USER GUIDE FOR SIGFOX SENSOR WITH ANALOG INPUT WSSFC-AI

THIS IS **OBSOLETE** MANUAL

Please access https://www.iot.daviteq.com/wireless-sensors for updated manual

WSSFC-AI-MN-EN-01	FEB-2020

This document is applied for the following products

SKU	WSSFC-AI	**HW Ver.**	2.4	**FW Ver.**	1.9.3
Item Code	WSSFC-AI-9-01	Sigfox Sensor with Analog input 0-20mA or 0-10VDC, pre-calibrated, Internal antenna, Type C battery 1.5 - 3.6VDC, IP67, M12-M for sensor connection, M12-F for external power supply, RC2-RC3-RC4-RC5 zones			
	WSSFC-AI-8-01	Sigfox Sensor with Analog input 0-20mA or 0-10VDC, pre-calibrated, Internal antenna, Type C battery 1.5 - 3.6VDC, IP67, M12-M for sensor connection, M12-F for external power supply, RC1-RC6-RC7 zones			

1. Functions Change Log

HW Ver.	FW Ver.	Release Date	Functions Change
1.0	1.0.1	FEB-2020	
1.0	1.0.1	08-MAY-2020	Updated correct file for CONFIGURATION TEMPLATE FILE FOR SIGFOX WSSFC-AI FW1.9.3.csv

2. Introduction

WSSFC-AI is the modular design Sigfox wireless sensor, based on 10-year experience in design and manufacturing Industrial sensor of Daviteq Company. It can accepts the analog output signal 0-20mA/0-10VDC from any sensor, transmitter...It can supplies the power to external sensor at 15VDC @ 50mA max. With Ultra-low power design and smart firmware allow the complete Wireless and Sensor package run on a Single battery C type up to 10 years. WSSFC-AI can support all regions of Sigfox network in over the World, RC1, RC2, RC3, RC4, RC5, RC6, RC7.

3. Specification

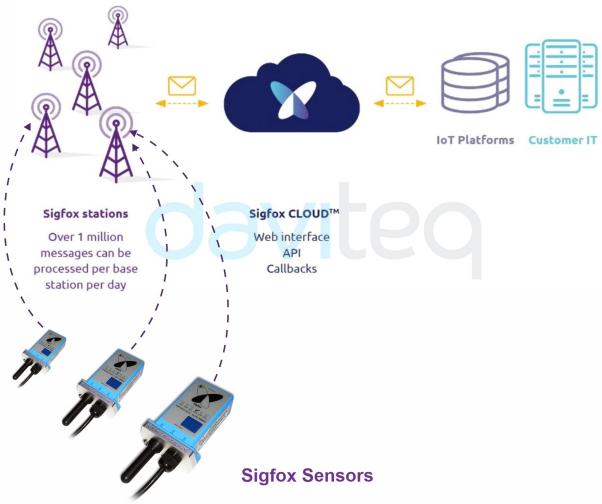
Input	01 x Analog input, 0 .. 20mA or 0..10VDC, selectable
Accuracy	0.05% of span
Resolution	1/3000
Temperature drift	< 50ppm
Power supply to sensor	15VDC @ max 50mA
Electrical connection	M12-M connector
Sigfox zones	select RC2-RC3-RC4-RC5 or RC1-RC6-RC7
Antenna	Fixed external Antenna 2.67 dbi
Battery	01 x C Type 1.5 - 3.6VDC, working time up to 10 years (depends on configuration), extendable by external battery box or power supply
RF Module complies to	CE, FCC, ARIB
Working temperature	-40oC..+85oC (using LS26500 battery)
Dimensions	H106xW73xD42 (Wireless part only)
Netweight	190 grams (Wireless part only)
Housing	Aluminum + Polycarbonate plastic, IP67

