USER GUIDE FOR WIRELESS RADAR LEVEL METER

WS433-MA-RD-MN-EN-01	NOV-2020

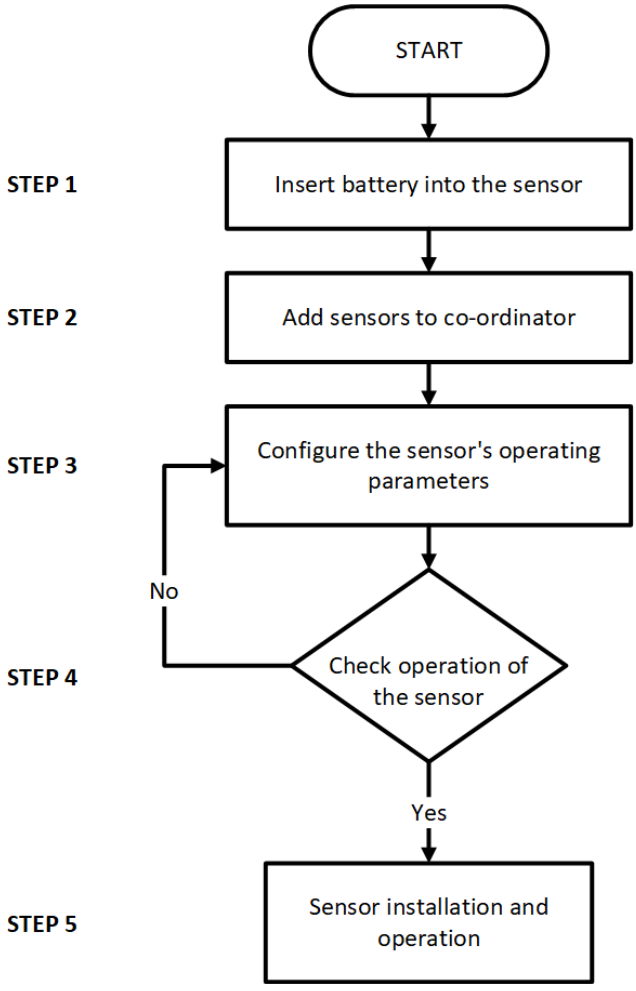
This document is applied for the following products

SKU	WS433-MA	**HW Ver.**	2.5	**FW Ver.**	5.0
Item Code	WS433-MA-31	Wireless Sensor 1-channel 0-20mA DC current input, IP67, battery AA 1.5VDC, 24VDC Output for Instrument power supply			

SKU	RD269X	**HW Ver.**		**FW Ver.**	
Item Code	RD2695S-P-B(J)-04-A3(04)-V-4-L-N-V-6	26GHz RadarLevel transmitter, 78mm PVDF protection tube, SUS304 JIS10K 80A RF Flange, 0-6m cablibrated range, 4-20mA output, looped power, HART, IP67 aluminum housing			

0. Configuration Check List

0.1 Wireless sensor configuration check list



STEP 1: Insert battery into the sensor

1. Remove the battery cover of the sensor;
2. Insert a type D battery into the sensor.

Please note the battery terminals for correct installation

STEP 2: Add sensor to co-ordinator

After inserting the battery for the sensor, power on the co-ordinator and bring the co-ordinator closer to the sensor to add the sensor automatically.

STEP 3: Configure the sensor's operating parameters

Use Modbus tool to check added sensors and configure sensor operating parameters.

