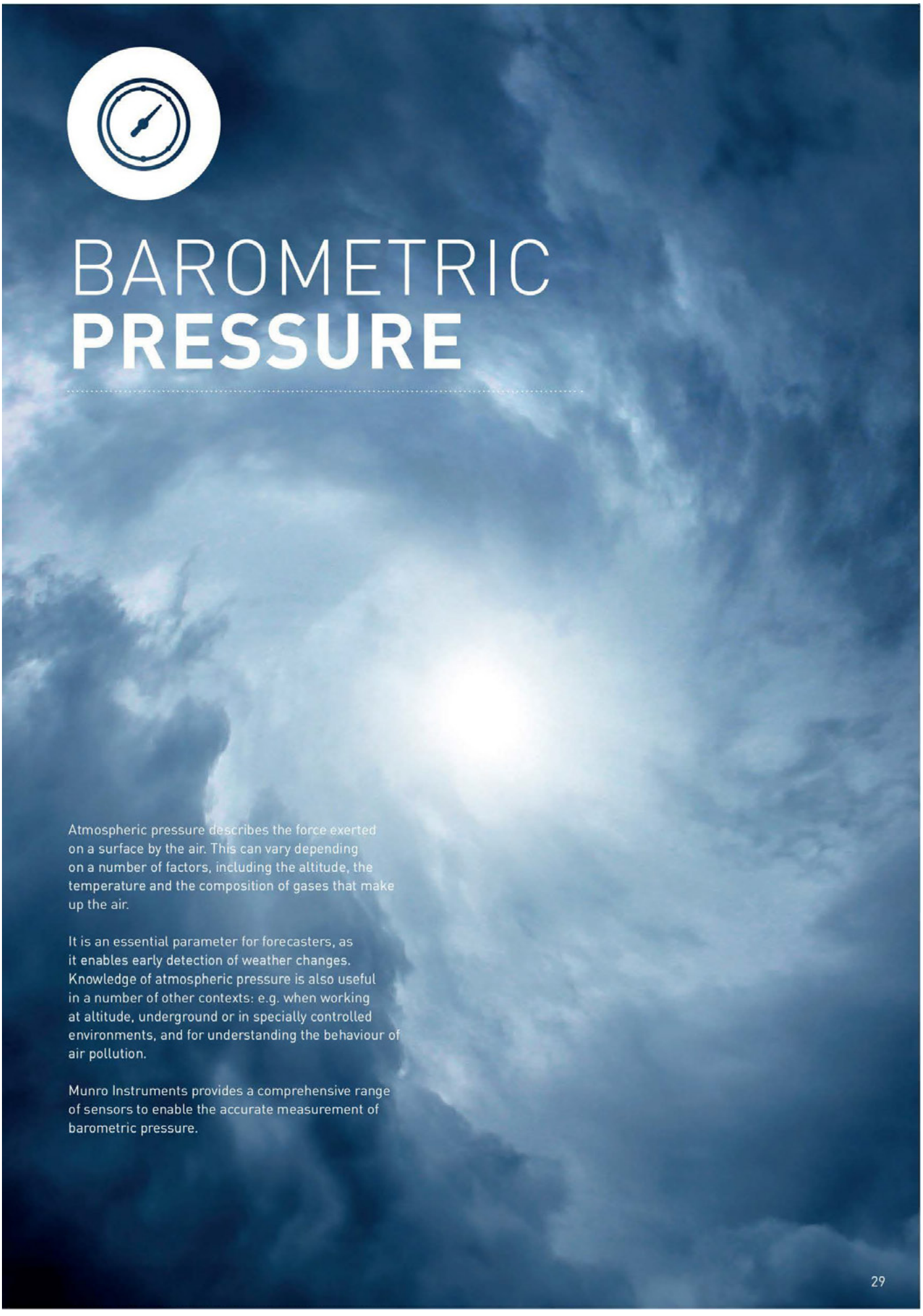
Readings don't get any more rapid:
Because the ATMOS-14 is plug and play, setup is quick. And responses are equally fast. Thanks to a Teflon protection screen that keeps liquid water out, but vapor moving freely through, it responds rapidly while keeping dust and liquid water off the sensor. Both features add up to time saved on your part.

For everything it measures, there's not much to it:
With ATMOS-14, all your basic microclimate measurements are covered using a small, simple integrated sensor. This versatile, low-maintenance sensor will rapidly and reliably measure air temperature, relative humidity, barometric pressure, and vapor pressure, making benchmarking quick and hassle-free.

ATMOS-14

Technical Specifications

RELATIVE HUMIDITY (RH)	
Range	0 to 100% RH
Resolution	0.1% RH
Accuracy	Sensor measurement accuracy is variable across a range of RH. ±2% between 20°-40°C
Long-term drift	< 0.5% RH/year, typical
TEMPERATURE	
Range	-40 to 80°C
Resolution	0.1°C
Accuracy	Sensor measurement accuracy is variable across a range of temperatures. ±0.3° between 20°-40°C
Long-term drift	< 0.04 °C/year typical
VAPOR PRESSURE	
Range	0 to 47 kPa
Resolution	0.01 kPa
Accuracy	Sensor measurement accuracy is variable across a range of temperatures and RH. Approx. ±0.1kPa
BAROMETRIC PRESSURE	
Range	50 to 110 kPa
Resolution	0.01 kPa
Accuracy	±0.4 kPa
COMMUNICATION SPECIFICATIONS	
Output	DDI serial or SDI-12 communications protocol
Data logger compatibility	METER data loggers (ZL6, EM50/60 series) or any data acquisition system capable of 3.6- to 15-VDC power and serial or SDI-12 communication.
PHYSICAL SPECIFICATIONS	
Dimensions	Diameter: 2.0 cm Height: 5.4 cm
Operating temperature range	Minimum: –40 °C Maximum: +80 °C NOTE: Sensors may be used at higher temperatures under certain conditions; contact Customer Support for assistance.



BAROMETRIC PRESSURE

Atmospheric pressure describes the force exerted on a surface by the air. This can vary depending on a number of factors, including the altitude, the temperature and the composition of gases that make up the air.

It is an essential parameter for forecasters, as it enables early detection of weather changes. Knowledge of atmospheric pressure is also useful in a number of other contexts: e.g. when working at altitude, underground or in specially controlled environments, and for understanding the behaviour of air pollution.

Munro Instruments provides a comprehensive range of sensors to enable the accurate measurement of barometric pressure.

61402
BAROMETRIC PRESSURE SENSOR

Product Description

Barometric Pressure Sensors combine high accuracy and low power over a wide range of pressures and temperatures.
Now available with SDI-12 output.
61402V provides a calibrated 0-5 VDC analog output. Analog current consumption is less than 4 mA. A special “sleep” mode further reduces current draw to a few µA. RS232 serial output is also available.
Model 61402L features a standard 4-20 mA output or user selectable serial interfaces SDI-12, RS-232, RS-485.
The compact size of the barometer allows easy placement in most standard instrument enclosures. A plug-in connector simplifies wiring.
For outdoor use, an optional Weatherproof Enclosure offers a convenient mounting location while the Pressure Port helps minimize dynamic pressure errors due to wind.

Technical 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	0.08% FS per year
Update Rate	1.8 Hz max
Serial Output	Full duplex RS-232 SDI-12, half duplex RS-485 (61402L only) 1200 to 38400 baud Polled or continuous ASCII text, NMEA
Analog Output	0 to 5000 mV, 0 to 2500 mV (61402V) 4 to 20 mA (61402L)
Resolution	Serial 0.01 hPa Analog 0.025% of analog scale
Power	7 to 30 VDC 61402V: Vout, 3.6 mA Sleep mode, 2.7 µA RS-232, 7.6 mA 61402L: 4-20mA, 25mA max RS-232 or RS-485, 8.5mA SDI-12, 1.5mA
Dimensions	90 mm x 60 mm x 20 mm
Weight	44 g

BaroVUE10
DIGITAL BAROMETER

Product Description

The BaroVUE10 is a highly accurate barometer that can measure pressures over a range of 500 to 1100 hPa and can be used in a range of applications that includes meteorology and hydrology. This sensor includes our zero downtime recalibration. Other sensors on the market need to be taken offline and sent back to the manufacturer to be recalibrated, often for weeks at a time, causing a loss in valuable data and time, as well as an additional expense. The sensor card for the BaroVUE10 is pre-calibrated. Replacement sensor cards are also pre-calibrated, requiring only one trip to the field station and no downtime. The design of the BaroVUE10 allows you to remove and replace your sensor card quickly and easily without either having to disassemble the equipment in the enclosure or having to send the equipment back to the manufacturer.

Detailed Description:

The BaroVUE10 is a low-power, digital barometer (-40 to +60°C) that provides best-in-class accuracy and stability (±0.1 hPa/yr) over the entire pressure and temperature range. It can run continuously & does not require power cycling unlike other products in this category. The digital output is both SDI-12 and RS-232, which reduces noise and measurement uncertainty compared with analog sensors, and makes the BaroVUE10 compatible with all MUNRO SDI-12 devices. Moreover, this barometric pressure sensor can be installed and integrated into many new and existing weather stations. The transducers used in the BaroVUE10 are direct-to-digital sensors, and no reconversion takes place inside the barometer.

Benefits and Features:

- Highly reliable measurements (multiple cells)
- Direct-to-digital measurements
- Very low noise
- Integrated identification and diagnostics
- Zero downtime/recalibration
- Easy firmware updates
- Cost effective
- SDI-12 device.

BaroVUE10

Technical Specifications

Note	These specifications assume the recommended desiccation is used
Pressure Range	500 to 1100 hPa
Temperature Range	-40° to +60°C
Supply Voltage	9 to 28 Vdc
Elevation	~609.6 m (2,000 ft) below sea level (as in a mine) to 4,572 m (15,000 ft) above sea level
Current Consumption	200 µA (sleep mode) < 5 mA (active)
Digital Output	SDI-12, RS-232 serial
Pressure Fitting	Barbed fitting for 0.318 cm
Dimensions	2.2 x 9.0 x 10.2 cm
Weight	226.8 g
ACCURACY	
Calibration Uncertainty	±0.15 hPa
Uncertainty	±0.3 hPa (at 20°C)
Total Uncertainty	±0.5 hPa (at -40° to +60°C)
Long-Term Stability	±0.1 hPa/yr
Power Supply Rejection	Negligible
Measurement Noise	0.05 hPa (RMS)
Resolution	0.1 hPa

SOLAR, CLOUD & LIGHTNING

With solar power becoming an increasingly vital component of the world's energy mix, the need for high precision solar monitoring equipment is now more important than ever. We supply a broad range of sensors to cover all solar-related applications, including cell research, module development, site selection, performance evaluation and meteorological observation.

Our solar sensor range incorporates the following instrument types:

Pyranometer (Secondary Standard, First Class and Second Class): Used to measure Broadband Solar Irradiance.

Pyrheliometers: A thermopile sensor used to measure Direct Normal Irradiance (DNI).

Spectroradiometers: Used as reference instruments for outdoor spectral irradiance measurements. This is useful for determining the individual properties of a light source at each wavelength.

We also supply a number of different Sun Trackers. Pyranometers and Pyrheliometers can be mounted to a Sun Tracker to enable a broader set of measurements to be taken.

In addition, Munro Instruments actively supports the measurement of a number of other sky parameters through the supply of thunderstorm detection systems and ceilometers.

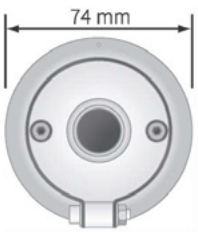
CHP1/SHP1

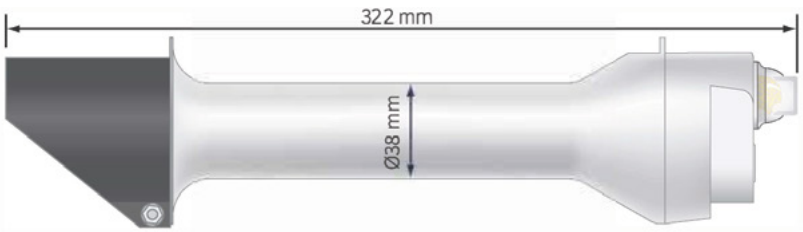
PYRHELIOMETER, C0NCENTRATED SOLAR POWER, FOR DIRECT NORMAL INCIDENCE SOLAR RADIATION MEASUREMENT

Field of view of 5°:
A pyrheliometer is an instrument designed specifically to measure DNI (Direct Normal Incidence) with a field of view of 5°. This is achieved by the shape of the collimation tube, with precision apertures, & the detector design.

Analog or digital outputs:
CHP1 Pyrheliometer is a pyrheliometer that offers reliability & durability without requiring any power. The analog outputs allow easy connection to virtually any data logger. SHP1 has a Modbus® interface plus amplified analog output, improved response time and temperature corrected measurement data.

Pyrheliometers mounted on sun trackers:
A pyrheliometer needs to be pointed accurately at the sun at all times. MUNRO sun trackers provide a stable mounting to keep the pyrheliometer pointing at the sun to accurately measure DNI.





CHP1/SHP1

Technical Specifications

MODEL	CHP1	SHP1
Classification to ISO 9060:2018	Spectrally Flat Class A	Spectrally Flat Class A
Sensitivity	7 to 14 µV/W/m²	-
Expected output range(0 to 1400 W/m²)	10 to 20 mV	-
Maximum operational irradiance	4000 W/m²	-
Analog output• V-version	-	0 to 1 V
Analog output range*	-	-200 to 2000W/m²
Analog output• A-version	-	4to 20 mA
Analog output range*	-	0 to 1600 W/m²
Serial output	-	RS-485 Mod bus® RTU
Serial output range	-	-400 to 4000 W/m²
Response time (63 %)	< 1.7 s	< 0.7 s
Response time (95 %)	< 5 s	< 2 s
Spectral range (50 % points)	200 to 4000 nm	200 to 4000 nm
Zero offsets (unventilated) (b) temperature change (5 K/h)	< 1 W/m²	< 1 W/m²
Non-stability (change/year)	< 0.5 %	< 0.5 %
Non-linearity (0 to 1000 W/m²)	< 0.2 %	< 0.2 %
Spectral selectivity (350 to 1500 nm)	< 1 %	< 1 %
Required sun tracker accuracy	< 0.5° from ideal	< 0.5° from ideal
Weight (excluding cable)	0.9 kg	0.9 kg
Slope angle	1° ±0.2°	1° ±0.2°
Temperature response	< 0.5 % (-20°C to +50°C)	< 0.5 % (-30°C to +60°C) < 1 % (-40°C to +70°C)
Field of view	5° ±0.2°	5° ±0.2°
Power consumption (at 12 VDC)	-	V-version: 55 mW A-version: 100 mW
Supply voltage	-	5 to 30 VDC
Software. Windows	-	SmartExplorer Software, for configuration, test and data logging
Operating & storage temperature range	-40°C to +80°C	-40°C to +80°C
Humidity range	O to 100 %	O to 100 %
MTBF (Mean Time Between Failures)**	> 10 years	> 10 years
Ingress Protection (IP) rating	67	67
Recommended applications	High performance direct radiation monitoring for meteorological stations or concentrated solar energy applications	

SOLYS2/2AP
FOR SOLAR-TRACKING AND PC-BASED POSITIONING OPERATIONS

Product Description

Solar radiation is normally measured using a pyranometer that sees the whole hemisphere above it and responds to radiation from both sun and sky, the 'global' solar radiation. However, it is often necessary to accurately measure the 'direct' radiation coming only from the sun.
A pyrheliometer has a 5° view, slightly larger than the sun and its aureole, and does not see the rest of the sky. To make measurements it must point precisely at the sun and this is achieved using an automatic two-axis sun tracker. A shading assembly blocks the direct solar radiation from reaching a pyranometer mounted on the tracker so that the 'diffuse' solar radiation from the sky can be measured. The sun tracker provides a stable mounting for the pyrheliometer and moves horizontally (azimuth) and vertically (zenith) to follow the solar arc. Stepping motors controlled by a micro-processor drive through belts or gears to provide movement with the desired torque and accuracy. An on-board programme requires accurate longitude, latitude, altitude, date, and time information for the measurement site. It then calculates the current position of the sun and points the pyrheliometer & shading assembly towards it.

Benefits and Features:

- Accuracy suitable for any requirement
- All-weather construction
- Unattended operation
- Virtually maintenance-free
- Wide range of mounting configurations
- Ideal for BSRN stations.

SOLYS2/2AP

Applications:
Sun trackers are widely used in networks of solar monitoring stations that measure direct, diffuse & global radiation, for inputs to weather forecasting and climate models. Other applications include atmospheric chemistry research, pollution forecasting and materials testing.
With growing interest in renewable energy good quality solar radiation data is becoming increasingly important, particularly the direct component, with regard to photovoltaic systems and thermal energy solar collectors. Activities include research and development, production quality control, determination of optimal power plant locations, monitoring the efficiency of installed systems and predicting the output under various sky conditions.

The Baseline Surface Radiation Network (BSRN):
Solar, atmospheric and terrestrial radiation drive almost every dynamic process on the Earth's surface and above, from ocean current circulation to weather, climate and life itself. Small changes can have large and long-lasting effects that are difficult to predict. Accurate data regarding the radiation at the Earth's surface is fundamental to under-standing its climate system, global warming and global dimming.
BSRN comprises a global network of solar monitoring stations using the best equipment and practices currently available and is a key part of the World Climate Research Programme. BSRN is linked to other international climate projects such as WMO-GAW, ARM, GEWEX and GCOS.
MUNRO sun trackers and radiometers are widely used in all of the above programmes and we can supply complete BSRN compatible solar monitoring systems.

Choice of Sun Tracker:
2AP has been in production for many years and is used around the world as the basis of top quality solar monitoring stations for research and in networks, such as BSRN. The high power and rugged design enables operation in extreme conditions, from deserts to Antarctica.
However, not every customer needs these capabilities and for some users 2AP is over-specified. Our SOLYS2 provides BSRN level performance and is easier to install and operate than any other tracker on the market. It is very efficient and ideal for operation using solar energy power sources.

Technical Specifications

TYPICAL SOLAR MONITORING SYSTEM	
Sun Tracker	-
Shading Ball Assembly	-
Pyrheliometer	Direct solar radiation
Pyranometer	Global solar radiation
Pyranometer (shaded)	Diffuse solar radiation
Data Logger	-

BASIC BSRN STATION	
Sun Tracker	sun sensor recommended
Shading Ball Assembly	-
Pyrheliometer, with temperature sensor	Direct solar radiation
Pyranometer, ventilated, with temperature sensor	Global solar radiation
Pyranometer (shaded), ventilated, with temperature sensor	Diffuse solar radiation
Pyrgeometer (shaded), ventilated	Downwards infrared radiation
Data Logger	-

SOLYS2/2AP

SOLYS2 is an advance over conventional automatic sun trackers. It does not require a computer and software for installation. The integrated GPS receiver automatically configures location and time data. Multi-colour LEDs indicate the operating status & an Ethernet port allows for software upgrades, testing and fault diagnosis. The high-efficiency belt drive system requires no maintenance.
The tough & distinctive cast aluminium housing has a matching tripod stand with levelling feet. A side plate with mountings for a MUNRO pyrheliometer is included as standard and a second side plate can be fitted, with a range of mounting kits for an additional pyrheliometer or other instruments. Two top mount-ing plates are available for convenient horizontal mounting of one, or up to three, MUNRO radiometers. The shading ball assembly accessory includes the large top mounting plate and a second side plate & allows SOLYS2 to be configured as a complete solar monitoring station. SOLYS2 does not suffer from internal clock drift because time is updated by the GPS receiver. A sun sensor is available for active tracking where the stability of the support platform cannot be guaranteed.

The cost-effective & simple sun tracking solution:

- Fully Automatic • Integrated GPS Receiver
- Easy to Install • BSRN Level Performance
- Both AC and DC Power Inputs • Very Low Maintenance.

SOLYS2/2AP

2AP has proven performance in the harshest climates. High power motors and precision gear drives have the torque to break ice and to operate in high winds. The optional cold weather cover and internal heaters enable operation down to -50 °C. After setup using the supplied Win2AP software and a PC (not included) operation is stand-alone with only occasional checks of the internal clock required. Two small side plates are included as standard, but no instrument mountings.
An active tracking sun sensor is available to correct for clock drift or movement of the support platform. The large side mounting plate takes the sun sensor & a MUNRO pyrheliometer (or two pyrheliometers). The optional shading ball assembly includes two side plates and a rear mounting plate for up to three ventilated MUNRO radiometers. Adapters are available for unventilated radiometers.
A unique feature of the 2AP is the positioning capability. The Win2AP software can be used to configure a sequence of pre-programmed movements to point at a series of targets.

The high-end market leader for all conditions:
• Highest Accuracy Available • Highest Load and Torque Available • BSRN Level Performance
• AC and DC Power Versions • Operates in Extreme Climates • Positioning Capability.

SOLYS2/2AP

Technical Specifications

MODEL	SOLYS2	2AP
Pointing accuracy	<0.1 ° passive tracking <0.02 ° active tracking (with optional sun sensor)	<0.1 ° passive tracking <0.02 ° active tracking (with optional sun sensor)
Torque	>20 Nm (at maximum load & angular velocity) * >23 Nm (when sun tracking) *	>40 Nm (at maximum load & angular velocity) >40 Nm (when sun tracking
Payload (balanced)	20 kg	65 kg
Angular velocity / Angular acceleration	up to 5 °/s / up to 3.6 °/s²	up to 1.8 °/s / up to 3.6 °/s²
CONDITIONS & DIMENSIONS		
Supply voltage	18 to 30 VDC and 90 to 264 VAC, 50 / 60 Hz	24 VDC only, or 115 / 230 VAC (selectable), 50 / 60 Hz
Power sun tracker	21 W (reduces to 13 W at night)	50 W
Power heater	100 W (heater is standard, AC only)	100 W (heater is optional)
Operating temperature range	- 20°C to +50°C (DC power) - 40°C to +50°C (AC power)	0°C to +50°C -20°C to +50°C with optional cold cover -50°C to +50°C with optional cold cover & optional heater
Weight	23kg (sun tracker), 5kg (tripod stand)	30 kg
Dimensions (WxDxH)	50x34x38cm (excluding tripod stand)	42 x 26 x 38 cm
FEATURES		
Transmission	Inverted tooth belts	Worm and bevel gear
Location, time/date info & setup	Automatic by integrated GPS	Manual by Win2AP software & PC (not included)
Mounting base	Tripod stand included	Flat base plate (optional heavy duty tripod stand & height extension tube)
Zenith axis fittings	One side plate / pyrheliometer mounting kit standard	Two small side plates standard, no mounting kit
Heater for low temperature operation	Standard (AC power only)	Optional (must be used with cold cover)
Communication	Ethernet and web interface	RS 232 and Win2AP software for PC (not included)
Indicators	Power, internal temperature & status	N/A
Positioning mode	Ethernet and web interface	By Win2AP software and PC
Maintenance	No scheduled maintenance required	Annual inspection and grease gears
OPTIONS		
Sun sensor kit **Side mounting plate**	For active sun tracking For fitting to zenith axis shaft on opposite side to standard side plate/ pyrheliometer mounting	For active sun tracking Large side mounting plate for zenith axis including mountings for two pyrheliometers
Large top mounting plate	3 positions for MUNRO radiometers (with or without ventilation units)	N/A
Small top mounting plate	1 position for a MUNRO radiometer (with or without ventilation unit)	N/A
Shading ball assembly	Includes large top mounting plate, second side mounting plate, 2 shading balls on adjustable rods	Includes rear mounting plate for 3 ventilated radiometers, two large side mounting plates, 3 shading balls on rods
Adapter kit	Not needed	For unventilated radiometers
Radiometer mounting kits	For absolute cavities, pyrheliometers, PGS-100 sun photometer and other instruments	

Note: The performance specifications quoted are worst-case and/or maximum values
*** The standard torque setting is ideal for all normal measurement applications, but it is adjustable in firmware. Torque can be reduced to save power, or increased to a maximum of 30 Nm when sun tracking.**

CMP/SMP-SERIES
PYRANOMETERS, FOR THE ACCURATE MEASUREMENT OF SOLAR IRRADIANCE

Product Description

If you want to measure solar radiation on Earth's surface, you start with a pyranometer. Solar radiation drives almost every dynamic process on the Earth from ocean current circulation to weather, climate and the biosphere. The determination of the radiation budget at the surface of the Earth is fundamental to understanding the Earth's climate system and weather patterns.

Solar irradiance:

PV systems harnessing solar irradiance are the most widely installed source of zero-emission renewable energy. High quality, reliable radiation data is crutial to the efficienct operation of solar energy projects in both photovoltaic (PV) and concentrating solar power (CSP) thermal systems.
A pyranometer is a radiometer designed for measuring the irradiance in W/m2 resulting from radiant fluxes incident upon a plane surface (horizontal or tilted) from the hemisphere above, and integrated over a wavelength range of at least 300 to 3000 nanometers.

Benefits and Features:

- The widest range of high quality, reliable pyranometers available
- ISO 9060:2018 Spectrally Flat, from Class C to beyond the requirements of Class A
- Accurate and independent data for performance ratio calculations
- Installed around the world by national meteorology and climate networks
- Used by major solar energy organisations for performance monitoring
- A choice of analog or industry standard Modbus® RTU outputs
- Mean Time Between Failures (MTBF) in excess of 10 years®.

CMP/SMP-SERIES

The different components of solar radiation:
A pyranometer measures global horizontal solar irradiance (GHI); which is composed of diffuse horizontal solar irradiance (DHI) from the sky and direct normal solar irradiance (DNI) from the sun. If shaded from the direct sun a pyranometer measures diffuse horizontal solar irradiance (DHI). Direct normal irradiance (DNI) is measured by a pyrheliometer continuously pointed at the centre of the sun by an automatic sun tracker.

Solar energy:
A pyranometer tilted in the plane of array (POA) of solar panels provides critical input data to the calculation of performance ratios and efficiencies in photovoltaic energy installations.
MUNRO has been manufactuing pyranometers since 1924. As the market leader, we produce models at all price and performance points, up to the very best available. All comply with the requirements of ISO 9060:2018 'Solar energy - Specification and classification of instruments for measuring hemispherical solar and direct solar radiation' and are fully traceable to the World Radiometric Reference (WRR) in Davos, Switzerland, where MUNRO instruments form part of the World Standard Group.

The best mtbf performance:
MUNRO pyranometers are designed for simple operation and maintenance and have a wide range of accessories available. The long operational life and reliability is proven by an MTBF (Mean Time Between Failures) of more than 10 years. Many have been in continuous operation for over 30 years.
MUNRO pyranometers have been developed to be suitable for use in all environments, from the Antarctic to deserts. They are installed around the world for meteorology, hydrology, climate research, solar energy, environmental and materials testing,
greenhouse control, building automation and many other applications.
Our top level pyranometers have individually optimized temperature compensation and individually measured directional response, with test results provided. These important features ensure the highest possible accuracy.

