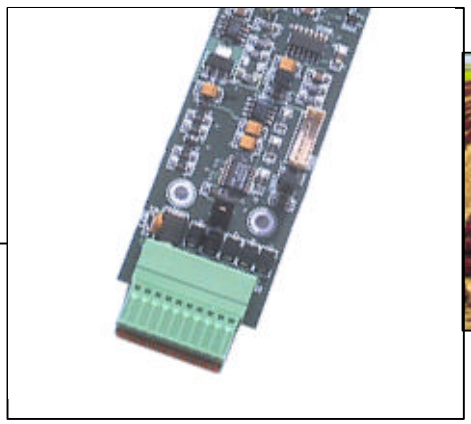
Sentek sensor technologies

EnviroSMART™
Current Probe Interface Manual



Version 1.01

October 16, 2001

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Statements of Compliance

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 Probe has been tested and found to comply with the product family standard "EN61326:1997 EMC standard for equipment for measurement, control and laboratory use".

The EnviroSMART Probe has passed the following tests:

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

Table of Contents

Table of Figures

The EnviroSMART Current Probe Interface

About the EnviroSMART Current probe interface

This section provides information about the **EnviroSMART** Current probe interface.

What is the Current probe interface?

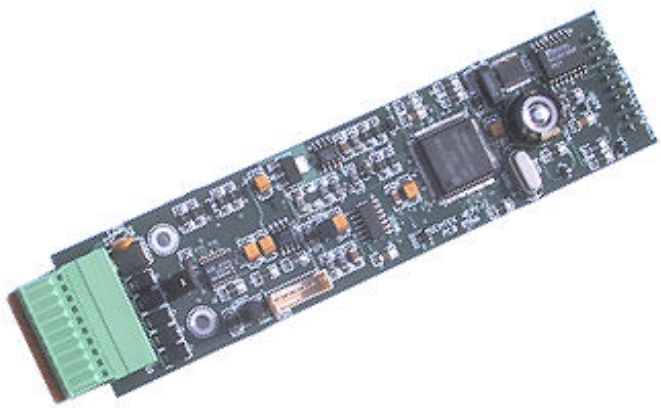
The **EnviroSMART** Current probe interface is used to provide a separate analogue signal (current loop) representing the volumetric soil water content (mm/10cm) from each sensor or a total of the selected sensors. This allows the probe interface to be connected to any analogue compatible data logger.

After all sensors are sampled, the **EnviroSMART** Current probe interface sets the current for the appropriate outputs of the interface connector. This current is held until the sensor is sampled again.

How does the Current probe interface sample sensors?

The **EnviroSMART** Current 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 current is held at the appropriate pins of the interface connector until the sensors are sampled again (set by sampling interval, see section What is the Intelligent Probe Configuration Utility), at which time the new current is held.

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



Current probe interface power features

The **EnviroSMART** Current probe interface provides two power methods, "Permanent Power Mode", or "Power On mode".

Permanent Power Mode

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

Power On Mode

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 applied to the Power On (V_{po}) line will turn off the interface, and a voltage (5 – 18V @ <1mA) applied to this line will turn on the interface.

When a voltage is applied to the Power On (V_{po}) line, the **EnviroSMART** Current probe interface samples the attached sensors and places the current at the sensor output pins. The data logger must wait (approximately 1.2 seconds x the number of sensors to be read) before reading these currents, 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 (V_{po}) 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** Current 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 current output range for the probe. This information, except for the date/time, is stored in non-volatile memory on the **EnviroSMART** Current probe interface, and is used to produce the Volumetric Water Content (mm/10cm) and a corresponding current for each sensor on the probe.

Note: Temperature Sensors are currently not supported by the **EnviroSMART** Current probe interface.

Note: Information stored in non-volatile memory will not be lost when power is removed from the **EnviroSMART** Current 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.

