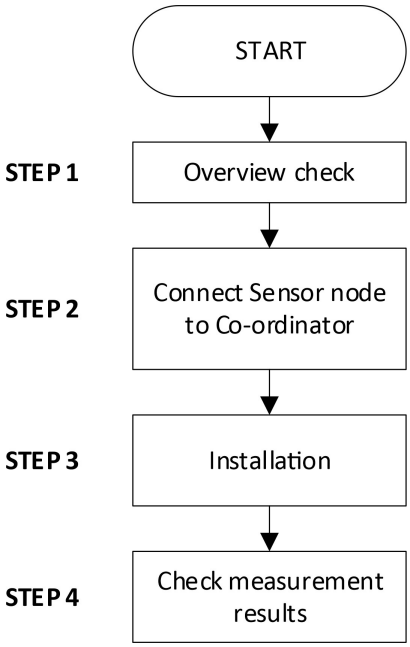
USER GUIDE FOR ULTRASONIC LEVEL SENSOR FOR TRASH BIN WS433-ULA

WS433-ULA-MN-EN-01	FEB-2022

This document is applied for the following products

SKU	WS433-ULA	**HW Ver.**	2.5	**FW Ver.**	6.01
Item Code	WS433-ULA-01	Wireless Ultrasonic Level Sensor for Trash bin, Internal antenna, 4500mm range, Type AA battery 1.5VDC, IP67			

0. Configuration Check List



Step 1: Overview check	
• Check cope of delivery • Make sure the device shows no signs of damage	Refer to **section 5** for details
Step 2: Connect Sensor node to Co-ordinator	
• Make sure that the battery is installed properly • Follow every steps Add sensors node to Co-ordinator WS433-CL or with iConnector integrated Co-ordinator	Refer to **section 6.4** for details
Step 3: Installation	
• Make sure compliance with manufacturer's recommendations • Make sure the correct measuring range	Refer to **section 6** and **section 7** for details
Step 4: Check measurement results	
• Check the reliability of the measurement compared with reality	

1. Functions Change Log

HW Ver.	FW Ver.	Release Date	Functions Change
2.5	6.01	FEB-2022	

2. Introduction

WS433-ULA is a ultrasonic level sensor to measure solid surface level in trash bin for waste management systems ... This level sensor uses ultrasonic technology to measure the solid surface of waste, the principle is to measure the time of flight of the ultrasound pulse in the air environment. The ultrasound pulse will be ejected from ultrasonic transducer, go thru the air and reach the solid surface of the waste, then reflected back to the ultrasonic transducer, the measuring circuit will measure the flight time of the pulse then calculated distance from the transducer to the surface. The sensor will connect wirelessly to the Wireless Coordinator WS433-CL then export the data to RS485 / modbusRTU and from there easily connect to any monitoring and control system. LOS distance from sensor to receiver is 1000m and can be extended by Extender. Typical applications include: Machine Health Monitoring, Predictive Maintenance Installations, Vibration Monitoring, Impact & Shock Monitoring, Bearing monitoring...