Choice of Pyranometer:
ISO 9060:2018 defines three classifications of pyranometer by their key performance parameters; from Class C, to Class B, to Class A and our top models considerably exceed ISO Class A requirements. In effect, this is the calculation of GHI from accurate DHI and DNI measurements.
The most appropriate model for an application largely depends upon the desired accuracy and performance, and the type of signal interface required. We offer two ranges of pyranometers, the passive CMP series and the Smart SMP series, both widely acknowledged by meteorological and solar energy customers.



CMP/SMP-SERIES

CMP-Series:
Our CMP series pyranometers are well known around the world for their high quality, durability and accuracy. The instruments do not require any power and are ideal for remote sites with limited power availability or for field studies. Each has an individual calibration factor/sensitivity to convert the mV output signal to W/m2 of irradiance.
The signal output is a very low voltage, typically around 10 millivolts on a bright sunny day. To measure 1 W/m2 of irradiance requires a data logger 'accuracy' of better than 10 microvolts. This normally means a specialized meteorological data logger. Industrial type analogue inputs do not usually have sufficient sensitivity and the SMP series should be used.
CMP3 and CMP10 have internal desiccant that lasts for at least 10 years to reduce maintenance costs. Other CMP models have self-indicating desiccant in an easily accessed drying cartridge that should be inspected monthly and the desiccant changed when necessary.

Smart SMP Series:
Our SMP range of pyranometers is based on the proven technology of the CMP series, but has a micro-processor, memory and firmware that makes them Smarter and faster.

Smart Interface:
Modbus® RTU interfaces directly to, PLC's, SCADA systems, industrial networks and controllers. Smart instruments are addressable, and up to 247 units can be connected to a single network. Measurement data is updated every second and the user can access irradiance, type and serial number, instrument settings, full calibration history, status information, & more. The digital signal avoids all the issues of analogue-to-digital conversion performance that arise with many industrial data loggers and input modules, preserving the accuracy of the pyranometer's 24-bit differential input ADC.
SMP Series pyranometers can operate from 5 to 30 VDC and the power input has both reverse polarity and over-voltage protection. They have a feed-forward algorithm that makes them faster than our passive CMP series and an integrated temperature sensor and polynomial functions for better temperature correction.

Smartexplorer windows software:
Our free, & easy to use, SmartExplorer Windows™ software enables configuration of Smart pyranometers communication settings, monitoring of measurements and status parameters, and logging of the data. Even if the communication parameters are lost, or unknown, the software is able to establish communication and set the instrument back to a defined state.

CMP/SMP-SERIES

SMP models have internal desiccant that lasts for at least 10 years to reduce maintenance costs. In addition, the new SMP12 introduces a tilt sensor and an internal humidity monitor.
All pyranometers with a Smart Interface also have a 0 to 1 V (-V models) or 4 to 20 mA (-A models) analogue output. These fixed analogue outputs eliminate the need to adjust the data logger after re-calibration.

Spectrally Flat Class C Pyranometers:
Our Spectrally Flat Class C CMP3 pyranometer is smaller and lighter than the other CMP series pyranometers. It has a robust 4 mm thick glass dome to protect the thermopile from external influences. The small size and low cost make this the ideal choice for horticulture, entry-level weather stations and routine monitoring in solar energy installations. It does not have any compensation for change in sensitivity with temperature. A screw-in mounting rod is available for easy installation to a pole or mast.
SMP3 is the Smart version of CMP3 and is ideal for routine monitoring in solar energy installations. Because of the faster response, standardized digital Modbus® RTU interface and the built-in digital temperature compensation the SMP3 is superior to the CMP3.

Spectrally Flat Class B Pyranometers:
CMP6 has a similar detector to CMP3, but has improved performance due to the increased thermal mass and the double glass dome construction, making it a Class B pyranometer. It is recommended for cost-effective, good quality, measurements in meteorological and hydrological networks and for agriculture. SMP6 has similar applications to CMP6. Internal temperature compensation in all SMP's is over a large range from -40°C to +70 °C and significantly reduces the measurement uncertainty.

Spectrally Flat Class A Pyranometers:
Each Class A instrument is supplied with its own temperature and directional (cosine) response data.
CMP10 uses a temperature compensated detector with a superior technology to the CMP3 and CMP6. It has better linearity and long-term stability, lower thermal offset and faster response. It is a step up in performance and particularly suitable for upgrading meteorological networks. The faster response time meets the requirements for solar energy research and development applications. CMP10 is also ideal for use in sun tracker based solar monitoring stations. It has internal desiccant instead of the external drying cartridge fitted to the rest of the double dome CMP series.
The CMP21 is characterized and compensated over a larger temperature range. A sensor is fitted to monitor the housing temperature. It is the choice for scientific use and in top level solar radiation monitoring networks such as the Baseline Surface Radiation Network (BSRN) and Global Atmospheric Watch (GAW) of the World Meteorological Organisation (WMO).
CMP22 has all the features of CMP21 but uses vry high quality quartz domes for a wider spectral range, improved directional response, and reduced thermal offsets. MUNRO is confident that CMP22 is the best passive pyranometer currently available.
SMP10 is the Smart digital equivalent of the CMP10 series pyranometers. They have faster response and more flexible connectivity. Internal temperature compensation in all SMP's is over a large range from -40°C to +70°C. The digital polynomial temperature correction significantly reduces the measurement uncertainty provides better performance than the passive correction in the CMP versions, especially for extreme climates. The new SMP12 is a fast response spectrally flat Class A pyranometer combining solid-state dome heating, no moving parts, and best-in-class surge protection to maximize accuracy and minimize maintenance. The SMP22 shares all class-leading characteristics of the CMP22, in additional to the advantages of a smart pyranometer, including temperature compensation over a large range. A 10 K thermistor internal temperature sensor is standard, a Pt-100 sensor is optional.

CMP/SMP-SERIES

Building a System:
The system capabilities of MUNRO pyranometers can be extended with our wide range of compatible products and accessories.

Ventilation unit:
The CVF4 ventilation unit is designed for use with all CMP and SMP Series pyranometers (it is slightly less effective with the CMP3 and SMP3 because of the smaller dome diameter). Ventilation helps to keep the dome clean from soiling, evaporates dew and raindrops, and reduces infrared thermal offsets. The heating can be used to melt frost and snow. Ventilation provides better quality measurement data and reduces the frequency of cleaning, reducing maintenance costs. The CVF4 is waterproof to IP68 and has a 5-year warranty.

Sun trackers:
SOLYS sun trackers are all-weather reliable instruments used to accurately point a pyrheliometer at the sun for direct normal irradiance measurements (DNI). When fitted with an optional shading assembly and a pyranometer they measure diffuse horizontal irradiance (DHI) with no need for periodic manual adjustments. Adding a second pyranometer for global horizontal irradiance (GHI) makes a complete high quality solar monitoring station.

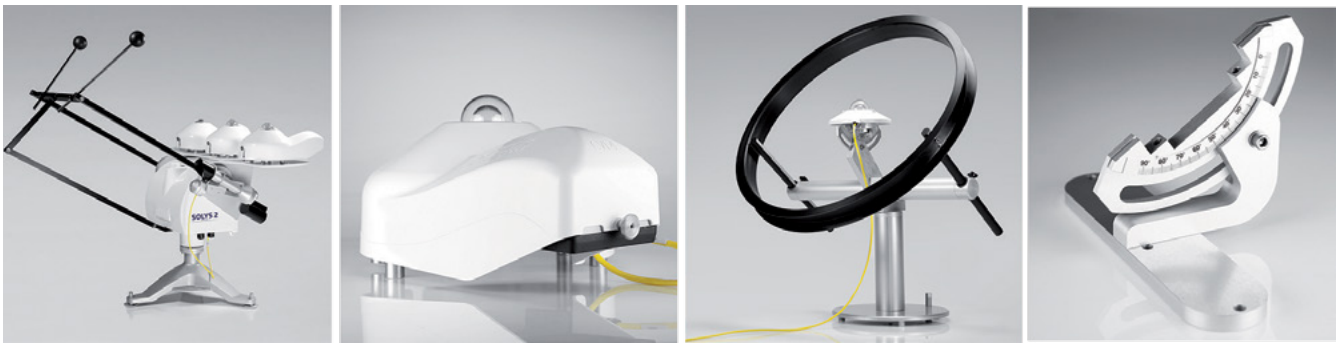
Shadow ring:
The combination of a pyranometer and a CM121 shadow ring offers a simple solution for measuring diffuse solar radiation from the sky. It does not require any power, but the ring requires a simple adjustment every few days to ensure that the shadow covers the pyranometer dome completely as the sun declination changes during the year.

Mountings:
We offer mounting fixtures for horizontal pyranometers. CMF1 is a small round plate with integral rod for mounting upward and/or downward facing pyranometers without a ventilation unit. CMF4 does the same for pyranometers fitted with the CVF4 ventilation unit. A screw-in rod is available for CMP3 & SMP3. The CMB1 is a mounting bracket for attaching mounting rods to a mast, pole or wall.

Data loggers:
MUNRO has a range of high performance products for use with CMP or SMP series pyranometers to acquire and store analogue or digital measurement data. The AMPBOX converts the mV output of a CMP pyranometer into a 4-20 mA signal.

Albedometer:
Two pyranometers, mounted back-to-back, make an albedometer. The albedo of a surface is the extent to which it diffusely reflects solar radiation. It is the ratio of the reflected radiation to the incoming radiation.

CMP/SMP-SERIES

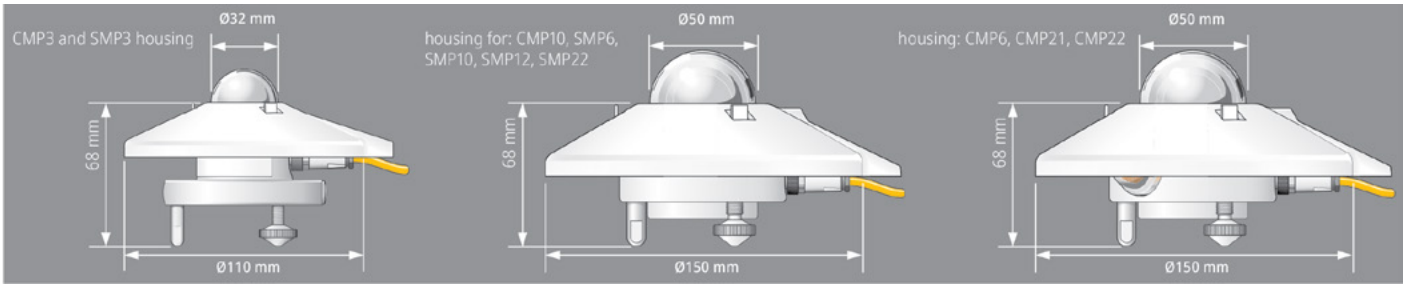


Adjustable tilt mounting kit:

Use the Adjustable Tilt Mounting Kit to securely and accurately mount a CMP or SMP pyranometer at a solar zenith angle between 0° and 90°, to measure global tilted irradiance (GTI) or POA radiation for fixed-angle PV arrays.

Glare screen kit:

A downward facing pyranometer used to measure reflected solar radiation should not see any radiation coming from the hemisphere above or from the sun when it is below the horizon of the detector.
To prevent this, a glare screen kit is available for use with CMP and SMP series pyranometers (except the SMP3 and CMP3).



CMP-SERIES

Technical Specifications

MODEL	CMP3	CMP6	CMP10	CMP21	CMP22
Classification to ISO 9060:2018	Spectrally Flat Class C	Spectrally Flat Class B	Spectrally Flat Class A	Spectrally Flat Class A	Spectrally Flat Class A
Sensitivity	24 to 32 µV/W/m²	5 to 20 µV/W/m²	7 to 14 µV/W/m²	7 to 14 µV/W/m²	7 to 14 µV/W/m²
Impedance	80 to 140 Ω	20 to 200 Ω	10 to 100 Ω	10 to 100 Ω	10 to 100 Ω
Expected output range(0 to 1500 W/m²)	0 to 48 mV	0 to 30 mV	0 to 21mV	0 to 21mV	0 to 21mV
Maximum operational irradiance	2000 W/m²	2000 W/m²	4000 W/m²	4000 W/m²	4000 W/m²
Response time (63 %)	< 6 s	< 6 s	< 1.66 s	< 1.66 s	< 1.66 s
Response time (95 %)	< 20 s	< 12 s	< 5 s	< 5 s	< 5 s
INSTRUMENT ACCURACY					
Spectral range (20% points)	285-3000 nm	270-3000 nm	270-3000 nm	270-3000 nm	210-3600 nm
Spectral range (50 % points)	300-2800 nm	285-2800 nm	285-2800 nm	285-2800 nm	200-3600 nm
Zero offsets (unventilated) **(a) thermal radiation (at 200 W/m²)** **(b) temperature change (5 K/h)** **(c) total zero offset**	< 15 W/m² < 5 W/m² < 20 W/m²	< 8 W/m² < 2 W/m² < 10 W/m²	< 7 W/m² < 2 W/m² < 9 W/m²	< 7 W/m² < 2 W/m² < 9 W/m²	< 3 W/m² < 1 W/m² < 4 W/m²
Additional signal processing errors	n.a.	n.a.	n.a.	n.a.	n.a.
Non-stability (change/year)	< 1 %	< 1 %	< 0.5 %	< 0.5 %	< 0.5 %
Non-linearity (100 to 1000 W/m²)	< ±3 %	< 1 %	< 0.2 %	< 0.2 %	< 0.2 %
Directional response (up to 80 ° with 1000 W/m² beam)	< 20 W/m²	< 20 W/m²	< 10 W/m²	< 10 W/m²	< 5 W/m²
Clear sky GHI spectral error	< 0.2 %	< 0.1 %	< 0.1 %	< 0.1 %	< 0.04 %
Spectral selectivity (350 to 1500 nm)	< 3 %	< 3 %	< 3 %	< 3 %	< 3 %
Tilt response (0° to 180° at 1000 W/m²)	< 1.5 %	< 1 %	< 0.2 %	< 0.2 %	< 0.2 %
Temperature response	<4% (-10°C - +40°C)	<2% (-10°C - +40°C)	<1% (-10°C - +40°C)	<1% (-20°C - +50°C)	<0.5% (-20°C - +50°C)
Field of view	180 °	180 °	180 °	180 °	180 °
Accuracy of bubble level	< 0.2 °	< 0.1 °	< 0.1 °	< 0.1 °	< 0.1 °
Temperature sensor output				10 k Thermistor (optional Pt-100)	
Detector type	Thermopile	Thermopile	Thermopile	Thermopile	Thermopile
Operating & storage temperature range	-40°C - +80°C	-40°C - +80°C	-40°C - +80°C	-40°C - +80°C	-40°C - +80°C
Humidity range	0 to 100 %	0 to 100 %	0 to 100 %	0 to 100 %	0 to 100 %
MTBF (Mean Time Between Failures)	> 10 years	> 10 years	> 10 years	> 10 years	> 10 years
Ingress Protection (IP) rating	67	67	67	67	67
Recommended applications	Economical solution for routine measurements in weather stations, field testing	Good quality measurements for hydrology networks, greenhouse climate control	Meteorological networks, PV panel and thermal collector testing, materials testing	Meteorological networks, reference measurements in extreme climates, polar or arid	Scientific research requiring the highest level of measurement accuracy and reliability

Note:
The performance specifications quoted are worst-case and/or maximum values.
Standard 10 k thermistor or optional Pt-100 temperature sensor with CMP21 and CMP22.
Individual directional response and temperature dependence test data with CMP10, CMP21 and CMP22.

SMP-SERIES

MODEL	SMP3	SMP6	SMP10	SMP12	SMP22
Classification to ISO 9060:2018	Spectrally Flat Class C	Spectrally Flat Class B	Spectrally Flat Class A	Fast Response Spectrally Flat Class A	Spectrally Flat Class A
Analogue output • V-version	0 to 1 V	0 to 1 V	0 to 1 V	N/A	0 to 1 V
Analogue output range • V-version*	-200 to 2000 W/m²			N/A	-200 - 2000 W/m²
Analogue output • A-version	4 to 20 mA	4 to 20 mA	4 to 20 mA	N/A	4 to 20 mA
Analogue output range • A-version*	0 to 1600 W/m²			N/A	0 - 1600 W/m²
Serial output	RS-485 Modbus®				
Serial output range*	-400 to 2000 W/m²		-400 to 4000 W/m²		
INSTRUMENT ACCURACY					
Response time (63 %)	< 1.5 s	< 1.5 s	< 0.7 s	< 0.15 s	< 0.7 s
Response time (95 %)	< 12 s	< 12 s	< 2 s	< 0.5 s	< 2 s
Spectral range (20% points)	285 to 3000nm	270 to 3000nm	270 to 3000nm	280 to 3000nm	210 to 3600nm
Spectral range (50 % points)	300 to 2800nm	285 to 2800nm	285 to 2800nm	285 to 2750nm	250 to 3500nm
Zero offsets (unventilated) (a) thermal radiation (at 200 W/m²) (b) temperature change (5 K/h) (c) total zero offset	< 15 W/m² < 5 W/m² < 20 W/m²	< 8 W/m² < 2 W/m² < 10 W/m²	< 7 W/m² < 2 W/m² < 9 W/m²	< 1 W/m² < 1.5 W/m² < 3 W/m²	< 3 W/m² < 1 W/m² < 4 W/m²
Additional signal processing errors	< 3 W/m²	< 2 W/m²	< 2 W/m²	< 3 W/m²	< 1 W/m²
Non-stability (change/year)	< 1 %	< 1 %	< 0.5 %	< 0.5 %	< 0.5 %
Non-linearity (100 to 1000 W/m²)	< 3 %	< 1 %	< 0.2 %	< 0.2 %	< 0.2 %
Directional response (up to 80 ° with 1000 W/m² beam)	< 20 W/m²	< 15 W/m²	< 10 W/m²	< 10 W/m²	< 5 W/m²
Clear sky GHI spectral error	< 0.2 %	< 0.1 %	< 0.1 %	< 0.1 %	< 0.04 %
Spectral selectivity (350 to 1500 nm)	< 3 %	< 3 %	< 3 %	< 3 %	< 3 %
Tilt response (0° to 180° at 1000 W/m²)	< 1.5 %	< 1 %	< 0.2 %	< 0.2 %	< 0.2 %
Temperature response	<3% (-20°C - +50°C) <4% (-40°C - +70°C)	<2% (-10°C - +40°C) <4% (-40°C - +70°C)	<1% (-20°C - +50°C) <2% (-40°C - +70°C)	<1% (-10°C - +40°C) <2% (-40°C - +70°C)	<0.3% (-20°C - +50°C) <0.3% (-40°C - +70°C)
Field of view	180 °	180 °	180 °	180 °	180 °
Accuracy of bubble level	< 0.2 °	< 0.1 °	< 0.1 °	< 0.1 °	< 0.1 °
Power consumption (at 12 VDC)	V-version: 55mW A-version: 100mW	V-version: 55mW A-version: 100mW	V-version: 55mW A-version: 100mW	V-version: 3.5mW	V-version: 55mW A-version: 100mW
Software, Windows™	SmartExplorer software, for configuration, test and data logging				
Supply voltage	5 to 30 VDC	5 to 30 VDC	5 to 30 VDC	10 to 30 VDC	5 to 30 VDC
Detector type	Thermopile	Thermopile	Thermopile	Thermopile	Thermopile
Operating & storage temperature range	-40°C to +70°C	-40°C to +70°C	-40°C to +70°C	-40°C to +70°C	-40°C to +70°C
Storage temperature range	-40°C to +80°C	-40°C to +80°C	-40°C to +80°C	-40°C to +80°C	-40°C to +80°C
Humidity range	0 to 100 %	0 to 100 %	0 to 100 %	0 to 100 %	0 to 100 %
MTBF (Mean Time Between Failures)**	> 10 years	> 10 years	> 10 years	> 10 years	> 10 years
Ingress Protection (IP) rating	67	67	67	67	67
Recommended applications	Economical solution for efficiency & maintenance monitoring of PV power installations, routine measurements in weather stations, agriculture, horticulture & hydrology	Good quality measurements for Solar Monitoring, hydrology networks, greenhouse climate control	High performance for PV panel & thermal collector testing, solar energy research, solar prospecting, materials testing, advanced meteorology & climate networks	High performance for PV panel & thermal collector testing, solar energy research, solar prospecting, materials testing, advanced meteorology and climate networks	Scientific research requiring the highest level of measurement accuracy & reliability under all conditions

* adjustable with SmartExplorer Software
** extrapolated after introduction in January 2012
Note: The performance specifications quoted are worst-case and/or maximum values.

PRECIPITATION & **PRESENT WEATHER**

Regular rainfall measurement is an essential requirement in many aspects of agriculture, forestry, industry, education and other activities.

Rainfall is rarely uniform in intensity or duration across a wide area. As such, continuous data on local conditions is of particular importance to farmers and those concerned with irrigation, scientists researching crop performance and soil erosion, and to water and river authorities in respect of reservoir supplies and ground water feeding into rivers.

Munro offers a range of precision rain gauges, many built to a British Meteorological Office or World Meteorological Organization (WMO) specification, ensuring accurate rainfall collection and measurement.

We are also pleased to offer a state-of-the-art Present Weather Sensor for use in situations where visibility measurements and automatic detection of precipitation type (fog, haze, drizzle etc.) are required.

52202
TIPPING BUCKET RAIN GAUGE

Product Description

The MUNRO Tipping Bucket Rain Gauge meets the specifications of the World Meteorological Organization (WMO).
The design uses a proven tipping bucket mechanism for simple and effective rainfall measurement. The bucket geometry and material are specially selected for maximum water release, thereby reducing contamination and errors.
Catchment area of 200cm^2 & measurement resolution of 0.1 mm meet the recommendations of the WMO. Leveling screws and bullseye level are built-in for easy and precise adjustment in the field.
Measured precipitation is discharged through a collection tube for verification of total rainfall.
Model 52202 is heated for operation in cold temperatures. An unheated version, 52203, is available for use in moderate climates.
To discourage birds from perching on the funnel rim, accessory bird wire assembly may be attached to the gauge.

Technical Specifications

Size	18 cm dia. x 30 cm high, (39 cm high with mounting base)
Catchment Area	200 cm^2
Resolution	0.1 mm per tip
Accuracy	2% up to 25 mm/hr 3% up to 50 mm/hr
Output	Magnetic reed switch (N.O.), rating 24VAC/DC 500mA
Operating Temperature	-20°C to +50°C (heated)
Power	18 Watts for heater only
Mounting	Clamp for 1" (1.34" dia.) iron pipe or 3 bolts on 160mm dia. circle
Other	Leveling adjustment, thermostatic control for heater, intake screen

RAIN-VUE10
RAIN GAUGE DIGITAL OUTPUT

Product Description

The Rain-VUE10 is ideal for many hydrological or meteorological applications such as weather stations and flood warning systems. The Rain-VUE10 is an SDI-12 tipping bucket rain gage in the Rain-VUE10 family of products. Advanced algorithms and digital processing within the sensor compensate for errors caused by high-intensity rain and provide accurate precipitation and intensity measurements. Constructed of an aerodynamic plastic funnel, the Rain-VUE10 is cost effective and minimizes the amount of liquid precipitation that is lost due to the effects of wind. This rain gage offers the user flexibility with the option to select from a series of set cable lengths or a user-defined cable length.

Benefits and Features:

- Durable ASA plastic construction providing UV stability and exceptional strength for all environments
- Digital processing to correct for high-intensity precipitation errors up to 500 mm/h (20 in./h)
- Precipitation intensity measurements up to 1000 mm/h
- Meets WMO recommendations for funnel area
- Tilt, internal temperature, & voltage measurement for remote diagnostics on the sensor
- Built-in bubble level for easy leveling
- Adjustable mounting feet to simplify leveling
- Unique aerodynamic shape to increase accuracy by minimizing effects of wind
- Built-in data recording and battery backup to prevent data loss from power or communications disruptions.

RAIN-VUE10

Technical Specifications

Sensor Type	Tipping bucket with magnetic reed switch
Material	njection-molded, highly robust, UV-stabilized plastic (ASA LI-911)
Output	SDI-12 version 1.4
Sensor Configuration	SDI-12 or USB
Operating Temperature Range	-40 to +70°C (including melting snow) 1 to 70°C (liquid precipitation only)
Power Requirements	6 to 18 Vdc
Current Drain	1 mA (active) 0.07 mA (quiescent)
Internal Battery	240 mAh lithium battery (provides up to 15 days of continual operation after power loss; battery will last longer under ideal conditions)
Response Time	1 s (for M1! command) 0 s (for M0! command)
Measurement Uncertainty	1° (tilt) 0.25°C (temperature) 0.5 V (supply voltage) Note: Accuracy over the rain intensity range requires a mechanical calibration that is within 1% at a 1 in./h intensity. Rain-VUE10 sensors are calibrated at the factory to meet this specification but should be verified prior to deployment.
Orifice Diameter	20.0 cm
Collecting Area	314.16 cm^2
Height	43.5 to 46.5 cm with feet adjustment
Weight	2 kg
0.01 INCH OPTION	
Measurement Range	0 to 1200 mm/h
Precipitation Amount Resolution	0.254 mm
Precipitation Amount Measurement Uncertainty	1% at 0 to 1200 mm/h intensity
Precipitation Intensity Range	0 to 1200 mm/h
WMO Compliant	No
0.1 MILLIMETER OPTION	
Measurement Range	0 to 500 mm/h
Precipitation Amount Resolution	0.1 mm
recipitation Amount Measurement Uncertainty	The larger of 0.1 mm or 4% error at 0 to 500 mm/h intensity
Precipitation Intensity Range	0 to 500 mm/h
Precipitation Intensity Measurement Uncertainty	≤ 3.5% at 0 to 300 mm/h ≤ 5% at 0 to 500 mm/h
WMO Compliant	Yes
0.2 MILLIMETER OPTION	
Measurement Range	0 to 1000 mm/h
Precipitation Amount Resolution	0.2 mm
Precipitation Amount Measurement Uncertainty	< 4% at 0 to 1000 mm/h intensity
Precipitation Intensity Range	0 to 500 mm/h
Precipitation Intensity Measurement Uncertainty	4% at 0 to 1000 mm/h
WMO Compliant	No

CS120A
HIGH PERFORMANCE VISIBILITY MEASUREMENTS

Product Description

The CS120A Visibility Sensor uses tried-and-tested, infrared for-ward-scatter technology, and uses the proven 42° scatter angle to report meteorological observable range (MOR) for fog and snow in the range 10 to 30,000 m. It combines a high specification with a very competitive price & is ideal for stand-alone applications or in combination with automatic weather stations in road, aviation, wind-energy, and marine environments.

