Sentek RT6

HARDWARE MANUAL

Version 3.2

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Chapter 1: Introduction

About this Manual

This manual describes the Sentek RT6 soil water monitoring system and includes technical information, installation and maintenance procedures.

It is intended to be used as a guide to the assembly and maintenance of the Sentek RT6 System.

This manual should be read in conjunction with:

- Access Tube Installation Manual
- EasyAG Installation Manual
- IrriMAX Manual (or online help)
- Data Exchange Manual (or online help)
- RT6 Logger Manager (or online help)
- Remote Connection Manger - RCM (or online help)

Study of this manual does not allow users who have not undertaken the appropriate Sentek training course to install, maintain and repair the Sentek RT6 System under the warranty conditions.

Superseded Equipment

For details of the superseded RT5 systems and the related 4-wire boards, sensors and installation methods please refer to:
EnviroSCAN Hardware Manual, Version 3.0, November 1997
See Appendix L for an overview of RT5/RT6 similarities and differences.

Glossary of Terms

Caution: A caution defines a procedure which, if not strictly observed, could result in damage to, or destruction of, equipment.

Warning: A warning defines a procedure which, if not strictly observed, could result in personal injury or loss of life.

Communication	Describes the process of transferring commands or data between the logger and the computer.
RS232	Is the standard which describes the specification for single ended serial transmission of data, which is the standard for the COM 1 and COM 2 ports on a computer.
RS422/RS485	Is the standard which describes the specification for serial transmission of data, which is the standard for long distance communications. This is a differential signal and is specified to be used with cable runs up to 1km depending on baud rate and type of data cable used.
Radio Modem	Is the circuitry that converts the signals from the logging facility into a form that can be transmitted and received by radios.
PCB	Is an abbreviation for "Printed Circuit Board"
VHF	Is a frequency band used by radio and is an abbreviation for "Very High Frequency"
UHF	Is a frequency band used by radio and is an abbreviation for "Ultra High Frequency"
AC	This an abbreviation for "Alternating Current" and describes the type of current and voltage which is commonly used to power solenoids (e.g. 24 volts AC)
DC	This is an abbreviation for "Direct Current" and describes the type of current and voltage which is derived from batteries (e.g. 12 volts DC)
EMC	Abbreviation for Electro-Magnetic Compliance
EMI	Abbreviation for Electro-Magnetic Interference
SLA Battery	Abbreviation for Sealed lead Acid. This describes the construction of the type of battery used to power the logger.

I/O	Abbreviation for “Input” (I) and “Output”(O) usually in reference to signals into and out of a device
ID	Abbreviation for “Identification”
IEC 60529	Standard IEC 60529 Degrees of protection provided by enclosures (IP code). The Access tube top cap is rated to IP55: IP5x = complete protection from contact. Dust allowed but does not affect function. IPx5 = (water) jets from a nozzle in all directions.

Electro-Magnetic Compliance

EMC approvals The Sentek RT6 System has been tested and found to comply with the following EMC guidelines:

EN55011/CISPR11 (AS/NZS2064) Group 1 Class B
EN50082-1 : 1992 (IEC 801-2,3,4)
FCC Part 15 Class B
FCC Part 2 Class B

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

Caution: ***Any modifications to any part of the system or to any peripherals may void the EMI compliance of the system or peripherals.***

Caution: ***The sensors/probes are not to be operated in free air as they may cause interference to radio communication devices.***

Caution: ***External power supplies connected to the logging facility must comply with safety and EMC requirements of the country in which the system is to be used***.

Caution: ***Ferrite beads must be fitted to both ends of the probe cabling in order to comply with EMC and FCC requirements.***

Chapter 2: General Description

System Overview

The Sentek RT6 System has been designed to log readings from multiple EnviroSCAN soil moisture probes/sensors at pre-selected time intervals (as short as 1 minute) for downloading into a computer. The software provides graphical data manipulation for analysis by trained growers, scientists or agronomists.

System components

The Sentek RT6 System consists of :

- logging facility
- EnviroSCAN probes or EasyAG probes
- access tube/top cap
- soil moisture sensors
- cabling
- IrriMAX software

Appendix A illustrates the components that make up a typical Sentek RT6 System and how it appears in the field.

Maximum configuration

The central logging facility is connected by cable to probes at each monitoring site. Probes can be located within cable runs of up to 500 meters from the logger. The logging facility supports 2 cable runs with each run supporting up to 16 sensors. See Appendix B for examples of configurations. The 16 sensors on each run can be connected on 1 probe or spread across up to 8 probes depending on application. With standard components the array of sensors can extend to a soil depth of 2.0 meters. Probes are available in standard lengths of 0.5m, 1m, 1.5m, 2m. The system has the capability of monitoring greater depths if required upon special request. See Appendix C for examples of probe configurations.

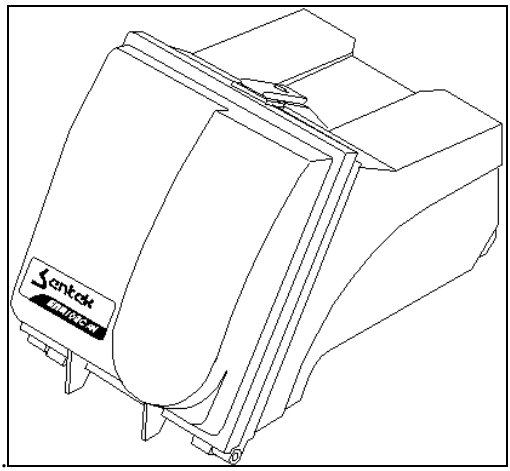
Downloading

Downloading of data can occur either in the field via a downloading cable to a notebook computer or in the office by removing the logger and transferring the data to a desktop computer. Additionally external

telemetry devices can be connected to the RT6 Main Board to provide remote communication or the system can be hard-wired to a computer utilizing RS485 communication.

System description

Logging Facility



The logging facility consists of :

- water resistant housing
- front panel
- RT6 Main Board
- removable logger
- battery

Housing

The UV-resistant housing is fixed to an aluminium mounting pole. The solar panel (if used) will also mount onto this pole.

The housing is designed to be water resistant and manufactured from a compound which is resistant to chemicals typically used in agricultural applications. The housing has a latched front lid that opens to gain access to the communication port for data downloading, removing logger for downloading back at office, running diagnostics or for servicing

(replacing fuses, etc).

Front Panel

The front panel is fixed to the Main Board and provides :

- front panel accessible fuses
- RS232 local communication port
- local/remote switch

See Appendix D for visual of the RT6 front panel.

Main Board

The Main Board provides the I/O connections to the removable logger, battery, probes, solar panel and external communications. The Main Board also performs the following functions :

- solar charger for SLA battery
- 10.5/11.5volt battery cut-off (ensures the SLA battery does not over-discharge)
- RS485 communication drivers
- RS232 communication drivers
- power drivers for Run-A and Run-B
- encoders, drivers and buffers for Run-A and Run-B
- receiver decoders for Run-A and Run-B
- lightning/surge protection

Removable logger

The removable logger contains the intelligence of the logging facility for control of I/O signals and recording of measurements.

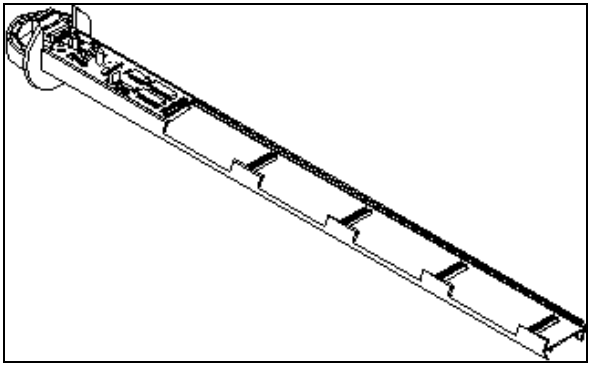
The removable logger performs the following functions :

- controls individual addressing of sensors to be powered and measured
- measures signal from sensors at preset sampling intervals
- stores measurements from sensors into battery backed memory
- controls separate powering of probe runs when sampling
- stores logger configuration in non-volatile memory
- battery backed time/day clock

- provides serial data communication with computer or external telemetry devices
- measures system voltages during diagnostics

Battery The SLA battery provides power to the logging facility during night periods (if solar powered) or in the event of external power failure.

EnviroSCAN Probes



The probe consists of :

- a plastic extrusion
- datum setting handle
- 5-wire interface board
- 20 way ribbon cable running along its length with connectors for sensors every 100mm

Up to 16 sensors may be connected at desired depths on any one probe for example sensors placed at 10, 20, 30, 50, 70, 90 and 120 cm. The sensors snap on to the probe with slots provided every 10 centimeters allowing the user to specify the sensor depths during installation or subsequently re-positioning sensors if required. See Appendix C for examples.

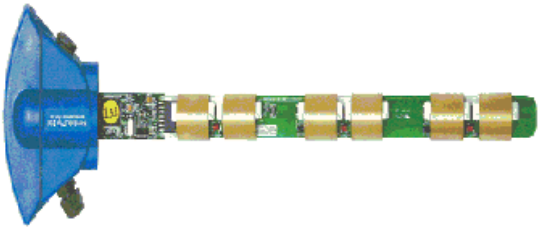
Standard length probes of 0.5 meters are used for shallow rooted crops or turf while 1, 1.5 or 2 metre probes are used for tree crops, vines and broadacre crops such as cotton. In research, waste water management, environmental and mining applications probes of longer lengths such as 5, 10 or 15 meters

are used.

Up to 8 probes may be connected to each run to support multiple probes on a site or multiple sites. See Appendix B for examples of configurations.

The maximum distance of any probe from the logging facility is *a 500 metre cable length*.
Cable joins should be no further than 0.5 meters from the probe. When a probe is needed more than 0.5m away from the main cable run, it should be looped in and cut close to the probe site to allow for joining. This will increase the length of the cable run, but ensure reliable operation of the system (so long as it stays under 500m).
Failure to follow these cabling guidelines can result in erratic readings.

EasyAG Probes



An EasyAG probe is a cost reduced fixed configuration (30cm or 50cm) instead of the fully configurable EnviroSCAN probe. The EasyAG probe consists of :

- An EasyAG top cap and integrated access tube
- 5-wire EasyAG interface board connected to an integrated sensor board with three or five sensors at 10cm intervals
- EasyAG sensors have a smaller diameter than EnviroSCAN sensors

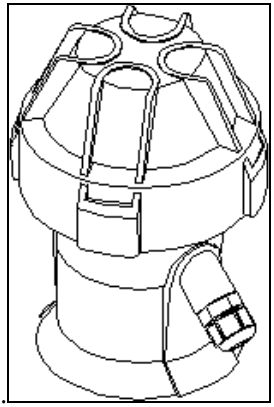
EasyAG probes can be intermixed with EnviroSCAN probes.
They must conform to the same cabling restrictions that apply to EnviroSCAN Probes.

Access Tube

The EnviroSCAN access tube (56.5 mm diameter) and the EasyAG access tube (32 mm diameter) have been manufactured to very high standards with a fine tolerance inside diameter so as to provide minimal internal air gap for the sensor.

Tube installation tools and cutting edges have been specially designed to install the access tubes into various soil types without air gaps. See the Access Tube Installation Manual or EasyAG Installation Manual for details.