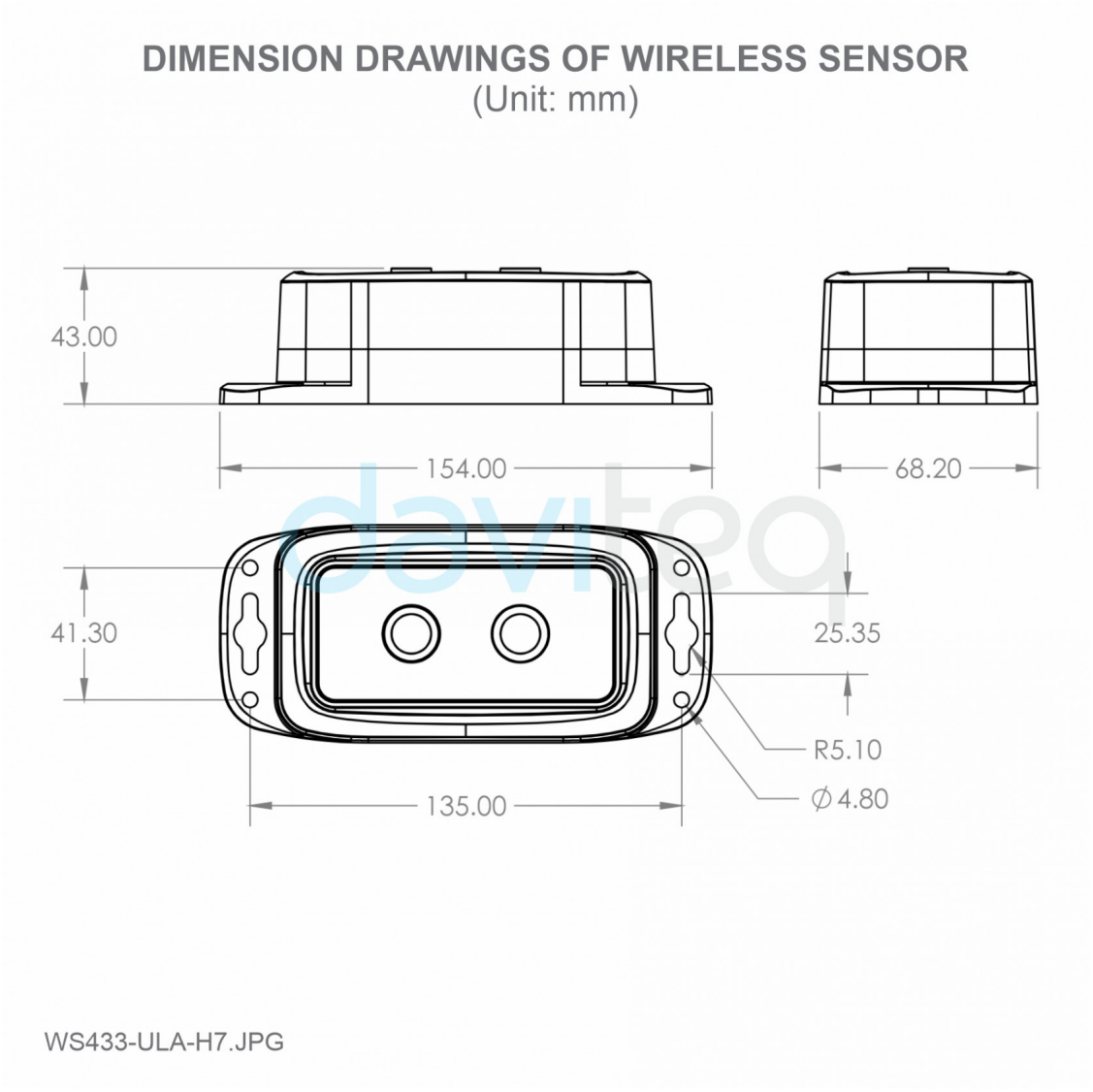
WS433-ULA-H1.JPG

3. Specification

SENSOR SPECIFICATION:	
Sensor	Ultrasonic sensor
Measurement range	30 .. 1500 mm
Resolution & accuracy	1.0mm, +/- 10 mm
Sensor sampling rate	configurable from 10s up to 3600s
Alarm setting	setting the alarm threshold for calculated value
WIRELESS SPECIFCATION:	
Data speed	Up to 50kbps
Tranmission distance, LOS	1000m, internal Antenna
Battery	02 x AA 1.5VDC, up to 10-year operation, depends on configuration
Frequency Band	ISM 433Mhz, Sub-GHz technology from Texas Instrument, USA

International Compliance	ETSI EN 300 220, EN 303 204 (Europe) FCC CFR47 Part15 (US), ARIB STD-T108 (Japan)
Vietnam Type Approval Certification	QCVN 73:2013/BTTTT, QCVN 96:2015/BTTTT (DAVITEQ B00122019)
Security Standard	AES-128
Operating temperature of PCB	-40°C..+60°C (with AA L91 Energizer)
Housing	Poly-carbonate, IP67
Installation method	Integrated with Sensor
Product dimensions & weight	150x30x30mm, < 260g (without battery), with sensor
Box dimension & gross weight	190x50x50mm, < 300g

4. Dimensions



5. Scope of delivery

1. Wireless ultrasonic level sensor
2. Magnet key
3. BTP1- PARTSKIT-ULA

6. Operation Principle

6.1 Process of measurement

> When the sensor sampling time interval is reached, For example**2 minutes**, the 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.

For example: the measurement time is 200mS, after this time, the node will read the value of sensor, node will switch OFF power supply to external sensor to save energy.

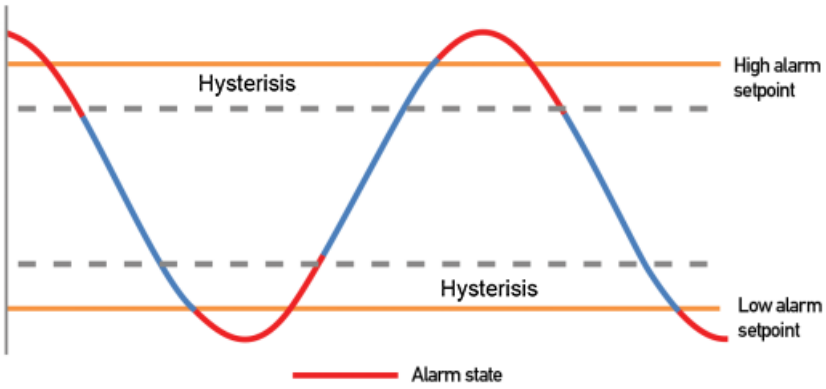
The measured value is the raw value of the sensor. The measured value can be scaled according to the following formula:

$$Y = aX + b$$

- **X:** the raw value from the sensor
- **Y:** the calculated value for parameter 1's value or parameter 2's value
- **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.



Status bytes of sensor Node

- Hi-Byte is error code

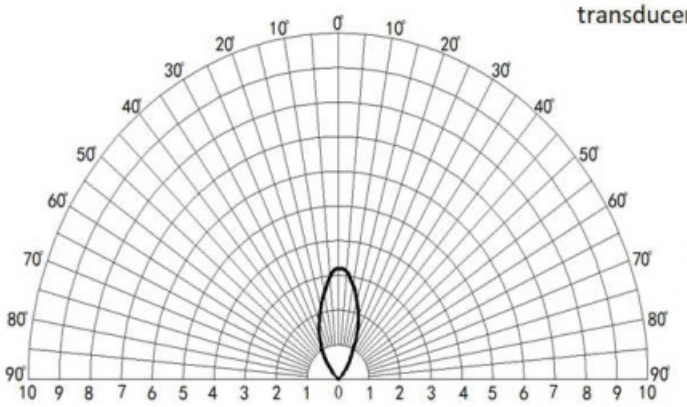
Error code	Description
0	No error
1	Just exchange the sensor module but node has not been reset ==> please take out the battery for 20s then install it again to reset node to recognize the new sensor module
2	Error, sensor port M12F shorted to GND
3	Error, sensor port M12F shorted to Vcc
4	Error, sensor port M12F shorted each other

- Lo-Byte is sensor type

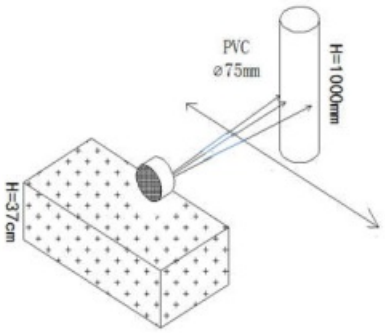
Error code	Description
0	No error
1	Just exchange the sensor module but node has not been reset ==> please take out the battery for 20s then install it again to reset node to recognize the new sensor module
2	Error, sensor port M12F shorted to GND
3	Error, sensor port M12F shorted to Vcc
4	Error, sensor port M12F shorted each other