STEP 4: Check operation of the sensor

1. Use the Modbus tool to check the configurations;
2. Test the configuration settings on the sensor.

STEP 5: Sensor installation and operation

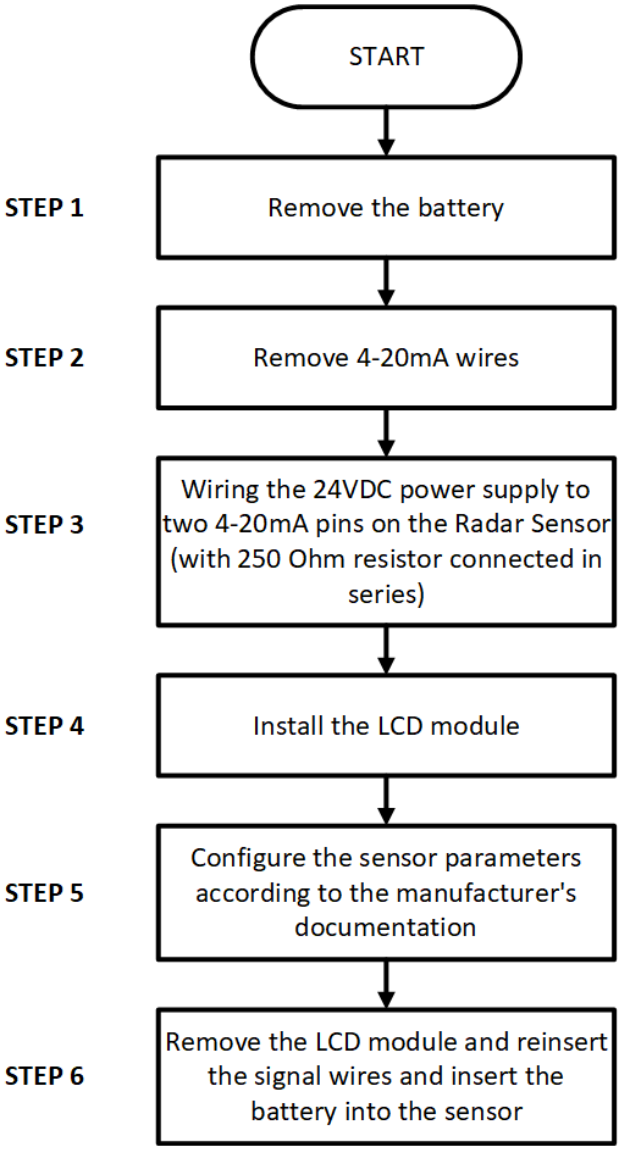
Install sensor on site

0.2 Radar level meter configuration check list

PLEASE REFER TO THE MANUFACTURER'S INSTRUCTIONS CAREFULLY TO AVOID DAMAGING THE DEVICE:

USER MANUAL OF RADAR LEVEL METER

INSTRUCTIONS FOR CONFIGURING SENSORS WITH LCD MODULE



STEP 1: Remove the battery

1. Remove the battery cover of the sensor;
2. Remove a type D battery in the sensor.

STEP 2: Remove 4-20mA wires

1. Open the radar sensor cover;
2. Remove the 4-20mA wire plugged in the sensor.

STEP 3: Power supply 24VDC to 2 pins 4-20mA on the Radar Sensor

Power supply 24VDC to 2 pins 4-20mA on the Radar Sensor with 250 Ohm resistor connected in series.

STEP 4: Install the LCD module

Install the LCD module to the radar sensor for configuration.

STEP 5: Configure the sensor parameters according to the manufacturer's documentation

1. Carefully read the manufacturer's instructions before configuring the radar sensor;
2. Power supply 24VDC to the sensor;
3. Configure the parameters of the sensor according to the manufacturer's instructions via buttons

STEP 6: Remove the LCD module and reinsert the 4-20mA signal wires and insert the batteries into the sensor

1. Remove the LCD module of the radar sensor;
2. Remove the power supply cables connected to the 4-20mA port on the sensor;
3. Insert the 4-20mA signal cables of the WS433-MA into 4-20mA port on the sensor;
4. Insert the battery into the sensor.

1. Functions Change Log

HW Ver.	FW Ver.	Release Date	Functions Change
2.5	5.0	DEC-2019	• Change RF data rate by button

2. Introduction

This is a wireless sensor that measures water level using radar technology. The combination of a high-tech radar level sensor combined with a wireless sensor using Texas Instrument's advanced Sub-GHz technology enables long-range transmission with extremely low energy consumption. It will connect 2-way wireless with WS433-CL wireless co-ordinator to send data and receive configuration. It can be configured with operational parameters such as data delivery interval, health check cycles ... remotely from the Globiots platform or via the ModbusRTU software (via WS433-CL). Its default data rate is 50 kbps, which can be converted to 625 bps for increased communication range. The sensor can operate for up to 10 years with just one AA battery. Sensors can be used to measure water or liquid levels as well as for measurement in areas such as river level monitoring, chemicals, municipal water supply and drainage, etc.

