SENTEK SDI-12 SERIES II

Probe Interface Manual Version 1.1
(*For firmware revision 1.3.4 or above*)

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Details of SDI-12 specifications can be obtained from the SDI-12 Support Group, Technical Committee, at http://www.sdi-12.org/

Sentek - 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 EnviroSCAN and EasyAG SDI-12 Series II probes comply with standard "EN61326:1997 Amendment 1:1998, Amendment 2:2001, Amendment 3:2003 EMC standard for equipment for measurement, control and laboratory use"

The equipment complies with the following specifications:

- EN55011: 1998, Amendment 1: 1999 Radiated and conducted emissions
- EN61000-4-2: 1995 Immunity to Electrostatic Discharge (ESD)
- EN61000-4-3: 2002 Immunity to Radiated Fields (RF)
- EN61000-4-4: 1995 Immunity to Electrical Fast Transients (EFT)/ Bursts
- EN61000-4-5:1995 Immunity to Surges
- EN61000-4-6:1996 Immunity to Conducted RF
- FCC Part 15 Class B

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 EnviroSCAN and EasyAG SDI-12 Probe Interface

About the SDI-12 probe interface

This section provides information about the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces.

> **Note:**
> Sentek Temperature and Humidity sensors require an EnviroSCAN probe interface with Firmware SDI12 version 1.4.1 or later. Earlier versions will operate successfully but will not detect these sensors.

What is SDI-12?

SDI-12 (Serial Digital Interface at 1200 baud) is a standard communication protocol, allowing connection of multiple sensors to an SDI-12 compatible data logger. SDI-12 communicates using a cable containing three(3) conductors:

- a serial communication line
- a ground line
- a 12V line

The **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces support commands from version 1.2 of the SDI-12 communication protocol. For more information on SDI-12, visit www.sdi-12.org.

What are the EnviroSCAN and EasyAG SDI-12 probe interfaces?

The **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces are used to allow an SDI-12 compatible device to communicate with and retrieve data from multiple **Sentek** sensors installed on a single probe.

Both **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces behave as a slave device, meaning they are not capable of logging information or sampling data themselves. The interface must be attached to an SDI-12 compatible device acting as a master device, which will issue SDI-12 commands to instruct the probe interface what to do. When instructed to sample data, the SDI-12 probe interface will retrieve values from each sensor configured on the probe. These values are returned to the master device for storage.

The probe and its sensors are configured using the Intelligent Probe Configuration Utility (see section What is the intelligent Probe Configuration Utility?).

References

- Sentek Probe Configuration Utility
- Sentek TriSCAN Agronomic User Manual
- Sentek Calibration Manual

What is the Intelligent Probe Configuration Utility?

The Intelligent Probe Configuration Utility is provided to configure the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces with depth location, normalization values (air and water counts) and calibration information for each sensor installed on the probe. This information is stored in non-volatile memory, and is used to produce the calculated value (value that has been processed via the interfaces calibration formula) from each sensor on the probe.

Communication between the Intelligent Probe Configuration Utility and the **EnviroSCAN** and **EasyAG** SDI-12 probe interface is done using the Intelligent Probe Configuration Utility cable from a computers communication port to the probe interfaces TTL port.

Note: Temperature Sensors are currently not supported by the **EnviroSCAN** and **EasyAG** SDI-12 probe interface.

Note: Information stored in non-volatile memory will not be lost when power is removed from the SDI-12 probe interface.
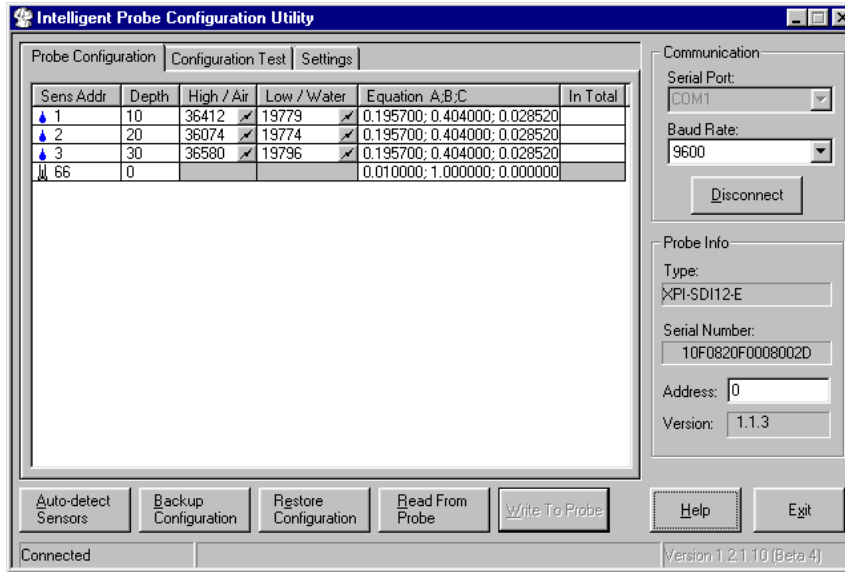
Figure 1 Intelligent Probe Configuration Utility software

Setting the Probe Configuration

The Intelligent Probe Configuration Utility is provided to configure the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces with depth location, normalization values (air and water counts) and calibration.

Auto-detect Sensors

Auto-detect Sensors will detect all sensors currently installed on the probe. After the sensors are detected the configuration information (including type of sensor) will be displayed in the Probe Configuration list.

All sensor information must be valid before the configuration can be written to the probe.

Normalising Sensors

Normalization is the setting of the range over which the sensor is effective. For example, soil moisture sensors have a range bounded by the 2 extremes, air and water. The normalization process is necessary to adjust for any variances that may occur during the production of the sensor.

Changing the Calibration Information

The sensor coefficients cell is used to store A, B and C coefficients. The coefficients are entered in A, B then C order, separated by semicolons.

It is possible to change the calibration coefficients through the Probe Configuration Utility:

- Moisture sensor A,B,C values should only be changed to reflect the characteristics of the soil in which the probe is installed. See the Sentek Calibration Manual for further information.
- Salinity sensor ABC values should not be changed.
- Temperature sensors ABC values are preset to supply values in degrees Celsius.
- Humidity sensors ABC values are preset to return humidity in the range 0% to 100%.

Setting the SDI-12 Address

The address of the probe should be in the range "0" to "9", "A" to "Z" and "a" to "z".

SDI-12 Probe Interface

About setting up the EnviroSCAN and EasyAG SDI-12 probe interface

This section provides information on setting up the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces.

Why do I need to configure the SDI-12 probe interface?

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface must be configured to ensure valid information is reported to the data logger when data is requested. This information includes the number of sensors, normalization values (air and water counts) and calibration information.

By default, each SDI-12 probe interface is supplied with an SDI-12 address of "0". If multiple probes are to be installed on an SDI-12 bus, each SDI-12 probe interface must be assigned a unique address (see section Addresses).

Warning!

Incorrect configuration information stored in the EnviroSCAN or EasyAG SDI-12 probe interface will result in incorrect volumetric water content (mm/10cm) readings being reported to the controlling device.