6.2 The Effective Detection Range

The PVC tube is paralled to the ultrasonic transducer and moved from left to right

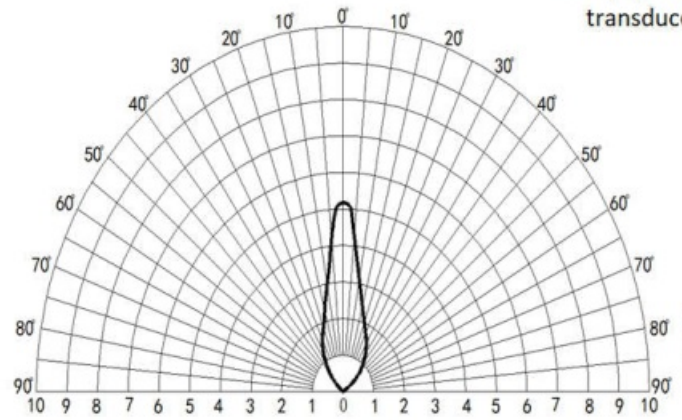


Beam pattern of PVC Unit: meter

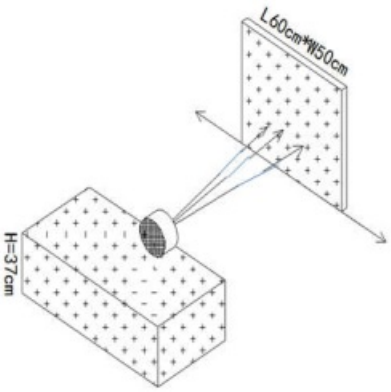


2. The tested object is the corrugated case, perpendicular to 0° axle wire, length is 60cm, width is 50cm:

The paper board is paralled to the ultrasonic transducer and moved from left to right



Cambered surface beam pattern of paper sheet Unit: meter



6.3 Range of measurement

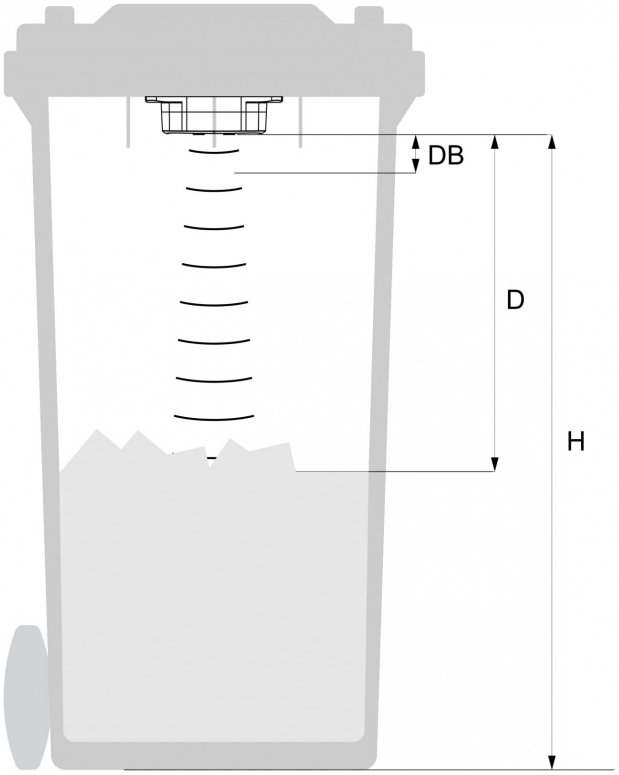


Figure – Ultrasonic Level Transmitter

- **DB:** Dead band **0..30 mm** (This is a short range in front of the ultrasonic sensor can not measure distances)
- **H:** Maximum measuring distance **4500mm** (with flat object)
- **D:** Distance

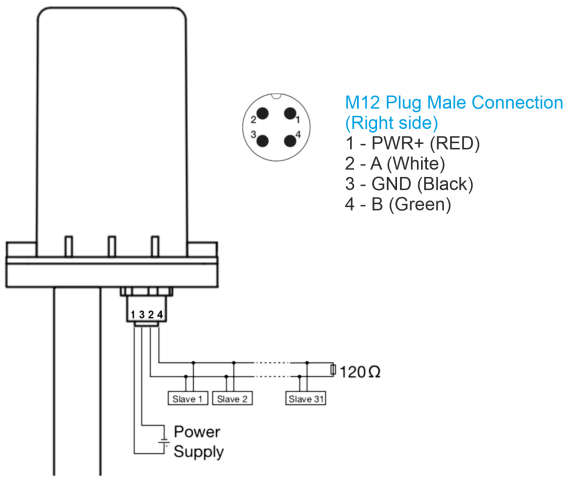
6.4 Add sensors node to Co-ordinator WS433-CL

6.4.1 Add Sensor Node ID automatically

CONNECT CO-ORDINATOR TO RS485 - CONFIGURATION CABLE via M12 CONNECTOR

WS433-CL-H12.PNG

PIN ASSIGNMENT & WIRING



WS433-CL-H18.PNG

Step 1: After supplying power the Co-ordinator via M12 connector, the Node ID must be registered within the first 5 minutes, up to 40 WS.

Step 2: Bring the wireless sensor closer to the Co-ordinator's antenna then take off the wireless sensor battery, wait for 5s then insert the battery again. If:

- Buzzer plays **1 peep** sound, LED blink 1 time, that means registering Node ID on Co-ordinator **successfully.**
- Buzzer plays **2 peep** sounds, LED blink 2 times, that this Node ID is **already registered.**

> If you do not hear the "Peep" sound, please disconnect the power the co-ordinator, wait a few minute and try again.

