Manual
SDI-12 transmitter

CODE 06750004

Transmitter for reading a tri-sensor for soil's volumetric water content (VWC)
or soil water potential, temperature, and EC (electrical conductivity)
through an SDI-12 communication bus.

It offers the following benefits:

- Reading such a sensor:
    - TEROS - 12 Meter Group: VWC, EC, and temperature
    - Aquacheck: 3 levels of VWC depth
    - TEROS - 21 Meter Group: Soil water potential and temperature
- The transmitter adapts the signals coming from the sensor and generates an output in standard 4-20mA current values.

- You can use a Module Reader to configure, from the transmitter itself, the soil variety and the format of values that the sensor must deliver.

SDI-12 transmitter

Multilevel sensor

SDI-12 transmitter

VWC + temperature + EC Sensors
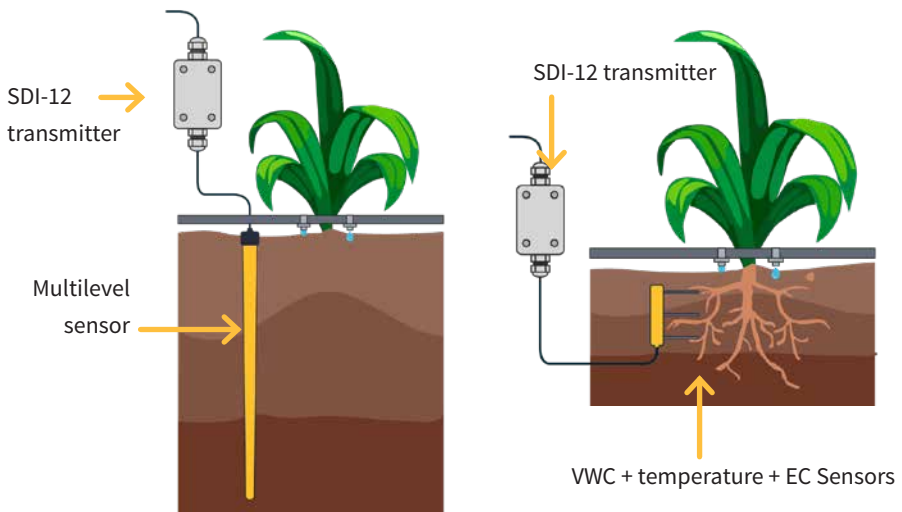
Technical characteristics

Feed		
Power supply	12 Vdc to 20 Vdc	
Energy consumption	Less than 0.9 W	
Overvoltage fuse	Input	Thermal (PTC) 0.4 A at 25°C, self-resettable
Reverse Current Protection	Yes	

Outputs		
Output sign	4 – 20 mA	3 outputs
Sensor power supply	3 Vdc to 12 Vdc	1 output

Inputs	
Number	1
Type	SDI-12 Bus

Maximum distance
Transmitter power supply (12 Vdc, with 2x1.5mm2 cable): 100 metres
From sensor to transmitter: 50 metres
4-20 mA current output: 1000 metres

Environment	
Temperature	-10 °C to +60 °C
Degree of protection	IP65
Moisture	< 95 %
Height	2000 m
Pollution	Grade II

Transmitter box dimensions	
High	99 mm
Width	65 mm
Depth	39 mm
Weight (approx.)	0,4 Kg

This symbol indicates that electronic devices should not be disposed of along with household waste at the end of its useful life. The product must be taken to the corresponding collection point for recycling and properly treating electronic equipment in accordance with the national legislation.

Installation

- The transmitter should be positioned horizontally so that moisture does not accumulate at the ends.
- The transmitter should be placed in a location that is not directly exposed to sunlight.
- It is absolutely necessary to keep the box water-tight.
- Feed the hose cable through the stuffing box and tighten them as well as you can.
- Do not place the transmitter cables next to power lines.

Surface fastening hole

Surface fastening hole

Connecting

The transmitter is provided with two 1.5m cable hoses that allow you to make different connections more easily without the need to access the interior.

Sensor connection hose, 6-wire:

Connection between transmitter and sensor			
Wire colour		ID	Function
	White	A1	SDI-12 sensor data
	Brown	0V	Common power supply, SDI-12 sensor
	Green	VA1	SDI-12 sensor power supply
	Yellow	A2	"Enable external 1" in low consumption mode*
	Grey	0V	Common, enable external
	Pink	A3	"Enable external 2" in low consumption mode*

*Because the SDI-12 transmitter requires a long power supply time due to the SDI bus operating protocol, you can operate it with external modules by configuring the "low power mode." This mode makes the transmitter reduce its consumption and only generates the 4-20 mA current when it receives an external enable signal (12V for at least 400ms, coming from the external module). So, in this mode, it is sufficient to supply the transmitter with a 5W panel + regulator + 7A battery.