For more information on setting up the **EnviroSCAN** and **EasyAG** SDI-12 probe interface, refer to the Intelligent Probe Configuration Utility online help.

SDI-12 Communication

About the SDI-12 Communication

This section provides information about the SDI-12 communication protocol used by the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces.

Power Sequence

Figure 2 shows the typical power consumption modes (at 12V) of the **EnviroSCAN** and **EasyAG** SDI-12 probe interface during communication with an SDI-12 compatible device.

When power is applied, it takes about 750ms before the probe can process SDI-12 commands.

The SDI-12 probe interface, at power up, will remain in idle mode for 150milliseconds. If a break is not received, the probe interface will be placed in sleep mode.

An SDI-12 compatible device will send a break to wake all SDI-12 probe interfaces on the SDI-12 bus before a command is sent. When this break is received, the SDI-12 probe interface will then be placed in idle mode, ready to communicate with the controlling device. The probe interface will remain in idle mode while the command is being processed. If a break (and valid communication) is not received within 150 milliseconds of the last command, the SDI-12 probe interface will be placed back into sleep mode.

During a request to sample data, the SDI-12 probe interface will sample all sensors on the probe (sampling mode), then be placed into standby mode.

See sections *EnviroSCAN Technical Specifications* and *EasyAG Technical Specifications* for current usage graphs at different supply voltages.

For more information on SDI-12 operation, visit www.sdi-12.org.

Note: Valid communication must have an SDI-12 address included in the command that matches that of the probe interface, and in the format of a valid SDI-12 command.
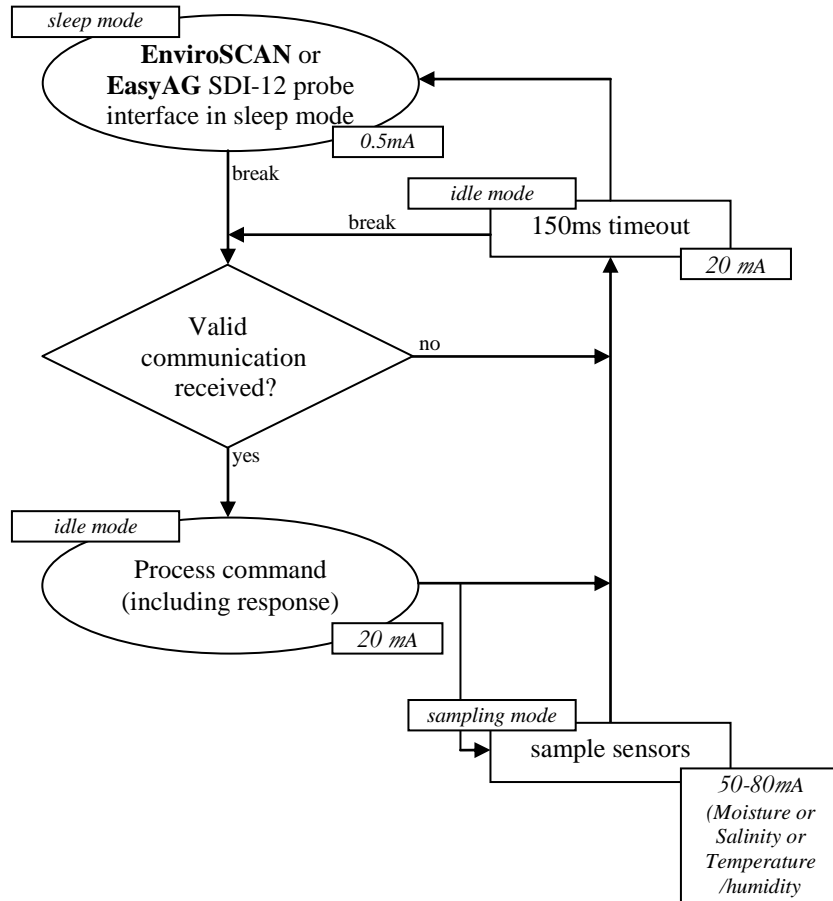
Figure 2 Sentek SDI-12 probe interface communication power sequence

Timing

Figure 3 shows voltage levels on the SDI-12 line during transmission of an Acknowledge Active command (?!) using the "?" wildcard address.
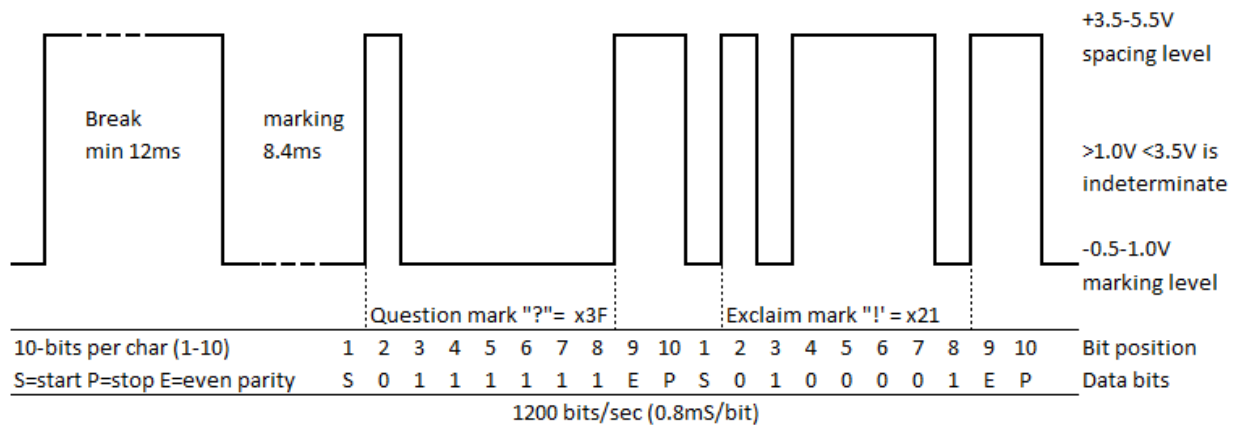
Figure 3 Voltage levels on the SDI-12 line during an Acknowledge Active command (a!)

After the break condition has been sent to the **EnviroSCAN** or **EasyAG** SDI-12 probe interface by holding the line high (above 3.5V, spacing) for 12ms, the line is held low (below 1 V, marking) for a minimum of 8.3ms before the first character is transmitted.

Each character transmitted consists of a Start Bit (spacing), followed by 7 data bits, followed by an even parity bit, followed by a stop bit (marking). Characters are transmitted least significant bit (LSB) first with each bit in the character being 0.833ms wide.

In this example shown in Figure 3, there is no inter-character gap sent by the SDI-12 probe interface. The start bit for the second character follows immediately after the stop bit (marking) from the first character.

Note: The **EnviroSCAN** and **EasyAG** SDI-12 probe interface will permit up to 4 bit-times between characters before rejecting the command.

Following the terminating character (!) of the command, the controlling device must release the line within 6.5ms. The **EnviroSCAN** and **EasyAG** SDI-12 probe interface will hold the line at the marking level for a minimum of 8.33ms before transmitting the first character of the response.

Addresses

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface accepts SDI-12 addresses in the range "0" to "9", "A" to "Z" and "a" to "z". Setting the probe interface address can be done using the Change Address command (aAb!) (see SDI-12 Commands Supported) or using the Intelligent Probe Configuration Utility.