Node id added in this way will be written to the **smallest node_id_n** address which is = **0.**

Set **Rssi_threshold** (see **RF MODE CONFIG** (in the **Modbus Memmap of WS433-CL**), default **-25**): The case if Co-ordinator is on high position and need to add node sensor. We set the sensor as close as possible and set the **Rssi_threshold** to **-80**, **-90** or **-100** to increase the sensitivity to allow WS433-CL-04 can add sensors at a longer distance. After that, perform 2 steps of adding sensors and then reset Rssi_threshold = -25.

Enb_auto_add_sensors configuration (see **RF MODE CONFIG** (in the **Modbus Memmap of WS433-CL**)): In case you do not want to turn off the power WS433-CL, you can set **Enb_auto_add_sensors = 1**, this way we have 5 minutes to add nodes (add up to 40 nodes) . After 5 minutes **Enb_auto_add_sensors** will automatically **= 0.**

> **Memmap resgisters**
>
> You can download Modbus Memmap of WS433-CL with the following link:
>
> **https://filerun.daviteq.com/wl/?id=BKEaUzdArkoc0Hc7nfpRShdPVToVrqQZ**

6.4.2 Add sensor node into WS433-CL-04 (1) through intermediate WS433-CL-04 (2) and Modbus

> **In case the sensor need to be added to WS433-CL-04 (1) has been installed in a high position, the sensor cannot be brought close to WS433-CL-04 (1). For more details:**

http://www.daviteq.com/en/manuals/books/long-range-wireless-co-ordinator-ws433-cl/page/user-guide-for-long-range-wireless-co-ordinator-ws433-cl

6.5 Magnet Function

Open the cover of sensor then use the magnet key to set the data transfer speed for the first 30 seconds when the battery is first installed, after 30 seconds the magnet key function does not work.

Get the magnet close to the magnet mark on the label . Then

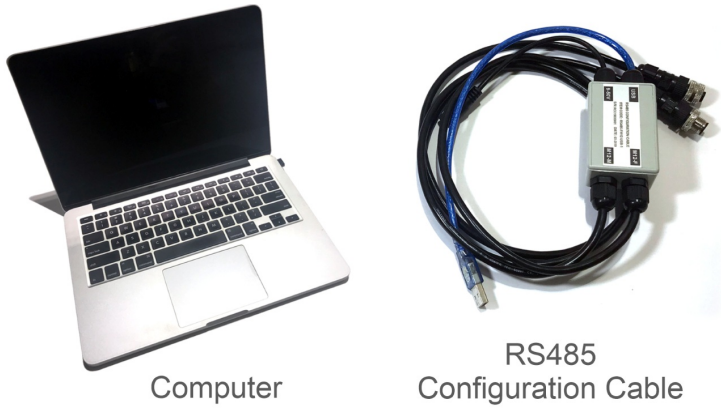
- Buzzer beep **1 time** => Release the magnet to set Data rate RF **50kbps**
- Buzzer beep **2 times** => Release the magnet to set Data rate RF **625bps**
- Buzzer beep **3 times** => Release the magnet to reset RF parameters (frequency, RF output power, data rate), if held for more than 30 seconds then the magnet function does not work.

> **Reset default WS433:**
>
> Frequency: 433.92 MHz

RF transmit power: 15 dBm
RF data rate: 50 kbps

6.6 Configuration

First, you need to prepare



WS433-CL-H9.PNG

Num of Node will indicate the number of nodes managed by WS433-CL.
Every time a node is **added**, the Num of Node will **increase** by 1.
Every time a node is **deleted**, the Num of Node is **reduced** by 1.
Writing Num of Node = 0 will **delete all** 40 node ids to 0.
If you want to delete a node id, then write it = 0 with the **Write** function is **16** and the **Read** function is **3**.

Step 1: Connect Antenna, RS485 - configuration cable and power supply co-ordinator

INSTALL ANTENNA

WS433-CL-H10.PNG

CONNECT CO-ORDINATOR TO RS485 - CONFIGURATION CABLE via M12 CONNECTOR

WS433-CL-H12.PNG

SUPPLY POWER 12-24VDC

WS433-CL-H11.PNG

CONNECT RS485 - CONFIGURATION
TO COMPUTER via USB

WS433-CL-H13.PNG

Step 2: Open Modbus tool on PC

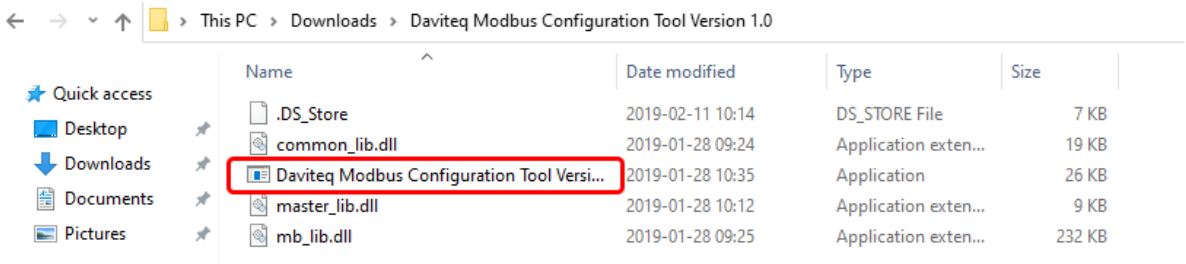
- You can download Daviteq Modbus Configuration Tool with the following link:

https://filerun.daviteq.com/wl/?id=yDOjE5d6kqFlGNVVlMdFg19Aad6aw0Hs

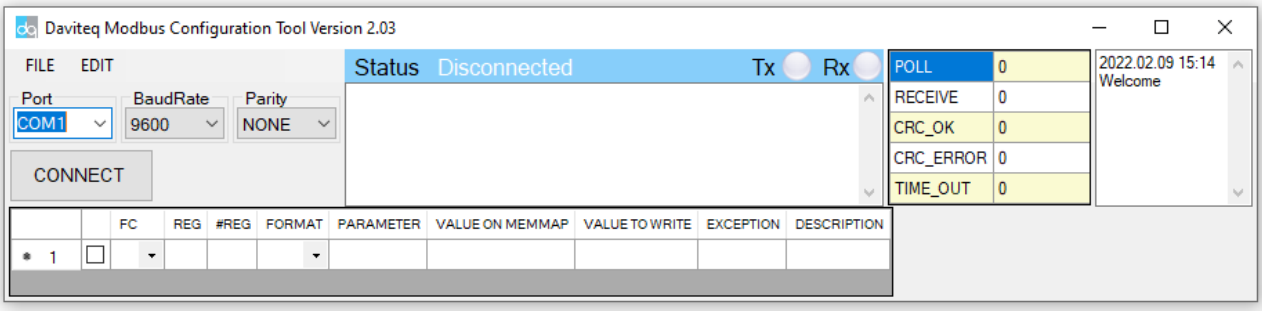
Template File: https://filerun.daviteq.com/wl/?id=BOfpTe7woBFbNULuHqsLhlJl4GmZ33fi

How to use the Modbus configuration software

- Unzip file and run file application "Daviteq Modbus Configuration Tool Version"



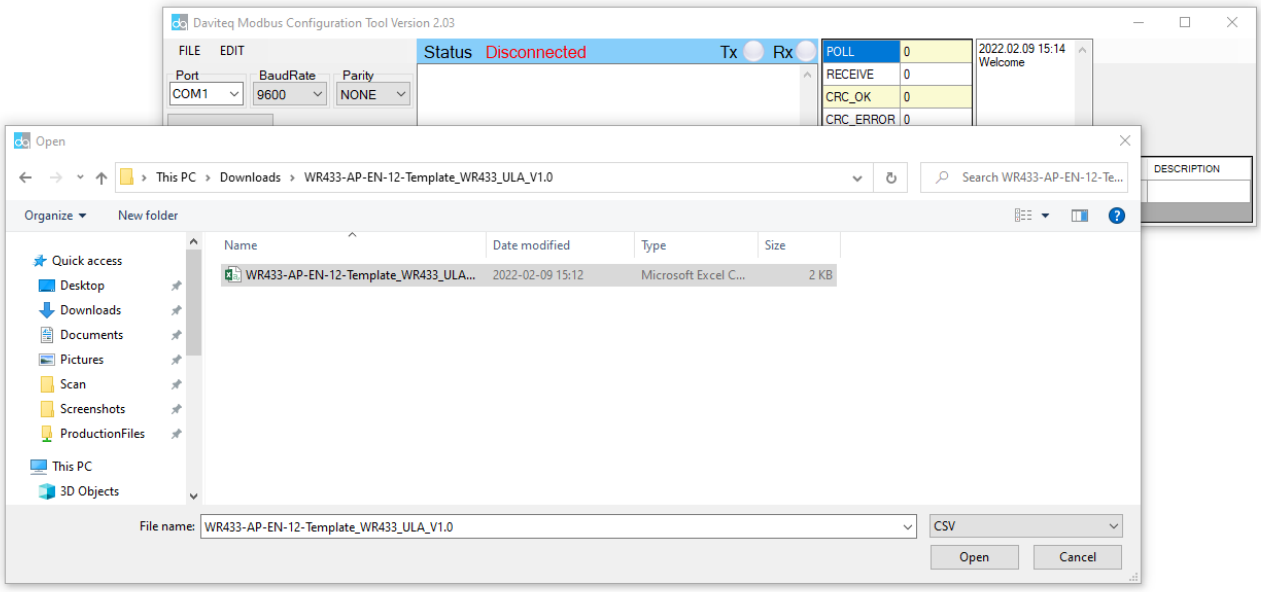
- Choose **COM Port** (the Port which is USB cable plugged in)
- Set the **BaudRate: 9600**, **Parity: none**



- Click " **Connect** " untill the Status displays "**disconnected**" to "**connected**". It means the WS433-CL-04 is

being connected with computer;

- Next, we need to import the configuration file for WS433-CL-04 by importing the csv file: Go to MENU**FILE / Import New / =>** select the **template file**.



Step 3: Configure parameters of the sensor.

> **Memmap resgisters**
>
> You can download Modbus Memmap of WS433-CL with the following link:
>
> **https://filerun.daviteq.com/wl/?id=BKEaUzdArkoc0Hc7nfpRShdPVToVrqQZ**

In the memmap file, refer to the **Memmap of WS433-ULA** sheet to configure the sensor's operating parameters accordingly.

> **The reference memmap addresses are based on the order of the sensors added in the Memmap file above**

Typical sensor parameters:

Function Code (Read)	Function Code (Write)	# of register	Byte Size	Description	Value Range	Default	Format	Property	Explanation
4		1	2	%Battery of sensor Node	10,30,60,99		uint16	Read	Battery level, only 04 levels: 10%, 30%, 60% and 99% (full). When 10% ==> Need to replace the battery
4		2	4	Level value of sensor Node (parameter 1)	mm		float	Read	Value from ultrasonic level sensor. This value is parameter 1 of a wireless sensor node
4		1	2	Status bytes of sensor Node			uint16	Read	Hi-Byte is error code, Lo-Byte is sensor type

4		2	4	Distance value of sensor Node (parameter 2)	mm		float	Read	Value from ultrasonic level sensor. This value is parameter 2 of a wireless sensor node
4		1	2	Logic status of parameters			uint16	Read	Hi-Byte is Logic status of parameter 1, Lo-Byte is Logic status of parameter 2
3		1	2	Data status of Node	0-9, 99		byte	Read	0-9: Interval updated data 99: Disconnected
3		1	2	RF Signal strength of Node	0-4		byte	Read	From 0 to 4 with 0 is being lost connection RF and 4 is the strongest RF
3	16	1	2	Cycle_wakeup	1-3600(s)	120	uint16	Read / Write	Every time interval of Cycle_wakeup sensor node would ONLY send data to co-ordinator if the new measured value was changed more than the Delta value of the last measured value. Default Cycle_wakeup is 120 seconds
3	16	1	2	Cycle_healths	60-7200(s)	600	uint16	Read / Write	Every time interval of Cycle_healths sensor node will absolutely send data to co-ordinator regardless any condition
3	16	2	4	Co-ordinator id		0	uint32	Read / Write	Configure the ID number of Co-ordinator that wireless sensor want to connect to the Co-ordinator when only adding the sensor manually