4. Product Pictures

SIGFOX SENSOR - ANALOG INPUT BATTERY POWERED

WSSFC-AI-H1.PNG

SYSTEM ARCHITECTURE



WSSFC-AI-H2.PNG

SIGFOX SENSOR ANALOG INPUT CONNECT WITH 4-20mA LEVEL SENSOR

WSSFC-AI-H3.PNG

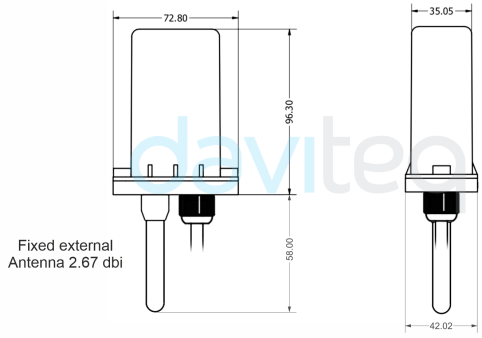
SIGFOX SENSOR ANALOG INPUT CONNECT WITH 4-20mA SOIL MOISTURE SENSOR

WSSFC-AI-H4.PNG

SIGFOX SENSOR ANALOG INPUT CONNECT WITH 4-20mA PRESSURE SENSOR

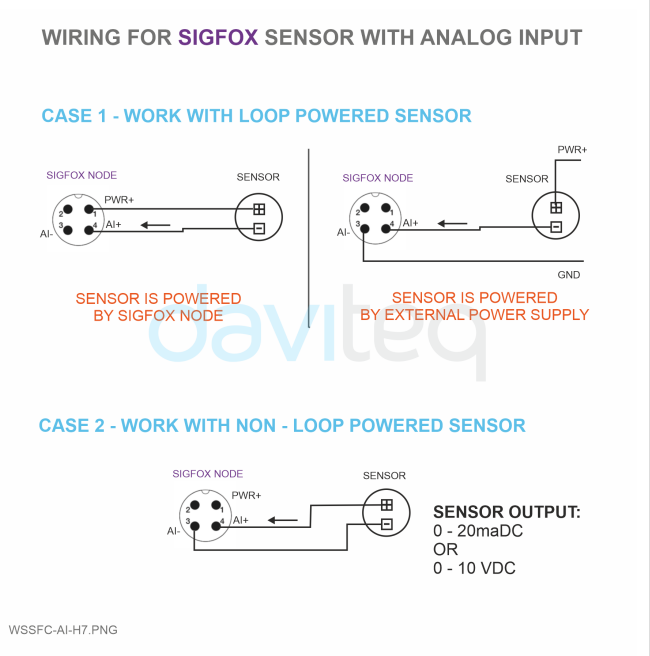
WSSFC-AI-H5.PNG

DIMENSION DRAWINGS FOR SIGFOX SENSOR WITH ANALOG INPUT

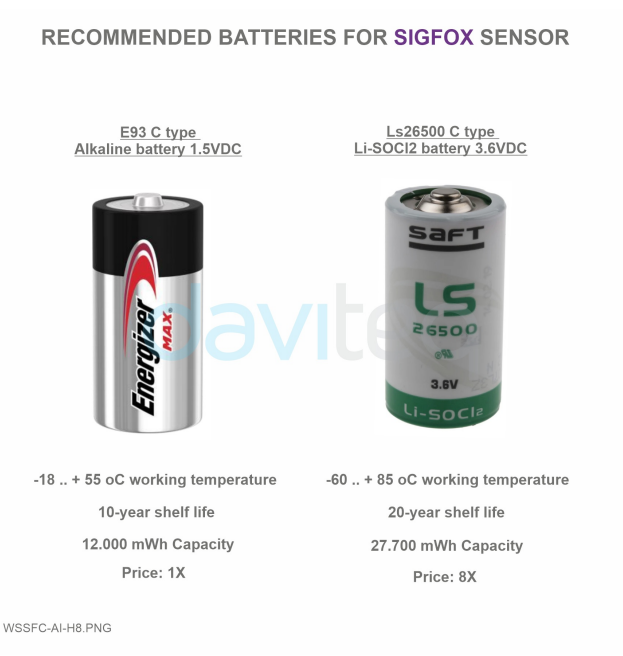


UNIT: mm

WSSFC-AI-H6.PNG



WSSFC-AI-H7.PNG



WSSFC-AI-H8.PNG

5. Operation Principle

SIGFOX SENSOR WITH ANALOG INPUT WSSFC-AI has one port of analog can accept the DC current input from 0 - 20mA. It can also provide the power supply to the external sensor or field instrument, the power supply is at 15VDC @ max 50mA.