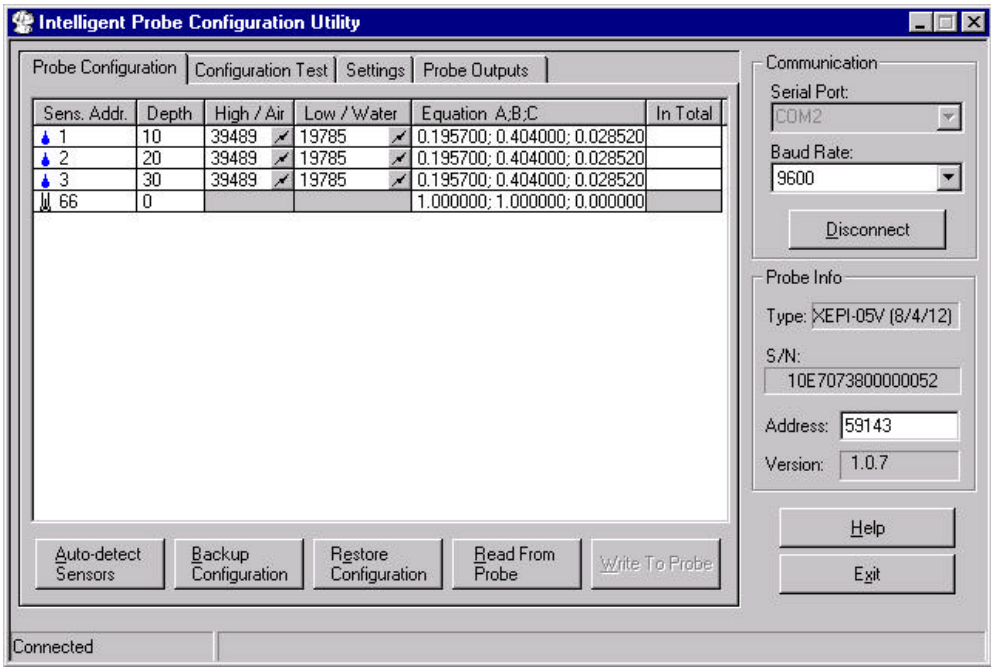


Figure 1: Intelligent Probe Configuration Utility software

Setting up the Current Probe Interface

About setting up the EnviroSMART Current probe interface

This section provides information on setting up the **EnviroSMART** Current probe interface.

Why do I need to configure the Current probe interface?

The **EnviroSMART** Current 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 current outputs.

Warning!

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

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

Connecting to the Current loops to take measurements

The "current source" power supply used with the current outputs must be able to supply more than 9 Volts DC @ 200mA. The current outputs may become unstable if supplied less than 8 volts. The absolute maximum "current source" supply is 30 V DC, the maximum recommended is 24 Volts DC. This supply may be provided by the receiving device being used.

Using the recommended "current source" power supply mentioned above, connect the current loop outputs to the analogue inputs of the receiving device being used (Figure 2). Ensure that the receiving device is capable of measuring current. If it is not then you may be able to connect a high precision resistor in series (100 ohm 0.1%) to convert the current to a voltage (Figure 3).