EnviroSCAN Top Cap



The Top Cap assembly has been designed to prevent water and dust entry to IP55 IEC 60529 standard (see glossary). The assembly is made up of a body which has a removable cap with "O" ring that is screwed onto the body. The Top Cap body is glued to the top of the access tube. Removing the screw cap enables easy insertion and removal of the probe for repair or re-configuration without disturbing the soil profile surrounding the site.

The Top Cap has locaters for the probe which minimizes translocation effects resulting from rotating the probe in the tube following removal and re-insertion.

A cable gland located at the bottom of the body provides a watertight entry of the cable from the logging facility.

The Top Cap also has a stop for the probe so that the sensors are positioned vertically in the correct position in relation to the soil depth being monitored. The body automatically positions the probe so that it locates the first sensor at 10cm depth. Location of the first sensor at 50mm is achieved by fixing the body of the top cap assembly onto the access tube at 50mm from the soil surface.

After installation of the access tube, bottom stopper and top cap (see the Access Tube Installation Manual), the probe is lowered into this tube. Readings of soil water content are taken through the PVC access tube without any contact between the sensor and the soil. The bottom of the access tube is sealed with a watertight bottom stopper to protect the probe from entry of water.

EnviroSCAN Sensors

The sensor consists of a tubular housing with two brass rings. The electronic circuit contained within this housing plugs into a ribbon cable running along the extruded support rod which supports the sensors. This support rod can be fitted with multiple sensors (up to 16), located at 100mm intervals along its length.

The sensors slide onto the extrusion at the desired depth. The sensors may be replaced in the field. No gluing or soldering is necessary. A link is provided on each sensor to enable it to be easily addressed and re-addressed.

The sensors can be mounted on the support rod at depth intervals to suit a variety of crops and soil variability (see Appendix C). Each configuration of multiple sensors on the support rod is called a "probe".

The sensors/probe are lowered into a 50mm plastic access tube which is vertically installed in the soil and sealed at the top (with a screwed top cap) and bottom (with an expandable bung).

Cabling

The cabling between the logging facility and probes can be either:

1. SENTEK specific cable
SENTEK has undertaken to produce its own cable based on the exact electrical specifications of the TYFLO cable:

- UV resistant outer sheath with standard colors of inside cables
- solid filled sheathing to minimize water travelling down inside of the sheath into the access tubes.
- suitable for direct burial

Specifications of SENTEK cable are:

Make	TYFLO for SENTEK
Code	WMX57032-BK
Cores	5
Size	7/0.32
Area	0.56mm

2. TYFLO irrigation cable specification
The manufacturers of the TYFLO irrigation cable state it is Multicore Tyflo, Sheathed, Irrigation / Sprinkler Systems (http://tycab.com.au).

1. PRODUCT CODE WMX57032
2. DESCRIPTION 5 Core 7/.32 (0.56sq mm) HDPE insulated. Solid fill UV stable P.V.C. sheathed cable. Low Voltage. Not for mains connection.
3. CONSTRUCTION
3.1 CONDUCTOR: 7 strands of 0.32mm Annealed Copper to AS1125 drawn from Class 110A copper to AS1574.
Max. D.C. resistance at 20C : 33.0 ohms / km
3.2 INSULATION: Coloured High Density Polyethylene.
Nominal Diameter : 1.8 mm
Nom. Wall Thickness: 0.4 mm
3.3 LAY UP: 5 cores laid up around a circularising filler.
1. White 2. Yellow 3.Red 4. Green 5. Blue
3.4 SHEATH: Coloured (black) UV STABLE PVC.-

SOLID FILL
Nominal Diameter : 6.15 mm
Nom. Wall Thickness : 0.6 mm

The cables can be joined by way of water resistant 3M crimp connectors which are placed inside a water resistant junction box which also provides mechanical protection to the joins. The junction boxes can be filled with approved epoxy compounds to provide additional water resistance if required.

It is recommended that the cabling be installed in conduit to prevent damage by machinery, insects (ants, termites, etc) and animals.
Cabling should not be installed in close proximity to high voltage equipment (e.g. electric pumps). Cable running parallel with high voltage wires (including over-head power lines) can cause erratic readings.

Caution: ***Ferrite beads must be fitted to both ends of the probe cabling in order to comply with EMC and FCC requirements.***

Software

The IrriMAX software is an interactive Microsoft Windows system which provides the user with multiple options to access and graph or inspect the processed data.

The IrriMAX utility Data Exchange can communicate directly with the logger, through the RT6 front panel, or through a modem dial-up using the IrriMAX Remote Connection Manager (RCM).

The RT6 Logger Manager allows the configuration and testing of the logger.

For more information on these functions consult the IrriMAX manuals and online help.

Chapter 3: Technical Description

General System Operation

Sampling

Between sampling only the necessary circuitry of the logging facility is powered while it waits for the next sampling period. No power is applied to the probe cabling or probes between sampling.

During sampling the Sentek RT6 logger applies power to the probe cabling (and probes) and a signal to power up (address) a particular sensor. The address signal is processed by the probe interface (5-wire board) which applies power down one of the wires of the ribbon cable on the probe. The sensor that has been addressed (via PCB link) picks up the power from the ribbon cable and begins to oscillate at a frequency depending on moisture content of the soil. The signal from the sensor (open collector 40 to 80 kHz) is applied to a common wire on the probe ribbon cable back to the interface board.

Signal from sensor to logging facility

The 5-wire interface board converts the signal from open collector to differential drivers for transmission back to the logger via probe cabling.

Signal measurement

After addressing the sensor the logger waits for 0.5 seconds (while sensor stabilizes) then counts pulses for 0.5 seconds and records the reading in the removable loggers memory with a time/date stamp. The logger then sends a signal to power up (address) the next sensor (while turning off previous sensor) and repeats the process. Once all sensors have been recorded the logger removes power from the probes and waits for the next sampling interval.

Detailed technical description

Logging facility

The logging facility is capable of reading and storing data from multiple sensors at pre-selected sampling intervals ranging from 1 minute to 9999 minutes (i.e.

6.9 days). The sampling interval can be readily altered using the software. Note sampling intervals of less than 10 minutes require external power to be supplied to the logger as the solar panel may not provide sufficient charge for long term logging at 1 minute sampling intervals.

The logger memory will only hold a certain amount of data before the memory "wraps" and the oldest data is overwritten with newer data. Refer to Appendix J – Formula to Calculate Logger Storage Capacity to determine the time before readings are overwritten in the logger memory.

Between sampling intervals only the removable logger and part of the Main Board is powered and no power is supplied to the probes/sensors. When the sampling interval begins power is supplied to the first cable run (Run-A) and a signal is sent from the logger to power up (address) the first sensor. The logger waits for 0.5 seconds (while sensor stabilizes) then counts pulses for 0.5 seconds and records the reading with a time/date stamp. The logger then sends a signal to power up the second sensor (turning the previous sensor off) and repeats the process. Once all sensors configured on Run-A are recorded the logger powers up Run-B (while removing power from Run-A) and repeats the process until all sensors configured on Run-B are recorded. The logger then removes power from Run-B and waits for next sampling interval. Therefore the power is only applied to probes/sensors for a maximum of 32 seconds (32 sensors) at typical sampling intervals of 15 to 120 minutes which minimizes power consumption.
The removable logger is fitted with a Ni-Cad battery which is charged by the solar panel (or external power supply) and the internal SLA battery. The Ni-Cad battery protects the contents of the data memory and time/date clock when the logger is removed to download data in the office. Once removed from the logging facility the data is secure for approximately 2 days.

A computer is connected to the logging facility to configure the system and set the time/date clock. The configuration is stored in the removable loggers non-volatile memory which includes:

- Number of sensors on Run A
- Number of sensor on Run B
- Sampling interval
- Logger ID

Probe

Each EnviroSCAN/EasyAG probe comprises one or more soil moisture sensors placed along a support rod. The probe, usually with an array of multiple sensors, is installed into a vertical PVC access tube at representative locations.

During sampling the logger applies power to the probes and a signal to power up (address) a particular sensor. The address signal is processed by the interface (5-wire board) which applies power down one of the wires of the ribbon cable. The sensor that has been addressed (via PCB link) picks up the power from the ribbon cable and begins to oscillate depending on moisture content of the soil. The signal from the sensor (open collector 40 to 80 kHz) is applied to a common wire on the ribbon cable back to the interface board.

The 5-wire interface board converts the signal from open collector to differential drivers (RS485 type) for transmission back to the logger via probe cabling.

Sensor

The principle of operation of the EnviroSCAN/EasyAG soil moisture sensor is based on capacitance.

A capacitor consists of two conductive plates separated by an insulating material (dielectric). The value of capacitance (C) is determined by the area of the plates, distance between the plates and the

dielectric constant of the material between the plates.

The conductive rings of the sensor forms the plates of the "capacitor". As the area of the plates/rings and the distance between the plates/rings are fixed on the EnviroSCAN/EasyAG sensor, the capacitance (C) varies with varying complex dielectric constant of the material (dielectric) surrounding the plates/rings.

This “capacitor” is connected to circuitry which forms an oscillator. The frequency of oscillation is depending on the capacitance (C) which is effected by the changing complex dielectric constant of the material in the sensors sphere of influence. The oscillating capacitance field generated between the two rings of the sensor extends beyond the PVC access tube into the surrounding medium/soil (dielectric). Sensor sensitivity (sphere of influence) has been independently identified in laboratory conditions to be horizontally - 130 mm to 150 mm radius of axial centre in free air and vertically – 85 mm to 120 mm either side of axial centre.

If we assume that the soil and organic matter remains constant then capacitance varies with varying fertilizer (salinity), water and air. The frequency of oscillation was selected from scientific studies on high frequency excitation of various soil types with varying salinity, temperature and moisture content. The EnviroSCAN/EasyAG sensor has been designed to oscillate at frequencies where variations in salinity and temperature have minimal effect. Therefore the sensor is relatively immune to salinity/fertilizer variations at levels typically found in irrigated crops so responds by varying frequency of oscillation proportional to varying moisture content.

Due to logistics of transmitting (along cable) and recording very high frequencies (VHF) the frequency of oscillation of the sensor has been divided down by a factor of 2048 thus providing an output frequency proportional to frequency of oscillation. The data logger powers the sensor up for 0.5 seconds then

counts the pulses over 0.5 seconds to provide a "count" (hence equal to half the frequency). For example if the sensor is oscillating at 100 MHz the output of the sensor would be 48.828 kHz (100,000,000/2048) so the logger would record a count (equal to half frequency) of 24,414 (48,828/2).

These counts are recorded by the logger and downloaded to a computer without being processed. Software in the computer passes the counts through a calibration equation to provide values in soil water content for graphing. The default calibration equation provided in software was independently established (by CSIRO, USDA, etc) on various soil types using gravimetric sampling which is the international standard used to calibrate soil moisture sensors and soil moisture instruments such as the Neutron Probe.

Caution: ***The default calibration equation in the IrriMAX software is provided for those customers who require only soil moisture dynamics for irrigation scheduling purposes. Customers who require accurate soil moisture data for their particular soil type must calibrate the sensors to that soil. Gravimetric sampling is the recognized method for determining calibration equation (and constants) for a particular soil type.***

Following the calibration process on a specific soil/medium the constants of the calibration equation can be changed in the software to provide more accurate data.

Power Supply

SLA battery

The Sentek RT6 has an internal 12 volt 7A/hr SLA battery which provides power during night periods (if solar powered) or in the event of external AC/DC power failure. This battery has its charge maintained by applying a power source to the Main Board which incorporates a charger specifically designed to charge SLA batteries.