Note: If the new address is invalid, the current address will be kept.

Note: The probe interface will remain unresponsive for approximately 30 ms while the new address is saved in non-volatile memory.

Note: The probe interface supports "?" (wildcard) as an address *only* for the Acknowledge Active command (a!).

Data Reading

The **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces accept the Start Measurement command (aM! or aMn!) and Start Concurrent Measurement command (aC! or aCn!) for obtaining calibrated values from the probes sensors.

Note: The **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces do not support the Continuous Measurement command (aRn!). The probe will respond with a<CR><LF> in response to this command.

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface returns sensor values in sensor depth order, starting at the shallowest depth (i.e. 10 cm). A moisture or salinity sensor with a depth of zero (an un-configured sensor) will not be reported by the SDI-12 probe interface.

As the Start Measurement command (aM! or aMn!) reports how many sensor readings to expect, the controlling device should issue Send Data commands (aDn!) until it either receives a reply with no data a<CR><LF>, indicating that the probe abandoned sampling, or that all data has been received), or until it has received all of specified number of sensor values.

For aMn! Commands, the probe will issue respond with a service request a<CR><LF> when the sample data is available. The controlling device may request data (aDn!), either after the service request or after the time specified in the response to the aMn! command.

Note: The controlling device may choose not to issue all Send Data commands (aDn!) when retrieving the data.

Note: The **EnviroSCAN** and **EasyAG** SDI-12 probe interface currently uses a fixed format of "sign followed by three digits, followed by the decimal point, followed by four decimal digits" (±nnn.nnnn) to return readings. This may change in future issues of the **EnviroSCAN** or **EasyAG** SDI-12 probe interface firmware (software should not rely on this fixed format).

Note 1: Valid soil moisture values will always be in the range +000.0000 to +101.0000. Soil moisture data which would result in values in the range -0.1 to 0.0 will be returned as +000.0000. Any soil

moisture values outside of this range (caused by faulty sensors, incorrect probe installation or configuration) will be returned as -999.9999. A failed sensor will also return a value of -999.9999.

Note 2: Some third party loggers cannot represent full 7-digit accuracy so convert -999.9999 to -1000.000.

Note 3: The SDI-12 response time for Series II probes is less than the time in some examples.

Data Reading using the Start Measurement Command (aM! or aMn!)

The following table shows the allocation of the Start Measurement commands (aM! or aMn!):

aM!   Read Soil Moisture values 1 – 9

aM1!   Read Soil Moisture values 10 – 16

aM2!   Read Salinity values 1 – 9

aM3!   Read Salinity values 10 – 16

aM4!   Read Temperature values 1 – 9 (EnviroSCAN only)

aM5!   Read Temperature values 10 – 16 (EnviroSCAN only)

aM6!   Read Humidity values 1 – 9 (EnviroSCAN only)

aM7!   Read Humidity values 10 – 16 (EnviroSCAN only)

Note: Start Measurement commands (aM! or aMn!) above "aM7!" will result in a response of "a0000<CR><LF>".

Soil Moisture Values (aM! and aM1!)

The Start Measurement command (aM! or aM1!) allows up to nine (9) values to be returned. As it is possible to have up to sixteen(16) soil moisture values from the SDI-12 probe interface, two(2) Start Measurement commands (aM! or aM1!) are required. The Send Data command (aDn!) may return up to three (3) values.

Command	Response
aM!	a0139<CR><LF>

The response indicates that 9 soil moisture values will be available within a time of 13 seconds. Before the 13 seconds elapse the probe will issue a Service Request (a<CR><LF>, where "a" is the probe address). The controlling device can then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+001.0000+001.1234+000.0200<CR><LF>
aD1!	a+000.1234+000.0000+123.1234<CR><LF>
aD2!	a+010.1200+000.1243+044.8750<CR><LF>

If there are more than 9 soil moisture values, a further Start Measurement command aM1! must be issued.

Command	Response
aM1!	a0117<CR><LF>

The response indicates that another 7 soil moisture values will be available within a time of 11 seconds. Before the 11 seconds, the probe will issue a Service Request (a<CR><LF>, where "a" is the probe address), and the controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+002.0010+003.1234+001.0200<CR><LF>
aD1!	a+011.1234+001.0100+011.3344<CR><LF>
aD2!	a+012.0230<CR><LF>

Note: The Send Data commands (aDn!) must be issued in increasing order.

Salinity Values (aM2! and aM3!)

The Start Measurement command (aM2! or aM3!) allows up to nine (9) values to be returned. As it is possible to have up to sixteen(16) salinity values from the SDI-12 probe interface, two(2) Start Measurement commands (aM2! or a3M!) are required. The Send Data command (aDn!) may return up to three(3) values.

Command	Response
aM2!	a0239<CR><LF>

The response indicates that 9 salinity values will be available within a time of 23 seconds. Before the 23 seconds have elapsed the probe will issue a Service Request a<CR><LF>, where "a" is the probe address. The controlling device can then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+001.0000+001.1234+000.0200<CR><LF>
aD1!	a+000.1234+000.0000+123.1234<CR><LF>
aD2!	a+010.1200+000.1243+044.8750<CR><LF>

If there are more than 9 salinity values, a further Start Measurement command (aM3!) must be issued.

Command	Response
aM3!	a0187<CR><LF>

The response indicates that another 7 salinity values will be available within a time of 18 seconds. Before18 seconds elapse, the probe will issue a Service Request a<CR><LF>, where "a" is the probe address, and the controlling device can then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+002.0010+003.1234+001.0200<CR><LF>
aD1!	a+011.1234+001.0100+011.3344<CR><LF>
aD2!	a+012.0230<CR><LF>

Note: The Send Data commands (aDn!) must be issued in increasing order.

Temperature and Humidity (aM4! through aM7!)

Temperature and humidity sensors are not available on EasyAG device. The (aM4! through aM7!) commands will get a reply of a0000!

Each Start Measurement command (aMn!) allows up to nine values to be returned. As it is possible to have up to sixteen(16) values from the **EnviroSCAN** SDI-12 probe interface, two Start Measurement commands (aM4! and aM4! for temperature), or (aM6! And aM7! for humidity) are required. The Send Data command (aD0! to aD2!) may return up to three values.

Command	Response
aM4!	a0039<CR><LF>

The response indicates that 9 temperature values will be available within a time of 3 seconds. Before about 3 seconds the probe will issue a Service Request a<CR><LF>, where "a" is the probe address. The controlling device can then issue Send Data commands (aDn!) to read the values.

If the data command aDn! requests data beyond the number of sensors reported by the aMn! Command, the response will be a!

Command	Response
aD0!	a+24.99402+24.52802+24.97996<CR><LF>
aD1!	a+24.52375+25.09555+24.48068<CR><LF>
aD2!	a+24.95815+24.38614+24.73441<CR><LF>
aD3!	a<CR><LF>

If there are more than 9 temperature values, a further Start Measurement command (aM5!) must be issued.

Command	Response
aM5!	a0027<CR><LF>

Data Reading using the Start Concurrent Measurement Command (aC! or aCn!)

