Rev 1.0

User Manual

SWITCH DATALOGGER

EWS AUSTRALIA

CONTENTS

GLOSSARY

Term	Description
DC	Direct Current – A power supply regime whereby a constant voltage is provided at each output connection
DFU	Device Firmware Upgrade – A feature of the Switch that allows firmware upgrades to be performed in the field
Iridium	Iridium Communications Inc. is a company that provides services that enable telemetry communication via satellite communications network
LED	Light Emitting Diode – A low power light used by the Switch to display information such as power or Bluetooth connectivity
LTE	Long Term Evolution – A standard for wireless broadband for mobile devices
RTC	Realtime Clock – A module inside the Switch designed to accurately keep time and present it in a human readable format
SDI	Serial Digital Interface – A communications protocol supported by the Switch for communicating with sensors. Information is transferred as ASCII characters at 1200 baud with seven data bits and a stop bit.
USB	Universal Serial Bus - A communications protocol supported by the Switch for connecting to a computer
WiFi	A set of communications protocols based on the IEEE 802.11 standards for wireless networking

PRODUCT OVERVIEW

Key Features

- Allows coordination of up to 20 channels of sensor data to be periodically sampled and reported back to a central database
- Supports multiple communications protocols such as USB, Bluetooth, WiFi, cellular or via the Iridium satellite communications network
- Supplied with internal antennas (external antenna for improved range is also supported)
- Data reported to cloud and accessible by any internet enabled computing device
- Supports a direct connection via USB for configuration
- Wireless connection via Bluetooth for sensor readings and configuration
- Can connect to your local area network via WiFi connection
- May be powered via solar panel, battery or via direct power supply input
- Supports multiple common sensor communication protocols such as Modbus, SDI, 4-20mA loop and pulse input

Product Codes

Description	Order Code
Switch, Iridium Modem**, Internal Antenna, Rechargeable battery pack, 485, Pulse, Power, USB, Bluetooth**	EWS I-SWITCH-012
Switch , Cellular Modem**, Internal Antenna, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth**	EWS C-SWITCH-013
Switch, Iridium Modem**, Internal Antenna, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth**	EWS I-SWITCH-013 EWS I-SWITCH-013
Switch , Cellular Modem**, Internal Antenna, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-021
Switch , Iridium Modem**, Internal Antenna, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-021
Switch , Cellular Modem**, Internal Antenna, Rechargeable battery pack, 485, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-022
Switch , Iridium Modem**, Internal Antenna, Rechargeable battery pack, 485, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-022
Switch , Cellular Modem**, Internal Antenna, Rechargeable battery pack, SDI, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-023
Switch , Iridium Modem**, Internal Antenna, Rechargeable battery pack, SDI, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-023
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, USB, Bluetooth**	EWS C-SWITCH-031E
Switch , Iridium Modem, External Antenna**, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, USB, Bluetooth**	EWS I-SWITCH-031E
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, 485, Pulse, Power, USB, Bluetooth**	EWS C-SWITCH-032E
Switch , Iridium Modem, External Antenna**, Rechargeable battery pack, 485, Pulse, Power, USB, Bluetooth**	EWS I-SWITCH-032E
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth**	EWS C-SWITCH-033E
Switch , Iridium Modem, External Antenna**, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth**	EWS I-SWITCH-033E
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-041E

Switch , Iridium Modem, External Antenn**a, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-041E
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, 485, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-042E
Switch , Iridium Modem, External Antenna**, Rechargeable battery pack, 485, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-042E
Switch , Cellular Modem, External Antenna**, Rechargeable battery pack, SDI, Pulse, Power, Bluetooth Only (No USB)**	EWS C-SWITCH-043E
Switch , Iridium Modem, External Antenna**, Rechargeable battery pack, SDI, Pulse, Power, Bluetooth Only (No USB)**	EWS I-SWITCH-043E
Switch , Cellular Modem**, External Antenna, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, USB, Bluetooth -** Terminal Block Onl**y**	EWS C-SWITCH-051TB
Switch , Iridium Modem**, External Antenna, Rechargeable battery pack, 485, SDI, 4/20, Pulse, Power, USB, Bluetooth -** Terminal Block Only	EWS I-SWITCH-051TB
Switch , Cellular Modem**, External Antenna, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth -** Terminal Block Onl**y**	EWS C-SWITCH-052TB
Switch , Iridium Modem**, External Antenna, Rechargeable battery pack, SDI, Pulse, Power, USB, Bluetooth -** Terminal Block Only	EWS I-SWITCH-052TB

Summary

The Switch family of telemetry data loggers provide a convenient and flexible environmental sensor measurement and data access solution. Connected sensors connect to a cloud-based storage solution via the Iridium satellite network, WiFi, or through cellular connection. They are designed with remote operation in mind and may be connected to solar panel, powered by battery or connected directly to a DC power source.

A range of different Switch models are available to suit your needs. Options are available for a NEMA-4 compliant enclosure where environmental conditions such as dust and moisture are of concern and options for surge and lightning protection are available. Units are powered via an internal battery and then charged by an externally provided solar panel, battery or other power source. Wireless data connectivity may be supplied via the Iridium, 4G/LTE or WiFi modem links compatible with operation on networks such as Telstra and many international service providers; or via the Iridium satellite network. Wireless connectivity may be achieved via the convenience of an in-built antenna and/or extended range capabilities provided via using an external antenna.

Switch units may be conveniently monitored via Bluetooth using the free EWS SwitchComm app. This provides a convenient, wireless interface that facilitates reading of sensor measurements and configuration of sensors; including measurement schedules, measurement averaging/scaling, alarms and a variety of other status and diagnostic information. Direct PC connection via USB cable is also supported.

Power and data connections are provided by the reliable and field installable M8 and M12 connectors. Switch units may be connected to an external DC power source, and provide connections for Modbus, 4-20mA current loop, pulse, SDI and a relay switch contact.

GETTING STARTED

The Switch

The minimal system configuration setup comprises a Switch and a sensor (whose data is to be logged).

You will need to consider how you intend to power your Switch in its intended application. For more information about how to power your Switch in the field, refer to the Power Considerations section of this manual.

The switch can be configured to include an internal battery, which is charged at the time of manufacture. The inbuilt battery will usually provide sufficient power for the initial out-of-box testing and setting up your configuration options. However, the initial level of battery charge cannot be guaranteed; it will deplete over time, even if the device is not used. For this reason, you may need to charge your Switch prior to first use. This is especially true if it has been unused for a period of six months or more.

For a Switch configured to operate with a non-rechargeable battery you should not charge before use.

Connection Guide

The Switch will come with a number of connectors for supplying power and communication with sensors. To begin, you should connect your first sensor via the cabling provided

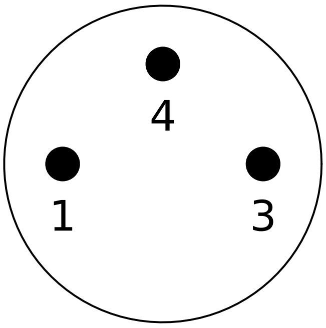

Examples of the usage of various types of sensors have been provided in the Application Examples section of this manual.

Types of Connectors

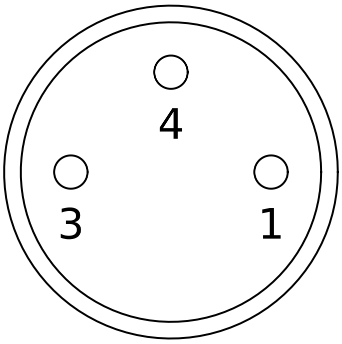
M8

The M8 connector allows for three signal lines. It allows for easy installation in the field and environmental protection rated to IP67 and IP68.

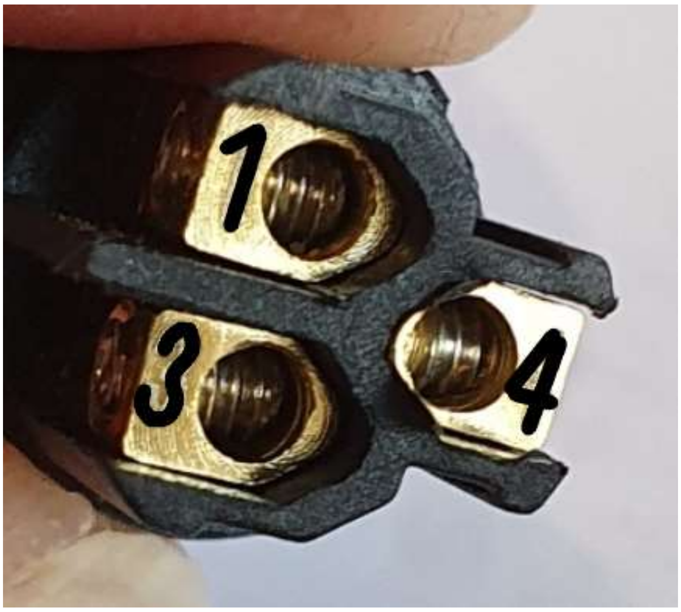
The Switch comes with a male M8 connector, which is used to supply power. When viewing the pins of a male connector with the three pins in the upper hemisphere, pins are numbered from 1 to 4 in an anti-clockwise (counter clockwise) manner starting from the leftmost pin, noting that the bottom (where hypothetical pin 2 would appear) is empty.



When viewing the pins of a female M8 connector with the three holes in the upper hemisphere, pins are numbered from 1 to 4 in a clockwise manner starting with the rightmost pin, noting that the bottom (where hypothetical pin 2 would appear) is empty.



If your application requires the use of an external DC power supply ($12V$) a cable may be supplied to provide extra cable length between the Switch and the power supply. The cable provides a female M8 connector to mate with the Switch and a 3-pin screw terminal to allow for convenient wiring to the power supply.



