Sentek™ technologies

Sentek™ MULTI

Hardware Manual
Version 2.0

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SENTEK MULTI - 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 *MULTI* system complies with the following specifications;

- FCC Part 15 Subpart B
  Radio Frequency Devices – Unintentional Radiators
- CISPR 11:2009
  Industrial Scientific and Medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement
- 61000.6.1:2005
  Generic standards—Immunity for residential, commercial and light industrial environments

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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SENTEK MULTI INTRODUCTION

BACKGROUND

Sentek MULTI combines the scientifically and commercially proven soil moisture sensor technology of Sentek EnviroSCAN systems with web enabled, wireless communication and the ability to continuously track fertilizer / salinity data through the use of TriSCAN sensors, rainfall and irrigation from pulse output sensors, and temperature from RTD sensors. Sentek MULTI can utilise GPRS, 3G or Satellite communications to send all of this data from the probe to a server, allowing the user to download it to their own PC via the internet. Alternatively, it provides for direct in-field download if telemetry services become unavailable.

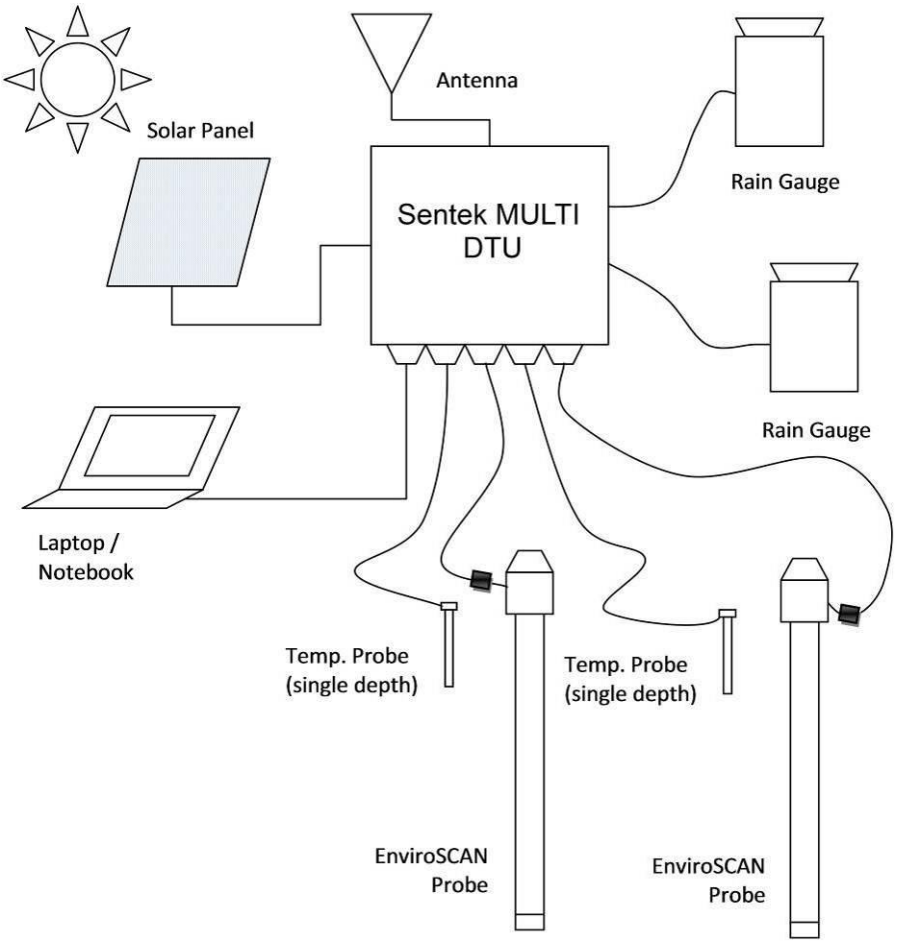


Figure 1 Block Diagram of the Sentek MULTI in use

REFERENCED DOCUMENTS

- EasyAG Installation Guide
- Access Tube Installation Guide
- Sentek MULTI Field Installation (Power Point presentation in Distributor Kit)
- IrriMAX Data Exchange User Guide
- IrriMAX Help
- Probe Configuration Utility Version 1.8.3 (or later) Manual
- Environdata Rain Gauge Handbook
- TB069-Pconfig USB cable driver installation instructions.pdf

FEATURES

SENTEK ENVIROSCAN MULTI PROBES

- Configured using Sentek's Probe Configuration Utility software
- Utilises EnviroSCAN Moisture & TriSCAN sensors, tubes and probe rod
- Each Interface can store over 2000 samples (~21 days @ 15 minute sampling intervals)
- Each interface can log all or any combination of temperature and rain gauge sensors
- On-board TCP/IP Stack for initiating internet connection
- Ability to automatically transfer data via FTP to a remote server (using Sentek MULTI DTU)
- Network feature allows flexible modem configuration

SENTEK MULTI DATA TRANSMISSION UNIT (DTU)

- 2 x inputs for Sentek MULTI Probes, which can be connected to the DTU via up to 200 metres of cable
- 2 x pulse inputs for Sentek recommended sensors (for measuring rain, irrigation or flow)
- 2 x RTD inputs for Sentek recommended temperature sensors (for measuring in air or soil)
- Sentek MULTI DTU includes:

- GPRS, NextG or Satellite Communication Module (antenna not included)
- 12-volt battery
- Front Panel, with
    - Solar charging circuit
    - LED indicators
    - USB probe communication port
    - On/Service Mode switch

- Direct communication from Sentek MULTI probe to the Internet

SENTEK MULTI WITH IRRIMAX SOFTWARE SUITE

- Seamless download from an internet accessible FTP or email server
- Dial in feature allows probe settings to be changed remotely*
- Webify and Email functions allow data to be viewed online or emailed

* Internet firmware only. See section *Firmware and board type*.

SENTEK MULTI PULSE INPUTS

- E.g. Tipping bucket rain gauge or flow meter

SENTEK MULTI RTD (RESISTANCE TEMPERATURE DETECTOR) INPUTS

- Temperature sensor (e.g. soil temp., air temp. etc.)

Note: for information about suitable RTD and pulse sensors, refer to section *Technical Specifications – Sentek MULTI DTU.*

SENTEK MULTI SERIAL CONNECTION (FRONT PANEL DOWNLOAD)

As an alternative to downloading from an FTP server using the Internet, it is also possible to download by directly connecting your computer to the front panel connector on the Sentek MULTI DTU. This is typically done with a portable computer. This option can be useful when the modem/Internet connection is not working. For further Information on how to do this please refer to the Data Exchange User Guide (Help).

HARDWARE REQUIREMENT LISTS FOR SENTEK MULTI

REQUIRED PARTS TO ASSEMBLE A COMPLETE SYSTEM

- Sentek MULTI Front Panel and DTU housing
- 12V 7.5 AH sealed lead acid (SLA) battery
- Mounting Pole (DTU)
- 12V solar panel & solar panel bracket
- Solar panel bird deterrer
- Up to 200m Length of data cable to connect to each probe*
- Ferrite bead for cable at each probe
- Optional GPRS, NextG or Satellite modem*
- Appropriately selected antenna with cable
- Up to 2 Sentek probes
- Up to 2 temperature sensors*
- Radiation shield (for air temp. sensor)*
- Up to 2 pulse sensors*
- Mounting pole/slab (rain gauge)*
- Cable for pulse sensors*

  * Only Sentek supplied parts are explained in this manual and supported by Sentek

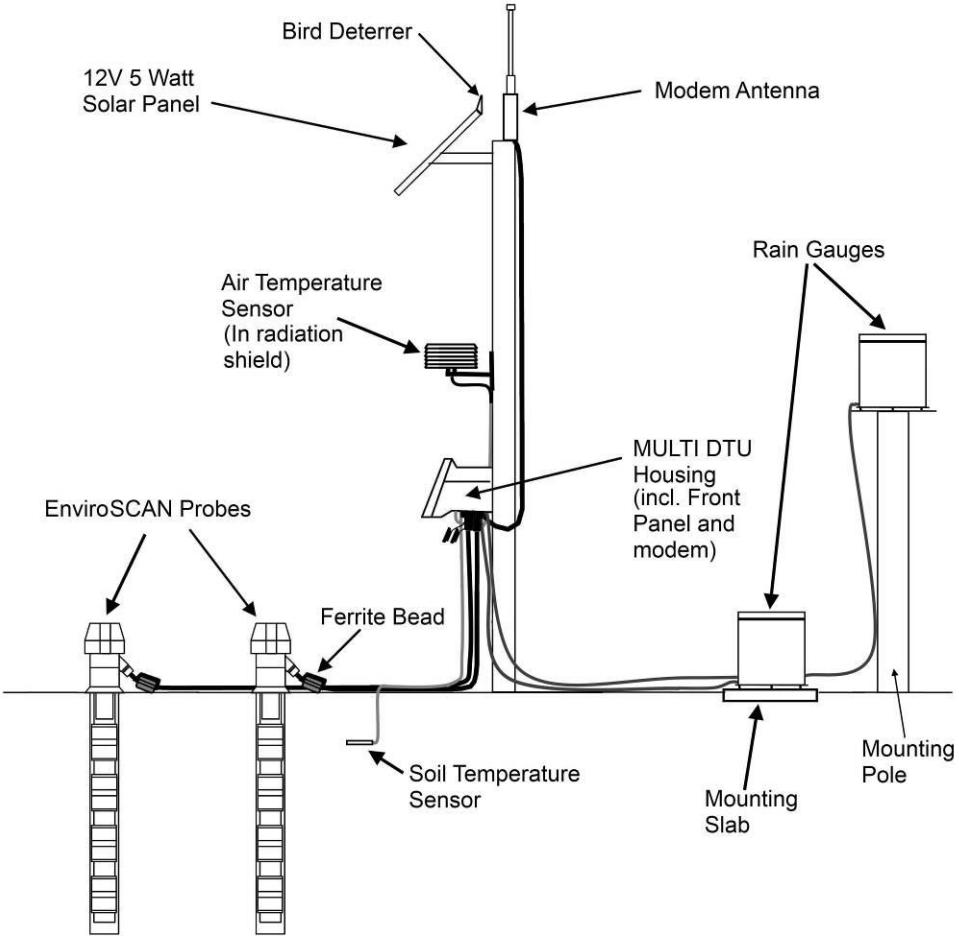


Figure 2 Completed system block diagram

DETAILED SYSTEM SETUP

DATA TRANSFER AND HOSTING

A Sentek MULTI probe with Internet firmware* must have access to the internet and somewhere to send its data to. In basic terms; it needs a computer set up as an FTP server which can be accessed via the internet. The probes will make a connection to the internet at each upload interval, connect to the FTP server and copy the data files to the computer directory specified.

Sentek MULTI probes with Satellite firmware* must have a satellite modem which is registered with the Iridium satellite network and it will also need an email account which Iridium can forward the probe's data to. At each upload interval, the probe will power the satellite modem, which searches for satellites and then sends an SBD file containing the readings to the satellite. The satellite will forward the SBD file as an email attachment to the email address/es that are registered for that modem.

* For explanation of "Internet" versus "Satellite" firmware, see section *Firmware and board type*.

Internet firmware - Buying a SIM card and packet data plan for modem

Sentek MULTI systems will require a SIM card for each system with a Sentek supplied GPRS or NextG modem. This SIM card must have a data plan associated with it and must have reasonable coverage in the area where the probe will be installed. This data plan is similar to what is needed for accessing the internet on your mobile (cell) phone.

It is not necessary to get a plan with cheaper voice calls, SMS rates, voice mail options or other such features, as the probe will only use the data features of the plan, thus the GPRS or NextG data part of the plan must be the cheapest aspect.

For use of the Dial-in feature, the SIM card must have a data (CSD) number that can be called.

When sourcing the SIM card and data plan make certain of the factors detailed below:

No Session Fees

Every time data is uploaded to the internet from the probe the network provider may charge what is called a session fee or flag fall. For systems uploading frequently this can become very expensive.

A typical session fee is around 25 cents. If uploads occur every 3 hours (8 uploads/day) this would cost around $60 per month, on top of data usage charges.

Low Data Rates

To keep costs down, it is important when choosing a plan that you try to assess how much data you will be uploading, and how often you will be uploading it and then choose a plan accordingly.

Most data plans work in much the same way as a voice plan, costing a certain amount each month for a certain volume of data, and once this has been exceeded a charge for the excess data is applied.

As an example plan, the following may be the case:

- Base cost of $5 per month
- No session fees
- 2,000 kB included per month
- 1 cent per excess kB

If 1,800 kB is used, this plan will cost $5 per month, if however 2,200 kB is used in a month that month's usage will come to $7.

A system with one probe logging every 15 minutes and uploading every 90 minutes will use roughly 1,000 – 1,500 kB each month. If two probes are connected to the DTU and set to the same sample and upload rate, this figure can be doubled.

Uploading less often (which is recommended for power savings) will reduce data usage more than sampling less often (within certain limits), however a system that samples every 30 minutes, and uploads every 3 hours would transmit half as much data as the system described previously.

Note: Due to variable coverage, internet congestion or other circumstances, uploads may fail. The data will be available after the next successful upload, but in areas where these

issues occur, more frequent uploads may help ensure that data is accessible when required.

As every upload has a fixed overhead containing configuration information, it is advisable to maximise the number of samples per upload to reduce data usage.

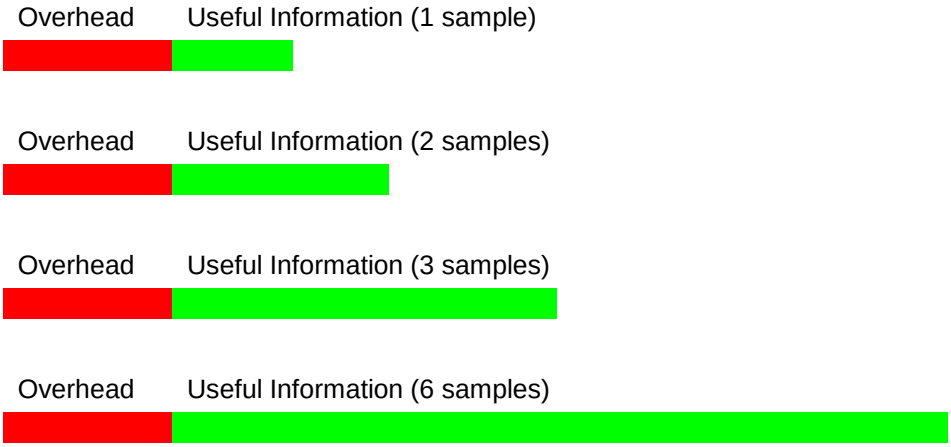


Figure 3 Data usage for different numbers of samples per upload

Naturally, the requirement for up-to-date data being available also needs to be considered. Generally, a good balance is to be found by uploading between two and four times a day. A system with two probes, which are set to sample every 15 minutes, each uploading twice a day should use no more than 2000 kB (≈2MB) per month.

The number of sensors on a probe has little affect on the amount of data being transferred. It should also be noted that because of the way the internet operates and the charging structures that telecommunication companies use, it is impossible to get an exact figure for the amount of data that will be sent, however, rough figures can be calculated using the above values.

Available Service

When choosing a service provider you should make certain that GPRS or NextG coverage is available in the area that you intend to install your system. It may also be useful to check the quality of service available. Unfortunately this is something that can only be determined using local knowledge, as service providers' estimates of their coverage are often overly optimistic, particularly in rural areas.

Internet firmware - Choosing a FTP Server (Host)

When choosing or setting up a web server, there are a number of requirements that should be considered. These are outlined below.

FTP Server

It is essential that the host server support FTP access using port 21. FTP is the protocol used by the probe to upload data to the internet and without it the system can not function. Port 21 is standard for FTP on the internet, and very few servers do not use it.

Fixed Address

Because the probe stores the address of the server in its internal memory the address for the server must be fixed. The server address should be associated with a static IP address or a domain name as it is essential that the address does not change or the probe will need to be reconfigured each time a change occurs.

Supporting Multiple Users

It is important that a server supports multiple users connecting at a time. It is possible in the case of multiple probe owners that more than one probe will try to upload at once, or that one or more users may attempt to use IrriMAX Data Exchange to log on and download from the server whilst a probe is uploading.

Although uploads can be staggered using the sample origin setting (see section *Probe Configuration*), it is desirable that the chosen server can support multiple FTP sessions connected at one time and potentially more than one session at a time using the same log in username and password.

File Storage

Whilst the total amount of data uploaded by a single probe is not significant, there are a number of factors that may increase the required amount of storage well beyond what is expected.

A single probe is unlikely to upload more than 2000 kB of data per month to be stored on the server. Data Exchange can be set to remove files older than a configurable number of days (the default is 90 days).

However, the cluster size of the server must be considered - this is the minimum size each file counts as on the hard disk. On most servers, this will be 4 or 8 kB. This would mean, for example, that a directory containing 1500 files of 200 bytes each, would count for approximately 5.9 megabytes on a server with a 4kB cluster size or 11.7 megabytes on one with an 8kB cluster size, despite the total amount of data stored being less than 300 kB. **A server may therefore require at least 20 megabytes of storage space per probe, depending on configuration**.

The number of files allowed on a chosen FTP server may also cause problems. It is known that some servers restrict the total number of individual files to a maximum of around 50,000 or less, and many will truncate file lists at 2000 files.

A probe uploading every hour will produce 732 files in a month. Over 3 months, this amounts to around 2200 files. If the file list is truncated at 2000 files, even if Data Exchange is set to delete files older than 90 days, data from the most recent 8 days will appear to not be available to download, despite being on the server and the probe saying that it has been uploaded successfully.

Domain Registration

A static IP address can be used for the upload destination, but is preferable to have an actual domain name.

When choosing between using a domain name or IP address, consideration must be given to the fact that when using an IP address, a change of this address will result in probes and download settings needing to be reconfigured, often on site by a trained technician.

When a server is attached to the internet it is given what is called an IP address. An IP address is essentially a unique number to identify a machine connected to the internet - for example the original Sentek FTP server at ftp.enviroscanplus.com had an IP address of 72.9.224.170, but this has now changed. Provided that it is static (i.e. permanently assigned to that server), it is possible to configure a Sentek MULTI system to upload to an IP address.

However, this can be difficult to remember and is prone to error. When choosing a server you should also ask the host company about registering a domain name for that server. This way when setting up probes and downloading data, a normal URL (web site address or name) can be used instead of an IP address.

Data Allowance (Bandwidth)

Most web hosting agreements include a limit to the amount of data traffic (bandwidth) a server can receive during a month. Most companies offer around 500 MB a month as standard. Unless the server is hosting an extremely large number of probes, or is likely to have a large number of users downloading the data, this should be quite sufficient.

Regular Backups

Whilst it is not essential, it is strongly recommended that the host of your FTP server has a good backup strategy. This should include daily backups and some form of off-site data store. All reliable hosting companies will have something like this.

HTTP

IrriMAX Data Exchange also has the ability to retrieve a directory listing and download files over HTTP.

The main advantage of downloading over HTTP is that it is generally a quicker when compared to FTP.

It should be noted that some servers, by default, do not enforce password protection for HTTP access, but can be configured with it. Also note that while some servers do not allow file alteration or deletion over HTTP, others do.

Note: FTP access is still required, as probes are only able to upload over FTP

HTTP would also be required for viewing Webified IrriMAX data. Having HTTP and FTP access to the server allows for it to be used for uploading and viewing of both probe and Webify data. For more information about Webify, see the IrriMAX Help.

Where to Buy

Numerous web hosting providers are available that offer packages that are suitable for use with Sentek MULTI. Due to the nature of the internet it is not essential that the hosting company be based in your home country. Many US based companies offer very competitive deals.

Alternatively, with your own IT support you can set up your own server machine to host the data. Provide your IT support person with this section of the manual when asking them to set up the server.

Satellite firmware – Creating an email account

Sentek MULTI (Satellite firmware) probes require an email account for the probe data to be forwarded to. The emails must be on a POP mail server which is accessible to the PC on which IrriMAX will be downloading the data.

Where to buy

Some distributors may have their own mail servers with a personalised domain name. In this case the IT support person responsible for managing this mail server should be contacted and asked to create the new account/s. Remember to request the POP server address, account user name and password and information on whether SSL connection is needed.

Alternatively, there are many free mail account providers, such as Gmail, Yahoo and Zoho Mail which can provide the service needed. These accounts can easily be set up online and IrriMAX download settings be viewed in the providers' settings area of their web site.

How many email accounts are needed?

There is no limit to how many probes' data can be stored in one email account, however it is recommended that careful consideration be given to how many accounts will be required and what the addresses will be.

For example, consider that each PC downloading the data will require the mail account password and will have access to all emails in that account. So it would make sense to have a minimum of one account per customer or farm/site manager.

The total amount of emails in the account inbox will only make a noticeable difference to the download speed the first time a Windows user downloads the data. Emails are cached on the user's PC after each download to save having to download old emails again.

