HydroMet

User Manual

iRIS 270

KISTERS
Empowering decisions of tomorrow

04-2024 – 01-14-005

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I Disclaimer

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred.

This manual does not include all of the details of design, production, or variation of the equipment nor does it cover every possible situation which may arise during installation, operation or maintenance. KISTERS shall not be liable for any incidental, indirect, special or consequential damages whatsoever arising out of or related to this documentation and the information contained in it, even if KISTERS has been advised of the possibility of such damages.

Any errors found in any KISTERS product should be reported to KISTERS where every effort will be made to quickly resolve the problem.

This document is public.

II Safety Instructions

- Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS iRIS 270. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.
- Keep the user manual on hand for later reference!
- If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support.
- KISTERS iRIS 270 is intended to be used in hydrometeorological or environmental monitoring applications.
- Before starting to work, you have to check the functioning and integrity of the system.
  - Check for visible defects on the iRIS 270, this may or may not include any or all of the following mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.
  - If defects are found that jeopardize the operational safety, work must be stopped. This is true for defects found before starting to work as well as for defects found while working.
- Do not use the KISTERS iRIS 270 in areas where there is a danger of explosion.
- The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating the KISTERS iRIS 270 must strictly comply with these specifications.
- Perform maintenance only when tools or machinery are not in operation.
- If guards are removed to perform maintenance, replace them immediately after servicing.
- Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances. Return the product to the manufacturer's named repair centre. You can find information on how to return items for repair in the relevant section of the KISTERS website.
-  Disposal instructions: After taking the KISTERS iRIS 270 out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS iRIS 270 is never to be disposed of in household waste!
-  Inputs and outputs of the device are protected against electric discharges and surges (so-called ESD). Do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

1 Introduction

Thank you for choosing our product. We hope you will enjoy using the device.

KISTERS manufactures, sells, installs and operates quality instrumentation, data loggers and communication technology. Products are designed with passion for environmental monitoring and with a deep understanding of the quality, accuracy and robustness needed to fulfil the requirements of measurement practitioners in the field.

The present User Manual will help you understand, install and deploy the device. If, however, you feel that a particular information is missing, incomplete or confusing, please do not hesitate to contact us for further support!

The iRIS 270 is the perfect marriage of the proven iRIS design legacy with a future-proof architecture. It is compact, cost effective, ruggedized, IP-capable and easily configured - and due to its dual telemetry slots the iRIS 270 extends the telemetry options and the range of pluggable devices.

General Characteristics

The iRIS 270 is supplied in an environmentally sealed (IP67) enclosure constructed from a special corrosion-resistant aluminium alloy that is finished in a hard-anodised coating. This provides a very high degree of mechanical strength and EMI shielding, and enables completely stand-alone mounting in outdoor situations.

The iRIS 270 supports a maximum of fifty external sensors (1-50). Sources for these sensors may be chosen from physical digital or analogue inputs or virtual sources (via serial communication or calculations).

Sources may also be from internal measurements (battery voltage, supply voltage, temperature and RSSI). Each sensor has six associated alarms, each with separate trigger and reset levels. Each alarm also has a duration, which is used to delay the alarm trigger for analogue inputs and to determine the time over which pulse input counters should be totalised (rainfall etc.).

Data from all enabled sensors are logged format which includes full date and time stamp to a 1 second resolution. The iRIS 270 supports SDI-12 134 communication with a range of industry standard intelligent sensors.

Figure 1 – iRIS 270 External View

Typical Applications

The iRIS can be used for a wide range of diverse applications, including but not limited to:

- Rainfall measurement
- River level monitoring
- Water / power / gas metering
- Remote control
- Wind measurement

- Mobile temperature monitoring
- Irrigation monitoring / control
- IP ←→ RS232 communications gateway

For more information, see the following subsections:

1.1 About this Manual

This manual is intended as a detailed guide for iRIS 270 installation, configuration and operation.

This manual is also available online in Adobe Acrobat® pdf format for download at www.hyquestsolutions.com.

Throughout this document, small icons are used to identify additional information. These are as follows:

Note Indicates extra detail to expand the current discussion.

Warning Describes something that may cause problems if not heeded.

Note: The term “iRIS” is used throughout this manual in all references to the iRIS 270.

1.2 Key Features

This chapter contains the following subsections:

1.2.1 Telemetry and SDI-12 Diagnostics

Monitoring operation of the communications modules and SDI-12 bus is possible from the iLink software. The architecture allows for remote monitoring, monitoring over open channels (radio) and even monitoring of the operation of the channel being used. The information obtained is stored with a corresponding time stamp in a real-time log with log entries on three levels (information, warning, error), which can be filtered and captured for later analysis.

1.2.2 Power Management

The iRIS supports power management in two main ways. These can be used to save power for sites that have a small power budget:

- LED and LCD activity – The status LED and LCD backlight can be set to turn off after a user defined timeout.
- Checking SMS on Cellular module – the checking for incoming SMS can be disabled to save power.

1.2.3 Data Logging

The iRIS supports the logging of data from up to fifty virtual sensors. Each of the virtual sensors can obtain information from one of the following data sources:

- Analogue input on AIN1 – AIN2
- Pulse counter attached to DI1, DI2 or DIO
- Simulated pulse counter enabled by DI1, DI2 or DIO
- Frequency counter attached to DI1, DI2 or DIO

- Up/down counter attached to DI1, DI2 or DIO simultaneously
- SDI-12 instrument channel
- Change of status on charger input (DC supply)
- Battery voltage
- Supply (charger) voltage
- Logger temperature
- Received Signal Strength Indication (RSSI)
- Change Of State on digital I/O channels DI1, DI2 or DIO
- Serial instrument (using the Modbus protocol)

Each sensor can be set up to scale the raw data source into engineering units through the application of a multiplier and offset (slope and constant). The scaled value can be logged to non-volatile memory at rates between once per minute to once per hour or immediately in true event mode for pulse inputs.

It is also possible to configure a sensor to also log associated values such as minimum, maximum, standard deviation (for all source types) or a calculated flow rate or volume (pulse type sources only). See the next section for further details on configuring these extended logging features as part of the Sensor Configuration menus.

1.2.4 Logged Data Array Identification

Each sensor's logged data is identified by an array ID number. For the primary logged data, the ID is the sensor number itself. For the optional supplementary data (min, max, deviation, flow/vol), the array ID has an offset added to the sensor number that it is associated with. These ID offsets are as follows:

Minimum:	+50
Maximum:	+100
Deviation:	+150
Flow/Volume	+200
Check Count	+250

For example, Sensor 4 has been configured to log the average value, plus the maximum and standard deviation. Three data arrays will be logged for this sensor at each logging interval with IDs of 4, 104 and 154 respectively. In HydroTel™ or SODA these require point identifiers of 4, 104 and 154 respectively.

Array 0 (zero) is a special array identifier and is used as a system event log. Currently this is only used to log a restart (either at the initial connection of power, on a watchdog reset or a user program start after an upgrade). The logged value in this case contains a value that can be decoded to determine the cause of the restart. In HydroTel the identifier for this item is 0.

1.2.5 Alarm Processing

There is a "pool" of up to 100 free-format alarms. These can be assigned to any virtual sensor. It therefore possible to have two alarms on every sensor or else more on some sensors and less or none on others. Each alarm has separate trigger and reset levels, an activation delay or accumulation period depending upon the data type, comms interval, enable call-in and an option to send a customised SMS text to a specified number when the alarm is triggered.

Each sensor has an associated flag that is set if any alarm on the sensor is active. This can be used to vary the logging rate for the sensor. For example, taking more frequent logs when water level is high compared to a less frequent "routine" log in normal conditions.

The iRIS also maintains a global "alarms active" flag that is set if any alarm on any sensor in the device is active. This is used to trigger a call-in or data transfer to the designated host. As well as the call-in, this flag can also control the digital outputs.

1.2.6 Real Time Clock & Calendar

The iRIS has a non-volatile real time clock that can be read and/or synchronised using HydroTel™ or iLink 3.

1.2.7 Security

The iRIS can be configured with a PIN code to prevent unauthorised access to restricted information through the LCD and keypad. This is especially useful when the iRIS is installed in a location where it is accessible to the general public.

2 Installation

This chapter contains the following subsections:

2.1 Mounting

The iRIS can be mounted by installing suitable screws through the mounting pillars which are exposed when the lid is opened. The recommended mounting screws are M5 machine screws or Twinfast® wood screws.

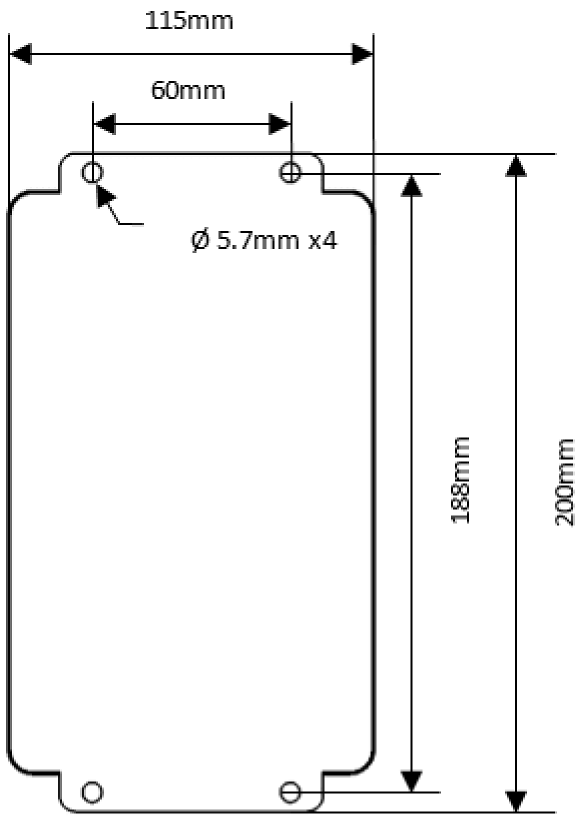


Figure 1 – Mounting Diagram

It is very important that the four screws retaining the lid are tightened firmly after installation to maintain the IP67 rating of the enclosure.

2.2 Opening/Closing the Housing

The front of the iRIS enclosure is secured by four machine screws with Phillips® heads.

To Open: Undo all four screws. There is no need to remove them completely as they are retained in the lid. The front cover should then be lifted away from the base until the hinges are extended. Then the lid should be able to be swung open (to the right), to a maximum angle of 90°.

To Close: Gently swing the front cover closed, holding it straight while refitting the screws. Tighten screws securely to maintain the IP67 rating of the enclosure.

2.3 I/O Connector

All I/O and power supply terminations are via 5 mm (0.2”) pitch screw terminals provided on a 12-way and 10- way pluggable connector. The I/O connectors are positioned externally on each side of the iRIS enclosure to allow easy unplugging of the iRIS. The function of each I/O termination is shown in the diagrams below.

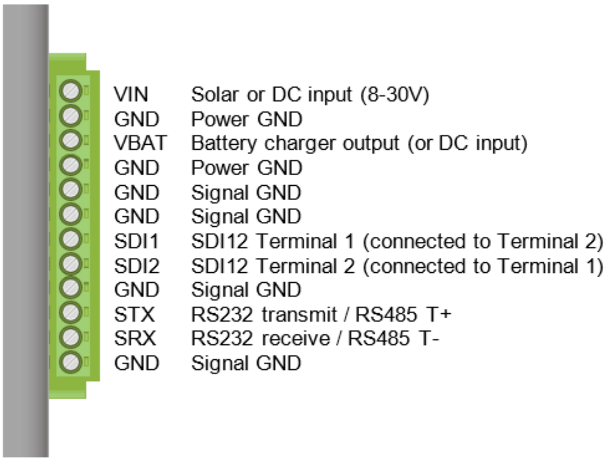


Figure 2 – Right hand side I/O Connector

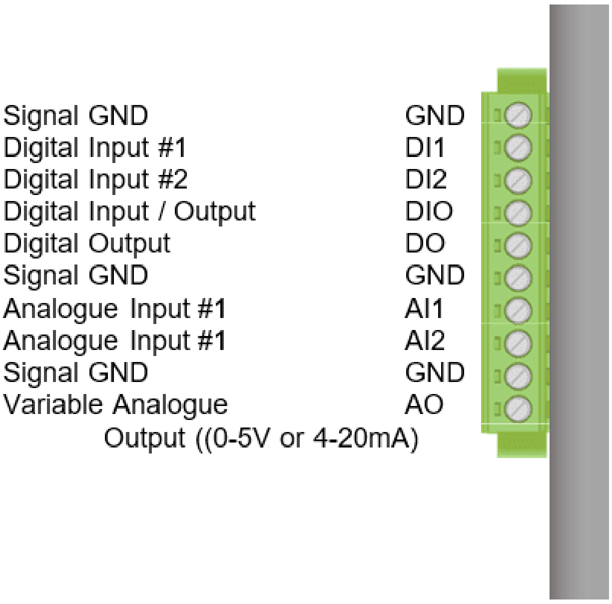


Figure 3 – Left hand side I/O Connector

For more information, see the following subsections:

- External (Charger) Power Supply 13
- Analogue I/O 13
- Digital I/O 15
- Serial Sensor Interface (SSI) 19

2.3.1 External (Charger) Power Supply

The iRIS can operate solely from the external battery which is charged externally, or you can connect any external DC power source ranging from 8 – 30 V DC, including a solar panel, without requiring an additional solar regulator.

The battery charging circuitry for sealed lead acid (SLA) batteries utilises a switch mode regulator, employing Maximum Power Point Tracking (MPPT) for maximum efficiency. The external power supply is protected against over-voltage by ultra-fast acting protection devices and a self-resetting semiconductor fuse.

See section Solar Regulator 105 for more information on configuration of the internal solar regulator.

Warning A cable length of lesser than 3m is required on the VIN port.

Warning When using the charger feature of the iRIS an external battery needs to be attached. The input supply must be connected to VIN and the battery connected to VBAT. When an external charger or DC source is used this must be connected to VBAT and NOT VIN. In this case VIN should be left disconnected.

Failure to follow these instructions will cause the power to iRIS to drop out irregularly and it will reboot.

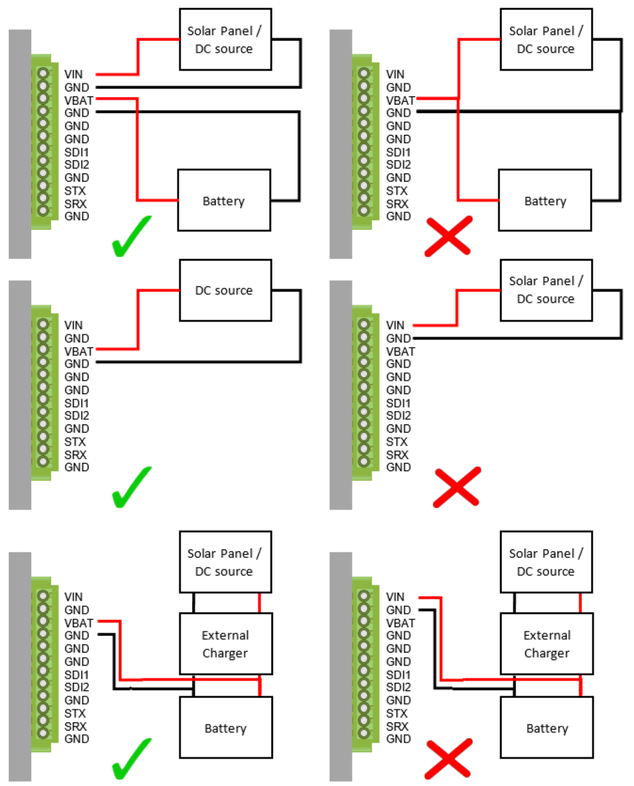


Figure 4 – Shows examples of the correct and incorrect methods of connecting the iRIS to power source and an external battery

2.3.2 Analogue I/O

This chapter contains the following subsections:

2.3.2.1 Analogue Inputs

The two analogue inputs are unit-polar 0 - 100 mV DV, 0 - 5 V DC or 0 - 30 V DC with 16-bit resolution. Each input presents a load impedance of 123.74 kΩ to the input signal.

Scaling factors should be chosen to convert from a raw value of, e.g. 0.0000 – 5.0000, which reflects the input signal range of 0 - 5 V. When current sources such as 0 - 20 mA or 4 - 20 mA are connected, an internal sink resistor (100 Ω) is enabled by an internal user-settable link. In this mode the measured voltage range is 0 - 2 V for a 0 - 20 mA input and the scaling factor should take this into account.

As the analogue inputs have an input impedance of 123.74 kΩ, the actual sink resistor impedance will be slightly lower than the value fitted. When, for example, the current mode link is fitted, a sink resistor of 100 ohms is installed. The actual impedance will theoretically be 99.92 Ω; therefore, the voltage measured by the iRIS will also be slightly lower than expected.

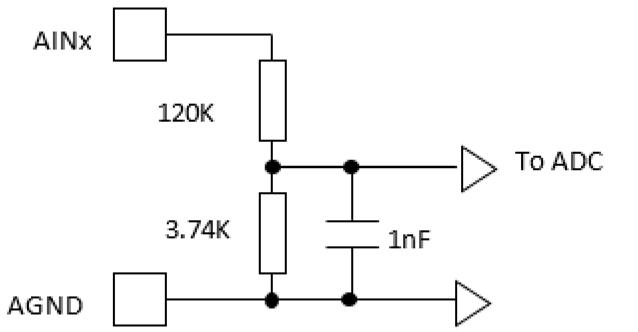


Figure 5 – Simplified Analogue Input Circuit

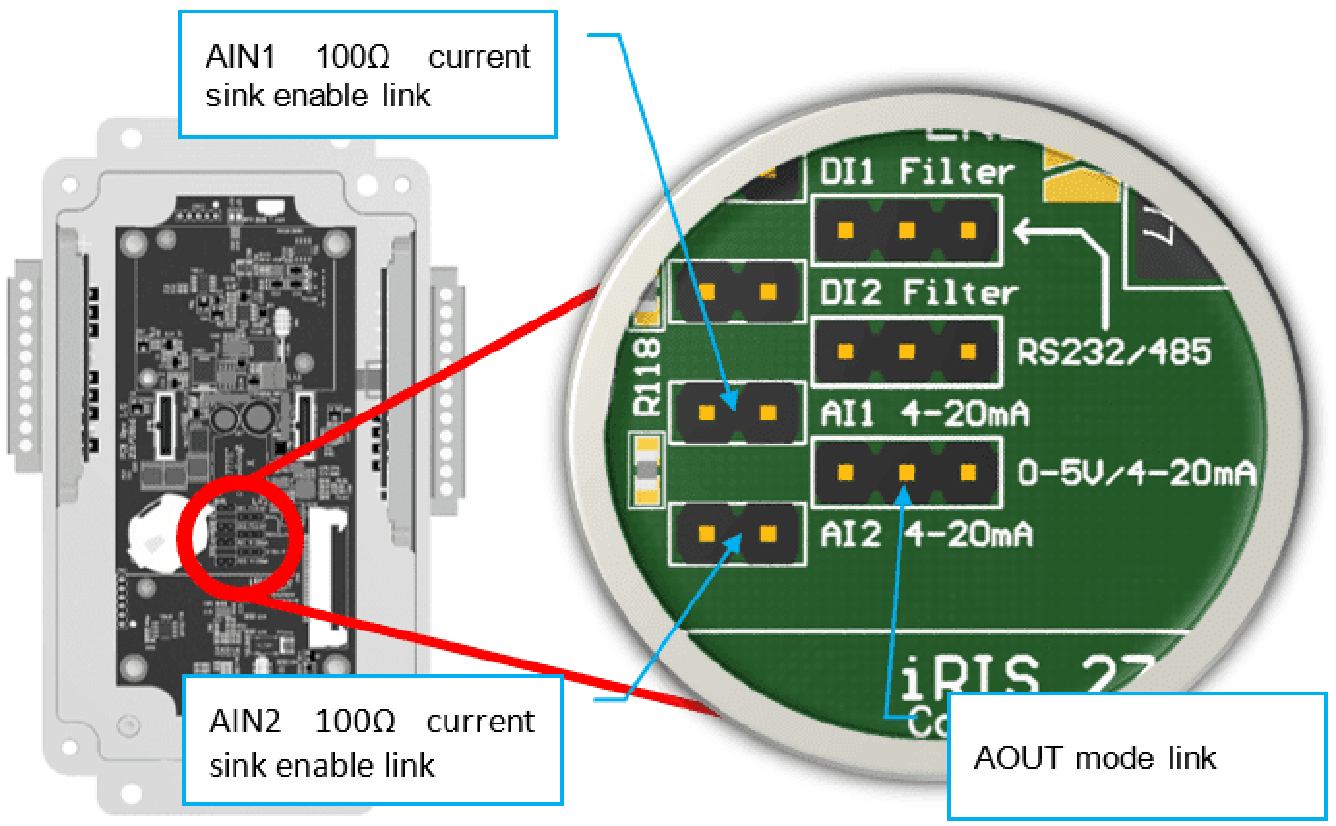


Figure 6 – Analogue Input / Output Links

It is possible to use an external resistor such as a 250 Ω to raise the voltage range measured.

I.e. 100 Ω will give a working range of 0.4 V to 2 V, 250 Ω will give a range of 1 V to 5 V.

In this case, ensure the internal sink enable link is open. The resistor value in the analogue scaling calculator in iLink will need to be changed to the value actually used. Also, a voltage measurement range for the analogue input range needs chosen instead of current.

2.3.2.2 Analogue Output

The iRIS has a single variable analogue output. This may be configured to deliver either a voltage output ranging between 0 - 5 V or a current output ranging from 4 - 20 mA. The output's electrical signal (voltage or current) is link selectable. See section I/O Configuration 36 for details on configuring the analogue output.

2.3.3 Digital I/O

The iRIS has four digital I/O channels which can each be configured as either an input or output. When set as an output, the channel can either supply switched 12 V or else act as a pull-down switch for loads with a different supply voltage. If the digital output configuration is set to 0 (Disabled) the channel is by default an input. See section I/O Configuration 37 for details on configuring the digital outputs.

- Digital Channels as Inputs 15
- Digital Output 17

2.3.3.1 Digital Channels as Inputs

The digital inputs are selectable for either mechanical or electronic operation. In either case it is necessary to pull the input down to 0Vdc to activate it. Inputs will handle up to 30 V DC in the off state for parallel connection across existing equipment. The “debounce” is enabled by a jumper link, which if fitted enables a longer time constant circuit to eliminate multiple pulses caused by contact bounce. The debounce jumpers are positioned in the centre of the PCB. The picture below shows the links in their default positions.

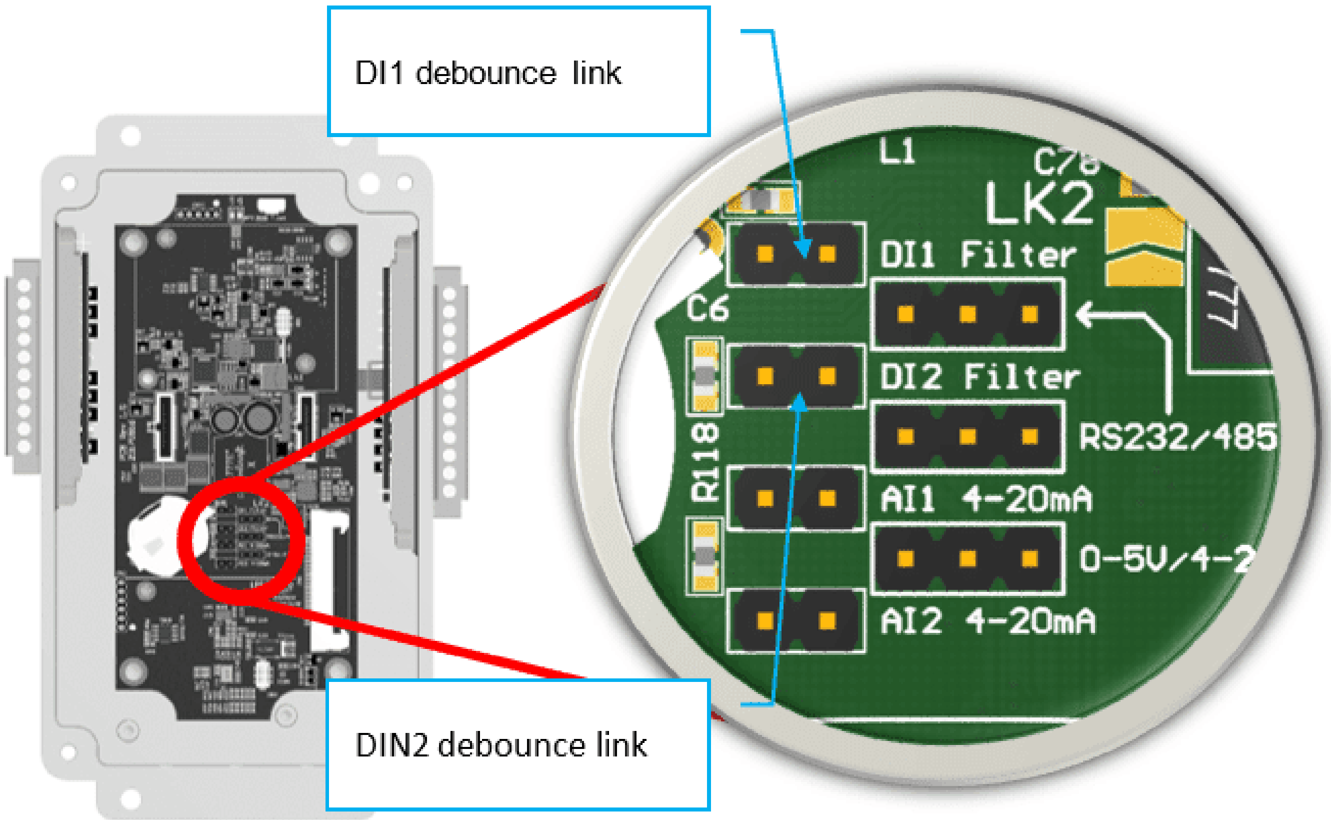


Figure 7 – Digital Input Debounce Links

Fit the jumper for mechanical switching at up to 20 Hz. In this mode the input is normally pulled up to 12 V through a 10 kΩ resistor providing a wetting current of approximately 1.2 mA. A 100 nF capacitor is also fitted across the input to provide limited hardware debounce, preventing false triggering due to contact bounce.

Remove the appropriate jumper for electronic switching at up to 5 kHz. In this mode the input is normally pulled up to 5V through a 57 kΩ resistance, providing a wetting current of approximately 100 mA. When DIO is used as an input the debounce circuit is permanently connected to the input pin.

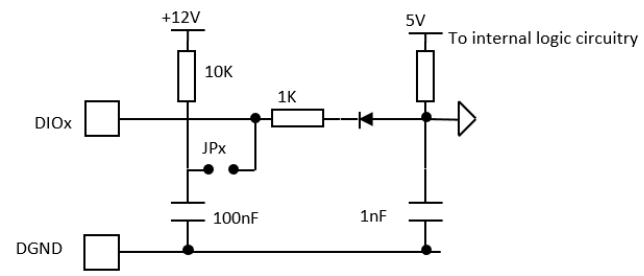


Figure 8 – Digital Input Circuit

Important note!

In almost all installations where an iRIS is connected in parallel with other equipment to share a common pulse input (e.g. from a flow meter), there has not been a detrimental effect, as the iRIS inputs present a relatively high impedance to the circuit. However, in the event that connecting an iRIS does cause pulse failure, KISTERS recommend removing the debounce selection link for the appropriate input. This sets the input to electronic switching mode, even if the actual pulse source is a clean contact (reed switch or similar).

The debounce jumpers are located in the centre of the PCB and can be accessed once the front cover is opened. See Figure Digital Input Debounce Links above.

Hint: When removing a jumper, simply fit it to only one pin of the connector to avoid it being lost.

2.3.3.2 Digital Output

When the iRIS digital I/O channel is configured as an output it can be operated electrically in one of two ways. Either:

Open-drain Pull-down which is capable of sinking up to 100 mA at 30 V DC. An integral diode provides transient protection. Typically, this output mode can be used to drive a relay or lamp powered by an auxiliary DC supply (e.g. 12 V). In this mode, the negative of the load supply must be connected to one of the iRIS GND terminals.

Although it may appear possible to directly control sensors by switching the sensor negative supply lead using a digital output, this will introduce measurement errors and may possibly damage the sensor. Always use a digital output configured as a switched 12 V output to power sensors.

Or:

Switched 12 V output which is capable of sourcing up to 100 mA. Typically, this output mode will be used to drive a sensor, relay or lamp powered by the iRIS's 12 V supply.

Care should be taken to avoid the load discharging the internal and/or external 12 V battery. Ensure adequate power supply charging capacity is available to cater for the demands of both the iRIS and load.

The digital outputs may also be programmed to follow the state of the IP connection so that they will be active when a wireless IP session has been established. This mode can be used to control power to an external data radio when using the iRIS as a radio-based gateway.

Typically, an output is configured to follow a schedule for use in powering loads. There is a similar mode termed "Schedule Plus".

In "Schedule Plus" mode, the relevant output(s) will be activated when a user is logged on to allow sensor calibration or radio communication testing.

Alternatively, they can be selected for remote control directly from a HydroTel™ base station, activation if any alarm is active in the iRIS or to operate in response to absolute set points against the current sensor value on Sensor #1 for applications such as triggering sediment samplers.

See section I/O Configuration 37 for details on the digital output modes.

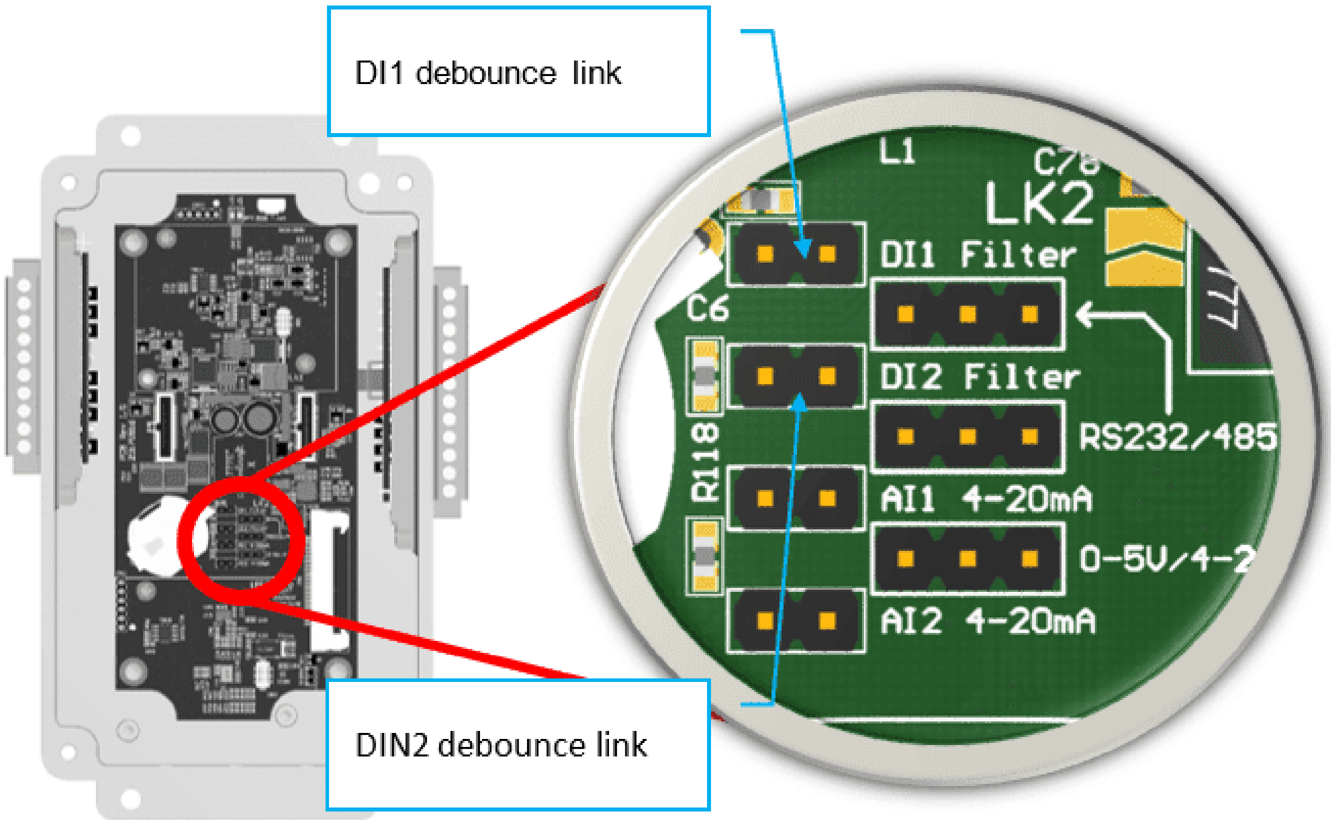


Figure 9 – Digital Input Debounce Links

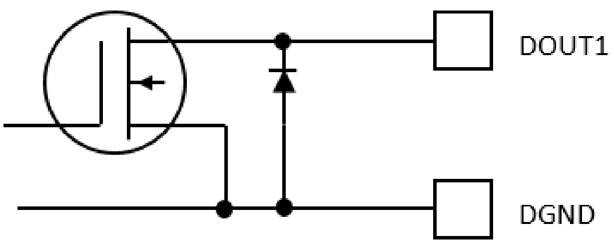


Figure 10 – Pull-Down Mode Circuit

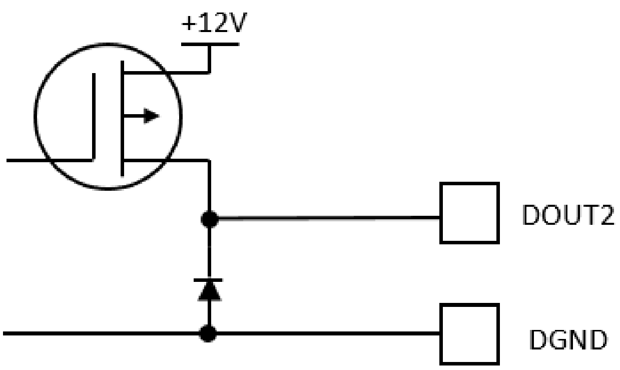


Figure 11 – Switched 12V Mode Circuit

2.3.4 Serial Sensor Interface (SSI)

The sensor serial interface is a three-wire serial port intended to be used with serial based sensors.

It can operate as either RS-232 or RS-485 signalling.

Terminal Label	RS-232	RS-485
STX	RS232 transmit (iRIS input)	RS485 D- (A)
SRX	RS232 receive (iRIS output)	RS485 D+ (B)
GND	Signal GND	N/A

Table 1 – SSI terminal definition

- Selecting Serial Mode 19

2.3.4.1 Selecting Serial Mode

The choice of RS-232 or RS-485 modes must be made in both physic jumper selection and firmware configuration selection. Please see section Serial Sensor Interface (SSI) 40 for more details on configuring the firmware mode.

The RS-232 and RS-485 connections cannot be used at the same time. Which is currently being used is selected by iRIS configuration via iLink.

When operating in RS-232 mode, the SSI port has an auto-shutdown feature. If no signal is measured on the STX terminal, then the port will be in auto-shutdown and will not transmit. If the devices connected to the SSI port also have this feature, the SSI diagnostics will display a no-response error message. To check if this is the cause of the no response, measure the voltage between SRX and GND, if it is close to zero then the port is in shutdown mode.

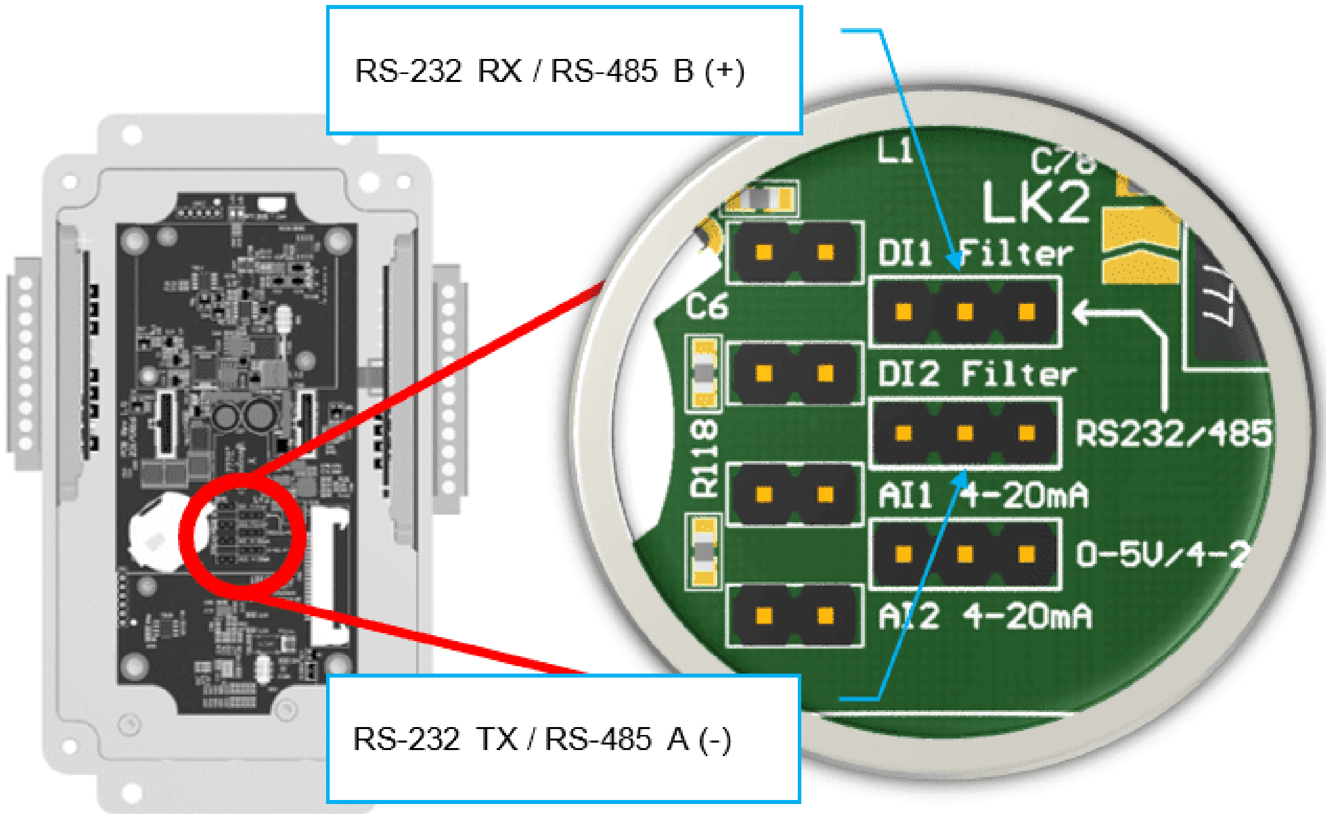
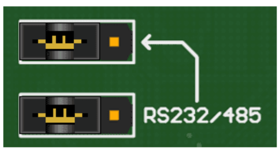
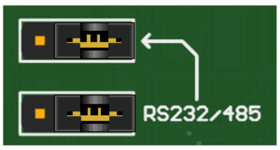


Figure 12 – location of serial mode selection jumpers



RS-232 Position
(Both to the left)



RS-485 Position
(Both to the right)

Figure 13 – detail depiction of RS-232 / RS-485 jumper positions

2.4 Telemetry Module

The iRIS the can be fitted with any combination of the modules in this section.

- Cellular 20
- Serial 21
- Ethernet 23

2.4.1 Cellular

This chapter contains the following subsection:

- Removing/Fitting the SIM Card 21

2.4.1.1 Removing/Fitting the SIM Card

Important! Ensure the iRIS is depowered before attempting to remove or fit the SIM card. Exercise care when inserting or removing the SIM card, as the carrier is fragile.

Open the front cover as described above.

Using a finger nail or small screwdriver inserted into one of the two oval holes on the sliding holder, gently lower the slide downwards to unlock it. The slide can now be swung forwards from its top end to enable the SIM card to be inserted or removed. Reverse the procedure to close and lock the card into place.

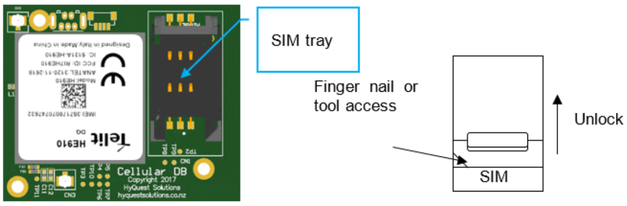


Figure 14 – SIM Carrier

2.4.2 Serial

An iRIS fitted with a serial daughter board will be supplied with a short pigtail cable assemble, terminated with a DB9 connector in RS-232 DTE configuration.

DB9 Pin Number	Signal Direction*	Wire Colour	Signal Name
1	Input	Red	Carrier detect (CD)
3	Output	Green	Transmit Data (TXD)
2	Input	White	Receive Data (RXD)
4	Output	Black	Data Terminal Ready (DTR)
5	0V	Orange	Signal Ground
6	Input	Purple	Data Set Ready (DSR)
7	Output	Brown	Ready to Send (RTS)
8	Input	Blue	Clear to Send (CTS)
9	Input	Yellow	Ring Indicator (RI)

Table 2 – Serial Daughter Board factory fitted pigtail pinout and wiring | * Signal direction is with respect to the iRIS

Note: The shield of the DB9 connector is connected to the ground of the iRIS.

- Serial DB I/O Connector 22

2.4.2.1 Serial DB I/O Connector

In situations where the supplied pigtail is unwanted, for example direct serial connection between two devices, or RS-485 is to be used. Then the cable can be directly wired to the serial daughter board connector. The cable needs to be feed through the gland before terminating. The Phoenix connector used on the daughter board has the following cable specification/limitations:

Conductor cross section solid min.	0.14 mm^2
Conductor cross section solid max.	1.5 mm^2
Conductor cross section flexible min.	0.2 mm^2
Conductor cross section flexible max.	1.5 mm^2
Conductor cross section flexible, with ferrule with plastic sleeve min.	0.25 mm^2
Conductor cross section flexible, with ferrule with plastic sleeve max.	0.75 mm^2
Conductor cross section AWG min.	26
Conductor cross section AWG max.	16

The signal order and details are depicted and listed in the following figure and table:

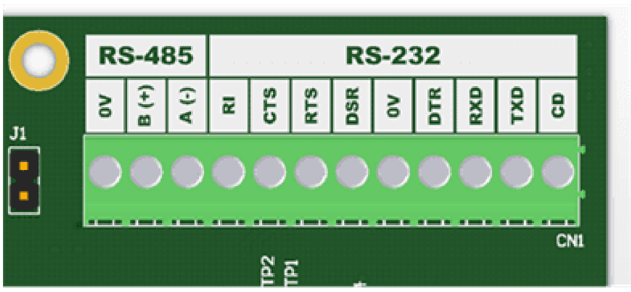


Figure 15 – Serial Daughter board I/O connector and labelling

Serial Mode	PCB Label	Signal Direction*	Name
RS-232	CD	Input	Carrier detect (CD)
	TXD	Input	Receive Data (RXD)
	RXD	Output	Transmit Data (TXD)
	DTR	Output	Data Terminal Ready (DTR)
	0V	0V	Signal Ground
	DSR	Input	Data Set Ready (DSR)
	RTS	Output	Ready to Send (RTS)
	CTS	Input	Clear to Send (CTS)
	RI	Input	Ring Indicator (RI)
RS-485	A (-)	Bidirectional	
	B (+)	Bidirectional	
	0V	0V	

Table 3 – Serial daughter board connector details | * Signal direction is with respect to the iRIS

The RS-232 and RS485 connections cannot be used at the same time. Which is currently being used is selected by iRIS configuration via iLink.

2.4.3 Ethernet

The Ethernet module has two indicator LEDs which can be used for basic network diagnostics. These are described in the table below.

LED	Colour	Description of operation
Left	Green	100BASE-TX Link Activity (constant on when link exists, blinks when data transmitting)
	Amber	10BASE-T Link Activity (constant on when link exists, blinks when data transmitting)
Right	Green	In Use (constant on when connection established). If it is not eliminated constantly then there may be a cable problem.
	Amber	Fault (blinks when IP fault)

Table 4 – Ethernet module LED Indicator

An iRIS fitted with an Ethernet module will not have any cabling fitted when it is manufactured, unless this is requested during the sales process.

The Ethernet module connector is of an RJ45 type. The gland that is mounted on the base of the enclosure (for cable passage) will not allow the RJ45 connector to pass, so the cable must be feed thought the gland and then terminated to the connector.

It is recommended that 8 core twisted pair cable be used, CAT5 or CAT6 cable is sufficient.

There are two wiring schemes, standard and crossover. The standard scheme is used when the iRIS is connected to a network switch or hub. The crossover scheme is used when the iRIS is connected directly to another network appliance (without intermediate switch or router).

- Standard Wiring 24
- Crossover Wiring 25

Features

- KISTERS Server/Client
- SODA Server/Client
- Modbus TCP Master (Client)/Slave (Server)

Modbus TCP Master

- The client (server) must be available prior to starting the logger.
- The Master will try to connect to the server 5 times, if this fails it will only try to reconnect again after a power cycle.
- When a successfull connection breaks the ethernet module will restart. In order to avoid 'TCP Port numbers reused' the ethernet board will be offline for at least 60 seconds.

2.4.3.1 Standard Wiring

The standard wiring between a pair of RJ45 connectors using 8-core twisted pair cable is shown below. The actual colour codes are not important as long as there is a 1-1 pin mapping.

Pin #	Wire Colour	Pin #
1	White/Orange	1
2	Orange	2
3	White/Green	3
4	Blue	4
5	White/Blue	5
6	Green	6
7	White/Brown	7
8	Brown	8

Table 5 – Ethernet RJ45 T568B standard wiring example

2.4.3.2 Crossover Wiring

The crossover wiring between a pair of RJ45 connectors using 8-core twisted pair cable is shown below. This swaps the transmit and receive pairs between connectors.

Pin #	Wire Colour	Pin #
1	White/Orange	3
2	Orange	6
3	White/Green	1
4	Blue	7
5	White/Blue	8
6	Green	2
7	White/Brown	4
8	Brown	5

Table 6 – Ethernet RJ45 T568B crossover wiring example

2.5 Telemetry Module Connectors/Interface

The physical connections from the telemetry module to the “outside world” have different types of apertures through the enclosure depending on the type. There are two type of enclosure aperture layouts.

- Two Coaxial + One Gland 25
- Two Glands 28

2.5.1 Two Coaxial + One Gland

The iRIS has an industry standard SMA connector which protrudes through the bottom edge of the enclosure base.

In areas of good signal strength, a small “stubby” or omni-directional type antenna will suffice. In areas of more marginal coverage, the antenna should an external high gain type such as a Yagi, via appropriate low-loss high frequency coaxial cable and male SMA connector.

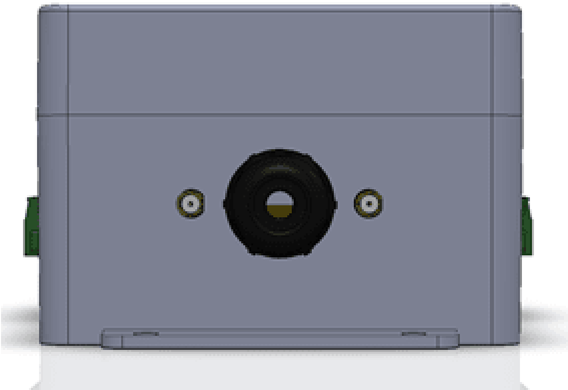


Figure 16 – Antenna and communications port configuration (Two Coaxial + One Gland)

Important note!

The LTE CAT-1 module employs a two antenna approach for cellular communications. They are called Main and Diversification. The main can be used by itself, but to get better reception a second antenna can be connected to the iRIS diversity aerial connector.

This means there is a different definition to the two SMA antenna connection when an LTE CAT-1 module is fitted compared to 3G modules. Please see Table below.

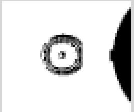
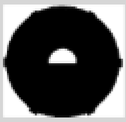
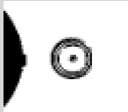
Communications Module A	Communications Module B					
Cellular	None	3G	MA-GPS	Unused	3G	MA-Cellular
		4G†	MA-Cellular		4G†	MA-DIV
		4G‡	MA-Cellular		4G‡	MA-GPS
Cellular	Cellular	3G	MB-Cellular	Unused	3G	MA-Cellular
		4G†	MA-Cellular		4G†	MB-Cellular
		4G‡	MA-Cellular		4G‡	MB-Cellular
Serial	None	Unused		Serial (MA)	Unused	
Cellular	Serial	3G	MA-GPS	Serial (MB)	3G	MA-Cellular
		4G†	MA-Cellular		4G†	MA-DIV
		4G‡	MA-Cellular		4G‡	MA-GPS
Satellite	None	TBD		Unused	TBA	
Satellite	Serial	TBD		MB-Serial	TBA	
Cellular	Satellite	TBA		Unused	TBA	
Cellular	Ethernet	3G	MA-GPS	Ethernet (MB)	3G	MA-Cellular
		4G†	MA-Cellular		4G†	MA-DIV
		4G‡	MA-Cellular		4G‡	MA-GPS

Table 7 – Communications port connector designations

Key:	
MA	Connected to Module A.
MB	Connected to Module B.
Cellular	2G/3G/4G main antenna connection.
DIV	4G CAT-1 diversification antenna connection.
GPS	global positioning system antenna connection.
Serial	Either a short external lead through the gland with DB9 connector fitted for RS232 or internal screw terminal for RS485 connection to cable fitted through the gland.

Key:	
Ethernet	Either a short length of twisted pared cable terminated with a pair of RJ45 connectors. Or empty gland.
3G	When fitted with a 3G module labelled with HE910 (see next section).
4G†	When fitted with a 4G LTE CAT-1 module labelled with LE910-C1 (see next section).
4G‡	When fitted with a 4G LTE CAT-M1/NBIoT module labelled with ME910-C1 (see next section).