The function of each of the pins is provided in Table 1. Note that pin 3 is only used to ensure that the connector is correctly aligned when mating and does not serve any other purpose. A power supply of 12V is provided between pins 1 and 4, with pin 4 referenced to ground.

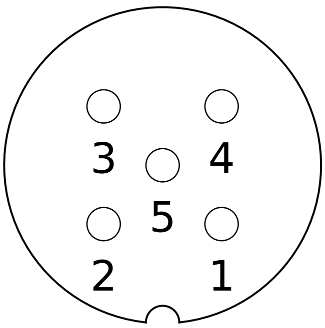
Table 1 – Power Connector Wiring

Number	Function
Pin1	SW Power 12v+
Pin3	-
Pin4	GND

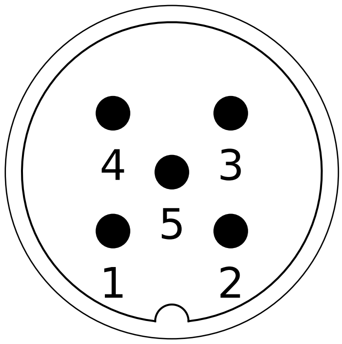
M12

The M12 connector allows for five signal lines. It allows for easy installation in the field and environmental protection rated to IP67 and IP68.

When viewing the pins of a female connector (as provided on the Switch) with the notch facing downward the pins are numbered from 1 to 4 in a clockwise manner starting from the bottom right pin, with pin 5 in the centre.



When viewing the pins of a male connector with the notch facing downward the pins are numbered from 1 to 4 in an anti-clockwise (counter clockwise) manner starting from the bottom left pin, with pin 5 in the centre.



The Switch may contain one or two M12 connectors. The connection regime on these connectors may be configured as *Sensor 'A'*, or *Sensor 'B'*, or both.

Sensor 'A' is a sensor wiring configuration designed to provide the flexibility to accommodate many sensor applications. It allows for a power connection, up to two sensor communication protocols and a relay output. The function for each pin in a cable configured as Sensor 'A' is provided in Table 2.

Table 2 - Sensor 'A' Wiring

Number	Function
Pin1	4-20mA/pulse2
Pin2	SDI-12
Pin3	SW Power 12v+
Pin4	GND
Pin5	Relay out

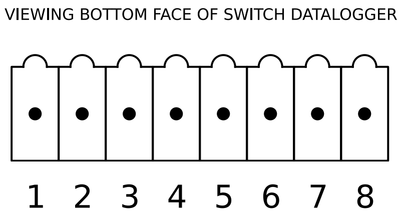
Sensor 'B' is an alternative sensor wiring configuration may be requested in addition to (or instead of) Sensor 'A' to provide further application flexibility. It allows for a power connection, and two sensor communication protocols including the industry standard Modbus protocol. The function for each pin in a cable configured as Sensor 'B' is provided in Table 3.

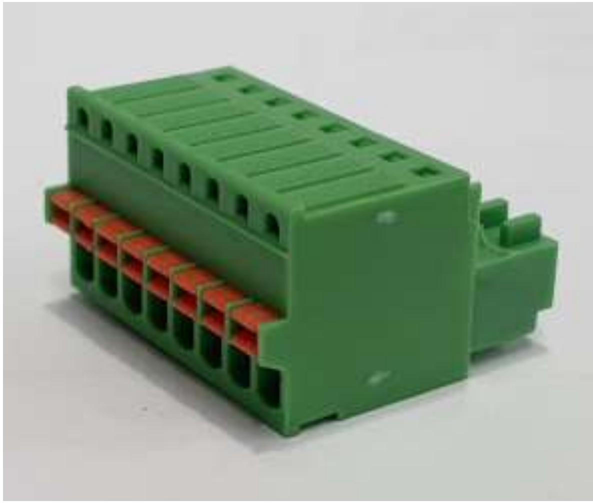
Table 3 - Sensor 'B' Wiring

Number	Function
Pin1	Modbus A+
Pin2	Modbus B-
Pin3	SW Power 12v+
Pin4	GND
Pin5	4-20mA/pulse1

Terminal Block

The Phoenix 8 pin terminal block provides the flexibility of wiring your sensors directly from bare wires. In many applications this is a quick and convenient method for connecting sensors. However, caution is advised when applying wiring, as connecting wires incorrectly may result in damage to your Switch. Terminal block connectors provide less protected against environmental hazards such as dust and water compared to M12 connectors.





When viewing a terminal block from the rear so that the areas where wires are connected are directed to the front and the screw terminals are oriented upwards, the pins are labelled from one through 8 from left to right. The function for each pin in a cable configured as Sensor 'A' is provided in Table 2.

Table 4 – Terminal Block Wiring

Number	Function
Pin1	4-20mA/Pulse 2
Pin2	SDI-12 Data
Pin3	Relay Out
Pin4	GND
Pin5	12v Switch power out
Pin6	4-20mA/Pulse 1
Pin7	Modbus B (-)
Pin8	Modbus A (+)

SMARTPHONE APPLICATION

Installation

To begin, you first need to download the SwitchComm app from your smartphone's app store.

1. Open the *Google Play Store* app on Android or *Apple Store* app on iPhone
2. Search for *EWS SwitchComm*

Look for the EWS logo.

The app name will be *SwitchComm* by *EWS Australia*. It will likely be categorised under *Weather*

3. Select the SwitchComm app to see more details (and installation options)

4. Click Install

5. Wait for the SwitchComm to download and install.
6. Click Open

7. If successfully opened, you will see the main splash page featuring the EWS Australia logo.

8. After the app successfully loads you will see the main menu featuring the EWS Australia logo and buttons for each of the available menu options.

9. You have now successfully installed the EWS Australia SwitchComm app and are ready to connect to your Switch

Transportation Mode

When not in use, the Switch can be made to operate in a special low power *transportation mode*. In this mode all features are switched off, with the exception of an occasional blink of a red LED every 25 seconds. Upon initial unboxing of a new unit, it should already be in this mode. (If there is no blinking LED on the unit, you may need to change the battery.)

To remove the Switch from transportation mode, simply place a magnet on the magnet symbol (shown below) on the side of the logger. This will instantly turn the LED green and then flash every 25 seconds to confirm the Switch is in logging mode.

If required, to place the Switch in transportation mode again, simply hold the magnet on the magnet symbol for 10 seconds. Ensure the LED is solid red while you are holding it on the symbol, then the red LED will flash every 25 seconds after this to confirm it has entered transportation mode.

Bluetooth Pairing

1. Hold a magnet on the magnet symbol for 1 second to activate Bluetooth pairing mode. While the magnet is being held near the magnet symbol, a red LED should illuminate.

2. A flashing blue LED indicates the Switch is waiting to pair to your smart device via Bluetooth.

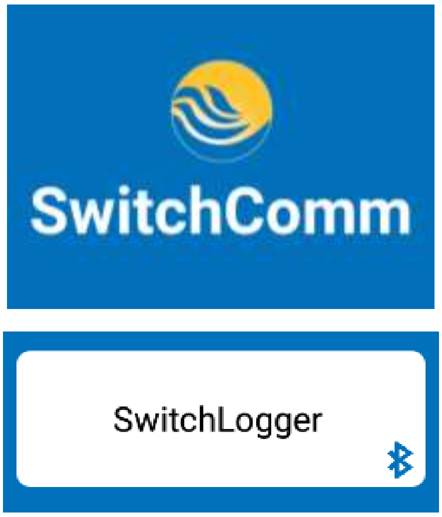
3. On the SwitchComm app, tap the *SwitchLogger* button.

4. You should see the following notifications appear in the top section of the app, just under the notification bar:
    a. SEARCHING...
    b. CONNECTING RIGCOM
    c. CONNECTED
    d. WAIT READING DEVICE.
    e. READ OK

5. When you have successfully connected to your Switch, you will see the Bluetooth logo in the *SwitchLogger* button appear blue

Switch Logger Menu

From the main menu of the SwitchComm app, pressing the SwitchLogger menu button will allow you view the device information relevant to the particular Switch you are connected to. Some of the information presented can only be read, whereas other options will allow you to force the device to perform a specific function or change the mode of operation.

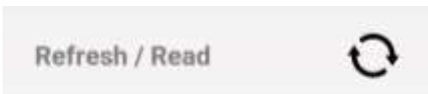


Upon entering the SwitchLogger menu you will see a back button, which can be used to return you to the main menu.

Below this you will see the heading *Switch Logger* and a number of different configuration options, each of which will be explained in turn. The *Switch Logger* menu can only be accessed once you have successfully paired via Bluetooth to a Switch, otherwise tapping *Switch Logger* will attempt to create a Bluetooth connection.

Refresh / Read

The Refresh / Read button forces the Switch to immediately take a measurement reading for all sensors. Tap this button once to ensure that all sensor readings are at their most up-to-date values.

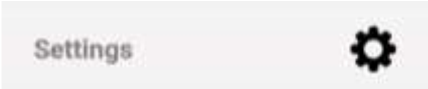


Force Transmission

The Force Transmission button will force the Switch to immediately upload the most recently recorded sensor data to the cloud. Tap this button transmit the current sensor readings to be stored in the cloud-based database.

Settings

Tapping Settings button will open a new menu that gives you the ability to view and modify configuration information specific to the Switch unit that you are currently connected to.

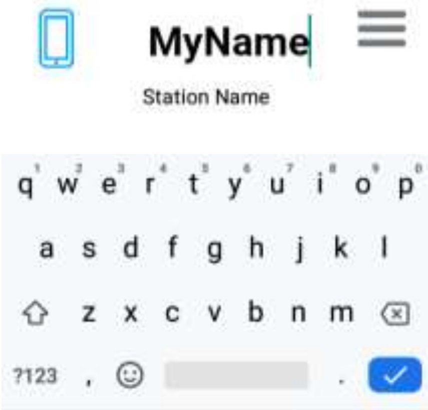


Upon entering the Settings menu, you will see a SettingPage button, which can be used to return you to the SwitchLogger menu.

