METER

HYDROS 11

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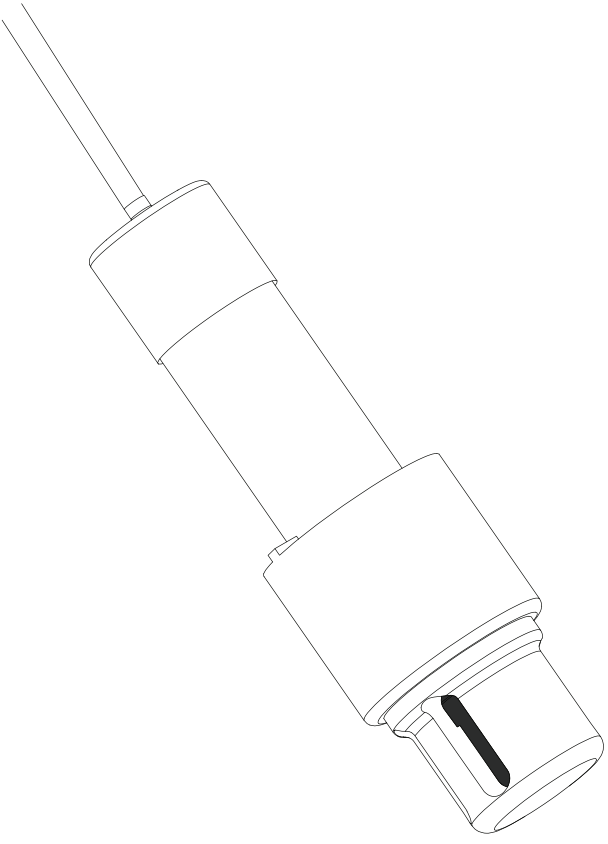
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1. INTRODUCTION

Thank you for choosing the HYDROS 11 Electrical Conductivity and Temperature Sensor from METER Group.

The HYDROS 11 sensor measures in an irrigation pipe, a water body, or in a tank. A thermistor in thermal contact with the probe provides water temperature, while the screws on the surface of the sensor from a four-electrode array to measure electrical conductivity (EC). EC is useful for measuring salinity levels or quality of irrigation water.

Prior to use, verify the HYDROS 11 arrived in good condition.

2. OPERATION

Please read all instructions before operating the HYDROS 11 to ensure it performs to its full potential.

⚠ PRECAUTIONS

METER sensors are built to the highest standards, but misuse, improper protection, or improper installation may damage the sensor and possibly void the manufacturer's warranty. Before integrating HYDROS 11 into a system, follow the recommended installation instructions and have the proper protections in place to safeguard sensors from damage.

2.1 INSTALLATION

Follow the steps listed in Table 1 to set up the HYDROS 11 and start collecting data.

Table 1 Installation

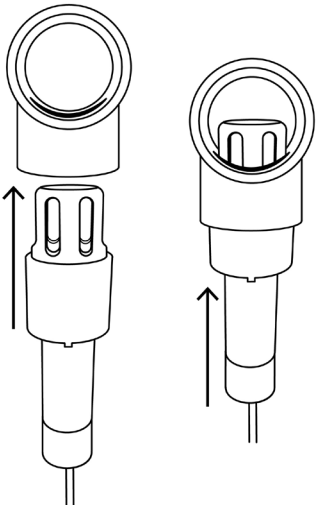
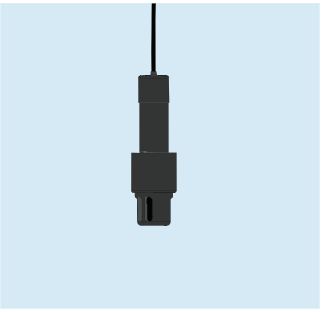
Preparation	**Determine Installation Type** Decide if the HYDROS 11 will take measurements in a pipe or water body. If the HYDROS 11 will be installed in a pipe, obtain PVC glue. **Conduct System Check** Plug the sensor into the logger (Section 2.2) to make sure the sensor is functional. Verify all sensors read within expected ranges. To validate both sensor and logger functionality, take a sensor measurement in air and water.
Pipe Installation	**Connect HYDROS 11 to Pipe** Apply PVC glue to the outside of the end cap, following manufacturer's instructions. DO NOT apply glue to cap slots. Slide the HYDROS 11 into a 1-in Tee socket pipe fitting, ensuring the alignment notch is in the direction of flow. Orient the sensor with the cable end facing down or to the side. This will allow air to escape from the sensing area. Allow for the appropriate curing time of the glue before installing pipe.  **Twist sensor into pipe fitting**