Power sources

The following power sources can be applied to the Main Board :

- Solar panel which is rated at 10 watts at 12 volts
- External DC supply which can range from 16 to 24 volts DC capable of supplying 1.5 amps. This can be from available DC supply or via two 12 volt car batteries (in series to give 24 volts)
- External AC supply which can range from 12 to 16 volts AC. This can be from available low voltage AC supply or via a 240 volt AC plug pack which delivers 16 volts AC at 1.5 amps.

Ni-Cad charger

The data logger board is fitted with a Ni-Cad battery which is also charged by the solar panel (or external power supply) or the SLA battery. This battery protects the contents of the data memory and time/date clock if the logger is removed to download data in the office. Once removed from the logging facility the data is secure for approximately 2 days. Connecting the logger to an "Office Download Cable" which is connected to power will charge this battery, thus prolonging the time the logger can be removed from the logging facility.

Power modes

There are 3 power modes:

1. No logger connected. With the battery cable plugged into the main board and without the logger plugged in, the battery charging circuit is active and is ready to receive charge from the external supply. This is done so that the battery can continue being charged while the logger has been removed from the logging facility for downloading.
2. Logger present. When the logger is connected to the unit then power is applied only to the circuitry that runs continuously. This is done to minimize power drain.
3. Sampling Sensors. During sampling of data from the sensors, only the circuitry that is required is powered. This is under control of the logger and is done also to minimize power requirements of the system.

Logger as on/off switch The removable logger acts as a power on/off switch when plugged and unplugged.

Caution: ***Always unplug the logger when repairing or re-configuring probes and probe cabling.***

Data downloading Options

The downloading of data from a logger can be performed in the following ways:

- In the field by using a notebook computer and a "Field Download Cable" connected to the front panel.
- Visiting the site, removing the logger, taking it to the office and downloading the data using the "Office download Cable". Then returning it to the site. This will result in gap in readings while the logger is not connected to the probes.
- Downloading in an office environment using remote communication by radio modem or phone line modem via an external RS232 remote telemetry device connected to the Main Board or via a remote device with RS485 capability connected to the Main Board.

Consult the Data Exchange Manual for details regarding the download process.

Sentek Technical Briefs are available to assist in designing and installing some types of modems.

Chapter 4: System Installation

Note: *It is essential that site selection and probe configuration planning be done before starting physical assembly and installation in the field.*
This planning is described in both:

- Access Tube Installation Manual, and
- EasyAG installation manual

At the end of this planning the required components can be ordered and the probe configurations are known.

It is recommended that the probes be built in an office environment then normalized before installation in access tubes in the field.
This chapter discusses the physical installation and electrical connection of the logging facility, solar panel and probes.

For information on the software see the IrriMAX Manuals.

Positioning

Mounting poles

The aluminium mounting poles are used to mount the logging facility and solar panel. Care should be taken when selecting the position of the mounting pole to ensure that there are no buried pipes or cables in close proximity.

Logging Facility

The logging facility should be attached onto the mounting pole in a position that gives easy access to the user and is out of the way of machinery. The logging facility should also be placed away from the access tubes to avoid compaction of the surrounding soil.

Solar Panel

The solar panel is mounted on top of its mounting pole so that it is free from obstruction of current and potential crop canopy.

It should point:
due north - for the southern hemisphere or
due south - for the northern hemisphere.

The panel should be angled to suit the sites latitude and season so that the sun shines at right angles to the face of the solar panel. In normal applications fixed setting of the unit to 45° from horizontal should suffice. For more efficiency the panel can be angled typically to 60° from horizontal in winter and 30° from horizontal in summer. The solar panel bracket has slots cut into the side to assist in setting these angles.

Access Tubes

The access tubes should be positioned to provide the best representation of the site to be monitored.

See the appropriate Installation Manual for details on installation of the access tubes and top caps.

Top Caps

See the Access Tube Installation Manual for details on installation of the access tubes and top caps.

Cabling

External Power

The length of the cable supplied with the solar panel should be sufficient for normal applications. If alternative external power sources are to be connected to the unit or the solar panel cable needs to be extended then the cable to be used is a 2 core sheathed cable with 16/0.3mm conductors.

Joining Cables

The following describes the method used for extending cable if greater distance is required or a repair is necessary.

1. Insert the cables into the junction box and pull through enough cable to make joining easy (approx 50cm).
2. Strip back the outer sheath so that 5cm of inner wires are exposed.

3. Insert the wires to be joined into the 3M Scotchlok connectors (Sentek part number 80100 Scotchlock, 2/4 wire cable) and crimp. To do this hold the connector with the button side down and insert the wires all the way into the ports and then crimp the button fully. Ensure that the cables are fully inserted into the gel-filled connectors prior to crimping. Failure to do this may result in unreliable connections. **Note:** Sentek recommends joining each wire in the cable, even if the wire is unused.
4. After all connections have been made pull back the cables so that 5-10mm of the outer sheath protrudes from the cable gland. Tighten the cable glands.
5. Tuck the connections into the box and attach the top cover.

Connection

The cables should be connected to the "SOLAR PANEL" connector X5 with the following color allocation (see Appendix E – Overlay Diagram);

Solar Panel	Red	=	+
	Black	=	-

Note:

The panels may be supplied to American standards which is the reverse of the above.

These cables should be marked with + and – however they can be checked with multi-meter for correct polarity. Check with diagnostics following installation and if diagnostics shows that Vsol is 0 volts (or low voltage) then cable is wrong way around.

If Extension Cable is used connect

Red	=	+
black	=	-

Internal Battery Cabling

The cable supplied to connect the internal battery to the main board has spade connectors at one end and a

2-pin plug at the other. The cables should be connected to the "BATT" connector X6 and the battery with the following color allocation (see Appendix E – Overlay Diagram);

Battery Cable	Red	= +
	Black	= -

EnviroSCAN Probe Cabling – at probe

Note: *This section is for EnviroSCAN probe cabling. The EasyAG Installation Manual describes cabling method for EasyAG probes.*

Only the specified cable should be used to interconnect probes with the logging facility.

The following is the method of connection of the cable run to the probe;

1. Loop the cable loosely twice through the ferrite bead (it will be repositioned later).

2. Pass the cable through the cable gland and into the centre of the top cap assembly.
3. Strip back the outer sheath of the cable so that 150mm of inner cables are exposed.
4. Strip the inner cables to expose 5 mm of bare copper conductor.
5. Screw the conductors into the 5-way connector plug found on the 5-wire board according to the wiring diagram in Appendix F. Check that the connector is crimping the copper wire strands

and not the plastic sheath of the cable. Ensure that less than 2mm of copper wire protrudes from connector else the cables may short when moved.

6. Pull the cable back through the cable gland until the black outer sheath no longer protrudes into the top cap.
7. Tighten the cable gland with a 15-mm open-end spanner.
8. Inject a small quantity of silicon into the centre of the cable and around the edges of the conductors, this will stop any moisture that may enter into the top cap assembly via the cable.
9. Reposition and tighten the ferrite bead cable so the ferrite bead is within 10cm of the top cap.

Caution: ***Ferrite beads must be fitted to both ends of the probe cabling in order to comply with EMC and FCC requirements.***

Probe Cabling – at logging facility

Only the specified cable should be used to interconnect probes with the logging facility.

The following is the method of connection of the cable run to the logging facility;

1. Loop the cable loosely twice through the ferrite bead (it will be repositioned later).
2. Pass the cable through the cable gland at the bottom of the logging facility housing.
3. Strip back the outer sheath of the cable so that 150mm of inner cables are exposed.
4. Strip the inner cables to expose 5 mm of bare copper conductor.
5. Screw the conductors into the 5-way connector plug supplied with the Main Board according to the wiring diagram in Appendix F. Check that the connector is crimping the copper wire strands and not the plastic sheath of the cable. Ensure that less than 2mm of copper wire protrudes from connector else the cables may short when moved.
6. Pull the cable through the cable gland until sufficient length is available to provide easy

access to Main Board when tilted forward for servicing.

7. Tighten the cable gland with a 15-mm open-end spanner.
8. Reposition and tighten the ferrite bead cable so the ferrite bead is within 10cm of the cable housing gland.

Caution: ***Ferrite beads must be fitted to both ends of the probe cabling in order to comply with EMC and FCC requirements.***

External RS232 cabling

The "RS232" connector on the RT6 Main Board (see Appendix E – Overlay Diagram for locations) provide serial RS232 signals which can be connected to external devices. These devices may be in the form of radio modems, computers, etc.

The following signals are made available for connection to these devices:

0V	=	0 volts or ground
RTS	=	request to send
TD	=	transmit data
RD	=	receive data
12V	=	12 volts (fused)

Consult the external device manual for the correct wiring method to these devices. Note that null modem connections need to be made at the computer end (see Appendix H) of the cable.

The cable used for connection should be attached through a cable gland in the base of the logger housing to ensure a watertight seal is maintained.

RT6 Jumper Settings: Jumpers JP1 and JP2 are shown on Appendix E – Overlay Diagram.

Jumper JP1 "TERM" is needed when multiple RT6 loggers are chained together on an RS485 cable. The

jumper must be on only the first logger and the last logger on the RS485 cable. If it is not present communications may be unstable on a long cable run (see Appendix I - RS485 connections).

Jumper JP2 "RS232/RS485" is used to select either RS232 or RS485 external communications.

To enable external RS232 connection the "RS232/RS485" jumper JP1 should be in the "RS232" position as marked.

Front panel/remote switch

Also, the switch on the Front Panel should be set to "Remote" position for communication through the external RS232 connection or to "Front Panel" for local communication through front panel RS232 connector.

RS485 cabling

Multiple RT6 logging facilities can be connected together (multi-dropped RS485) on a twisted pair screened data cable back to a computer. Note normal telephone cable is not suitable. Although only one pair is required for RS485 communication it is recommended that at least a two pair cable be installed in the event of failure.

Cable lengths up to 1km from computer to last logger can be used depending on cable specifications and data rate (baud rate). If problems are experienced with communication then lower baud rates should be tried.

The cable must daisy chain from logger to logger without the use of junction boxes or joins which effect the efficiency of the cables screen. Under no circumstances are T-joins to be used as this will effect reliable data transmission.

All "A" wires are connected together and all "B" wires are connected together and all screens are connected together. See Appendix I for wiring diagrams.

Jumper settings

The RS485 signal must be terminated at both ends of the cable. The last logger is terminated by installing the "TERM" jumper (JP1). All other loggers connected to the cable must have their "TERM" jumper removed.

Note un-terminated loggers can be removed without effecting data communication between computer and loggers. However the last terminated logger must not be removed without leaving the cable terminated.

If the Main Board is to be removed for a period during which data communication is to occur, either put a 120 ohm resistor between Pin A and Pin B on the RS485 cable-end connector or move the terminator to the prior RT6 logger and unwire the final cable from that logger.

Jumper JP2 (see Appendix E – Overlay Diagram) is used to select either RS232 or RS485 external communications. To enable RS485 connection the "RS232/RS485" jumper should be in the "RS485" position as marked.

Front panel/remote switch

Also, the switch on the Front Panel should be set to "Remote" position for communication through the RS485 connection or to "Front Panel" for local communication through front panel RS232 connector.

RS232-RS485 converters

Various forms and makes of RS232-RS485 converters are available for computers which may be purchased from local computer suppliers along with appropriate twisted pair screened data cable.