Below this you will see the heading *Settings* and a number of different configuration options, each of which will be explained in turn.

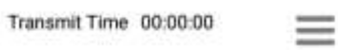
Station Name

You can provide the Switch a meaningful name to describe the station for which measurements are being recorded. The Station Name may comprise a sequence of upper and lowercase characters, numbers or symbols with a total length of 16 characters or less.

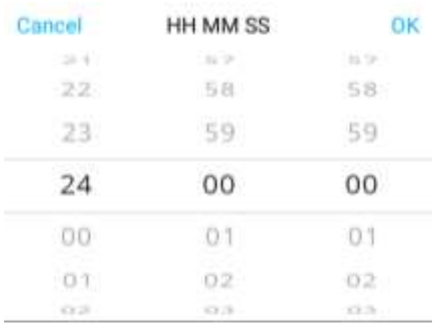


Transmit Time

The Transmit time describes the time at which the first set of recorded sensor data are to be uploaded to the cloud.

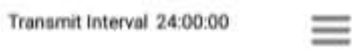


Tapping the button will bring up a time picker to allow you to configure the Transmit Time. Three numbers can be chosen to represent hours, minutes and seconds respectively. Swipe each number up or down to change its respective value. Tap OK once you are happy with the Transmit Time that has been selected.

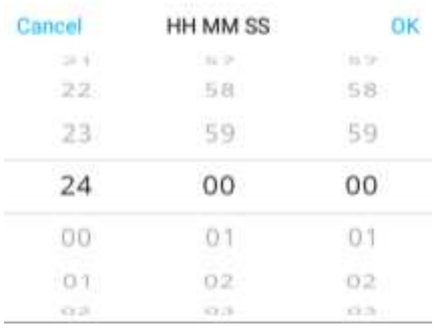


Transmit Interval

The Transmit Interval describes the time between successive uploads of recorded sensor data to the cloud.



Tapping the button will bring up a time picker to allow you to configure the Transmit Interval. Three numbers can be chosen to represent hours, minutes and seconds respectively. Swipe each number up or down to change its respective value. Tap OK once you are happy with the Transmit Interval that has been selected.

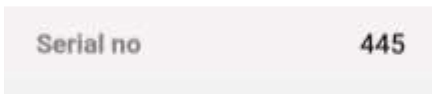


RTC

The Real Time Clock (RTC) feature is used store ad configure the time as displayed by the Switch in a human readable format. The RTC operates independently of the main processor inside the Switch and will remain active even while the logger is in transportation mode. You will need to set the RTC whenever the unit completely loses power (for example, if the battery is replaced).

Serial no

The serial number is a unique identification number associated with the particular Switch you are connected to. Take note of this number in case it is needed for the purpose of correspondence in relation to this particular unit.



IMEI

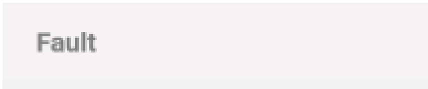
The International Mobile Equipment Identity is a unique 15-digit identification number that may be used to identify any communications enabled devices embedded within the Switch.

Battery Level

The Battery Level reports the current measured voltage of the internal battery. The battery may be of rechargeable or non-rechargeable type. The Switch will work out which type of battery you have and report the relevant battery voltage reading.

Fault

The Fault indicator provides details about any current fault conditions that are active. If there are no active fault conditions the label does not contain any information other than the text *Fault*.



Mode

The Mode describes the behaviour of the relay output. The relay may be manually turned on / off, or it may be configured to activate once a specified alarm condition is met.

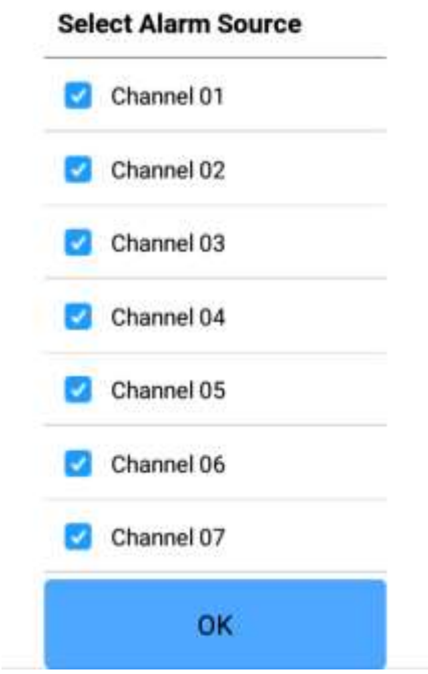
Tapping the Mode button will display a list of three relay operation modes:

- Always Off: In this mode, the relay output will be permanently disabled.
- Always On: In this mode the relay output will be permanently enabled.
- Configured source: In this mode the relay will become enabled if an alarm condition is met. For more details about alarm conditions, read the Alarm Source section below.

Alarm Source

The Alarm Source describes which measurement channels are configured to drive the relay output (to trigger an alarm). Tapping the text *open* will open a menu to configure which measurement channels are set as a source to trigger the relay alarm.

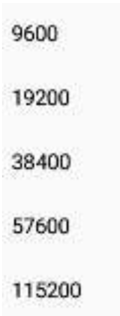
Any combination of measurement channels may be selected as an alarm source. The exact conditions under which a given channel will cause an alarm to trigger is configurable. (See section Sensors Menu, subsection Alarm Config for more details on how to configure alarms for a particular channel.)



Modbus Baud Rate

The Modbus protocol requires agreement between the Switch and sensor about the speed at which data transfer is to occur. The sensor being used may allow for this information rate (the Modbus Baud Rate) to be set by the user, or it may be a preconfigured rate, which should be described in the datasheet for the sensor. The Modbus Baud Rate describes the number of bits of information that may be sent and received each second. You must select a Modbus Baud Rate equal to the rate required by your sensors. In general, a higher Modbus Baud Rate will be associated with faster exchange of data, but also a higher likelihood that the data will be corrupted when communicating between the sensor and Switch.

The Switch supports standard Mobus Baud rates.



Parity

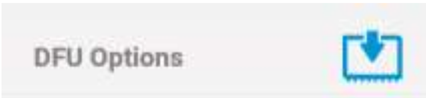
The Modbus protocol provides a Parity checking feature that can be used to help to detect when sensor data has become corrupted during the transmit of information between the sensor and Switch.

Importantly, the Parity configuration of the sensor being used must match the Parity configured in the Switch.

The Parity options are None, Odd and Even. Odd and Even describe whether the number of digital 1 and 0 sent for each byte of data transferred are odd or even respectively. The None option may be applied to forego parity checking.

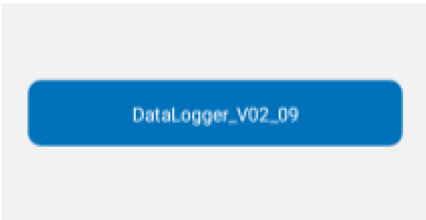
DFU Options

The Device Firmware Upgrade option may be used to apply software updates and patches to the Switch. Tapping the menu item will open the Firmware Upgrade menu.



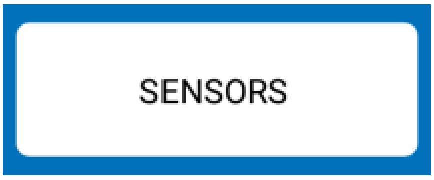
Upon entering the Firmware Upgrade menu, you will see a Firmware Upgrade button, which can be used to return you to the SwitchLogger menu.

Each of the available firmware upgrade options will be listed. Tap to upgrade to the selected version of firmware.



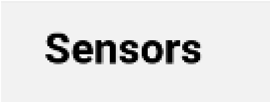
Sensors Menu

From the main menu of the SwitchComm app, pressing the Sensors menu button will allow you view the sensor measurement relevant to the particular Switch you are connected to.



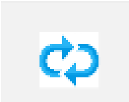
Upon entering the Sensors menu, you will see a back button, which can be used to return you to the main menu.

Below this you will see the heading *Sensors* and a number of different sensors listed.



Refresh / Read

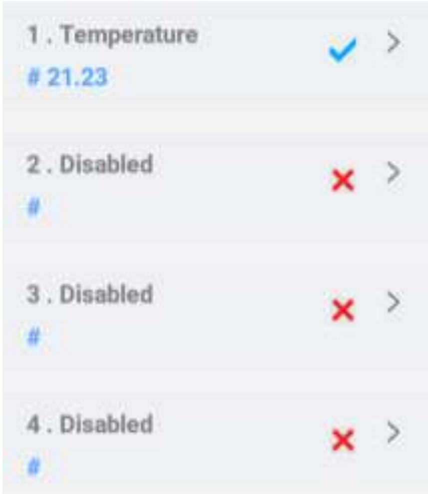
A Refresh / Read button has been included for convenience. It performs the same function as the Refresh / Read button described in the Switch Logger section of this manual; tapping this button will force all sensors to record a new set of measurement data.



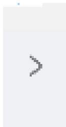
Whilst a refresh is in progress, this button will temporarily disappear and "Reading.." status will be displayed.

Sensor Status

A list of sensor channels is provided, each with a brief summary describing the channel number, sensor type, most recent read value (if any) and status of the channel.



Tapping the arrow next to any particular sensor will display a more detailed set of configuration options particular to that sensor.



Upon entering the menu for your selected sensor, you will see a back button, which can be used to return to the Sensor menu.

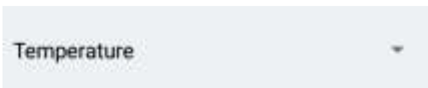
Below this you will see a heading describing the sensor channel number and a description of the type of sensor configured to this channel.