If two probes are connected to one DTU, data from both probes will be forwarded to the same address.

Storage

The email account will need a minimum of 1MB of storage per probe. This would be sufficient for approximately one years' worth of data. However, Data Exchange will automatically delete emails older than 28 days.

The size of storage required in the email account will depend on the amount of probes uploading into it, the value stated above is a guide only, but would be enough for a probe uploading relatively large amounts of data.

Backup

For extra data security, it is recommended that emails be forwarded to a second 'backup' account that is not used for downloading data. IrriMAX will automatically delete emails from the account that are older than 28 days (at the time of download).

Satellite firmware – Registering modem with Iridium

The Sentek MULTI (Satellite firmware) probe will send data to the satellite in the form of an SBD file. This file will only be forwarded on as an email attachment if there is an agreement in place with Iridium to do so. The Iridium network will identify the files by the modem IMEI. **The modem IMEI must be matched to an email address in a contract with an Iridium reseller.**

Figure 4 Satellite Modem IMEI location

Sentek currently has an agreement with an Iridium reseller which allows distributors to easily and cost effectively set up data forwarding contracts for their modems. **Sentek distributors can request a copy of the partially completed order form from Sentek.** This is the registration method recommended and supported by Sentek.

Alternatively, a distributor may arrange their agreement with an Iridium reseller, but Sentek is not obliged to provide assistance with this.

RTD SENSORS (RESISTANCE TEMPERATURE DETECTOR)

1. Either install the sensors to measure; air temperature or soil temperature as follows
   a) air temperature
      i. Screw the radiation shield bracket to a fixed object (preferably the DTU mounting pole)
      ii. Insert the RTD sensor into radiation shield and tighten the cable gland
      iii. Screw the radiation shield to its bracket
   b) Soil Temperature
      i. Dig a hole to the depth which the soil temperature measurement is required
      ii. Push the sensor into the wall of the hole so that it lays horizontally
      iii. Back-fill the soil into the hole

Warning: Do not place the soil temperature sensor within 20cm of a Sentek Probe or interference may occur and measurements could be affected

2. Run the cables back to the Sentek MULTI DTU site.

Hint: Label each cable with a site ID about 30cm from the bare (DTU) end so that they can be identified later on.

PULSE SENSORS

1. Mount sensors according to sensor manufacturer's recommendations and run cables back to DTU site.

Hint: Label each cable with a site ID about 30cm from the bare (DTU) end so that they can be identified later on.

Sentek supplied Environdata Rain Gauge installation instructions can be found inside the Environdata Rain Gauge Handbook.

SENTEK MULTI DTU

For more detailed assembly instructions see Sentek MULTI Field Installation (see References).

CAUTION: Ensure that the power (battery and solar) is disconnected before connecting anything to it.

Solar Panel

1. Mount the solar panel on the supplied bracket and then onto the mounting pole.

2. Pull the solar panel cable through the cable gland into the DTU
3. Connect the two wires to the solar terminal plug on the DTU connector board

Important: Do not plug the solar panel in to the DTU before the battery is connected and ensure the solar panel is always disconnected during transportation.

4. Pull enough cable through the cable gland so that the Front Panel can lay down in the lid of the enclosure (the writing on the Connector Board should be the right way up when you look at it). Tighten the cable gland with a spanner.

Antenna

1. Mount the GPRS or Satellite antenna:
   - Mount the GPRS antenna bracket and GPRS antenna on the solar panel bracket. A GPRS/NextG antenna should have a view in the direction of the mobile phone tower(s)

Figure 5 GPRS Antenna

   - Mount the Satellite antenna at the top of the DTU pole. A Satellite antenna must have a clear view of the sky (desirable in all directions)

Figure 6 Satellite Antenna

2. Remove the nut from the cable gland. Insert the antenna cable into the empty hole in the bottom of the DTU, slide the nut over the cable and fasten it to the enclosure using a spanner on each side.
3. Fasten the antenna cable to the modem

Note: Some modems require an adaptor, which fits in between the modem connector and the antenna connector, to enable the cable to fit inside the enclosure without placing it under excessive stress.

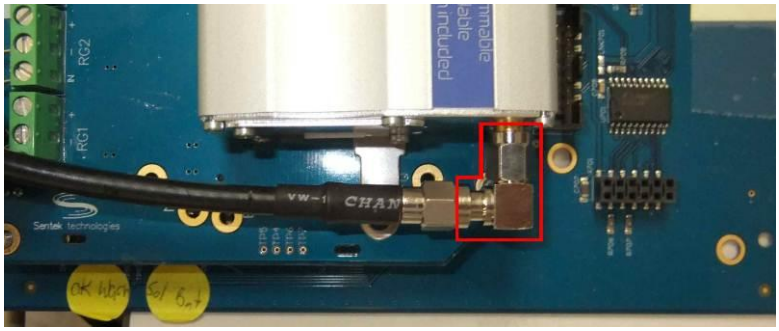


Figure 7 Right angled adaptor example

4. Pull enough cable through the cable gland so that the Front Panel can lay down in the lid of the enclosure (the writing on the Connector Board should be the right way up when you look at it). Tighten the cable gland with a spanner.
5. Loop and fasten any spare antenna and solar panel cable behind the solar panel.

RTD and Pulse sensors

For each sensor,

1. Remove a grommet from the bottom of the DTU enclosure
2. Remove the nut from the cable gland
3. Insert the cable and cable gland into the enclosure
4. Slide the nut over the bare end of the cable
5. Screw the nut onto the gland thread and tighten with a pair of spanners
6. According to the wiring diagram in Figure 8, connect each wire to the Connector Board
7. Adjust the length of cable inside the enclosure (as per step 4) and tighten the cable gland with a spanner

Note: Ensure gland is tightened over heat shrink area. This ensures a good environmental seal.

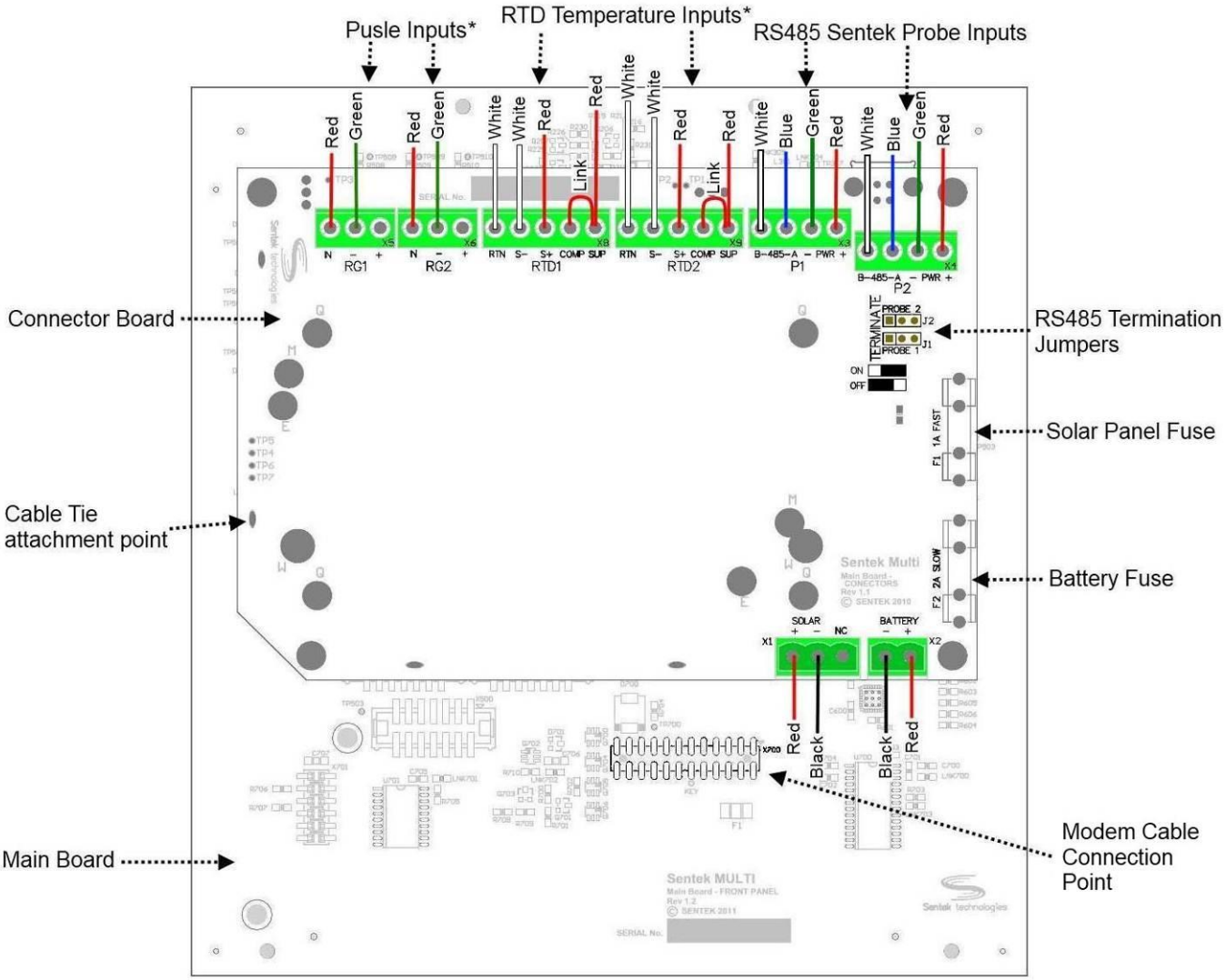
Battery

1. Attach the supplied battery cable to the supplied 12V battery (red wire to red terminal & black to black)
2. Insert the battery with terminals facing towards rear of DTU.
3. Ensure that the DTU Front Panel is not switched on, that there are no loose or bare connections and then plug the battery into the Connector Board.

DTU Front Panel RS485 termination

As Sentek MULTI utilises RS485 communication between the DTU and the probes, RS485 termination resistors must be used at either end of the P1 and P2 cable lengths. In the case of Sentek MULTI, P1 and P2 inputs are individual RS-485 transceivers, so both probes and both inputs at the DTU need to be terminated.
At the TERMINATE section on the Connector Board, ensure that PROBE 1 and PROBE 2 jumpers are both in the ON position (see Figure 8).

JP202 on the probe interface should also have the jumper in place (refer to section *Assemble & Normalise*)



* Colours specified relate to Sentek supplied RTD temperature sensors and Environdata RG12U raingauges only. Other sensors may vary in wire colour.

Figure 8 Sentek MULTI Front panel (rear view)

PROBES

Introduction

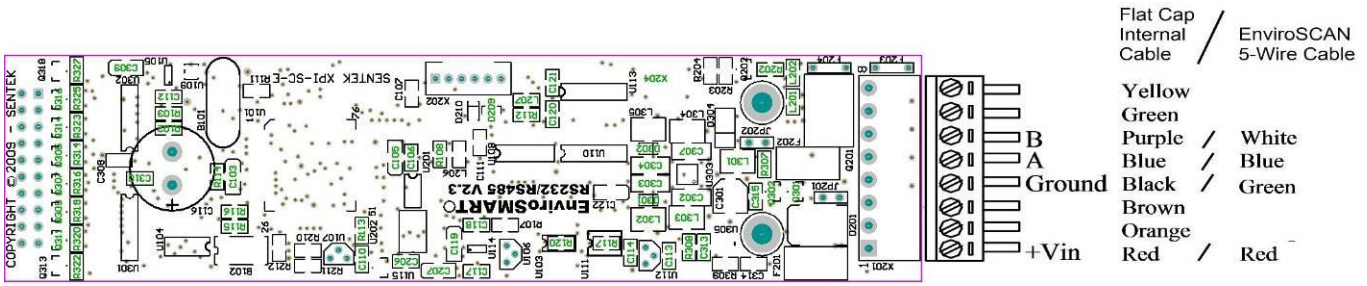


Figure 9 EnviroSCAN MULTI probe interface wiring

Sentek MULTI probes are configured using the Sentek software Probe Configuration Utility (PConfig) version 1.8.1 or later. The most recent version of the Probe Configuration Utility is always available on the Sentek website. This manual should be used in conjunction with the PConfig Help file.

A combination of Flat Cap and Screw Cap probes can connect to the one Sentek MULTI DTU.

Each probe connected to the Sentek MULTI DTU runs independently and must be configured separately. So for each probe;

Assemble & Normalise

1. Ensure that the jumper is in place on the pins at position JP202 on the probe interface. This activates the RS485 termination resistance. Any device at either end of a RS485 cable run must be terminated.

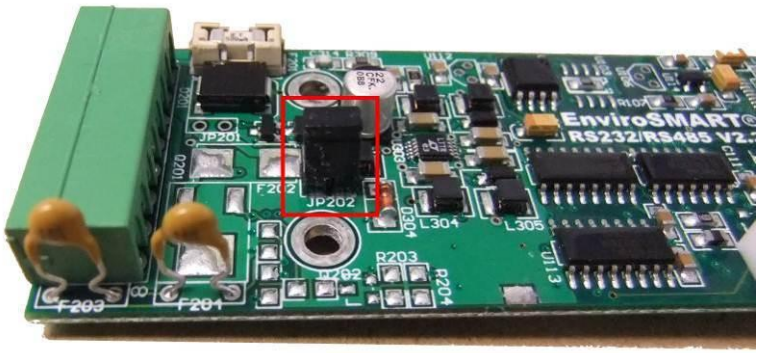


Figure 10 JP202 jumper in place

2. Assemble probes according to EnviroSCAN (Flat Cap or Screw Cap) assembly guides and as demonstrated during official distributor training.

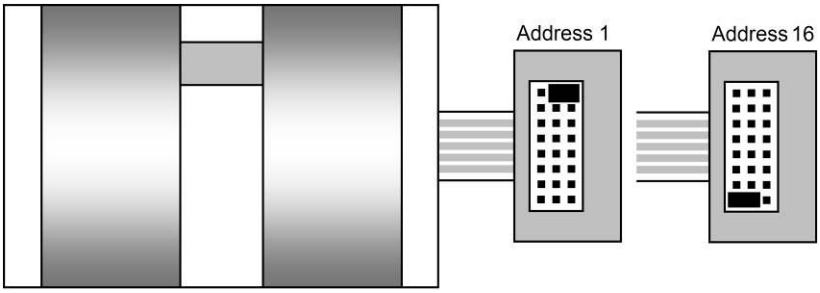


Figure 11 EnviroSCAN sensor addressing

3. Load the version of MULTI firmware (Satellite or Internet) you require onto the probe interface. For more information about firmware versions, see section Firmware and board type.
4. Use PConfig to normalise each sensor on the probe. For detailed normalisation instructions, refer to the "Normalizing the Sensor Air & Water Counts" section of the PConfig Help file. Basic step by step normalisation instructions can be found further down in the Configuration section.

Note: For best results, probes should be normalised using power supplied by the DTU, through the actual cable (with ferrite bead fitted) that is to be used in the field.

Note: Sensors placed in the very top position of the Flat Cap probe cannot be normalized in the standard Sentek normalization container. Refer to the EnviroSCAN Flat Cap manuals for detailed instructions.

5. Label each probe and save back-ups of Normalisation to computer.

Install

1. Install access tubes according to the method described in the Sentek Access Tube Installation Guides (Flat Cap or Screw Cap), and as demonstrated during official Sentek distributor training.
2. Connect cable to the interface. Cabling and connections for the EnviroSCAN Screw Cap and Flat Cap vary, so some of the steps are broken up into two sections below. Choose either Install

EnviroSCAN Screw Cap or Install EnviroSCAN Flat Cap depending on the type of probe you are installing.

Install EnviroSCAN Screw Cap

Hint: Insert cable into Screw Cap and wire into interface connector before gluing Cap onto the access tube to avoid compromising the glue seal.

i. Insert the probe cable through the cable gland into the access tube, ensuring cable is looped around ferrite bead as near to cable glands as practical (see Figure 2) and tighten the gland with a spanner.

Hint: Pull enough cable through into the Screw Cap so that it can wrap around the handle (see Figure 12).

ii. Strip 60mm of the outer black insulation from the cable, trim out the internal nylon strand and yellow wire, and then strip about 10mm insulation from each of the four remaining wires

iii. Twist each exposed copper wire and fold in half. Then fasten each wire into the probe connector according to Figure 9.

iv. Insert the probe into the tube and plug the connector in.

Figure 12 Probe sitting correctly in tube, showing correct wiring

v. Insert a silica gel bag through the probe handle and screw the lid onto the cap, taking care not to tear the bag or leave any overhang where the O-ring in the lid will make contact.

Figure 13 Gel bag

Install EnviroSCAN Flat Cap

Attach Internal Cable

i. If not already done, run internal cable down through the sensors on the back of the probe rod

ii. Loop the cable through a ferrite bead as close to the interface as possible

iii. Screw each wire of the internal cable into the interface connector according to the diagram in Figure 9.

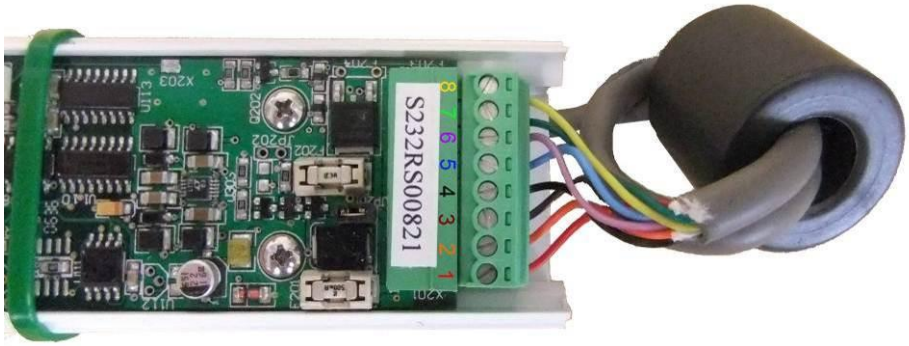


Figure 14 Flat Cap interface wiring

iv. Plug the other end of the internal cable into the Flat Cap and attach the Cap to the probe

v. Insert the probe into the access tube

Join cables

This is only necessary if the cable attached to the EnviroSCAN Flat Cap is not long enough to comfortably connect to the Sentek MULTI DTU.

i. Inside a valve box, use Scotchlok UR2 connectors to Join the Flat Cap cable to the EnviroSCAN 5-Wire cable. Use *Table 1* to determine the correct wires to join. Full instructions can be found in the EnviroSCAN Flat Cap installation manual.

Table 1 Flat Cap Cable Junction wiring

	+V	**0V**	**A**	**B**
Flat Cap Cable (Grey Sheath)	Red	Black	Blue	Purple
EnviroSCAN 5-Wire Cable (Black Sheath)	Red	Green	Blue	White

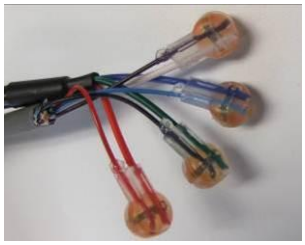


Figure 15 Picture of joined cables

Hint: When joining wires inside a Scotchlok connector, have the bottom of the connector facing towards you, so that you can see that both wires are inserted all of the way in. Use a 3M crimping tool (or large pair of Linemen's Pliers) to crimp the connector, whilst continuing to apply inward pressure on the wires. Ensure that the Scotchlok button has been fully depressed and is flat with the body of the connector.

Figure 16 Scotchlok crimping

ii. Run the cable back to the Sentek MULTI DTU, ensuring that it is protected from potential machinery or vermin damage and labelled with the Site ID.

Note: Although 5-wire cable is recommended, Sentek RT6 5-Wire interfaces are not compatible with Sentek MULTI.

Sentek MULTI Probe Cable Connector

This section describes how to assemble the connector needed to connect the probe cable to the Sentek MULTI DTU. The procedure is the same for Flat Cap and Screw Cap, except when installing the connector directly onto the Flat Cap (grey) cable, in which case just the cable sheath and wires are a different colour.

