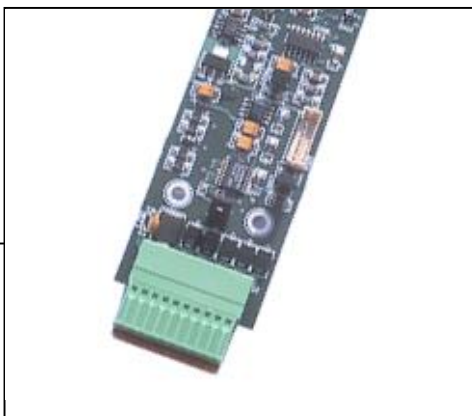




**Sentek** sensor technologies

**EnviroSMART™ & EasyAG®**  
Voltage Probe Interface Manual



*Version 1.5*

*November 11, 2002*



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## EnviroSMART – Statements of Compliance

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### FCC note of compliance and statement of liability

#### Electro-Magnetic Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorientation or relocation of the receiving antenna.
- Connection of the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consultation with the dealer or an experienced radio/TV technician.

### EMC approvals

The EnviroSMART and EasyAG Voltage probes comply with “EN61326:1997 EMC standard for equipment for measurement, control and laboratory use”.

The equipment complies with the following specifications:

- EN55022/CISPR22  
AS/NZS3548 Class B  
FCC Part 15 Class B.
- IEC1000-4-2
- IEC1000-4-3
- IEC1000-4-4
- IEC1000-4-5
- IEC1000-4-6

### Marking

The above EMC approvals allow the product to be marked CE, C-tick and FCC.

### Modifications

Any modifications to any part of the equipment or to any peripherals may void the EMC compliance of the equipment.

### Radio Interference

The probe is not to be operated in free air as it may cause interference to radio communication devices

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## The EnviroSMART and EasyAG Voltage Probe Interface

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### About the EnviroSMART and EasyAG Voltage probe interface

This section provides information about the **EnviroSMART** and **EasyAG** Voltage probe interface.

#### What is the Voltage probe interface?

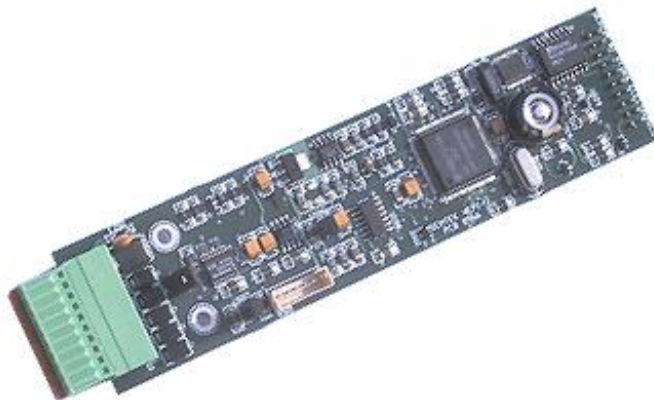
The **EnviroSMART** and **EasyAG** Voltage probe interface is used to provide a separate analogue signal (voltage) representing the volumetric soil water content (mm/10cm) from each sensor or a total of the selected sensors. This allows the probe interface to be connected to any analogue compatible data logger.

After all sensors are sampled, the **EnviroSMART** and **EasyAG** Voltage probe interface produces a voltage on the appropriate pins of the interface connector. This voltage is held there until the sensor is sampled again.

#### How does the Voltage probe interface sample sensors?

The **EnviroSMART** and **EasyAG** Voltage probe interface samples sensors immediately on power up and then continues to sample at user preset intervals for as long as power is present. The voltage is held at the appropriate pins of the interface connector until the sensors are sampled again (set by sampling interval, see What is the Intelligent Probe Configuration Utility section), at which time the new voltage is held.

**Note:** All voltages are placed at the analog outputs after the last sensor on the probe has been sampled.



## Voltage probe interface power features

The **EnviroSMART** and **EasyAG** Voltage probe interface provides two power methods, “Permanent Power Mode”, or “Power On mode”.