3. Specification

3.1 WS433-MA Specification

Measuring range	0 .. 20mA
Accuracy	0.05% of span
Resolution	1/3000
Temperature drift	< 50ppm
Optional accessories	304SS Adapter PG9/male 1/2"NPT or PG13.5 or M20 to allow direct mounting on Process instruments or electrical panel
Data speed	Up to 50kbps
Transmission distance, LOS	500m

Antenna	Internal Antenna, 3 dbi
Battery	01 x AA 1.5VDC, up to 10-year operation, depends on configuration
Frequency Band	ISM 433Mhz, Sub-GHz technology from Texas Instrument, USA
Receiving Sensitivity	-110dBm at 50kbps
International Compliance	ETSI EN 300 220, EN 303 204 (Europe) FCC CFR47 Part15 (US), ARIB STD-T108 (Japan)
Security Standard	AES-128
Operating temperature of PCB	-40oC..+60oC (with AA L91 Energizer)
Housing	Poly-carbonate, IP67
Installation method	L-type bracket SUS304 , by M4 screws or double-sided 3M tape (included)
Product dimensions	125x30x30mm
Net weight (without battery)	< 100g
Box dimension	190x50x50mm
Gross weight	140g

3.2 RD-2695S Specification

Features	Sealed antenna with anti-corrosion cover
Application	Be suitable for strong acids, alkalis, or other strongly corrosive liquids, or liquids with heavy steam, etc.
Antenna size	** 62mm, corresponding to flange sizes, DN80, DN100 ** 96mm, corresponding to flange sizes, DN150, DN200
Measuring range (Maximum)	35m
Process connection	Flange
Process temperature	-60°C ... +150°C
Process pressure	-0.1 ~ 1.0MPa
Accuracy	±3mm
Frequency range	26GHz
Explosion proof	Ex ia IIC T6
Enclosure protection grade	IP67
Signal output	4-20mA/ HART (2-wire/ 4-wire), RS485/ Modbus

4. Operation Principle

4.1 WS433 Wireless Transmitter

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 using I2C, node will switch OFF power supply to external sensor to save energy.

Once reading the sensor value, the raw data is X, it can be scaled to any engineering value by the following formula:

$$Y = aX + b$$

Where

X: the raw value from 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.

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

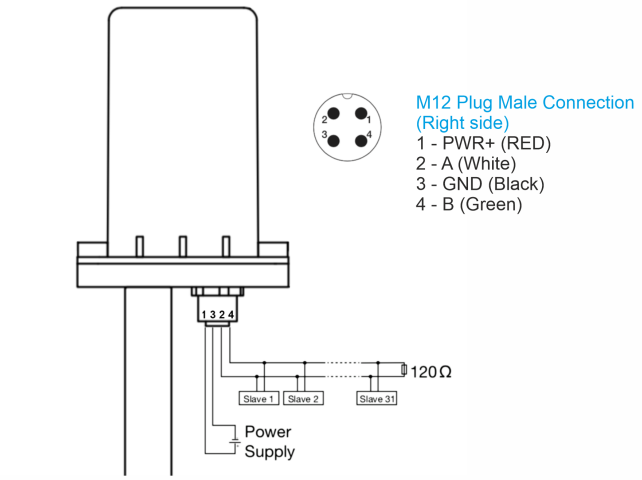
4.1.1 Add sensor to co-ordinator

After inserting the battery for the sensor, power on the co-ordinator and bring the co-ordinator closer to the sensor to add the sensor 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**

4.1.2 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

4.1.3 Button Function

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

- Press and hold the button for 2 seconds => LED blinks once => Release the button to set Data rate RF 50kbps

- Press and hold the button for 5 seconds => LED blinks twice => Release the button to set Data rate RF 625bps
- Press and hold the button for 10 seconds => LED blinks 3 times => Release the button to reset RF parameters (frequency, RF output power, data rate), if held for more than 30 seconds then the button function does not work.