Channel Config

Inside each channel there will be a Channel Config menu item, which may be used to modify channel specific configuration options.

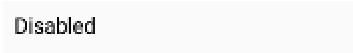
Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

Sensor Type

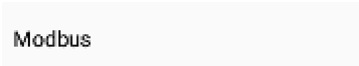


Tapping the arrow next to the sensor type will bring up a drop-down menu that provides the different types of sensor measurements available.

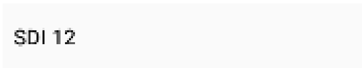
Disabled
The Disabled option is used when the sensor channel is not required. No measurement data will be reported for the selected channel.



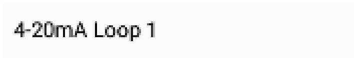
Modbus
The Modbus option is used to communicate to a sensor that uses the Modbus communications protocol. The sensor datasheet should confirm whether it supports this or not.



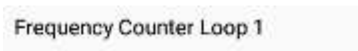
SDI 12
The SDI 12 option is used to communicate to a sensor that uses the SDI 12 communications protocol. The sensor datasheet should confirm whether it supports this or not.



4-20mA Loop
The 4-20mA Loop option is used to communicate to a sensor that supports the 4-20mA Loop sensor measurement protocol. More than one sensor may be supported by your Switch. A numeric index is provided after the text '4-20mA Loop' to denote which particular sensor to read. Please refer to the Connection Guide section of this manual for more information about which pin corresponds to which sensor channel.



Frequency Counter Loop
The Frequency Counter Loop records the number of pulses received between successive samples. More than one frequency counter type sensor may be supported by your Switch. A numeric index is provided after the text *Frequency Counter Loop* to denote which particular sensor to read. Please refer to the Connection Guide section of this manual for more information about which pin corresponds to which Pulse sensor channel.



Rechargeable Battery Voltage
The Rechargeable Battery Voltage option is used so that a sensor channel reports the current battery voltage (if applicable) for the Switch's rechargeable battery. The voltage is reported as a voltage (in volts).

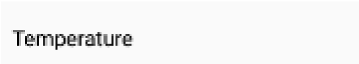
The Switch typically uses a Lithium-Polymer (LiPo) battery comprising two 3.6V LiPo cells. A fully charged battery will have a voltage around $8.4V$, whereas a fully discharged battery will record a voltage of around $6.0V$. The voltage of a LiPo battery does not decrease uniformly over time; a freshly charged battery will quickly discharge to around $7.4V$. The voltage level will fall relatively slowly over time until about $7.0V$. Once the battery nears full discharge the voltage will rapidly fall in a relatively short period of time. A battery nearing full discharge may exhibit a voltage level that drops while sensor measurements are being taken, but returns to its former level after measurements complete.

Non-Rechargeable Battery Voltage

The Non-Rechargeable Battery Voltage option is used so that a sensor channel reports the current battery voltage (if applicable) for the Switch's non-rechargeable battery. The voltage is reported as a voltage (in units volts).

Temperature

The Temperature option is used so that a sensor channel reports the on-board temperature sensor that is mounted inside the Switch. It is important to note that this temperature reading is primarily affected by ambient temperature, but also a slight temperature rise caused by heating of the internal circuitry as it operates. It is recommended that this voltage be sampled periodically in the event that cross correlating temperature values with sensor measurement values becomes necessary.

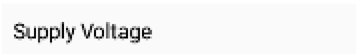


Reference Voltage

The Reference Voltage option is used so that a sensor channel reports the on-board reference voltage produced inside the Switch. This voltage should exhibit minimal change across time and with variation in battery voltage and ambient temperature. It is recommended that this voltage be sampled periodically in the event that cross correlating reference voltage measurements with sensor measurement values becomes necessary.

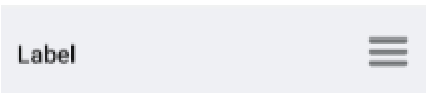
Supply Voltage

The Supply Voltage option is used so that a sensor channel reports the current supply voltage (if applicable) for the supply voltage used to charge the Switch. The voltage is reported as a voltage (in volts).



Label

The Label option is used to provide a meaningful name to the sensor measurement channel. A maximum of 8 characters is allowed. These characters may comprise any alphabetic or numeric characters and standard symbols.

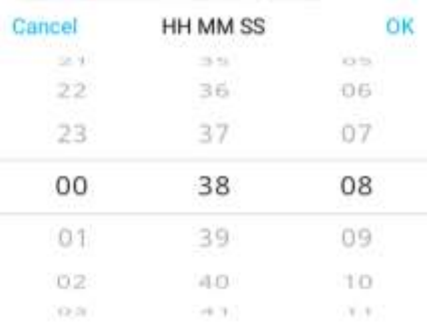


Current Reading

The Current Reading reports the most recently measured sensor value for the selected channel. Any processing (such as gain, offset or scaling) is included in the reported value.

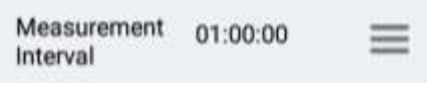
Measurement Start Time

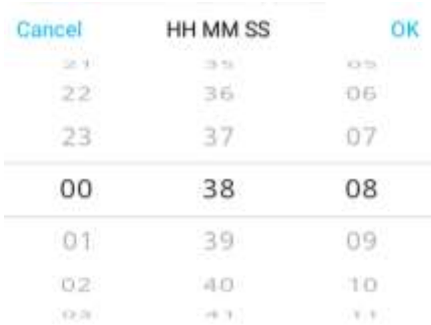
The Measurement Start Time describes the time at which periodic measurements are to commence. This option is configurable and is represented in 24 hour format relative to the time zone of the smart device that was used to set the Switch RTC.



Measurement Interval

The Measurement Interval describes the time between the reporting of each periodic measurement. A *measurement* is defined as being a collection of samples that have been averaged together, applying any gain or offset and reported to the cloud-based storage. This option is configurable.





Sampling Interval

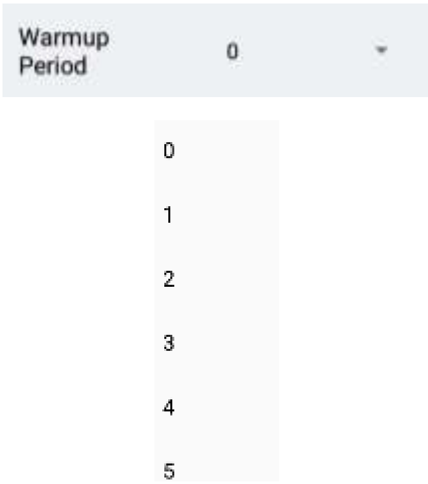
The Sampling interval describes the time between successive sensor samples. A *sample* is defined as being any individual reading taken by a particular sensor. This option is configurable.

Averaging Time

The Averaging Time describes the time over which sensor samples are averaged. The Switch will typically wake up before reporting a measurement by an amount of time approximately equal to the time required to take a single measurement, plus the averaging time. Successive samples taken inside the Averaging Time interval will be averaged together before the measurement is reported. This option is configurable.

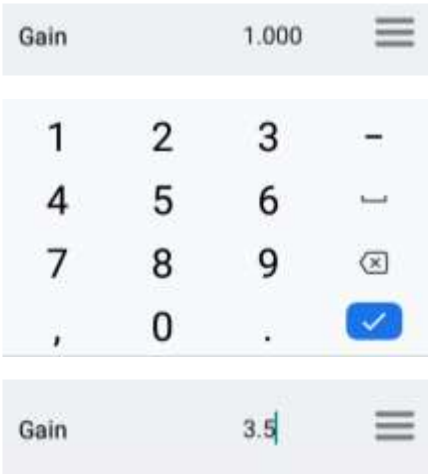
Warmup Period

The Warmup Period describes the time in which power is applied to a sensor before a measurement is taken. In some instances, a sensor may report a different value when cold than once it has been allowed to warm up. For consistency, allowing sufficient time for the sensor to warm up will result in consistent measurements. Alternatively, some sensors may require a start-up procedure between being powered and being able to report measurements. In any case, it is recommended that you consult the datasheet for your particular sensor to see what warmup period will be required. The longer the warmup period is selected, the more battery power will be consumed for each sensor measurement, so it is advised to select a warmup period that is not significantly longer than the minimum requirement.



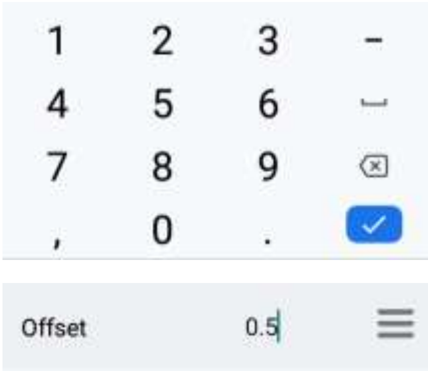
Gain

The Gain describes a multiplicate factor applied to the raw sensor sampled data. The sampled sensor data is multiplied by the gain and the offset is added before averaging and reporting as a measurement.



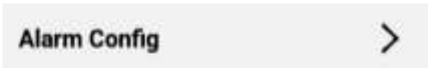
Offset

The Offset describes an additive term applied to the raw sensor sampled data. The sampled sensor data is multiplied by the gain and the offset is added before averaging and reporting as a measurement.

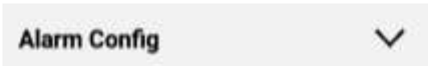


Alarm Config

Inside each channel there will be an Alarm Config menu item, which may be used to modify alarm notification settings specific to the selected channel.



Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.



