SEN-PROBE-LR is an IoT based soil moisture and soil temperature sensor. It is a portable, robust and waterproof solution to obtain critical information about the tested soil. There are 4 different probe variations based on the soil depth ranging from 20cm, 60cm, 80cm and 120cm. The device helps in providing relevant information to maintain ideal conditions to provide high quality and high yield crops.

The **SEN-PROBE-LR** can last up to 3 years with a single change of batteries when configured to report daily. It only requires an initial configuration based on the length of the probe and the frequency of reports. It requires no further calibration and is easy to install.

All **SENSUM** devices come with three months of free access to the Sensum IoT Platform. For more information on the features and benefits of using **SEN-PROBE-LR** please visit www.sensum.co.nz/senprobe/.

Mechanical Features

Device Dimensions	L 83mm x W 63mm x H 33mm L 111mm x W 63mm x H 33mm (including flange)
Weight	145g including battery
Operating Temperature	-20ºC to 60ºC
IP Rating	IP67 housing
Mounting	Flanged box mounted with two screws
Gland	SKINTOP® STR M12 x1.5 (light grey)
Antenna Type	Configurable, External monopole whip (L 100mm x D 20mm x H 5mm) External dipole (L 120mm x W 20mm x H 5mm, cable length 100mm)

Connectivity

Network	LoRaWAN
Transmission Band	923MHz
Region	AS923
Transmission Range	Urban environment radius – 15 km
Transmission Frequency	Configurable, 2 transmissions per day by default

Reporting Information

Information	Battery voltage, Probe voltage, Ambient temperature, Soil depth temperatures, Soil water concentration
Features	Low battery warnings,
Online Dashboard	Sensum IoT platform

Battery	
Type	3 x AAA lithium cells (battery not included)
Operating Voltage	4.5V
Sleep Current	35 uA
Estimated Lifetime	3 years based on the default configuration of 2 reports per day (see figure 1)

Probe	
Operating Voltage	3.6V
Probe Size Variations	a. 20cm – 2 sensors @ 10cm, 20cm b. 60cm – 6 sensors @ 10cm, 20cm, 30cm, 40cm, 50cm, 60cm d. 80cm – 6 sensors @ 10cm, 20cm, 30cm, 40cm, 60cm, 80cm b. 120cm – 6 sensors @20cm, 40cm, 60cm, 80cm, 100cm, 120cm
Sensor Accuracy	Each sensor inside the probe is of 10cm length, the temperature is measured at 4cm from the top of the sensor this measures the average soil water content and soil temperature through a 10cm horizon depth.
Probe Configurations	- Soil moisture probe (60cm,80cm,120cm) – can record data on soil temperature / moisture. - Golf course probe (60cm,80cm) – can log data on soil temperature/ moisture on golf courses on golf courses where obstacles aren't allowed to visible at all. - Hydroponics probe (20cm) – can record data on soil temperature / moisture in plant nurseries inside plant pots. (see figure 2) - Sub-surface probe (80cm) – can record data on soil temperature/ moisture in areas that are prone to be disturbed on the surface. The entire probe is underneath the earth's surface. (see figure 3)