Benefits and Features:

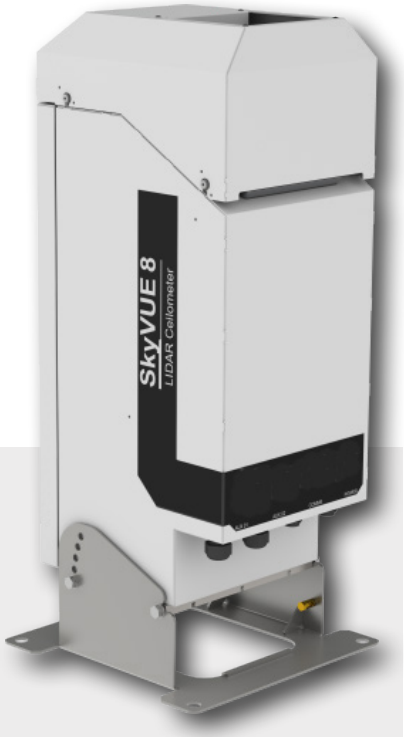
- High-performance sensor at a competitive price
- FAA-recommended 42° scatter angle for good Meteorological Observable Range (MOR) readings in all precipitation types
- Incorporates automatic dew and hood heaters for all weather operation
- ISimple field calibration using optional calibration kit
- ILow power—suitable for remote application
- IAutomatic status check for faults or window contamination Sensor design minimizes air flow disruption at measurement volume.

Technical Specifications

OPERATIONAL	
Max. / Min. Reported Visibility	32 km / 10 m
Operating Temperature	-25° to +60°C
Operating Humidity	0 to 100%
Wind Speed	Up to 60 m s^{-1}
Sensor Sealing	Rated to IP66
Accuracy	0 to 10,000 m: ±10% 10,000 to 20,000 m: ±20%
OPTICAL	
Emitter Light Frequency	850 nm
Lens Contamination Circuitry	Monitors both the source and detector lenses for contamination/blockage at 1 s intervals; sensor adjusts its calibration for low to moderate window contamination
Light Source Stability Control	Ensures stable operation through variations in temperature and with sensor aging; corrected at 1 s intervals.
MECHANICAL	
Weight	~3 kg (dependent upon mounting system)
Height / Width / Depth	44.7 cm / 64 cm / 24.6 cm
Mounting	Stainless-steel V-bolt bracket that attaches to a pole with a 32 to 52.5 mm outer diameter

SkyVUE8

8 KM CEILING LIDAR CEILOMETER



Cloud measurement with state-of-the-art signal processing

The SkyVUE™8 LIDAR Ceilometer is ideal for measuring cloud base heights and vertical visibility at airports, helipads (onshore or offshore), & other meteorological applications. The SkyVUE™8 measures the atmosphere with high stability and repeatibility, providing you with information on cloud base heights, sky condition (up to five layers), vertical visibility, and raw backscatter profiles. Notably, the ceilometer meets or exceeds all the necessary ICAO, CAA, and WMO requirements and recommendations.
Because of its robust construction, the SkyVUE™8 only requires minimal maintenance and can be continuously used in either static or mobile applications in harsh environments. Its compact design and low weight of 18 kg make it easy to transport and deploy. With an operational reporting range of 8 km, the SkyVUE™8 has one of the highest in its class. It is easy to use yet features advanced signal processing and unique optics to provide superior resolution and performance. The SkyVUE™8 has many standard features, from a tilting base and two-axis inclinometer for automatic correction of cloud base heights to heaters, blowers, and a sun filter for operation under all conditions-making deployments possible around the world. Unique standard features include an easy-to-operate stratocumulus calibration, long-life back-up battery, and twin clocks to augment its many continuous diagnostic self-checks & provide assurance of continuous, reliable, and accurate performance.

Benefits and Features:

- Single-lens design for high signal-to-noise ratio and maximized detector sensitivity, resulting in greater performance at low and high altitudes
- High performance and high specification at a competitive price
- Low power consumption.
- Tilt angles to 24°, improving performance during precipitation events and reducing impact of solar glare
- Unique continuous comparison of two separate internal quartz clocks to eliminate possibility of clock drift and ensure measurement confidence
- User-friendly stratocumulus calibration capability & easy test with a calibrator plate provided as standard for easy field calibration.

SkyVUE8

Detailed Description:

The SkyVUE™8 LIDAR ceilometer measures cloud base heights and vertical visibility for meteorological and aviation applications. Using LIDAR (LIght Detection And Ranging) technology, the ceilometer transmits fast, low-power laser pulses (not harmful to eyes) into the atmosphere and detects backscattered returns from clouds and aerosols above the instrument.

A unique, efficient, single-lens design increases optical signal-to-noise ratio and allows for larger optics in a compact package, improving accuracy and measurement performance.

This approach, along with state-of-the-art electronics, provides a powerful and stable platform from which to measure cloud base heights and vertical visibility to high accuracy. The SkyVUE™8 measures the atmosphere with high stability and repeatability, delivering excellent performance in even the harshest of conditions.

The SkyVUE™8 provides information on cloud base heights, sky condition (up to five layers), vertical visibility, and raw backscatter profiles to a range of 8 km.

The unique stratocumulus calibration capability, which allows users to calibrate measurements of scatter coefficients, uses a simple and user-friendly field method, giving complete confidence in the scatter profiles reported and removes the requirement to have the unit sent back for calibration.

Reliable range measurement is further assured by cross-checking two separate internal quartz clocks, eliminating the possibility of unidentified errors due to clock drift.

The SkyVUE™8 can be tilted at various angles up to 24°. Tilting the SkyVUE™ by even a few degrees can be important, as it allows the ceilometer to resist high levels of reflection from large raindrops and frozen particles that can impair vertical-type sensors. The tilt also improves rain run-off on the ceilometer window, resulting in a much higher performance compared with vertical ceilometers.

Tilting to 24° also means that it can be operated anywhere in the world without the sun shining into the lens and resulting in missing data. An internal two-axis inclinometer provides automatic correction of cloud base heights at all angles, ensuring ease of installation and confidence that cloud base heights are automatically corrected throughout the lifetime of the installation.

The SkyVUE™8 complies with ICAO, CAA, and WMO guidance and meets or exceeds all recommendations and specifications. (This includes ICAO 9837, ICAO Annex 3, CAP437, and CAP746.)

Software for data visualization and interpretation

Ceilometer data can be displayed using MUNRO's Viewpoint software or fed directly into existing data systems. The MUNRO's Viewpoint software will display the output from the ceilometer in a convenient and configurable form, including information on sky condition, mixing layers, scatter profiles, etc. All can be displayed simultaneously or separately with ranges and time scales. For more information on Viewpoint click here.

SkyVUE8

Technical Specifications

Dimensions	737 x 294 x 240 mm (29.0 x 11.6 x 9.5 in.) including tilt base
Power Supply Cable Length	10.06 m (33 ft)
Data Cable Length	10.06 m (33 ft)
Weight	18 kg (39.7 lb)
INSTRUMENT PERFORMANCE	
Reporting Range	0 to 8 km (0 to 26,250 ft)
Minimum Reporting Resolution	5 m (16.4 ft)
Hard Target Range Accuracy	±0.25%, ±4.6 m (15.1 ft)
Reporting Cycle	2 to 600 s
Cloud Layers Reported	Up to four layers
Sky Condition	Up to five layers with cover in oktas according to WMO requirements for SYNOP and METAR codes as standard
Vertical Visibility	Reported when there is obscuration but no clouds detected
Laser Type	InGaAs
Laser Wavelength	912 nm (±5 nm)
ELECTRICAL SPECIFICATION	
Power Source	AC power source 115/230 Vac ±15% (auto switching), 50 to 60Hz Power drain from 230V is 15W minimum, up to 380W with all the heaters on. (Optional current limited mode: 250 W max.)
Battery	Internal 12 V 7 Ah battery backup
Interfaces	Maintenance - USB 2.0 (USB 1.1 compatible) Data - RS-232 / RS-422 / RS-485 / Ethernet option Baud Rate - 300 to 115200 bps
ENVIRONMENTAL SPECIFICATION	
Temperature Range	- 40° to +60°C (-40° to +140°F) excluding battery - 50° to +60°C (This extended version is available as a special. Contact MUNRO for more inf.)
Humidity Range	0 to 100% RH
IP Rating	IP66 (NEMA 4X)
Maximum Wind Speed	55 m/s (123 mph)
COMPLIANCE AND TESTING	
Note	Further details regarding compliance & testing are available upon request
EMC Compliance	EN 61326-1:2013
Electrical Safety Compliance	EN 61010-1:2010
Laser Safety Compliance	EN 60825-1:2014
Eye Safety Standard	Class 1M
Vibration	BS EN 60068-2-6:2008 Test Fc: Vibration (Sinusoidal)
Frequency Range	5 to 150 Hz (exceeds Lloyd's Register test levels)

SkyVUEPRO
10 KM CEILING LIDAR CEILOMETER

Cloud measurement with advanced signal processing

The SkyVUE™PRO LIDAR Ceilometer measures cloud height and vertical visibility for meteorological and aviation applications and is ideal for long-term research applications where a high level of detail is required.
Its robust construction is ideal for long-term installation, as it requires minimal maintenance and features a unique stratocumulus calibration procedure- allowing the ceilometer to be calibrated in the field.
The SkyVUE™PRO complies with CAA, WMO, and ICAO guidance and meets or exceeds all recommendations and specifications, including CAP437, CAP670, and CAP746.
With an operational reporting range of 10 km, the SkyVUE™PRO is easy to use yet boasts advanced signal processing and unique optical arrangements to provide superior resolution and performance.
The SkyVUE™PRO has many standard features, from a tilting base & two-axis inclinometer for automatic correction of cloud heights to heaters, blowers, and a sun filter for operation under all conditions making deployments possible around the world.
Unique standard features include an easy-to-operate stratocumulus calibration, long-life back-up battery, and twin clocks to augment its many continuous diagnostic self-checks and provide assurance of continuous, reliable, & accurate performance.

Benefits and Features:

- Single-lens design for high signal-to-noise ratio and maximized detector sensitivity, resulting in greater performance at low and high altitudes
- High performance and high specification at a competitive price
- Tilt angles to 24°, improving performance during precipitation events and reducing impact of solar glare
- Unique continuous comparison of two separate internal quartz clocks to ensure measurement confidence
- Mixing layer height assessment option for air-quality applications
- User-friendly stratocumulus calibration capability & easy test with a calibrator plate provided as standard for easy field calibration.

SkyVUEPRO

Detailed Description:

The SkyVUE™PRO LIDAR ceilometer measures cloud height and vertical visibility for meteorological and aviation applications or long-term research applications where a high level of detail is required. Using LIDAR (LIght Detection And Ranging) technology, the instrument transmits fast, low-power laser pulses into the atmosphere and detects backscattered returns from clouds and aerosols above the instrument.

A unique, efficient single-lens design increases optical signal-to-noise ratio and allows for larger optics in a compact package, improving accuracy and measurement performance. The optics are immune to damage from direct sunlight.

This approach, along with state-of-the-art electronics, provides a powerful and stable platform from which to measure cloud height and vertical visibility to high accuracy. The SkyVUE™PRO measures the atmosphere with high stability and repeatability, delivering excellent performance in even the harshest of conditions.

The SkyVUE™PRO provides information on cloud height, sky condition (up to five layers), vertical visibility, and raw backscatter profiles to a range of 10 km.

An automated Mixing Layer Height (MLH) option is available for air-quality applications. MLH is an important parameter in modelling air quality and air pollution episodes. The MLH is determined based on the operational algorithm used by KNMI, which detects the top of boundary layers.

The algorithm runs within the SkyVUE™PRO itself, and the results are incorporated in data messages, making it easy to incorporate the MLH into whatever systems are already in use without the need to run external special software. If you require the MLH option, please contact us.

The unique stratocumulus calibration capability, which allows users to calibrate measurements of scatter coefficients, uses a simple and user-friendly field method, giving complete confidence in the scatter profiles reported and removes the requirement to have the unit sent back for calibration.

Reliable range measurement is further assured by cross-checking two separate internal quartz clocks, eliminating the possibility of unidentified errors due to clock drift.

The SkyVUE™PRO can be tilted at various angles up to 24°. A small tilt is important, as it allows the ceilometer to resist high levels of reflection from large raindrops and frozen particles that can impair vertical-type sensors. The tilt also improves rain run-off on the ceilometer window, resulting in a much higher performance compared with vertical ceilometers.

Tilting to 24° also means that it can be operated anywhere in the world without the sun shining into the lens and resulting in missing data. An internal two-axis inclinometer provides automatic correction of cloud height at all angles, ensuring ease of installation and confidence that cloud heights are automatically corrected throughout the lifetime of the installation.

Software for data visualization and interpretation

Ceilometer data can be displayed using MUNRO's Viewpoint software or fed directly into existing data systems. The MUNRO Viewpoint software will display the output from the ceilometer in a convenient and configurable form, including information on sky condition, mixing layers, and scatter profiles. All can be displayed simultaneously or separately with ranges and time scales. For more information on Viewpoint click here.

SkyVUEPRO

Technical Specifications

Dimensions	100 x 32.7 x 28.1 cm (39.4 x 12.9 x 11.1 in.) including base
Shipping Dimensions	120 x 45.0 x 45.0 cm (47.2 x 17.7 x 17.7 in.)
Weight	32 kg (71 lb) without cables
Shipping Weight	58 kg (127.9 lb)
INSTRUMENT PERFORMANCE	
Reporting Range	0 to 10 km (0 to 33,000 ft)
Minimum Reporting Resolution	5 m (16.4 ft)
Hard Target Range Accuracy	±0.25%, ±4.6 m (15.1 ft)
Reporting Cycle	2 to 600 s
Cloud Layers Reported	Up to four layers
Sky Condition	Up to five layers with cover in oktas according to WMO requirements for SYNOP and METAR codes as standard
Vertical Visibility	Reported when no clouds selected
Laser Type	912 nm (±5 nm)
Eye Safety Standard	Class 1M
ELECTRICAL SPECIFICATION	
Power Source	110, 115, 230 Vac ±10%, 50 to 60 Hz, 470 W maximum
Battery	Internal 12 Vdc, 2 Ah battery backup Provides 2 h measurement, without blower/heater, in the event of mains failure.
Interfaces	Data - RS-232 / RS-422 / RS-485 / Ethernet Baud Rate - 300 to 115200 bps Maintenance - USB 2.0 (USB 1.1 compatible
Laser Safety Compliance	EN60825-1:2001
Electrical Safety Compliance	EN61010-1
ENVIRONMENTAL SPECIFICATION	
Temperature Range	- 40° to +60°C (-40° to +140°F) excluding battery - 20° to +50°C (4° to +122°F) with standard battery
Humidity Range	0 to 100% RH
IP Rating	IP66 (NEMA 4X)
Maximum Wind Speed	55 m/s (123 mph)
Frequency Range	5 to 150 Hz (exceeds Lloyd's Register test levels)

OTT-RLS
NON-CONTACT WATER LEVEL SENSOR FOR LONG TERM SURFACE WATER MEASUREMENTS

Non-contact water level sensor for long term surface water measurements

The OTT-RLS is a non-contact radar level sensor with pulse radar technology.
The OTT-RLS offers a large measurement range with a small blanking distance and narrow beam width and it easily connects to most dataloggers. The RLS has extremely low power consumption & is ideal for remote or solar powered sites.

- Application - Surface water
- Parameters measured - Water level/distance to water
- Measurement technology - Non-contact pulse radar
- Product Highlights - Measures water level or depth to water from a bridge, pier or mounting arm
- Measurement range - 0.4 ... 35m
- Accuracy - 0.8 ... 2 m: ± 10 mm; 2 ... 30 m: ± 3 mm; 30 ... 35 m: ± 10 mm
- Internal data logger - No
- Interface - SDI-12, RS-485 (using SDI-12), or 4 ... 20 mA

Advantages

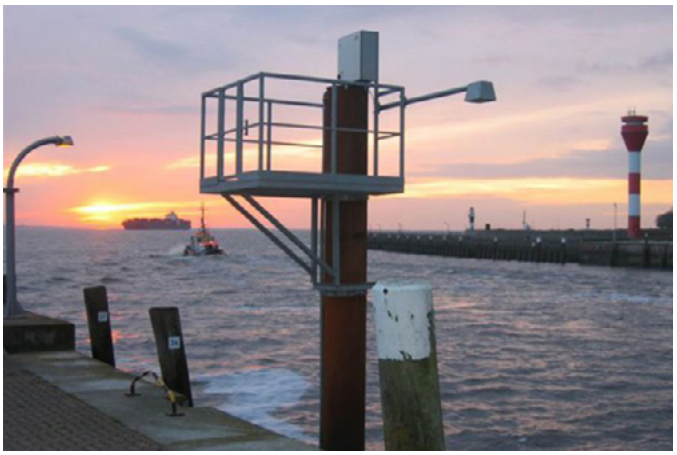
- No drift over time
- High Performance-Measurements are unaffected by air temperature, humidity, flood events, floating debris, or contaminated water; reduces the likelihood of missing data and reduces data post processing
- Low Maintenance-Flat antenna design eliminates nesting areas for insects and periodic maintenance requirement
- Flexible Integration/Easy Setup–Connects to most data loggers via standard communication interfaces, SDI-12 or 4 ... 20 mA; no need for additional PC software
- Simple Installation-Light weight compact design facilitates easy mounting on bridges, extension mounting bracket or inside a small protective housing
- Low Profile Design-Unobtrusive appearance is ideal for urban installation sites or sites prone to vandalism
- Low Power Consumption-Ideal for remote or solar powered sites; requires only 12 mA when active.

OTT-RLS

Example for Use

For surface water level measurement of:
- Streams and rivers
- Tidal zones
- Reservoirs and lakes

Ideal for monitoring:
- Surface waters prone to flooding
- Sediment or debris laden streams and rivers
- Migrating channels.



Technical Specifications

Water Level Measurements	
Measuring range: distance to water surface	0.4 ... 35 m
Resolution SDI-12 output	0.001 m
Accuracy (SDI-12)	0.4 ... 2.0 m: ±10 mm; 2.0 ... 30 m: ±3 mm; 30 ... 35 m: ±10 mm
Average temp. coefficient (-20 ... +40°C)	0.01 % full scale/10K
Accuracy (4 ... 20 mA)	±0.1 % full scale
Average temperature coefficient	10 ppm full scale/°C (at 20°C)
Measuring time	20 s
Beam angle of antenna (width of beam)	12 °
Electrical Data	
Power supply	5.4 ... 28 V DC, typ. 12/24 V DC
Power consumption in active mode (at 12V)	<15 mA
Power consumption in rest mode (at 12 V)	<0.05 mA
Interfaces	4 ... 20 mA, SDI-12, RS-485 (SDI-12 Protocol)
Material	
Housing	ASA (UV-stabilized ABS)
Radom (front plate)	TFM PTFE
Mounting bracket **Lateral axis**	1.4301 (V2A) ±90 °
Longitudinal axis	±15 °
Dimensions and Weight	
Weight (incl. mounting bracket) **Operating temperature:**	approx. 2.1 kg -40 ... +60°C
Storage temperature	-40 ... +85°C
Relative humidity	0 ... 100 %
Type of Protection	
With horizontal mounting	IP67 (submersion depth max. 1 m; submersion duration max. 48 h)
EMV limits and radio approvals	
EMV for low power radio devices	ETSI EN 301 489-3
Low-voltage device safety	EN 60950-1
Radio approval for low power radio devices* Short Range Device (SRD)	
Europe	ETSI EN 300 440
USA	FCC 47 CFR Part 15
Canada	RSS 210 Issue 7

OTT-CBS
NON-CONTACT BUBBLER SENSOR FOR LONGTERM SURFACE WATER LEVEL MONITORING

Non-contact, bubbler sensor for longterm surface water level monitoring

The OTT-CBS is a compact, accurate, and low power bubbler sensor for surface water level monitoring. The OTT-CBS meets or exceeds USGS standards for accuracy, and will not drift over time. It features outputs for SDI-12 and 4...20 mA.

- Application - Surface water, Groundwater
- Measurement technology - Bubbler-in
- Product Highlights - Drift-free water level measurement - no pressure sensor or electronics in the water
- Measurement range - 0 to 15 m or 0 to 30 m
- Accuracy - ± 3 mm (high accuracy version); ± 5 mm (standard and 30 meter versions)
- Internal data logger - No
- Interface - SDI-12, RS-485 (using SDI-12), or 4 ... 20 mA

Advantages

- Accurate—Meets and exceeds USGS guidelines for water level accuracy, and will not drift over time
- Complete Solution—Combining the CBS with an EPS-50 bubble chamber reduces the influence of wave action and prevents unnecessary noise in your data
- Low Maintenance—No desiccant, pump maintenance, or lubrication required
- Easy-to-Start/Install—All programming can be completed using DIP switches; connect into existing platforms using 3/8' O.D. or 4mm O.D. measuring tube (no adapters required)
- Compact Size—small and powerful pump motor generates the required volume of air to perform measurement.
- Low Power—Intelligent pumping strategy compares the previous measurement to the actual pressure at the current measurement, and optimizes the pumping time depending on the difference (i.e., small changes in level are measured with very short pump cycles)

OTT-CBS

Example for Use

For surface water level measurement of:
- Streams, rivers, channels, or canals
- Groundwater wells
- Reservoirs, lakes, and wetlands

Ideal for monitoring:
- Continuous water level networks
- Lightning prone areas
- Channels with long, flat embankments

Technical Specifications

Water Level Measurements - Measuring range	
Version ''Standard'' & ''USGS specification''	0 ... 15 m (0...50 ft)
Version ''30 m measuring range''	0 ... 30 m (0...100 ft)
Resolution	1 mm (0.01 ft)
Accuracy - Version ''Standard'' and ''30m measuring range''	±5 mm
Accuracy - Version ''USGS specification''	0 ... 15 ft: ±0.01 % 15 ... 50 ft: ±0.065 % of measurement value or 0.02 ft, whichever is less
Accuracy - Units	m, ft, bar, PSI
Electrical Data	
Interfaces	4 ... 20 mA, SDI-12, SDI-12 via RS-485
Power supply	10 ... 30 V DC, typ. 12/24 V DC
Current consumption	
Interfaces	
Material	
Measuring interval 1 min	typ. 320 mAh/day
Measuring interval 15min	typ. 25 mAh/day
Housing material	ABS
Dimensions L x W x H	165 mm x 205 mm x 115 mm
Weight	approx. 1,500 g
Protection class	IP43
Environmental conditions	
Operating temperature	-20 ... +60°C
Storage temperature	- 40 ... +85°C
Relative air humidity	10 ... 95 %; not condensing
Measuring tube	inner diameter typ. 2 mm or 4 mm
EMV - limit values	According to IEC61326 and EN61326

OTT-KL-010 SERIES
CONTACT GAUGES FOR MEASUREMENTS OF DEPTH TO WATER, TEMPERATURE AND CONDUCTIVITY

Contact Gauges for measurements of depth to water, temp. & conductivity

Contact Gauges are essential for manual measurements of depth to water, temperature, & conductivity in groundwater. The drum is held by a stable frame and is easy to carry. It is very smooth, so that you can effortlessly drain and haul the probe.

OTT-KL-010
The OTT-KL-010 Contact Gauge measures the distance to water. Once the probe touches the water surface, you get a signal and you can see the distance to water.

For depths of 15 ... 750 m

OTT-KL-010-TM
In addition to the OTT-KL-010 the OTT-KL-010-TM comes with a temperature sensor and display for displaying the water temperature. Also suitable for depth profile measurement.

For depths of 25 ... 500 m

OTT-KL-010-TCM
With conductivity sensor and display for the output values temperature, conductivity and TDS (Total Dissolved Solids). Also for creating temperature and conductivity profiles.

For depths of 30 ... 500 m.

- Measurement range - Measuring tape lengths KL-010: 15 ... 750 m; KL-010-TM: 25 ... 500 m;
  KL-010-TCM 30 ... 500 m
- Application - Groundwater
- Measurement technology - Contact gauge
- Parameters measured - Water level / Distance to water, Temperature, Conductivity
- Product Highlights - Manual water level, temp. &/or conductivity measurement.

Advantages
- Optic and acoustic signals.
- High-strength special plastic frame with robust drum.
- Probe body: stainless steel (V2A) /nickel-plated brass; easy to clean.
- Accurate, length-stable measuring tape with cm graduation and dm marking.
- Optional: temperature measurement with LCD-display.
- Optional: conductivity- and temperature measurement with LCD-display.

OTT-KL-010 SERIES

Example for Use

OTT-KL-010 Series in general
- Measurement of depth to water in monitoring wells
- Control and reference measurements, calibration of groundwater dataloggers
- Test measurements at pumping tests

OTT-KL-010-TM
- Creating temperature profiles
- Monitoring impacts on groundwater temperature
- Depth and temperature measurements

OTT-KL-010-TCM
- Creating temperature and conductivity profiles
- Check for salt water intrusion in coastal areas
- Indicator measurements at immission pumping tests
- Spot measurements for potential pollution.

Technical Specifications

OTT-KL-010	
Measuring tape lengths	15, 25, 30, 50, 80, 100, 150, 200, 250, 300, 500 and 750 m
Measuring accuracy	0.1 % FS
Signalling	Optical (signal lamp; LED optionally) & accoustic
Power supply	6 V DC; 4 x 1.5 V C-type cells (alkaline)
Operating life	≥12 months (KL 010 / TM)
Probe body	Stainless steel/nickel-plated brass, 15 mm Ø, 190 mm long
Weight	approx. 3.8 kg (15 m), 18.5 kg (750 m)
Operating temperature range	-30 ... +75°C
OTT-KL-010-TM	
Measuring tape lengths	25, 50, 100, 150, 200, 250, 300 and 500 m
Resolution	0.1 % FS
Temperature sensor	-5°C ... +60°C
Accuracy	±0.1°C
Resolution	0.1°C
Signalling/Indication	Display (LCD), 3 ½ digits, Button to display battery capacity in %, Optical signal (LED) & accoustic
Power supply	6 V DC; 4 x 1.5 V C-type cells (alkaline)
Operating life	≥12 months (KL 010/TM)
Probe body	Ø 15 mm, 183 mm long
Material	Stainless steel/nickel-plated brass
Weight	approx. 3.6 kg (25 m), 14.3 kg (500 m)
Operating temperature range	-30 ... +75°C
OTT-KL-010-TCM	
Measuring tape lengths	30, 50, 100, 150, 200, 250 and 500 m
Resolution	0.1 % FS
Temperature sensor	-1 ... + 70°C
Accuracy	±0.1°C
Conductivity measuring cell	0 ... 200 mS/cm
Accuracy	±0.5% of measured value, min. ±2 S/cm
Signalling/Indication	Display (LCD), 3 digits, bar graph display for battery state, Optical signal (LED) & accoustic
Power supply	6 V DC; 4 x 1.5 V C-type cells (alkaline)
Operating life	approx. 18 h operating time
Material	Stainless steel
Probe body	Ø 20 mm, 238 mm long
Weight	approx. 3.7 kg (30 m), 14.5 kg (500 m)
Temperature operating range	-20 ... +75°C
GENERAL	
Measuring tape	White polyethylen tape (2 wires), Conductor in high strength, rust & acid resistant stainless stell wires, Meter graduation in red, centimetre marks and decimetre graduation in black on white tape
Tape drum	Special plastic, high strength, resistant to low temperatures, Protection Class IP64
Frame design 1	Cast aluminium, steel
Frame design 2	Special plastic, high strength, resistant to low temperatures

OTT-PLS-500

ROBUST CERAMIC PRESSURE TRANSDUCER FOR WATER LEVEL MEASUREMENT

Building on years of experience with the robust & accurate OTT-PLS, the OTT-PLS-500 water level monitoring solution adds innovative metadata and internal sensors to remotely verify device performance providing peace of mind for long term deployment.