3	16	2	4	Radio frequency	433.05-434.79, 433 Mhz	433.92	float	Read / Write	Configure the operating frequency of wireless sensor by Co-ordinator, should be configured from 433.05-434.79 MHz, only for advanced users
3	16	1	2	Tx power	-10,10,15	15	int16	Read / Write	Configure the RF power of wireless sensor by Co-ordinator, only for advanced users + 15 <=> tx power = 15dBm + 10 <=> tx power = 10dBm + -10 <=> tx power = -10dBm
3	16	1	2	Data rate RF	0-1	0	uint16	Read / Write	Configure the air data rate of wireless sensor by Co-ordinator, only for advanced users + 0 <=> data rate RF at 50kbps + 1 <=> data rate RF at 625bps
3	16	2	4	a1		1	float	Read / Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1) + b1. For sensor value scale
3	16	2	4	b1		0	float	Read / Write	Scale value of parameter_1 = (a1 * Raw sensor value of parameter_1) + b1. For sensor value scale
3	16	2	4	a2		1	float	Read / Write	Scale value of parameter_2 = (a2 * Raw sensor value of parameter_2) + b2. For sensor value scale

3	16	2	4	b2		0	float	Read / Write	Scale value of parameter_2 = (a2 * Raw sensor value of parameter_2) + b2. For sensor value scale
3	16	2	4	Delta_1		0	float	Read / Write	Delta value, this is the threshold to allow sending data to co-ordinator when the new value of parameter 1 is changed from the last value a delta value which is higher than the threshold.
3	16	2	4	High_threshol		0	float	Read / Write	High threshold value for parameter 1
3	16	2	4	Low_threshol		0	float	Read / Write	Low threshold value for parameter 1
3	16	2	4	High_threshol		0	float	Read / Write	High threshold value for parameter 2
3	16	2	4	Low_threshol		0	float	Read / Write	Low threshold value for parameter 2
3	16	1	2	Num_of_samp			float	Read / Write	Number of sampling times

7. Installation

7.1 Installation location

Wireless sensor utilize the ultra-low power 433Mhz RF signal to transmit/receive data with Wireless co-ordinator.

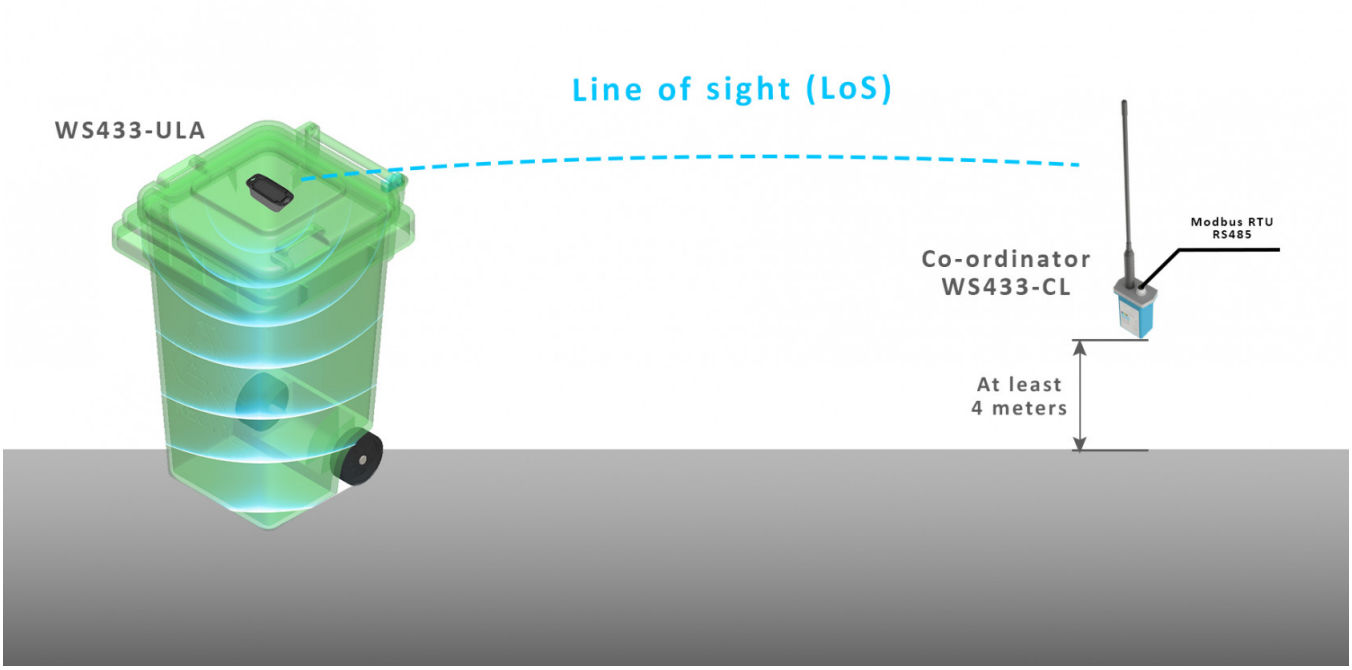
To maximize the distance of transmission, the ideal condition is Line-of-sight (LOS) between the Wireless sensor and Gateway. In real life, there may be no LOS condition. However, the two modules still communicate each other, but the distance will be reduced significantly.

ATTENTION:

DO NOT cover the Wireless sensor or its antenna inside a completed metallic box or housing, because the RF signal can not pass through the metallic material.

