SOJI
STABILITY

USER GUIDE
fuel - level sensor

Analog (0...9V); Frequency (500...2000Hz); RS232/ RS485 interface

This guide provides introduction for installation, help on getting started and extensive documentation of feature.
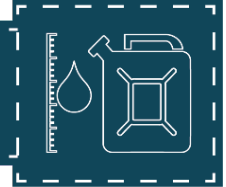We hope you enjoy building with our products as much as we enjoyed developing it.

FUEL LEVEL SENSOR
SP-RS232
LiCO
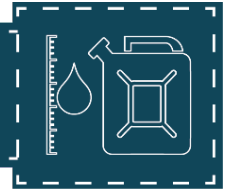SN: SP803500
www.sojielectronics.com

User Manual/ fuel - level sensor

LIGO SP & SP-PRO series

20.02.2020

CONTENTS

I. GENERAL INTRODUCTION

LIGO Fuel level sensor is produced and developed by SOJI Electronics Join Stock Company. The device is designed to measure the level of liquid fuels and other non-conductive liquids in vehicle's tanks and stationary fuel storages, applicable in different fields. The measured values will be t transformed into output signal in the form of: Analog, Frequency, RS232, RS485... and transmitted to a connected external device

Under particular conditions, the device can reach a high accuracy up to 99.5%. At present, on the market there are several lines of sensor using different technologies to measure fuel level such as: magnetically operated switches (reed switches), ultrasound wave (ultrasonic sensor), capacitive sensing (capacitive sensor). Among these ones, capacitive sensing technology is considered to have highest accuracy and greatest lifespan.

II. HIGHLIGHT FEATURES

- High accuracy up to 99.5%.

- Wide operating voltage range (only applicable to LIGO-SP-PRO with the voltage from 7.5 to 75V).

- Inside isolation voltage up to 2500V (only applicable to LIGO-SP-PRO).

- Can be optionally cut off or prolonged up to 6000mm.

- Automatic recognition for new length after being cut.

- Wide operating temperature range from -40°C to +85°C.

- A filter protects the probe from dregs and water.

- IP67 waterproof standard.

- Interference filter and thermal error compensation system.

- Installation and configuration software... on PC through a Connection Device.

- Quick installation, security seal.

III.   APPLICATIONS

- Trucks, container cars, excavators, trains…

- Boats, barges.

- Electric generators.

- Industrial oil storage tanks and stationary storage tanks.

- Factories, industrial zones.

- Fuel storage tanks in agricultural machines and maritime transportation…

IV.   TECHNICAL SPECIFICATIONS

1.   *Technical specifications of the LIGO-SP product*

PARAMETER	AF	RS232	RS485
Standard length (L),mm	700, 1000, 1500...up to 6000 mm	700, 1000, 1500...up to 6000 mm	700, 1000, 1500...up to 6000 mm
Measuring error, %	± 0.5 %	± 0.5 %	± 0.5 %
Output signal	Analog (0...9V), Frequency (500...2000Hz).	RS232	RS485
Baud rate, bit/sec	9600	2400, 4800, 9600, 19200, 38400, 57600, 115200.	2400, 4800, 9600, 19200, 38400, 57600, 115200.
Power supply (DC input voltage, V)	15-37	12-37	12-37
Maximum power consumption, mA	20	20	20
Waterproof standard (Ingress protection rating, IP)	IP67	IP67	IP67
Operating temperature, °C	-40...+85	-40...+85	-40...+85
Maximum allowed humidity level,%	100	100	100
Resolution, bit	12	12	12
Digital reading range corresponding to the minimum level measurement value	Analog (0...8V); Frequency (500...1500 Hz)	0	0
Digital reading range corresponding to the maximum level measurement value	Analog (1...9V); Frequency (1000...2000 Hz)	4095	4095
Average sampling period, (s)	0...255	0...255	0...255
Message interval, (s)	Continuous	1...60	1...60
Absolute error in temperature measurement within the entire temperature measuring range, °C	±2	±2	±2
Average service life, (years))	8	8	8

2. Technical specifications of the LIGO-SP PRO product

- LIGO-SP PRO product is designed for devices having wide input voltage (7-75V), the voltage of the internal sensing printed circuit board isolated from outside is 2500V. The internal temperature sensor has a very low error at <0.6°C. The product is designed to operate in extreme environment.

PARAMETER	AF	RS232	RS485
Standard length (L),mm	700, 1000, 1500...up to 6000 mm	700, 1000, 1500...up to 6000 mm	700, 1000, 1500...up to 6000 mm
Measuring error, %	± 0.5 %	± 0.5 %	± 0.5 %
Output signal	Analog (0...9), Frequency (500...2000Hz).	RS232	RS485
Baud rate, bit/sec	9600	2400, 4800, 9600, 19200, 38400, 57600, 115200.	2400, 4800, 9600, 19200, 38400, 57600, 115200.
Power supply (DC input voltage, V) 2500V internal isolated	**7-75**	**7-75**	**7-75**
Maximum power consumption, mA	20	20	20
Waterproof standard (Ingress protection rating, IP)	IP67	IP67	IP67
Operating temperature, °C	-40...+85	-40...+85	-40...+85
Maximum allowed humidity level,%	100	100	100
Resolution, bit	12	12	12
Digital reading range corresponding to the minimum level measurement value.	Analog (0...8V); Frequency (500...1500 Hz)	0	0
Digital reading range corresponding to the maximum level measurement value	Analog (1...9V); Frequency (1000...2000 Hz)	4095	4095
Average sampling time, (s)	0...255	0...255	0...255
Message interval, (s)	continuous	1...60	1...60
Absolute error in temperature measurement within the entire temperature measuring range, °C	**±0.6**	**±0.6**	**±0.6**
Average service life, (years)	**10**	**10**	**10**

Notes!

- *LiGO SP Fuel Level Sensor measures the accurate fuel level in fuel tanks, therefore the device installation process also needs to be extremely accurate.*

- *Installation technicians should be well-trained by specialists or experts in this field before installing the device.*

- *Implement protection against electric shocks and electrical fires, labour safety and hygiene.*