NOTE If you are not working in "low power mode" (enable external), leave the yellow, grey, and pink cables disconnected.

- With **TEROS - 12 METER GROUP** sensor:

Connection between transmitter and controller/module			
Wire colour		ID	Function
	White	0V	- (negative) power supply
	Brown	12V	+ (positive) power supply
	Green	S1	Output 1: 4-20 mA (VWC)
	Yellow	S2	Output 2: 4-20 mA (EC)
	Grey	S3	Output 3: 4-20 mA (ºC)

- With **AQUACHECK** sensor:

Connection between transmitter and controller/module			
Wire colour		ID	Function
	White	0V	- (negative) power supply
	Brown	12V	+ (positive) power supply
	Green	S1	Output 1: 4-20 mA (VWC depth level 1)
	Yellow	S2	Output 2: 4-20 mA (VWC depth level 2)
	Grey	S3	Output 3: 4-20 mA (VWC depth level 3)

- With **METER GROUP TEROS - 21** sensor:

Connection between transmitter and controller/module		
Wire colour	**ID**	**Function**
White	0V	- (negative) power supply
Brown	12V	+ (positive) power supply
Green	S1	Output 1: 4-20 mA (Water potential)
Yellow	S2	Output 1: 4-20 mA (ºC)
Grey	S3	--

Consult the manual of each sensor for detailed information about how to install and connect it.

SDI-12 transmitter   Watertight connection terminals   Sensor
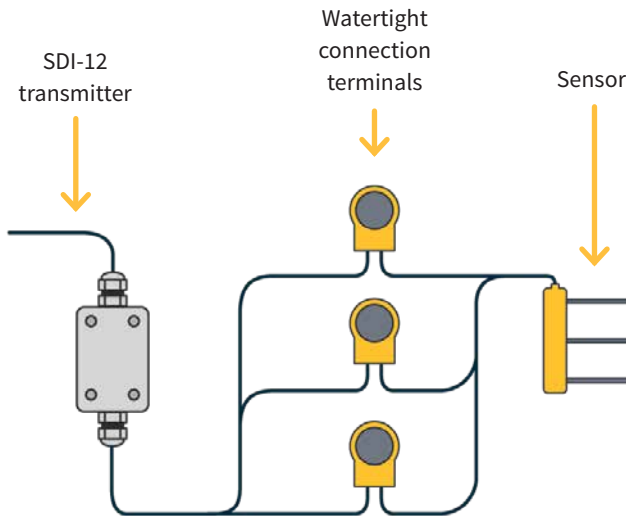
To guarantee that the module hose wire connections are water-tight, it is recommended that you use water-tight terminals. Do not strip the cable wires when making the connection through these terminals.

The 3M Scotchlok series (www.3m. Com), ES Caps from TYCO Electronics (www.tycoelectronics. com), or Cellpack resin connection and derivation kits (www.cellpackiberica.com) can be used as connection elements.

NOTE	It is recommended that loose cables also be connected with an excess 3M connector to avoid possible short circuits or from them getting wet.

Configuration

The transmitters are generally configured at the factory. However, it is possible to make consultations or configurations by using a "Module Reader," consisting of a screen and four keys that are connected to the transmitter through the only visible connector inside.

Press the ↵ key to enter the main menu.
With the − and + keys, you can change the option within the menu. With the ↵ key, you can enter the selected menu option. With the c/c key, the previous hierarchy.

Within the main menu, you can see the following options:
- Consultation
- Configuration

CONSULTATION MENU

Transmitter general reference menu, where you can view:
- Controller firmware version No.
- Transmitter type (depending on the sensor used)
- Consultation of the 4-20 mA current value being delivered (output 1 to 3)

CONFIGURATION MENU

Sensor parameter configuration menu. You can configure:
- Soil type
- Reading format
- Low Power Mode Settings

NOTE The "internal address" of the SDI-12 sensor itself is not relevant, since the transmitter only takes a reading from a single sensor.

The possibility of selecting one or another type of soil, as well as the format of the readings, is determined by the manufacturer of the sensor itself. When you make this selection, you allow the transmitter to carry out one process or another with the sensor readings, as recommended by the manufacturer:

- TEROS - 12 Meter Group:
    - Format 0 (Agronomic):
        » Value-1: VWC [%]
        » Value-2: EC soil/pore water solution [dS/m=mS/cm]
        » Value-3: Temperature [ºC]
    - Format 1 (raw values):
        » Value-1: Constant dielectric value of the medium ε[]
        » Value-2: EC bulk [dS/m=mS/cm]
        » Value-3: Temperature [ºC]
    - Format 2 (raw values):
        » Value-1: VWC [%]
        » Value-2: EC saturation [dS/m=mS/cm]
        » Value-3: Temperature [ºC]

If the reading format is Format-2 (EC given in saturation), the "bulk density" value must be configured. This value must be equal to or greater than 0 and less than 2.65.