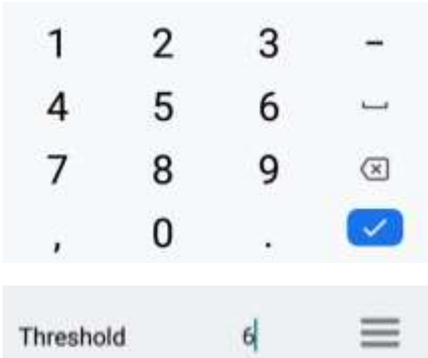
Mode

The mode describes whether an alarm is to be active or not for the selected channel and whether an alarm should trigger when the measurement data is above (or below) a certain level.

When the alarm mode is set to Off, the selected channel will not cause any alarms to trigger. When set to Hi, an alarm will trigger when the recorded measurement is above the threshold value. When set to Low, an alarm will trigger when the recorded measurement is below the threshold value.

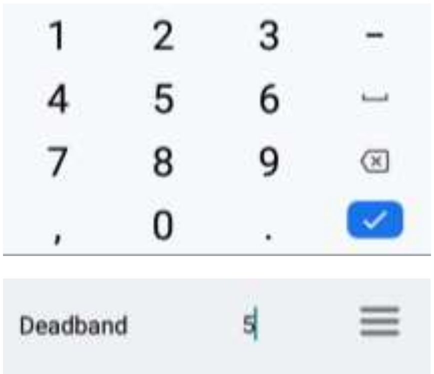
Threshold

The Threshold describes the critical value at a which an alarm is set to trigger. When the measured data exceeds the threshold value, an alarm will be triggered for the current channel. Depending on the relay configuration, this can cause the relay to change state.



Deadband

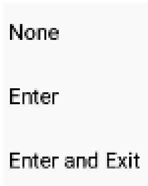
The Deadband describes the hysteresis associated with the alarm measurement. Without a deadband, an alarm condition could trigger multiple times in the event that successive sensor measurements occur very close to the threshold value. To ensure the alarm only triggers only once, a deadband may be set. Once an alarm has triggered, the sensor must record at least measurement that is below the threshold by the amount of the deadband before another alarm can be triggered.



Telemetry Notification

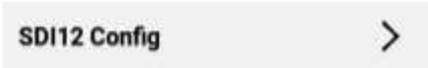
The Telemetry Notification describes the conditions under which alarm updates are to be reported. It is possible to set whether alarm notifications will be provided for the selected channel and also whether a second alarm notification should occur once the alarm condition is no longer active.

A value of None indicates that no telemetry notification will be sent when an alarm condition is encountered. A value of Enter indicates that a telemetry notification will be sent when an error condition first becomes active in the selected sensor channel. A value of Enter and Exit indicates that a telemetry notification will be sent whenever an error condition becomes active, and a second telemetry notification will be sent once the error condition ceases to be active.

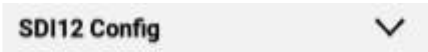


SDI 12 Config

If the SDI 12 communications protocol has been selected under the *Channel Config* menu, an SDI 12 menu item will appear, which may be used to modify specific settings relevant to the SDI12 communications protocol.



Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

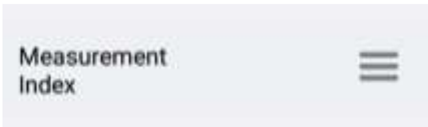


Address

Multiple SDI12 devices may be connected to the same set of physical wiring on the Switch. The Address is used to select a particular device from the string of connected SDI12 sensors. Each sensor must have a unique Address associated with it.

Measurement Index

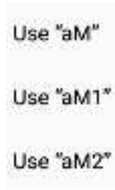
The measurement index is a number between one and ten inclusive. It defines which particular reading is to be collected by the sensor that has been addressed.



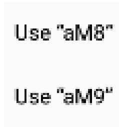
Measurement Command

The Measurement Command is used in the SDI12 protocol to define which set of measurements to collect.

Up to ten measurements are available using command *aM* (at *Measurement Index* 1 through 10). Alternative commands *aM1* through to *am9* are available to extend the collection of available measurements, adding up to ten extra readings (at *Measurement Index* 1 through 10) for each command.



…



Modbus Config

If the Modbus communications protocol has been selected under the *Channel Config* menu, a Modbus Config menu item will appear, which may be used to modify specific settings relevant to the Modbus communications protocol.

Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

Modbus Address

Multiple Modbus devices may be connected to the same set of physical wiring on the Switch. The Modbus Address is used to select a particular device from the string of connected Modbus sensors. Each sensor must have a unique Modbus Address associated with it.

Modbus Register

The particular piece of measurement information being sought from the sensor can be addressed using the Modbus Register. This is an integer number; the particular number required for your measurement of interest will most likely be documented in a user manual, programmer's manual or other technical documentation published by the device manufacturer.

Register Data Type

The Register Data Type defines how digital information (a string of ones and zeros reported by the sensor) ought to be interpreted.

Available options include *16 bit integer*, *32 bit integer*, and *IEEE single precision float*. A 16 bit integer can support 65,536 integer values. A 32 bit integer can support over 4 billion integer values; however, this comes at the cost of increased transmission time for every packet sent. A IEEE single precision float can support any arbitrary numeric value, but suffers from rounding errors which occur in proportion to the size of the number. The particular format required for your measurement of interest will most likely be documented in a user manual, programmer's manual or other technical documentation published by the sensor manufacturer.

Register Endianess

The Register Endianess defines the order in which digital information (a string of ones and zeros) ought to be interpreted. The difference between big endian and little endian is that information is transmitted in the reverse order for each with respect to the other.

The particular format required for your measurement of interest will most likely be documented in a user manual, programmer's manual or other technical documentation published by the device manufacturer.

Timeout

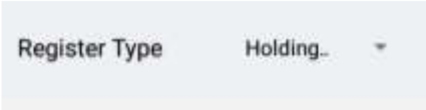
When communicating via Modbus protocol, the Switch will send a command to the sensor and wait for the sensor to reply with information. If a sensor is defective or disconnected, a reply may never be sent. The Timeout defines how long the Switch will wait before giving up and reissuing the command.

Retry Count

The Retry Count describes the maximum number of retries to be attempted. The Switch will reissue commands for this number of times before giving up and assuming that the sensor cannot be reached (or is not responding).

Register Type

The Modbus protocol defines a type of data to be held in a given register. The particular format required for your measurement of interest will most likely be documented in a user manual, programmer's manual or other technical documentation published by the device manufacturer.



Input registers typically contain sensor input data (such as status information or sensor readings), they may be read and not written. Holding registers typically contain configurable data; they may be written as well as read from.

Help Menu

At any time, you may press the *Help* button to access this guide.

POWER CONSIDERATIONS

Solar Power Operation

The Switch has an internal solar regulator, which allows it to be connected directly to a $30W$ solar panel using the M8 connector's pin 1 (+) and pin 4 (-). (For more information relating to the pin connections of the Switch, please see Table 1 in the Types of Connectors section of this manual.)

As an example, a Switch with a $30W$ solar panel under 8 hours of sunlight per day would typically be able to log $1-2$ measurements at (up to) 30 minute intervals and transmit hourly. If multiple transmissions are required per hour (for example, every 15 or 30 minutes), or if there are many hours with little or no sun, one of the following options is recommended.

Solar Power Operation with Charger

The Switch may be connected to a gel cell battery, which is charged by a solar panel through a solar regulator. The capacity of the battery and solar panel required will depend on the level of sunlight received at the site and also on the frequency of transmission required.

As an example, a $5Ah$ gel cell battery and $5W$ solar panel would typically provide sufficient power to accommodate the logging of a water level measurement (for example) at a 15 minute interval, transmitting every 15 minutes (provided that it receives at least 8 hours of sunlight on average each day).

Powering with External Power Supply

The Switch may be connected directly to a power supply. It can take an input voltage between $12V$ to $24V$.

The Switch can be powered by a $240V$ AC or $110V$ AC (depending on your country) power supply capable of supplying an output voltage between $12V$ and $24V$. The power supply output may then be connected to the Switch using the M8 connector's pin 1 (+) and pin 4 (-).

Powering via Battery

If the unit is required to transmit at most once per day, an external battery (such as the EWS non-rechargeable $14.4V$, $68.4Wh$ lithium battery pack) can be used.

For a transmission once daily of hourly (or less frequent) logged data from $1-3$ sensors, the expected lifespan is between 2 and 5 years.

FCC Warning Statement:

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

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

- This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

— Reorient or relocate the receiving antenna.

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

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

INSTALLATION GUIDE

It is recommended that considerations relating to the installation of the Switch are planned before sending the unit to the field for deployment. A brief description of some of the more important considerations is provided.

1. Ensure that you have configured your Switch by first familiarising yourself with the menu options available in the Smartphone Application section of this manual. You may also wish to view the Application Examples section for examples that may be relevant to your particular application.

   The cost / difficulty of configuring your Switch may increase significantly the longer you leave it. It is far cheaper (and will give piece of mind) to verify the configuration is working to your liking on your desk than to discover you have a misconfigured device that has already been deployed in a remote location of which you have no convenient access.

   It is recommended that you first test your Switch with the sensors you intend to use before deploying the device in the field (if possible).

2. To plan for the installation of your Switch you must ensure that your test site has:

a. Physical accessibility to the unit
b. A weatherproof enclosure to house the unit
c. Allowances to mount the unit using the mounting holes provided or by another mounting arrangement
d. Access to a DC power supply or solar panel and cabling of a sufficient length to apply power to the unit; or
e. Sufficient battery capacity for your intended operation
f. Access to the sensors, ensuring a sufficient length of cabling is available to connect to the unit
g. An external antenna (if applicable) with a clear line-of-site to interfacing network nodes
h. Line of sight to the sky (can be through a plastic enclosure) if using an internal antenna

3. Mount your Switch inside a weatherproof enclosure. This will reduce exposure to environmental conditions and extend the longevity of the device. Many options are available in terms of the choice of enclosure you may use. However, your application needs may affect which style of enclosure you choose.

