

## **SENTEK DRILL & DROP SDI-12**

### **SERIES III**

Probe Manual Version 1.0

## Sentek SDI-12 Drill & Drop Probe Manual

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SDI-12 Drill & Drop Rev 1.0 (2015-01-30)

## Sentek - Statements of Compliance

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### FCC note of compliance and statement of liability

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 Drill & Drop system complies with the following specifications;

- FCC Part 15 Subpart B  
Radio Frequency Devices – Unintentional Radiators
- CISPR 11:2010 Ed 5.1  
Industrial Scientific and Medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement
- IEC 6132601:2012 Ed 2  
Electrical equipment for measurement, control and laboratory use – EMC requirements. Part 1: General requirements.

### RoHS

- EN 50581:2012  
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

### Marking

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

### Modifications

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

### Radio Interference

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

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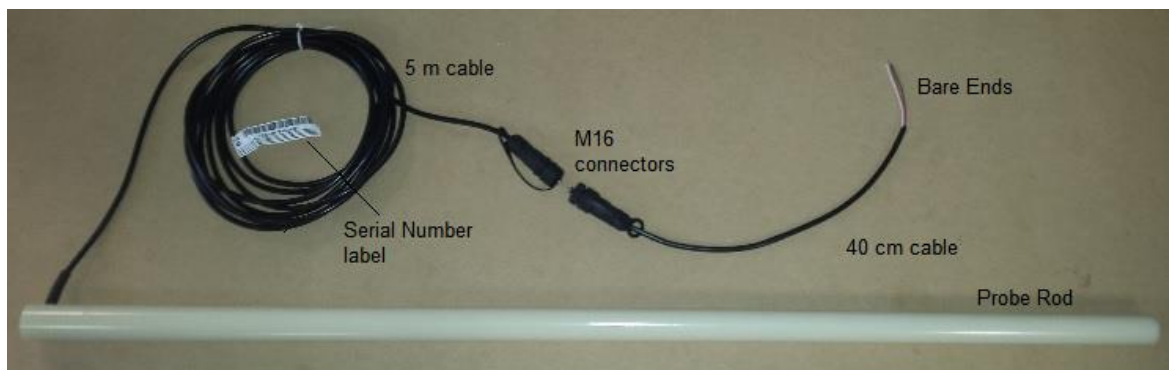
## The SDI-12 Drill & Drop Probe

This manual supports the Sentek SDI-12 Drill & Drop probe. Only SDI-12 protocol is supported. A third party SDI-12 logger is required to communicate with the probe and log data.

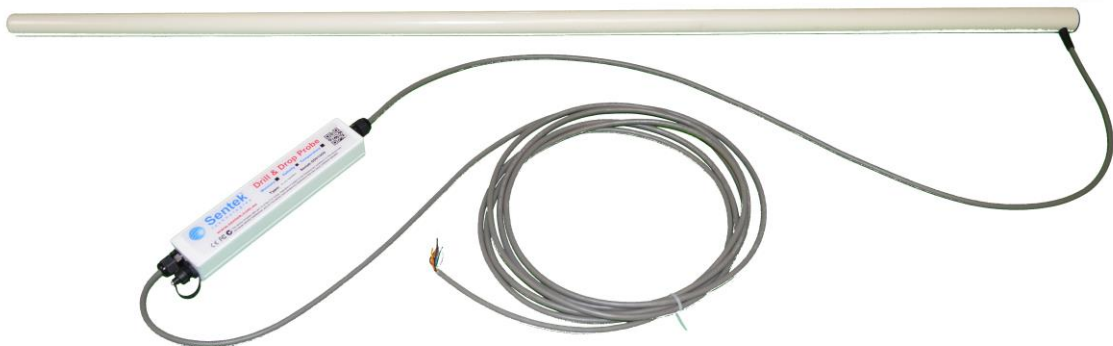
The Probe Configuration Utility version 1.9.3 or later now supports configuring the probe using the SDI-12 protocol, but with a subset of available configuring options. An SDI-12 programming cable is required.

The probe comes in four sensor configurations of 3, 6, 9 or 12 sensors (30, 60, 90 or 120cm), all moisture sensors or all TriSCAN sensors, together with a temperature sensor on each sensor.

The probe electronics are all encapsulated in the probe rod which is integrated with a 3-wire SDI-12 cable:



This probe has similar functionality to the Sentek Drill & Drop Probe which incorporates a Sentek EnviroSCAN interface box with SDI-12 Series II firmware.



## References

- Sentek Drill & Drop Installation Manual
- Sentek Drill & Drop Probe Manual
- Sentek Probe Configuration Utility (version 1.9.3 or later)
- TriSCAN Agronomic User Manual
- Sentek SDI-12 Series II Probe Interface Manual
- SDI-12 - A Serial-Digital Interface Standard for Microprocessor-Based Sensors Version 1.3 January 26, 2013 ([www.sdi12.org](http://www.sdi12.org))

## Probe

The sensors and cable are encapsulated inside the probe rod:

- 3, 6, 9 or 12 moisture sensors
- 3, 6, 9 or 12 moisture and salinity sensors
- Every sensor has an associated temperature sensor
- Sensors are spaced at 10 cm intervals, with the first sensor and its temperature sensor centred at 5 cm.
- Probe length 30 cm (12 inches), 60 cm (24 inches), 90cm (32 inches) or 120 cm (48 inches)
- The probe is preconfigured with SDI-12 address "0" and all sensors are normalised.
- Sensor numbers increase with sensor depth.
- Sensor depths are not stored in the probe.