- Application - Surface water, Groundwater
- Measurement technology - Vented pressure cell
- Parameters measured - Water Level, Pressure, Temperature, Position of Sensor, Internal Relative Humidity.
- Product Highlights - Water level and temperature measurement - for use with external data logger
- Measurement range - 0 ... 10, 20, 40, and 100 m
- Accuracy - ± 0.05% full scale (linearity and hysteresis) // Meets USGS OSW
- Internal data logger - No
- Interface - SDI-12 and RS485 (SDI-12 v1.4 and Modbus RTU).

Example of Use

Measuring water level in surface and groundwater, including:

- Stations with sloping bottom, e.g. water banks
- Small diameter pipes or holes (from 1" Ø)
- Dams, weirs, irrigation systems
- Water ways that occasionally ice over
- Brackish water, saltwater
- Flood warning
- Waterways that do not contain water throughout the year (e.g. retaining basins).

OTT-PLS-500

Advantages

The OTT-PLS-500 measures water level, depth to water, or pressure by means of an easy to maintain, ceramic pressure cell. This highly accurate sensor includes design features such as four internal compensations, stainless steel housing, and a rugged cable making it ideal for monitoring water level in a variety of applications. Common communication protocols (SDI-12 and Modbus RTU) allow for seamless integration with external data loggers. The accurate temperature measurements and built-in microcontroller compensate for environmental changes in water density. Built-in QA/QC and metadata along with reduced sensor drift allow you to have full confidence in your long-term data.

- **Automatic Compensations:** Automatically compensate for changes in atmospheric pressure with the vented probe. Reduce the amount of equipment needed in field by forgoing additional barometric pressure sensors and achieve better accuracy with a single compensated sensor.
- **Custom Cable:** All PLS 500s are manufactured with cables cut to the users specifications upon order. Please specify the length of cable (meters or feet) that you require with any quoted item
- **Position Sensor:** Remotely monitor probe movement in the field with an internal inclinometer, enabling warnings if sensor position has changed due to in-stream events via automatic status flags or direct measurement.
- **Internal Humidity Sensor:** The integrated internal humidity sensor outputs automatic status flags or direct humidity measurements to help you understand if condensation may have formed, impacting your pressure measurements.
- **Data Processing:** Internally convert high frequency (4 Hz) measurements to calculations such as computed averages, minimum/maximum levels, and instantaneous values over user defined intervals, enabling greater information reporting and eliminating manual data post-processing/analysis.
- **Discharge Calculations:** Automatically calculate discharge from either a user defined rating table or ISO 1100-2 exponential formula set-up via SDI-12 commands. Minimize the need for data post-processing by directly outputting discharge from a trusted level sensor.
- **Rugged Design:** Ceramic pressure cell resistant to physical force and enclosure made of high-quality, saltwater resistant 904L stainless steel for use in coastal environments. The robust ceramic pressure cell offers industry-leading accuracy and does not deform over time like membrane technology, providing long-term measurement stability.

OTT-PLS-500

Technical Specifications

WATER LEVEL (PRESSURE)	
Measurement Range	0 ... 10 m, 20 m, 40 m, 100 m / 0 ... 33 ft, 66ft, 131 ft, 328 ft
Accuracy (linearity and hysteresis)	±0.05 % full scale
Accuracy (linearity and hysteresis) USGS OSW 0 ... 10m / 0 ... 1 bar variant	±2mm / 0 ... 5m (-5 ... +55°C) ±3mm / 0 ... 5m (-20 ... -5°C; +55 ... +70°C) ±5mm / 5 ... 10m (-20 ... +70°C) 0.007ft / 0...17ft (+23...+131°F) 0.010ft / 0...17ft (-4...+23°F; +131...+158°F) 0.017ft / 17... 33ft (-4... +158°F)
Long-term stability (linearity & hysteresis)	± 0.1%/full scale
Units	m, cm, mm, bar, mbar, kPa ft, inch, psi
Pressure Sensor	Ceramic / temperature compensated
Resolution	0.001m / 0.1cm / 0.00001bar / 0.01mbar 0.001ft / 0.001in / 0.00001psi
Temp.-compensated operating range	-20°C (ice-free) ... +70°C / -4°F (ice-free) ... +158°F
TEMPERATURE	
Measuring Range	-40°C ... +70°C / -40°F ... +158°F
Resolution	0.01°C / 0.01°F
Accuracy	±0.15°C (Typ. ± 0.05°C) / ±0.07°F (Typ. ± 0.03°F)
Units	°C / °F
INTERNAL RELATIVE HUMIDITY	
Measuring Range	0 ... 100% RH (non-condensing)
Resolution	1% RH
Accuracy	± 3% (0 ... 100% RH) Typically ± 2% (10 ... 80% RH)
Units	% RH
COMMUNICATION	
Physical interfaces	SDI-12 and RS-485
R5-485 protocols	SDI-12 (V1.4), Modbus RTU
POWER	
Supply voltage	5.5 ... 28.8 V, typically 12/24 V DC
Power consumption - sleep	< 250 µA; typically 15 µA
Power consumption - active	< 4mA; typically 2.9 mA
MEASUREMENT	
Measured Values	- Water level/water pressure - Internal Relative Humidity - Water temperature - Position of sensor
Value Processing	- Average pressure or level over measurement interval - Minimum pressure or level over measurement interval - Maximum pressure or level over measurement interval - Median pressure or level over measurement interval - Standard deviation of pressure over measurement interval
Derived Parameters	Discharge
Measurement Interval	0.5 s ... 59.5 s (1.5 s default)
ENVIRONMENTAL	
Temperature range, operating	-20°C (ice-free) ... +70°C / -4°F (ice-free) ... +158°F
Temperature range, storage	-40°C ... +80°C / -40°F ... +176°F
Humidity	0% ... 100%
IP rating (probe)	IP68
DIMENSIONS/WEIGHT	
Pressure probe	LxD: 194x22 mm / LxD: 7.7 x 0.9 in
Cable length	2 ... 200 m, ± 1% / ± 5 cm // 7 ... 656 ft, ± 1% / ± 0.17 ft *Longer cable lengths available upon request.
Pressure probe	~650 g / ~22.9 oz
Pressure probe cable	~ 55 g/m // ~0.51 oz/ft
MATERIAL	
Pressure probe housing	POM, Stainless steel 1.4539 (904L); resistant to sea water
Membrane	AI203 ceramics
Cable jacket	PUR (UV resistant)
REGULATORY	
FCC CE DIN EN ISO 4373	FCC/ICES Suppliers Declaration of Conformity (SDoC) FCC Part 15 Rules Section §15.109 IEC61326-1:2013 Measurement reliability / performance class 1

OTT-PLS-C
PRESSURE PROBE WITH CONDUCTIVITY MEASUREMENT CELL

The OTT-PLS-C measures water conductivity, level, and temperature in both surface and groundwater applications with a robust ceramic pressure cell and 4-electrode conductivity cell. Its extremely low power consumption makes it ideal for long-term deployment, particularly at solar powered measuring stations for ground-and surface waters.

- Application - Surface water, Groundwater
- Measurement technology - Vented pressure cell & 4-electrode graphite conductivity cell
- Product Highlights - Water level, temperature, & conductivity measurement - for use with external data logger
- Internal data logger - No
- Interface - SDI-12 or RS-485 (using SDI-12).

Example of Use

Water level, temperature, and conductivity measurement of:

- Groundwater wells
- Streams, rivers, channels, and canals
- Reservoirs, lakes, and wetlands.

Ideal for monitoring:

- Continuous monitoring networks
- Short-term or long-term projects
- Salt water intrusion
- Aquifer storage and recovery
- Estuaries and wetlands.

Advantages

Outputs for conductivity include specific conductivity, salinity, and total dissolved solids

- The robust ceramic pressure cell offers industry-leading accuracy and does not deform over time like membrane technology, providing long-term measurement stability
- Rugged design: Ceramic pressure cell resistant to physical force (4 x burst pressure) and enclosure made of high-quality saltwater resistant steel for use in coastal environments
- Vented pressure probe, automatically compensates for changes in barometric pressure
- Robust cable with Kevlar core for length stabilization and capillary tube for venting
- Built-in microcontroller – compensates for temperature effects and applies correction values for gravitational acceleration or water density
- Simple setup and connection to external dataloggers using SDI-12.

OTT-PLS-C

Technical Specifications

WATER LEVEL MEASUREMENT (PRESSURE)	
Pressure sensor	ceramic, temperature-compensated
Measuring range	0 ... 4 m, 0 ... 10 m, 0 ... 20 m, 0 ... 40 m, 0 ... 100 m water col.
Resolution	0.001 m; 0.1 cm; 0.01 ft; 0.1 mbar; 0.001 psi
Accuracy (linearity + hysteresis)	≤ ± 0.05 % FS
Long-term stability (linearity+hysteresis)	≤ ± 0.1 %/a FS
Zerodrift	≤ ± 0.1 % FS
Pressure sensor capability to withstand overloads without permanent mechanical damage	≥ 4 x measuring range
Temp.-compensated operating range	-5°C ... +45°C (ice free)
Units	m, cm, ft, mbar, psi
TEMPERATURE MEASUREMENT	
Sensor	NTC
Measuring range	-25°C ... +70°C (ice free)
Calibrated range	+5°C ... 45°C
Resolution	0.01°C
Accuracy	±0.1°C
Units	°C, °F
CONDUCTIVITY MEASUREMENT	
Sensor	4 graphite electrodes
Calibrated range	+5°C ... 45°C
MEASURING RANGE 5 ... 2.000 MS/CM	
Resolution	1µS/cm
Accuracy	±1 µS/cm or ± 0.5 % of measured value (whichever is higher)
Unit	µS/cm
MEASURING RANGE 0.1 ... 100 MS/CM	
Resolution	0.01 mS/cm
Accuracy	± 0.01 mS/cm or ±1.5 % of measured value (whichever is higher)
Unit	mS/cm
OPTIONS	
Temp. compensation, conductivity	freshwater, saltwater, standard method 2510, ISO 7888/EN27888
Salinity calculation	Standard method or USGS 2311
ELECTRICAL DATA	
Supply voltage	6 ... 27 V DC, typically 12/24 V DC
POWER CONSUMPTION	
SDI-12 sleep-mode	<30 µAV
SDI-12 active-mode	<32 mA
Interfaces	SDI-12, RS-485 (SDI-12 protocol)
MECHANICAL DATA	
Dimensions: Probe (Ø x h)	317 mm x 22 mm
Dimensions: Cable length	SDI-12: 1 ... 100 m RS-485: 1 ... 1000 m
Material: Housing material probe	POM, stainless steel (DIN 1.4539, 904 L), resistant to sea water
Material: Cable jacket	PUR
Weight: Probe	approx. 0.43 kg
Weight: Probe cable	approx. 82 g/m
AMBIENT CONDITIONS	
Storage temperature	- 40°C ... + 85°C
Type of protection	Probe: IP 68
EMC limits	EG 2004/108/EG, EN 61326-1:2013

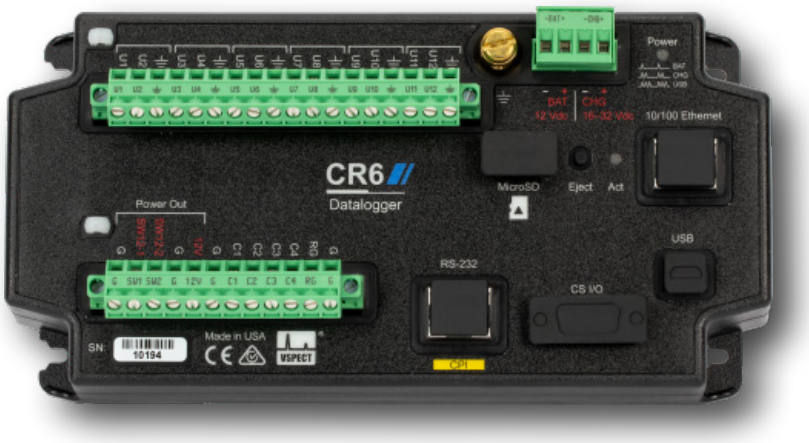
DATA LOGGERS

At the centre of any automatic meteorological or environmental monitoring system is a data logger. We supply a number of data loggers and data acquisition systems to suit the different needs of individual users. However, at their core, they share a number of features:

- Compatibile with a wide range of sensors
- Onboard data processing
- Rugged design to allow operation in extreme conditions
- Suitable for any application in which remote/unattended monitoring is required
- Seamless communication via 3G, UHF Radio Frequency, Zigbee Wireless, Modbus, USB, Ethernet (wired)

Your choice of data logger will likely depend on a number of factors including required communication protocol, sensor outputs and polling frequency. If you would like assistance selecting the data logger best suited to your needs, do not hesitate to ask.

CR6
RUGGED, WIRE-LESS EDGE DEVICE & GATEWAY WITH BUILT-IN CONNECTIVITY



Designed for geotechnical, structural, and environmental projects

The CR6 Automated Monitoring Platform, designed on decades of infrastructure and environmental monitoring experience, is used by some of the largest monitoring networks worldwide. With the unique ability to serve both as an edge device and gateway, this simplifies networks that would otherwise require discrete devices to provide complete access to your data. This unique platform is used where reliability, flexibility, and compatibility are essential to your success. The CR6 ecosystem supports an array of powerful peripherals that add channel capacity, distributed measurements, and communication capabilities, as well as measure vibrating wire sensors dynamically.

Benefits and Features:

- All-in-one edge device and gateway with built-in connectivity
- Native vibrating wire measurements using VSPECT
- Integrated communication options, charge regulator, and expandable storage to provide simplicity and reduced costs.
- Configurable Universal (U) measurement and control terminals to measure virtually any sensor or application
- Availability of MUNRO qualified support staff
- Designed and manufactured for long-term operation in extreme environments.

Detailed Description:

The CR6 is the only monitoring platform currently available that operates as an edge device and gateway with connectivity, provides an industry standard for rugged design,has universal sensor compatibility and communication options, and includes VSPECT for vibrating wire measurements.

CR6

Edge and Gateway Device:

The variability and site-specific challenges and constraints that exist in robust monitoring networks typically result in a wide array of devices to achieve full functionality. With built-in and modular measurement, processing, control, and communication capabilities, the CR6 is the only device that is needed.
As a gateway device, the CR6 converts the data measured into the format or protocol required to seamlessly communicate on your network—whether on your computer or the cloud. Entry into the network does not require a separate edge device, as the CR6 also fills this role. Additionally, the CR6 forms a network as a connectivity device via spread-spectrum radio, Wi-Fi, serial, and RS-485.
Using the CR6 as an edge device and gateway with connectivity allows you to standardize on a single platform in your monitoring program. This simplifies purchasing, inventory management, and an overall required knowledge base. The CR6 is capable of a wide range of over thirty-five M2M protocols that include PakBus, MQTT, DNP3, IPv4, IPv6, HTTP/HTTPS, and PPP. Connectivity options include cellular, radio, satellite, Ethernet, and Wi-Fi. These communication methods enable access to critical data and the ability to receive alarms triggered by user-configured thresholds and events.

Native Vibrating Wire Using VSPECT:

VSPECT, MUNRO's patented technology for measuring vibrating wire sensors, significantly improves vibrating wire sensor measurements—regardless of the manufacturer of the sensor. For more details about this unique technology visit our VSPECT® Essentials web resource.

Integrated Benefits for Simplicity and Reduced Costs:

The integrated benefits and capabilities of the CR6 make it the most flexible platform available.
In addition to several spread-spectrum radio options that are compatible with available frequencies across the world, it also includes Wi-Fi, Ethernet, and compatibility with modular cellular and satellite modems. Using MUNRO communication peripherals ensures complete compatibility and extremely low power consumption.
The built-in charge regulator, with direct connections for main power or solar panels, is used to keep your battery charged. An intelligently designed and maintained power supply ensures long-term functionality and helps to capture data from critical events when you need it.
With regular data collection intervals or remote access, the 4 MB of onboard CR6 memory will likely be sufficient. However, if your application requires high measurement frequency; long, unattended deployments; or data storage redundancy, the CR6 has built-in expandable memory via a microSD card.

Communication Options:

The CR6 Automated Monitoring Platform is available in different integrated communications frequency radio options.
CR6-WIFI - The CR6-WIFI comes factory-configured as a Wi-Fi access point. Alternatively, the CR6-WIFI can be configured to join an existing Wi-Fi network with standard or Enterprise (EAP) security.
CR6-RF407 - This 900 MHz, 250 mW, frequency-hopping spread-spectrum radio option can join a high-speed "mesh topology" radio network of other CR6s, ideal for medium-range, license-free radio communications.

CR6

CR6-RF412 - Designed primarily for unlicensed operation in Australia and New Zealand, this 922 GHz, 250 mW, frequency-hopping spread-spectrum radio can join a high-speed "mesh topology" radio network of other CR6s and is also ideal for medium-range, license-free radio communications.
CR6-RF422 - Used in the EU and ideal for short- to medium-range, license-free radio communications, this 868 MHz, 25 mW option includes listen-before-talk (LBT) and adaptive-frequency-agility (AFA). It can join a high-speed "mesh topology" radio network of other CR6s using the included RF422 radio.
CR6-RF452 - With this internal 900 MHz, 1 W, frequency-hopping spread-spectrum radio option, the CR6-RF452 can be part of a "star topology" network where all radio-frequency (RF) traffic routes back through the gateway. This option is ideal for long-range, license-free radio communications.

Universal Measurement and Control Terminals:

The Universal or "U" terminals allow each terminal to be configured to measure a multitude of different types of sensor outputs. This allows the CR6 to be used in many different applications, regardless of the sensor types required—analog, digital, smart, or vibrating wire. This nearly limitless array of sensors includes inclinometers, meteorologic, hydrologic, piezometers, water quality, etc. The flexibility of Universal channels allows you to standardize on a single monitoring platform for all projects.

Support Staff:

Recognized for more than 45 years for our outstanding customer support, MUNRO includes experienced product engineering teams, knowledgeable technical support, attentive sales staff, and market-focused professionals who are committed to ensuring your success throughout the lifetime of your project.

Rugged Design:

Unique to all CR6 Automated Monitoring Platforms is the design and manufacturing process used to ensure operational integrity in the most extreme environments. Each CR6:

- Includes surge electrostatic discharge (ESD) and over voltage protection, as well as dust protection.
- Is fully tested for shock and vibration tolerance.
- Is factory chamber tested for its full operational temperature range (standard range -40° to +70°C and extended range -55° to +85°C).
- Has been proven in hundreds of real-world applications.

These extreme measures are required to manufacture a product with a meantime between failure (MTBF) of 557 years! This means that if you purchase a CR6 today, your probability of failures during the warranty period (three years) is 0.6%. The CR6 Automated Monitoring Platform will last the entirety of your project, even if that means decades.

Technical Specifications

Note	• Additional specifications are listed in the CR6 Specifications Sheet. • This information applies to CR6 dataloggers with serial numbers 7502 and newer. These data-loggers have two blue stripes on the label.
Operating Temperature Range	• Non-condensing environment • -40° to +70°C (standard) -55° to +85°C (extended)
Maximum Scan Rate	1000 Hz
Case Material	High-impact-resistant polycarbonate and UV-resistant TPE, recycle code 7
Analog Inputs	Up to 12 single-ended or 6 differential (The CR6 has 12 universal [U] and 4 control [C] terminals that can be programmed for a variety of functions. The number of analog inputs, switched excitations, and digital ports assume all the ports are configured the same.)

CR6

Universal Inputs	12 individually configured inputs for analog or digital functions
Pulse Counters	16 (C1 to C4 and U1 to U12)
Communications Ports	Ethernet, USB Micro B, CS I/O, CPI, RS-485, RS-422, SDI-12
Data Storage Ports	microSD
Switched 12 Volt	2 terminals
Digital I/O	16 terminals (C1 to C4, U1 to U12) configurable for digital input & output. Terminals are configurable in pairs for 5V or 3.3V logic for some functions.
DIRECTION	±5 V
Analog Voltage Accuracy	• ±(0.04% of measurement + offset) at 0° to 40°C • ±(0.08% of measurement + offset) at -55° to +85°C (extended temp. range) • Accuracy specifications do not include sensor or measurement noise. • ±(0.06% of measurement + offset) at -40° to +70°C
ADC	24-bit
Power Requirements	• 16 to 32 Vdc for charger input (CHG) (Current limited at 12 Vdc to 1.2 A at 20°C maximum.) • 10 to 16 Vdc for battery input (BAT) (Current limited at 12 Vdc to 2.5 A maximum at 20°C.)
Real-Time Clock Accuracy	±3 min. per year (optional GPS correction to ±10 µs)
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, Telnet, HTTP(S), SFTP, FTP(S), POP3/TLS, NTP, SMTP/TLS, SNMPv3, CS I/O IP, MQTT
Communication Protocols	CPI, PakBus, SDM, SDI-12, Modbus, TCP, DNP3, UDP, NTCIP, NMEA 0183, I2C, SPI, and others
Battery-backed SRAM for CPU Usage & Final Storage	4 MB
Data Storage	4 MB SRAM + 72 MB flash (Storage expansion of up to 16 GB with removable microSD flash memory card.)
Idle Current Drain, Average	• < 1 mA • Assumes 12 Vdc on BAT terminals; add 2 mA if using CHG terminals.
Active Current Drain, Average	• 67 mA (20 Hz scan) • Assumes 12 Vdc on BAT terminals; add 2 mA if using CHG terminals. • 3 mA (1 Hz scan).
Static Vibrating Wire Measurements	Supported
Dimensions	21.0 x 10.2 x 5.6 cm (8.3 x 4.0 x 2.2 in.) Additional clearance required for cables and leads.
Weight	0.42 to 0.52kg (0.92 to 1.15lb) depending on communication option selected
CR6-RF407 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 928 MHz (US, Canada)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required(
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR6-RF412 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	915 to 928 MHz (Australia, New Zealand)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)

CR6

CR6-RF422 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	2 to 25 mW (user-selectable)
Frequency	863 to 870 MHz (European Union)
RF Data Rate	10 kbps
Receive Sensitivity	-106 dBm
Antenna Connector	RPSMA (External antenna required
Idle Current Drain, Average	9.5 mA
Active Current Drain, Average	20 mA
Power Requirements	
CR6-RF427 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 907.5 MHz/915 to 928 MHz (Brazil)
RF Data Rate	200 kbps
Receive Sensitivity	–101 dBm
Antenna Connector	RPSMA (External antenna required.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR6-RF452 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	10 to 1,000 mW (user-selectable)
Frequency	902 to 928 MHz
RF Data Rate	115.2 or 153.6 kbps (selectable speeds)
Receive Sensitivity	• -108 dBm at 115.2 kbps (for 10-4 BER) • -103 dBm at 153.6 kbps (for 10-4 BER)
RF Connector	Reverse Polarity SMA (RPSMA) jack (external antenna required)
Idle Current Drain, Average	15 mA (@ 12 Vdc)
Active Current Drain, Average	650 mA (@ 12 Vdc)
CR6-WIFI OPTION	
Operational Modes	Client or Access Point
Operating Frequency	2.4 GHz, 20 MHz bandwidth
Antenna Connector	RPSMA
Antenna	pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional with articulating knuckle joint for vertical or horizontal orientation
Transmit Power	7 to 18 dBm (5 to 63 mW)

CR300
COMPACT DATA LOGGER

Ideal for small applications

The CR300 is a multi-purpose, compact measurement and control data logger. This small, low-cost, high-value data logger offers fast communications, low power requirements, built-in USB, and excellent analog input accuracy and resolution. The CR300 can measure most hydrological, meteorological, environmental, and industrial sensors. It concentrates data, makes it available over varied networks, and delivers it using your preferred protocol. It also performs automated on-site or remote decision making for control and M2M communications. The CR300 is ideal for small applications requiring long-term, remote monitoring and control.

The CR300 includes Wi-Fi, cellular, or the following radio options for different regions:

- CR300-RF407: US and Canada
- CR300-RF412: Australia and New Zealand
- CR300-RF422: Europe
- CR300-RF427: Brazil

Benefits and Features:

- Connects directly to a computer's USB port
- Differentiates even slight changes in data values with higher resolutions measurements (24 bit Adc)
- Provides simple serial sensor integration and measurement with SDI-12 and/or RS-232
- Supports full PakBus networking
- Includes embedded web page for direct connection via web browser.

Detailed Description:

The CR300 is a low-powered data logger designed to measure sensors, analyze data, and store data and programs. A battery-backed clock assures accurate timekeeping. The on-board, BASIC-like programming language— common to all MUNRO data loggers—supports data processing and analysis routines.
The CR300 wiring panel includes a switchable 12 V terminal, and analog grounds dispersed among six analog terminals.