Table 1 Installation (continued)

Water Body Installation	**Suspend HYDROS 11 in Water Body** Suspend the sensor in the tank or water body. If this is not possible, make sure that the sensor is placed away from the sides of the tank or water body as much as possible.  **Sensor body suspended in water body**
Connecting	**Secure and Protect Cables** **NOTE: Improperly protected cables can lead to severed cables or disconnected sensors. Cabling issues can be caused by many factors such as rodent damage, driving over sensor cables, tripping over cables, not leaving enough cable slack during installation, or poor sensor wiring connections.** Install cables in conduit or plastic cladding when near the ground to avoid rodent damage. Gather and secure cables between the HYDROS 11 and the data logger to the mounting mast in one or more places. **Connect to Data Logger** Plug the sensor into a data logger. Use the data logger to make sure the sensor is reading properly. Verify that these readings are within expected ranges. For more instructions on connecting to data loggers, refer to Section 2.2.

2.2 CONNECTING

The HYDROS 11 works seamlessly with METER data loggers. The HYDROS 11 can also be used with other data loggers, such as those from Campbell Scientific, Inc. For extensive directions on how to integrate the sensors into third-party loggers, refer to the HYDROS 11 Integrator Guide.

HYDROS 11 sensors require an excitation voltage in the range of 3.6 to 15.0 VDC and operate at a 3.6-VDC level for data communication. HYDROS 11 can be integrated using DDI serial or SDI-12 protocol. See the HYDROS 11 Integrator Guide for details on interfacing with data acquisition systems.

HYDROS 11 sensors come with a 3.5-mm stereo plug connector (Figure 1) to facilitate easy connection with METER loggers. HYDROS 11 sensors may be ordered with stripped and tinned wires to facilitate connecting to some third-party loggers (Section 2.2.2).

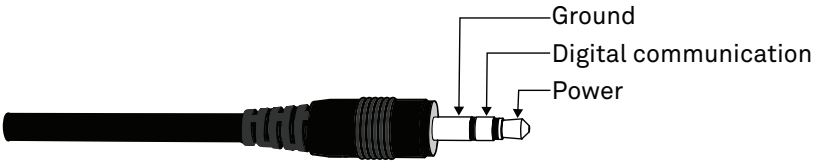


Figure 1 Stereo plug connector

The HYDROS 11 comes standard with a 5-m cable. It may be purchased with custom cable lengths for an additional fee (on a per-meter basis). In some instances, the cable can be extended beyond 75 m by the user, but this is discouraged for a variety of reasons. Please contact Customer Support for more details before extending or splicing cables.

2.2.1 CONNECT TO METER DATA LOGGER

The HYDROS 11 works most efficiently with METER ZENTRA series data loggers. Check the METER download webpage (meter.ly/software-downloads) for the most recent data logger firmware. Logger configuration may be done using either ZENTRA Utility (desktop and mobile application) or ZENTRA Cloud (web-based application for cell-enabled data loggers).

1. Plug the stereo plug connector into one of the sensor ports on the logger.
2. Use the appropriate software application to configure the chosen logger port for the HYDROS 11. METER data loggers will automatically recognize HYDROS 11 sensors.
3. Set the measurement interval.

   METER data loggers measure the HYDROS 11 every minute and return the average of the 1-min data across the chosen measurement interval.

HYDROS 11 data can be downloaded from METER data loggers using either ZENTRA Utility or ZENTRA Cloud. Refer to the logger user manual for more information about these programs.

2.2.2 CONNECT TO A NON-METER DATA LOGGER

The HYDROS 11 can be purchased for use with non-METER (third party) data loggers. Refer to the third-party logger manual for details on logger communications, power supply, and ground ports. The HYDROS 11 Integrator Guide also provides detailed instructions on connecting sensors to non-METER loggers.

HYDROS 11 sensors can be ordered with stripped and tinned (pigtail) wires for use with screw terminals. Refer to the third-party logger manual for details on wiring.

