Sentek™ Sentek IoT

Hardware Manual
Version 1.0

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SENTEK - SENTEK IoT - STATEMENTS OF COMPLIANCE

FCC COMPLIANCE STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Information to user

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:

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment to outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

EMC APPROVALS

Pending

RoHS

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

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INTRODUCTION

BACKGROUND

The Sentek IoT probe option combines the scientifically and commercially proven sensor technology of Drill & Drop probes, with Internet of Things (IoT) wireless communication.

Sentek IoT utilises 4G cellular communications to send soil water, fertiliser / salinity, temperature and voltage data from the probe to the cloud internet service of the Sentek IrriMAX Live software. It also is equipped with Bluetooth Low Energy which can be used for wireless testing using an Android Device (phone or tablet) with the Sentek App. A minimal maintenance is needed over the lifetime of the Sentek IoT product as it uses a solar panel to charge its battery.
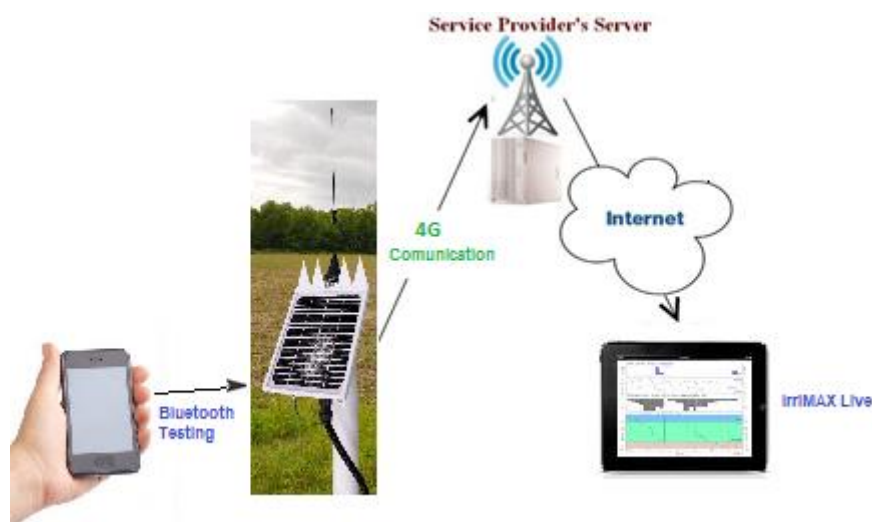
Figure 1 Block Diagram of the Sentek IoT in use

FEATURES

Sentek IoT Probe

➢ Utilises Drill & Drop probes which are available in 30cm to 120cm, containing 3, 6, 9 or 12 moisture or TriSCAN sensors. Each sensor also incorporates a temperature sensor.

➢ Easy installation

➢ Bluetooth testing with an Android or iOS Device (phone or tablet)

➢ Utilises 4G cellular communications with Global SIM Card Solution. Probes are pre-configured with 4G modem firmware and settings and will work provided they are in an area with reliable 4G network access.

➢ An external antenna for reliable signal strength

➢ Solar panel charged hi-capacity battery allowing years of maintenance free operation

➢ Facilitates direct communication from probe to the Sentek's cloud-based internet service

➢ Powerful IrriMAX Live software solution for data viewing and analysis

HARDWARE REQUIREMENT LISTS FOR SENTEK IOT

A complete Sentek IoT System comprises of the following hardware parts

• Plastic enclosure

• Internal 4G Modem/ Bluetooth board and with solar regulator option

• Antenna

- Solar panel
- Battery
- Drill & Drop probe
- Mounting bracket and mast

Antenna

4G Modem/
Bluetooth
board

Solar
regulator
board

Solar panel

Battery

Plastic
enclosure

Mast   Probe cable

Figure 2 SENTEK IoT block diagram

REFERENCED DOCUMENTS

- Sentek Drill & Drop Installation Guide
- Sentek Drill & Drop Probe Interface Manual
- Android Probe Utility App User Guide
- IrriMAX Live User Guide