The following table shows the allocation of sensors for the Start Concurrent Measurement commands (aC! or aCn!):

aC!   Read Soil Moisture values 1 – 16

aC1!   Read Salinity values 1 – 16

aC2!   Read Temperature values 1 – 16 (EnviroSCAN only)

aC3!   Read Humidity values 1 – 16 (EnviroSCAN only)

aC4!   Read Soil Moisture Configuration values C constants 1 – 16

aC5!   Read Soil Moisture Configuration values B constants 1 – 16

aC6!   Read Soil Moisture Configuration values A constants 1 – 16

aC7!   *Reserved*

aC8!   Read Salinity Sensor Depth values 1 – 16

aC9!   Read Soil Moisture Sensor Depth values 1 – 16

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface *will not* issue a service request (a<CR><LF>) for the aCn! Commands. So they can be issued to multiple probes (each with a different address) without waiting for the previous probe's data to be available. Data is not available for a probe until the time specified in the response to the aCn! command.

Note: Start Concurrent Measurement command "aC7!" will result in a response of "a0000<CR><LF>".

Soil Moisture Values (aC!)

The Start Concurrent Measurement command aC! allows all soil moisture values to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aDn!) may return up to eight (8) values.

Command	Response
aC!	a02116<CR><LF>

The response indicates that 16 soil moisture values will be available after a time of 21 seconds. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+001.0000+001.1234+000.0200+000.1234+000.0000 +123.1234+010.1200+000.1243<CR><LF>
aD1!	a+044.8750+002.0010+003.1234+001.0200+011.1234 +001.0100+001.0100+011.3344<CR><LF>

Salinity Values (aC1!)

The Start Concurrent Measurement command aC1! allows all salinity values to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aDn!) may return up to eight(8) values.

Command	Response
aC1!	A03616<CR><LF>

The response indicates that 16 salinity values will be available after 36 seconds. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+001.0000+001.1234+000.0200+000.1234+000.0000 +123.1234+010.1200+000.1243<CR><LF>
aD1!	a+044.8750+002.0010+003.1234+001.0200+011.1234

```
+001.0100+001.0100+011.3344<CR><LF>
```

Temperature and Humidity sensor values (aC2! and aC3!)

Temperature and humidity sensors are not available on **EasyAG** devices. The (aC2! through aC3!) commands will get a reply of a0000!

The Start Concurrent Measurement command aC2! and aC3! allow all temperature sensors or all humidity sensor values to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aD0! And aD1!) may each return up to eight(8) values.

There are no SDI-12 commands to retrieve the depth and calibration coefficient ABC from temperature sensor or humidity. You must inspect or change these values using Probe Configuration Utility.

Command	Response
aC2!	a00416<CR><LF>

The response indicates that 16 temperature sensors exists and values will be available after 4 seconds. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+24.96650+24.47385+24.96842+24.46163+25.01033+24.44856 +24.95718+24.48288<CR><LF>
aD1!	a+24.73719+25.11700+24.55654+25.03257+24.50156+25.02423 +24.55547+24.71886<CR><LF>
aD2!	a<CR><LF>

Soil Moisture Configuration Coefficient Values (aC4!, aC5! and aC6!)

The Start Concurrent Measurement commands (aC4! To aC6!) allow all soil moisture A, B and C constants to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aDn!) may return up to eight(8) values.

A Constants are retrieved with the Start Concurrent Measurement command aC6!

Command	Response
aC6!	a00116<CR><LF>

The response indicates that 16 A constant value will be available after 1second. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+000.1957+000.1957+000.1957+000.1957+000.1957 +000.1957+000.1957+000.1957<CR><LF>
aD1!	a+000.1957+000.1957+000.1957+000.1957+000.1957 +000.1957+000.1957+000.1957<CR><LF>

B Constants are retrieved with the Start Concurrent Measurement command aC5!

Command	Response
aC5!	a00116<CR><LF>

The response indicates that 16 B constant values will be available after 1second. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+000.4040+000.4040+000.4040+000.4040+000.4040 +000.4040+000.4040+000.4040<CR><LF>
aD1!	a+000.4040+000.4040+000.4040+000.4040+000.4040 +000.4040+000.4040+000.4040<CR><LF>

C Constants are retrieved with the Start Concurrent Measurement command aC4!

Command	Response
`aC4!`	`a00116<CR><LF>`

The response indicates that 16 C constant values will be available after 1 second. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
`aD0!`	`a+000.0285+000.0285+000.0285+000.0285+000.0285` `+000.0285+000.0285+000.0285<CR><LF>`
`aD1!`	`a+000.0285+000.0285+000.0285+000.0285+000.0285` `+000.0285+000.0285+000.0285<CR><LF>`

Temperature and Humidity Configuration Coefficient Values

These values are not available through SDI-12 commands. They can be viewed and changed using the Probe Configuration Utility.

Soil Moisture Sensor Depth Values (aC9!)

The Start Concurrent Measurement commandaC9! allows all soil moisture depth values to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aDn!) may return up to eight(8) values.

Command	Response
`aC9!`	`a00116<CR><LF>`

The response indicates that 16 soil moisture depth values will be available after 1second. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
`aD0!`	`a+010.0000+020.0000+030.0000+040.0000+050.0000` `+060.0000+070.0000+080.0000<CR><LF>`
`aD1!`	`a+090.0000+100.0000+110.0000+120.0000+130.0000` `+140.0000+150.0000+160.0000<CR><LF>`

Salinity Sensor Depth Values (aC8!)

The Start Concurrent Measurement command "aC8!" allows all salinity depth values to be sampled with a single command. Values are gathered in the same way as for the Start Measurement command (aM! or aMn!), but the Send Data command (aDn!) may return up to eight(8) values.

Command	Response
`aC9!`	`a00116<CR><LF>`

The response indicates that 16 salinity depth values will be available after 1second. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
`aD0!`	`a+010.0000+020.0000+030.0000+040.0000+050.0000` `+060.0000+070.0000+080.0000<CR><LF>`
`aD1!`	`a+090.0000+100.0000+110.0000+120.0000+130.0000` `+140.0000+150.0000+160.0000<CR><LF>`

Temperature and Humidity Sensor Depth Values

These values are not available through SDI-12 commands. They can be viewed and changed using the Probe Configuration Utility.

Identification

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface will respond with a string of the following format when sent the Send Identification command (aI!):

Example:

```
allccccccccmmmmmmvvvxxxxxxxxxxxx<CR><LF>
```

```
412SENTEK  XEPI  141C01108100000<CR><LF>
```

Where:
	`4`	The sensor address
	`12`	SDI-12 version number, version 1.2
	`SENTEK`	Company name
	`XEPI`	Model name
		(XEPI for EnviroSCAN, XIPI for EasyAG)
	`141`	Model version, version 1.4.1
	`C01108100000`	Interface Serial number

Note: The **EnviroSCAN** and **EasyAG** SDI-12 probe interface firmware version consists of a major/minor/sub-minor number. Since SDI-12 allocates only three characters, when any number exceeds 9, the characters "A" to "Z", then "a" to "z" is used. If the number exceeds 61 an asterisk (*) is shown.