Reset default WS433:

Frequency: 433.92 MHz
RF transmit power: 15 dBm
RF data rate: 50 kbps

4.1.4 Configure sensor parameters in Co-ordinator

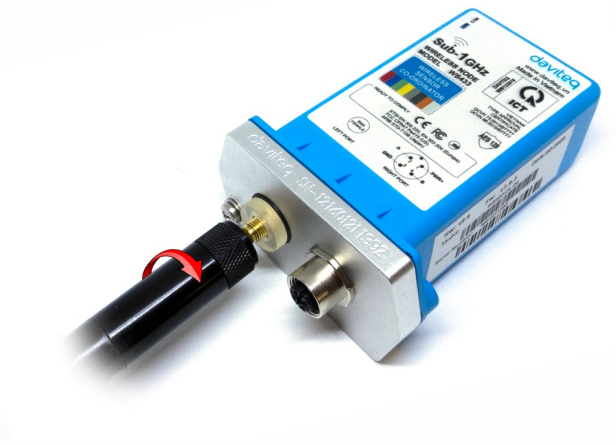
First, you need to prepare

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=qK0PGNbY1g1fuxTqbFW9SXtEvCw7bpc6

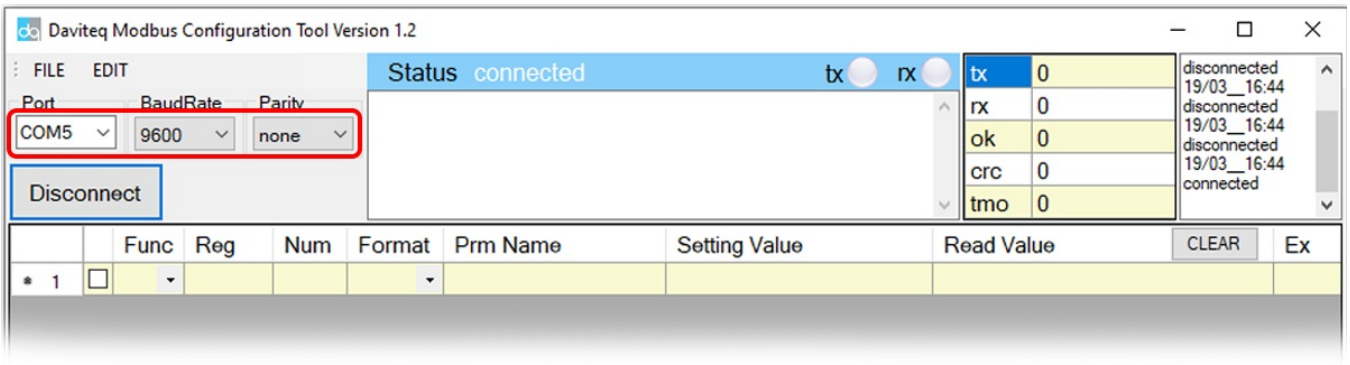
Template File: https://filerun.daviteq.com/wl/?id=hgrjOg3wwvyrvAZ54p8iZiFpDyXTcnec

How to use the Modbus configuration software

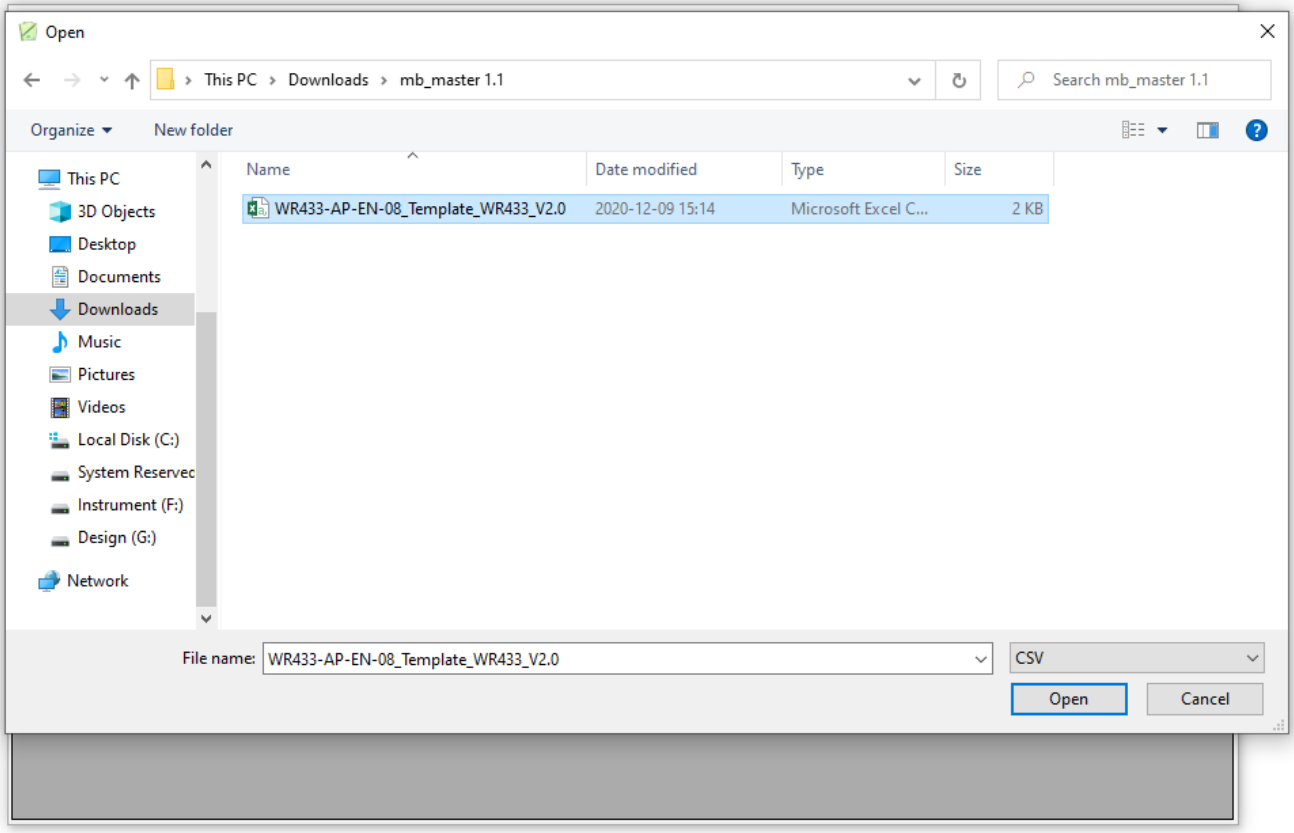
- Unzip file and run file application "**Daviteq Modbus Configuration Tool Version**"