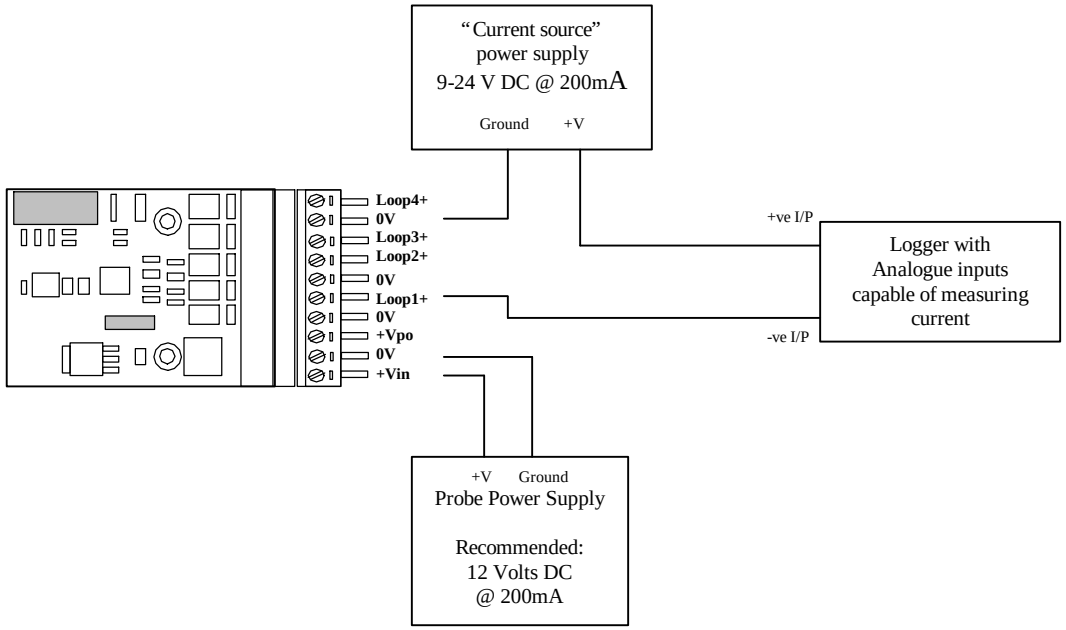


Figure 2: Connection to a logger that has current measuring capabilities.

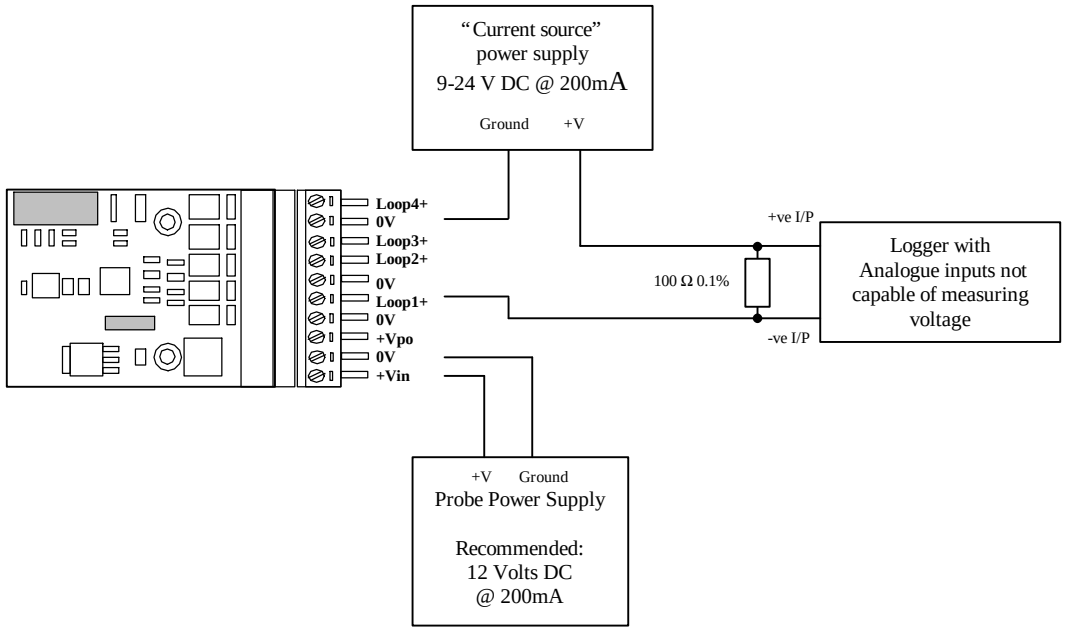


Figure 3: Connection to a logger that only has Voltage measuring capabilities.

To connect multiple channels, tie all the negative loops together and then connect them to ground at the "current source" power supply. Bring out the positive loops to the negative inputs of the receiving device channels. Link all the positive inputs of the loggers together and tie them to the positive output of the "current source" power supply (see Figure 4).

