

True TDR-310N

Soil Water-Temperature-BEC Sensor

The TDR-310N is a replacement to the former Acclima 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.

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Features

SDI-12 Interface
3-element 10 cm stainless steel waveguide
5 m 3-conductor waterproof cable (standard)
Waterproof Epoxy-filled Housing
20% to 80% Incident Wave Rise Time: 300 ps
Waveform Digitizing Resolution: 5 ps
Incident Wave Amplitude: 2.3 V

Measurement Functions

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

Measurement Performance

Parameter	Min	Max	Units
RELATIVE PERMITTIVITY			
Range	1	100	-
Resolution	0.1		-
Repeatability (RMS deviation)	0.07		-
Accuracy	-2	+2	-
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	-
VOLUMETRIC WATER CONTENT (VWC)			
Range[1]	0	100	%
Resolution	0.1		%
Repeatability (RMS deviation)	0.07		%
Accuracy	-2	+2	%FS[2]
Stability with Bulk Electrical Conductivity (0-3000 uS/cm)	-1	+1	%FS

[1] 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 of 100%, the sensor must be fully immersed in water at 20C with at least 2 cm of water around the rods on all sides and beyond the tips of the rods. VWC readings higher than 100% are possible when the permittivity is higher than 80.
[2] Percent Full scale, or +/- 2 percentage points

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TEMPERATURE[3]			
Range	-40	+60	°C
Resolution	0.1		°C
Repeatability (RMS deviation)	0.01		°C
Accuracy (+5 to +35 °C)	-0.25	+0.25	°C
Accuracy (-15 to +50 °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	%

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	+60	°C
	-40	+140	°F

Operating Conditions

Parameter	Min	Max	Units
Operating Supply Voltage	+6.5	+15	Volts
Operating Temperature (VWC errors due to ice)	-30	+55	°C
Operating Temperature (VWC accurate, no ice allowed)	0	+55	°C

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

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POWER CONSUMPTION			
Idle Current (sensor powered but inactive, 20 °C)	< 10		uA
Idle Current (-35 to +50 °C)	< 50		uA
Sensor read time	0.3 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

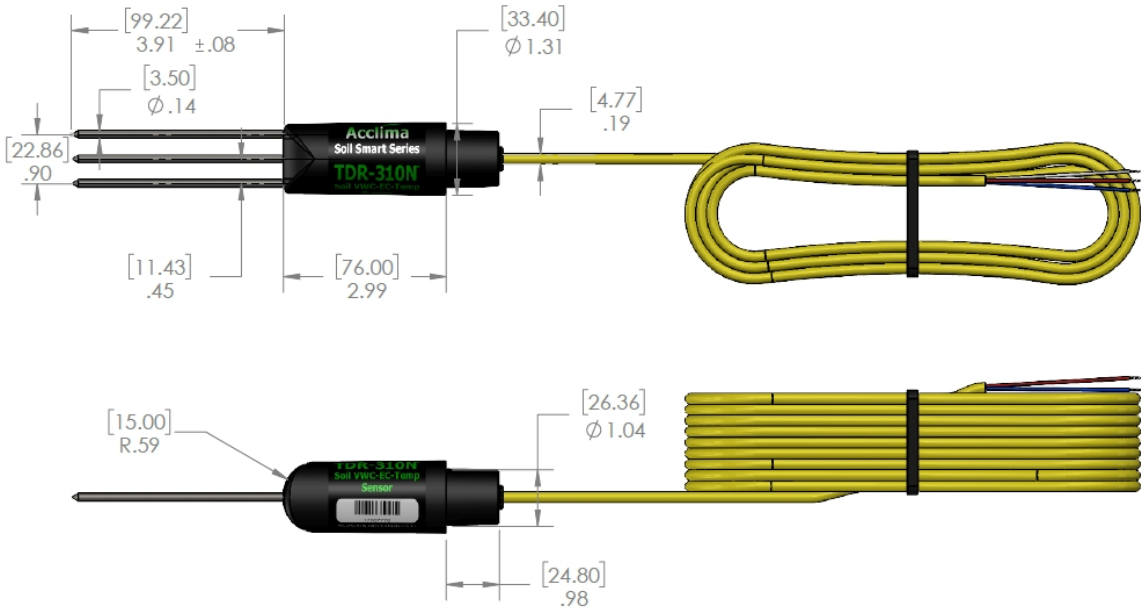
SDI-12 Data Line Electrical Characteristics

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	304 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

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