Name	Date modified	Type	Size
common_lib.dll	03/08/2019 5:08 PM	Application exten...	20 KB
Daviteq Modbus Configuration Tool Version	03/14/2019 10:30 AM	Application	27 KB
master_lib.dll	03/14/2019 10:27 AM	Application exten...	9 KB
mb_lib.dll	03/08/2019 5:08 PM	Application exten...	232 KB

- 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 the sensor's operating parameters.

Use Modbus tool to check added sensors and configure sensor operating parameters.

Memmap resgisters

You can download Modbus Memmap of WS433-CL-FW with the following link:

https://filerun.daviteq.com/wl/?id=WBbGm89AToHWyvIyMOc780N1KmjfUr3Y

In the memmap file, refer to the **Memmap of WS433-AI** 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

Below are examples of some 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	Analog value 1 of sensor Node (parameter 1)			float	Read	Value from Analog input sensor. This value is parameter 1 of a wireless sensor node
4		2	4	Value of parameter 2 of sensor Node			float	Read	Same value as parameter 1
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

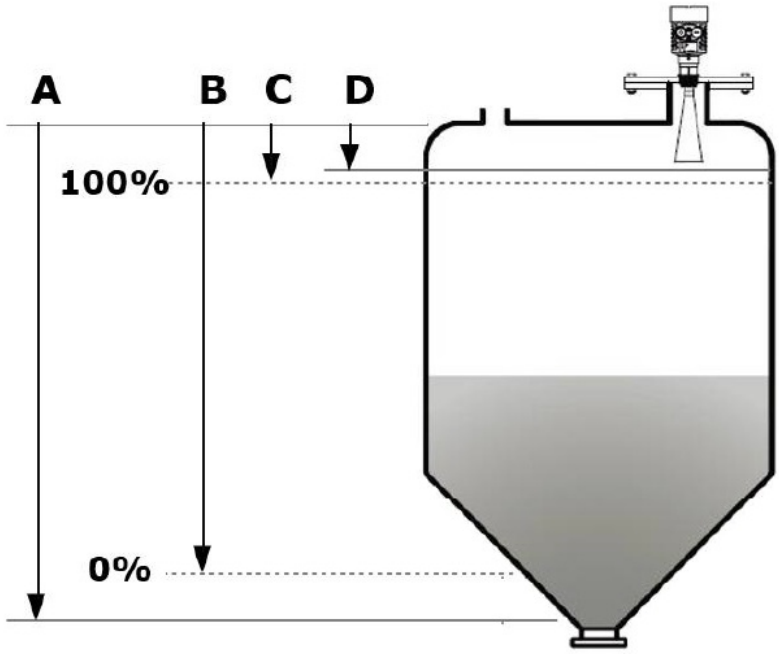
3	16	2	4	Radio frequency	433.05-434.79, 433 Mhz	433.92	float	Read/Write	Configure the operating frequency of wireless sensor by Co-ordinator, should be configured from 433.05-434.79 MHz, only for advanced users

