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HydraProbe SDI-12 Soil Moisture Sensor User Guide

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Introduction

SDI-12 is a specialized communication protocol designed specifically for environmental sensors.
It's an ideal choice for remote and low-power applications due to its minimal power consumption and reliable communication with minimal noise and interference.

Being a standardized protocol, SDI-12 allows for seamless integration of sensors and data loggers from different manufacturers into the same system, which simplifies setup and saves time and resources.

However, if you require longer communication distances, higher data rates, or need to interact with a wider range of devices, Modbus may be a better choice.

You can learn more about SDI-12 by visiting **http://www.sdi-12.org**

Older versions of Hydra Probe firmware may have different commands, contact Stevens Water for more information

Technical Specifications

Power	Requirements	9 to 16 VDC (12VDC Ideal)
	Consumption	1 mA Idle, 25 mA for 2s Active
Wiring	Red	+ Power Input
	Black	Ground
	Blue	SDI-12 Data Signal

How To Use

Using SDI-12 involves setting up a master-slave communication system between devices.

The master device sends requests to the slave devices to read or write data, and the slave devices respond with the requested data.

The basic steps to use SDI-12 are below:

1. Set up the physical connection: Connect the SDI-12 device to your data logger or microcontroller using a compatible interface cable.

    The cable should have three wires: power (positive and negative) and data.

2. **Set up the SDI-12 communication parameters:** Configure your data logger or microcontroller to communicate with the SDI-12 device.

3. **Assign SDI-12 addresses:** Assign a unique SDI-12 address to each slave device on the network.

4. **Send SDI-12 commands:** The commands typically include a command code (e.g., "M" for measurement) and an address (e.g., "0" for the first device on the bus).

    The device will respond with the requested data.

    Many data loggers have a "transparent mode" to communicate directly with the sensor.

5. **Interpret the data received from the SDI-12 device:** The data may be in a specific format or units depending on the device type.

6. **Test:** Test the communication between the devices and make any necessary adjustments to the commands or settings.

Addressing

The first character of any command or response on SDI-12 is the sensor address.

A lowercase 'a' is used to represent the address.

Each SDI-12 sensor must have its own unique address.

The default address is "0".

SDI-12 Command	Response	Description
aAb!	b	**Change Sensor Address** a – Sensor Address b – New Sensor Address

Identification

A request for identification will return the sensor address, part number, firmware version, sensor version, calibration, and serial number.

SDI-12 Command	Response	Description
aI!	a12STEVENSWnnnnnv.vvvcSNxxxxxxxx	Send Identification a – Sensor address 12 – SDI-12 protocol version STEVE NSW – Manufacturer nnnnn – Part nu mber v.vvv – Firmware version c – Calibration xxxxxxxx – Serial num ber

Measurements

SDI-12 Command	Response	Description
aM!	atttn	Request Measurement a – Sensor address ttt – seconds (000 – 999) until the measurement i s ready n – number of data fields (1-9) in the measureme nt

aD0!	a\<F>\<I>\<G>	Send Measurement Readings F – Soil Moisture I – Bulk EC (Temp Corrected) G – Temperature (C)
aD1!	a\<H>\<J>\<L>	Send Measurement Readings H – Temperature (F) J – Bulk EC L – Real Dielectric Permittivity
aD2!	a\<M>\<K>\<O>	Send Measurement Readings M – Imaginary Dielectric Permittivity K – Pore Water EC O – Dielectric Loss Tangent
aM1!	atttn	Request Measurement ttt – seconds (000 – 999) until the measurement is ready n – number of data fields (1-9) in the measurement
aD0!	a\<L>\<M>\<N>	Send Measurement Readings L – Real Dielectric Permittivity M – Imaginary Dielectric Permittivity N – Imaginary Dielectric Permittivity (Temperature Corrected)
aD1!	a\<O>\<P>	Send Measurement Readings O – Dielectric Loss Tangent P – Diode Temperature

The following tables list the values and units:

Selector Order	Parameter	Unit
F	Soil Moisture	Water fraction by Volume (wfv)
G	Soil Temperature	Celsius (C)
H	Soil Temperature	Fahrenheit (F)
I	Bulk EC (Temperature Corrected)	Siemens/Meter (S/m)
J	Bulk EC	Siemens/Meter (S/m)
K	Pore Water EC	Siemens/Meter (S/m)
L	Real Dielectric Permittivity	–
M	Imaginary Dielectric Permittivity	–
N	Imaginary Dielectric Permittivity (Temperature corrected)	–
O	Dielectric Loss Tangent	–
P	Diode Temperature	Celsius (C)

SDI-12 Measurement Sets

Command	P1	P2	P3	P4	P5	P6	P7	P8	P9
aM! and aC!	F	I	G	H	J	L	M	K	O
aM1! and aC1!	L	M	N	O	P				

Pore Water Offset

SDI-12 Command	Response	Description
aXR_PWOS!	a<Current Offset>	Read Pore Water Offset
aXW_PWOS_<New Offset>!	a<New Offset>	Write Pore Water Offset
aXD PWOS!	a+3.4	Reset Pore Water Offset to default 3.4

Calibration
The following extended command will change the coefficients in one of two general formulas that translate the real dielectric permittivity to soil moisture.
In many cases, the Hydra Probe will not need to be recalibrated.
The default General calibration has been heavily reviewed and will provide reasonable accuracy for most

applications.

If you need to change the calibration or if a custom calibration is required, we recommend referring to the Hydra Probe user manual for more information.

SDI-12 Command	Response	Description
aXR_SOIL!	a<G/O/R/C/K>	Get Current soil type G – General O – Organic R – Rockwool C – Custom 1 K – Custom 2
aXW_SOIL_<New Soil Type>!	a<G/O/R/C/K>	Write New Soil Type G – General O –Organic R – Rock Wool C – Custom 1 K – Custom 2
aXR_COEFA!	a<A>	Read coefficient A
aXR_COEFB!	a<B>	Read coefficient B
aXR_COEFC!	a<C>	Read coefficient C
aXR_COEFD!	a<D>	Read coefficient D
aXR_COEFE!	a<E>	Read coefficient E
aXR_COEFF!	a<F>	Read coefficient F
aXR_COEF!	a<A><B><C><D><E><F>	Read all coefficients
aXW_COEFA_<A>!	a<A>	Write coefficient A
aXW_COEFB_<B>!	a<B>	Write coefficient B
aXW_COEFC_<C>!	a<C>	Write coefficient C
aXW_COEFD_<D>!	a<D>	Write coefficient D
aXW_COEFE_<E>!	a<E>	Write coefficient E

aXW_COEFF_<F>!	a<F>	Write coefficient F
aXD_COEF!	a<A><B><C><D><E><F>	Reset all coefficient to default

Accuracy and Ranges

Parameter	
Soil moisture for inorganic mineral soils	**Accuracy*:** +/- 0.01 WFV for most soils (m^3, m^{-3}) +/- <0.03 for fine textured soil (typical) **Range:** From Complete Dry to Full Saturation (0% to 100% of saturation)
Bulk EC	**Accuracy:** +/- 2.0% or 0.02 S/m Whichever is greater **Range:** 0 to 1.5 S/m
Temperature	**Accuracy:** +/- 0.3 °C **Range:** -40 to 75 °C
Inter-Sensor Variability	+/- 0.012 WFV (Typical)
Pore Water EC	Hillforts Equation, depends on soil conditions

*Accuracy of soil moisture depends on the soil and is highly variable.

Model Numbers

Version Part # Suffix	
02	Professional, w/25 ft. cable
04	Professional, w/50 ft. cable
06	Professional, w/100 ft. cable

Documents / Resources

HydraProbe SDI-12 Soil Moisture Sensor [pdf] User Guide
SDI-12 Soil Moisture Sensor, SDI-12, Soil Moisture Sensor, Soil Moisture Sensor, Moisture Sensor, Sensor

References

- 🌐 **SDI-12 Support Group**
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