SYSTEM SETUP

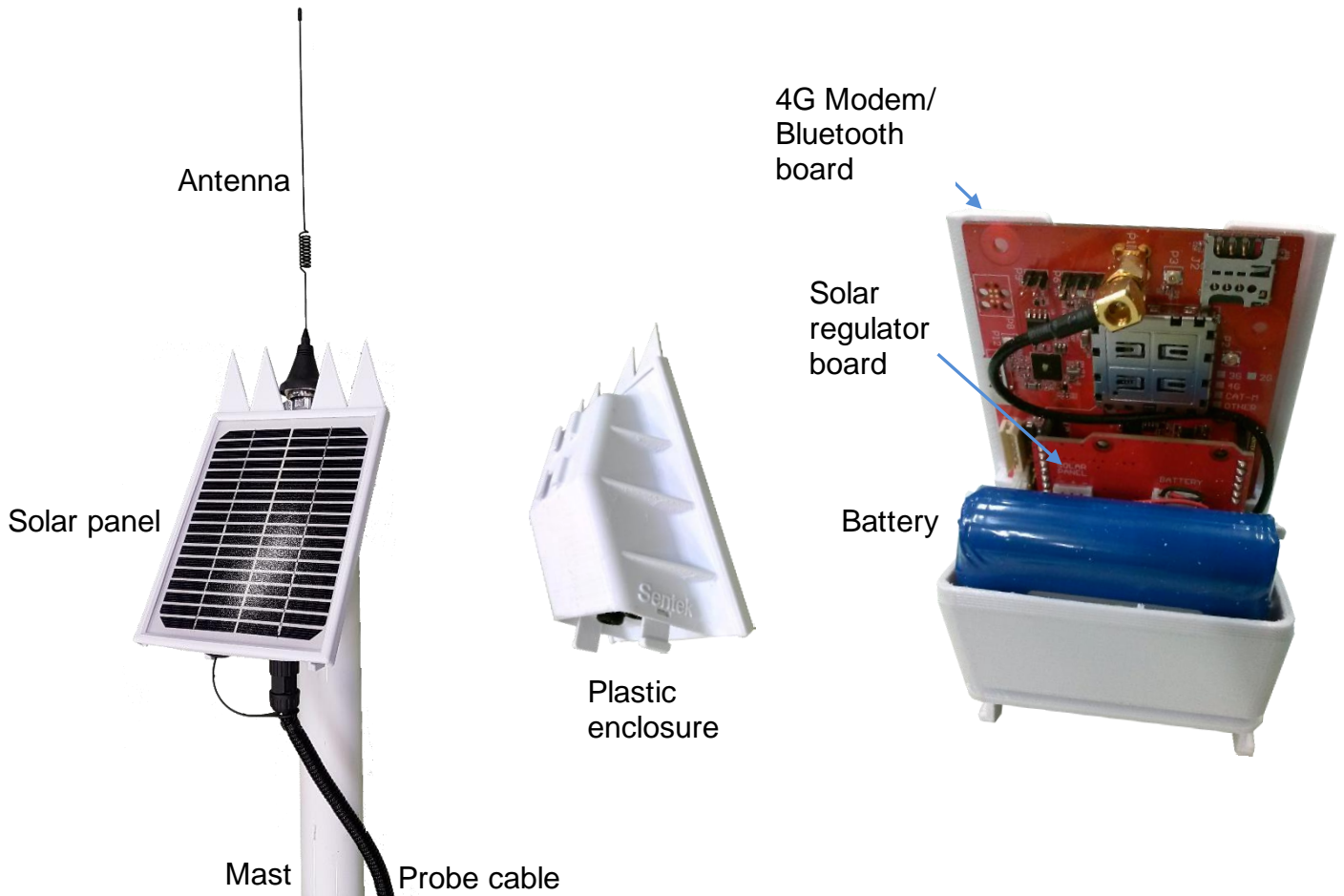Preparation, assembly and installation should generally be completed in the order of the steps in this section. Efficiencies might be gained by experienced installers altering the order of the steps taken.

INTERNET PROVISIONING

The Sentek IoT when purchased as a complete probe option has been normalised, configured and tested to allow an easy and fast installation process. Consequently, probe sensor data will be transferred automatically to Sentek servers. Once the first upload has occurred the probe data will be available for viewing on an internet enabled device e.g., smartphone, tablet, etc.

Data Transfer and Hosting

A Sentek IoT probe must have access to the internet to send its data to Sentek servers. It uses a Global SIM card that allows the modem to connect to the internet provided 4G cellular network coverage exists in the area of installation. The probe will make a connection to the internet at each upload interval.