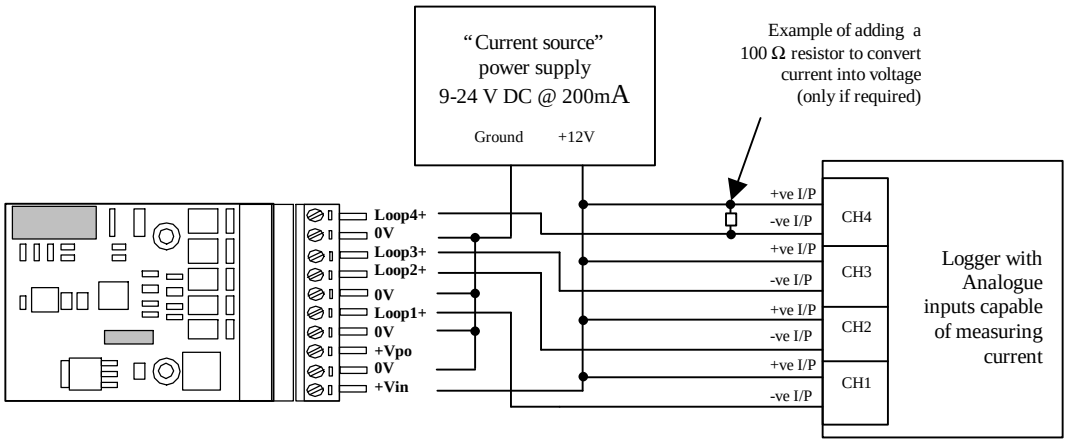


Figure 4: Connection to a logger that has current measuring capabilities using a single supply.

Note: Figure 4 also indicates the use of a 100-ohm resistor for a logger capable of measuring voltage.

Note: When using a single supply to power both the loops and the interface, the *maximum voltage that can be used is 20 volts*, due to the protection on the probe power inputs. 12 volts at 200 mA (or greater) is recommended.

Note: A 100-ohm is used to convert the 0-20mA to 0-2V using Ohm's Law ($V = I \times R$).

Translating the Current probe interface outputs

Current Output for Volumetric Water Content

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

- Current Lower Level (C_{ll})
- VWC Lower Level (N_{ll})
- Current Upper Level (C_{ul})
- VWC Upper Level (N_{ul})
- Current Invalid VWC (C_{err})

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

Given these values we can produce the following equation:

Probe Interface Current Output = C_{ll} + ((VWC – N_{ll}) * ((C_{ul} – C_{ll}) / (N_{ul} – N_{ll})))

Example:

C_{ll} = 4 mA

N_{ll} = 0 (VWC)

C_{ul} = 20 mA

N_{ul} = 70 (VWC)

Therefore, a recorded VWC reading of 12.72mm/10cm will be output as a current of:

Current Output = 4 + ((12.72 – 0) * ((20 – 4) / (70 – 0))

= 6.91 mA

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

Current Output for Sensor Errors

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

Note: Error Current (C_{err}) cannot be within the range set by Current Lower Level (C_{ll}) and Current Upper Level (C_{ul}).

Technical Specifications

Current Output Range Supported: User configurable between 0 (min.) and 20 (max.) mA

Resolution: maximum 12 bit at 0 – 20 mA

PCB Revision: 2.0

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

Current Interface pin configuration:

1	$+V_{in}$
2	Ground
3	$+V_{po}$ Power On
4	Ground
5	Loop*1*+
6	Ground
7	Loop*2*+
8	Loop*3*+
9	Ground
10	Loop*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 (T*x*)
3	Receive data (R*x*)
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:	1.2 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.