1. On bare (DTU) end of probe cable, install the supplied Sentek MULTI Probe Cable Connector

Figure 17 Sentek MULTI Probe Cable Connector

a) Use the assembly tool to unscrew the Insert Retaining Ring and remove the Contact Insert

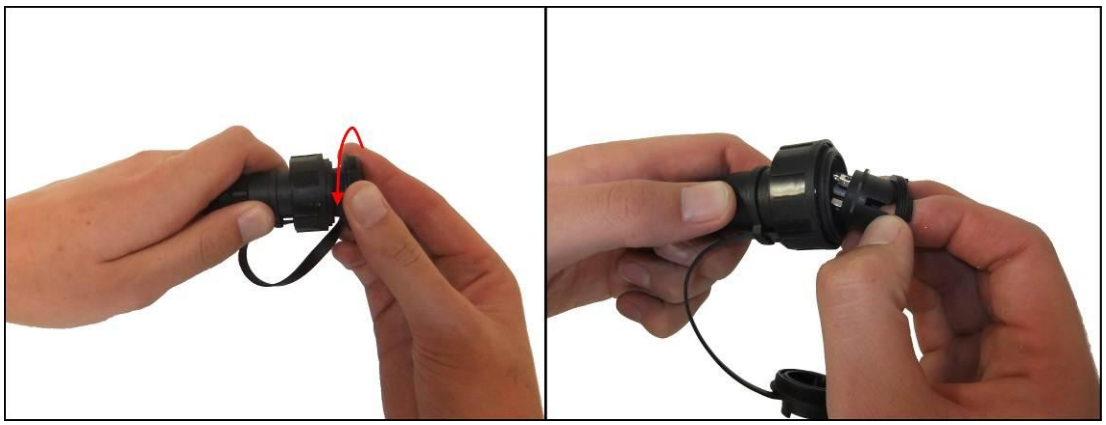


Figure 18 Removing Contact Insert

b) Unscrew the Gland Nut and ensure that the Gland is the white version and not black. The White Gland has a smaller inner diameter and therefore forms a better seal around the cable. Replace the Gland in the cage if necessary. Re-insert the Gland, Cage and Nut.

c) Insert the bare end of the probe cable into the Gland Nut and push it right through to the other side of the Flex Body Moulding.

Figure 19 Inserting cable through cable gland

d) Strip 30mm of the outer (black or grey) cable sheath from the end, and then 5-6mm off each coloured wire. The extra wires and filler strands can be trimmed back, as they are not used.

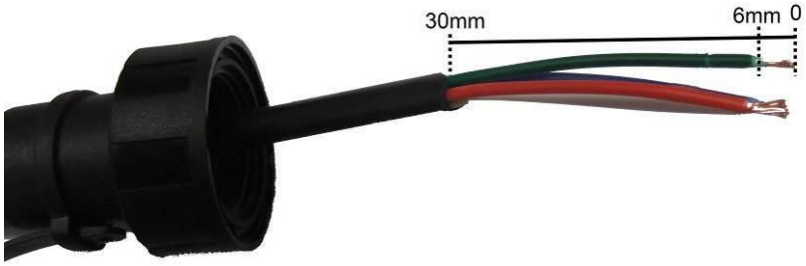


Figure 20 Trimming wires

e) One-by-one, insert each of the four wires into the Contact Insert Screw Terminals and screw them in. Use *Figure 21* to determine correct wiring order.

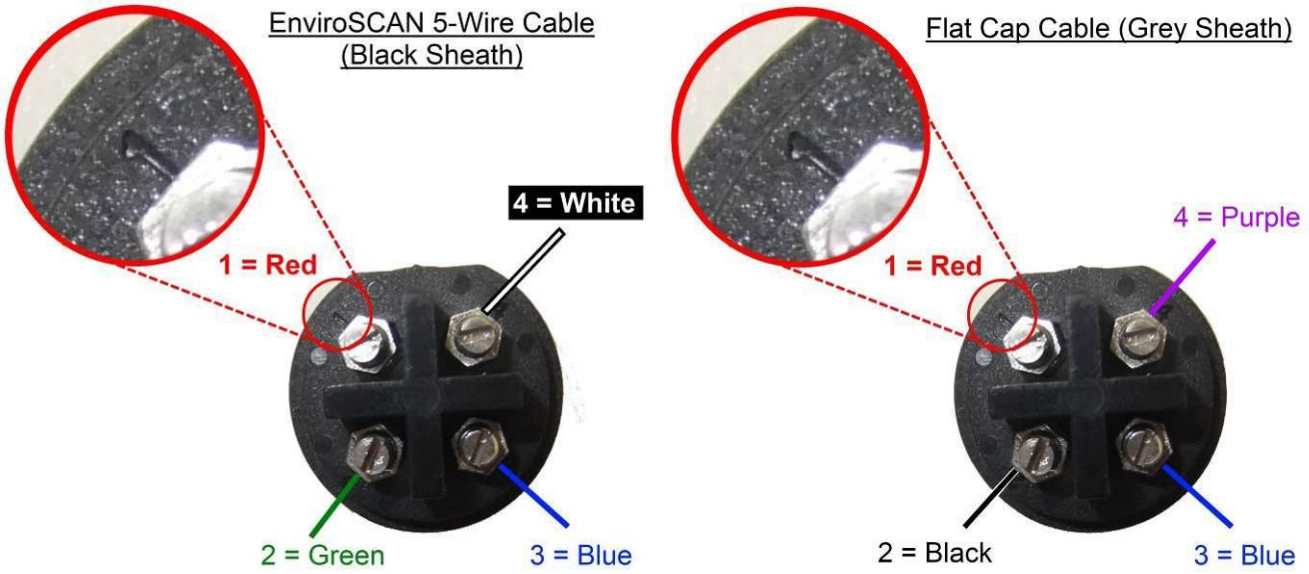


Figure 21 Contact insert screw terminals

f) Re-seat the Contact Insert in the Flex Body Moulding by pulling the cable back through the Gland.

g) Ensure that the flat edge on the Contact Insert lines up parallel with the flat edge inside the Flex Body Moulding. Then keep it there by holding pressure on the cable while screwing the Insert Retaining Ring back on. Use the back of the Assembly Tool to tighten the ring.

Warning: Failure to keep the flat edges together will cause the connector not to attach properly to the DTU, and may lead to moisture damage to the connector, probe and/or DTU.

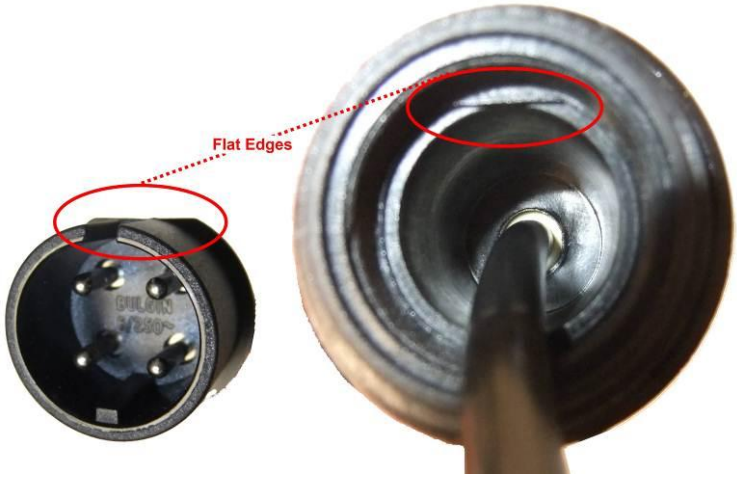


Figure 22 Flat edges

Figure 23 Tightening Retaining Ring

h) Tighten Gland Nut with a spanner and cover it with silicone to seal that end up completely

Figure 24 Sealing gland end

Hint: To avoid making a mess with the silicone, use a fast drying silicone and wait until the entire Sentek MULTI system is complete and has been fully tested before applying the silicone.

i) Plug the assembled Sentek MULTI Probe Cable Connector into the appropriate Panel Mount Connector on the bottom of the DTU, ensuring that it sits squarely, and screw the Locking Ring closed.

Probe Configuration

The Sentek MULTI probes can be configured either through the Front Panel on the DTU or through the TTL port on the probe interface. Each requires a different cable. Both cables have a USB connection to the computer. Both methods require USB drivers to be installed on the computer prior to use.

The USB Probe Programming Cable is used to communicate through the TTL port and instructions on how to install drivers for the cable can be found in Sentek Technical Brief *TB069-Pconfig USB cable driver installation instructions*.

The Sentek MULTI Download Cable is used to connect to the Front Panel, and instructions on how to install drivers for the Front Panel can be found in section *Sentek MULTI Front Panel USB* Drivers of this manual.

This section will describe how to configure the probes through the Front Panel.

Each probe is independent of the other and must be programmed separately.

Connecting

1. Connect the Sentek MULTI Download Cable to your computer and to the DTU Front Panel

Note: Do not plug the download cable into the DTU port before connecting the battery. This may cause the DTU to enter programming mode, and prevent communications with the probes.

Figure 25 Front Panel connection

2. On the DTU Front Panel, turn the unit On and select which probe you wish to communicate with. The switch matches what is physically connected to the inputs on the rear of the Front Panel, so make sure you know which probe is connected to which input.

Note: Power is supplied to the probes whenever the Front Panel is switched on.

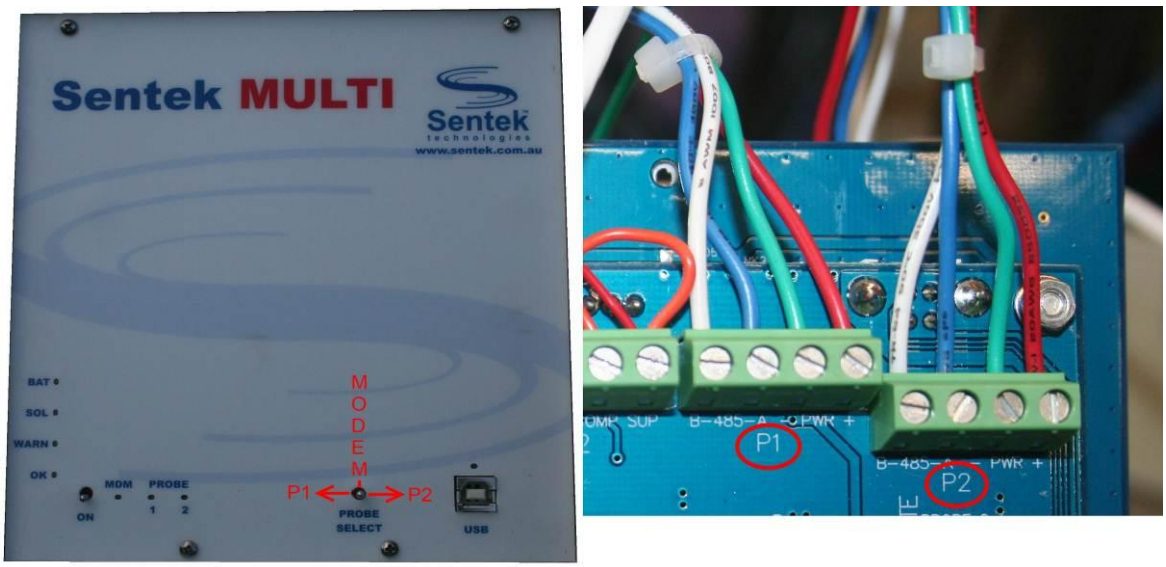


Figure 26 Communication Switch function

3. On your computer, open PConfig, set the Serial Port to the number which has been assigned to the cable (see the cable Tech Brief for information on how to check this) and the Baud Rate to "9600". Click Connect to begin communications with the probe.

Important: Ensure that the probe interface is the correct type and that the latest firmware is installed on it. For more information on interface type and firmware, see section *Additional Information*.

Configuration tab

Before beginning configuration, ensure you have the correct firmware on the probe interface and DTU.

1. Press the Auto-detect Sensors button to force the probe interface to read what soil moisture and salinity sensors are attached to the probe.

Note: This will not detect others sensors which aren't directly connected to the probe rod. For information on configuring other sensors see page 24.

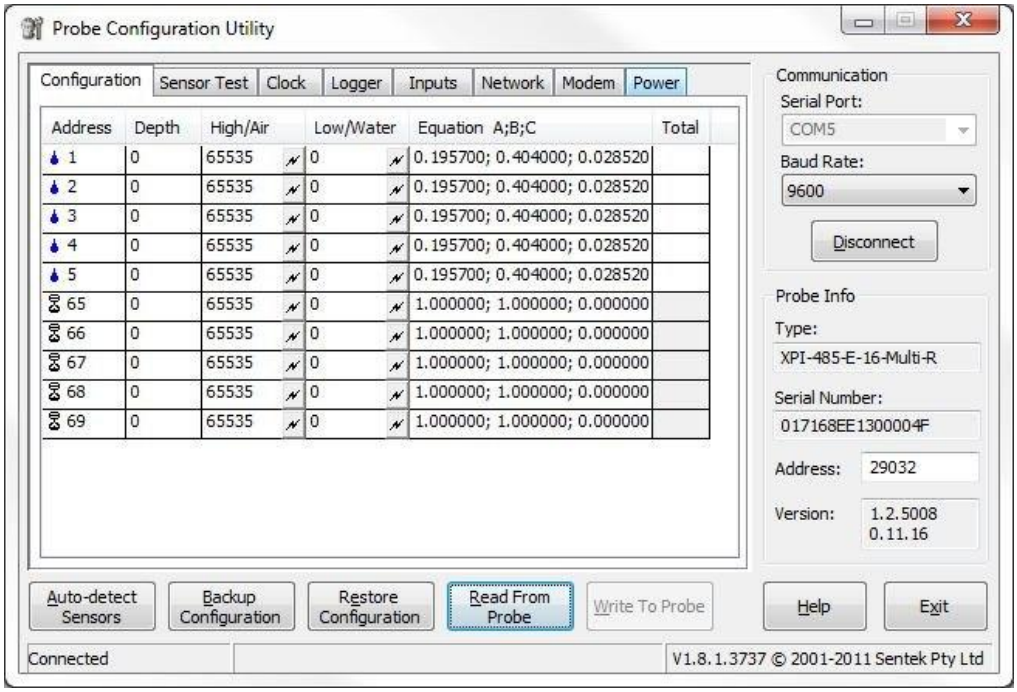


Figure 27 Connected and Auto-Detected

2. Set the depth of each sensor by clicking inside each cell within the Depth column and change the number by either clicking the up and down arrows or by typing it on the computer keypad. Sensors with addresses from 65 – 80 will automatically update depths once all other configuration information has been entered and written.

Note: TriSCAN sensors display as two sensors in the Configuration page. The moisture sensing function will be addressed according to the jumper settings on the sensor (i.e. 1-16). The VIC function also depends on the physical addressing of the pins, but range from 65 to 80 (where physical address 1 = 65 and 16 = 80)

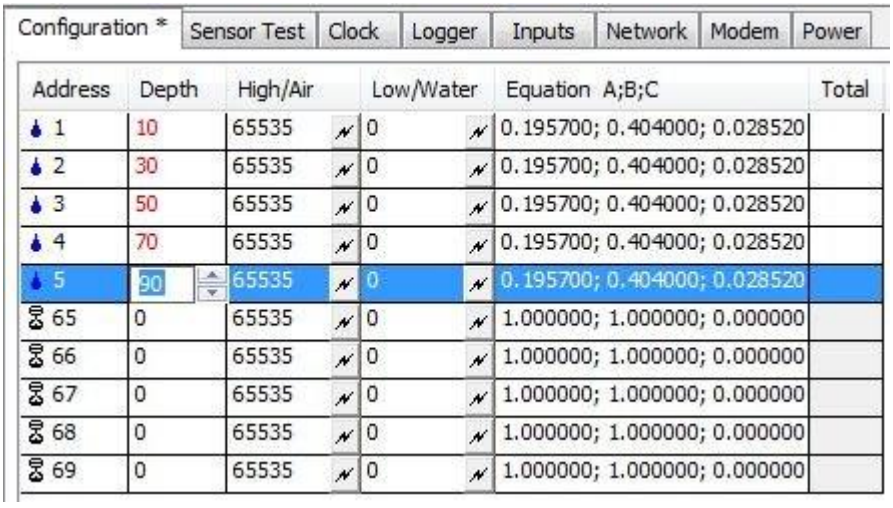


Figure 28 Setting depths

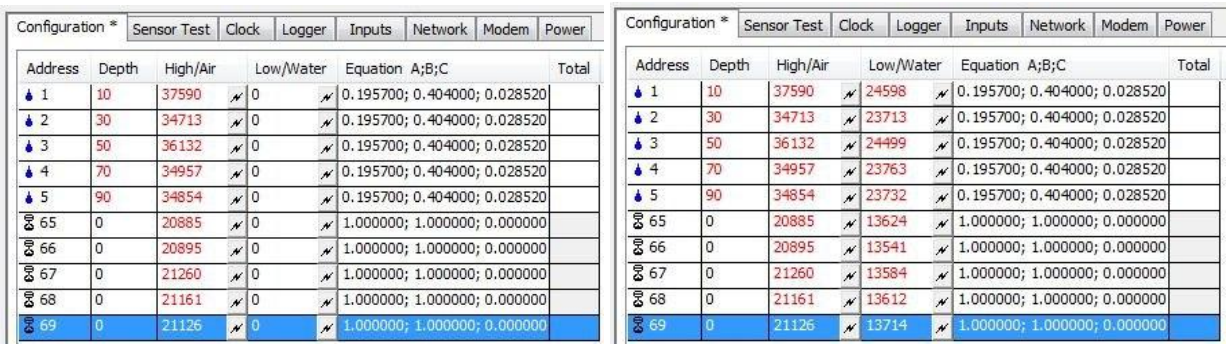
3. To obtain the High (Air) counts for each sensor; place the probe inside its access tube. Then ensure that there are no obstacles (i.e. hands, cables, soil, tables etc.) within the sensor's sphere of influence (keep >20cm radius clear) and click on the header row of the High/Air column so that the interface takes a reading from each sensor.

Note: Alternatively, the Air counts can be taken one sensor at a time by clicking on the lightning bolt next to each sensor

4. To obtain the Low (Water) counts, fill your Normalisation Container with water, slide the probe into the access tube until the first sensor is in the middle of the container. In the Low/Water column click

on the lightning bolt in the corresponding row of the sensor being read. Repeat for each sensor, and remember to take a water reading for both moisture and VIC when normalizing TriSCAN sensors.

Important: VIC water counts must be taken in reverse osmosis (RO) water (EC less than 300µScm-1). Always normalise sensors under the same conditions to ensure maximum repeatability.



Configuration * | Sensor Test | Clock | Logger | Inputs | Network | Modem | Power

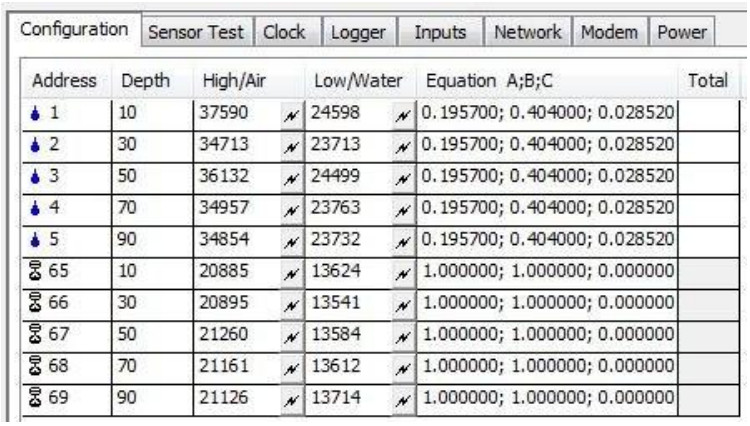
Address	Depth	High/Air	Low/Water	Equation A;B;C	Total
1	10	37590	0	0.195700; 0.404000; 0.028520	
2	30	34713	0	0.195700; 0.404000; 0.028520	
3	50	36132	0	0.195700; 0.404000; 0.028520	
4	70	34957	0	0.195700; 0.404000; 0.028520	
5	90	34854	0	0.195700; 0.404000; 0.028520	
65	0	20885	0	1.000000; 1.000000; 0.000000	
66	0	20895	0	1.000000; 1.000000; 0.000000	
67	0	21260	0	1.000000; 1.000000; 0.000000	
68	0	21161	0	1.000000; 1.000000; 0.000000	
69	0	21126	0	1.000000; 1.000000; 0.000000	

Configuration * | Sensor Test | Clock | Logger | Inputs | Network | Modem | Power

Address	Depth	High/Air	Low/Water	Equation A;B;C	Total
1	10	37590	24598	0.195700; 0.404000; 0.028520	
2	30	34713	23713	0.195700; 0.404000; 0.028520	
3	50	36132	24499	0.195700; 0.404000; 0.028520	
4	70	34957	23763	0.195700; 0.404000; 0.028520	
5	90	34854	23732	0.195700; 0.404000; 0.028520	
65	0	20885	13624	1.000000; 1.000000; 0.000000	
66	0	20895	13541	1.000000; 1.000000; 0.000000	
67	0	21260	13584	1.000000; 1.000000; 0.000000	
68	0	21161	13612	1.000000; 1.000000; 0.000000	
69	0	21126	13714	1.000000; 1.000000; 0.000000	

Figure 29 Air counts and then Water counts

5. If required, enter custom calibration coefficients for each sensor. Each coefficient should be separated by a semicolon (i.e. A;B;C). See the Calibration Manual for more information.
6. Save (write) these settings to the probe by clicking Write to Probe. The Configuration page is complete.



