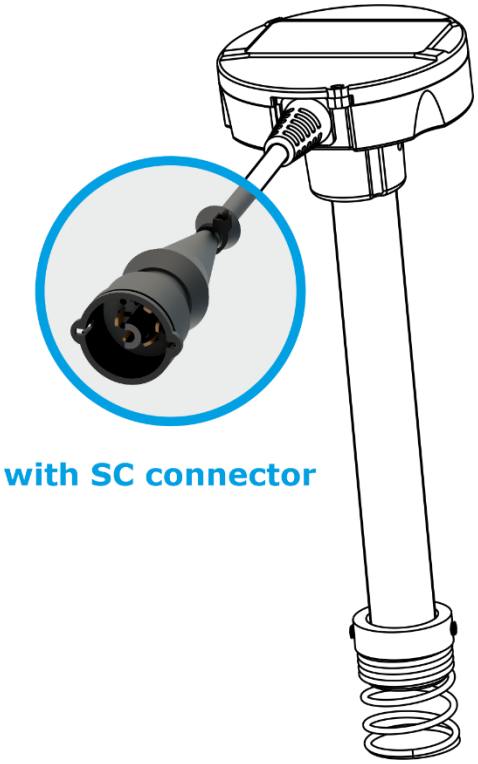
DUT-E

FUEL LEVEL SENSOR



Model code
05

DUT-E AF

OPERATION MANUAL

Version 1.0

IoT BURGER

TECHNOTON
ADVANCED MACHINERY TELEMATICS

E28 10 R - 04 1549

Contents

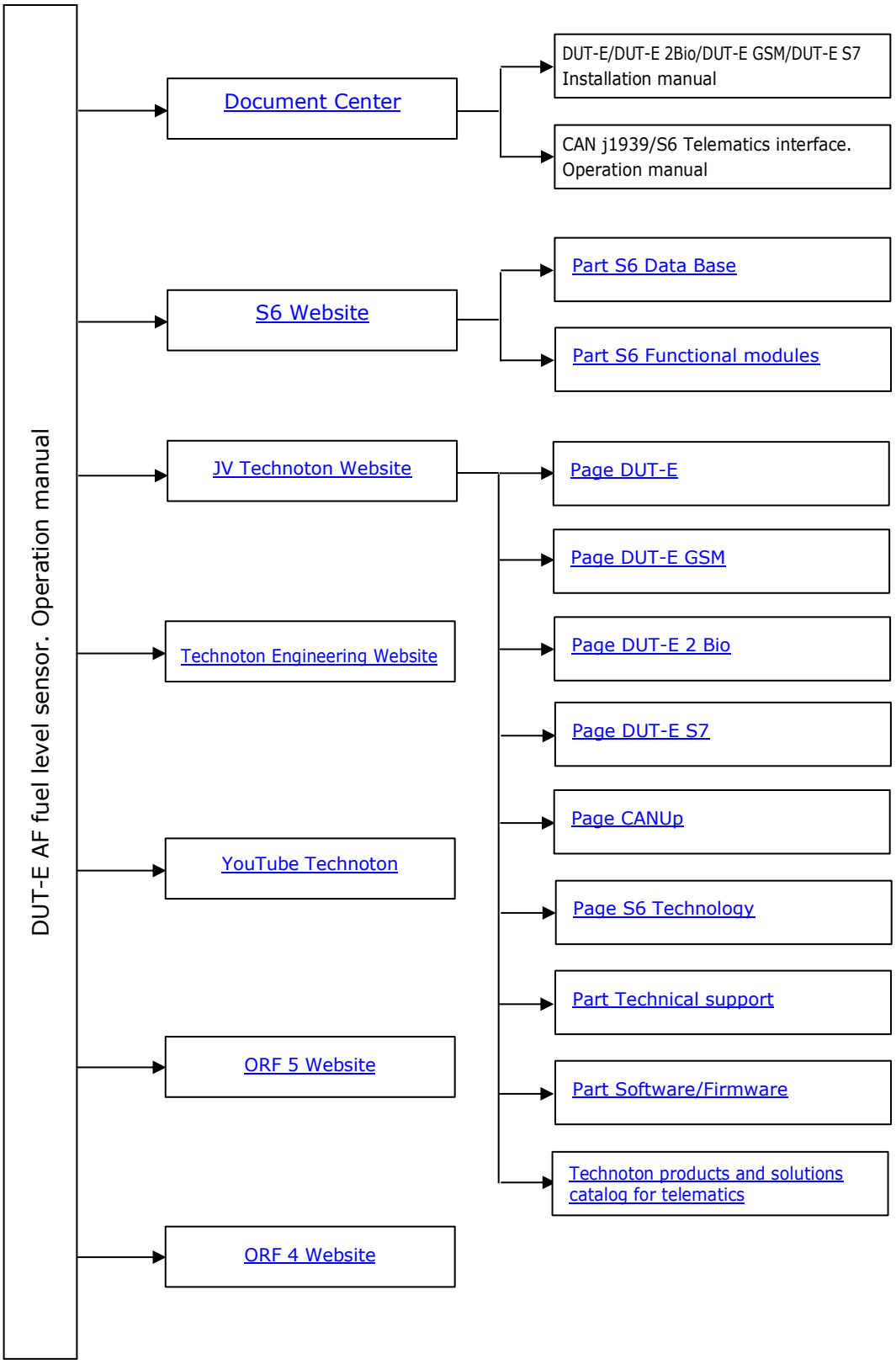
Contents 2
Revision history 4
Structure of external links 5
Terms and Definitions 6
Introduction 8
1 General information and technical specifications of DUT-E AF 10
1.1 Purpose of use and areas of application 10
1.2 Exterior view and delivery set 12
1.3 Design and operation principle 13
1.4 Technical specifications 15
1.4.1 Main specifications 15
1.4.2 Specifications of output signals 16
1.4.3 Compatibility with Terminals and receiving devices 17
1.4.4 Overall dimensions 18
2 DUT-E AF installation 19
2.1 Exterior inspection prior to works start 19
2.2 General recommendations for sensor installation 20
2.2.1 Standard fuel sensor replacement 20
2.2.2 Installation into a special hole 21
2.2.3 Probe cutting according to tank depth 24
2.2.4 Length extension 25
2.2.5 Mounting a screen filter and fixing the sensor 26
2.3 Sensor configuration by means of cable connection to the PC 28
2.3.1 Connecting sensor to PC 28
2.3.2 Interface of Service S6 DUT-E software 31
2.3.3 Authorization 32
2.3.4 Operations with the sensor profile 33
2.4 Wireless configuration of sensor using Android devices 35
2.4.1 Wireless connection of the sensor to the Android device 35
2.4.2 Interface of application 38
2.4.3 Authorization 39
2.4.4 Operations with the sensor profile 41
2.5 Electrical connection 42
2.6 Sensor calibration 45
2.7 Fuel tank calibration table 47
2.8 Adaptation of sensor to specific conditions of operation 49
2.9 Parameters of output connection 51
2.10 Summation of data 52
3 Sealing 55
4 Measurement accuracy check 56
4.1 Basic principles 56
4.2 Check tests procedure 57
5 Diagnostics and troubleshooting 58
6 Maintenance 59
6.1 General instructions 59
6.2 Demounting 60
6.3 Examination 61
6.4 Cleaning 62

7 Packaging 63
8 Storage 64
9 Transportation 65
10 Utilization/re-cycling 66
Contacts 67
Annex A Template of check test report 68
Annex B Sensor parameters configured and displayed with the help of service software and mobile application 69
B.1 Self-diagnostics FM 69
B.2 Fuel level sensor FM 71
B.3 Fuel level control FM 74
B.5 Vehicle Power Supply FM 76
Annex C Sensor firmware upgrade 78
Annex D Electromagnetic compatibility specifications 79
Annex E Method of recording the calibration table for tanks of great capacity 80
Annex F Videography 81

Revision history

Version	Date	Editor	Description of changes
1.0	03.2023	OD	Basic version.

Structure of external links



Terms and Definitions

IoT Burger is the Technology of creating smart sensors and complex telematics IIoT devices operating in real time with built-in analytic features (further on – IoT Burger). The basis of IoT Burger is the software/hardware core, a set of ready-to-use universal Functional Modules, the database of standartized IoT parameters.

Particular features of IoT Burger:

- inbuilt analytic features for maximum treatment of signals within the device itself;
- a possibility to design devices with extremely low power consumption;
- doesn't require programming in the majority of applications, flexible setup;
- using inexpensive industrially manufactured equipment parts;
- measurement and treatment of "quick" processes which is impossible to implement using cloud technologies;
- an option of ready Reports delivery to the user avoiding server platforms;
- the inbuilt system of data authenticity assurance (self-diagnostics, authorization, impact control).