NOTE:

Integrated WS433-CL / iConnector Coordinator The coordinator must be placed at least**4 meters** above the ground and the WS433-ULA clearly visible.



7.2 Mounting

7.2.1 Installation method

Mounting the sensor under the bottom and at the center of the trash bin lid

WARNING:

Avoid causing strong impact on the 2 probes on the sensor;

DO NOT install the sensor in complete metal trash bin because the signal can't transmit to the WS433-CL

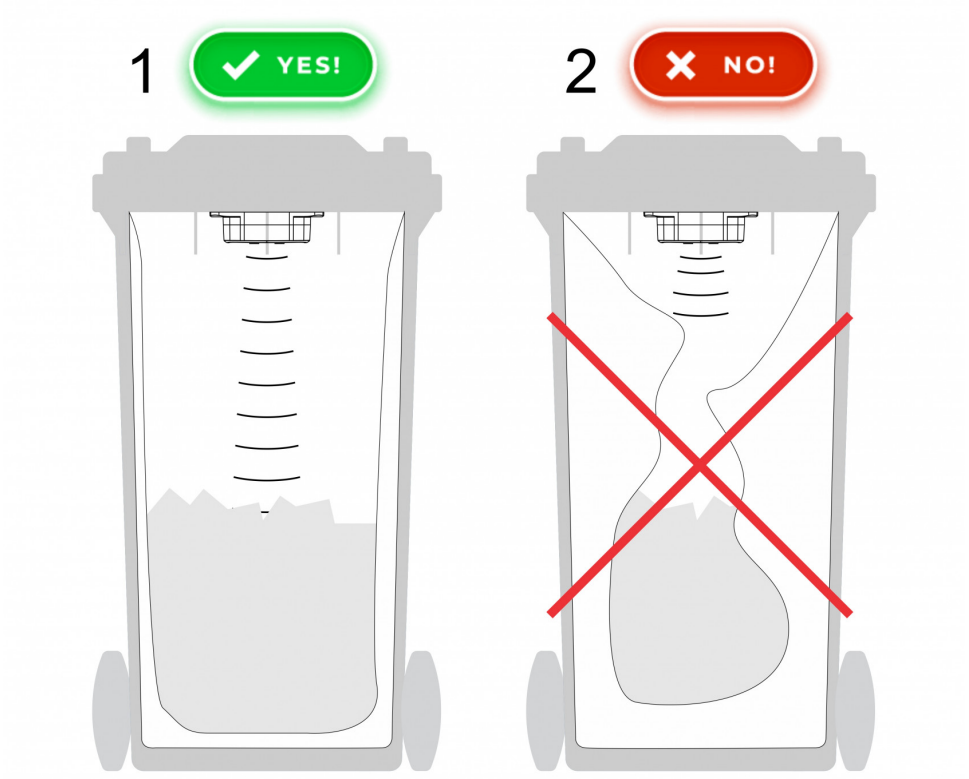
Step 1: Determine the center of the trash bin

Step 2: Mounting the sensor under the trash bin lid by fasten the 4 screws that are included

7.2.2 Installation conditions

Align the sensor so that it is vertical to the solid surface **(1)**

When installing, do not let the plastic bag inflate too much to block the path of the sensor **(2)**