CR300

Technical Specifications

Note	Additional specifications are listed in the CR300-Series Specifications Sheet.
Operating Temperature Range	• Non-condensing environment • -40° to +70°C (standard)
Maximum Scan Rate	10 Hz
Case Material	Powder-coated aluminum
Analog Inputs	6 single-ended or 3 differential (individually configured)
Pulse Counters	8 (P_SW, P_LL, C1, C2, and SE1 to SE4)
Voltage Excitation Terminals	2 (VX1, VX2)
Communications Ports	• RS-232 • USB Micro B
Switched 12 Volt	1 terminal
Digital I/O	7 terminals (C1, C2, P_SW, and SE1 to SE4) configurable for digital input and output. Includes status high/low, pulse width modulation, external interrupt, and communication functions. Exception: The SE4 terminal doesn't do external interrupt.
Input Limits	-100 to +2500 mV
Analog Voltage Accuracy	• Accuracy specifications do not include sensor or measurement noise. • ±(0.04% of measurement + offset) at 0° to 40°C • ±(0.1% of measurement + offset) at -40° to +70°C
ADC	24-bit
Power Requirements	• 16 to 32 Vdc for charger input (CHG) (Current limited to 0.9 A maximum for power converter or solar panel input.) • 10 to 18 Vdc for external batteries (BAT)
Real-Time Clock Accuracy	±1 min. per month
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, NTP, Telnet, HTTP(S), FTP(S), SMTP/TLS, POP3/TLS
Communication Protocols	PakBus, Modbus, DNP3, SDI-12, TCP, UDP, and others
CPU Drive/Programs	80 MB serial flash
Data Storage	30 MB serial flash
Idle Current Drain, Average	1.5 mA (@ 12 Vdc)
Active Current Drain, Average	• 23 mA (@ 12 Vdc with processor always on) • 5 mA (@ 12 Vdc for 1 Hz scan with 1 analog measurement)
Dimensions	13.97 x 7.62 x 4.56 cm (5.5 x 3.0 x 1.8 in.) Additional clearance required for cables and leads.
Weight	242 to 250 g (0.53 to 0.55 lb) depending on communication option selected
CR300-RF407 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 928 MHz (US, Canada)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR300-RF412 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	915 to 928 MHz (Australia, New Zealand)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)

CR300

Technical Specifications

Idle / Active Current Drain, Average	12 mA (@ 12 Vdc) / < 80 mA (@ 12 Vdc)
CR300-RF422 OPTION	
Radio Type	868 MHz SRD 860 with Listen Before Talk (LBT) and Automatic Frequency Agility (AFA)
Output Power	2 to 25 mW (user-selectable)
Frequency	863 to 870 MHz (European Union)
RF Data Rate	10 kbps
Receive Sensitivity	-106 dBm
Antenna Connector	RPSMA (External antenna required)
Idle Current Drain, Average	9.5 mA
Active Current Drain, Average	20 mA
CR300-RF427 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 907.5 MHz/915 to 928 MHz (Brazil)
RF Data Rate	200 kbps
Receive Sensitivity	–101 dBm
Antenna Connector	RPSMA (External antenna required.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR300-WIFI OPTION	
Operational Modes	Client or Access Point
Operating Frequency	2.4 GHz, 20 MHz bandwidth
Antenna Connector	Reverse Polarity SMA (RPSMA)
Antenna	pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional with articulating knuckle joint for vertical or horizontal orientation
Transmit Power	7 to 18 dBm (5 to 63 mW)
CR300-CELL205 OPTION	
Note	The CR300-CELL205 option is not compatible with a Verizon cellular network
Certifications	IC (Industry Canada) 10224A-201611EC21A
Cell Technologies	• 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
3G Frequency Bands	850, 1700/2100 (AWS), and 1900
4G Frequency Bands	700, 850, 1700/2100 (AWS-1), 1900
Antenna Connector	SMA (External antenna required)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3V
Radio Output Power	• 23dBm on LTE • 24dBm on UMTS • 27dBm on EDGE • 33dBm on GSM
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR300-CELL210 OPTION	
Note	The CR300-CELL210 option is only compatible with a Verizon cellular network
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	700, 850, 1700, 1900, 2100
Antenna Connector	SMA (External antenna required)
Power Consumption - Low Power Mode	5 mA
Power Consumption - Idle	35 mA
Power Consumption - Active	70 mA
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR300

Technical Specifications

CR300-CELL215 OPTION	
Note	The CR300-CELL215 option is intended for use in EMEA countries
Cell Technologies	• 2G (GSM/GPRS/EDGE) • 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
2G Frequency Bands	900 and 1800 MHz
3G Frequency Bands	850, 900, and 2100 MHz
4G Frequency Bands	800, 850, 900, 1800, 2100, and 2600 MHz
Antenna Connector	SMA (External antenna required)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	
CR300-WIFI OPTION	
Operational Modes	• 23dBm on LTE • 24dBm on UMTS • 27dBm on EDGE • 33dBm on GSM
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR300-CELL220 OPTION	
Note	The CR300-CELL220 option is intended for use in Australia and New Zealand
Cell Technologies	• 4G (LTE CAT-1) • 3G (UMTS/HSPA+)
3G Frequency Bands	• 850, 900, 1900, and 2100 MHz (EC-21AU) • 850 and 2100 MHz (EC-21AUT)
4G Frequency Bands	• 700, 900, 1700, 1800, 1900, 2100, and 2600 MHz (EC-21AU) • 700, 850, 1800, 2100, and 2600 MHz (EC-21AUT)
Antenna Connector	SMA (External antenna required)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	• 24 dBm on UMTS • 23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR300-CELL225 OPTION	
Note	The CR300-CELL225 option is intended for use in Japan
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	800 (lower), 800 (upper), 850+, 900, 1800, and 2100 MHz
Antenna Connector	SMA (External antenna required)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR310
COMPACT DATA LOGGER WITH ETHERNET

Ideal for small applications

The CR310 is a multi-purpose, compact, low-cost measurement and control data logger that includes an integrated 10/100 Ethernet port and removable terminal connectors. This entry-level data logger, with its rich instruction set, can measure most hydrological, meteorological, environmental, and industrial sensors. It will concentrate data, making it available over varied networks and deliver it using your preferred protocol. The CR310 also performs automated on-site or remote decision making for control and M2M communications. The CR310 is ideal for small applications requiring long-term, remote monitoring and control.

The primary differences between the CR300 and CR310 are that the CR310 offers removable connectors and a 10/100 Ethernet connection.

The CR310 has multiple radio options that are suitable for different regions:

- CR310-RF407: US and Canada
- CR310-RF412: Australia and New Zealand
- CR310-RF422: Europe
- CR310-RF427: Brazil

Benefits and Features:

- Set up easily with PC software and USB connectivity
- Measure with confidence analog and digital sensors
- Internet ready–email, FTP, HTTP/web, TCP–with required add-ons
- Trust in the MUNRO quality, including integral surge and ESD protection
- Save money and space using the integrated Ethernet port
- Network wirelessly to another node or Internet gateway with integrated radio option
- CR310-WIFI ideal for short-range, wireless IP communication
- Wiring made easy through removable terminal block
- Communicate from anywhere when using cellular or satellite peripheral
- Charge batteries using the integrated 12 V battery solar charge regulator
- Measure smart sensors using RS-232 or SDI-12
- Connect with PakBus, Modbus, DNP3, GOES, and other standard communication protocols
- Analyze and control with programmability and multiple general purpose I/O
- Notify with event-driven communications and physical outputs.

CR310

Detailed Description:

- One switched 12 V terminal (SW12V) for powering sensors or communication devices, 1100 mA @ 20°C
- Two sensor excitation or continuous 0.15 to 5 V terminals (VX1, VX2) for sensor excitation or output control
- Six multipurpose analog input terminals (SE1 - SE6).
  - Analog functions (SE1 - SE6)
    - Analog inputs: 6 single-ended or 3 differential inputs with -100 to +2500 mV and ±34 mV ranges 24 bit ADC
    - 4 to 20 mA or 0 to 20 mA inputs (SE1, SE2 only)
  - Digital I/O functions (SE1 - SE4) consist of 3.3 V logic levels for:
    - High frequency counter (35 kHz)
    - Pulse width modulation
    - Interrupts and timer input
    - Period average (200 kHz, amplitude dependent).
- Two Pulse Counting Terminals (P_SW, P_LL).
  - P_SW
    - Switch closure (150 Hz)
    - High frequency counter (35 kHz)
  - P_LL
    - Low level ac (20 kHz)
    - High frequency counter (20 kHz).
- Two Control Terminals (C1, C2): C terminals are software configurable for digital functions.
  - Digital I/O functions consist of 5 V output and 3.3 V input logic levels for:
    - SDI-12
    - High frequency counter (3 kHz)
    - Switch closure (150 Hz)
    - General status/control
    - Voltage source 5 V: 10 mA @ 3.5 V
      Interrupts
    - Serial asynchronous communication Tx/Rx pair.

Technical Specifications

Note	Additional specifications are listed in the CR300-Series Specifications Sheet.
Operating Temperature Range	• -40° to +70°C (standard) • Non-condensing environment
Maximum Scan Rate	10 Hz
Case Material	Powder-coated aluminum
Analog Inputs	6 single-ended or 3 differential (individually configured)
Pulse Counters	8 (P_SW, P_LL, C1, C2, and SE1 to SE4)
Voltage Excitation Terminals	2 (VX1, VX2)
Communications Ports	• USB Micro B • RS-232 • 10/100 Ethernet RJ45
Switched 12 Volt	1 terminal
Digital I/O	7 terminals (C1, C2, P_SW, and SE1 to SE4) configurable for digital input and output. Includes status high/low, pulse width modulation, external interrupt, and communication functions. Exception: The SE4 terminal doesn't do external interrupt.
Input Limits	-100 to +2500 mV
Analog Voltage Accuracy	• Accuracy specifications do not include sensor or measurement noise. • ±(0.04% of measurement + offset) at 0° to 40°C • ±(0.1% of measurement + offset) at -40° to +70°C
ADC	24-bit
Power Requirements	• 16 to 32 Vdc for charger input (CHG) (Current limited to 0.9 A maximum for power converter or solar panel input.) • 10 to 18 Vdc for external batteries (BAT).
Real-Time Clock Accuracy	±1 min. per month
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, NTP, Telnet, HTTP(S), FTP(S), SMTP/TLS, POP3/TLS
Communication Protocols	PakBus, Modbus, DNP3, SDI-12, TCP, UDP, and others

CR310

Technical Specifications

CPU Drive/Programs	80 MB serial flash
Data Storage	30 MB serial flash
Idle Current Drain, Average	10 mA (@ 12 Vdc with Ethernet link idle)
Active Current Drain, Average	56 mA (@ 12 Vdc with Ethernet link active, processor always on)
Dimensions	16.26 x 7.62 x 5.68 cm (6.4 x 3.0 x 2.2 in.)
Weight	288 to 306 g (0.64 to 0.68 lb) depending on communication option selected
CR310-RF407 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 928 MHz (US, Canada)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR310-RF412 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	915 to 928 MHz (Australia, New Zealand)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)
CR310-RF422 OPTION	
Radio Type	868 MHz SRD 860 with Listen Before Talk (LBT) and Automatic Frequency Agility (AFA)
Output Power	2 to 25 mW (user-selectable)
Frequency	863 to 870 MHz (European Union)
RF Data Rate	10 kbps
Receive Sensitivity	-106 dBm
Antenna Connector	External antenna required
Idle Current Drain, Average	9.5 mA
Active Current Drain, Average	20 mA
CR310-RF427 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 907.5 MHz/915 to 928 MHz (Brazil)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR310-WIFI OPTION	
Operational Modes	Client or Access Point
Operating Frequency	2.4 GHz, 20 MHz bandwidth
Antenna Connector	Reverse Polarity SMA (RPSMA)
Antenna	pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional with articulating knuckle joint for vertical or horizontal orientation
Transmit Power	7 to 18 dBm (5 to 63 mW)

CR310

Technical Specifications

CR310-CELL205 OPTION	
Note	This option is not compatible with a Verizon cellular network
Cell Technologies	• 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
3G Frequency Bands	850, 1700/2100 (AWS), and 1900
4G Frequency Bands	700, 850, 1700/2100 (AWS-1), 1900
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
CR310-CELL210 OPTION	
Note	The CR310-CELL210 option is only compatible with a Verizon cellular network
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	700, 850, 1700, 1900, 2100
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
CR310-CELL215 OPTION	
Note	
Active Current Drain, Average	The CR310-CELL215 option is intended for use in EMEA countries
Cell Technologies	• 2G (GSM/GPRS/EDGE) • 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
2G Frequency Bands	900 and 1800 MHz
3G Frequency Bands	850, 900, and 2100 MHz
4G Frequency Bands	800, 850, 900, 1800, 2100, and 2600 MHz
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
CR310-CELL220 OPTION	
Note	The CR310-CELL220 option is intended for use in Australia & New Zealand
Cell Technologies	• 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
3G Frequency Bands	• 850 and 2100 MHz (EC-21AUT) • 850, 900, 1900, and 2100 MHz (EC-21AU)
4G Frequency Bands	• 700, 850, 1800, 2100, and 2600 MHz (EC-21AUT) • 700, 900, 1700, 1800, 1900, 2100, and 2600 MHz (EC-21AU)
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
CR310-CELL225 OPTION	
Note	The CR310-CELL225 option is intended for use in Japan
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	800 (lower), 800 (upper), 850+, 900, 1800, and 2100 MHz
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V

CR350
COMPACT DATA LOGGER WITH RS-485

Ideal for small applications

The CR350 is a multi-purpose, extremely low power, compact measurement and control data logger. This entry-level data logger, with its rich instruction set, can measure most hydrological, meteorological, environmental, and industrial sensors. The CR350 concentrates data, makes it available over varied networks, and delivers it using your preferred protocol. The CR350 also performs automated on-site or remote decision-making for control and M2M communications. This data logger is ideal for small applications requiring long-term, remote monitoring and control.

The following outlines the primary differences between the CR300, CR310, and CR350 dataloggers:

- The CR310 and CR350 offer removable connectors.
- The CR310 includes a 10/100 Ethernet connection.
- The CR350 has two independent RS-232/RS-485 ports and USB-C.

The CR350 includes Wi-Fi, cellular, or the following radio options for different regions:

- CR350-RF407: US and Canada
- CR350-RF412: Australia and New Zealand
- CR350-RF422: Europe
- CR350-RF427: Brazil

Benefits and Features:

- Two dedicated SDI-12 terminals to expand SDI-12 sensor use
- Extremely low current requirements
- Two dedicated RS-232/RS-485 terminals to support smart sensors or modems
- Easy setup with PC software and USB-C connectivity
- Ability to measure analog and digital sensors with confidence
- Trusted MUNRO quality, including integral surge and ESD protection
- Integrated radio option to network wirelessly to another node or Internet gateway
- CR350-WIFI ideal for short-range, wireless IP communication
- Removable terminal block for easy wiring
- Ability to communicate anywhere using built-in cellular or satellite peripherals
- Integrated 12 V battery solar charge regulator to charge batteries
- Flexibility to connect with PakBus, Modbus, DNP3, GOES, & other standard communication protocols
- Multiple general-purpose I/O and programmability to analyze and control measurement acquisition
- Event-driven communications and physical outputs for notifications.

CR350

Detailed Description:

The CR350 is a low-powered data logger designed to measure sensors, analyze data, and store data and programs. A battery-backed clock assures accurate timekeeping. The on-board, BASIC-like programming language—common to all MUNRO data loggers—supports data processing and analysis routines.

Terminal Descriptions

- Two switched 12 V terminals (SW12V) for powering sensors or communication devices, 2100 mA
- Two sensor excitation or continuous 0.15 to 5 V terminals (VX1, VX2) for sensor excitation or output control
- Four multipurpose analog input terminals (SE1–SE4).
  - Analog functions (SE1 - SE4)
    - Analog inputs: 4 single-ended or 2 differential inputs with -100 to +2500 mV and ±34 mV ranges 24 bit ADC
    - 4 to 20 mA or 0 to 20 mA inputs (SE1, SE2 only)
  - Digital I/O functions (SE1 - SE4) consist of 3.3 V logic levels for:
    - High frequency counter (35 kHz)
    - Pulse width modulation
    - Interrupts and timer input
    - Period average (200 kHz, amplitude dependent).
- Two Pulse Counting Terminals (P_SW, P_LL).
  - P_SW
    - Switch closure (150 Hz)
    - High frequency counter (35 kHz)
  - P_LL
    - Low level ac (20 kHz)
    - High frequency counter (20 kHz).
- Two Control Terminals (C1, C2): C terminals are software configurable for digital functions.
  - Digital I/O functions consist of 5 V output and 3.3 V input logic levels for:
    - SDI-12
    - High frequency counter (3 kHz)
    - Switch closure (150 Hz)
    - General status/control
      Voltage source 5 V: 10 mA @ 3.5 V
    - Interrupts
    - Serial asynchronous communication Tx/Rx pair.

Technical Specifications

Operating Temperature Range	• -40° to +70°C (standard) • Non-condensing environment
Maximum Scan Rate	10 Hz
Case Material	High-impact-resistant polycarbonate, recycle code 7
Analog Inputs	4 single-ended or 2 differential (individually configured)
Pulse Counters	8 (P_SW, P_LL, C1, C2, and SE1 to SE4)
Voltage Excitation Terminals	2 (VX1, VX2)
Communications Ports	• USB Type C 2.0 • RS-232 • RS-485
Switched 12 Volt	2 terminals
Digital I/O	7 terminals (C1, C2, P_SW, and SE1 to SE4) configurable for digital input and output. Includes status high/low, pulse width modulation, external interrupt, and communication functions. Exception: C2 and P_SW don't do pulse-width modulation
Analog Input Limits	-100 to +2500 mV
Analog Voltage Accuracy	• Accuracy specifications do not include sensor or measurement noise. • ±(0.04% of measurement + offset) at 0° to 40°C • ±(0.1% of measurement + offset) at -40° to +70°C
ADC	24-bit
Power Requirements	16 to 32 Vdc for charger input (CHG) (Current limited to 1.1 A maximum for power converter or solar panel input.)

CR350

Technical Specifications

Real-Time Clock Accuracy	±3 min. per year
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, NTP, Telnet, HTTP(S), FTP(S), SMTP/TLS, POP3/ TLS, MQTT(S)
Communication Protocols	PakBus, PakBus Encryption, Modbus RTU/ASCII/TCP, DNP3, SDI-12, and others
CPU Drive/Programs	50 MB serial flash
Data Storage	50 MB serial flash
Idle Current Drain, Average	0.5 mA (@ 12 Vdc)
Active Current Drain, Average	• < 1.5 mA (@ 12 Vdc for 1 Hz scan with 1 analog measurement) • 8 mA (@ 12 Vdc with processor always on)
Dimensions	16.3 x 8.4 x 5.6 cm (6.4 x 3.3 x 2.2 in.) Additional clearance required for cables and leads
Weight	288 to 306 g (0.64 to 0.68 lb) depending on communication option selected
CR350-RF407 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 928 MHz (US, Canada)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR350-RF412 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	915 to 928 MHz (Australia, New Zealand)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)
CR350-RF422 OPTION	
Radio Type	868 MHz SRD 860 with Listen Before Talk (LBT) and Automatic Frequency Agility (AFA)
Output Power	2 to 25 mW (user-selectable)
Frequency	863 to 870 MHz (European Union)
RF Data Rate	10 kbps
Receive Sensitivity	-106 dBm
Antenna Connector	RPSMA (External antenna required(
Idle Current Drain, Average	9.5 mA
Active Current Drain, Average	20 mA
CR350-RF427 OPTION	
Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 907.5 MHz/915 to 928 MHz (Brazil)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)

CR350

Technical Specifications

CR350-WIFI OPTION	
Operational Modes	Client or Access Point
Operating Frequency	2.4 GHz, 20 MHz bandwidth
Antenna Connector	Reverse Polarity SMA (RPSMA)
Antenna	pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional with articulating knuckle joint for vertical or horizontal orientation
Transmit Power	7 to 18 dBm (5 to 63 mW)
CR350-CELL205 OPTION	
Note / Certifications	The CR350-CELL205 option is not compatible with a Verizon cellular network / IC (Industry Canada) 10224A-201611EC21A
Cell Technologies	• 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
3G Frequency Bands	850, 1700/2100 (AWS), and 1900
4G Frequency Bands	700, 850, 1700/2100 (AWS-1), 1900
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	• 23dBm on LTE • 24dBm on UMTS • 27dBm on EDGE • 33dBm on GSM
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR350-CELL210 OPTION	
Note	The CR350-CELL210 option is only compatible with a Verizon cellular network
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	700, 850, 1700, 1900, 2100
Antenna Connector	SMA (External antenna required
Power Consumption - Low Power Mode	5 mA
Power Consumption - Idle	35 mA
Power Consumption - Active	70 mA
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR350-CELL215 OPTION	
Note	The CR350-CELL215 option is intended for use in EMEA countries
Cell Technologies	• 2G (GSM/GPRS/EDGE) • 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
2G Frequency Bands	900 and 1800 MHz
3G Frequency Bands	850, 900, and 2100 MHz
4G Frequency Bands	800, 850, 900, 1800, 2100, and 2600 MHz
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	• 23dBm on LTE • 24dBm on UMTS • 27dBm on EDGE • 33dBm on GSM
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)
CR350-CELL220 OPTION	
Note	The CR350-CELL220 option is intended for use in Australia & New Zealand
Cell Technologies	• 3G (UMTS/HSPA+) • 4G (LTE CAT-1)
3G Frequency Bands	• 850 and 2100 MHz (EC-21AUT) • 850, 900, 1900, and 2100 MHz (EC-21AU)
4G Frequency Bands	• 700, 850, 1800, 2100, and 2600 MHz (EC-21AUT) • 700, 900, 1700, 1800, 1900, 2100, and 2600 MHz (EC-21AU)
Antenna Connector	SMA (External antenna required
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	• 23 dBm on LTE • 24 dBm on UMTS
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR350

Technical Specifications

CR350-CELL225 OPTION	
Note	The CR350-CELL225 option is intended for use in Japan
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	800 (lower), 800 (upper), 850+, 900, 1800, and 2100 MHz
Antenna Connector	SMA (External antenna required)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V
Radio Output Power	23dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR1000X
FLAGSHIP DATA LOGGER

Accurate, rugged, reliable

The CR1000X is our flagship data logger that provides measurement and control for a wide variety of applications. Its reliability and ruggedness make it an excellent choice for remote environmental applications, including weather stations, mesonet systems, wind profiling, air quality monitoring, hydrological systems, water quality monitoring, and hydrometeorological stations.
The CR1000X is a low-powered device that measures sensors, drives direct communication and telecommunications, analyzes data, controls external devices, and stores data and programs in onboard, nonvolatile storage.
The electronics are RF-shielded by a unique sealed, stainless-steel canister. A battery-backed clock assures accurate timekeeping. The onboard, BASIC-like programming language, common to all contemporary MUNRO data loggers, supports data processing and analysis routines.

Benefits and Features:

- Operational in extreme environments with a standard operating range of -40° to +70°C and an extended operating range of -55° to +85°C
- Connects directly to a computer's USB port
- Captures quickly changing data values with fast analog measurement capabilities (300+ Hz)
- Differentiates even slight changes in data values with higher-resolution measurements (24 bit Adc)
- Includes two non-isolated current input channels for directly connecting sensors with 0-to-20 mA or 4-to-20 mA current outputs
- Contains an onboard CPI port for hosting MUNRO high-speed sensors and distributed modules (CDM)
- Directly connects to Ethernet
- Includes microSD card drive for extended memory requirements
- Provides simple serial sensor integration and measurement with SDI-12, RS-232, and/or RS-485
- Supports full PakBus networking
- Includes embedded web page for direct connection via web browser.

CR1000X

Detailed Description:

The CR1000X is a low-powered device designed to measure sensors, drive direct communication and telecommunications, analyze data, control external devices, and store data and programs in on-board, non-volatile storage. The electronics are RF-shielded and glitch-protected by a unique sealed, stainless-steel canister. A battery-backed clock assures accurate timekeeping. The on-board, BASIC-like programming language—common to all MUNRO data loggers—supports data processing and analysis routines.
The CR1000X wiring panel includes two switchable 12 V terminals, analog grounds dispersed among 16 analog terminals, and unpluggable terminal blocks for quick deployment.

Technical Specifications

Note	Additional specifications are listed in the CR1000X Specifications Sheet
Operating Temperature Range	• -40° to +70°C (standard) • -55° to +85°C (extended) • Non-condensing environment
Maximum Scan Rate	1000 Hz
Case Material	Anodized aluminum
Analog Inputs	16 single-ended or 8 differential (individually configured). Two analog inputs can measure 4 to 20 mA or 0 to 20 mA natively. Four analog inputs can provide pulse/digital I/O functions
Pulse Counters	10 (P1 to P2 and C1 to C8)
Voltage Excitation Terminals	4 (VX1 to VX4)
Maximum Source/Sink Current	• ±40 mA (voltage excitation) • 50 mA (switched regulated)
Communications Ports	Ethernet, USB Micro B, CS I/O, RS-232, RS-422, CPI, RS-485
Data Storage Ports	microSD
Switched 12 Volt	2 terminals
Digital I/O	8 terminals (C1 to C8) configurable for digital input and output. Includes status high/low, pulse width modulation, external interrupt, edge timing, switch closure pulse counting, high-frequency pulse counting, UART, RS-232, RS-485, SDM, SDI-12, I2C, and SPI function. Terminals are configurable in pairs for 5 V or 3.3 V logic for some functions.
Input Limits	±5 V
Analog Voltage Accuracy	• Accuracy specifications do not include sensor or measurement noise. • ±(0.04% of measurement + offset) at 0° to 40°C • ±(0.06% of measurement + offset) at -40° to +70°C • ±(0.08% of measurement + offset) at -55° to +85°C (extended temperature range)
ADC	24-bit
Power Requirements	10 to 18 Vdc input
Real-Time Clock Accuracy	±3 min. per year (Optional GPS correction to ±10 µs)
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, Telnet, HTTP(S), SFTP, FTP(S), POP3/TLS, NTP, SMTP/TLS, SNMPv3, CS I/O IP, MQTT
Communication Protocols	CPI, PakBus, SDM, SDI-12, Modbus, TCP, DNP3, UDP, NTCIP, NMEA 0183, I2C, SPI, and others
Battery-backed SRAM for CPU Usage & Final Storage	4 MB
Data Storage	4 MB SRAM + 72 MB flash (Storage expansion of up to 16 GB with removable microSD flash memory card.)
Idle Current Drain, Average	< 1 mA (@ 12 Vdc)
Active Current Drain, Average	• 1 mA (1 Hz scan @ 12 Vdc) • 55 mA (20 Hz scan @ 12 Vdc)
Dimensions	23.8 x 10.1 x 6.2 cm (9.4 x 4.0 x 2.4 in.) Additional clearance required for cables and leads.
Weight	0.86 kg (1.9 lb)

ZL6
ADVANCE CLOUD DATA LOGGER

ZL6 introduces cloud-based data delivery, Bluetooth® configuration, GPS, firmware-over-the-air updates, & integrated metadata, all which simplify and speed up the process of data collection, management, and sharing. It does all the legwork for you, so you can spend more time being a data visionary. The ZL6 uses ZENTRA Cloud to deliver near-real-time data wherever and whenever you need it. The ZL6 connects up to six different types of MUNRO sensors, so you can monitor different parameters, such as weather, soil moisture, and soil water potential, all at the same time, giving you deeper insight.

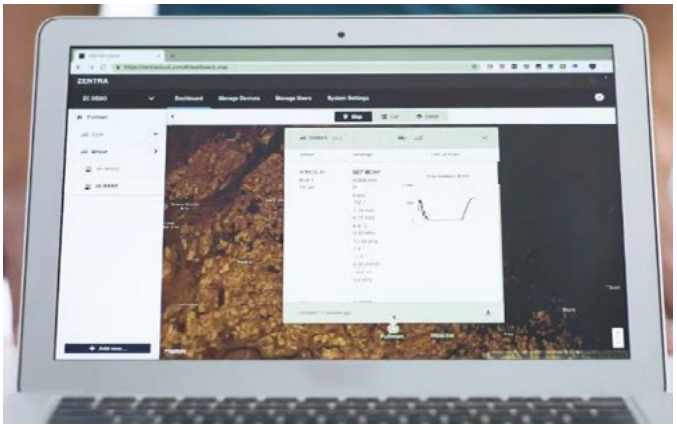
Benefits and Features:

- Ultra-rugged and durable construction
- Configure via Bluetooth with the ZENTRA Utility app
- Plug and play with MUNRO sensors
- Six sensor ports
- Works with ZENTRA Cloud to enable near real-time data viewing anywhere with an internet connection (data can also be downloaded via USB)
- Integrated GPS and barometric pressure measurement
- Simple setup
- Firmware-over-the-air updates
- Built-in solar panel for extended deployments
- Rechargeable nickel-metal hydride (NiMH) batteries
- Stores 40,000 to 80,000+ records, depending on sensor configuration
- Best for viewing data on the go
- See signal strength & connection quality in real time: test connectivity at your site Before installation
- Transmitted data is backed up in the data logger memory to give you extra data protection.