## Cables

- Non-removable 5m SDI-12 probe cable with male M16 connector
- 40 cm SDI-12 Logger cable with female M16 connector, terminated in bare ends
- SDI-12 Drill & Drop Probe Programming Cable with female M16 connector (for Probe Configuration Utility and firmware reprogramming) - ordered separately.

## Sentek Probe Configuration Utility (PConfig)

### Warning!

Probes are supplied pre-normalised. Modifying information stored in the Drill & Drop probe may result in incorrect readings being reported to the controlling device.

The Probe Configuration Utility (PConfig) is provided to configure 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.

If PConfig is not installed on your computer, please follow the instructions in *Appendix A Probe Configuration Utility Installation* and *Appendix B USB Driver Installation*.

It is not necessary to configure the sensors or normalise Drill & Drop probes as they are sold fully preconfigured and normalised. An optional Drill & Drop Programming cable is available if required.

See the Probe Configuration Utility manual or help for further information.

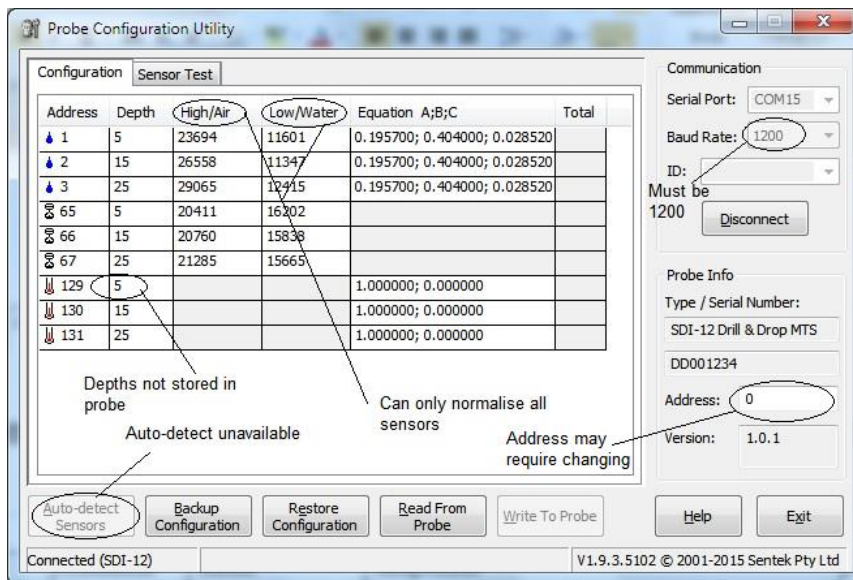
**Note:** Not all capabilities of Probe Configuration Utility can be utilised on SDI-12 Drill & Drop Probe.

- Depths (5, 15, 25 etc) are shown on the Configuration tab, but are not stored in the probe, consequently the SDI-12 logger must setup appropriate depths if required.
- Configuration cannot change so Auto-Detect Sensors is not available
- Air and water normalisation can only be performed for all sensors (not individually)
- Salinity sensor calibration coefficients (ABC) cannot be changed

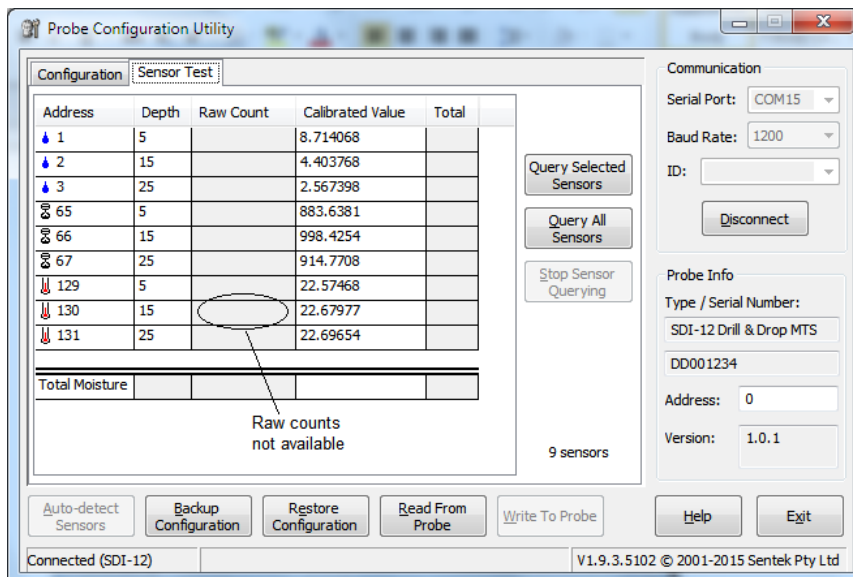
### Note:

The standard Sentek normalisation container is not suitable for Drill & Drop probes and cannot be used for water normalisation. After updating the probe firmware, if you cannot restore the configuration for a previously saved backup Configuration you must use a water container long enough to fully cover all sensors at the one time.