- *List of installing tools is provided in section APPENDIX A below.*

- *List of accessories is provided in section APPENDIX B below.*

V.   INSTALLATION

1. *Selecting the location to install sensor*

- Installation location should be as close as possible to the geometric center and placed at the deepest level of the tank.
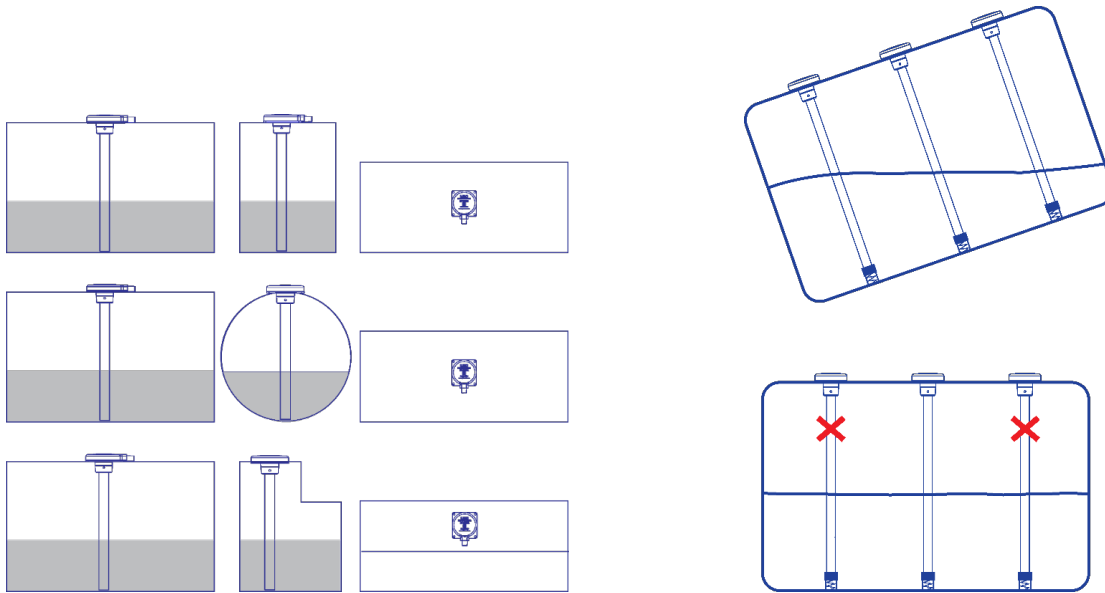
Figure 1. Selecting the location to install sensor

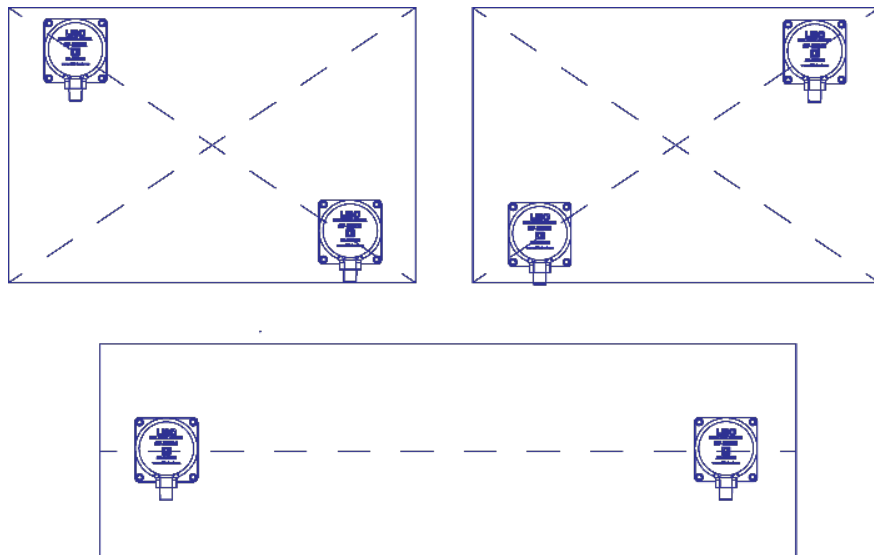- When being installed, the sensor should not be in contact with reinforcement ribs inside the tank

Figure 2. Installation of two sensors in one tank allows for significant reduction

2. Drilling the hole on fuel tank

- o Drill out the central bore by bimetal core drill **ø38** mm
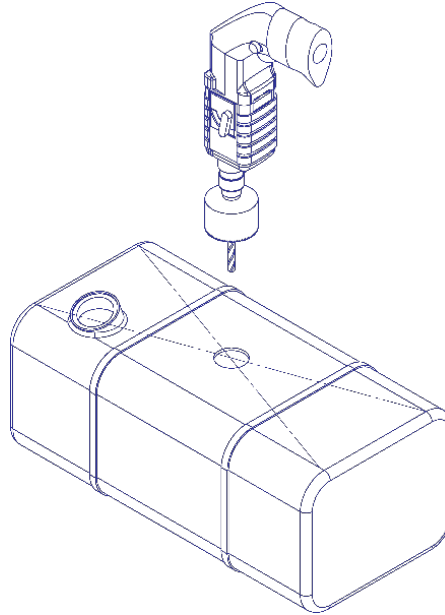
Figure 3. Drilling the selected hole

- o Drill out four mounting holes according to the diagram:

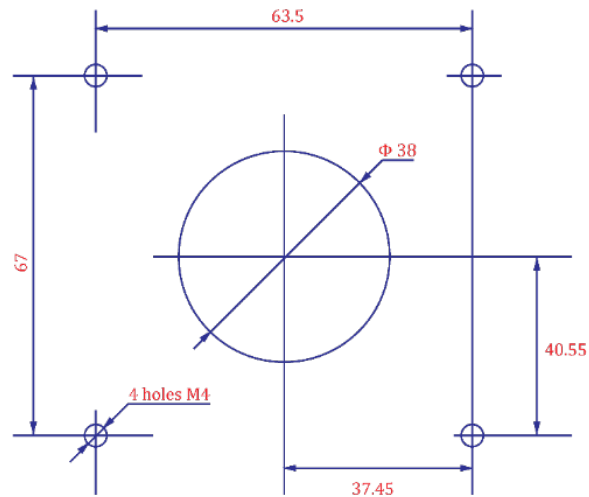*Figure 4. Drill out four mounting holes*

The mounting hole diameter depends on the tank material:

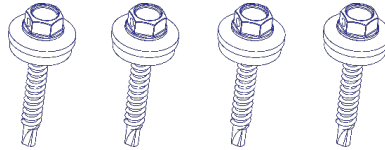- ø 4 mm – for metal tank with wall thickness over 3 mm (cut M5 self screw M4.8)

Figure 5.