4.2 Radar Sensor RD-2695S

The Radar Level Transmitter antenna emits narrower micro wave pulses which will be transmitted via the antenna. The micro wave will be reflected back after touching the surface of a medium, then antenna system will receive it and transmit it into the electrical circuit, which will be automatically turned into the level signals.

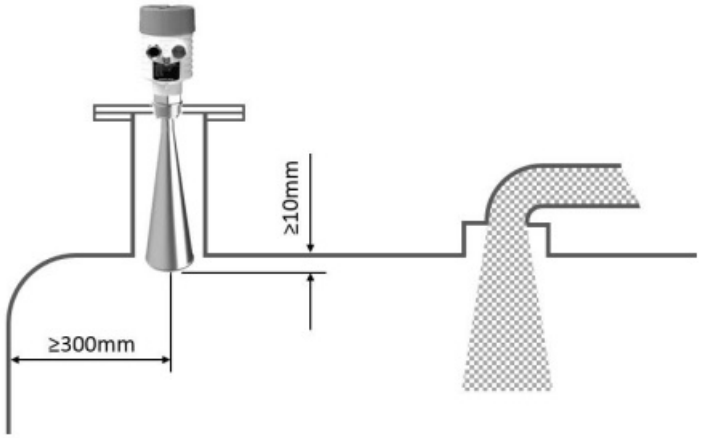
Note:

When using the radar level transmitter, must keep the highest level of medium out of the dead zone (see area **D** shown in the drawing)



- **A:** Setting measuring range
- **B:** Low level adjustment
- **C:** High level adjustment
- **D:** Dead zone

Measuring reference: the bottom surface of threads or the sealing surface of a flange.



Keep away from feeding mouth

The minimum distance between the symmetrical central line of the transmitter and the inner tank wall should be at least 300mm

PLEASE REFER TO THE MANUFACTURER'S INSTRUCTIONS CAREFULLY TO AVOID DAMAGING THE DEVICE:

USER MANUAL OF RADAR LEVEL METER

INSTRUCTIONS FOR CONFIGURING SENSORS WITH LCD MODULE

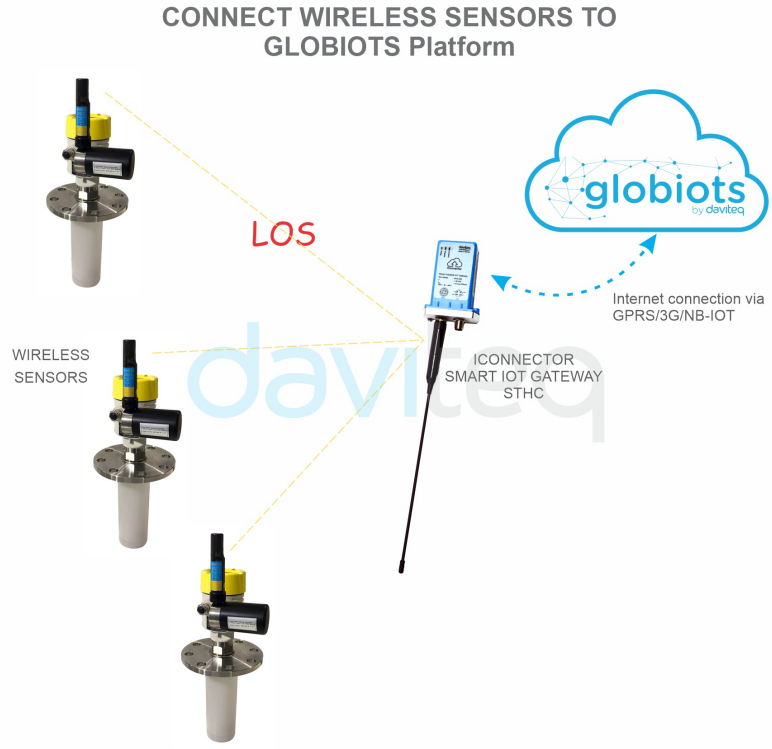
5. Wireless sensor installation

5.1 Installation location

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 Wireless sensor still communicates with Gateway, but the distance will be reduced significantly.