The **EnviroSCAN** and **EasyAG** SDI-12 probe interface stores a 64-bit serial number. The Probe Configuration Utility will report all 64 bits as a hexadecimal number. The first two digits (8 bits) of this serial number are always "10" or "01", and the last two digits (8 bits) are a Cyclic Redundancy Check (CRC). The serial number reported via SDI-12 omits the first and last 8 bits, providing the remaining 48 bits as the serial number.

The serial number for the above example is:

```
 10C4223800000097  As reported by Probe Configuration Utility
   C42238000000    As reported by SDI-12
```

Supported Commands

SDI-12 Commands Supported

The following commands are supported by the **EnviroSCAN** and **EasyAG** SDI-12 probe interfaces:

Command	Name	Response
a!	Acknowledge Active	a<CR><LF> The probe interface address
aI!	Send Identification	allcccccccccmmmmmmvvvxxxxxxxxxxxxx<CR><LF> Identification information
aAb!	Change Address	a<CR><LF> The probe interface address
aM!	Start Measurement	atttn<CR><LF> Delay (ttt) in seconds and number of values (n) up to 9
aMn!	Start Measurement n in range "1" – "7"	atttn<CR><LF> Delay (ttt) in seconds and number of values (n) up to 9 Note: A response of a0000<CR><LF> is provided indicating all values are served by previous Start Measurement commands (aMn!)
aC!	Concurrent Measurement	atttnn<CR><LF> Delay (ttt) and number of values (nn) up to 16
aCn!	Concurrent Measurement n in range "1" – "9"	atttnn<CR><LF> Delay (ttt) and number of values (nn) up to 16 Note: A response of a0000<CR><LF> is provided indicating all values are served by previous Start Concurrent Measurement (aCn!) commands
aDn!	Send Data n in range "0" – "9"	Refer to "Data Reading" section
aV!	Start verification	a0000<CR><LF>
aRn!	Continuous Measurement	a<CR><LF> Not supported Probe interface will respond with its address

Extended Commands Supported

There are no extended commands supported by the **EnviroSCAN** and **EasyAG** SDI-12 probe interface.

EnviroSCAN Technical Specifications

SDI-12 Protocol	:	Version 1.2
PCB Revision:		2.4

This revision has optimised the SDI-12 and TTL connector positions to facilitate easier normalization in the access tube. Earlier Series II versions have the connector positioned differently but functionality remains the same.

SDI-12 Interface connector type: Brand: Phoenix Contact

MC 1,5/3-ST-3,5 (Socket)

EMC 1,5/3-G-3,5 (Plug)

SDI-12 Interface pin configuration:

1. $+V_{in}$
2. Ground
3. SDI-12 data

Voltage Supply: 5 – 15 Volts DC (SDI-12 connector $+V_{in}$)

Fuse specification: F201 Littelfuse 0154-500 (500mA fast blow)

SDI-12 Interface baud rate: 1200 bits per second

TTL Interface connector : 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. Reserved
5. Reserved
6. Ground

Voltage Supply (TTL +Vcc): 5 Volts, supplied by the EnviroSCAN probe interface

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

Time to sample 1 sensor: 0.050 seconds maximum (Moisture only)
0.100 seconds maximum (TriSCAN)

Maximum sensors supported: 16 Moisture sensors or
16 TriSCAN sensors
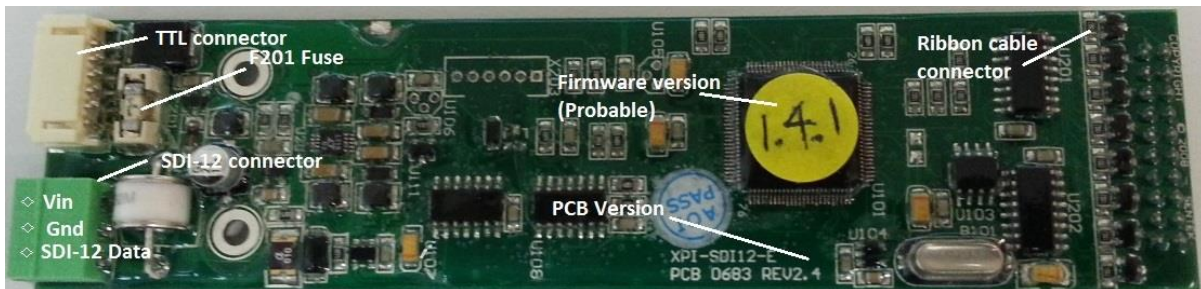And 16 temperature and humidity sensors

Figure 4: EnviroSCAN SDI-12 probe interface board layout

EnviroSCAN Current consumption:

Typical initial power on characteristic at 5.5V is maximum current draw 200mA and the interface enters the idle state after about 120ms.