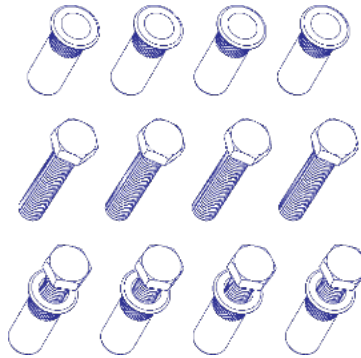- ø 7 mm – for plastic and metal tank with wall thickness up to 3 mm (for rivets)
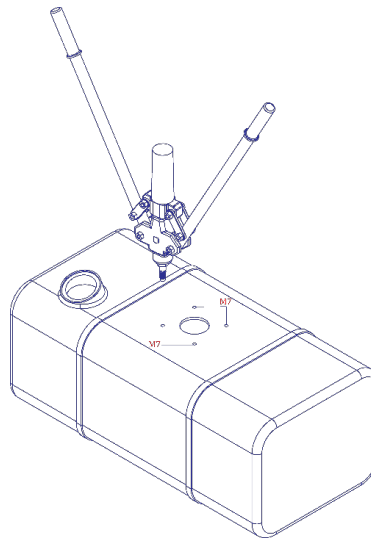

Figure 6. Rivet nut M5

Figure 7. Installing revit nut if tank's wall is thinner than 3mm

3. Measuaring the tank depth and cutting sensor'measuring probe
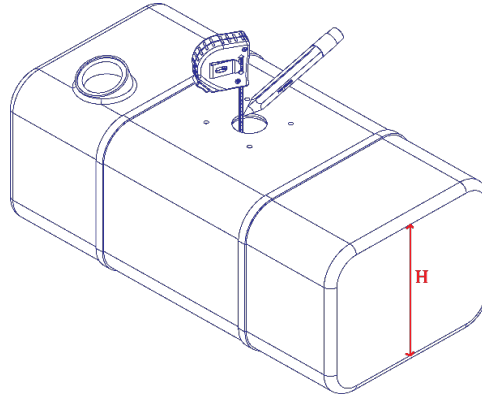

Figure 8. Measuring the tank depth

- Cut the sensor's measuring probe so that its length is **25 mm** less than the depth of the tank. Ensure that shearing line is perpendicular to the sensor longitudinal axis
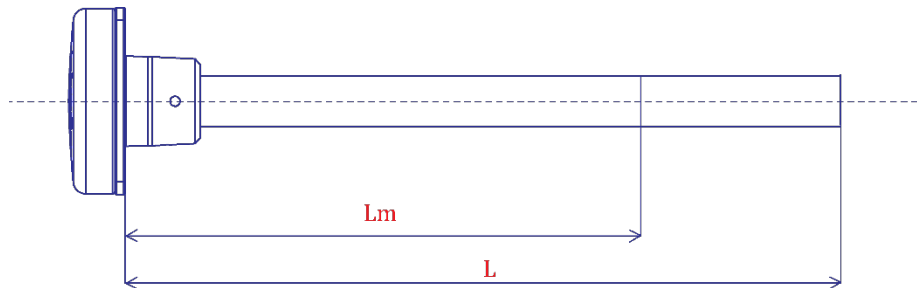

Figure 9. Origin length (L) and length after cutting (Lm).

Notes:

Minimum allowable length of the measuring probe is 150 mm.

VI.   INSTALLING SOFTWARE AND CONNECTING CONFIGURATION TOOL

Preparation:

-   Laptop or PC

-   Power supply 12 -24VDC or battery 12V

-   USB to RS232 cable.

-   Configuration tool from   SOJI ELECTRONICS (We recommend to upgrage to the latest possible version)
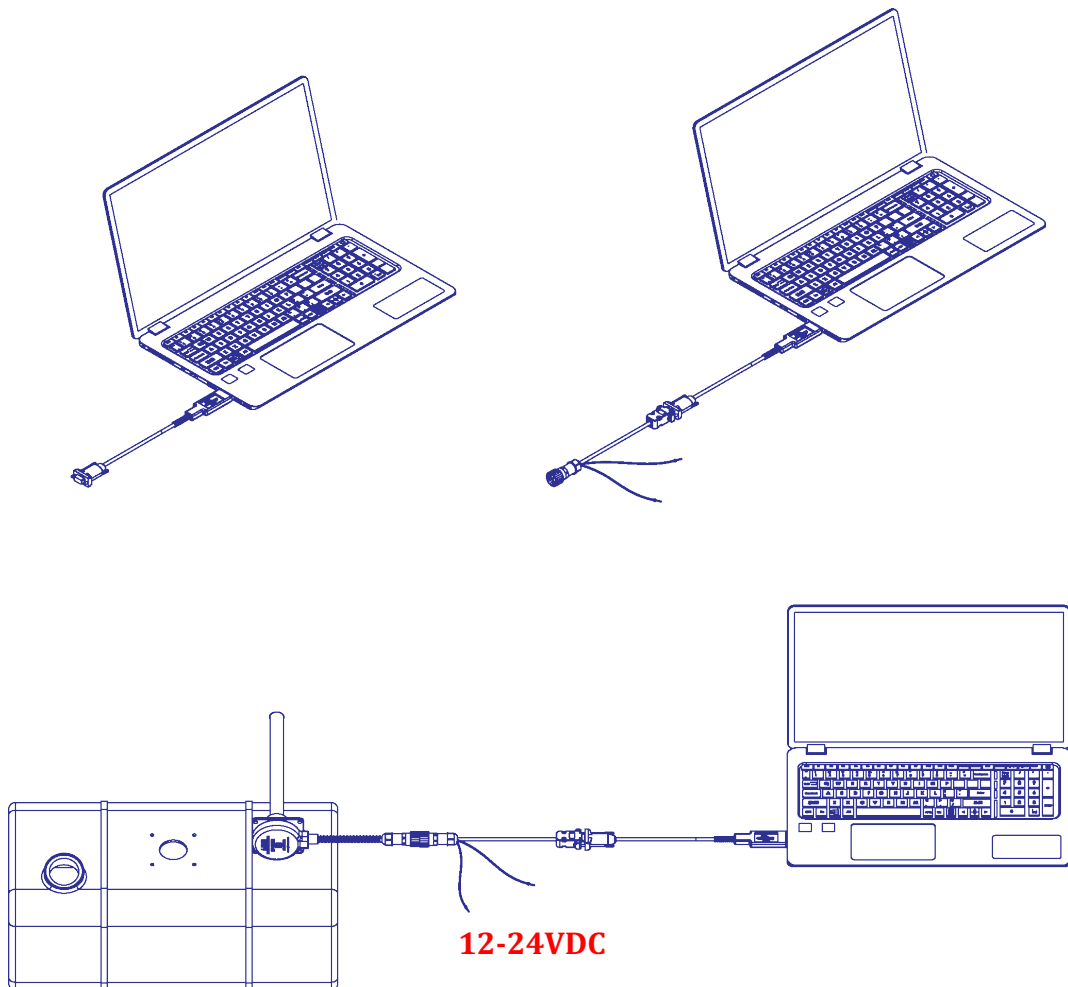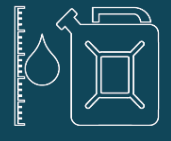