> Upon power on, the Sigfox node has 60 seconds to wait for off-line configuration (via cable with ModbusRTU protocol).

After that, sigfox node will send the first message to Base station.

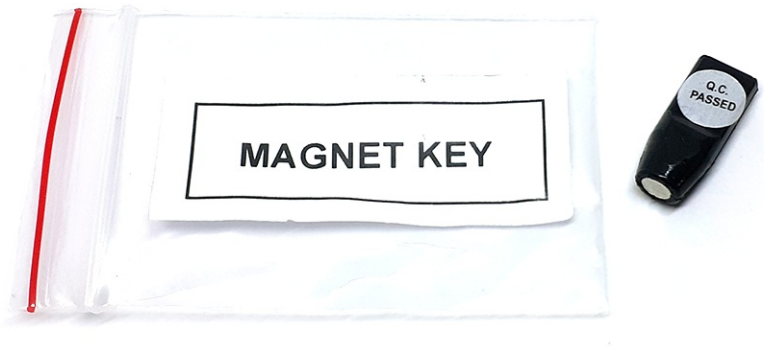
Then during the operation, there are 03 cases of sending data to base station:

1. When the sensor sampling time interval is reached, the Sigfox node will read the data from Input or sensor and performing the calculation. After that it will check calculated value with alarm thresholds. If the calculated was out off the threshold values (Lo or Hi), called alarm, and the number of times of alarm did not pass the limit of number of alarms, then it will send data to Base station immediately;

   > **NOTE:**
   >
   > Once sending the data to base station by this alarm event, the timer of sending time interval will be reset.

2. When the sending time interval is reached, it will send data to Base station immediately, regardless of value;
3. By using the magnet key, the Sigfox node can be force to send data to base station immediately.

   > *** Notes:**
   >
   > Once sending the data to base station by the magnet key, the timer of sending time interval will be reset;
   >
   > The shortest duration between 02 times of magnet key activation should be larger than 15s (no downlink) or 60s (with downlink);



5.1 LED meaning

Whenever the data is sent to base station, the LED will lit with colour codes as below:

- **RC1:** RED colour
- **RC2:** GREEN colour
- **RC4:** BLUE colour

5.2 RC technical details

The RF transmit power will be automatically set as the max value as allowed by the Zone.
Sigfox Radio Configuration (RC) defines the radio parameters in which the device shall operate: Sigfox operating frequencies, output power, spectrum access mechanism, throughput, coexistence with other radio technologies, etc.

Each radio configuration includes 4 uplink classes: 0u, 1u, 2u, and 3u.

The Sigfox network globally works within the ranges from**862 to 928 MHz**. But not all RCs require such a wide range of operation.

	RC1	RC2	RC3	RC4	RC5	RC6	RC7
Uplink center frequency (MHz)	868.130	902.200	923.200	920.800	923.300	865.200	868.800
Downlink center frequency (MHz)	869.525	905.200	922.200	922.300	922.300	866.300	869.100
Uplink data rate (bit/s)	100	600	100	600	100	100	100
Downlink data rate (bit/s)	600	600	600	600	600	600	600
Sigfox recommended EIRP (dBm)	16	24	16	24	14	16	16
Specifics	Duty cycle 1% *	Frequency hopping **	Listen Before Talk ***	Frequency hopping **	Listen Before Talk ***		Duty cycle 1% *

* **Duty cycle** is 1% of the time per hour (36 seconds). For an 8 to 12 bytes payload, this means 6 messages per hour, 140 per day.

** **Frequency hopping**: The device broadcasts each message 3 times on 3 different frequencies. Maximum On time 400 ms per channel. No new emission before 20 s.

*** **Listen Before Talk**: Devices must verify that the Sigfox-operated 200 kHz channel is free of any signal stronger than −80 dBm before transmitting.

Sigfox’s high limit EIRP recommendation is included in each column although regulations sometimes allow for more radiated power than the Sigfox recommendation.

