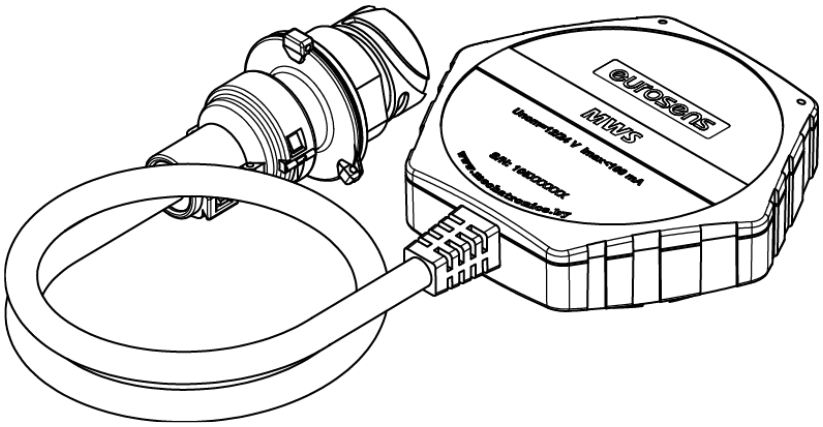
UNIVERSAL DISTANCE SENSOR

eurosens MWS



User Manual

MECHATRONICS

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TERMS AND DEFINITIONS:

Sensor – eurosens MWS.

Radar – sensing element of eurosens MWS sensor.

Tank calibration tab – a tab with a conversion table of distance to volume.

Calibration – changing of sensor settings.

PC – personal computer.

Vehicle – a truck, tractor, bus, locomotive, river boat, diesel genset, stationary tank, boiler/burner.

1 GENERAL INFORMATION

1.1 USE

The universal eurosens MWS distance sensor is used to measure the distance to an object or product reflecting radio waves.

1.1.1 APPLICATION OF eurosens MWS

- Measurement of liquid level in container.
- Measurement of bulk products in/out of container.
- Measurement of distance to the surface or soil.
- Control of the presence of the object.

1.1.2 MEASUREMENT OF LIQUID LEVEL IN CONTAINER

The sensor transducer can be installed via tapping into the hole drilled in a container (Fig. 1) or glued to its outer surface (Fig. 2.). Metal tanks require installation via drilling a hole. Installation without drilling a hole is possible for tanks made of dielectric materials (e.g. intermediate bulk containers), but the result depends on the wall thickness and the measured product.

Fig. 1. eurosens MWS installation via tapping

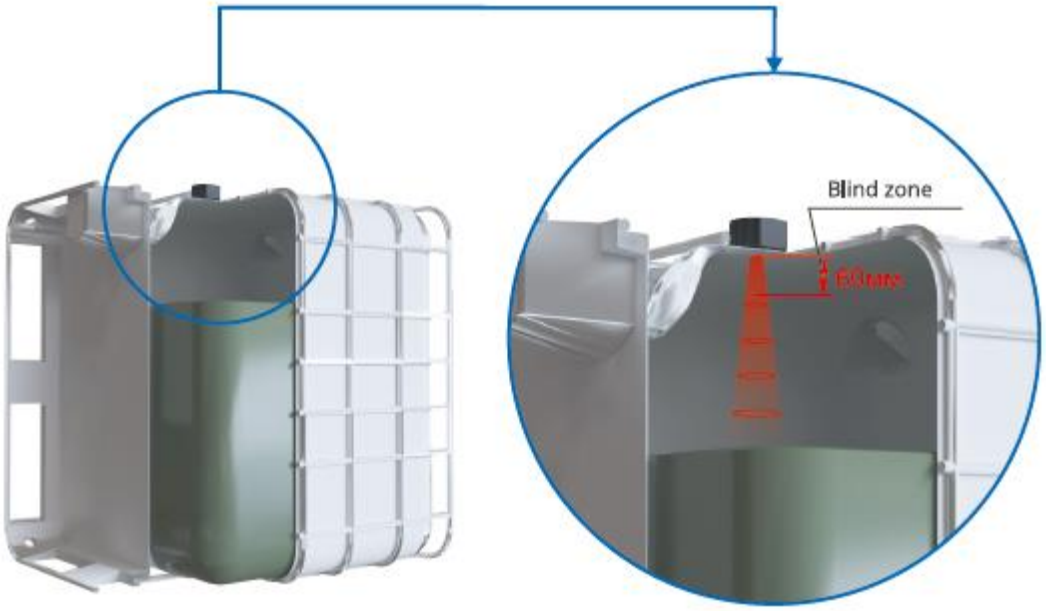


Fig. 2. eurosens MWS installation without drilling

1.1.3 MEASUREMENT OF BULK PRODUCTS IN/OUTSIDE CONTAINER

The sensor can measure the height of bulk solids in and outside the container (Fig. 3).

Fig. 3. Measurement of bulk products

1.1.4 MEASUREMENT OF DISTANCE TO SURFACE OR SOIL

eurosens MWS can be used in automatic position control systems for special equipment when it is important to maintain a given distance to the ground.

1.1.5 CONTROL OF PRESENCE OF OBJECT

The sensor emits short microwave pulses towards the surface of the measured object. When the pulse reaches the surface, some of the energy is reflected back to the receiver, where it is processed by the sensor electronics. The time difference between the emitted and reflected pulses is determined by the microprocessor and then converted into distance. The distance is used to calculate the level of the product in the tank (Fig. 4).

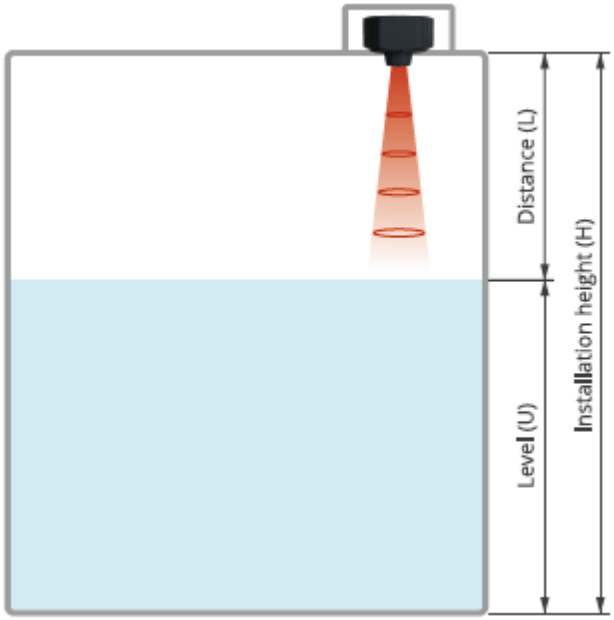


Fig. 4. Control of the presence of the object

2 SPECIFICATION OF eurosens MWS

Table 1

Parameter	Value
Power supply, V	10 - 50
Reverse polarity protection	Yes
Measurement error, mm	± 4 (up to 1 meter), ± 10 (up to 2 meters)
Ambient operating temperature, °C	-40 - +85
Output interface	RS-485
Data interface	RS-485
Output protocol	MODBUS, LLS
Ingress protection rating	IP 67

eurosens MWS has a "blind zone", where the measurement is inaccurate or impossible.
The "blind zone" can be divided into three areas (Fig. 5).