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- Raw value are not shown on the Sensor Test tab
- Query Selected sensors must read all sensors but only displays selected sensors



### Auto-detect Sensors

The Probe configuration is fixed so Auto-detect Sensors is not required and is not available.

### Normalizing 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. Sentek supplies the SDI-12 probes preconfigured so normalization values should not be changed.

Probes are supplied pre-normalised, so normalization is not required. If the firmware needs updating (see *Appendix C - Firmware Update Wizard*) you must Backup Configuration and Restore Configuration after the new firmware has been loaded.

The Sentek Normalisation container does not support Drill & Drop probes.



### **Changing the Calibration Information**

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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.

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.

Temperature sensors ABC values are pre-set to show values in degrees Celsius.

### **Setting the SDI-12 Address**

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Drill & Drop SDI-12 probes are preconfigured to SDI-12 address 0.

If multiple probes are on the one SDI-12 bus it will be necessary to use either your SDI-12 logger or PConfig to change the SDI-12 address of the probe in the range "0" to "9", "A" to "Z" and "a" to "z".

### **Sensor Test**

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After setup in the field the Query All Sensors function can be used to confirm all sensors are operational.

## SDI-12 Communication

This section provides information about the SDI-12 communication protocol version 1.3 used by the SDI-12 Drill & Drop probe interfaces.

Note: Protocol version 1.3 is compatible with version 1.2 with the addition of checksum commands and responses.

For more information on SDI-12 operation and the SDI-12 specification, visit [www.sdi-12.org](http://www.sdi-12.org).

### Power Sequence

The SDI-12 can either be continuously powered or powered when needed. When continuously powered the probe responds as specified in the SDI-12 protocol specification. The probe requires about 1 second to power up before it will respond to SDI-12 commands.

An SDI-12 compatible device (logger) 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 in low power standby.

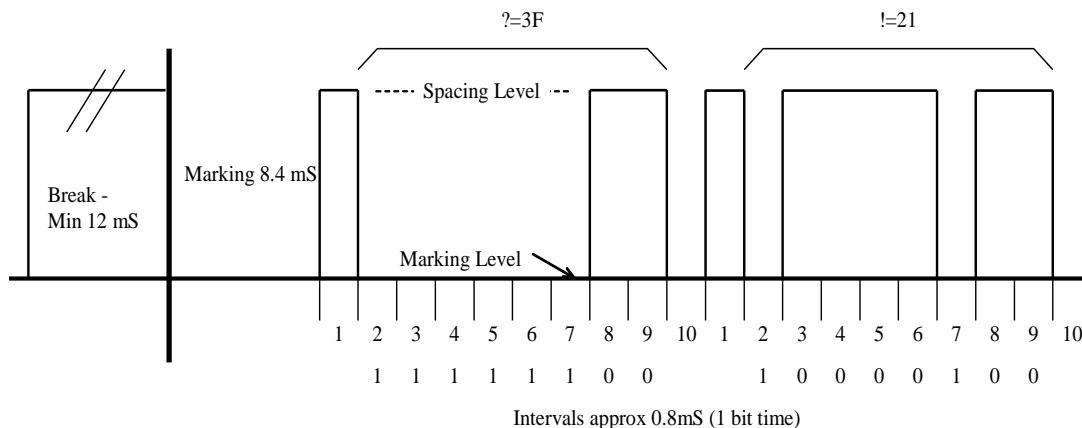
### Timing

The timing diagram below shows voltage levels on the SDI-12 line during transmission of an Acknowledge Active command (a!) using the "?!" (wildcard) address query.

After the break condition has been sent to the 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, 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.



Following the terminating character (!) of the command, the controlling device must release the line within 6.5mS. The 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.

## SDI-12 Basic Commands Supported

The following commands are supported by the SDI-12 Drill & Drop probes

See SDI-12 specification section 4.4.12 Requesting a Cyclic Redundancy Check (CRC) for use of SDI-12 commands with CRC response.

Command	Name	Response
?!	Address Query	a<CR><LF> The probe interface address (not suitable in a multi-drop situation)
a!	Acknowledge Active	a<CR><LF> The probe interface address
aI!	Send Identification	allccccccccmmmmmmvvvxxxxxxxxxxxxx<CR><LF> > Identification information
aAb!	Change Address	a<CR><LF> The probe interface address
aM! and aMC!	Start Measurement	atttn<CR><LF> Delay (ttt) in seconds and number of values (n) up to 9
aMn! and aMCn!	Start Measurement N = 1 to 5 and 9	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! And aCC!	Concurrent Measurement	atttnn<CR><LF> Delay (ttt) and number of values (nn) up to 12
aCn! And aCCn!	Concurrent Measurement n = 1 to 2 and 9	atttnn<CR><LF> Delay (ttt) and number of values (nn) up to 12 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 = 0 to 9	apd.dapd.d ...(etc.)<CR><LF> Refer to "Data Reading" section
aV!	Start verification	a0000<CR><LF> Not supported Probe interface will respond with its address
aRn!	Continuous Measurement	a<CR><LF> Not supported Probe interface will respond with its address

## SDI-12 Extended Commands Supported

These commands are not in the standard SDI-12 basic commands but are compatible with SDI-12 Extend commands (SDI-12 Specification section 4.4.13). They all start with the letter "X". These commands are used by PConfig 1.9.3 and later.