Configuration | Sensor Test | Clock | Logger | Inputs | Network | Modem | Power

Address	Depth	High/Air	Low/Water	Equation A;B;C	Total
1	10	37590	24598	0.195700; 0.404000; 0.028520	
2	30	34713	23713	0.195700; 0.404000; 0.028520	
3	50	36132	24499	0.195700; 0.404000; 0.028520	
4	70	34957	23763	0.195700; 0.404000; 0.028520	
5	90	34854	23732	0.195700; 0.404000; 0.028520	
65	10	20885	13624	1.000000; 1.000000; 0.000000	
66	30	20895	13541	1.000000; 1.000000; 0.000000	
67	50	21260	13584	1.000000; 1.000000; 0.000000	
68	70	21161	13612	1.000000; 1.000000; 0.000000	
69	90	21126	13714	1.000000; 1.000000; 0.000000	

Figure 30 Completed Sentek sensor configuration

Clock tab

1. Click on the Clock tab to display the clock settings. Decide how often the probe should take a reading and set the desired sampling interval accordingly.
2. Set the probe clock to the desired time (usually probe local time) by either typing it in or synchronizing it with your computer clock.

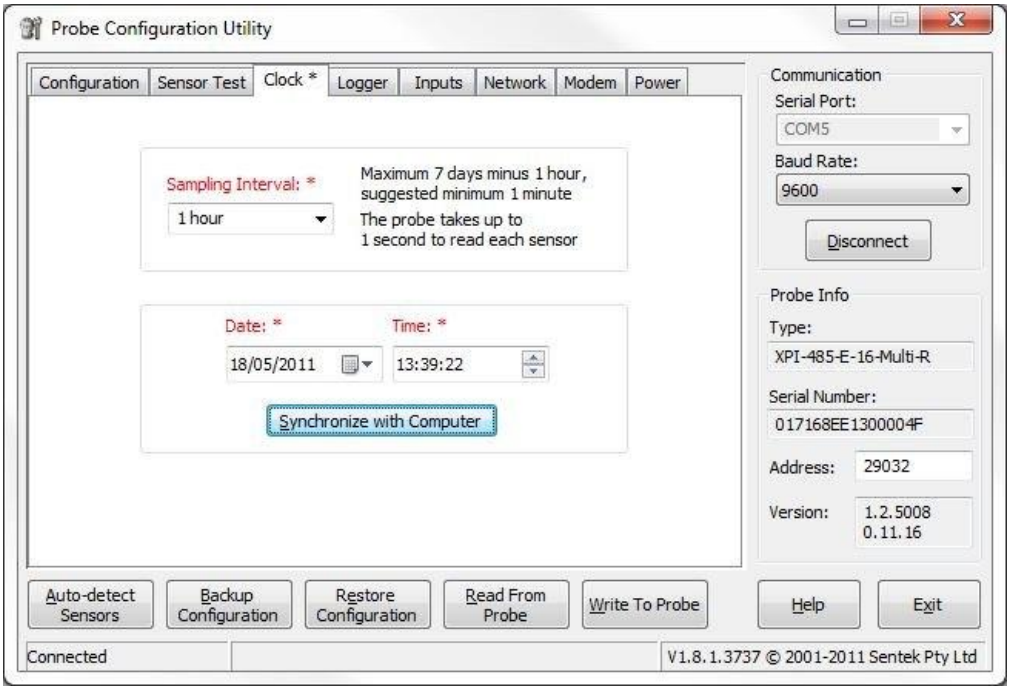


Figure 31 Clock page

3. Write to Probe

Logger tab

1. Click on the Logger tab to display identification, uploading, and modem communication details.
2. Type in a Logger ID specific to the probe so that the data can be identified later. This name is used to supply the IrriMAX database Logger ID. The default is the probe's serial number. The logger ID can be up to 16 alpha-numeric characters and underscores and cannot contain any spaces.
3. Set your desired Sample Origin. This determines when the first reading will be taken by the interface. All subsequent readings will use the Sample Origin as a starting reference. I.e. if the Sample Interval is 1 hour, and the Sample Origin is midnight, but the probe is only switched on at 7:05am, the first reading will occur at 8:00am, then 9am, 10am etc.

Note: Sample Origins of the two probes connected to a MULTI DTU should be offset to avoid them trying to upload at the same time. For more information about upload origins, see section *Interaction between two probes and modem*.

4. Set the Sample Count. For a Sentek MULTI probe, this is the number of samples taken before an upload is initiated. A value of zero disables the upload process. For more information on minimizing data costs, see the section Internet firmware - Buying a SIM card and packet data plan for modem.

Sentek MULTI **Satellite** firmware users skip to step *10*

5. Set the Dial-in Uptime. This is the amount of time that the telemetry will remain enabled after each upload. Using Sentek Remote Connection Manager (RCM) software, during this time it is possible to dial-in to the modem or other telemetry connected to the probe. This allows the Probe Configuration Utility and Data Exchange to remotely connect to the probe.
   The uptime is counted from the beginning of the upload – for example, if the upload is at 12.00 and takes one minute, and the Dial-in Uptime is set to 5 minutes, RCM can connect remotely to the probe between 12.01 and 12.05, although attempting to connect very near the beginning or the end of the dial-in interval may fail.
   If Dial-in is disabled (Uptime set to 0) while connected remotely, this will not take effect until after the Probe Configuration Utility is disconnected.
   For information on how to dial into a probe, see the RCM Help file.

Note: if the upload takes longer than the Uptime, the Dial-in functionality will not be activated.

6. To complete the Destination URL field, click on the Edit button and enter in the FTP server details (these are specific to each probe). Alternatively, the full URL can be typed in without going into Edit. The format of the URL is:

ftp://<user name>:<password>@<host/Internet address>/<url-path>

Your FTP server administrator should provide this information. If the URL is blank the upload process is disabled. For more information, see the section *Internet firmware - Choosing a FTP Server (Host)*.

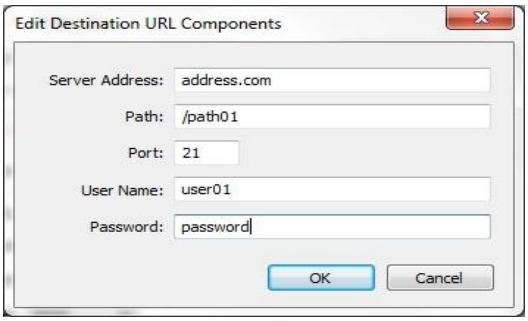


Figure 32 Edit screen

7. Set the Connection Timeout. This is the maximum time in seconds that the probe allows from the start of an upload until communications with the FTP server are established before the upload attempt is abandoned. The default of 120 seconds is generally sufficient. Altering the Network settings may affect this.
8. Set the Response Timeout. This is the maximum time in seconds before the probe abandons waiting for a reply confirming that data has been transferred to the server. The default of 30 seconds is generally sufficient, but some connections (e.g. slow server responses) may require a larger value.
9. Set the Baud Rate and Parity to match the modem port communication settings. GPRS and NextG Modems supplied by Sentek are preconfigured to the default of 9600 baud and no parity, the probe settings must match this for them to communicate with each other.
10. Press the Delete Readings button to delete any unwanted data that may have been recorded before the probe was installed.

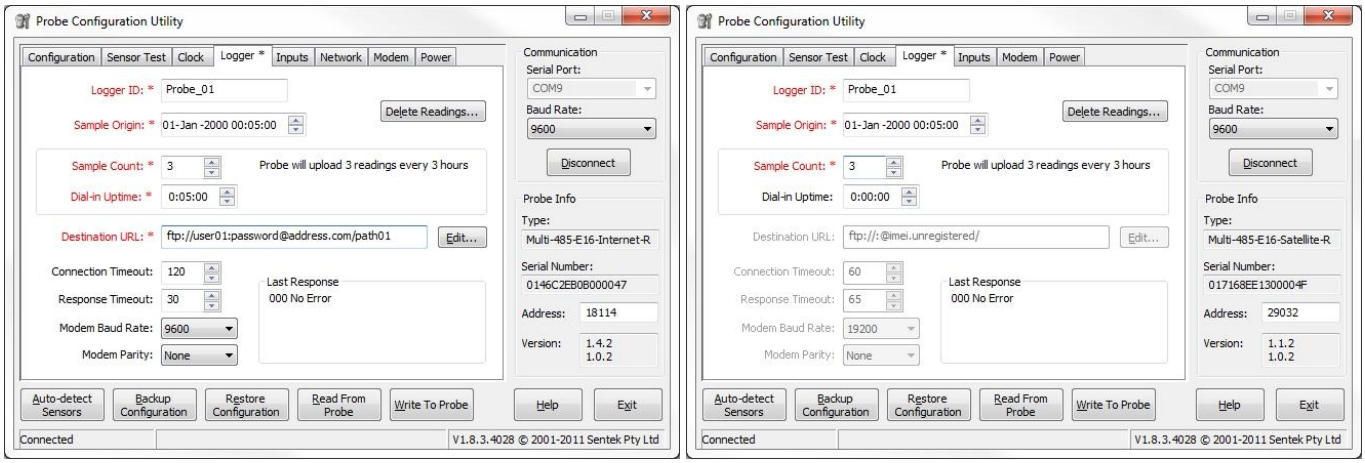


Figure 33 Completed Logger page (Internet and Satellite firmware)

11. Write to Probe

Note: the Last Response field is explained in the section *PConfig Response Fields*.

Inputs tab

The Inputs page in PConfig is where you can configure how the probe records data from the RTD and pulse sensors that are connected to the physical DTU inputs.

Temperature Sensor 1 corresponds with the RTD1 input on the DTU Connector Board, Temperature Sensor 2 with RTD 2, Pulse Sensor 1 with RG1 and Pulse Sensor 2 with RG2.

1. Choose which sensor inputs you would like to log on this interface by ticking the corresponding Logged check boxes.

Note: To reduce data costs on two probes systems, only log inputs on one of the probes.

2. For each temperature sensor that has been selected to log, set the depth (in centimetres) at which it is buried below ground level. Leave this value at zero if the sensor is not buried.
   The Temp value is a live reading of the RTD sensor. The Temp will read ERROR when the DTU cannot read a value on the input. This could be because the sensor is not connected, or there is a fault with the sensor.
3. For each Pulse sensor,
   a) Choose the sensor **Type** from the drop down list
   b) Specify the value that should be logged for each pulse received from the sensor. Rain and Irrigation pulses represent a millimetre amount, while a pulse from a Flow meter represents a Litre amount. For more information on setting the correct pulse value, see the pulse sensor's manufacturer specifications.
   The **Count** value displayed is the total number of pulses since power was connected to the DTU. Removing power will reset the count. The probe records the difference in the total counts between each sample. If a sample is missed the probe will discard the pulses taken after the previous sample and record an INVALID reading.
   The **Status** value can be Stuck, ERROR or it will be blank. Stuck indicates that the pulse contact could be stuck and/or faulty. For certain flow meters this may be a valid state. ERROR represents a problem will the sensor. The field will be blank in all other circumstances.

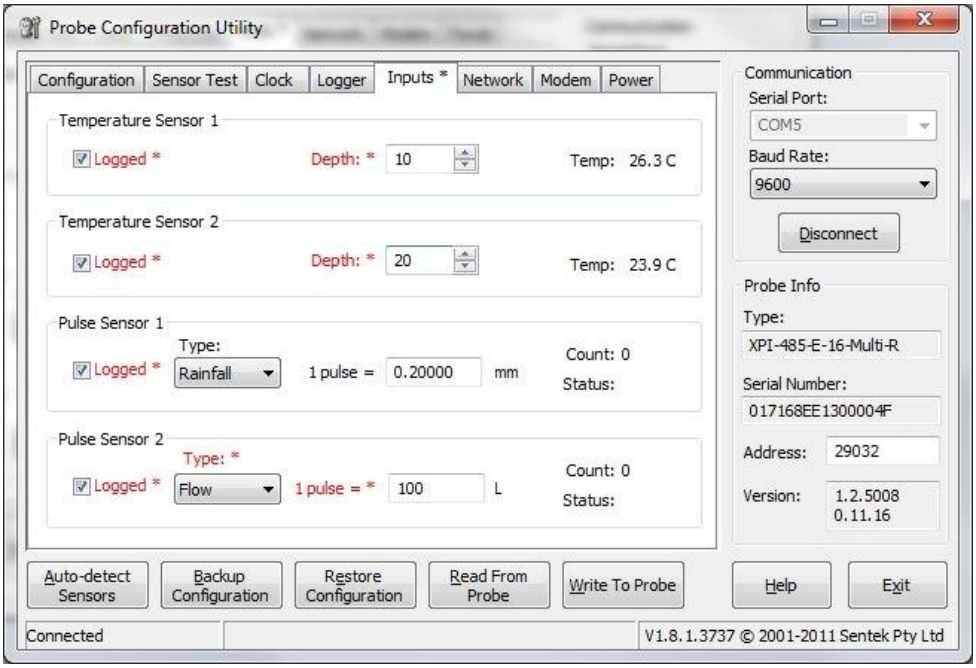


Figure 34 Configured for RTD and Pulse sensors

4. Write to Probe

Sentek MULTI **Satellite** firmware users skip to *Power* section.

Network tab

The Network settings page contains command strings needed to prepare the modem, connect to the internet and shut the modem down properly. It is not present when interface is MULTI Satellite.

The Network Access fields allow entry of a Username and Password if this is required by the mobile network service provider.

The Command Strings fields dictate the communications sent between the probe and modem. The fields on the left contain commands that will be sent to the modem (AT… commands), as well as command switches that control the behaviour of the probe (\... & |). The fields on the right are the responses expected from the probe. When a Response from the modem matches any of the expected responses the probe will move to sending the next command.

For more information on the upload process and how the Network settings are used, see section *Additional Information*.

1. Ensure that you are using the latest available Network settings for the modem that is on the DTU.

Note: Latest Network settings are available on the official Sentek web site underneath the MULTI product category in the Downloads section. Distributors will be notified whenever there is a change made to the recommended settings and are encouraged to keep copies of each settings file on their field computer.

a) Ensure that you have written any unsaved changes to the interface and then press the **Restore Configuration** button at the bottom of the screen.

i. Browse to the folder on your computer where you have saved the Network configuration files.

ii. Select the file which matches your modem and press Open. The files will be named by the modem type and have the file extension ".cfg".

iii. PConfig will display a warning, saying that there are no sensors in the configuration file, press OK.

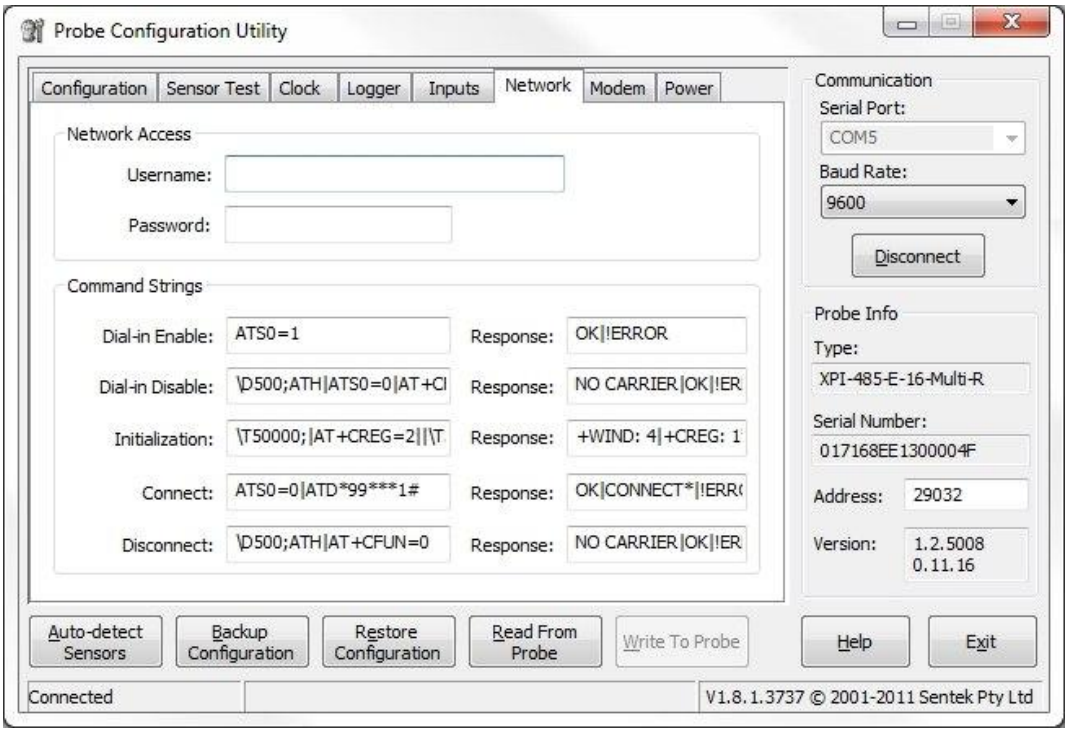


Figure 35 Network settings (with no unwritten changes)

b) If there are any changes, Write to Probe.

Power tab

1. Click on the Power tab to display the power related settings on the interface.

Operating Thresholds do not need to be changed from the default values. For advanced users, each field is explained below.

Disable Probe is the voltage at which the probe will shut down and stop logging.

Enable Probe is the voltage at which the probe will start up and begin logging again, after the voltage has dropped below the Disable Probe level.

Disable Telemetry is the voltage at which the probe will stop attempting to use the modem.

2. For each power measurement that is to be logged, place a tick in the Logged check boxes next to the power measurements. All measurements are logged by default. Probe Supply Voltage is not optional.

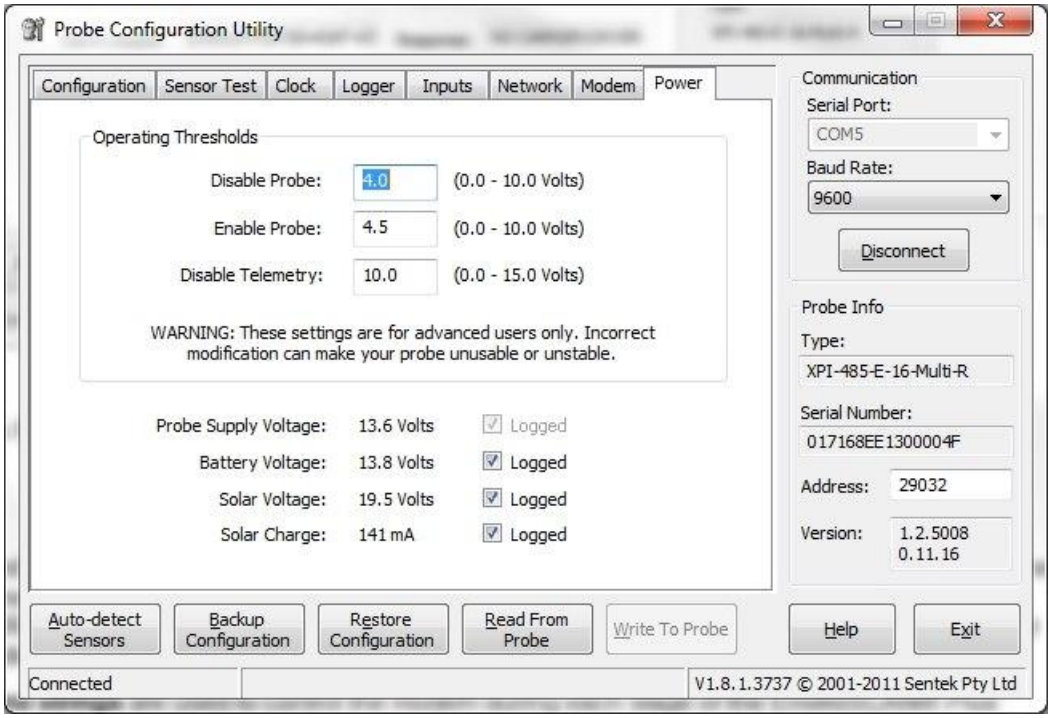


Figure 36 Power settings

3. If there are any changes, Write to Probe.

No modem configuration is needed for satellite modems supplied by Sentek. Sentek MULTI **Satellite** firmware users skip to *Testing* section.

MODEM

This section applies only to Sentek MULTI Internet firmware. It explains what is needed to configure the GPRS and NextG modems supplied by Sentek.

The Modem page is used to communicate with the modem, test the upload functionality, and manually upload any data that may be on the probe interface.

Modems are programmed and tested in Australia. This testing can only be done with a local network service provider. Therefore modems are sold with settings specific to that service provider. The steps below include instructions on how to configure the modem for your chosen service provider. These steps should be followed during every Sentek MULTI set up to ensure smooth operation.

Steps below are modem specific, and therefore only need to be completed once. It makes no difference which probe is used to gain communications with the modem.

1. Whilst still connected in PConfig, click the Modem tab to display the modem communications and upload options.
2. Click Open Session to initiate communications with the modem. This will power the modem and allow you to send communications directly to it.
   Commands can be sent to the modem by typing in the AT Commands field and pressing send. The commands will be echoed in the Modem Response field as well as any communications received from the modem. Sending a simple "AT" should get a response of "OK", indicating the probe can successfully communicate with the modem. Some messages will be preceded by a "*" - these are messages generated by the probe, during communication with the modem.

Note: Modems can take up to a minute after power up before they are ready to process commands. Sentek configured modems will display a message (for more details, see section *Useful AT Commands*) when the modem reaches this stage of readiness.

Note: If a SIM is PIN enabled (that is if the modem requires a PIN upon start-up), the PIN must be entered in the modem before some commands are accepted by the modem. To enter the PIN, send "AT+CPIN=XXXX".

Note: Longer delays between sending modem commands and receiving responses may be experienced when communicating through the DTU Front Panel, when compared to the probe TTL port.

3. Set the correct frequency band for the service provider.
   By default, Sentek supplied ETM modems are set to auto select, and should not need to be changed.
   The Fastrack modem is set with the command "AT+WMBS=n" (where n = the band select value). For all possibilities of "n", see section Useful AT Commands. For information about which frequency band to use, consult your service provider.
4. Set the service provider's Access Point Name (APN).
   This is set with the command AT+CGDCONT=1,"IP","<APN>", where <APN> is replaced with the correct APN supplied by the service provider. For details about which APN to use, consult your service provider.

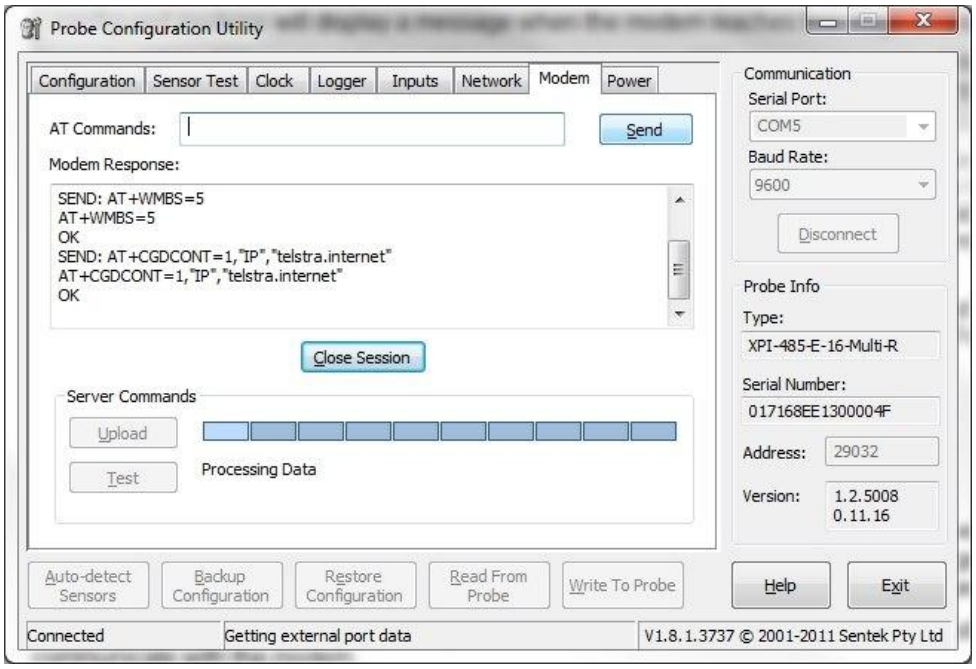


Figure 37 Sending modem settings (Response from a Fastrack modem shown above).

TESTING BOTH THE CONFIGURATION AND UPLOADING

Note: It is desirable that bench testing of the configured system be done before field installation. This can find mismatches in parameter settings and confirmation of the end-to-end steps from probe to IrriMAX.

This is the most important stage of the setup process. If successful it will indicate that all preceding steps have been completed correctly. Testing should be conducted for each Sentek probe connected to the Sentek MULTI DTU.

1. Whilst still connected in PConfig, test the operation of the Sentek probe sensors on the Sensor Test page. With the probe correctly configured and installed there should be no INVALID readings for Calibrated Values of individual sensors (Ignore the "Total Moisture" row).
2. On the Inputs page, test the Pulse Counts and Temp readings. To test the Pulse Counts, the sensor may have to take simulated readings, such as tipping water into a rain gauge.

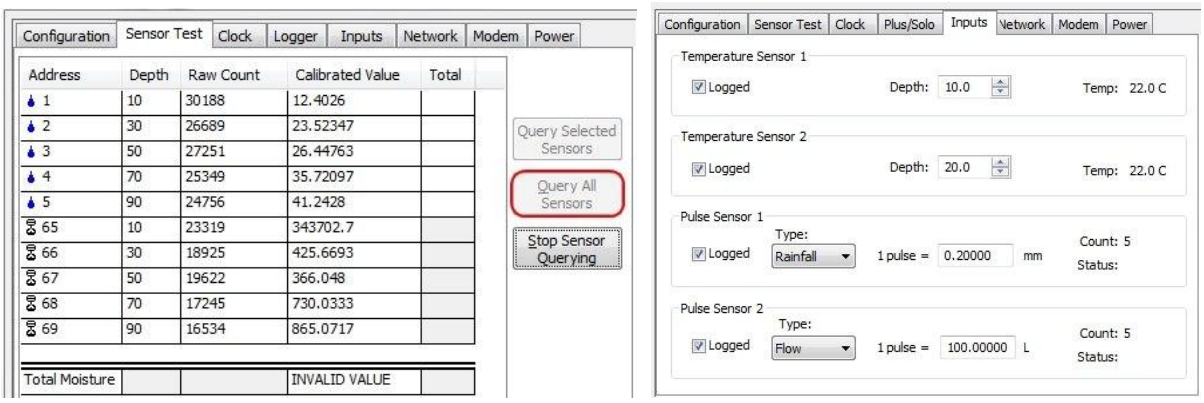


Figure 38 Sensor testing

3. On the Modem page, press "Test" to initiate a test upload. This will upload a text file, instead of sending data in the usual form. This test will check all settings related to the modem as well as communications between it and the probe. The end response in the Server Commands field should be "040 Success".

Note: when using Sentek MULI **Satellite** firmware, "040 Success" only indicates that the file has been sent to the satellite. This does not guarantee that the file will be forwarded to the email server. See next section.

4. Create a backup of the probe settings on your computer by pressing the Backup Configuration button and then selecting a folder and file name for it. The backup will be saved with a ".cfg" file extension.

Caution: The backup files may contain the destination URL and do not have any form of coding on the password. Please keep the files in a safe place if data security is a concern.

5. In PConfig, press Disconnect. Physically disconnect the cable from the DTU and shut the lid on the enclosure.

If setting up downloads and graphs on the customer's computer immediately after testing it may be beneficial to upload any data stored on the probe to the server by pressing the **Upload** button. Any readings taken since the last upload (scheduled or user initiated) will be uploaded.

VERIFYING TEST UPLOAD WAS SUCCESSFUL

Note: This optional step requires IrriMAX and access to the Internet, so will probably be performed in the office. It confirms that the end-to-end transmission of data.

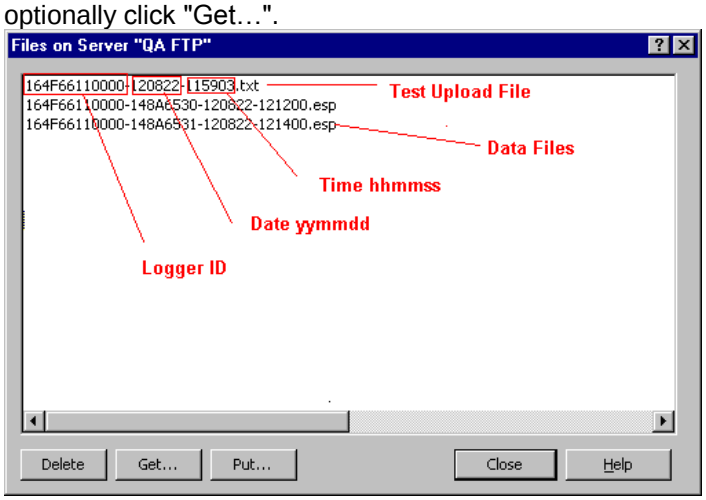
Even if PConfig reported "040 Success" The data may not appear at the expected location. This can happen when:

- For Internet firmware: FTP URL in the probe does not does not match the Edit Sentek Plus/Multi Server detail specified in Data Exchange
- For Satellite firmware: IMEI is not registered and linked to an email address by the Iridium reseller, or
- Sentek Plus/Multi (Satellite) source email parameters wrong for POP Server, User, Password and Logger ID in Data Exchange.

Internet Upload verification

1. In Data Exchange select Source "Sentek Plus/Multi", then select Server & Path previously setup for this probe, or set it up now to match the destination URL in PConfig.

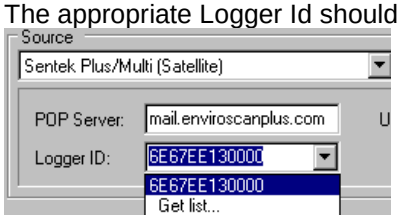
2. Click "Server Files". Inspect the list of ".txt" files and find the one for the appropriate Logger Id, and optionally click "Get…".



3. If the expected filename (<logger Id>-<yymmdd>-<hhmmss>.txt) is not present, check the URL in Data Exchange against the URL in the saved PConfig file from Backup configuration.

Satellite Upload verification

1. In Data Exchange Select Source "Plus/Multi (Satellite)", enter the email account details, and in the Logger Id field Select "Get List….".
2. The appropriate Logger Id should appear.



3. Select an appropriate Destination and Click Start to run a download
4. If the Logger Id is not present in the list box or not in the Data Exchange Log file, check the Data Exchange POP server details match the email details registered with Iridium.
5. When the download completes there should be a Test upload message, in the log file (default is DEX.Log). View Data Exchange log file for a message confirming "Last Response: 040 Success Connection". e.g.

```
2012-07-11 18:38:12
300134010219510_003700.sbd -  Logger ID: 6E67EE130000 Board ID: XEPI-485
(16/SAT)(RMT) Version: 1.1.5 Build: Apr 20 2012 12:00:28 Serial:
6E67EE130000
Last Response: 040 Success Connection: +CSQ=05
```

VIEWING DATA

At this stage data should already be uploading as .esp files to an FTP server (Internet firmware) or being forwarded from satellites to an email server. To view the data it must first be downloaded to a local drive available to the computer. This is done using the IrriMAX utility program Data Exchange. The data can be downloaded directly into ".csv", ".txt" or ".xls" format for viewing with a text editor or within Microsoft Excel. However Sentek recommends that for maximum benefits to be achieved from the data, Sentek's IrriMAX software should be used for viewing data. To view the data in IrriMAX it must be downloaded into ".sdb" format.

Downloading

Each probe will require a download and separate database.

Any computer which is required to download the data must have IrriMAX 9 or later installed.

It is recommended that the installer configures the downloads in a way that the end user can easily repeat them without risk of download settings being changed and/or data being stored in the wrong location. By using the Download Wizard with IrriMAX, the download settings can be stored within the customer's IrriMAX workspace. Command line switches allow the workspace download process to be run from a script (or batch file).

Please refer to IrriMAX and Data Exchange Help files for information on downloading and running operations from command lines.

Hint: When downloading Sentek MULTI Internet data, IrriMAX (using Data Exchange) requires the details of the FTP server where the data is being stored. These details will be the same as what is entered in the probe, in the Destination URL field. Copy the details before leaving the probe site.

Viewing

Graphs can be created from the databases (.sdb files) within the IrriMAX software.

Data from RTD and Pulse inputs will be stored in the probe databases (depending on the probe configuration).

It is recommended that the data is made easily available for the end user. Graphs should be organized into IrriMAX Workspaces that can be accessed by the end user without it requiring them to know where the graph and workspace files are saved on the computer. To do this, shortcut icons for the workspaces (.sws files) should be created on the customers desktop.

For further information on how to create, manipulate and save graphs, refer to distributor training notes and the IrriMAX Help documentation.

MAINTENANCE

Sentek MULTI Distributors can provide a regular maintenance program which consists of regular visits by an authorised installer to test and ensure correct operation of the system. A regular maintenance program such as this will ensure that the Sentek MULTI system functions properly and continues to give worry free operation.

DTU

Regular maintenance of the Sentek MULTI DTU should include removal of dust and grime, especially around all seals.

The DTU and probes should be checked regularly for insect infestation. Some insects can cause low resistance between wiring tracks on the circuit boards which can cause intermittent or unreliable operation.

PROBE

The probe top caps should be checked regularly for cracks or breakages. Machinery should be kept well away from the probes. This will avoid damage to the probe rods as well as avoid compaction of the soil around the probe, which could give a false indication of the soil moisture content

If problems are experienced, running tests may assist in determining any system faults. Consult section *Troubleshooting Guide* for more information.

SOLAR PANEL

Keep solar panel clean at all times. Clean with water and dry with soft cloth. A commercially available glass cleaner can be used for stubborn stains.

Regular checks on the orientation and angle of the solar panel should be performed. Winds, birds etc. can move the panel from its ideal position reducing its efficiency. If birds are a problem a "Bird Deterrer" can be fitted to top of solar panel.

CABLING

Corroded, shorting and broken wires can affect the operation of the equipment. Regular inspection of the cabling for damage from insects, animals or machinery should be carried out. If necessary the cabling can be elevated away from potential damaging elements.

SLA BATTERY

The Sealed Lead Acid (SLA) battery supplied with the Sentek MULTI has a typical life expectancy of 2 to 3 years. The life of the battery is effected by number of discharges, depth of discharges and operating temperature. When the battery does not hold charge (causing loss of data in absence of light on the solar panel) it will require replacing. Use the IrriMAX software to monitor the condition of the battery and charging circuit.

These recommendations are based on the fact that a working solar panel is installed. Systems without a solar panel are not recommended as battery life would be impractical from a maintenance perspective.

SENTEK MULTI PROBE CABLE CONNECTOR

The connector which connects the probe cable to the DTU is rated to IP68 for its dust and water resistance ability when installed and connected correctly. The connector will lose its water resistance when not used correctly.

Check for dirt inside the connector and be sure that the two halves of the connector are pushed flat all the way together before screwing them together to avoid cross threading the locking ring. This will be obvious if there is any uneven gap visible where the locking ring meets the other side of the connector.

Ensure sealing caps are used on each connector when the probe has been disconnected from the DTU.

Screw sealing caps together when they are not in use. Doing this will keep the connector sealed while disconnected and prevent the rubber O-rings from falling out or becoming brittle.

Once the gland nuts have been loosened they might not seal as well as they originally did. Therefore **Sentek strongly recommends covering them in silicone** or a similar product to help prevent moisture intrusion.

ADDITIONAL INFORMATION

SENTEK MULTI FRONT PANEL USB DRIVERS

In order to be able to communicate with Sentek MULTI probes via the Front Panel, USB drivers must be installed on the computer being used.

USB Drivers should be installed before connecting the computer to the Front Panel.

Each new computer that the Front Panel connection is used on will need drivers installed on it.

You can either get the drivers from the Sentek USB Driver CD or download the drivers from the Sentek website.

Drivers might occasionally be updated by the USB interface manufacturer. The most current drivers will be available on the Downloads page at sentek.com.au.

Note: Ensure you log on to the computer with full administrator user rights before you begin the driver installation process.

Installing drivers

Note: DO NOT plug the Download Cable in to the Sentek MULTI Front Panel or computer USB port before or during installation of drivers.

1. Either;
   a) Downloaded the drivers from www.sentek.com.au/downloads/downloads.asp and extract them from the .zip file **or**
   b) Insert the USB Driver CD containing the drivers into the CD drive.
2. Locate the CP210x_VCP_Win_...exe file (where you downloaded, then extracted it to, or on the Drivers CD), click on it once and then press Enter on the key board.
3. Follow the on-screen instructions in the InstallShield Wizard to firstly copy the driver files to your computer and then to run the driver installer.

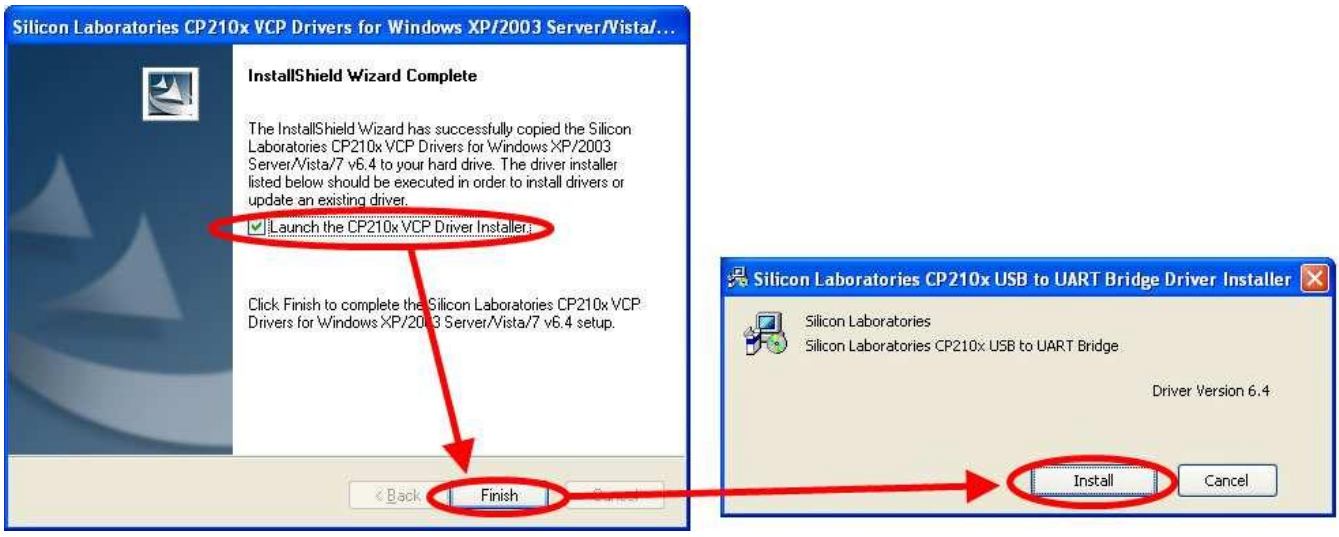


Figure 39 Files successfully copied. Starting driver installation

4. If requested, restart the computer.

Verifying drivers are installed and COM port number

Once drivers are installed the Front Panel can be connected to the computer using the Sentek MULTI Download Cable. When the Front Panel is first connected to the computer (not the just the cable itself), the computer may take a few moments to recognize it and assign a COM port number. To check what that COM port number is, find the Device Manager program in Windows and look at the Silicon Labs CP210x USB to UART Bridge device in the Ports list.

To check COM port in Windows Device Manager;

1. Click on the Start menu
2. Go to Control Panel and ensure it is in Classic Mode
3. Click on System
4. Click on the Hardware tab (skip step if Hardware option not available)
5. Select Device Manager
6. Expand the Ports (COM & LPT) tree by clicking the + symbol to the left of the heading

If the drivers are installed, and the Sentek MULTI Download Cable is plugged into a USB port on the computer and the Sentek MULTI Front Panel, the COM port number should be displayed in brackets alongside the Silicon Labs CP210x USB to UART Bridge device. This COM port number should be used when attempting to communicate with the probes through the Front Panel.

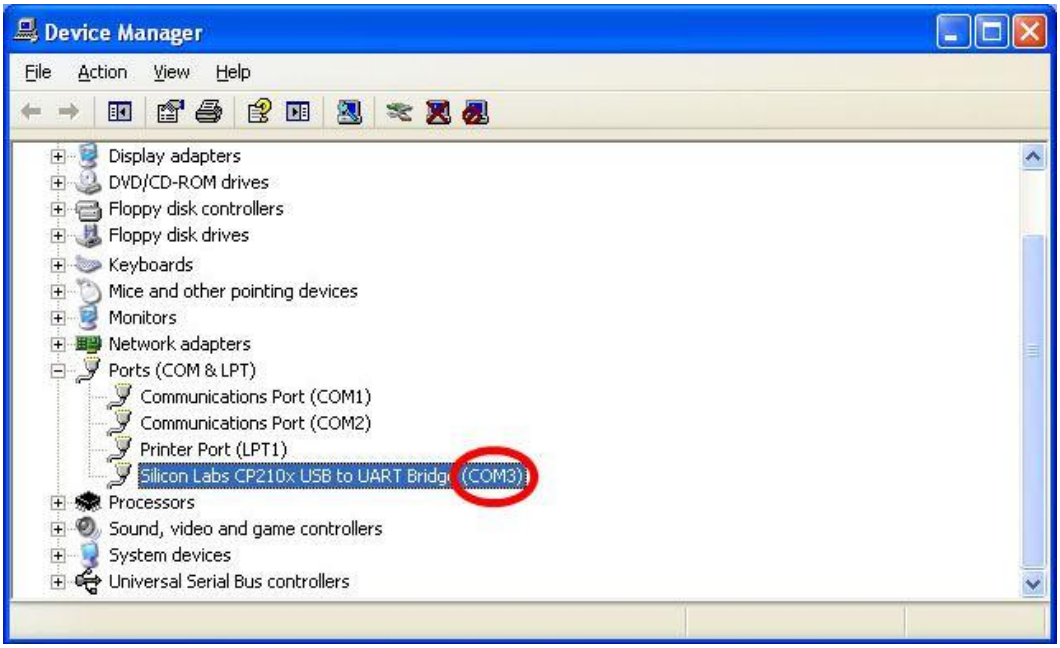


Figure 40 Identifying COM port in Device Manager

EXTRA MODEM INFORMATION

Compatible Modems

Sentek MULTI (**Internet** firmware) provides the ability to customise the various strings used to control the modem. As well as allowing certain parameters to be re-configured to suit the area in which a system is installed, this has the potential to allow any device that has a serial port and supports dial-up networking to be used with Sentek MULTI systems.