Fig. 5. Structure of the eurosens MWS "blind zone"

3 INSTALLATION OF eurosens MWS

3.1 INSTALLATION RECOMMENDATIONS

- It is recommended to mount the sensor at the maximum distance to the measured object (empty vessel).
- There should be no objects or structures in the measurement area that interfere with the propagation of the radio beam (pipes, fittings, cables, other sensors).
- When installing the sensor make sure that the flow of liquids or bulk materials during loading/unloading does NOT fall into the measurement zone of the sensor (Fig. 6).

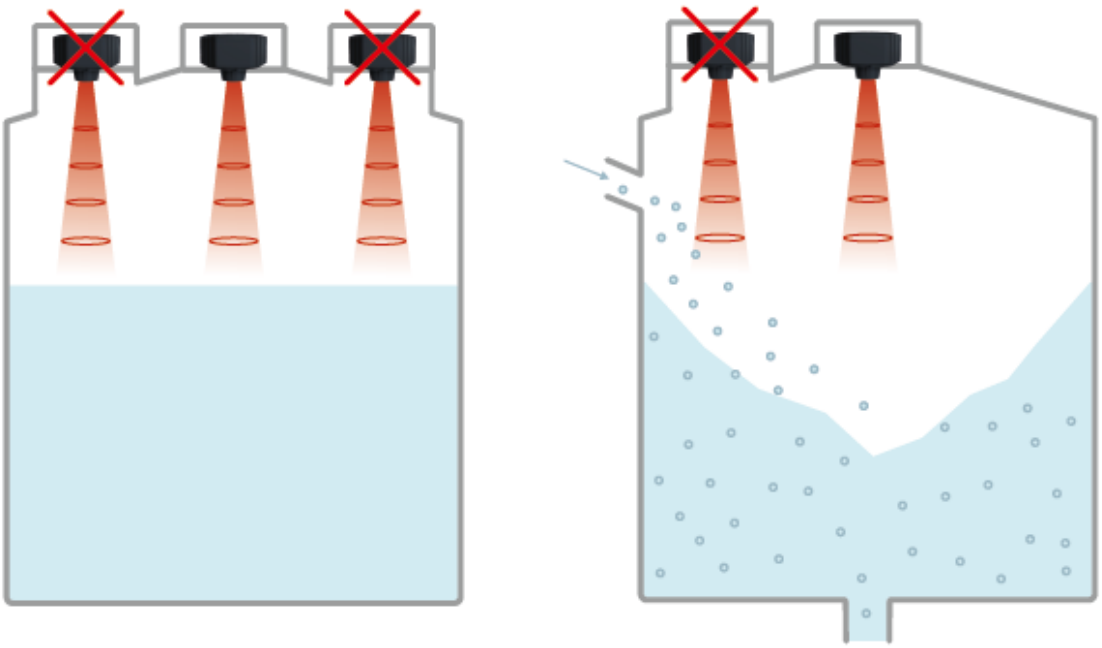


Fig. 6. Recommended place of installation

- The sensor must be oriented to the lowest point of the tank to ensure level measurement over the entire depth of the tank.

- When installing the sensor outdoors, it is recommended to install the sun shield above the sensor.

Inclined mounting of the sensor is allowed.

Methods for sensor installation:

- tapping into a container;
- gluing to the outer surface of a container.

When mounting the sensor, use the bayonet included in the eurosens MWS mounting kit (Fig. 7).

Fig. 7. Mounting kit

3.2 INSTALLATION VIA TAPPING

1) Drill a hole in a container with a 38 mm drill bit (Fig. 8).

2) Make 5 holes for screws or self-tapping screws to match the holes in the bayonet plate.

It is recommended to use screws and tapped holes when installing the sensor on vessels with metal wall thickness of 3 mm or more.

3) Place the rubber gasket from the mounting kit between the container and the bayonet plate.

If self-tapping screws are used for attachment, it is recommended to turn the rubber gasket so that the self-tapping screws DO NOT match the holes of the gasket.

Fig. 8. Drilled hole for sensor installation

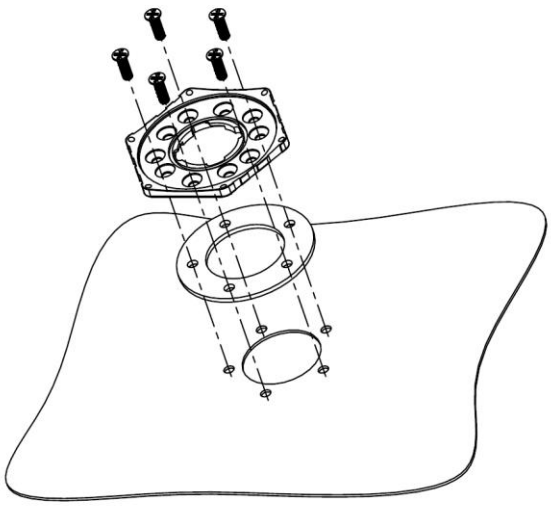


Fig. 9. Bayonet mount

4) Install the bayonet plate using screws or self-tapping screws. (Fig. 9).

5) Place the rubber ring (O-ring) into the slot of the bayonet plate.

6) Place the sensor into the bayonet hole till it stops and turn the sensor clockwise until fixed.

It is recommended to seal the sensor after installation.

4 SETTINGS OF eurosens MWS

Configuration of eurosens MWS is performed with the service software eurosens MWS Configurator and a service adapter (e.g. a programming device eurosens Destination 02).

4.1 CONNECTION PROCEDURE

1) Download the service software eurosens MWS Configurator from the eurosens MWS product page and install it on your PC.
2) Connect the service adapter to your PC.
3) Run the service software.
4) Click the button “Searching” (Fig. 10).