Figure 10. Connecting USB to RS232 cable and configuration tool to laptop or PC

VII. DOWNLOAD AND INSTALL SOFTWARE. DOWNLOADING AND INSTALLING SOFTWARES

1. *Installing USB to RS232 driver*

  o Installing driver for USB to RS232 cable

  o After finishing right click and check to ensure the driver is installed successful "**Computer**" >> "**Manager**" >> "**Device Manager**" >> "**Port (COM & LPT)"** as follow the picture bellow, otherwise, please check the cable and cable driver.
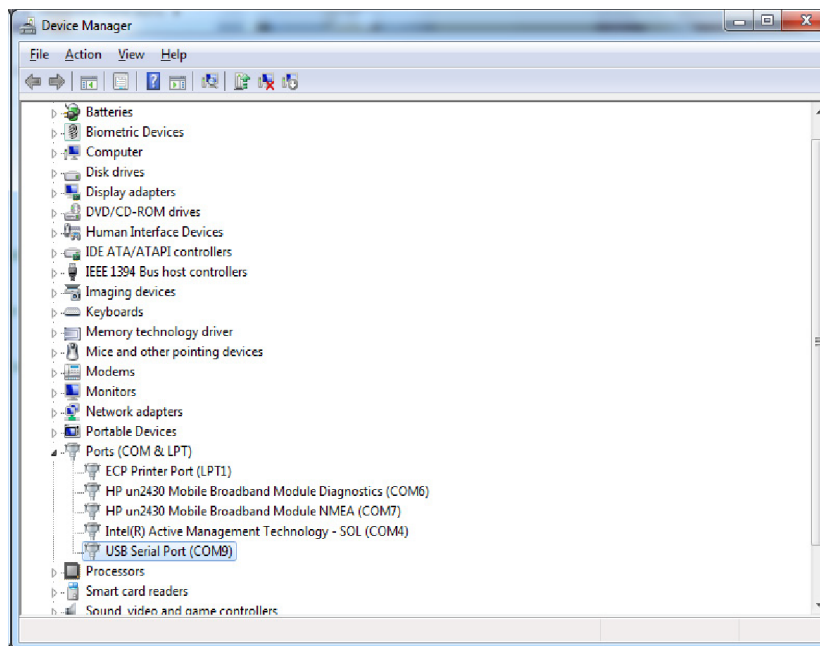

Figure 11. Installing USB to RS232 driver successful

2. Installing sensor software configuration

o Visit our website: http://sojielectronics.com/support/download/ and download setup file "Setup Utility Program "
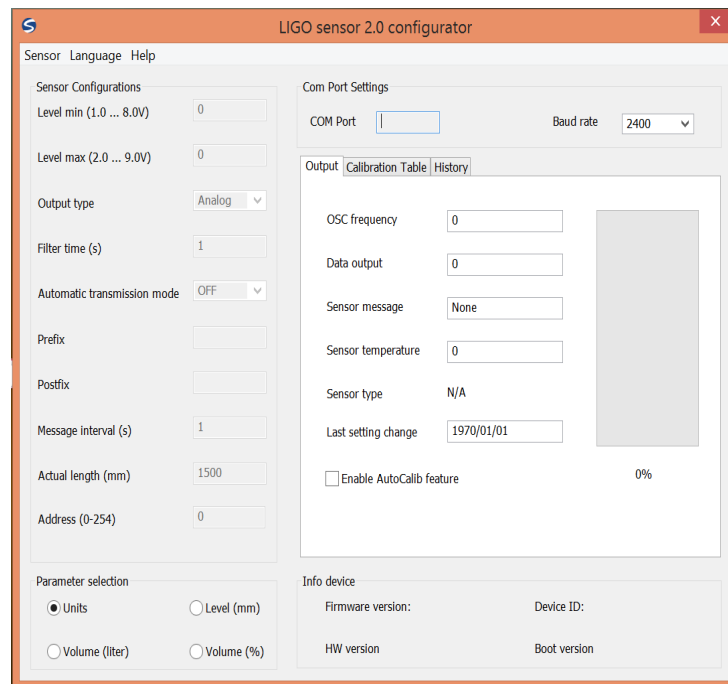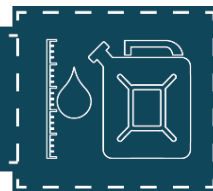

Figure 12. Sensor configuration tool

Parameters descriptions:

Load config: Load configurations from sensor to PC. *Note: user must load configurations from sensor before changing configurations on PC.*

Save config: Save configurations from PC to sensor

Update firmware: Upgrade new firmware for sensor (visit www.sojielectronics.com for the latest firmware version)

Set full: Set Full for maximum fuel level calibration

Set Empty: Set Empty for minimum fuel level calibration

Level Min: Configure LIGO SP-AF output voltage or frequency range according to the voltage or frequency range of the tracking device input.

Level Max: Configure LIGO SP-AF output voltage or frequency range according to the voltage or frequency range of the tracking device input

Output type: Selecting voltage or frequency output (*used only for AF sensor*)

Filter time: Setting output signal processing time (0-255). Default is 60 seconds.

Automatic transmission mode: Automatic transmission mode applied only for RS232/RS485 defines sensor output message type:

- **Off** – no automatic message transmission, sensor waits for tracking device request;
- **HEX** - automatic message transmission in binary format (used by default);
- **ASCII** - automatic message transmission in text format;
- **ASCII EXT** – automatic message transmission in extended text format. Additional Prefix and Postfix configurable parameters are available for this mode to insert required header or ending of the message.

Message interval: Time period the sensor automatically send output message to the tracking device. Parameter value range is 1...255 seconds with 1 second step. Default value is 1 second.

Actual length: The actual length of sensor probe

Address (0-254): Set the network address for the sensor. When several sensors are connected to one external device, they should have a unique network address.

Parameter selection: Selection of output value type for sensor data
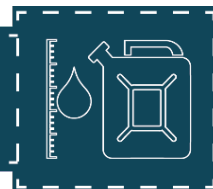
One of the following output value types available for RS232 and RS485 sensor

- Fuel level in standard (normalized) units (0...1000).

- Fuel level in millimeters (mm), 0.1 mm step.

- Fuel volume in liters (L), 0.1 L step.

- Fuel volume in percentage (%), 0.4% step.

Output:

OSC frequency: Initial measuring generator frequency (Hz)

Data output: Data output (0-4095)

Sensor message: Sensor working message if sensor message is none sensor works fine, otherwise malfunction codes are displayed as table:

Sensor message	Transcript of the malfunction Code	Possible solution
255 or 254	Calibration error	Check if the measuring probe actual size value is inserted correctly and (or) re-calibrate the sensor
253	Short circuit in measuring probe tubes	Wash the measuring probe tubes with clean fuel, clean fuel tank of mud and water.
252	Calibration error	Check if the measuring probe actual size value is inserted correctly and (or) re-calibrate the sensor
251	Hardware failure	Contact your supplier

250	Calibration error	Check if the measuring probe actual size value is inserted correctly and (or) re-calibrate the sensor.