Sentek currently supplies and supports one modem for GPRS networks, one for Telstra's NextG network and one for Iridium's satellite network. Sentek pre-configures Sentek MULTI interfaces for use with the desired modem, but settings can be changed by the distributor. The recommended modem specific settings can change and it should not be assumed that the settings in the probe interface are correct at the time of use. Currently supported settings files can be downloaded from the Sentek website. For more information on how to restore these settings to the interface, see section Probe Configuration.

Sentek is not obliged to provide support for modems which it has not supplied or agreed to support.

Fastrack Xtend FXT009 modems must have Fastrack Xtend firmware version 7.45 or later. The firmware version of a Fastrack modem can be queried using the ATI3 command (see Figure 41).

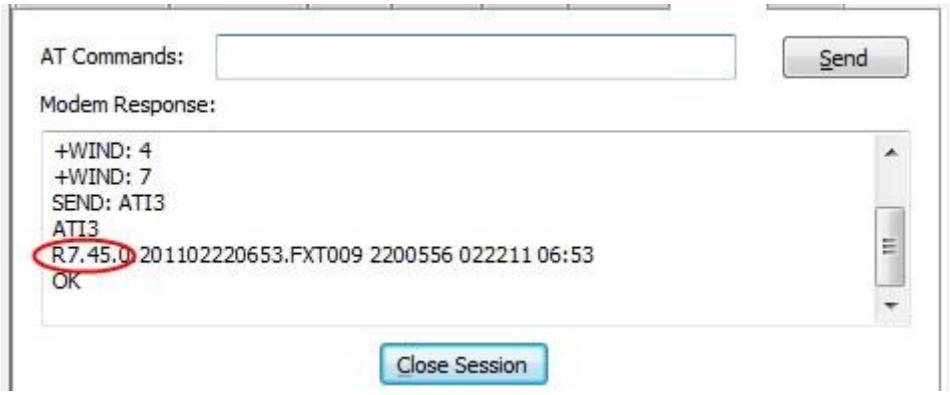


Figure 41 Fastrack Xtend firmware query

Contact your supplier of the modem if firmware is an earlier version than 7.45.

SIM Card PIN codes

The section is only relevant for Sentek MULTI **Internet** firmware users.

If the SIM card to be used in the modem is PIN locked, it can be unlocked using a mobile phone or by asking your provider to do so.

Alternatively, the Sentek MULTI interfaces may be set up with the PIN in the Initialization string. This is the same as having to enter a PIN into a mobile phone when it is turned on, and gives some added security. To do this, when selecting the Network settings (.cfg) file to restore to the probe, select the file name which matches your modem and has the "PIN" identifier at the end of the file name (i.e. GPRS_Fastrack_PIN.cfg). Then, in the Initialization string on the Network page, replace the "XXXX" with the four digit PIN that is locking the SIM. Write the changes to the probe.

For example;

Initialization string for a Fastrack modem, with no SIM PIN enabled:

\T50000;|\T5000;AT+CREG=2||AT&D2|AT+CSQ|AT+CCED=0,1|AT+ADC?

With PIN enabled configuration file restored:

\T50000;|AT+CPIN=XXXX||\T5000;AT+CREG=2||AT&D2|AT+CSQ|AT+CCED=0,1|AT+ADC?

For SIM with PIN of "1234":

\T50000;|AT+CPIN=1234||\T5000;AT+CREG=2||AT&D2|AT+CSQ|AT+CCED=0,1|AT+ADC?

Note: The response string would also need to change in this example, because after power up, the modem does not report the "+WIND: 4" indication until after the PIN has been entered. So for the initialization process to begin, "+WIND: 1" must be added as an acceptable response.

Useful AT Commands

Below is a list of modem commands and descriptions on how to use them. These are just a small selection of the possible modem commands, but have proven to be most useful for use in the Sentek PLUS and MULTI systems. For full lists of commands, please contact the modem manufacturers.

These commands can be sent to the modems in the PConfig program, by pressing **Open Session**, typing commands in the **AT commands** field and pressing **Send**. The sent commands and the modem responses will appear in the Modem Response field.

Table 2 Modem Commands

Command	NextG (ETM9xxx)	GPRS (Fastrack)	Satellite (Iridium)	Response
AT	Yes	Yes	Yes	Should return "OK"

Command	NextG (ETM9xxx)	GPRS (Fastrack)	Satellite (Iridium)	Response
AT+CSQ	Yes	Yes	Yes*	Shows the current signal strength and service quality in the form "+CSQ: 22, 0". The first number shows the signal strength. A result of 99 indicates no signal, anything else over 14 is good. This number can vary considerably, and two or three readings should be taken to get a good indication. Consistent results of 99, or below 10 may indicate antenna problems or other connection issues. The second number can be ignored.
AT+CPIN?	Yes	Yes	N/A	Shows the PIN status of the SIM card. A response of "READY" indicates that the PIN has been correctly entered, or the card is not PIN locked.
AT+CGDCONT?	Yes	Yes	N/A	Used to query the APN currently set in modem. Response should be in the form AT+CGDCONT=1,"IP","<APN>",0,0 A value of 1,"IP",,,0,0 indicated the APN has not been set.
AT+CGDCONT=1,"IP","<APN>"	Yes	Yes	N/A	Used to set the APN for your service provider. Where <APN> is replaced with your service provider's APN. e.g. AT+CGDCONT=1,"IP","telstra.internet"
AT^SCFG="Radio/Band"	Yes	N/A	N/A	Used to query the frequency band on which the modem will operate. See set band command below.
AT^SCFG="Radio/Band",n	Yes	N/A	N/A	Used to set the band on which the modem will operate. Where n has the following possibilities; • 127 - auto select (from GSM 900, GSM 1800, WCDMA 2100 & WCDMA 850Mhz) • 64 - UMTS 850Mhz (NextG) • 1 - GSM 900 e.g. AT^SCFG="Radio/Band",127 See also section *Extra Frequency Band information*.
AT+WMBS?	N/A	Yes	N/A	Used to query the band on which the modem will operate. See set band command below.

Command	NextG (ETM9xxx)	GPRS (Fastrack)	Satellite (Iridium)	Response
AT+WMBS=n	N/A	Yes	N/A	Used to set the band on which the modem will operate. Where n is replaced by one of the following possibilities; • 0 - mono-band 850MHz • 1 - mono-band mode 900 extended MHz (900E) • 2 - mono-band mode 1800 MHz • 3 - mono-band mode 1900 MHz • 4 - dual-band mode 850/1900 MHz • 5 - dual-band mode 900E (extended) / 1800 MHz • 6 - dual-band mode 900E (extended) / 1900 MHz e.g. AT+WMBS=4 See also section *Extra Frequency Band information*.
AT+CIER=1,0,1,0	N/A	N/A	Yes	Enables unsolicited indicator event reporting for service availability. Each time the service state changes, the modem will out put one of the following: +CIEV:1,1 – Service available +CIEV:1,0 – No service
AT+CGSN	N/A	N/A	Yes	Returns modem IMEI
AT+CGMR	N/A	N/A	Yes	Returns modem firmware version

*+CSQ results from Iridium Satellite modems range from 0 to 5 and do not give a good indication of signal strength. However, consistent results of zero may give a reasonable indication that there is a problem with the modem or antenna.

Extra Frequency Band information

Modems will need to be power cycled (turned off and back on) before frequency changes will take effect. In PConfig, pressing Close Session, waiting a few seconds so that the modem can close down properly and then pressing Open Session will achieve this.

NextG (ETM9xxx)

Note: Some ETM modems may have the ability to utilise other frequency bands, such as the ETM9910-1, which can use the WCDMA 900 band. Please contact the modem manufacturer if you wish to use a band other than GSM 900, GSM 1800, WCDMA 2100 or WCDMA 850. This would only be necessary if using a service provider other than Telstra.

ETM9910-1 modems are preconfigured to AT^SCFG="Radio/Band",211, which covers all bands supported by the modem.

GPRS (Fastrack) Modem bands

GSM 900 / GSM 1800 MHz are used in most parts of the world: **Europe, Asia, Australia, Middle East, Africa.**
GSM 850 / GSM 1900 MHz are used in the **United States, Canada, Mexico** and **most countries of South America**.

There are some exceptions to this, so please consult your service provider if unsure.

Information sourced from worldtimezone.com, viewed at 26 July 2011, <http://www.worldtimezone.com/gsm.html>

FIRMWARE AND BOARD TYPE

Avoid firmware mismatches.

There are two separate variants of Sentek MULTI probe interface firmware:

1. Sentek MULTI Internet – probe is programmed to use the attached modem and data plan to facilitate a PPP internet connection using its own internal TCP/IP stack. Modem communications can be controlled in the Network page of PConfig.
2. Sentek MULTI Satellite – probe is programmed to use the attached Iridium modem to send data to Iridium satellites. Modem communications are completely controlled by the firmware and cannot be altered by the user.

Either version of interface firmware can be loaded onto the Sentek RS485 logging interfaces by a Sentek distributor. The probe interface firmware must match the type of modem being used in the DTU. There is only one DTU firmware, which will work with either type of modem.

Both probe and DTU firmware should be updated to the most recent available version at the same time. Some versions of probe firmware may not work well with certain versions of DTU firmware. This is important to remember when performing troubleshooting and/or replacing components on a system.

The current versions of firmware will always be available on the Sentek web site; in the download section. For instructions on how to update the probe firmware, please read the Readme file included in the firmware download, as this contains full instructions.

Interface

Sentek MULTI requires a Sentek RS485 logging interface with Sentek MULTI firmware installed on it. The most accurate method of determining whether you have the correct type of interface and firmware is by using the PConfig software to connect to and read the interface.

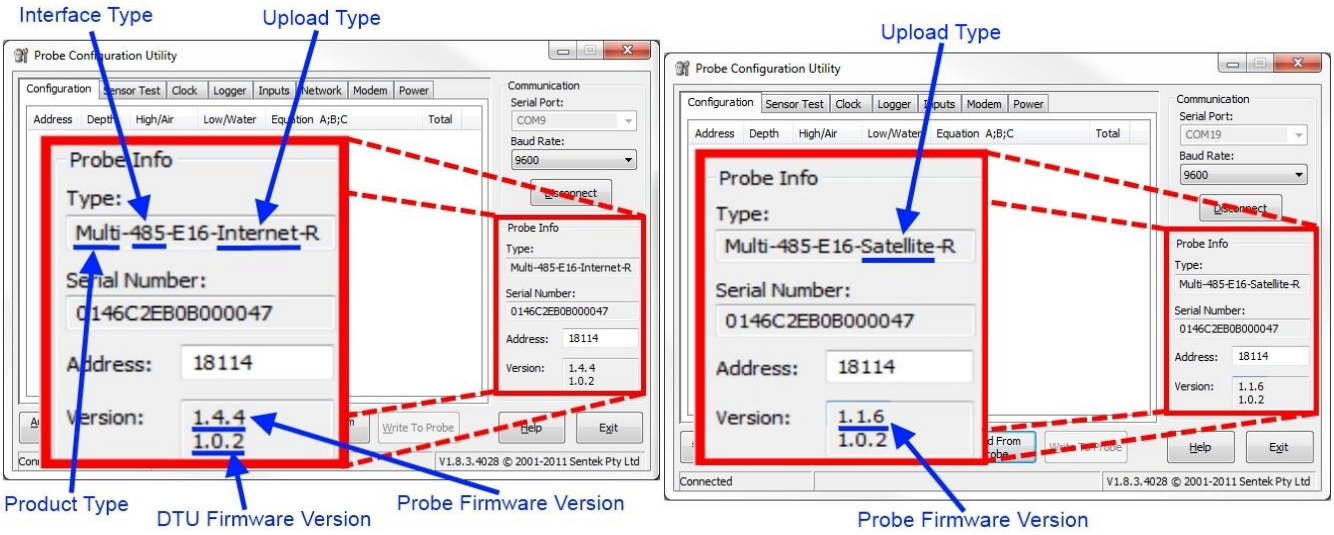


Figure 42 PConfig probe type and version legend

Logging interfaces can be identified by the Super Cap (C116) at the bottom of the interface. Only the logging versions of the interface have this component installed.

RS485 interfaces will have the RS485 (U201) chip installed.

Figure 43 RS485 logging interface

DTU

The Sentek MULTI Front Panel has firmware loaded on it which is separate to the probe firmware. It is recommended that the Front Panel firmware also be updated when possible.

The version of firmware currently installed on the Front Panel, can be read in PConfig. See Figure 42 above.

The firmware can be upgraded through the front panel communication port, using the MULTI DTU firmware wizard.

UPLOADED FILES

Internet firmware

At each scheduled upload or each time the Upload button in PConfig is pressed, the probe will create .esp files containing the data and send them to the specified FTP server directory. The .esp files will be named as follows:

`Logger ID-Sequence Number-Date (YYMMDD)-Time (HHMMSS).esp`

The time and date in the file name is the time and date of the first reading in the .esp file.

A .txt file containing probe information and details from the last failed upload/Test attempt will be uploaded to the specified FTP server directory each time the Test button in PConfig is pressed and when the first successful upload occurs after a failed scheduled Upload. The .txt file will be named as follows:

`Logger ID-Date (YYMMDD)-Time (HHMMSS).txt`

These files can be viewed in through the **Server Files…** feature in Data Exchange or in third party FTP client software.

Satellite firmware

At each scheduled upload or each time the Upload button in PConfig is pressed, the probe will create .SBD files containing the data and send them to the Iridium satellites. Provided there is a contract with Iridium for the modem IMEI, the SBD file will be forwarded to the email addresses specified in the contract (see Figure 4 Satellite Modem IMEI location).

To save data costs, the probe configuration is not sent with every upload. Data Exchange will only add read data that is preceded by a configuration file. Therefore, if the first configuration file is deleted from the email account, readings that would have followed it will not be added. A configuration file will be sent at an upload interval:

- every three days, and
- after the probe is powered up (if a configuration file has not been sent within the previous 24 hours), and
- after a change to the probe configuration, or
- when an upload is initiated by the user in the PConfig program (by pressing the Upload button)

The details in the emails that are sent are explained below:

Subject line format = `SBD Msg From Unit: <Modem IMEI>`

SBD File Name format = <Modem IMEI>_<MOMSN>.sbd

IMEI = IMEI is short for International Mobile Equipment Identity, it is a unique number on the Iridium modem (see Figure 4 Satellite Modem IMEI location).

)MOMSN = This is a sequence number. Data Exchange uses this to help sort emails during downloads.

Unit Location = Geographic location of the modem. The latitude and longitude provide a center point.

CEPradius = Provides the radius of a circle around the Unit Location center point. The reported position is accurate (within the reported circle) 80 per cent of the time.

Example email from Iridium:

With attachment file name: 300134010219510_004142.sbd (173 B)

```
From: sbdservice@sbd.iridium.com [mailto:sbdservice@sbd.iridium.com]
Sent: Friday, 31 August 2012 16:44
To: <your email name>@<your email address>
Subject: SBD Msg From Unit: 300134010219510

MOMSN: 4142
MTMSN: 0
Time of Session (UTC): Fri Aug 31 07:14:30 2012
Session Status: 00 - Transfer OK
Message Size (bytes): 16

Unit Location: Lat = -34.892018 Long = 138.591776
CEPradius = 2
```

PCONFIG RESPONSE FIELDS

Last Response

The **Last Response** shown on the Logger page of PConfig is the result of the last attempt by the probe to upload a file. This upload attempt can be a scheduled upload (triggered by the **Sample Origin**), or a user initiated **Test** or **Upload** in the Modem page of PConfig. See below for more detail on these Responses.

Test/Upload Result Codes

The 053 error in the example picture was caused by modem power cable being unplugged.

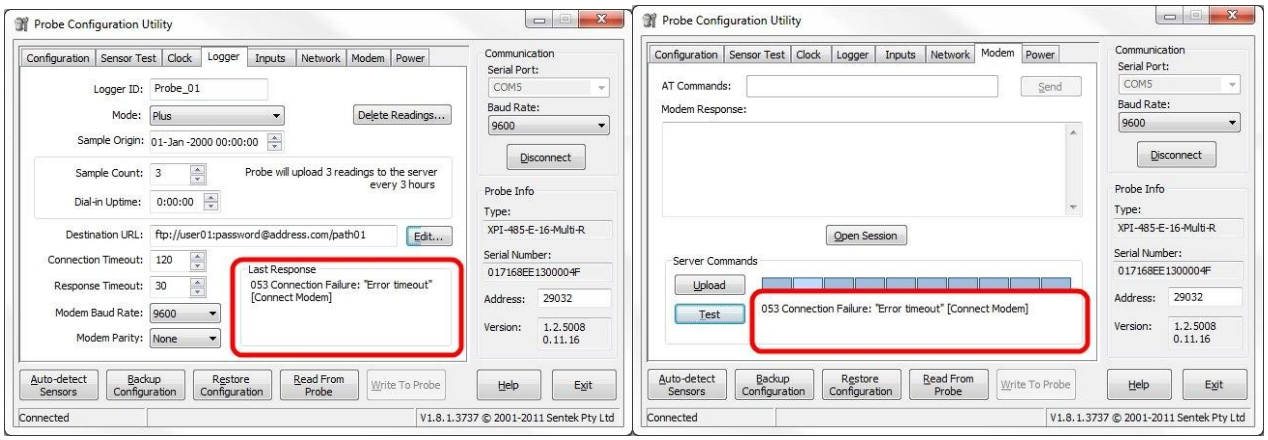


Figure 44 Upload result codes from most recent upload attempt

Table 3 Last Response and uploading response codes

Code	Message Detail	Description
Progress codes		
000	**No Error**	Only occurs after first ever power on (no upload has been attempted)
001	**Initializing Interface**	Preparing modem (Initialisation and Connect strings being sent)

Code	Message Detail	Description
002	**Initializing FTP**	Connecting to FTP Server
003	**Transferring**	Transferring data
004	**Uploading to Server**	Uploading file/s to FTP server or Satellite
005	**Disconnecting from Server**	Disconnecting from FTP server, APN server and shutting down modem
006	**Satellite transfer failure**	Data transfer failed - retrying

Upload Responses

040	**Success**	Upload was Successful (file transferred to FTP server)
041	**Success (No Data)**	No new data to upload
042	**User Cancel**	Pressed Cancel in PConfig
043	**Success (WARNING: Clock needs to be synchronized)**	Test upload was success, but clock has never been synchronized in PConfig and date is still set in year 2000.
051	**Clock Not Set**	Clock needs to be reset (modify or re-sync with PC and write to probe)
053	**Connection Failure**	Modem not responding to commands, or could not connect to internet (see note below)
054	**Server Error**	Problem communicating with FTP server
056	**Dial in Active**	Attempted to perform modem function while connected through Dial-In
057	**Supply voltage too low**	Voltage below Telemetry Disable level
058	**Invalid URL**	Destination URL invalid
060	**Satellite Error**	Modem fault
061	**Transfer Failure**	See section *061 Transfer Failure.*
063	**Transfer Timeout**	Timed out waiting for service. Poor satellite service.
080	**Modem In use**	Attempted to upload while modem was in use (by other probe, or by front panel)

053 Connection Failure – Internet firmware

If test upload fails with the error "053 Connection Failure: "Error timeout" [Connect Modem]", it could be caused by the probe not seeing any of the acceptable responses within the timeout period set at the beginning of the Initialisation string (see section *Network*).

In PConfig, measure the time it takes after clicking Open Session for each message to appear in the Modem Response field. The timeout at the beginning of the Initialisation string should exceed the time it takes for the first expected response to appear.

For example; the first expected response could be "+WIND: 4", and this commonly takes anywhere from 15 to 40 seconds to appear after modem power up. So the initialization string should start with "\T50000;|". This would mean that the modem has 50 seconds to display the +WIND: 4, if it's seen the probe continues through to the Initialisation string. If it takes longer than 50 seconds (or doesn't appear at all), the probe will timeout and abort the attempt.