Sigfox’s recommendation is set to comply with the Sigfox technological approach of:

- Low current consumption
- Balanced link budget between uplink and downlink communication

5.3 Process of measurement

When the sensor sampling time interval is reached, for example 2 minutes, the Sigfox node will wake up and switch **ON** the power supply to supply the energy to external sensor to start the measurement. Depends on the type and characteristic of external sensor, the sensor will take a certain time to finish the measurement and deliver the stable output of DC current.

For example, the measurement time is 500ms, after this time, the Analog input port of Sigfox node will read the value of DC current and then perform the calculation inside the micro-controller unit, with low cut and high cut performing Upon finished reading, Sigfox node will switch **OFF** power supply to external sensor to save energy. The shorter of measurement time, the more saving of energy of battery. The measurement time will be configured via offline Modbus configuration tool.

Once reading the analog value, the raw data is from 0 .. 4095 (unsigned integer), it can be scaled to any engineering value by the following formula:

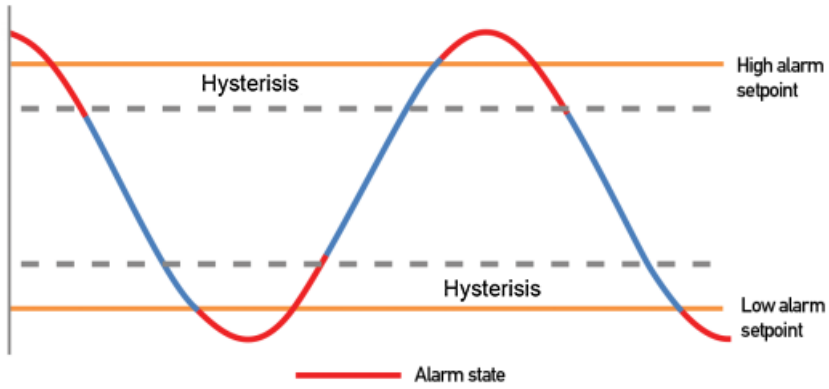
$$Y = aX + b$$

Where:

- **X:** the raw value (0..4095) from analog input port
- **Y:** the calculated value will be sent to Sigfox base station in the payload data.
- **a:** constant (default value is 1)
- **b:** constant (default value is 0)

So, if there is no user setting for **a** and **b** ==> **Y** = **X**

The **Y** value will be compared with Lo and Hi threshold. Please refer below the graph of alarm processing.



5.4 Payload Data

The folllowing is the format of payload data will be sent to Sigfox server. Length is 6 bytes, it is future-proof for expansion to 12 bytes.

Sensor type (1 byte)	Status (1 byte)	1st - Parameter (4 bytes)

Meaning of Data in the Payload

Data	**Size (byte)**	**Bit**	**Format**	**Meaning**
Sensor type = 00000001	1	all	Uint8	- Sensor type = 00000001 means Sigfox node with analog 0-20mAdc input
Status: batt level	1	Bit 7 and 6	Uint8	Battery capacity in 04 levels 11: battery level 4 (99%) 10: battery level 3 (60%) 01: battery level 2 (30%) 00: battery level 1 (10%) The next - 2 bits : The next - 2 bits : b

Status: error		Bit 5 and 4		Node status 01: error 00: no error
Status: alarm 1		Bit 3 and 2		Alarm status of 1st - parameter (Y value) 11 : Hi alarm 01 : Lo alarm 00 : No alarm
Status: alarm 2		Bit 1 and 0		Spare for alarm status of 2nd - parameter
1st - Parameter	4	all	float	- Y value (calculated value of measurement)

6. Configuration

> Serial port configuration on computer: **9600** baud, **None** parity, **1** stop bit.
>
> Reading data by **Function 3.**
>
> Writing data by **Function 16**.

During connection with Modbus configuration tool, the Sigfox node will send all data in realtime: Battery, Battery level, Vref, Button status, reedswitch status, PCB temperature, Measured value, alarm status.

Step to configure & check data:

> **NOTE:**
>
> the Modbus configuration can be done in the first **60s** after power up the Sigfox node. After 60s, if user can not finish the configuration, user need to reset the power of Sigfox node again.