2.5.2 Two Glands

In the case where the iRIS is fitted with two communications modules that require more than one gland it will have two glands mounted on the bottom of the base of the enclosure.

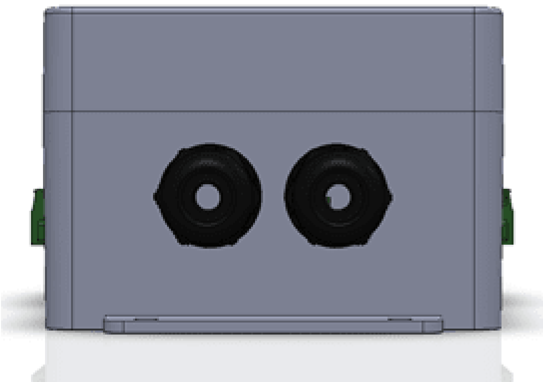


Figure 17 – Communications port configuration (Two Glands)

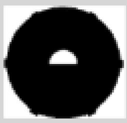
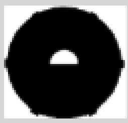
Communications Module A	Communications Module B		
Ethernet	Serial	Serial (MB)	Ethernet (MA)
Serial	Serial	Serial (MB)	Serial (MA)

Table 8 – Communications port connector designations

Key:	
MA	Connected to Module A.
MB	Connected to Module B.
Serial	Either a short external lead through the gland with DB9 connector fitted for RS232 or internal screw terminal for RS485 connection to cable fitted through the gland.

Key:	
Ethernet	Either a short length of twisted pared cable terminated with a pair of RJ45 connectors. Or empty gland.

2.6 Cellular Modem Type Identification

The cellular generation employed by the modem fitted to the iRIS can be determined by reading the label on the modem. Open the iRIS and locate the communications module (Module A is in the top half; Module B is located in the bottom half of the iRIS enclosure). The location of the label is shown below:

Model Number	**Region**	**Primary Technology**	**Secondary Technology**
HE910[1]	Global	3G	2G
LE910C1-AP	Asia Pacific	4G LTE CAT-1	3G
LE910C1-EU	Europe, Middle East and Africa	4G LTE CAT-1	3G + 2G
LE910C1-LA	Latin America	4G LTE CAT-1	3G + 2G
LE910C1-NF	North America	4G LTE CAT-1	3G
LE910C1-WWX	Global	4G LTE CAT-1	3G + 2G
ME910C1-AU	Australia and New Zealand	4G LTE CATM-1 and 4G LTE CAT-NBIoT	
ME910C1-WW	Global	4G LTE CATM-1 and 4G LTE CAT-NBIoT	2G

[1] This is a legacy modem type

Figure 18 – Location of cellular modem model number and table of modem technologies

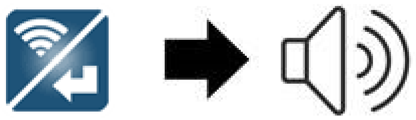
3 Configuration

The iRIS configuration is done by iLink or HydroTel. This description assumes a computer running the Microsoft® Windows® operating system is being used and all examples relate to the configuration tool in iLink 3. The following sections show the configuration using iLink 3 installed on a Microsoft® Windows® operating system.

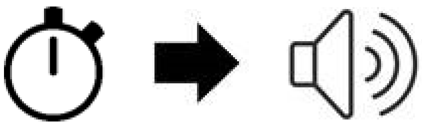
For more information, see the following subsections:

3.1 Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi (Windows 10)

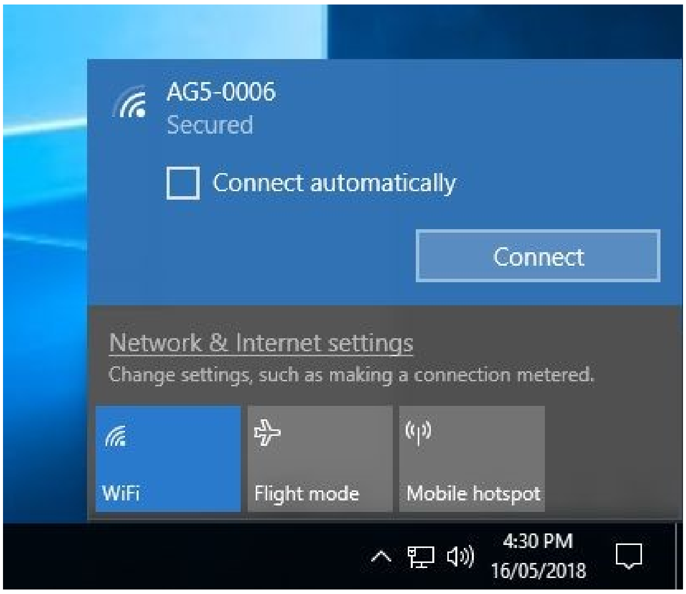
The first step is to establish a Wi-Fi connection between the PC and the iRIS.



On the iRIS press and hold the Wi-Fi/Enter button for 3 seconds until a beep, then release.

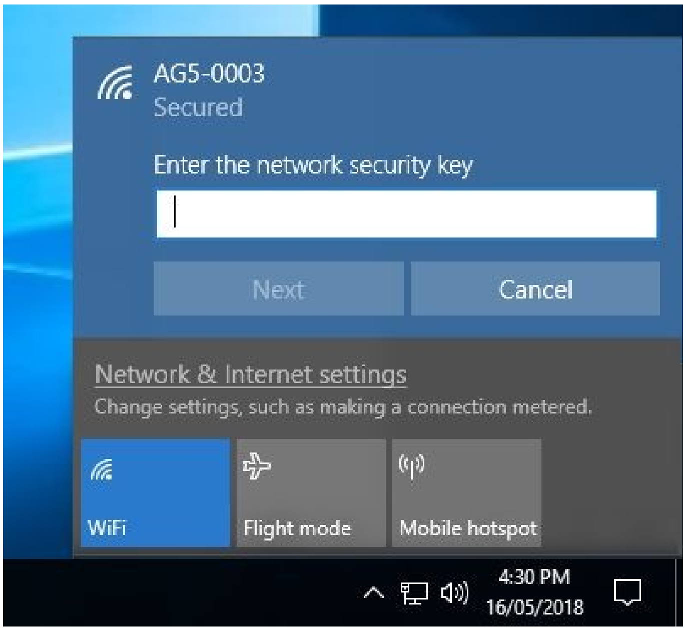


Wait for a second beep (lower tone) to indicate that the iRIS Wi-Fi access point is operating.



On PC/Laptop select the SSID that matches the iRIS you are connecting to.

Note: Refer to connecting devices documentation on how to establish a Wi-Fi connection to an access point. The example shown here is for Windows 10.

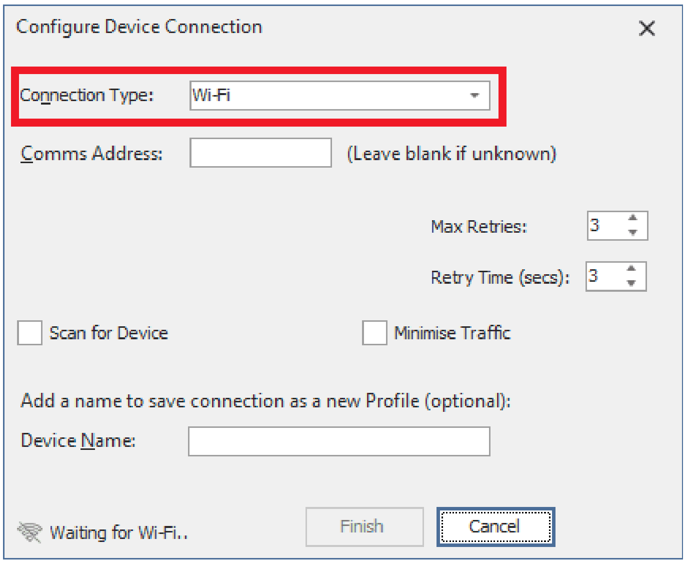


When prompted enter password Wi-Fi Password. The default password is `HyQuestSolutions`.

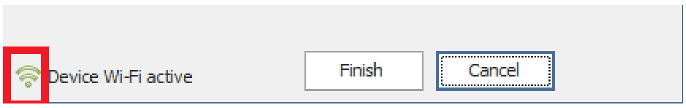
Then follow any other prompts to complete Wi-Fi pairing.

Open iLink3.

Click the **Quick Connect** button on the **Home** ribbon.



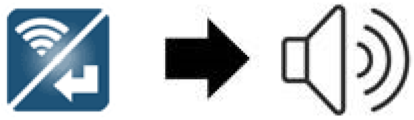
Select **Connection type: Wi-Fi**



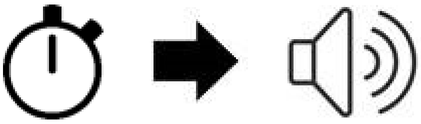
When the Wi-Fi icon changes from grey to green, click [**FINISH**] to connect to the iRIS.

3.2 Turn off Wi-Fi Access Point

The Wi-Fi access point will turn itself off after a predetermined time (see section Wi-Fi 39) or it can be turned off on demand via SMS command (see section SMS Text Commands 108) or via the Keypad by following the instructions:



On the iRIS press and hold the Wi-Fi/Enter button for 3 seconds until a beep, then release.

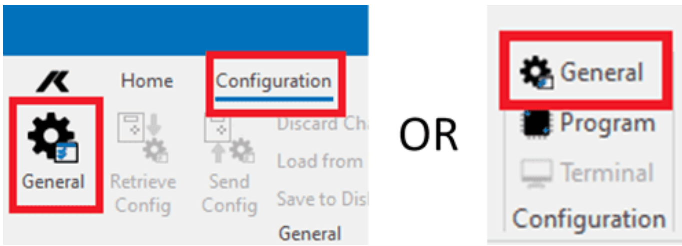


Wait for second longer beep to indicate the iRIS Wi-Fi access point has shutdown. Also, the Wi-Fi LED should have turned off.

3.3 Changing the Wi-Fi password with iLink Desktop software via Wi-Fi (Windows 10)

For added security the Wi-Fi password can be changed from the default to either an organisation wide or per site password. Connect to the iRIS via Wi-Fi using the steps in section Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi 30.

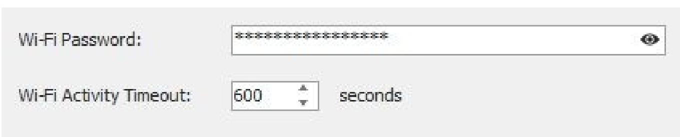
Warning: Please make sure to safely note down or remember the new Wi-Fi password. Otherwise it will not be possible to connect to the iRIS again through the Wi-Fi interface once the default password is changed.



From the overview screen click the shortcut button **General** on the right side of the **Home** ribbon or;

Select the **Configuration** ribbon and click on the **General** button.

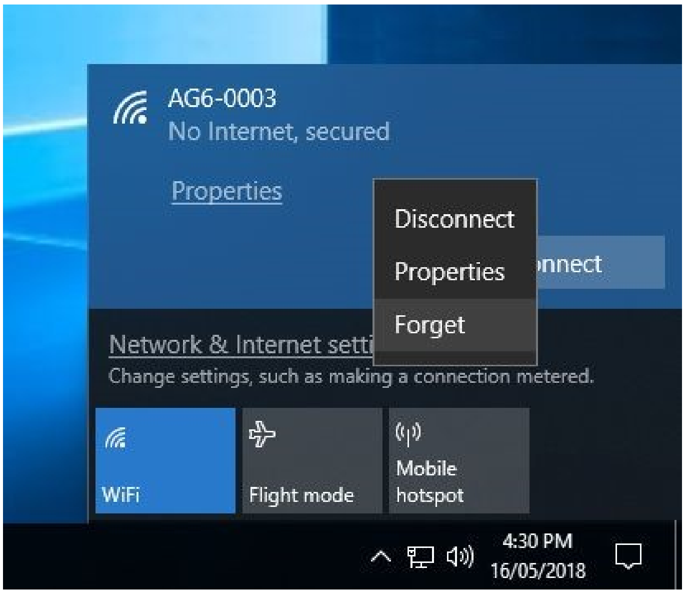
Expand the **Comms** branch of the tree and select the **Wi-Fi (WLAN)** Node.



Change the Wi-Fi Password, ensure it is between 8 and 63 characters long.

Click on the **Send Config** button to commit the change to the iRIS. **Please note** the password change will not take effect until the Wi-Fi AP has been reinitialised.

Click on the **Disconnect** button in the **Home** ribbon.



On PC/Laptop right click on the Wi-Fi network connection and click on [**FORGET**]. This tells the operating system to prompt for a new password next time you connect.

Note: Refer to connecting devices documentation on how change the saved password used for the iRIS access point. Example shown here is for Windows 10.

See section Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi 30.

Now Repeat the steps in section Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi 30 to reconnect to the iRIS this time using the new password.

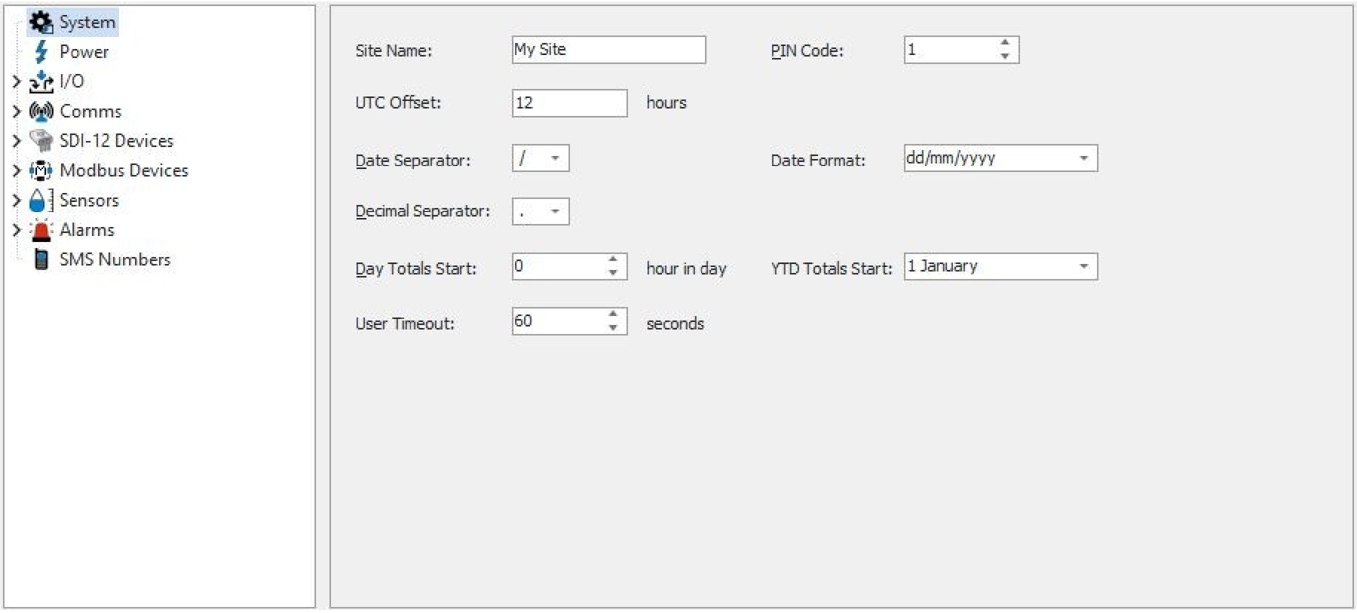
3.4 Configuration Menus

All the configuration can be done by connecting the device using iLink 2012. Once the iRIS is connected to your computer, as per section Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi (Windows 10) 30, click on the General option under the Configuration tab to see the configuration settings for the device.

For more information, see the following subsections:

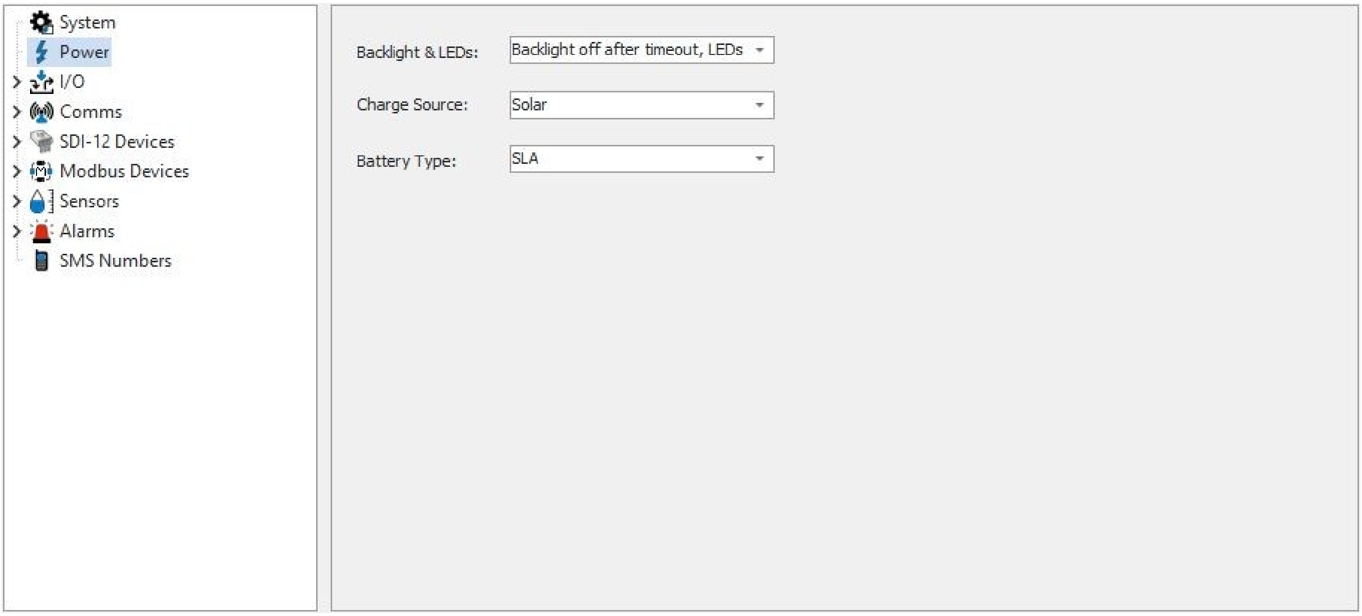
- System 34
- Power 35
- I/O Configuration 35
- Comms 38
- SDI-12 Devices 50
- Modbus Devices 54
- Sensor Configuration 55
- Alarm Configuration 61
- SMS Numbers 62

3.4.1 System



Site Name:	This setting is used to enter a name for the site that will be displayed on the main title screen of the LCD. **Note** that the maximum length of the site name is fixed at 19 characters.
PIN Code:	Enter a security PIN code between 0 and 9999. This PIN code is used to restrict access to specific LCD screens. If the PIN code is set to 0 then only the four status and the totaliser (view only) LCD screens are accessible. The factory default is 0.
UTC Offset:	Enter the offset from UTC in hours for the iRIS's time zone in this field.
Date Separator:	This option is used to select the date format as displayed throughout the iRIS (LCD screens, configuration menus and FTP file exports).
Date Format:	This setting is used to select the format of the date field, for example dd/mm/yyyy.
Decimal Separator:	This option is used to select the separator between whole and decimal numbers as seen on the LCD. For example, 1.234 or 1,234 are the same number.
Day Totals Start:	Enter the hour of the day to start calculating Day to Now totals. Default 0 (midnight).
YTD Totals Start:	Enter the month of the year to start calculating Year to Date totals. Default 1 (January).
User Timeout:	You can set the user to be logged off automatically after a certain period of no key presses. Enter the time in seconds in this column. Default 60.

3.4.2 Power



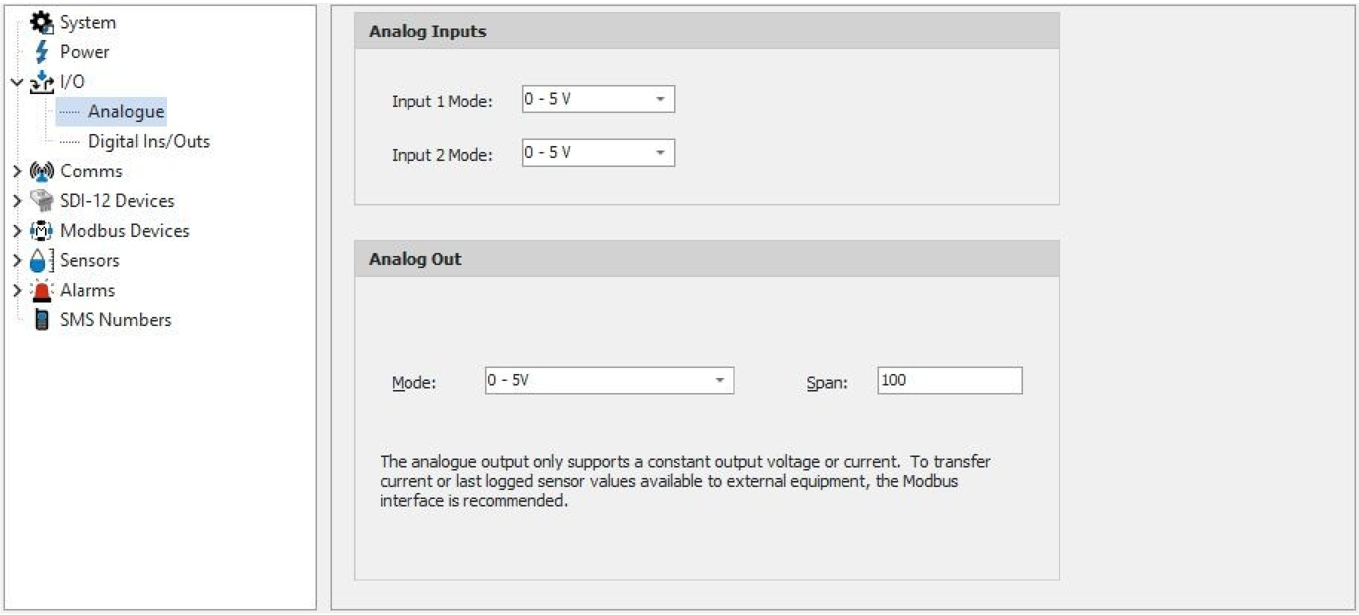
Backlight & LEDs:	This option allows you to choose additional power saving features. Possible options: ▪ Backlight off after timeout, LEDs always active ▪ Backlight always on, LEDs always active ▪ Both off after timeout The timeout referred to is the **USER TIMEOUT** setting configured in **SYSTEM** branch (see section System 34)
Charger Source:	Enter the power source for the charger: **DC** power supply or **SOLAR**. This selects the battery charging profile the iRIS will use. Only select **SOLAR** if the iRIS charger is being used to charge the battery. If there is an external solar charger, set the mode to **DC**.
Battery Type:	This option selects the battery type connected to VBAT terminal of the logger. Currently only **SLA** can be selected as battery type.

3.4.3 I/O Configuration

This chapter contains the following subsections:

- Analogue I/O 36
- Digital I/O 37

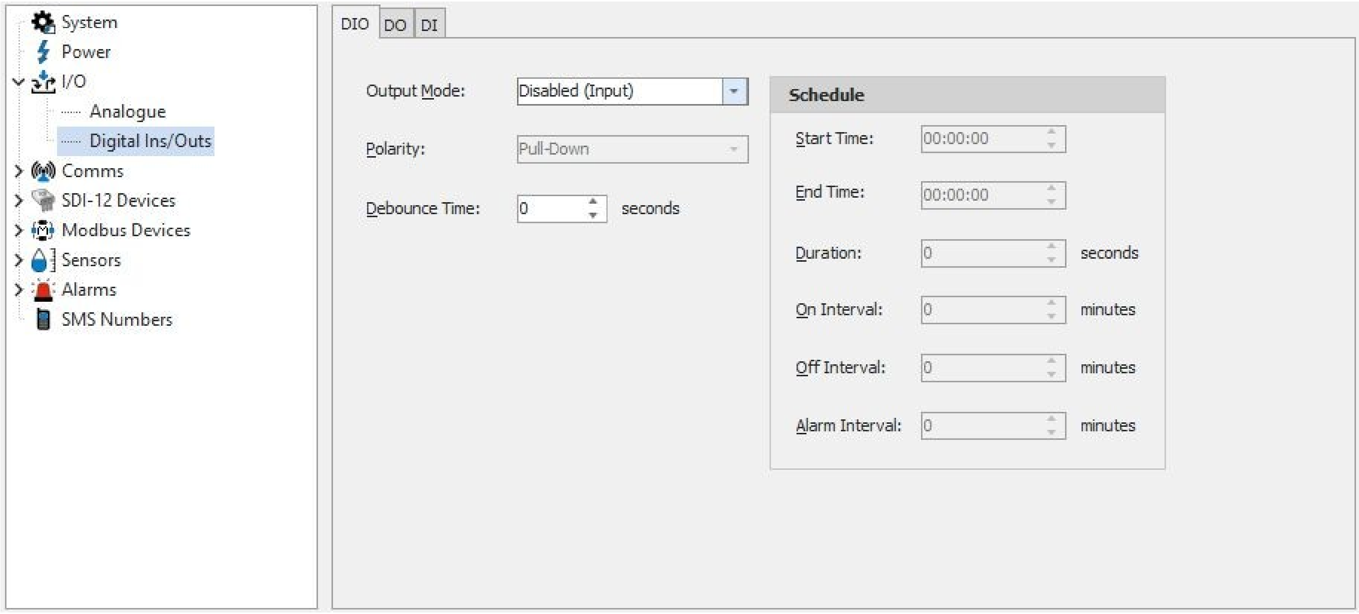
3.4.3.1 Analogue I/O



Analogue Inputs	
Input 1 Mode & Input 2 Mode:	This option allows to select the analogue input range to be used by the iRIS, the options are 0-20 mA, 4-20 mA, 0-100 mV, 0-5 V and 0-30 V.

Analogue Output	
Mode:	This allows the selection of either 0-5 V or 4-20 mA for the output.
Span:	Sets the actual value representing the maximum signal output (5 V or 20 mA). The Span setting is used to set the output as a percentage of the desired range (e.g. when 0-5 V mode is selected, and Span is set to 50, the output should be 2.5 V).

3.4.3.2 Digital I/O



<table>
<tr>
<td>Output Mode:</td>
<td>
Choose the operating mode of the output from the available options. Valid digital output modes are:
<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>Disabled</td><td>The Digital I/O channel will operate as a digital input.</td></tr>
<tr><td>Schedule</td><td>Follows the schedule as defined by the settings.</td></tr>
<tr><td>Schedule Plus</td><td>Follows the schedule as defined by the settings. Also activate the output when a user is logged in or an RS232 Telemetry mode call-in is in progress. If a user is logged on via the LCD/keypad interface OR the power mode is set to RS232 Telemetry and an alarm requiring transmission to a base station is pending, the output will be on.</td></tr>
<tr><td>Alarm</td><td>The output is on if any sensor alarm is active. Turns off when all alarms are inactive.</td></tr>
<tr><td>Remote</td><td>Remote Control from HydroTel or via a custom script. DIO1 is controlled by bit 0 of d1000, DIO2 by bit 1 of d1000, DIO3 by bit 2 of d1000 and DIO4 by bit 3 of d1000.</td></tr>
<tr><td>Online (DBA)</td><td>Follow wireless link state i.e. the output is on if the wireless modem is on-line (for Daughter board in slot A).</td></tr>
<tr><td>Online (DBB)</td><td>Follow wireless link state i.e. the output is on if the wireless modem is on-line (for Daughter board in slot A).</td></tr>
<tr><td>On</td><td>Always on.</td></tr>
<tr><td>Off</td><td>Always off (as opposed to tristate).</td></tr>
</table>
Table 9 – Digital Output Modes
</td>
</tr>
</table>

<table>
<tr><td>Polarity:</td><td>Select the switching polarity of the output. This relates to the output’s electrical state with respect to its logical on/off state. It also defines whether the output type is a pull-down (switch to GND) or pull-up (switch 12 V). Please refer to the table below.
<table>
<tr><th>Polarity</th><th>Output Logical State</th><th>Output Electrical State</th></tr>
<tr><td rowspan="2">Normal Pull-Down</td><td>Off</td><td>Open-circuit (Input)</td></tr>
<tr><td>On</td><td>Pulled down to 0 V (GND)</td></tr>
<tr><td rowspan="2">Inverted Pull-Down</td><td>Off</td><td>Pulled down to 0 V (GND)</td></tr>
<tr><td>On</td><td>Open-circuit (Input)</td></tr>
<tr><td rowspan="2">Normal Pull-Up</td><td>Off</td><td>Open-circuit (Input)</td></tr>
<tr><td>On</td><td>Pulled up to +12 V</td></tr>
<tr><td rowspan="2">Inverted Pull-Up</td><td>Off</td><td>Pulled up to +12 V</td></tr>
<tr><td>On</td><td>Open-circuit (Input)</td></tr>
</table>
Table 10 – Digital Output Polarity

If the polarity setting is Normal, the output will be electrically on when the output logical state is on and be high impedance (open-circuit) when the output is logically off.
If the polarity setting is Inverted, the output will be high impedance (open-circuit) when the output logical state is on and be electrically on when the output is logically off.
If the polarity setting is Pull-Down, the output will short the output terminal to GND. A maximum of 100 mA can be sunk in this mode from an external load.
If the polarity setting is Pull-Up, the output will supply 12 V to an external load at up to 100 mA.
</td></tr>
<tr><td>Debounce Time:</td><td>For DIO, DI1 & DI2 only. The amount of time to wait for the input signal to be stable to consider it active. This setting is in seconds.</td></tr>
<tr><td>Start Time:</td><td>This is the time at which the iRIS is allowed to start controlling the output if the mode is set to Schedule.</td></tr>
<tr><td>End Time:</td><td>This is the time at which the iRIS must stop controlling the output if the mode is set to Schedule.</td></tr>
<tr><td>Duration:</td><td>Enter the length of time in seconds that you want the iRIS to keep the output energised for if the mode is set to Schedule or Schedule Plus.</td></tr>
<tr><td>Interval:</td><td>Enter the length of time in minutes between the successive operations of the output if the mode is set to Schedule.</td></tr>
<tr><td>Alarm Interval:</td><td>Enter the length of time in minutes between the successive operations of the output if the mode is set to Schedule - when there are one or more active alarms in the iRIS.</td></tr>
</table>

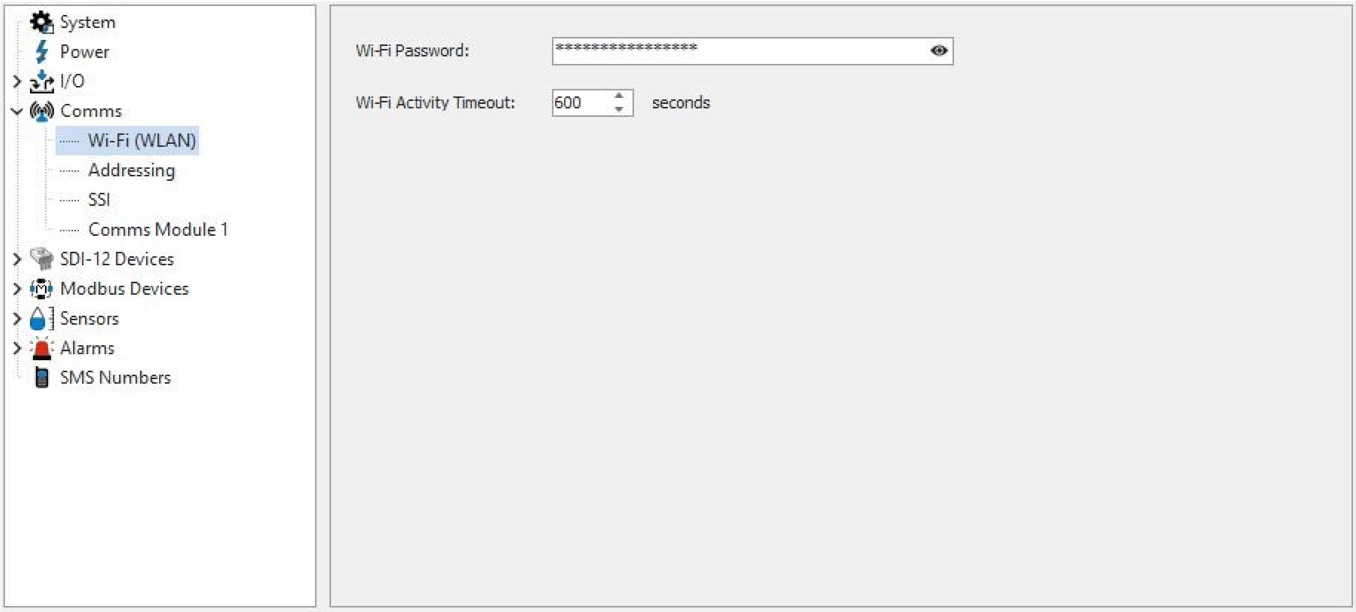
3.4.4 Comms

The comms configuration menu is the starting point for configuring all iRIS communication settings:

- Wi-Fi 39
- Addressing 39

- Serial Sensor Interface (SSI) 40
- Telemetry Daughter Board 41

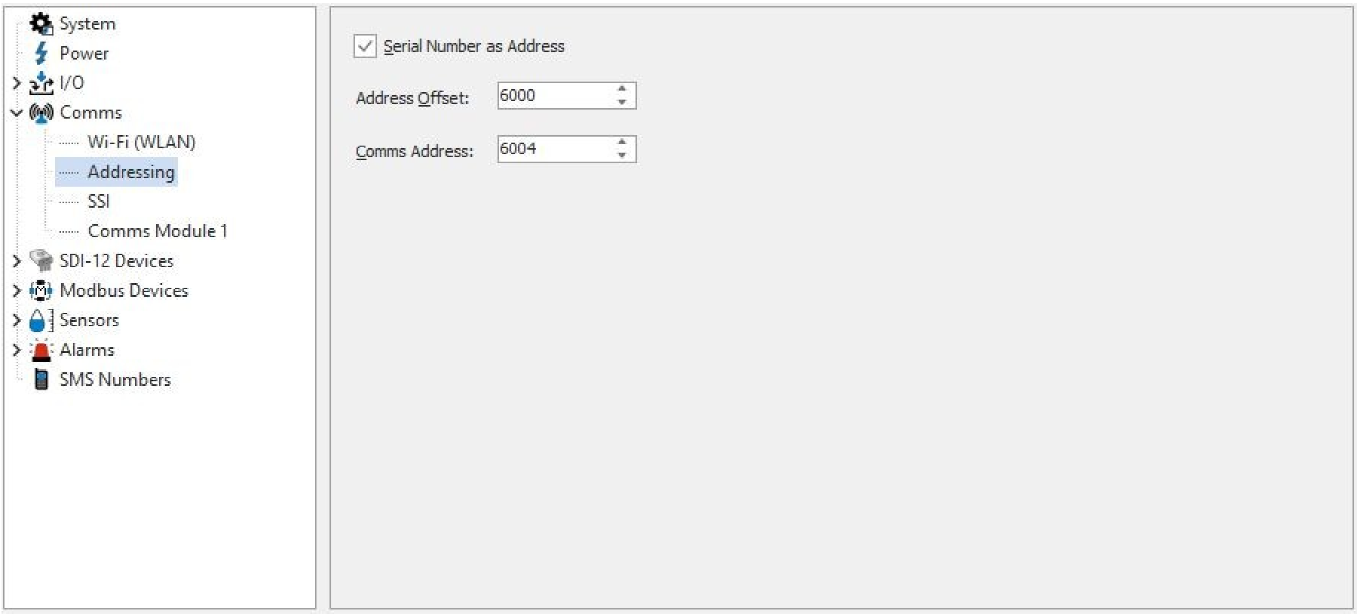
3.4.4.1 Wi-Fi



Wi-Fi Password:	Allows you to change the password for accessing the Wi-Fi access point on the iRIS. A change in password will not take effect until the Wi-Fi session has be reinitialized.
Wi-Fi Activity Timeout:	This is the time in seconds that the iRIS will maintain an active access point, the default is 10 minutes.

See section Changing the Wi-Fi password with iLink Desktop software via Wi-Fi (Windows 10) 32.

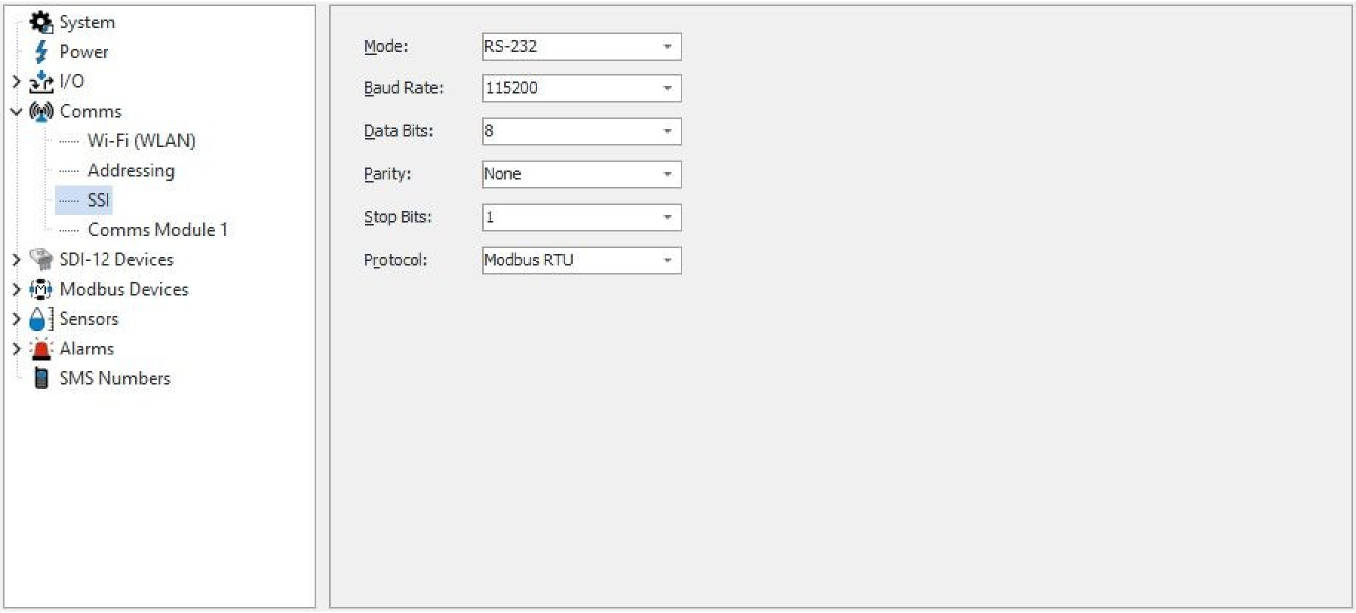
3.4.4.2 Addressing



Serial Number as	Tick this checkbox if you want the address to be obtained automatically from the device's serial

Address:	number.
Address Offset:	If the 'Use Serial number as Address' check box is enabled, then an optional offset can be entered which can be used to categorise units into regions. **Note**: The address obtained by adding the serial number and offset must not exceed 32767.
Comms address:	If the automatic serial number mode is not enabled, enter the communication address for the device (the factory default is 1). This address is used to identify the unit in all HyQuest protocol communication and must be unique on a HydroTel™ communications interface.

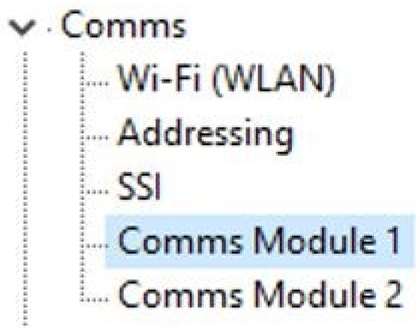
3.4.4.3 Serial Sensor Interface (SSI)



Mode:	Serial mode to be used on the SSI port, possible options are RS-232 and RS-485. In addition to this setting a jumper pair needs to be in the matching position on the PCB see section Selecting Serial Mode 19.
Baud Rate:	The baud rate setting, possible options are 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Default is 1200.
Data Bits:	This option configures the number of data bits in each serial frame, possible options are 7, 8, and 9. The default is 8
Parity:	This option configures the type of parity check bits in each serial frame, possible options are None, Even and Odd. The default is None.
Stop Bits:	This option configures the number of stop bits in each serial frame, possible options are 1 and 2. The default is 1.
Protocol:	This is the protocol to be used over the SSI port, possible options are: ▪ **MODBUS RTU** – this is binary format of Modbus (used over serial connections) ▪ **MODBUS TCP** – or Modbus TCP over Serial, to be used with Serial to Ethernet converters.

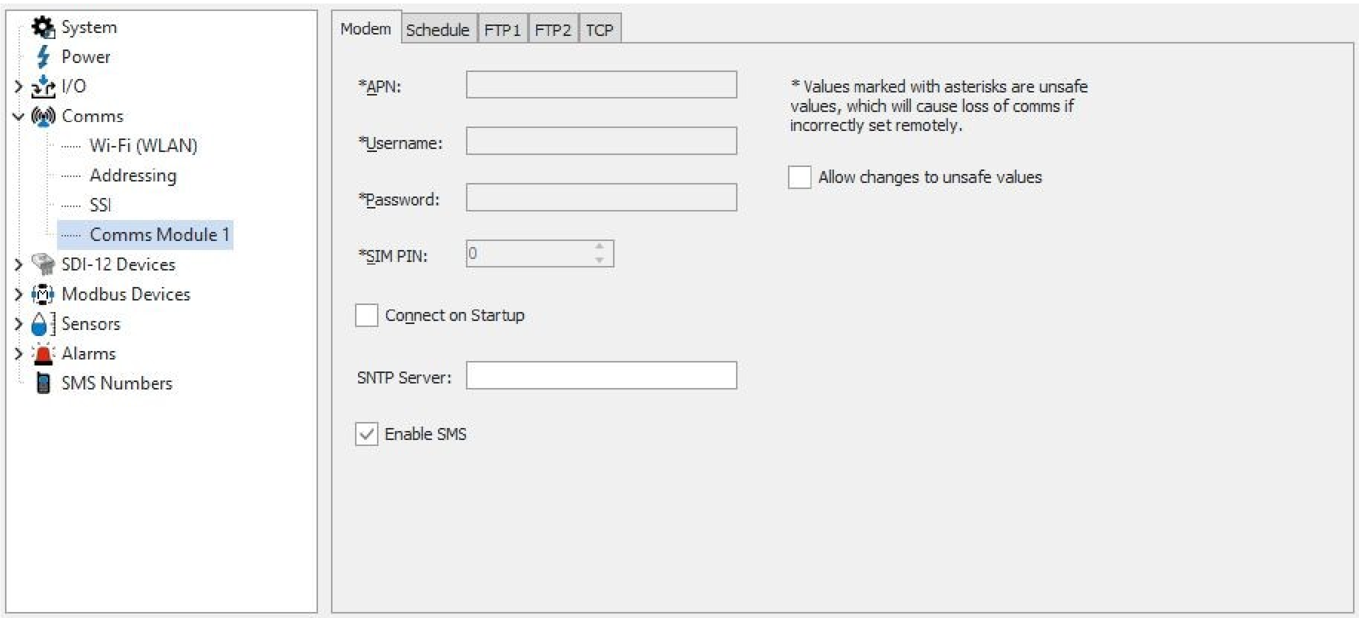
3.4.4.4 Telemetry Daughter Board

The iRIS can be equipped with up to two telemetry daughter boards. The iRIS and iLink automatically detect the number and type and display this in the configuration tree, listed as Comms Module 1 and Comms Module 2. The next sections describe the configuration screens for the daughter supported. If the tree has does not have either of these nodes then the iRIS is not fitted with any daughter boards.



- Cellular Modem - Modem 41
- Cellular Modem - Schedule 42
- Cellular Modem - FTP 1 & FTP 2 43
- Cellular Modem - TCP 45
- Serial – Serial 46
- Ethernet – Ethernet 47
- Ethernet – Schedule 49

3.4.4.4.1 Cellular Modem - Modem

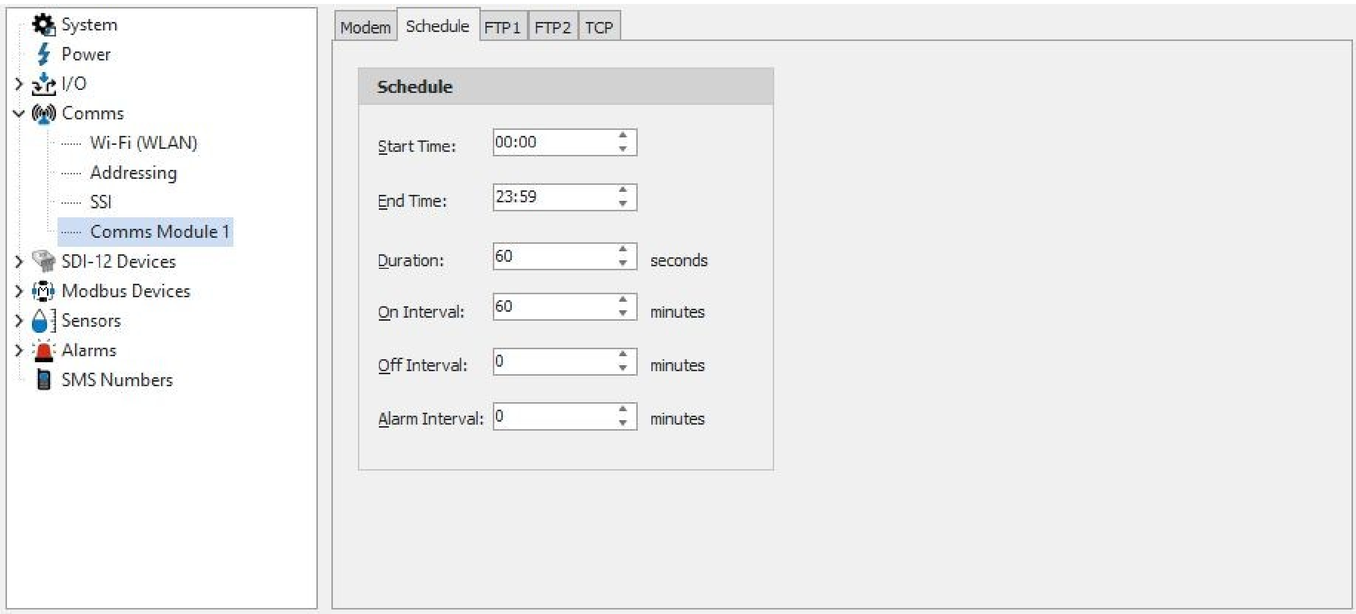


APN:	Enter the name of the APN (Access Point Name) allocated by your network provider (e.g.: hyquest.gdsp.nz).
User Name:	Enter the user name required by your network provider. **Note**: Many providers do not require any login credentials, in which case this and the password parameter below should be empty.
Password:	Enter the password required by your network provider. **Note**: Many providers do not require any login credentials, in which case this and the user name above parameter should be empty.

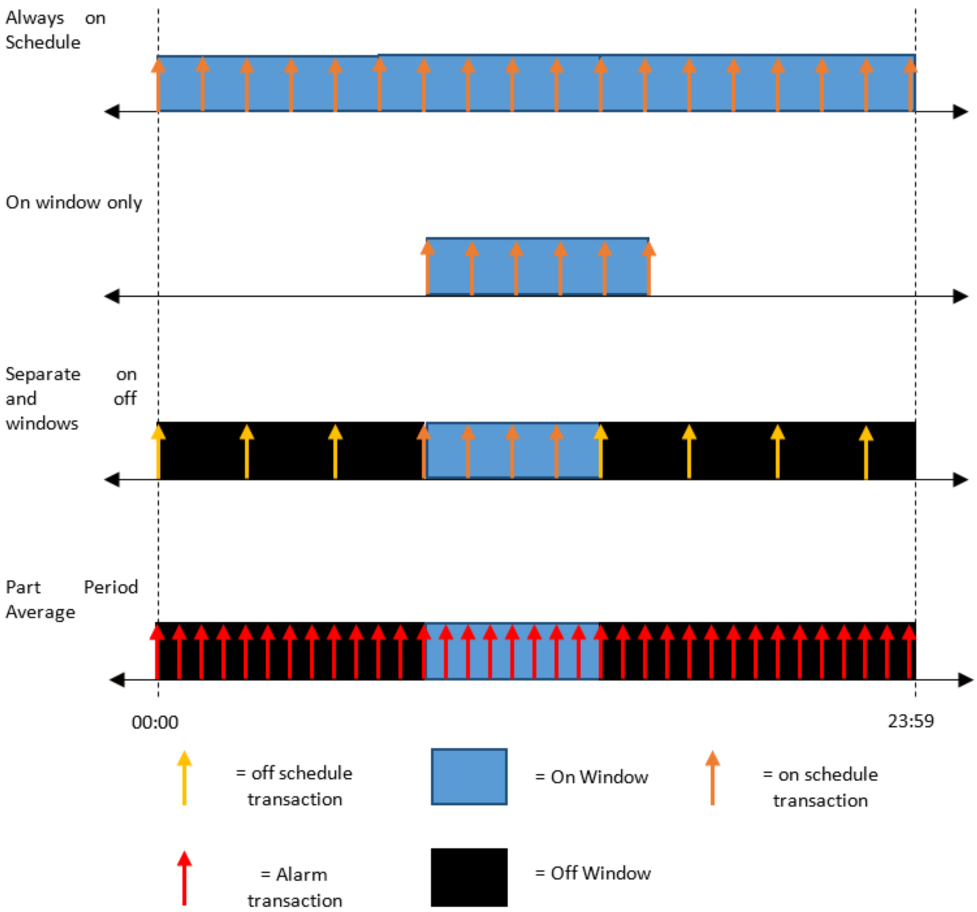
Connect on Startup:	This option will cause the device to initiated a connection as soon as it has initialised after a start-up.
SIM PIN:	If the SIM card installed has a PIN code enabled for security purposes, use this option to define it. If a PIN code is not required, enter zero (0) for this setting. If a SIM PIN is required and an incorrect PIN is entered, the unit will not operate correctly. Also, if the SIM PIN is set incorrectly, repeated attempts by the iRIS to log-on may result in the SIM card becoming locked out. This situation will require knowledge of the SIM's PIN Unlock Key (PUK) and/or contacting the SIM provider for unlock details.
SNTP Server:	Enter the SNTP (Simple Network Time Protocol) server IP address in this field. This can be used to syntonise the logger clock, if no other source is needed (for example HydroTel or SODA). To not use this feature leave the field blank.
Enable SMS:	When this box is checked, the logger checks and responds to SMS messages. This is a power saving feature. Please see section SMS Numbers 62 for more information.
Allow Changes to Unsafe Values:	The APN, Username and Password are marked as unsafe values, which may cause loss of comms if incorrectly set remotely. If you want to edit these columns, the option **ALLOW CHANGES TO UNSAFE VALUES** should be enabled.
SNTP Server:	Enter the address of a SNTP server here. If an address is entered the logger will update the internal timestamp using this SNTP server at each transmission.
Enable SMS:	If enabled the logger will check for SMS inbetween transmissions and will react on them accordingly (see SMS Communications 108)

3.4.4.4.2 Cellular Modem - Schedule

The schedule configuration menu is provided to manage the wireless communication schedule.