SENTEK IOT DTU SETUP

1. Partially Slide out the Internal 4G Modem/ Bluetooth board with the piggy-backed solar regulator board from the Sentek IoT enclosure to reveal the various connectors on these boards.
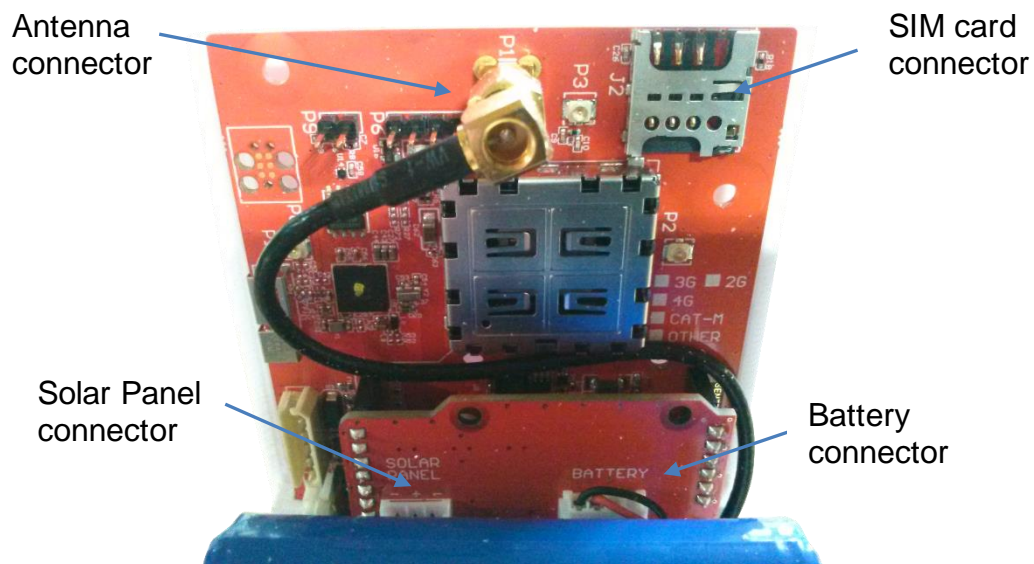
Figure 3 Internal 4G Modem/ Bluetooth/ Solar Regulator board and connections

2. Ensure there is an inserted SIM card. The Sentek IoT is supplied with a Global SIM and should only be replaced by a suitable Sentek supplied SIM.
3. Ensure the Solar Panel and the Antenna cable plugs are attached to the corresponding board connectors.
4. Attach the battery to the board. The Sentek IoT is powered up now and will automatically do a test upload to the Sentek Server once a new Drill & Drop Probe is attached.
5. Slide back the board assemblies into the Sentek IoT enclosure.

6. Using the mounting bracket mount the Sentek IoT enclosure and the external antenna to the mast.

7. Install the Sentek IoT in such a way as to maximise solar irradiation onto the solar panel throughout the year. The Sentek IoT is designed for to achieve reasonable solar collection around the world when installed on a vertical post.

SENTEK IOT PROBE SETUP

1. Make sure the Sentek IoT mast and in particular the probe connector socket is within the reach of the length of the Drill and Drop probe cable when the probe is installed in the ground.

2. Properly install Sentek Drill & Drop probe into the ground by following the instructions contained in the Sentek Drill & Drop Installation Manual.

Figure 4 Properly installed probe

3. Connect the probe cable connector to the Sentek IoT socket ensuring they are both clean and free of any dirt or debris. If Sentek IoT is already powered by the battery or solar then connecting the new probe will immediately trigger a test upload event. This can be monitored through Bluetooth with an Android Device (phone or tablet) and the Sentek App as described in the following section.