Calibration Table: This entry is used to record fuel tank calibration into the sensor internal memory. The table is filled out with the data achieved during fuel tank calibration procedure. The data is entered as a table of correspondence between measured fuel level value (Fuel level (uint) field) and fuel volume in the tank (Volume (L) field). Recommended number of table entries is 15. Max possible is 30 entries.

Enable AutoClib feature: Sensor automatically calibrates Min, Max levels after cutting. User does not need to reconfigure after cutting.
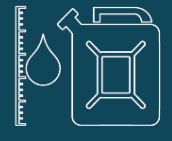
3. Min/Max Calibration

a) Set Empty level

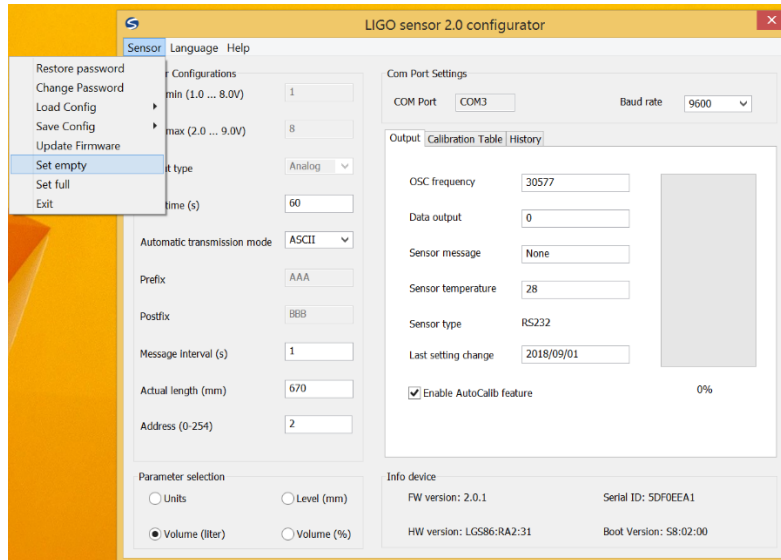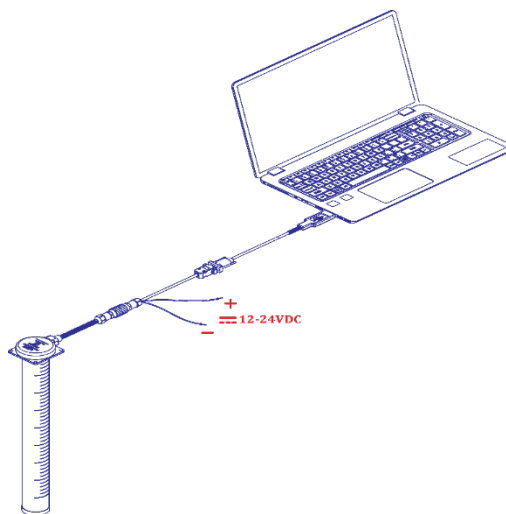- o Keeping sensor apart from fuel and set Empty level

Figure 13. Setting Empty level.

b) Set Full level

- o Fill the measuring container with fuel.
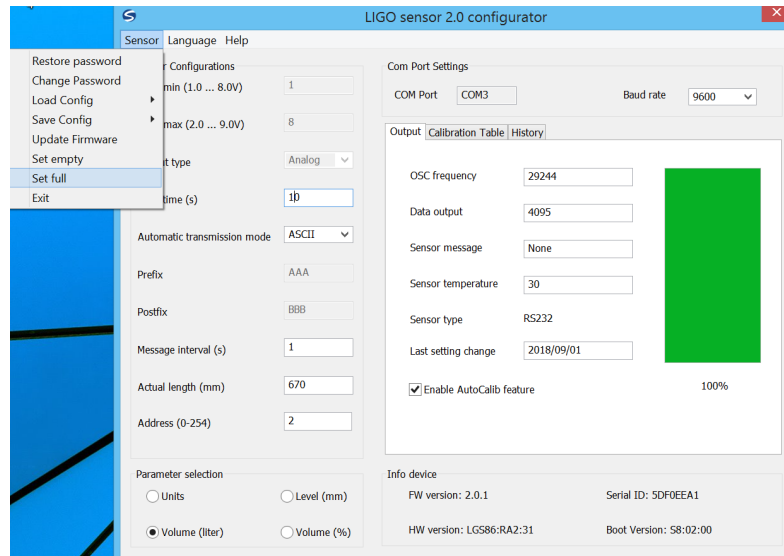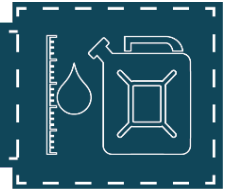- o Immerse the sensor in the fuel to the full length of the measuring probe and set Full level

Figure 14. Setting Full level

c) *Installing screen filter*

Screen filter is mounted on the measuring probe of sensor to protect measuring probe electrodes from mud and water. Using the filter extends significantly faultless lifetime of the sensor.

Screen filter mounting order: firstly put on fixator, then put on bottom stop and fix it with two side screws. Put the screen filter over bottom stop and fasten it with a fixator locks.
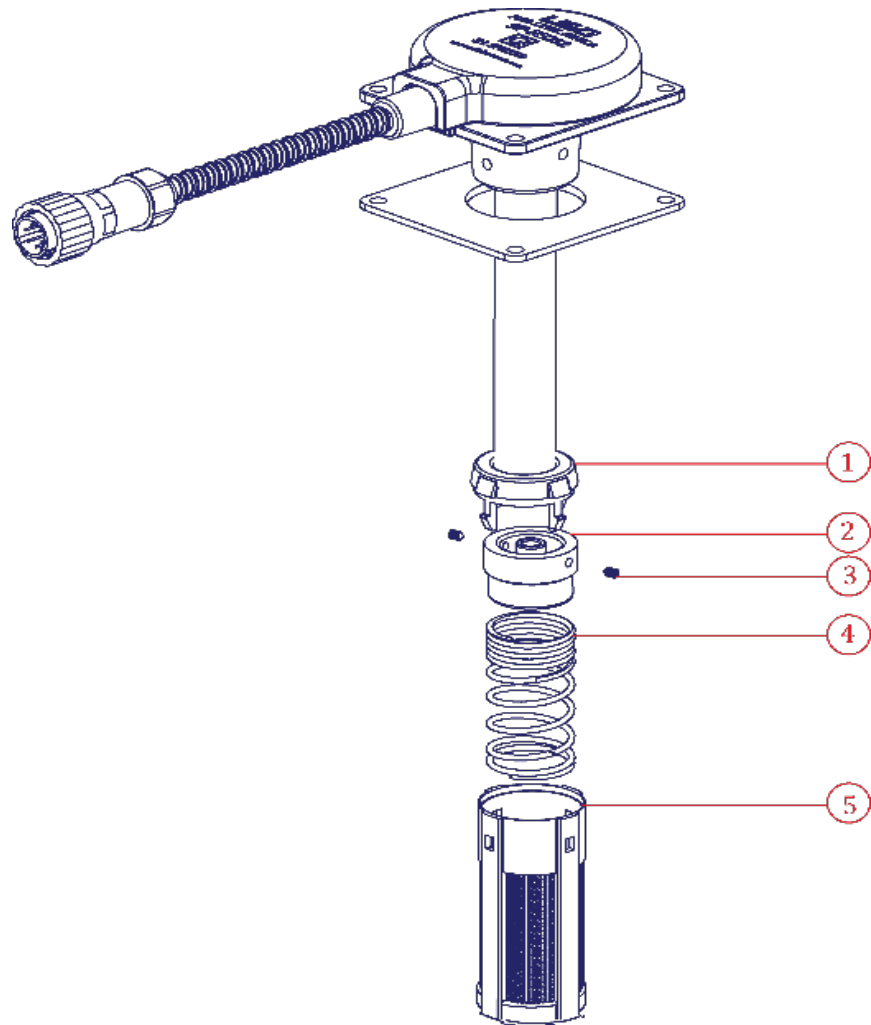
Figure 15. Installing screen filter procedue

