User Manual

Capacitive Fuel Level Sensor

«Etalon 5-15»

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1. Application

Fuel level sensors «ETALON 5-15» with frequency output detect the level of fuels and lubricants like petroleum, diesel and oil. They can be installed in vehicles and fuel depots, in systems that measure and control the amount of fuel and lubricants.

Fuel level sensors «ETALON 5-15» measure the level of immersion of the probe into fuel and generate a frequency output signal in proportion to the measured level.

Fuel level sensors «ETALON 5-15» can be used together with display units or programmable controllers what have suitable electrical inputs.

Figure 1 – Design of fuel level sensor «ETALON 5-15»

Main advantages of fuel level sensors «ETALON 5-15» in order to improve reliability and performance:

- ✓ the sensor is equipped with built-in voltage regulator. So the device is independent of voltage fluctuations.
- ✓ the sensor is equipped with built-in value averaging system, allowing to average data during prescribed time period.
- ✓ the sensor is equipped with built-self-diagnostic system.
- ✓ Exchangeability.

2. Specifications

Sensor accuracy	≤ 1,0 %
Additional full-scale accuracy (depending on temperature)	≤ 1%
Operating temperature	-60 to 85 °C
Output type	frequency 500 to 1500 Hz
Sensor length	up to 2000 mm
Operating supply voltage (be mounting in vehicles tanks)	12-24 V
Operating voltage	13,5±0,5 27,0±1,0 V
Current consumption	≤ 10 mA
Interference protection	200 V by 350 mS
Max. load current (be mounting in vehicles tanks)	500 mA
Starting time	≤ 20 s
Sensor size	≤ Ø70 x 2020 mm
Sensor weigh	≤ 4,0 kg
Running time (uninterrupted)	no limit
Mean time to failure	≥ 50 000 h
Y-percentile storageability time by y = 95 %	12 years
IP level protection of sensor body	IP68

3. Delivery Set

Description	Number
Fuel Level Sensor «ETALON 5-15»	1 pcs.
Rubber ring	1 pcs.
Self-tapping screws	5 pcs.
Rotor seal	1 pcs.
Probe	1 pcs.
Cable assembly 7 m	1 pcs.
Product certificate, warranty certificate	1 pcs.

*Sensor standard length – 680 mm, customized length up to 2000 mm.

4. Sensor description and operation principle

«ETALON 5-15» is a capacitance level sensor. The sensing element is a capacitor containing two concentric probes whose capacity is changed by changing of probe immersion into the fuel. This capacitor is connected with a predetermined measuring generator circuit. That way the signal time from the measuring generator depends on capacity of the sensing element and therefore the level of immersion of probes into the fuel. After that the microcontroller measures the signal time from the measuring generator, normalizes and averages it, checks for validity of the measured values. If the check result is successful, the microcontroller generates a frequency signal in the operating frequency (500 to 1500 Hz) directly proportional to the level of immersion of the probes into the fuel. If the check result of the signal time is not successful or error-marked, the microcontroller generates a frequency signal with frequency typical for this error code.

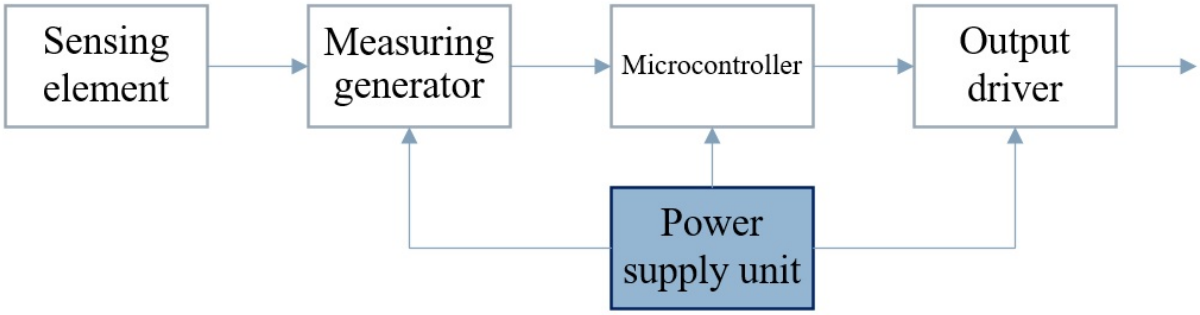

Figure 2 – Block diagram fuel level sensor «ETALON 5-15»

The power supply unit is used to generate the stabile voltage for supplying of the sensor components, to protect the sensor from voltage fluctuations in the vehicle on-board network, reverse polarity and distorting actions.