SYSTEM TEST

Select device from list Screen

The proper operation of the Sentek IoT telemetry system is automatically verified upon connection of a new probe as mentioned briefly in the previous section. To see the status of this test upload through Bluetooth run the Sentek App and press the "Scan for bluetooth device" button.
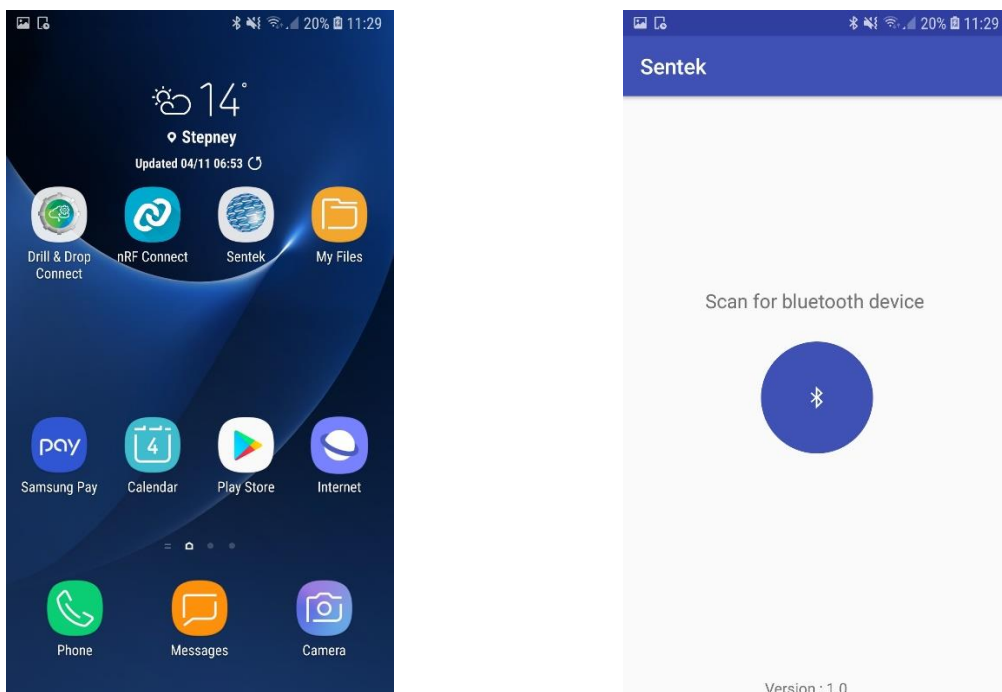
Figure 5 Sentek IoT Android App in use

The test upload should be completed, and the result displayed a few minutes from the time the new probe was connected. For a complete list of the modem "Last Response" numbers please see *Table 2 Last Response codes*. In the case of failure please see *Appendix D - the Troubleshooting Guide* section.
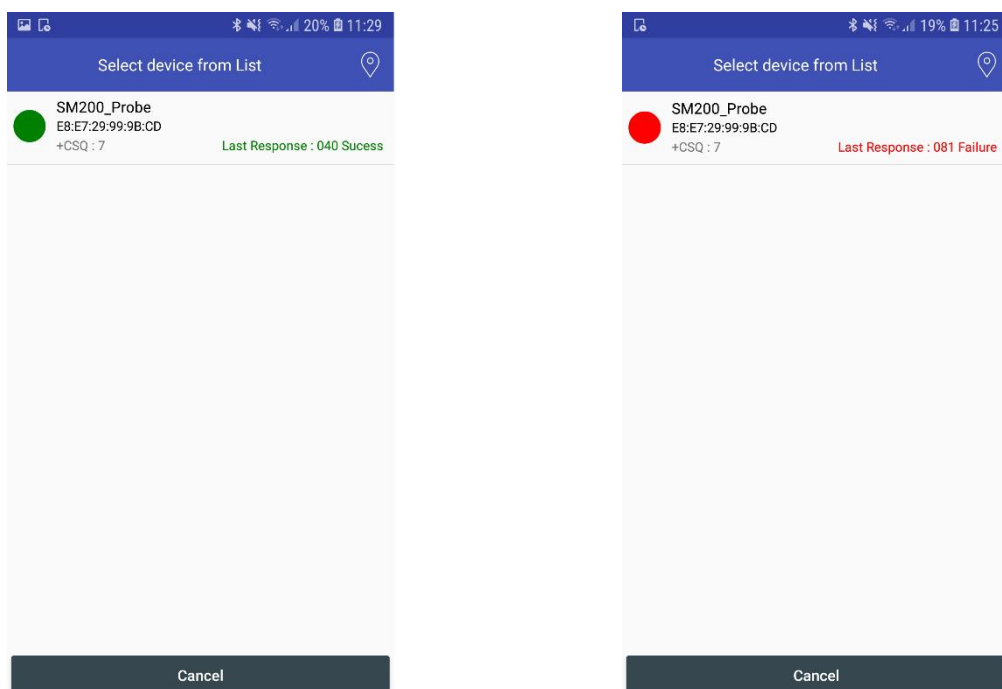
Figure 6 Sentek IoT Android App in use, cont.