d) Installing and connecting

    ○ Applying oil-and-petrol resistant non-conductive sealant to ruber gasket
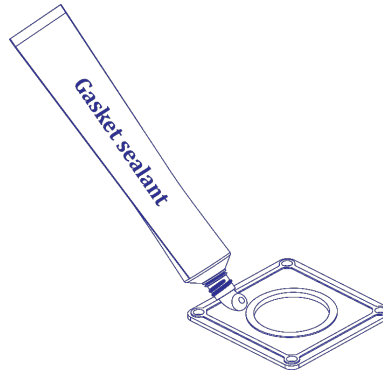

Figure 16. Applying the sealant to gasket

    ○ Put the sensor into the tank and fix: when fixing with rivets, use a rivet driver when bolting, put on a seal (per bolt), a spacer and a spring washer when fixing to plastic tanks with wall thickness over 3 mm, use vendor furnished self-tapping screws and a seal (per self-tapping screw)
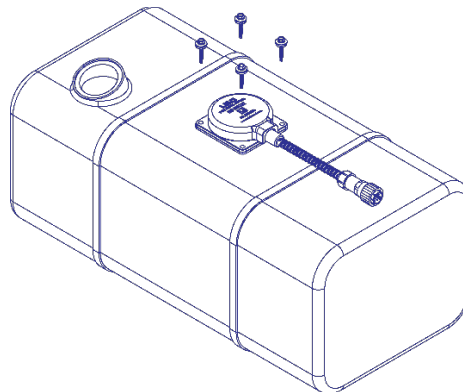

Figure 17. Put sensor into the tank

    ○ Connect the sensors to an external device using 7m cable
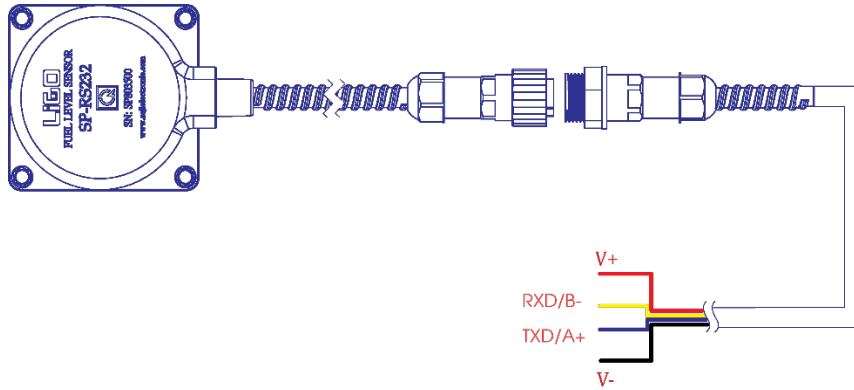
The wire cable color:

RS232/RS485:

Figure 18. Wiring diagram of RS232 and RS485 output signals

WIRE COLOUR		DESCRIPTION
	Black	GND (Ground) **(V-)**
	Yellow	**RXD/B-**
	Blue	**TXD/A+**
	Red	12-37 VDC **or 7.5-75V for SP PRO series**

AF:
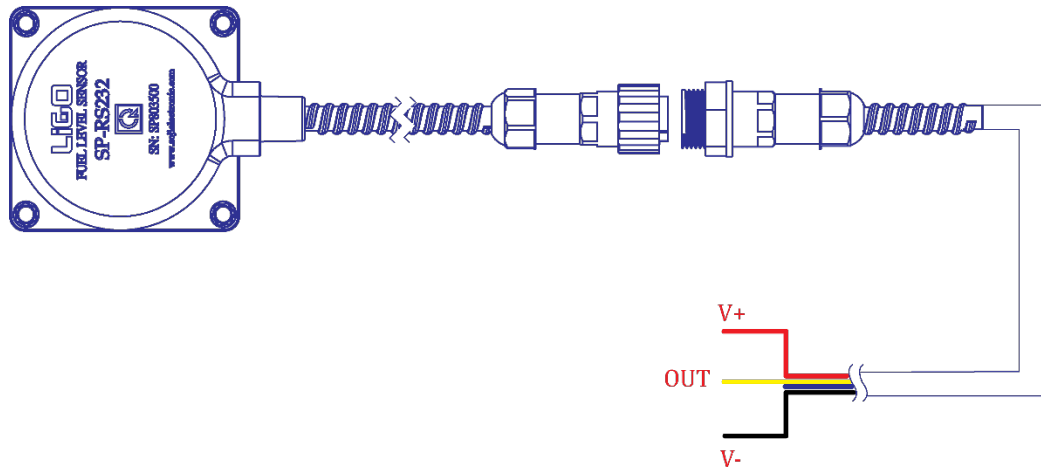
Figure 19. Wiring diagram of Analog and Frequency output signals.