The technology provides for the availability of several measurement channels in any device including pre-set analytical treatment (filtration, linearization, thermal compensation) and the controlled error of measurement.

Devices created using IoT Burger may be united to form a wire-connected or wireless connection network. Data may be transmitted to the telematics server, to popular IoT platforms, by SMS, E-mail, to social networks.

At present, 2G/3G/LTE/NB-IoT/Wi-Fi/BLE data transmission standards are used in devices with IoT Burger. The reports transmitted contain data on instant and average values of Parameters, Counters, Events. The flexible system of Reports setup enables the user to select the optimal ratio of the data completeness and the volume of traffic.

DUT-E AF fuel level sensor is designed using IoT Burger Technology.

S6 is the Technology of combining smart sensors and other IoT devices within one wire network for monitoring of complex stationary and mobile objects: vehicles, locomotives, smart homes, technological equipment etc. The Technology is based and expands SAE j1939 automotive standards.

Information on cabling system, service adapter and S6 software refer to CAN j1939/S6 Operation manual.

ORF 4 / ORF 5— is the by Technoton telematic services designed for receiving and processing Onboard reports via Internet, displaying Operational Dataoverlapped on area maps, information storage in database and Analytical reports generation upon user's request.

PGN (Parameter Group Number) — is a combined group of S6 parameters, which has common name and number. Functional modules (FM) of the Unit can have input/output PGNs and setup PGNs.

SPN (Suspect Parameter Number) — informational unit of S6. Each SPN has determined name, number, extension, data type and numerical value. The following types of SPN exist: Parameters, Counters, Events. SPN can have a qualifier which allows qualification of parameter's value (e.g. – Onboard power supply limit/Minimum).

Analytical report — report generated in ORF 4 / ORF 5 on Vehicle or group of Vehicles operation for chosen time period (usually a day, week or month). Can be composed of numbers, tables, charts, mapped route of vehicle, diagrams.

Onboard equipment (OE) — Telematics system elements, directly installed in Vehicle.

Onboard reports (the Reports) — information about vehicle which is returned to a user of Telematics system in accordance with inputted criteria. The Reports are generated by a terminal unit both periodically (Periodic reports) and on Event occurrence (Event report).

GNSS (Global Navigation Satellite System) — System for area positioning of an object through satellite signal processing. GNSS is composed of space, ground and user segments. Currently, there are several GNSSs: GPS, GLONASS, Galileo, BeiDou.

Model code — digits designating the product modification. For DUT-E AF sensor, its model code **(05)** is identified by the 1st and the 2nd digits of its serial number placed on its measuring probe and on its packing label.

Parameter — time-varying or space characteristic of the Vehicle (SPN value). For example, speed, fuel volume in the tank, hourly fuel consumption, coordinates. Parameter is usually displayed in the form of graph, or averaged data.

Server (AVL Server) — hardware-software complex of Telematics service ORF 4 / ORF 5, used for processing and storage of Operational data, formation and transmission of Analytical reports through Internet by request of ORF 4 / ORF 5 users.

Event — a relatively rare and sudden change in SPN. For example, the sharp increase of volume in the tank is the Event "Fuelling". An Event may have one or more characteristics. Thus, the Event "Fuelling" has the following characteristics: "volume of fuel at the beginning of the fueling", "volume of fuel at the end of the fueling", "volume of the fueling" and so on. As soon as an Event is detected, the Terminal registers the time of the Event which is subsequently specified in the Report of the Event. The Event is always linked to the time and the location where it was detected.

Counter — cumulative numerical characteristic of Parameter. Counter is displayed by a single number and over time its value is increasing. Examples of counters: fuel consumption, trip, engine hours counter etc.

Telematics terminal (Tracking device, Telematics unit) is a unit of Telematics system used for reading the signals of Vehicle standard and additional sensors, getting location data and transmitting the data to the Server.

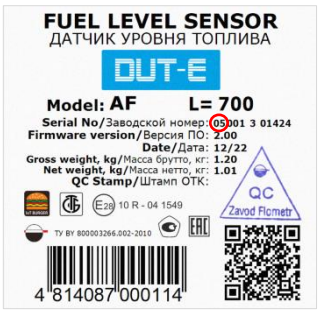
Telematics system — complex solution for vehicle monitoring in real time and trip analysis. The main monitored characteristics of the vehicle: Route, Fuel consumption, Working time, technical integrity, Safety. In includes On-board report, Communication channels, Telematics service ORF 4 / ORF 5.

Vehicle is an object controlled by the Vehicle Tracking System. This is generally a truck, a bus or a tractor, sometimes a locomotive, a ship, a utility vehicle. From the point of view of Vehicle Tracking System, static equipment such as diesel generators, heating boilers, burners, and so on are considered vehicles.

Function module (FM) unit-embedded component of hardware and software combination, executing a group of special functions. Uses input/output PGNs and settings PGNs.

Introduction

Recommendations and rules set out in this Operation Manual apply to **DUT-E AF fuel level sensor** (further on — DUT-E AF), model code: **05**, manufactured by Technoton company.
Model code is identified by the first two digits of its serial number printed at its measuring probe or on its packing label:



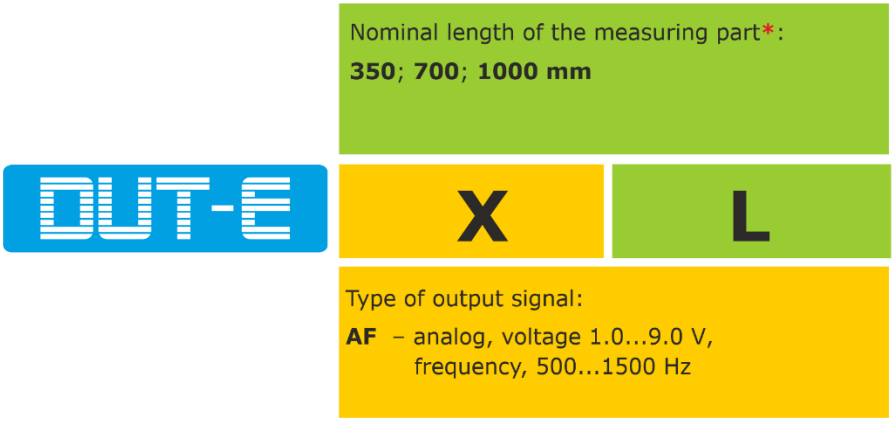
The manual contains information on design, operation principle, specifications and instructions on installation, use and maintenance of DUT-E AF. Besides, this document defines the procedure for wire-connected and wireless connection configuration of sensors.

DUT-E AF **— intellectual sensor within Telematics systems employed for accurate level measurement of diesel fuel and of other non-conductive liquids in tanks of any vehicles / stationary tanks.**

DUT-E AF key features:

- it is designed based on IoT Burger Technology — the internal data processing (filtering and normalization of Parameters, the tank calibration table is recorded into the sensor memory) simplifies the Server and Telematics terminal operation;
- function of digital self-diagnostics for sensor quality control;
- adjustable temperature correction for automatic measurement correction based on ambient temperature;
- automatic compensation of ambient temperatures effect on the electronic sensor module;
- length extension up to 6 m using additional sections (purchased separately);
- summation of fuel volume values in several tanks (up to 8 pcs.) with the help of DUT-E SUM AF summators (purchased separately);
- wireless configuration using Android devices, via Bluetooth, with the help of S6 BT Adapter;
- full set of mounting accessories and connection cable included;
- bottom spring for better mounting rigidity;
- screen filter (purchased separately) for secure protection from water and mud;
- built-in voltage stabilizer – output signal does not depend on vehicle power supply voltage;
- reverse polarity and short circuit protection of any output to vehicle electrical system and chassis;
- ergonomic bayonet mount allows to save installation time;
- sealing possibility to avoid unauthorized intrusion and tampering;
- compliance with national and European standards;
- great experience of operation, high quality of technical support and documentation.

See figure 1 for identification codes for DUT-E AF ordering.



* Any length up to 1400 mm can be manufactured upon special order
(in case the order is less than 200 pcs. per one quarter, the price is 20% higher).

Figure 1 — DUT-E AF order identification codes

Examples of DUT-E AF ordering identification codes:

"Fuel level sensor DUT-E AF L=1000 mm"
(analog/frequency output signal; nominal length of the measuring part — 1000 mm).

For DUT-E AF configuration using cable connection to the PC you should use S6 SK service adapter (to be purchased separately) and the Service S6 DUT-E service software (the software current version can be downloaded at https://jv-technoton.com/, Section Software/Firmware).
For wireless configuration of DUT-E AF using an Android device you should use S6 BT Adapter service adapter (to be purchased separately) and the Service S6 DUT-E (Android) service software (the software current version can be downloaded at Google Play).

ATTENTION: It is strongly recommended to follow strictly the instructions of the present Manual when using, mounting or maintaining DUT-E AF.