These two graphs were prepared from a sample EnviroSCAN PCB revision 2.4 manufactured in 2012. Other revisions may have slightly different characteristics.
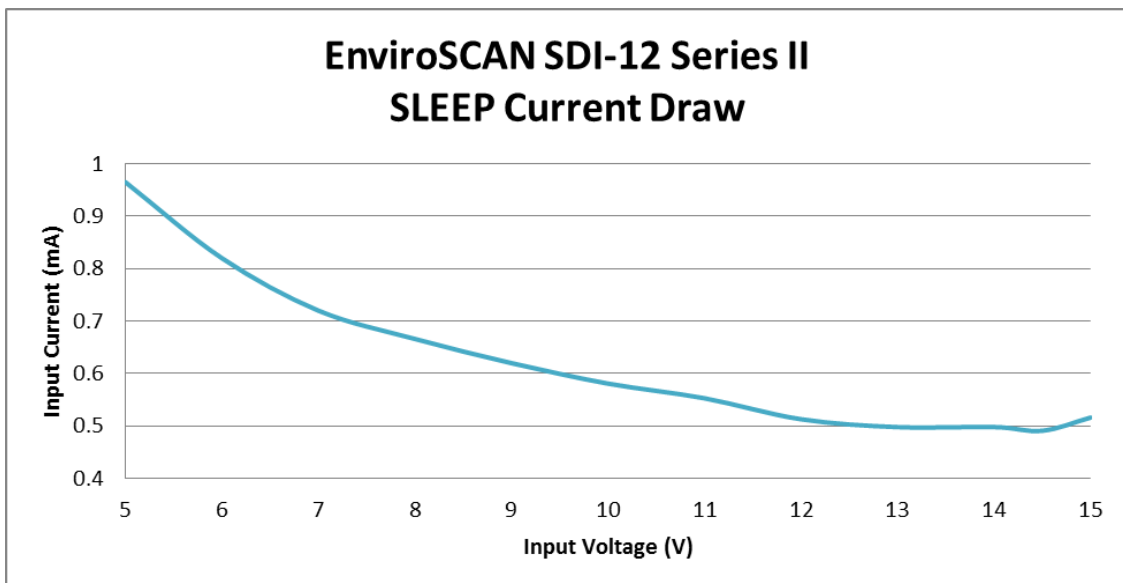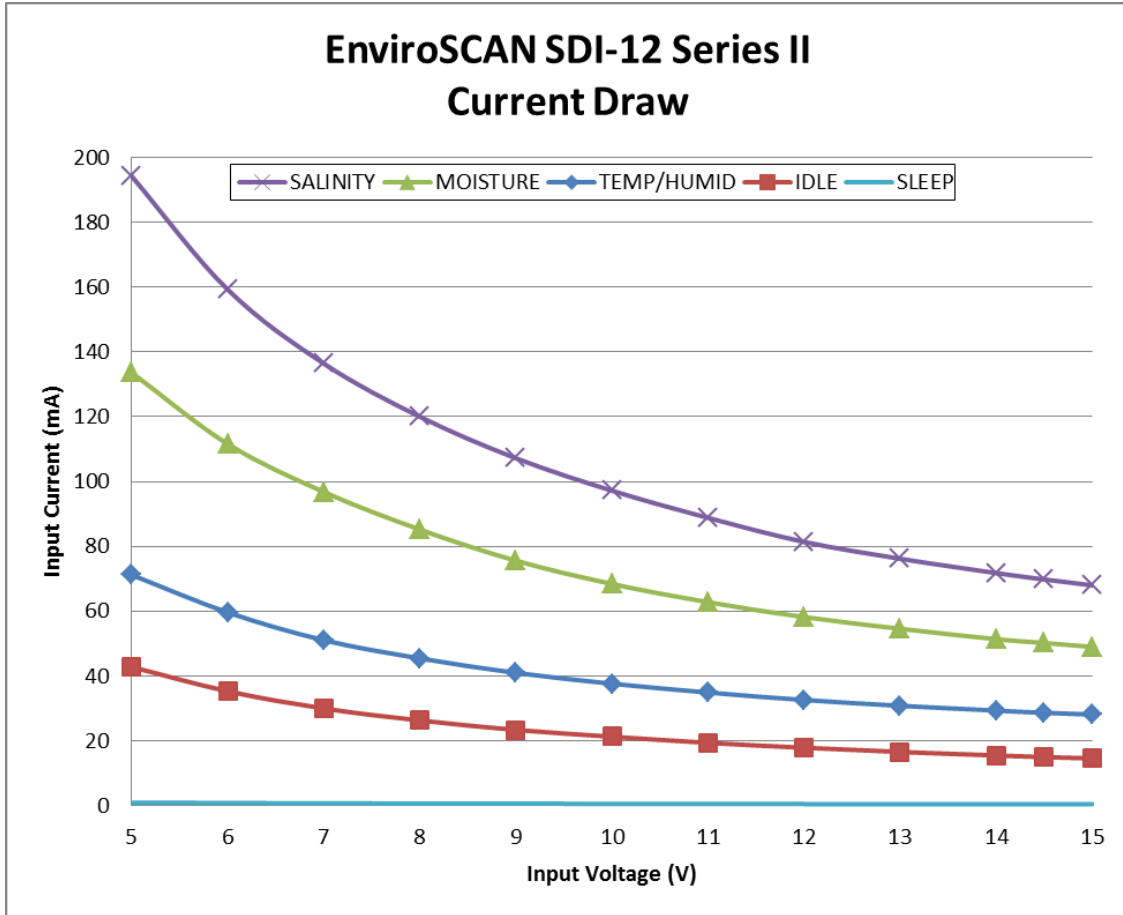
EasyAG Technical Specifications

SDI-12 Protocol: Version 1.2

PCB Revision: 2.3

SDI-12 Interface connector type: Brand: Phoenix Contact

MPT0.5/3-2.54

SDI-12 Interface pin configuration:

    1. $+V_{in}$
    2.   Ground
    3.   SDI-12 data

Voltage Supply: 5 – 15 Volts DC (SDI-12 connector $+V_{in}$)

Fuse specification: F201   Littelfuse 0154-500 (500mA fast blow)

SDI-12 Interface baud rate: 1200 bits per second

TTL Interface connector: 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.   Reserved
    5.   Reserved
    6.   Ground

Voltage Supply (TTL +Vcc): 5 Volts, supplied by the EasyAG probe interface

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

Time to sample 1 sensor: 0.050 seconds maximum (Moisture only)

0.100 seconds maximum (TriSCAN)

**Maximum sensors supported:** 5 Moisture sensors or

5 TriSCAN sensors

Figure 5 EasyAG SDI-12 probe interface board layout

EasyAG Current consumption:

Typical initial power on characteristic at 5.5V is maximum current draw 200mA and the interface enters the idle state after about 120ms.