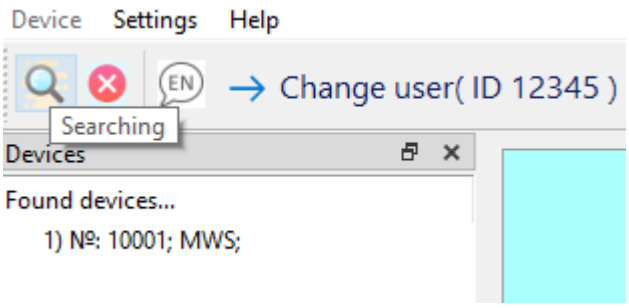


Fig. 10. Device search

The program automatically searches for the connected devices, detects the adapter COM port and eurosens MWS sensor. The serial number of the sensor and its name appears in the window “Devices”.

5) Right-click the mouse to open the context menu (Fig. 11).

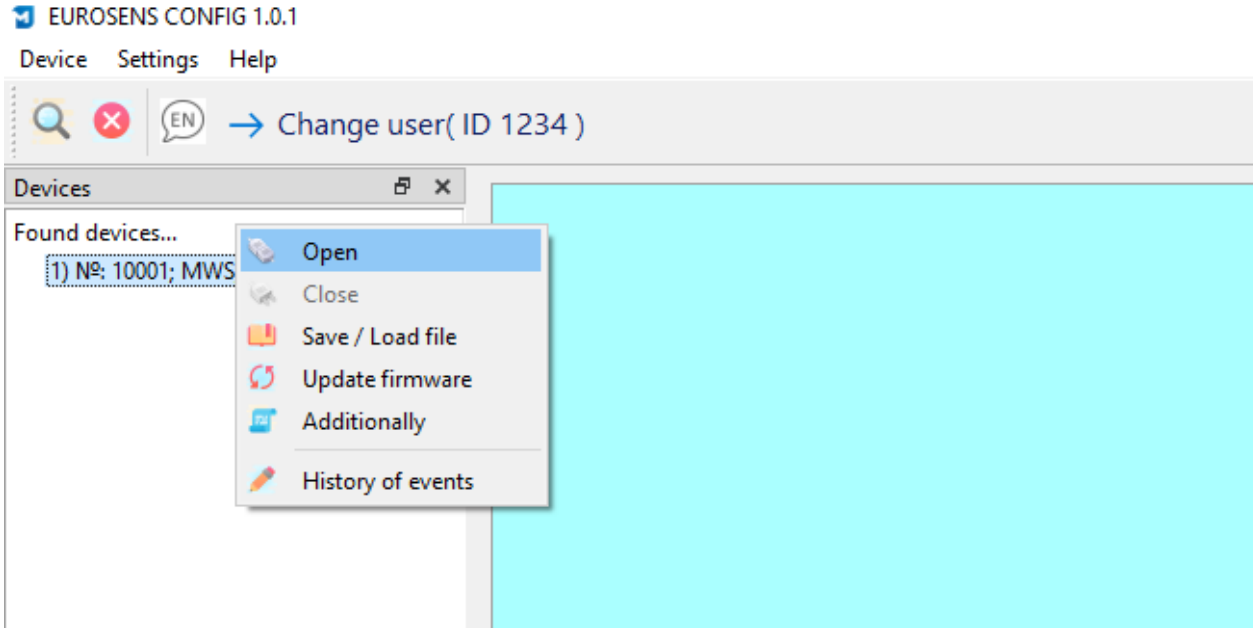


Fig. 11. Sensor operation menu

6) Click the button “Open” to see the “Device settings” tab (Fig. 12).