   If you intend to communicate to the Iridium network via the internal antenna, you must ensure that the Switch has line-of-sight to the sky. The unit must be oriented in portrait mode (cables oriented downward) and the enclosure must be transparent to radiofrequency signals. A metal enclosure cannot be used, as this will block the signal; however, a plastic enclosure should be acceptable. Please be aware that any metal within $30cm$ of the Switch may degrade the performance of the device. The area around and immediately above the unit must be kept as clear as possible.

   If you intend to use a metal enclosure, then you must use an antenna that is mounted externally to the enclosure. For best results, ensure that the externally mounted antenna has a clear view of the network that it (wirelessly) interfaces with. Please be aware that the requirements of your antenna are dependent on the type of wireless communication being used. For example, an Iridium antenna can only be used for communication to the Iridium satellite network and an LTE antenna must be used for LTE communications; the two are generally not cross-compatible.

4. Ensure your Switch is located in a location with physical access. You may wish to attach a USB cable to communicate with the unit; or if you wish to communicate via the SwitchComm App, you will need physical access to the unit in order to apply a magnet to enable Bluetooth pairing.

5. The Switch may be mounted using two M8x50mm bolts that may be mated with mounting holes that appear in the upper-left and lower-right corners of the unit.

6. With your Switch installed at the intended site, you may now connect your sensors via the M12 connectors or terminal block (depending on which your unit contains).

7. You may connect your Switch to a DC power source using the M3 connector.

APPLICATION EXAMPLES

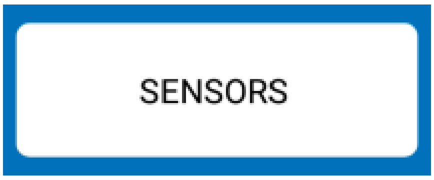
Switch Temperature Reading

The Switch contains an inbuilt temperature sensor to understand the ambient operating environment in which it operates. Use of this temperature sensor is independent of the application environment and other sensors being used. It is often a useful diagnostic tool to verify that you are able to read the ambient temperature measurement as a successful read will validate that the unit is operational correctly and able to communicate with the SwitchComm app.

1. Ensure your smartphone or mobile device is loaded with the EWS Australia SwitchComm app.
2. Whist standing within Bluetooth pairing distance from the Switch, navigate to the SwitchComm and tap *SwitchLogger* to pair.

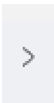
3. Upon a successful connection you should see the Bluetooth logo illuminate in blue. Device specific configuration options, including the transmission schedule can be configured by tapping the *SwitchLogger* button once more. For a detailed description of the options available, refer to the Switch Logger section of this manual.

4. Tap the *SENSORS* button to view and modify the sensor-specific configuration options for each of the sensor channels on the Switch VWT or Switch SVWT.

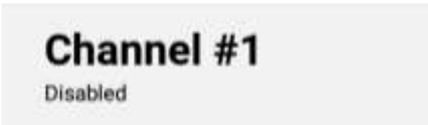


5. The sensors menu will open, listing all of your available sensor channels.

6. We are interested in the first channel, so we tap the arrow button to see the configuration options for this particular sensor.



7. The configuration options for channel one will be displayed.

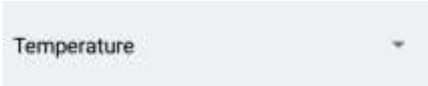


8. Inside each channel there will be a Channel Config menu item which may be used to modify channel specific configuration options.

9. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

10. A dropdown to define the sensor type should be visible. Tap the arrow to expand this menu.

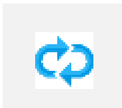
11. Select *Temperature* as the sensor type.



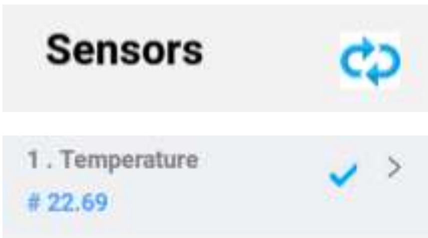
12. We now tap the back button to return to the *SENSORS* menu.

13. The temperature reading will be listed in the first sensor channel.

14. Pressing the refresh button will force a measurement to be taken by the temperature sensor.



15. The sensor reading will read and update



VWT Vibrating Wire Piezometer Frequency and Temperature Measurement

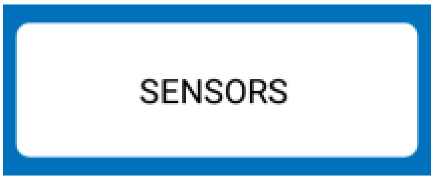
In this example a Switch VWT or Switch SVWT is used to take frequency and temperature measurements from two separate Vibrating Wire Piezometers (VWP) on a 15-minute measurement schedule. Samples are taken every minute and averaged over a moving 30-minute window.

1. Ensure your smartphone or mobile device is loaded with the EWS Australia SwitchComm app.
2. Ensure your VWP sensor is connected to channel VWP1 of the Switch VWT/SVWT.
3. Whist standing within Bluetooth pairing distance from the Switch VWT/ SVWT, navigate to the SwitchComm and tap *SwitchLogger* to pair.

4. Upon a successful connection you should see the Bluetooth logo illuminate in blue. Device specific configuration options, including the transmission schedule can be configured by

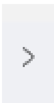
tapping the *SwitchLogger* button once more. For a detailed description of the options available, refer to the Switch Logger section of this manual.

5. Tap the *SENSORS* button to view and modify the sensor-specific configuration options for each of the sensor channels on the Switch VWT or Switch SVWT.

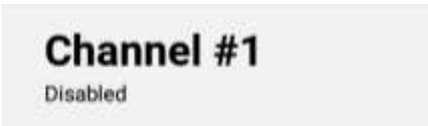


6. The sensors menu will open, listing all of your available sensor channels.

7. We select the first sensor channel, which will (in this example) be configured to measure the frequency of the vibrating wire on channel VWP1. Tapping the arrow next to the information listed for channel one will allow us to set channel configuration options.



8. The configuration options for channel one will be displayed.

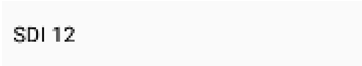


9. Inside each channel there will be a menu item entitled *Channel Config* which may be used to modify channel specific configuration options.

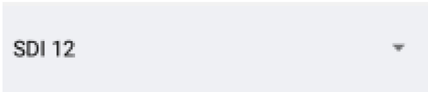
10. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

11. A dropdown to define the sensor type should be visible. Tap the arrow to expand this menu.

12. Select *SDI 12* as the sensor type.



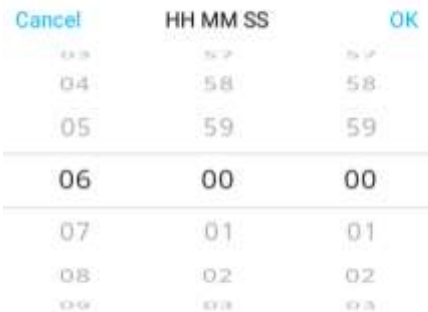
13. You should see SDI 12 selected in the configuration menu. This means the SDI12 configuration menu will be enabled, which we will later use to address our VWP sensor channel.



14. We give our sensor channel a meaningful name. As this is a frequency measurement on channel VWP1, we have chosen the name *VWP1[Hz]*. A more meaningful name (such as the location of your sensor) may be preferred for your particular application.

15. We need to select a time for our measurements to start. This is achieved by tapping the *Measurement Start Time* menu item.

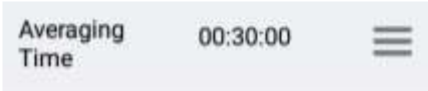
16. We will set our measurements to start at 6AM in this example.



17. After successfully configuring the start time, you should see this listed in the *Channel Config* menu

18. We wish for measurements to be reported on a fifteen-minute schedule. This is configured via the *Measurement Interval* menu option

19. For our samples to be averaged on a rolling 30-minute schedule we navigate to the *Averaging Time* menu option and adjust it accordingly

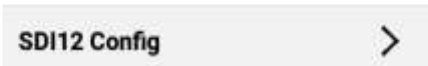


20. We desire samples to be taken each minute. This can be set via the *Sampling Interval* menu option

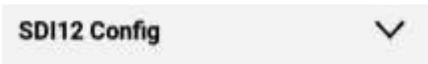
21. To give the sensor time to warm up and settle to a consistent state before taking measurements, we will adjust the *Warmup Period*, setting it to 5 seconds

22. We wish to keep the measurements as reported by the sensor, without applying any scaling or offset.

23. Navigate to the menu item entitled *SDI12 Config* which may be used to modify channel specific configuration options.



24. Upon tapping the arrow, the menu will expand to list the set of SDI12 addressing options available for the selected channel.

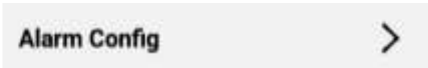


25. In a Switch VWT or Switch SVWT, the integrated VWP sensor channels are configured to SDI 12 channel 1. Therefore, we will select our SDI 12 address as channel 1.

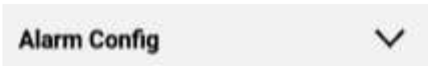
26. We wish to record the frequency of channel VWP1. This is achieved by selecting *Measurement Index* as channel 1. Note: For a description of VWT measurement indices, refer to *Appendix 1: VWT Measurement Index Channels.*

27. The command to communicate to the inbuilt VWP sensors is "*aM*". Select this option if it is not already selected as default.

28. In this example, we will not enable alarms. To achieve this, we navigate to the menu item entitled *Alarm Config*



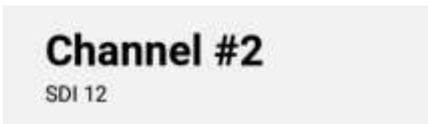
29. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.