### Permanent Power Mode

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Permanent power mode is set by having jumper JP201 attached (closed). The interface will sample sensors at power up, and hold the relative voltage at the sensor output pins until the next sampling interval where the new voltage will be provided.

### Power On Mode

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Power On mode is a power saving feature and is set by having jumper JP201 removed. In this mode the interface can be completely turned off (Sleep), so the current draw is close to zero. Using a data logger (or another external device) to control the Power On ( $V_{po}$ ) line. Zero Volts will turn off the interface and a supply of a voltage (5 – 18V @ <1mA) through this line will turn on the interface.

When a voltage is applied to the Power On ( $V_{po}$ ) line, the **EnviroSMART** and **EasyAG** Voltage probe interface samples the attached sensors and places the voltages at the sensor output pins. The data logger must wait (approximately 1.1 seconds multiplied by the number of sensors to be read) before reading these voltages, after which, it can turn the interface off by setting the Power On ( $V_{po}$ ) line back to zero Volts.

**Note:** The interface cannot operate just by using the power from the voltage supplied to the Power On line. The Power On line is simply a control line, which switches the supply on and off. Therefore a power supply voltage is still required to be attached to the  $+V_{in}$  line when in this mode of operation.



## What is the Intelligent Probe Configuration Utility?

The Intelligent Probe Configuration Utility is provided to configure the **EnviroSMART** and **EasyAG** Voltage probe interface with depth location, normalization values (air and water counts) and calibration information for each sensor installed on the probe, as well as date/time, sensor sampling interval and voltage output range for the probe. This information, except for the date/time, is stored in non-volatile memory on the **EnviroSMART** Voltage probe interface, and is used to produce the Volumetric Water Content (mm/10cm) and the corresponding voltage for each sensor on the probe.

**Note:** Temperature Sensors are currently not supported by the **EnviroSMART** and **EasyAG** Voltage probe interface.

**Note:** Information stored in non-volatile memory will not be lost when power is removed from the **EnviroSMART** and **EasyAG** Voltage probe interface.

**Note:** A super-capacitor is used to provide approximately 2 weeks of power (when fully charged) for the operation of the real time clock without any external power applied to the interface.