NOTE	By default, the transmitter is factory configured to work with **Format-0** (Agronomic).

In addition to the temperature [°C] and EC [µS/cm] values, (the transmitter converts this reading to [mS/cm]=[dS/m]), the sensor displays a RAW value, which the transmitter converts into VWC [%] (Volumetric Water Content or Soil Water Content) using the following expression:
VWC [%] = a*RAW3 + b*RAW2 + c*RAW + d, and depending on the type of soil:

i.Mineral:
a = 0
b = 0
c = +3.879E-4
d = -0.6956

ii.Soilless:
a = +6.771E-10
b = -5.105E-6
c = +1.302E-2
d = -10.848

iii.Coconut fiber:
a = +1.03E-10
b = -1.01E-6
c = +3.58E-3
d = -3.7108

Regardless of the data format configured, the values that are displayed of the three quantities are converted, by the transmitter itself, to the standard 4-20 mA current (800 - 4000 mV in the Agrónic format). So, in the controller in question, you have to select the preferred data format. It is the responsibility of the user to change the data that characterizes said format.

In the case of a TEROS 12 sensor, these are:

Parameter	TEROS-12 sensor format			
	Default value			
	Value 1		Value 2	Value 3
	ε [ ]	VWC [%]	CE [mS/cm]	Temperature [°C]
N. of integers	2	3	2	2
N. of decimals	1	1	2	1
Sign	no	no	no	Yes
Units	-	%	mS/cm	°C
Calibration Point 1				
True value	800 mV	800 mV	800 mV	800 mV
Logical value	01,0	000,0 %	00,00 mS/cm	-40.0 °C
Calibration Point 2				
True value	4000 mV	4000 mV	4000 mV	4000 mV
Logical value	80,0	100,0 %	23,00 mS/cm	+60.0 °C

- Aquacheck:

This sensor gives a value between 0 and 100, which represents the soil's volumetric water content index (VWC). To obtain the desired VWC value, the relevant equation must be applied according to the type of soil, which the SDI-12 transmitter already does internally:

i. Mineral:
VWC[%] = -7.4347 + 0.5564 * (SF-reading)

ii. Sand:
VWC[%] = -8.6463 + 0.5219 * (SF-reading)

iii. Clay:
VWC[%] = -5.9575 + 0.6193 * (SF-reading)

iv. Mud-Loam:
VWC[%] = -2.7900 + 0.4392 * (SF-reading)

v. Loam:
VWC[%] = -4.8372 + 0.4851 * (SF-reading)

vi. Sand-Loam:
VWC[%] = -8.4439 + 0.5650 * (SF-reading)

where the "SF-reading" is the value that the sensor directly delivers.

The transmitter can take VWC readings **up to three levels deep** from an AQUACHECK sensor (the first 3 levels, from lowest to highest depth).

The values that are obtained from the VWC [%] are converted, by the transmitter itself, to the standard 4-20 mA current (800-4000 mV in the Agrónic format). So, in the controller in question, you have to select the preferred data format. It is the responsibility of the user to change the data that characterizes said format. In the case of an AquaCheck sensor, these are:

AquaCheck sensor format	
	Default value
Parameter	Value 1
	VWC [%]
N. of integers	3
N. of decimals	1
Sign	no
Units	%
Calibration Point 1	
True value	800 mV
Logical value	000,0 %
Calibration Point 2	
True value	4000 mV
Logical value	100,0 %

Soil table in the Aquacheck sensor						
Sensor	Soil					
	Mineral	Sand	Clay	Mud/Loam	Loam	Clay/Loam
AquaCheck-4/-8	X	X	X	X	X	X

- **TEROS - 21 Meter Group:**

Said sensor delivers the Soil Water Potential (kPa) and the soil temperature [ºC].

The values obtained from Potential [kPa] and Temperature [ºC] are converted, by the transmitter itself, to the standard 4-20 mA current (800-4000 mV in the Agrónic format). So, in the controller in question, you have to select the preferred data format. It is the responsibility of the user to change the data that characterizes this format. In the case of a TEROS-21 sensor, these are:

Teros-21 sensor format		
	Default value	
Parameter	**Value 1**	**Value 2**
	Potential [kPa]	**Temperature [°C]**
N. of integers	4	2
N. of decimals	1	1
Sign	Yes	Yes
Units	kPa	-
Calibration Point 1		
True value	800 mV	800 mV
Logical value	-9.0	-40,0
Calibration Point 2		
True value	4000 mV	4000 mV
Logical value	-2000,0	+50,0