Warranty	
Warranty Period	12 months

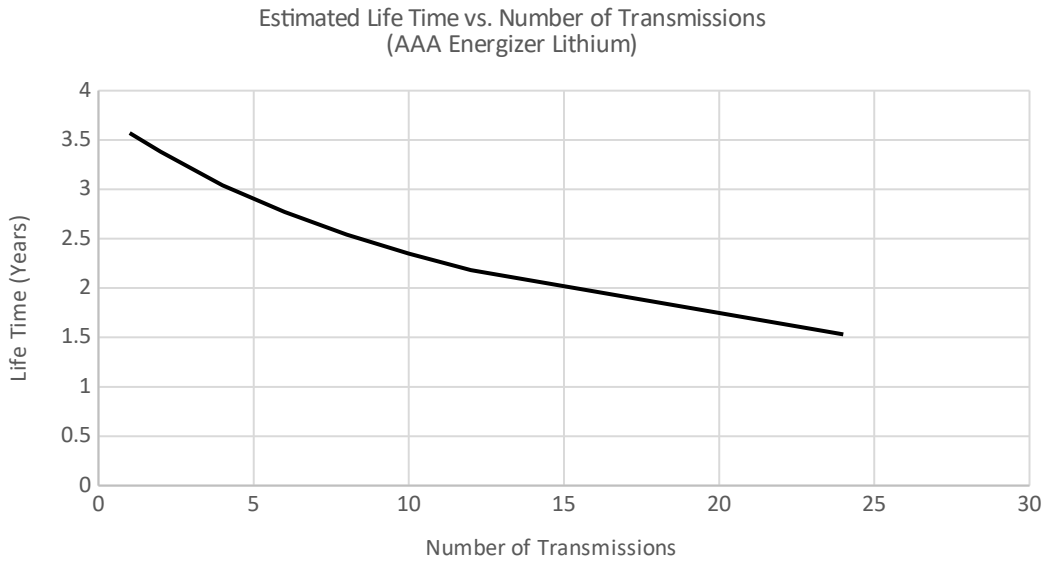

Figure 1: Estimated Life Time vs Number of Transmissions using an Energizer AAA Lithium Battery

Figure 2: Sen-Probe-LR with the 20cm hydroponics probe attached to it

Figure 3: 80cm sub-surface probe

INSTRUCTIONS TO CONNECT A PROBE TO THE SENPROBE

1. Remove the lid of the box by unscrewing the 4 screws on top.
2. Unscrew the cap of the gland and remove the rubber grommet found inside.
3. Pass the cap of the gland through the water meter cable and then pass the rubber grommet afterwards.
4. Pass the cable of the meter through the gland into the inside of the box.
5. Now that the wires are inside the package they are to be connected to the board through the green connector. Hold down connector buttons to open and release the individual connections. Connect wires according to Fig. 4 and Table 1 below.