Of high importance to the reliability of the telemetric transmissions through the 4G cellular network is the signal strength. This is represented by the +CSQ value as shown in the status of the upload. The following table presents the relation between the signal strength condition and the +CSQ values.

Table 1 Signal strength condition

+CSQ Value	Signal Condition
2-9	Marginal
10-14	OK
15-19	Good
20-30	Excellent
99	Not known

Information screen

Tap the displayed probe on the screen to see information held in the probe. It also has three buttons to navigate to the other functions of the Sentek App.

Figure 7 Probe Utility information screen

Type

Sentek IoT probes have the same type

Serial Number

Unique serial number of the probe not to be confused with Serial number label on the Interface

Version

Version of the firmware in the probe

Logger ID

This name is used to supply the IrriMAX Live database Logger ID. The default is the probe's serial number.

Sample Interval

Time between readings taken by probe

Upload Interval

Time between uploads to the internet

Next Sample Time

Time of the next reading.

Caution:
Automatic scheduled samples and uploads do not occur while the Sentek App is connected to the probe. If a scheduled sample interval occurs while the App is connected the sample will not be taken and an invalid reading (gap in the graph) will be recorded. Sampling will not reoccur until at least 60 seconds after the App is disconnected.

Next Upload Time

If the App is still connected at this time the upload will not occur and the upload will not occur until the next sample time

Pressing **Back** button from this screen terminates the App, with the quick message:

Device connection was lost

Figure 8 Connection lost prompt

Tapping the **Sensor Test**, **Clock** or **Modem** buttons take you to those appropriate screens

Sensor Test Screen

This screen initiates the retrieving of sensors in the probe then allows querying of all sensors.
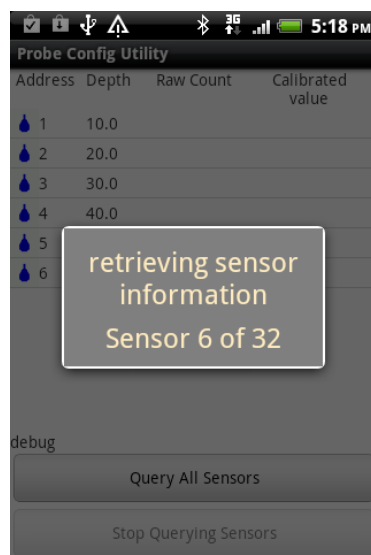
Figure 9 Sensor test tab

The table contains four columns of information for all sensors in the probe. Sensors are displayed in the order of each sensor type then depth within each type.

Sensors symbols and addresses:

- 💧 Moisture sensor addresses start at 1

- 🔱 TriSCAN Salinity sensor addresses start at 65, they are linked to corresponding moisture sensor at same depth

- 🌡 Temperature sensors start at 161

Sensor Depth

- Multiples of 10cm

Raw count

- Updated about once per second while Query All Sensors is active
- Correctly operating when value is not zero and not 65534 or 65535)

Calibrated Value

- Updated about once per second while Query All Sensors is active
- Correctly operating when the value is not zero and not "Invalid"
- Value of "invalid" when in soil indicates the sensor is not operating correctly

Note: You can drag to scroll the sensor list if there are more sensors than will fit on one screen.

The two buttons Query All Sensors and Stop Querying Sensors, start and stop sensor querying respectively. During sensor querying the raw count values and moisture values are continuously retrieved from the probe and displayed in the list.

Press the Back button to return to the Information screen.

Clock Screen

The clock screen shows the probe's date and time.

The probe's time/date and the Android time/date should be within a few minutes of the current local time. The Android time is shown at the top of the Android screen in the indicator items area.

If the times do not closely match, tap the **Synchronise with Device** and the probe time will be within a few seconds of the Android's.

Caution:
The probe's time may be wrong if it has been unpowered for an extended time (about 1 week).

Figure 10 Time tab

Press the **Back** button to return to the Information screen.