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At present commands and responses requiring a value in the format "pd.d" must be nine characters long (sign plus seven digits including a decimal point) e.g. +1234.567.

Command	Name	Response
aXA!	Air normalisation	Perform air normalisation of moisture and salinity measurements - measures all sensors and stores the results as air normalisation values. Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure) Where nn is the number of sensors normalised
aXAnndddd ssss!	Store Air normalisation value sensor nn	Write air normalisation moisture value dddd and salinity value ssss for sensor nn Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure)
aXAnndddd !	Store Air normalisation value sensor nn	Write air normalisation moisture value dddd for sensor nn Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure)
aXAnn!	Read Air normalisation value sensor nn	Read air normalisation for sensor nn Response: annddd<CR><LF> (for moisture only probe) Response: anndddssss<CR><LF> (for salinity probe)
aXW!	Water normalisation	Perform water/base normalisation of moisture and salinity measurements - measures all sensors and stores the results as water/base normalisation values. Response: ann<CR><LF> Where nn is the number of sensors normalised
aXWnndddd ssss!	Store water normalisation value sensor nn	Write water normalisation moisture value dddd and salinity value ssss for sensor nn Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure)
aXWnndddd !	Store water normalisation value sensor nn	Write water normalisation for sensor nn Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure)
aXWnn!	Read water normalisation value sensor nn	Read water normalisation for sensor nn Response: annddd<CR><LF> (for moisture only probe) Response: anndddssss<CR><LF> (for salinity probe)
aXEnnpd.dp d.dpd.d!	Set ABC for moisture sensor nn	Set moisture equation for sensor nn Equation is formed by 3 coefficients, A, B and C which are of the form pd.d as per SDI-12 aDn! results. Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure or invalid sensor number)

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Command	Name	Response
aXEnn!	Read ABC for moisture sensor nn	Read moisture equation for sensor nn Response: annpd.dpd.dpd.d<CR><LF> Response data is as per set data.
aXTnnpd.dpd!	Set linear calibration constants for temperature sensor nn to the supplied constants.	First constant is slope (A, unitless) and second constant is offset (B, in Degrees C) such that: $T\text{-cal} = A * T\text{-measured} + B$ Note: Linear calibration can be used to convert result into Fahrenheit if values used are 1.8 and 32.0. Response: ann<CR><LF> (for success) Response: a<CR><LF> (for failure)
aXTnn!	Read linear calibration constants for temperature sensor nn.	Response: annpd.dpd.d<CR><LF>

### Data Reading

The 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 SDI-12 probe interfaces do not support the Continuous Measurement command (aRn!). The probe will respond with its address followed by <CR><LF> in response to this command.

The SDI-12 probe interface returns sensor values in sensor depth order, starting at the shallowest depth (i.e. 5 cm).

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.

Temperature sensors return temperature in degrees Celsius.

**Note 1:** The controlling device may choose not to issue all Send Data commands (aDn!) when retrieving the data.

**Note 2:** The SDI-12 probe for moisture, salinity and temperature values "pd.d" currently uses a fixed nine character format of "sign followed by three digits, followed by the decimal point, followed by four decimal digits" ( $\pm$ nnn.nnnn) to return readings. This may change in future issues of the SDI-12 probe firmware (software should not rely on this fixed format).

**Note 3:** 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 4:** Some third party SDI-12 loggers cannot represent full 7-digit accuracy so convert -999.9999 to -1000.000.

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

The following table shows the allocation of the Start Measurement commands (aM! or aMn! or aMC! or aMCn!). The (aMCn!) Commands are SDI-12 version 1.3 command that have a CRC checksum in their response.

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**Note:** Although the commands support up to 16 sensors, SDI-12 Drill & Drop Probes have 3, 6, 9 or 12 sensors.

- aM! (aMC!) Read Soil Moisture values 1 – 9
- aM1! (aMC1!) Read Soil Moisture values 10 – 12
- aM2! (aMC2!) Read Salinity values 1 – 9
- aM3! (aMC3!) Read Salinity values 10 – 12
- aM4! (aMC4!) Read Temperature values 1 – 9
- aM5! (aMC5!) Read Temperature values 10 – 12
- aM9! (aMC9!) Read Supply Voltage

**Note:** Other Start Measurement commands will result in a response of "a0000<CR><LF>".

### Soil Moisture, Salinity and Temperature Values (aM! through aM5!)

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

Command	Response
aM!	a0029<CR><LF>
	a<CR><LF> Service request response

The response indicates that 9 values will be available within a time of 2 seconds. After approximately 2 seconds the probe will issue a Service Request (a<CR><LF>, where "a" is the probe address). The controlling device will 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 values, a further Start Measurement command (aM! or aMn!) must be issued.