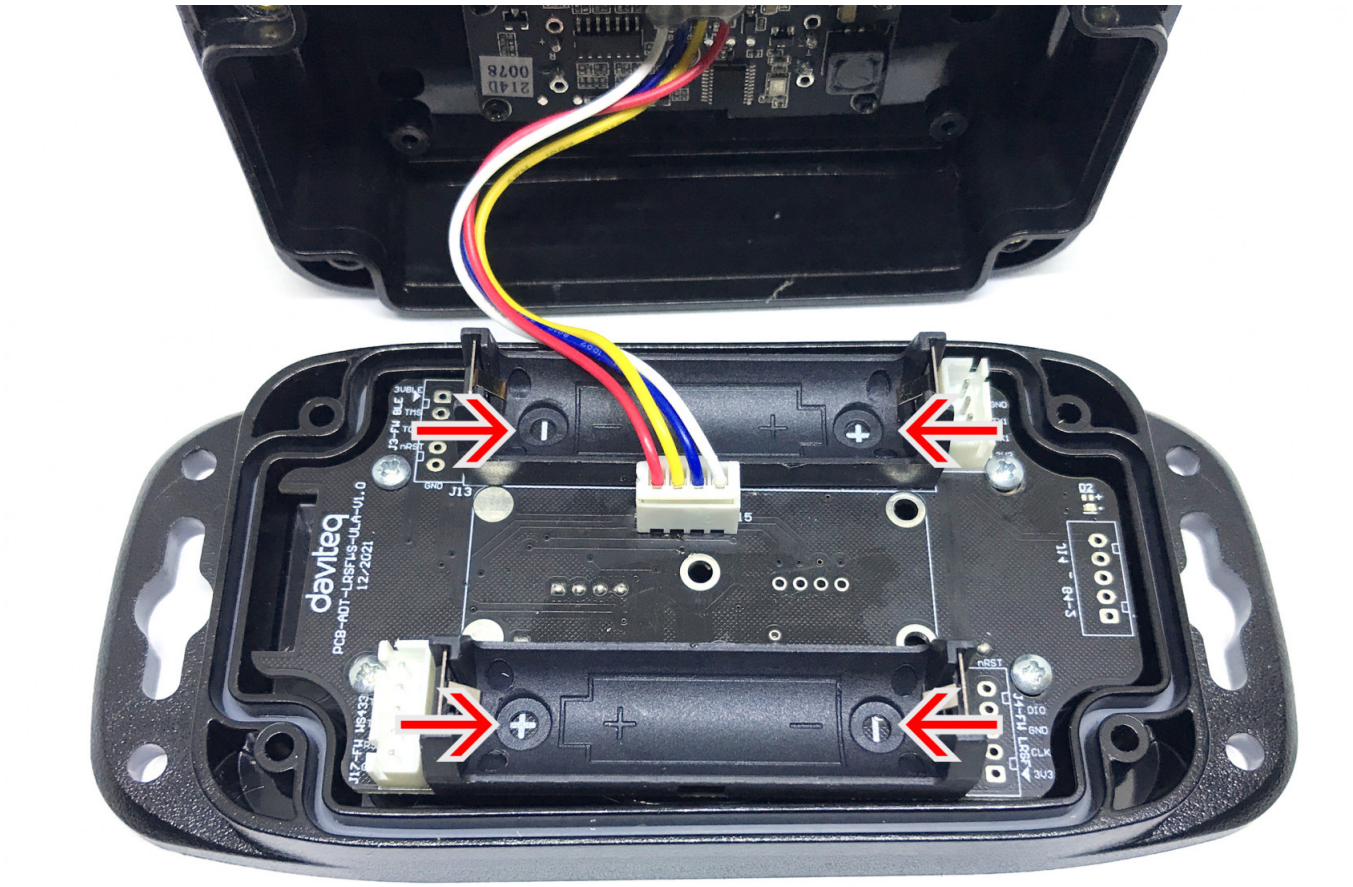
7.3 Battery installation

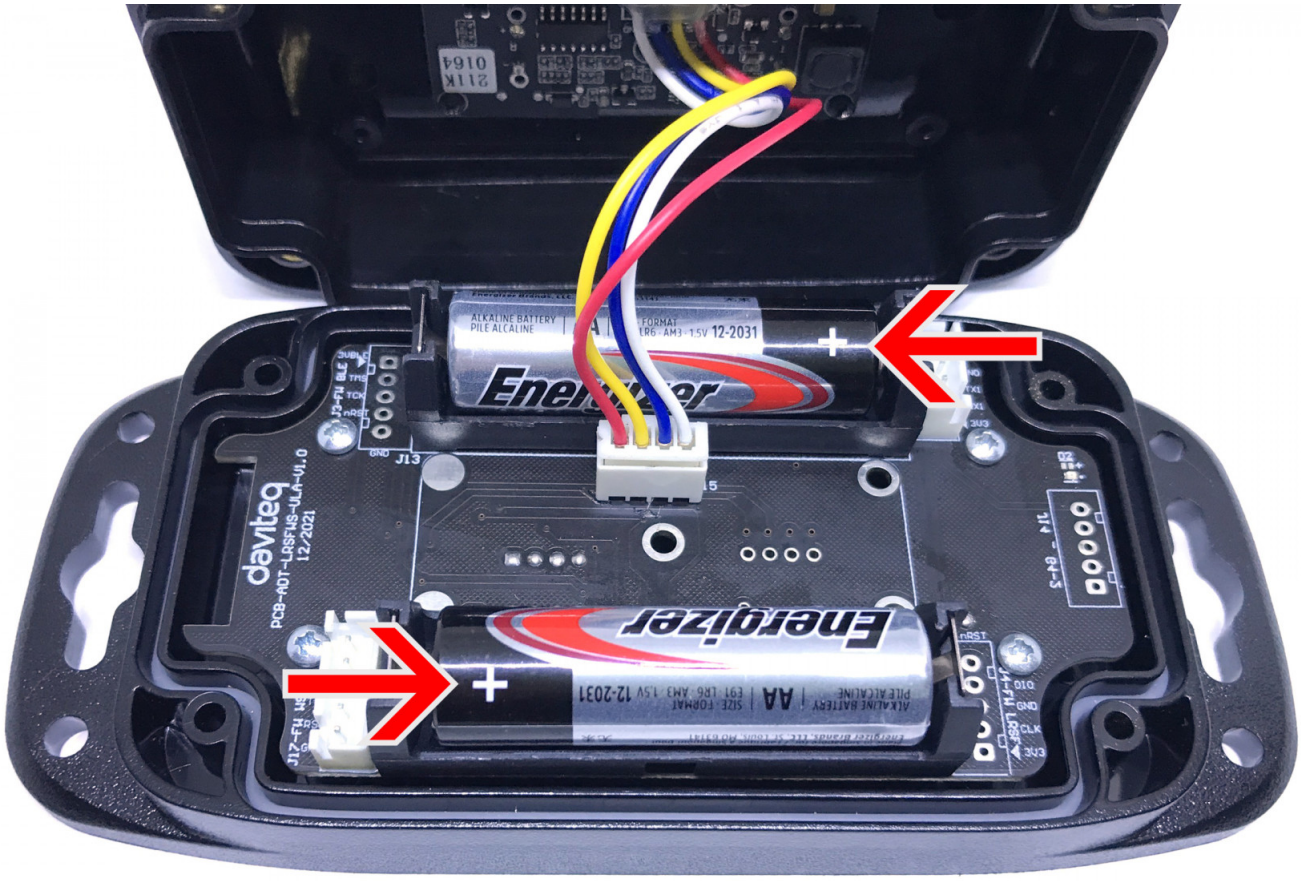
Steps for battery installation:

Step 1: Using Philips screw driver to unscrew 4 screws under the housing.

Step 2: Pull out the cover then insert 02 x AA 1.5VDC battery, please take note the poles of the battery.

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





Step 3: Insert the top plastic housing and locking the cover

7. Troubleshooting

No.	Phenomena	Reason	Solutions
1	The status LED of wireless sensor doesn't light up	• No power supply • Configuration function of the LED is not correct	• Check that the battery is empty or not installed correctly • Reconfigure the led light function exactly as instructed
2	Wireless sensor not connected to co-ordinator	• No power supply • The configuration function of the RF data rate is incorrect	• Check that the battery is empty or not installed correctly • Reconfigure the RF data rate with the button according to the instructions

8. 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**

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Revision #10
★ Created Tue, Feb 8, 2022 1:50 AM by Kiệt Anh Nguyễn
Updated Fri, Feb 11, 2022 12:25 AM by Kiệt Anh Nguyễn