Modem Test and Upload Screen

This screen appears when the **Modem** button is tapped on the Information screen.
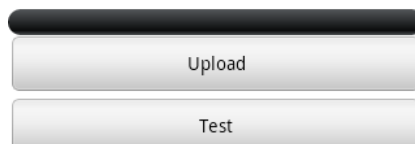
1. The result of any previous operation (App or periodic upload) will appear above the progress bar.
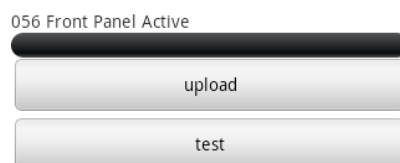
2. Tap the **Test** button to schedule an upload of a test file. Usually the **Test** button is sufficient to confirm the Internet is accessible. Tap the **Upload** button to schedule an upload of all reading currently in the probe.
   While the **Test** or **Upload** button is in operation an animated progress bar shows the operation is still running.
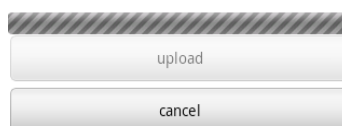
Above the progress bar is the probe's last response:

- 041 Success (No Data)
  There is no data in the probe, so no upload of readings will occur (upload is not exercised, so use the **Test** button)

- 081 Deferred Upload [190s after disconnect]
  The test or upload has been scheduled and will occur 1 minute after you exit the App. The upload will not be completed until least 190 seconds (3 minutes 10 seconds) have passed.

3. You must then press the **Back** button until the App exits and you get the message:

4. Wait for the 190 seconds after this message.

5. Reenter the App and tap the **Modem** button.
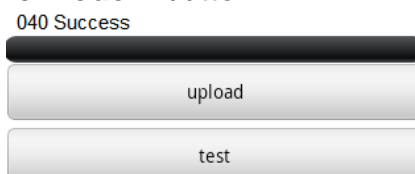
Above the progress bar is the probe's last response:

- 081 Deferred upload
  You reconnected before the upload commenced - go back to *step 3*
- 040 Success
  The Test or Upload showed the probe successfully uploaded to the Internet.
- 053 Connection Failure (…) or Other numeric codes
  The modem could not successfully upload to the Internet.
- For a complete list of the modem's "Last Response" numbers please see *Table 2 Last Response codes*. In the case of failure please see *Appendix D - the Troubleshooting Guide* section.

Press the **Back** button to return to the Information screen.

VIEWING DATA

At this stage data should already be uploading to the Sentek cloud internet service. To view the data, sign in with your username and password at https://www.irrimaxlive.com/.

For information on how to use the IrriMax Live service, refer to distributor training notes and the IrriMAX Help documentation.

MAINTENANCE

Sentek IoT 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 IoT system functions properly and continues to give worry free operation.

DTU

Regular maintenance of the Sentek IoT system should consist of cleaning of the DTU to ensure dust and grime is kept to a minimum, especially around all seals.

Opening the DTU should only be required when the battery requires replacement or if the SIM card needs replacing under instruction from Sentek.

If seals are damaged, then they will need to be replaced with new seals.

PROBE

The probe top 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 can give a false indication of the soil moisture content.

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 or buried away from potential damaging elements.

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.

BATTERY LIFE

The battery supplied with the Sentek IoT has a typical life expectancy of 3 years. The life of the battery is affected by many factors: solar panel charges, normal operational discharges, temperature to name a few. When the battery does not hold charge (causing loss of data at night) it will require replacing. Use the IrriMAX Live software to monitor the condition of the battery.

APPENDIX A – MODEM INFORMATION

BUILT IN MODEM

Sentek IoT uses a built in 4G modem.

AirPrime® HL7800 LPWA Module

4G LTE

Category	Cat-M1
Frequency Bands	B1, B2, B3, B4, B5, B8, B9, B10, B12, B13, B14, B17, B18, B19, B20, B25, B26, B27, B28, B66

Data Speed

Peak Download Rate	300Kbps
Peak Upload Rate	375Kbps

Technical

SIM interface 1.8V/3V	1
Temperature Range	Industrial Grade: -40°C / +85°C

Approvals

Carrier	AT&T, docomo, KDDI, Sprint, Telstra, Verizon, Vodafone
Planned Carrier	LGU+, Rogers, T-Mobile, Sierra Wireless
Regulatory	FCC, GCF, IC, JRF, JPA, PTCRB