⚠ **WARNING!!!** Please note that long-term exposure to the sensor by full-scare voltage (and especially over full-scare voltage) can lead to irreversible destructions in the elements of safety circuits due to overheating and breakdown what can lead to malfunction of the device. The operating voltage is shown in "Specifications".

5. Operation Manual

5.1. Operation requirements

- To prevent failure avoid the contact of the sensor with aggressive medium, electromagnetic fields, as well as mechanical and climatic loads over the described in this manual.
- After the installation of the sensor in the vehicle it is recommended to seal all electrical connections.
- Before starting the sensor operation it is necessary to make its visual test. By mechanical damage (cracks, chips, dents, etc.) the sensor cannot be installed.
- Operators should examine the device, the operating principles and all the principle instructions given in this manual before operation and use.
- The dielectric capacity of the medium should be constant. The non-compliance with it can lead to increase of measuring errors.

5.2. Installation overview

The sensor is mounted in the fuel tank. It is recommended to install it in the center of the tank in order to avoid the influence of tilting of the vehicle on the measurement results. If a vehicle is equipped with two tanks two sensors should be installed. In some cases (when vehicles are used on undulating ground), it is recommended to install two sensors in one tank. In this case, they should be placed on one diagonal at the opposite side walls of the tanks.

The probes must be equipped with blind plugs. The sensor should be cut and calibrated with the installed blind plug.

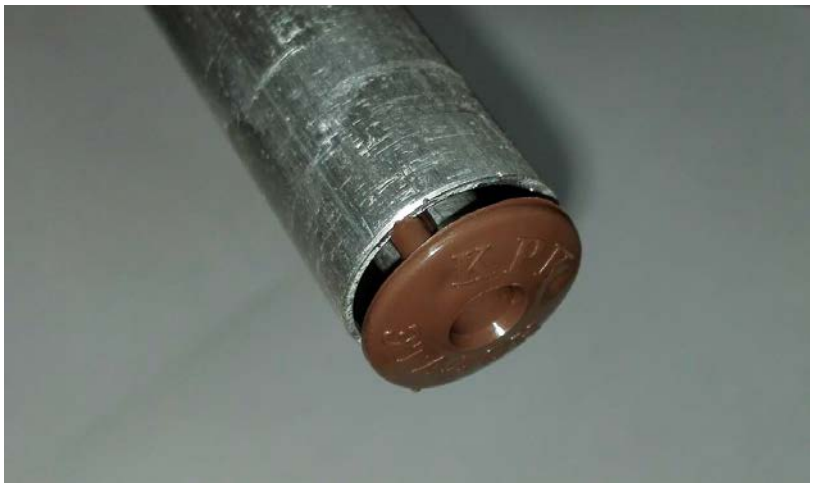

Figure 3 – Sensor blind plug

5.3. Connection diagrams

Pin assignment			
Connector pin	**Assignment**	**Cable colour**	
1	Supply «-»	green	
2	Supply «+»	black	
3	Output signal	blue	

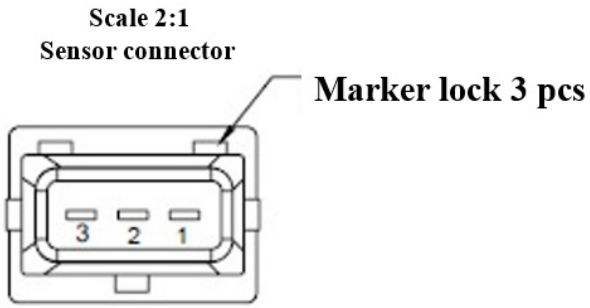

Figure 4 – Connector of sensor «ETALON 5-15»

Variant 1

Operation ONLY BY SWITHED-ON DIS-CONNECTOR (CONNECTION AFTER DIS-CONNECTOR) – EASY VARIANT.