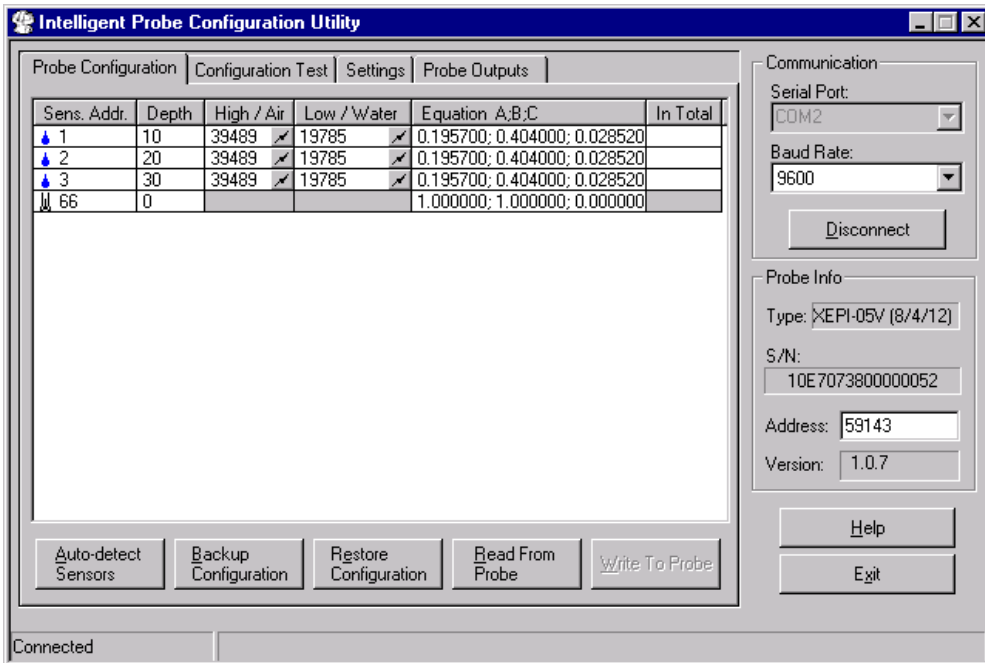


Figure 1: Intelligent Probe Configuration Utility software

## Setting up the Voltage Probe Interface

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### About setting up the Voltage probe interface

This section provides information on setting up the **EnviroSMART** and **EasyAG** Voltage probe interface.

### Why do I need to configure the Voltage probe interface?

The **EnviroSMART** and **EasyAG** Voltage probe interface must be configured to ensure valid information is reported to the receiving device through the probe outputs. This information includes the number of sensors, normalization values (air and water counts) and calibration information.

All configuration information is set up using the Intelligent Probe Configuration Utility, and is then stored in non-volatile memory. The configuration information for each sensor is used to provide volumetric water content (mm/10cm) values and corresponding voltage outputs.

#### Warning!

*Incorrect configuration information stored in the **EnviroSMART** and **EasyAG** Voltage probe interface will result in incorrect volumetric water content (mm/10cm) and corresponding voltage outputs being reported to the receiving device.*

For more information on setting up the **EnviroSMART** and **EasyAG** Voltage probe interface, refer to the Intelligent Probe Configuration Utility online help.

### Translating the Voltage probe interface outputs

#### Voltage Output for Volumetric Water Content

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The following values are set using the Intelligent Probe Configuration Utility:

- Voltage Lower Level ( $V_l$ )
- VWC Lower Level ( $N_l$ )
- Voltage Upper Level ( $V_u$ )
- VWC Upper Level ( $N_u$ )
- Voltage Invalid VWC ( $V_{err}$ )

where VWC is Volumetric (soil) Water Content (mm/10 cm)

Given these values we can produce the following equation:

$$\text{Voltage Output} = V_l + ((\text{VWC} - N_l) * ((V_u - V_l) / (N_u - N_l)))$$

**Example**

$$V_{ll} = 0.25 \text{ V}$$

$$N_{ll} = 0 \text{ (VWC)}$$

$$V_{ul} = 5.0 \text{ V}$$

$$N_{ul} = 70 \text{ (VWC)}$$

Therefore, a recorded VWC reading of 3.55mm/10cm will be output as a voltage of:

$$\begin{aligned} \text{Voltage Output} &= 0.25 + ((3.55 - 0) * ((5.0 - 0.25) / (70 - 0))) \\ &= 0.4909 \text{ V} \end{aligned}$$

**Example 2:**

$$V_{ll} = 0 \text{ V}$$

$$N_{ll} = 0 \text{ (VWC)}$$

$$V_{ul} = 4.9 \text{ V}$$

$$N_{ul} = 98 \text{ (VWC)}$$

Therefore, a recorded VWC reading of 3.55mm/10cm will be output as a voltage of:

$$\begin{aligned} \text{Voltage Output} &= 0 + ((3.55 - 0) * ((4.9 - 0) / (98 - 0))) \\ &= 0.1775 \text{ V} \end{aligned}$$

**Note:** Example 2 shows how the EnviroSMART or EasyAG Voltage interface is programmed for connection with a 0-5V input pre-set for a 0-100 value range. The value of 98 for the upper limit of 4.9V is set because 5V is set for the Error value (each 0.1 step in voltage equates to a VWC value of 2).

**Note:** Valid sensor readings outside of the range set by  $N_{ll}$  and  $N_{ul}$  will be limited (clipped) to the value  $V_{ll}$  or  $V_{ul}$  as appropriate.