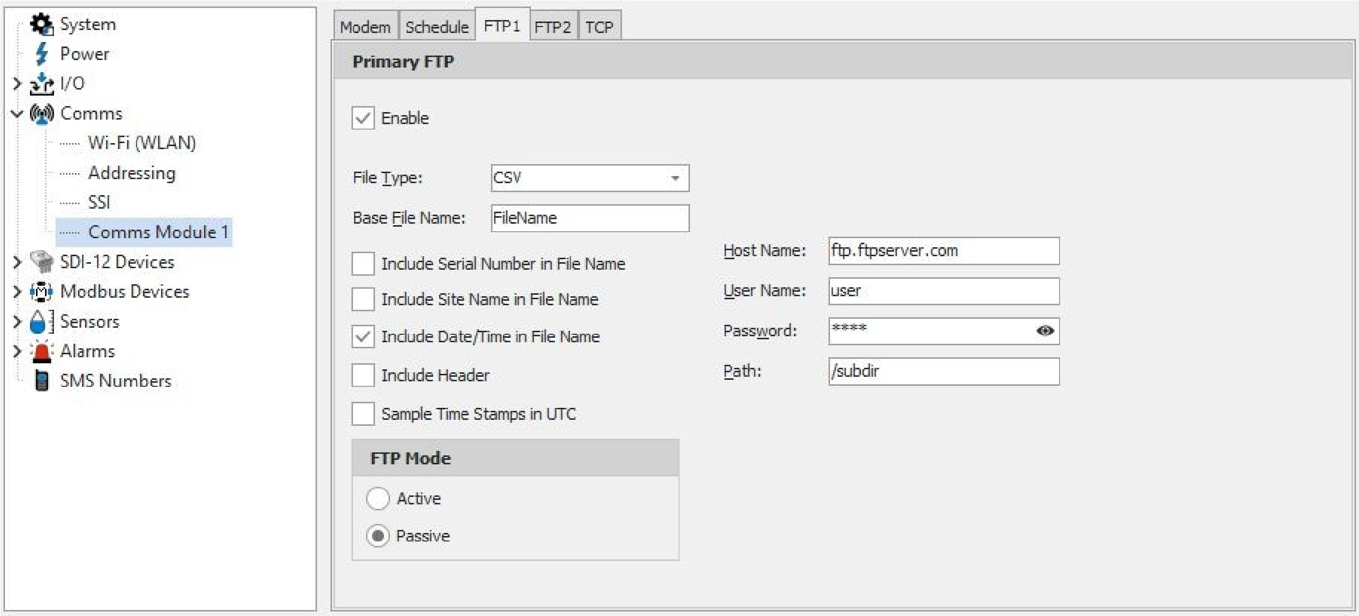


Start Time:	Enter the time at which the iRIS is allowed to start establishing wireless IP sessions or sending SMS messages.

End Time:	Enter the time after which the iRIS must stop establishing wireless IP sessions. 
Duration:	This is the length of time in seconds that you want the iRIS to keep each wireless IP session active.
On Interval:	Enter the length of time in minutes between each successive wireless IP session being established or an SMS message being sent when the time is in the "on" period (i.e. between the start and end times).
Off Interval:	Enter the length of time in minutes between each successive wireless IP session being established or an SMS message being sent when the time is in the "off" period (i.e. before the start time or after the end time). This setting will normally be 0 (no activity), but this option allows a different connection rate to be configured if required.
Alarm Interval:	Enter the length of time in minutes between each successive wireless IP session being established or an SMS message being sent – when there are one or more active alarms in the iRIS.

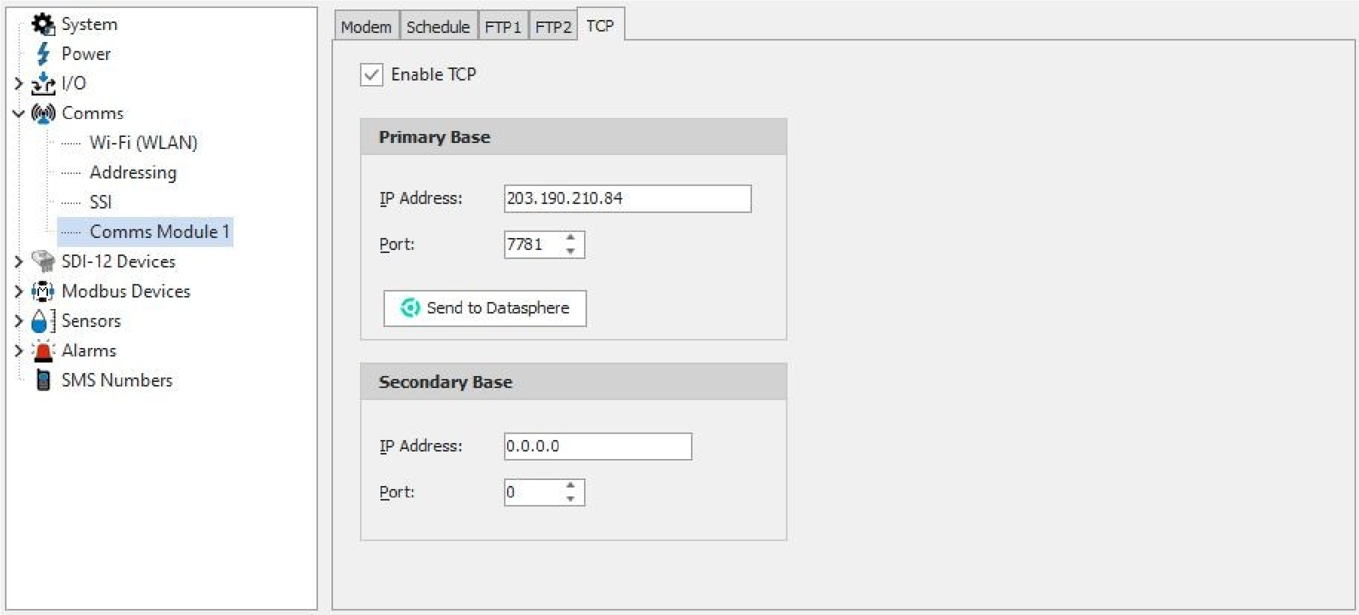
3.4.4.4.3 Cellular Modem - FTP 1 & FTP 2

The iRIS allows the push of data to up to two FTP servers and this is done in the FTP1 an FTP2 configuration tabs, both are identical in format and operation so only one is shown below. If one or both are not needed simply remove the check from the enable box.



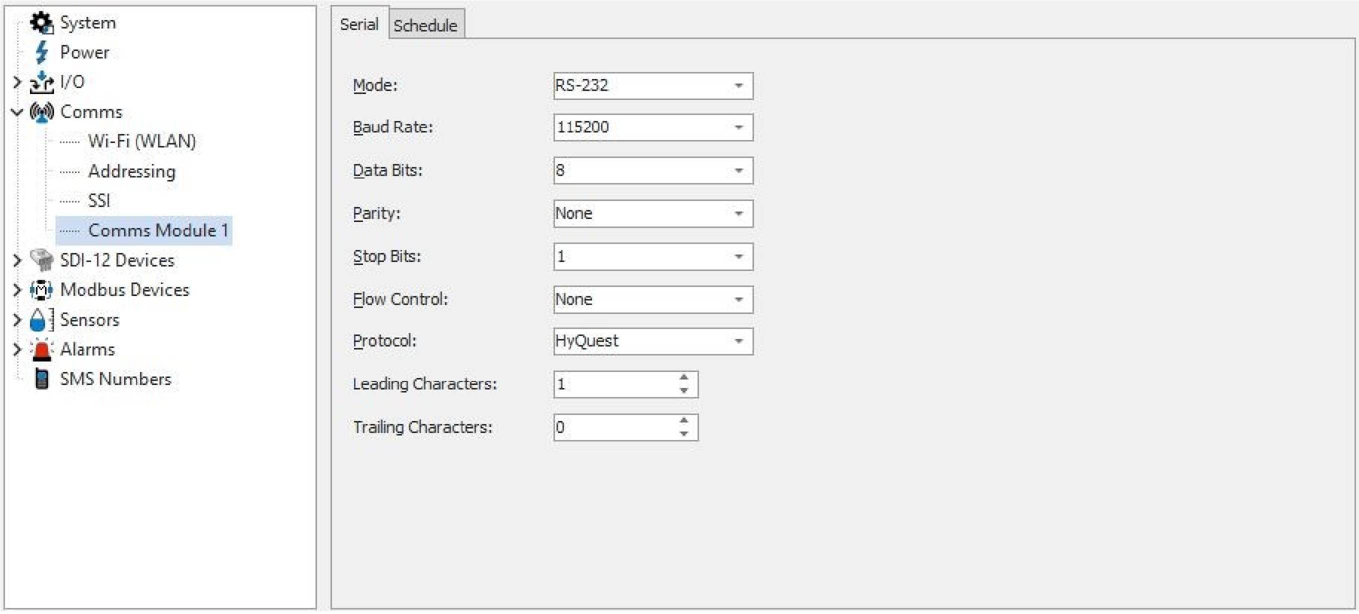
Enable:	If checked a call-in will include an FTP transaction (both scheduled and user initiated).
File Type:	This allows the selection of file type or extension of the file created by the iRIS, this is either CSV or ZRXP
Include Serial Number in File Name:	If checked the serial number of the iRIS will be included in the file name generated on the server (see section File Name Convention 114).
Include Site Name in File Name:	If checked the site name of the iRIS (see section File Name Convention 114) will be included in the file name generated on the server (see section File Name Convention 114 for more details on file name convention).
Include Date/Time in File Name:	If checked the date and time of the upload will be included in the file name generated on the server (see section File Name Convention 114 for more details on file name convention).
Include Header:	If checked a header is place on the first row or line of the file generated on the server (see section CSV File Formats 114).
Sample Time Stamps in UTC:	If checked the sample in the file generated on the server will have time stamps in UTC (UTC+0), otherwise the time stamps will include the iRIS's UTC offset as configured in section File Name Convention 114 (see section CSV File Formats 114 for more details on file contents). This also applies to the time element of the file name, i.e. UTC offset is applied to file name and contents or neither.
Active/Passive Mode:	If checked the FTP transaction will use Passive mode otherwise Passive mode is used. Passive Mode is recommended for most cases. A description of Active and Passive mode can be found in section Active verses Passive mode 136.
Host Name:	Enter the host name of the FTP server to upload files to, this can be a URL or IP address.
User Name:	Enter the user name required to login to the FTP server.
Password:	Enter the password required to login to the FTP server.
Path:	Enter the sub-folder path (if required) on the FTP server.

3.4.4.4.4 Cellular Modem - TCP



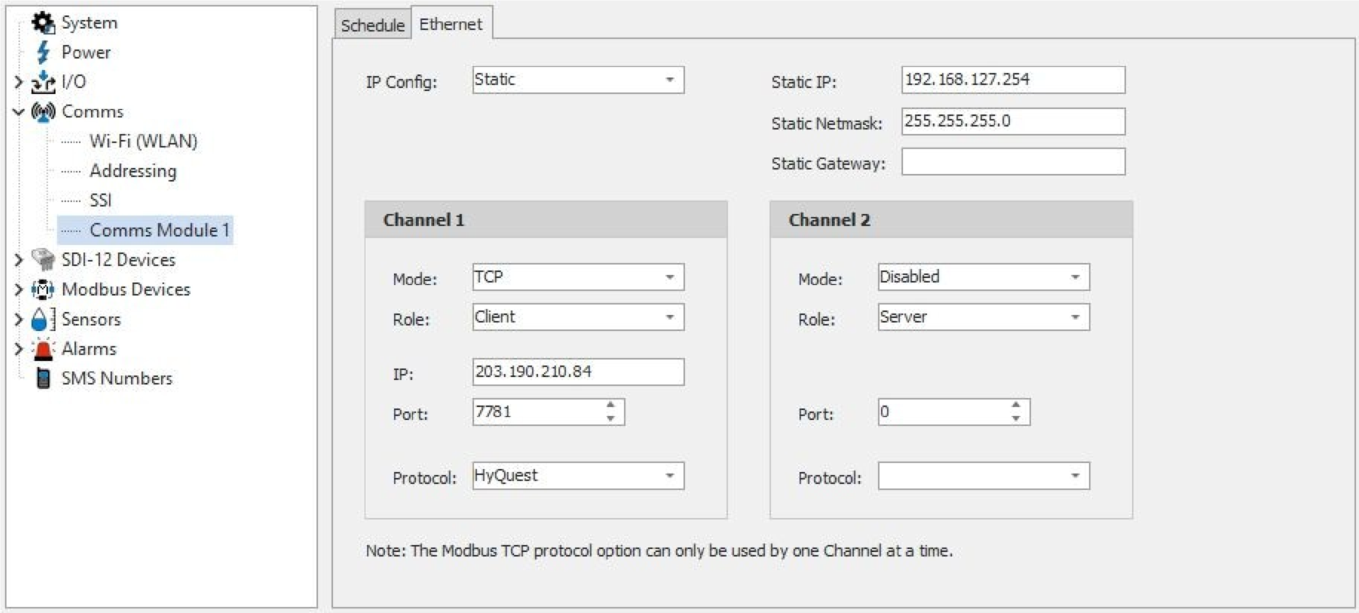
Enable:	Enables a call-in to the primary and secondary base (if configured).
Primary Base IP:	Enter the remote IP address you want to have the iRIS connect to as its primary base (host server).
Primary Base Port:	Enter a non-zero port number to use for the IP socket.
Secondary Base IP:	Enter the optional secondary base remote IP address that you will connect to. **Note: To disable this feature set the IP address to '0.0.0.0'.**
Secondary Base Port:	Enter the remote port number for the optional secondary base. **Note: To disable this feature set the port to zero.**
Send to Datasphere:	Clicking this button will populate the primary base IP and port with that of Datasphere. Please contact the KISTERS sales team to learn more about Dataphere or visit https://www.hyquestsolutions.eu/products/software/monitoring-software/kistersdatasphere.

3.4.4.4.5 Serial – Serial



Mode:	Serial mode to be used with give daughter board, possible options are RS-232 and RS-485.
Baud Rate:	The baud rate setting, possible options are 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Default is 1200.
Data Bits:	This option configures the number of data bits in each serial frame, possible options are 5, 6, 7, 8, and 9. The default is 8. ⚠ The second or lower daughter board is limited to a data bit range of 7, 8, and 9.
Parity:	This option configures the type of parity check bits in each serial frame, possible options are None, Even and Odd. The default is None.
Stop Bits:	This option configures the number of stop bits in each serial frame, possible options are 1 and 2. The default is 1.
Flow Control:	This option configures the flow control mode, possible options are None and Hardware. The Hardware option uses RTS and CTS has hardware flow control lines. The default is None.
Protocol:	This is the protocol used by the iRIS via the given serial daughter board. The options are: ▪ HyQuest – used with iLink, HydroTel and SODA. ▪ Modbus RTU – this is binary format of Modbus (used over serial connections) ▪ Modbus TCP – or Modbus TCP over Serial, to be used with Serial to Ethernet converters.
Leading Characters:	This option configures the number leading 0xFF characters applied to the beginning of each HyQuest protocol packet. This can be used to provide a delay after initial transmission before valid packet data is transmitted.
Trailing Characters:	This option configures the number trailing 0xFF characters applied to the end of each HyQuest protocol packet. This can be used to provide a delay after transmission valid packet data to ensure the radio channel is kept open and not truncating the end of the packet.

3.4.4.4.6 Ethernet – Ethernet



IP Config:	The iRIS needs to have an Internet Protocol (IP) address to operate on an Ethernet network. This option instructs the iRIS to either, attempt to obtain the one from the network using DHCP (Dynamic Host Configuration Protocol) or use one supplied by the user (Static setting). The address, irrespective of if it is statically or dynamically allocated, is used to identify the iRIS on the network, it is not the address the iRIS uses to connect to.
Static IP: **Note**: Only applies when the IP Config setting is set to Static, in other modes these setting will be hidden as they have no effect.	This is the static internet protocol address or fixed address the iRIS uses on the network. The address is an IPV4 format (Internet Protocol version 4), statically assigning IPV6 address is not possible. Static IP addressing is used on networks that do not have access to a DHCP (Dynamic Host Configuration Protocol) or the IP address needs to be fixed.
Static Netmask:	This is the Subnet Netmask for the network address range that the iRIS will operate on. The mask is an IPV4 format (Internet Protocol version 4), statically assigning IPV6 masks is not possible. Static IP addressing is used on networks that do not have access to a DHCP (Dynamic Host Configuration Protocol) or the IP address needs to be fixed. An explanation of Netmasks is outside the scope of this document.
Static Gateway:	An IP network may have a gateway(s) that joins two or more networks. In practice this is often a gateway to the internet. The iRIS uses this address to forward packets to IP addresses that are not within the network it is within. The address is an IPV4 format (Internet Protocol version 4), statically assigning IPV6 address is not possible. If the all components of the system are on the same network, then this setting can be left blank. Static IP addressing is used on networks that do not have access to a DHCP (Dynamic Host Configuration Protocol) or the IP address needs to be fixed.
Mode:	This is the protocol mode used for the channel, it is either TCP (Transmission Control Protocol) or UDP (User Datagram Protocol).
Role: **Note**: This setting only applies to the when Mode is set to TCP and	This is the TCP role that the iRIS will act as for the channel. The client role means the iRIS will connect to host IP address using a schedule (see Ethernet – Schedule 49 for more information), the server role means the iRIS will listen for a connection to the iRIS form a TCP client.

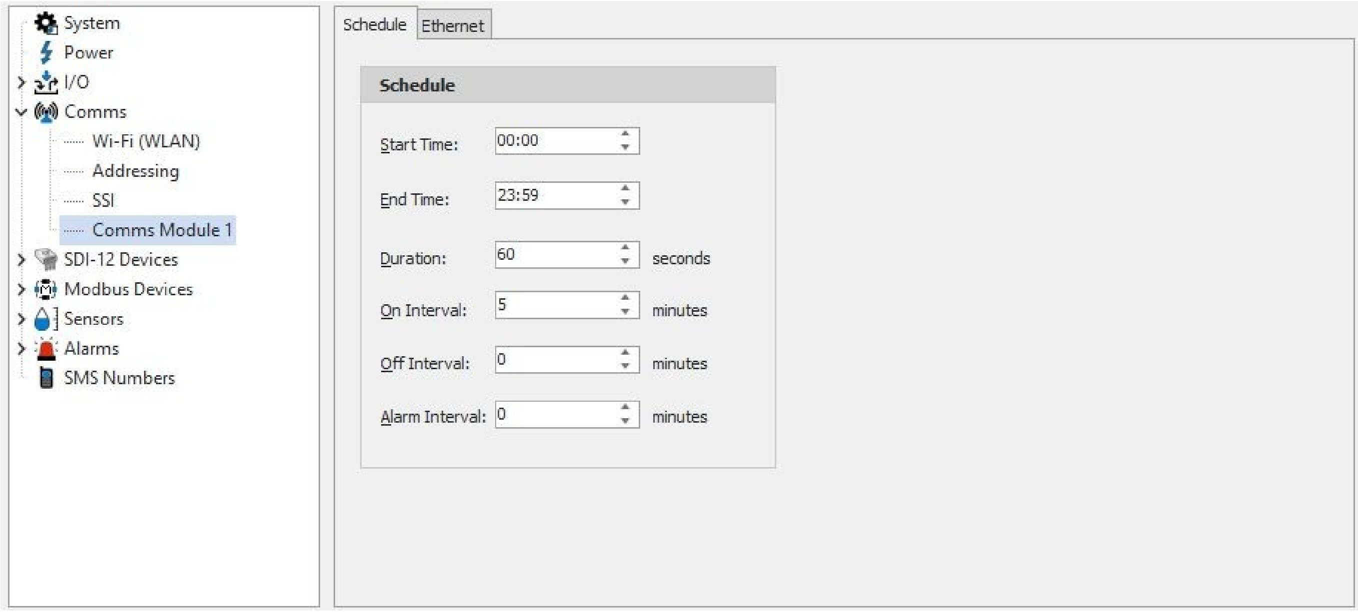
is hidden if another mode is selected.	
Port:	This is the port number the iRIS uses, it can be a value between 0-65535.
Protocol:	There are two options for this setting. The HyQuest protocol is used in conjunction with HyQuest or Kisters software packages. The Modbus protocol is the open industrial protocol, see section Modbus Protocol 68 for more information on the protocol or section Modbus Devices 54 for information on configuring Modbus devices on the iRIS.

Note the Ethernet module has two independent channels for TCP/IP operation, the following configuration items are the same for both channels:

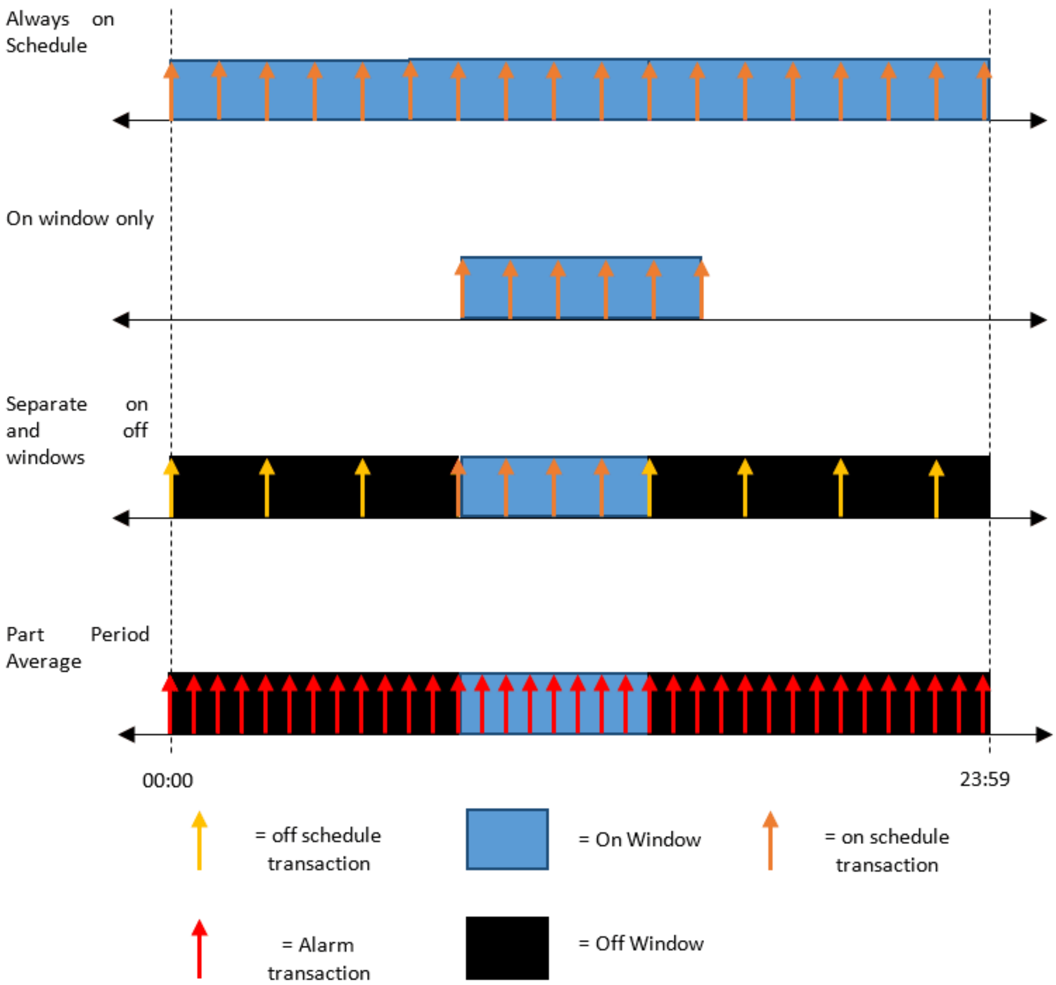
Mode:	This is the protocol mode used for the channel, it is either TCP (Transmission Control Protocol) or UDP (User Datagram Protocol).
Role: **Note**: This setting only applies to the when Mode is set to TCP and is hidden if another mode is selected.	This is the TCP role that the iRIS will act as for the channel. The client role means the iRIS will connect to host IP address using a schedule (see Ethernet – Schedule 49 for more information), the server role means the iRIS will listen for a connection to the iRIS form a TCP client.
Port:	This is the port number the iRIS uses, it can be a value between 0-65535.
Protocol:	There are two options for this setting. The HyQuest protocol is used in conjunction with HyQuest or Kisters software packages. The Modbus protocol is the open industrial protocol, see section Modbus Protocol 68 for more information on the protocol or section Modbus Devices 54 for information on configuring Modbus devices on the iRIS. The Modbus protocol can only be selected for one of the two channels, while the HyQuest protocol can run on both channels in parallel.

3.4.4.4.7 Ethernet – Schedule

The schedule configuration menu is provided to manage the TCP client role communication schedule. In other words, it defines the how often the iRIS will connect to a host.



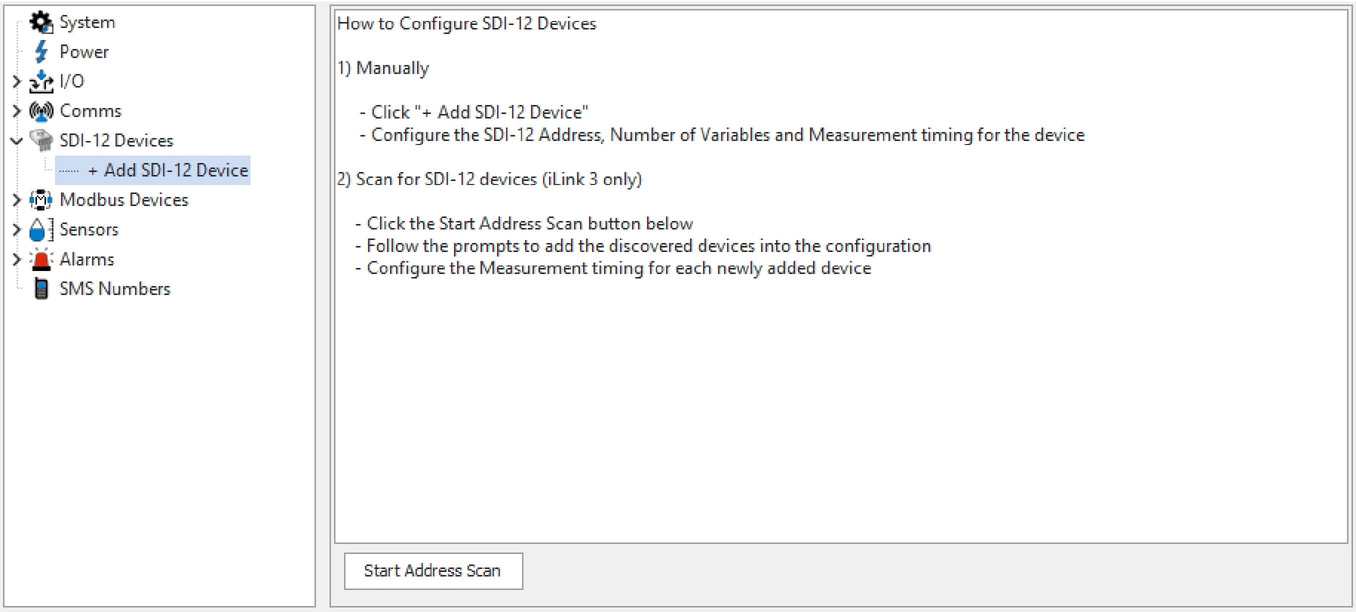
Start Time:	Enter the time at which the iRIS is allowed to start establishing IP sessions.

<table>
<tr><td>End Time:</td><td>Enter the time after which the iRIS must stop establishing wireless IP sessions.

</td></tr>
<tr><td>Duration:</td><td>This is the length of time in seconds that you want the iRIS to keep each IP session active.</td></tr>
<tr><td>On Interval:</td><td>Enter the length of time in minutes between each successive IP session being established when the time is in the “on” period (i.e. between the start and end times).</td></tr>
<tr><td>Off Interval:</td><td>Enter the length of time in minutes between each successive IP session being established when the time is in the “off” period (i.e. before the start time or after the end time). This setting will normally be 0 (no activity), but this option allows a different connection rate to be configured if required.</td></tr>
<tr><td>Alarm Interval:</td><td>Enter the length of time in minutes between each successive wireless IP session being established when there are one or more active alarms in the iRIS.</td></tr>
</table>

3.4.5 SDI-12 Devices

The SDI-12 134 Devices configuration menu is used to configure each of the 10 SDI-12 Devices attached to the iRIS 270.

To minimise clutter, iLink implements a dynamic device management system for the iRIS 270. Clicking on the SDI-12 Devices of the tree displays the instructions on how to use this feature.



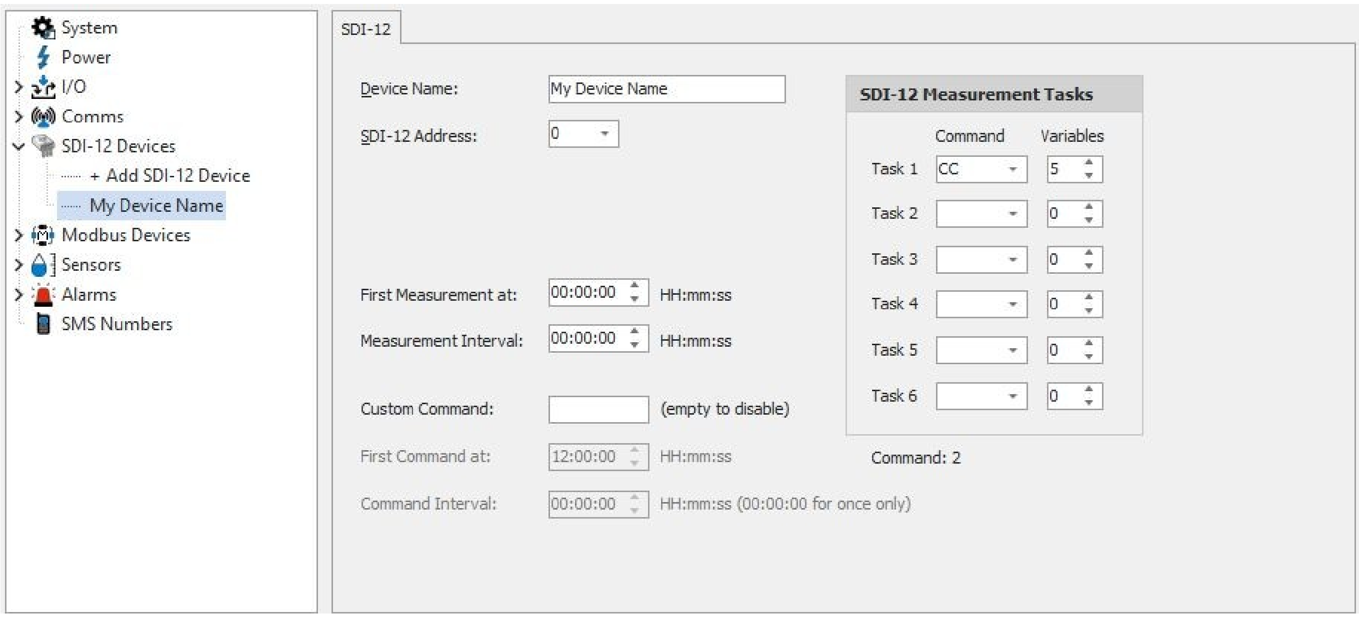
For more information, see the following subsections:

- Manually Adding SDI-12 Devices 51
- Adding SDI-12 Devices via Address Scan 52

3.4.5.1 Manually Adding SDI-12 Devices

Manually adding an SDI-12 device can be used when the sensor is not connected (offline configuration creation/amendment or offsite pre-deployment setup). If the sensor is already connected to the device we recommend using the Automatic Device addition method (see ch Adding SDI-12 Devices via Address Scan 52)

To be able to configure successfully, the device's SDI-12 address, the appropriate measurement command and number of variables the device returns for the given command.



Device Name:	User friendly name for assistance with setup of virtual sensors.
SDI-12 Address:	The SDI-12 address of the device, this is in the range of 0-9, A-Z or a-z. It must be unique.
Task 1-6:	An SDI-12 task is used to configure the measurement command to be issued to the device. Up to 6 separate tasks (commands) can be configured for each device. These commands are issued

<table>
<tr><td></td><td>sequentially (task 1-6).

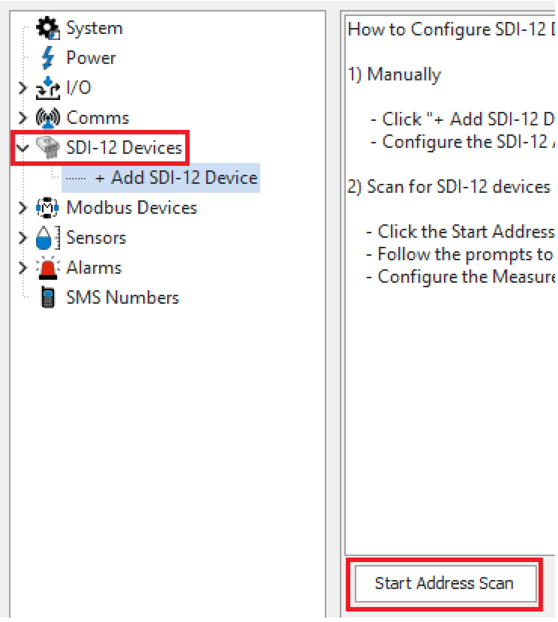
Note: This feature requires FW 1.8.80 or later. Older versions only support a single task.

<table><tr><th>Task Setting</th><th>Description</th></tr><tr><td>Command</td><td>This is a list of the supported SDI-12 measurement commands, e.g. aCC! aM! etc</td></tr><tr><td>Variables</td><td>The number of variables returned by the associated Measurement Command (see below). This field is obtained automatically when using a device scan, see section Adding SDI-12 Devices via Address Scan 52.</td></tr></table></td></tr>
<tr><td>First Measurement at:</td><td>This is the time that the first poll will happen (relative to iRIS local time). Allowing the polling interval to be offset. If this setting and Measurement Interval are set to 00:00:00 then the automatic poll regime will be employed.</td></tr>
<tr><td>Measurement Interval:</td><td>The interval at which the device will be polled. Actual poll time can be offset by using a non-zero First Measurement at setting. If this setting and Measurement Interval are set to 00:00:00 then the automatic poll regime will be employed.</td></tr>
<tr><td>Custom Command:</td><td>This is an optional command that can be issued on a separate schedule to the poll for measurements schedule. The command can be any SDI-12 command, without the address or closing exclamation mark (!), these are automatically added by the iRIS. Example of use of this function are, to perform a wipe of the sensor lens or reset a running total. If this command is blank then the associated schedule will not have an effect.</td></tr>
<tr><td>First Command at:</td><td>This is the time that the first custom command will be issued (relative to iRIS local time). Allowing the custom command issuing interval to be offset. If this setting and Command Interval are set to 00:00:00 then the custom commands will not be issued.</td></tr>
<tr><td>Command Interval:</td><td>The interval at which the custom command will be issued. Actual command issue time can be offset by using a non-zero First Measurement at setting. If this setting is set to 00:00:00 and the First Command at setting is not 00:00:00, the custom command will be issued once at the time defined by the First Measurement at setting.</td></tr>
</table>

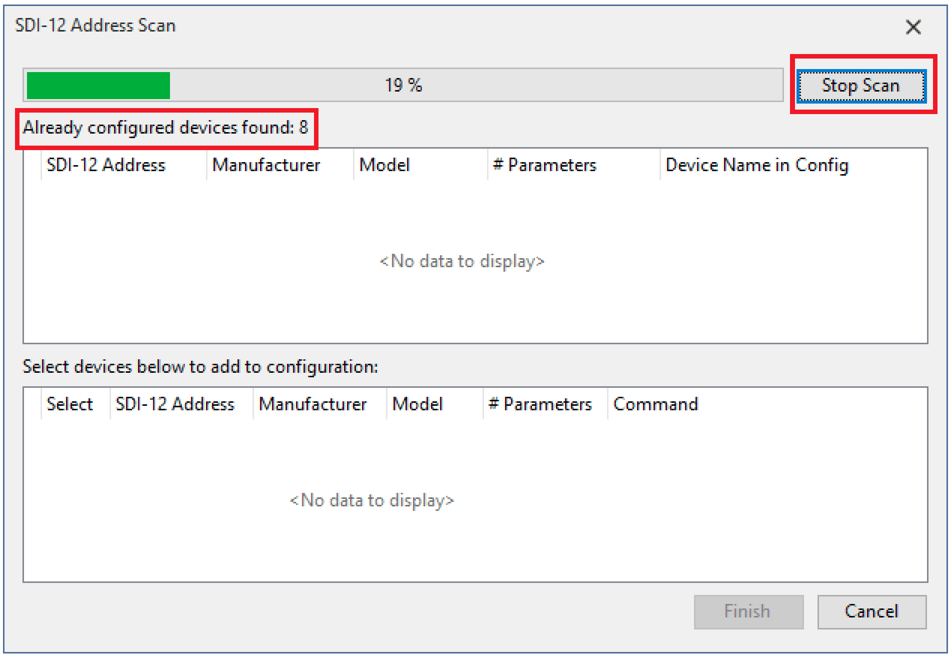
3.4.5.2 Adding SDI-12 Devices via Address Scan

An SDI-12 device can be detected and setup automatically by using the Address Scan feature of iLink. The device(s) needs to be attached to the iRIS and have each have a unique address.

A device is initiated by click on the [**START ADDRESS SCAN**] button in the **SDI-12 DEVICES** branch of the configuration tree.

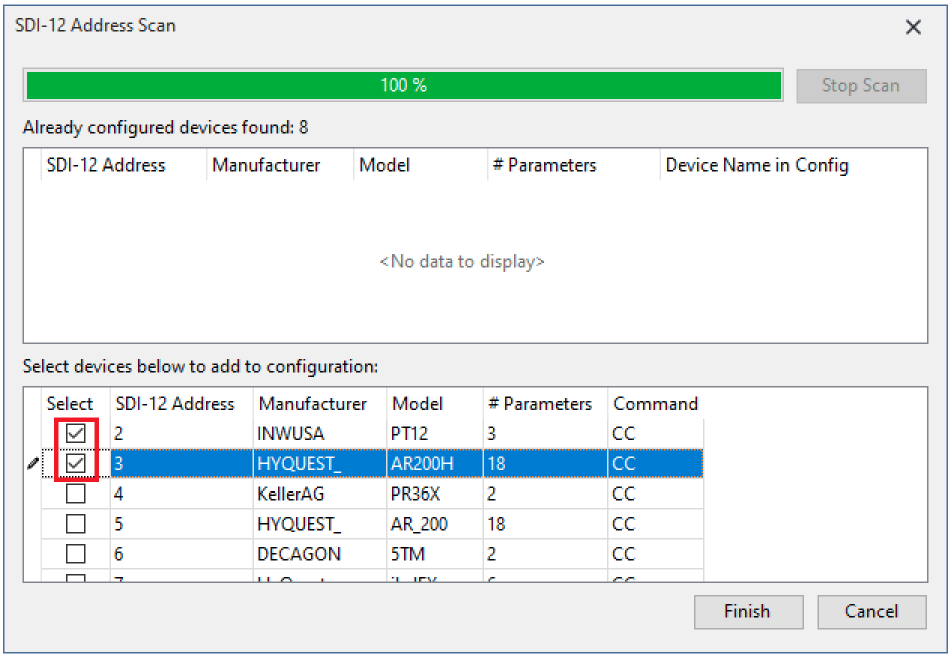


The scan will start immediately and scans the address range 0-9, a-z, A-Z. To speed up the process, click the [**STOP SCAN**] button when the **TOTAL DEVICES FOUND** is equal to the amount of device attached (already configured or not).



Once the scan is complete or it has been stopped by the user. The devices found on the bus will be displayed in the list at the bottom of the scan window.

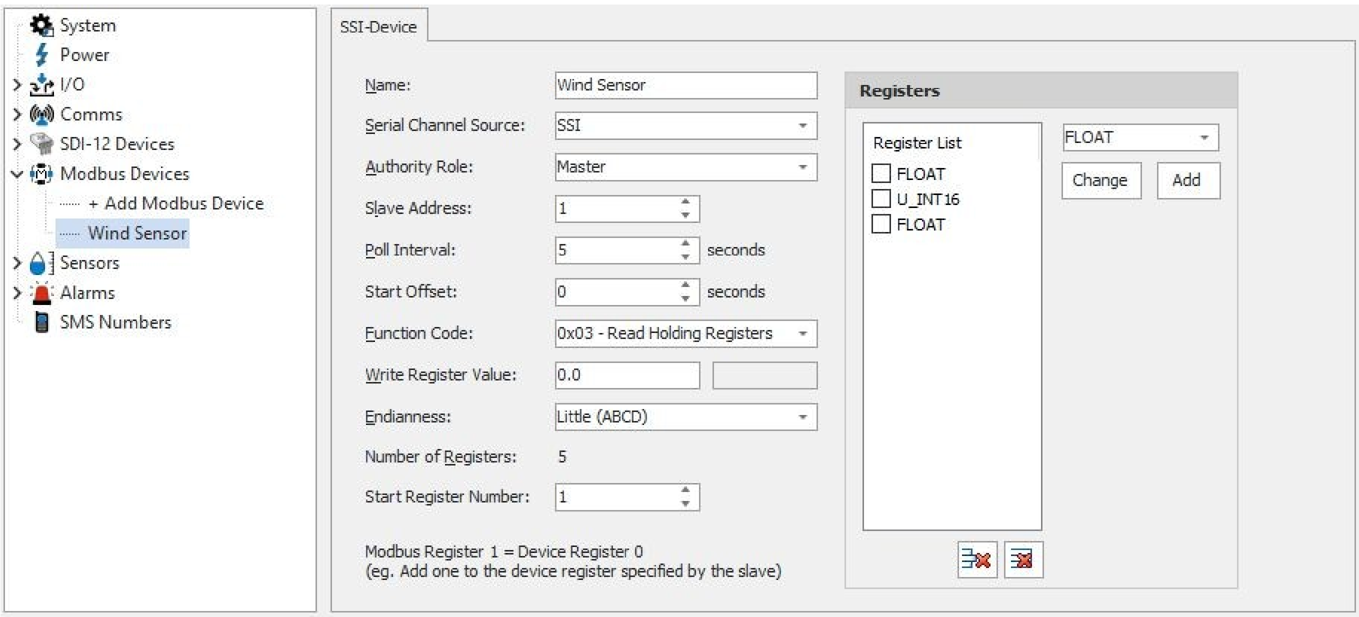
Select the devices to be added to the iRIS configuration by checking the **SELECT** box and clicking the [**FINISH**] button. The devices selected will be added to the SDI-12 Devices branch of the configuration.



Note: An automatically added device has a default polling schedule, which is to poll as often as possible. If this is not desirable then the Measurement Interval and Start Measurement setting need to be non-zero, see section Manually Adding SDI-12 Devices 51 for more information on these settings.

3.4.6 Modbus Devices

The Modbus Devices branch is used to configure devices that communicate via RS232, RS485 or Ethernet and are connected to either of the Communication modules or via RS232, RS485 on the SSI port. A device can be a sensor (acting as a slave) or the iRIS itself (when it is acting as a slave).



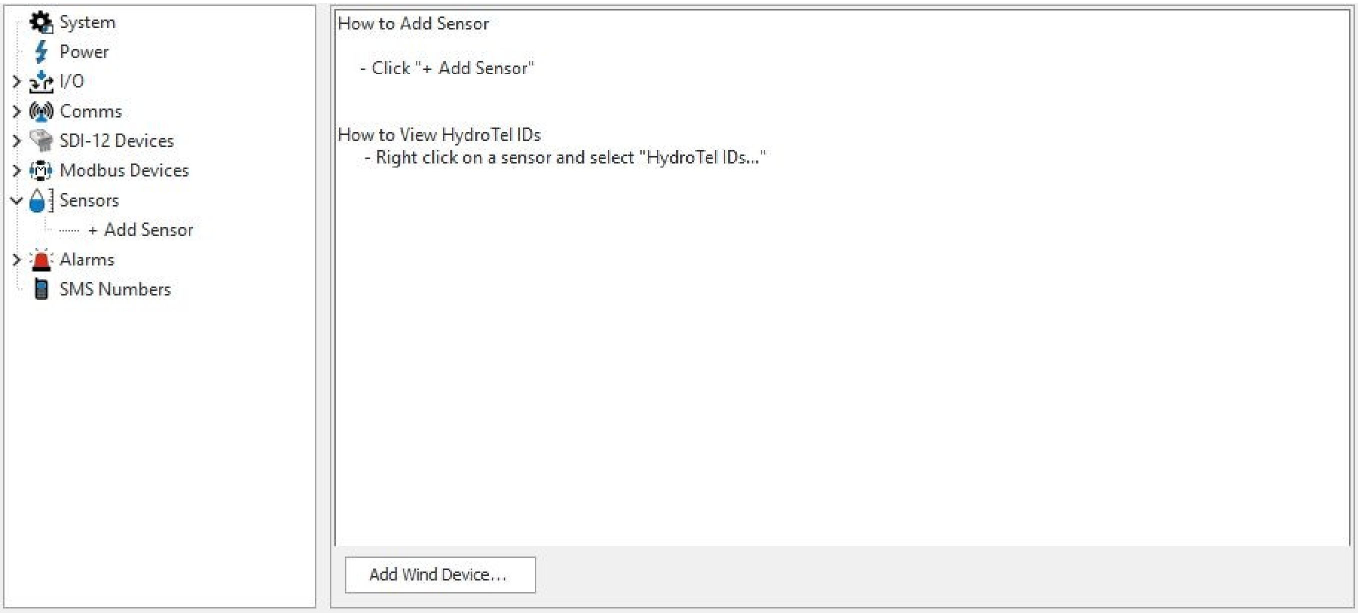
Name:	Enter a name for the Device (maximum 10 characters). This name will be displayed is used in sensor configuration.
Serial Channel Source:	This is the channel or physical interface that the device is attached, options are DBA (DaughterBoard A), DBB (DaughterBoard B) and SSI.

Authority Role:	This is the Modbus Authority, when set to Master the iRIS will interrogate the devices. When set to Slave the iRIS responds to the master device requests. For DBA and DBB modbus is only supported for Cellurlar and Serial Dauthgerboards. ⚠ Only one Slave device can be configured, all others are set to Master.
Slave Address:	This is the address of the Modbus slave, when the Authority Role is set to Master, this address is for the device connected to the iRIS. When the Authority Role is set to Slave, this address is the Modbus address of the iRIS. **Note**: Address 0 is reserved as a **broadcast** address, slave devices (irrespective of their address) **must** accept any message with address 0 and the slave should **never** respond to any command with address 0. ▪ Addresses between 1 and 247 are allowed ▪ The address range from 248 to 255 is reserved
Poll Interval:	Only Applies to Authority Role Master: this is the interval that the iRIS will make requests to the given device.
Start Offset:	Only Applies to Authority Role Master: this offset the **POLL INTERVAL**. For example, if the Poll Interval is 15 seconds and the offset is 5, then the iRIS will poll the device every 15 seconds offset by 5 seconds, 00:00:05, 00:00:20, 00:00:35, 00:00:50, 00:01:05, 00:01:20, 00:01:35 … 23:59:35, 23:59:50.
Function Code:	Only Applies to Authority Role Master: This is the Modbus Function code see section Modbus Protocol[68] for more details.
Write Register Value:	Only Applies to Authority Role Master: This is a value that will be written to the device if the function code is set to 0x06 Write single register.
Endianness:	This is the Endianness of the data contained in the Modbus registers, see section Modbus Protocol[68] for more details.
Start Register number:	This is the Modbus registers start address, see section Modbus Protocol[68] for more details.
Registers List:	The Registers list defines the data types for the registers in the device. A datatype can be chosen with the dropdown box and then click Add button to add to the list. To change an item(s) in the list simply check the incorrect item(s), select a new data type and click the change button.
	This button is used to delete items in the list that are checked.
	This button is used to delete ALL of the items in the list.

3.4.7 Sensor Configuration

The Sensor Configuration menu is used to configure each of the fifty virtual sensors. Refer to the data logging[8] features of this document for a discussion on data logging and virtual sensors.