Assembly

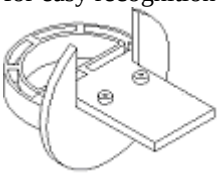
EnviroSCAN Probes

Note: ***This section does not apply to EasyAG probes.***

A step by step assembly training guide is available in EnviroSCAN probe assembly.ppt on the Distributor Resource Kit CD.

With a permanent marker pen, write the probe number on each probe (on the probe handle, top cap and access tube) as per the system specification to avoid mixing up the components during assembly and for easy recognition in the field

Handle



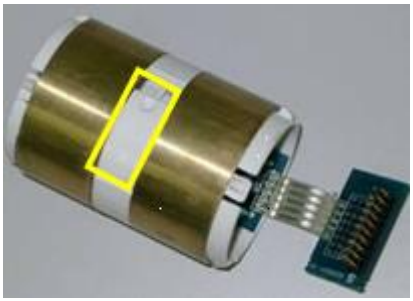
Attach the probe handle to the probe rod with the use of the backing plate and locating screws.

Interface board

Attach the 5-wire board to the probe rod making sure the connector pins are properly located in the socket on the probe rod and secure using the screws.

A cable tie placed around the probe rod at the 5-wire board connector that plugs onto the probe will prevent it from becoming loose and causing intermittent contact.

Fitting sensors



Slide sensors onto the probe rod while pressing on the locator lever (highlighted on the picture) between the

brass rings and position at the required depth locations. It may be necessary to slightly rotate the sensor assemble to allow the locator to interlock with the slot in the probe rod. To allow the sensor to be easily slid along the probe rod gently pull out the ribbon/pin connector assembly and fold it back over the top of the sensor.

Addressing sensors Once all sensors have been attached to the probe rod address them using the addressing link according to the system specifications (refer to Appendix G for address link positioning). Run diagnostics to ensure the sensors have been addressed correctly.

The probe can be inserted into the access tube ensuring that the cut-out in the probe handle aligns with the tabs inside the top cap. The connector can be plugged into the interface board and the top cap screwed on.

Caution: ***To ensure accurate and consistent readings for each sensor it must be normalized during initialization of the logger configuration by IrriMAX. This is generally done in an office environment, before the probe is installed in the access tube. See Operating Instructions chapter.***

EasyAG 5-wire Probes

Attach 5-wire interface board to sensor PCB Line up the sensor assembly and interface so that the main component sides of both PCB's are facing the same way.
Push the 14 pin interface socket onto the sensor PCB pins. Using the small holes in the PCB's, secure by looping two small cable ties between the two PCB's.

Set Sensor addresses In order for the logger and mainboard to be able to determine which sensor is which, each sensor must have a separate "address".
When using the EasyAG probe, this is done on the interface by linking the wires soldered into the sensor tracks (labeled S1 to S8) to appropriate sensor positions (1 to 16) in ports P1 and P2.
When using the standard supplied wire, the wires do

not need to be soldered into ports P1 and P2.
Refer to Appendix G for detailed diagrams of sensor addressing

Logging Facility

Caution: ***All cabling must be completed before plugging the battery cable or external power (solar panel etc) into the main board.***

Caution: ***Never work on the unit or cabling when either the battery or external power is connected and the logger is plugged in.***

Order Plug cables into the Main Board/Front panel in the following order;

- RS485 (X8)
- external RS232 (X7)
- probe cables (X2/3)
- battery power (X6)
- external power (X5)

Reverse the above order when removing Main Board.

Probe cables ***RT6 Main Board***
Attach each 5 way connector of the cable runs to the main board to position X2 or X3 (see Appendix E – Overlay Diagram) taking care to connect the Run A cable to the Run A connector (X2) on the Main Board and likewise with Run B (X3).

SLA Battery The SLA battery is inserted into the logger housing with the terminals positioned to the rear and the cable protruding over the top left-hand side of the battery.

Connect the battery to the Main Board at position X6 (see Appendix E – Overlay Diagram).

Fixing Main Board/front panel Position the main board/front panel assembly in the logger housing with the logger ribbon connection cable protruding from under the left side of the Main Board and secure with screws, taking care not to screw through the logger cable.

Logger Connect the logger to the logger ribbon cable and

position the logger in the fold-down front cover of the logging facility. Velcro fasteners will hold the logger in place when the front cover is closed.

Caution: ***Only connect the logger once all other components (including probes, probe wiring, external power wiring, etc.) have been assembled, installed and connected.***

Chapter 5: Operating Instructions

Initial logger configuration and normalization

It is recommended to configure the RT6 Logger and assemble the sensors and normalize them in an office environment before installation of the probe in the field.

The software in the logger must be configured to match the probe configuration assembled for this Sentek RT6 System. This involves:

1. In IrriMAX, setup the database using the Logger Configuration dialog then click "Send to RT6" to put the configuration in the logger. This specifies the Logger Id, sampling interval, probe and sensor configuration on Run A and Run B and communication baud rate.
2. Then using the Logger Configuration dialog, normalize the sensors in each probe.
3. Using Logger Manager to set the logger wake up times.

This process is described in the Logger Configuration section of the IrriMAX manual and in the Logger Manager manual.

Day-to-Day Operation

Once installed the Sentek RT6 System will operate continuously without requiring the user to perform any regular ongoing tasks.

The logger will store readings taken by the sensors and hold these readings in its memory until cleared by the user or overwritten by the logger itself.

Note: The logger memory will only hold a certain amount of data before the memory “wraps” and the oldest data is overwritten with newer data. Refer to Appendix J – Formula to Calculate Logger Storage Capacity to determine the time before readings are overwritten in the logger memory.

At the appropriate time, when required, the user will download these readings from the logger and store them in the database on a computer for manipulation using the IrriMAX software. (Refer to the Data Exchange Manual for instructions regarding the download process and other software information).

Front Panel Download

If you have a laptop computer and a Field Download Cable you can visit the RT6 logger site and download the readings into the laptop.
The reading can either:

- be saved in a Logger Image file for later updating of an IrriMAX database, or
- directly update the IrriMAX database on the laptop.

In either case you can transfer the laptop data to a an IrriMAX database on the office computer using Data Exchange.

To download in the field:

1. ensure your laptop is fully charged
2. connect the Field Download Cable from your laptop and to the Front Panel communications connector
3. On Front Panel position the "Remote/Front Panel" to "Front Panel".
4. On the laptop Start Data Exchange, select source "RT6 Logger" and destination the matching IrriMAX database or the required Logger Image file.
5. click Start
6. when the download is complete, close Data Exchange
7. unplug the communication cable
8. reposition the "Remote/Front Panel" to "Remote" (this step not necessary if a modem is not used).

Removing the logger for downloading

Removal of the logger from the logger housing to download the data onto the computer should be done and returned as quickly as possible. The reasons for this are twofold:

- Whilst removed from the system no further readings are being taken of the soil moisture content. The logger controls the process of data collection and stores these readings. Without the logger connected this cannot occur.
- The logger contains a rechargeable Ni-Cad battery that maintains the contents of the loggers memory as well as the time and date clock. If this battery is discharged sufficiently this information can be lost and vital data along with it. When connected to the system, this battery is recharged to the correct level. Disconnected from the system the battery should hold the configuration for approximately 48 hours.

Chapter 6: Maintenance

System

Regular maintenance of the Sentek RT6 System should consist of cleaning of the logger housing to ensure dust and grime is kept to a minimum.

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 compacting of the soil around the probe, thus giving a false indication of the soil moisture content

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

Sentek Distributors can provide a regular maintenance program which consists of regular visits by an authorized installer to test and ensure correct operation of the system. A regular maintenance program such as this will ensure that the Sentek RT6 System functions properly and continues to give worry free operation.

If problems are experienced, running diagnostics may assist in determining any system faults. Consult the RT6 Logger Manager Manual for further details.

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 Scarer” can be fitted to top of solar panel.

Cabling

Regular inspection of the cabling for damage from insects, animals or machinery should be carried out. If necessary the cabling can be trenched (with or without conduit) or elevated away from potential damaging elements.

Joining Cables

The following describes the method used for repairing damaged cable;

1. Insert the cables into a two-way junction box and pull through enough cable to make joining easy (approx 50cm).
2. Strip back the outer sheath of the cable so that 5cm of inner cables are exposed. If transmitters and receivers are not being used in the system then cut back the white cable.
3. Insert the cables to be joined into the 3M Scotchlok connectors (Sentek part number 80100 Scotchlock, 2/4 wire cable) and crimp. To do this hold the connector with the button side down and insert the wires all the way into the ports and then crimp the button fully. Ensure that the cables are fully inserted into the gel-filled connectors prior to crimping. Failure to do this may result in unreliable connections. **Note:** Sentek recommends joining each wire in the cable, even if the wire is unused.
4. After all connections have been made pull back the cables so that 5-10mm of the outer sheath protrudes from the cable gland. Tighten the cable glands.
5. Tuck the connections into the box and attach the top cover.

SLA battery

The SLA battery supplied with the Sentek RT6 System has a typical life expectancy of 1 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 at night) it will require replacing.

Removable loggers Ni-Cad battery

The Ni-Cad battery inside the removable data logger has a typical life expectancy of 1 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 and time/date when removable logger is unplugged) it will require replacing. This can be done by a Sentek approved electronic technician.

Chapter 7: Moving & Storing

The Sentek RT6 System has been designed as a system that can be removed, transported, stored and re-installed with care. It has not been designed as a truly portable unit and therefore great care must be taken when this is undertaken.

Caution: ***The SLA battery must be removed from the logger housing whenever it is being moved or transported. Failure to do this may result in mechanical damage.***

Caution: ***To maintain your Sentek Warranty, system removal and re-installation should only be undertaken by a Sentek Authorized Installer***

System Removal

Note: *Some of these steps do not apply to EasyAG probes. Removing those tubes is described in the EasyAG Installation Manual.*

The following steps are to be followed when removing the system. This will ensure the system will function correctly when re-installed:

Disconnect the Logger

- Open the logger housing and disconnect logger by carefully pulling out the connector

Remove SLA battery

- Remove the front panel to gain access to the battery
- Remove the battery and replace the front panel

Disconnect the Probe/s

- Unscrew the top cap
- Unplug the 5-wire cable from the 5-wire board

Remove the Probe/s from the access tubes and immediately place in transport tube/s

- Grasp the probe handle and while holding the 5-

wire cable out of way, pull out the probe. Gently wobble the probe while pulling upwards to assist in removal if necessary
- Place probes inside transport tubes and seal.

Where probes are long or removal is in an awkward situation preventing the probes from immediate placement in transport tubes, a clean ground sheet is essential to place probes on.

Remove the Top Cap Lower Assembly
- carefully remove the top cap lower assembly from the access tube
- clean inside the top cap assembly to remove any silastic (sealant)

Remove the Bottom Stopper from the access tube
- Use the bottom stopper tool (found in Toolkit 1) to remove the bottom stoppers from the access tubes.

Remove the Access Tube
- Short access tubes (0.5m) can often be pulled out by hand
- Longer tubes may require digging out or wetting of the soil to pull out, or use of the access tube extraction tool (or Extraction tool, EasyAG).
- If access tube is to be re-used inspect the tube for damage and clean as appropriate

Remove the Solar Panel and Logger Housing from the Mounting Pole
- Leaving the solar panel cable connected to logger housing, loosen the solar panel bracket and remove from the mounting pole
- Loosen the logger housing bracket and remove from the mounting pole
- Remove and roll up the probe cabling carefully to avoid tangling, and secure
- Remove the logger housing/solar panel mounting pole
- Place the logger housing and solar panel into padded transport box/boxes

Caution: ***The SLA battery must be removed from the logger housing whenever it is being moved or transported. Failure to do this may result in mechanical damage***

due to battery movement.