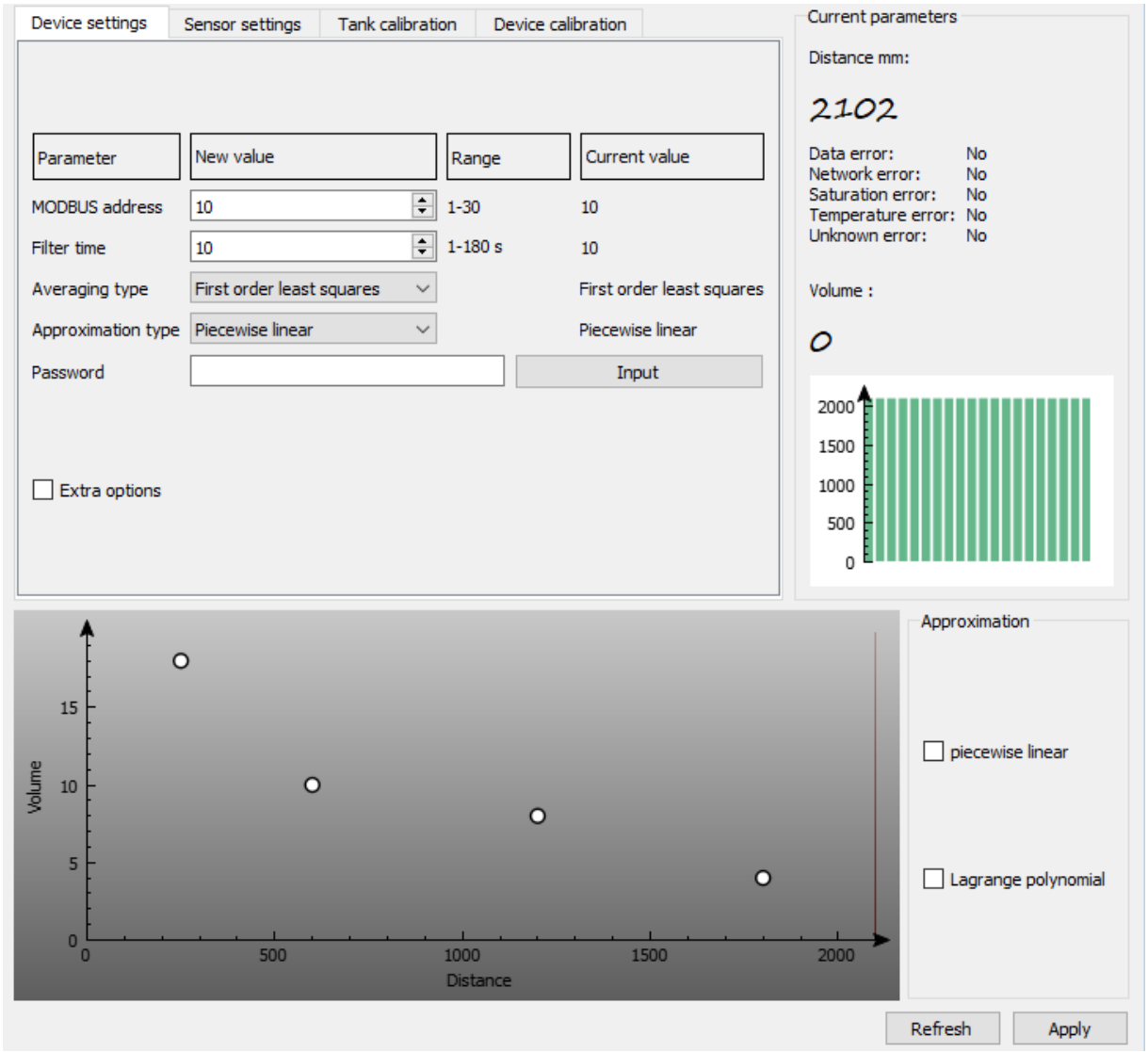


Fig. 12. Device settings tab

4.2 PROGRAM SETTINGS

4.2.1 DEVICE SETTINGS TAB

- **MODBUS** address – indicate the sensor address in the range from 1 to 30.
- **Filter time** – specify the averaging time of the measured sensor values in seconds.
- Select one of the **averaging types** and one of **data approximation methods**, set a password for the sensor settings.
- Set additional parameters listed in the tab **Extra options** if necessary (Fig. 13).

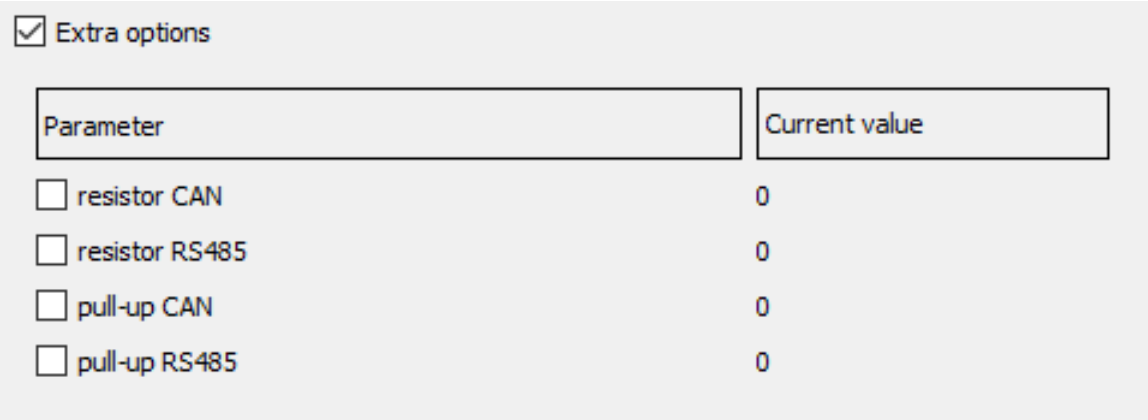


Fig. 13. Extra options

4.2.2 SENSOR SETTINGS TAB (Fig. 14)

- **Beginning of measurement** – specify the minimum distance from the sensor to the measuring object, which defines the “blind zone” of the sensor.
- **Measurement range** – specify the maximum distance from the sensor to the measuring object.

- **Signal amplification** is the gain of the receiver used in the sensor. Low gain may result in the sensor being unable to determine the distance to the measurement object. Too high gain can result in false data.

- **HWAAS** is the number of pulses averaged in the radar to produce one data point. The measurement time is proportional to the HWAAS value.

- **Running average** is filtration coefficient used by the radar of the sensor.

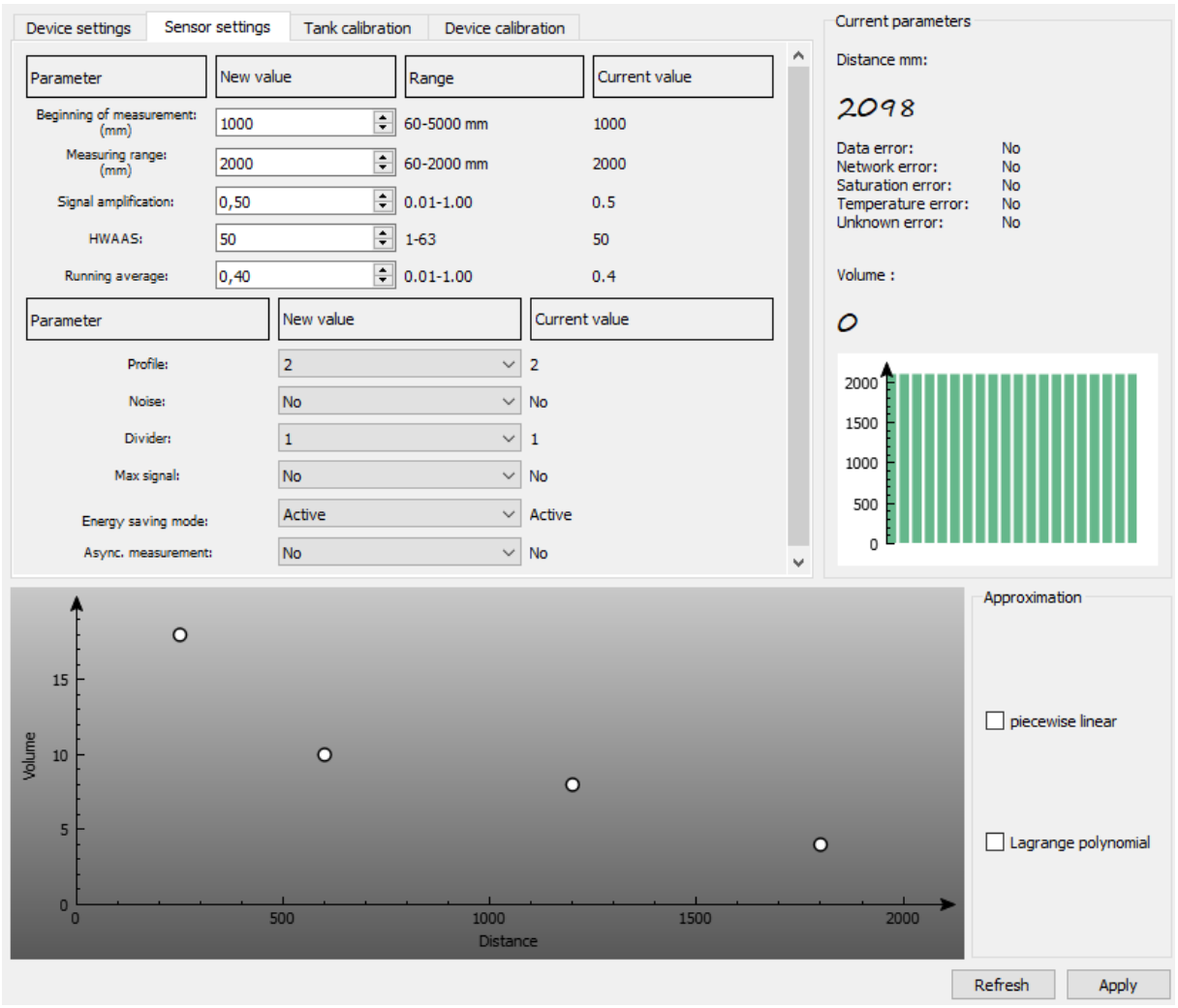


Fig. 14. Sensor settings tab

- **Profile** determines the settings of the radar of eurosens MWS. There are 5 profiles which differ in pulse length and type of sampling of the incoming pulse. Profiles with lower numbers have shorter pulse, and profiles with higher numbers have longer pulse.