The Manufacturer guarantees DUT-E AF compliance with the requirements of technical regulations subject to the conditions of storage, transportation and operation set out in this Manual.

ATTENTION: Manufacturer reserves the right to modify DUT-E AF specifications that do not lead to a deterioration of the consumer qualities without prior customer notice.

1 General information and technical specifications of DUT-E AF

1.1 Purpose of use and areas of application

DUT-E AF is designed for accurate level/volume measurement of diesel fuel and other non-conductive liquids in tanks of vehicles and tractors and in stationary tanks (see figure 2).

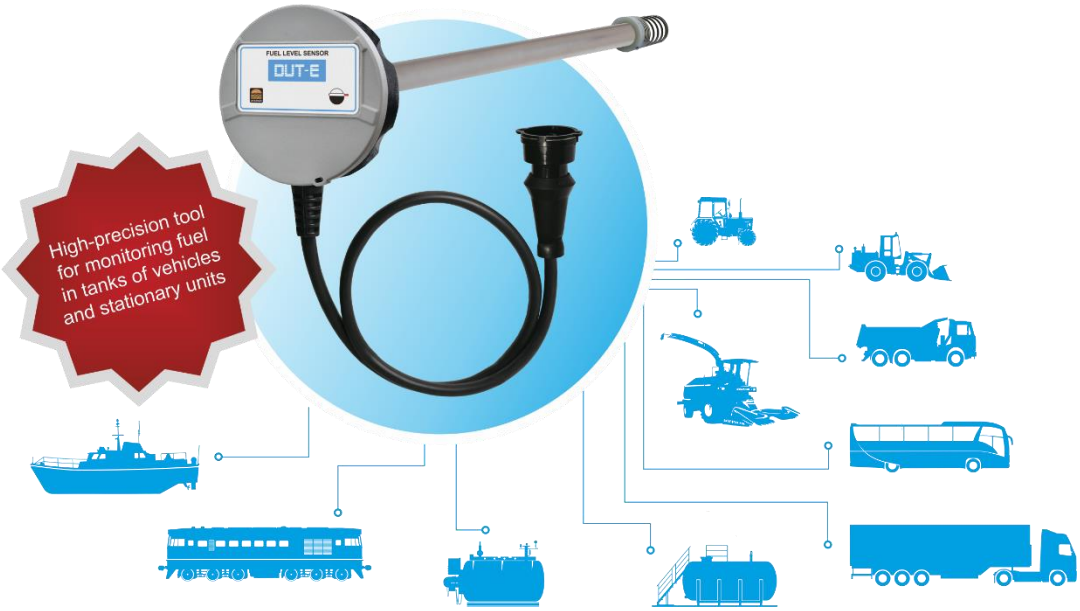


Figure 2 — DUT-E AF purpose of use

Areas of application:

DUT-E AF is employed in Telematics systems (see figure 3) for monitoring trucks, buses, railway and water transport, fixed fuel tanks, diesel generators, boilers and burners.

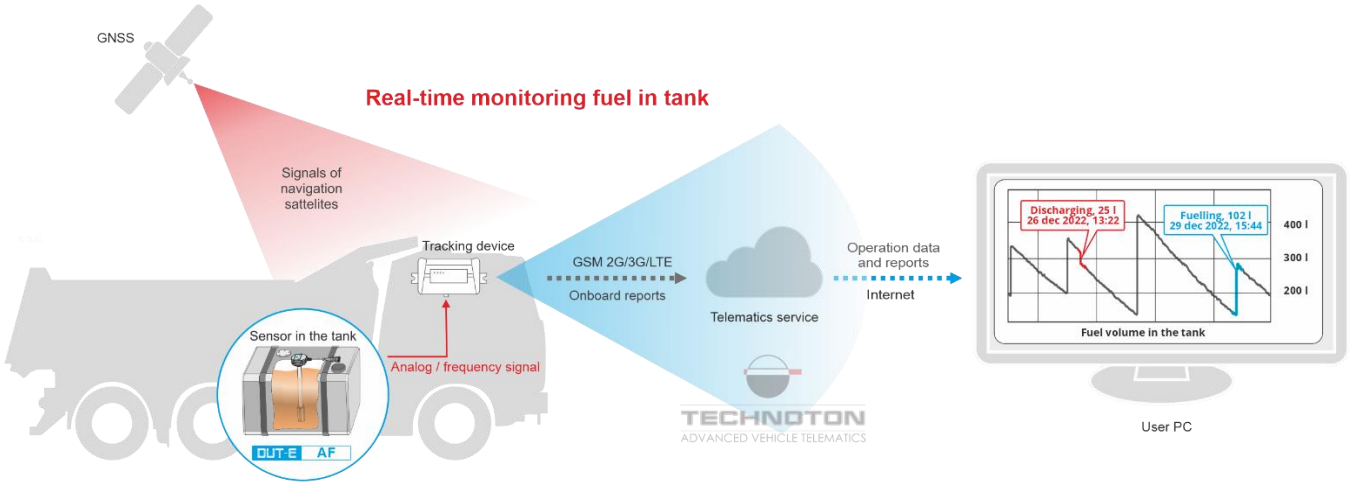


Figure 3 — Example of DUT-E AF operation as part of the Telematic system

DUT-E AF is mounted in a vehicle tank or in a fixed tank. The sensor measures the level of fuel in the tank and transmits the output analog or frequency signal to the respective input of the Telematics terminal. The Terminal collects, records and stores the received data and transfers them to the Telematics server.

Server software processes and analyzes the received data to generate Analytical reports for a selected period of time (see figure 4).

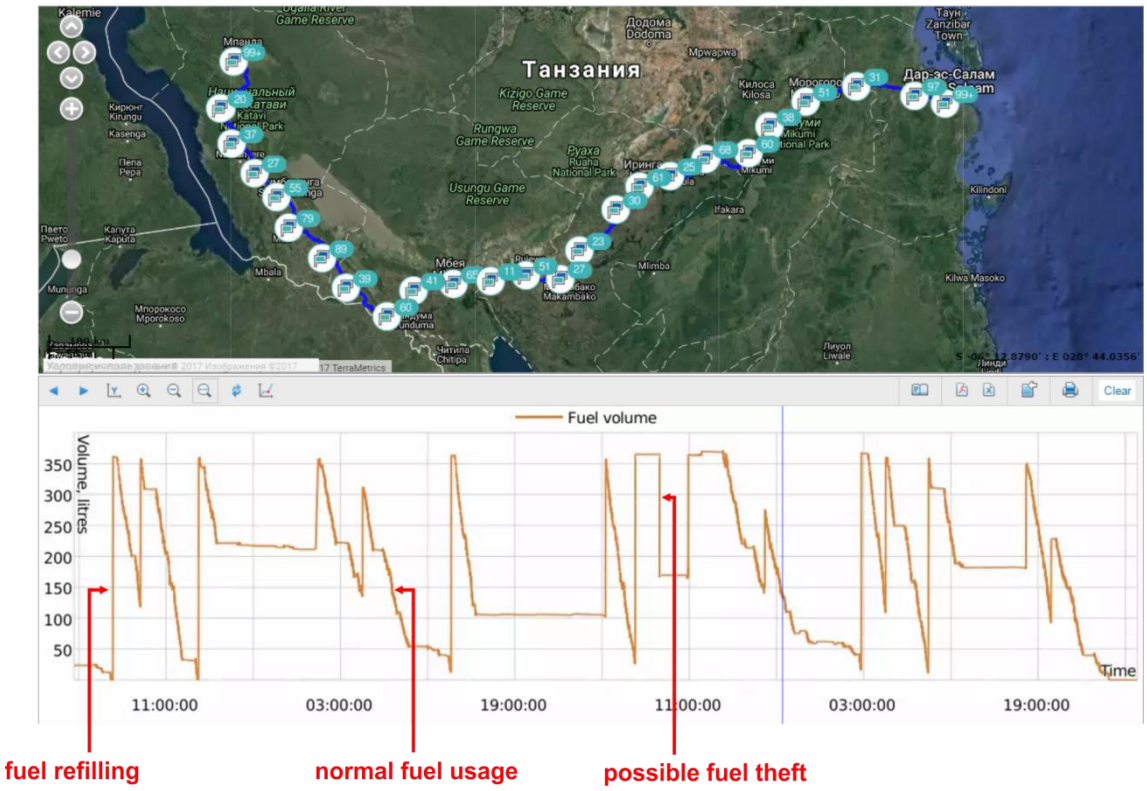
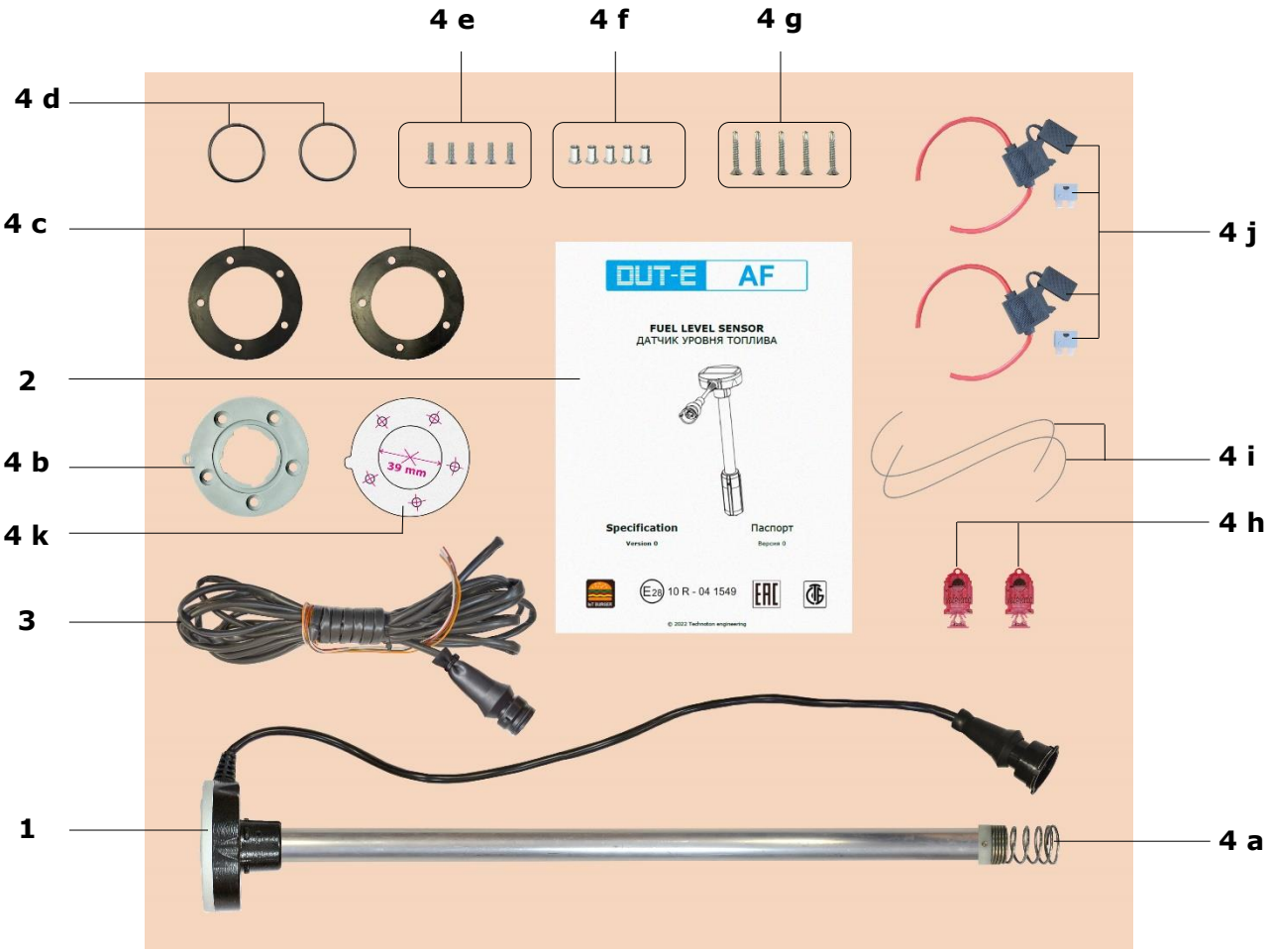


Figure 4 — Example of a Report on changing the volume of fuel in the tank, based on data received from DUT-E AF

RECOMMENDATION: ORF 4 / ORF 5 vehicle monitoring web-server provides the best accuracy of reports on movement tracking and fuel consumption monitoring.
Reports contain detailed data required for effective monitoring of vehicles and drivers' operation: operation time, time and location of parking, fuel consumption, refueling and fuel drains/thefts, movement route, speed and other parameters.

1.2 Exterior view and delivery set



1	- DUT-E AF fuel level sensor	– 1 pc.;
2	- Specification with factory settings sheet	– 1 pc.;
3	- S6 SC-CW-700-RS signal cable (7.0 m)	– 1 pc.;
4	- Mounting kit (1 pc.) including:	
	a) bottom stop	– 1 pc.;
	b) plastic mounting plate	– 1 pc.;
	c) rubber gasket	– 2 pcs.*;
	d) sealing rubber ring	– 2 pcs.*;
	e) bolt	– 5 pcs.;
	f) threaded rivet	– 5 pcs.;
	g) self-tapping screw	– 5 pcs.;
	h) plastic seal	– 2 pcs.**;
	i) sealing cord	– 2 pcs.;
	j) fuse with holder (2 A)	– 2 pcs.;
	k) hole placement template	– 1 pc.

Figure 5 — DUT-E AF delivery set

* 1 pc. is for initial DUT-E AF mounting and 1 pc. as a spare part.
The delivery set may include just 1 gasket of 4 mm.
**Exterior of seal can be different.

1.3 Design and operation principle

DUT-E AF fuel level sensor (see figure 6) consists of a measuring probe **(1)**, measuring "head" with an electronic module located inside **(2)**, interface cable **(3)** with connector for electrical connection **(4)**.

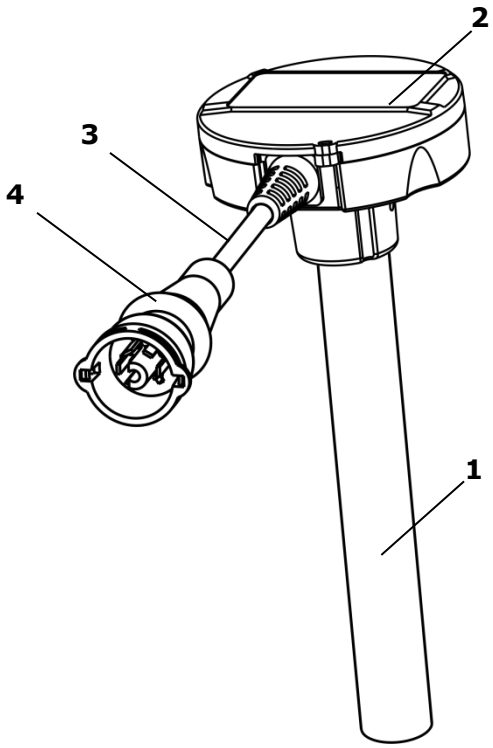


Figure 6 — Structure of DUT-E AF

DUT-E AF operation principle is based on condenser capacitance measurement, where measuring probe pipes are used as capacitor plates. Electric capacitance changes depending on measuring probe immersion depth in the fuel which is dielectric liquid. The sensor analyzes current value of electric capacitance and then generates an appropriate analog/frequency output signal.

WARNING: Capacitive principle ensures highest accuracy of liquid measurement when the liquid has **constant dielectric permeability coefficient**. Otherwise, additional inaccuracy of measurement may appear.

Fuel level translation is carried out in accordance with calibration table. To create the table, it is necessary to calibrate the fuel tank. This procedure is a sequence of fixed refueling portions from empty to full tank. During calibration, the value of DUT-E AF output signal is established depending on fuel amount in a particular tank (see DUT-E fuel level sensor installation video for details).

DUT-E AF can produce the output signal corresponding to the level or volume of fuel in the tank, in accordance with the calibration table, which is recorded into the sensor internal memory in the process of its configuration during its cable connection or wireless connection (see 2.7).

When using DUT-E AF within the Telematics system, the fuel volume is calculated by the Tracking device (e.g. by the Terminal) or by the Telematics Server software.

To increase measurements accuracy, DUT-E AF has configurable features of the output signal automatic correction — filtering by time, thermal correction (see 2.8) and thermal compensation (see figure 7).

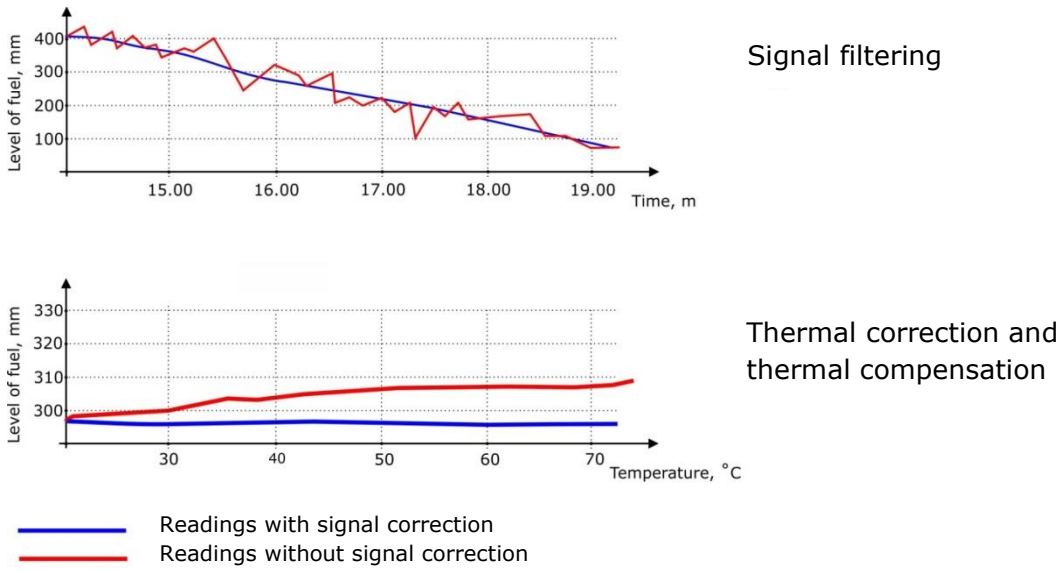


Figure 7 — Activated features of DUT-E AF output signal automatic correction

1.4 Technical specifications

DUT-E AF is powered by on-board power supply of the Vehicle where it is installed.

DUT-E AF can be used in the conditions of temperate and cold climate.

For resistance to mechanical impact DUT-E AF is shake and shockproof.

1.4.1 Main specifications

Table 1 — DUT-E AF main specifications

Parameter, measuring unit	Value
Working fluid	Diesel fuel**
Fuel level sensor operating principle	Capacitive
Output signal	Analog / Frequency
Service interface	K-Line (ISO 14230)
Sensor sensitivity to fuel level changes, mm	0.1
Relative measuring error (to the length of the measuring part), %, not more than	±1.0
Power supply voltage range, V	10…45
Maximal current consumption at supply voltage 12/24 V, mA, not more than	50/25
Maximum trimming of the measuring probe*	to any length
Maximum length increase*, mm, not more than	6000
Temperature range, °C	-40…+85
Level of sealing protection from dust and moisture	IP55/IP57
Electromagnetic compatibility	see annex D
Weight, kg, not more than	0.6 (at L=1000 mm) 0.5 (at L=700 mm) 0.4 (at L=350 mm)

* After cutting/length extension of the measuring probe the sensor calibration is obligatory.

** The sensor is allowed to operate using other types of fuel. However, it should be taken into consideration that while using the sensor in the explosive environment, the sensor must be electrically connected through the external power and spark protection unit (purchased separately), to meet the requirements regarding the spark-proof electric circuit.
The spark-proof circuit must meet the following parameters:
- maximum input voltage — 10 V;
- maximum input current — 200 mA;
- maximum internal capacity — 15.0 μF;
- maximum inherent inductance — 1.188 mHn.

1.4.2 Specifications of output signals

DUT-E AF sensor has an analog or frequency output which is configured via K-Line (ISO 14230) service interface using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (see 2.9).

Output signal of DUT-E AF linearly depends on measured level of fuel in tank and is independent from supply voltage.

Resolution of digital-analog conversion of output signal is 12 bits.

Depending on configuration, DUT-E AF sensor's output can represent:

- fuel level in the tank (mm);
- fuel volume (L);
- total fuel volume (L) of up to eight tanks.

Summation of readings of up to 8 pcs. of DUT-E AF sensors is allowed during their use together with DUT-E SUM AF summators (purchased separately). In this case, each sensor must have a unique network address from 101…108 range. Besides, the calibration table for the respective tank must be recorded into the memory of each sensor used (see 2.10).

Table 2 — Specifications of DUT-E AF output signal

Parameter, measuring unit	**Value***	
	voltage output	**frequency output**
Adjustable range of voltage change, V	1.0…9.0**	-
Range of frequency change, Hz	-	500…1500
Frequency signal form	-	Meander
Duty cycle, %	-	50
Low level voltage, V, not higher than	-	0.5
High level voltage, V	-	10.0±1.0
Output resistance of high level, kOhm, not higher than	-	5
Output resistance of low level, kOhm, not higher than	-	50
Input resistance of connected device, kOhm, not higher than	10	-

* The values are applicable for sensor with standard measuring length. In case of changing probe length (cutting/extending) sensor calibration should be carried out.

** Sensor output signal voltage range may be specified both in direct and inverse relation.

1.4.3 Compatibility with Terminals and receiving devices

DUT-E AF sensor may be used together with Telematics terminals or other tracking devices whose input specifications correspond to parameters of output signals, in accordance with 1.4.2.

Technoton regularly conducts compatibility and mutual accuracy tests of all manufactured products with Terminals of different models.

A table containing the up-to-date list of Declarations of compatibility of Telematics terminals from different manufacturers with products manufactured by Technoton is provided at: https://www.jv-technoton.com/.

Recommendations on the equipment connection and configuration can be received at the Technoton technical support service.

1.4.4 Overall dimensions

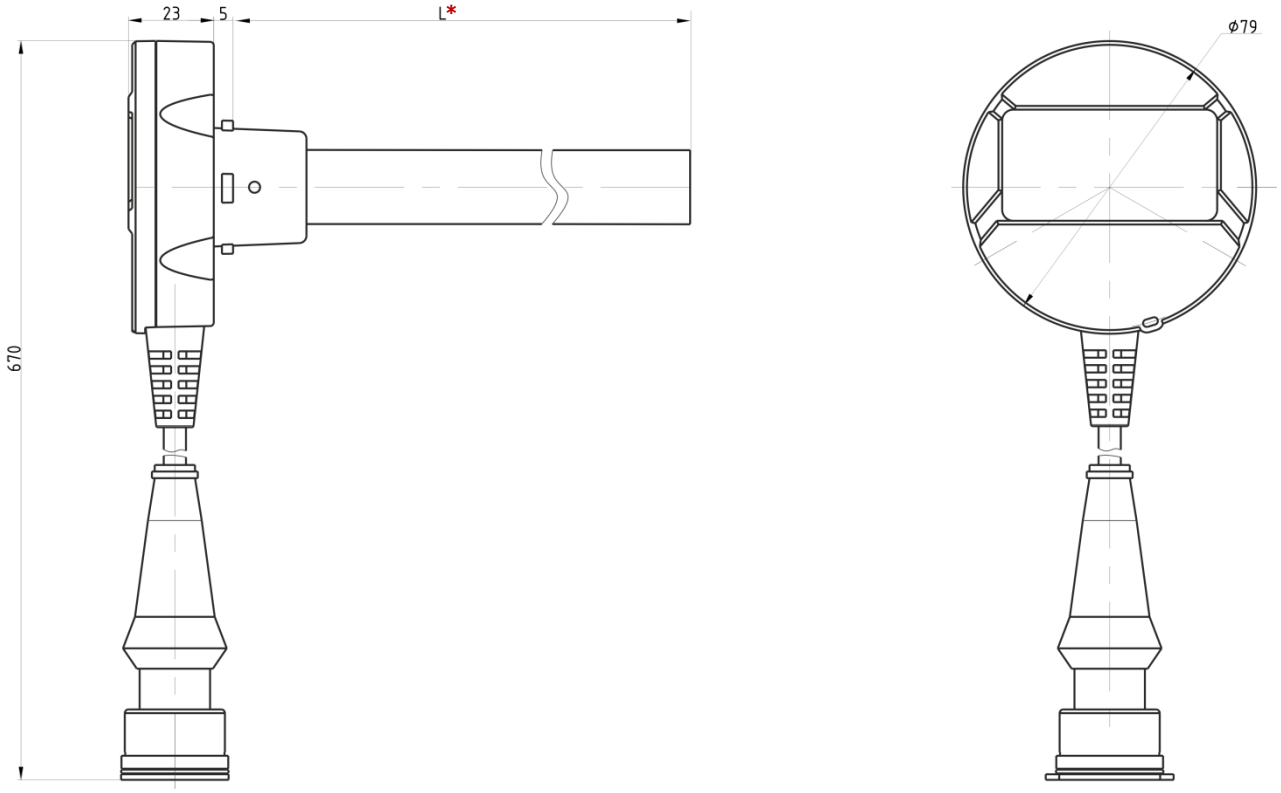


Figure 8 — Overall dimensions DUT-E AF

* Nominal measuring probe length (350 / 700 / 1000 mm).

2 DUT-E AF installation

For DUT-E AF correct operation its mounting and configuration should be carried out by certified specialists who have passed corporate technical training.

ATTENTION: During sensor mounting you are to follow general health and safety rules for repairing vehicles and tractors, as well as health and safety rules established at a particular company.

In this chapter, general recommendations regarding mounting DUT-E AF sensor are provided. Detailed instructions regarding the sensor installation are provided in the DUT-E/DUT-E 2Bio/DUT-E GSM/DUT-E S7 installation manual.

The following tools and accessories are recommended to have for DUT-E AF mounting:

- Small tools: (box wrench kits, drive sockets, screwdrivers, pliers, jab saw or angle grinder with a cutoff disk, rivet spinner).
- Drill (screw driving machine) with a set of drill bits for metal.
- Hollow drill set, d=38 mm.
- Verified measuring reservoir for fuel (10…20 l volume).
- If the tank volume is greater than 200 l, the fuel filling station with a counter or DUT-E ATS automatic calibration station are desirable.
- Calibration pipe with one end sealed, its length being no less than the height of the tank to be equipped.
- Silicone sealing compound.
- Rags.
- Diesel fuel; full tank for each Vehicle.
- Spare tank for fuel of volume equal to that of the given fuel tank;
- In case of configuration using the cable system — S6 SK service adapter and PC with the installed Service S6 DUT-E service software.
  In case of wireless configuration — S6 BT Adapter service adapter and the Android device with the installed Service S6 DUT-E (Android) service mobile application;

RECOMMENDATION: Tank calibration using DUT-E ATS automatic calibration station eliminates the impact of human factor on the calibration accuracy and reduces the calibration error down to ±0.5 % of the tank volume, it also reduces by 2…3 times labor costs and time for the tank calibration (see DUT-E ATS operation manual).

2.1 Exterior inspection prior to works start

It is necessary to conduct DUT-E AF exterior inspection for the presence of the possible defects arisen during transportation, storage or careless use.

Contact the product supplier if there any defects.

2.2 General recommendations for sensor installation

2.2.1 Standard fuel sensor replacement

DUT-E AF can be mounted either into the flange of factory mounted float sensor* or into a specially drilled hole of the fuel tank.

ATTENTION: If the standard fuel sensor is not located in the geometrical center of the tank, it is not recommended to replace it with DUT-E AF. DUT-E AF installation far from the geometrical center of the tank will lead to significant fluctuations in fuel level readings.

Dismount the standard sensor and clean the mounting area before DUT-E AF mounting.

M5x16 bolts can be used for installation; they are included into the delivery set. Bolt or screw heads must be completely sunk in the mounting plate (see figure 9).

Figure 9 — Mounting plate screwed to the tank

Preorder correspondent mounting plate to replace the standard sensor with **SAE 5 bolt** bores layout.

RECOMMENDATION: For a further easier sealing of sensor pass the sealing cord through the sealing hole of the plate **prior** to fastening the plate to the tank!

* Study carefully the layout of the mounting bores for a factory mounted fuel sensor and compare it with the drawing of bores for a mounting plate.

2.2.2 Installation into a special hole

IMPORTANT:

1) Before drilling a bore in a fuel tank, the tank must be emptied, dismounted (if necessary) and dried or filled with water.

2) Before drilling, make sure that there are no bulkheads that interfere DUT-E AF installation.

3) Eliminate contact of DUT-E AF measuring probe with the bar of the standard float fuel sensor.

Sequence of operations during mounting DUT-E AF:

1) Determine installation location. **Geometrical center of the fuel tank** is recommended (see figure 10). This will reduce measurement errors caused by fuel level deviation during driving.

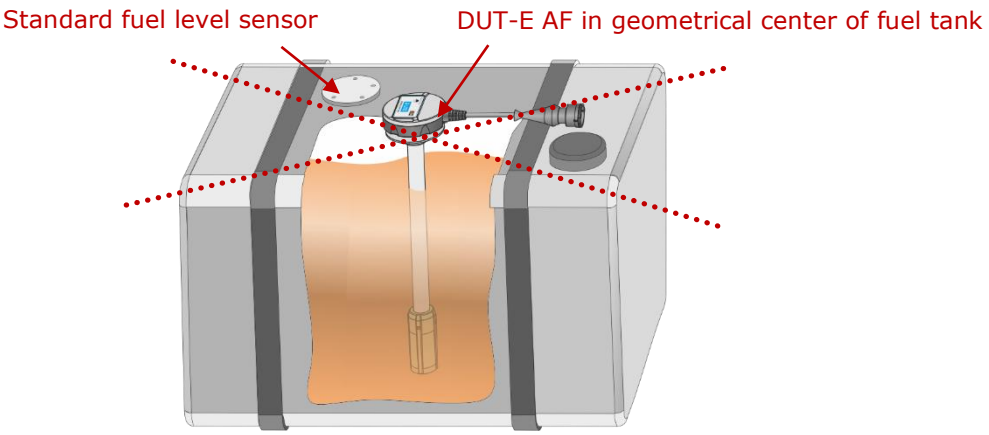
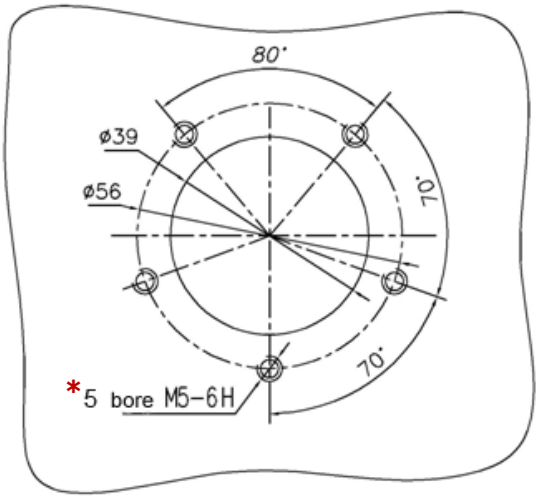


Figure 10 — Recommended location for a DUT-E AF installation

2) Stick hole placement template from DUT-E AF delivery set to the top of the tank and drill holes accordingly (see figure 11).

We recommend to drill a hole for the sensor mounting plate with a hollow drill set **38 mm** in diameter.

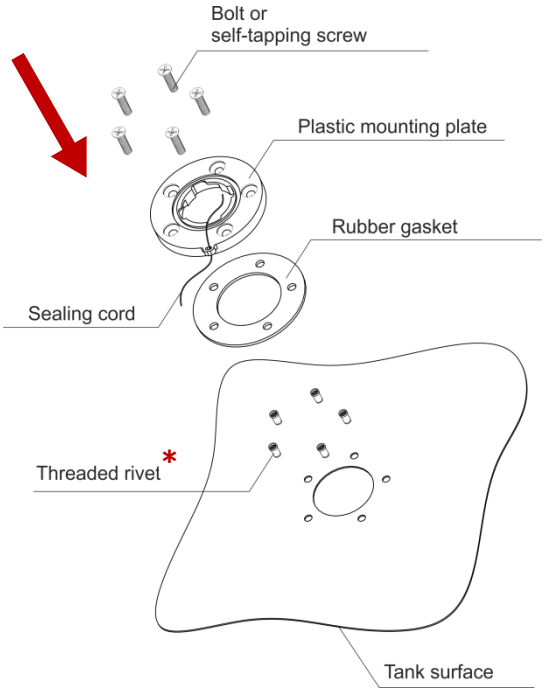
BE CAREFUL: The mounting plate can be installed only in one position on the bores prepared! Before marking and drilling, examine the place where you plan to fix the mounting plate because sealing holes should be accessible.



* While installing fastening plate with threaded rivets, make d=**7 mm** holes for rivets.

Figure 11 — Bores layout for sensor mounting plate fastening

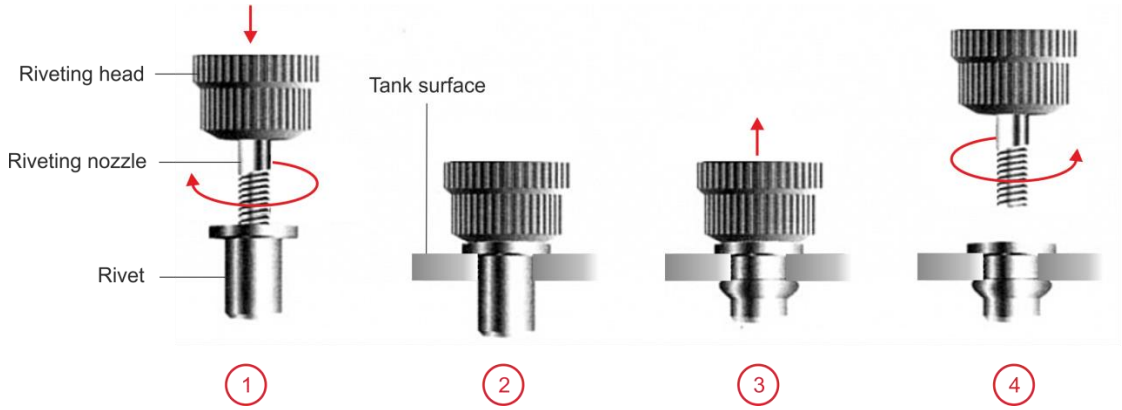
3) Put rubber gasket and fastening plate over prepared holes, fix them with screws and threaded rivets of with self-tapping screws from MK DUT-E mounting kit (see figure 12).