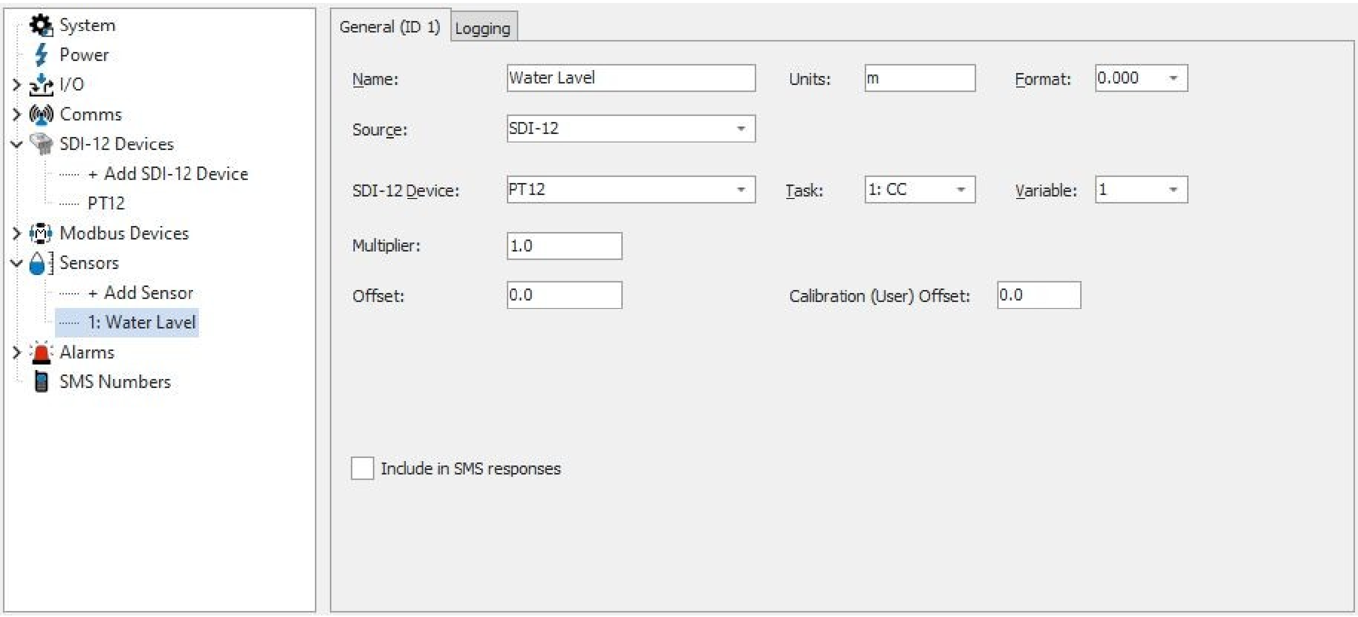
To minimise clutter due to a large number of potential sensors, iLink implements a dynamic virtual sensor management system for the iRIS 270. Clicking the Sensors Branch of the tree displays the instructions on how to use this feature.



For more information, see the following subsections:

- General 56
- Logging 59

3.4.7.1 General



Name:	Enter a name for the sensor (maximum 10 characters). This name will be displayed on the iRIS LCD sensor screens.
Units:	Enter the engineering units of the selected sensor.
Format:	This is the display format to use for the selected sensor. This is used on the LCD screen of the iRIS to display the sensor readings. **Please note** if the number to be displayed has more most significant figures than the format configuration allows for then the text on the LCD will be inverted and truncated. For example, when the format is configured as 0.000 and the value to be displayed is 12.2, the value displayed on the LCD will be 2.200.

Source:

Choose the source from which the virtual sensor should acquire its data. Use option 0 to disable the sensor. Valid data sources are shown in the table below.

Description	Raw Range
Unused / disabled	N/A
Supply Voltage	
Battery Voltage (External)	
Battery Voltage (Internal)	
Supply Current	
Battery Current (External)	
Analogue Input 1	Configurable (see section Analog I/O 36)
Analogue Input 2	Configurable (see section Analog I/O 36)
Internal Temperature	
Change of State on DI1	0 to 1
Change of State on DI2	0 to 1
Change of State on DIO	0 to 1
Pulse Counter on Digital Input 1	0 to 1
Pulse Counter on Digital Input 2	0 to 1
Pulse Counter on Digital Input 3	0 to 1
Auto Pulse Counter on Digital Input 1	0 to 1
Auto Pulse Counter on Digital Input 2	0 to 1
Auto Pulse Counter on Digital Input 3	0 to 1
Frequency Counter on Digital In 1	0 to 400 Hz
Frequency Counter on Digital In 2	0 to 400 Hz
Frequency Counter on Digital In 3	0 to 400 Hz
Change of State on DI1	0 to 1
Change of State on DI2	0 to 1

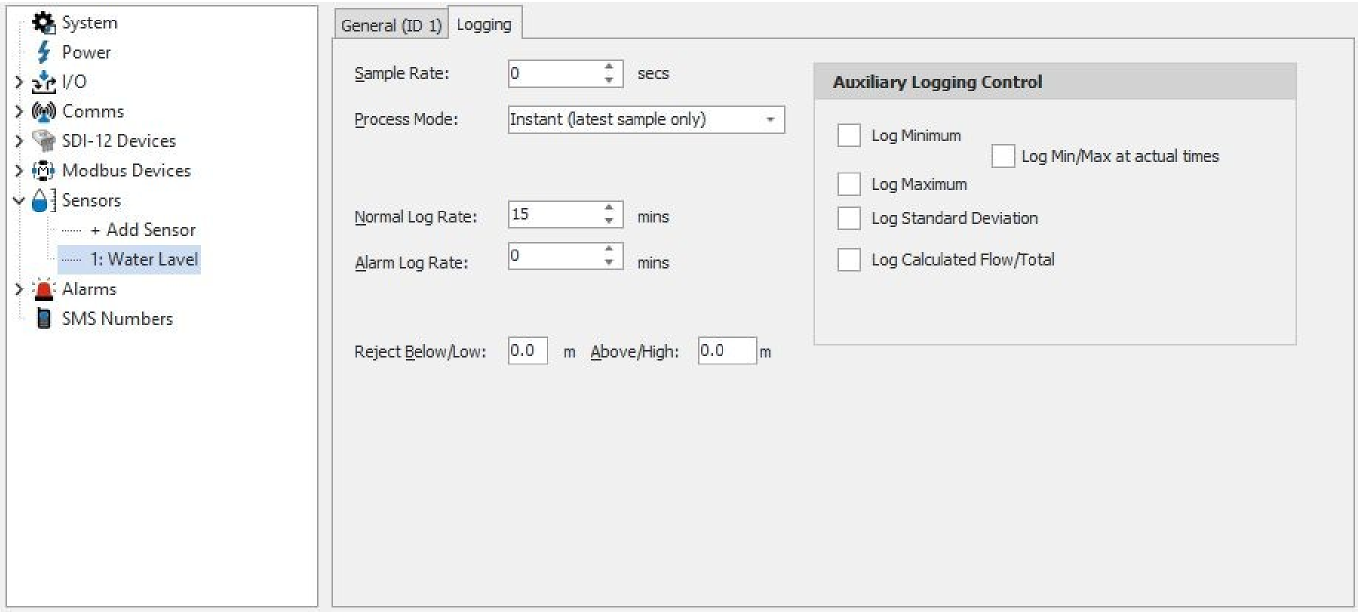
Description	Raw Range
Change of State on DIO	0 to 1
Day to Now on Digital Input 1	
Day to Now on Digital Input 2	
Day to Now on Digital Input 3	
Day to Now on Digital Input 4	
Year to Date on Digital Input 1	
Year to Date on Digital Input 2	
Year to Date on Digital Input 3	
Year to Date on Digital Input 4	
Running Total on Digital Input 1	
Running Total on Digital Input 2	
Running Total on Digital Input 3	
Running Total on Digital Input 4	
Received Signal Strength DBA	-113 to 0 dBm
Received Signal Strength DBB	-113 to 0 dBm
SDI-12	
Modbus Device	

Table 11 – Standard Sensor Sources

Multiplier:	This option is used to enter a scalar multiplier. This multiplier is used to convert the raw input into engineering units. It is the “m” variable in the $y = mx + c$ scaling equation.
Offset:	Enter a scaling offset in this column. This offset is added to the scaled engineering value. It is the “c” variable in the $y = mx + c$ scaling equation.
Calibration (User) Offset:	This is the offset to shift the scaled value’s datum.
SDI-12 Device:	Select which SDI-12 device the virtual sensor will use as a source. **Note**: Only available when **SDI-12** is chosen as the source

Modbus Device:	Select which modbus device the virtual sensor will use as a source (see section Modbus Devices 54). **Note**: Only available when **MODBUS DEVICE** is chosen as the source
Variable:	Select the variable index of the output string from the SDI-12 device selected above or the register index as per the list created in modbus device configuration (see section Modbus Devices 54), as the raw source. **Note**: Only available when **SDI-12** or **MODBUS DEVICE** is chosen as the source
Include in SMS Message:	When this option is enabled the given sensors reading is included in the SMS command responses (see section SMS Communication 108 for more information).

3.4.7.2 Logging



<table>
<tr><td>Sample Rate:</td><td>The sample rate is the rate (in secs) at which the source is sampled.</td></tr>
<tr><td>Process Mode:</td><td>Choose the process mode to apply to the measurements. The available modes are:
<table>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>Instant</td><td>Logs only the most recent sample.</td></tr>
<tr><td>Event</td><td>(Only valid for pulse input sources) Logs non-zero samples.

If the logging rate is 0, then any pulse is logged immediately.

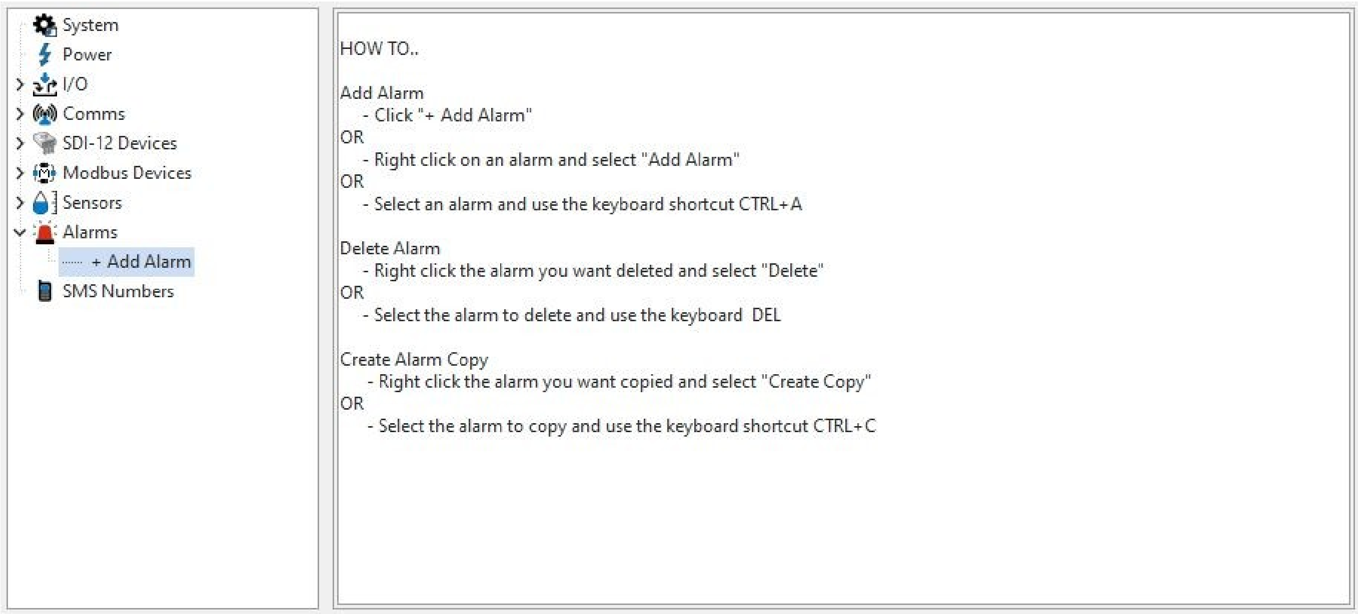
If the logging rate is > 0, then the total accumulated in the period is logged only if it is not zero. In this mode, if there was no sample logged at the last log time, a zero sample is also logged, time stamped with last log time/date. This is required for time series management purposes.</td></tr>
<tr><td>Period Average</td><td>Logs the average of all samples taken over logging period.</td></tr>
</table>
</td></tr>
</table>

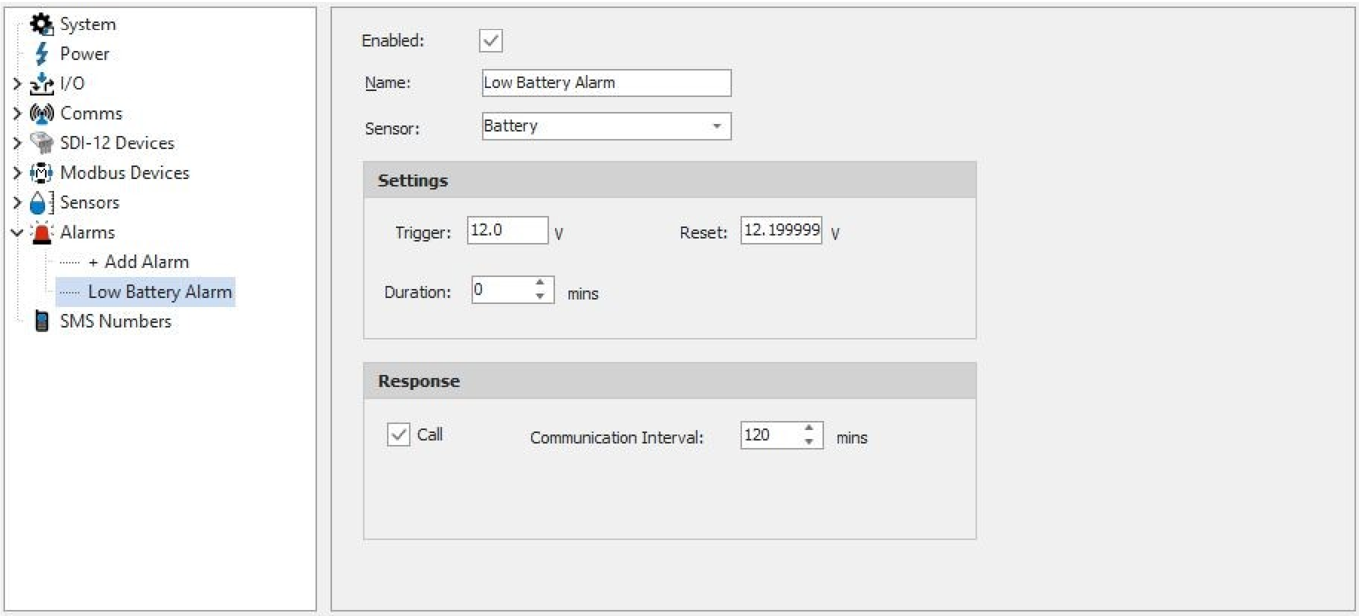
<table>
<tr><td></td><td>
<table>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>Partial Period Average</td><td>Logs are averaged of the duration period of the time defined by the Duration setting (see below), not the full logging period. The averaging occurs in the proceeding number of minutes before the logging event.</td></tr>
<tr><td>Scalar Average
(for Wind Direction)</td><td>Logs the average of all samples taken over logging period, but uses scalar calculations to calculate the average.</td></tr>
<tr><td>Vector Wind Speed Average</td><td>Logs the magnitude average of all samples taken over logging period, using vector averaged method. To function correctly when using this source, it must be mapped to a related sensor that provides source of angle. See section Wind Vector Averaging Configuration 125 for details on how to configure vector averaging. For information on the calculations used for vector averaging, see section Scalar and Vector Average 141.</td></tr>
<tr><td>Vector Wind Direction Average</td><td>Logs the direction average of all samples taken over logging period, using vector averaged method. To function correctly when using this source, it must be mapped to a related sensor that provides a source of magnitude. See section Wind Vector Averaging Configuration 125 for details on how to configure vector averaging. For information on the calculations used for vector averaging, see section Scalar and Vector Average 141.</td></tr>
</table>
</td></tr>
<tr><td>Related Sensor:</td><td>This is a reference to the paired sensor that is need for vector averaging. This configuration item will only be available when the source setting is set to Vector Wind Speed Average or Vector Wind Direction Average.</td></tr>
<tr><td>Normal Log Rate:</td><td>This is the logging rate (in mins) when the sensor is not in alarm. If you wish to log digital data on change of state you can enter a value of 0. If this parameter is left at 0 for analogue sources, they will not be logged.</td></tr>
<tr><td>Alarm Log Rate:</td><td>This is the logging rate (in mins) when the sensor is in alarm.</td></tr>
<tr><td>Duration Rate (only available for Partial Period mode described above):</td><td>The is the period of time in minutes before the logging interval that is used for generating the average to be logged.</td></tr>
<tr><td>Reject Below/Low:</td><td>This option is used to enter a simple rejection value. Any value equal to or below this will be ignored and the last “good” value retained.</td></tr>
<tr><td>Reject Above/High:</td><td>Any value equal to or above this will be ignored and the last “good” value retained.</td></tr>
<tr><td>Auxiliary Logging Control:</td><td>You can also configure the extended datalogging options using the logging flags. The list of the available flags is given below.
1. Log Minimum value sampled in the log period.
2. Log Maximum value sampled in the log period.
3. Log Standard Deviation of samples in log period.
4. Log Calculated Flow Rate (in l/s) over log period or Log Accumulated Volume for sensors with an analogue or frequency source.
5. Log Check Count. This optionally logs the background incrementing counter.</td></tr>
</table>

3.4.8 Alarm Configuration

The Alarm configuration menu is used to configure each of the 100 alarms. These can be attached to any of the 50 virtual sensors (see section Modbus Devices 54 for details on Sensor configuration).

To minimise clutter due to a large number of potential alarms, iLink implements a dynamic alarm management system for the iRIS 270. Clicking on the Alarms Branch of the tree displays the instructions on how to use this feature

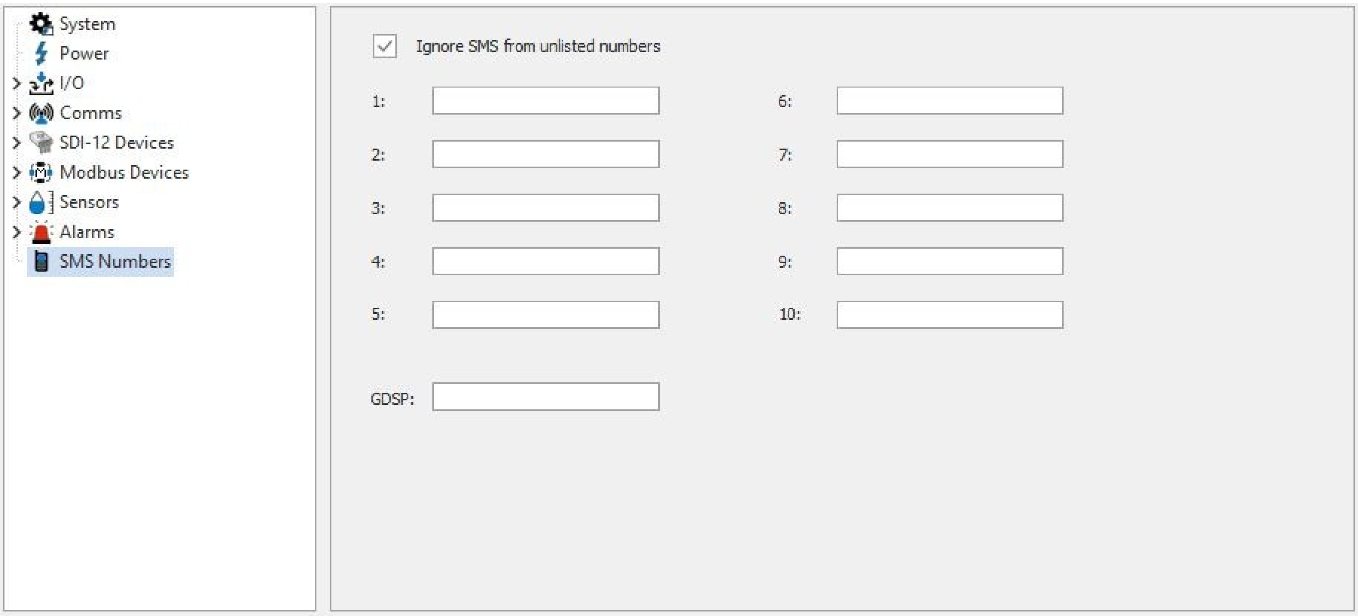




Name:	User friendly name of the alarm.
Sensor:	Choose the sensor which you want to activate the alarm for from the list.
Enable:	Tick the box in the Enable column to enable an alarm. If the **ENABLED** setting is unchecked, the alarm will not have any effect on the logger operation. This is useful if the sensor driving the alarm is not operating as expected.
Trigger:	Enter a value in engineering units that you want to use as the trigger point for the alarm. When the scaled value crosses this threshold, the alarm will become active. The trigger direction is

	determined by the reset level and whether it is less than the trigger (rising alarms such as water level) or greater than the trigger (falling alarms such as battery voltage).
Reset:	Enter a value in engineering units that you want to use as the reset point for the alarm. When the scaled value crosses this threshold when the alarm is active, it will be reset.
Duration:	This is the time in seconds to delay alarm activation. This can be used to implement alarm hysteresis for analogue data sources that vary. If the data source is one of the internal counters, then this time is used to totalise individual sample values. If the total over the given alarm duration is above the trigger level then an alarm is generated. Typically, this feature is used for rainfall alarms.
Call:	If this is checked (on by default) a call-in via the configured communications method will be initiated as soon as the alarm becomes active.
Communications Interval:	If this value is non-zero, it can be used to increase the rate at which call-ins occur on scheduled communication by overriding the comms scheduler's preconfigured normal and alarm intervals. The comms scheduler will use the smallest non-zero interval value from its own or those of any currently active alarms. This is useful for reporting data more often during an event.

3.4.9 SMS Numbers



In order to prevent unwanted access to the iRIS, only SMS commands coming from a number listed in these fields will be processed.

3.5 SDI-12 Command Mode

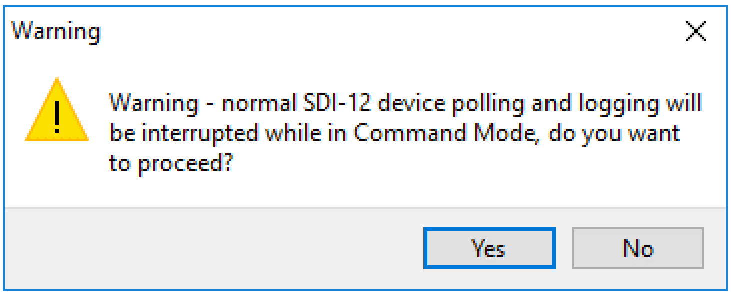
An extension to the real time diagnostic function (as described in section Real-time Diagnostics 122) the iRIS is capable of sending user commands across the SDI-12 bus and displaying the results. It also has a handy address change function and SDI-12 address scan function.

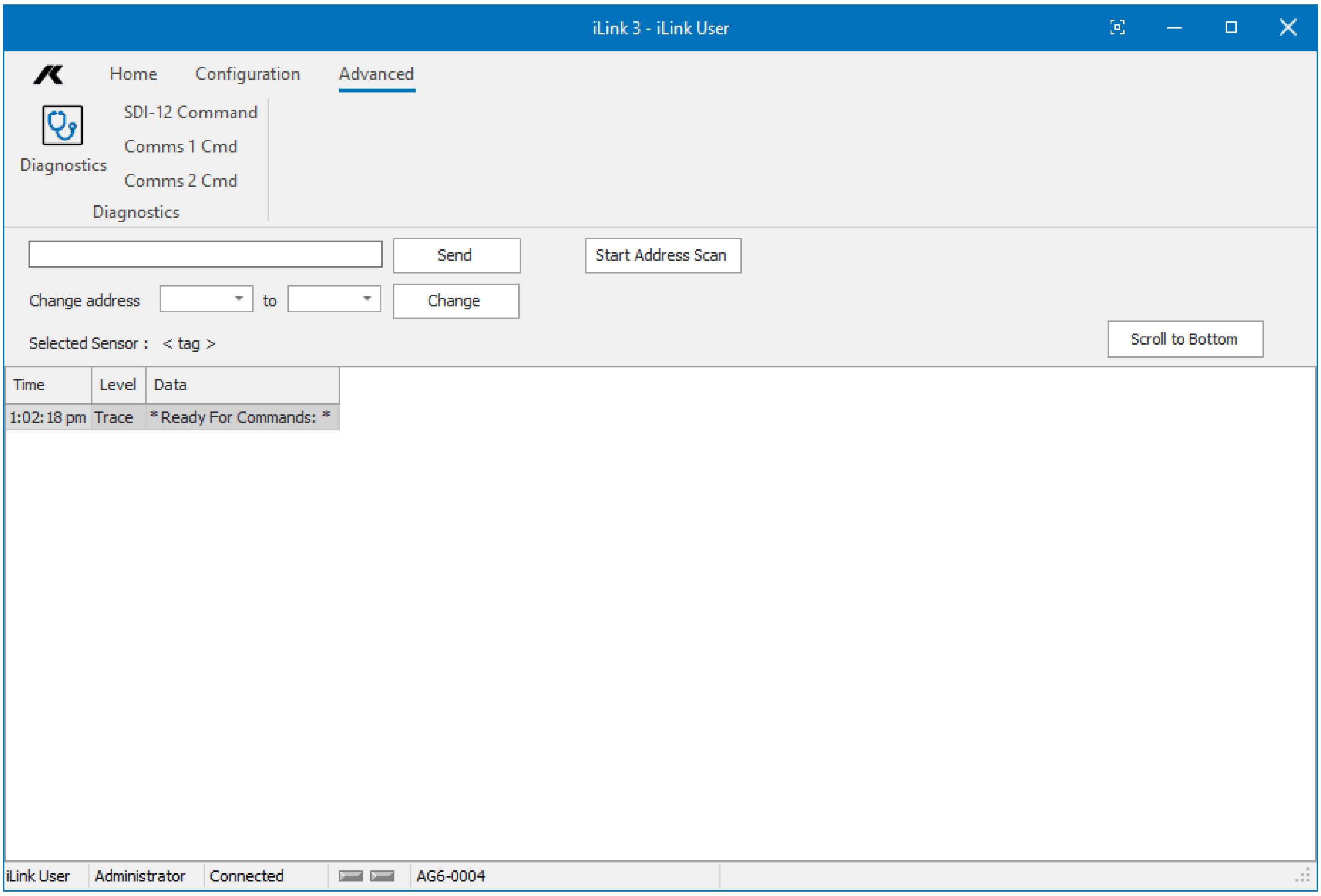
For more information, see the following subsections:

- Accessing 63
- Sending user command to device 64
- Address Change function 64
- Address Scan 64

3.5.1 Accessing

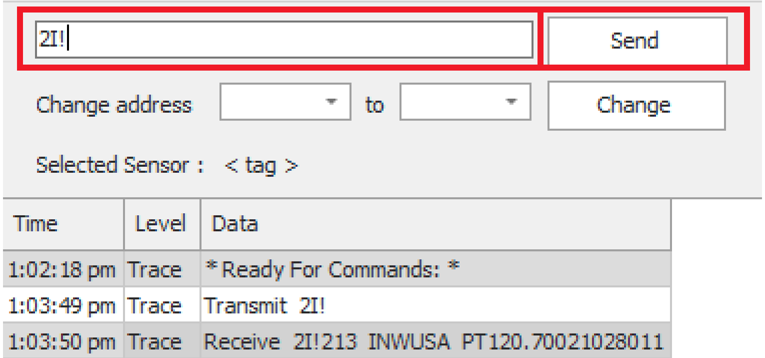
The command mode is accessible via the SDI-12 Command option in the advanced ribbon of iLink. When entering the SDI-12 command mode the user is prompted that the action will disable normal SDI-12 communications:





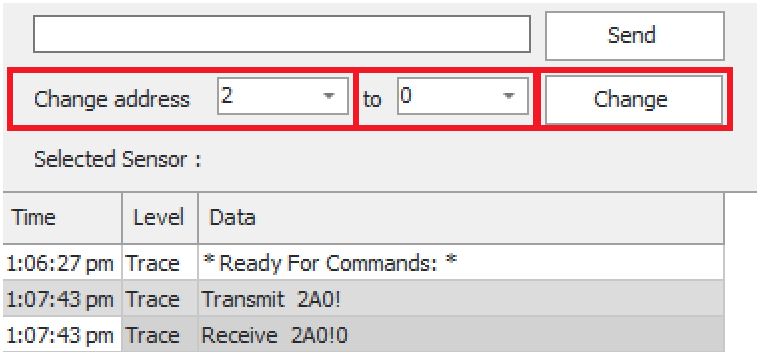
3.5.2 Sending user command to device

A specific SDI-12 command can be entered in to the edit box at the top of the window then click send button. See Appendices 134 for more information on SDI-12 134.



3.5.3 Address Change function

Although it is possible to change the address of the SDI-12 sensor using the user command function in the previous section, iLink can automatically formulate the command. From the first drop down box select the address of the sensor, then in the next drop-down box select the address to change to. To make the change click the Change button.



3.5.4 Address Scan

The address scan is now part of the SDI-12 Devices in the configuration section of iLink (see section Adding SDI-12 Devices via Address Scan 52).

3.6 Using iLink's Sensor Configuration Tool

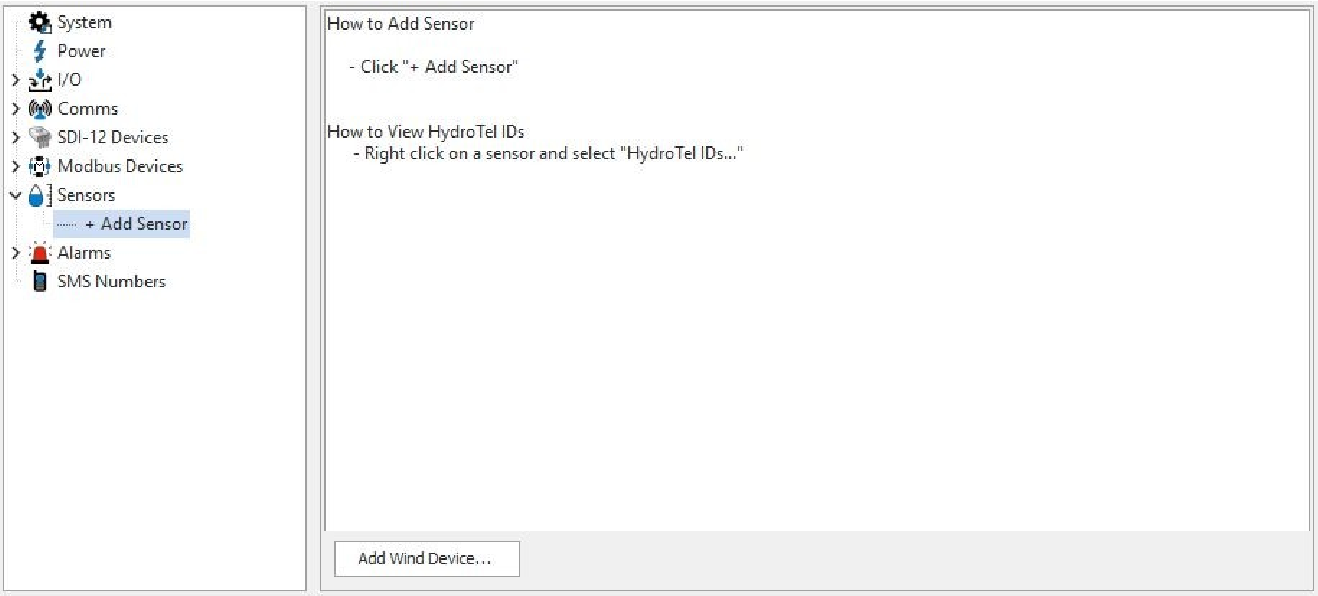
To optimize the process of maintaining multiple iRIS installations with the same (or similar) sensor configuration, iLink includes a graphical configuration tool. This allows the configuration of any of the sensors to be changed, sent to the iRIS or saved to the disk. It also supports the retrieval of sensor settings from the iRIS and from disk. This means that setting up new iRIS is made very simple as a common configuration file can be sent to each iRIS.

- iRIS Sensor Configuration Example 64

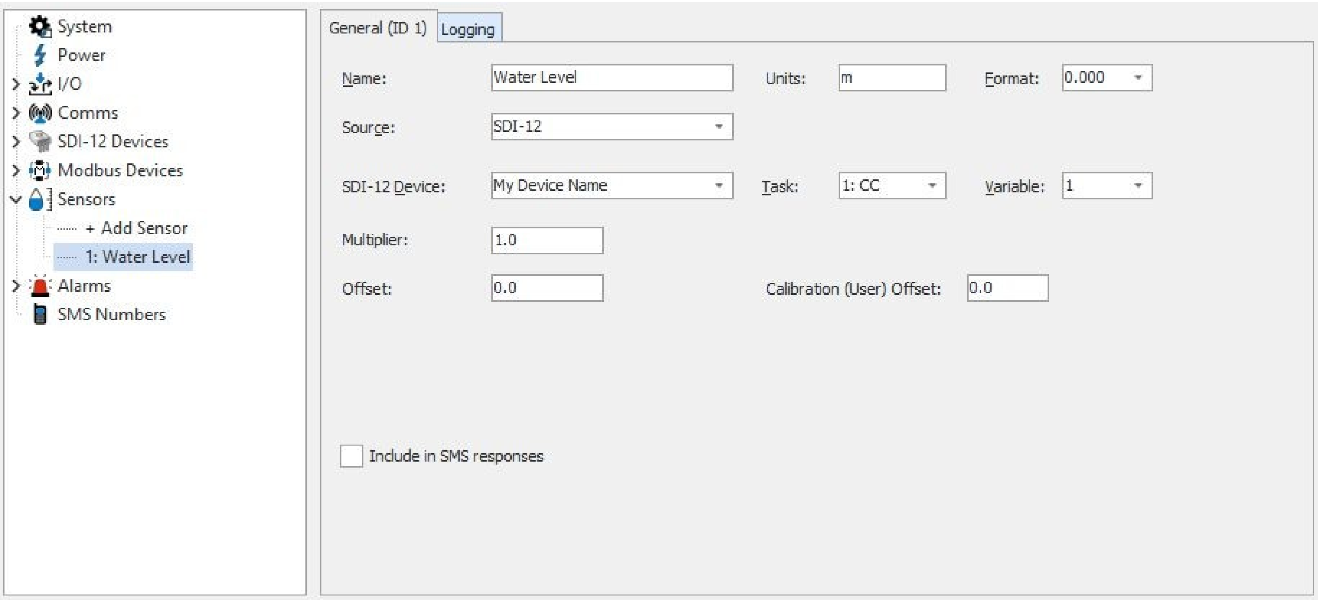
3.6.1 iRIS Sensor Configuration Example

This example shows how to set up a simple iRIS sensor configuration to measure water level from an SDI-12 sensor and also log internal battery voltage. This example is valid for all iRIS.

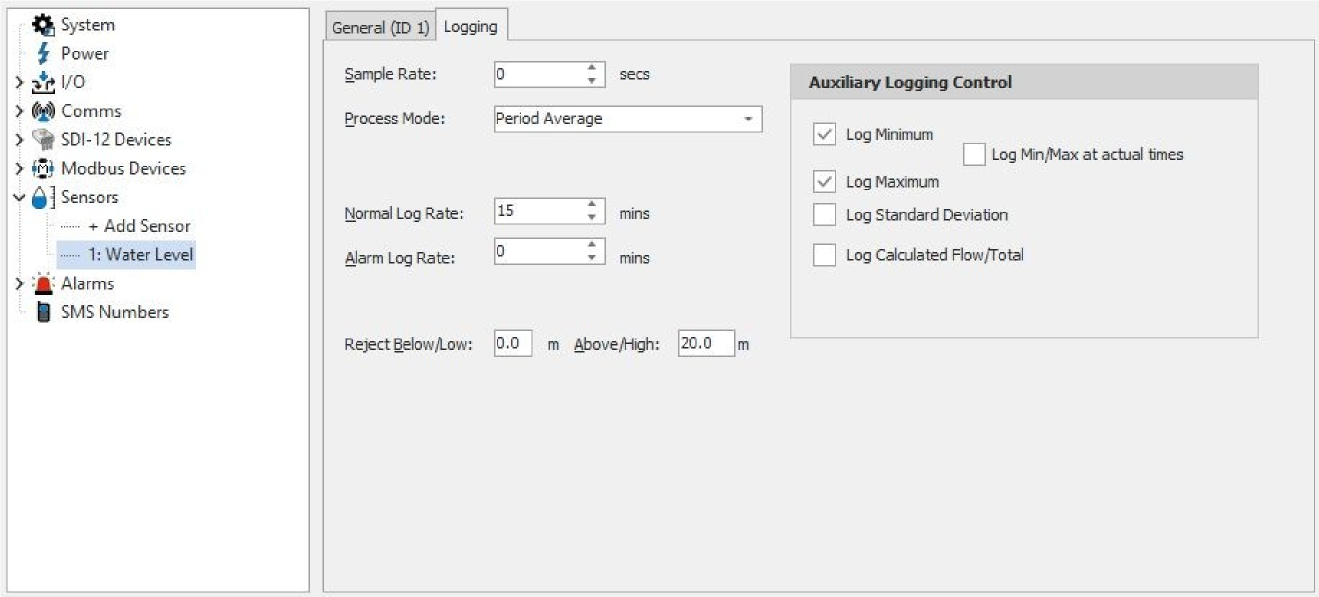
1. Connect to the iRIS using iLink.
2. Invoke the iRIS sensor configuration form by selecting Sensors node from Configuration General Menu.
3. Expand the sensors branch and click the +Add Sensor option.



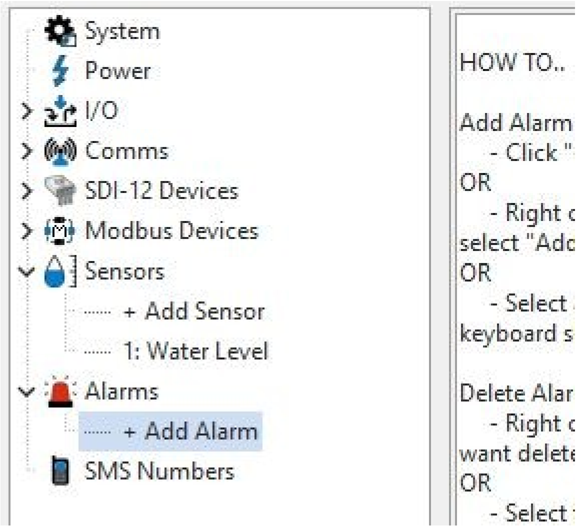
4. Click on the newly created sensor labelled "Disabled".
5. Set up the water level sensor. Enter the sensor name "Water Level".
6. Now set the sensor source from the drop-down list. Select source SDI-12. Then select the correct SDI-12 device, task and variable. In our example, the instrument is 'Hydserv-AD375M-H-104' and we require the first value (variable 1).
7. Enter the multiplier to scale the value. For SDI-12 instruments, the multiplier is typically 1 as the instrument itself provides an actual value in engineering units.
8. Enter the offset if required and known at this point. Usually, this is set on site to calibrate the measurement to a known reference of datum. In this case the offset can be set by using the LCD calibration screen. See section Sensor Calibration Screen (Level 6) 100.
9. Enter the units of measurement (max 7 characters). This text is displayed on the LCD and included in iLink unloaded data files.
10. The General Configuration should look like this:



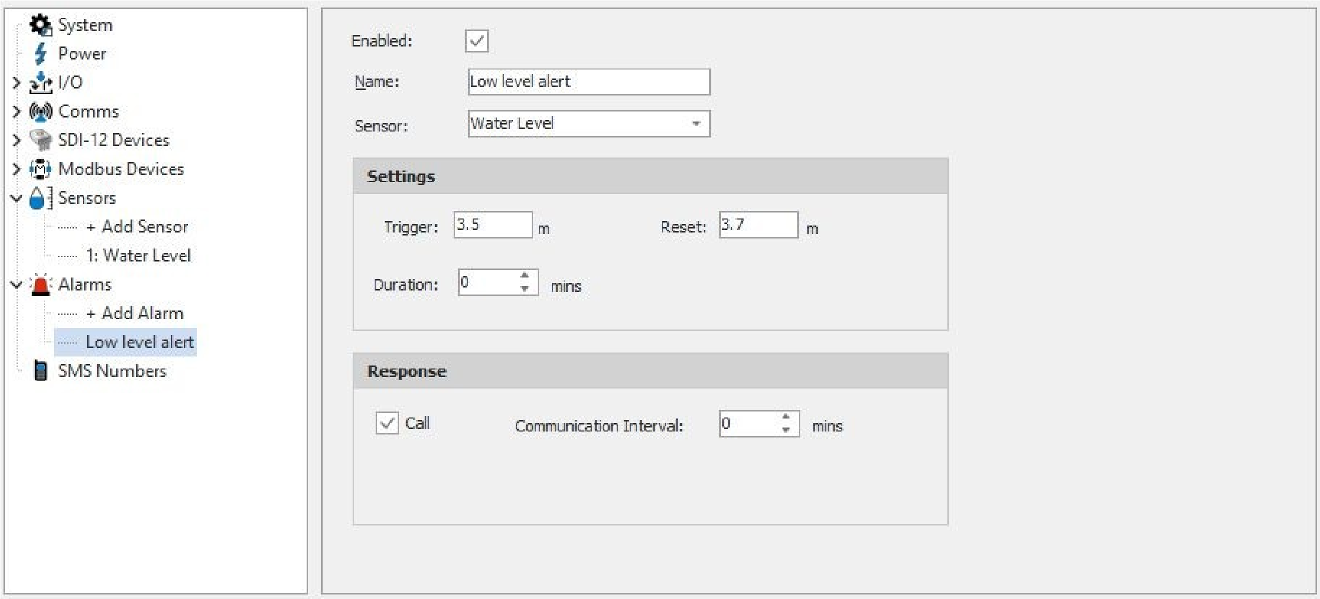
11. Now select the "Logging" tab and set up the logging parameters. In this example, we are measuring averaged water level in metres. The Normal log rate in this example is fixed at 15 minutes.
12. Our hypothetical sensor generates an error value of 999.99 if it develops a fault or is unable to take a measurement. Rather than have this cause a spike in our data, we will choose to reject values above our expected maximum of 20 metres by setting the Reject Above (High) value appropriately.
13. We also want to capture the minimum or maximum values over the period, so we enable the logging of these additional values as well.
14. The logging configuration should now look like this:



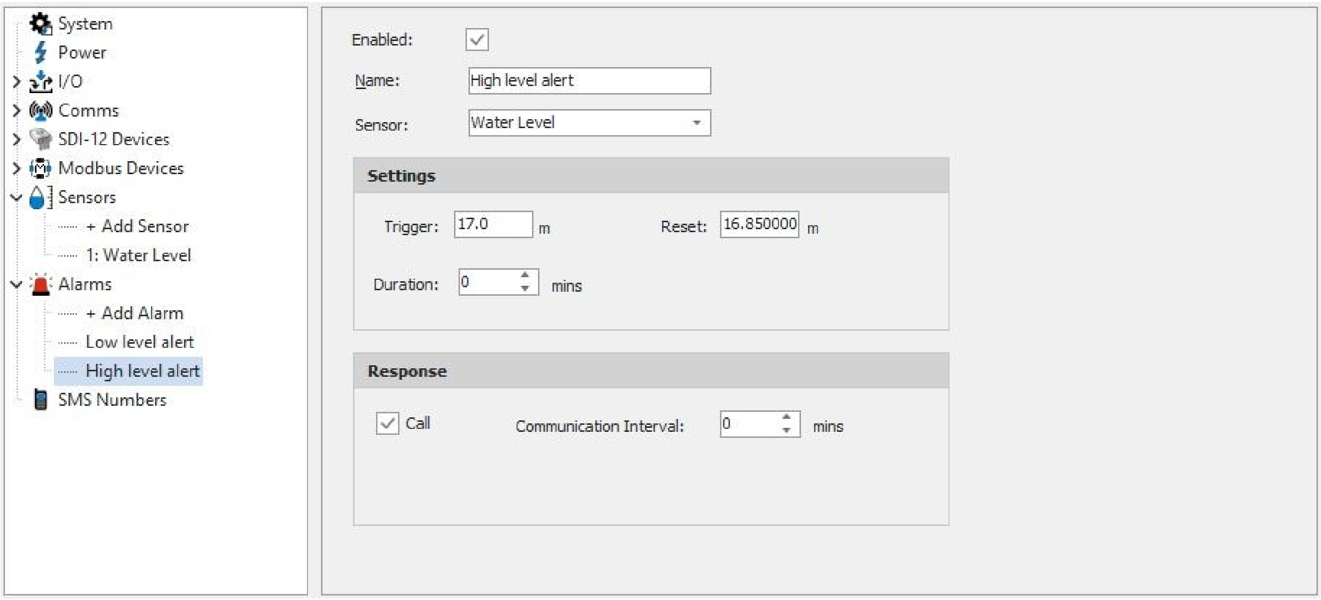
15. Next select the "Alarms" node. We are going to set a low level alarm at 3.5 metres and a high level alarm at 17 metres. Both alarms will have a reset differential of 0.1 metres making the reset levels 3.6 metres and 16.9 metres respectively. The alarms are set to be immediately acting, so no duration delay is required.
16. Click Add Alarm node to create the first alarm:



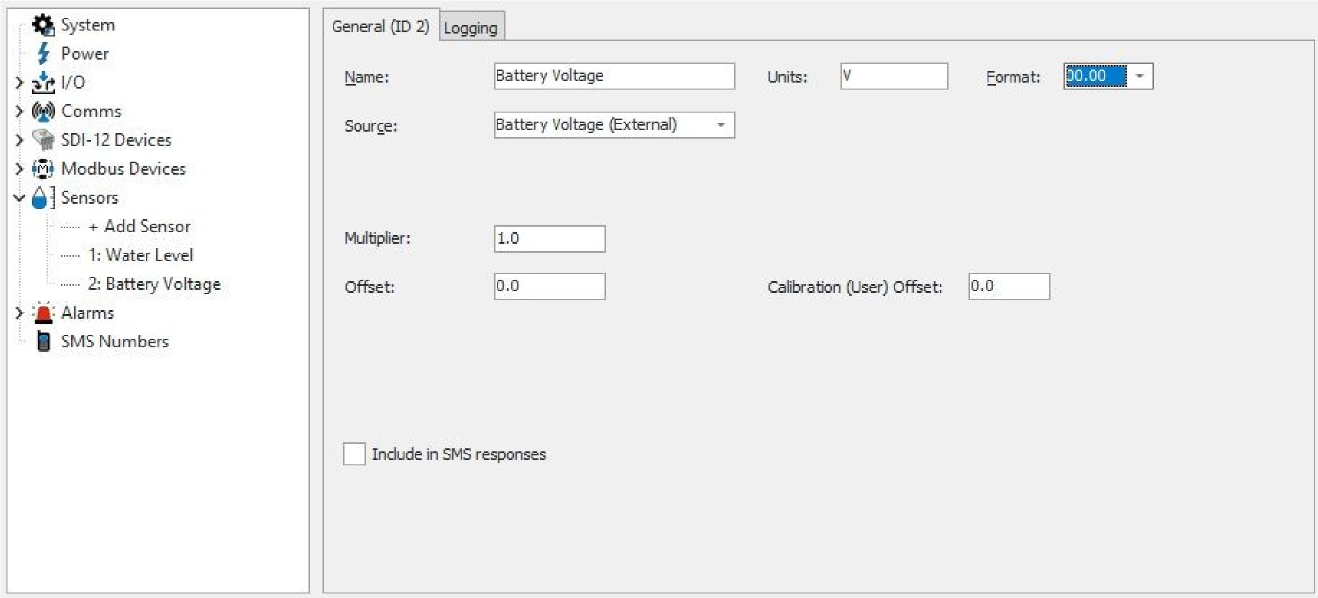
17. Click on the newly created alarm labelled "Disabled".
18. Click the enabled check box and give the alarm a name, e.g. "Low level Alert".
19. Now choose "Water Level" sensor as a source.
20. In the trigger box enter 3.5 and in the reset box enter 3.7.
21. Click the Call check box to get the iRIS to make a call-in when the event occurs.
22. The Alarms Configuration should look like this:



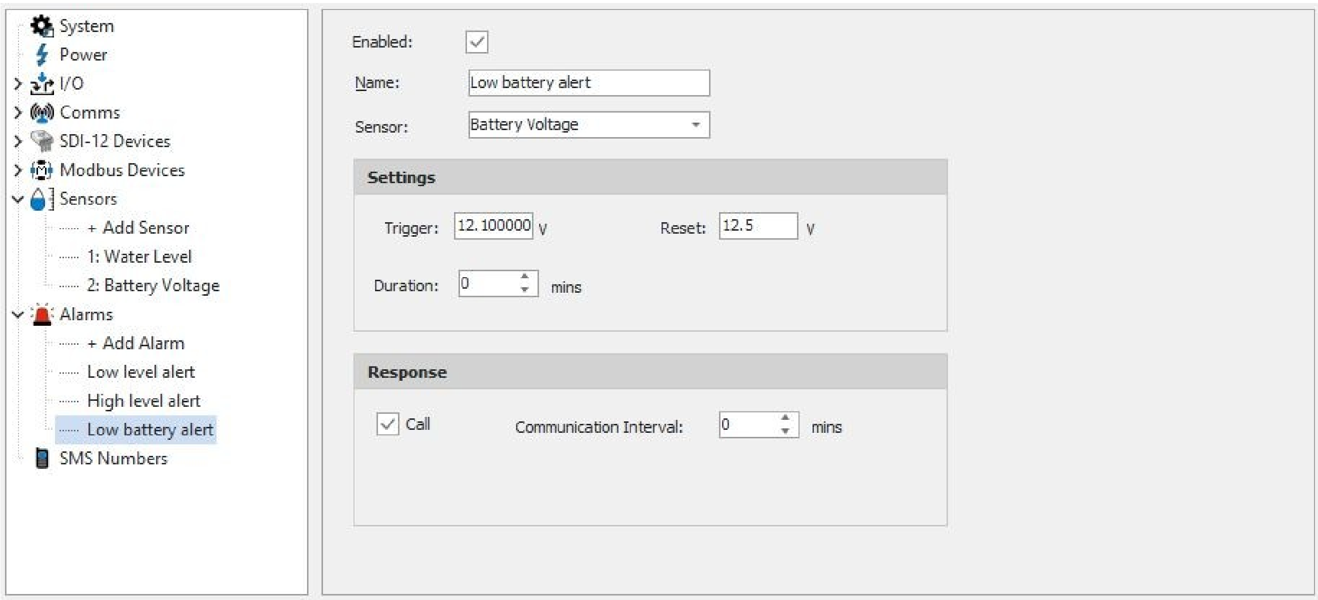
23. Repeat this for the high level alarm, but this time name it "High level Alert", use a trigger of 17 and a reset of 16.85. The Alarm Configuration should look like this:



24. Next set up the Sensor 2 to log the internal battery voltage. Expand the sensors branch and click the +Add Sensor option.
25. Click on the newly created "Disabled" sensor in the tree. Then repeat the steps used for configuring the Water Level sensor earlier, but in this case, select Battery Voltage (External) and name it "Battery Voltage". The configuration should look like this:



26. Set up the logging parameters, with a simple 60 log rate.
27. In our example we are logging the averaged battery voltage every 60 minutes. We have set a low voltage alarm at 12.1 volts which resets when the battery rises to at least 12.5 volts again. The configuration tabs should look like this:



28. The sensor configuration is now complete. Now enter the iRIS's site name in the Site Name field in the General section. The site name is the text that appears on the title screen on the LCD and also in the header of downloaded data files.
29. Save the configuration to disk by clicking the "Save to Disk" button. Enter a suitable name for your configuration. Our example uses the file name "SDI-12 Level and Battery.270cfg". The file can then be opened and sent to other iRIS requiring the same sensor configuration at a late date.
30. Finally, send the configuration to the connected iRIS. To do this, click the [**SEND CONFIG**] button.
31. The progress can be seen on the status bar at the bottom of the iLink window.
32. The process is now complete. If you want to edit or save the configuration in an already configured iRIS, the reverse operation can be done by using the [**RETRIEVE CONFIG**] button. The configuration can then be edited and sent back to the iRIS and/or saved to disk.