Command	Response
aM1!	A0023<CR><LF>
	a<CR><LF> Service request response

The response indicates that another 3 values will be available within a time of 2 seconds. After approximately 2 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<CR><LF>

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The aMCn! Commands perform the same function as the aMn! command but the aDn! response includes a CRC checksum. The 16 bit CRC is encoded as three ASCII characters appended before the <CR><LF> characters. Example:

Command	Response
0MC!	00023<CR><LF>
	a<CR><LF> Service request response
aD0!	0D0!0+0.155954+0.008233+0.033187@BQ<CR><LF>
aD1!	0AP@<CR><LF>

### Data Reading using Concurrent Measurement Command (aCn! or aCCn!)

The following table shows the allocation of sensors for the Start Concurrent Measurement commands (aC! or aCn!). The (aCCn!) Commands are SDI-12 version 1.3 command that have a CRC checksum in their response.

- aC! (aCC!) Read Soil Moisture values 1 – 12
- aC1! (aCC1!) Read Salinity values 1 – 12
- aC2! (aCC2!) Read Temperature values 1 – 12
- aC9! (aCC9!) Read Supply voltage

**Note:** Other Start Concurrent Measurement commands will result in a response of "a0000<CR><LF>".

The aCCn! Commands perform the same function as the aCn! command but the aDn! response includes a CRC checksum.. The 16 bit CRC is encoded as three ASCII characters appended before the <CR><LF> characters. Example:

Command	Response
0CC!	000203<CR><LF>
0D0!	00+0.174914+0.008619+0.034194HNs<CR><LF>
0D1!	0AP@<CR><LF>

### Soil Moisture, Salinity and Temperature Values (aCn! and aCCn!)

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

Command	Response
aC!	a00312<CR><LF>

The response indicates that 12 soil moisture values will be available after a time of 3 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<CR><LF>

**Note:** The SDI-12 probe interface *will not* issue a service request for this command.

**Note:** Refer to notes on Start Measurement (aM! or aMn!) command above.

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### Supply Voltage Values (aM9! And aMC9 or aC9! and aCC9!)

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The supply voltage commands returns the value of the supply voltage to the probe.

Command	Response
aM9!	a0001<CR><LF>

The response contains one value which is the supply voltage detected within the probe. This may be slightly less than the supplied voltage due to cable and component voltage drops. The controlling device will then issue Send Data commands (aDn!) to read the values.

Command	Response
aD0!	a+4.966250<CR><LF>

### Send Identification Command (aI!)

---

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

```
allccccccmmmmmmvvvxxxxxxxxxxxxx<CR><LF>
```

a = Probe address

l = "13" SDI-12 protocol version 1.3

c = "SENTEK " company name

m = "DD MT " - probe type Moisture & Temperature

m = "DD MTS" - probe type Moisture, Temperature & Salinity.

v = firmware version number

x = Serial number (reported by PConfig, present on cable label)

Example:

```
013SENTEK DD MTS101DD001000 <CR><LF>
```



## Wiring the Probe Cable

The SDI-12 Drill & Drop probe is supplied with a 5m cable terminated with a 3-pin water-proof (IP67) M16 male connector and a companion 40cm SDI-12 logger cable with female M16 connector and 3 bare wires to connect into your SDI-12 logger. The probe cable has an attached label showing the probe Serial Number. This number matches the number stored in the probe (SDI-12 command 0I! and shown in PConfig Probe Info Serial Number).



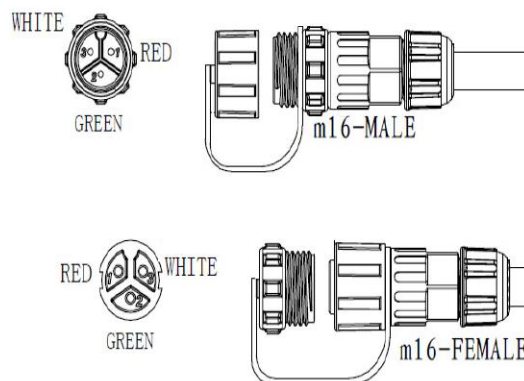
### Caution:

Damage to the Drill & Drop cable or loose connectors may result in moisture entering the cable, resulting in corrosion and cable failure.

## SDI-12 Probe cable

The 5m probe cable is integrated into the probe and cannot be removed. The M16 connectors must be (with fingers) tightly screwed together to prevent the entry of moisture. If wanted the connector can be removed and the cable wired directly to the SDI-12 logger.

Please contact Sentek if you require connectors to extend the cable beyond 5 m.



M16, 3-pin, Rigoal connectors

An SDI-12 probe requires connection to a third-party SDI-12 logger, consequently the 40 cm SDI-12 logger cable is terminated in 3 bare wires.

SDI-12 Cable	+Vin	0V	DATA
3-wire cable	Red	Green	White

## SDI-12 Probe Programming cable

This cable's female M16 connector is compatible with the male M16 connector on the SDI-12 probe cable. The cable is not water-proof.