WIRE COLOUR		DESCRIPTION
	Black	GND (Ground) **(V-)**
	Yellow	Out (Analog/Frequency)
	Red	15-37 VDC **or 7.5-75V for SP PRO series**

o Connect the fuse holder to LIGO sensor power cable (brown wire) in close vicinity to the vehicle power supply circuit
o Installing the fuse in the fuse holder
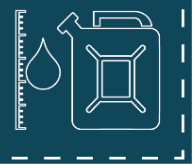
e) *Calibration*

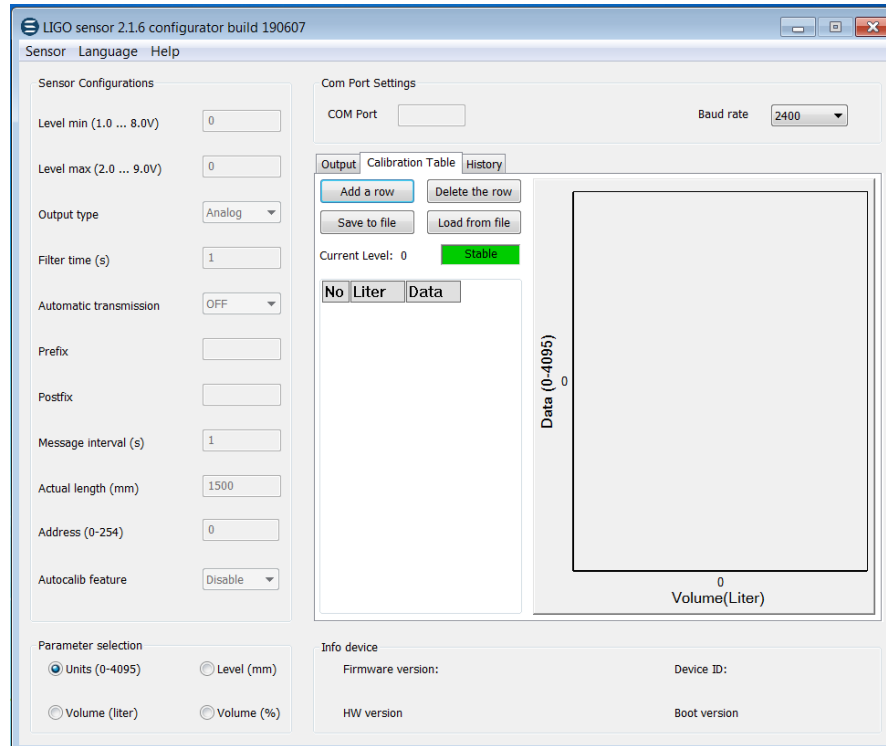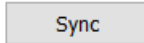- Launch **Sensor** >> **load Config** >> **From Sensor** >> **Calibration Table**

Figure 20. Calibration table

- Pump fuel in the tank, the amount of pumped fuel depends on the tank's volume (at least 20 times of pumping)

- After pumping, wait for a while (about 2 minutes) for the output data to be stable, then select **"add a row"** and insert the actual pumped liters in **"liter"** box, input the data given by sensor into **"Data"** box. User can click on the [Sync] button to sync up data, or read data in the **"output"** tab as the image below.

- Repeat the above steps until the oil tank is full (**Attention: It is recommended to write down the information on the paper to compare with input data and avoid mistaking during the process**)

- After completing the above process, select **"Volume (liter)"** as the output data.

Figure 21. Parameter selection

- o Finally, click on the **"Sensor"** button at the top left corner -> **Save config** -> **To sensor** to save data for the sensor.

Attention:

- The time between each pumping must be at least 2 minutes apart or wait for measured values to be stable, then comes the next pumping.

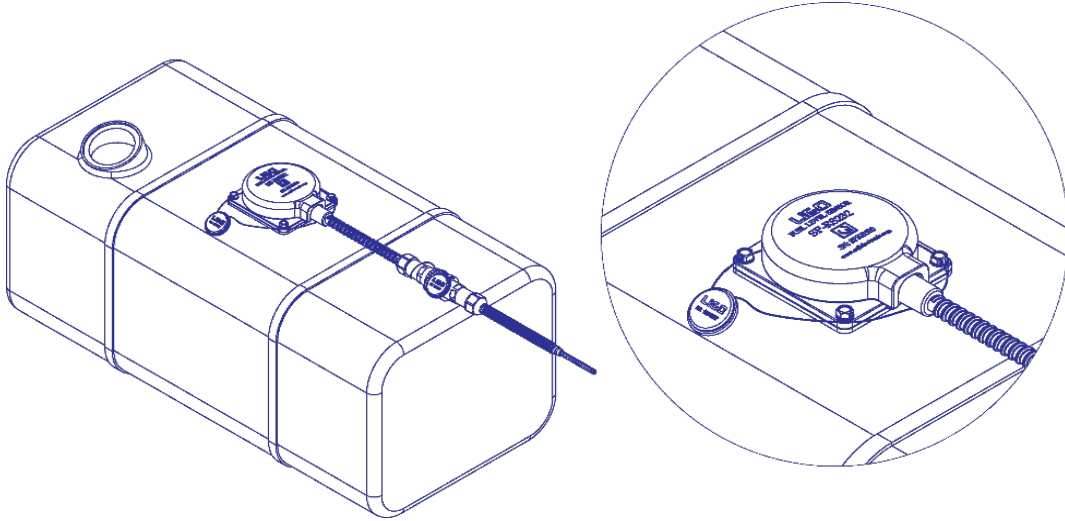*f)* *Sealing*

o Install the bolt through a hole in the seal.

Figure 22. Sealing

USER MANUAL LIGO SP SERIES FUEL LEVEL SENSOR

Apendix A

- **List of equipment for fuel level sensors installation**

STT	Descriptions	Qty
1	Bimetal core drill ø38 mm	1
2	Core drill shank	1
3	Metal drill ø7 mm & ø4 mm	1
4	Hacksaw	1
5	T Spanner 8mm Single Sided	1
6	Tap M5 with holder	1
7	Snap-seal for bolt/self-tapping screw	1
8	Laptop	1
9	DC power supply unit 12V-24V or battery 12V	1
10	Measuring container	1
11	Fuel	1
12	Gauging container	1
19	USB to RS232 cable	1
20	Tape mesaure	1

Apendix B

Sensor *LIGO SP* and all the accessories
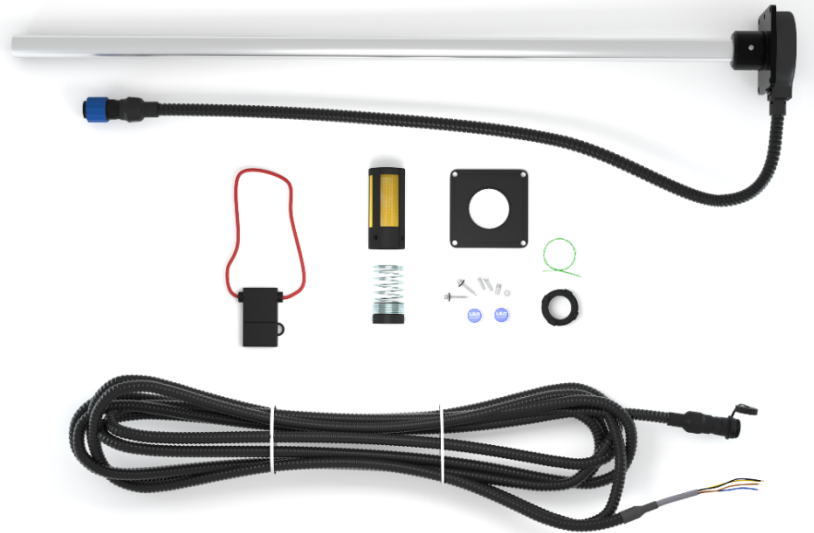
Figure 23. Sensor LIGO SP and all the accessories

STT	Description	Qty
1	LIGO Fuel Level Sensor. Standard lengths: 700, 1000, 1500mm (for other customized lengths, please contact the manufacturer)	01
2	7m cable	01
3	Gasoline resistant rubber gasket	01
4	Oil filter	01
5	Anti-vibration spring	01
6	Fuse 2A	01
7	Sealing cord	02
8	Rivet and screw M5x20mm	04
9	Self-drilling screw M4.8x32mm	04

Quick installation without PC

This method is only applicable to configure Min and Max level.