3.7 Modbus Protocol

This chapter contains the following subsections:

3.7.1 Protocol Overview

Modbus is a serial communications protocol originally published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). Modbus has become a de facto standard communication protocol and is now a commonly available means of connecting industrial electronic devices.

A detailed reference guide can be found at the following web address:

http://modbus.org/docs/PI_MBUS_300.pdf

This section will be a brief overview of the protocol, with indication as to which aspects are supported by the iRIS.

Modbus protocol uses a Master and Slave topology. A single Master device can interrogate (both read and writing data) to one or more slaves. Communications is achieved over a serial or TCP interface, at this point in time the iRIS supports RS-232 and RS-485 serial protocols. The Modbus Protocol can be used on the following interfaces:

- Serial communication daughter board (when fitted in Slot A) – see section Serial 21 for more information about configuration.
- Serial communications daughter board (when fitted in Slot B) – see section Serial 21 for more information about configuration.
- Serial Sensor Interface – see 4.2.4 for more information about configuration.

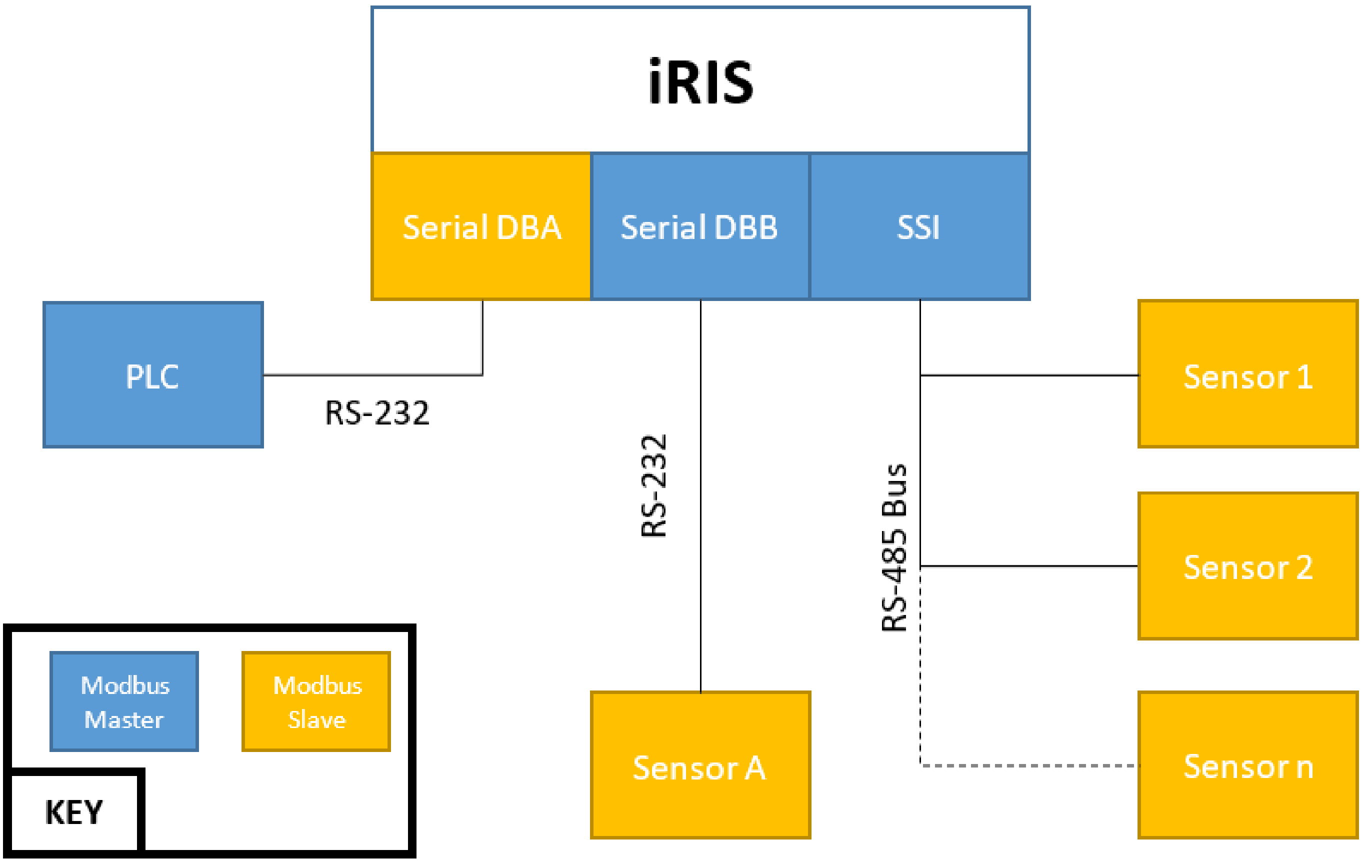


Figure 19 – Block diagram of an example of physical connection of Modbus devices to the iRIS

Note the actual type communications daughter(s) board fitted to the give iRIS may vary.

There are three main application of the master/slave topology that can be used on the iRIS:

- **Data Collection** – the iRIS acts as a master and the sensor(s) act as slaves.
- **Data Source** – The iRIS acts as slave and another system which acts as a master. The iRIS provides scaled measurements obtained from its physical channels (e.g. Analogue, digital and SDI-12 inputs) to the master.
- **Protocol Gateway** – the iRIS acts as a slave to another system which acts as a master. Information is passed between the host (e.g. HydroTel) and the Master via the iRIS. In addition, the iRIS can act as a data source to both the Modbus host and the base.

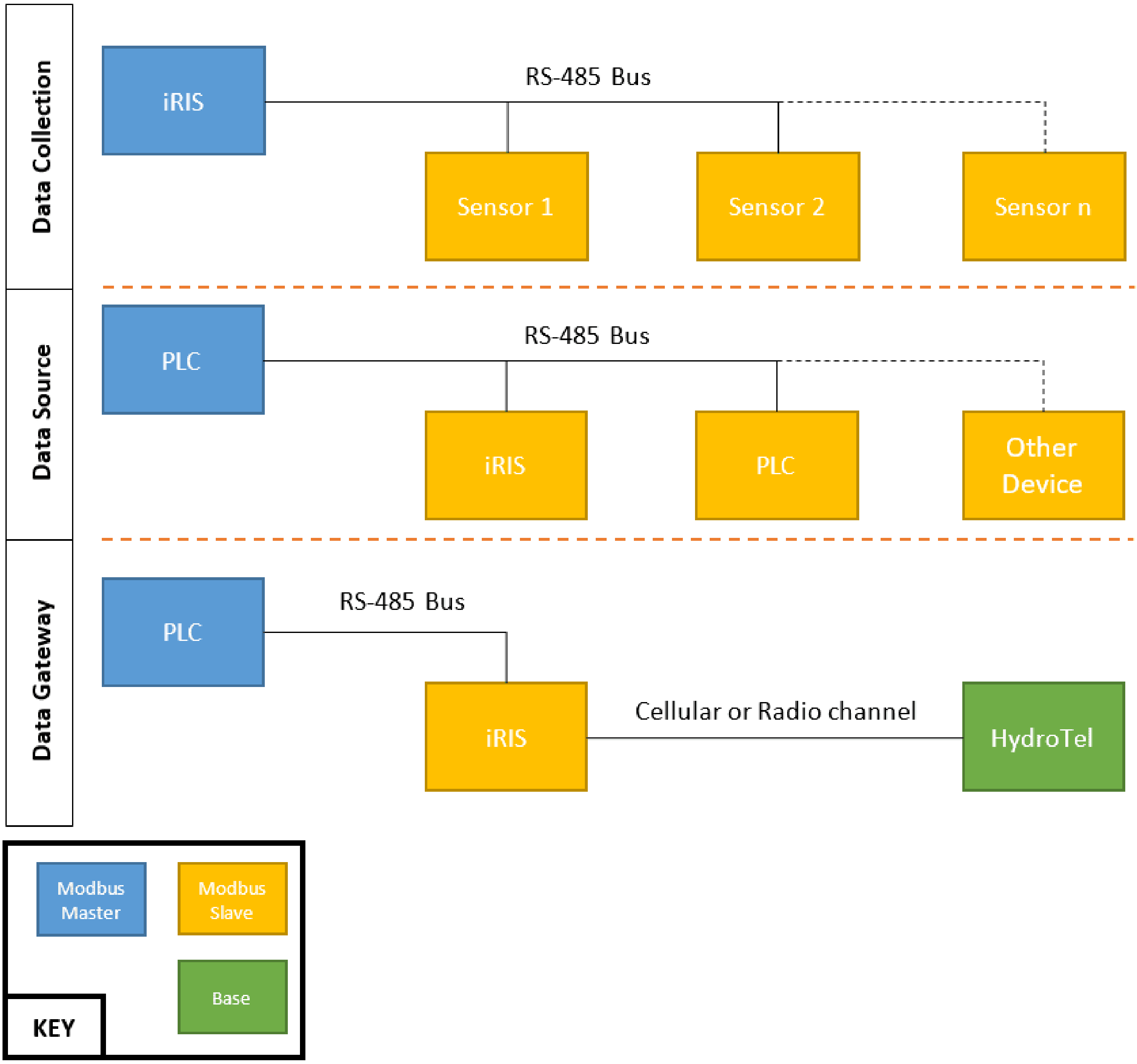


Figure 20 – Block diagram of the application topologies that can be implemented by the iRIS

Note the RS-485 bus can be replaced with an RS-232 connection, with a single slave.

One of the key concepts of Modbus is the function code. Most requests from the Master contains the address of the slave it wishes to converse with, the function code and the number of registers required.

When the iRIS acts as a Master, it can support the following function codes, the two digit hexadecimal code is the packet and is often referenced in the sensor manual.

Function code	Name	Description
0x01	Coils	A coil is considered as a discrete output and is either a zero or one (1 bit)
0x02	Discrete Inputs	The is a single input and is either a zero or one (1 bit)
0x03	Holding Registers	A holding register is 16 bit and can be interpreted as different data types
0x04	Input Registers	An input register can be considered as a bit field of inputs (16 bits per register)

Table 12 – Supported reading function codes when the iRIS is a Master

The most versatile of the register types is the Holding register. Each is 16 bits in length and several can be can be combined to make lager dater types.

Data Type Label	Number of registers used	Description
U_INT16	1	The unsigned integer type represents whole numbers between 0 and 65,535
S_INT16	1	The signed integer type represents whole numbers between -32,768 and 32,768
ON_OFF	1	Single bit either zero or one.
U_INT32	2	The unsigned integer type represents whole numbers between 0 and 4,294,967,295
S_INT32	2	The signed integer type represents whole numbers between -2,147,483,648 and 2,147,483,647
FLOAT	2	The floating point data type is in an IEEE754 single precision format.

Table 13 – Data types supported by the iRIS

Since a register is a 16-bit word (2 bytes) and a data type can consume two registers (32 bits or 4 bytes), there is more than one way to order the transmission of bytes for the slave to the master. The term for this is Endianness and there are two main types, Big and Little. For sorting it does not matter which type is used as long as the master and slave use the same endianness.

Endianness	Notation for 1 Register	Notation for 2 Registers	Notes
Little	AB	ABCD	Bytes are sent in order from least significant to most significant. For example, for an unsigned 16-bit integer (single register), a value of 1234 is 0x04D2. The first byte sent would be 0x04, then 0xD2.
Big	BA	DCBA	Bytes are sent in order from most significant to least significant. For example, for an unsigned 16-bit integer (single register), a

Endianness	Notation for 1 Register	Notation for 2 Registers	Notes
			value of 1234 is 0x04D2. The first byte sent would be 0xD2, then 0x04.
Little (byte swapped)	N/A	CDAB	This is the same as Little (above), but only applies to two register data types where the first and second words are swapped. **Note**: The iRIS currently supports this only for the Float datatype.
Big (byte swapped)	N/A	BACD	This is the same as Big (above), but only applies to two register data types where the first and second words are swapped. **Note**: The iRIS currently supports this only for the Float datatype.

When the iRIS acts as a slave the Master can either read the current and last logged values for each of the sensor (1-50). These are held in holding registers and represented as floating point data types (using two registers). The register address for each address are listed in Table Modbus holding register map for iRIS sensors 72.

Also, the Master can write data to the iRIS as a data source. This is done by performing either a single or multiple holding register write. The starting holding register location for this is at 40201. The location of each of the registers that follow are dynamically allocated based on the user created data types.

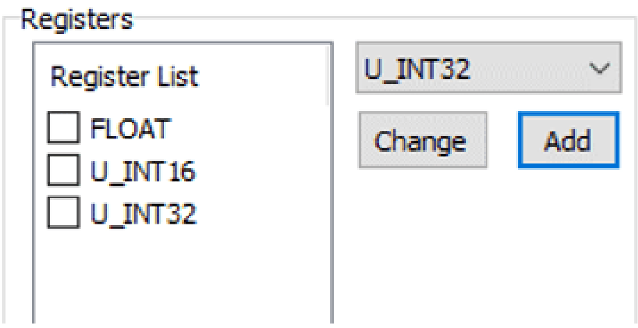


Figure 21 – Example of slave register map in iLink

Register address	Data Type	# Regs
40201 – 40202	Float	2
40203	Unsigned Integer	1
40204 – 40205	Unsigned Integer (32 bit)	2

Table 14 – Location of example slave register Map in Figure Example of slave register map in iLink 72

Register address	Description	Data Type
40001 – 40002	Sensor 1 Current Value	Float
40003 – 40004	Sensor 1 Last logged	Float
40005 – 40006	Sensor 2 Current Value	Float

Register address	Description	Data Type
40007 – 40008	Sensor 2 Last logged	Float
40009 – 40010	Sensor 3 Current Value	Float
40011 – 40012	Sensor 3 Last logged	Float
40013 – 40014	Sensor 4 Current Value	Float
40015 – 40016	Sensor 4 Last logged	Float
40017 – 40018	Sensor 5 Current Value	Float
40019 – 40020	Sensor 5 Last logged	Float
40021 – 40022	Sensor 6 Current Value	Float
40023 – 40024	Sensor 6 Last logged	Float
40025 – 40026	Sensor 7 Current Value	Float
40027 – 40028	Sensor 7 Last logged	Float
40029 – 40030	Sensor 8 Current Value	Float
40031 – 40032	Sensor 8 Last logged	Float
40033 – 40034	Sensor 9 Current Value	Float
40035 – 40036	Sensor 9 Last logged	Float
40037 – 40038	Sensor 10 Current Value	Float
40039 – 40040	Sensor 10 Last logged	Float
40041 – 40042	Sensor 11 Current Value	Float
40043 – 40044	Sensor 11 Last logged	Float
40045 – 40046	Sensor 12 Current Value	Float
40047 – 40048	Sensor 12 Last logged	Float
40049 – 40050	Sensor 13 Current Value	Float
40051 – 40052	Sensor 13 Last logged	Float
40053 – 40054	Sensor 14 Current Value	Float
40055 – 40056	Sensor 14 Last logged	Float

Register address	Description	Data Type
40057 – 40058	Sensor 15 Current Value	Float
40059 – 40060	Sensor 15 Last logged	Float
40061 – 40062	Sensor 16 Current Value	Float
40063 – 40064	Sensor 16 Last logged	Float
40065 – 40066	Sensor 17 Current Value	Float
40067 – 40068	Sensor 17 Last logged	Float
40069 – 40070	Sensor 18 Current Value	Float
40071 – 40072	Sensor 18 Last logged	Float
40073 – 40074	Sensor 19 Current Value	Float
40075 – 40076	Sensor 19 Last logged	Float
40077 – 40078	Sensor 20 Current Value	Float
40079 – 40080	Sensor 20 Last logged	Float
40081 – 40082	Sensor 21 Current Value	Float
40083 – 40084	Sensor 21 Last logged	Float
40085 – 40086	Sensor 22 Current Value	Float
40087 – 40088	Sensor 22 Last logged	Float
40089 – 40090	Sensor 23 Current Value	Float
40091 – 40092	Sensor 23 Last logged	Float
40093 – 40094	Sensor 24 Current Value	Float
40095 – 40096	Sensor 24 Last logged	Float
40097 – 40098	Sensor 25 Current Value	Float
40099 – 40100	Sensor 25 Last logged	Float
40101 – 40102	Sensor 26 Current Value	Float
40103 – 40104	Sensor 26 Last logged	Float
40105 – 40106	Sensor 27 Current Value	Float

Register address	Description	Data Type
40107 - 40108	Sensor 27 Last logged	Float
40109 - 40110	Sensor 28 Current Value	Float
40111 - 40112	Sensor 28 Last logged	Float
40113 - 40114	Sensor 29 Current Value	Float
40115 - 40116	Sensor 29 Last logged	Float
40117 - 40118	Sensor 30 Current Value	Float
40119 - 40120	Sensor 30 Last logged	Float
40121 - 40122	Sensor 31 Current Value	Float
40123 - 40124	Sensor 31 Last logged	Float
40125 - 40126	Sensor 32 Current Value	Float
40127 - 40128	Sensor 32 Last logged	Float
40129 - 40130	Sensor 33 Current Value	Float
40131 - 40132	Sensor 33 Last logged	Float
40133 - 40134	Sensor 34 Current Value	Float
40135 - 40136	Sensor 34 Last logged	Float
40137 - 40138	Sensor 35 Current Value	Float
40139 - 40140	Sensor 35 Last logged	Float
40141 - 40142	Sensor 36 Current Value	Float
40143 - 40144	Sensor 36 Last logged	Float
40145 - 40146	Sensor 37 Current Value	Float
40147 - 40148	Sensor 37 Last logged	Float
40149 - 40150	Sensor 38 Current Value	Float
40151 - 40152	Sensor 38 Last logged	Float
40153 - 40154	Sensor 39 Current Value	Float
40155 - 40156	Sensor 39 Last logged	Float

Register address	Description	Data Type
40157 – 40158	Sensor 40 Current Value	Float
40159 – 40160	Sensor 40 Last logged	Float
40161 – 40162	Sensor 41 Current Value	Float
40163 – 40164	Sensor 41 Last logged	Float
40165 – 40166	Sensor 42 Current Value	Float
40167 – 40168	Sensor 42 Last logged	Float
40169 – 40170	Sensor 43 Current Value	Float
40171 – 40172	Sensor 43 Last logged	Float
40173 – 40174	Sensor 44 Current Value	Float
40175 – 40176	Sensor 44 Last logged	Float
40177 – 40178	Sensor 45 Current Value	Float
40179 – 40180	Sensor 45 Last logged	Float
40181 – 40182	Sensor 46 Current Value	Float
40183 – 40184	Sensor 46 Last logged	Float
40185 – 40186	Sensor 47 Current Value	Float
40187 – 40188	Sensor 47 Last logged	Float
40189 – 40190	Sensor 48 Current Value	Float
40191 – 40192	Sensor 48 Last logged	Float
40193 – 40194	Sensor 49 Current Value	Float
40195 – 40196	Sensor 49 Last logged	Float
40197 – 40198	Sensor 50 Current Value	
40199 – 40200	Sensor 50 Last logged	

Table 15 – Modbus holding register map for iRIS sensors

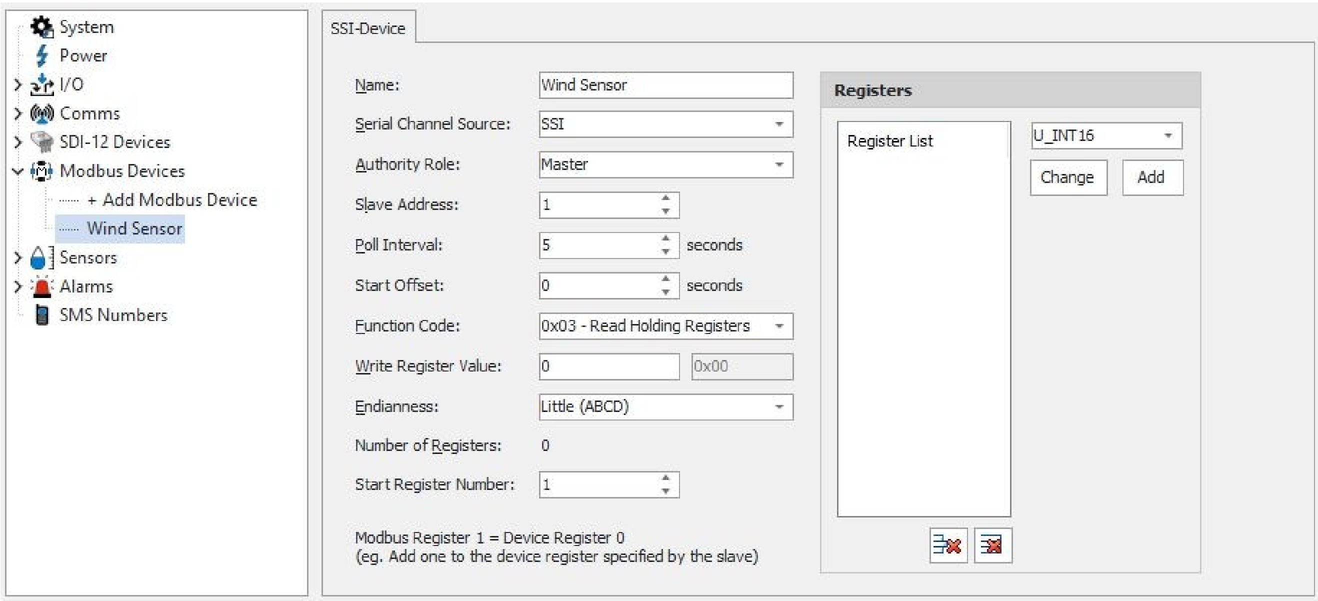
3.7.2 Example of iRIS acting as a Master

This section describes how to use iLink to configure the iRIS to obtain information from a fictitious sensor that measure wind speed, wind direction and temperature. Real sensors will have a different register map etc. and please refer to the sensor manual.

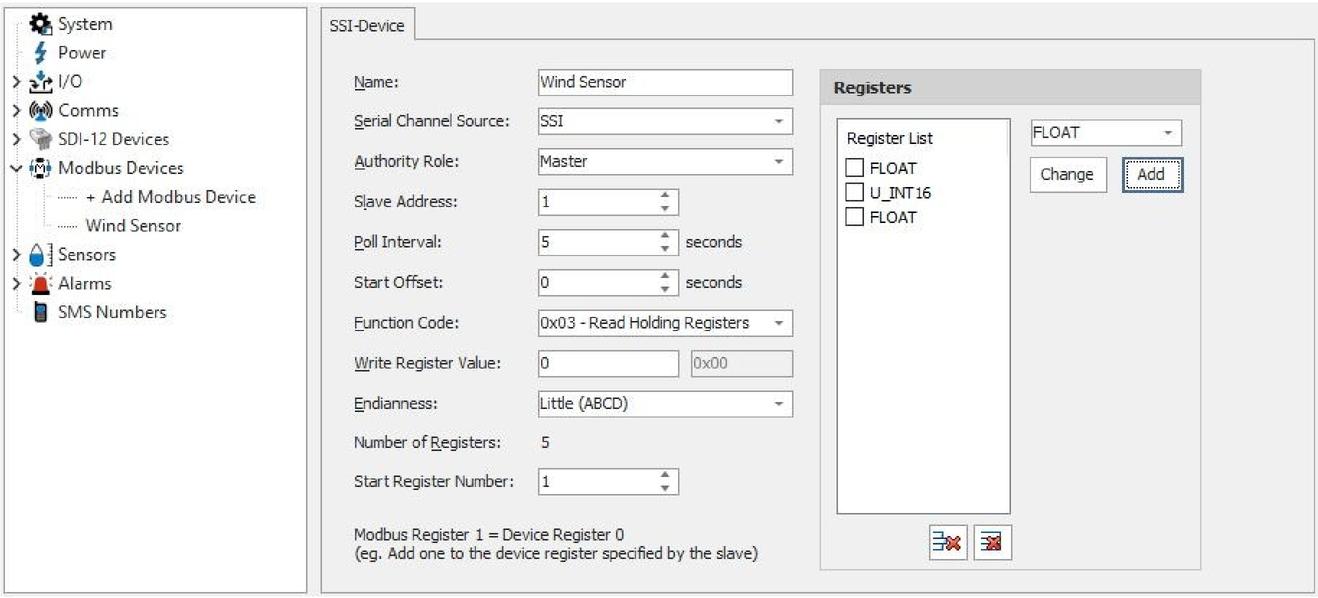
The example also assumes that the sensor has been wired to the Serial Sensor Interface which has been configured appropriately.

1. Connect to the iRIS with iLink and navigate to the configuration section.
2. Expand the **MODBUS DEVICES** branch and select the **+ ADD MODBUS DEVICE** option.
3. Give the device a name, this is used in the Virtual sensor configuration later.
4. Change the following:

Serial Channel Source:	SSI
Authority Role:	Master
Slave Address:	1
Poll Interval:	5
Function Code:	0x03 Read Holding Registers
Endianness:	Little (ABCD)
Start Register:	1

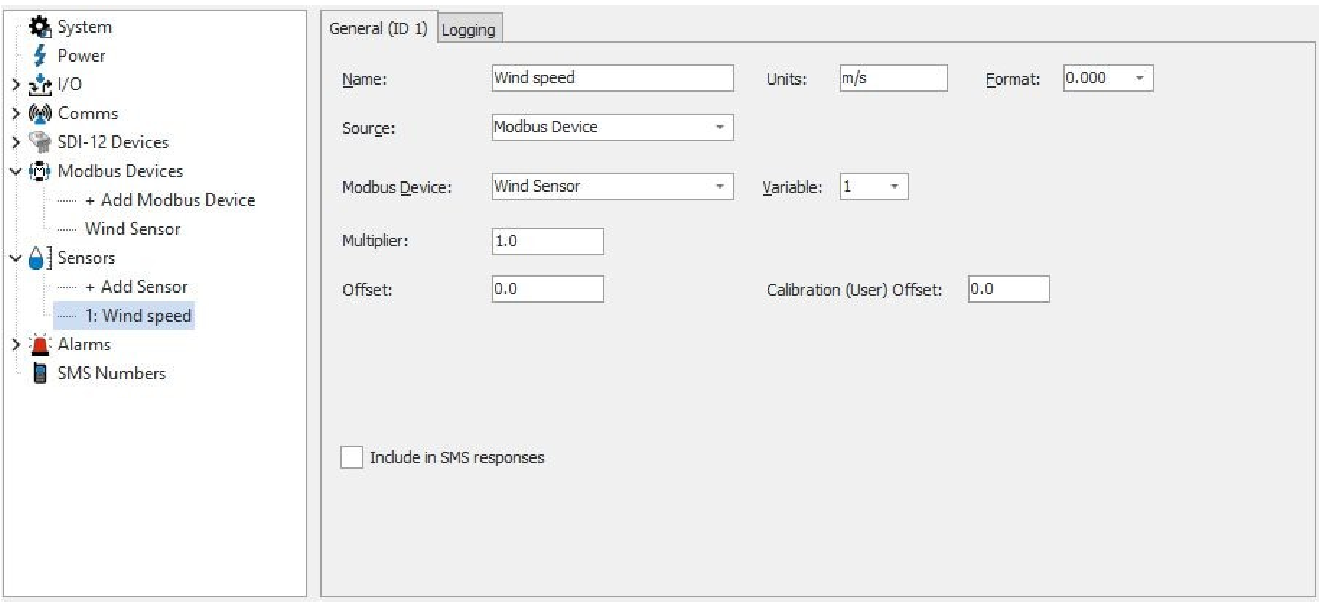


5. In the **REGISTERS** section select the **FLOAT** data type and click the **ADD** button. This will add Float datatype to the Registers List. In this example this represents the wind speed. If the type is incorrect then click the tick box next to the incorrect datatype in the list, choose the correct type and click the Change button.
6. In the **REGISTERS** section select the **U_INT16** data type and click the **ADD** button. This will add U_INT16 datatype to the Registers List. In this example this represents the wind direction.
7. In the **REGISTERS** section select the **FLOAT** data type and click the **ADD** button. This will add Float datatype to the Registers List. In this example this represents the Air Temperature. The Resisters list should look like this:



8. Click the Send Config button to commit this to the iRIS.
9. Click the Retrieve Config button to obtain the dynamically created indices.
10. Navigate to the Sensors section of the configuration tree and click the + Add Sensor branch.
11. In the newly created sensor enter the following:

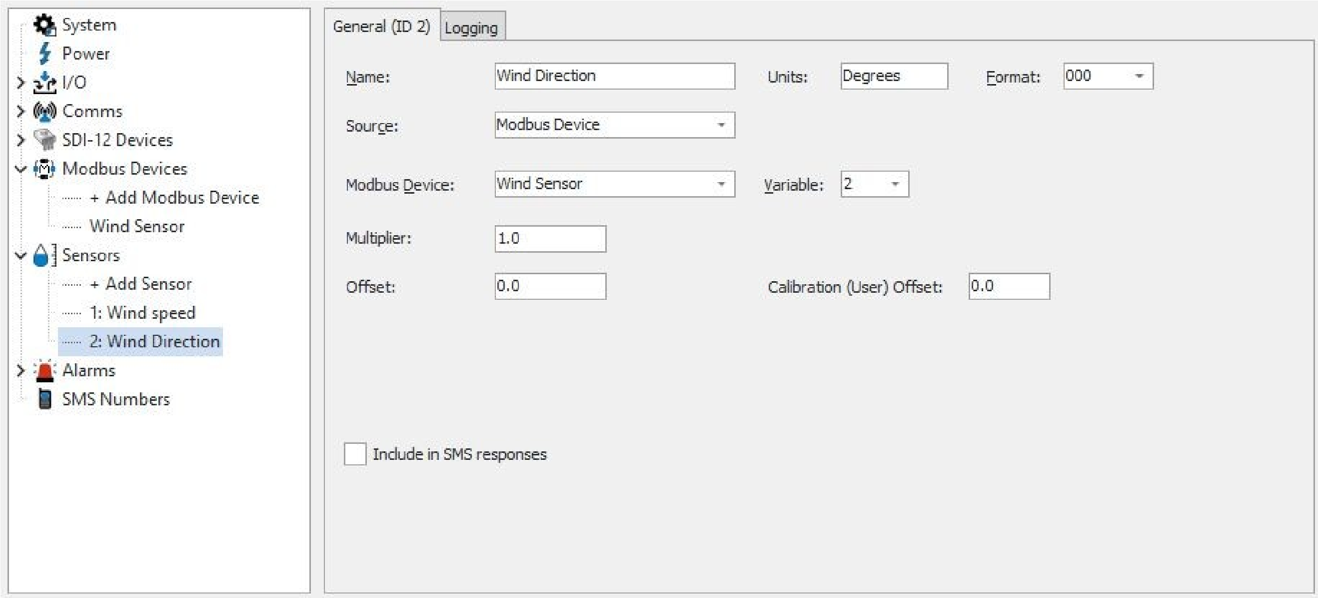
Name:	Wind Speed
Source:	Modbus Device
Modbus Device:	<Name given in step 3>
Variable:	1
Units:	m\s



12. Click the **+ ADD SENSOR** branch and in the newly created sensor enter the following:

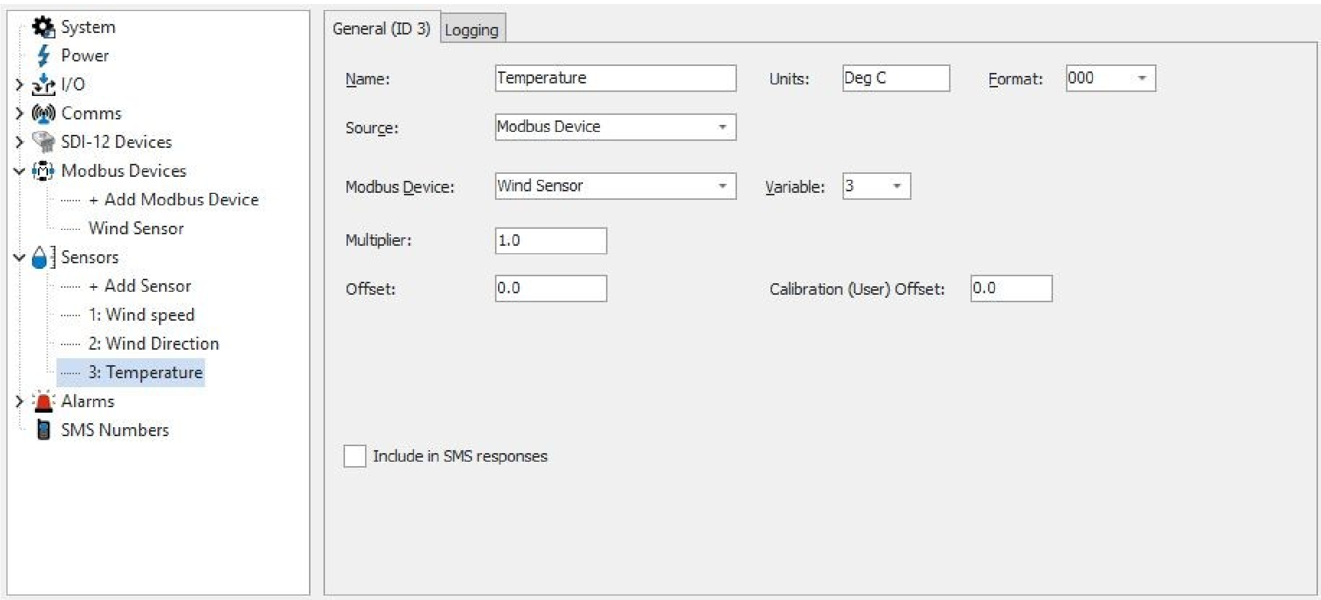
Name:	Wind Direction
Source:	Modbus Device

Modbus Device:	<Name given in step 3>
Variable:	2
Units:	Degrees



13. Click the **+ ADD SENSOR** branch and in the newly created sensor enter the following:

Name:	Temperature
Source:	Modbus Device
Modbus Device:	<Name given in step 3>
Variable:	3
Units:	Degrees C



14. Configure logging as required.

15. Click the [**SEND CONFIG**] button to commit the settings to the iRIS.

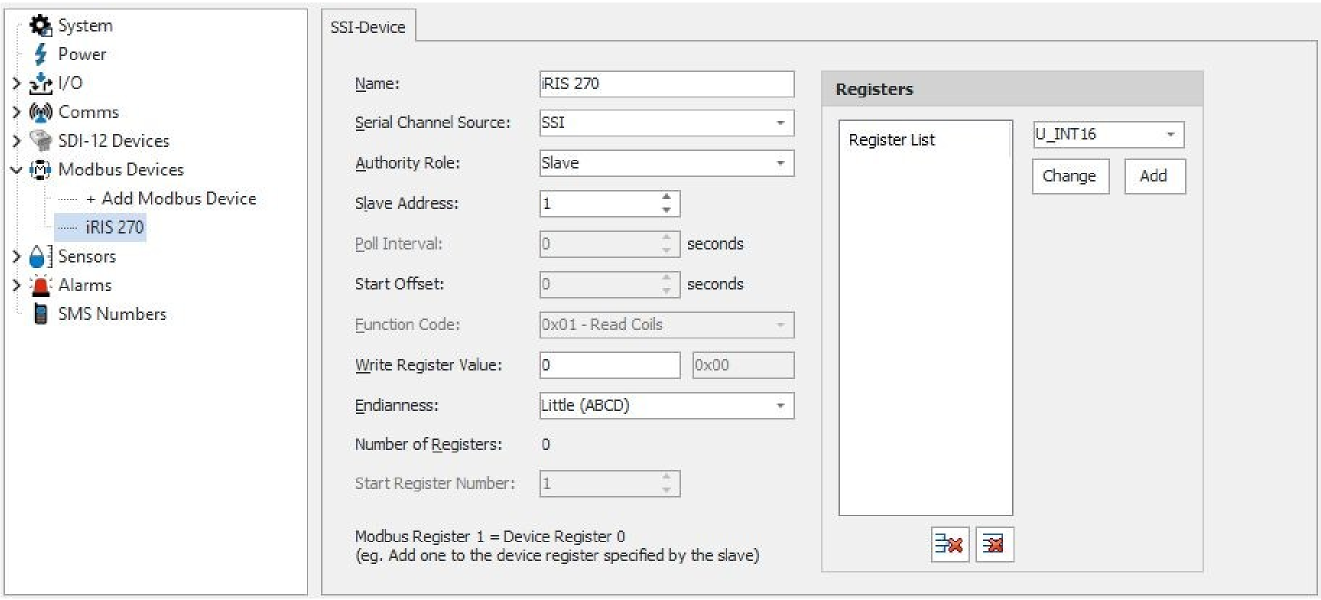
3.7.3 Example of iRIS acting as a Slave Sensor

This section describes how to use iLink to configure the iRIS to provide information it has obtained from it analogue and digital inputs to a Modbus Master, for example a Programmable logic controller (PLC).

The example also assumes that the PLC has been wired to the Serial Sensor Interface which has been configured correctly.

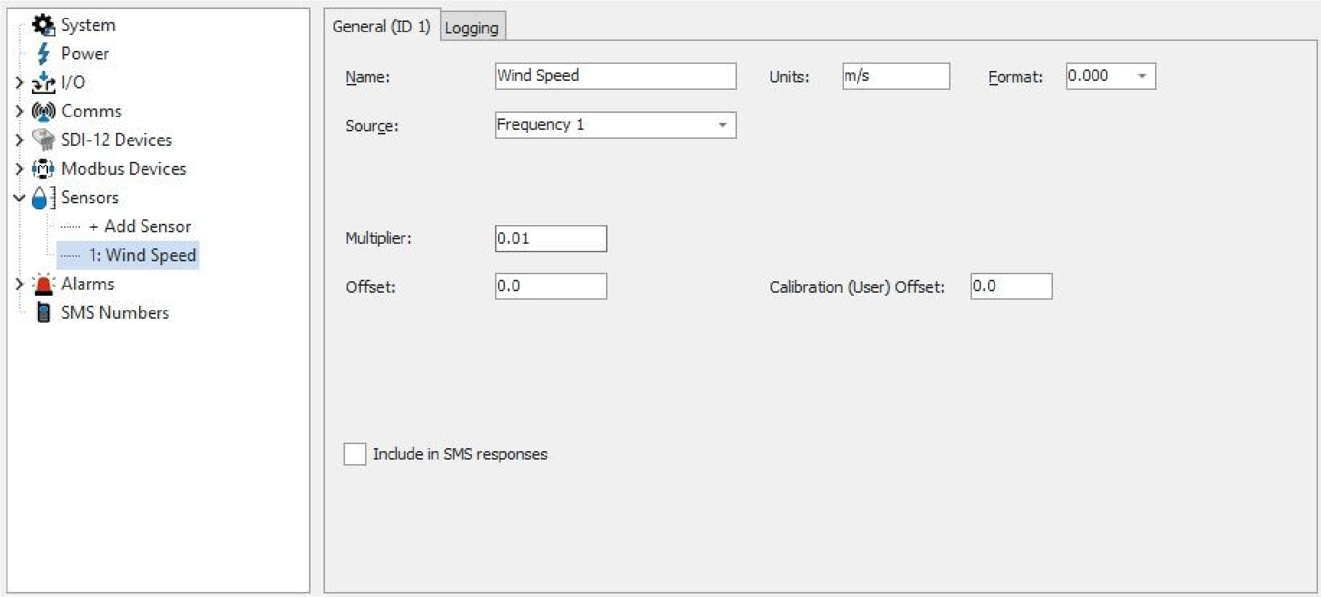
1. Connect to the iRIS with iLink and navigate to the configuration section.
2. Expand the **MODBUS DEVICES** branch and select the **+ ADD MODBUS DEVICE** option.
3. Give the device a name, this is used in the Virtual sensor configuration later.
4. Change the following:

Serial Channel Source:	SSI
Authority Role:	Slave
Slave Address:	1
Endianness:	Little (ABCD)



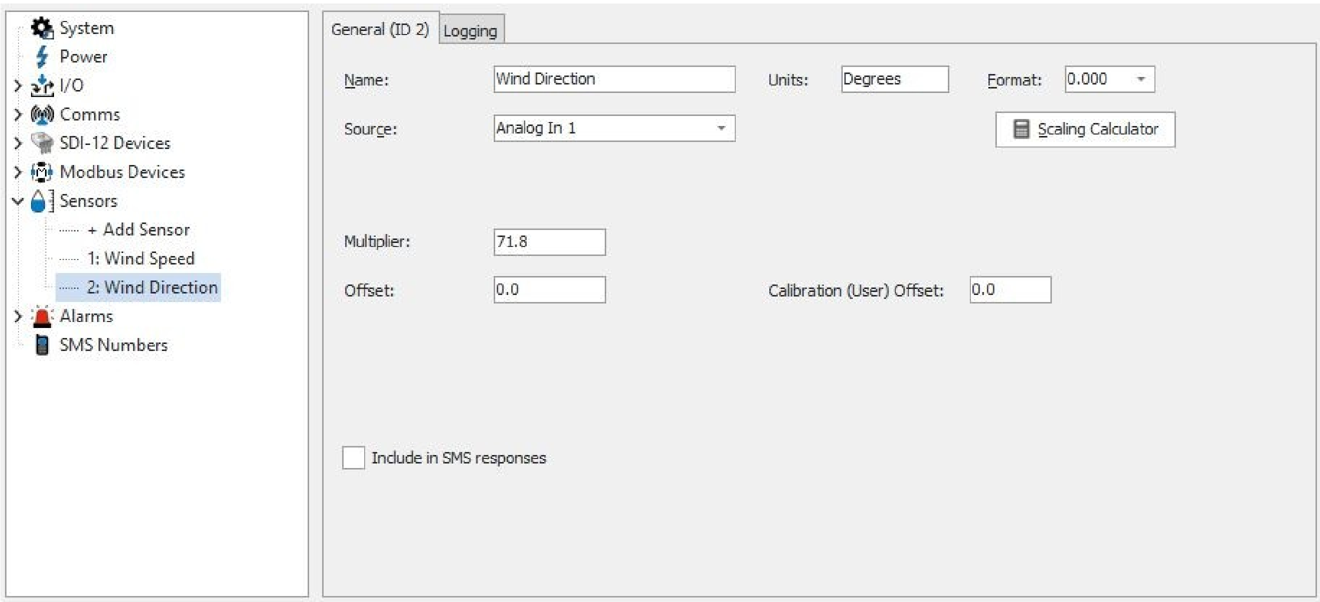
5. Leave the Registers list blank.
6. Click the [**SEND CONFIG**] button to commit this to the iRIS.
7. Click the [**RETRIEVE CONFIG**] button to obtain the dynamically created indices.
8. Navigate to the **SENSORS** section of the configuration tree and click the **+ ADD SENSOR** branch.
9. In the newly created sensor enter the following:

Name:	Wind Speed
Source:	Frequency 1
Multiplier:	0.01
Units:	m\s



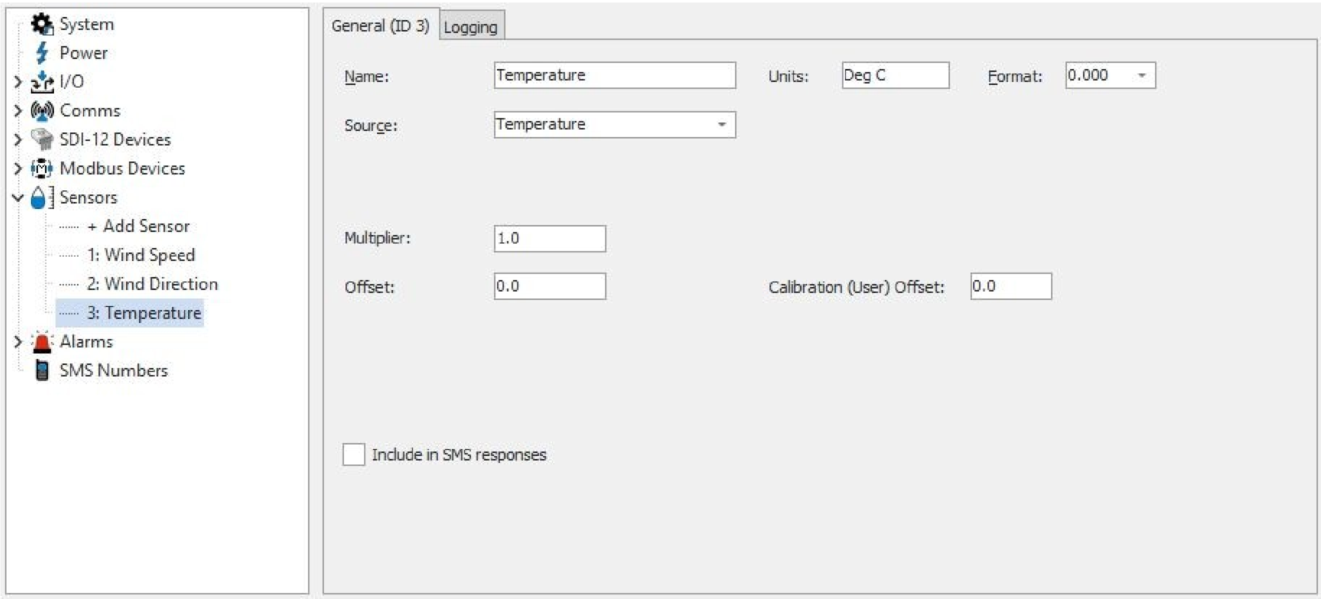
10. Click the **+ ADD SENSOR** branch and in the newly created sensor enter the following:

Name:	Wind Direction
Source:	Analogue Input 1
Multiplier:	71.8
Units:	Degrees



11. Click the **+ ADD SENSOR** branch and in the newly created sensor enter the following:

Name:	Temperature
Source:	Temperature
Multiplier:	1
Units:	Deg C



12. Configure logging as required.
13. Click the [**SEND CONFIG**] button to commit the settings to the iRIS.
14. Configure the PLC to poll the iRIS with the following details:

Function:	Read Multiple Holding Registers
Slave Address:	1
Register address:	40001 or 0 (depends on PLC operation)
Number of registers to retrieve:	a. 12 **Note**: The number of registers is calculated from the number of sensors to be obtained x 2 (current value and last logged) x 2 (number of registers per float data type). In this example the number of registers is 3 x 2 x 2 = 12.
Register data type:	Single precision float

The data retrieved by the PLC will be in the following order and have the meaning described in the table:

Holding Register	Register Address	Value
40001 – 40002	0 – 1	Current Wind Speed
40003 – 40003	2 – 3	Last logged Wind Speed
40005 – 40006	4 – 4	Current Wind Direction
40007 – 40008	6 – 5	Last logged Wind Direction
40009 – 400010	8 – 7	Current Temperature
400011 – 400012	10 – 11	Last logged Temperature

3.7.4 Example of iRIS acting as a protocol gateway (Modbus Slave)

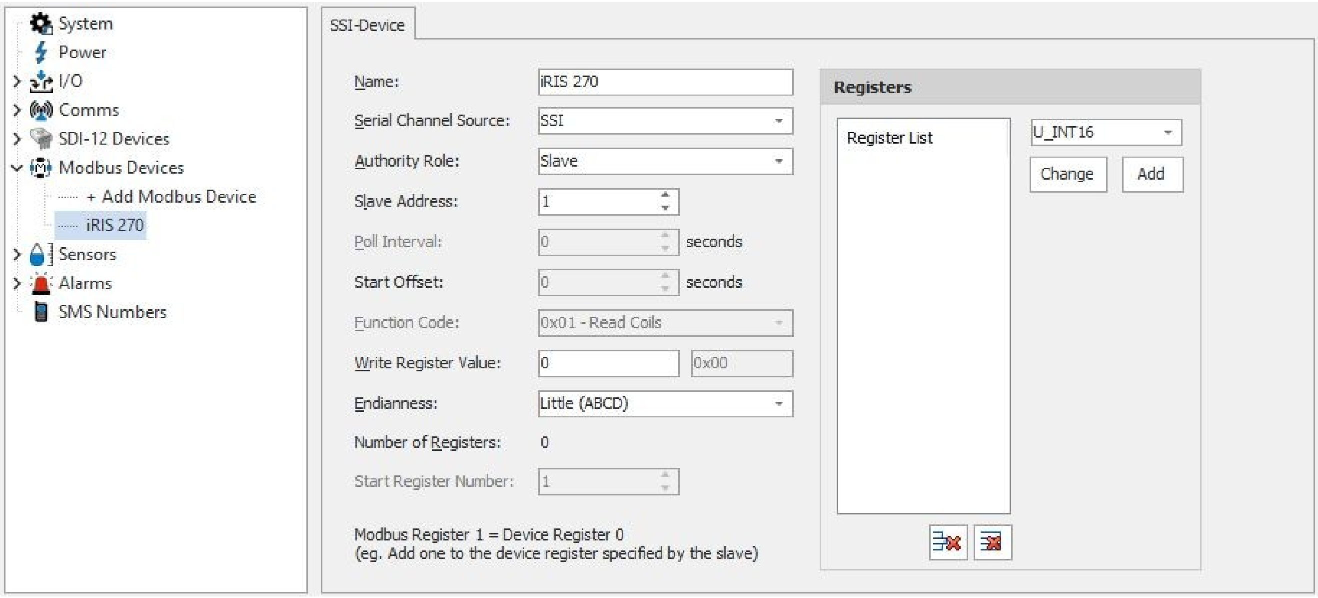
This section describes how to use iLink to configure the iRIS to act as a gateway between a Modbus host (for example a Programmable Logic Controller (PLC)) and HydroTel. The iRIS will operate as Modbus Slave and the PLC will read and write values into holding registers that can be read and written too by HydroTel.