If a test upload fails with "053 Connection Failure: "Framing errors" [Connect Modem]", the problem is usually because of poor communication between the probe and modem. This can be caused by a mismatch of baud rate and/or parity. The baud rate and parity used to communicate to the modem can be set on the Logger page of PConfig.

061 Transfer Failure - Satellite firmware

Because the 061 Transfer Failure can be caused by Irridium satellites moving out of sight from the modem's antenna, the satellite firmware will re-attempt the upload at the next sample interval (rather than at the next upload interval, as is the case with most other error results).

The detail of the message will provide important clues as to the cause of the error. The generic format is:

`061 Transfer Failure:"<message>" [<state>]`

`<message>` Extended error message; e.g. Connection Lost

`<state>` Internal software state; e.g. SBD transfer: RETRY

Possible transfer failure messages and associated meanings are listed in the table below.

Table 4 Last Response "061 Transfer Failure" message detail

<message>	Meaning
Access Denied	Access to satellite network denied
Session Incomplete	Gateway reported session did not complete
Connection Lost	Connection lost (RF drop) during transfer
Link Failure	Network connection started, then lost (low signal). This may happen intermittently when a satellite goes out of range. If it persists check antenna has a clear view of the sky.
No Service	No network service at this time (no signal). If this error persists, check antenna connections and antenna orientation.
Antenna Fault	Antenna fault, check its connections
Timeout, No Service	Timed out waiting for network service If this error persists, check antenna connections.
Response=<rsp>	Unrecognised modem response, where <rsp> is the response received. If this error message is seen, the exact error result should be recorded and communicated to Sentek by a Sentek distributor

Open Session

In PConfig, error messages may appear in the Modem Response field when a session with the modem is open (after Open Session has been clicked). Below is a description of what some of these messages can mean:

Table 5 Open Session codes

Message	Description
Not Available, Dial in Active	Connected to probe through Dial in, cannot use Open Session
Modem in Use	Modem in use (by other probe, or by front panel)
Comm Error: No Response	No response from DTU This is unlikely to occur when connected through Front Panel, but is possible (PConfig would likely loose communication with probe also). When connected through interface TTL port, the likely cause of the error message "Com Error: No Response", is a bad (wiring) connection between the probe and the DTU. It can also occur when the Front Panel cable has been plugged in before the battery (this causes the DTU to go into firmware update mode).

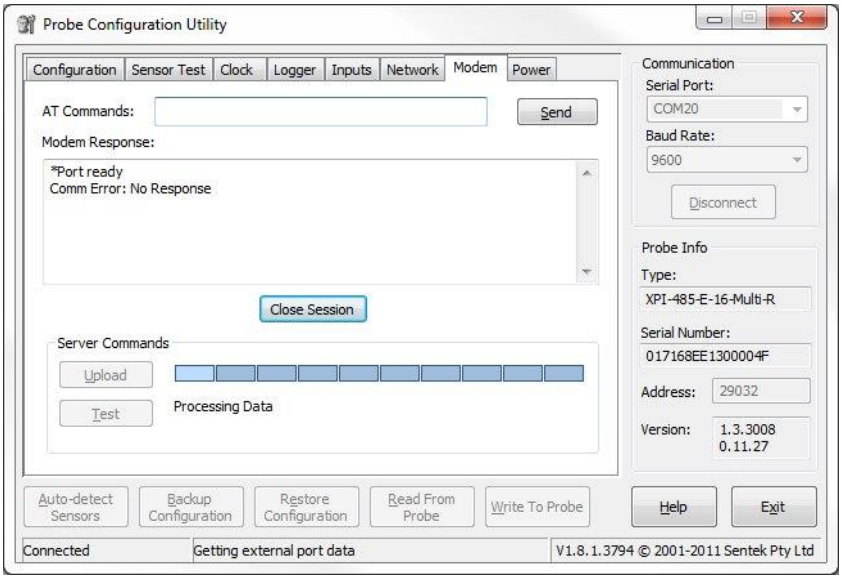


Figure 45 Open Session Com Error

UPLOAD LOG

It is possible to retrieve from the probe, a log of the codes from the last upload attempt. Only the information from the previous upload test, whether it was a scheduled upload or user initiated Test, is kept in the log. To retrieve the logged upload information from the probe;

1. Connect to the probe in the PConfig software.
2. Go to the Modem page of PConfig
3. Press Open Session
4. Wait until the modem has finished sending the Unsolicited Result Codes and then, using the AT Commands field, send the command below:

```
\showdetails
```

The log information should be displayed in the Modem Response field. Copy all text in this field into a text editor program (i.e. Notepad). Save the information.

This manual does not attempt to explain how to interpret the \showdetails information. Sentek Distributors can send a copy of the response to Sentek for interpretation and troubleshooting help.

UPLOAD OPERATION DIAGRAM

Table 6 Internet firmware upload operation diagram

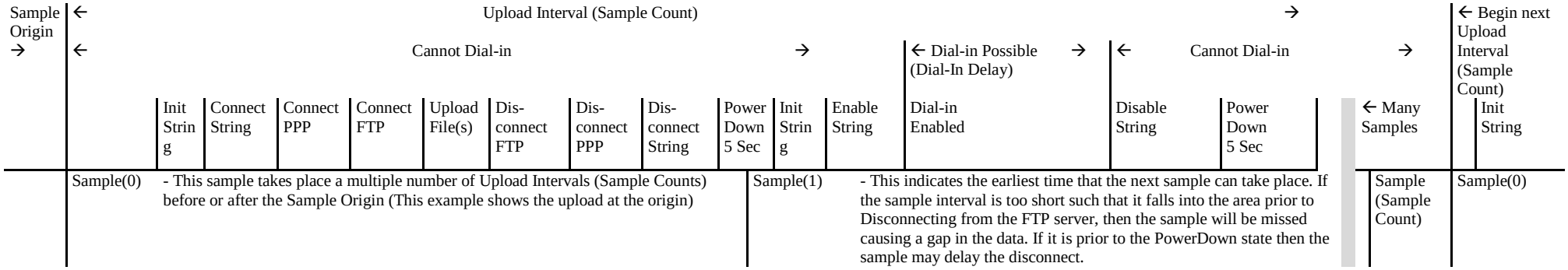
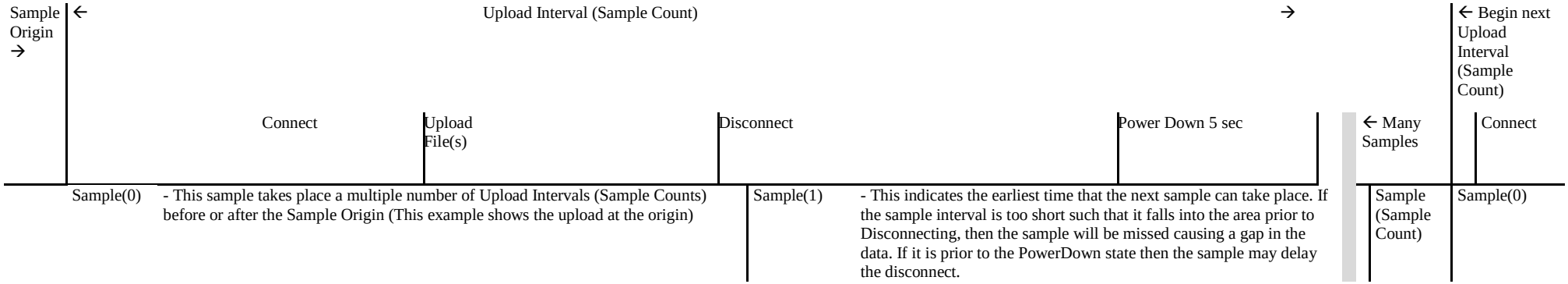


Table 7 Satellite firmware upload operation diagram



INTERACTION BETWEEN TWO PROBES AND MODEM

As both probes are independent of each other and both utilize the same DTU and modem, there has been functionality written into the DTU to ensure that there is no unexpected errors or loss of data caused by the two probes interfering with each other.

Upload Intervals

Note:
It is suggested that probe 1 and probe 2 have different Sample Origins e.g. one probe offset by the sample interval or half the upload interval.

When two probes on one DTU have the same, or very close, sample origins, there may be times when the uploads and dial-in periods overlap.

If one probe (P2) reaches its scheduled upload time and finds that the modem is already in use, it will not attempt to upload. The probe will subsequently retry the upload at the next **sampling interval**. There are a few situations where the modem may already be in use:

- Other probe (P1) is in process of uploading.
- During Dial-in period of P1.
- User has Sentek MULTI Download Cable connected to DTU Front Panel, and Probe Select is in middle (Modem) position.

It is possible to have the Dial-in set at a period greater than the sample interval. When using a Sentek MULTI DTU and Sentek supplied modem this should not cause any problems. If a modem that was not supplied and fitted by Sentek is used, there is potential for the modem RF transmissions to interfere with the sensor readings.

PCONFIG NETWORK PAGE EXPLAINED

Username and **Password** (Not used in Dial-in mode)**:** These are for the GPRS or NextG network that the SIM card connects to – they are related to the APN server, not the FTP server. Many network providers allow these to be blank. For correct settings, contact your network provider.

The **Command strings** are used to control the modem during each stage of the Sentek MULTI system upload process. Generally, they should not be altered from their defaults. Sentek provides configuration files on the Sentek website to restore the network strings for modems sold by Sentek.

Dial-in Enable: In Dial-in mode, after every Sample Count interval has been reached the telemetry power is turned on and this string (up to 80 characters) is sent to the modem. The telemetry remains powered for the time specified in Dial-in Uptime, then the Dial-in Disable string is sent.
In normal (not Dial-in) mode, this string (up to 80 characters) is sent upon completion of an upload unless the Dial-in Uptime is set to zero – in this case, the dial-in feature is inactive.

This field can be used to command the modem to auto-answer incoming messages, for the uptime period, after the sample count scheduled time.

Dial-in Disable: In Dial-in mode, after a Dial-in Enable is sent, and when the end of Dial-in Uptime has been reached, this string (up to 80 characters) is sent, then the power is removed from the telemetry.

This field can be used to prevent the modem auto-answering incoming messages at times other than the sample count scheduled time.
In normal (not Dial-in) mode, this string (up to 80 characters) is sent before starting an upload. The Dial-in Enable is sent at the completion of the upload. The telemetry remains powered for the time specified in Dial-in Uptime, then the Dial-in Disable string is sent.
If the Dial-in Uptime is zero the dial-in feature is inactive.

Init String: This string (up to 80 characters) configures the modem for communication, after it has been powered on.

Connect: (Not used in Dial-in mode) This string (up to 80 characters) supplied by your Network provider, is the command needed to connect to the network. It generally initiates the dialing of a specific telephone number.

Disconnect: (Not used in Dial-in mode) This string, up to 80 characters, is sent to the modem after the probe has sent the data to the network. It will disconnect the modem from the network.

Response(s): After being sent a command the modem replies with a response. If the specified response string is not received within the Connection Timeout (see section *Probe Configuration, Logger tab*) the

probe abandons communication until the next scheduled time. This includes responses that do not match the response string. The Dial-in Enable and Disable timeout is not dependant on the Connection Timeout value. A reply is considered matching when the start of the reply exactly matches the response string (up to 40 characters).

TECHNICAL SPECIFICATIONS - ENVIROSCAN SERIES II RS485 INTERFACE

PCB Revision: REV2.3

Identification Label: XPI-SC-E-RS485L

RS485 Interface connector type: Brand: Phoenix Contact
MC 1,5/8-ST-3,5 (Plug)
EMC 1,5/8-G-3,5 (Socket)

RS485 Interface pin configuration:

1. +V*in*
2. *Reserved*
3. *Reserved*
4. Ground
5. A – RS485 Data
6. B – RS485 Data
7. Screen
8. *Reserved*

Voltage Supply (RS485 +Vin): 4 - 15 V* (12 V DC @ >200mA recommended)

*Firmware default power-on is 8.5V

RS485 Interface baud rate: fixed @19200 bits per second

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

JP201 Jumper RS485 line terminator: Jumper should be present

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. *Reserved*
5. *Reserved*
6. Ground

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

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

Total current consumption: 400µA standby @ 12 V DC
105mA sampling (Moisture) @ 12 V DC
130mA Sampling (TriSCAN) @12 V DC

Time to sample 1 sensor: 45 milliseconds maximum (Moisture only)
90 milliseconds maximum (TriSCAN)

Maximum sensors supported: 16 Moisture Sensors or
16 TriSCAN Sensors

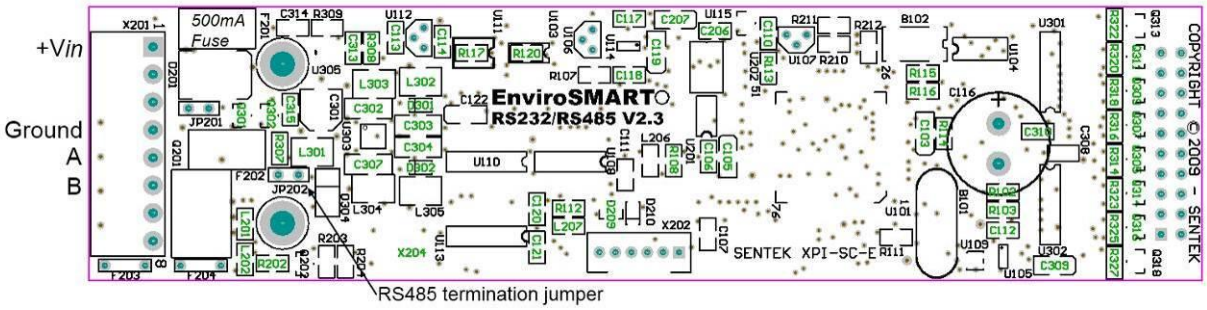


Figure 46 EnviroSCAN RS485 probe interface board layout

TECHNICAL SPECIFICATIONS – SENTEK MULTI DTU

Connector Board

Voltage Supply (X2, Battery): 12 V 7.5Ah Battery

Charge Voltage Supply: 16.5 V, 4.5 Watt Solar Panel

Minimum charging voltage 17 V nominal, Maximum charge current 650mA. A larger solar panel will not increase the battery charge during full light conditions.

Charger automatically adjusts charge current to meet minimum charge voltage.

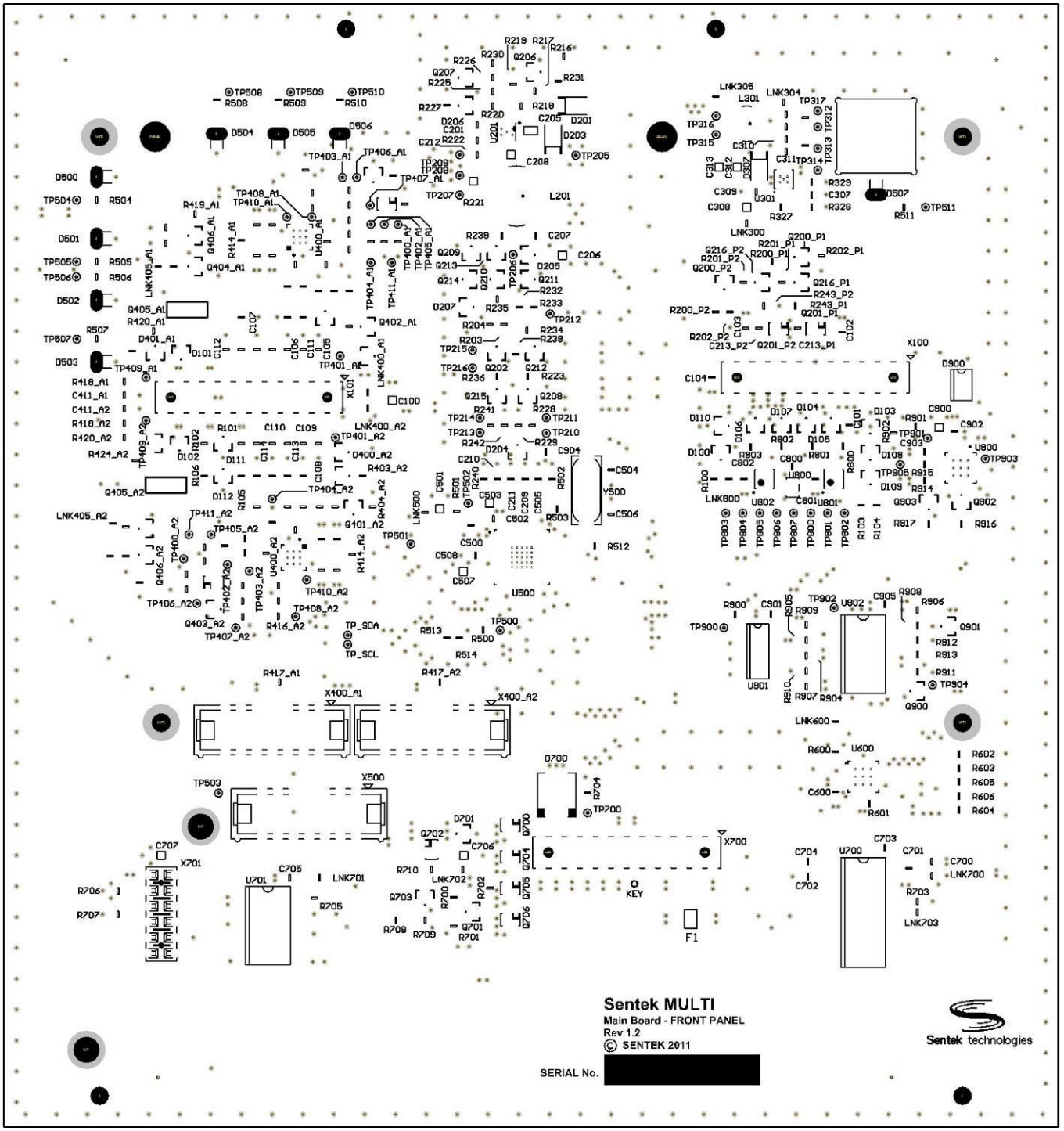


Figure 47 Sentek MULTI Front Panel (rear view)

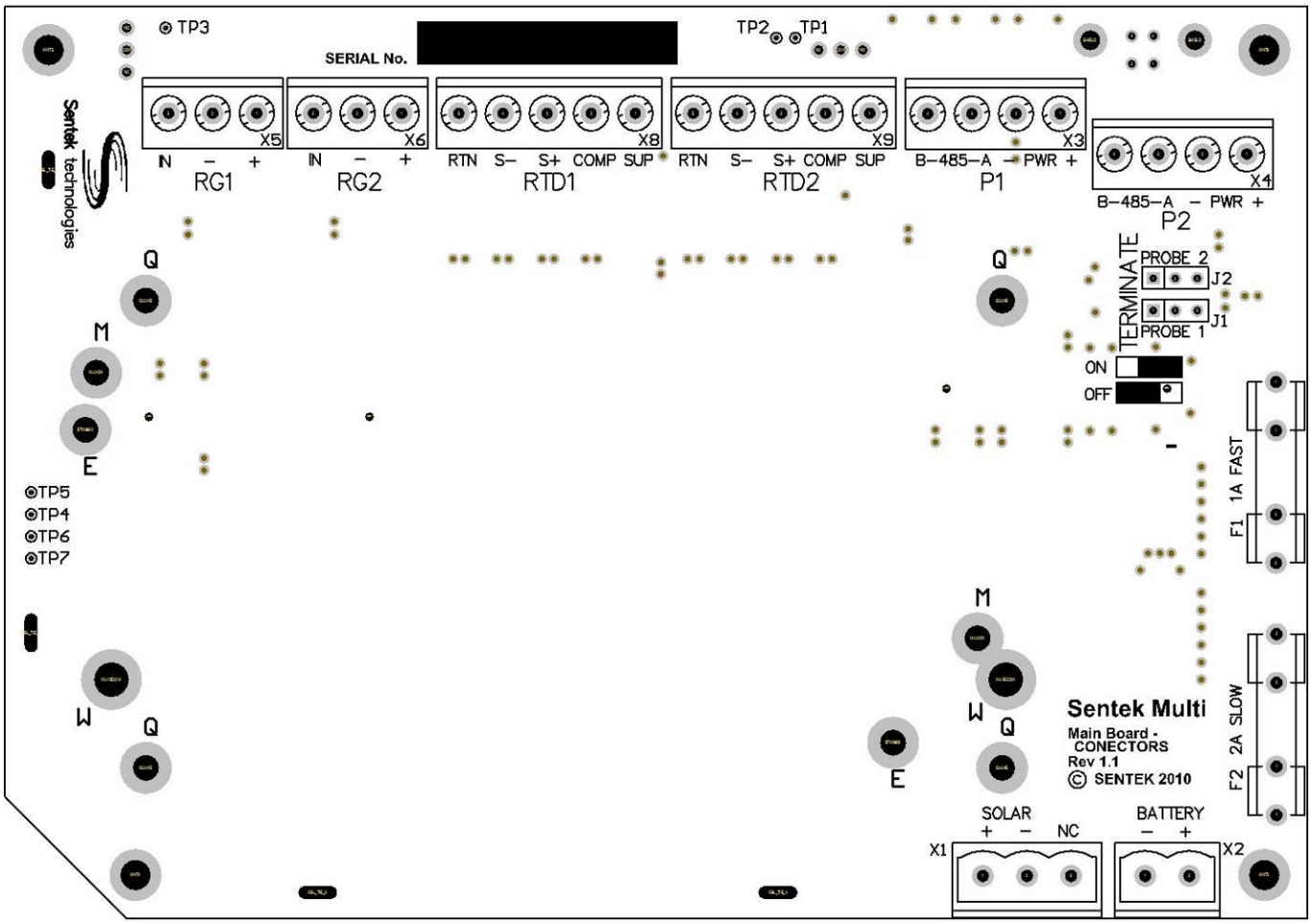


Figure 48 Sentek MULTI Connector Board

RTD1 and RTD2 Temperature Inputs

Inputs: PT100 RTD type temperature sensors.