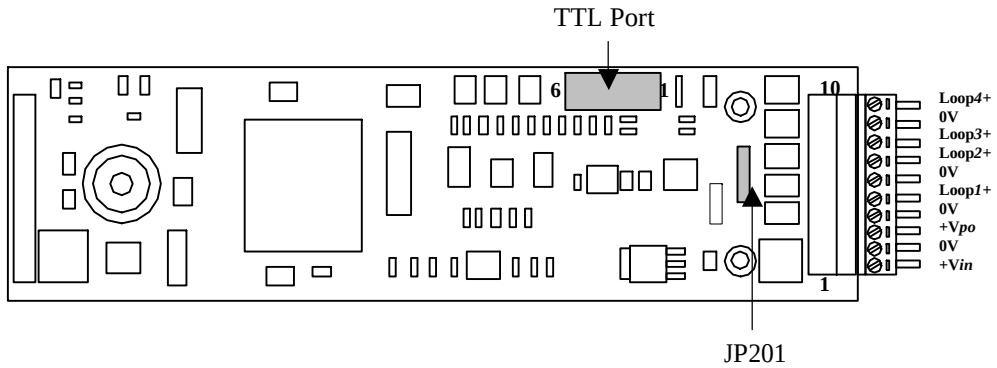


Figure 5: **EnviroSMART** Current probe interface board layout

Circuit Information

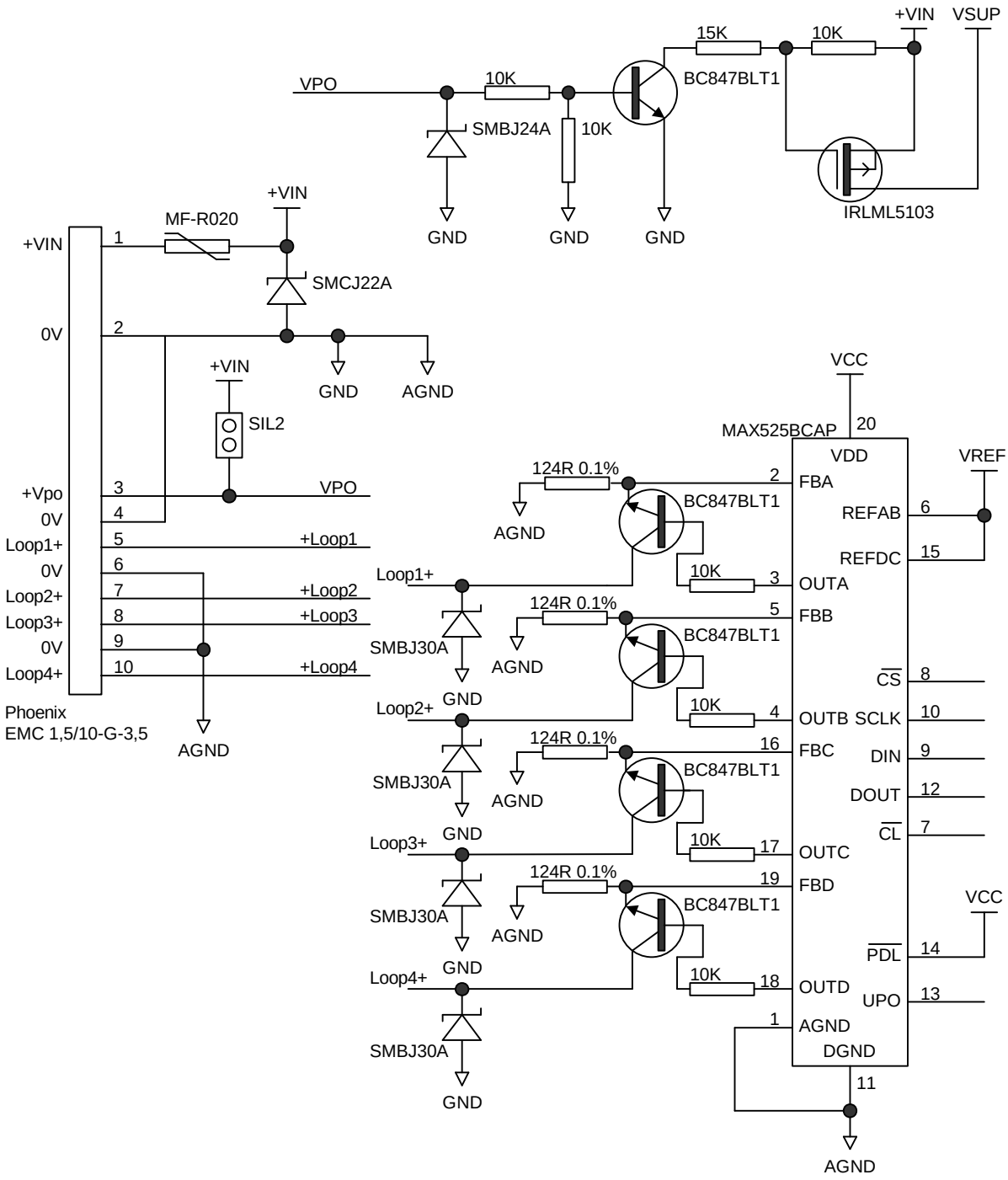


Figure 6: Current interface circuit diagram

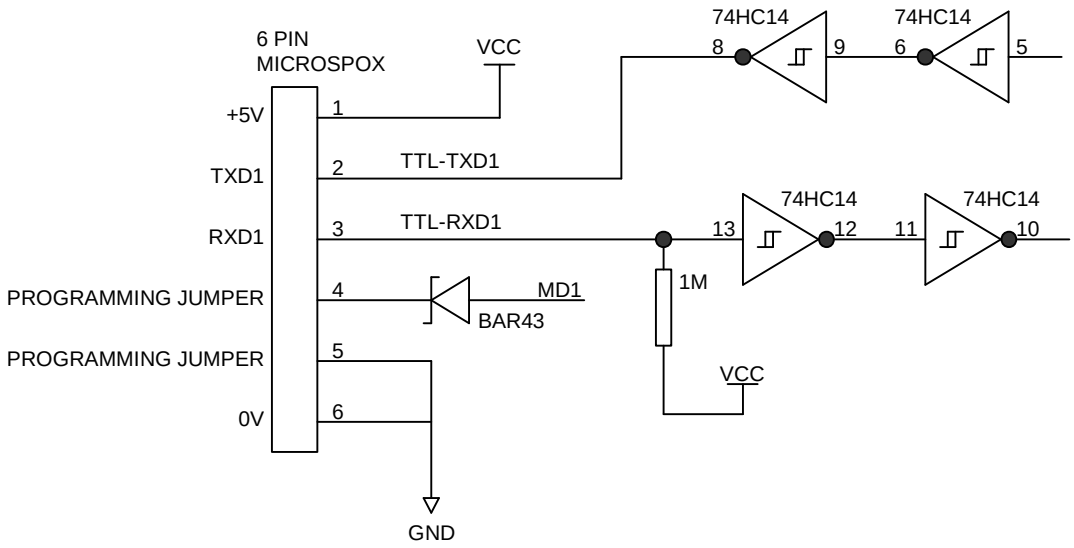


Figure 7: TTL interface circuit diagram

Revision Information

PCB Revision 1.2

- Interface connector type changed from:

  Brand: Phoenix Contact

  FK-MC 0,5/12-ST-2,5 (Socket)

  MC 0,5/12-G-2,5 (Plug)
- Interface pin configuration changed from:
  1. $+V_{in}$
  2. Ground
  3. $+V_{po}$ Power On
  4. Ground
  5. Loop*1*+
  6. Loop*1*-
  7. Loop*2*+
  8. Loop*2*-
  9. Loop*3*+
  10. Loop*3*-
  11. Loop*4*+
  12. Loop*4*-

Appendix A – Soil Moisture Management

What soil volume does the Current 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.