Step 1: Install the Modbus Configurator Software in the link below

https://filerun.daviteq.com/wl/?id=BaX6RFIaEySKSYHX2j5nYHKBgeWckrox

> **How to use the Modbus configuration software**

Step 2: Plug the configuration cable to computer via usb port and install the driver;

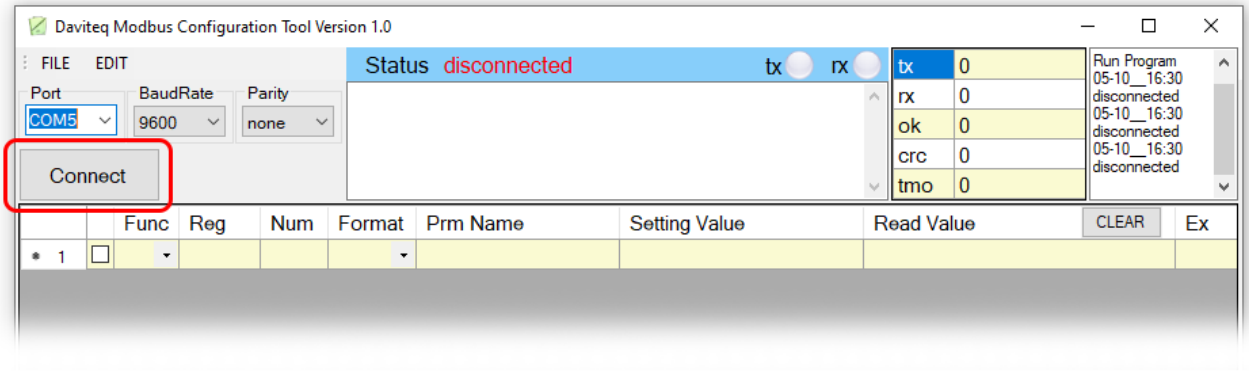
Step 3: Open the plastic housing;

Step 4: Plug the connector to the configuration port;

Step 5: Insert the battery;

Step 6: Import the configuration file by importing the csv file: Go to MENU:**FILE / Import New /** => select the file with name CONFIGURATION TEMPLATE FILE FOR SIGFOX WSSFC-AI FW1.9.3.csv (in the link below). Then click **Connect**;

CONFIGURATION TEMPLATE FILE FOR SIGFOX WSSFC-AI FW1.9.3.csv



Here is the table of Data will be read by Modbus tool

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code	# of Registers	Description	Range	Default	Format	Property	Comment
0	0	3	2	device info			string	Read	Product name
2	2	3	4	firmware version		1.0	string	Read	
6	6	3	2	hardware version		1.0	string	Read	
8	8	3	2	device ID			hex	Read	Product ID
10	A	3	4	device PAC			hex	Read	Product PAC
14	E	3	1	sen_type	1-255		uint16	Read	Sensor or Input Type
15	F	3	1	batt level	0-3		uint16	Read	Battery level
16	10	3	1	err_status	0-1		uint16	Read	Sensor error code
17	11	3	1	prm1 alm_status	0-2		uint16	Read	Alarm status of 1st parameter
18	12	3	1	prm2 alm_status	0-2		uint16	Read	Alarm status of 1st parameter
19	13	3	2	prm1 value			float	Read	1st calculated value
21	15	3	2	prm2 value			float	Read	2nd calculated value
23	17	3	1	batt %	10%, 30%, 60%, 99%		uint16	Read	Battery %
24	18	3	2	batt volt	0-3.67 vdc		float	Read	Battery Voltage
26	1A	3	2	temp	oC		float	Read	RF module temperature
28	1C	3	1	vref	0-3.67 vdc		uint16	Read	Vref of RF Module

29	1D	3	1	btn1 status	0-1		uint16	Read	Button status, 0: released, 1: pressed
30	1E	3	1	btn2 status	0-1		uint16	Read	Reedswitch status, 0: opened, 1: closed

Here is the table for Configuration:

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code (Read)	Function Code (Write)	# of Registers	Description	Range	Default	Format	Property	Comment
256	100	3	16	1	modbus address	1-247	1	uint16	Read/ Write	Modbus address of device
257	101	3	16	1	modbus baudrate	0-1	0	uint16	Read/ Write	Baudrate: 0: 9600, 1: 19200
258	102	3	16	1	modbus parity	0-2	0	uint16	Read/ Write	Parity: 0: none, 1: odd, 2: even
259	103	3	16	9	serial number			string	Read/ Write (PW)	Product S/N
268	10C	3	16	2	password for setting			uint32	Read/ Write	Password for setting
270	10E	3	16	1	Radio Configuratio	1-6	4	uint16	Read/ Write	RC zones selection 1..6 is RCZ1 .. RCZ6
271	10F	3	16	1	tx_power		20	int16	Read/ Write	RF Tx power
272	110	3	16	1	tx_repeat	0-1	1	uint16	Read/ Write	Number of repeat, 0: 1 time, 1: 3 repeats
273	111	3	16	1	downlink_fla	0-1	0	uint16	Read/ Write	1: enable Downlink, 0: disable Downlink (Fw v1.0 hasn't got Downlink function)
274	112	3	16	2	cycle_send_		900	uint32	Read/ Write	Data sending cycle, in seconds
276	114	3	16	2	spare					Spare for future
278	116	3	16	1	alarm_limit		44	uint16	Read/ Write	Limit number of alarm sending in 24h
279	117	3	16	1	spare					Spare for future

280	118	3	16	2	sensor1: sampling_ra		120	uint32	Read/ Write	Sensor/Input 1 sampling rate, in seconds
282	11A	3	16	2	sensor1: calc_time		100	uint32	Read/ Write	Measuremer time of sensor/input 1, in ms
284	11C	3	16	2	sensor2: sampling_ra		120	uint32	Read/ Write	Sensor/Input 2 sampling rate, in seconds
286	11E	3	16	2	sensor2: calc_time		100	uint32	Read/ Write	Measuremer time of sensor/input 2, in ms
288	120	3	16	2	prm1: a		1	float	Read/ Write	Constant a for scaling measured value 1
290	122	3	16	2	prm1: b		0	float	Read/ Write	Constant b for scaling measured value 1
292	124	3	16	2	prm1: Delta		-1	float	Read/ Write	Delta value for calculated value 1
294	126	3	16	2	prm1: High threshold		100000	float	Read/ Write	Hi Threshold for calculated value 1
296	128	3	16	2	prm1: High Hysteresis		10000	float	Read/ Write	Hysterisis for Hi for calculated value 1
298	12A	3	16	2	prm1: Low threshold		0	float	Read/ Write	Lo Threshold for calculated value 1
300	12C	3	16	2	prm1: Low Hysteresis		10000	float	Read/Write	Hysterisis for Lo for calculated value 1
302	12E	3	16	2	prm1: High cut		100000	float	Read/ Write	High cut value for calculated value 1
304	130	3	16	2	prm1: Low cut		0	float	Read/ Write	Low cut value for calculated value 1
306	132	3	16	2	prm2: a		1	float	Read/ Write	Constant a for scaling measured value 2
308	134	3	16	2	prm2: b		0	float	Read/ Write	Constant b for scaling measured value 2

310	136	3	16	2	prm2: Delta		-1	float	Read/ Write	Delta value for calculated value 2
312	138	3	16	2	prm2: High threshold		100000	float	Read/ Write	Hi Threshold for calculated value 2
314	13A	3	16	2	prm2: High Hysteresis		10000	float	Read/ Write	Hysterisis for Hi for calculated value 2
316	13C	3	16	2	prm2: Low threshold		0	float	Read/ Write	Lo Threshold for calculated value 2
318	13E	3	16	2	prm2: Low Hysteresis		10000	float	Read/ Write	Hysterisis for Lo for calculated value 2
320	140	3	16	2	prm2: High cut		100000	float	Read/ Write	High cut value for calculated value 2
322	142	3	16	2	prm2: Low cut		0	float	Read/ Write	Low cut value for calculated value 2

