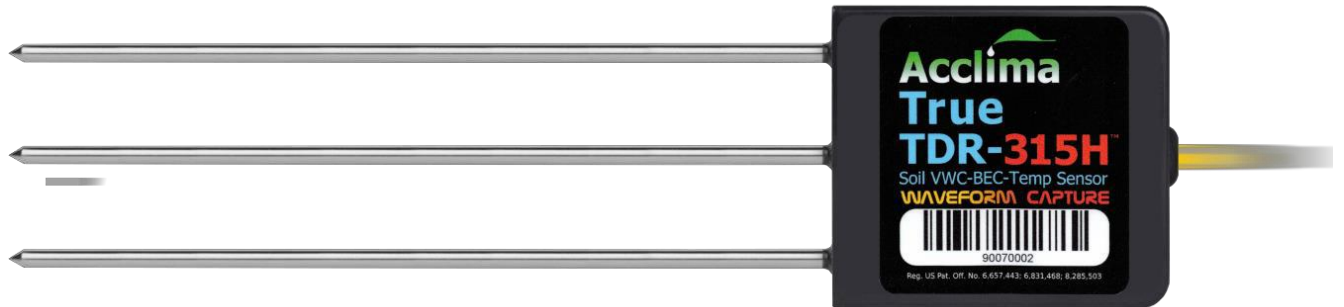


# Data Sheet

## True TDR-315H Soil Water-Temperature-BEC Sensor



### Description:

The TDR-315H is the replacement to the former Acclima TDR-315 and TDR-315L. It is fully compatible with those sensors but incorporates several improvements. It is a complete integrated time domain reflectometer that combines ultra-fast waveform generating and digitizing functions with a precision 5 ps 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 shallower horizontal installations where it is forced into the sidewall of a trench that has been dug to the desired measurement depth. A probe guide is provided to insure that the waveguide rods are parallel when pushing them into the soil. Its main improvements over the '315L are its faster rise time, its shaped incident wave, its lower power consumption and its very fast response time. Its rise time is as fast as the TDR-315 but its power consumption is much lower than the TDR-315 and its price is also lower. Its interface is SDI-12 and is compatible with any data recorder that is compliant with SDI-12 version 1.4.

### Features:

- 3-element 15 cm stainless steel waveguide
- 10 m 3-conductor waterproof cable
- Waterproof Epoxy-filled Housing
- 20% to 80% Incident Wave Rise Time: 150 ps
- Waveform Digitizing Resolution: 5 ps

### Measurement Functions:

|                                      |                                    |
|--------------------------------------|------------------------------------|
| Volumetric Water Content:            | 0% to 100%                         |
| Medium Permittivity:                 | 1 to 80                            |
| Medium Bulk Electrical Conductivity: | 0 to 5000 $\mu\text{S}/\text{cm}$  |
| Medium Temperature:                  | -40 to +60 degrees C               |
| Pore Water EC (Hilhorst Model):      | 0 to 55000 $\mu\text{S}/\text{cm}$ |

## Battery Operation Performance:

A major advantage of the TDR-310H over its predecessor TDR-315L is that its battery life has been increased 10 fold. This is due to lower current consumption and a faster read time.

|                                                                    |                    |        |         |
|--------------------------------------------------------------------|--------------------|--------|---------|
| Read Time (from issuance of read command until the return of data) | 0.25 seconds       |        |         |
| Operating Voltage Range:                                           | 3.5 to 15 volts dc |        |         |
| Idle Current Consumption:                                          | < 10 $\mu$ A       |        |         |
| Idle Daily Energy Consumption @ 3.5 v:                             | 2J/day             |        |         |
| Current and Energy Consumption during Read:                        | current            | power  | energy* |
| 15v                                                                | 32 mA              | 0.48 W | 0.12 J  |
| 12v                                                                | 36 mA              | 0.43 W | 0.11 J  |
| 6v                                                                 | 62 mA              | 0.37 W | 0.09 J  |
| 3.5v                                                               | 88 mA              | 0.31 W | 0.08 J  |

\*A typical 18650 Lithium ion battery stores about 40,000 Joules of energy

## Permittivity Reporting:

Permittivity is calculated directly from waveform propagation time and does not incorporate any voltage or current parameters. Hence the permittivity calculation is independent of soil electrical conductivity. This is the main advantage of true Time Domain Sensors over other types of sensors.

|                                                |                                                         |
|------------------------------------------------|---------------------------------------------------------|
| Reading Range:                                 | 1 to 80 relative permittivity units                     |
| Reporting Resolution:                          | 0.1 relative permittivity units                         |
| Repeatability (RMS deviation):                 | 0.07 permittivity units                                 |
| Reporting Accuracy:                            |                                                         |
| Coarse and medium textured soils:              | $\pm 1$ relative permittivity units                     |
| Fine textured soils:                           | $\pm 2$ relative permittivity units                     |
| Stability of permittivity readings vs Bulk EC: | < 1 relative permittivity unit 0 to 4000 $\mu$ S/cm BEC |

## Volumetric Water Content Reporting:

VWC is calculated from permittivity using the Topp equation. Hence the accuracy of VWC reporting is that of the permittivity reporting and those further small errors imposed by the Topp equation. Note that the Topp equation is effective only to about 50% VWC. Acclima has replaced that segment of the equation with a linear function of propagation time beyond 50% VWC.

|                                       |                                               |
|---------------------------------------|-----------------------------------------------|
| Reading Range:                        | 0 to 100% VWC                                 |
| Reporting Resolution:                 | 0.1% VWC                                      |
| Repeatability (RMS deviation):        | 0.07%                                         |
| Reporting Accuracy:                   |                                               |
| Coarse and medium textured soils:     | $\pm 1$ percentage point                      |
| Fine textured soils:                  | $\pm 2.5$ percentage points                   |
| Stability of VWC readings vs Bulk EC: | < 1 percentage point 0 to 4000 $\mu$ S/cm BEC |

## Bulk Electrical Conductivity Reporting:

Bulk Electrical Conductivity of the soil is calculated from soil resistance measurements between the waveguide elements. Chromium oxide deposits on the waveguide elements becomes significant at high EC levels and the error correspondingly degrades in accuracy at those levels.

|                                      |                                   |
|--------------------------------------|-----------------------------------|
| Reading Range:                       | 0 to 5000 $\mu\text{S}/\text{cm}$ |
| Reporting Resolution:                | 1 $\mu\text{S}/\text{cm}$         |
| Repeatability (RMS deviation):       | 3 $\mu\text{S}/\text{cm}$         |
| Reporting Accuracy:                  |                                   |
| 0 to 1000 $\mu\text{S}/\text{cm}$    | 25 $\mu\text{S}/\text{cm}$        |
| 1000 to 2000 $\mu\text{S}/\text{cm}$ | $\pm 2.5\%$                       |
| 2000 to 5000 $\mu\text{S}/\text{cm}$ | $\pm 5\%$                         |

### Temperature Reporting:

Soil Temperature is measured with a highly precise thermistor that is located about 2mm from one of the outer waveguide electrodes.

|                                |                      |
|--------------------------------|----------------------|
| Reading Range:                 | -40C to +60C         |
| Reporting Resolution:          | 0.1 degree C         |
| Repeatability (RMS deviation): | 0.01 % C             |
| Reporting Accuracy:            | $\pm 0.25$ degrees C |

### Pore Water EC Reporting:

This reading is calculated from permittivity and bulk EC using the Hilhorst model with an assumed soil type. Hence it is of limited accuracy and should be used only as a ball-park reading.