Profile 1	– measures strong reflections and small distances (<20 cm).
Profiles 2, 3	– operates best at the distance range from 20 cm to 1 m.
Profiles 4, 5	– measures distances over 1 m.

- **Divider** determines the sample rate of the signal.

Higher value of the Divider parameter increases the response speed of the sensor and lowers the current consumption due to a decrease in accuracy. Smaller value gives more precision in distance measurement.

- **Energy saving mode** defines the state in which the sensor is between measurement cycles.

The "Active" mode gives the fastest sensor response; the "Switched off" mode provides the slowest response and low power consumption.

- **Async. measurement** mode allows the sensor to send previously received data during the current measurement.

4.2.3 TANK CALIBRATION TAB

Tank calibration tab (Fig. 15) allows you to set the calculation table for distance-to-volume conversion.

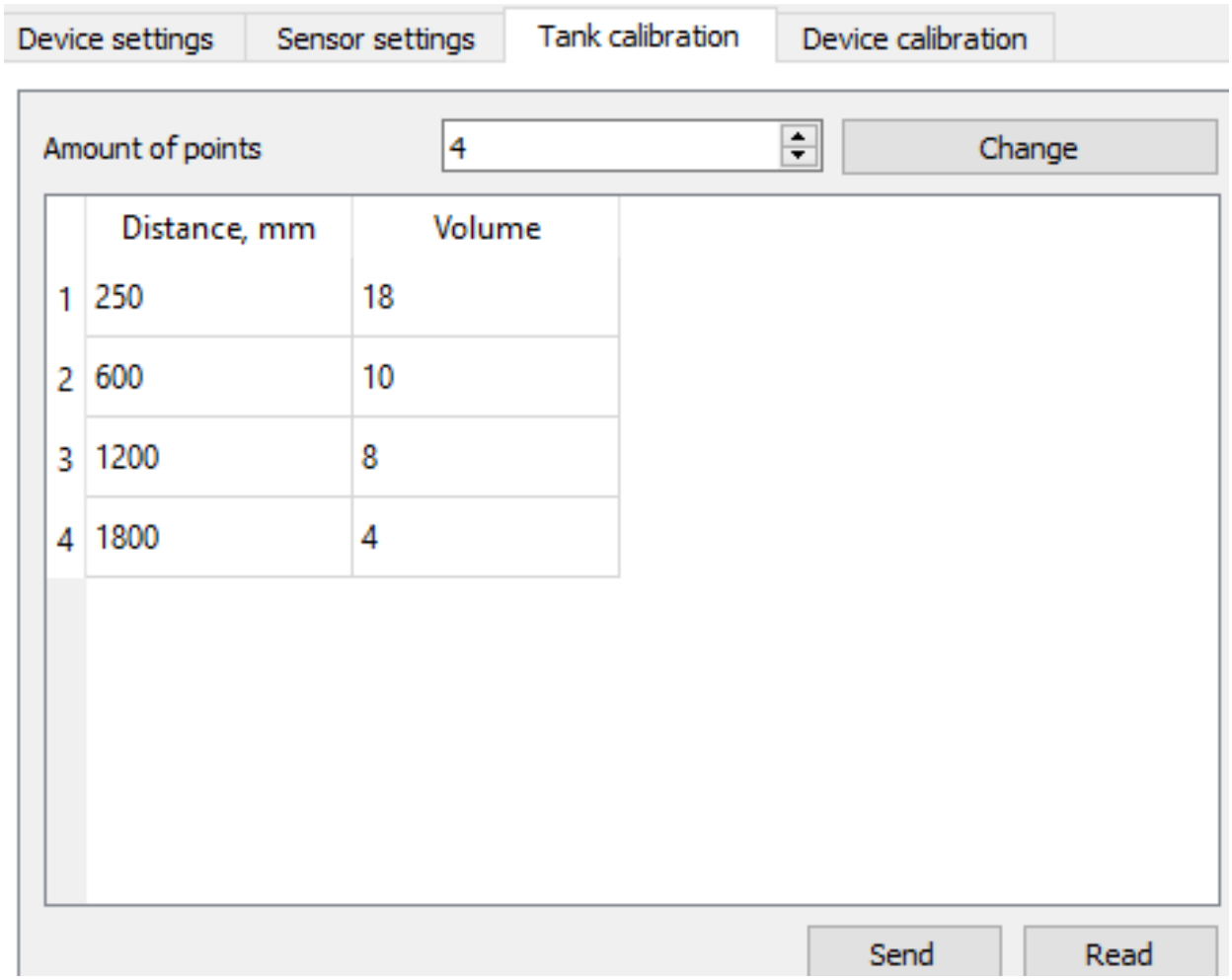


Fig. 15. Tank calibration tab

4.2.4 DEVICE CALIBRATION TAB

Device calibration tab (Fig. 16) is used to correct the nonlinearity of the sensor's distance measurement, if necessary.

To correct the nonlinearity:

1) make a series of reference distance measurements;
2) compare them with the values previously obtained by the sensor;
3) enter reference measurement results in the "Real distance" field.

To calculate the new logarithmic regression coefficients, it is necessary to take at least 8 reference measurements.