I. *Preparation before setting up*

o The sensor's auto-recognisation mode needs to be turned on by checking the **"Enable AutoCalib Feature**" box.
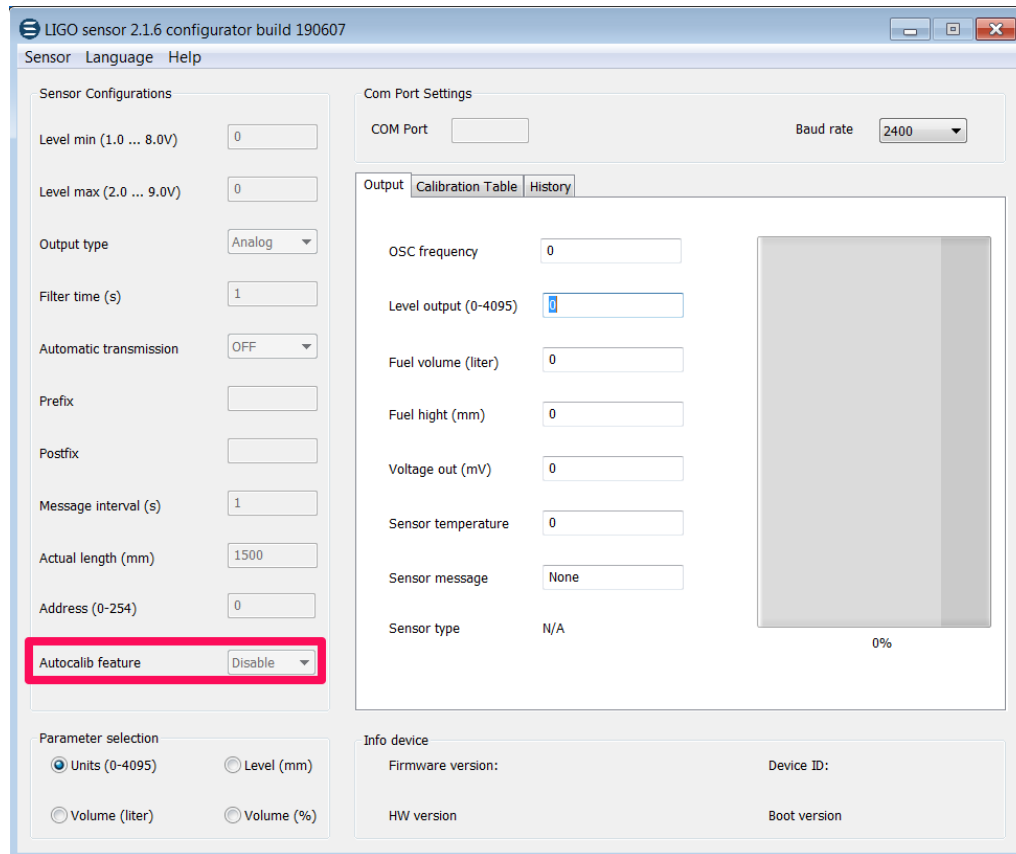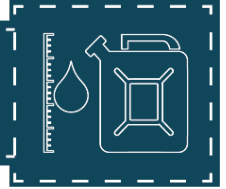

Figure 24. Turning on the auto-recognisation mode before installing

o External devices such as GPS tracking or Dataloger... must have the software integrated with the configurator. The configuration is performed directly on the device.

II. *Automatically setting up and configuring the sensor after cutting*

- After measuring and cutting sensor, remove iron filings and clean burrs between the tubes, then follow steps below:

> Step 1: Do not allow the sensor to contact oil.

> Step 2: Ensure 12-24VDC stable power supply for the sensor.

> Step 3: Make sure the sensor is under stable condition within 30-60s. The sensor will automatically recognise Min and Max level.

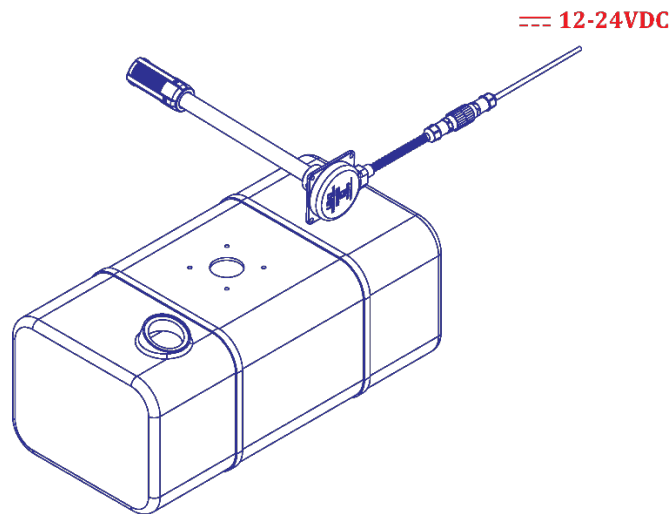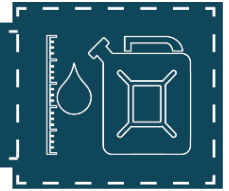> Step 4: Cut the power and reboot. The sensor now recognizes new configurations.

Figure 25. Leave the sensor in the air, provide with a stable power supply in 30-60s to configure **"Min"** level.

Attention:

- In case of improper operation and the sensor cannot recognise properly the actual Min, Max level, user should reconfigure using a PC.

Attention!

- The manufacturer is not responsible for product availability in case of non-compliance of requirements of this service manual, unauthorized service and repair; if device has damage or traces of opening of head's body, mechanical damage of the probe or the interface cable, as well as traces of corrosive acids, open flame, high voltage, lightning strikes or other natural factors.

Address of service center

SOJI ELECTRONICS .,JSC

Tel: +84 24 62 932 369

Add: NO-04, LK-03 Ha Tri, Ha Cau, Ha Dong,

Hanoi, Vietnam.

Email: contact@sojielectronics.com

http://sojielectronics.com/