Transportation

The following should be observed whenever transporting the Sentek RT6 System:

Caution: ***Never tip logger housing forward withSLA battery installed as this may cause damage to Main Board by battery movement***

Caution: ***The SLA battery must be removed from the logger housing whenever it is being moved or transported. Failure to do this may result in mechanical damage due to battery movement.***

Caution: ***Probes/logger housing/solar panel must be transported in padded transport boxes/transport tubes and these must be secured***

Caution: ***Solar panels should be protected from any damage by objects dropping onto the glass***

Caution: ***Avoid dropping or jarring of equipment during transport***

Storage

While the Sentek RT6 System is not installed in the ground it can be safely stored until it is required for re-installation.

The following points should be observed to ensure the system is fully functioning when re-installed:

- Remove the Sentek RT6 System according to the procedures outlined above.
- Transport the system to storage area according to procedures outlined above
- Connect the solar panel and SLA battery to the main board. Leave the removable logger disconnected.
- Store the system in a secure area where the solar panel receives direct light in normal daylight conditions. Ensure that the logger is positioned so that the SLA battery can not move forward.
- Clean the solar panel from time to time

-

Caution: ***Failure to follow this procedure will cause the internal SLA battery to discharge below the recommended minimum voltage which may damage the battery permanently, requiring replacement.***

Chapter 8: Trouble Shooting

Caution: ***Trouble shooting and fault rectification should only be undertaken by a Sentek trained RT6 System installer. Failure to do so will result in the Warranty being void.***

Fuses

RT6 Main Board To allow easier replacement of fuses the RT6 Main Board has the three fuses which protect the circuitry, accessible from the front panel (see Appendix D).

Description:

- Fuse F1 (0.5 amp): Protects the power supply circuitry that provides power to each of the cable runs,
- Fuse F10 (1.0 amp): Protects the Solar Panel or Plug Pack from damage caused by failure in the rest of the Sentek RT6 System, and in some cases damage to the system from Plug Pack power surges,
- Fuse F11 (1.0 amp): Protects the battery against damage caused by system failure.

Faults

The Sentek RT6 System has been developed to a point that allows relatively easy identification of faulty or troublesome parts and enables quick identification and replacement of these parts.

To assist in diagnosing and determining the components most likely at fault the software contains RT6 logger Manager (Refer to its manual for an explanation of this program).

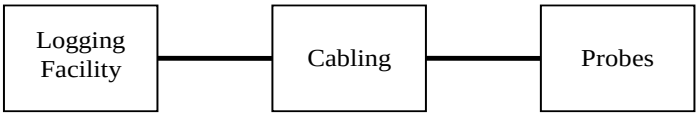
Identifying a fault There are three ways of identifying whether the Sentek RT6 System has a problem that requires attention. They are:

- The RT6 Logger Manager program not showing any "Immediate" raw value on one or more sensors,
- The RT6 Logger Manager not showing any

calibrated values when connected the relevant database for one or more sensors,

- Unable to connect to the logger with RT6 Logger Manager or with Data Exchange program.

When determining where in the Sentek RT6 System a problem lies, it is easier to divide the components into three major sections and identify which of these areas could be at fault. They are as follows:



Once you have been able to determine in which of these three major components the problem lies, it is then easier to identify and replace the faulty unit or repair the fault.

Fault Determination

Symptom	Possible Cause	Rectification
No communication with logger	Battery low (<12.5V)	Solar panel failed or dirty
	Fuse blown	Replace fuse
	Download cable faulty	Replace cable
	Logger 25 way cable faulty	Replace cable
	Logger faulty	Replace logger
	Main board faulty	Replace main board
	Jumpers incorrectly set	Check positioning of jumpers
	Local/Remote switch on RT6 front panel incorrectly positioned	Check and reposition if necessary
	Logger baud rate is not the same as the baud rate using to connect	Try all baud rates available.

Symptom	**Possible Cause**	**Rectification**
	Connecting through wrong COM port	Ensure the COM port selected is the one to which the computer cable is plugged..
Missing data	Battery faulty e.g. data missing only at night	Replace battery
	Solar panel faulty	Clean or replace solar panel
	Logger 25 way cable faulty	Replace cable
Sensor not working	Sensor failed	Replace sensor
	5-wire board failure	Replace board
	Probe failure	Replace probe rod
	Main board failure	Replace main board
	Logger failure	Replace logger
Probe not working	Probe failed	Replace probe rod
	Receiver failed	Replace receiver
	5WB failed	Replace 5WB
	Cable faulty	Repair or replace cable
	Main board failure	Replace main board
	Logger failure	Replace logger
Run A and/or B not working	Cable faulty	Repair or replace cable
	Fuse blown	Replace fuse
	Probe faulty	Identify faulty probe by unplugging probes one-by-one, then repair the probe.
	Main board failure	Replace main board
	Logger failure	Replace logger

Cable Faults

Checking for breaks:

Disconnect all components from the cable run that you wish to test.

Place a Shorting Link on the connector at one end of the cable run and at the other end using a multi-meter check the resistance between every conductor on all of the connectors on that run.

Zero resistance for each of the conductors between the shorting link and multi-meter indicates that there is no break.

Infinite resistance indicates there is a break in the cable run and you may need to move the multi-meter or shorting link to another location to pinpoint the section of cable in which the break occurs.

Checking for shorts:

Disconnect all components from the cable run that you wish to test.

Using a multi-meter check the resistance between every conductor on any of the connectors on that run.

Low resistance indicates there is a short somewhere on that cable run. If the cable run has 3-way junction boxes on it you will need to remove the scotchloks connectors from the conductors showing the short and test each section of cable individually until the short is located.

Replacement Procedures

Battery

Caution:

Do not install a flat or low charge (<50%) battery when ambient temperature is above 40 degree C. Component damage may result.

1. Unplug logger
2. Remove the front panel screws and tilt panel to access rear of main board
3. Unplug the battery cable from main board and remove battery from compartment
4. Remove battery cable from old battery and

connect to new battery
5. Install battery into compartment in housing
6. Plug in battery cable into main board
7. Screw front panel onto housing
8. Plug in logger
9. Run diagnostics

Main Board/ Front panel

1. Unplug logger
2. Remove the front panel screws and tilt panel to access rear of main board
3. Unplug cables from main board/front panel in the following order;
    - external power (X5)
    - battery power (X6)
    - probe cables (X2/3)
    - external RS232 (X7)
    - RS485 (X8)
4. Plug cables into a replacement main Board/Front panel in the following order;
    - RS485 (X8)
    - external RS232 (X7)
    - probe cables (X2/3)
    - battery power (X6)
    - external power (X5)
5. Insert the front panel screws
6. Plug in logger
7. Run diagnostics

Probe

1. Remove the top cap
2. Lift probe sufficiently to unplug the connector of the probe cable
3. Lift probe completely from access tube
4. Insert new probe into access tube until cable can be plugged in
5. Plug in probe cable connector
6. Insert probe fully into access tube
7. Replace top cap

5-wire board

It is not recommended to replace failing EasyAG 5-wire boards in the field.

1. Remove the top cap
2. Lift probe sufficiently to unplug the connector of the probe cable

3. Lift probe completely from access tube

EnviroSCAN Probe only

4. Remove the screws that hold the 5-wire board
5. Remove the faulty 5-wire board
6. Insert the replacement 5-wire board
7. Re-install the screws that hold the 5-wire board

EasyAG Probe only

8. Cut the cable ties holding the 5-wire board to the sensor board
9. Take note of the current 5-wire board sensor address wiring and change the replacement 5-wire board addressing to match. (see page 36 EasyAG 5-wire Probes and Appendix-G)
10. Plug the 5-wireboard to the sensor board
11. cable tie the 5-wire board to the sensor board

Both EnviroSCAN and EasyAG probes

12. Insert probe into access tube until cable can be plugged in
13. Plug in probe cable connector
14. Insert probe fully into access tube
15. Replace top cap

EnviroSCAN Sensor

Failing EasyAG sensors cannot be replaced in the field.

1. Remove the top cap
2. Lift probe sufficiently to unplug the connector of the probe cable
3. Lift probe completely from access tube
4. Remove the sensors from the probe until the faulty sensor has been removed
5. Replace the faulty sensor
6. Replace the sensors that have been removed
7. Perform sensor normalization as per instructions in the IrriMAX Manual
8. Insert probe into access tube until cable can be plugged in
9. Plug in probe cable connector
10. Insert probe fully into access tube
11. Replace top cap

Solar Panel

1. Unplug logger
2. Remove the front panel screws and tilt panel to access rear of main board

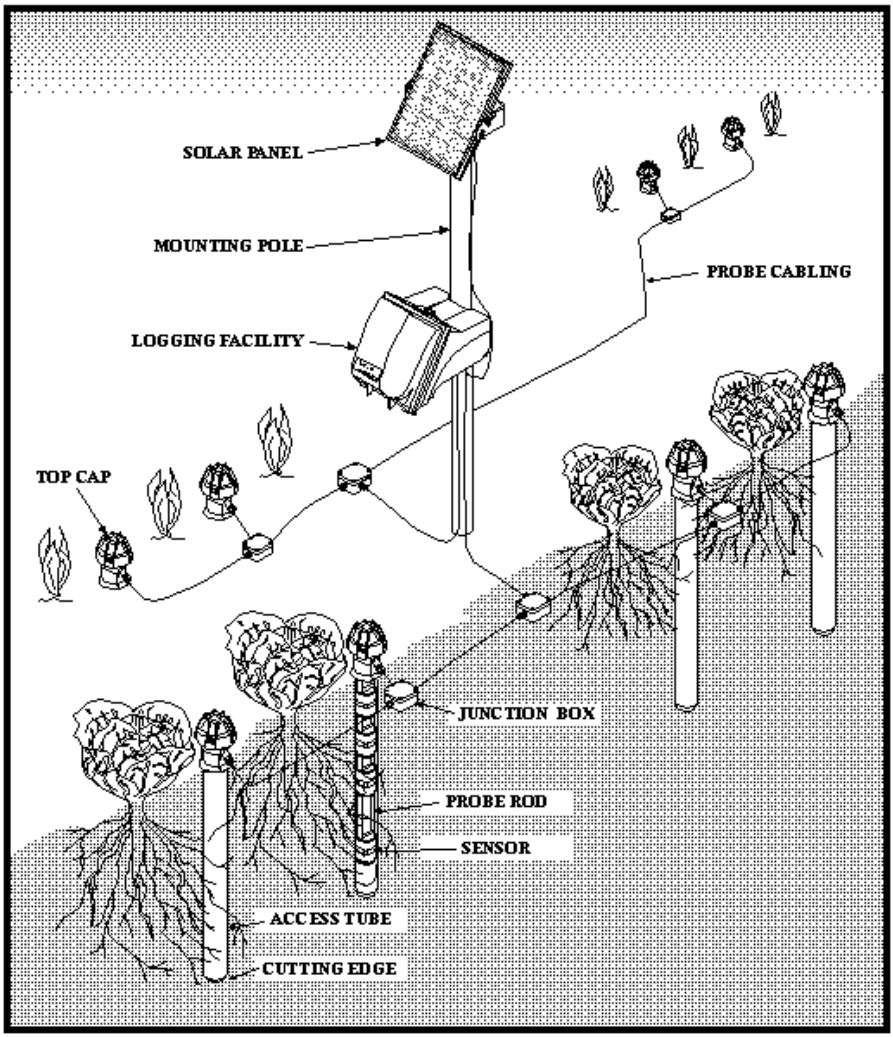
3. Unplug the solar panel cable from main board
4. Remove cable from plug
5. Undo the cable gland and remove the solar panel cable
6. Unbolt the faulty solar panel from the solar panel bracket
7. Install the replacement solar panel and check angle
8. Insert cable into cable gland at bottom of housing
9. Install cable into plug (note orientation)
10. Plug the cable into the main board
11. Tighten the cable gland
12. Screw front panel onto housing
13. Plug in logger
14. Run diagnostics