## Voltage Output for Sensor Errors

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A sensor error (invalid count returned by a sensor) will produce a voltage output equal to the Error Voltage set in the Intelligent Probe Configuration Utility.

**Note:** Error Voltage ( $V_{err}$ ) cannot be within the range set by Voltage Lower Level ( $V_{ll}$ ) and Voltage Upper Level ( $V_{ul}$ ).

## EnviroSMART Technical Specifications

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**Voltage Output Range Supported:** User configurable between 0 (min.) and 5 (max.) Volts

**Output Resolution:** maximum 12 bit at 0 – 5 Volts

**PCB Revision:** 2.0

**Voltage Interface connector type:** Brand: Phoenix Contact  
MC 1,5/10-ST-3,5 (Socket)  
EMC 1,5/10-G-3,5 (Plug)

**Voltage Interface pin configuration:**

1	+ $V_{in}$
2	Ground
3	+ $V_{po}$ Power On
4	Ground
5	+ $V_1$ for Output 1
6	Ground
7	+ $V_2$ for Output 2
8	+ $V_3$ for Output 3
9	Ground
10	+ $V_4$ for Output 4

**Voltage Supply (+ $V_{in}$ ):** 9 – 20 Volts DC (12 Volts DC @ >200mA recommended)

**Power On Signal Voltage (+ $V_{po}$ ):** 5 – 18 Volts DC @ >1mA (Standby)  
Ground (Sleep)

**TTL Interface connector type:** Brand: JST  
B 6B-PH-K (Socket)  
PHR- 6 (Plug), SPH-002T-P0.5S (Crimp connectors)

**TTL Interface pin configuration:**

1	+ $V_{cc}$
2	Transmit data (Tx)
3	Receive data (Rx)
4	Programming Jumper
5	Programming Jumper
6	Ground

**Voltage Supply (+ $V_{cc}$ ):** 5 Volts, supplied by the EnviroSMART interface

**TTL Interface baud rate:** 1200, 2400, 9600 (*default*), 19200 and 38400 bits per second

- Total current consumption:** <7mA @ Standby  
 0mA @ Sleep  
 100mA @ Sampling
- Time to sample 1 sensor:** 1.1 seconds maximum
- Dallas 1-wire protocol/circuitry:** Temperature sensor
- Maximum sensors supported:** The Interface is capable of taking readings from 8 sensors, but only 4 sensors can have their readings displayed on the outputs pins. Alternatively 3 sensors can be displayed individually and one out put can be allocated to display a total output for all selected sensors to be totaled.

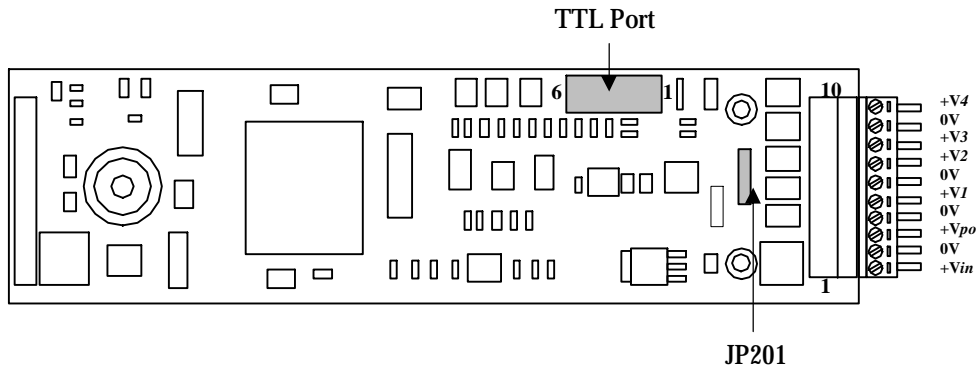


Figure 2: **EnviroSMART** Voltage probe interface board layout

## EasyAG Technical Specifications

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**Voltage Output Range Supported:** User configurable between 0 (min.) and 5 (max.) Volts