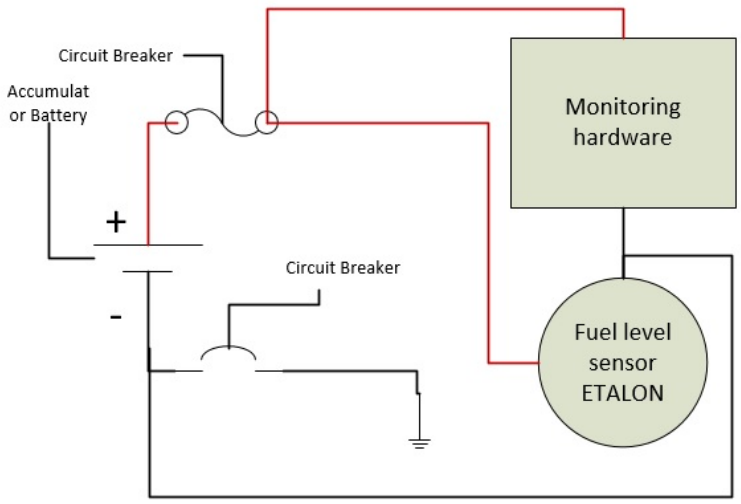

Figure 5 – Connection schema after dis-connector

⚠ The circuit breaker should be placed as near as possible to the connection point «+ supply» in order to protect the vehicle wiring from possible short-circuit of power supply of the monitoring system.

⚠ It is recommended to connect before circuit breakers in order to avoid their destruction because of addition load.

"-" is on the vehicle body under the dash board.

⚠ **WARNING!!! "-" of the sensor and "-" of the terminal should be from the same place!**

Advantages:

- ✓ reliability
- ✓ simplicity

Disadvantages:

- ✓ continuous monitoring is not possible

<u>Variant 2</u>

CONTINUOUS operation (CONNECTION BEFORE DIS-CONNECTOR). The variant is used for the round-the-clock monitoring of the vehicle. The sensor and the monitoring terminal should be connected directly to the accumulator battery.

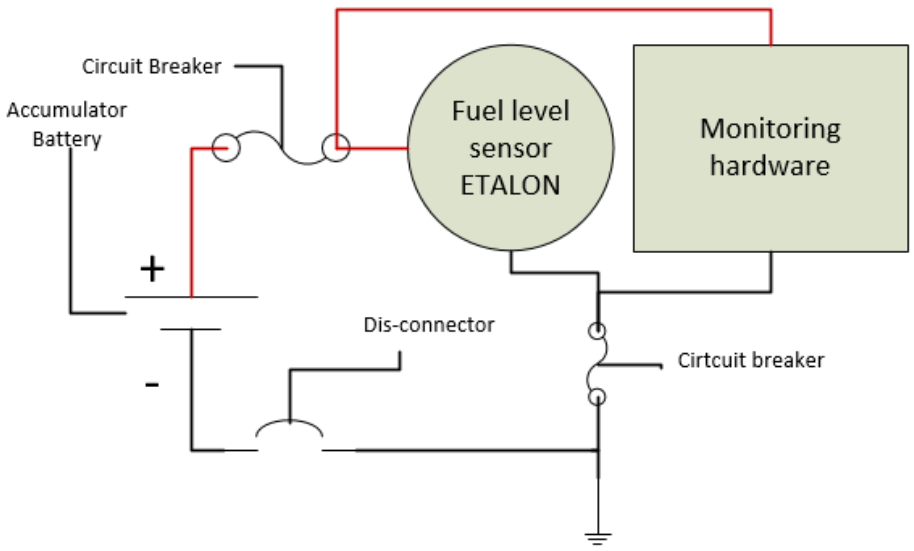

Figure 6 – Connection schema before dis-connector

⚠ The circuit breaker should be placed as near as possible to the connection point «+ supply» in order to protect the vehicle wiring from possible short-circuit of power supply of the monitoring system of fuel flow.

⚠ **WARNING!!!** This schema is NOT ALLOWED for using in vehicles with gasoline (petrol) engine.

⚠ **WARNING!**!! The breaker should be installed on "-". If by operation with the disconnected dis-connector the outside probe of the sensor and tank walls contact, the breaker will protect the wiring from the disturbing.

Advantages:

- ✓ simplicity
- ✓ round-the-clock monitoring

5.4. Installation

1. Drill a central hole for the sensor. Use for drilling a bimetal bit with diameter 35 mm. Put the probes and set marks for other holes. The holes are not symmetric! See Fig. 7 Hole pattern for screws.