7. Installation

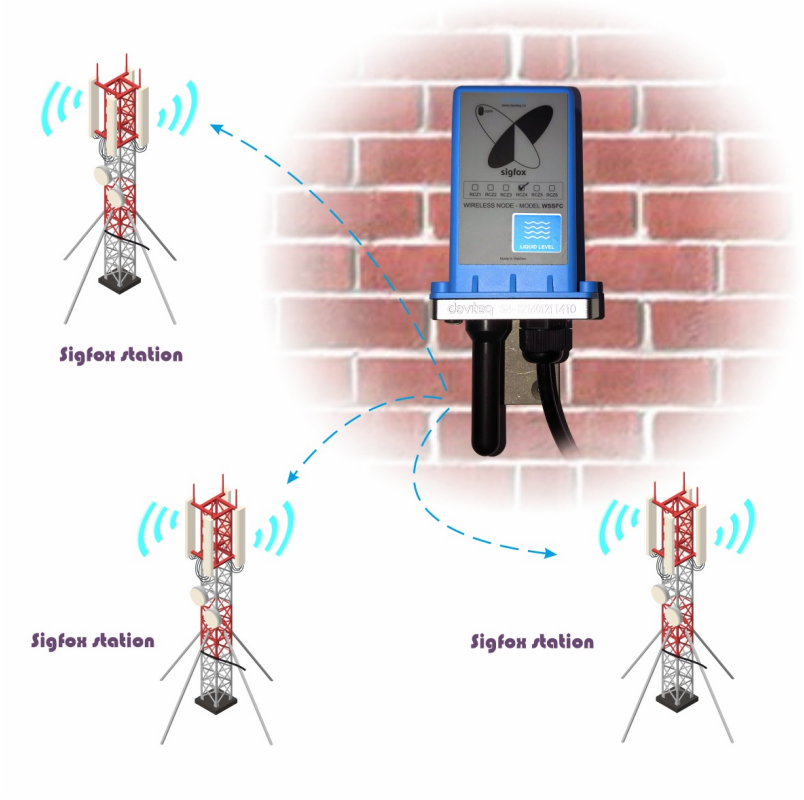
7.1 Mounting bracket installation

The mounting bracket is made from hard metallic material. Following to these steps as the below picture

7.2 Installation location

To maximize the distance of transmission, the ideal condition is Line-of-sight (LOS) between the Sigfox sensor and Station. In real life, there may be no LOS condition. However, the Sigfox sensor still communicates with Station, but the distance will be reduced significantly.

> **ATTENTION:**
>
> **DO NOT** install the Sigfox sensor or its antenna inside a completed metallic box or housing, because the RF signal can not pass through the metallic wall. The housing is made from Non-metallic materials like plastic, glass, wood, leather, concrete, cement...is acceptable.



7.3 IO Wiring & Sensor installation

WSSFC-AI can use both **Internal** and **External** Power sources. When we plug in an**External** power source, WSSFC-AI will prioritize using external power. When the external power is **disconnected**, WSSFC-AI will use the**Internal battery** power.

WSSFC-AI has two M12 connectors :**POWER** and **SENSOR** .

7.3.1 POWER Connector

The **POWER** connector is an **3..3.6VDC** external battery port, so if you want to use this port you must connect the **POWER** port to the **POWER** voltage converter cable as shown below.

The input power of the voltage converter cable is **12 ... 24VDC** with DC jack and the output is **3.6VDC** M12 Connector to connect with WSSFC-AI.

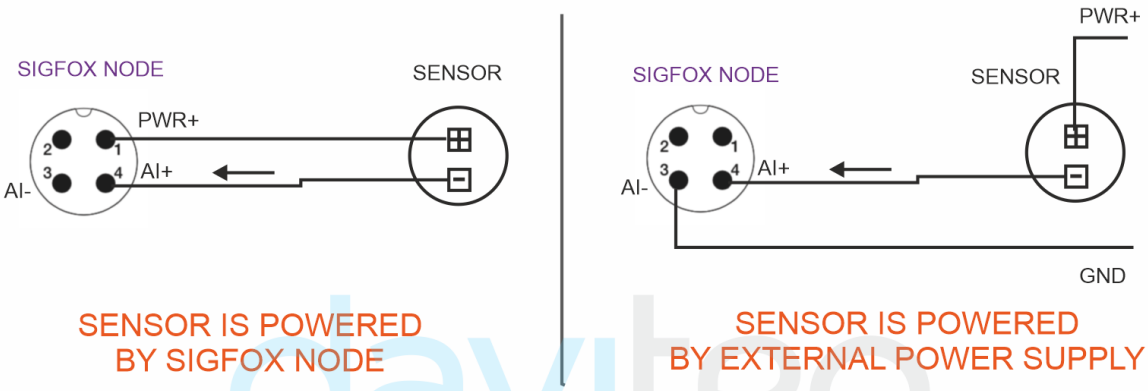
> **NOTE:**
>
> Please do not supply the WSSFC-AI **POWER** port directly with **12 ... 24VDC** without voltage converter cable.