These two graphs were prepared from a sample EasyAG PCB revision 2.3 manufactured in 2012. Other revisions may have slightly different characteristics.
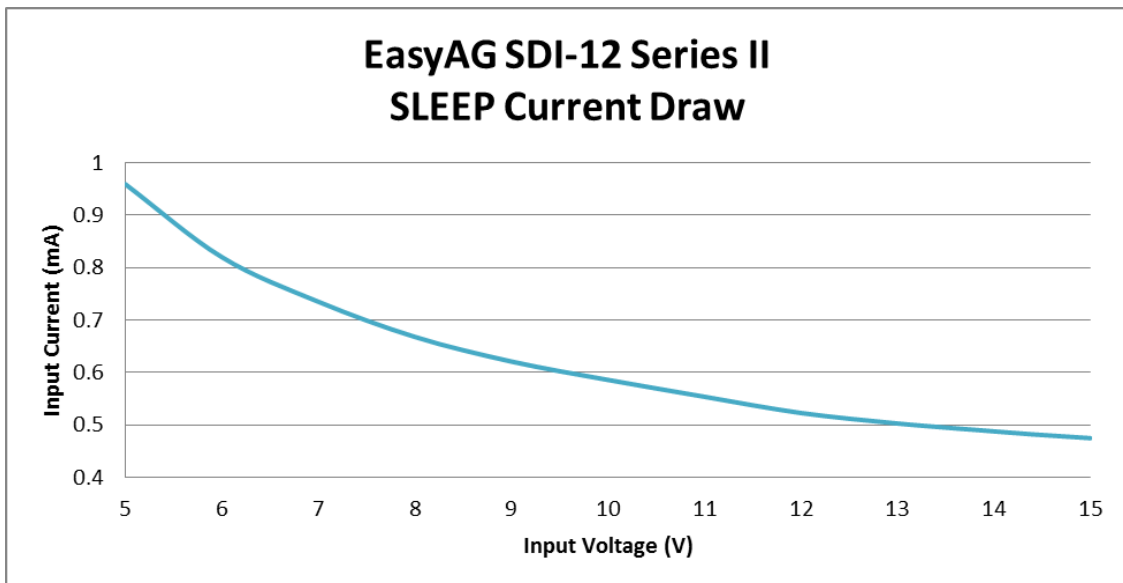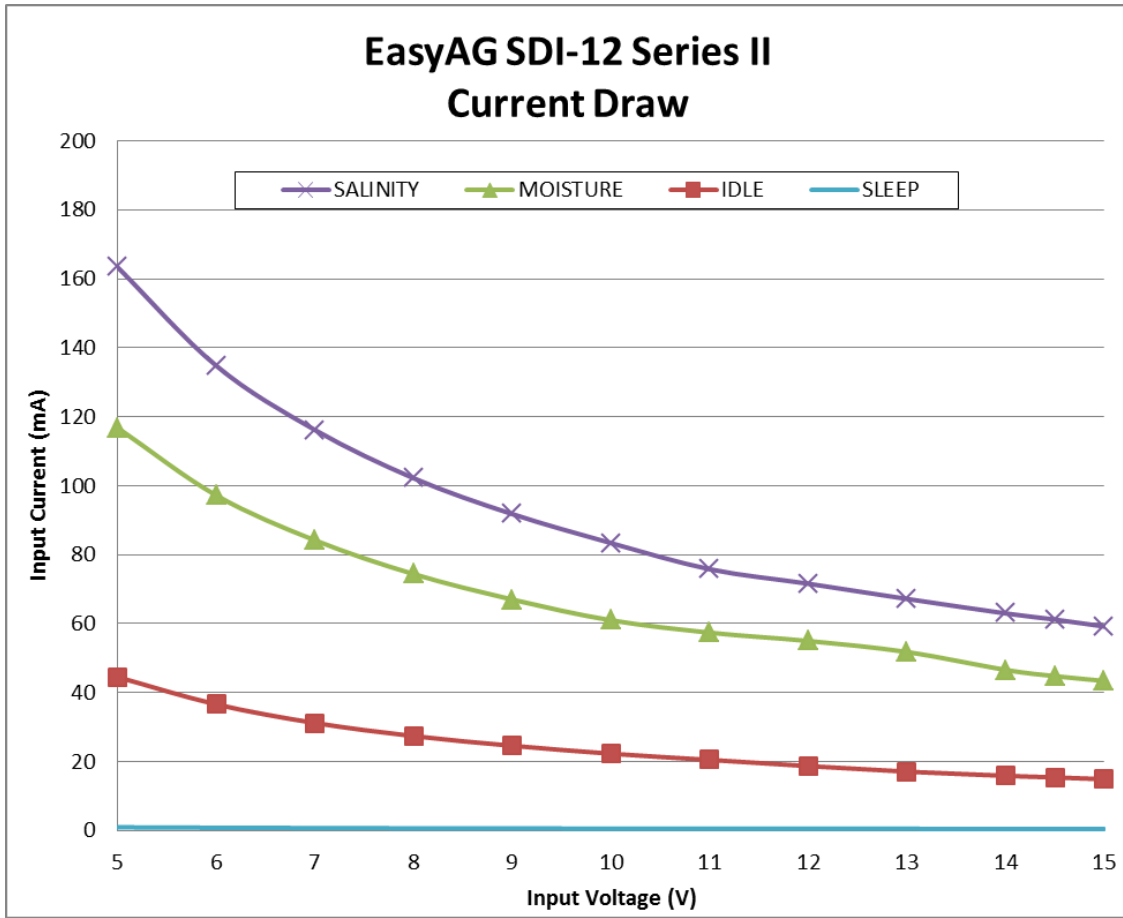
Circuit Information

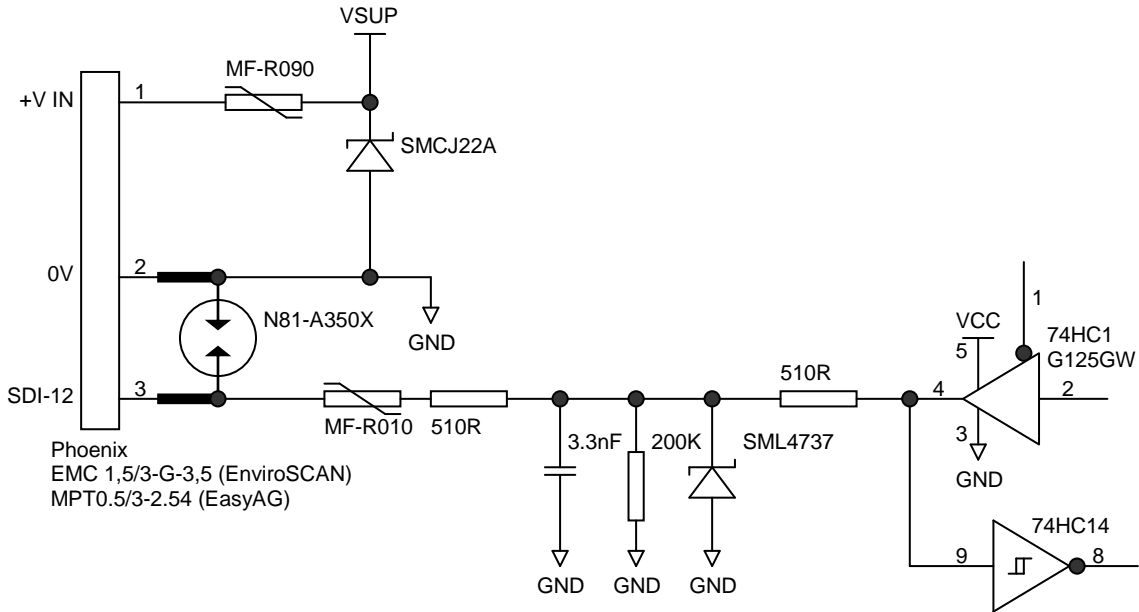This information may be required by third party integrators with SDI-12 loggers.

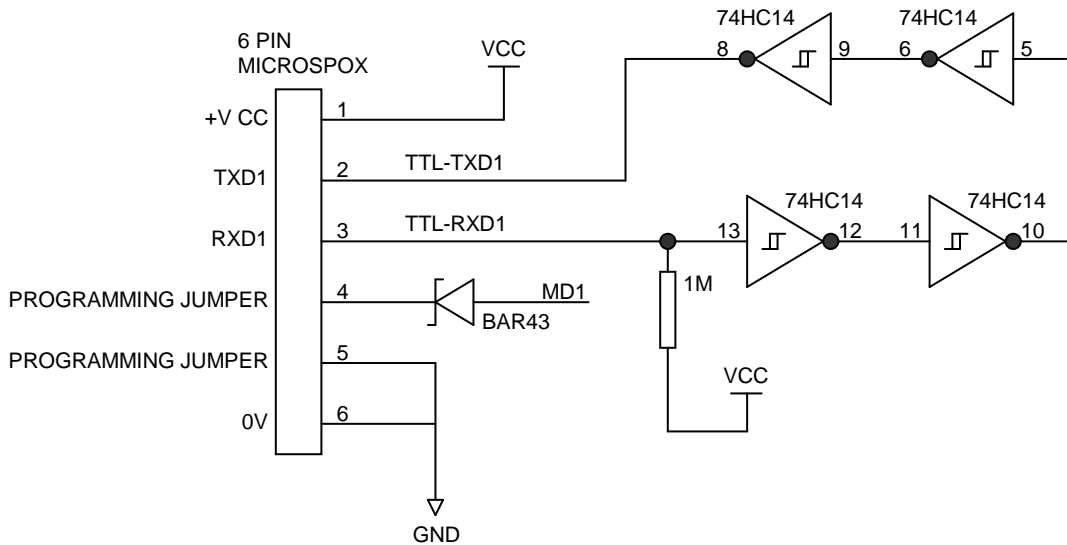Figure 6: SDI-12 interface circuit diagram