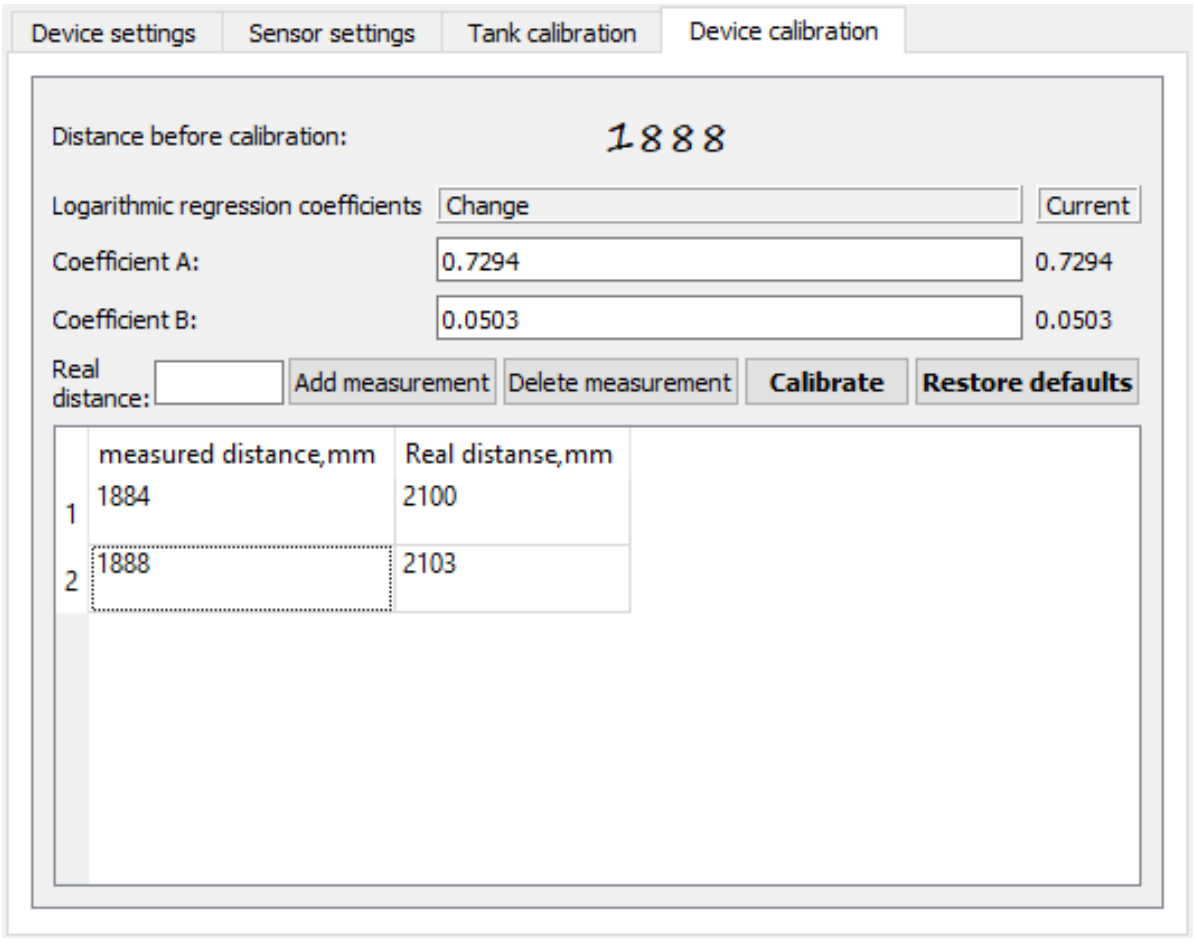


Fig. 16. Device calibration

4.2.5 ADDITIONAL OPTIONS

Update the firmware of eurosens MWS in the **Device** menu, if necessary (Fig. 17).

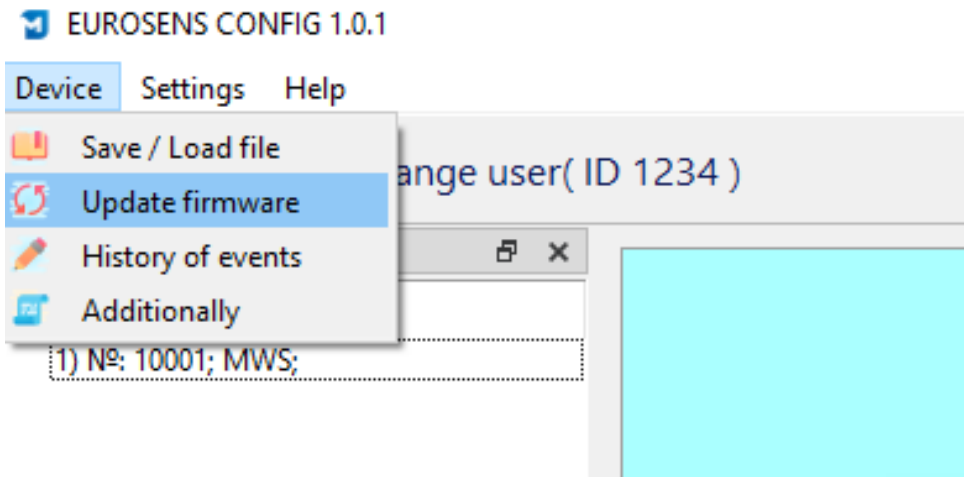


Fig. 17. Device menu

5 CONNECTION OF eurosens MWS

eurosens MWS is connected to the corresponding inputs of the monitoring device (e.g. vehicle monitoring terminal). Pin assignment information for the eurosens MWS connector (Fig. 18) is given in the product specification.

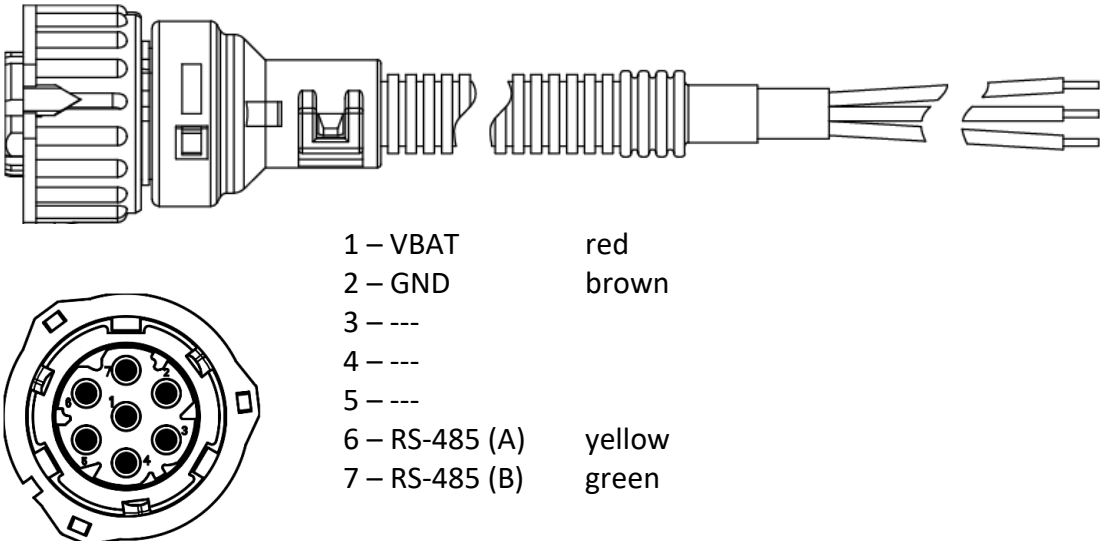


Fig. 18. Pin assignment

Use special cables and splitters to connect eurosens MWS to the sensor network (Fig. 19).