## Installation and setup of the Drill and Drop probe

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Physical installation at the desired field location is described in the Drill and Drop Installation Manual.

The only required configuration setup is setting the SDI-12 address. This can be done in the field with a Windows laptop or with an office windows computer. Alternatively it can be done using your SDI-12 logger if that capability is available.

### Set Probe Address (if needed)

1. Install the USB device driver (see *Appendix B USB Driver Installation*) - it is already installed if the computer is running Windows 7 or later
2. Plug in the SDI-12 programming cable into any USB port on your computer.
3. Connect the SDI-12 programming cable to the connector on the probe cable. The probe gets its 5V supply from the USB port.
4. Open Probe Configuration Utility and Click Baud rate drop down and select 1200
5. Click Select the Serial port drop down on the Serial Port and select the first COM port. If there is more than one option you may have to try the other ones in turn if the next step fails to connect
6. Click the Connect button. If you get the message "Timeout occurred while trying to connect to the probe" repeat the previous step and try the next COM port.
7. The probe will now be connected. The Probe Info will show the Type, Serial Number and Address (it uses the "?!" SDI-12 address query command to get the probe address).
8. If you need multiple probes on the one SDI-12 logger you should change the probe address(s) from "0" to a unique number (0-9, a-z or A-Z) for each probe on this logger.
9. If the address was changed click Write to Probe and Click OK to the Confirm writing to the probe.
10. Click Backup Configuration and save the file in an appropriate folder.

#### **Caution:**

You must not restore a configuration saved from a different Probe because the normalisation values will not be appropriate.

11. You can verify that the sensors are operational by selecting the Sensor Test tab and Clicking Query All Sensors.
12. Click Disconnect and unplug the probe.

### Connect probe to your SDI-12 Logger

13. Wire your SDI-12 logger to the Sentek SDI-12 logger cable
14. Plug the SDI-12 probe cable connector to the SDI-12 logger cable

The probe is now ready for logging of readings.

## Drill & Drop Technical Specifications

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All sensors and electronics are encapsulated within the probe rod. The cable to the probe rod cannot be disconnected.

SDI-12 Protocol: Version 1.3

Sensors are measured starting from the bottom sensor (3, 6, 9 or 12)

Moisture Sensor Resolution: 1:10000

Moisture Sensor Precision:  $\pm 0.03\%$  vol.

TriSCAN Sensor Resolution: 1:6000

Temperature Sensor Accuracy:  $\pm 2$  Deg. C @ 25 Deg C.

Temperature Sensor Resolution: 0.3 Deg C.

Temperature range (operating): -20 Deg C to +60 Deg C.

Voltage Supply (+Vin): 2.7V to 15 Volts DC, Nominal 12V

**Note:** When operating below 5V, the probe will still drive the SDI-12 data line at the 5V specification so the logger will also need to be 5V tolerant. Permanent damage may result if the probe is operated above 15V for extended periods of time. Above 15V the probe will draw higher current (up to about 100 mA).

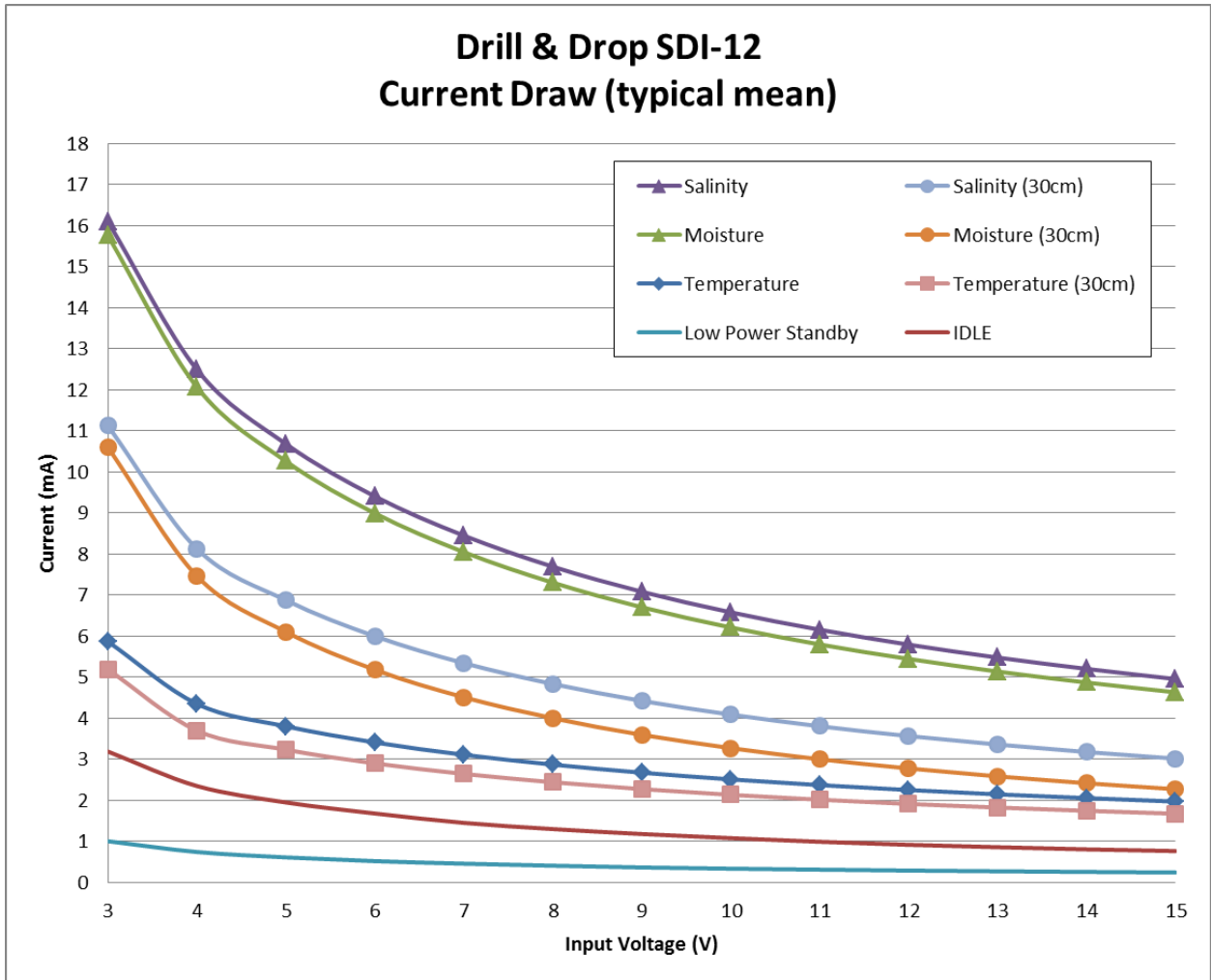
Time to Sample Sensors: See following table (typical values)

