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# Moisture•Point<sup>TM</sup>

## Technical Paper

### MP-917 Technical Brief 1

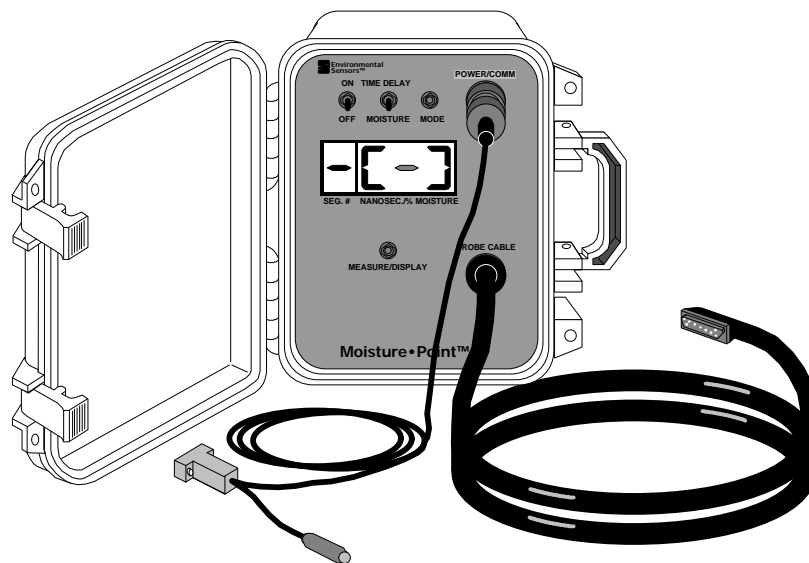
## Moisture•Point TDR SYSTEM

Conventional time domain reflectometry (TDR) techniques, using variations on cable testing instruments, have been successfully applied to soil moisture measurements for many years.

**Moisture•Point** utilizes TDR as its baseline technology but it also employs novel signal discrimination and processing techniques which set it apart from conventional TDR based instruments now in use. These techniques solve the signal-to-noise ratio, waveform detection and discrimination, signal quality validation and circuit stability problems specific to soil applications of TDR. **Moisture•Point** also adds the third dimension to spatial investigations of soil moisture. This feature enables the user to obtain a profile from a single probe with minimal disturbance of the surrounding soil.

**Moisture•Point** was developed with features for both scientific and general purpose users. The **Moisture•Point** system has undergone over four years of laboratory and field testing.

- As a general purpose data gathering tool, **Moisture•Point** can be employed by untrained individuals who simply insert the probe, connect it to the instrument and push a button. The instrument then "does it all" by automatically interrogating the probe, processing the segment waveforms, and displaying the numerical result.
- As a scientific data gathering and analysis tool, **Moisture•Point** allows direct or remote access to signal calibration and gain variables. Scientific users can also directly monitor, capture and store both raw and processed waveforms using a PC.



## INSTRUMENT

The instrument is sealed in a small, portable, thermoplastic box. It is designed to be waterproof when the lid is closed, and splash proof (can be used in the rain) when the lid is open. An optional datalogger can be completely integrated into the instrument and its operation is fully automatic. The instrument comes with a two (2) meter cable which will plug into any standard **Moisture•Point** probe using a waterproof environmental connector.

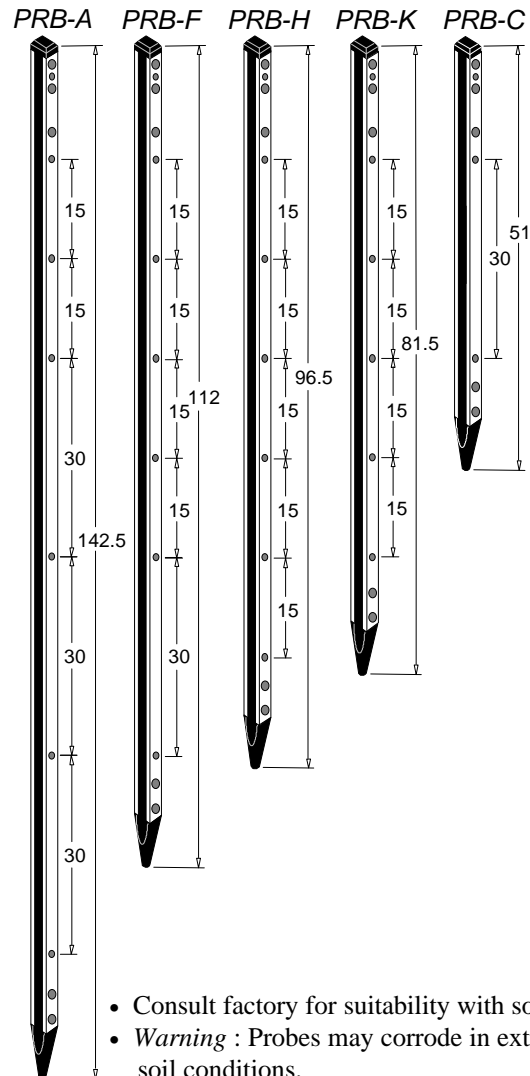
Optional DOS based software (View•Point) for the MP-917 allows PC access via an RS-232 I/O port. PC access enables adjustment of gain, on-line analysis of waveforms and evaluation of relative time delay data which is produced with the moisture measurement.