ZL6

Technical Specifications

Sensor input ports	6 (supports MUNRO analog, digital, or pulse sensors)
Sensor port type	3.5-mm stereo plug connector
Logging interval	5 min to 12 h
Reporting interval	Hourly with additional charges for more frequent reporting
Data storage	8 MB (40,000 to 80,000+ records depending on configuration)
Memory type	Nonvolatile flash, full data retention with loss of power
Global position	Integrated 56-channel GPS/QZSS receiver
GPS position update	Daily (automatic) and on-demand (manual)
GPS position accuracy	±3 m, with good sky view
Timekeeping	Synchronize automatically & on-demand; GPS system, cellular, or software
Battery capacity	6 AA NiMH or alkaline batteries
NiMH battery charging	Solar energy harvesting or USB
NiMH battery life	3+ years with unobstructed view of sun
Alkaline battery life	3–12 months depending on configuration
Computer communication	Standard USB cable, USB A to micro-B
Cellular specifications	UMTS 3G 5-band cellular module with 2G fallback
Cellular coverage	T&T® and T-Mobile® in USA, 200+ global partner carriers. Cellular and data hosting service provided by us.
Internet downloads	SSL/TLS encrypted
Enclosure	Weather-, impact-, and UV-resistant polymer
Enclosure rating	IP56, NEMA 3R
Enclosure size	14.9 cm × 25 cm × 6.3 cm (5.9 in × 9.9 in × 2.5 in)
Enclosure access	Hinged door with latches and eyelets for lock or zip tie
Operating environment	–40 to +60°C (0%–100% relative humidity)
Compliance	Manufactured under ISO 9001:2015 EM ISO/IEC 17050:2010 (CE Mark)



MeteoPV
SAVES TIME, SPACE, AND ENERGY

Offers your project an unparalleled quality of data

The MeteoPV is a purpose-built photovoltaic (PV) resource data platform, ideal for distributed PV monitoring and functioning as a plane-of-array (POA), albedo, and soiling secondary weather station. As an easy-to-use sunstation solution, the MeteoPV has the flexibility to communicate with smart pyranometers, reference cells, back-of-module temperature sensors, and compact weather sensors.

With its small footprint and DIN-rail mounting, the MeteoPV can be easily integrated with existing combiner boxes or other control panels. The MeteoPV also obtains Power-over-Ethernet compatibility, a convenient method for supplying power, eliminating the need for additional power supplies.

The MeteoPV also hosts an intuitive onboard user interface accessed by a web browser. This interface simplifies the initial communication configuration and long-term sensor management.

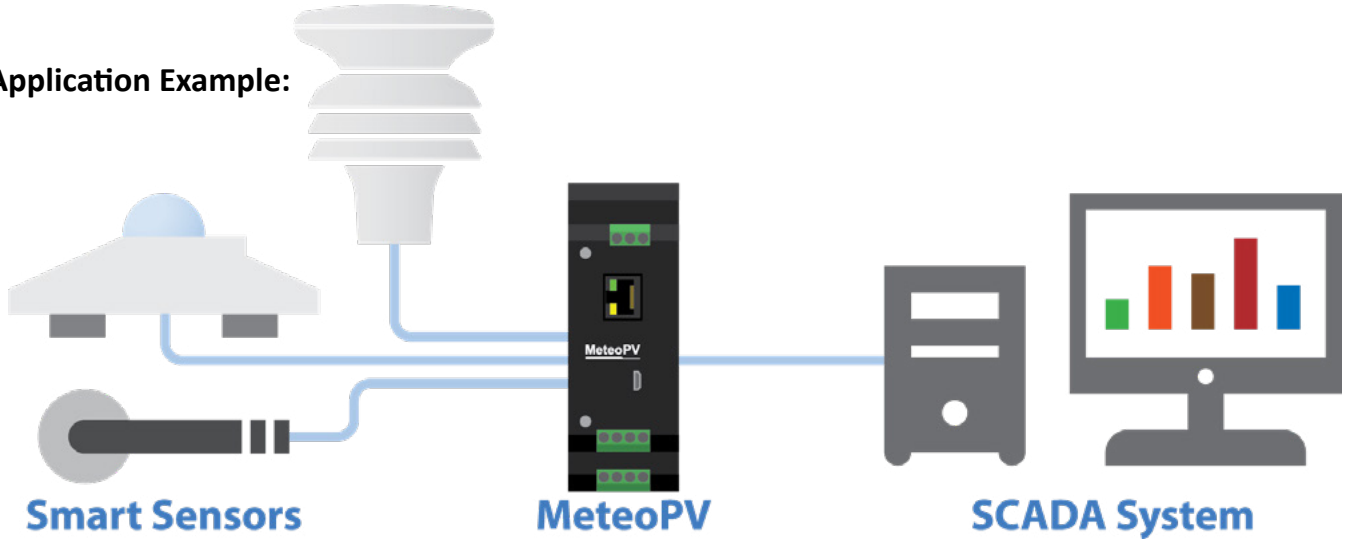
With the MeteoPV you can expect simple and easy configuration, easy-to-create field commissioning reports, sensor metadata and management, and a communications troubleshooter. The MeteoPV is expertly designed and purposefully built, guaranteeing a simplified data-collection experience.

Benefits and Features:

- Flexible for easy integration into an existing PV monitoring system
- Near-zero learning curve—no data logger programming necessary
- Embedded web UI for quick setup of measurements with instant visual feedback and data streaming
- Small footprint and DIN-rail mounting for integration with combiner boxes or other control panels
- MUNRO reliability and quality
- Compatible with industry-standard pyranometers, reference cells, back-of-module temperature sensors, and compact weather sensors
- Designed to exceed the life of a PV plant with IEC Class 4 integrated surge and ESD protection
- SCADA ready with Modbus RTU and Modbus TCP/IP.

MeteoPV

Application Example:



Detailed Description:

The MeteoPV communicates with smart pyranometers, reference cells, back-of-module temperature sensors, and compact weather sensors, making it a flexible and easy-to-use POA sunstation solution. The Modbus RTU protocol over RS-485 is used to interface with the sensors, while Modbus TCP/IP protocol is used to communicate with the local SCADA system or other data collection platform. A Modbus map is built into the MeteoPV, providing aggregation of sensor readings and valuable metadata from one source.
With its small footprint and DIN-rail mounting, the MeteoPV is ready for integration with existing combiner boxes or other control panels. Power-over-Ethernet compatibility is a convenient method for supplying power without needing additional power supplies.
Installation and commissioning are straightforward without the headache of navigating, configuring, and addressing multiple sensor interfaces or generic gateway devices.
The MeteoPV hosts an intuitive onboard user interface accessed by a web browser. The browser-based interface simplifies the initial communication configuration and long-term sensor management. Simply connect, select your sensors, and start measuring.

Technical Specifications

CPU	ARM Cortex M4 (running at 144 MHz)
Operating Voltage	9 to 30 Vdc
Operating Temperature Range	-40° to +70°C
Power Consumption @ 12 Vdc	~30 mA (not including sensors)
Isolated Sensor Power	12 Vdc, 800 mA
Isolated POE	802.3af compliant
EMC Immunity	IEC 61000-4-2 Class 4
USB Micro B	2.0 full-speed 12 Mbps (for computer connection)
SCADA Interface Port	RJ45 jack 10/100Base-TX, full and half duplex Auto-MDIX, magnetic isolation, and TVS surge protection
SCADA Interface Protocol	Modbus TCP/IP
Sensor Interface Port	Half-duplex RS-485
Sensor Interface Protocol	Modbus RTU over RS-485
Internal Memory	3 months' storage of 1- and 10-minute average, maximum, minimum, and standard deviation data (worst case scenario with 9 sensors connected)
Dimensions	11.76 x 11.56 x 4.14 cm (4.63 x 4.55 x 1.63 in.)
Weight	272.16 g (0.6 lb)

Granite9

MEETING YOUR TOP TESTING PRIORITIES

Measurement and Control Data-Acquisition System

The GRANITE™9 and GRANITE™10 are the most computationally powerful data-acquisition devices from MUNRO. As an all-digital measurement and control DAQ, the GRANITE 9 is designed as the core of the data acquisition network, integrating with all GRANITE measurement modules, including the VOLT 108, VOLT 116, TEMP 120, VWIRE 305, and CH400.

Detailed Description:

The GRANITE 9 enables you to perform the following:

- Standard measurement functions
- Advanced math and processing functions
- Control functions.

Benefits and Features:

- Traditional network connections via Ethernet port
- EPI port switch for high-speed connection to all GRANITE™ measurement modules
- Onboard storage of streaming data with 2 GB of DDR3 SDRAM & a 64 GB solid-state hard drive (SSD)
- Built-in GPS for network synchronization.

A complete GRANITE system installation may include the following components:

- GRANITE Chassis • GRANITE 9 • CH400
- Power source (mains or solar) Software.

Technical Specifications

Note	Additional specifications are listed
Power Requirements	9.6 to 32 Vdc (voltage input)
Real-Time Clock Accuracy	±3 min. per year
Operating Temperature Range	• Non-condensing environment •-55° to +85°C (extended) • -40° to +70°C (standard)
Case Material	Stainless steel 304 and aluminum 6061
Communications Ports	Ethernet, USB Micro B, USB host, CS I/O, 0 to 5 V serial, SDI-12, RS-485 RS-422, CPI/RS-232, EPI
Data Storage Ports	microSD, USB host
Digital I/O	8 terminals (C1 to C8) configurable for digital input and output. Terminals are configurable in pairs for 5 V or 3.3 V logic for some functions.
Data Storage	• 4 MB SRAM + 128 MB NOR flash (Storage expansion of up to 16 GB with removable microSD flash memory card.) • 64 GB SSD
Dimensions	21.4 x 12.0 x 5.0 cm (8.4 x 4.7 x 2.0 in.) Additional clearance required for cables and leads.
Weight	1.0 kg (2.2 lb)

Aspen10
MAKES A SENSOR IOT CLOUD CONNECTED

Edge Device for a Single Sensor

The revolutionary Aspen™10 Internet of Things (IoT) Edge Device allows users to easily connect their environmental sensor to the cloud. It is rugged and durable and may be mounted outdoors without the need for a second enclosure. It has an integrated solar panel and internal rechargeable battery, making the Aspen10 a truly self-sustaining device.

The Aspen10 is also small and compact, which makes it easy to install in a variety of locations without disturbing the environment it is monitoring. An integrated IoT cellular modem allows the Aspen10 to transmit data to the cloud, and a global positioning system (GPS) receiver provides automated installation location.

Setting up the Aspen 10 to read your sensor is quick and easy thanks to a new sensor interface technology, AQWire, that allows automatic identification of any sensor with an SDI-12 or one-wire identification. The Aspen10 publishes this ID to the cloud, in return receiving a customized measurement configuration and program for your specific sensor and application. You can then monitor your data from anywhere. internal rechargeable battery, making the Aspen10 a truly self-sustaining device.

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Benefits and Features:

- IoT device using local cellular networks as the low-power wide-area network (LPWAN)
- Cellular CAT M1 for worldwide roaming
- Geolocation to automatically determine the edge device's location
- Solar charging to keep the IoT device operational indefinitely using just a few hours of daily sunlight
- Internal rechargeable LiFePO4 battery with reserve power for more than one month's operation without charge for all supported sensors
- Smart sensor detection and identification (AQWire)
- Smart sensor power automatic optimization for the attached sensor.

Aspen10

Detailed Description:

The Aspen10 is a multipurpose, compact, entry-level edge device with a simple plug-and-play interface. Supported sensors measure hydrological, meteorological, environmental, and industrial phenomena. The Aspen10 is part of the IoT and makes sensor data accessible anywhere via the Aspen10's compatibility with the MQTT protocol and its integration with MUNRO Cloud. The Aspen 10 provides maintenance-free sensor power and automates cellular connectivity, data storage, and data forwarding to MUNRO Cloud, where users can both visualize their data and manage API access.

The Aspen10 is similar to a full MUNRO system and comprises a data logger, wiring terminals, enclosure, solar panel, charge regulator, battery, modem, and antenna—all in one small package.

Compatible sensors are cabled using the AQWire standard. A detect pin lets the Aspen10 know that it has connected to a sensor with either an SDI-12 or one-wire capability of self-identification. After identifying the sensor, the Aspen 10 connects to MUNRO Cloud to retrieve the appropriate configuration and program for that sensor, which enable the edge device to power the sensor appropriately and make accurate analog or digital measurements.

A free app, MUNRO Go, enables secure NFC/Bluetooth pairing between a phone and the Aspen10. This greatly simplifies the installation process with real-time sensor readings, diagnostic tools, & data-to-cloud delivery information while you are on-site. This gives you confidence that everything is working from end to end before leaving the installation site. All of this allows you to collect data from the selected sensor in the location you need from practically anywhere on the globe.

Technical Specifications

Processor	32-bit arm cortex (CPU)
Memory	• 2 MB flash • 640 KB SRAM
Program Execution Period	1 s to 1 day; 1 s increments
Real-Time Clock Resolution	±1 s
Real-Time Clock Accuracy	Synchronized with MUNRO Cloud once per day
Operating Temperature Range	•-20 to +60°C(standard) • -40 to +75°C(extended) • Outdoor environment
Maximum Scan Rate	1 s
Analog Inputs	Up to 2 single-ended or 1 differential can be programmed for a variety of analog inputs. Pulse and digital I/O functions are also supported.
Communication Protocols	SDI-12, HTTP(S), MQTT
Case Material	• High-impact-resistant and UV-resistant ASA, recycle code 7 • IP65 water-resistant rated, Gore-Tex breathability
Digital I/O	Terminals are configured for SDI-12.
Certifications	CB Certificate Number NO127343
Dimensions	16.2 x 8.0 x 5.8 cm (6.4 x 3.2 x 2.3 in.)
Weight	• 395 g (0.9 lb) for -ST option • 352 g (0.8 lb) for -XT option
POWER	
Battery	Note: Charge and discharge characteristics are controlled internally according to battery type.
Battery for -20° to +60°C (-ST) Option	3.2 Vdc, 7.2 Ah, Li-Po PHD26650
Battery for -40° to +75°C (-XT) Option	3.65 Vdc, 5.6 Ah, Li-ion Saft MP176065 xtd
Average Current Drain	• <0.35 uA (deep sleep) • <1 mA (idle) • 10 uA (ultra-low power) for 5 Vdc sensor power supply • 5 mA for 5 Vdc sensor power supply • 14.3 mA for 8 Vdc sensor power supply • 30 mA for 12 Vdc sensor power supply.

Aspen10

Technical Specifications

POWER OUTPUT	
Note	Regulated 5, 8, or 12 Vdc (disabled when battery capacity <0.5 Ah)
5 Vdc Current Limit	• 30 mA (ultra-low power) • 210 mA
8 Vdc Current Limit	210 mA
12 Vdc Current Limit	210 mA
COMMUNICATIONS	
Protocols	SDI-12
Internet Protocols	HTTP(S), MQTT
Near Field Communication (NFC)	Target device compatible with us
Bluetooth Low Energy (BLE)	• Compatible with us • Maximum distance of 50 m (165 ft)
SDI-12	One SDI-12 compliant terminal meets SDI-12 Standard v 1.4

BP7
FOR A CR6 OR CR300-SERIES DATALOGGER

7 Ah 12 V Sealed Rechargeable Battery

The BP7 is a 12 Vdc, 7 Ah rechargeable battery typically used with a CR6 or CR300-series datalogger. It consists of a sealed rechargeable battery, battery cable, and a mounting bracket. The cable terminates in stripped and tinned leads that attach to the onboard regulator of your CR6 or CR300-series datalogger. You can use the bracket to secure the battery to an enclosure backplate in either a vertical or horizontal position. A BP7 mounted vertically fits under the 31143 Hinged Stack Bracket. You can house the BP7 in any standard environmental enclosure.

Benefits and Features: Allows data loggers to be powered by either solar or ac sources.

Detailed Description:

The BP7 is a 7 Ahr, sealed rechargeable battery. This battery is shipped with the following:
• pn 17374 cable • pn 31149 BP7 shelf battery bracket • Four screws • Four grommets
The 17374 cable terminates in pigtails that attach to the data logger's terminal strip or the MorningStar regulator (a component of the 25295 power supply).
When used with the CR200(X) series, remember that the 17365 is too large for the ENC200 enclosure. It can be housed in any of our standard environmental enclosures (for example, ENC10/12, ENC12/14).

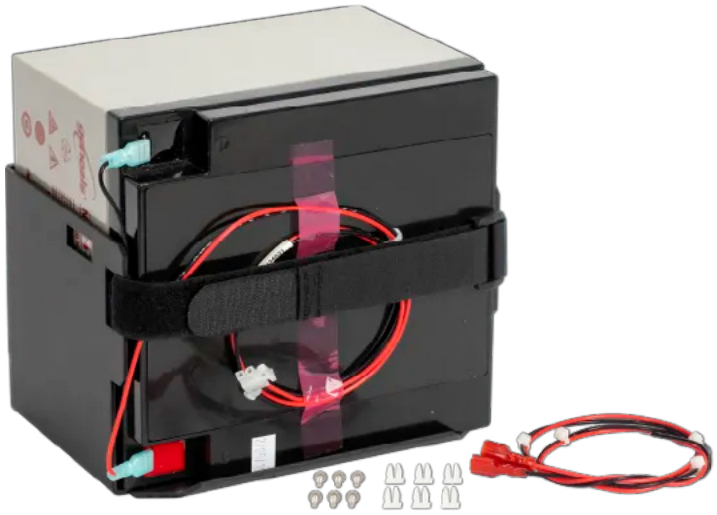
Powering a CR800, CR850, or CR1000X Datalogger:

The PS150 and PS200 are the preferred 7 Ah power supplies for the CR800, CR850, and CR1000X dataloggers. The BP7 can be used instead of the PS150 or PS200 when the battery needs to be mounted under the 31143 Hinged Stack Bracket. Neither the PS150 nor PS200 fit under the stack bracket.
To use the BP7 to power a CR800, CR850, or CR1000X, purchase the 22024 cable and either the CH150 or CH200 regulator. The 22024 cable terminates in a connector that attaches to the CH150 or CH200.

Technical Specifications

Battery Type	Sealed lead acid (SLA)
UL Approval File Number	MH16464
Output Voltage	12 Vdc
Nominal Rating	7 Ah
Cable Length	45.7 cm (18 in.)
Dimensions / Weight	15 x 9.4 x 6.4 cm (5.9 x 3.7 x 2.5 in.) / 2.72 kg (6 lb)

BP24
SEALED RECHARGEABLE BATTERY



24 Ah 12 V Sealed Rechargeable Battery

The BP24 is a rechargeable 12 Vdc, 24 Ah battery pack that can power a MUNRO system. It is intended for high-current-drain systems, such as satellite transmitters, that require more power.

Detailed Description:

The BP24 requires a regulated charging source (provided by the CH150 or CH200 regulator connected to an unregulated solar panel or a wall charger). The BP24 includes a 24 in. attached cable that terminates in a connector for attaching the battery to a CH150 or CH200 regulator. The BP24 also comes with a 24 in. cable for use with the CR6 datalogger or other products that need a pigtail termination instead of a white connector. (This cable is bagged and taped to the battery.) Switching the standard cable for the pigtail cable is easily accomplished by the user. The BP24 is shipped with a bracket that secures the BP24 to an enclosure backplate. An ENC16/18 enclosure is recommended.

Technical Specifications

Note	Usable length of the red and black power leads extends at least 20 cm (8 in.) past the white cable tie tab.
Battery Type	Sealed lead acid (SLA)
UL Approval File Number	MH16464
Output Voltage	12 Vdc
Nominal Rating	24 Ah
Battery Cables Length	0.6 m (2 ft)
Dimensions	16.5 x 17.5 x 12.5 cm (6.5 x 6.9 x 4.9 in.) for battery only 21.3 x 17.7 x 13.0 cm (8.4 x 7.0 x 5.1 in.) battery with mounting bracket
Weight	10.2 kg (22.4 lb)

CH201
12 V CHARGING REGULATOR

Optimized Power Performance

The CH201 is a microcontroller-based smart charge controller that is ideal for charging 12 Vdc VRLA batteries. The charger uses MPPT (maximum power point tracking) technology to safely manage amperage and voltage for optimal battery charging and longevity. It has dual inputs for use with a solar panel and/or any 15 to 50 Vdc charging source. The dual inputs provide the option for fail-safe charging. The CH201 also outputs various parameters to allow close monitoring of the battery and power usage via RS-232 or SDI-12.

In your system, use the CH201 to charge your battery and supply power to your peripherals and data logger. The 12 V output is regulated and switched, with the ability to charge a 12 V battery at a rate of 10 A.

Benefits and Features:

- Dual inputs for simultaneous charging, allowing a fail-safe if one source drops out
- Real-time measurements of charging source voltages, battery voltage, battery charging current, load current, charge state, and on-board temperature, plus a check-battery flag
- Efficient continuously adaptive MPPT (maximum power point tracking)
- Two-step constant voltage charging and temperature compensation to optimize battery charging and increase battery life
- Reverse battery protection
- Programmable LVD (low-voltage disconnect) to protect batteries
- DevConfig user interface to change system parameters or install a new OS
- Two 15 to 50 Vdc inputs to accommodate multiple solar panels
- Synchronous rectification in the switching regulator for increased DC/DC conversion efficiency
- Individually programmable current limits on both of two inputs
- Solid-state circuit breaker for automatic reset and more precise trip current
- DC-to-DC converter with built-in output current control
- Serial communication wiring through three terminals.

CH201

Detailed Description:

The CH201 provides 10 A of charge current, making it ideal for systems with short periods of sun, or higher-current draw systems that require higher recharge rates. The CH201 has two input terminals that enable fail safe charging should one source drop out. It also incorporates an MPPT (maximum power point tracking) algorithm to maximize available solar. The CH201 has a programmable, low-voltage disconnect to help protect the battery. RS-232 and SDI-12 terminals allow the CH201 to be configured and to convey charging parameters to a data logger.

Compared to the CH200, the CH201 offers faster charging with the use of larger solar panels, up to 160 W. (Larger solar panels can be connected; however, when the system is running at full power, not all the current will be used.)

Compared to the SunSaver SS-10-12V, the CH201 offers:

• Dual inputs • Current monitoring via RS-232 and SDI-12 • Configurability

• Low-voltage disconnect (The SunSaver SS-10-12VL has LVD.) • Low current drain.

Technical Specifications

Operational Temperature	-40° to +60°C (VRLA battery manufacturers state that “heat kills batteries” and recommend operating batteries at less than 50°C.)
IP Rating	IP51
Dimensions	11.4 x 10.08 x 3.38 cm (4.49 x 3.97 x 1.33 in.)
Weight	226.8 g (0.5 lb)
SOLAR TERMINALS (SOLAR PANEL OR OTHER DC SOURCE)	
Note	Battery voltages below 8.7 V may result in less than 3.0 A current limit because of fold-back current limit.
Input Voltage Range	15 to 50 Vdc
BATTERY CHARGING	
Note	Two-step temperature-compensated constant-voltage charging for valve-regulated lead-acid batteries; cycle and float charging voltage parameters are programmable with the default values listed.
Maximum Charging Current	10 A
CYCLE Charging	Vbatt(T) = 14.70 V - (24 mV) x (T-25°C)
FLOAT Charging	Vbatt(T) = 13.65 V - (18 mV) x (T-25°C)
QUIESCENT CURRENT	
No Charge Source Present	300 µA maximum
No Battery Connected	Typical 5 mA at 40 Vdc
POWER OUT (+12 TERMINALS)	
Voltage	• Unregulated 12 V from battery • 4.6 A solid-state circuit breaker; self-resettable thermal
LVD (Low-Voltage Disconnect)	6 Vdc (default)
MEASUREMENTS	
Input Voltage	±(1% of reading + 15 mV)
Battery Voltage	±(2% of reading + 15 mV)
Load Current	±(2% of reading + 2 mA) Impulse-type changes in current may have an average current error of ±(10% of reading + 2 mA).
Battery Current	±(2% of reading + 10 mA) Impulse-type changes in current may have an average current error of ±(10% of reading + 2 mA).
Charger Temperature	± 2°C

PS150
ETL LISTED CLASS 2 POWER SUPPLY

12 V Power Supply with Charging Regulator and 7 Ah Sealed Rechargeable Battery

The PS150 is a 12 Vdc power supply that includes a rechargeable 7 Ah valve-regulated lead-acid (VRLA) battery & charging regulator. Charging power for the PS150 is typically supplied by an unregulated solar panel, AC/AC transformer, or AC/DC converter.
The PS150 provides charging with temperature compensation for optimal charging and battery life. A maximum power point tracking algorithm is incorporated for solar inputs to maximize available solar charging resources.
The PS150 is ETL certified. The ETL Mark is proof of product compliance to North American safety standards.

Benefits and Features:

- Protects against high-amperage and high-voltage damage to power supply
- Battery reversal protection
- Allows simultaneous connection of two charging sources (e.g., solar panel, ac wall charger)
- ETL listed Class 2 power supply.

Detailed Description:

The PS150 is a micro-controller-based smart charger with temperature compensation that optimizes battery charging and increases the battery's life. Two input terminals enable simultaneous connection of two charging sources. They also incorporate a maximum power point tracking algorithm for solar inputs that maximizes available solar charging resources.
The PS150 has several safety features intended to protect the charging source, battery, charger, and load devices. Battery-reversal protection is included, as well as ESD and surge protection on all of the PS150 inputs and outputs.