7.3.2 SENSOR Connector

Connect the sensor to WSSFC-AI as shown below

WIRING FOR SIGFOX SENSOR WITH ANALOG INPUT

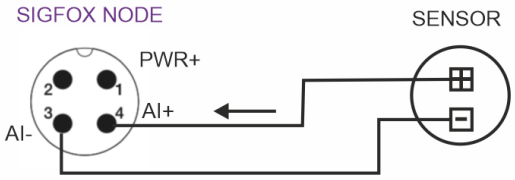
CASE 1 - WORK WITH LOOP POWERED SENSOR



SENSOR IS POWERED BY SIGFOX NODE

SENSOR IS POWERED BY EXTERNAL POWER SUPPLY

CASE 2 - WORK WITH NON - LOOP POWERED SENSOR



SENSOR OUTPUT:
0 - 20maDC
OR
0 - 10 VDC

WSSFC-AI-H7.PNG

For example: Connect the WSSFC-AI sensor to the Submersible Liquid Level Transmitter via M12 Connector


Submersible Level Transmitter
Material: SS316 Protection: IP68
Output: 4-20mA Range: 0 - 5m H20
Cable length: 7m
Connector: M12-female 4-pin code A
Model: LEET-M-01-005-SS-PU-M12
S/N: LEET026001 MFD 01-2020
POWER
SENSOR


SENSOR
433MHZ WIRELESS SENSOR
POWER
SENSOR

7.4 Power Supply & Battery installation

Steps for battery installation:

Step 1: Using L hex key to unscrew M4 screws at the side of housing

Step 2: Carefully pull out the top plastic housing in the vertical direction

Step 3: Insert the type C battery, please take note the poles of battery

> **ATTENTION:**
>
> REVERSED POLARITY OF BATTERIES IN **10 SECONDS** CAN DAMAGE THE SENSOR CIRCUIT!!!

Step 4: Insert the top plastic housing and locking by L hex key

> **ATTENTION:**
>
> When reinstalling the cover, pay attention to put the PCB edge into the middle slot of the box inside as shown below)

8. Troubleshooting

No.	Phenomena	Reason	Solutions
1	Node does not send RF to base station periodically, LED does not blink	• No power supply • Configuration sending cycle is incorrect	• Check that the battery is empty or not installed correctly • Check the power supply • Check the send cycle configuration
2	Node does not send RF to base station according to the alarm, LED does not blink	• The alarm configuration is incorrect • Running out of the number of alarms set for the day	• Check alarm configuration • Check the configuration for the maximum number of alarms per day
3	Node does not send RF to base station when activated by the magnetic switch, LED does not blink	• Magnetic switch has malfunctioned	• Read the status of the magnetic switch via modbus (when powering or attaching the battery) to see if the magnetic switch is working.
4	Node has blinked LED when sending RF but the base station cannot received	• Out of the number of RF packages per day (140 packages / day)	• Check on the base station whether the event message exceeds the number of RF packets
5	Node has sent RF but the LED does not blink	• LED malfunction • LED welding is not good	• Check LED condition and LED weld
6	The value of the sensor is 0	• Sensor connecting 4-20mA is loose	• Check sensor connection

9. Support contacts

Manufacturer

Daviteq Technologies Inc
No.11 Street 2G, Nam Hung Vuong Res., An Lac Ward, Binh Tan Dist., Ho Chi Minh City, Vietnam.
Tel: +84-28-6268.2523/4 (ext.122)
Email: info@daviteq.com | www.daviteq.com

Distributor in **Australia** and **New Zealand**

Templogger Pty Ltd
Tel: 1800 LOGGER
Email: contact@templogger.net

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