In this example there are three parameters for each direction. As the iRIS is acting purely as a gateway the type of values/data represented by the parameters (e.g. water level, temperature, etc.) is irrelevant and hence not referred to in the iRIS configuration. This will be defined in data originator (HydroTel and the PLC)

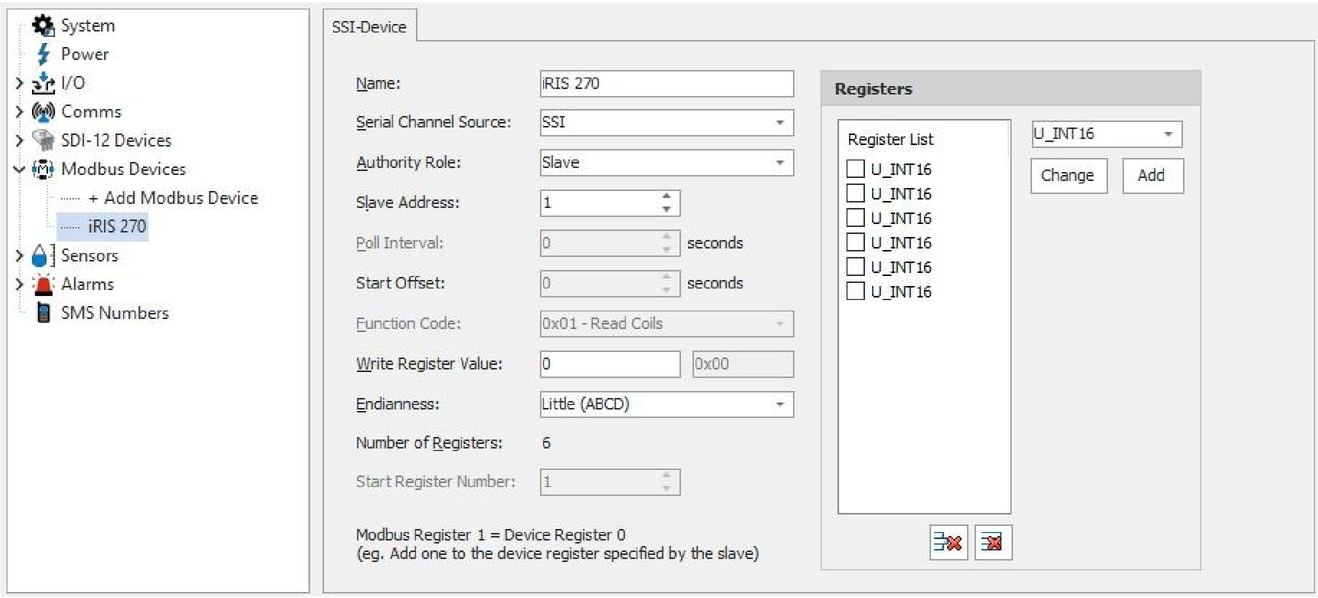
The example also assumes that the PLC has been wired to the Serial Sensor Interface which has been configured correctly. Also, that appropriate settings for iRIS to HydroTel communications has been set to the iRIS and tested.

1. Connect to the iRIS with iLink and navigate to the configuration section.
2. Expand the **MODBUS DEVICES** branch and select the **+ ADD MODBUS DEVICE** option.
3. Give the device a name, this is used in the Virtual sensor configuration later.
4. Change the following:

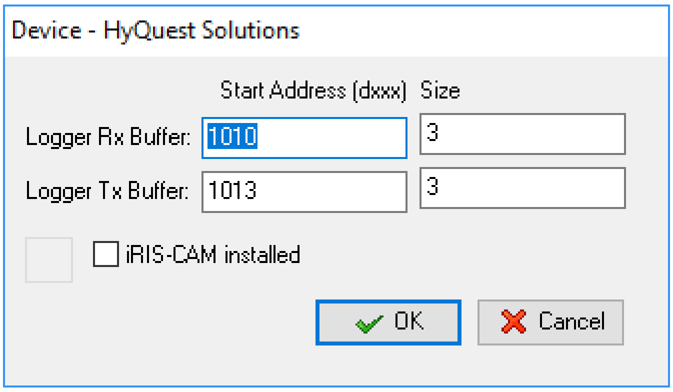
Serial Channel Source:	SSI
Authority Role:	Slave
Slave Address:	1
Endianness:	Little (ABCD)



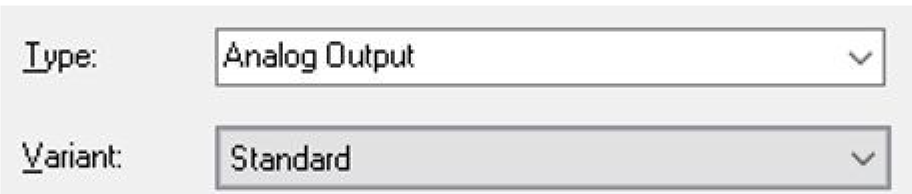
5. In the **REGISTERS** section select the **S_INT16** data type and click the [**ADD**] button. This will add signed integer data type to the Registers List. If the type is incorrect entered then click the tick box next to the incorrect data type in the list, choose the correct type and click the Change button.
6. Repeat previous step 5 times, until there are six S_INT16 data types in the Register List.



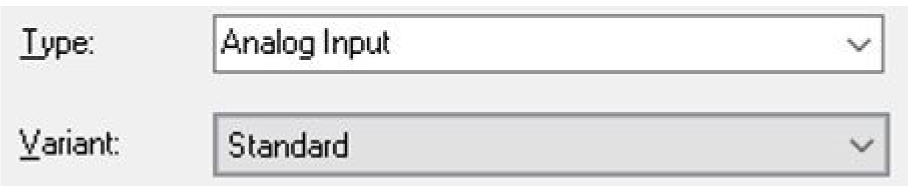
7. Click the [**SEND CONFIG**] button to commit this to the iRIS.
8. Click the [**RETRIEVE CONFIG**] button to obtain the dynamically created indices.
9. In HydroTel Client, if not already done so create a logger and site.
10. For the Device Parameters configure the:
    a. **Logger RX Buffer Start Address (dxxx)** to be **1010** and the **Size** to be **3**. This is the locations that are written to in the iRIS from HydroTel.
    b. **Logger TX Buffer Start Address (dxxx)** to be **1013** and the **Size** to be **3**. This is the locations that are read from the iRIS by HydroTel.



11. Create three objects and points with Object **TYPE: ANALOGUE OUTPUT**:



12. The points associated with these objects should have unique (with in the group) Identifier of 0, 1 and 2.
13. Create three objects and points with Object **Type: Analogue Input**:



14. The points associated with these objects should have unique (with in the group) Identifier of 0,1 and 2.
15. Configure the PLC to poll the iRIS with the following details:

Function:	Write Multiple Holding Registers

Slave Address:	1
Register address:	40201 or 200 (depends on PLC operation)
Number of registers to write:	3
Register data type:	Signed 16-bit Integer

16. Configure the PLC to poll the iRIS with the following details:

Function:	Read Multiple Holding Registers
Slave Address:	1
Register address:	40204 or 203 (depends on PLC operation)
Number of registers to retrieve:	3
Register data type:	Signed 16-bit Integer

The configuration is complete. To aid in understanding the data flow in this example the following table may act as a visualisation. The objects listed are those created above (the actual names will differ in reality, for example Gate height SP, etc.).

"Database Location" is where information is stored that the iRIS can then use.

HydroTel			**iRIS**			**PLC**
Object	Point ID	Function	Database Location	Modbus Reg	Modbus Addr	Function
Analogue Out A	0	Write →	1010	40201	200	→ Read
Analogue Out B	1		1011	40202	201	
Analogue Out C	2		1012	40203	202	
Analogue In A	0	← Read	1013	40204	203	← Write
Analogue In B	1		1014	40205	204	
Analogue In C	2		1015	40206	205	

Table 16 – Data flow visualisation of the Modbus gateway example

3.8 Upgrading Firmware

This section describes the procedure to use when upgrading the firmware component in an iRIS.

The upgrade procedure has been carried out many times without issue. However, because the process does involve erasing and reprogramming of flash memory, it is important that a good, securely connected power supply is provided to the iRIS throughout the upgrade process.

This chapter contains the following subsections:

3.8.1 iRIS Executive Firmware File Naming Conventions

The iRIS firmware is available as a single file for downloading and flash upgrading using iLink. The upgrade file is in the format:

iRIS270_x-y-z.bin where:

x-y-z is the firmware version:

x – Major version

y – Minor version

z – Build version

e.g. iRIS270_1-0-0.bin iRIS 270 Firmware, 1.0.0

The default repository for the firmware files in iLink is C:\ProgramData\iQuest\iLink3\Programs.

3.8.2 Active verse Pending Firmware

There are up to two copies of firmware stored on the iRIS, they are stored in the Active and Pending regions of non-volatile memory. The version information for both of these areas can be obtained using iLink.

Active – current running firmware image.

Pending – the area containing firmware image that will be used to upgrade the Active area or used as a backup if the Active area is corrupted. It is a landing area for new firmware to be placed while the operation of the iRIS is not affected, thus allowing for interruptions to communications a power.

Upon completion of upload of a new firmware file, the activate command is sent to the iRIS, invalidating the Active area and forcing c copy of the pending area to the Active.

A pending version of preceded with a 9 indicates that the firmware is partially uploaded to the iRIS. For example, 91.4.3 indicates that version 1.4.3 of the firmware is part way through being uploaded to the iRIS.

3.8.3 iRIS Automated Upgrade Procedure (Firmware)

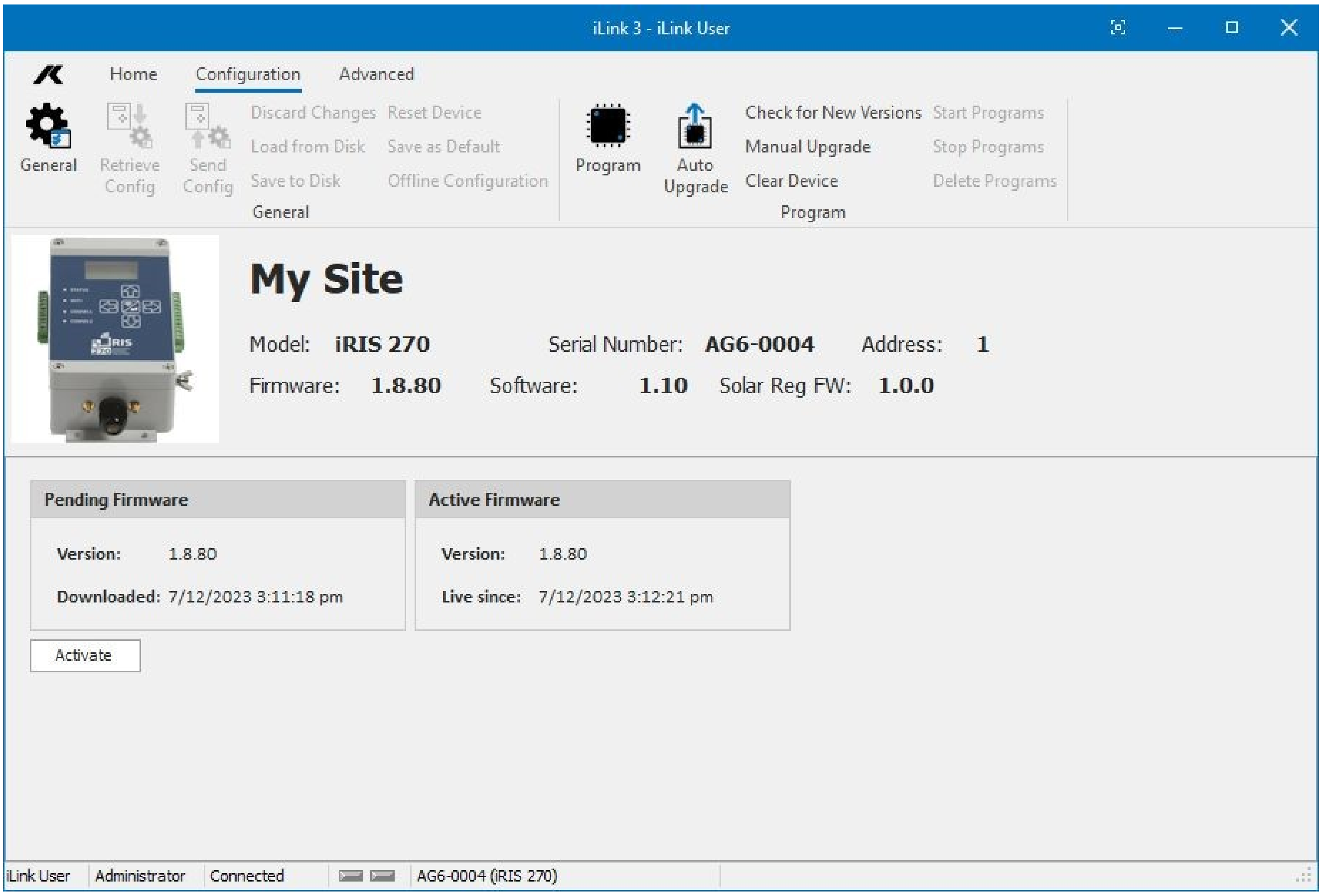
iLink has an automated firmware upgrade tool that supports the iRIS 270. This tool includes several checks to confirm the validity of the components being installed.

The automated upgrade tool will automatically select the latest version of firmware.

The example given below shows a full, automatic firmware upgrade for an iRIS 270.

1. Make sure the required upgrade files are available on the computer. Ideally these should be located in the default deployment folders listed above in section iRIS Executive Firmware File Naming Conventions 86.
2. Connect to the iRIS using iLink.
3. Click the Program button under the button under the Configuration tab.
4. Click the Auto Upgrade button.

5. Click OK to load the selected programs to the device. The progress of the upgrade can be seen on the status bar.

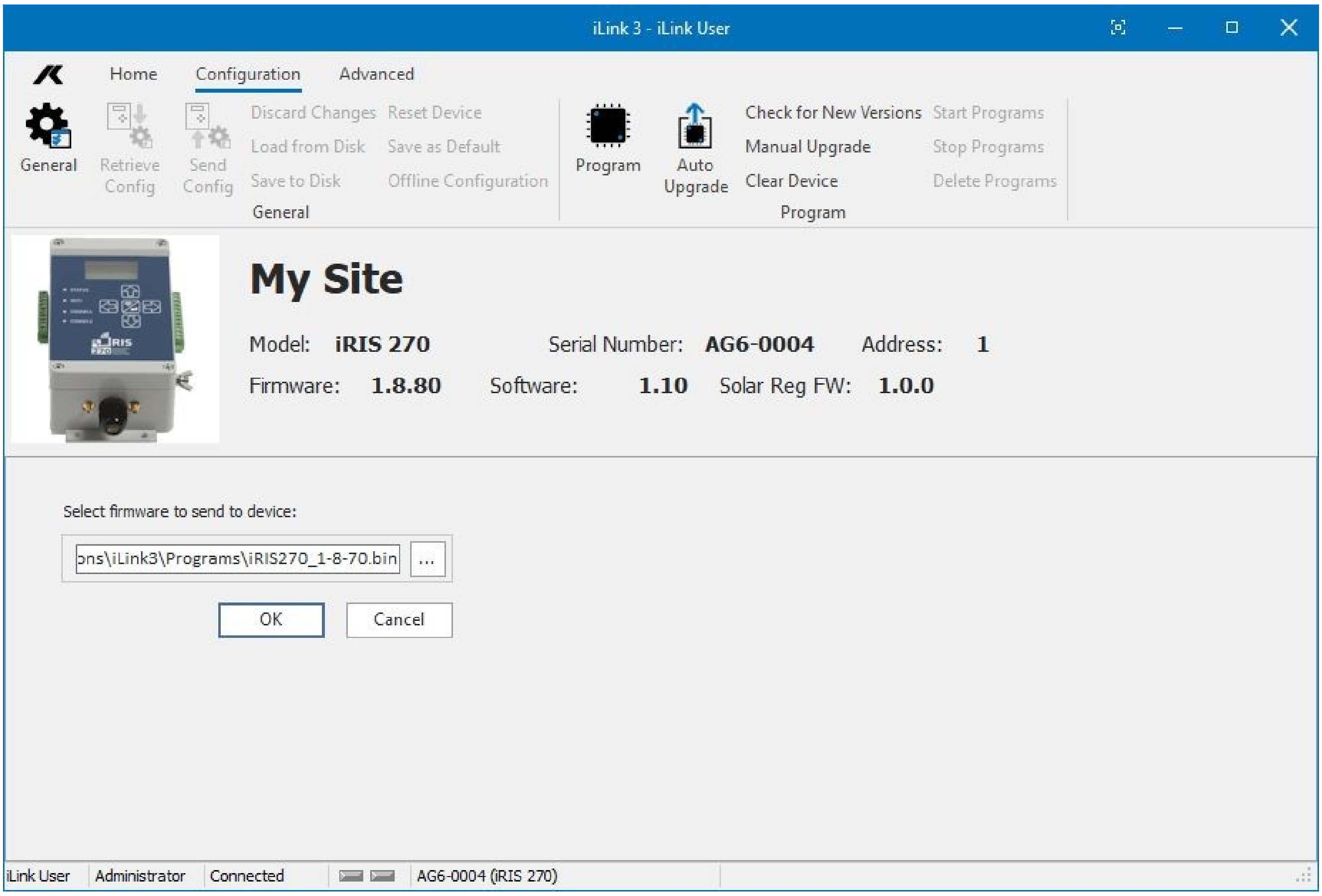


6. Once the process is completed, you can see a message saying "Upgrade completed successfully" on the status bar and the iLink window will show the current software status of the device.

3.8.4 iRIS Manual Upgrade Procedure (Firmware)

iLink also allows you to upgrade the software and firmware manually. Please go through the below steps to do a manual upgrade of software and firmware for the iRIS.

1. Make sure the required upgrade files are available on the computer. Ideally these should be located in the default deployment folders listed above in section iRIS Executive Firmware File Naming Conventions 86.
2. Connect to the iRIS using iLink.
3. Click the [**PROGRAM**] button under the **CONFIGURATION** tab.
4. Click on **MANUAL UPGRADE**.
5. Select the new firmware file using the firmware browse button.



6. Click [**OK**] to load the selected programs to the device.
7. Once the process is completed, you can see a message saying "Upgrade completed successfully" on the status bar and the iLink window will show the current software status of the device.
8. Click the Activate button to commit the new firmware to the unit overwriting current version.

4 Operation

This chapter contains the following subsections:

4.1 General Hints

- If the iRIS will be installed in an outdoor situation, try to ensure that the LCD is facing away from direct sunlight. This will help to enhance the readability of the display.
- If the unit is not to be used for some time, disconnect the internal battery to prevent it discharging.
- Always check the time and date are correct when commissioning the unit. The internal clock runs in UTC (GMT) and all logged data is time/date stamped in this time zone. HydroTel™ and/or iLink 3 automatically adjust for this. The configured UTC offset is used to adjust the date/times on the LCD (as viewed by users) to the local standard time zone. If configured, also the timestamps in the FTP files can be written in local standard time zone (see Cellular Modem - FTP 1 & FTP 2 43).

4.2 LED Indicators

The iRIS has several LED indicators. The main status LED and two diagnostic LEDs are visible from the front of the enclosure. There are an additional two LED located with the iRIS enclosure.

4.2.1 Status LED

The status LED is a colour device that is used to indicate the unit status.

4.2.2 Front panel Diagnostic LEDs

The iRIS has three LED indicators that are useful for diagnostic purposes. These are visible through the front of the enclosure.

WiFi	Illuminated red when Wi-Fi (WLAN) access point is active.
Comms 1	Flashes red to indicate status of coms module in the primary slot, see Table below.
Comms 2	Flashes red to indicate status of coms module in the secondary slot, see Table below.

State	One Second	One Second	One Second	One Second
Powered down				
Initialisation	Actual time will vary			
Ready				
Ready (zero signal)				
Connecting				
Connected				

Table 17 – Shows the front panel Comms status LED sequence for cellular module (Measured in 100 mS slices)

4.3 LCD & Keypad

This chapter contains the following subsections:

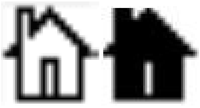
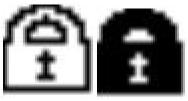
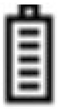
4.3.1 LCD Operation

The iRIS LCD is controlled to optimise power consumption. If the display has powered down (in full power save mode), the unit is in the lowest power mode and can be woken by pressing any key on the keypad.

After a certain period of no key presses, the display and backlight will power down again, although other functions continue normally. If the user was logged on (PIN entered), they will be logged off. The timeout period is user configurable see section System 34.

4.3.2 Status Icons

At the top of the LCD is a row of status icons.

 Indicates current connection state as given below: ▪ **Invisible** Modem shut down. ▪ **Outline** Disconnected in wireless mode. ▪ **Solid** Connected in wireless mode.	 Flashes when an unsolicited call-in is pending or in progress. This can be the result of an alarm activation or a user request for a test call-in.
 Indicates current access level ▪ **Invisible** logged in. ▪ **Outline** logged out. ▪ **Solid** secure (PIN is set to zero).	 Indicates signal strength. Only updated when wireless modem is powered up but wireless IP session is not active.
 Indicates current battery charge. The level indication bars cycle when charging is in progress.	

4.3.3 Display Menu Structure

The actual LCD screens that are available will depend upon the level of access that has been enabled (no access, not logged-in, or logged-in). The screens available in each mode are shown below:

1. Minimum Access (PIN code = 0, Log-in is not possible)

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	Status 1					
	Status 2					
	Status 3					
	Status 4					
	Status 5					
	Status 6					
	Status 7	Totaliser [1..3]				

2. View Only Access (PIN code <> 0, but user is not logged-in)

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Log-In	Status 1					
	Status 2					
	Status 3					
	Status 4					
	Status 5					
	Status 6					
	Status 7	Main Menu				
			Sensors Menu			
				Sensors 1-16		
				Sensors 17-32		
				Sensors 33-50		
					Sensor Menu	
						Sensor data
			Totaliser [1..3]			
			Comms Module 1			
			Comms Module 2			

3. Full Access (PIN code <> 0 and user is logged-in)

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Log-Out	Status 1					
	Status 2					
	Status 3					
	Status 4					
	Status 5					
	Status 6					
	Status 7					

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	Log Control	Main Menu				
			Sensors Menu			
				Sensors 1-16		
				Sensors 17-32		
				Sensors 33-50		
					Sensor Menu	
						Sensor Settings [1..4]
						Sensor calibration
						Sensor data
			Totaliser [1..3]			
				Totalisers Reset		
			Comms Module 1			
				Comms Menu		
					Comms Settings [1..8]	
					Test Call	
			Comms Module 2			
				Comms Menu		
					Comms Settings [1..8]	
					Test Call	

4.3.4 Keypad Buttons

The five keypad buttons are used to navigate through the LCD screens. Their use varies depending upon the current screen in view.

Up

In Menus: Scrolls up through menu items.

In Screen Groups: Scrolls/steps through screens in the up direction.

In Numerical entry: Increments the selected digit.

Press and held: no action.

Down

In Menus: Scrolls down through menu items.

In Screen Groups: Scrolls/steps through screens in the direction.

In Numerical entry: decrements the selected digit.

Press and held: no action.

Left

In Menus: returns to previous menu or screen group.

In Screen Group: returns to previous menu or screen group (if available).

In Numerical entry: shifts edit cursor to the digit to the left of the current digit.

Press and held: no action.

Right

In Menus: acts on the selected menu item.

In Screen Groups: access sub menus (if available).

In Numerical entry: shifts edit cursor to the digit to the right of the current digit.

Press and held: no action.

Enter/Wi-Fi

In Menus: no action.

In Screen Groups: no action.

In Numerical entry: allow edit of numerical field and accepts changes to numerical fields.

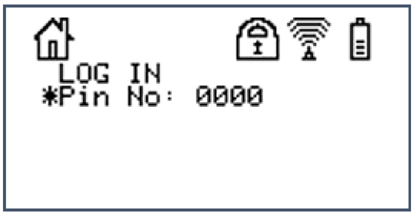
Press and held: for more than 3 seconds will enable the Wi-Fi access point.

4.3.5 Primary LCD Display Screens

This chapter contains the following subsections:

4.3.5.1 Log In Screen (Level 0, when not logged in)

The Log-In screen is a special screen that is allocated level 0. It is used to enter a PIN and then enable access to restricted screens. It is reached by pressing by navigating to the status screens and pressing the left key when the unit is not logged in.



Up	Increment digit by one.*
Down	Decrement digit by one.*
Right	Move right to next digit.*
Left	Move left to next digit.*
Enter	Press to enter or exit edit mode.

* When in edit mode only

Once the PIN number matches that programmed into the device and the <Enter> key is pressed, the user will be logged in and returned to the top-level Welcome (System Status 1) screen. A successful login will also remove the padlock icon from the top of the display.

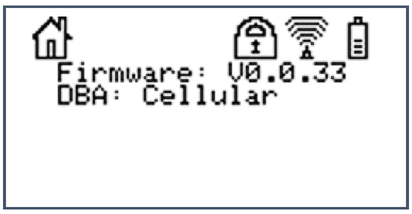
4.3.5.2 System Status 1 Screen (Level 1)

The System Status 1 screen is the default screen shown at system power up, hence its designation as display level 1. Useful information shown on this screen includes the site name, model, serial number, HyQuest protocol communications address and the current time and date.

Up	Wrap around to System Status 7 screen or Logging Control if user is logged in.
Down	Move down to System Status 2 screen.
Right	Move across to main menu screen.
Left	Log in (If PIN code <> 0), or log out if already logged in.
Enter	Not used.

4.3.5.3 System Status 2 Screen (Level 1)

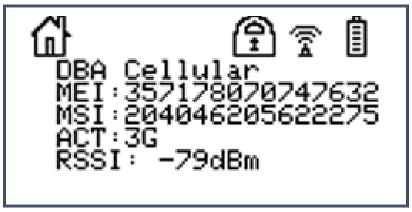
The System Status 2 screen is always available, no matter what level of access has been selected. The information shown on this screen includes the firmware and communications module type.



Up	Move up to System Status 1 screen.
Down	Move down to System Status 3 screen.
Right	Move across to main menu screen.
Left	Log in (If PIN code <> 0), or log out if already logged in.
Enter	Not used.

4.3.5.4 System Status Screen 3 (Level 1) (Cellular variant only)

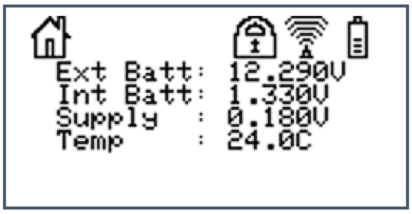
This System Status 3 screen is only available when there is a module fitted in slot A. It displays the SIM IMSI and the modem IMEI. The last 5 digits of the IMSI comprise the GDSP SMS short code when the iRIS is using a GDSP SIM.



Up	Move up to System Status 2 screen
Down	Move down to System Status 4 screen
Right	Move across to main menu screen
Left	Log in (If PIN code <> 0), or log out if already logged in
Enter	Not used

4.3.5.5 System Status 4 Screen (Level 1)

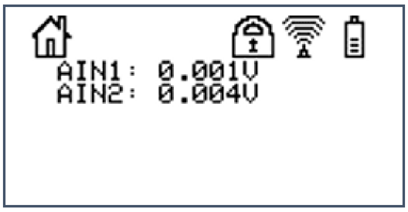
The System Status 4 screen is always available, no matter what level of access has been selected. The information shown on this screen includes the internal battery voltage, supply voltage, internal temperature.



Up	Move up to System Status 3 screen
Down	Move down to System Status 5 screen
Right	Move across to main menu screen
Left	Log in (If PIN code <> 0), or log out if already logged in
Enter	Not used

4.3.5.6 System Status 5 Screen (Level 1)

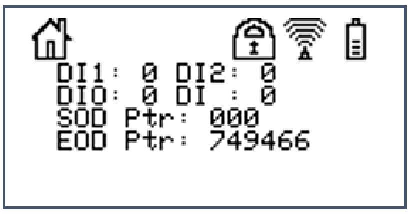
The System Status 5 screen is always available, no matter what level of access has been selected. The information shown on this screen includes the voltage being measured at the AI1 – AI2 terminals in volts. These values are useful for checking input signals and also for the calibration process.



Up	Move up to System Status 4 screen.
Down	Move down to System Status 6 screen.
Right	Move across to main menu screen.
Left	Log in (If PIN code <> 0), or log out if already logged in.
Enter	Not used.

4.3.5.7 System Status 6 Screen (Level 1)

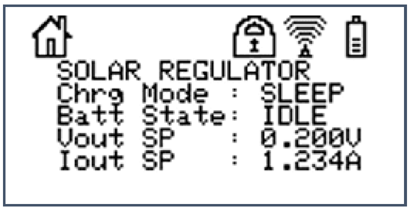
The System Status 6 screen is also always available, no matter what level of access has been selected. The information shown on this screen includes the current status of the digital channels whether they are an input (DIx:y) or an output (DOx:y) (where x is the channel and y is the state 0=OFF, 1=ON). Finally, it displays the Start Of Data (SOD) and End Of Data (EOD) pointer values.



Up	Move up to System Status 5 screen
Down	Move down to System Status 7 screen
Right	Move across to main menu screen
Left	Log in (If PIN code <> 0), or log out if already logged in
Enter	Not used

4.3.5.8 System Status 7 Screen (Level 1)

The System Status 7 screen is also always available, no matter what level of access has been selected. The information shown on this screen includes the current status of the internal solar regulator. See section Solar Regulator 105 for more details on the solar regulator.



Up	Move up to System Status 6 screen
Down	Wrap around to System Status 1 screen or move down to Logging Control screen, if user is logged in
Right	Move across to main menu screen
Left	Log in (If PIN code <> 0), or log out, if already logged in
Enter	Not used

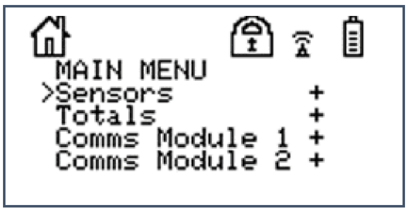
4.3.5.9 Logging Control Screen (only accessible when logged in)

The Logging Control screen is a special screen that is only available on level 1 when a user is logged in. It can be used to temporarily disable logging when the logged in user is making changes to or testing sensors and does not want to have the data logged. It is reached by pressing the down key from Status Screen 7. Use the Enter key to enter edit mode and the left and right keys toggle logging on or off. If the logging is disabled, it is always re-enabled automatically when the user logs out, either manually or on an inactivity timeout (30 minutes).

Up	Move up to System Status 7 screen.
Down	Wrap around to System Status 1 screen.
Right	Move across to main menu screen, in edit mode toggle between enabled and disabled.
Left	Log in (If PIN code <> 0), or log out, if already logged in. In edit mode toggle between enabled and disabled.
Enter	Press to enter and exit edit mode.

4.3.5.10 Main Menu Screen (Level 2)

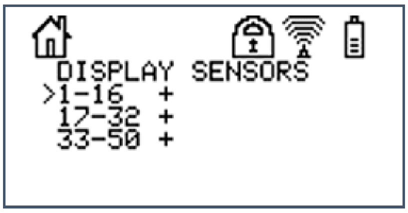
The Main Menu screen is used to select which type of information you want to look at.



Up	Move up through the menu items.
Down	Move down through the menu items.
Right	Select the menu item pointed to by > pointer.
Left	Move to Status Screen 1.
Enter	Not used.

4.3.6 Sensor Selection Sub menu (Level 3)

Allows the user to jump to a group ahead in the list of sensors, rather than having to scroll through 50 possible sensors.



Up	Move up through the menu items
Down	Move down through the menu items
Right	Select the menu item pointed to by > pointer.
Left	Move to Main Menu
Enter	Not used

4.3.7 Sensor Related Screens

This chapter contains the following subsections:

4.3.7.1 Sensor Status Screen (Level 4)

This screen provides an overview of each sensor.

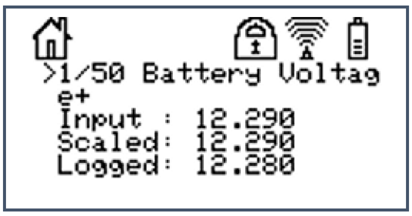
Line 1 indicates sensor ID, data source and its composite status including:

'.'	if sensor is enabled.
':'	if sensor and alarm(s) are enabled.
'*'	if sensor and alarm(s) are enabled and alarm(s) currently active.

Line 2 indicates the raw input value.

Line 3 indicates the scaled (engineering unit's) value. **Note** an inverted value (for example 23.24) then the number being displayed has more most significant digit than the sensor format (see section Format option in section General 56.

Line 4 indicates the last logged value.



Up	Move up through sensors.
Down	Move down through sensors.
Right	View sensor historical data, if logged in access to sensor menu.
Left	Move to Sensor Selection Sub Menu.
Enter	Not used.

4.3.7.2 Sensor Menu Screen (Level 5)

The Sensor Menu screen is used to select sensor options.

Up	Move up through the menu items.
Down	Move down through the menu items.
Right	Select the menu item pointed to by > pointer.
Left	Move to Sensor Screen.
Enter	Not used.

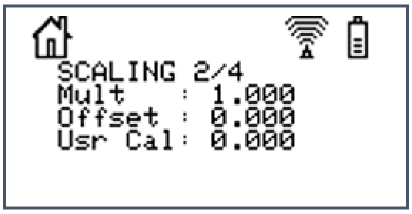
4.3.7.3 Sensor Settings Screen 1/4 - Process (Level 6)

The Sensor Process screen shows the processing mode used to convert the incoming raw data to engineering units. For pulse input sources I also shows the check counter.

Up	Move up through sensor setting screens
Down	Move down through sensor setting screens
Right	Not Used
Left	Move to Sensor Menu
Enter	Not used

4.3.7.4 Sensor Settings Screen 2/4 - Scaling (Level 6)

The Sensor Scaling screen shows the multiplier and offset used to convert the incoming raw data to engineering units. It also shows the user calibration value (which is generated by the calibration operation) and is added to the basic scaled value. See the calibration section on the next page.

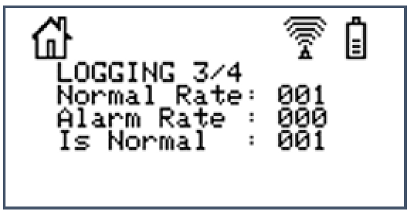


Up	Move up through sensor setting screens.
Down	Move down through sensor setting screens.
Right	Not Used.
Left	Move to Sensor Menu.
Enter	Not used.

4.3.7.5 Sensor Settings Screen 3/4 - Logging (Level 6)

Sensor Settings Screen 3/4 - Logging (Level 6)

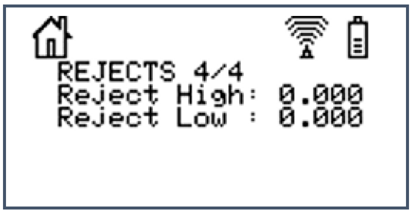
The Sensor Logging screen shows the defined normal and alarm logging rates for this sensor and the currently selected one. All rates are in minutes.



Up	Move up through sensor setting screens.
Down	Move down through sensor setting screens.
Right	Not Used.
Left	Move to Sensor Menu.
Enter	Not used.

4.3.7.6 Sensor Settings Screen 4/4 - Logging (Level 6)

The Sensor Validation screen shows the defined Reject high and Reject Low settings for the given sensor.



Up	Move up through sensor setting screens.
Down	Move down through sensor setting screens.
Right	Not Used.
Left	Move to Sensor Menu.
Enter	Not used.

4.3.7.7 Sensor Calibration Screen (Level 6)

The Sensor Calibration screen is provided as a convenient tool for adjusting the sensor scaling offset on site, without a tool such as a laptop being required. The calibration process is done by entering the actual sensor value as measured by an external reference source such as a gauge board, EPB or thermometer.

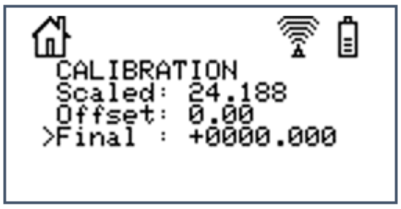
- 'Scaled' is the current, adjusted sensor value reading. This is the value

  $$Scaled = raw \times m_{EU} + c_{EU} + c_{user}$$

  Where:
  - m_{EU} is the multiplier used to convert to engineering units.
  - c_{EU} is the offset used to convert to engineering units.
  - c_{user} is the offset calculated during this calibration.

All of these parameters can be edited in iLink. Additionally the Sensor Calibration Screen alows to modify the user offset.

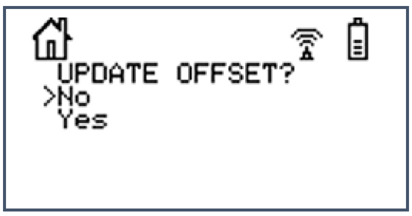
- 'Offset' shows the user offset. When entering the screen it will show the current user offset. After entering a calibration value it will show the updated user offset.
- 'Final' allows the user to set the target value and hence the user offset by performing the following steps:
  - Press enter in order to edit the value
  - Choose a digit with the left- and right key
  - Set the digit with the up- and down key
  - Confirm the target value by pressing the enter key. This will update the 'Offset' value
  - In order to store the 'Offset' press the left key which will lead to the 'Sensor Callibration Acceptance Screen' (see this section for details).



Up	Increment digit by one.*
Down	Decrement digit by one.*
Right	Move right to next digit.*
Left	Move left to next digit.*
Enter	Press to enter or exit edit mode.

4.3.7.8 Sensor Calibration Acceptance Screen (Level 6)

The Sensor Calibration Acceptance screen is used to accept or decline the sensor calibration. If No is selected, the calibration offset is discarded. If Yes is accepted, the interim offset entered in the calibration screen previously is stored in the sensor's offset location and overwrites the previous value.



Up	Move select up the menu items
Down	Move select up the menu items
Right	Not used
Left	Not used
Enter	Accept select option

4.3.7.9 Sensor Data Screen (Level 6)

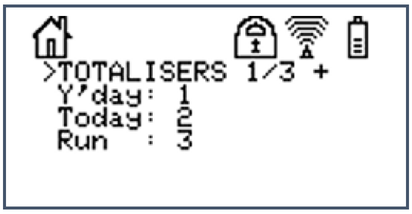
The Sensor Data screen is used to view the logged sample data for a sensor. The data pointer value for the top sample is displayed on the top right-hand side.

Up	Move up through sample values.
Down	Move down through sample values.
Right	Not used
Left	Move to Sensor Menu
Enter	Not used

4.3.8 Totaliser Related Screens

The Totaliser screens show yesterday's total (from 00:00:00 to 23:59:59 yesterday), the daily (since 00:00:00 today) and running (since last totaliser reset) totals for the four pulse input counters.

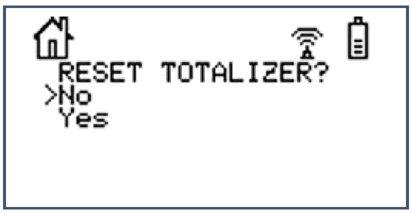
4.3.8.1 Total Screen x/3 (Level 3)



Up	Move up through sensor total screens
Down	Move down through sensor total screens
Right	Access reset menu for given input, if logged in.
Left	Move to Main Menu
Enter	Not used

4.3.8.2 Reset Total Screen (Level 4)

The Total Reset screen is used to reset the two daily and the running totals for the selected totaliser.



Up	Move up through sensor total screens
Down	Move down through sensor total screens
Right	Access reset menu for given input, if logged in.
Left	Move to Main Menu
Enter	Not used

4.3.9 Comms Related Screens

This chapter contains the following subsections:

- Comms Setting Screen 8/8- SMS Settings (Level 5) 104
- Comms Test Screen (Level 5) 104

4.3.9.1 Comms Module 1 Status Screen (Level 3)

The Comms Status screen displays the current state of the wireless IP connection. The RSSI display shows the Received Signal Strength Indication (RSSI) in dBm.

Up	Access Comms Module 2 Status Screen.
Down	Access Comms Module 2 Status Screen.
Right	Access Comms Menu if user is logged in.
Left	Move to Main Menu.
Enter	Not used.

4.3.9.2 Comms Module 2 Status Screen (Level 3)

The Comms Status screen displays the current state of the wireless IP connection. The RSSI display shows the Received Signal Strength Indication (RSSI) in dBm.

Up	Access Comms Module 1 Status Screen.
Down	Access Comms Module 1 Status Screen.
Right	Access Comms Menu if user is logged in.
Left	Move to Main Menu.
Enter	Not used.

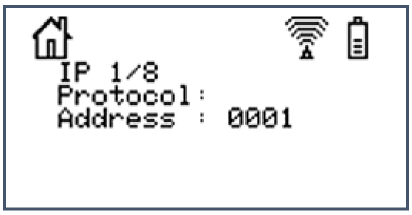
4.3.9.3 Comms Menu Screen (Level 4)

The communications menu screen is used to select communication options.

Up	Move up through the menu items.
Down	Move down through the menu items.
Right	Select the menu item pointed to by > pointer.
Left	Move to Comms Status Screen.
Enter	Not used.

4.3.9.4 Comms Setting Screen 1/8 - Protocol (Level 5)

The Protocol screen displays the current IP protocol and the iRIS's communication address.



Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

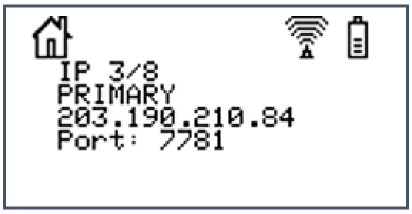
4.3.9.5 Comms Setting Screen 2/8 – APN / Local IP (Level 5)

The APN screen displays the name of the access point used to connect to the wireless network. It also displays the local IP address allocated to the SIM card inserted in the unit for static IP address applications or the most recent IP address assigned by the network when in dynamic IP mode.

Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.6 Comms Setting Screen 3/8 - Primary Base (Level 5)

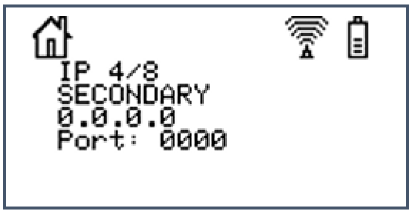
This screen displays the remote IP address and port number to use for communication with the primary base.



Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.7 Comms Setting Screen 4/8 - Secondary Base (Level 5)

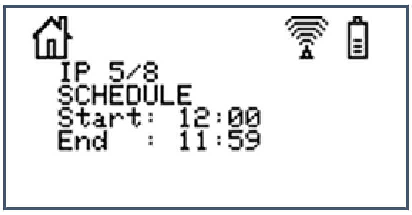
This screen displays the remote IP address and port numbers to use for communication with an optional secondary base. If only a single base is used, these settings should be set to zero.



Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.8 Comms Setting Screen 5/8 - Schedule 1 (Level 5)

This screen displays the time range during which the unit is allowed to make a connection to the wireless network. Refer to the Communications Schedule (section Cellular Modem - Schedule 42) for details on how these settings affect the communication availability.



Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

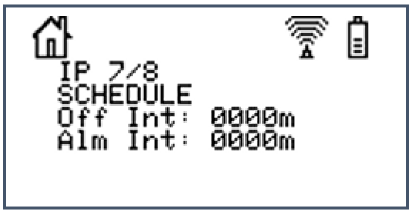
4.3.9.9 Comms Setting Screen 6/8 - Schedule 2 (Level 5)

This screen displays the duration that the unit will stay connected to the wireless network and the interval between connections during the allowable time range.

Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.10 Comms Setting Screen 7/8 - Schedule 3 (Level 5)

This screen displays the interval between connections during the outside the allowable time range and the alarm interval.



Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.11 Comms Setting Screen 8/8– SMS Settings (Level 5)

This screen displays the primary and secondary phone numbers for the iRIS to use when it initiates the sending of a SMS text message (SMS call-back mode).

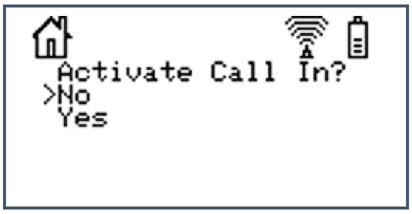
Up	Move up through the Settings Screens.
Down	Move down through the Settings Screens.
Right	Not used.
Left	Move to Comms Menu Screen.
Enter	Not used.

4.3.9.12 Comms Test Screen (Level 5)

The Comms Test screen is used to initiate a user connection to the wireless network based on the call-back mode and then send an announcement message to the base station or destination cellular phone. If the base type is set to "Auto Send" the unit will forward any unreported data to the base station.

This may mean connecting to the wireless network (when mode = IP), or simply sending a text message (when mode=SMS).

The actual call-back message sent and the communication method used depends on the call-back mode and base type settings. See section Comms 38 for further details.



Up	Move up through the menu items.
Down	Move down through the menu items.
Right	Select the menu item pointed to by > pointer.
Left	Move to Comms Status Screen.
Enter	Not used.

4.4 Solar Regulator

This is a 3 stage battery charger with predefined stages and thresholds for 'SLA' batteries.

For more information, see the following subsections:

- Charging Batteries cycles 105
- Charging Process 106
- Charger LED Flash States 107

4.4.1 Charging Batteries cycles

Different chemistry batteries need to be charged in different ways, to obtain an optimum life from the battery. The following section depict charge cycles, only SLA is currently supported.

- Sealed Lead Acid Batteries 106

4.4.1.1 Sealed Lead Acid Batteries

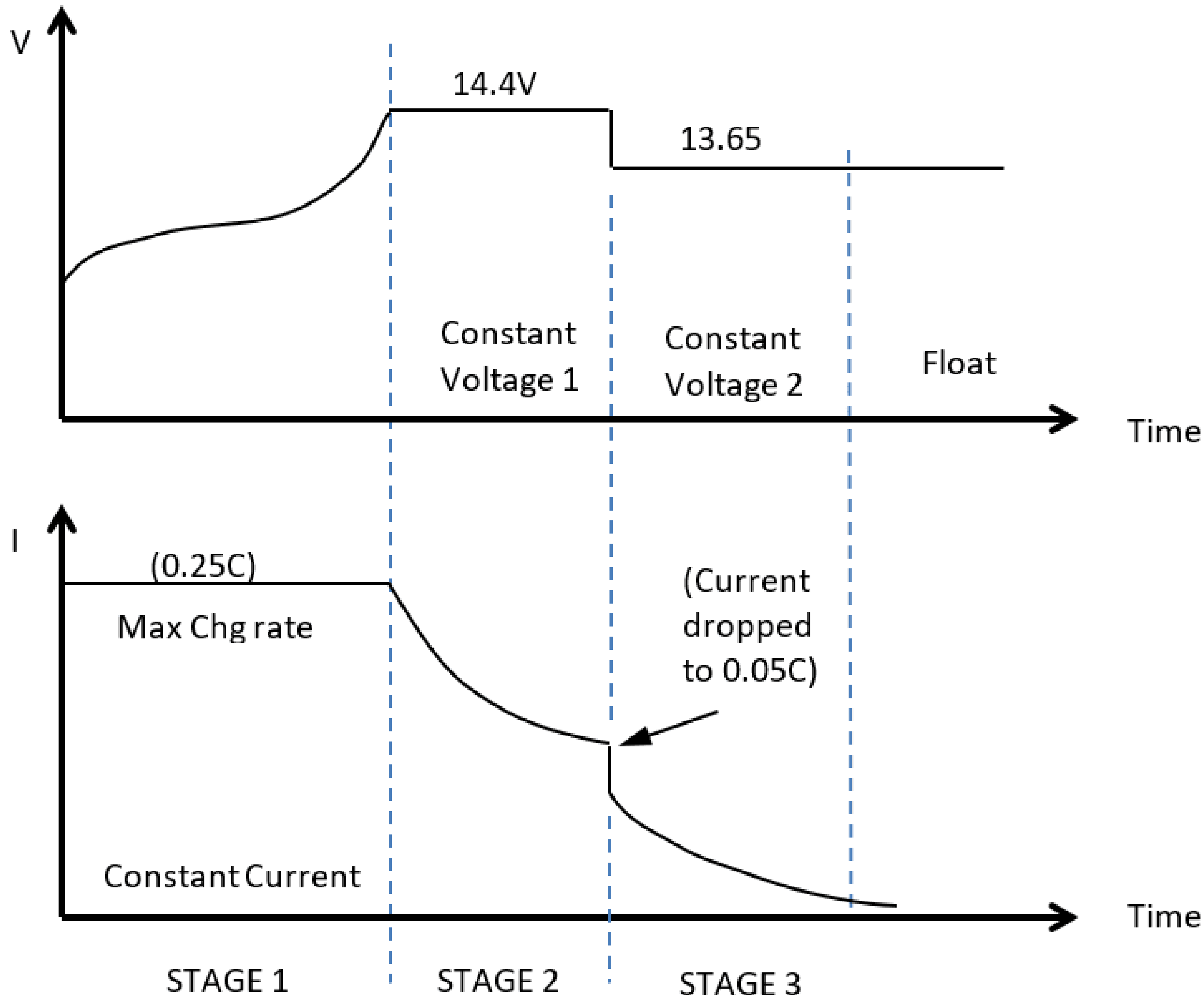


Figure 22 – (Ideal charging of an SLA battery)

SLA Battery Type (Pre-set values):

Stage 1: CC @ 0.45A – stop when V reaches 14.4V (+ 5hr time limit).

