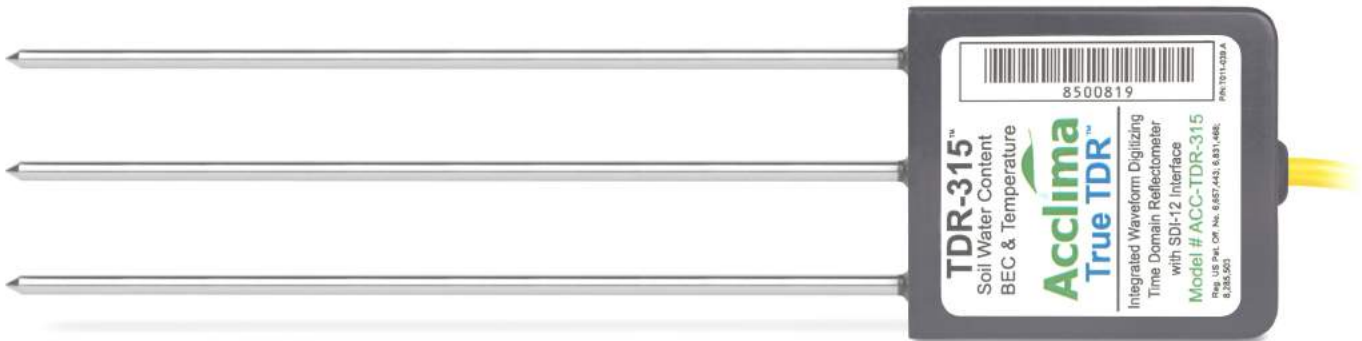




# TDR-315



## Description:

The TDR-315 is a true waveform digitizing Time Domain Reflectometer that derives soil permittivity and water content from the propagation time of an electromagnetic impulse conveyed along its waveguide. Like many of its expensive predecessors (conventional TDR mainframes) it contains an ultra-fast rise time step function generator, a waveform digitizer (200 GSPS) and a picosecond-resolution time base (5ps). Unlike these predecessors it eliminates the bandwidth-constraining coax cable, the bulky console, and 90-97% of the cost. Because it is a true time domain device its readings are not derived from current and voltage magnitudes and relationships and hence are not impacted by soil electrical conductivity and compaction. Its high immunity to EC allows credible application in non-saturated soils wetted with sea water. It uses the standard SDI-12 interface and is compatible with all data recorders that are version 1.3 compliant.

## Functions:

Volumetric Water Content (0 to 100% with 0.1% resolution)

Permittivity (1 to 80 with 0.1 unit resolution)

Soil Electrical Conductivity a.k.a. Bulk EC (0 to 5000  $\mu\text{S}/\text{cm}$  -resolution depends on reading range)

Soil Temperature (-40 to +60 degrees C with 0.1 degree resolution)

Pore Water Electrical Conductivity (0 to 55000  $\mu\text{S}/\text{cm}$ )

## Features:

10 meter, flexible, waterproof cable

15 cm X 3.5mm stainless steel 3-element waveguide

Rugged, waterproof epoxy housing

Typical 100ps incident wave rise time applied directly to the soil (no bandwidth limiting coax cable). Input bandwidth to the waveform digitizer is also unrestrained because of the absence of a coax cable. Using special SDI commands, very high quality and high bandwidth TDR waveforms can be downloaded for use in soil physics research.

## Operating Parameters:

Read time: 1.0 seconds

Voltage Requirements: 6 to 15 volts DC

Idle Current Consumption: <30  $\mu\text{A}$  @ 6 to 15 VDC

Read Current Consumption: 300 mA @ 6 to 15 VDC

Idle Energy Consumption: 15 J per day at 6 VDC

Read Energy Consumption: 1.8 J per reading at 6 VDC, 2.2 J per reading @ 12 VDC

**VWC and Permittivity Performance Specifications:** Permittivity to VWC conversion method = Proprietary Dielectric Mixing Model with 0 to 100% range.

\* Closely follows Topp Equation to 46% VWC.

**Permittivity Reporting Accuracy:**  $\pm 1\%$  of full scale 1 to 80 relative permittivity units

\* From 0 to 4000  $\mu\text{S}/\text{cm}$  Bulk (in-soil) Electrical Conductivity

\* From  $-20\text{ C}$  to  $+50\text{ degrees C}$ , however permittivity of water changes drastically in solid vs liquid states. Therefore the VWC reading will only report liquid water.

**Volumetric Water Content Reporting Accuracy:** Dependent upon soil type – but typically  $\pm 2$  percentage points

\* Less than 1 percentage point change with Bulk EC changes from 0 to 4000  $\mu\text{S}/\text{cm}$

\* Change in VWC with compaction follows only the change in soil volume.

**Temperature Performance Specifications:** Temperature is measured using a precision thermistor. The thermistor is located within 2 mm of the outer waveguide rod where it enters the epoxy housing.

**Temperature Reporting Performance:** Typical  $\pm 0.2$  degrees C, Worst Case  $\pm 0.5$  degrees C over  $-12$  to  $+50\text{ C}$

**Electrical Conductivity Performance Specifications:** EC is calculated from the long term (200 ns) amplitude of the reflected wave using a geometric parameter called the ‘waveguide constant’. This constant is derived in the factory during factory calibration.

**EC Reporting Accuracy:**  $\pm 1\%$ ,  $\pm 35\text{ }\mu\text{S}/\text{cm}$  maximum error from 0 to 5000  $\mu\text{S}/\text{cm}$  Bulk EC.

\* Note that the 1% error applies to higher values of EC while the 35  $\mu\text{S}/\text{cm}$  error applies to very low values of EC.

#### Dimensions:

