Fuel Level Sensor STRELA


# SETTING of FLS "STRELA" 232 and 485

( user's manual v 1.1 10-09-2011)

**www.skontrol.ru**

***Chelyabinsk, Russia***

**10.09.2011**

# 1. THE CONNECTION OF SENSORS STRELA D232 AND D485 TO LAPTOP

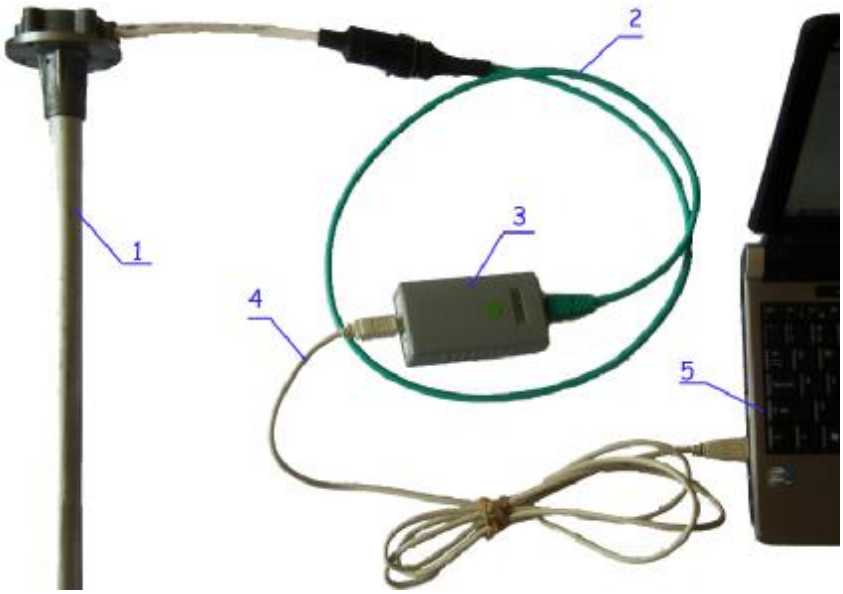
It is necessary to make a sensor calibration according to received length after cutting before installation of fuel level sensor Strela D232 and D485. To do this you need to connect sensor to PC. The calibration of other types of sensors is done by manufacturer.

## 1) Connecting sensor Strela D485 to PC

### Version 1. by usage of universal service adapter (recommended and simple way)

1. Connect sensor wire to service wire of universal service adapter (fig.1).
2. Connect service wire to universal service adapter.
3. Connect universal service adapter to PC USB-port.

**Fig. 1. Universal service adapter**




1-Sensor

2-FLS cable

3-Universal service adapter

4-USB cable

5-Laptop

**Fig.2. Connection scheme**

**Version 2: by usage of adapter USB-RS485**


1. Joint "negative" side of sensor supply with "negative" side and "ground" of adapter unit USB-RS485
2. Joint sensor output RS-A with adapter pin 1.
3. Joint sensor output RS-B with adapter pin 2.
4. Connect positive side of sensor supply to power source 12 (24) Volts.

**Fig. 3. RS485-USB adapter**

The adapter unit USB-RS85 uses standard drivers FTDI with image COM-port. By connecting the adapter to USB- port it will be found as a new device. You can find adapter drivers here:
http:// ftdichip.com/Drivers/CDM/CDM%202.04.16%20WHQL%20Certified.zip
If collision appears while installing a diver, see recommended guideline in Application 3.

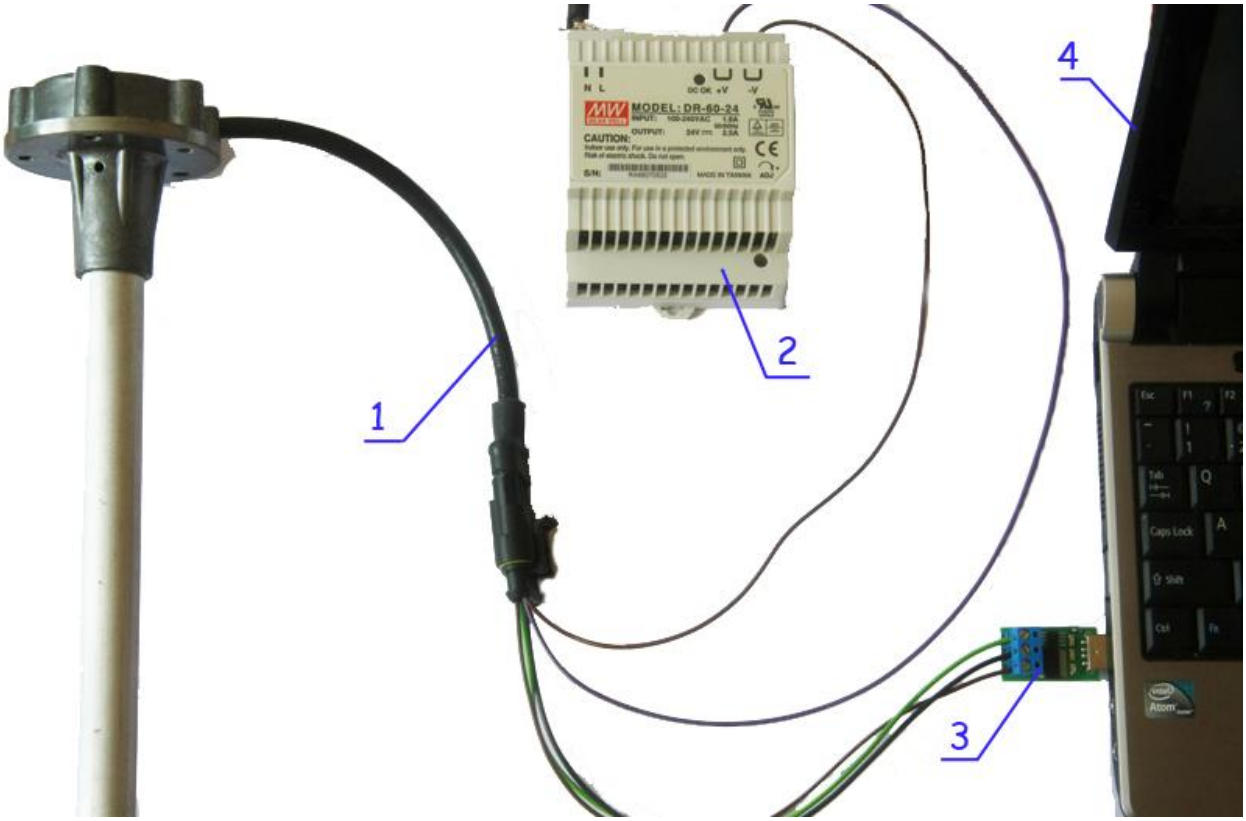



**Fig. 4 Connection scheme**

1 – Strela D485;

2 – Power supply;

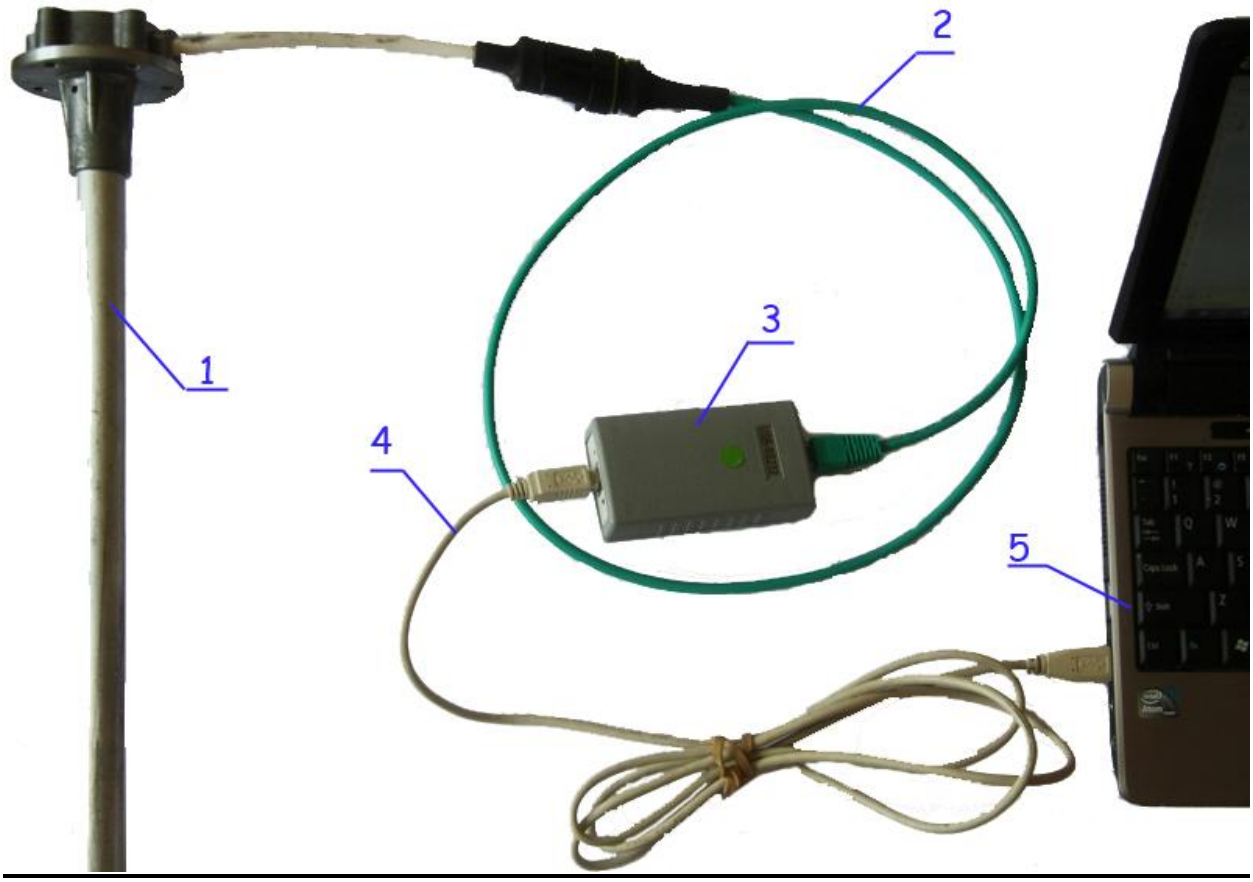
3 – Adapter USB-RS485;

4 – Laptop.

## 2) Connecting sensor Strela D232 to PC

**Version 1. By usage of universal service adapter (recommended and simple way)**

1. Connect sensor wire to service wire of universal service adapter (fig.8).
2. Connect service wire to universal service adapter.
3. Connect universal service adapter to PC USB-port.




1 – Sensor Strela D232;
2 – Sensor cable RS-232;
3 – Universal service adapter USB-RS232;
4 - USB-cable;
5 – Laptop.

**Fig. 5. Connection scheme**

**<u>Version 2: by usage of RS232 service cable</u>**

1. Connect sensor to service cable (fig.6).
2. Connect service cable to PC COM-port or through additional adapter unit USB-RS232 (fig.7) to USB-port.
3. Joint negative side of sensor wire supply with negative side of power supply.
4. Connect positive side of sensor wire supply to power source 12 (24) Volts.

**External reference source of voltage is required for this process.**

**Fig. 6 Service cable RS232**

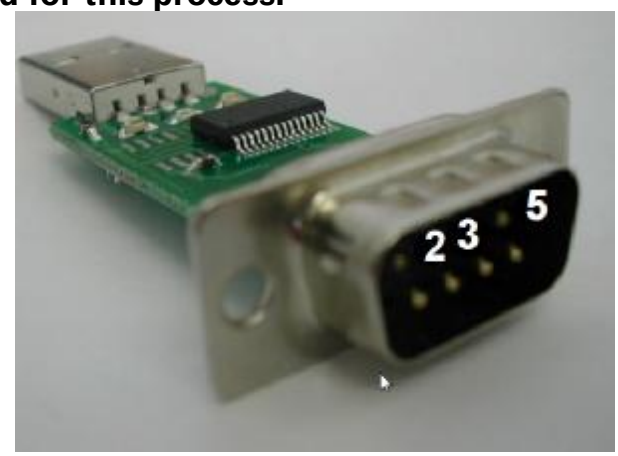
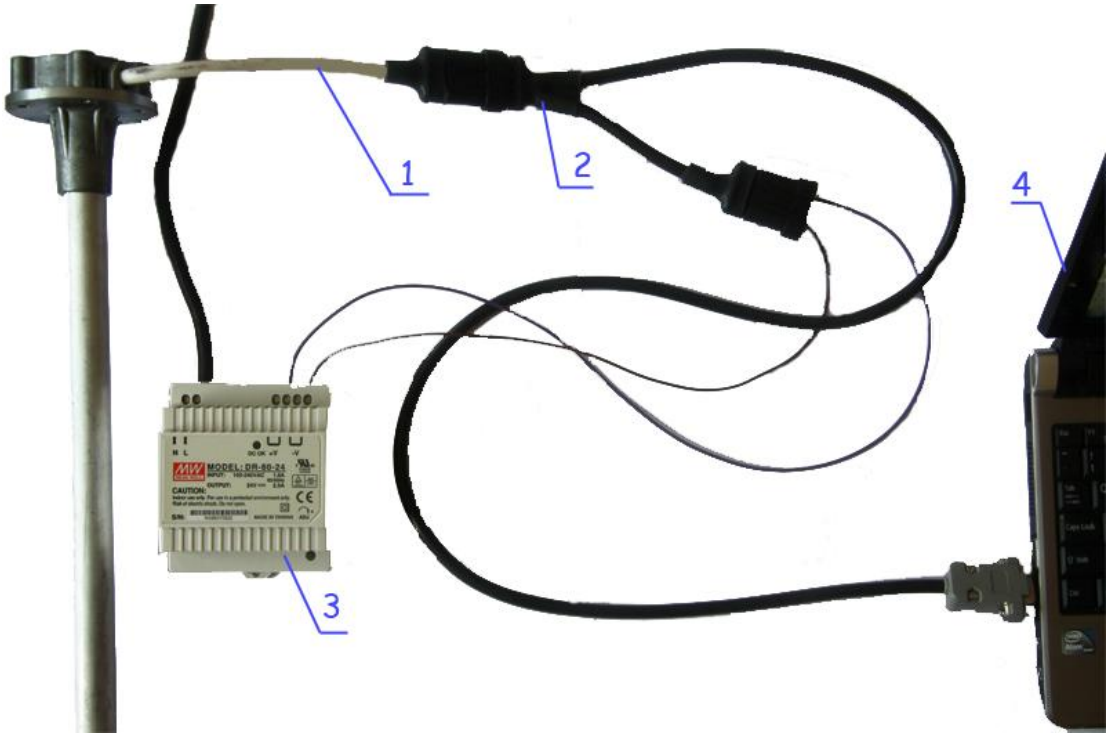


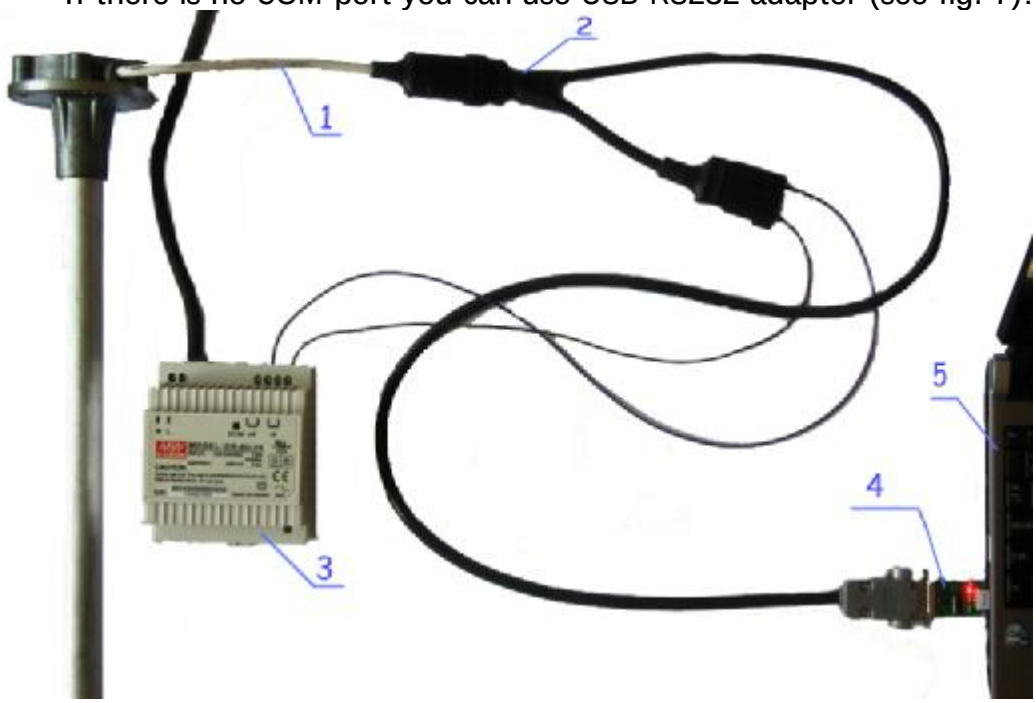

**Fig. 7 USB-RS232 adapter**




1 – Sensor Strela D232
2 – Service cable RS232
3 – Power supply12 (24) B;
4 – Laptop;

**Fig. 6 Connection scheme**

If there is no COM-port you can use USB-RS232 adapter (see fig. 7):




1 – Sensor Strela D232
2 – Service cable RS-232
3 – External supply 12 (24) V;
4 - USB-RS232 adapter
5 – Laptop;

**Fig. 7 Connection scheme**

## 2. INSTALLATION OF DRIVERS

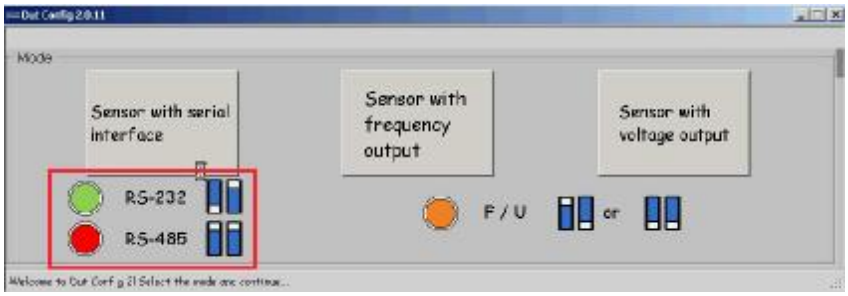
Driver USB-RS485 uses standard drivers FTDI which can also be used by other devices connected to the personal computer. Thus working with the device through USB-port can be done in two modes: directly or through virtual COM-port. If any other installer device runs through virtual COM-port no problems will arise.

Let's consider a case of operation with Autograph GSM terminals which are also set through the USB-interface, but in a direct access mode.

In this case before the first connection of the adapter the installer already has driver FTDI installed and the device is called Autograph:

## 3. CONNECTION TO SOFTWARE

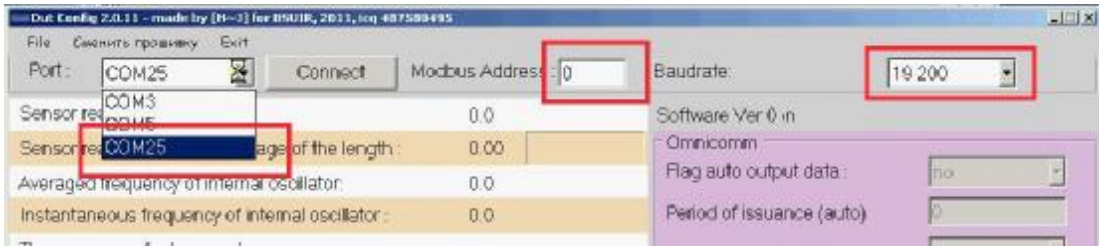
1. Install the driver.
2. Check whether switches on 232 and 485 of Strela are installed in the right way and whether the light from Strela cable side is lighten.
3. After setting the switches connect the universal service adapter to the computer. The green light should light up on the universal service adapter box from USB-cable side.




4. Start program DutConfig 2.exe
5. Click the button Sensors with interface output.
6. a) Choose COM-port. You can find its number in the Window Device Manager where it is given to the universal service adapter driver.

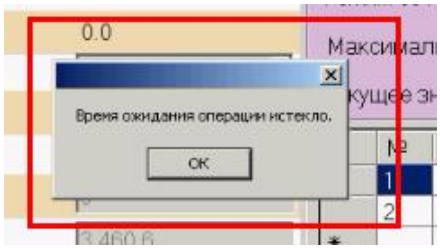
b) Choose MODBUS address. For 232 sensors this parameter can be equal to any number, it doesn't matter. For 485 set 0 – search will be done by all addresses. If you know the exact address (02, 03) set it. By default the sensor address from factory is 99.

c) Standard work speed with the sensor – 19200.




Click CONNECT button

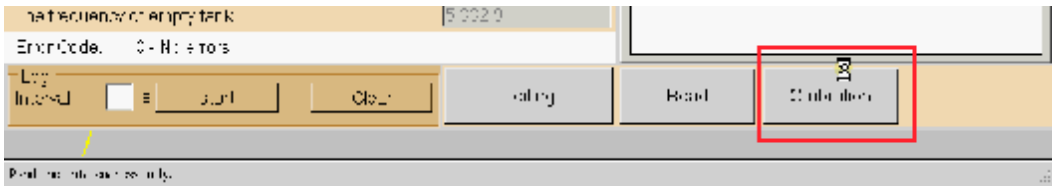
If there is a note WAIT TIME OUT, please check the port and address.



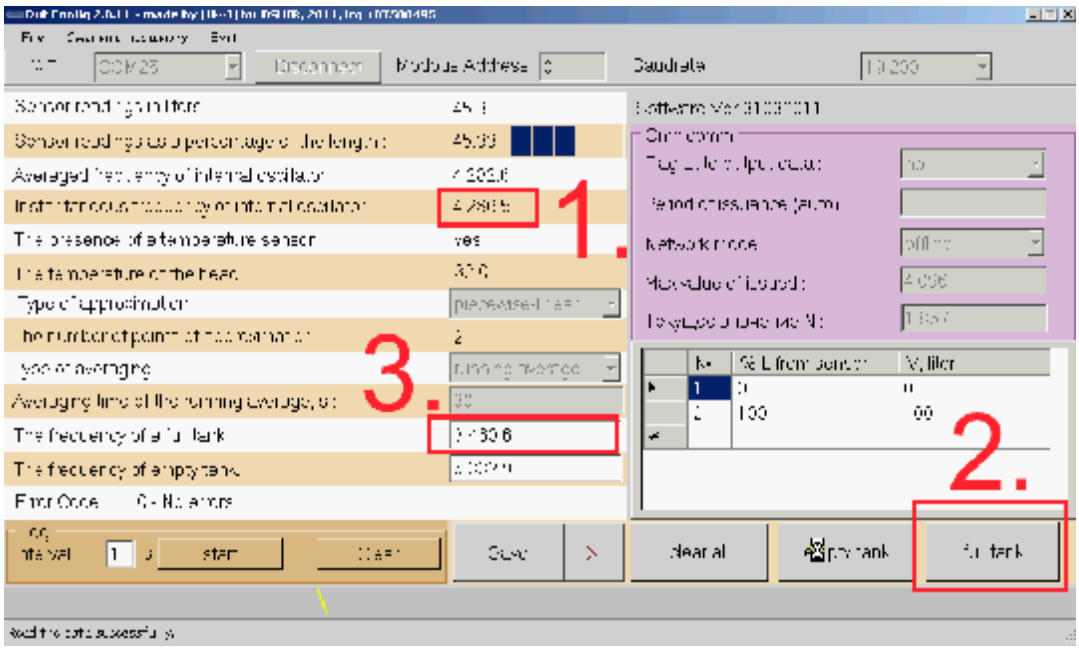

## 4. SENSOR CALIBRATION

You need to do sensor calibration after its final cut. The calibration purpose is to set a minimum and a maximum for sensor operation, to divide height into equal intervals, and to set corresponding values of output signal to each filling level.

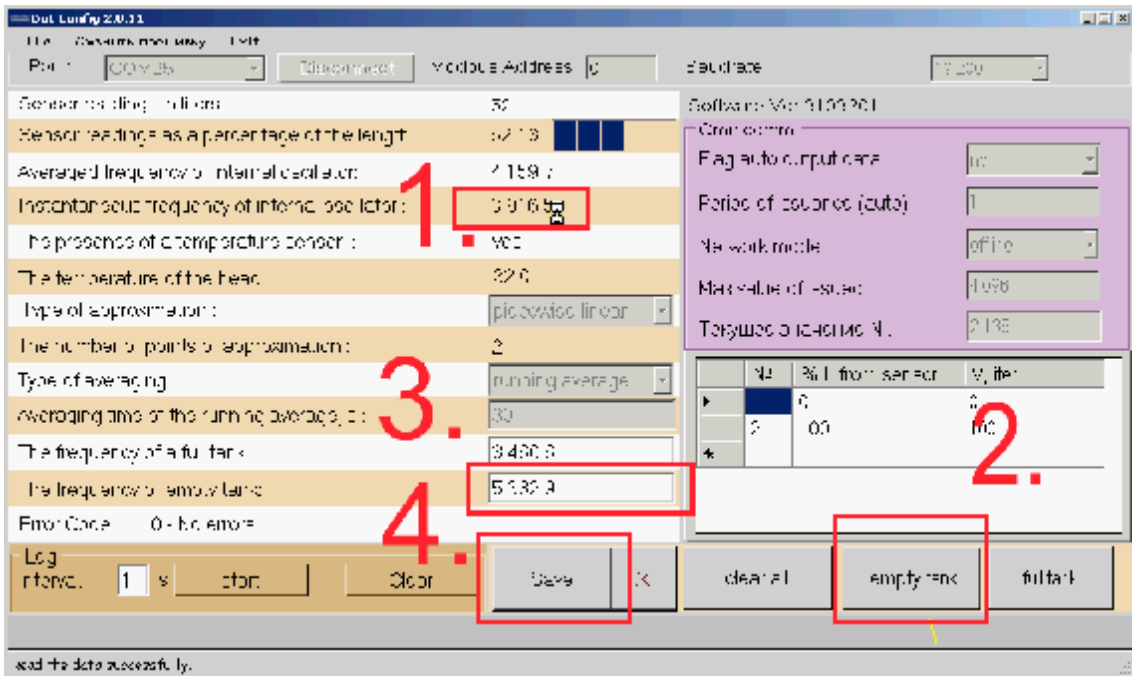
1. Sink the sensor in a capacity with fuel completely.
2. Connect it to the computer (see above part 1 CONNECTION).
3. Click on CALIBRATION button.



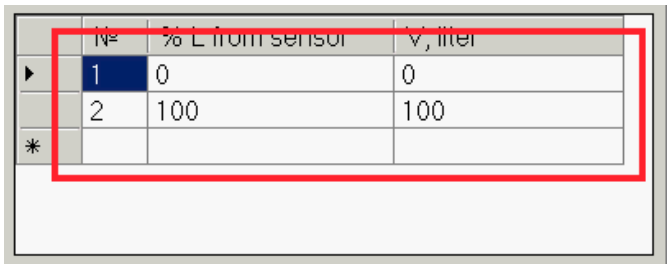
4. Wait till in the box INSTANT FREQUENCY fuel indication becomes invariable (1). Click button FULL TANK (2). Thus indications will be put in the box FREQUENCY FOR THE FULL TANK.




5. Take the sensor out of capacity with fuel and let the fuel flow down. Wait till in the box INSTANT FREQUENCY fuel indication becomes invariable (1). Click button EMPTY TANK (2). Thus indications will be put in the box FREQUENCY FOR THE EMPTY TANK (3).




6. The setting of the correspondence table. You need to check (to add if necessary) 2 lines in the table:



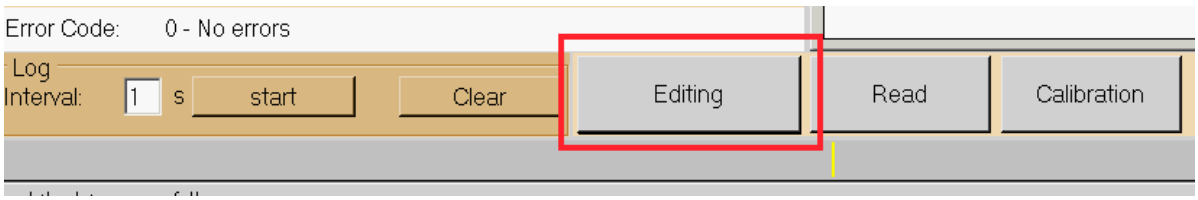

In that case, output value of the sensor will code % from immersing height. For example, at digit capacity 4096the output value 2000 will correspond to fuel level height 2000/4096 of the sensor height.

7. Save changes by pressing the button SAVE (4).

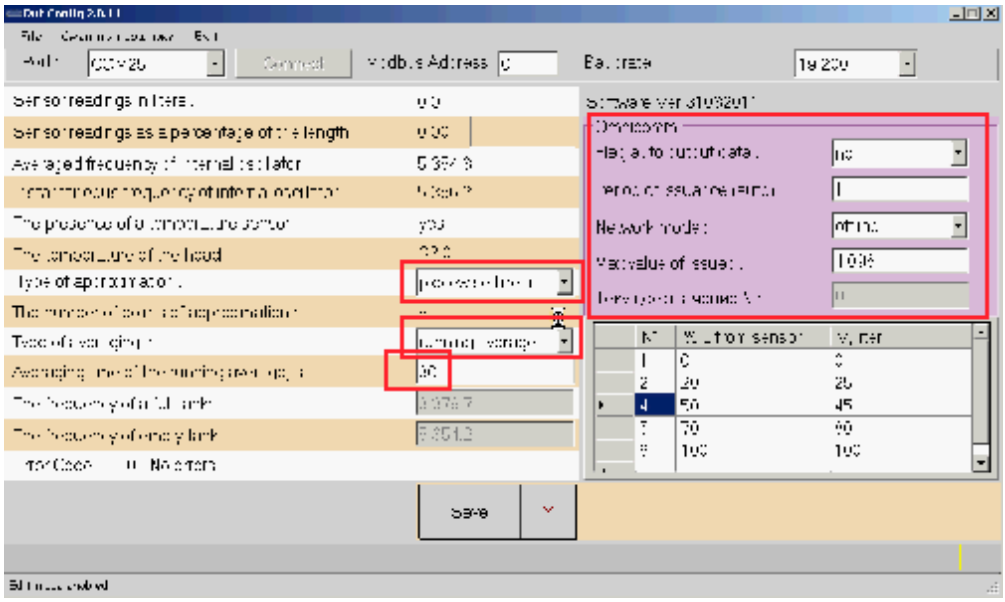
## 5. SETTING OF DATA OUTPUT FORMAT

You can set data output format in the menu EDITING

1. Press EDITING




2. Set following parameters:




Flag auto output data. You need to choose YES if the terminal can't interrogate the sensor itself. Then set the PERIOD of DATA OUTPUT.

Network mode. If one 232 sensor or one 485 sensor is connected to the terminal you need to set AUTONOMOUS mode. If you use some 485 sensors connected to one terminal you need to set NETWORK mode and to choose MODBUS ADDRESS. MODBUS addresses of the sensors should differ (01, 02 etc.).

Max value of issued - any number to 65536 which the terminal supports. For example, 1024, 4096, 9999, etc. The higher the value is the higher there solution (that is accuracy of data coding).

You need to set Averaging time of the running average, s – the period of averaging of sensor indications per second. It changes in arrange from 0 to 255 (0-255 sec). We recommend to set from 30 to 60 seconds for usual transport. The worse the traffic conditions are the longer is the averaging time. It is also possible to average data through the terminal, but sensor internal averaging allows transferring more exact value to the terminal.

Type of Approximation – choose piecewise-linear. Polynomial approximation and its use are described below.

Averaging type – leave RUNNING AVERAGE for squared shape tanks and set EXPONENTIAL for the cylindrical form tanks.

3. Save changes, by clicking the button SAVE (4).

After data entering it is recommended to disconnect and to connect sensorto computer once again to be sure that settings were saved correctly.

# 6. SPECIAL CASE 1. SETTING OF CALIBRATION TABLE IN THE SENSOR FOR THE SQUARED SHAPE TANK

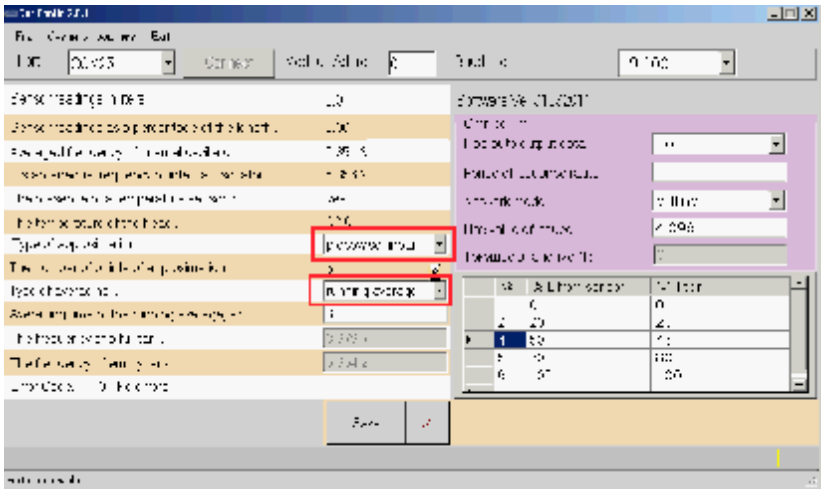
*For flexibility in the operation we recommend to use this function only when the terminal or dispatching software can't store inside the calibration table.*

The sensor can store inside the calibration table. The sensor will give out at the output value in % from its volume, instead of % of filling throughout the height. For example, at digit capacity 4096 output value 2000 will correspond to fuel level height 2000/4096 of the sensor volume.

1. CALIBRATION of the SENSOR and SETTING of the DATA OUTPUT FORMAT (see as above). To set data output format check that you have selected

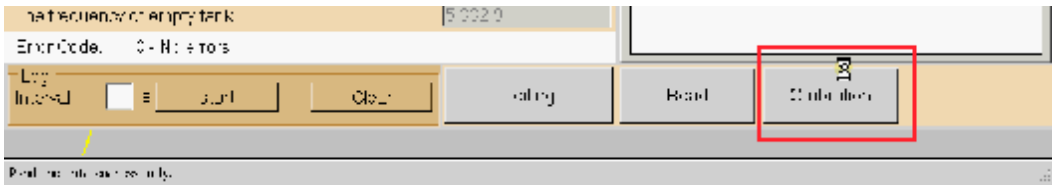
**Approximation type** – piecewise linear.

**Averaging type** –running average

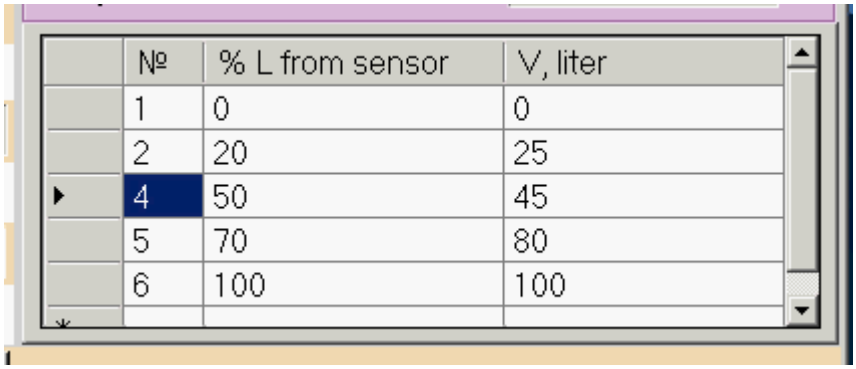


1. You should enter calibration table in the calibration mode:

Click CALIBRATION button.



Add to the table additional lines of percent correspondence of tank filling tolitres:



| № | % L from sensor | V, liter |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 20 | 25 |
| 4 | 50 | 45 |
| 5 | 70 | 80 |
| 6 | 100 | 100 |

The sequence of lines isfree (it doesn't have to be exactlyascending or descending). Lines entered by mistake can be deleted.

# 7. SPECIAL CASE 2. SETTING OF CALIBRATION TABLEIN THE SENSOR FOR THE CYLINDRICAL TANK SHAPE

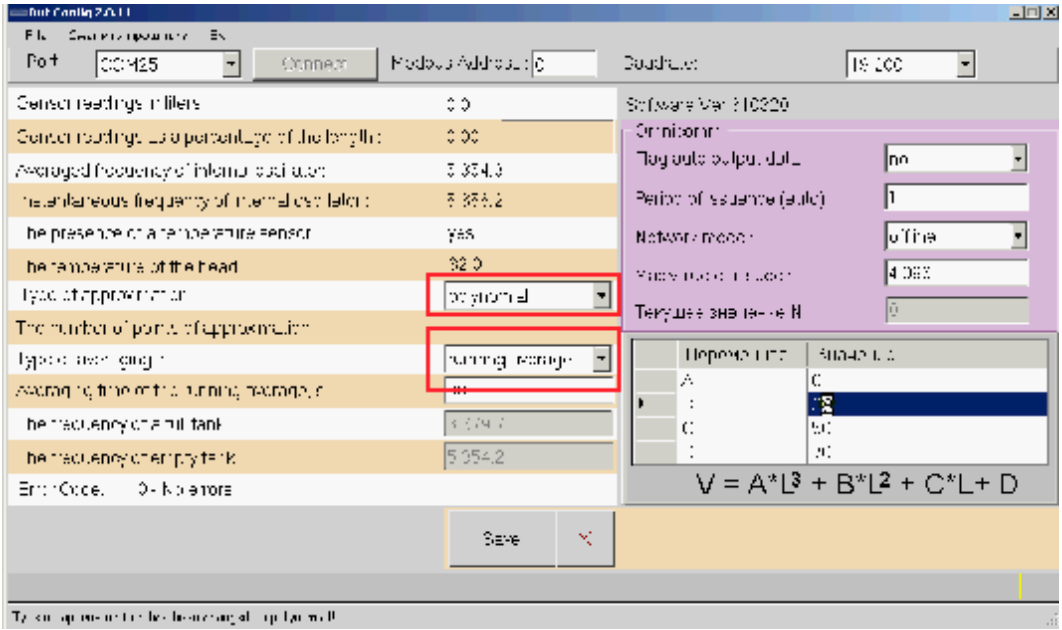
*For flexibility in the operation we recommend to use this function only when the terminal or dispatching software can't store inside the calibration table.*

Polynomial approximation is developed for tanks of the cylindrical and elliptic form (gasoline tank trucks, tank-trucks). In this case while calibration you create the correspondence table for filled fuel to output value of the sensor as before. But in the sensor you enter factors A, B, C, D mathematically defined at calibration, which describe this correspondence function. Then you only need to enter in the terminal the tank size and the sensor will give out an output value in % from its volume, instead of % of filling throughout the height. That is, value 511 at digit capacity 1023 will correspond 511/1023=50 % of tank volume.

1. CALIBRATION of the SENSOR and SETTING of the DATA OUTPUT FORMAT (see as above). To set data output format check that we have selected

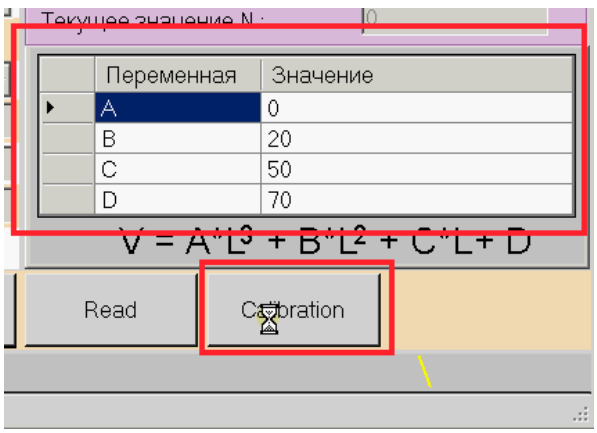
**Approximation type** – polynomial

**Averaging type** – exponential (preferably) or running average




1. You should enter calibration table in the calibration mode:

Click CALIBRATION button and enter values that describe function:



# 8. Appendix 1. Description of sensor Strela D232 (D485) communication protocol

Communication protocol of fuel level sensor with peripheral device consists of two parts: general use open part and private part.

Private part serves to set sensor parameter with the help of application program DYTConfig.exe. Private part commands can change without additional report and they are not supported by certain type of fuel level sensors Strela, however they are supported by application program DYTConfig.exe.

Open part commands are supported by all type of sensors Strela that has digital interface. Commands cannot be changed and will be supported by new type of sensors Strela.

Open part of protocol supports two types of communication protocols; in binary form (HEX) or symbol form (ASCII-sequence communication). It is recommended to use binary communication protocol to work.

After power connection to fuel level sensor Strela and before issuing the first interrogation command it is necessary to wait at least 100 msec. The command issued during 100 msec. after switching on is not interpreted, communication will restore only after 100 msec. of “silence“ in communication channel.

If working sensor is in Slave-mode, you need to wait for an answer from sensor after interrogation command is sent. Answer lag time depends on rate of data exchange and type of communication protocol but no more than 100 msec. If the answer is not received after 100 msec. it is possible to send issue again.

Communication between sensor and peripheral device is performed in standard messages form. The message read in packets of byte. Byte transfer begins by START-bite and stops by STOP-bite (figure 11). Data are transferred by lower byte first.

Period between following bytes in packet (Tt) should be less than time transfer of 35 bites or less than 1 msec, if:

$$\frac{35}{\text{speed (bod)}} < 1 \text{ ms}$$

The end of byte packet is deemed the situation when next byte is not received during period of time that exceed top interval (Tt) + 1 msec. (Figure 12)

Tbyte - transfer time of one information byte

Tt – timeout between following bytes in packet.

This order spreads out on sensor Strela work and on peripheral device work.

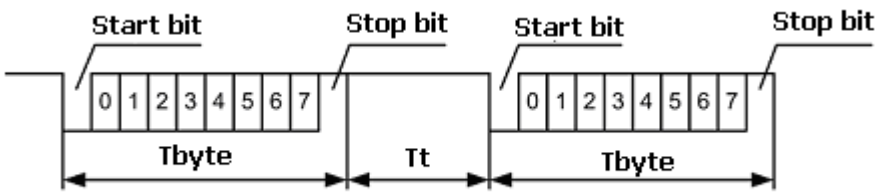



**Fig.8 Communication signal**

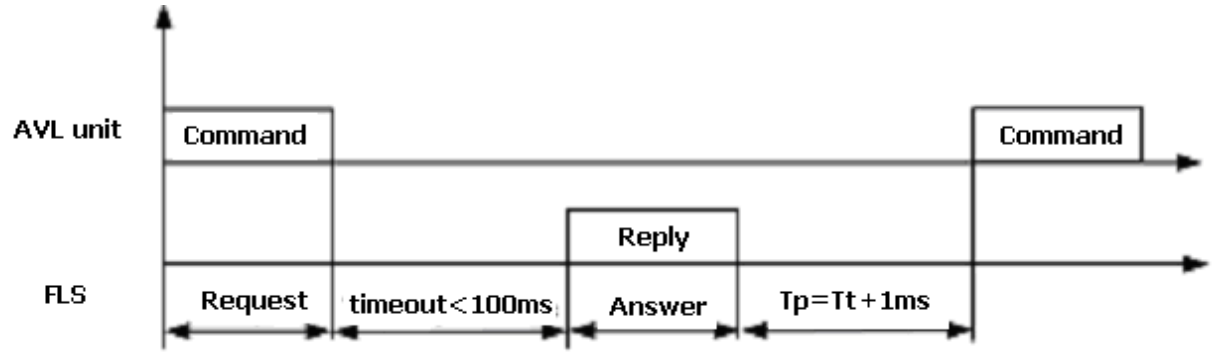



**Fig.9 Communication signal**

# *Description of commands for binary communication protocol*

### Messages format for binary communication protocol

All commands of binary communication protocol have the same standard format presented in table 10:

**Tab.10**

| Field # | Field name | Field width, byte | Description |
|---|---|---|---|
| 1 | Prefix | 1 | This field is a beginning-of-massage marker. Incoming messages must have prefix 31h and outgoing messages should be produced by program with prefix 3Eh. |
| 2 | Network address | 1 | The field contains:<br>- Messages destination network address for prefix 31h;<br>- Messages source network address for prefix 3Eh. |
| 3 | Operation code | 1 | The field contains:<br>- operation code that have to be run by program for prefix 31h;<br>- return response operation for prefix 3Eh. |
| 4 | Data | Depend on code | Data composition and field format depend on operation code. |
| 5 | Control total | 1 | The field is used for data integrity control. Computing algorithm is described in Application A. |

### Single-valued scan out (command 06h)

The command is designed for current scan out: relative level, temperature, frequency. The relative level is produced by sensor in interval set by parameters as 'Lowest indicated value', 'Top indicated value' settings.

Data are transferred by lower byte first.

Command format:

| Offset value, byte | Field width, byte | Value | Description |
|---|---|---|---|
| 0 | 1 | 31h | Prefix. |
| +1 | 1 | 00h...FFh | Destination network address. |
| +2 | 1 | 06h | Operation code. |
| +3 | 1 | 00h...FFh | Control total. |

Response format:

| Offset value, byte | Field width, byte | Value | Description |
|---|---|---|---|
| 0 | 1 | 3Eh | Prefix. |
| +1 | 1 | 00h...FFh | Source network address. |
| +2 | 1 | 06h | Operation code. |
| +3 | 1 | -128...127 | Temperature in Celsius degree. |
| +4 | 2 | 0000h...FFFFh | Relative level. |
| +6 | 2 | 0000h...FFFFh | Frequency rate. |
| +8 | 1 | 00h...FFh | Control total. |

The results of level measurement are not valid after sensor activation until moment of the set point solid performance test (time for various sensor models is equal to several seconds). In such case sensor returns level value LVL that exceeds 0FFFh digit (or 4095d). If you received a packet with such level value it is recommended to shut down future data processing, wait 1 -2 seconds and repeat request to sensor.

**Repeating data output (command 07h)**

The command is designed for turning on the repeating data output.

After command processing sensor begins to produce repeating output of such data as fuel level, temperature, frequency with time period set by command 13h. By zero value of period data output is not issued.

The repeating data output turning off is performed after receiving of any valid command, processor reset or power off, if default data output mode is not set.

Data message format is represented in the table (tab.7). Data are transferred by lowest byte first.

# *Description of commands for symbol communication protocol*

The symbol communication protocol consists in reception and sending of ASCII symbols read as interrogation and reply commands.

**Data reading**

Command is designed for current data reading: relative level, temperature, frequency.

Command represent string of ASCII symbols '"D" and "O". After receiving of command "DO" the program will produce a response in the form of ASCII symbols string.

For example, F=0AF9 t=1A N=03FF.0 <CR><LF>

Where F is current frequency value, t – current value of temperature in Celsius degree, N – fuel level value. All values are in hexadecimal format.

If frequency value more than FFFh data is not valid.

**Repeating data output**

The command is designed for turning on of repeating data output.

After command processing the sensor begins to produce the repeating output of such data as relative fuel level, temperature and frequency in symbol format (ASCII codes). Data are produced at regular intervals that were determined by sensor settings (by program DYT Config.exe). If time of data output equal to zero data output is not issued.

The repeating data output turning on is performed through sending of string of symbol "DP". After command processing symbol string will be received.

# Algorithm CRC

For CRC with polyniom a^8 + a^5 + a^4 + 1 following algorithm is used (C-language):

```
U8 CRC8 (U8 data, U8 crc)
{  U8 i = data ^ crc;
  crc = 0;
  if(i & 0x01) crc ^= 0x5e;
  if(i & 0x02) crc ^= 0xbc;
  if(i & 0x04) crc ^= 0x61;
  if(i & 0x08) crc ^= 0xc2;
  if(i & 0x10) crc ^= 0x9d;
  if(i & 0x20) crc ^= 0x23;
  if(i & 0x40) crc ^= 0x46;
  if(i & 0x80) crc ^= 0x8c;
  return crc; }
```

**Application 3. The resolution of USB-RS485/RS232 work conflicts**.

Driver USB-RS uses standard drivers FTDI which can be used by other equipment connected to PC. In this case equipment handing to USB-port can be realized in two modes: direct or through image COM-port. If another installer's equipment operates through image COM-port no problems will emerge. In other cases you will need to switch USB devices to mode "LOAD VCP" through Windows device manager.

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