Logger

1. If possible download the data using Data Exchange
2. Unplug the logger
3. Plug in the replacement logger
4. Configure the logger as per the IrriMAX Manual
5. Run diagnostics with RT6 Logger Manager

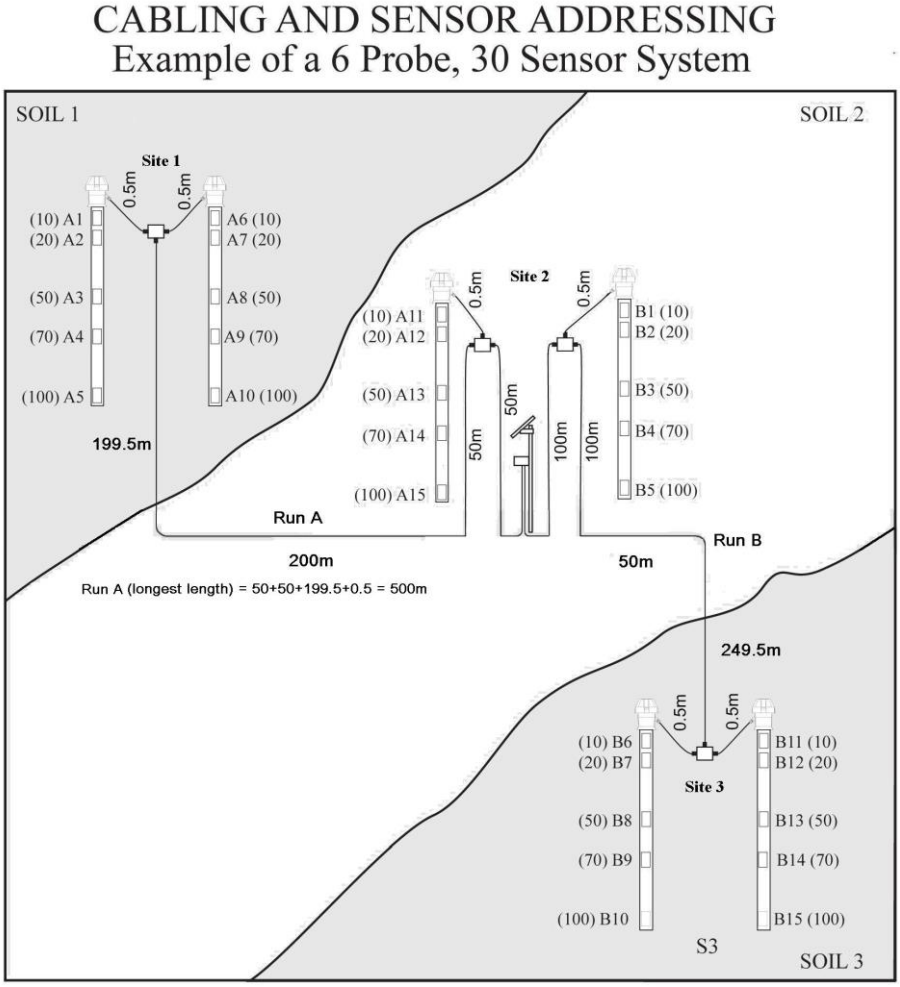
APPENDIX A

System Overview

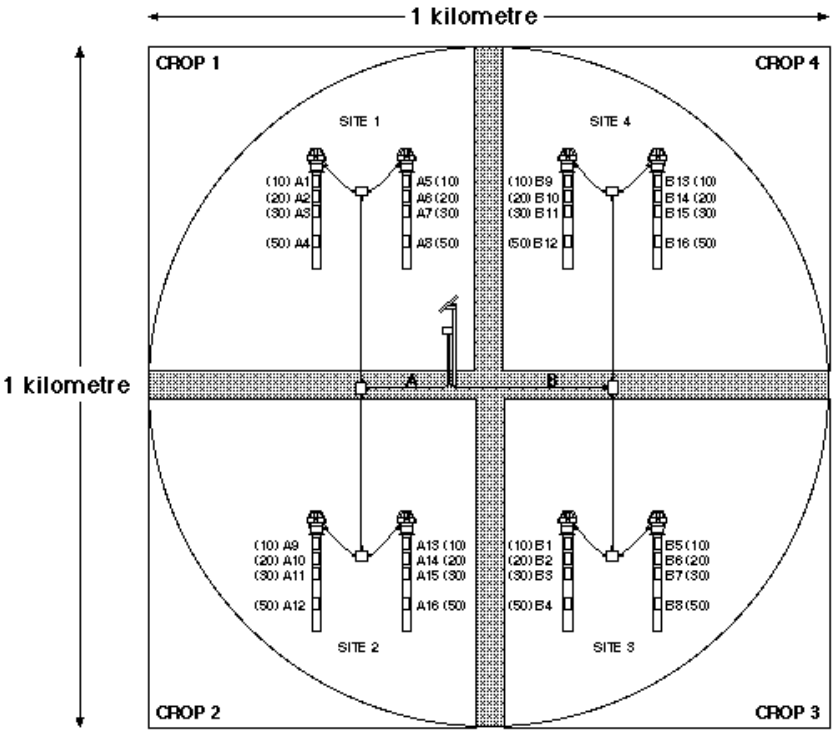


APPENDIX B

System configuration examples



CABLING AND SENSOR ADDRESSING
Example of an 8 Probe, 32 Sensor System

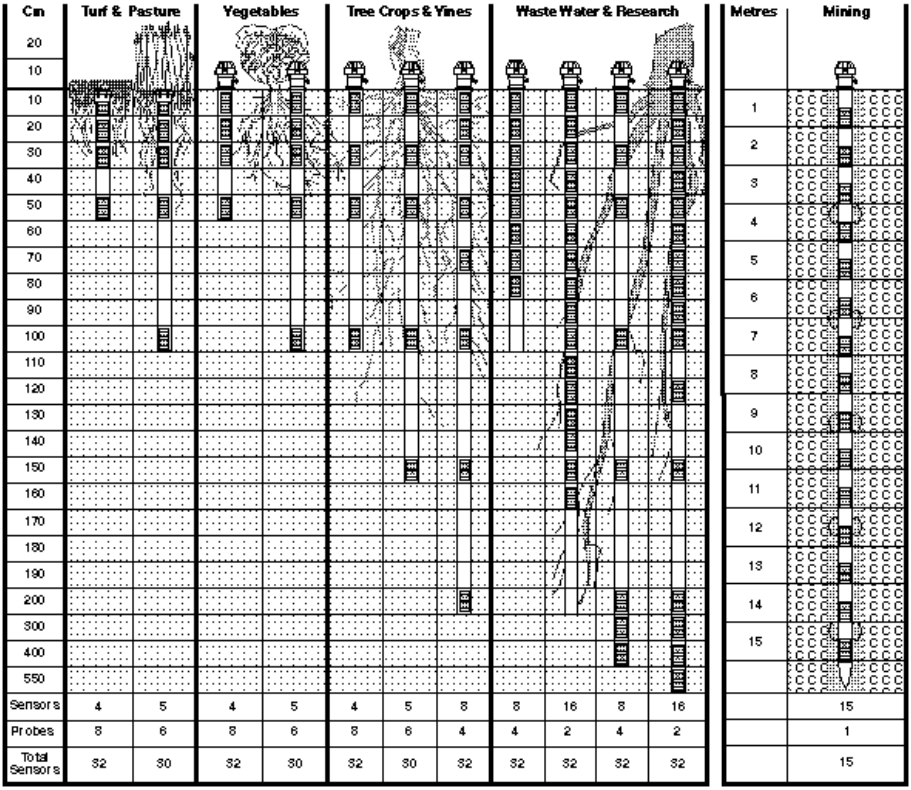


APPENDIX C

Probe configuration examples

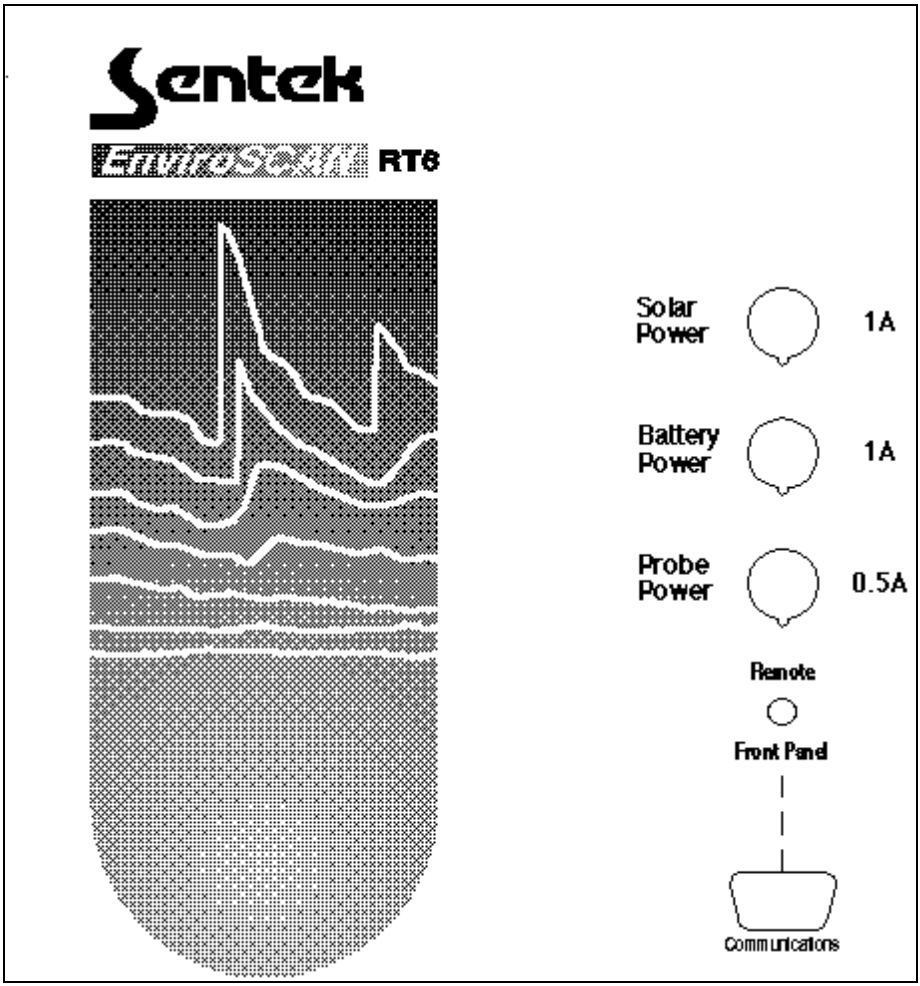
Sentek
ENVIRONMENTAL INNOVATIONS

SENSOR DEPTHS



APPENDIX D

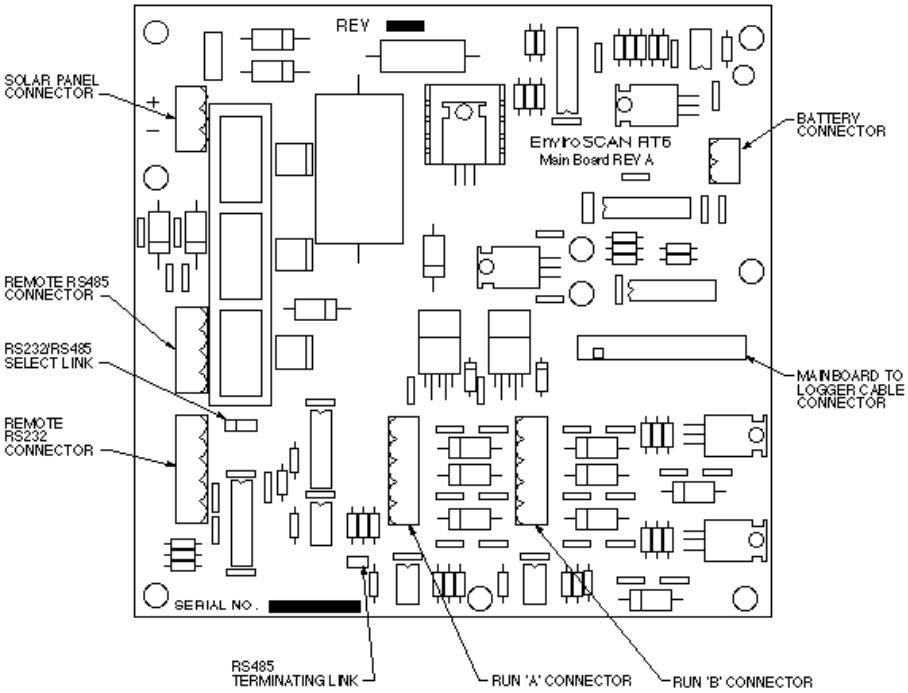
Front panel visual



APPENDIX E

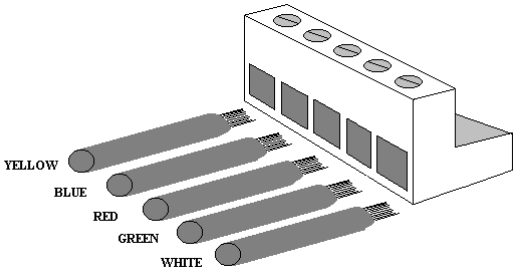
Overlay diagram

RT6 Main Board Overlay



APPENDIX F

Cable Wiring Order



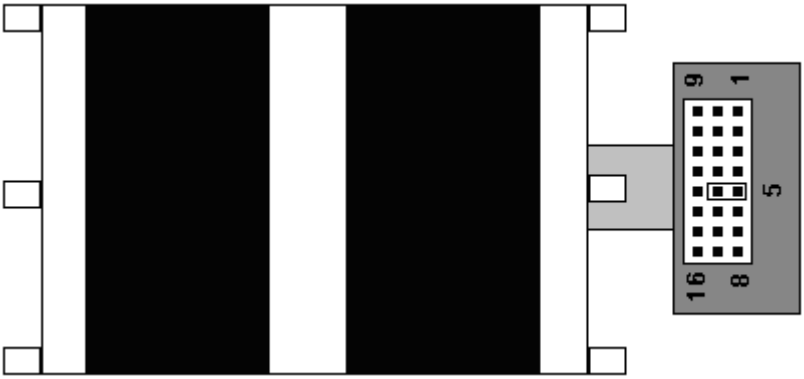
5-wire Connector

APPENDIX G

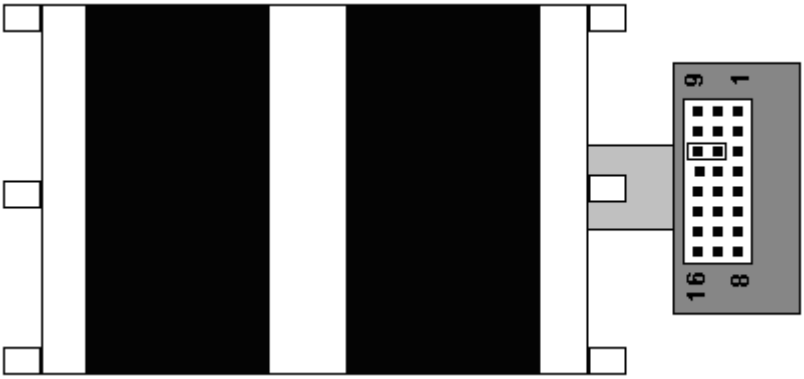
EnviroSCAN Sensor Addressing

Run A