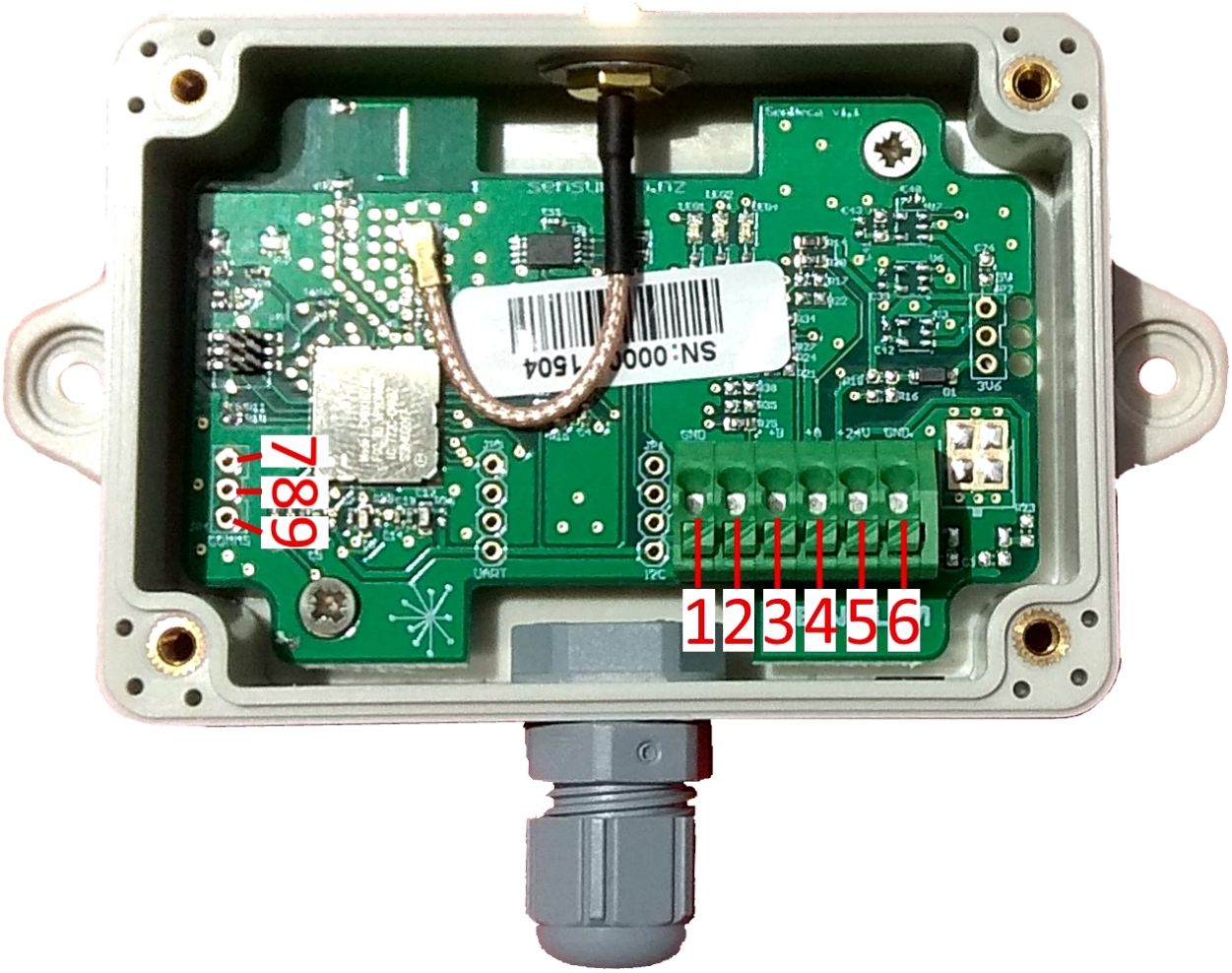

Figure 4: SenProbe wire connection guide.

	1	2	3	4	5	6	7	8	9
SenProbe	GND	RX (To Probe)	TX (From Probe)	Power (Probe)	3V	GND	GND	TX - To PC	RX - From PC

Table 1: Connection guide for the different mode configurations.

CONFIGURATION INSTRUCTIONS

1. It is not necessary to have your metering device connected to your SenProbe in order to configure it.
2. If you don't have one already install a serial terminal on your computer to be able to configure the SenProbe. This device uses USART serial communication for configuration. For a simple setup we suggest you install and use the termite terminal and use the setting in Fig. 5
3. Power device on, after which you will have a 30 second window to connect to it through your serial interface. If you have missed your opportunity to connect, reset the device by unplugging the power, waiting 10 seconds then powering the device again.
4. Using a serial cable, physically connect the device to your computer by the pins 7/8/9 shown in Fig. 4.
5. Your device should be visible in the serial terminal at this point, you just need to set the COM port related to your device. In Fig. 5 the terminal is set to the port COM5 but in your case this will depend on which port you plugged your device into.
6. Now that you are in the configuration command line, use the commands listed in Table 2 to configure report rate, leak period, burst thresholds, device mode and current time.
7. ***Make sure you begin by setting device mode first.***
8. After typing your configuration settings, they will be saved but not implemented into the device until the "***flash save config***" command is entered.
9. Once you are done configuring, just close the command line and disconnect the serial cable. Your device is now ready to add your meter to the IoT network.

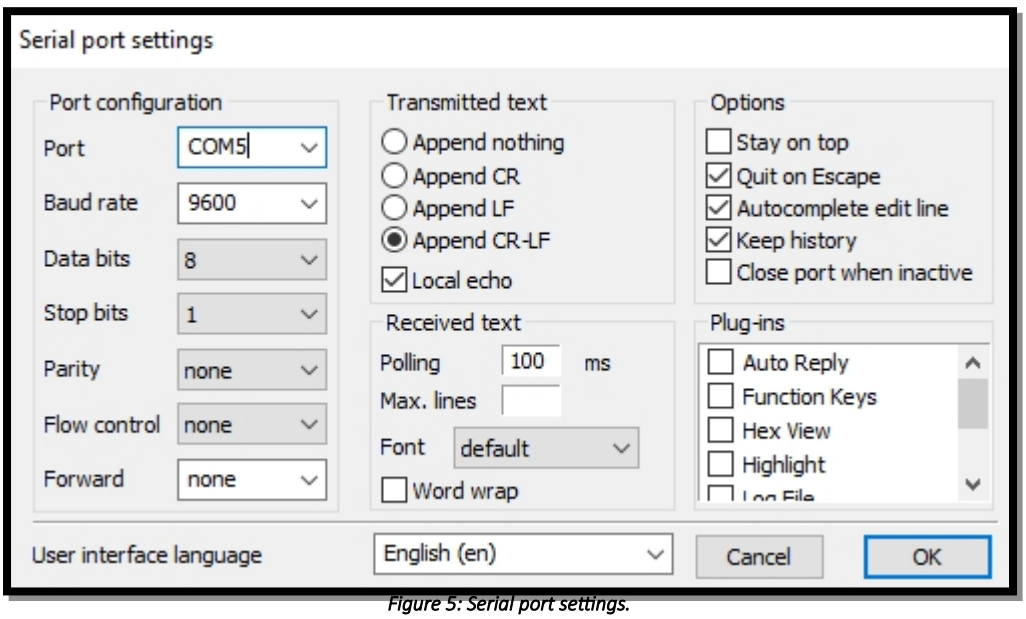

Figure 5: Serial port settings.