**Output Resolution:** maximum 12 bit at 0 – 5 Volts

**PCB Revision:** 2.0

**Voltage Interface connector type:** Brand: Phoenix Contact  
MPT 0,5/10-2,54

**Voltage Interface pin configuration:**

1	+V <sub>in</sub>
2	Ground
3	+V <sub>po</sub> Power On
4	Ground
5	+V <sub>1</sub> for Output 1
6	Ground
7	+V <sub>2</sub> for Output 2
8	+V <sub>3</sub> for Output 3
9	Ground
10	+V <sub>4</sub> for Output 4

**Voltage Supply (+V<sub>in</sub>):** 9 – 20 Volts DC (12 Volts DC @ >200mA recommended)

**Power On Signal Voltage (+V<sub>po</sub>):** 5 – 18 Volts DC @ >1mA (Standby)  
Ground (Sleep)

**TTL Interface connector type:** Brand: JST  
B 6B-PH-K (Socket)  
PHR- 6 (Plug), SPH-002T-P0.5S (Crimp connectors)

**TTL Interface pin configuration:**

1	+V <sub>cc</sub>
2	Transmit data (Tx)
3	Receive data (Rx)
4	Programming Jumper
5	Programming Jumper
6	Ground

**Voltage Supply (+V<sub>cc</sub>):** 5 Volts, supplied by the EnviroSMART interface

**TTL Interface baud rate:** 1200, 2400, 9600 (*default*), 19200 and 38400 bits per second

<b>Total current consumption:</b>	<7mA @ Standby 0mA @ Sleep 100mA @ Sampling
<b>Time to sample 1 sensor:</b>	1.1 seconds maximum
<b>Dallas 1-wire protocol/circuitry:</b>	Temperature sensor
<b>Maximum sensors supported:</b>	4 sensors