A datalogger equipped **Moisture•Point** instrument can also be used in unattended applications. In the unattended mode, the instrument takes measurements on a user selected sampling interval (1 minute to 120 minutes). Up to 2,500 samples may be logged with the addition of an external supplemental power supply or external battery pack. This can be further expanded to more than 10,000 samples with additional datalogger memory modules. RS-232 serial output of all measurement data is also available to external third party datalogger or an on-line modem link interface.

## PROFILING PROBES

**Moisture•Point** probes are available in a variety of segment configurations (number and length) for optimum flexibility in a multitude of applications. They are environmentally benign and designed for long term exposure to the environment. In general, the probe is a long rod with a rectangular cross section and a length determined by the number of segments and their aggregate length. The material construction is a molded "sandwich", 1.3 cm x 1.9 cm x (probe length) of two thin stainless steel bars and epoxy. Epoxy is injected between the two bars to fix a standard separation (transmission line), and to encapsulate the electronic components between the two bars. There is an high density plastic environmental connector molded into the top and a high impact high density plastic point on the bottom of the probe. Physically the profiling probe looks like a short, hard, black spear with stainless steel sides. The segments are defined by components molded into the probe along its length. **Moisture•Point** probes also have integral solid state I.D. tags. The tags enable any instrument equipped with a **Moisture•Point** datalogger to read the probe serial number and automatically tag the data with the time/date and I.D. number.

During a typical installation, profiling probes are pressed into preformed pilot holes made with a steel pilot rod. They can also be placed into prepared core holes which are then backfilled with soil. In an optimum field situation probes are permanently installed and the instrument is attached to the probe for data acquisition. The MP-917 interrogates the probe and reduces the segment data to a numerical data set for display, or export to a datalogger. It takes approximately 15 seconds per segment for the instrument to interrogate, analyze data and log moisture. A standard five segment probe will take approximately 75 seconds to completely measure the moisture for all segments. The entire process is automatic once the MP-917's MEASURE button is pressed. Digital data displayed is an average "Volumetric Water Content" measured over the length of each probe segment. **Moisture•Point** readings achieve the stated accuracy without soil calibration.



## Moisture•Point Profiling Probe Types

There is a range of standard **Moisture•Point** probes available. One example is the **PRB-A** probe designed for the USDA-ARS for general agricultural and prairie soil moisture profile applications. The total length of a probe is approximately 25 cm. longer than the 'active' length. There are inactive sections at the top (the connector/impact head assembly), and bottom (the point). The probe point extends 10 cm below the bottom of the last segment.

The MP-917 is pre-loaded with factory calibration coefficients for the standard probes. Other probe types are supported by changing instrument calibration tables using the **View•Point** software.

The MP-917 can also accommodate special probe requirements not listed in the tables at right. There is a \$2000 US proto-typing charge to design, test and validate probe configurations not listed in the above tables (refer to Technical Brief #8 for details). In general terms, probes should be limited to 1.5 meters total length, with not more than seven segments and with no segment shorter than fifteen (15) centimeters. These probe criteria relate to the standard instrument cabling and automatic segment addressing software. There is some additional design flexibility for special circumstances.

### Standard Probe Types:

Part No.	# of Seg.	Segment Lengths	Overall length	Active length
PRB-A	5	15, 15, 30, 30, 30	142.5	120.0
PRB-C	1	30	52.5	30.0
PRB-F	5	15, 15, 15, 15, 30	112.5	90.0
PRB-K	4	15, 15, 15, 15	81.5	60.0
PRB-H	5	15, 15, 15, 15, 15	97.5	75.0

(lengths in centimetres, segments listed top to bottom)

### Non-Standard Probe Types Also Available:

Part No.	# of Seg.	Segment Lengths	Overall length	Active length
PRB-B	2	20, 20	62.5	40
PRB-D	2	15, 15	72.5	30
PRB-E	3	15, 15, 15	67.5	45
PRB-L	2	30, 30	104.5	60
PRB-M	5	30, 30, 30, 30, 30	172.5	150

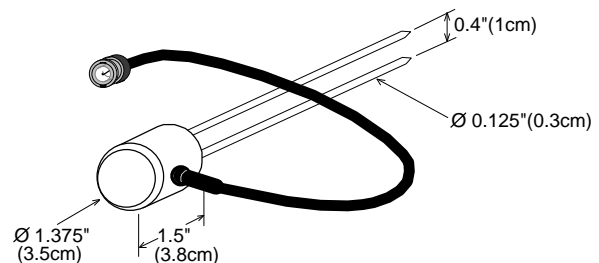
(lengths in centimetres, segments listed top to bottom)

## SINGLE DIODE PROBES

Single diode probes have two prongs, varying in length from 15 cm to 60 cm. in length. These probes can be fabricated for a wide variety of applications at minimal cost. Correct use of single diode probes may require interpretation of probe waveforms and adjustment of instrument parameters via **View•Point** software (purchased separately). See Technical Brief 13.