Connect the HYDROS 11 wires to the data logger as illustrated in Figure 2 and Figure 3, with the power supply wire (brown) connected to the excitation, the digital out wire (orange) to a digital input, and the bare ground wire to ground.

NOTE: Some early HYDROS 11 (formerly ES-2) units may have the older Decagon wiring scheme where the power supply is white, the digital out is red, and the bare wire is ground.

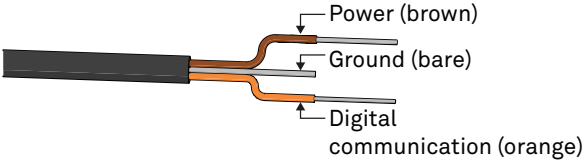


Figure 2 Pigtail wiring

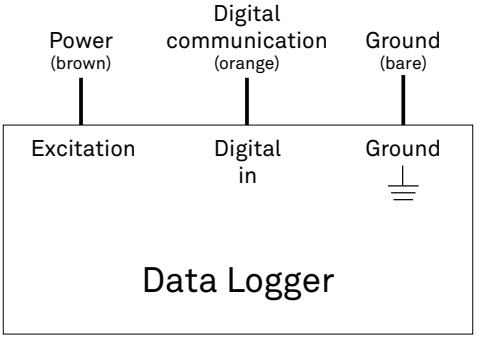


Figure 3 Wiring diagram

NOTE: The acceptable range of excitation voltages is from 3.6 to 15.0 VDC. To read the HYDROS 11 with Campbell Scientific data loggers, power the sensors off a switched 12-V port.

If the HYDROS 11 cable has a standard stereo plug connector and needs to be connected to a non-METER data logger, use one of the following two options:

Option 1

1. Clip off the stereo plug connector on the sensor cable.
2. Strip and tin the wires.
3. Wire it directly into the data logger.

This option has the advantage of creating a direct connection and minimizes the chance of the sensor becoming unplugged. However, it then cannot be easily used in the future with a METER readout unit or data logger.

Option 2
Obtain an adapter cable from METER.

The adapter cable has a connector for the stereo plug connector on one end and three wires (or pigtail adapter) for connection to a data logger on the other end. The stripped and tinned adapter cable wires have the same termination as in Figure 3: the brown wire is excitation, the orange is output, and the bare wire is ground.

NOTE: Secure the stereo plug connector to the pigtail adapter connections using adhesive-lined heat shrink to ensure the sensor does not become disconnected during use.

2.3 COMMUNICATION

The SDI-12 protocol requires that all sensors have a unique address. HYDROS 11 sensor factory default is an SDI-12 address of 0. To add more than one SDI-12 sensor to a bus, the sensor address can be changed using a ZSC Bluetooth® sensor interface and the ZENTRA Utility Mobile app as described below:

NOTE: The sensor SDI-12 address must be returned to 0 to work with ZENTRA loggers.

1. Using a mobile device, open the ZENTRA Utility Mobile app.
2. Connect the sensor to the ZSC.
3. Under Sensor Information, select the SDI Address dropdown.
4. Scroll through the options and select the desired SDI-12 address.

   NOTE: Address options include 0-9, A-Z, and a-z.

Detailed information can also be found in the application note Setting SDI-12 addresses on METER digital sensors using Campbell Scientific data loggers and LoggerNet.

When using the sensor as part of an SDI-12 bus, excite the sensors continuously to avoid issues with initial sensor startup interfering with the SDI-12 communications.

3. SYSTEM

This section describes the specifications, components, and theory of the HYDROS 11.

3.1 SPECIFICATIONS

MEASUREMENT SPECIFICATIONS

Temperature	
Range	–40 to 60 °C
Resolution	0.1 °C
Accuracy	±1 °C
Bulk EC	
Range	0 to 120 dS/m
Resolution	0.001 dS/m
Accuracy	±0.01 dS/m or ±10% (whichever is greater)

COMMUNICATION SPECIFICATIONS

Output
DDI serial or SDI-12 communication protocol
Data Logger Compatibility
METER ZL6 data loggers and any data acquisition system capable of 3.6- to 15-VDC power and serial or SDI-12 communication

PHYSICAL SPECIFICATIONS

Dimensions	
Length	10.9 cm (4.30 in)
Width	2.4 cm (0.95 in)
Thread	1/2-in National Pipe Thread
Operating Temperature Range	
Minimum	–40 °C
Maximum	60 °C

NOTE: Sensors may be used at higher temperatures under certain conditions; contact Customer Support for assistance.