- Addressed as link 1 to 16
- address as A1 to A16 in software setup

Run B
- Addressed as link 1 to 16
- address as B1 to B16 in software setup



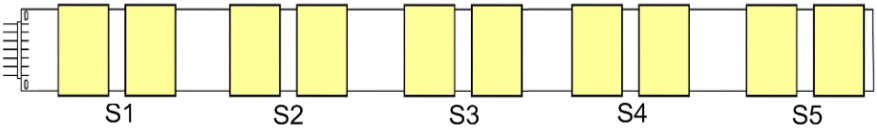
Box around pin number five shows the link installed to address as sensor five.



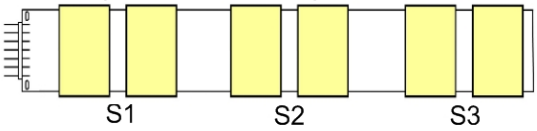
Box around pin number eleven shows the link installed to address as sensor eleven.

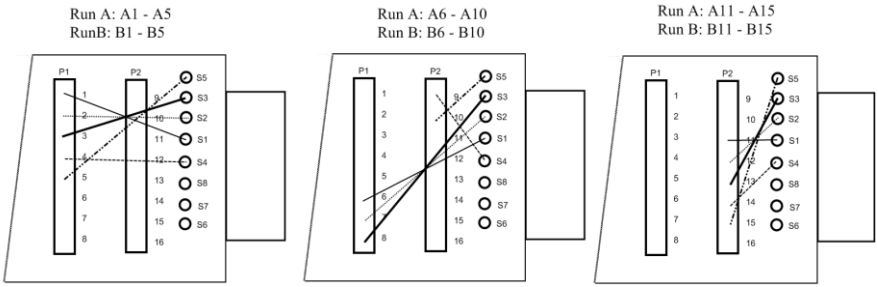
EasyAG Sensor Addressing

50cm EasyAG sensor assembly

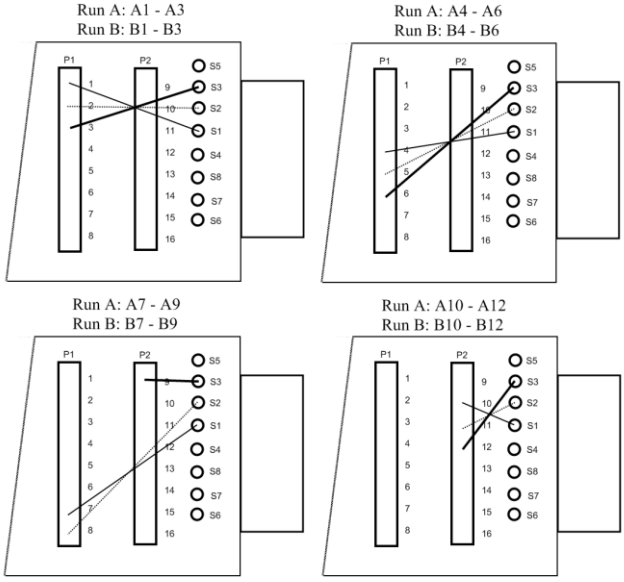


30cm EasyAG sensor assembly





This example shows wiring for a 6 probe 50cm 5-wire EasyAG configuration.

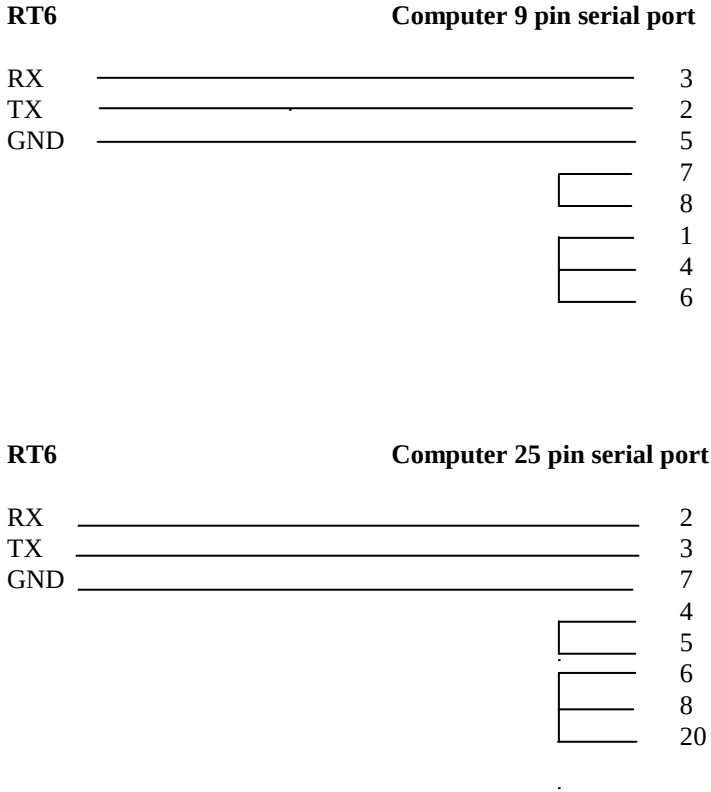


This example shows an 8 probe 30cm 5-wire EasyAG sensor configuration

APPENDIX H

External RS232 to computer cable diagram

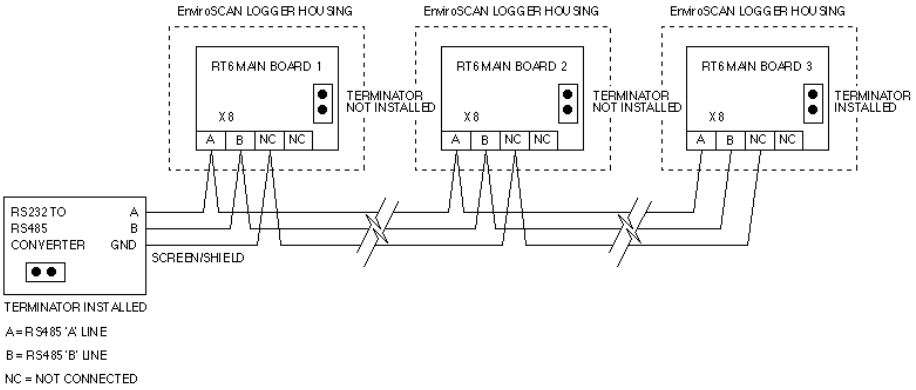
The following diagram shows the wiring connections between the external RS232 connector and computers serial port.