30. We ensure that *Mode* is set to *Off*

31. Now that we have applied all the required channel-specific configuration options, we tap the back button to return to the *SENSORS* menu.

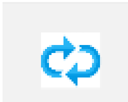
32. To configure our second sensor channel to take the associated temperature measurement, we repeat the above steps from 8 with a few notable exceptions
    a. We apply the configuration to sensor channel 2



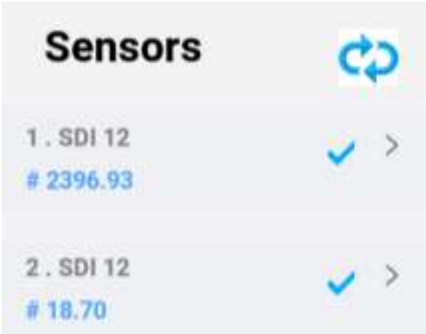
    b. We set our sensor label to VWP1[°C]

c. We select SDI 12 *Measurement Index* channel 2, which we deduce from referring to *Appendix 1: VWT Measurement Index Channels*

33. From the *SENSORS* menu, we wait for the next scheduled measurement and tap the refresh button to view the latest measurement data.



34. In this example we note a frequency of $2.4kHz$ ad the frequency, which is listed in channel 1 and a temperature of $18.70°C$ which is listed in channel 2. Note that the reported units (Hz and $°C$) are not inherently known by the Switch; they are simply a reporting of raw data as provided by the attached sensor (with the configured averaging, gain and scaling applied).



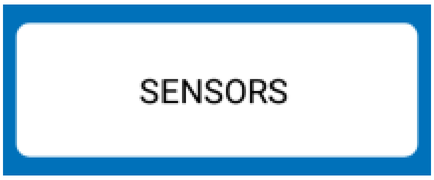
Water Temperature Measurements with an In-Situ Inc. Level TROLL 500 Multiparameter Sonde via MODBUS

In this example a Switch is used to take a water temperature measurement on an hourly schedule. Battery level measurements are also reported.

1. Ensure your smartphone or mobile device is loaded with the EWS Australia SwitchComm app.
2. Ensure your TROLL 500 sensor is connected to the Switch.
3. Whist standing within Bluetooth pairing distance from the Switch, navigate to the SwitchComm and tap *SwitchLogger* to pair.

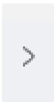
4. Upon a successful connection you should see the Bluetooth logo illuminate in blue. Device specific configuration options, including the transmission schedule can be configured by tapping the *SwitchLogger* button once more. For a detailed description of the options available, refer to the Switch Logger section of this manual.

5. Tap the *SENSORS* button to view and modify the sensor-specific configuration options for each of the sensor channels on the Switch.

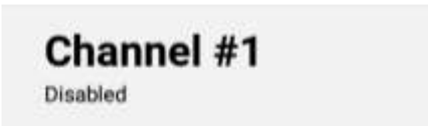


6. The sensors menu will open, listing all of your available sensor channels.

7. We select the first sensor channel, which will (in this example) be configured to measure the rechargeable battery voltage.



8. The configuration options for channel one will be displayed.

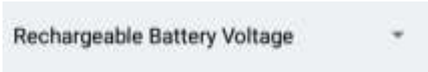


9. Inside each channel there will be a menu item entitled *Channel Config* which may be used to modify channel specific configuration options.

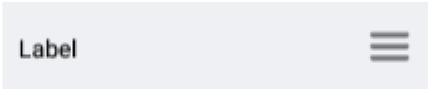
10. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

11. A dropdown to define the sensor type should be visible. Tap the arrow to expand this menu.

12. Select *Rechargeable Battery Voltage* as the sensor type.



13. We assign a meaningful label to this channel



14. Measurements are scheduled to begin at 12 noon

15. Measurements are set to be taken each hour

16. Averaging is not required so we set it to zero

17. The sampling interval can be set to zero

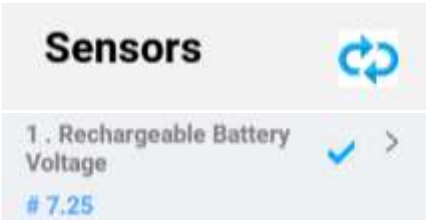
18. Battery voltage measurements can be performed instantaneously without any warmup required, so we can set the *Warmup Period* to zero. This will save battery power because the

longer the Switch remains awake during the measurement process, the more power will be consumed.

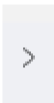
19. We do not need to apply any gain or offset adjustments to the battery reading, so can leave the gain and offset as one and zero respectively

20. Tapping the *SensorsList* button to return to the *Sensors* menu

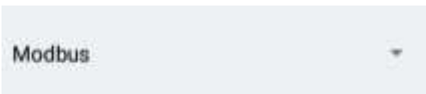
21. You should see the voltage sensor listed. (The most recent voltage reading level will only appear after the sensor's next scheduled measurement.)



22. We now configure the Level TROLL to take water temperature measurements. (The previous section of this example is not required for the purpose of taking water temperature measurements; it has been included to demonstrate how a variety of different types of sensor measurements may be included.) To access the configuration options for our water temperature measurements, we tap on the arrow listed next to channel two.



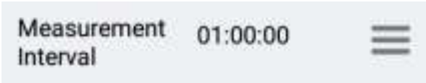
23. Select *Modbus* as the sensor type.



24. We assign a meaningful label to this channel. In this example we use $G24$ to denote some arbitrary sensor and $[^\circ C]$ to describe that the temperature reading is taken in degrees Celsius. You should replace this label with something that is meaningful in your application.

25. Measurements are scheduled to begin at 12 noon

26. Measurements are set to be taken each hour



27. Averaging is not required so we set it to zero

28. The sampling interval can be set to zero

29. We require our sensor to warm up to a stable condition before taking measurements. We will set the *Warmup Period* to 11 seconds. (For this particular type of sensor, we recommend a *Warmup Period* of at least 5 seconds.)

30. We do not need to apply any gain or offset adjustments to the battery reading, so can leave the gain and offset as one and zero respectively

31. We will configure the modbus protocol specific configuration options, which are listed under the menu item entitled Modbus Config

32. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

33. We select *Modbus Address* as 1. We have determined this address by consulting the sensor datasheet.

34. We select *Modbus Register* as 45. We have determined this address by consulting the sensor datasheet.

35. We select *Register Data Type* as *IEEE single precision float.* We have determined this data type by consulting the sensor datasheet.

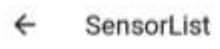
36. We select *Register Endianess* as *Little Endian*. We have determined this data format by consulting the sensor datasheet.

37. We set a *Timeout* of 500ms

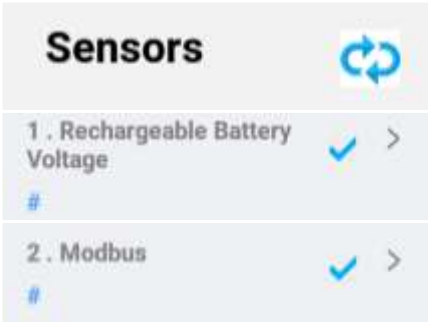
38. We set *Retry Count* to attempt to resend data up to three times if there is an error transmitting

39. We set the *Register Type* as a *Holding Register*. We have determined this register type by consulting the device datasheet.

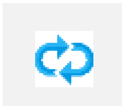
40. Tapping the *SensorsList* button to return to the *Sensors* menu



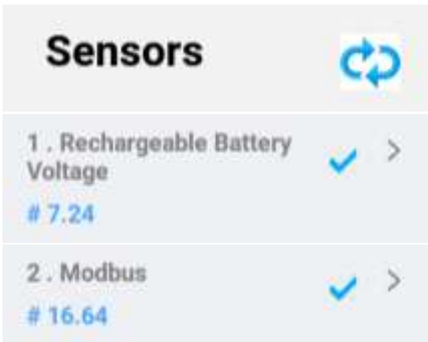
41. The temperature sensor is now listed as *Modbus*



42. Pressing the refresh button will force a measurement to be taken from each sensor, which we will do to ensure that the sensors have been configured correctly



43. The sensor readings will read and update



Electrical Conductivity Measurement using 4-20mA Current Loop

In this example a Switch is used to take a conductivity measurement with an EC (electrical conductivity) sensor. In this example we use an electrical conductivity sensor with conductivity in the range $0 \rightarrow 20mS/cm$.

When connecting a 4-20mA sensor, it is important to check the manufacturers manual for wiring requirements. Sensors commonly comprise 2-wires (as required to make a current loop), with one wire to provide power and the other to sense the return current. Some sensors will contain 3-wires. The third wire (an ultra-low current ground connection) is not required by the Switch and may be left disconnected. The Switch supports up to two 4-20mA sensors. The pin connections (for 2-wire sensors) are shown in Table 5.

Table 5 – 4-20mA Sensor Pins

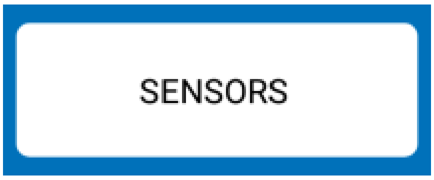
Number	Sensor A (4-20mA Loop 1)	Sensor B (4-20mA Loop 2)
SW Power 12V+	Pin 3	Pin 3
4-20mA	Pin 1	Pin 5

Measurements for a 4-20mA current loop are provided in terms of the current (in milliamperes) that has been detected. To translate this reading into a value that has a more intuitive meaning, you will need to multiply the sensor reading by an appropriate gain and add an appropriate offset value. In our example we will require a gain of 1.25 and offset of -5.

1. Ensure your smartphone or mobile device is loaded with the EWS Australia SwitchComm app.
2. Ensure your 4-20mA sensor is connected to the Switch according to the pin connections described in Table 5.
3. Whist standing within Bluetooth pairing distance from the Switch, navigate to the SwitchComm and tap *SwitchLogger* to pair.