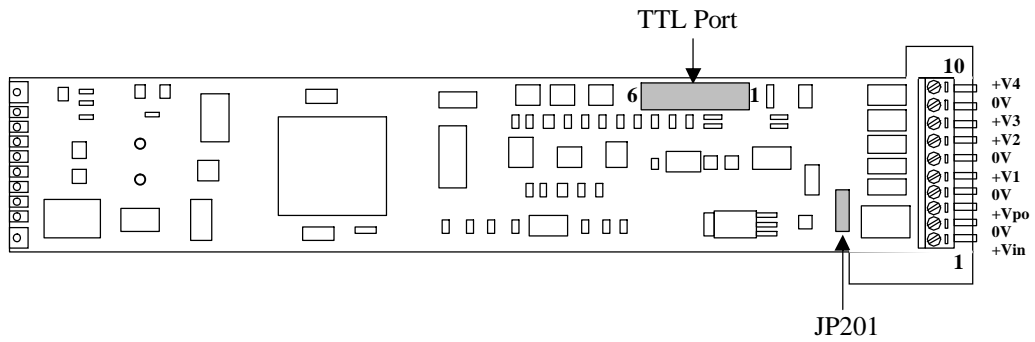


Figure 2: EasyAG Voltage probe interface board layout

Circuit Information

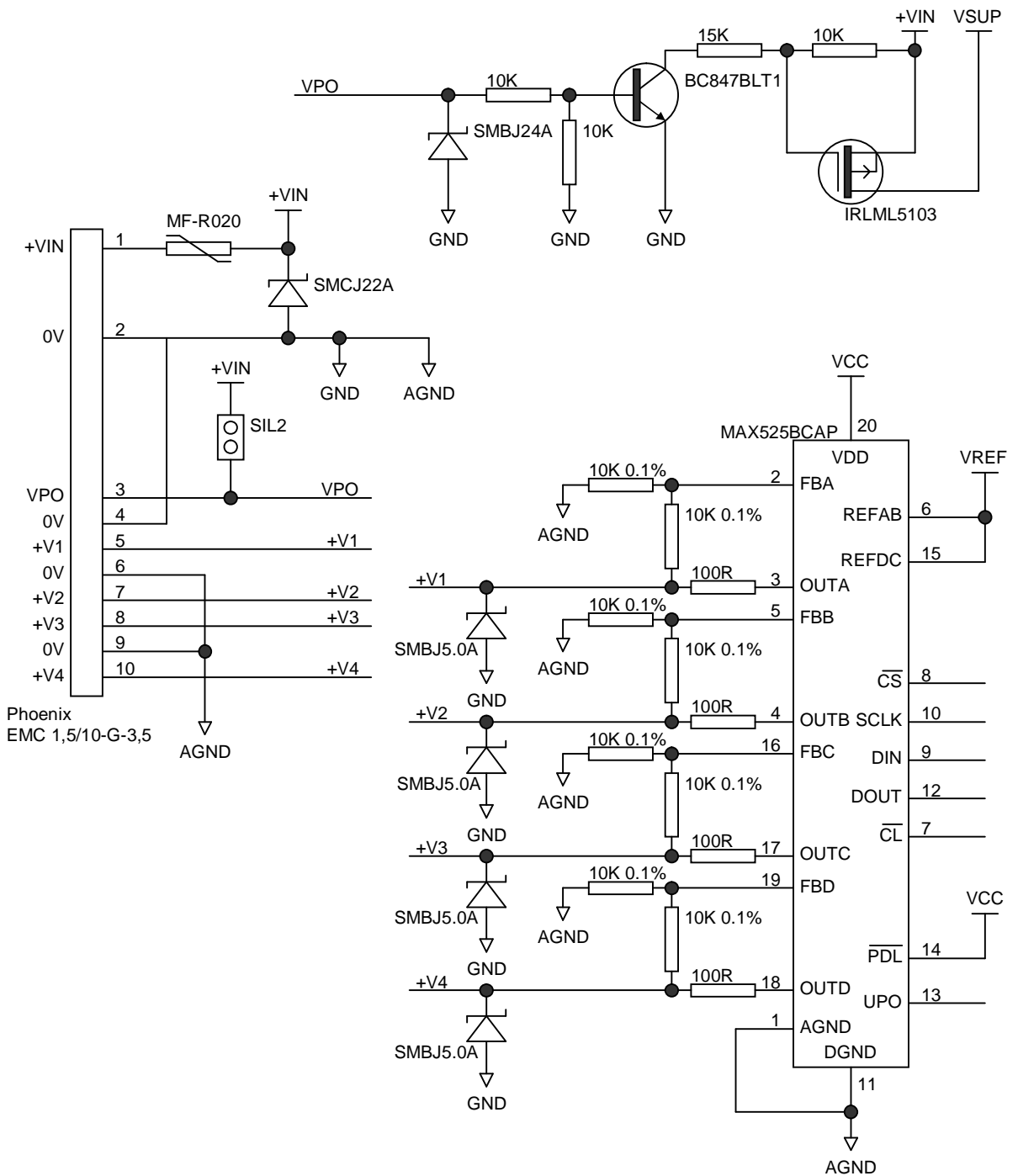


Figure 3: EnviroSMART and EasyAG Voltage interface circuit diagram



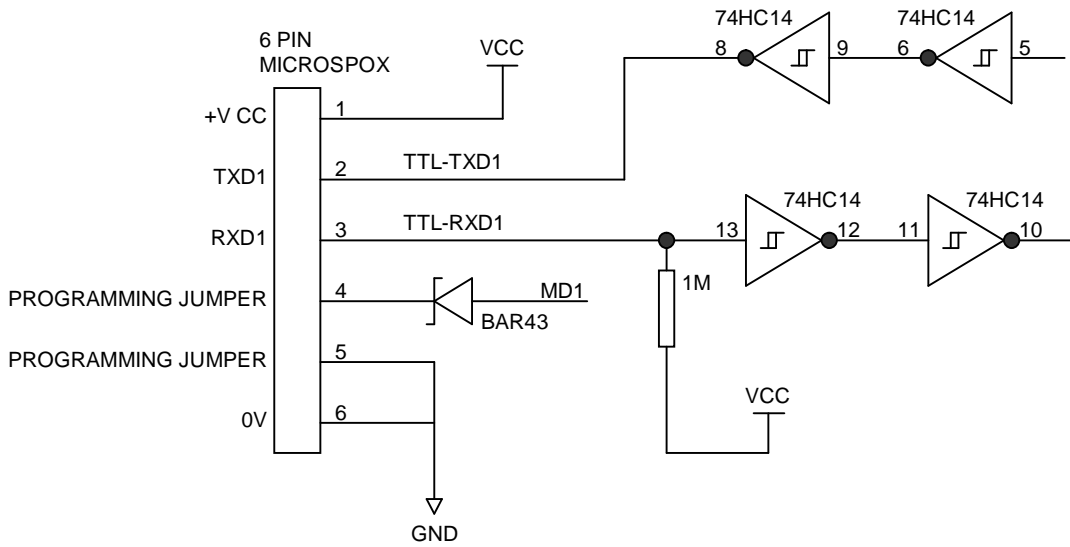


Figure 4: TTL interface circuit diagram

## Revision Information

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### EnviroSMART Revision Information

PCB Revision 1.2

- Interface connector type changed from:
  - Brand: Phoenix Contact
  - FK-MC 0,5/10-ST-2,5 (Socket)
  - MC 0,5/10-G-2,5 (Plug)

### EasyAG Revision Information

No previous revisions.

## Appendix A – Soil Moisture Management

### What soil volume does the Voltage probe interface measure at a single sensor?

At a single depth level, a sensor on the probe records volumetric water content from a soil volume outside the access tube, which has a sphere of influence of:

- ⇒ 10cm vertical height
- ⇒ 5-10cm radial distance from the outer wall of the access tube

### What are the water units?

If a calibrated sensor reads one(1) millimeter, there is one(1) millimeter of volumetric water content in a soil volume 10cm deep.