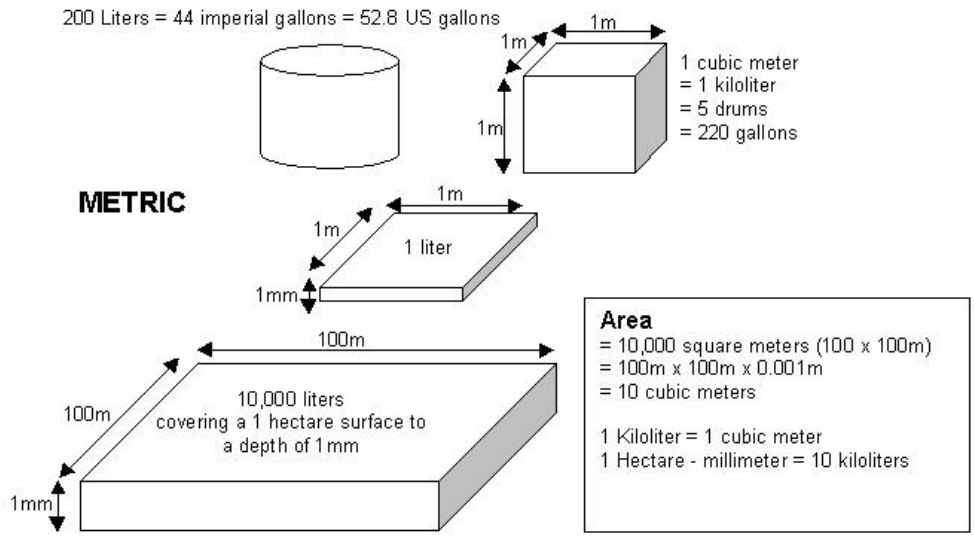


Figure 8: Measurements using metric units

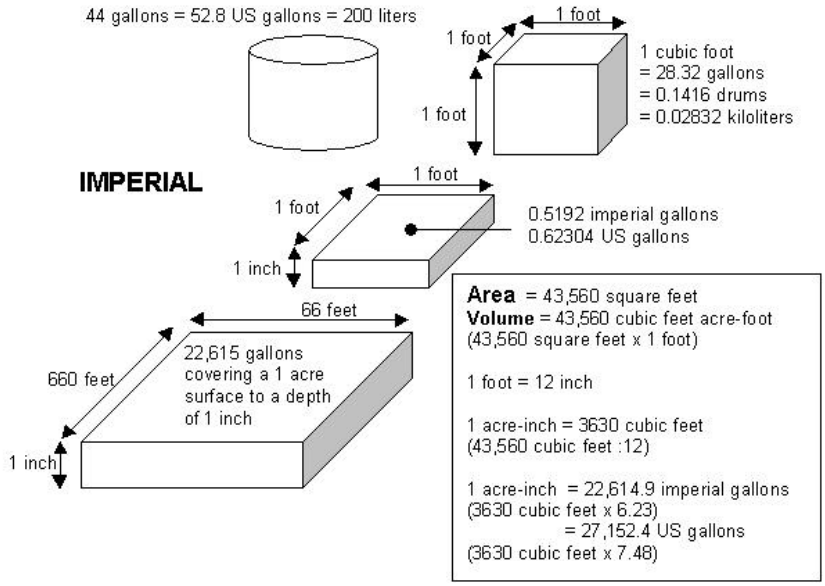


Figure 9: Measurements using imperial units

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).

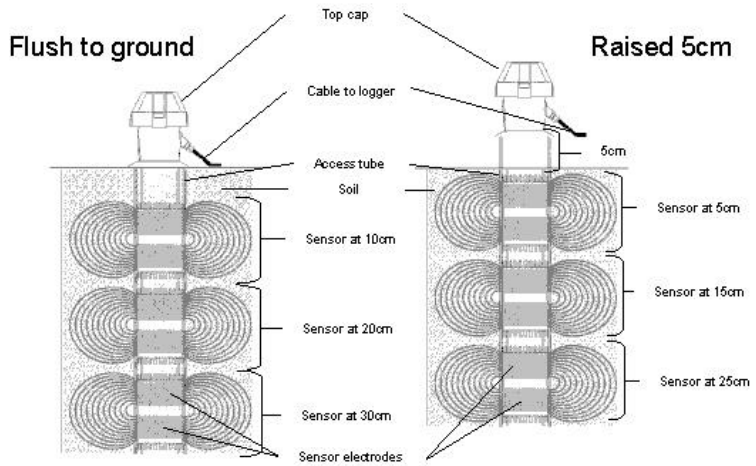


Figure 10: Measurements of multiple sensors on the probe