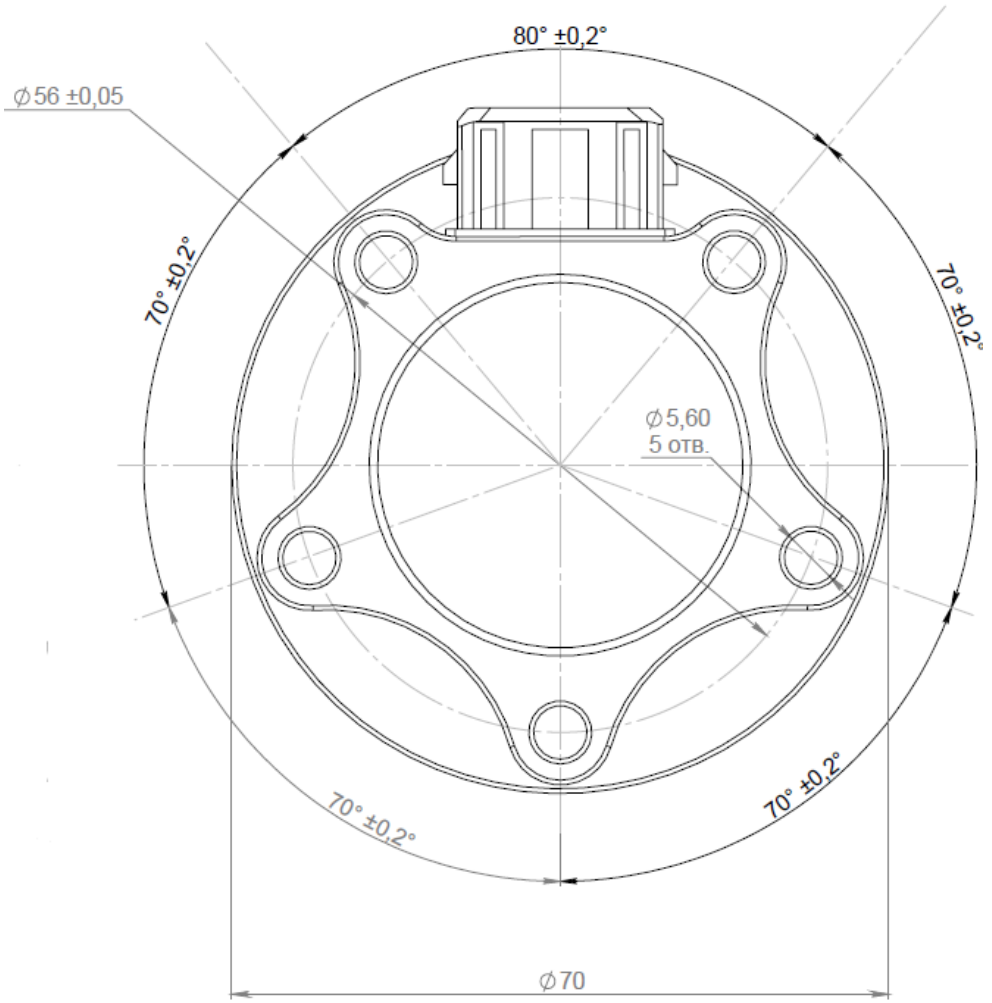

Figure 7 – Hole pattern for screws

⚠ **WARNING!!!** Before holes drilling the fuel tank should be full in order to avoid a vapor explosion! The fuel tank in a vehicle with gasoline (petrol) engine should be filled with water or demounted and gasoline bottoms should be vaporized.

2. Cut down the probes as necessary. Hacksaw the aluminum probes according to the height of the tank, leave minimum 20 mm between the sensor end and tank bottom for water and mud. Clean the probes from cutting waste, break corners, put the blind plug on the probe end (see Fig. 3)

3. Calibrate the sensor after cutting down (see chapter 6). The calibration is not necessary if the sensor was not cut down.

4. Put the cable for the sensor connection, make all connections according to the connection scheme (see chapter 5.3).

5. Install the sensor and fix it with self-tapping screws.

6. Connect the cable to the sensor. The socket should be oiled with protection lubricant (for example silicon fluid, technical vaseline). The protection lubricant should be not electrically conductive!

7. Seal the sensor.

⚠ **WARNING!!!** Do not confound the cables! Wrong connection can destroy the sensor!

⚠ **WARNING!**!! Do not connect to the voltage over 60 V!

6. Sensor calibration

The sense of the calibration is the maximum output bit rate by reducing the length of the sensing element.

By calibration of the fuel level sensor «ETALON 5-15» the capacity of the output signal becomes maximal:

- output frequency of the non-dropped sensor – 500 ± 1 Hz.
- output frequency of the full-dropped sensor – 1500 ± 1 Hz.
- frequencies of the output signal ≈1000 Hz.

⚠ **WARNING!!!** If the sensor «ETALON 5-15» should be cut down after the calibration the sensor should be calibrated again in order to avoid the dead zone at the bottom.