ATTENTION:

DO NOT install the Wireless 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.



5.2 Power supply and battery installation

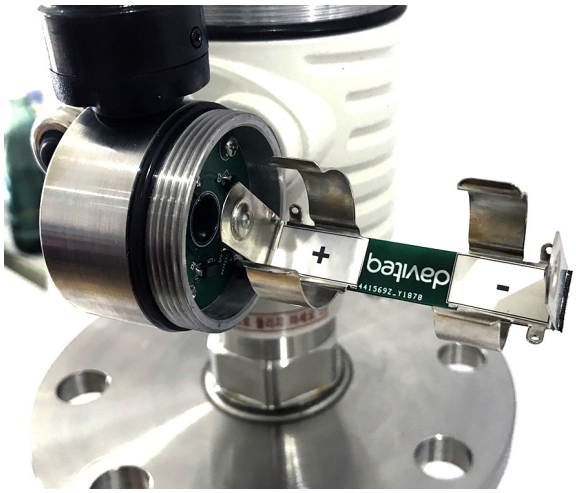
5.2.1 battery installation

Recommends using **type D** batteries for wireless sensors.

ATTENTION:

REVERSED POLARITY OF BATTERIES IN 10 SECONDS CAN DAMAGE THE SENSOR CIRCUIT !

Step 1: Remove the battery cover of the sensor



Step 2: Insert a type D battery into the sensor

5.2.2 Power Supply

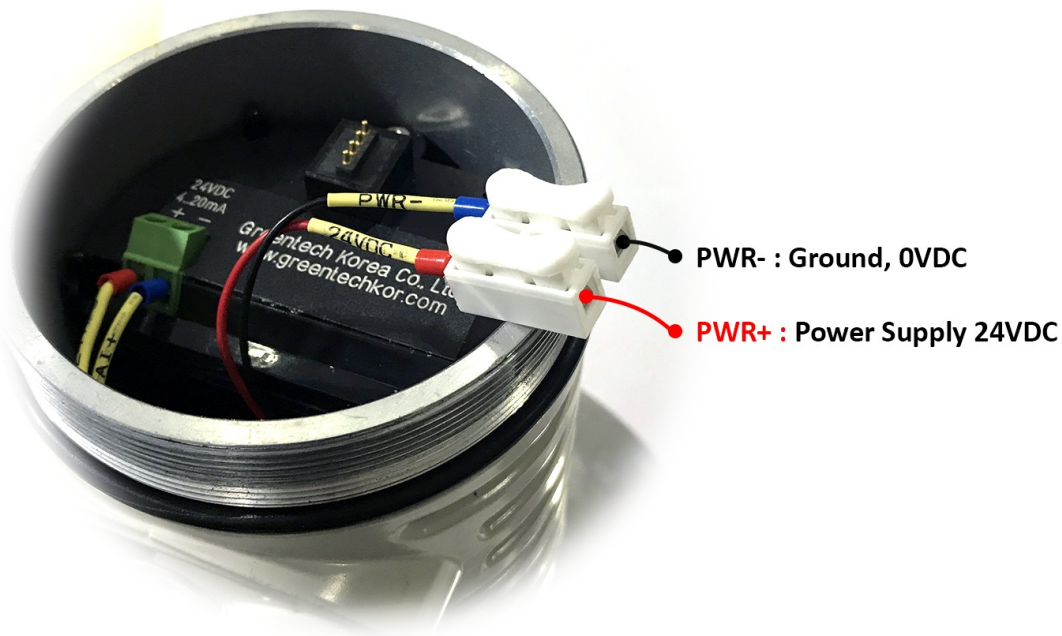
Insert the power cord into the sensor via Cable Gland

Power supply 24VDC and GND into electric domino

ATTENTION:

WHEN CONNECTING A WIRING PLEASE PAY ATTENTION TO THE NAMES MARKED ON THE LINE

REVERSED POLARITY CAN DAMAGE THE SENSOR CIRCUIT !



6. 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

7. Support contacts

Manufacturer

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Revision #17
Created Tue, Nov 3, 2020 1:38 AM by Kiệt Anh Nguyễn
Updated Mon, Aug 30, 2021 3:22 AM by Kiệt Anh Nguyễn