Figure 7 TTL interface circuit diagram

Appendix A – Soil Moisture and Salinity Management

What soil volume does the SDI-12 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) millimetre, there is one(1) millimetre 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) litre of water to cover one(1) square meter (m²) to a soil depth of one(1) millimetre.
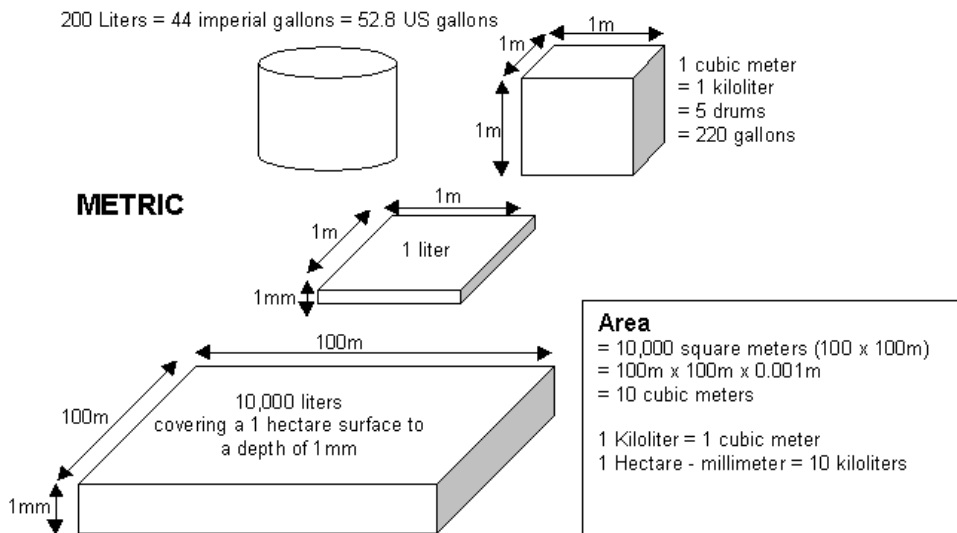

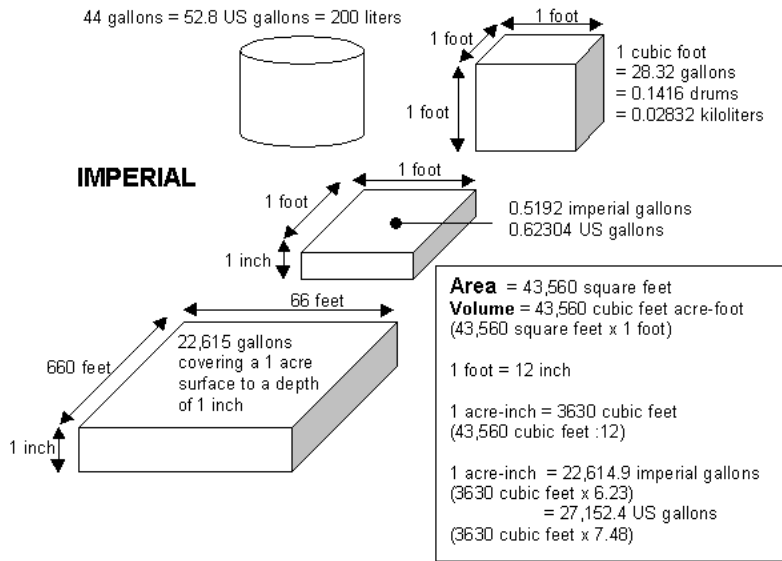Figure 8: Measurements using metric units

Figure 9: Measurements using imperial units

What part of the soil profile do 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).
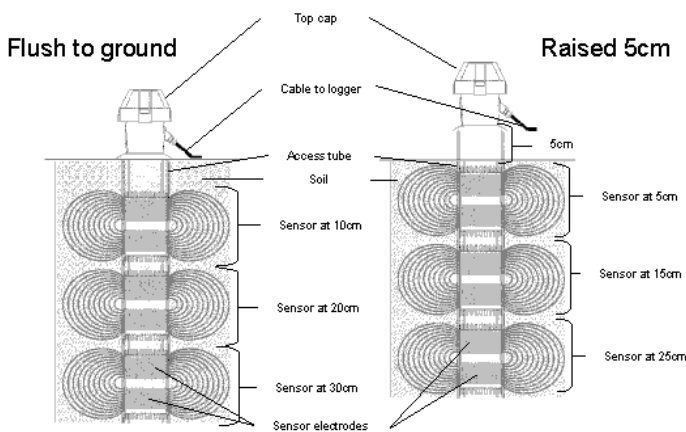

Figure 10: Measurements of multiple sensors on the probe

Salinity Management

Please refer to the TriSCAN Agronomic User Manual

Appendix B - Sensor Specifications

EasyAG sensors

EasyAG sensors are supplied in four standard configurations:

- 3 or 5 Moisture sensors at consecutive 10cm intervals
- 3 or 5 TriSCAN sensors at consecutive 10cm intervals

Note: EasyAG does not support temperature/humidity sensors.

EnviroSCAN sensors

Up to 16 EnviroSCAN sensor can be installed on an EnviroSCAN probe rod. They can be configured in any combination of depths at 10cm sensor spacing. Five sensor types are available

- Moisture
- TriSCAN
- Moisture with temperature and humidity
- TriSCAN with temperature and humidity
- Temperature and Humidity

See TriSCAN Agronomic User Manual for setting up EnviroSCAN sensors.

Note 1: SDI-12 probe interface firmware version 1.4.1 or later is required to support temperature/humidity sensors.

Note 2: Series I interfaces do not support temperature/humidity sensors.

Appendix C- Troubleshooting

This section assumes that the person is trained in installation and configuring Sentek probes.

Symptom or error message	Possible cause	Possible solution
PConfig Timeout while connecting to the probe	The wrong COM port has been selected	Try every COM port in the PConfig list
	Interface incorrectly powered	5V to 15V DC must be supplied through the SDI-12 connector on the interface
PConfig Auto-detect sensors does not find Temperature/Humidity sensors	Series I interface is not supported or wrong Interface firmware	Firmware must be Version1.4.1 or later (displayed on the PConfig main page
Moisture sensor data not present in SDI-12 data	Moisture sensor depths must be non-zero	Set depths on PConfig Configuration page
Salinity sensor data not present in SDI-12 data	Salinity sensors must be normalised	Normalise all sensors on PConfig Configuration page
SDI-12 data is -999.9999	Sensor not detected	Check cables and connectors
	Normalization values are incorrect	Re-normalised the sensor or all sensors
	Sensor jumpers loose or wrong position	Check/reseat sensor jumpers
SDI-12 data is -1000.000	Some third-party loggers cannot handle full 7-digit accuracy and round -999.9999 to -1000.000 (The logger may be limited to 24-bit IEEE values)	Program the logger to process -1000.00 values as invalid
SDI-12 data not recorded or intermittent	possible SDI-12 message clashing	Ensure all probes on the one SDI-12 cable have different addresses (PConfig main page)
	Cable damage	Replace/repair cable
	Supply voltage out of range	the probe will not operate if voltage is below about 5V or above 15V.