4-wire pin configuration:

1.	SUP	Approx 3.3v switched supply.
2.	COMP	Short to SUP
3.	S+	Positive measurement across RTD.
4.	S-	Negative measurement across RTD.
5.	RTN	Approximate 1mA current sink.

Cable Length

Cable lengths will depend on the specification of the sensor being used. The length and gauge of cable will generally have an impact on the output of the sensor reading, so extending or joining cables beyond the cable supplied by the sensor manufacturer is not recommended.

Sentek may quote a maximum cable length for Sentek supplied temperature sensors, but this is not a limitation of the Sentek MULTI system itself.

4 wire measurement method and range

Temperature readings are obtained by measuring the resistance between the S+ S- inputs using an approximate fixed current source (1mA) and scaling against an accurate 120 ohm reference.

The measurement is guaranteed to measure between 85 and 125 ohms. (-40 Deg C to 65 Deg C)

Temperature is the calculated using the following simple linear approximation (for a PT100 RTD):

$$T = (Rt – 100) / 0.385$$

Where T is the temperature in Degrees Celsius

And Rt is the measured resistance.

3-wire pin configuration

3 Wire temperature measurements can be made by connecting the red pair of wires to SUP and COMP (removing the shorting link) and connecting the white wire to RTN. COMP and S+ need to be shorted together and S- and RTN need to be shorted together. Use only similar type gauge wires, do not join the two white wires together !

1.	SUP	RED
2.	COMP	RED
3.	S+	Short to COMP
4.	S-	Short to RTN
5.	RTN	WHITE

The 3 Wire configuration is less accurate than 4-wire, but should still be within 1 degree.

RG1 and RG2 pulse inputs

Cable Length

Sentek supports cable lengths of up to 10m being connected to the pulse inputs.

Cable lengths longer than 10m are possible, but are highly dependent on the environment in which they are installed. Factors such as other cables and power lines can cause interference and possibly false counts in the readings taken by the Sentek MULTI system. As with all data cables, you should avoid running the pulse sensor cable parallel with other cables, especially high voltage lines.

If cable lengths longer than 10m are going to be used, distributors must be aware that it is up to them to test the system operation in that specific environment. A given cable distance may work in one situation, but not work in another situation.

RG1 and RG2 pin configuration

1.	+	Reserved for future use
2.	-	Switch Input (Ground)
3.	IN	Pulse input

RG inputs count pulses on a normally open contact between - and IN or pulses on a direct signal feed into the IN pin.

The IN pin has an approximately 5mA wetting current for dry contact reed switches.

Direct driving the input requires a voltage between – and IN to be: input low 0.5V (max) and input high 2.5V (min).

The IN pin has a maximum rating of 12V.

The IN pin is software debounced with a 22ms period to remove spurious noise or switch bouncing. However the maximum frequency is 20Hz, anything higher than this may not be measured correctly.

If the IN pin is held in the low state for greater than 1.5 seconds, PConfig will show this as a "Stuck" input and the probe will log the data as an invalid reading.*

*Note: only for the rain gauge. If recording flow it will ignore the stuck state.

X700 Modem Connection Plug (cable end)

Connector housing:	BH2-2X12-LF
Crimp Pins:	BHT-G
Locating key plug:	BHKEY

Table 8 X700 color chart

1	TXD	(Yellow)	Output
3	RXD	(Red)	Input
4	CTS	(Blue)	Input
5	DCD	(Brown)	Input
6	RTS	(White)	Output
7	DTR	(Green)	Output
8	Signal Ground	(Black)	
9	DSR	(Violet)	Input
12	KEY	** Insert suitable polarizing key to fill hole	
15	RI	(Grey)	Input
19	Switched BAT Power	(Orange) ** Twisted when paired with 21	
21	Switched BAT Power	(Orange)	
22	GND	(Black) ** Twisted when paired with 24.	
24	GND	(Black)	

Table 9 X700 Connector layout, looking from back (pin entry) of connector body.

23	21	19	17	15	13	11	9	7	5	3	1
24	22 >	20	18	16	14	12 >	10	8	6	4	2 >

Note: ARROW ">" is a marking shown on the body of the connector

GLOSSARY OF TERMS

Table 10 glossary of terms

3G	Third Generation mobile phone network
BW	Bandwidth, the amount of traffic allowed in a set period
Domain name	Name given to web location e.g. www.sentek.com.au
DTU	Data Transmission Unit (housing containing modem, battery and solar charger board)
FQDN	Fully qualified domain name
FTP	File Transfer Protocol – used to upload / download files
GPRS	General Packet Radio Service (Used by selected Modems)
Host	Web site / data storage provider
HTTP	Hyper Text Transfer Protocol - Used to download files
Hz	Hertz - number of cycles per second
IMEI	IMEI is short for International Mobile Equipment Identity, the unique identification on the Modem
IP Address	Internet Protocol address – Numbered address of host
Iridium (Satellite)	Global satellite network consisting of 66 LEO (Low Earth Orbit) satellites arranged in 6 orbital planes of 11 satellites evenly spaced around the planet
kB	Kilobytes
MB	Megabytes
MOMSN	Mobile Originated Message Sequence Number (part of Iridium emails)
NextG	Telstra Australia implementation of 3G
PIN	Personal Identification Number on a SIM card
RG	Abbreviation for Rain Gauge
RTD	Resistance temperature detector
SBD	Short Burst Data. Duplex data only plan over Iridium satellite network.
Service mode	Front Panel ON switch is moved to the off/up position. Power is removed from the probes and the modem. There may be up to a one minute delay before the WARN LED stops flashing and the DTU enters service mode. The pulse counters continue recording.
SIM Card	Subscriber Identity Module, required for GSM/GPRS/NextG Access
Storage Capacity	Available space on server to store data files
URL	Universal Resource Locator
WCDMA	Wideband Code Division Multiple Access (standard used in 3G telecommunications networks)

APPENDIX - SENTEK MULTI (GPRS & NEXTG) QUICK REFERENCE GUIDE

This appendix is designed to be a short guide for installers of Sentek MULTI. It can be printed and carried into the field and act as a reminder for the basic steps needed to install a complete Sentek MULTI system. It does not replace the manual, it merely supplements it.

PRODUCT SET-UP CHECKLIST

Preparation

1. Select probe, DTU, and other sensor sites, test signal strengths and decide on system configuration.
2. Organise data transmission and hosting, as detailed in Sentek MULTI Hardware Manual section Data Transfer and Hosting.
3. If practical, mount and wire-up DTU housing, solar panel, antenna, temperature and other sensors onto a mounting pole prior to field installation.
4. Using PConfig, for each probe;
   - Check the interface and DTU both have the latest and correct version of firmware
   - Configure Sentek Soil Moisture sensors (Auto-detect, set depths & normalise sensors)
   - Set Clock (Time & sampling interval)
   - Input Multi settings (Logger ID, upload interval & ftp server details)
   - Configure Inputs on one or both probes (Temp & RG)
   - Internet firmware only - Configure Modem Settings (Restore network configuration which matches modem being used)
   - Check system (**Test**)

(For further information, refer to Sentek MULTI hardware manual and PConfig Help)

Warning: Do not leave the 12V battery in the housing during transportation or damage may occur

Field Installation

1. Install access tubes and mounting poles as per the Sentek Access Tube Installation Guides (Flat Cap or Screw Cap), and as demonstrated during official Sentek training.
2. EnviroSCAN Screw Cap probes only, skip to step 3 for Flat Cap.
   a) Insert the probe cables through the cable glands into the access tube, ensuring cable is looped around ferrite beads as near to cable glands as practical (see Figure 2) and tighten the glands.

Hint: Insert cable into top cap before gluing it onto the access tube to avoid compromising the glue seal.

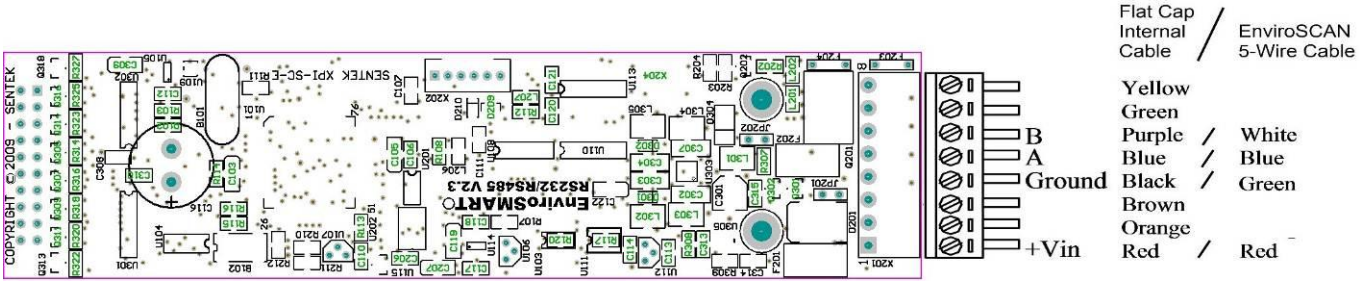
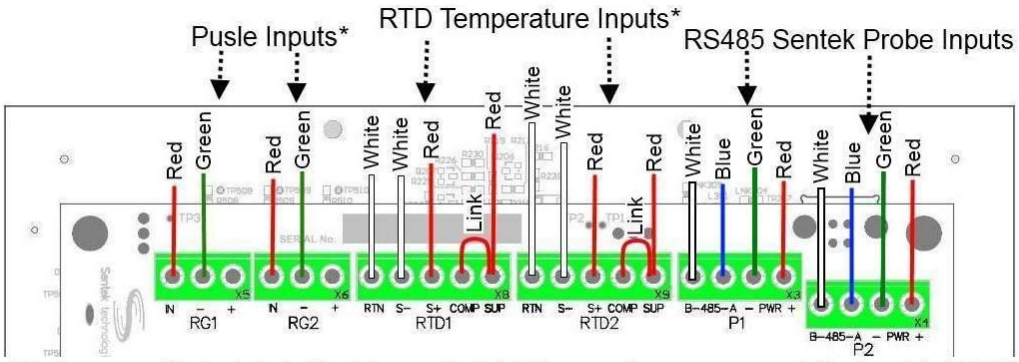


Figure 49 EnviroSCAN MULTI interface wiring

3. Insert the probes into the access tubes.
4. Connect probes, temperature and pulse sensors to the DTU using the wiring diagrams in Figure 8



* Colours specified relate to Sentek supplied RTD temperature sensors and Environdata RG12U raingauges only. Other sensors will vary in wire colour.

Figure 50 Sentek MULTI DTU input wiring

5. Connect the antenna, battery and then solar panel to the DTU.
6. Switch the DTU on and test all of the sensors. Then test the upload function from all connected probes.
7. As the last thing you do before you leave, flick the DTU switch up, wait for a slow flash from the red LED before switching back ON again.

Software

Allow probes time to upload readings.

1. Enter the server details into Data Exchange
2. For each probe, use the New Database Wizard and Download Wizard within IrriMAX to set up new databases and associated downloads within a workspace.
3. Create graphs, save the workspace and create a batch file to run the downloads.

Example Batch File: "Path to IrriMax.exe" "path to workspace.sws" /DOWNLOAD

TROUBLESHOOTING GUIDE

Once a problem has been flagged, troubleshooting should be carried out in this order:

1. Download all data and review graphs, looking at all sensors for problem symptoms and causes.
2. Before picking up any tools, moving cables or altering the system in any way, connect to the probes in PConfig and identify what the current fault is. If you miss this step, you will not know whether you have fixed the original problem or not.

Tip: Upload readings and back up probe configuration before changing any probe settings.

3. Using Table 11 as a starting point, begin finding the cause of the fault. Change only one thing at a time and then check to see if it has changed the original symptom of the fault. Try something else if the symptom has not changed.

Warning: Flicking the DTU switch up (not On), may not immediately switch off power to the probe. If the modem is active, probes can stay powered on for up to 65 seconds after the DTU is switched off.

4. Once the cause and symptom have been found and rectified, test all sensors and upload operation in PConfig. If a new symptom appears, start again at step 2.

Tip: Disconnect 12V battery and solar panel when servicing the DTU; this includes any wiring to the connectors or whenever the antenna is to be disconnected. See also warning above.

Table 11 Troubleshooting

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
Cannot connect to probe with Probe Configuration Cable (through interface TTL port) "Timeout occurred while trying to connect to the probe"	Wrong COM Port selected in PConfig	Check COM Port number in Windows Device Manager	Ensure cable drivers are installed and correct COM port is selected
	Low power supplied to interface	Measure DC voltage at interface and DTU points P1/P2, F2 & X2	Replace battery Replace corroded wires or connectors Re-strip and connect all probe cable wires Replace F2 fuse
	Power Switched off	Check DTU power switch	Ensure switch is in the On (down) position and WARN LED is not flashing or lit
	PConfig cable not connected	Visual check	Make sure cable is fully connected with TTL port on interface **Note:** The USB port supplied voltage cannot be used to power the interface.

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
	Bad wiring at DTU or Probe (specifically power and ground wires)	Use wiring diagram to re-terminate all wires	Make sure wiring is correct to interface. Re-wire if unsure
	Blown (F201) fuse on interface	Measure voltages at each end of fuse	Replace fuse (check wiring first)
	Probe is busy communicating to DTU	Check probe LED's on front panel of DTU. If flickering, the probe is communicating.	Wait a few seconds until LED stops flickering and try again.
Cannot connect to probe through Front Panel USB cable "Timeout occurred while trying to connect to the probe"	Probe select switch in wrong position	Check switch and probe's physical connection to DTU	Select correct switch position (P1 or P2)
	Cable not connected	Orange LED above USB port on DTU on when cable is connected correctly	Plug cable in and restart PConfig
	Wrong COM Port selected in PConfig	Check COM Port number in Windows Device Manager	Ensure Front Panel USB port drivers are installed and correct COM port is selected
	DTU ON switch in Service mode (up) position	Check switch	Flick Switch to On (Probe light should flicker once for each probe connected)
	Front Panel USB port drivers not installed	Check COM Port number in Windows Device Manager	Install Drivers
	USB cable plugged in before unit powered up	Remove USB cable and power cycle DTU	Remove and re-insert cable in front panel
	Bad wiring at DTU or Probe (specifically A and B wires)	Use wiring diagram to re-terminate all wires	Make sure wiring is correct to interface. Re-wire if unsure
Modem "Test" upload fails e.g. PConfig Last response field in the 050 to 058 range (also refer to Sentek MULTI manual section *Test/Upload Result* Codes)	Modem not powering up (test with Open Session in PConfig)	MDM LED on DTU should be on	Replace DTU panel if off
		Should be 12V on the heavy gauge red wire going to modem power connector at the X700 connector	Replace DTU panel if voltage less than battery voltage

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
		Watch for lights on modem (if power is getting to it). Note: Some modems only have a slow flash and Iridium modem has no LED	Replace modem if there are no lights coming on
		Check if other probe is using modem	Unplug other probe or wait until it has finished upload/dial in (switching DTU off does not interrupt uploads or dial-in for 65 seconds)
	Probe settings	Check Network Settings match the type of modem (Internet firmware only)	Download Network settings .cfg files from Sentek web site and Restore correct file to probe
		Modem powers up but doesn't communicate with probe in Open Session	Adjust Parity and Baud Rate in PConfig one at a time and check in Open Session after each change until probe communicates with modem
		"053 Connection Failure [Connect Modem]" result code	Increase Connection Timeout in probe
	Low Voltage	Measure probe supply voltage (Pin1, red wire)	Replace battery or probe cable if low
	Bad wiring at DTU or Probe (specifically A and B wires)	Use wiring diagram to re-terminate all wires	Make sure wiring is correct to interface. Re-wire if unsure
	Modem Cable damaged or not connected properly	Check both ends of modem cable (X700)	Re-insert or replace cable
In PConfig, cannot read Inputs or voltages and Com Error when attempting Open Session while connected through interface TTL port.	Bad wiring at DTU or Probe (specifically A and B wires)	Use wiring diagram to re-terminate all wires	Make sure wiring is correct to interface. Re-wire if unsure
Data updating after download, but not up to correct time	Probe Clock incorrect	Check using PConfig	Change probe clock to correct local time
Invalid moisture and salinity sensor data, but voltage readings ok (0 raw counts)	Interface pins not all in socket	Remove interface screws and check	Re-install interface on probe (refer to EnviroSCAN probe assembly guide)

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
RG sensor reporting ‘Stuck’ in PConfig	Sensor stuck	Check pulse counter	Clean, reinstall or replace sensor
	Faulty wiring	Check sensor to DTU cable and connections	Replace cable and/or re-wire connections
Input sensors report "Error" or "Unavail" in PConfig	Error - Sensor faulty or Not present	Check sensor to DTU cable and connections Swap with a spare sensor and check again	Replace sensor if fault is isolated to sensor
	Unavail - (all four input sensors) Wiring problem	Check DTU to Probe cables and connections	Replace cable and/or re-wire connections from probe to DTU
	Unavail - DTU Fault	Corresponding RTD and RG inputs both report "Unavail" (i.e. RTD1 & RG1)	Replace DTU Front Panel
Temp sensor reading high or low (compared to known reference)	Incorrect wiring	Compare to Sentek MULTI Hardware Manual *Figure 8*	Rewire sensor into DTU
Probe uploads okay, but no data to download (Satellite firmware)	Satellite modem not registered with Iridium	Check Iridium reseller contract	Register modem IMEI with Iridium reseller
	Incorrect email address	Check Iridium reseller contract	Change address that is registered for modem IMEI or create and use address listed in contract
Probe uploads okay, but no data to download (Internet firmware)	Incorrect server details used in Data Exchange	Check destination URL in probe and compare to Data Exchange	Change ‘Edit Server’ details in Data Exchange
	FTP server directory file limit reached	Check number of files in directory in FTP client program	Delete some files from directory
			Use HTTP to download

RECOMMENDED MAINTENANCE SCHEDULES

3 years

- Replace 12V battery

12 months

- Check for dust and/or water ingression into DTU housing
- Check quick connector pins for signs of corrosion/moisture
- Check cable for damage to outer sheath and wires
- Check antenna is secured tightly
- Ensure all cables are neat
- Clean SIM contacts
- Clean solar panel

6 months (or each time access tube is opened)

- Check probes and access tubes for moisture
- Replace gaskets (EasyAG)
- Replace silica gel bags
- Check and clean antenna

Monthly

- Clean rain gauge

SENTEK MULTI LED'S

NOTE: FLASH cycle is "n" flashes in approximately 4 second period, where "n" is the number/rate of flashes.
i.e. FLASH (double) = two quick flashes every 4 seconds.

BAT - Battery Status

- FLASH (single) – Charging, voltage > 14.2V
- FLASH (double) – Battery low, voltage < 11V
- OFF – Battery OK

SOL - Solar Status

- ON – Charging
- FLASH (single) – Solar voltage present (> 17V)
- OFF – Solar voltage not present

WARN - Warning Indicator

- FLASH (fast) – Entering service mode
- FLASH (single) – Service mode active (probes powered off)
- FLASH (double) – Firmware update mode
- ON – Board fault

OK - General status

- FLASH (single) – System idle, OK
- FLASH (double) – System active, OK

USB - USB Status

- ON – USB connected (device has been detected by the computer and is not suspended)
- OFF – USB not connected (or connected but suspended by host controller)

Warning:
If the USB LED is on but all other LEDs are OFF or WARN is Flash (double), the DTU is in firmware programming mode and not responsive to normal operation.

PROBE 1 - Probe 1 activity

- ON – Front panel connected and PROBE SELECT switch in P1 position (left) or Probe 1 activity
- Flickering - Probe 1 is communicating with the DTU

PROBE 2 - Probe 2 activity

- ON – Front panel connected and PROBE SELECT switch in P2 position (right), or Probe 2 activity
- Flickering - Probe 2 is communicating with the DTU

MDM - Modem activity

- ON – Front panel connected and PROBE SELECT switch in Modem position (centre) or Modem activity