SDI-12 Command	Measurement Time (ms)			
	30cm	60cm	90cm	120cm
C!	1045	1080	1620	2160
C1!	1260	1480	2220	2960
C2!	245	480	720	960
M!	1045	1080	1620	1620
M1!	X	x	x	1045
M2!	1260	1480	2220	2220
M3!	X	x	x	1260
M4!	245	480	720	720
M5!	X	x	x	245

# Sentek SDI-12 Drill & Drop Probe Manual

Current consumption:

See following graph (typical values)



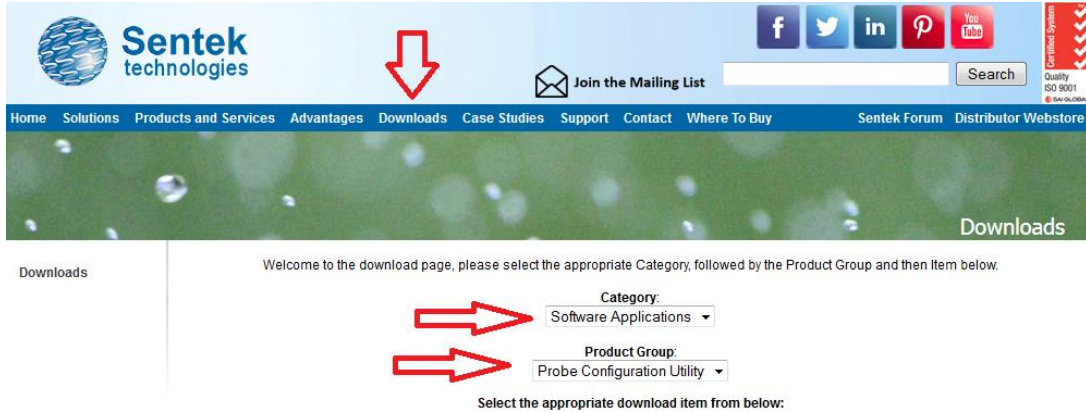
## Appendix A Probe Configuration Utility Installation

This step is not required if Probe Configuration Utility version 1.9.3 or later is already installed.

**Note:**

This application must be installed using Administrator privileges, but can be run with normal user privileges.

15. On the Sentek main page [www.sentek.com.au](http://www.sentek.com.au), select option Downloads and category Software Applications and Product Group Probe Configuration Utility



16. Click the [download] option for the following and follow the prompts

**Probe Configuration Utility (Ver. 1.9.x) - [download]**

Install the application from the downloaded PConfig\_setup.exe.

## Appendix B USB Driver Installation

The same USB driver is used for Probe Configuration Utility and the SDI-12 Drill & Drop Firmware Update Wizard.

**Note 1:**

If you are running Windows 7 or later the driver is already available so the following steps are not required. Sentek will notify you if the Windows 7 or later driver must be updated.

**Note 2:**

This driver must be installed using Administrator privileges.

17. On the Sentek main page [www.sentek.com.au](http://www.sentek.com.au), select option Downloads and category Drivers and Product Group USB (TTL) Probe Programming Cable



18. Click the [download] option for both the following and follow the prompts  
**Driver Installation Instructions - [download].**  
**Drivers for Win. 2000,XP,Vista, 7 & Server 2003,08 - [download]**
19. Read the Driver Installation instructions and install the Driver.
20. You may need to restart the computer
21. The installation instructions will describe how to identify the allocated COM port number.