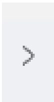
4. Upon a successful connection you should see the Bluetooth logo illuminate in blue. Device specific configuration options, including the transmission schedule can be configured by tapping the *SwitchLogger* button once more. For a detailed description of the options available, refer to the Switch Logger section of this manual.

5. Tap the *SENSORS* button to view and modify the sensor-specific configuration options for each of the sensor channels on the Switch.

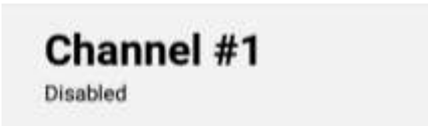


6. The sensors menu will open, listing all of your available sensor channels.

7. We select the first sensor channel, which will (in this example) be configured to measure the 4-10mA sensor current.



8. The configuration options for channel one will be displayed.

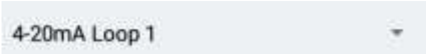


9. Inside each channel there will be a menu item entitled *Channel Config* which may be used to modify channel specific configuration options.

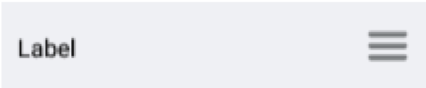
10. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

11. A dropdown to define the sensor type should be visible. Tap the arrow to expand this menu.

12. We select *4-20mA Loop 1* as the sensor type. The sensor is of type 4-20mA current loop and the index 1 corresponds to the sensor measurement taken with Sensor 'B'. (See Types of Connectors section in for more details.)



13. We assign a meaningful label to this channel. In this example we call our sensor Cond001 as it is the conductivity sensor at location 001. You will need to choose a label that is meaningful in the context of your application.



14. Measurements are scheduled to begin at 12 noon

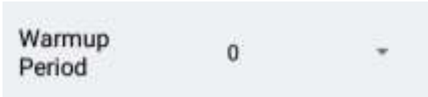
15. Measurements are set to be taken each hour

16. Averaging is not required so we set it to zero

17. The sampling interval can be set to zero

18. Our conductivity measurement can be performed instantaneously without any warmup required, so we can set the *Warmup Period* to zero. This will save battery power because the

longer the Switch remains awake during the measurement process, the more power will be consumed.



19. We wish to scale our current reading (in mA) to a conductivity (in mS/cm). Our sensor is specified to measure the range $0 \rightarrow 20mS/cm$. That is, a current reading of $4mA$ corresponds to a conductivity of $0mS/cm$ and a current reading of $20mA$ corresponds to a conductivity of $20mS/cm$. By applying a gain of 1.25 and an offset of -5 the value reported by the Switch may be interpreted as though it were in units of mS/cm.

You will need to select an offset and gain relevant to your particular application. For a reference of common scaling factors, please refer to Appendix 2: 4-20mA Current Loop Scaling Factors

20. Tapping the *SensorsList* button to return to the *Sensors* menu

21. You should see the voltage sensor listed. (The most recent conductivity reading will appear after the sensor's next scheduled measurement.)

Rainfall Measurements with a Tipping Bucket Rain Gauge Pulse (Frequency Counter Loop) Measurement

A tipping bucket rain gauge (TBRG) may be used to measure the quantity of rain that has fallen in a given period. Each time a certain volume of rain has fallen, the TBRG will tip and sent a pulse signal to the Switch. The frequency of pulses detected may be used to gauge the rate of rain that has fallen at the sensor location.

The Switch can support up to two pulse (frequency counter loop) measurements. The pins for detecting such a sensor output are labelled *Pulse* in Table 2, Table 3 and Table 4. A summary of the pins required for pulse (frequency counter) measurements is provided in Table 6. The appropriate SwitchComm App menu option for selecting this type of sensor measurement is $Frequency\ Counter\ Loop$.

Table 6 – Pulse Sensor Pins

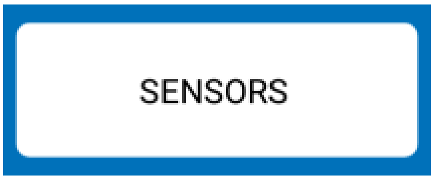
Number	Sensor A (Pulse 2)	Sensor B (Pulse 1)
PULSE	Pin 1	Pin 5
GND	Pin 4	Pin 4

In this example, we consider a TBRG with a $0.2mm/tip$ sensitivity. We can apply a gain of 0.2 to the raw sensor measurement to convert the pulse count into the quantity of rain that has fallen in millimetres.

1. Ensure your smartphone or mobile device is loaded with the EWS Australia SwitchComm app.
2. Ensure your TBRC pulse output is connected to the appropriate pins of the Switch. (See Table 6 for or the Connection Guide section for more information.)
3. Whist standing within Bluetooth pairing distance from the Switch, navigate to the SwitchComm and tap *SwitchLogger* to pair.

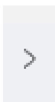
4. Upon a successful connection you should see the Bluetooth logo illuminate in blue. Device specific configuration options, including the transmission schedule can be configured by tapping the *SwitchLogger* button once more. For a detailed description of the options available, refer to the Switch Logger section of this manual.

5. Tap the *SENSORS* button to view and modify the sensor-specific configuration options for each of the sensor channels on the Switch.



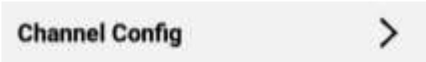
6. The sensors menu will open, listing all of your available sensor channels.

7. We select the first sensor channel, which will (in this example) be configured to measure the rainfall sensed by at TBRG.



8. The configuration options for channel one will be displayed.

9. Inside each channel there will be a menu item entitled *Channel Config* which may be used to modify channel specific configuration options.



10. Upon tapping the arrow, the menu will expand to list the set of configuration options available for the selected channel.

11. A dropdown to define the sensor type should be visible. Tap the arrow to expand this menu.

12. We select *Frequency Counter Loop 1* as the sensor type. The sensor is a pulse sensor (Frequency Counter Loop) and the index 1 corresponds to the sensor measurement taken with Sensor 'B'. (See the Types of Connectors section in for more details.)

13. We assign a meaningful label to this channel

14. Measurements are scheduled to begin at 12 midnight

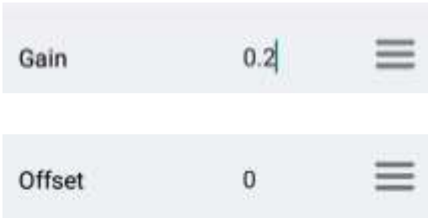
15. Measurements are set to be taken each hour

16. Averaging is applied at a 15-minute window

17. The frequency counter samples are taken every minute

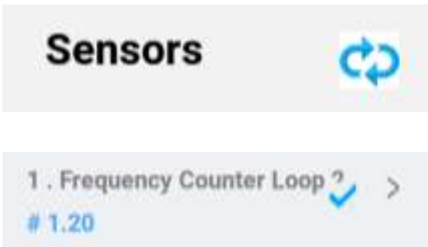
18. Our conductivity measurement can be performed instantaneously without any warmup required, so we can set the *Warmup Period* to zero. This will save battery power because the longer the Switch remains awake during the measurement process, the more power will be consumed.

19. We apply a gain of 0.2 and an offset of 0 to convert our TBRG pulse measurement (where the TBRG has a sensitivity of $0.2mm/tip$) to a rainfall measurement (in mm).



20. Tapping the *SensorsList* button to return to the *Sensors* menu

21. You should see the voltage sensor listed. (The most recent rainfall reading will only appear after the sensor's next scheduled measurement.)



TECHNICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Value	Unit
Input Voltage	25	V
Storage Temperature	60	$°$
Operating Temperature	40	$°$

Electrical Characteristics

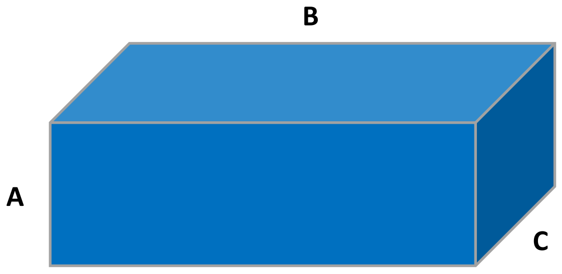
Parameter	Minimum	Typical	Maximum	Unit
Input Voltage	12	15	24	V
Current (Sleep Mode)	0.12	0.18	0.24	mA
Current (Sensor Measurement)	1	20	500	mA
Relay Voltage		12		V
Relay Current	0	100	500	mA

Mechanical Characteristics

Parameter	Minimum	Typical	Maximum	Unit
Weight	225	250	275	g
Operating Temperature	0	25	40	$°$

Mechanical Dimensions

Switch



Dimension	Minimum	Typical	Maximum	Unit
A	40	41	43	mm
B	112	115	118	mm
C	52	55	58	mm

APPENDIX 1: VWT MEASUREMENT INDEX CHANNELS

Sensor	Measurement Type	SDI 12 Address	Measurement Index
VWP1	Frequency	1	1
VWP1	Temperature	1	2
VWP2	Frequency	1	3
VWP2	Temperature	1	4
VWP3	Frequency	1	5
VWP3	Temperature	1	6
VWP4	Frequency	1	7
VWP4	Temperature	1	8

APPENDIX 2: 4-20MA CURRENT LOOP SCALING FACTORS

By applying the gain and offset values provided in the following table, you will scale your 4-20mA current sensor reading into the range of values listed.

Gain	Offset	Min ($4mA$)	Max ($20mA$)
0.312	-1.25	0	5
0.625	-2.5	0	10
1.250	-5.0	0	20
1.875	-7.5	0	30
2.500	-10.0	0	40
3.125	-12.5	0	50
3.750	-15.0	0	60
4.375	-17.5	0	70
5.000	-20.0	0	80
5.625	-22.5	0	90
6.250	-25.0	0	100