**Q.** What does 1mm volumetric water content / 10cm soil depth mean?

**A.** You require one(1) liter of water to cover one(1) square meter ( $m^2$ ) to a soil depth of one(1) millimeter.

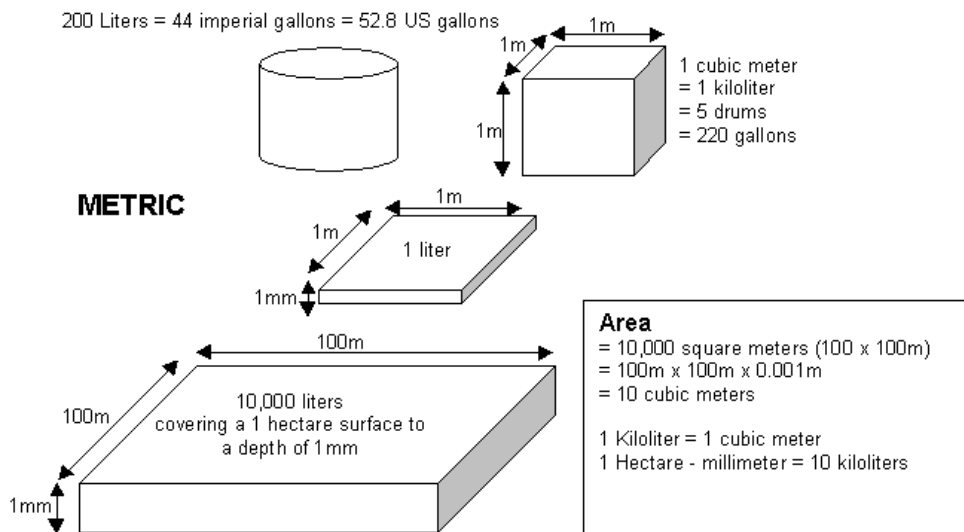


Figure 5: Measurements using metric units

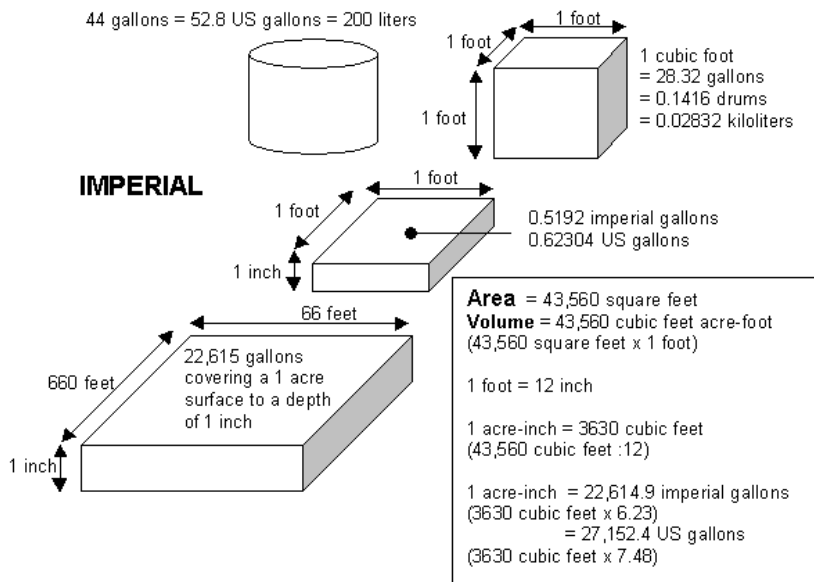


Figure 6: Measurements using imperial units

### What part of the soil profile does multiple sensors on the probe measure?

Probes in almost all cases have more than one sensor to monitor the depth of irrigation and the depth of the root zone. The first sensor is located at a soil depth of 10cm (if the datum plate of the top cap sits on ground level) measuring effectively the soil profile slice of 5-15cm depth. The next sensor is located at 20 cm measuring effectively 15 –25cm soil depths. With further sensors at 10cm intervals on the probe rod, the measurement depth would be respectively (25-35cm, 35-45cm and so on).

If you raise the datum plate of the top-cap 5cm above the ground surface, placing the center of the first sensor effectively at 5cm soil depth, the sphere of influence of the sensor will measure a soil slice from 0-10cm. For the other sensors at 10cm depth intervals on the probe rod, the measurement depth would be respectively (20-30cm, 30-40cm and so on).

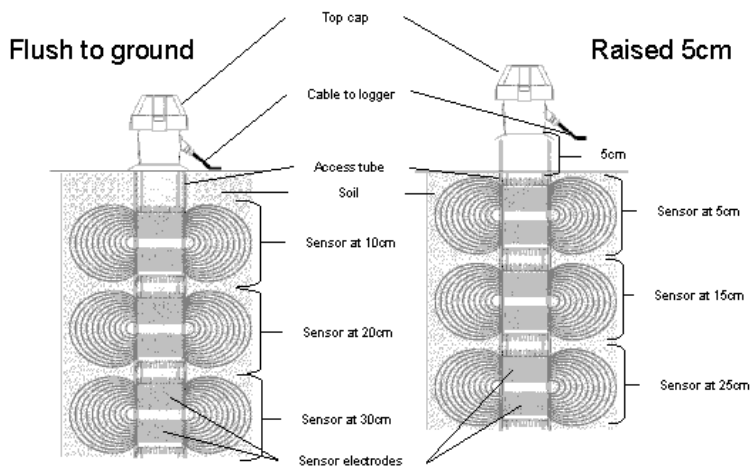


Figure 7: Measurements of multiple sensors on the probe