⚠ **WARNING!!!** If the sensor was in the fuel it should be dropped off during 10 minutes before the calibration.

For calibration only the calibration unit is used (Fig. 8).

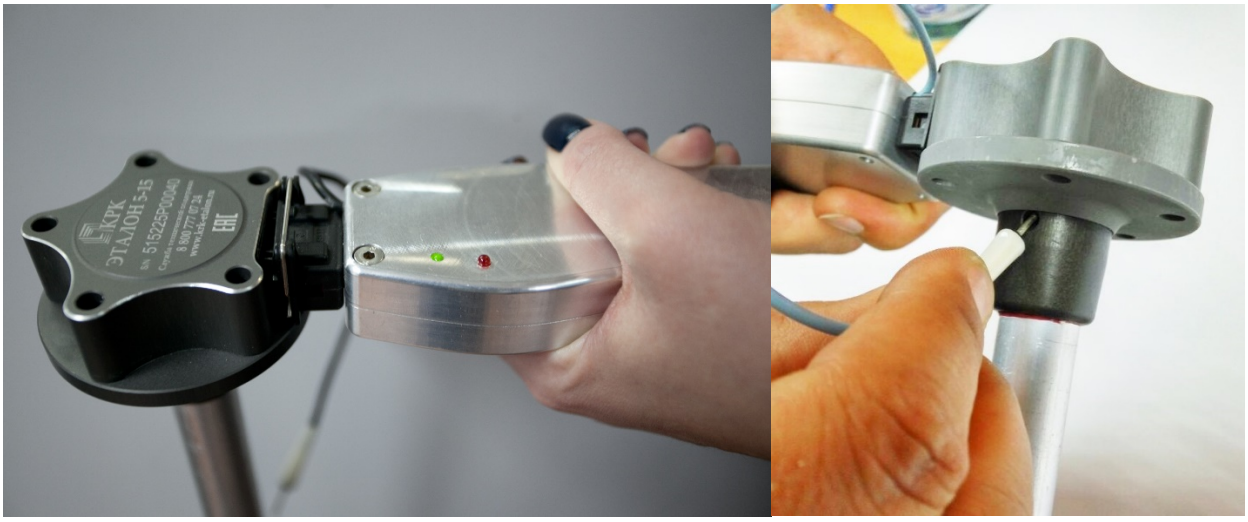

Figure 8 – Calibration unit

Calibration procedure:

1. Cut down the probes as necessary.
2. Clean the probes from cutting waste, break corners.
3. Put the blind plug on the probe end.
4. Connect the sensor to the calibration unit.
5. Switch on power supply of the calibration unit (two light-emitting diodes will glow, after some seconds a red light-emitting diode will glow).

6. Connect the feeler gauge to the central electrode thought the drainage hole of the sensor, wait for blinking of the red light-emitting diode, after 5 and more blinkers disconnect the feeler gauge.

⚠ **WARNING!!!** Do not touch the electrode with fingers!

7. Wait for blinking of the green light-emitting diode (usually 15 s). The green light-emitting diode means the finish of the calibration.
8. Disconnect the calibration unit and the sensor and switch off the power supply. After the calibration the frequency of the dry sensor is 500 Hz und the frequency of the full-dropped sensor is 1500 Hz.

7. Diagnostic codes

280 Hz - data damage in non-volatile memory (sensor change)
300 Hz - the sensor board is not calibrated (sensor calibration is necessary)
310 Hz - is not calibrated after weaving (sensor change)
350 Hz - frequency output of the generator is not in acceptable range.
370 Hz - the frequency of the generator is 0

Damage	**Damage description**	**Elimination**
the frequency of the generator is 0 **Code 370 Hz.**	The generator is not working– the sensor is not measuring. This error is periodically (water) or constant (mechanical jumper of probes). Cause: short-circuit of probes – water in fuel or mechanical jumper.	1. Dry the sensor, drain the water from the tank. 2. Insert the mechanical jumper. Test resistance between probes by the turned off sensor. The resistance should be **460 to 500 kOm.**
frequency output of the generator is not in acceptable range. **Code 350 Hz.**	The error is by the maximal immersion of the sensor (fuel-water emulsion). By changing the error to the error the frequency of the generator is 0 **code 370 Hz** water in fuel is detected. Cause: the measured liquid differs in composition from diesel fuel or gasoline.	Wait till fuel in the tank precipitates, drain the water from the tank bottom or wash the tank anв fill with fuel.