PS150

Technical Specifications

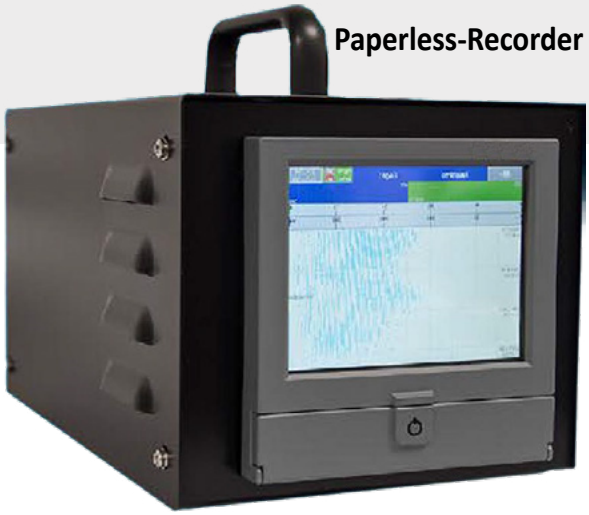
Operational Temperature	-40° to +60°C (VRLA battery manufacturers state that “heat kills batteries” and recommend operating batteries at ≤ 50°C.)
Dimensions	19.3 x 7.6 x 10.6 cm (7.5 x 3 x 4.2 in.)
CHARGE - CHARGE TERMINALS (AC OR DC SOURCE)	
AC	18 to 24 VRMS (internally limited to 1.2 Amps RMS)
DC	16 to 40 Vdc (internally limited to 0.85 Adc)
SOLAR TERMINALS (SOLAR PANEL OR OTHER DC SOURCE)	
Note	Battery voltages below 8.7 V may result in < 3.0 A current limit because of fold-back current limit.
Input Voltage Range	15 to 40 Vdc
Maximum Charging Current	4.0 Adc typical (3.2 to 4.9 Adc depending upon individual charger)
QUIESCENT CURRENT	
No Charge Source Present	160 µA at 13.7 Vdc
No Battery Connected	930 µA at 30 V input voltage (ac or dc)
BATTERY CHARGING	
Note	The "T" represents temperature in degrees Celsius.
FLOAT Charging	Vbatt(T) = 13.65 V - (24 mV) x (T - 25) + (0.24 mV) x (T - 25)2
Accuracy	±1% (on charging voltage over -40° to +60°C)
POWER OUT (+12 TERMINALS)	
Voltage	Unregulated 12 V from battery (4.65 A solid-state circuit breaker)
Standards	ETL Listed Class 2 power supply

MU-IM170-PRO
WEATHER STATION

Data-Logger

Wind & speed Direction

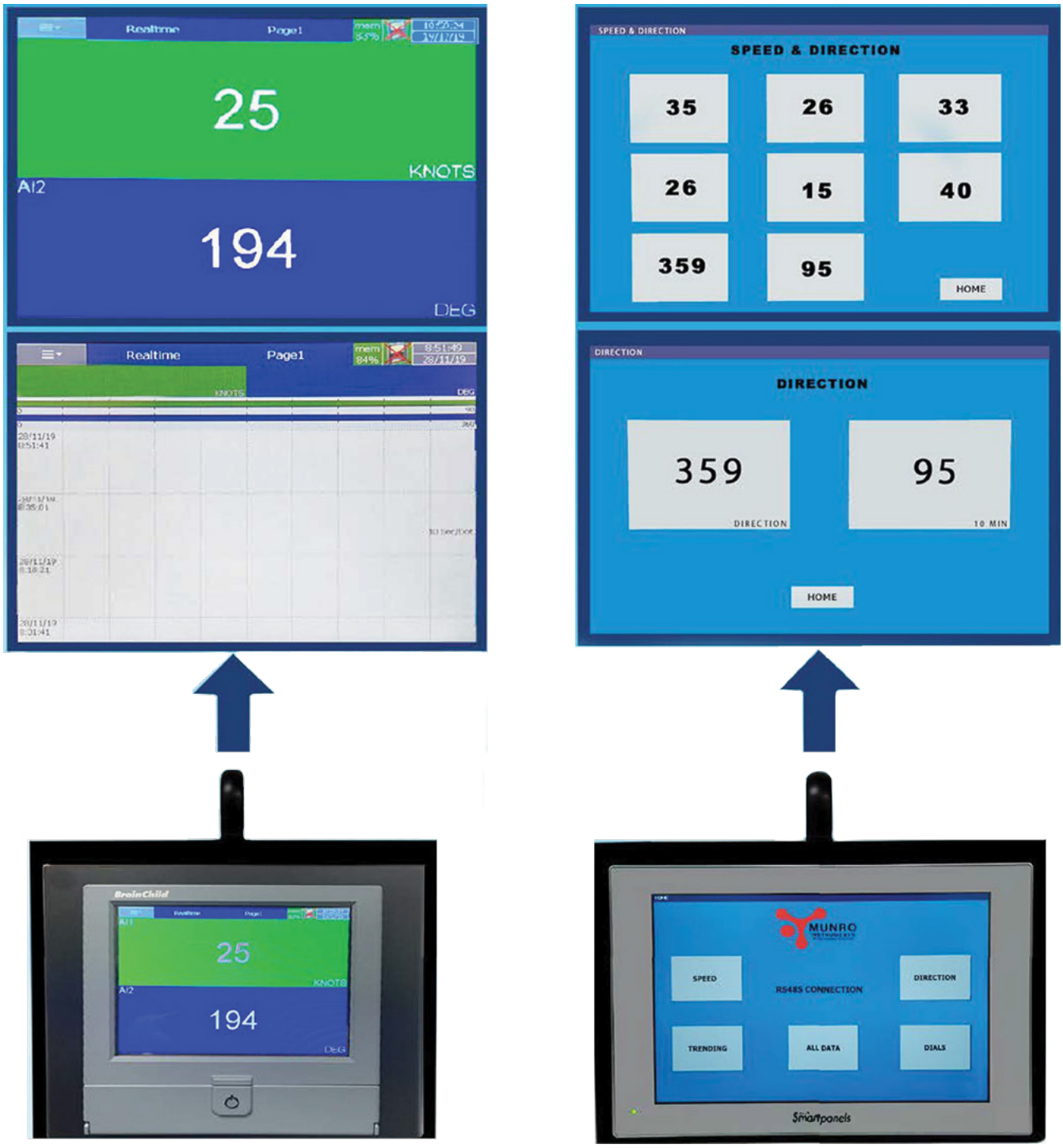
Paperless recorder:
The Paperless Recorder (PR) is a data acquisition unit with a 5.6" TFT touch screen. It is designed for use with our range of meteorological sensors.
The PR offers multiple real-time & historical views, as well as numerous archiving strategies to ensure data is never lost. Using the associated PC software, the user can view live data, generate reports, set alarms and configure the PR unit.



Paperless-Recorder

PC Software:
Powerful and versatile software allow the user to view and analyse data from the sensors. Configuration of the PR is also possible.
Key features: Live data monitoring (includes trending, with scalable time axis between 1 minute and 1 month). Historical review of data.
Customizable display screens: Configure the PR to display data in your chosen format. Choose from a variety of different display styles.
Configure alarms and relay outputs.
Download data for analysis offline.
Configuration wizards for easy set-up and trouble-shooting .

MU-IM170-PRO



Technical Specifications

Power	90-250VAC or 11-36VDC
Display	5.6" TFT touch screen
Resolution	640x480 pixel resolution, 65K colour
Internal Memory / RAM	256 MB
External Memory	SD card, USB x 2
Ethernet	Mod bus TCP/IP
Sampling Rate	100 ms max.
Maths Channels	Yes
Protection	IP65 front, IP20 rear
Operating Temperature	0°C to 50°C

SOIL QUALITY

Soil quality can broadly be defined as a measure of the soil's ability to support plant and animal life, maintain or enhance water and air quality, and support human health and habitation. The indicators required to assess soil quality depend on the way in which the soil is to be used (e.g. for agriculture, construction etc).

Munro Instruments provides sensors to measure the following soil quality parameters:

Electrical Conductivity (EC): Measures the ability of soil water to carry electrical current. This allows users to assess the EC response to salts and fertilisers in the soil.

Volumetric Water Content (VWC): Indicates the quantity of water held by the soil. This is achieved through measurement of the dielectric constant of the soil.

Soil Temperature: The temperature of the soil plays an important role in agricultural productivity.

Soil Water Potential: Indicates the tendency of water that is held by the soil to move.

TDR-310H
SOIL MOISTURE SENSOR

Temperature-BEC Sensor

The TDR-310H is one of MUNRO's H-series sensors, which are very low power and suited perfectly for power-conscious applications. Being part of the Soil Smart Series means that it's advanced waveform analysis works with all mineral soil types. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms. Its form factor is designed for easy vertical installation in an augered hole using a 34 mm flat-bottomed auger. It mates with a 1" schedule 40 PVC pipe that acts as a handle in its installation to any desired depth. It provides reading data through a 3-wire SDI-12 interface & is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Ultra-low power consumption and fast response time
- Housing designed for easy bore hole installation at any depth
- Soil Smart analysis works with all mineral soil types
- Incident Wave Amplitude: 400mV
- 20% to 80% Incident Wave Rise Time: 150 ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 10cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 80
Medium Bulk Electrical Conductivity	0 to 2000 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-310H

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	85	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.14		-
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-2000 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.3		%
Accuracy	-3	+3	%FS
Stability with Bulk Electrical Conductivity (0-2000 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	2000	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2000 uS/cm)	-2.5	+2.5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+60 +140	°C °F

TDR-310H

Operating Conditions:

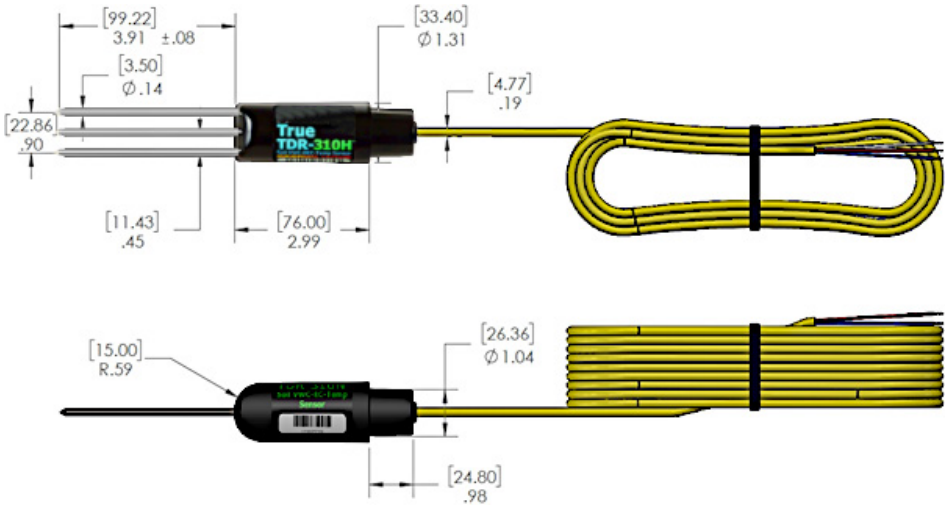
Parameter	Min.	Max.	Units
Operating Supply Voltage	+3.5	+15	Volts
Operating Temperature (VWC errors due to ice)	-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)	0	+55	°C
POWER CONSUMPTION			
Idle Current (sensor powered but inactive, 20°C)	< 10		uA
Idle Current (-35 to +50 °C)	< 50		uA
Sensor read time	0.25 typical		sec.
Sensor read current (Supply Voltage = 12V)	36 typical		mA
Sensor read current (Supply Voltage = 3.5V)	88 typical		mA
Sensor communications current	6 typical		mA

SDI-12 Data Line Electrical Characteristics:

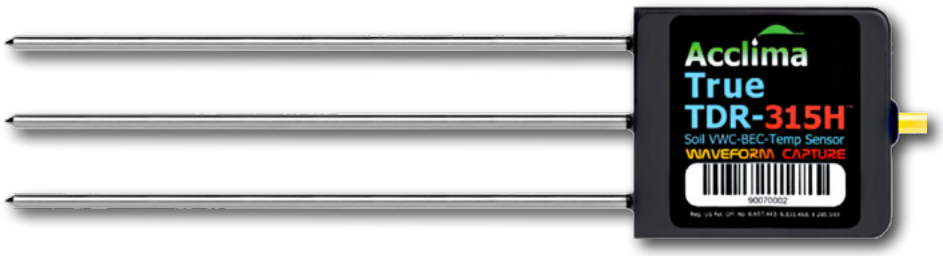
Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in "marking" state)	-1	1.3	V
VIH (required input voltage in "spacing" state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in "marking" state)	0	0.25	V
VOH (output voltage in "spacing" state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	20 cm x 3.3 cm
Weight (without cable)	132 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDR-315H
SOIL MOISTURE SENSOR



Temperature-BEC Sensor

The TDR-315H is one of MUNRO's H-series sensors, which are very low power and suited perfectly for power-conscious applications. Being part of the Soil Smart Series means that its advanced waveform analysis works with all mineral soil types. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms. It's longer waveguides provide a very large sampling volume and high accuracy of the waveform propagation.
Its form factor is designed for shallower horizontal installations where it is pushed into the sidewall of a trench that has been dug to the desired measurement depth. A probe guide is provided to ensure that the waveguide rods are parallel when pushing them into the soil. It provides reading data through a 3-wire SDI-12 interface and is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Ultra-low power consumption and fast response time
- Designed for easy use in shallower horizontal applications
- Very large sampling volume with the wide spacing and the longer 15cm waveguides
- High accuracy MUNRO sensor configuration
- Soil Smart analysis works with all mineral soil types
- Incident Wave Amplitude: 400mV
- 20% to 80% Incident Wave Rise Time: 150ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 15 cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing.

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 85
Medium Bulk Electrical Conductivity	0 to 2000 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-315H

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	85	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.07		-
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-2000 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.07		%
Accuracy	-2	+2	%FS
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	2000	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2000 uS/cm)	-2.5	+2.5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+60 +140	°C °F

TDR-315H

Operating Conditions:

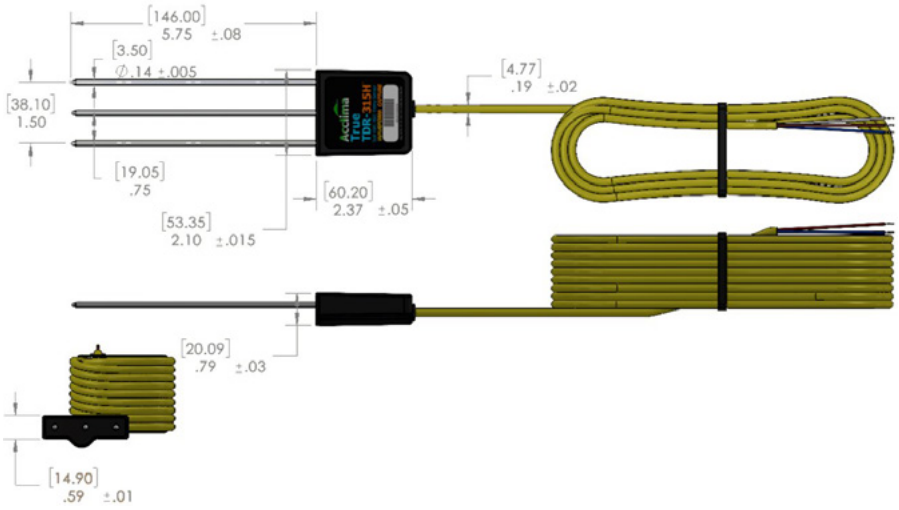
Parameter	Min.	Max.	Units
Operating Supply Voltage	+3.5	+15	Volts
Operating Temperature (VWC errors due to ice)	-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)	0	+55	°C
POWER CONSUMPTION			
Idle Current (sensor powered but inactive, 20°C)	< 10		uA
Idle Current (-35 to +50 °C)	< 50		uA
Sensor read time	0.25 typical		sec.
Sensor read current (Supply Voltage = 12V)	36 typical		mA
Sensor read current (Supply Voltage = 3.5V)	88 typical		mA
Sensor communications current	6 typical		mA

SDI-12 Data Line Electrical Characteristics:

Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in "marking" state)	-1	1.3	V
VIH (required input voltage in "spacing" state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in "marking" state)	0	0.25	V
VOH (output voltage in "spacing" state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	21 cm x 5.3 cm x 2 cm
Weight (without cable)	105 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDR-305N
SOIL MOISTURE SENSOR

Temperature-BEC Sensor

The TDR-305N is a 5cm waveguide version of the TDR-310N. The shorter waveguide allows this sensor to make very shallow measurements and to be used in significantly higher conductivity environments. It also has a much higher amplitude waveform than the H-series sensors, which consumes more power but makes it very effective in taking measurements in challenging soil environments. Being part of the Soil Smart Series means that its advanced waveform analysis works with all mineral soil types. It is a complete integrated time domain reflectometer that c ombines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms.
Its form factor is designed for easy vertical installation in an augered hole using a 34 mm flat-bottomed auger. It mates with a 1" schedule 40 PVC pipe that acts as a handle in its installation to any desired depth. It provides reading data through a 3-wire SDI-12 interface and is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Housing designed for easy bore hole installation at any depth
- Shorter waveguides are great for "check and go" type applications such as mobile readings on golf greens, other turf management, or limited space environments
- Ideal for high conductivity environments
- Soil Smart analysis works with all mineral soil types
- Incident Wave Amplitude: 2.3 V
- 20% to 80% Incident Wave Rise Time: 300 ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 5 cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing.

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 85
Medium Bulk Electrical Conductivity	0 to 6000 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-305N

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	85	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.21		-
Accuracy	-4	+4	%FS[1]
Stability with Bulk Electrical Conductivity (0-6000 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.5		%
Accuracy	-5	+5	%FS
Stability with Bulk Electrical Conductivity (0-6000 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	6000	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2500 uS/cm)	-2.5	+2.5	%
Accuracy (2500 – 6000 uS/cm)	-5	+5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+60 +140	°C °F

TDR-305N

Operating Conditions:

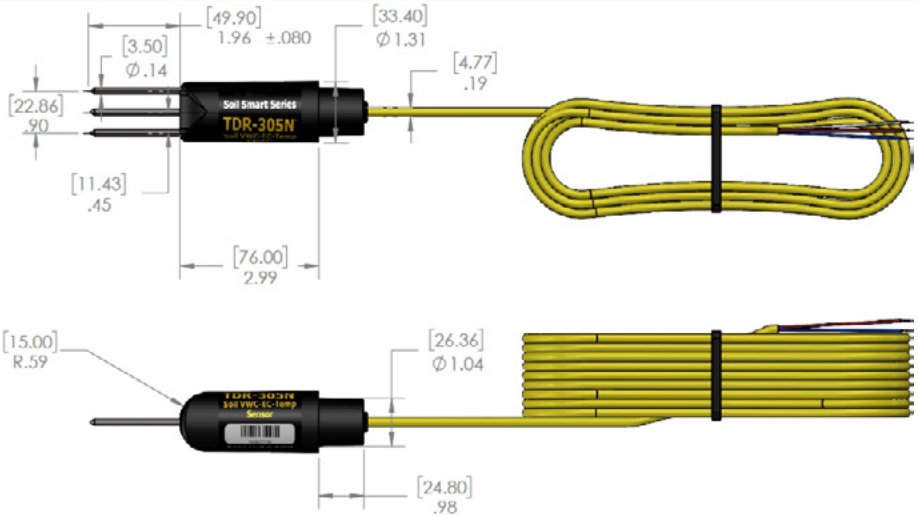
Parameter		Min.	Max.	Units
Operating Supply Voltage	Prior to 2H 2022	+4.2 +6.5	+15	Volts
Operating Temperature (VWC errors due to ice)		-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)		0	+55	°C
POWER CONSUMPTION				
Idle Current (sensor powered but inactive, 20°C)		< 10		uA
Idle Current (-35 to +50 °C)		< 50		uA
Sensor read time		0.4 typical		sec.
Sensor read current (Supply Voltage = 12V)		118 typical		mA
Sensor read current (Supply Voltage = 7V)		150 typical		mA
Sensor communications current		6 typical		mA

SDI-12 Data Line Electrical Characteristics:

Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in “marking” state)	-1	1.3	V
VIH (required input voltage in “spacing” state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in “marking” state)	0	0.25	V
VOH (output voltage in “spacing” state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	15 cm x 3.3 cm
Weight (without cable)	121 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDR-310N
SOIL MOISTURE SENSOR

Temperature-BEC Sensor

The TDR-310N is a replacement to the former MUNRO TDR-310L. It has a high voltage waveform output, which makes it effective in taking measurements when the soil electrical conductivity is high. It also consumes more power than the TDR-310H. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms.
Its form factor is designed for easy vertical installation in an augured hole using a 34 mm flat-bottomed auger. It mates with a 1" schedule 40 PVC pipe that acts as a handle in its installation to any desired depth. It provides reading data through a 3-wire SDI-12 interface and is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Housing designed for easy bore hole installation at any depth
- Larger sampling volume with the 10cm waveguides
- Soil Smart analysis works with all mineral soil types
- Incident Wave Amplitude: 2.3 V
- 20% to 80% Incident Wave Rise Time: 300 ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 10cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing.

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 85
Medium Bulk Electrical Conductivity	0 to 3000 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-310N

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	85	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.14		-
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.3		%
Accuracy	-3	+3	%FS
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	3000	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2500 uS/cm)	-2.5	+2.5	%
Accuracy (2500 – 3000 uS/cm)	-5	+5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+55 +140	°C °F

TDR-310N

Operating Conditions:

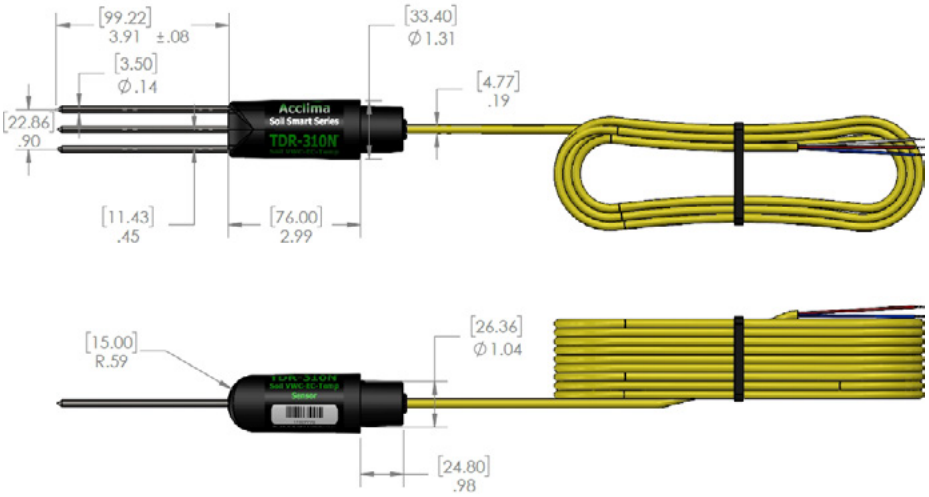
Parameter		Min.	Max.	Units
Operating Supply Voltage	Prior to 2H 2022	+4.2 +6.5	+15	Volts
Operating Temperature (VWC errors due to ice)		-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)		0	+55	°C
POWER CONSUMPTION				
Idle Current (sensor powered but inactive, 20°C)		< 10		uA
Idle Current (-35 to +50 °C)		< 50		uA
Sensor read time		0.4 typical		sec.
Sensor read current (Supply Voltage = 12V)		118 typical		mA
Sensor read current (Supply Voltage = 7V)		150 typical		mA
Sensor communications current		6 typical		mA

SDI-12 Data Line Electrical Characteristics:

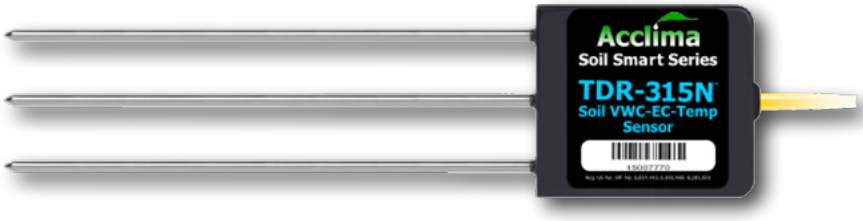
Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in “marking” state)	-1	1.3	V
VIH (required input voltage in “spacing” state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in “marking” state)	0	0.25	V
VOH (output voltage in “spacing” state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	20 cm x 3.3 cm
Weight (without cable)	132 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDR-315N
SOIL MOISTURE SENSOR



Temperature-BEC Sensor

The TDR-315N is MUNRO's flagship Soil Smart TDR moisture sensor. It has a much higher amplitude waveform than our H-series sensors, which consumes more power but makes it very effective in taking accurate measurements in challenging soil environments. Being part of the Soil Smart Series means that its advanced wave-form analysis works with all mineral soil types. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms. Its longer waveguides provide a very large sampling volume and high accuracy of the waveform propagation. Its form factor is designed for shallower horizontal installations where it is pushed into the sidewall of a trench that has been dug to the desired measurement depth. A probe guide is provided to ensure that the waveguide rods are parallel when pushing them into the soil. It provides reading data through a 3-wire SDI-12 interface and is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Designed for easy use in shallower horizontal applications
- MUNRO's largest sampling volume with the wide spacing & the longer 15cm waveguides
- Highest accuracy MUNRO sensor configuration
- Soil Smart analysis works with all mineral soil types
- Incident Wave Amplitude: 2.3 V
- 20% to 80% Incident Wave Rise Time: 300 ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 15 cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing.

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 85
Medium Bulk Electrical Conductivity	0 to 3000 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-315N

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	85	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.07		-
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	%FS
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.07		%
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	3000	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2500 uS/cm)	-2.5	+2.5	%
Accuracy (2500 – 3000 uS/cm)	-5	+5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80 and/or temperature compensation is active.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+60 +140	°C °F

TDR-315N

Operating Conditions:

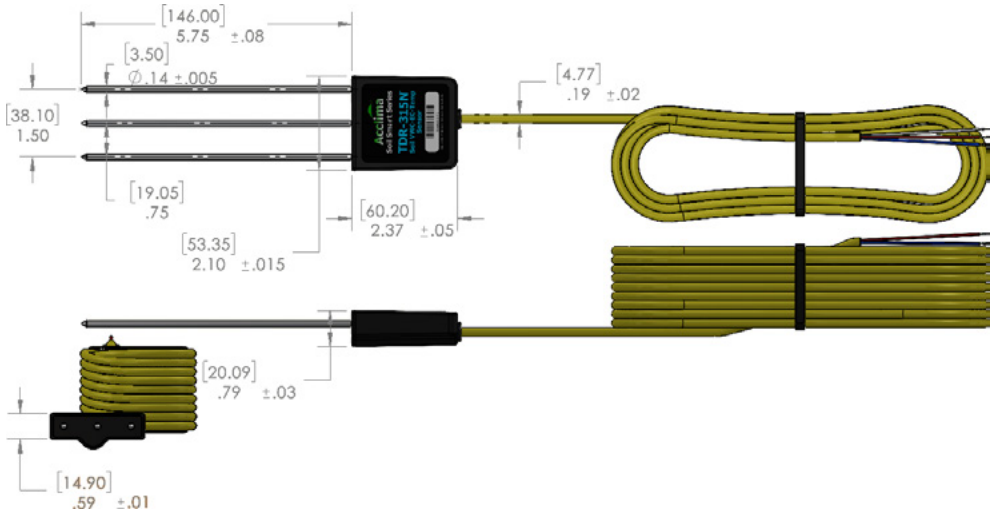
Parameter		Min.	Max.	Units
Operating Supply Voltage	Prior to 2H 2022	+4.2 +6.5	+15	Volts
Operating Temperature (VWC errors due to ice)		-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)		0	+55	°C
POWER CONSUMPTION				
Idle Current (sensor powered but inactive, 20°C)		< 10		uA
Idle Current (-35 to +50 °C)		< 50		uA
Sensor read time		0.4 typical		sec.
Sensor read current (Supply Voltage = 12V)		118 typical		mA
Sensor read current (Supply Voltage = 7V)		150 typical		mA
Sensor communications current		6 typical		mA

SDI-12 Data Line Electrical Characteristics:

Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in “marking” state)	-1	1.3	V
VIH (required input voltage in “spacing” state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in “marking” state)	0	0.25	V
VOH (output voltage in “spacing” state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	21 cm x 5.3 cm x 2 cm
Weight (without cable)	105 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDR-310W
SOIL MOISTURE SENSOR

Temperature-BEC Sensor

The TDR-310W is a modification to the MUNRO TDR-315N. Its shorter rods (10cm instead of 15cm) allow it to fit in standard rockwool blocks. The Soil Smart analysis engine is also tuned for non-mineral soils often used in Controlled Environment Agriculture (CEA), such as rockwool and coco coir, yet still performs well in traditional mineral soils. It also has a much higher amplitude waveform than the H-series sensors, which consumes more power, but makes it very effective in taking measurements in challenging soil environments. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 pico-second resolution time base and highly sophisticated waveform digitizing and analyzing firmware that provides true time domain analysis of soil-propagated waveforms. Its form factor is designed primarily for ease-of-use in non-mineral media commonly used in vertical farming applications. A probe guide is provided to ensure that the waveguide rods are parallel when pushing them into the soil. It provides reading data through a 3-wire SDI-12 interface and is compatible with any data recorder that is compliant with SDI-12 version 1.4 and earlier.