Stage 2: CV @ 14.4V – stop when I falls to 0.12A (+ 3hr time limit).

Stage 3: CV @ 13.65V – stop when I falls to 0.0A (that is never) (+ no time limit).

LV Control: Disconnect if Battery V < 10.0V: Reconnect if Battery V > 11.0V.

4.4.2 Charging Process

This chapter contains the following subsections:

- Charging Source 107
- Charge Algorithm Stages 107

4.4.2.1 Charging Source

The solar charger can be supplied from a constant DC source or solar panel, to optimize battery changing and maintain good battery conditioning the charger need to know what type of source is being fed into it. The following describes how the solar charger handles operation varies depending on charger source:

- Mains/DC – 1 hour on charge – then 1 hour off charge (charge algorithm and timing while charging). Starting in stage 1 and moving through to stage 3 – when the 1 hour elapses, it will stop charging at whatever stage it is in, then turn off charging for 1 hour then recommence charging where it left off.
- Solar – Operates to charge algorithm – up to a max of 18 hrs charging – then 1 hour rest (This is done in case solar is selected – but it is connected to the mains). The charging will move from one stage to the next and stay in stage 3 if required – until the solar is removed. When solar reappears, the sequence starts at stage 1 again.

Note: Charging control always starts at stage 1 and move through to stage 3. If stage 3 terminates due to a condition or timeout, then charging will turn off for 1 hour and then recommence at stage 1.

4.4.2.2 Charge Algorithm Stages

The following describes the operation of the different stages of the charge algorithm:

CC: Charge at a constant ‘current’ (trying to keep the Iout current constant) until the ’voltage’ (the Vout voltage) reaches the specified level with a maximum ‘interval’ specified. (0=> No time limit) If there is sufficient solar power for the current to reach the constant current level, the ‘charge mode’ returned is CC – if there is not sufficient power, the regulator enters maximum power point tracking mode and the ‘charge mode’ returned is M-CC. In this mode the Vin voltage and Iin current is monitored and the regulator adjusts itself so that the maximum power is retrieved from the solar. In MPPT mode, the minimum Vin voltage that is controlled down to is 10.5V.

CV: Charge at a constant ‘voltage’ (trying to keep Vout voltage constant) until the ’current’ (the Iout current) falls to the specified level with a maximum ‘interval’ specified. (0=> No time limit) If there is sufficient solar for the voltage to reach the constant voltage level, the ‘charge mode’ returned is CV – if there is not sufficient power, the regulator enters maximum power point tracking mode and the ‘charge mode’ returned is M-CV. In this mode the Vin voltage and Iin current is monitored and the regulator adjusts itself so that the maximum power is retrieved from the solar. In MPPT mode, the minimum Vin voltage that is controlled down to is 10.5V.

Disc: Forced disconnect mode. The solar is purposefully not used to charge the battery. Batteries last longer when cycled – that is, discharged and then charged – so disabling the charge for a time can, believe it or not, be beneficial to the battery.

Sleep: When there is no solar present the regulator enters sleep mode, waking once a second to see if solar is present. If solar has been absent for less than 4 hours (clouds passing overhead), the iRIS returns to the previous charging state – if however solar has been absent for more than 4 hours (overnight), the iRIS returns to a stage #1 charging state.

Note: Throughout this description:

Vin = Solar Voltage, Iin = Solar Current, Vout = Battery Voltage, Iout = Battery Charge Current

4.4.3 Charger LED Flash States

The solar regulator charge status can be determined by viewing the red status LED located at the top of the main board.

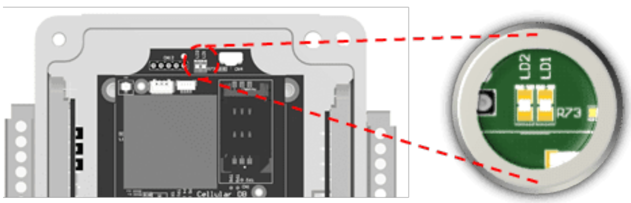


Figure 23 – Location of solar regulator status LED (Red)

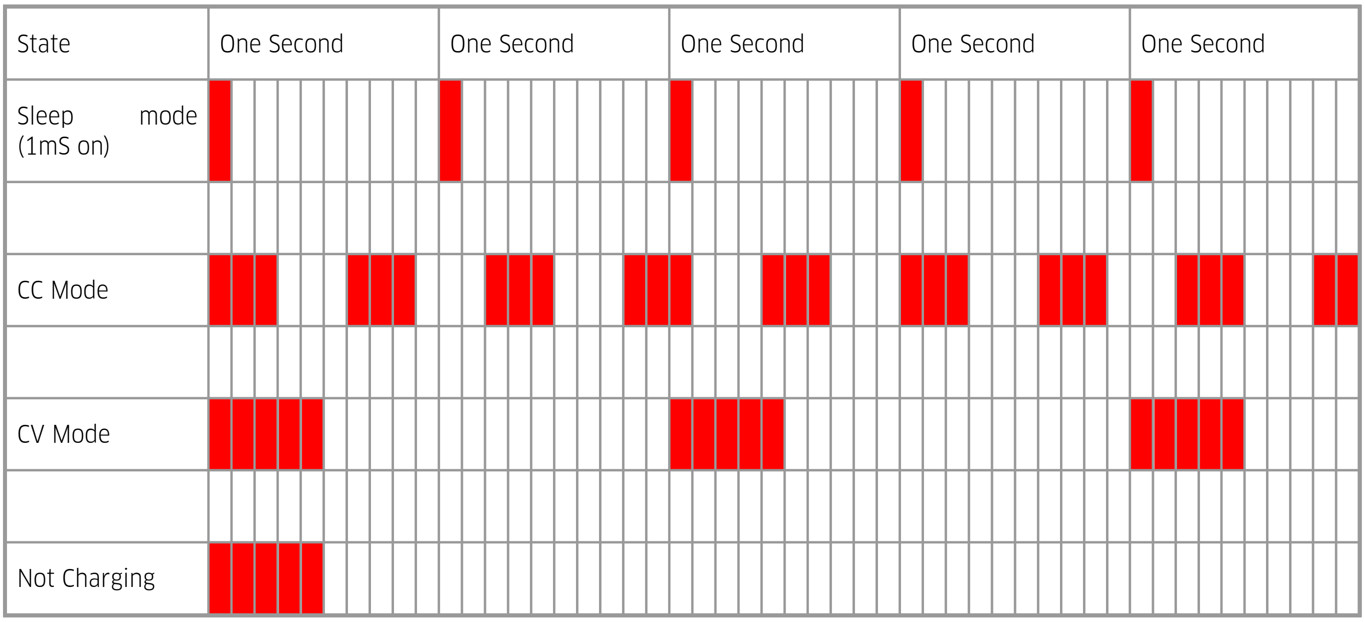


Table 18 – Shows the solar charge status LED sequence (Measured in 100mS slices, except for sleep where on time is 1ms)

4.5 SMS Communication

The iRIS can send a standard text message in response to a request received via SMS (see section below).

The SMS message is constructed from the site name, iRIS's time, plus the sensor name, last logged value, derived values (min, max, etc.) and units of all the sensors that have their SMS enable flag set in the sensor configuration.

My Site Name (AG6-0006),03/09/2020:12:34:56:Water Level=7.69m,Battery=12.73,RSSI=-085dBm

- SMS Text Commands 108

4.5.1 SMS Text Commands

The iRIS can accept incoming SMS messages and if they are valid it will respond appropriately. Any text message received that is invalid will be ignored.

To use the SMS receive function, simply send a text to the iRIS voice number with the appropriate message, as described below.

The iRIS will only act on the command if the received command is from one of the phone number in the approved/authorised SMS list (see section SMS Numbers for configuring these number). If a command is sent from an unauthorized number, the logger will respond with the Message 'Not Authorized!' To disable SMS validation of incoming messages, uncheck the checkbox **IGNORE SMS FROM UNLISTED NUMBERS** (see section SMS Numbers 62).

To ensure that the commands are executed via SMS, make sure that SMS processing is enabled (see section Cellular Modem - Modem 41). In addition, the sender's SMS number must either be included in the SMS list or the option **IGNORE SMS FROM UNLISTED NUMBERS** must be deactivated in the SMS numbers 62 section of the configuration.

None of the messages are case-sensitive. They are shown in upper case for clarity.

The commands supported are:

GOL - Go On-Line

This is useful as a poll-on-demand type function. The iRIS will not reply to this command, but will immediately initiate a transmission through all configured transmission channels.

Command	Description
GOL	Same action as scheduled task using details from schedule and TCP IP/Port or FTP or SMS settings.
GOL <IP>,<Port>, [<APN>,<UID>,<PWD>]	Same action as scheduled task using details from schedule except it creates a TCP connection and overrides the following: ▪ <IP> – TCP/IP address of host e.g. 203.190.210.84. ▪ <Port> - TCP/IP port of host e.g. 7781. ▪ <APN> - Access Point Name, if not omitted then the APN configured in the device will be used. ▪ <UID> - the <APN> must be included to use this parameter. ▪ <PID> - the <APN and <UID> must be included to use this parameter.

For example:

GOL

Or when to make a one-off connection (uses the already configured APN):

GOL 192.168.1.10,7777

RQ - ReQuest current sensor values

This command can be used to retrieve the iRIS details and current sensor readings. The reply message body is in the following format:

```
<SiteName>(<SerialNumber>),<DateTime>:<SensorAName>=<SensorAValue><SensorAUnits>,
<SensorBName>=<SensorBValue><SensorBUnits>, ,…
```

Where the elements are as follows and are derived from the iRIS's configuration:

Element	Description
<SiteName>	Site name of the iRIS.
<DateTime>	Date and time of the message as it is sent using the iRIS local settings.
<SensorAName>	Name of the first sensor that has include in SMS option set.
<SensorAValue>	Current value of the sensor in engineering units.
<SesnorAUnits>	Units for the first sensor.

Example message output:

RQ

My Site(AG6-0006)03/09/2020 9:52:09:Daily Rainfall=010.0mm,Battery=12.05 V,Signal=-077dBm

Only sensors that have been selected will be included in this message (see section General 56 for information one enabling/disabling sensor in the message output). By default, none of the sensors are included so the message will only contain site name, serial number and date/time.

The limit of the size of message that can be set is 160 characters. This means that it is important to consider which sensors are included in the message.

INT – change call-in schedule on INTerval

This command changes the call-in schedule On Interval setting (see section Cellular Modem - Schedule 42 from information on configuring this setting via iLink), allowing the user to increase or decrease the update rate of data sent out via the cellular telemetry module.

The message is in the format:

INT=t

Where **t** is the interval in units of minutes.

Example:

INT=60

Will change the schedule interval to 60 minutes

The iRIS will respond to this command with an SMS message with contents in the format:

```
<SiteName> (<SerialNumber>)<DateTime>: On Interval for module <n> now <t> mins.
```

Where elements are as follows:

Element	Description
<SiteName>	Site name of the iRIS.
<SerialNumber>	Serial number of the iRIS.
<DateTime>	Time of the message as it is sent using the iRIS local settings.
<n>	Module number (either 1 or 2).
<t>	Interval time (minutes) that has been change to.

For example:

INT=10

My Site(AG6-0006)03/09/2020 9:52:09: On interval for module 1 is now 10 mins.

For iRIS loggers fitted with more than one telemetry module, this command will only affect the schedule of the cellular module of which the SIM is fitted.

AINT – change call-in schedule Alarm INTerval

This command changes the call-in schedule Alarm Interval setting (see section Cellular Modem - Schedule 42 from information on configuring this setting via iLink), allowing the user to increase or decrease the update rate of data sent out via the cellular telemetry module while an alarm is active.

The message is in the format:

AINT=t

Where t is the interval in units of minutes.

Example:

AINT=6

Will change the schedule interval to 60 minutes.

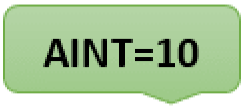
The iRIS will respond to this command with an SMS message with contents in the format:

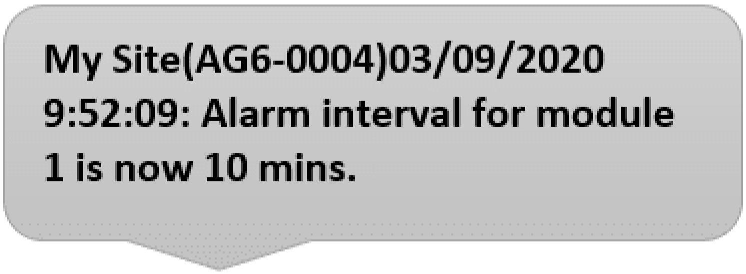
```
<SiteName> (<SerialNumber>)<DateTime>: Alarm Interval for module <n> now <t> mins.
```

Where elements are as follows:

Element	Description
<SiteName>	Site name of the iRIS.
<SerialNumber>	Serial number of the iRIS.
<DateTime>	Time of the message as it is sent using the device local settings.
<n>	Module number (either 1 or 2).
<t>	Interval time (minutes) that has been change to.

For example:





For iRIS loggers fitted with more than one telemetry module, use AINT1 and AINT2 instead of AINT in order to change the interval of the according telemetry module. When still using AINT while two telemetry modules are fitted the value will be set for the first value.For iRIS loggers fitted with more than one telemetry module, this command will only affect the schedule of the cellular module of which the SIM is fitted.

OUT – Change the state of the digital OUTputs

This command allows the user to control the digital outputs of the device. For this feature to be effective the digital output must be configured to Remote mode (see section Digital I/O 37, Digital Output Modes). Also, the iRIS will only act on the command if the received command is from one of the phone number in the approved/authorised SMS list (see section SMS Numbers 62 for configuring these number).

The possible commands are:

Command	Description
OUTx y	Change digital output x to state y. x = 1 – Digital IO (DIO) terminal. x = 2 – Digital Out (DO) terminal. y = On y = OFF.

The response is in the format (if the senders SMS number is authorised)

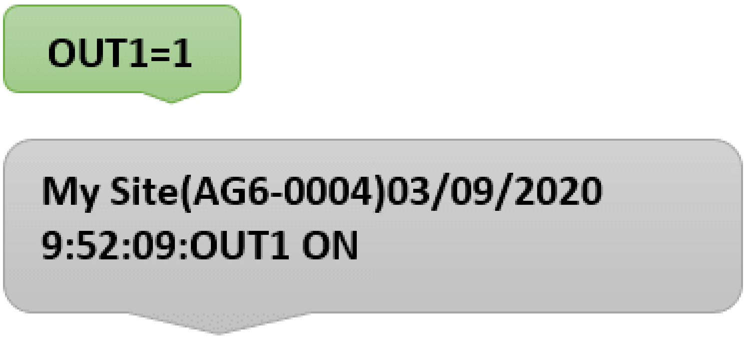
`<SiteName> (<SerialNumber>)<DateTime>:<MessageN> <State>`

Where elements are as follows:

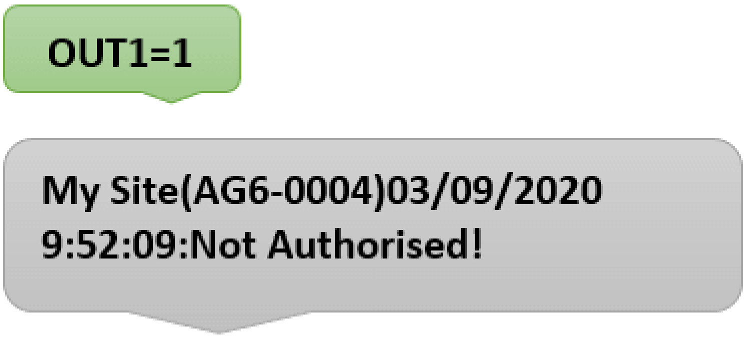
Element	Description	
<SiteName>	Site name of the iRIS.	
<SerialNumber>	Serial number of the iRIS.	
<DateTime>	Time of the message as it is sent using the iRIS local settings.	
<MessageN>	Default Message	User Message Index
	OUT1	1
	OUT2	2

Element	Description
<State>	State which the digital output was changed to and is text ON or OFF.

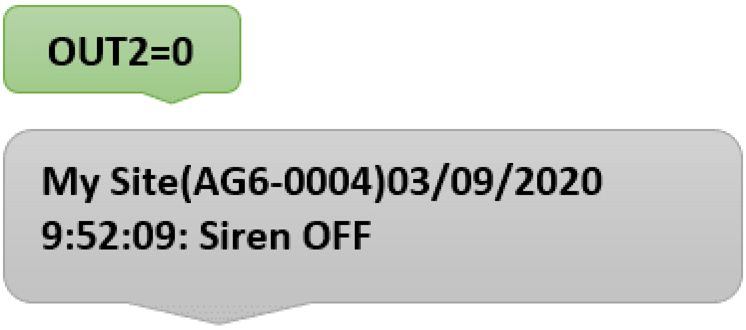
For example (in response to OUT1=1 from an authorised number and no custom messages):

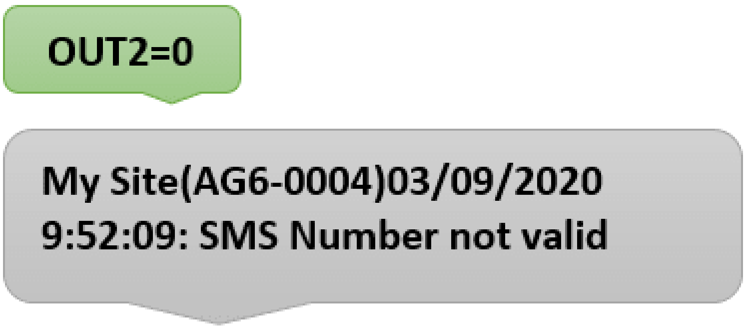


Or in response to OUT1=1 from an unauthorised number and no custom messages:



Or in response to OUT2=0 from an authorised number and with a custom messages index 1 = “Pump power” and index 2 = “Siren”





WiFi – Change the state of the Wi-Fi access point in the iRIS

This command can be used to turn on or off the Wi-Fi access point via SMS message, the same action as pressing and holding the centre button (see section Connecting to the iRIS 270 with iLink Desktop software via Wi-Fi (Windows 10) 30). This can be of use if the keypad of the iRIS is not easily accessible. The iRIS will not respond to this message.

To turn on the Wi-Fi send the message:

WiFi on

To turn off the Wi-Fi send the message:

WiFi off

4.6 File Transfer Protocol (FTP) Operation

The iRIS acts as an FTP client, when requested to connect to a given FTP server it will upload a file containing data since the last upload. The iRIS can communicate with up to two servers at the same time, each has an associated independent start of data pointer, which means only new data is uploaded not all data since beginning of memory. The data format and file name convention are described in the following sections.

4.6.1 File Name Convention

The file name is made up of a five elements and inclusion/exclusion of the elements is user configurable via a set of check boxes (see 0). The possible elements are as follows:

- **Base File Name** – this is a constant alphanumeric of up to 16 characters. Avoid using reserved characters such as \ /:*?"<>?| .
- **Serial Number** – the serial number of the iRIS in the format AG5-XXXX where XXXX is a number between 0000 and 9999.
- **Site Name** – the site name as configured in section System 34.
- **Date Time** – the date and time of the transaction. The order of the day month and year is defined by the Date format in the system configuration (see section System 34) and the application of the UTC offset (configured in section System 34) is defined by the **Sample Time Stamps in UTC** option in section Cellular Modem - TCP 45.
- **File Type** – this defines the extension either .CSV or .ZRXP.

The order of the elements is fixed and are separated by underscores (except the extension which is separated by a period), as follows:

```
<BaseFileName>_<SerialNumber>_<SiteName>_<DateTime>.Extention
```

The following are some examples of possible file name.

```
MyFile_AG5-0002_InnovationPark_240918204526.csv

AG5-0002_240918204526.csv

240918204526.zrxp

MyFile.csv

AG5-0002.csv
```

4.6.2 CSV File Formats

This file contents format is Comma Separated Values format (CSV). An optional header, which describes the columns can be placed on the first line/row of the file. The insertion is controlled by the Include Header option, see section Cellular Modem - Schedule 42. The header is as follows:

Sensor ID,Sample Date,Sample Time,Sample Value<CR><LF>

The remainder of the file contains one or more lines, each with four elements:

- **Sensor ID** – this is the Virtual Sensor number (1-20) as configured in section Modbus Devices 54.
- **Sample Date** – this is the date of when the sample is recorded, the format is configured in section System 34.
- **Sample Time** – this is the time of when the sample is recoded. The application of UTC offset (configured in section System 34) to this value is defined by the Sample Time Stamps in UTC option which can be configured in 0.

- **Sample Value** – the value measured by the iRIS at the sample date and time for the given sensor ID. The value has a fixed-point format and this can be configured on a per sensor basis and is configured by the Format setting (see section General 56).

An example of the file data is (without header):

```
1,23/09/2018,21:10:00,1.290000<CR><LF>
1,23/09/2018,21:10:00,1.310000<CR><LF>
1,23/09/2018,21:15:00,1.300000<CR><LF>
2,23/09/2018,21:10:00,25.125000<CR><LF>
2,23/09/2018,21:10:00,25.250000<CR><LF>
2,23/09/2018,21:15:00,25.125000<CR><LF>
3,23/09/2018,21:10:00,12.330000<CR><LF>
3,23/09/2018,21:10:00,12.350000<CR><LF>
3,23/09/2018,21:15:00,12.337626<CR><LF>
```

Note all lines are terminated with a carriage return and linefeed.

4.6.3 ZRXP File Formats

The data format ZRXP is a line-oriented text file format having ISO-8859-1 encoding which corresponds to ISO-LATIN-1. It allows to export various information about time series values (time stamp, the value itself; the unit of measurement, etc.). The related column definition is contained in the block header.

A file in ZRXP format consists of one or several segments (blocks) with each segment being divided into a data header and a time series value block.

Each segment always begins with a basic data header. At block with time series value(s) will follow the data header. After each block the file can end or a further segment can follow. Empty lines and comments are ignored; they can stand in any place in the file.

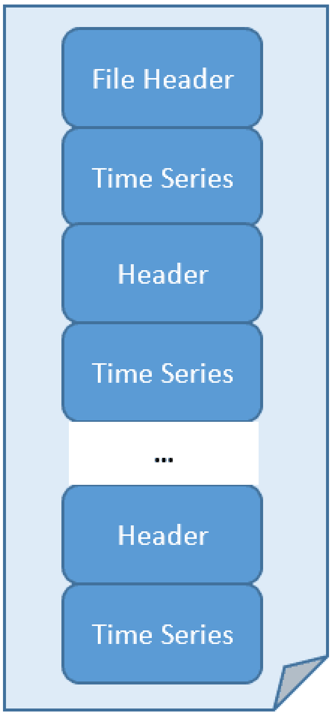


Figure 24 – ZRXP file block structure

Note:

- Comments begin with the character sequence “##” at the start of line.
- Each line begins with a number sign (#).
- The fields are separated by a separator (|*|)

The following is an example file contain data for two sensors, no samples for Rainfall (as it is event-based logging mode) and 3 samples for the water level:

<table>
<tr><td>#ZRXPVERSION3014|*|ZRXPCREATORiRIS270|*|
#CDASANAMEInnovation Park|*|
#CDASAAG6-0006|*|
#TZUTC12:00|*|
#CNR01|*|
#CUNITmm|*|
#CNAMERainfall|*|
#REXCHANGEAG6-0006_01|*|
#RINVAL-777|*|
#LAYOUT(timestamp,value,primary_status)|*|</td><td>Data header</td><td>Segment 1</td></tr>
<tr><td>#ZRXPVERSION3014|*|ZRXPCREATORiRIS270|*|
#CDASANAMEInnovation Park|*|
#CDASAAG6-0006|*|
#TZUTC12:00|*|
#CNR02|*|
#CUNITmm|*|
#CNAMEWater LvL|*|
#REXCHANGEAG6-0006_02|*|
#RINVAL-777|*|
#LAYOUT(timestamp,value,primary_status)|*|</td><td>Data header</td><td rowspan="2">Segment 2</td></tr>
<tr><td>20220405124500 040.427 0
20220405125000 040.709 0
20220405124000 039.817 0</td><td>Time Series</td></tr>
</table>

A header block is generated for each sensor configured in the iRIS (disabled sensors are omitted from the file). Header block will be generated for each Auxiliary logging method enabled for a given sensor. The keyword for the header block elements is described in the following table.

Keyword	Description	Values
ZRXPVERSION	ZRXP format release.	Format: VVYY.MM ▪ VV is the version without dot ▪ YY are the two last year digits when this version was issued Example: 3014
ZRXPCREATOR	The name of the creation tool of the current ZRXP file; metadata, can be ignored by import agent.	ZRXPCREATORiRIS270
CDASANAME	iRIS's Site name as defined in in section System 34.	Example: CDASANAME**Innovation Park**
CDASA	iRIS' Serial number.	Example CDASA**AG6-0006**
TZUTC	The UTC time zone of the time series to follow.	Format: HH:MM ▪ HH Hours +/- from 0 UTC ▪ MM minutes Example: #TZUTC12:45 is 12hours and 45 minutes ahead to UTC.
CNR	Logging array number, see section Logged Data Array Identification 9.	Format: NN or NNN ▪ NN is a value been 00 and 300
CUNIT	Unit of measurement of the sensor, see section General 56 for information on configuring the units.	Example: #CUNITmm is millimetres

CNAME	Sensor name see section General 56 for information on configuring the sensor name.	Format: NAME_AUX
		▪ NAME is the text sensor name
		▪ AUX is the text string indicating the time series is an auxiliary measurement. Possible options:
		  ▪ Max - maximum
		  ▪ Min - minimum
		  ▪ Std – standard deviation
		  ▪ Total – total count
		Example:
		#CNAME**Water lvl** the sensor name is Water level.
		#CNAME**Water lvl_Max** the sensor name is Water level and the time series will be the Maximum reading for the logging period.

REXCHANGE	Import number of import agent for time series.	Format: AG6-XXXX_NN ▪ XXXX is the Serial Number ▪ NN is the array ID (see CNR above)
RINVAL	Value for missing or invalid data record.	numeric with dot as decimal separator; default: -777.0
LAYOUT	specifies the column layout for the ZRXP data.	See Column layout.

Table 19 – SSI terminal definition

The time series data that follows each header block is in the following order and the description of the fields are in the table below.

```
#LAYOUT(timestamp,value,primary_status)
```

Column alias	Description
timestamp	Primary time stamp column format yyyymmdd[hhmmss].
value	Primary numeric value column floating-point numerical with decimal part, number of decimal places is arbitrary. Decimal separator is a dot [.], scientific notation is allowed. If the value is equal to the value for RINVAL key word, then this data record must be treated as missing.
primary_status	Primary status column decimal Integer values from is always zero 0.

Table 20 – SSI terminal definition

Note:

- Each line is terminated with CRLF (0x0D 0x0A).
- The time series fields are separated by the space character (0x20).

4.6.4 MIS File Formats

The MIS format is an ASCII format easily readable with a standard text editor. Each sensor is represented by its own block of data. A block starts with a header line containing the following components:

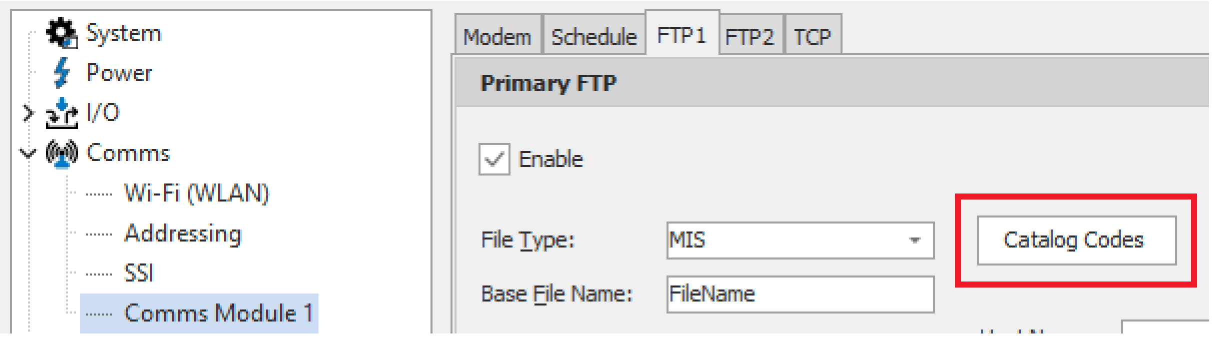
Header Parameter	Description
STATION	The station name
SENSOR	The catalog code
DATEFORMAT	The format of the date field in the data

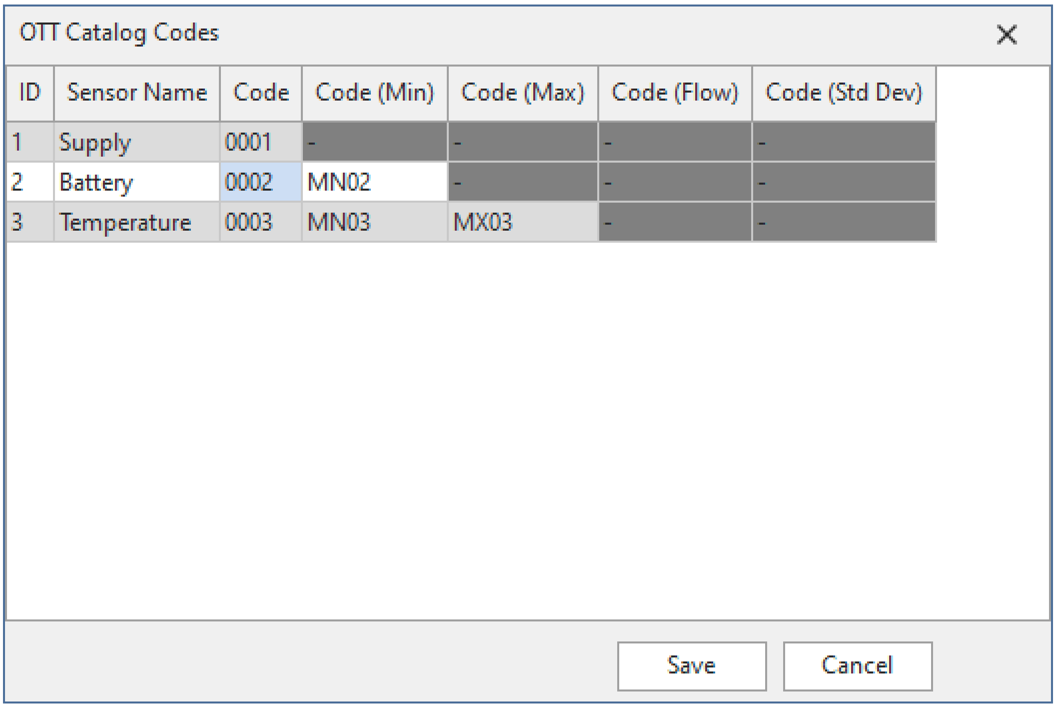
After the header, each value of the sensor is printed in its own line with the format `<date>;<time>;<value>`.

Example of a sensor block:

```
<STATION>My
Site</STATION><SENSOR>0</SENSOR><DATEFORMAT>YYYYMMDD</DATEFORMAT>
20220812;075100;26.812
20220812;075200;26.750
20220812;075300;26.750
20220812;075400;26.750
```

The catalog codes can be customized. To customize them, navigate to **COMMS** > **COMMS MODULE N** > **FTP1** in the configuration branch and click the [**CATALOG CODES**] button.





4.7 Logging Auxiliary sensor information

In addition of the main parameter being measured and recorded auxiliary information can be recorded without using an extra virtual sensor. These apply to period average sampling methods and the names of the different type of information are as follows:

- Minimum
- Maximum
- Standard Deviation
- Calculated flow rate or total
- Check count

Any combination of the above can be enabled on a per sensor basis (see section Logging 59).

- Minimum 119
- Maximum 120
- Standard Deviation 121
- Calculated Flow Rate or Total 121
- Check Count 122

4.7.1 Minimum

The minimum is measured for each logging period for the given sensor. For example, if water level is being logged every 15 minutes then minimum will be recorded once between each of the following inter 00:00:01 to 00:15:00, 00:15:01 to 00:30:00, 00:30:01 to 00:30:00 … 23:30:01 to 23:45:00, 23:45:01 to 00:00:00.

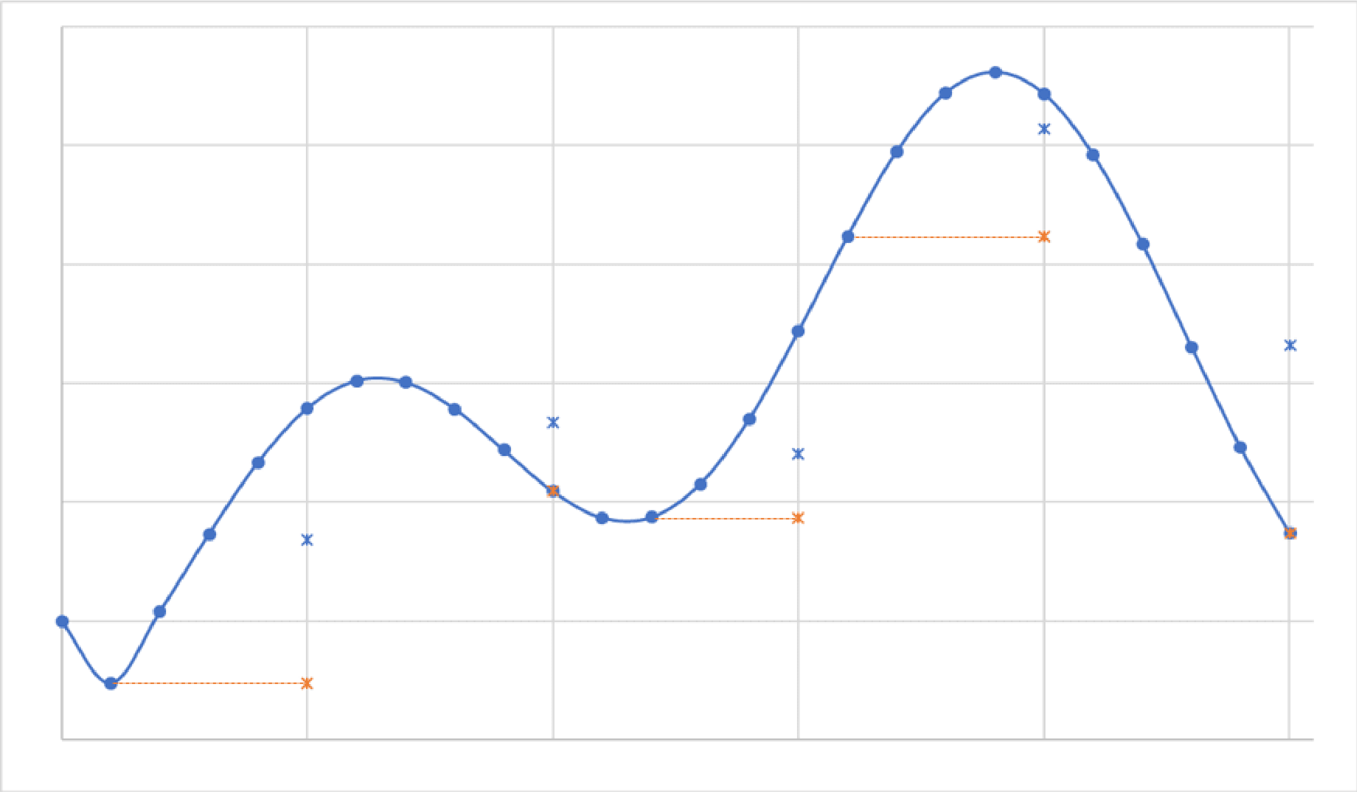


Figure 25 – Graphical example of when average value is measured (blue x) and minimum is measured (orange x)

4.7.2 Maximum

The Maximum is measured for each logging period for the given sensor. For example, if water level is being logged every 15 minutes then Maximum will be recorded once between each of the following inter 00:00:01 to 00:15:00, 00:15:01 to 00:30:00, 00:30:01 to 00:30:00 … 23:30:01 to 23:45:00, 23:45:01 to 00:00:00.

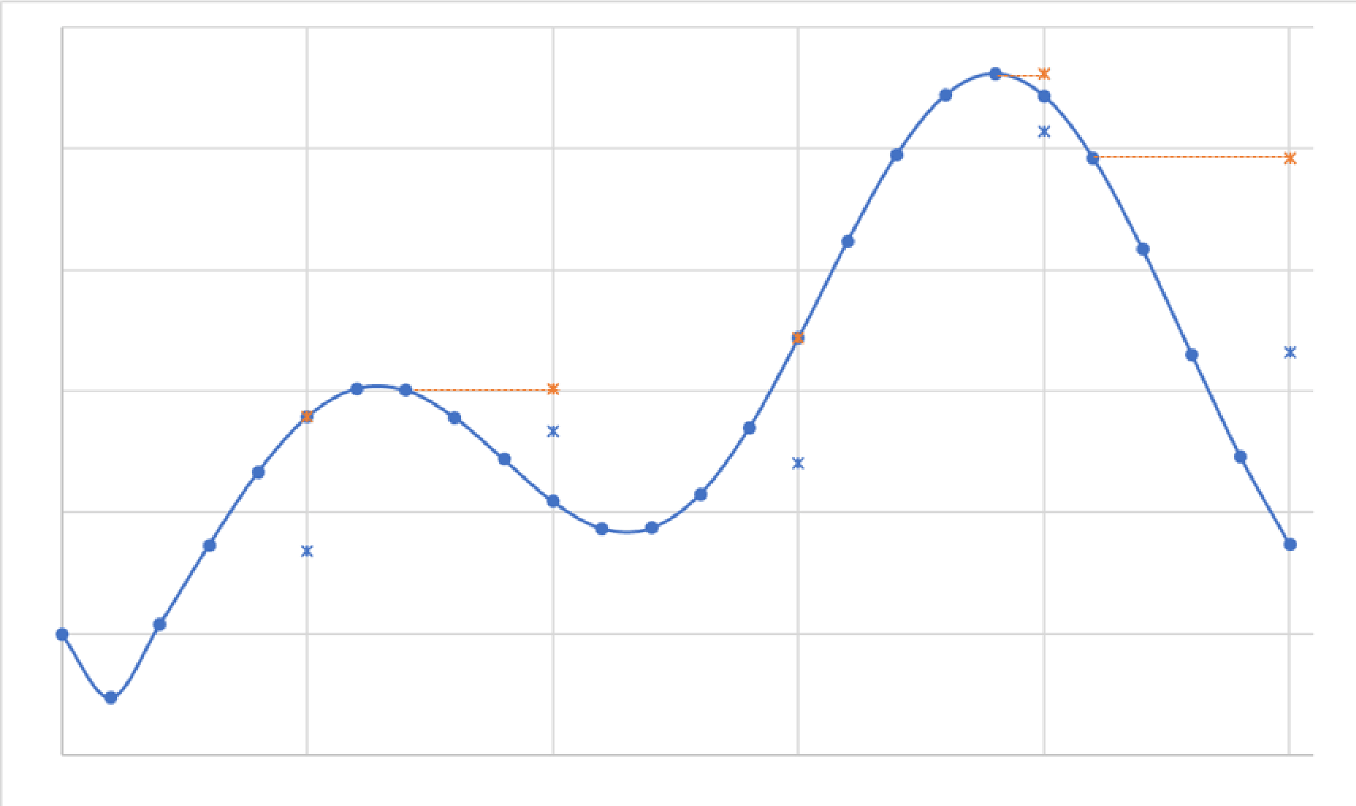


Figure 26 – Graphical example of when average value is measured (blue x) and maximum is measured (orange x)

4.7.3 Standard Deviation

The Standard Deviation auxiliary measurement is measure of the amount of variation of the samples taken over the logging period (e.g. 15 minutes). It is calculated and logged at the end of the period. A low value means the samples taken during period are close to the average value.

Standard deviation is found by taking the square root of the average of the squared deviations of the values. Since we average is not known until the end (samples for the period are not retained to the end of the period), we subtract square (average) from the Sum-of-Squares/N and square root that as Standard Deviation.

As each sample is measured the following two equations are used to keep a running sum of the squares and the count of the number of samples during the period:

$$RunningSquaredSum = RunningSquaredSum + Sample^2$$

$$AverageCount = AvergeCount + 1$$

At the end of the period the following is used to calculate the standard deviation:

$$StandardDeviation = \sqrt{\frac{RunningSquaredSum}{AverageCount} - Average^2}$$

4.7.4 Calculated Flow Rate or Total

This option is used to calculate the average flow rate for a given period from the total volume that flow for the period or vice versa.

When the iRIS is configured with a source of Pulse in then the main value being recorded is assumed to be a flow total accumulated over the period (e.g. 15 minutes) and is in units of cubic meters (m3). At the end of the period the following equation is used to calculated the average flow rate, recorded as the auxiliary value.

$$FlowRate = \frac{FlowTotal \times 1000}{60 \times LogRate}$$

Where LogRate is the period over which the total is being recorded (in units of minutes) and FlowRate is the average flow rate for the period (in units of litres per second l/s).

For example, a flow total of 1.32m^3 over 15 minutes will result in 1.32 x 1000 / 60 x 15 = 1.466 l/s

When the iRIS is configured with a source of Analog in then the main value being recorded is assumed be flow rate in units of litres per second l/s. At the end of the period the following equation is used to calculated the total volume based on the average flow rate during the period , recorded as the auxiliary value.

$$FlowTotal = \frac{FlowRate \times 60 \times LogRate}{1000}$$

Where LogRate is the period over which the total is being recorded (in units of minutes) and FlowTotal is the total volume for the period (in units of cubic meters m^3).

For example, a flow total of 1.46 l/s over 15 minutes will result in 1.466 x 60 x 15 / 60 x 15 = 1.32 m^3

4.7.5 Check Count

This auxiliary method is used to assess any missing event based rainfall measurement. Event based rainfall measurement is where the rainfall tips are recorded with a timestamp of the time they happen. As opposed recoding the total over a fixed period. It is easy to determine if a recorded sample is missing in the period total case just looking for gaps in the dataset. But it impossible to use this method for event based data.

To resolve this the Check Count is used. This is a total that accumulates over time (continuously, not just over period). To use this to evaluate missing data simply total the event values and compare it to the check count, the should be the same. The following is an example of 5 event based samples with Check Count logging enabled, the last check count value does not match the totaled event based. The difference is 0.5 and with a little more analysis, it can be deduced that the missing sample(s) are between 11:02:30 and 11:04:09.

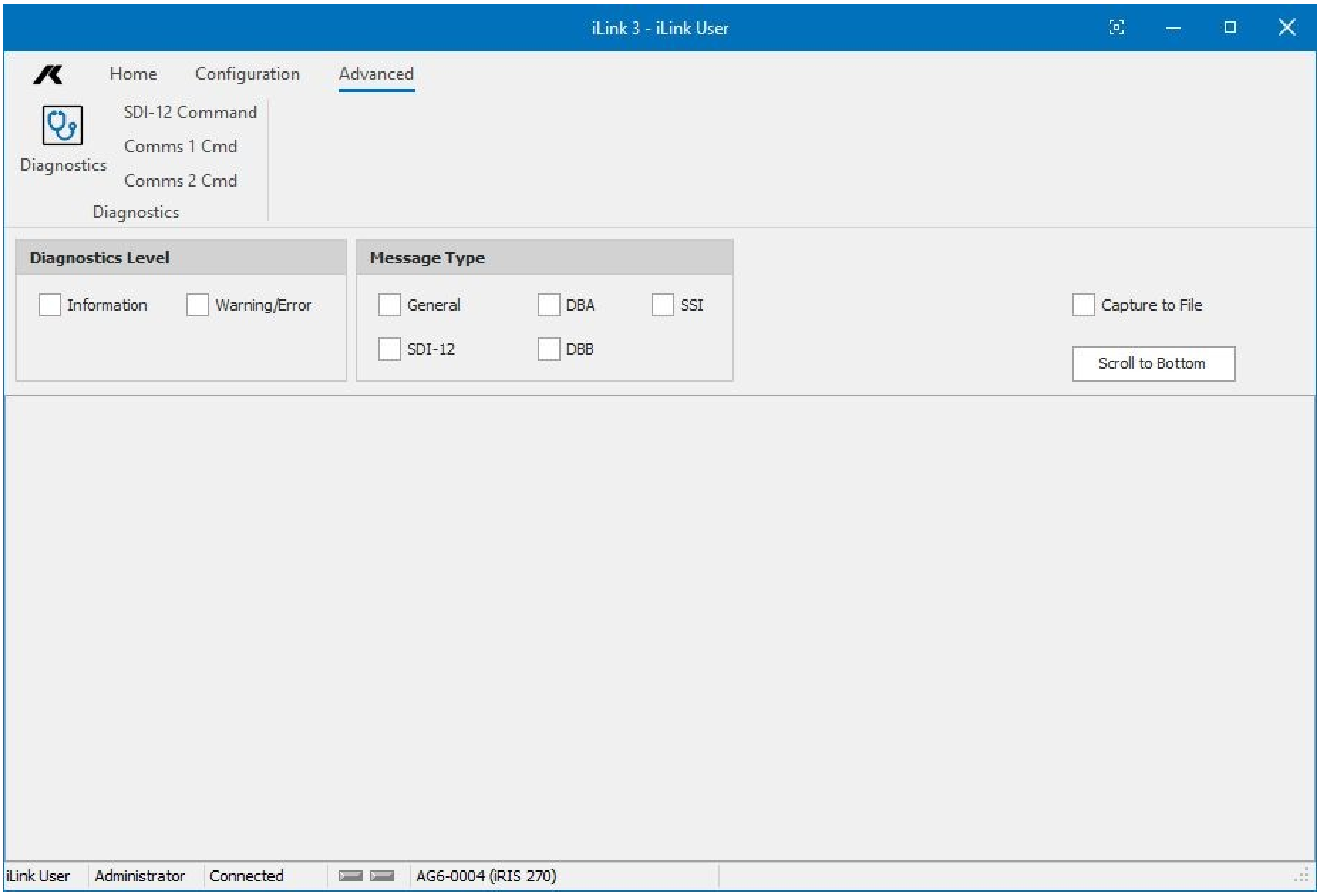
DT	Main Sample	Check Count
11/01/2020 10:56:22	0.5	0.5
11/01/2020 11:01:15	0.5	1.0
11/01/2020 11:01:49	0.5	1.5
11/01/2020 11:02:30	1.0	2.5
11/01/2020 11:04:09	0.5	3.5
	3.0	

4.8 Real-time Diagnostics

The iRIS allows for the user to monitor its operation, the communications daughter boards (if fitted) and the SDI-12 Bus in real time. This can be achieved either over the inbuilt Wi-Fi, cellular or Serial Daughterboard.

This feature can be found in the Advance ribbon of iLink and then clicking on the Diagnostics button.

Initially the diagnostic screen will not show any information, the appropriate sources and level need to be chosen by the user.



There are three levels of diagnostic information:

Information – regular statements about operation of the given source.

Warning\Error – this indicates an unexpected event occurring.

There are four message sources (or Message Types):

General – this relates to general operation of the iRIS, for example digital output schedules.