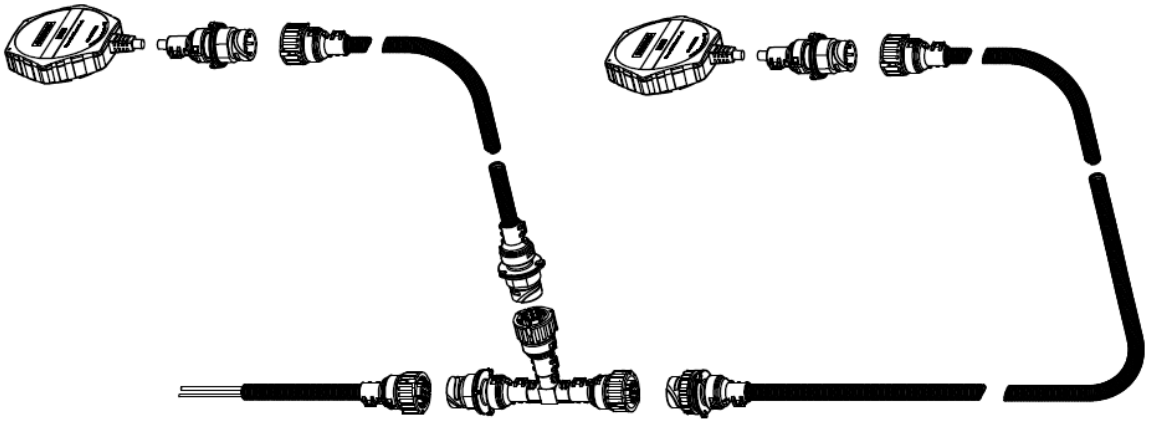


Fig. 19. Using T-Cable

If it's necessary to display information from eurosens MWS at the installation site, it is recommended to use eurosens Display RS or eurosens Display CAN (Fig. 20).

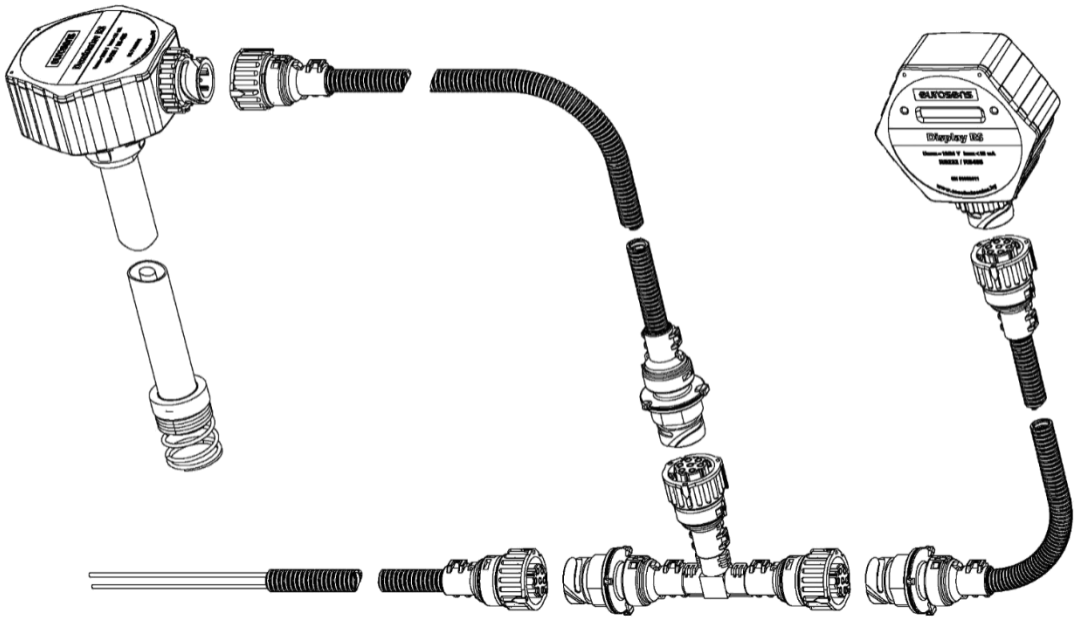


Fig. 20. Using eurosens MWS with eurosens Display

6 ADDITIONAL INFORMATION

6.1 STORAGE

It is recommended to store eurosens MWS in dry enclosed areas.
eurosens MWS may only be stored in its original packaging at temperature range from -50 to + 40 °C and relative humidity up to 100% at +25 ° C.
Do not store eurosens MWS with substances that cause metal corrosion and/or contain aggressive impurities.
The storage period of eurosens MWS should not exceed 24 months.

6.2 TRANSPORTATION

eurosens MWS must be transported in compartments that protect packages from mechanical damage and precipitation.
Air environment in transportation compartments must not contain acidic, alkaline and other corrosive impurities.
Shipping containers with eurosens MWS must be sealed.

6.3 DISPOSAL

eurosens MWS does not contain any substances or components that could be hazardous to health and the environment during and after the service life and disposal.

eurosens MWS does not contain precious metals in amount mandatory for accounting.

6.4 TECHNICAL SUPPORT

т: +375 (25) 602-75-50, +375 (25) 799-47-71

E-mail: support@mechatronics.by

6.5 CONTACTS

JSC Mechatronics
1 May str. 80, Vileyka, Belarus, 222417
t: +375 (1771) 71300
f: +375 (1771) 24190
E-mail: office@mechatronics.by
www.mechatronics.by/en

APPENDIX 1. LLS DATA PROTOCOL

eurosens MWS can transmit data via the RS-485 interface with LLS protocol support.

Table 2. LLS data

Field number	Field name	Length, bytes	Comments
1	Prefix	1	The field is a marker for the beginning of the message. Incoming messages must be prefixed with 31h, and outgoing messages must be prefixed with 3Eh.
2	Network address	1	The field contains: - for prefix 31h - the network address of the message recipient; - for prefix 3Eh - the network address of the message sender.
3	Operation code	1	The field contains: - for prefix 31h - code of the operation that the program must perform; - for prefix 3Eh - the code of the operation to which a response is given.
4	Data	Depends on operation code	Data composition and field format depend on the operation code.
5	Checksum	1	The field is used to monitor data integrity.