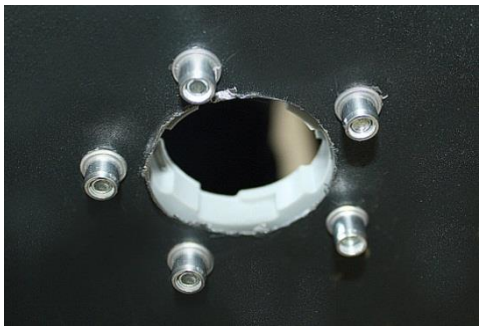
* Recommend for installation of sensor in fuel tank with thin walls (**less than 2 mm**).

Figure 12 — Mounting plate fastening

When using threaded rivets, they should be mounted using riveter and according to figure 13.



a) threaded rivets procedure of installation



b) installed fastening plate view of from inside of tank

Figure 13 — Threaded rivets usage for sensor installation

ATTENTION: When fixing the mounting plate to the tank, make sure that the bolt or screw heads are not skewed and completely sunk in the plate in order to provide **electrical isolation** between the tank and DUT-E AF.

2.2.3 Probe cutting according to tank depth

ATTENTION: It is allowed to cut the measuring probe of DUT-E AF **to any length needed**.

Sequence of operations during cutting the measuring probe of DUT-E AF:

1) Measure the depth of the tank from mounting plate to the bottom.

IMPORTANT: It is **required to leave a 20…30 mm gap** between the edge of the measuring probe and the tank bottom to:

- provide at least 10 mm operation area for bottom spring stopper (if the bottom spring is fixed in full loading position the bayonet mounting plate can get damaged);
- avoid the short circuit of the measuring probe tubes with conductive mud or water at the tank bottom.

2) Cut off DUT-E AF probe so that the edge of the probe is in 25 mm above the bottom of the tank.

Figure 14 — DUT-E AF measuring probe cutting and flushing the cut with fuel

RECOMMENDATION: Cut DUT-E AF probe with a metal hacksaw. Carefully clean the edge and wash the tubes with clean fuel (see figure 14).

3) After cutting DUT-E AF, the sensor calibration is obligatory (see 2.6).

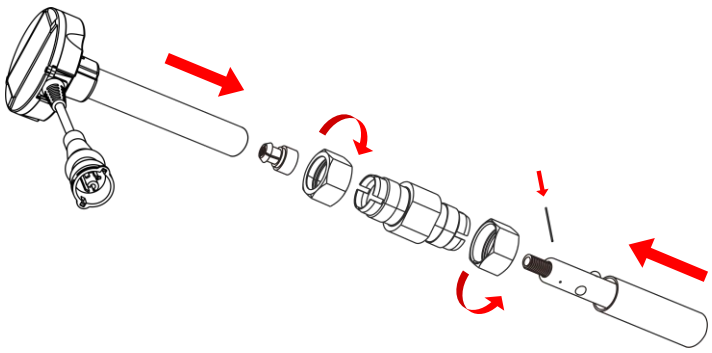
2.2.4 Length extension

ATTENTION: It is allowed to extend the length of DUT-E AF up to **6000 mm**.

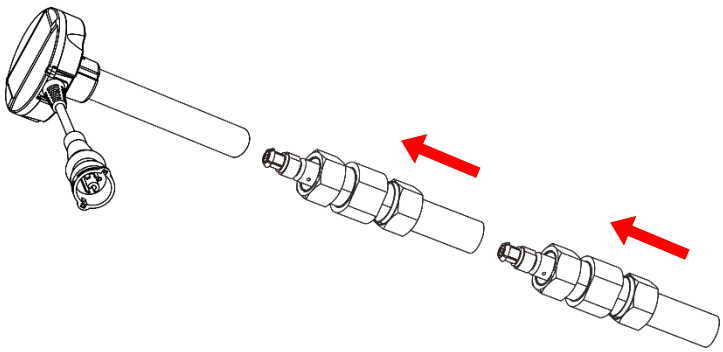
Length extension option significantly decreases expenses on storage and transportation. The sensor length is extended by means of attachment of additional sections of DUT-E to its measuring probe (see figure 15 and DUT-E Length extension with KDC video).

Model range of additional sections includes: **KDC 250**, **KDC 500** and **KDC 1000** (lengths of 250, 500 and 1000 mm respectively).

a) exterior view



b) fastening order



c) fastening order of two sections

Figure 15 — Additional section DUT-E

In case you fix additional sections, the force moment of tightening the threaded connection of the internal tube must be **10 N/m**, and that of the external tube must be **40 N/m**.

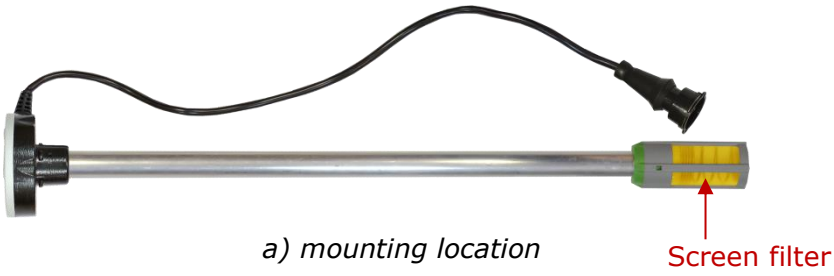
Additional sections can be cut to necessary size. Follow instructions of clause 2.2.3 when cutting the sections.

After length extension of DUT-E AF, the sensor calibration is obligatory (see 2.6).

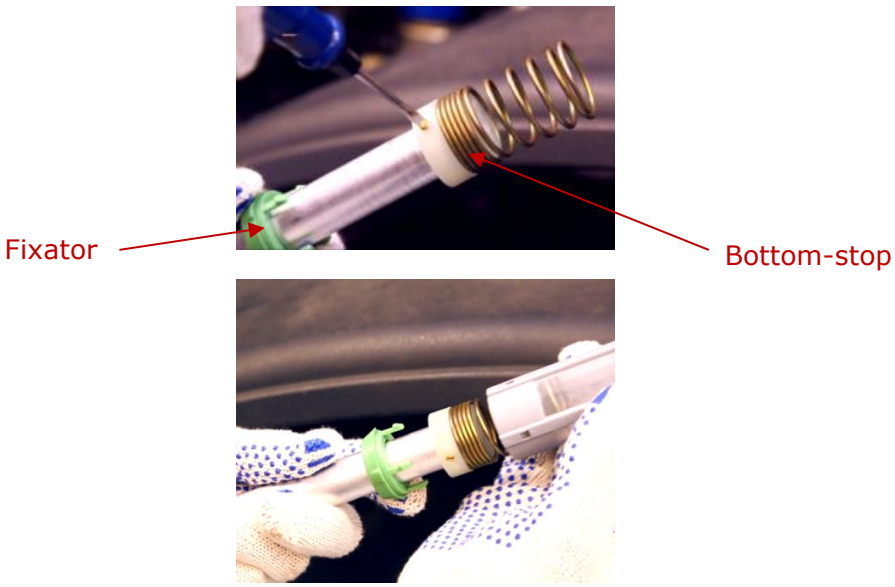
2.2.5 Mounting a screen filter and fixing the sensor

Before fixing DUT-E AF, put the **screen filter** (purchased separately) at the end of the sensor measuring probe (see figure 16 a); it serves to protect the measuring probe electrodes from water and dirt. Using the screen filter allows to increase considerably the sensor non–failure service life (see the video Screen filter of a fuel level sensor).

The screen filter is fixed in accordance with sequence of operations shown in figure 16 b. First, a fixing element is put on the measuring probe. Then, the bottom stop is mounted and fixed with two screws on the side. The screen filter is put over the bottom stop and fixed with locks of the fixing element.



a) mounting location



b) mounting order

Figure 16 — Mounting a screen filter

ATTENTION: Screen filter cannot be used without installed bottom spring stop.

To fix DUT-E AF place the sealing ring into the groove of the mounting plate and put the sensor measuring probe, with the screen filter mounted, down into the hole. Then, press the sensor "head" and fix it by turning it clockwise (see figure 17).

RECOMMENDATION: It is recommended to put some oil or fuel on the sealing ring of the mounting plate to prevent its deformation during DUT-E AF mounting.

The mounting should be carried out so that both sensor and mounting plate sealing holes would match one another after locking the DUT-E AF.