In-Line Pipe Connector Type
1-in Tee socket pipe fitting
Cable Length
5 m (standard) 75 m (maximum custom cable length) **NOTE: Contact Customer Support if a nonstandard cable length is needed.**
Connector Types
3.5-mm stereo plug connector or stripped and tinned wires

ELECTRICAL AND TIMING CHARACTERISTICS

Supply Voltage (VCC to GND)	
Minimum	3.6 V
Typical	NA
Maximum	15.0 V
Digital Input Voltage (logic high)	
Minimum	2.8 V
Typical	3.6 V
Maximum	5.0 V
Digital Input Voltage (logic low)	
Minimum	–0.3 V
Typical	0.0 V
Maximum	0.8 V
Digital Output Voltage (logic high)	
Minimum	NA
Typical	3.6 V
Maximum	NA
Power Line Slew Rate	
Minimum	1.0 V/ms
Typical	NA
Maximum	NA

Current Drain (during measurement)	
Minimum	20 mA
Typical	20 mA
Maximum	28 mA
Current Drain (while asleep)	
Minimum	NA
Typical	0.03 mA
Maximum	NA
Power Up Time (DDI serial)	
Minimum	NA
Typical	NA
Maximum	100 ms
Power Up Time (SDI-12)	
Minimum	100 ms
Typical	200 ms
Maximum	250 ms
Power Up Time (SDI-12, DDI disabled)	
Minimum	NA
Typical	125 ms
Maximum	NA
Measurement Duration	
Minimum	NA
Typical	25 ms
Maximum	50 ms

COMPLIANCE CE

2014/30/EU (EMC) via EN 61326-1:2013
2011/65/EU (RoHS) via EN 63000:2018
CISPR 11:2015+A1:2016+A2:2019 Group 1 Class A

COMPLIANCE STATEMENTS

This device complies with Canadian ICES-003 (Group 1 Class A).

This device complies with part 15 of FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Responsible Party: METER Group Inc, 2365 NE Hopkins Ct, Pullman, WA, 99163, USA, +1-509-332-2756

3.2 COMPONENTS

The HYDROS 11 uses four stainless steel electrodes for its conductivity measurement, which is less sensitive to contamination than a two electrode sensor (Figure 4). A thermistor in contact with the probe provides water temperature. A protective cap helps protect the electrodes from damage and contamination. The alignment notch helps ensure proper placement of the end cap to the sensor body as well as the placement of the sensor in a pipe installation flow.

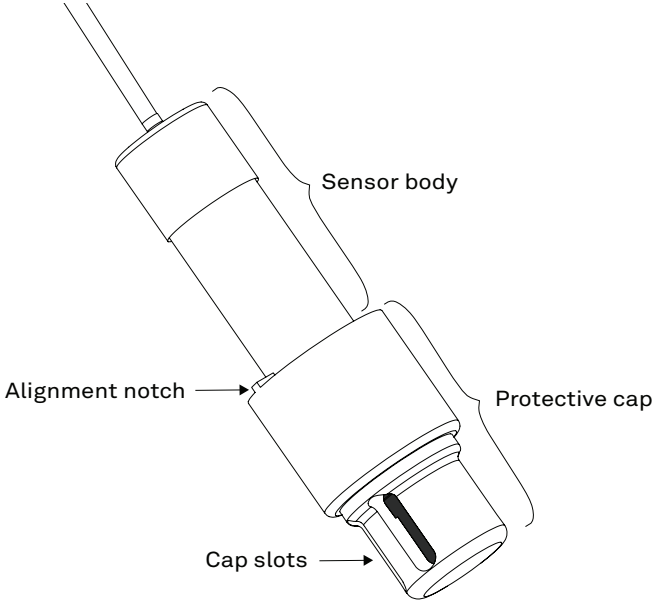


Figure 4 HYDROS 11 sensor

3.3 THEORY

The following sections explain the theory of temperature and electrical conductivity.

3.3.1 TEMPERATURE

A thermistor near the electrical conductivity (EC) sensor senses the temperature of the water. The sensor uses this temperature to adjust the EC measurements to their 25 °C value, and provides the temperature output for the data stream.