LLS COMMANDS

- **0x06** - Single data read;
- **0x21** - Request for serial number.

SINGLE DATA READ (COMMAND 06H)

The command reads the current data: volume, distance. Data is transferred with the least significant byte first.

Table 3. Command **06h**. Request

Offset, bytes	**Length,** bytes	**Value**	**Comments**
0	1	31h	Prefix
+1	1	00h...FFh	Network address of the recipient
+2	1	06h	Operation code
+3	1	00h...FFh	Checksum

Table 4. Command **06h**. Response

Offset, bytes	**Length,** bytes	**Value**	**Comments**
0	1	3Eh	Prefix
+1	1	00h...FFh	Network address of the sender
+2	1	06h	Operation code
+3	1	-128...127	Temperature in Celsius degrees
+4	2	0000h...FFFFh	Volume of 0.01 L
+6	2	0000h...FFFFh	Distance in mm
+8	1	00h...FFh	Checksum

REQUEST FOR SERIAL NUMBER (COMMAND 21H)

Data is transferred with the least significant byte first.

Table 5. Command **21h**. Request

Offset, bytes	**Length,** bytes	**Value**	**Comments**
0	1	31h	Prefix
+1	1	00h...FFh	Network address of the receiver
+2	1	21h	Operation code
+3	1	00h...FFh	Checksum

Table 6. Command **21h**. Response

Offset, bytes	**Length,** bytes	**Value**	**Comments**
0	1	3Eh	Prefix
+1	1	00h...FFh	Network address of the sender
+2	1	21h	Operation code
+3	3	000000h... FFFFFFh	Serial number
+6	1	00h...FFh	Device type
+7	1	00h...FFh	Checksum

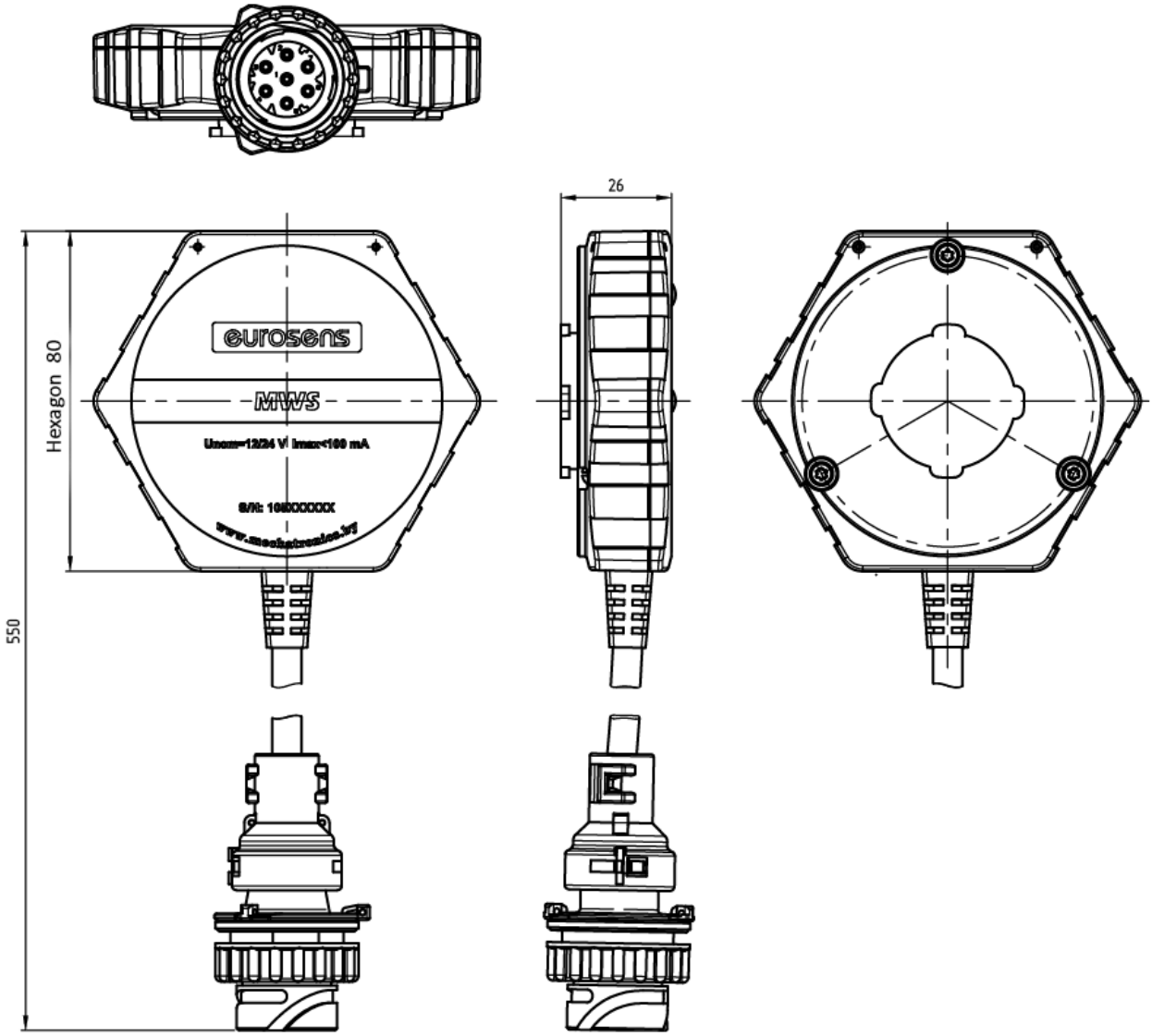
APPENDIX 2. MODBUS DATA PROTOCOL

eurosens MWS can transmit data via the RS-485 interface with MODBUS protocol support.

Table 7. Holding Registers – command **0x03/0x06(0x10)**

Byte addressing (1 byte)		**Two-byte addressing (2 bytes)**		**Type**	**Comments**	**Size**
Address (10)	Address 16)	Address 10)	Address (16)			
0x0	0x0	0x00	0x00	Uint16_t	Current measuring distance	2 bytes
0x2	0x2	0x01	0x1	Uint32_t	Current measuring volume	4 bytes

APPENDIX 3. DIMENSIONS



MECHATRONICS

JSC Mechatronics
1 May str. 80, Vileyka, Belarus, t: +375 (1771) 71300, f: +375 (1771) 24190
E-mail: office@mechatronics.by
www.mechatronics.by/en