SIM CARD

To Be Advised

APPENDIX B – RESPONSE FIELDS

LAST RESPONSE

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

Table 2 Last Response codes

Code	Message Detail	Description
Upload response codes.		
040	**Success**	Upload was successful (file transferred to FTP server)
041	**Success (No Data)**	No new data to upload
043	**043 Success**	WARNING: Clock needs to be synchronized. Probe clock has not been set. Uploaded data will have a date of 2000/01/01.
051	**Clock Not Set**	Clock needs to be reset (modify date and time or Synchronize with Computer 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 Sentek server
055	**Internal Error**	Corrupt file in probe memory. Need to clear memory (Delete Readings).
056	**Front Panel Active**	Attempt to perform modem function while connected through Dial-in or Front Panel
057	**Supply voltage too low**	Voltage below Telemetry Disable voltage level
058	**Invalid URL**	Destination URL invalid
080	**Modem In Use**	Cannot do an Open session from front panel.
081	**Deferred Upload**	Upload will commence when Android App is disconnected. Reconnect after 3 minutes (180 seconds) and check Last Response for 040 Success.

APPENDIX C- GLOSSARY OF TERMS

3G	Third Generation mobile phone network
4G	Fourth Generation mobile phone network
Sentek IoT	Sentek "Internet of Things" DTU & Probe system
BW	Bandwidth, the amount of traffic allowed in a set period
CDMA	Code Division Multiple Access (Used by selected Modems)
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
IP Address	Internet Protocol address – Numbered address of host
NextG	Telstra Australia implementation of 3G
PIN	Personal Identification Number
SIM Card	Subscriber Identity Module, required for GSM/GPRS/NextG/4G Access
Global SIM Card	A SIM card that works on more than one carrier network, and in more than one country
Storage Capacity	Available space on server to store data files
URL	Universal Resource Locator

APPENDIX D - TROUBLESHOOTING GUIDE

As Sentek IoT probes are configured before delivery, only user-controlled capabilities should be addressed in the field.

Any problem that cannot be resolved should be directed to your distributor.

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. Using Table 3 below 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.
3. Once the cause and symptom have been found and rectified, test all sensors. If a new symptom appears, start again at step 2.

Table 3 Troubleshooting

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
Cannot connect to probe through Sentek App	Battery not connected	Battery plug	Ensure battery plugs clicked together
	Solar panel either not connected or very dirty or at wrong orientation or angle	Solar panel plug, solar panel cleanliness, solar panel orientation and angle	Ensure Solar Panel plugs clicked together. Panel is clean and oriented at optimal angle for solar irradiation absorption
	Low power despite solar charging	Check if data gaping occurs at night. Measure battery DC voltage	Replace battery if battery voltage low
Failure of Modem "Test" upload	In accordance with Last Response codes	See *Table 2 Last Response codes*	Follow suggestions in the table
	Antenna not connected	Check that antenna is connected	Tighten antenna connectors

Symptom/Error Message	Possible Cause of Failure	Check	Possible Solution
	Poor signal strength	Check the signal strength parameter +CSQ with the Sentek App	Reposition Sentek IoT for better signal strength
Data uploaded does not show expected (correct) time	Probe Clock incorrect	Connect using Android App and check probe time	Select option to Synchronize with Computer

APPENDIX E - RECOMMENDED MAINTENANCE SCHEDULES

Daily

- Use IrriMAX Live graph to review battery voltage (V1, V2) profile and when the voltage shows signs of degradation ensure the solar panel is clean and free from any shadowing casted by overgrown vegetation. Check the orientation and angle of the solar panel. Replace battery if over 3 years old.

12 months

- Check for cleanliness of the Solar Panel and its orientation and angle
- Check for dust and/or water ingress into Sentek IoT housing
- Check cable for damage to outer sheath and wires
- Check antenna is secured tightly
- Ensure all cables are neat
- Clean SIM contacts

3 years

- Replace battery

FCC statement

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--Reorient or relocate the receiving antenna.

--Increase the separation between the equipment and receiver.

--Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

--Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement

This device complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device must operate with a minimum distance of 20 cm between the radiator and user body.

IC Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme aux CNR exemptes de licence d'Industrie Canada .

Son fonctionnement est soumis aux deux conditions suivantes :

(1) Ce dispositif ne peut causer d'interférences ; et

(2) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

This device must operate with a minimum distance of 20 cm between the radiator and user body.