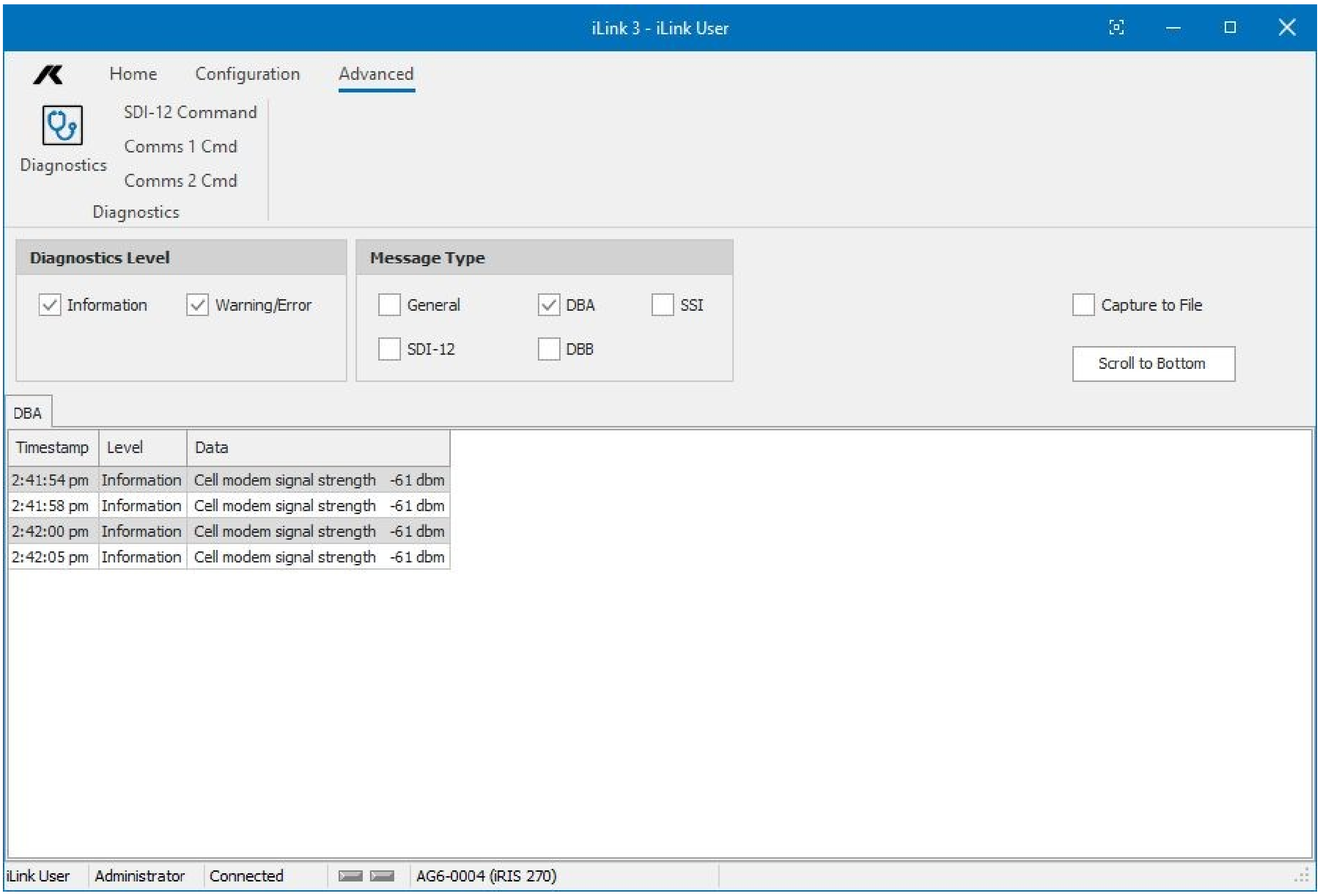
DBA – messages relating to the operation of the first daughter board.

DBB – messages relating to the second daughter board.

SDI-12 – messages relating to the activity on the SDI-12 Bus.

SSI – messages relating to the Sensor Serial Interface.

The following is an example of the power on sequence of the daughter board A and without a SIM card fitted:



The grid can be cleared by right clicking and selecting **Clear Grid**:

Diagnostics information can be saved by checking the **CAPTURE TO FILE** box. Information received after the box is checked will be recorded into a file per message type (e.g. one file for DBA and another for SDI-12):

To capture the information already in the grid, right click the grid and left click **SAVE GRID** menu item:

4.9 Analogue Input Scaling

This section explains the recommended procedure to use when scaling an analogue input (voltage or current). It makes use of the scaling calculator provided in the iLink program. However, the calculation can also be done manually using this formula. V = Input V, EU = Engineering Units (scaled output e.g. metres).

Multiplier = (Maximum EU – Minimum EU) / (Maximum V – Minimum V)

Offset = Maximum EU - (Multiplier * Maximum V)

- Example: A 4-20 mA Water Level Sensor 125

4.9.1 Example: A 4-20 mA Water Level Sensor

In this example, we have a water level instrument connected to the iRIS Analogue Input 1. This instrument is designed to provide a nominal 4-20 mA signal for a 0-10 metre water level range. However, in the real world, most instruments are not exact and a small difference in actual signal may occur.

The internal current sink resistor in the iRIS is 100 Ω (theoretically giving 2 V at 20 mA). An external resistor of a different value can be used if desired. E.g. 250 Ω will give 5 V at 20 mA.

Please see section Analogue Inputs 14 for more information for connecting the internal resistor to the input.

When using the internal resistor, it is important to configure the iRIS' input to 4-20 mA mode, see section Analogue I/O 36 on how to do this. The iRIS is calibrated to account for the manufacturing tolerance of the internal resistor and uses this to convert from volts to milliamps.

1. When an analogue input is select as a sensor source the Scaling Calculator button should be displayed:

2. Click this button and the Scaling Calculator will be displayed, **note** the input range should be automatically selected.
3. Now simply enter the minimum and maximum water levels, in this example 0 and 10 respectively, into the Scaled Output Range Min and Max fields.
4. Click the Calculate button, this will generate the Multiplier and Offset. See Figure below.
5. Click the OK button to accept the calculated values, iLink will automatically copy the calculated multiplier and offset into the given sensors' configuration fields.

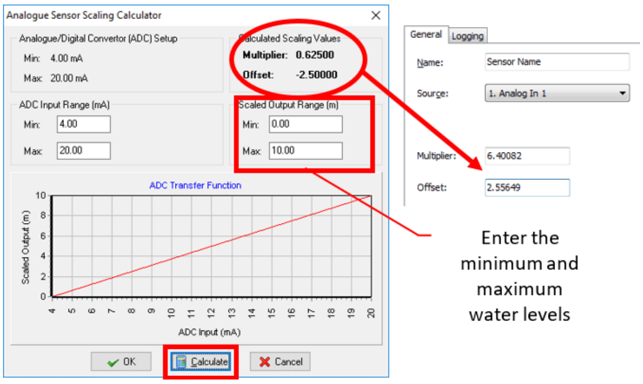


Figure 27 – Shows an example of using the scaling calculator for a 4-20 mA sensor

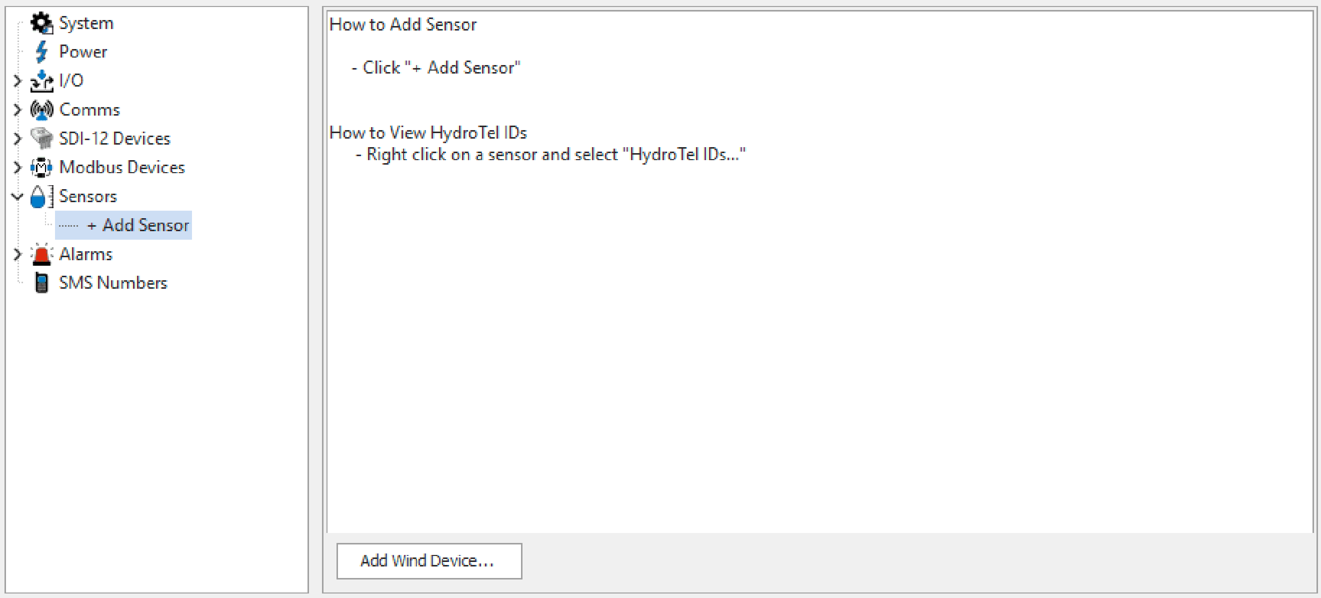
4.10 Wind Vector Averaging Configuration

Vector averaging uses both speed and direction to calculate the average of both speed and direction. This is compared to a separate period average of the wind speed and a scalar average of the wind direction. Please see section Wind Vector Averaging 141 for more information on how this works and the maths used for this.

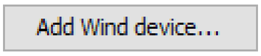
Creating Wind Device from Scratch

In the case where a iRIS is being configured for the first time or a wind sensor is being added, the procedure is as follows:

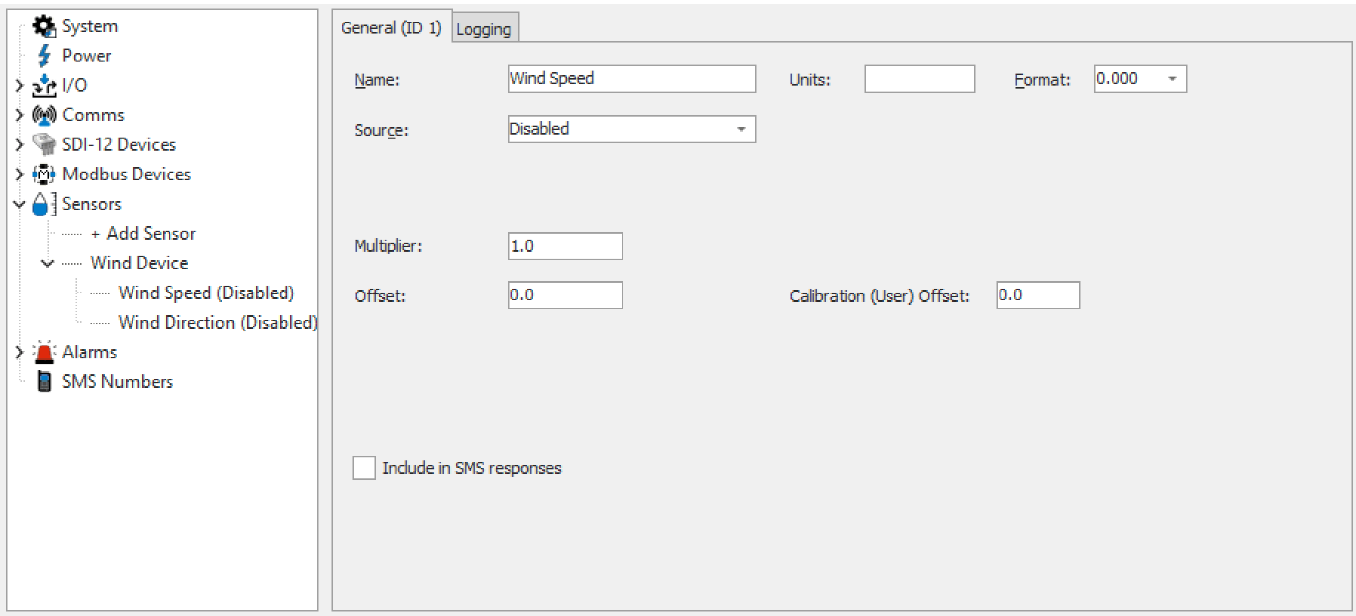
- Navigate to the **SENSORS** branch of the tree, ensure that the **SENSORS** node is selected. This will display:



- Click the [**ADD WIND DEVICE**] button:



This will generate two linked sensors under a **WIND DEVICE** branch.



- Select the **WIND SPEED** sensor in the tree and configure General settings per the usual method:
  - **SOURCE**: frequency, SDI-12 or Modbus
  - **UNITS**: e.g. m/s
  - **MULTIPLIER**
  - **OFFSET**
- Select the **LOGGING** tab and configure settings as usual. Making sure to leave the Process Mode unchanged.
- Select the **WIND DIRECTION** sensor in the tree and configure the general settings with the usual method:
  - **SOURCE**: analogue input, SDI-12 or Modbus
  - **UNITS**: e.g. degrees
  - **MULTIPLIER**
  - **OFFSET**
- Select the **LOGGING** tab and configure settings as per usual. Making sure to leave the Process Mode unchanged.
- Send the configuration to the iRIS by clicking the [**SEND CONFIG**] button.

Note: In the **LOGGING** tab, the **SAMPLE RATE**, **NORMAL LOG RATE** and **ALARM LOG RATE** for the Wind Speed sensor must match those in the Wind Direction sensor.

Creating Wind sensor from Existing Sensors

In the case where a wind speed and wind direction sensor have already been configured and vector averaging needs to be turned on. The following steps need to be performed:

- Expand the sensors branch of the tree and select the Wind Speed sensor.
- Select the **LOGGING** tab.
- Change the **PROCESS MODE** to **VECTOR SPEED AVERAGE**. This will reveal a Related Sensor configuration item.
- In the Related Sensor drop down box, select the Wind Direction sensor.

4.11 Redeploying an iRIS

When an iRIS logger is removed from one site and installed at another site, it is recommended that one of the following two procedures is followed. In both cases the logged data will be (irreversibly) erased from the logger's memory. If this is not done, it is possible that the enterprise telemetry software package (HydroTel or SODA) may extract data from the former site and assign it to the new site. Simply changing the configuration will not erase stored data.

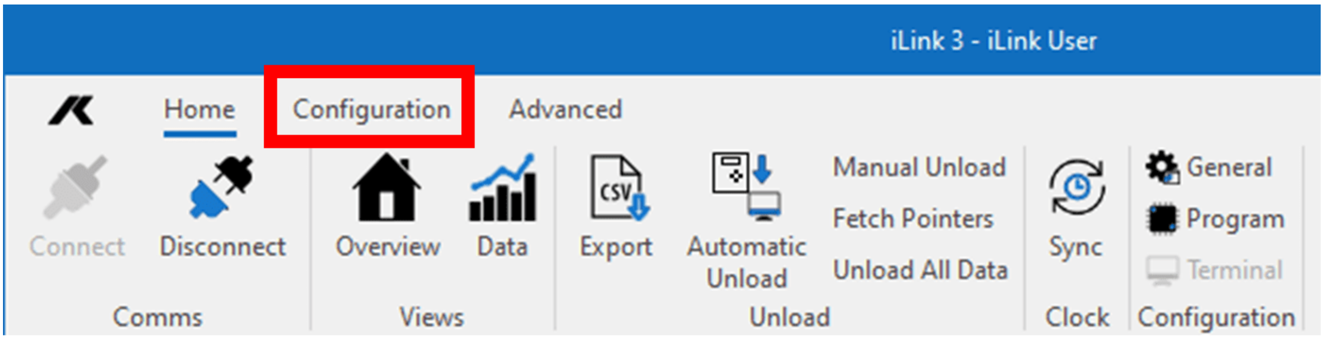
The two procedures are described in the following subsections:

- Resetting logger to factory defaults 127
- Keep configuration and clear data 128

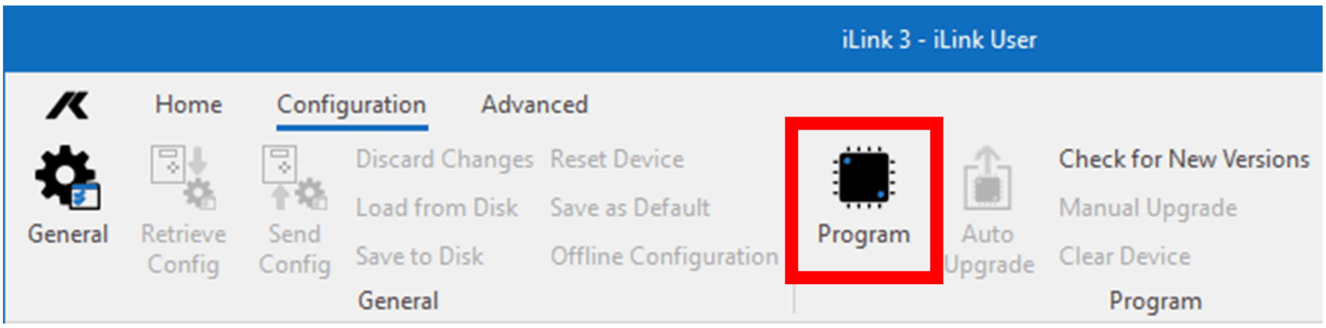
4.11.1 Resetting logger to factory defaults

This procedure should be followed if the iRIS is to be moved to another site using a different configuration.

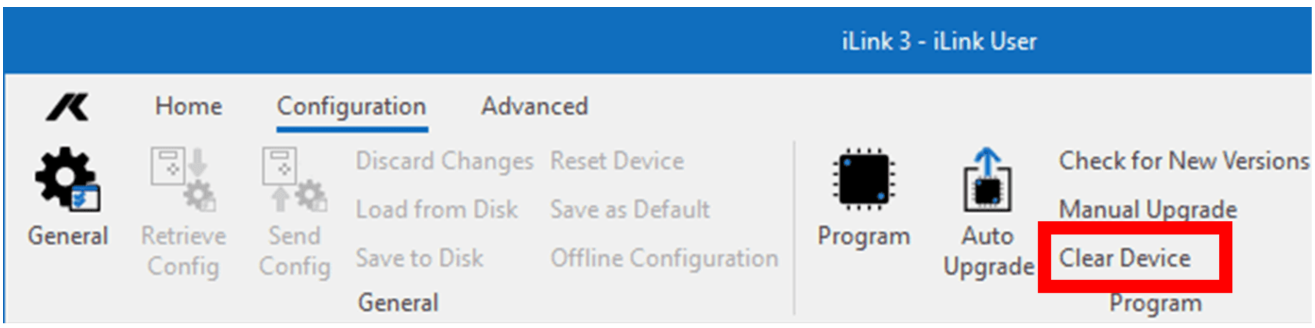
- Click on the **CONFIGURATION** ribbon.



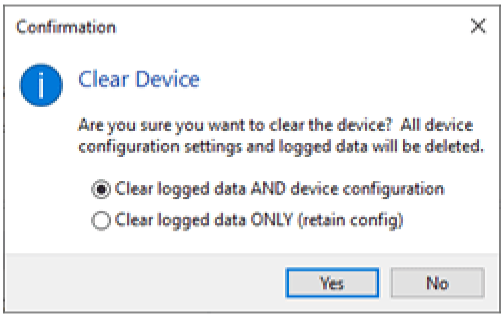
- Click on the **PROGRAM** button.



- Click on the **CLEAR DEVICE** button.



- Select the **CLEAR LOGGED DATA AND DEVICE CONFIGURATION** option.
- Click on the [**YES**] button to perform the clearing operation.



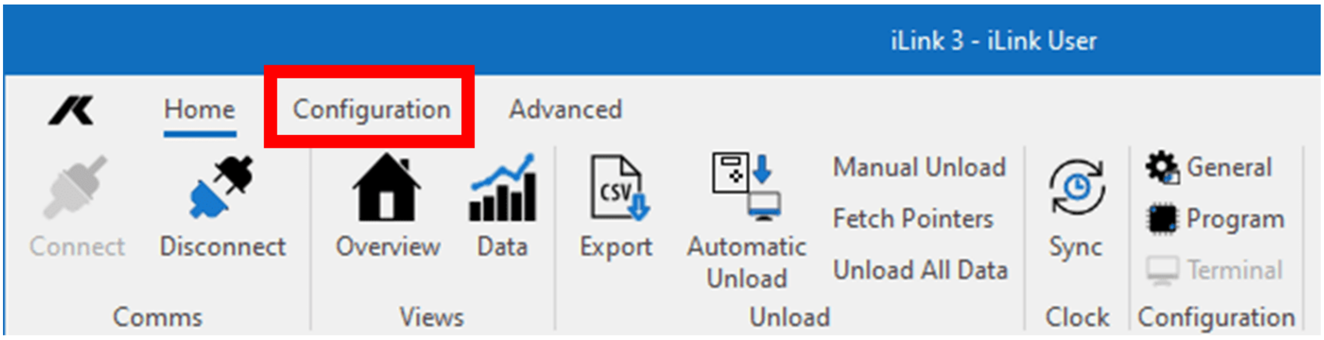
- Once the operation is complete, the iRIS can be reconfigured in the same way as described in the Installation 11 and Configuration 30 sections.

Important! Note that this operation will reset both the address and the Wi-Fi password. If these have been changed from the defaults, connection may be lost after the wipe operation is complete.

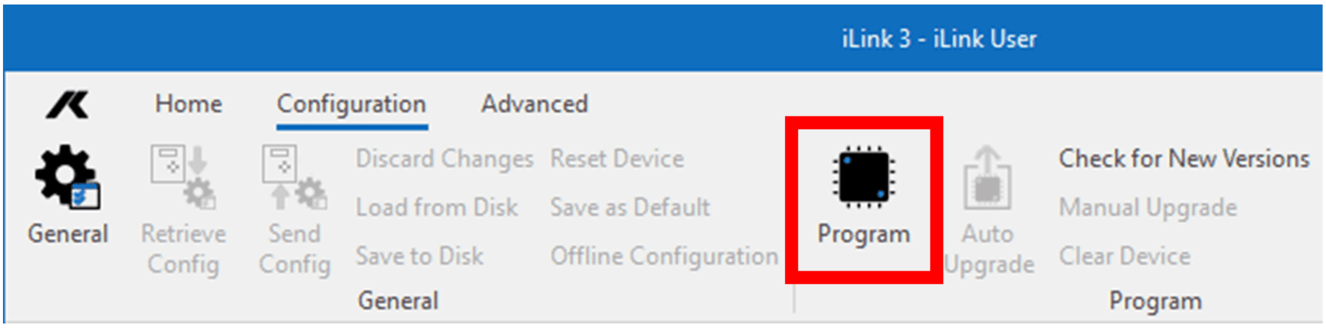
4.11.2 Keep configuration and clear data

This procedure should be followed if the iRIS is to be moved to another site using the same configuration. It may also be useful to clear data collected during commissioning without losing the configuration.

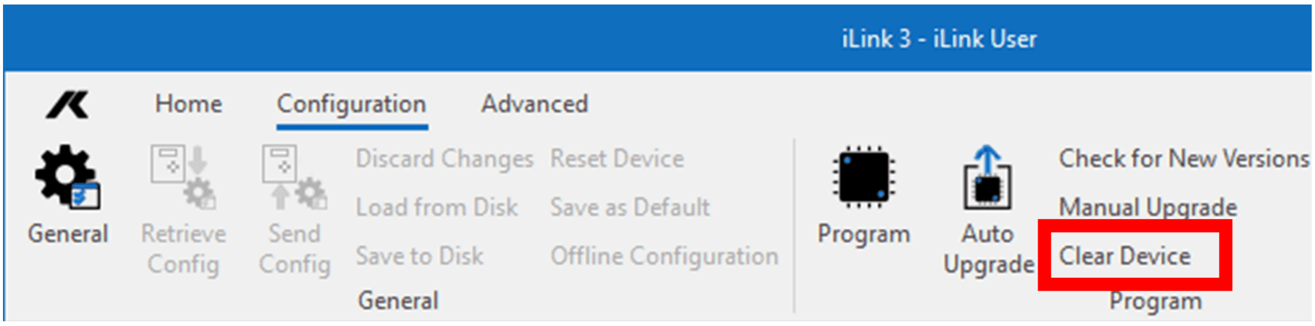
- Click on the **CONFIGURATION** ribbon.



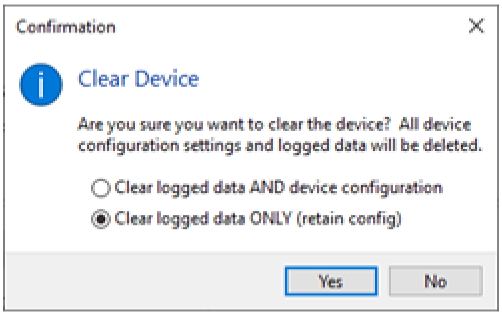
- Click on the **PROGRAM** button.



- Click on the **CLEAR DEVICE** button.



- Select the **CLEAR LOGGED DATA ONLY (RETAIN CONFIG)** option.
- Click on the [**YES**] button to perform the clearing operation.



5 Repair

KISTERS precision instruments and data loggers are produced in quality-controlled processes. All KISTERS production and assembly sites in Australia, New Zealand and Europe are ISO 90001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that KISTERS products perform to their fullest capacity when delivered.

Despite KISTERS most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases KISTERS' return and repair policy applies. For you as a customer, this means the following:

- Contact KISTERS using the Repair Request Form and the Declaration of Contamination made available online:

Region (Language)	Download Link
Asia-Pacific (English)	Repair Request Form (APAC) Declaration of Contamination (APAC)
Europe, the Middle East and Africa (English)	Repair Request Form (EMEA) Declaration of Contamination (EMEA)
Germany (German)	Repair Request Form (DE) Declaration of Contamination (DE)

  In response you will receive a reference number that must be referenced on all further correspondence and on the freight documents accompanying your return shipment.
- Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
- Please do not ship the goods prior to obtaining the reference number. KISTERS will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to KISTERS for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value. Please note that the customs invoice / dispatch documents should also clearly state: "Goods being returned to manufacturer for repair – No Commercial value". It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. KISTERS reserves the right to charge the customer for time spent rectifying incorrect customs documents.

Note: Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

6 Technical Data

Digital Input / Output	▪ 1 digital I/O channel, 1 digital output channel, 2 digital input channels ▪ Inputs: clean contact to 0 V or 3.6 - 12 V DC referenced to GND ▪ Outputs: switched 12 V or open-drain sinking to 0 V, both limited to 100 mA
Analogue Input / Output	▪ 2 analogue inputs: uni-polar, 16 bit resolution, 30 V DC surge-protection ▪ Input ranges: 0 - 0.1 V, 0 - 2.5 V, 0 - 5 V, 0 - 30 V ▪ Internal 100 Ω sink resistors allow use of input current (0 / 4 - 20 mA). ▪ 1 analogue (excitation) output for energizing passive instruments (e.g. potentiometer type wind vanes) or alternatively for sending a derived analogue signal to other equipment, selectable as 0 - 5 V or 4 - 20 mA
Communications	▪ Dual telemetry slots for wireless 4G / 3G modem, Ethernet, RS232 / RS485 ▪ Non-isolated 2-wire half-duplex RS232 / RS485 sensor port ▪ SDI-12 instrumentation port (two terminals), complies with SDI-12 Version 1.3 ▪ Wi-Fi
Power Supply	▪ External 12 V SLA, integral charger 10 - 30 V DC input, optional: solar panel ▪ Lowest power mode current 7 mA ▪ Overvoltage and reverse polarity protected with self-resetting fuse ▪ Voltage of battery and charger input: monitored, logged, displayed, alarmed ▪ Vin cable length max. 3 m
Data Storage: Flash Memory	▪ Total 32 MB, of which 16 MB allocated to logged data / stored images (1,398,101 samples) ▪ Typical autonomy: 2 parameters logged every 15 minutes and battery voltage logged hourly will give almost 10 years of storage
Status LEDs	▪ 1 LED for overall operational state ▪ 3 LEDs for status of communication devices (comms1, comms2, Wi-Fi)
Real-time Clock	High accuracy, backed by on-board lithium battery to prevent loss of date / time
Environmental Conditions	▪ Enclosure: IP66, die-cast aluminium alloy, hard grey paint finish, neoprene gasket ▪ Operating temperature: -40 °C to +70 °C (-40 °F to +158 °F) ▪ Storage temperature: -40 °C to +85 °C (-40 °F to +185 °F)
Size (W × H × D) and Mass	130 × 220 × 75 mm (5.12 in × 8.66 in × 2.95 in); 1.4 kg
Conformity / Compliance	RoHS, FCC, CE (WEEE pending)

7 Obligations of the Operator and Disposal

This chapter contains the following subsections:

7.1 Obligations of the Operator

European Union

In the Single European Market it is the responsibility of the operator to ensure that the following legal regulations are observed and complied with: national implementation of the framework directive (89/391/EEC) and the associated individual directives, in particular 2009/104/EC, on minimum safety and health requirements for the use of work equipment by employees at work.

Worldwide

Regulations: If and where required, operating licences must be obtained by the operator. In addition, national or regional environmental protection requirements must be complied with, regardless of local legal provisions regarding the following topics:

- Occupational safety
- Product disposal

Connections: Local regulations for electrical installation and connections must be observed.

7.2 Dismantling / Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

Before dismantling

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.
  - Loosen mechanical fastenings: Please note that appliances can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

Disposal

Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.

Electrical waste and electronic equipment must not be disposed of as household waste!

Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.

Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

EU WEEE Directive

As players in the environmental market, KISTERS AG is committed to supporting efforts to avoid and recycle waste. Please consider:

- Avoidance before recycling!
- Recycling before disposal!

This symbol  indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU. Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

8 Appendices

This chapter contains the following subsections:

8.1 SDI-12

This chapter contains the following subsections:

8.1.1 What is SDI-12?

SDI-12 stands for **S**erial **D**igital **I**nterface at **12**00 bps. It is a standard to interface battery powered data recorders with microprocessor-based sensors designed for environmental data acquisition (EDA).

EDA is accomplished by means of a sensor, or sensors, and a data recorder, which collects and saves the data. SDI-12 is a standard communications protocol, which provides a means to transfer measurements taken by an intelligent sensor to a data recorder. An intelligent sensor typically takes a measurement, makes computations based on the raw sensor reading, and outputs the measured data in engineering units. For example, an SDI-12 pressure sensor may take a series of pressure measurements, average them, and then output pressure in psi, inches of mercury, bars, millibars, or torrs. The sensor's microprocessor makes the computations, converts sensor readings into the appropriate units, and uses the SDI-12 protocol to transfer data to the recorder.

SDI-12 is a multi-drop interface that can communicate with multi-parameter sensors. Multi-drop means that more than one SDI-12 sensor can be connected to a data recorder. The SDI-12 bus is capable of having ten sensors connected to it. Having more than ten sensors, however, is possible. Some SDI-12 users connect more than ten sensors to a single data recorder.

Multi-parameter means that a single sensor may return more than one measurement. For example, some water quality sensors return temperature, conductivity, dissolved oxygen, pH, turbidity, and depth.

8.1.2 Advantages of SDI-12

A serial-digital interface is a logical choice for interfacing microprocessor-based sensors with a data recorder. This has advantages for sensors and data recorders.

- Unique and complex self-calibration algorithms can be done in microprocessor-based sensors.
- Sensors can be interchanged without reprogramming the data recorder with calibration or other information.
- Power is supplied to sensors through the interface.
- Hybrid circuit and surface mount technologies make it practical to include the power supply regulator, a microprocessor, and other needed circuitry in small sensor packages.
- Sensors can use low cost EEPROMs (electrically erasable programmable read only memory) for calibration coefficients and other information instead of internal trimming operations.
- The use of a standard serial interface eliminates significant complexity in the design of data recorders.
- Data recorders can be designed and produced independently of future sensor development.
- SDI-12 data recorders interface with a variety of sensors.
- SDI-12 sensors interface with a variety of data recorders.
- Personnel trained in SDI-12 will have skills to work with a variety of SDI-12 data recorders and SDI-12 sensors.

8.1.3 SDI-12 Electrical Interface

The SDI-12 electrical interface uses the SDI-12 bus to transmit serial data between SDI-12 data recorders and sensors. The SDI-12 bus is the cable that connects multiple SDI-12 devices. This is a cable with three conductors:

1) A serial data line
2) A ground line
3) A 12-volt line

In the following specifications, all values not indicating specific limits have an allowable tolerance of ±10 % of the value. The SDI-12 bus is capable of having at least 10 sensors connected to it.

- Serial Data Line 135
- Ground Line 135
- Volt-Line 135

8.1.3.1 Serial Data Line

The data line is a bi-directional, three-state data transfer line. Table 19 shows the logic and voltage levels for the transmission of serial data for the SDI-12 standard. The data line uses negative logic.

Condition	Binary state	Voltage range
Marking	1	-0.5 to 1.0 volts
Spacing	0	3.5 to 5.5 volts
Transition	undefined	1.0 to 3.5 volts

Table 21 – Logic and voltage levels for serial data on SDI-12 bus

Voltage Transitions

During normal operation, the data line voltage slew rate must not be greater than 1.5 volts per microsecond.

8.1.3.2 Ground Line

The ground line must be connected to the circuit ground and the earth ground at the data recorder. The sensor circuit ground also must be connected to the ground line, but not normally to its own earth ground. If it is necessary to connect the sensor circuitry to earth ground, a heavy (12 AWG or larger) ground wire should be connected between the sensor earth ground and the data recorder earth ground for lightning protection.

The ground conductor should be large enough to keep the voltage drop between the data recorder and all sensors less than 0.5 volts during the maximum combined sensor current drain.

8.1.3.3 Volt-Line

The data recorder (or the external power supply) provides between 9.6 volts and 16 volts to the 12-volt line, with respect to ground, as measured under a maximum sensor load of 0.5 amperes. SDI-12 does not require the data recorder to be the source of power to the 12-volt line. Sensors connected to the 12-volt line must not have inductive loads. SDI-12 does not require voltage limiting for transient protection in the sensor. Transient protection is however recommended.

Note:

This information is taken from:

SDI-12 Serial-Digital Interface Standard for Microprocessor-Based Sensors,

Version 1.3 – January 28, 2016

Prepared By

SDI-12 Support Group

(Technical Committee)

8.2 FTP Terminology

This chapter contains the following subsection:

8.2.1 Active verses Passive mode

The following explanation is paraphrased from the web page https://slacksite.com/other/ftp.html

Introduction

One of the most commonly seen questions when dealing with firewalls and other Internet connectivity issues is the difference between active and passive FTP and how best to support either or both of them.

FTP is a TCP based service exclusively. There is no UDP component to FTP. FTP is an unusual service in that it utilizes two ports, a 'data' port and a 'command' port (also known as the control port). Traditionally these are port 21 for the command port and port 20 for the data port. The confusion begins however, when we find that depending on the mode, the data port is not always on port 20.

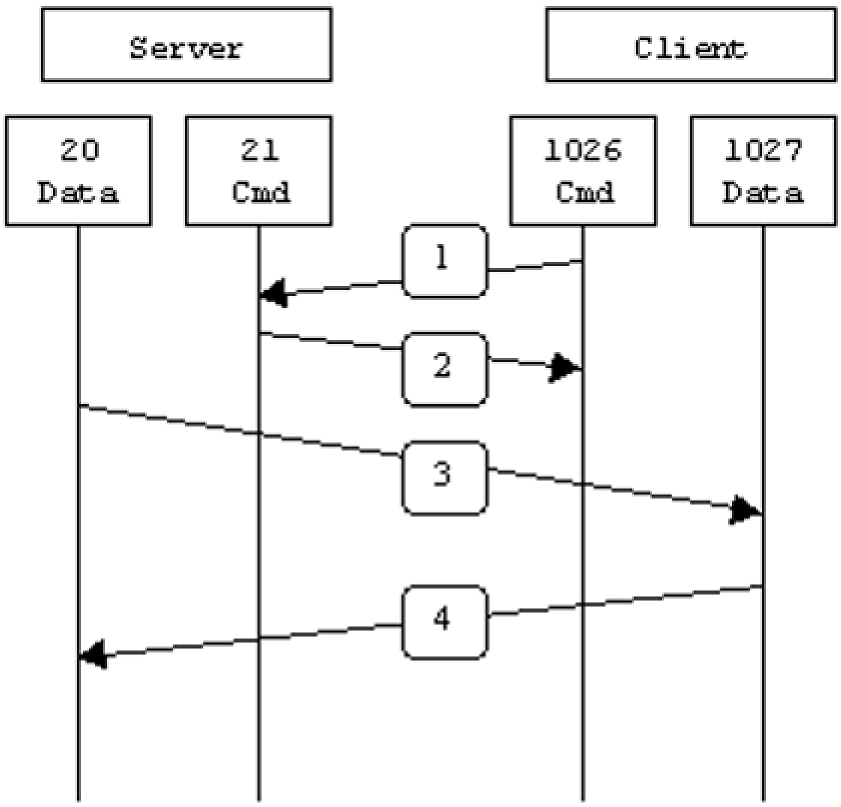
Active FTP

In active mode FTP the client (iRIS) connects from a random unprivileged port (N > 1023) to the FTP server's command port, port 21. Then, the client starts listening to port N+1 and sends the FTP command PORT N+1 to the FTP server. The server will then connect back to the client's specified data port from its local data port, which is port 20.

From the server-side firewall's standpoint, to support active mode FTP the following communication channels need to be opened:

- FTP server's port 21 from anywhere (Client initiates connection)
- FTP server's port 21 to ports > 1023 (Server responds to client's control port)
- FTP server's port 20 to ports > 1023 (Server initiates data connection to client's data port)
- FTP server's port 20 from ports > 1023 (Client sends ACKs to server's data port)

When drawn out, the connection appears as follows:



In step 1, the client's command port contacts the server's command port and sends the command PORT 1027. The server then sends an ACK back to the client's command port in step 2. In step 3 the server initiates a connection on its local data port to the data port the client specified earlier. Finally, the client sends an ACK back as shown in step 4.

The main problem with active mode FTP actually falls on the client side. The FTP client doesn't make the actual connection to the data port of the server--it simply tells the server what port it is listening on and the server connects back to the specified port on the client. From the client side firewall this appears to be an outside system initiating a connection to an internal client--**something that is usually blocked**.

Active FTP Example

Below is an actual example of an active FTP session. The only things that have been changed are the server names, IP addresses, and user names. In this example an FTP session is initiated from testbox1.slacksite.com (192.168.150.80), a Linux box running the standard FTP command line client, to testbox2.slacksite.com (192.168.150.90), a Linux box running ProFTPd 1.2.2RC2. The debugging (-d) flag is used with the FTP client to show what is going on behind the scenes. Everything in red is the debugging output which shows the actual FTP commands being sent to the server and the responses generated from those commands. Normal server output is shown in black, and user input is in **bold**.

There are a few interesting things to consider about this dialog. Notice that when the PORT command is issued, it specifies a port on the client (192.168.150.80) system, rather than the server. We will see the opposite behaviour when we use passive FTP. While we are on the subject, a quick note about the format of the PORT command. As you can see in the example below it is formatted as a series of six numbers separated by commas. The first four octets are the IP address while the last two octets comprise the port that will be used for the data connection. To find the actual port multiply the fifth octet by 256 and then add the sixth octet to the total. Thus, in the example below the port number is ((14*256) + 178), or 3762. A quick check with `netstat` should confirm this information.

```
testbox1: {/home/p-t/slacker/public_html} % ftp -d testbox2
Connected to testbox2.slacksite.com.
220 testbox2.slacksite.com FTP server ready.
Name (testbox2:slacker): slacker
---> USER slacker
331 Password required for slacker.
Password: TmpPass
---> PASS XXXX
230 User slacker logged in.
---> SYST
215 UNIX Type: L8
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> ls
ftp: setsockopt (ignored): Permission denied
---> PORT 192,168,150,80,14,178
200 PORT command successful.
---> LIST
150 Opening ASCII mode data connection for file list.
drwx------   3 slacker    users         104 Jul 27 01:45 public_html
226 Transfer complete.
ftp> quit
---> QUIT
221 Goodbye.
```

Passive FTP

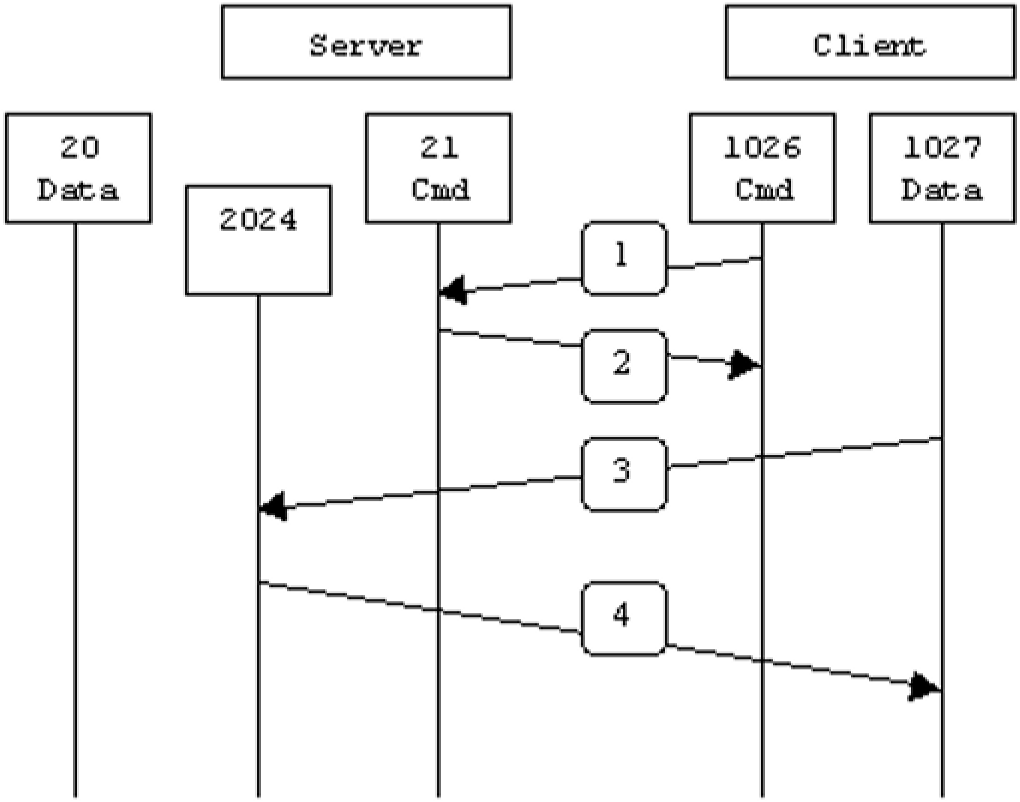
In order to resolve the issue of the server initiating the connection to the client a different method for FTP connections was developed. This was known as passive mode, or PASV, after the command used by the client to tell the server it is in passive mode.

In passive mode FTP the client initiates both connections to the server, solving the problem of firewalls filtering the incoming data port connection to the client from the server. When opening an FTP connection, the client opens two random unprivileged ports locally (N > 1023 and N+1). The first port contacts the server on port 21, but instead of then issuing a PORT command and allowing the server to connect back to its data port, the client will issue the PASV command. The result of this is that the server then opens a random unprivileged port (P > 1023) and sends P back to the client in response to the PASV command. The client then initiates the connection from port N+1 to port P on the server to transfer data.

From the server-side firewall's standpoint, to support passive mode FTP the following communication channels need to be opened:

- FTP server's port 21 from anywhere (Client initiates connection)
- FTP server's port 21 to ports > 1023 (Server responds to client's control port)
- FTP server's ports > 1023 from anywhere (Client initiates data connection to random port specified by server)
- FTP server's ports > 1023 to remote ports > 1023 (Server sends ACKs (and data) to client's data port)

When drawn, a passive mode FTP connection looks like this:



In step 1, the client contacts the server on the command port and issues the PASV command. The server then replies in step 2 with PORT 2024, telling the client which port it is listening to for the data connection. In step 3 the client then initiates the data connection from its data port to the specified server data port. Finally, the server sends back an ACK in step 4 to the client's data port.

While passive mode FTP solves many of the problems from the client side, it opens up a whole range of problems on the server side. The biggest issue is the need to allow any remote connection to high numbered ports on the server. Fortunately, many FTP daemons, including the popular WU-FTPD allow the administrator to specify a range of ports which the FTP server will use.

The second issue involves supporting and troubleshooting clients which do (or do not) support passive mode.

As an example, the command line FTP utility provided with Solaris does not support passive mode, necessitating a third-party FTP client, such as ncftp.

Note: This is no longer the case--use the -p option with the Solaris FTP client to enable passive mode!

With the massive popularity of the World Wide Web, many people prefer to use their web browser as an FTP client. Most browsers only support passive mode when accessing ftp:// URLs. This can either be good or bad depending on what the servers and firewalls are configured to support.

Passive FTP Example

Below is an actual example of a passive FTP session. The only things that have been changed are the server names, IP addresses, and user names. In this example an FTP session is initiated from testbox1.slacksite.com (192.168.150.80), a Linux box running the standard FTP command line client, to testbox2.slacksite.com (192.168.150.90), a Linux box running ProFTPd 1.2.2RC2. The debugging (`-d`) flag is used with the FTP client to show what is going on behind the scenes. Everything in red is the debugging output which shows the actual FTP commands being sent to the server and the responses generated from those commands. Normal server output is shown in black, and user input is in **bold**.

Notice the difference in the PORT command in this example as opposed to the active FTP example. Here, we see a port being opened on the server (192.168.150.90) system, rather than the client. See the discussion about the format of the PORT command above, in the Active FTP Example section.

```
testbox1: {/home/p-t/slacker/public_html} % ftp -d testbox2
Connected to testbox2.slacksite.com.
220 testbox2.slacksite.com FTP server ready.
Name (testbox2:slacker): slacker
---> USER slacker
331 Password required for slacker.
Password: TmpPass
---> PASS XXXX
230 User slacker logged in.
---> SYST
215 UNIX Type: L8
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> passive
Passive mode on.
ftp> ls
ftp: setsockopt (ignored): Permission denied
---> PASV
227 Entering Passive Mode (192,168,150,90,195,149).
---> LIST
150 Opening ASCII mode data connection for file list
drwx------   3 slacker    users         104 Jul 27 01:45 public_html
226 Transfer complete.
ftp> quit
---> QUIT
221 Goodbye.
```

8.3 Declaration of Conformity

We, of

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in accordance with the following Directives:

Article 3.1(b) of Directive 2014/53/EU
Article 6 of Directive 2014/30/EU

Standards met:

EN 301 489-1 V2.2.0 – 2017-03

Electro Magnetic Compatibility (EMC) standard for radio equipment and services

Part 1: Common Technical requirements

Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

AS/NZS CISPR-32:2015

Electromagnetic compatibility of multimedia equipment – Emissions requirements

FCC Code of Federal Regulations 47: Telecommunication

Part 15 – Radio Frequency Devices

Sub Part A – General
Sub Part B – Unintentional Radiators

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced standards and all products supplied under this Declaration will be identical to the sample tested.

Signed:

Name: Phil White
Position: Managing Director
Place: Hamilton
Date: 31/01/2019

8.4 Scalar and Vector Average

This document describes the algorithm used by the iRIS270 and iRIS Under Cover for the process modes of Scalar Average and Vector Average.

The following mathematical symbols and letters are used in the description of the algorithm:

- Inputs:

θ	is the scaled engineering reading of the angle (degrees) and is restricted to a value of 0 to 360 degrees by use of a modulus operation.
r	is the scaled engineering reading of magnitude, the units are not important to the calculation. When Scalar Average process mode is selected, this is set to 1.

- Outputs:

$\bar{\theta}$	is the scalar or vector average (depending on process mode chosen) of the angle (degrees) over the averaging period.
$\bar{r}$	is the scalar or vector average (depending on process mode chosen) of the magnitude (same units as the input) over the averaging period.

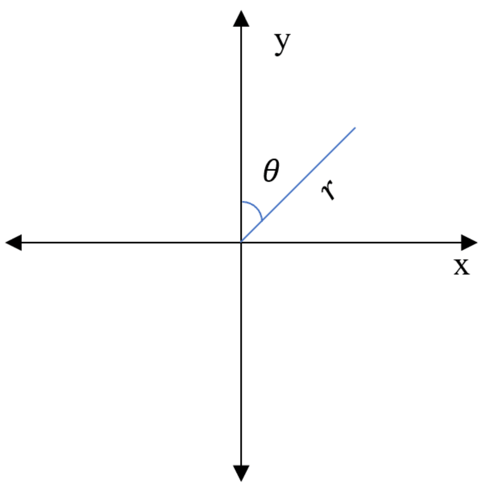
The process, as with all process modes, starts with the raw reading (for example Volts) and is converted to the engineering units using the Multiplier and Offset setting.

For each sample the angle is split into Cartesian coordinates, then a correction is performed for each quadrant.

When θ is the wind direction and r is the wind speed:

$$x = r \times sin\ \theta$$
$$y = r \times cos\ \theta$$

Note: that the angle is measured from the y-axis in a clockwise direction, this is different to the usual mathematics convention of the angle being measured from the x-axis in the anticlockwise direction.



The x and y vectors are then accumulated over the logging period:

$$x_{sum} = \sum_{i=1}^{n} x_i$$
$$y_{sum} = \sum_{i=1}^{n} y_i$$

A count is also kept of the number of values in x_{sum} and y_{sum}, or n.

At the end of the average period (i.e. logging time), the x and y vectors are averaged and then converted back to polar coordinates.

$$\bar{x} = \frac{x_{sum}}{n}$$

$$\bar{y} = \frac{y_{sum}}{n}$$

$$\bar{r} = \sqrt{\bar{x}^2 + y^2}$$

$$\bar{\theta} = sin^{-1}\left(\left|\frac{\bar{x}}{\bar{r}}\right|\right)$$

A quadrant correction is applied:

When $x_{avg} \geq 0$ and $y_{avg} \geq 0$:

$$\bar{\theta}$$

When $x_{avg} \geq 0$ and $y_{avg} < 0$:

$$\bar{\theta} = 180 - \bar{\theta}$$

When $x_{avg} < 0$ and $y_{avg} < 0$:

$$\bar{\theta} = \bar{\theta} + 180$$

When $x_{avg} < 0$ and $y_{avg} \geq 0$:

$$\bar{\theta} = 360 - \bar{\theta}$$

When using the Scalar Average process mode, the calculated value above $\bar{r} = 1$ is discarded, instead the mode selected for the magnitude sensor in the iRIS is used, for example the standard period average:

$$\bar{r} = \frac{1}{n}\sum_{i=1}^{n} r_i$$

Standard deviation for the wind speed and direction are calculated differently for each parameter.

For wind speed:

$$\bar{r}_{Scalar} = \frac{1}{n}\sum_{i=1}^{n} r_i$$

$$\sigma_{speed} = \sqrt{\frac{\sum_{i=1}^{n} {r_i}^2 - n \times {\bar{r}_{Scalar}}^2}{n - 1}}$$

For wind direction, the Yamartinto method is used.

$$s_a = \frac{1}{n}\sum_{i=1}^{n} sin\theta_i$$

$$c_a = \frac{1}{n}\sum_{i=1}^{n} cos\theta_i$$

$$\varepsilon = \sqrt{1 - ({s_a}^2 + {c_a}^2)}$$

$$\sigma_{direction} = arcsin(\varepsilon)\left[1 + \left(\frac{2}{\sqrt{3}}\right)\varepsilon^3\right]$$

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