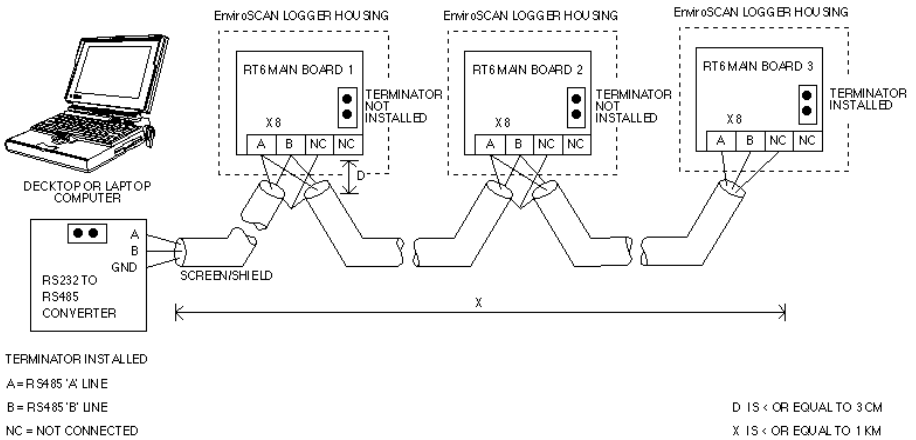
APPENDIX I

RS485 connections

RS485 Circuit Diagram



RS485 Physical Connections



APPENDIX J

Formula to Calculate Logger Storage Capacity

Please use the formula below to calculate the maximum period that you can allow to pass before you have to download your logger. Failure to download data within this period will lead to a partial loss of data, since the logger's memory will start to overwrite the data. The length of that period is determined by a constant (86), the sampling interval in minutes (which can be altered) and the number of sensors installed (variable).

$$\textbf{No. of Days until memory wraps} = \frac{\textbf{86 x Sampling Interval (min.)}}{\textbf{Number of Sensors}}$$

Example:

16 sensors logging every 2 hours: $\frac{86 \times 120}{16}$ = 645 days

12 sensors logging every 1 hours: $\frac{86 \times 60}{12}$ = 430 days

5 sensors logging every 10 minutes: $\frac{86 \times 10}{5}$ = 172 days

32 sensors logging every 10 minutes: $\frac{86 \times 10}{32}$ = 26 days & 21 hours

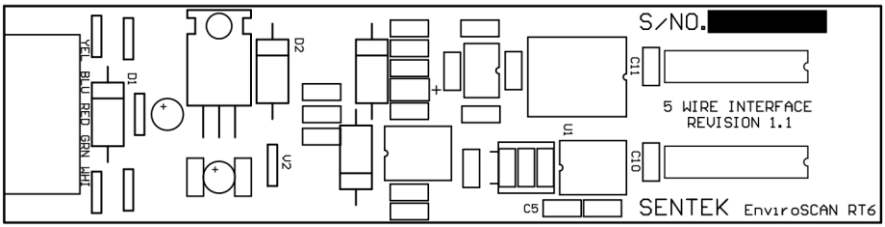
APPENDIX K

Specification Sheets

EnviroSCAN soil moisture sensors

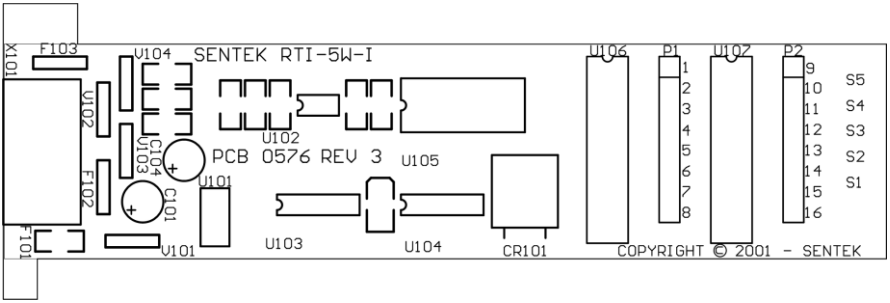
Note:	***This sensor specification does not apply to EasyAG probes.***	
Measuring Principle	Capacitance via the dielectric effect	
Installation	Non-contact via Sentek's 50mm PVC access tube	
Depth	Up to 5.5 m vertical depth (deeper upon request)	
Framework	PVC	
Sensing Elements	2 copper rings	length = 25mm diameter = 49mm spacing = 10mm
Sensitivity	Horizontal	130mm to 150mm radius of axial centre in free air
	Vertical	85mm to 120mm either side of axial centre
Spacing	Minimum interval between sensors of 100mm between axial centers	
Signal output	Maximum 100khz open collector (free air)	
Temperature range	-30 to +85 degrees Celsius	
Measurement range	No upper or lower limits of Volumetric soil water	
Resolution	+/- 0.002% (+/- 1 count in 50000)	
Accuracy	The correlation coefficient of the probe signal with soil water content is at R2 = 0.984 (as tested by CSIRO)	
Drift	Less than +/- 0.5%	

EnviroSCAN 5-Wire Technical Specifications



PCB Revision:	REVISION 1.1	
5-Wire Interface connector type:	Brand: Phoenix Contact MSTB 2.5-5.08 (Plug)	
5-Wire Interface pin configuration:	1	Yellow (Data A)
	2	Blue (Address)
	3	Red (Power)
	4	Green (Ground)
	5	White (Data B)
Total Power consumption:	0mA @ standby 5mA @ sampling (interface only) 90mA @ sampling (interface and sensor)	
Time to sample 1 sensor:	1.2 seconds maximum	
Maximum sensors supported:	16	

EasyAG 5-Wire Technical Specifications



PCB Revision:	PCB 0669 REV 4	
5-Wire Interface connector type:	Brand: Phoenix Contact MC1,5/5-ST-3,5 (Plug)	
5-Wire Interface pin configuration:	1	Yellow (Data A)
	2	Blue (Address)
	3	Red (Power)
	4	Green (Ground)
	5	White (Data B)
Total Power consumption:	0mA @ standby 5mA @ sampling (interface only) 90mA @ sampling (interface and sensor)	
Time to sample 1 sensor:	1.2 seconds maximum	
Maximum sensors supported:	5	

RT6 logger

Processor	Intel 80C552
Clock rate	11.0592 MHz
Memory	512K 100nS RAM 512K 200nS EPROM 256 x 8-bit Static CMOS EEPROM
Data retention	2 days from removal of power
I/O Capabilities	RS232 and TTL serial communications which are software selectable for 1200, 2400, 9600 and 19.2K Baud rates.16-bit counter
On board facilities	Clock Calendar (battery backed) Power fail detection
On board power	3.6 Volt Nickel Cadmium battery 5 Volt regulation
Capability	Maximum of sensors = 32 (2 runs of 16 sensors)
I/O Connections	Via female DB25 connector to Main Board

RT6 Main Board

Power regulation	SLA battery specific charging circuitry 50mA constant current Ni-Cad charger 5 Volt linear regulators
Protection	Over voltage protection for SLA battery charger Battery cutout at 10.5 Volts with 1 Volt Hysteresis 1 Amp fuse in line with 12 Volt battery 1 Amp fuse in line with solar/external power 0.5 Amp fuse in line with sensor drivers Over voltage protection on solar panel input Internal battery reverse bias protection Solar / external power reverse bias protection Lightning protection on all inputs and outputs
I/O Capabilities	2 x 5-wire drivers (to drive 2 runs of 16 sensors)
I/O Connections	25 way IDC connector to logger (1) DB9 connector on front panel for RS232 (1) 5 way screw connectors to probes (2) 2 way screw connector for battery power (1) 3 way screw connector for solar / external power (1) 5 way screw connector for ext. RS232 serial port (1) 4 way screw connector for RS485 serial port (1)
Capabilities	Drivers on board to address 32 sensors (2 runs of 16)

Power supply

Internal Battery

Make – YUASA (or equivalent)
Model – NP7-12
Rating - 12 Volt / 7 Amp/Hr
Type - Sealed / rechargeable SLA

Solar Panel

Make – Solarex
Model - MSX-10
Type - Semicrystalline Silicon
Rating - 10 Watts at peak power
- 17.5 Volts at peak power
- 0.54 Amps at operating voltage
Temperature range -40 to 90 degrees Celsius
Wind loading exceeding 200km/h
Surface withstands impact of 1" hail at terminal velocity (87km/h) without breakage

External DC Power

The DC supplied should be between 18 and 30 volts DC with sufficient current to operate circuitry and charge the internal battery.

The external DC supply can be provided from;
A DC supply which is rated at between 16 and 24 volts DC and be able to supply 1.5 amps.
Two car batteries connected in series which will supply 24 volts DC

External AC Power

The AC supplied should be between 12 and 16 volts AC and able to supply 1.5 amps.

The external AC supply can be provided from;
240 volt AC to 16 volt 1.5A AC plug pack
AC supply which is rated at between 12 and 16 volts AC and be able to supply 1.5 amps.

APPENDIX L

Superseded Systems

Note: ***This manual no longer covers the RT5 mainboard, RT5 logger or 4-wire board. This section is for information only. Please see the Introduction section of this manual for the previous version's manual.***
Sentek no can longer supply these devices.

Comparison of RT5 and RT6 Main Boards

Similarities Similarities between the RT5 and RT6 Main Board are:

1. same SLA battery
2. compatible circuitry to enable mix of RT5 and RT6 components
3. uses IrriMAX software, which provides multi-drop RS485 and radio communication capability

Differences Differences between the RT5 and RT6 Main board are:

1. receiver is incorporated onto the RT6 Main Board
2. components on the RT6 are mounted flat to prevent mechanical damage during handling and transport
3. SLA battery charger on RT6 Main Board is redesigned to be more efficient over extended temperature ranges and provides trickle charging
4. the RT6 has more robust buffering of signals to probes to prevent damage from lightning surges and/or shorts in probe cabling
5. front panel accessible fuses on RT6
6. local/remote communication switch on front panel of RT6 instead of jumper settings as on RT5
7. improved lightning immunity on RT6
8. automatically resetable fuses on RT6 to prevent damage if a surge occurs during sampling. These fuses automatically reset themselves when power is removed (between sampling)
9. the RT6 supports multi-drop RS485

communication with computer

Compatibility The RT6 Main Board is a direct replacement for the RT5 Main Board (only with receiver).
The RT6 will work with probe runs having 4-wire boards with transmitters.

Caution: ***Connecting probe runs with 4-wire boards (no transmitters) to the RT6 Main Board may cause damage to components.***

Removable Logger firmware revision

The RT5 logger will work with the RT6 Main Board and the RT6 logger will work with the RT5 Main Board.

However the logger must be RT6 version (with RT6 Main Board) to enable remote telemetry via multi-drop RS485 or radio.

Only RT6 logger model MRT6.3 with firmware RTtype991111 supports all RT6 system features.

Features of earlier versions can be viewed on the Sentek Web site Support > FAQ's > Version Table > RT5 / RT6 Loggers.

IrriMAX software will work with RT5 loggers.

Comparison of 4-wire and 5-wire board

The 5-wire board is the combination of the circuitry of the 4-wire board and transmitter. In addition to this the 5-wire board has resetable fuses to resist damage if a surge occurs during sampling. These fuses automatically reset themselves when power is removed (between sampling).

Compatibility Probes with 5-wire boards can be mixed on a probe run with probes having 4-wire boards (only with transmitters).
EasyAG only support 5-wire boards.

Caution: ***Probes on a run with 5-wire boards will not work with probes on the same run with 4-wire boards (without transmitters). Damage to components may occur if connected together on the same run.***