3.3.2 ELECTRICAL CONDUCTIVITY

EC is useful for measuring the concentration of salts in water and also gives information about dissolved solids. EC is measured by applying an alternating electrical current to two electrodes, measuring voltage drop with a separate set of electrodes. Then measuring the current flow through those electrodes and measuring the current with a separate set of electrodes. The conductance is the ratio of current to voltage. Conductivity is conductance multiplied by a cell constant based on common conductivity standards. It is important to realize that a four electrode sensor gives unpredictable readings in air because there is no connection between the voltage and current electrodes.

HYDROS 11 sensor bulk EC measurements are corrected to EC at 25 °C:

$$EC_{25} = \frac{EC_T}{\left[1 + 0.019(T - 25)\right]}$$

Equation 1

where EC_{25} is the normalized EC at 25 °C, EC_T is the EC measured by the probe at temperature T, and T is the temperature at the time of measurement.

4. SERVICE

This section describes the calibration and maintenance of the HYDROS 11. Troubleshooting solutions and customer service information are also provided.

4.1 CALIBRATION

METER calibrates EC sensors at the factory using potassium chloride (KCl) solutions of known concentration and calibration values are stored internally in flash memory.

Table 2 relates EC at 25 °C to concentration for various concentrations of KCl. Operators can verify HYDROS 11 performance using these solutions. The HYDROS 11 internally corrects output value to 25 °C.

Table 2 EC of KCl solutions for testing HYDROS 11 calibrations

Electrical Conductivity (µS/cm)	KCl (g/kg of distilled water)
100	0.0446
200	0.0930
500	0.2456
1,000	0.5120
2,000	1.0673
5,000	2.8186
10,000	5.8758
20,000	12.2490

4.2 MAINTENANCE

Replacement parts can also be ordered from METER. Contact Customer Support for more information.

Use the following steps to clean the HYDROS 11.

1. Remove protective cap.
2. Using a sponge and dish soap, scrub the screws until clean.
   NOTE: Do not touch the screws without gloves or allow any contact with oil or other nonconducting residue.
3. Clean the cap, if needed.
4. Rinse the sensor and cap thoroughly with tap or DI water.
5. Replace cap.

4.3 TROUBLESHOOTING

Table 3 lists common problems and their solutions. If the problem is not listed or these solutions do not solve the issue, contact Customer Support.

Table 3 Troubleshooting the HYDROS 11

Problem	Possible Solutions
Data logger is not recognizing sensor	If using a METER logger, update logger firmware. Check the logger configuration for a non-METER data logger using its user manual. Check power to the sensor.
Data logger is not receiving readings from the sensor	Check that the connections to the data logger are both correct and secure. Ensure that data logger batteries are not dead or weak. Check configuration of data logger through software to ensure the HYDROS 11 is selected. Ensure the software and firmware is up to date.
Sensor is not responding	Check the sensor was installed correctly. Check the pressure transducer tube to ensure that it is not clogged or damaged. Check sensor cable and connector integrity.
Cable or connector failure	If a stereo plug connector is damaged or needs to be replaced, contact Customer Support for a replacement connector and splice kit.

4.4 CUSTOMER SUPPORT

NORTH AMERICA

Customer service representatives are available for questions, problems, or feedback Monday through Friday, 7:00 am to 5:00 pm Pacific time.

Email: support.environment@metergroup.com
sales.environment@metergroup.com

Phone: +1.509.332.5600

Fax: +1.509.332.5158

Website: metergroup.com

EUROPE

Customer service representatives are available for questions, problems, or feedback Monday through Friday, 8:00 to 17:00 Central European time.

Email: support.europe@metergroup.com
sales.europe@metergroup.com

Phone: +49 89 12 66 52 0

Fax: +49 89 12 66 52 20

Website: metergroup.com

If contacting METER by email, please include the following information:

Name	Email address
Address	Instrument serial number
Phone	Description of the problem

NOTE: For products purchased through a distributor, please contact the distributor directly for assistance.

4.5 TERMS AND CONDITIONS

By using METER instruments and documentation, you agree to abide by the METER Group, Inc. Terms and Conditions. Please refer to metergroup.com/terms-conditions for details.

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