SENPROBE CONFIGURATION

Generic Commands ('x' denotes configuration value)	Description
mode x	Sets the operating mode, in the case of the SenProbe, this is set by the value 7
wakeup x	Sets the wakeup period (minutes) at which interval the SenProbe transmits data
rejoin x	Sets the re-join period (hours)
time hour x	Set the device clock (hours)
time minute x	Set the device clock (minutes)
time second x	Set the device clock (seconds)
help	Shows a list of available commands
run	Closes command line and runs
show	Shows current configuration
flash save config	Make configuration changes permanent
flash save data	Make data changes permanent

Table 2: SenProbe Configurations.

PACKET STRUCTURE – SEN PROBE

Initial/Start-up Packet – Header Value: 0

Type	*System Voltage*	*Reserved*	*Hours*	*Minutes*	*Seconds*	*Device Mode*	*Version*	*Hash*
4bit	*4bit*	*7bit*	*5bit*	*6bit*	*6bit*	*8bit*	*16bit*	*24bit*

MSB ***LSB***

Table 3: Packet sent on start-up

Temperature Packet – Header Value: 2

Type	*System Voltage*	*Temperature fields (1 – 6)*	*Ambient Temperature*
4bit	*4bit*	*8bit each*	*8bit*

MSB ***LSB***

Table 4: Data packet sent periodically.

Humidity Packet – Header Value: 6

Type	*System Voltage*	*Humidity fields (1 – 6)*
4bit	*4bit*	*7bit each*

MSB ***LSB***

Table 4: Data packet sent periodically.

Error Packet – Header Value: 1

Type	*System Voltage*	*CRC Error*	*No Probe*	*Reserved*
4bit	*4bit*	*1bit*	*1bit*	*6bit*

MSB ***LSB***

Table 5: Error packet sent if something goes wrong.

PACKET STRUCTURE – FIELD DESCRIPTIONS

Type	Indicates type of packet for the receiver to interpret. 'Header Value' indicates the value corresponding to the packet type.
System Voltage	The voltage input into the internal SenProbe circuit.
Hours/ Minutes/ Seconds	The time set on the Sensum device at the moment of transmission.
Device Mode	Indicates the type of Sensum device, in this case it is the SenProbe.
Version	The Sensum product iteration.
Hash	A unique code that represents the exact version of source code on the Sensum product. Used for diagnostics purposes by Sensum.
Reserved	Not for use.
Temperature	Twos-compliment Signed Temperature reading in °C.
Humidity	Humidity reading from the device. Value in packet is twice the actual humidity (i.e. packet value 100 is 50% humidity).

Table 6: Description of each field in the transmitted packets.

The table underneath shows the data field which needs to be scaled and offset to be interpreted correctly.

Field Properties

	Scaling Factor	**Offset**	**Decimals**	**Singed Y/N**	**Units**	**Range**
System Voltage	0.1	2	1	N	V	2V – 3.6V
Temperature	1	0	0	Y	°C	-127 °C - 127°C
Humidity	0.5	0	1	N	%H	0% - 100%

Table 7: Scaling and unit of system voltage field.

ERRORS

Device errors are indicated by the three LEDs. Table 11 below indicates what the errors are and the LED configurations which represent these errors. One thing to note is that when configuring your device, all LEDs will be on until it has joined to a network. This will be 30 s after switching the device on or when you configure the device to run.

Green	Orange	Red	Error meaning
			Joining network
			Unconfigured
			Peripheral test failed
			Failed at joining network

Table 8: LED indicated errors.

Revision History

REV 1	Initial release
REV 2	*Gland* and *PCB Connector* added to *Mechanical Features* Section
REV 3	*Warranty Period* added to *Warranty* Section
REV 4	- *"battery not included"* commented on *Type* in *Battery* Section - Addition of *Revision History* Section
REV 5	- *Added configuration instructions* - *Added Connecting instructions* - *Added packet and field descriptions* - *Added error indications*
REV 6	Modified Packet Structure to reflect changes in firmware