## Appendix C - Firmware Update Wizard

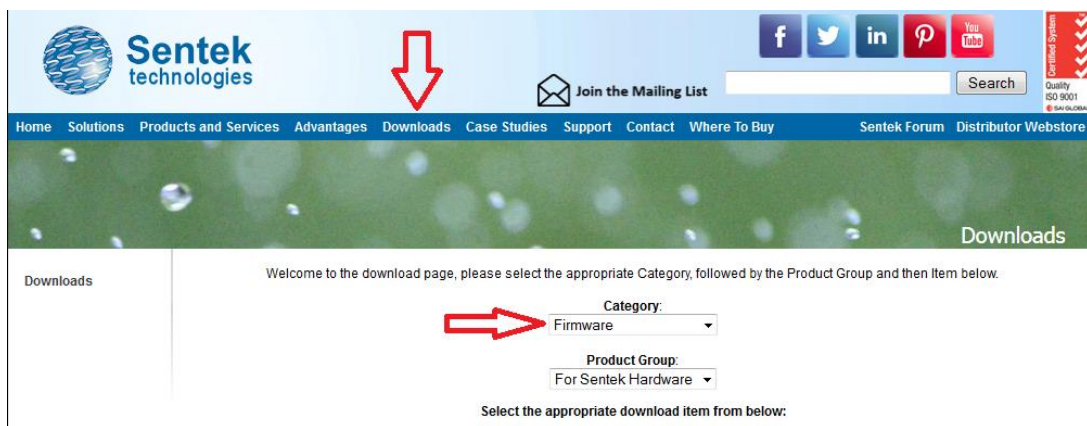
The firmware in the SDI-12 probe is the most recent when the probe is shipped. Sentek may add new capabilities or bug fixes for probes existing in the field. These changes will be announced indicating new versions are available for download from the Sentek web site [www.sentek.com.au](http://www.sentek.com.au).

Please review new firmware announcements and establish if the update is useful for your probe(s).

You require:

- ⇒ Sentek SDI-12 Drill & Drop probe(s),
- ⇒ Drill & Drop SDI-12 programming cable,
- ⇒ a laptop or desktop computer with Internet access (for downloading DnDFWUploadWiz.exe).
- ⇒ Probe configuration Utility 1.9.3 or later (PConfig)
- ⇒ USB FTDI Driver (Already available on Windows 7 or later)

22. On the Sentek main page [www.sentek.com.au](http://www.sentek.com.au), select option Downloads and category Firmware.



23. Click the [download] option and follow the prompts

### **Sentek SDI-12 Drill & Drop Firmware (Ver 1.0.x) - [download]**

24. Plug the SDI-12 programming Cable into any USB port on your computer and screw the cable connector to the Probe connector. The USB port supplies the 5V power for the probe.
25. Start the PConfig, select the appropriate COM port, Select Baud rate 1200 and click connect (you may need to select a different COM port if the Select is not successful).
26. In PConfig, click Backup Configuration and save the probe configuration to an appropriate folder.  
This configuration must be restored after the new firmware is loaded.
27. Double-click (run) the DnDFWUploadWiz.exe
28. Review the FIRMWARE LICENSE AGREEMENT, select "I accept the agreement" and click Next
29. Choose the Appropriate COM port (no need to change the baud rate) and click Next
30. Inspect the current and new versions and if the proposed firmware version is newer and matches the desired version Click Next.
31. The upload progress for about 1 minute and should complete with success at 100%.
32. If the upload fails, click Back and try again. If failure persists contact Sentek Technical Support.
33. Click close on the Upload wizard (unless further probes need to be updated, so repeat from Step 3)

## Sentek SDI-12 Drill & Drop Probe Manual

34. Start PConfig again and Connect to the probe.
35. Click Restore Configuration and select the configuration file saved in step 5.
36. Click Write to Probe and click OK to Confirm writing to probe.

The probe is now updated and ready to be re-installed in the field.



## Appendix D- 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
	Attempt to connect at 9600 baud	Set Baud rate to 1200 or Auto
	Interface incorrectly powered	3V to 15V DC must be supplied through the SDI-12 cable
	The PConfig version in use does not support SDI-12 protocol	Update to PConfig 1.9.3 or later
Salinity sensor data not present in SDI-12 data	Non-Salinity probe type	Check PConfig Probe Info Type: SENTEK MTS
SDI-12 data is -999.9999	Sensor not detected	Check cables and connectors
	normalization values are incorrect	Restore the configuration from the saved Backup configuration. If a backup is not available, water normalisation must be done in a water container long enough to cover all sensors at the same time.
SDI-12 data is -1000.000		Some third-party loggers cannot handle full 7-digit accuracy and round -999.9999 to -1000.000
PConfig or SDI-12 logger Sensor missed	Probe failure	Contact your Distributor or Sentek Technical support
SDI-12 data not recorded or intermittent	possible SDI-12 message clashing	Ensure that probes on the one SDI-12 cable have different addresses
	Supply voltage out of range	the probe will not operate if voltage is below about 3V or above 15V.