### Planter Style Single Diode Probe (SDP)

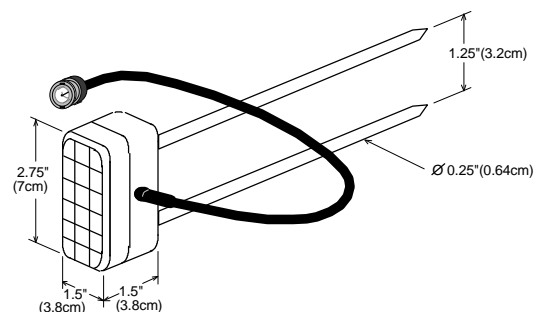
The planter style probe was designed for green house applications in seedling trays where it can be installed horizontally through several seeding pots. It provides accurate soil moisture measurements for reliable management of irrigation routines and thus, healthier seedlings. It can also be used with a second diode assembly (SDA) attached to the ends of the rods for greatest accuracy and best results.



Single Diode Probe: Planter Style

### Rugged Style Single Diode Probe (SDP)

The rugged single diode probe is sturdy enough to be inserted and extracted hundreds of times and even hammered into tight soils. This probe is offered in two configurations: rods with threaded collars that screw on and off the probe, for repeated insertions/extractions (available in several lengths), and rods that snap on and off the probe, for rods that are to be left in the soil. The head can be snapped onto the rods only for the duration of a moisture measurement.



Single Diode Probe: Rugged Style

## ACCESSORIES/FEATURES

### Special Tool Option

An Insertion/Extraction tool kit or equivalent is required for correct installation of profiling probes.

**Moisture•Point** profiling probes are rugged, but in a dense, rocky or high clay content soils where there is severe resistance or repeated direct "driving" into the soil, probe damage may result. The three kits available are the TK-917, TK-217, and TK-117. The TK-917 and TK-217 enable manual insertion/extraction when an hydraulic system (e.g. a Giddings Rig) is not available.

The TK-917 consists of a pilot rod, an extension shank, manual driver, coupling link & pin set and an extraction jack. All of these items are shipped in a reusable crate. The pilot rod is a steel bar with the same dimensions as a probe. The extension shank lengthens the rod or probe so that the manual driver is still effective when the rod/probe has been driven more than half its length into the ground. The extraction jack couples to the rod or probe, using the coupling link & pin set, and extracts them from the ground. The tools are all portable and designed to be used by one person.

The TK-217 consists of a pilot rod, extension shank and coupling link & pin set. This tool set assumes the user has a suitable steel fence post driver and a heavy duty farm jack available for driving and extraction operations. **Hammers should not be used to drive probes or the pilot rod.**

The TK-117 is useful if an hydraulic system is available. The TK-117 consists of a pilot rod and a coupling link & pin set. This tool set assumes the user has an hydraulic coring rig for inserting the extracting the pilot rods and probes. Minor modification may be required to adapt the pilot rod and coupling link hole patterns to match the coring rig piston arrangement.

### Moisture•Point Datalogger (optional)

The integral **Moisture•Point** datalogger (when installed) is operational when the MP-917 is powered. As measurement data is displayed, it is recorded by the datalogger, along with the time and date of the measurement. Windows\* based software is provided to download the data into a file which can be viewed directly or exported to other applications (e.g. spreadsheets). Datalogger memory can store up to 2,500 five segment probe data sets and is expandable to over 10,000 data sets. Data acquisition, storage and post-processing can be a paperless process. Data acquired by the logger is numerical and consists of the probe I.D. number, time delay (in raw counts) and volumetric water content in percent to the first decimal place.

The datalogger can also be used to automatically start measurements on a fixed time interval. This permits unattended field operation. Sample intervals can range from 1 minute to 120 minutes and are selected using the front panel buttons.

### Five Segment Probe Emulator


The five segment probe emulator electrically simulates a five segment probe. The probe emulator provides an easy to use reference standard for instrument performance and is a valuable tool for system troubleshooting.

### Multiplex/Remote Unattended Operation

The MP-917 can be employed in multiplexed systems allowing data acquisition from multiple probes. Our multiplexer systems can support configurations of up to eight, fifteen, twenty-two or twenty-nine probe field arrays with a maximum cable length to any probe of 100 meters. (Consult factory for more information).

**Moisture•Point** MP-917 is manufactured in Victoria, BC, Canada by ESI Environmental Sensors Inc. Consult factory for additional product information, application information, or technical support services.



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