Features:

- Designed for easy use with rockwool blocks and smaller grow media
- Large sampling volume with the wide spacing of the 10cm waveguides
- Soil Smart analysis optimized for non-mineral soil types, while still works well in mineral soils
- Incident Wave Amplitude: 2.3 V
- 20% to 80% Incident Wave Rise Time: 300ps
- Waveform Digitizing Resolution: 5 ps
- SDI-12 Interface
- 3-element 10cm stainless steel waveguide
- 5m or 10m 3-conductor waterproof cable (standard)
- Waterproof Epoxy-filled Housing.

Measurement Functions:

Volumetric Water Content	0% to 100%
Medium Permittivity	1 to 85
Medium Bulk Electrical Conductivity	0 to 4500 µS/cm
Medium Temperature	-40 to +55°C
Pore Water EC (Hillhurst Model)	0 to 55000 µS/cm

TDR-310W

Measurement Performance:

Parameter	Min.	Max.	Units
RELATIVE PERMITTIVITY			
Range	1	100	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.14		-
Accuracy	-2	+2	%FS[1]
Stability with Bulk Electrical Conductivity (0-4500 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[2]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.3		%
Accuracy	-2.5	+2.5	%FS
Stability with Bulk Electrical Conductivity (0-4500 uS/cm)	-1	+1	%FS
TEMPERATURE[4]			
Range	-40	+55	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +55 °C)	-0.5	+0.5	°C
BULK ELECTRICAL CONDUCTIVITY (BEC)			
Range	0	4500	uS/cm
Resolution	1		uS/cm
Repeatability (RMS deviation)	3		uS/cm
Accuracy (0 – 1000 uS/cm)	-25	+25	uS/cm
Accuracy (1000 – 2500 uS/cm)	-2.5	+2.5	%
Accuracy (2500 – 4500 uS/cm)	-5	+5	%

[1] Percent Full scale, i.e., +/- 2 percentage points

[2] VWC is calculated based on relative permittivity using the formula derived by Topp with minor modifications to allow readings in slurries and pure water. The relative permittivity of water varies with temperature, so to see a reading near 100%, the sensor must be fully immersed in water long enough to equilibrate temperature with the water. The water should be at 20.5C with at least 4cm of water around the rods on all sides, beyond the tips of the rods, and at least 1cm of the sensor body immersed. VWC readings higher than 100% are possible when the permittivity is higher than 80 and/or temperature compensation is active.

[4] The temperature sensing element is located next to one of the outer waveguide electrodes.

Absolute Maximum Ratings:

Stresses beyond those specified below may cause permanent damage to the sensor. These are stress ratings only and operation at these levels is not implied.

Parameter	Min.	Max.	Units
Supply Voltage (Measured between the red and white wires)	-16	+16	Volts
SDI-12 Data Voltage (Blue-White wires)	-16	+16	Volts
External Voltage Applied to sensor rod	-0.3	+4	Volts
Electrostatic discharge, center rod	IEC 61000–4–2 (ESD)		
Storage Temperature	-40 -40	+60 +140	°C °F

TDR-310W

Operating Conditions:

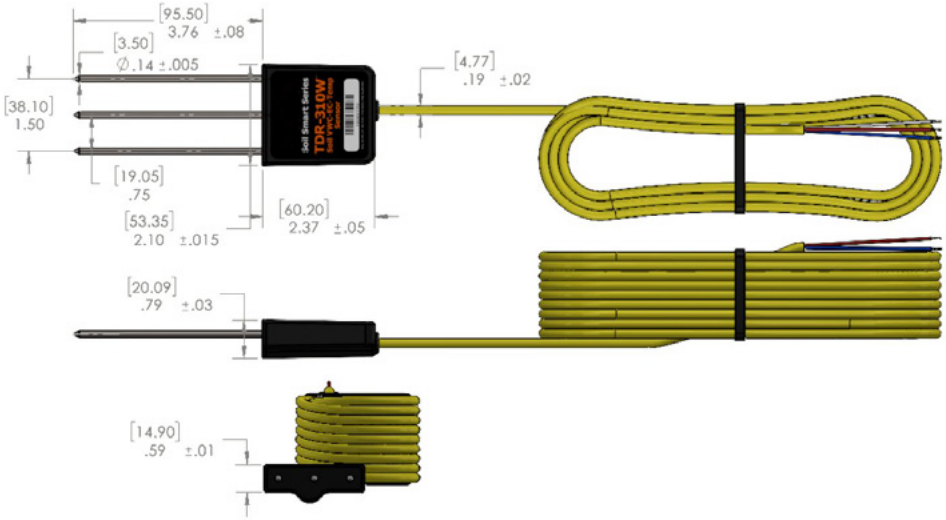
Parameter		Min.	Max.	Units
Operating Supply Voltage	Prior to 2H 2022	+4.2 +6.5	+15	Volts
Operating Temperature (VWC errors due to ice)		-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)		0	+55	°C
POWER CONSUMPTION				
Idle Current (sensor powered but inactive, 20°C)		< 10		uA
Idle Current (-35 to +50 °C)		< 50		uA
Sensor read time		0.4 typical		sec.
Sensor read current (Supply Voltage = 12V)		118 typical		mA
Sensor read current (Supply Voltage = 7V)		150 typical		mA
Sensor communications current		6 typical		mA

SDI-12 Data Line Electrical Characteristics:

Parameter	Min.	Max.	Units
INPUT (when sensor is idle or receiving data)			
Resistance to GND	160k	175k	Ohms
VIL (required input voltage in “marking” state)	-1	1.3	V
VIH (required input voltage in “spacing” state)	3.2	6	V
OUTPUT (when sensor is transmitting data)			
Output impedance	1000	1250	Ohms
VOL (output voltage in “marking” state)	0	0.25	V
VOH (output voltage in “spacing” state)	4.7	5.2	V

Physical Characteristics:

Dimensions (without cable)	16 cm x 5.3 cm x 2 cm
Weight (without cable)	94 g
Cable weight	32.7 g/m
Composition	316 Stainless Steel, Epoxy, ABS Plastic
Cable	3 copper conductor, 22 Ga., waterproof and UV resistant PVC jacket, 4.8mm overall diameter
Communication Protocol	SDI-12 Version 1.4



TDT
SOIL MOISTURE SENSOR

Temperature-BEC Sensor

The MUNRO Digital TDT® soil moisture sensor represents a revolutionary advance in the irrigation industry. It is the first soil moisture sensor to incorporate the accuracy of digitized Time Domain Transmissometry in a low-cost instrument providing highly accurate absolute readings of soil moisture under all conditions of temperature and soil chemistry where crops will grow. No other TDT sensor on the market matches its accuracy and stability. Independent test data from leading soil physicists verifies this extraordinary claim & are available upon request. This Digital TDT sensor incorporates a modified SDI interface capable of connecting directly to MUNRO data loggers or any other third-party SDI version 1.4 compliant device.
The MUNRO modified SDI interface also is capable of auto-detection and address collision repair with MUNRO data loggers.

Features:

• Works in all soils • Highly stable under a wide range of soil conductivity and temperature
• Range of 0 -100% volumetric water content • Made with durable inert materials
• Very low-power, battery operable • SDI-12 version 1.4 compliant • Low cost.

Physical Characteristics:

Dimensions (without cable)	20 cm x 5.33 cm x 1.5 cm
Weight (with 5m cable)	299 g
Composition	Type 304 stainless steel, crystalline-epoxy
PVC (insulation) Cable	3 conductor, 22 ga PVC sheath, 5 meters

Environmental Characteristics:

Operating Temp Range	1˚C to 50˚C for VWC (no ice), -20˚C to 50˚C for the other data
Storage Temp Range	20˚C to 75˚C
Lightning & Surge Protection	6 kV @ 3 kA, 8/50 µs

TDT

Operating Characteristics:

Volumetric Water Content	0 to 100%
Resolution	0.06% VWC
Absolute VWC Accuracy	±2% typical
VWC Soil EC Stability	±1% of full scale 0 to 5 dS/m BEC
Temp. Reporting Accuracy	±2˚C from +1˚C to +50˚C
EC Reporting Accuracy	±0.2 dS/m 0 to 5 dS/m BEC

Architectural Characteristics:

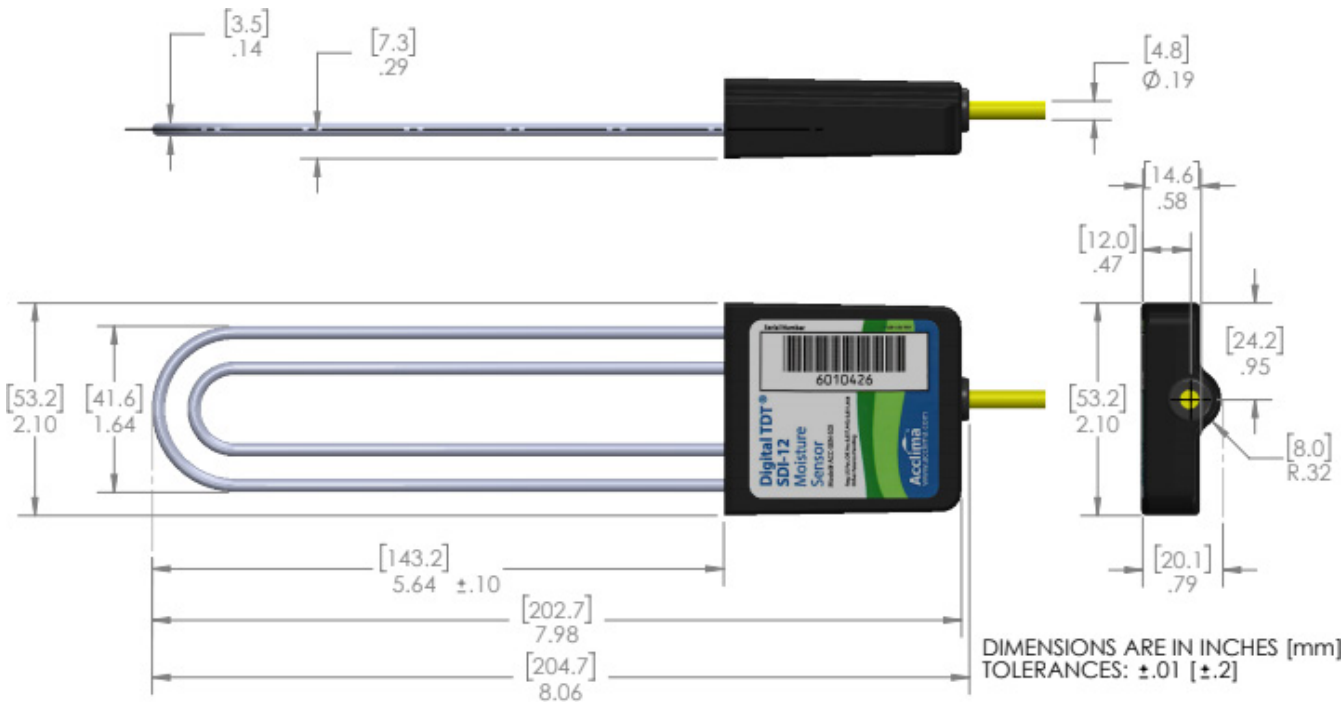
Technology	Waveform Digitizing Time Domain Transmissometer
Effective Acquisition Bandwidth	200 Giga-sample/second
Propagation Time Resolution	ps
Waveform Propagation Resolution	1.5 mm in air, 0.16 mm in water
Waveguide Length	30 cm
Permittivity to VWC Calculation	Modified Dielectric Mixing Model
Propagation Waveform Bandwidth	>2 GHz

Communications Characteristics:

ommunication Protocol	SDI-12 Revision 1.4
Maximum Cable Length	60 meters

Power Characteristics:

Operating Voltage Range	6–15 VDC
Listening/Sleep Mode Current	60 µA at 50˚C
Communications Current	6 mA typical, 8 mA max
Read Moisture Comm Time	425 ms total for each read cycle
Moisture Sense Current	84mA at 12VDC input, 98mA at 8 VDC input, 110mA at 6 VDC input
Moisture Sense Time	450 ms each sensing operation



EC-5/10HS/5TE/5TM/GS3 SOIL MOISTURE SENSORS

What is soil moisture?

Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration.

Preparation:

The ECH2O EC-5, 10HS, 5TE, 5TM, and GS3 can all be installed using the same installation method.Inspect and verify sensor components. When using the sensors in lightning-prone areas, follow the directions for providing protection for the sensors found in the application note Lightning surge and grounding practices.

Testing Sensors:

Take some measurements with the sensor using a data logger. Keep in mind that sensors will not necessarily read 100% VWC in water and 0% in air. The sensors are optimized to read soils, and the factory mineral calibration is done in real soils, not air and water. It is important to check the sensor functionality in air and water (see Functionallity in air and water table). Values are given in % VWC using the factory mineral soils calibration. Sensor values vary less than 1% from one sensor to the next.

Field Installation:

Proper installation of the sensors is critical for proper operation. The recommended technique is outlined below. Please read the complete user manuals.

Functionality in air and water:

Model	Water	Air
EC-5	50–60%	Slightly negative
10HS	50–60%	Slightly negative
5TE	-98%	Slightly negative
5TM	-98%	Slightly negative
GS3	-98%	Slightly negative

Values are given in % VWC using the factory mineral soils calibration. The container must be large enough to encompass the sensor's measurement volume.

TEROS-10
SOIL MOISTURE SENSOR

What is soil moisture?

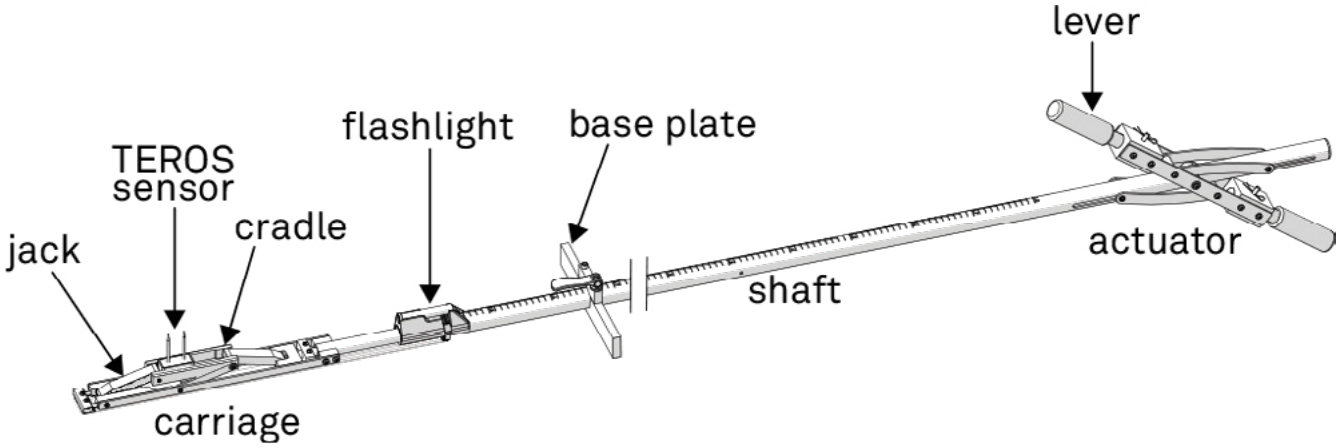
Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration.

Preparation:

Inspect and verify TEROS-10 components. The TEROS verification clip gives the best assessment of proper sensor function and accuracy. The TEROS-10 should read 0.35 to 0.42 m3/m3 on the verification clip.
If a verification clip is not available, test basic sensor functionality in air and water. The TEROS-10 will read ~0.64 m3/m3 in water and a slightly negative value in air.
Note: The sensors are optimzed to read in soils, therefore the sensor will not read 100% in pure liquid water. Values above use the mineral soil calibration.

Installation Tool:

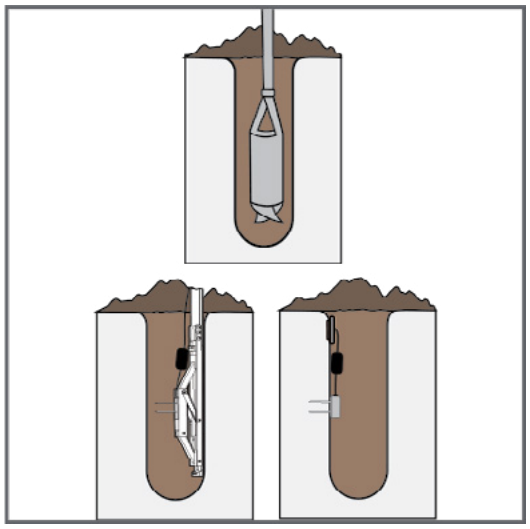
Proper installation of the sensors is critical for proper operation. Refer to the TEROS-10 User Manual for details. For easy installation, use the borehole installation tool. The installation tool (shown below) is available for rent from us.



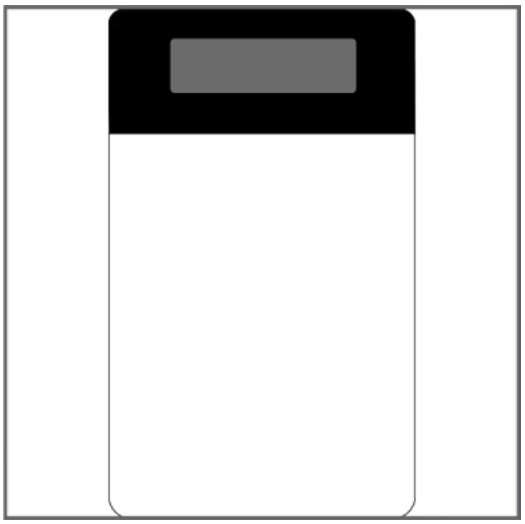
TEROS-10

Installation:

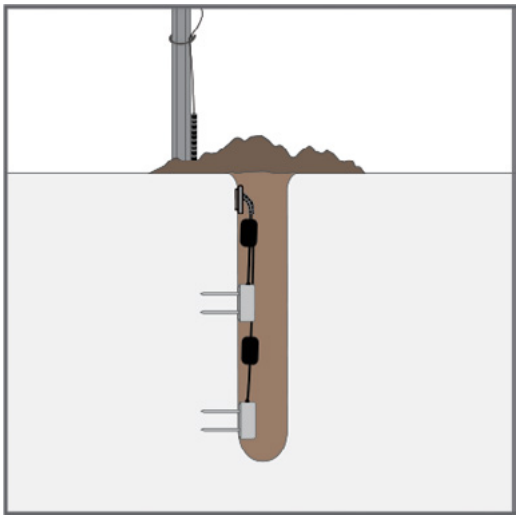
1. Insert Sensor - Auger or trench a hole to the desired sensor depth. Insert the sensor into the undisturbed soil. When using the borehole installation tool, load the TEROS-10 as shown. Lower the tool into the hole or trench with the back of the tool supported by the far wall. Pull on the lever to activate the jack and insert the sensor into hole wall.



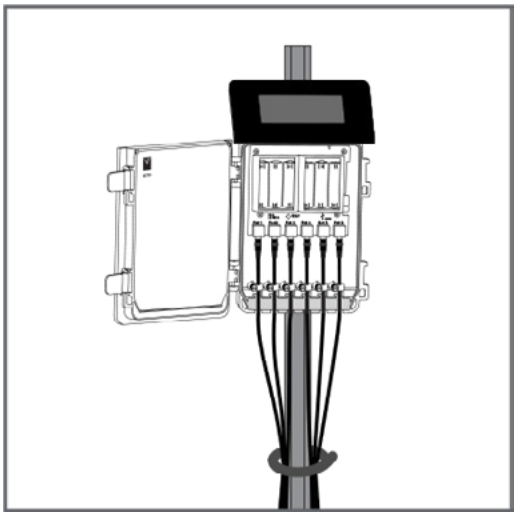
2. Check Sensor Operation - Plug the sensor into the data logger and use the SCAN function in the software to do a quick check of sensor operation before backfilling.



3. Repack Soil and Protect Cables - Secure and protect cables with PVC casing or flexible conduit and backfill the trench or hole.



4. Plug Sensor In and Configure Logger - Plug the sensor into the data logger. Use data logger software to apply appropriate settings to the sensors plugged into each data logger port.
The TEROS-10 is an analog sensor and will not be automatically recognized on our data loggers. Select the right sensor for each port.



TEROS-11/12
ADVANCED SOIL MOISTURE SENSORS

What is soil moisture?

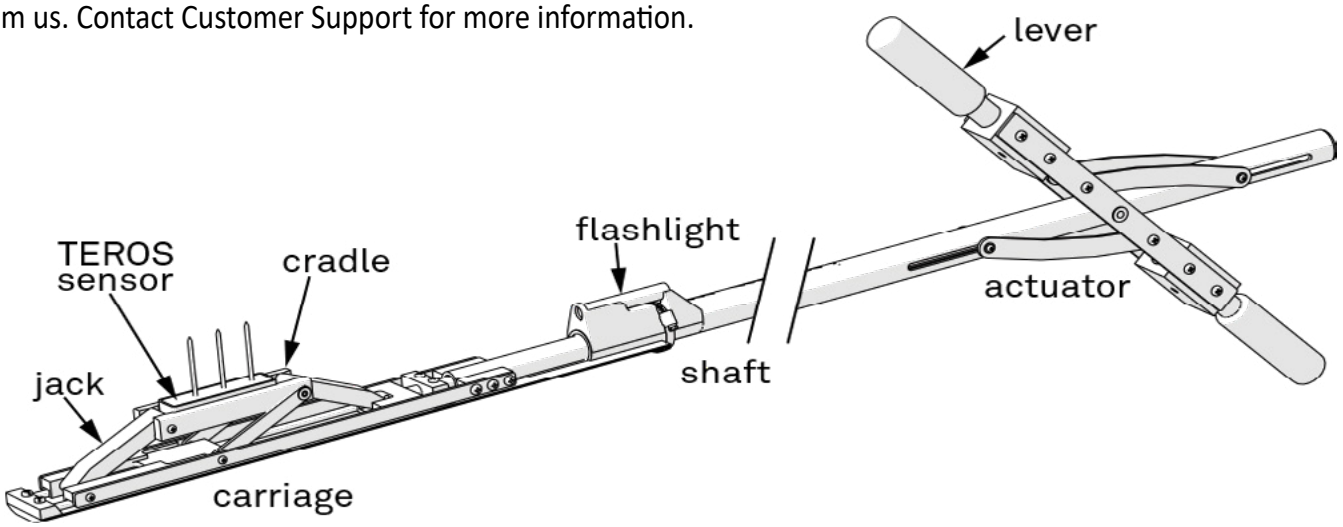
Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration.

Preparation:

Inspect and verify the sensor components (TEROS-11 Soil Moisture and Temperature or TEROS-12 Soil Moisture, Temperature, and Electrical Conductivity). The TEROS verification clip gives the best assessment of proper sensor function and accuracy. The TEROS-11/12 should read 0.332 to 0.363 m3/m3 on the verification clip. If a verification clip is not available, test basic sensor functionality in air and water. The TEROS-11/12 will read ~0.70 m3/m3 in water and a slightly negative value in air.
Note: The sensors are optimized to read in soils, therefore the sensor will not read 100% in pure liquid water. Values above use the mineral soil calibration.

Installation Tool:

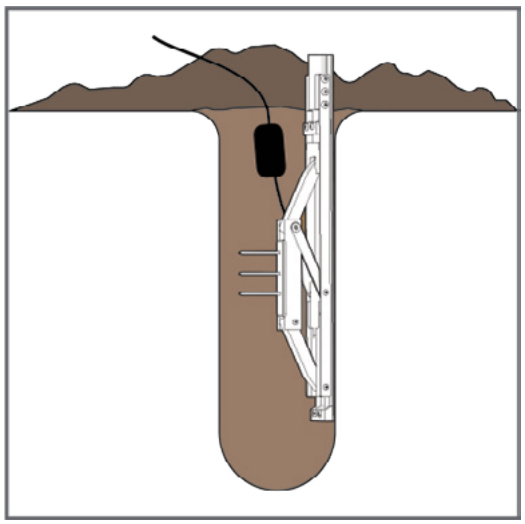
Proper installation of the sensors is critical for proper operation. Refer to the TEROS-11/12 User Manual for details.
For easy installation, use the borehole installation tool. The installation tool (shown below) is available for rent from us. Contact Customer Support for more information.



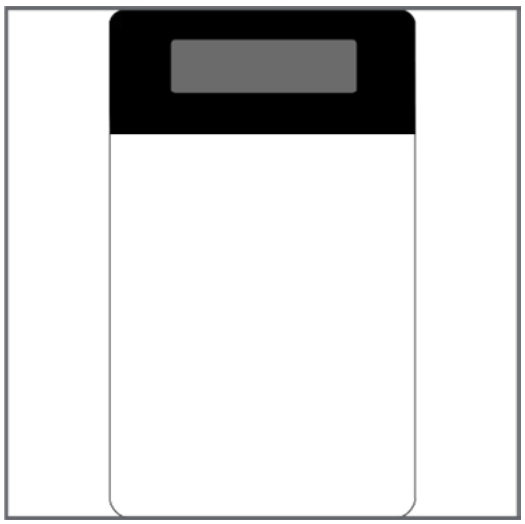
TEROS-11/12

Installation:

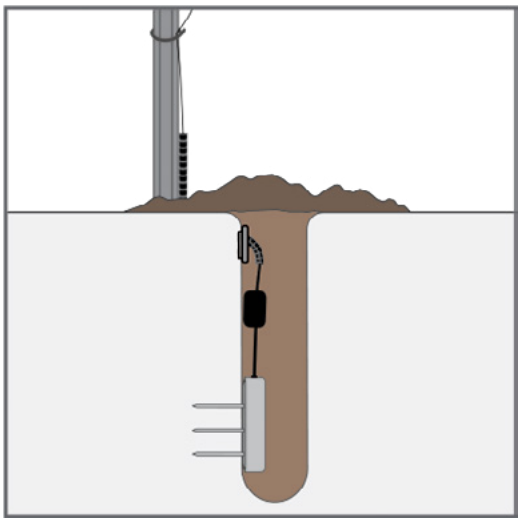
1. Insert Sensor - Auger or trench a hole to the desired sensor depth. Insert the sensor into the undisturbed soil.
When using the borehole installation tool, load the TEROS-11/12 as shown. Lower the tool into the hole or trench with the back of the tool supported by the far wall. Pull on the lever to activate the jack and insert the sensor into hole wall.



2. Check Sensor Operation - lug the sensor into the data logger and use the SCAN function in the software to do a quick check of sensor operation before backfilling.



3. Repack Soil and Protect Cables - Secure and protect cables with PVC casing or flexible conduit and backfill the trench or hole.



4. Plug Sensor In and Configure Logger - Plug the sensor into the data logger. Use data logger software to apply appropriate settings to the sensors plugged into each data logger port.