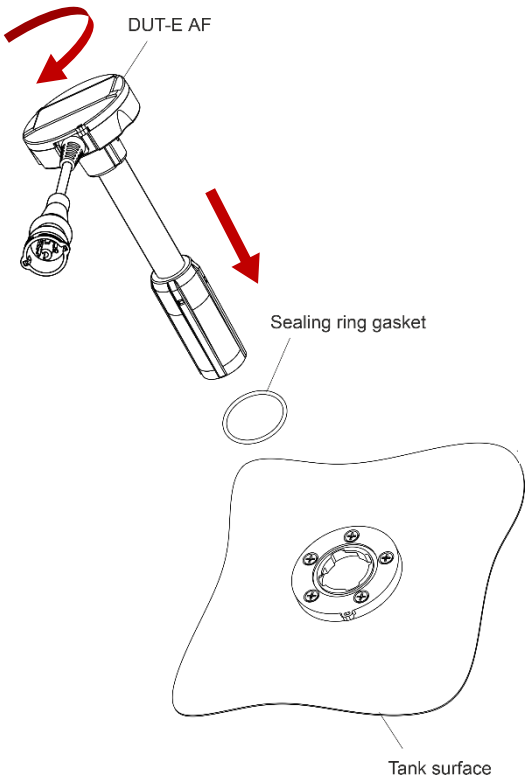


Figure 17 — DUT-E AF mounting order

2.3 Sensor configuration by means of cable connection to the PC

DUT-E AF setup is conducted via K-Line service interface (ISO 14230) using S6 SK service adapter which is to be purchased separately. To conduct the setup, connect the sensor to the personal computer (further on PC) using the service adapter.

ATTENTION: To avoid any service adapter faults in communication between PC and DUT-E AF make sure there are no sources of electromagnetic interference close to the workplace (running electric motors, welding equipment, high-power transformers, power lines, etc.).

Before starting with service adapter, it is necessary to download software from https://jv-technoton.com/ (Section Software/Firmware) and install it to PC:

- USB driver;
- Service S6 DUT-E software (not lower than version 6.05).

Note — Installation file of software has the view as: ServiceS6_DUT-E_X_X_Setup.exe. X_X corresponds to the version of software.

ATTENTION: For work with Service S6 DUT-E software, you need a separate PC (desktop or laptop) on which **only** Technoton service software meeting the following minimal requirements is installed:
- Windows 7/10 operating system, bit depth - X32/X64;
- CPU — Intel Core i3, dual-core, 2.0 GHz;
- RAM — 4 Gb;
- availability of port USB 2.0;
- display definition 1366x768.

S6 SK description can be found in CAN j1939/S6 Telematics interface Operation Manual.

See annex B for DUT-E AF settings, displayed and/or made by Service S6 software.

2.3.1 Connecting sensor to PC

ATTENTION: Prior to connecting DUT-E AF to a PC, it is necessary to turn off electrical circuits of the Vehicle*. To do this, use the battery switch or remove the battery terminals.

Before starting to use service adapter, have a closer look on its elements to detect defects which can occur while service adapter was transported, stored or handled carelessly.

Avoid the following when connecting service adapter to DUT-E AF, mounted into the tank of the Vehicle:

- ingress of fuel and lubricants and moisture to the contact pins of adapter slots or connectors of service cables;
- potential damage of the adapter and cables by the rotating and heating elements of the engine.

* When configuring DUT-E AF installed on Vehicle.

DUT-E AF is connected to PC according to the connection scheme (see figure 18) in the following order:

1) Connect the adapter to sensor:

- The connector of the service adapter is to be connected to the sensor interface cable connector by means of the plug connector which is contained in the S6 SK supplied accessories kit.
  Note — During DUT-E AF configuration you need to provide power supply for the sensor and the adapter from the battery or from a power source. Power is supplied through one of the free input connectors of the connector or via power supply wires of the adapter service cable.

2) Plug the adapter to USB port of PC with the USB cable.
Note – it is allowed to connect adapter to USB-port of your PC after turning on power supply of sensor and running Service S6 DUT-E software.

3) Connect power supply and ground wires to vehicle electrical system or battery.

4) Power on the vehicle (battery).

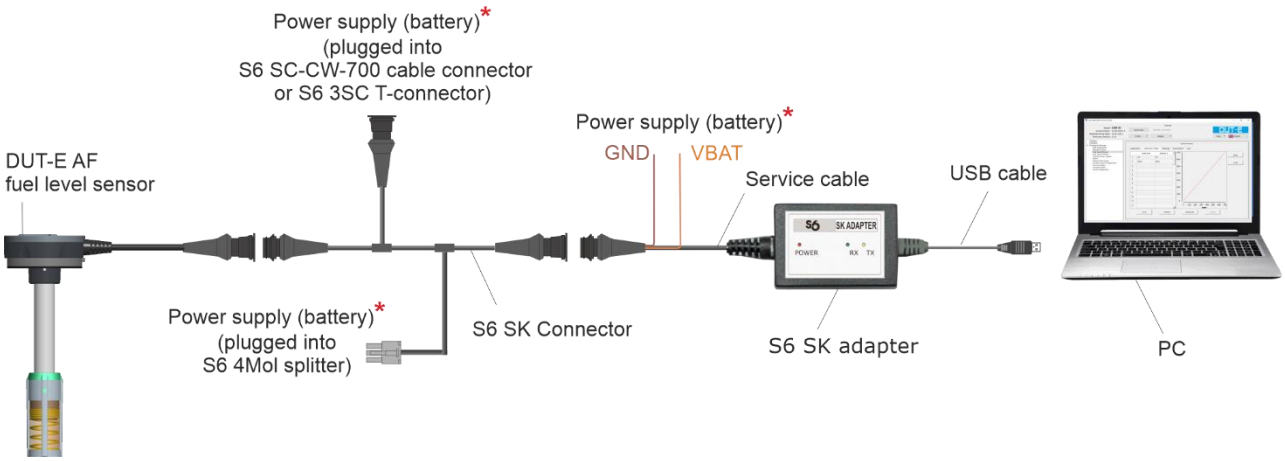
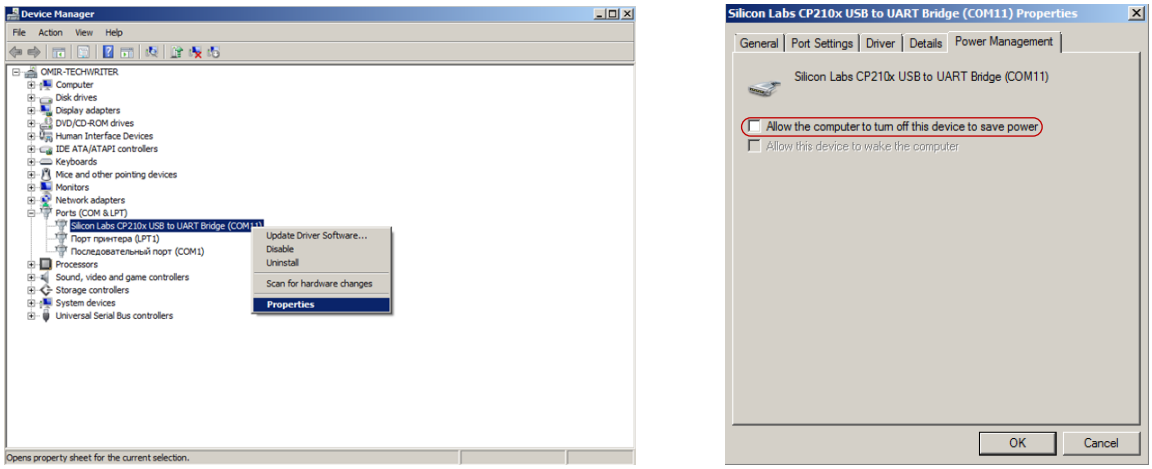


Figure 18 — Scheme of DUT-E AF connection to PC using S6 SK

* For connecting power supply (battery) you can choose any of marked places.

Windows automatically detects adapter connected to PC's USB port as USB device and enables virtual COM port driver for it. The virtual COM port will be displayed in the list of ports of Windows Device manager (see figure 19).

ATENTION: It is recommended to untick power save check box for Service S6 DUT-E in the virtual COM-port properties for energy safety purpose (see figure 19 b).



a) selecting port properties *b) disabling power save option*

Figure 19 — Setting up a virtual COM-port in the Device Manager

Service adapter is ready to use since the power is on. See table 3 for signal description of LED indicators located on the adapter.

Table 3 – S6 SK adapter LED signals description

LED Indicator			Signal description
Marking	**Status**	**Light color**	
POWER		Red	Power supply is on
	No signal		Power supply is off (or voltage is less than minimum required)
RX		Green	DUT-E AF data is being received
	No signal		No data from DUT-E AF
TX		Yellow	Data is being transmitted to DUT-E AF
	No signal		No data to DUT-E AF

2.3.2 Interface of Service S6 DUT-E software

Service S6 DUT-E software is launched with  desktop shortcut created during installation. Software interface consists of **Horizontal menu**, **Vertical menu, Sensor ID area** and **Information and Configuration area** (see figure 20).

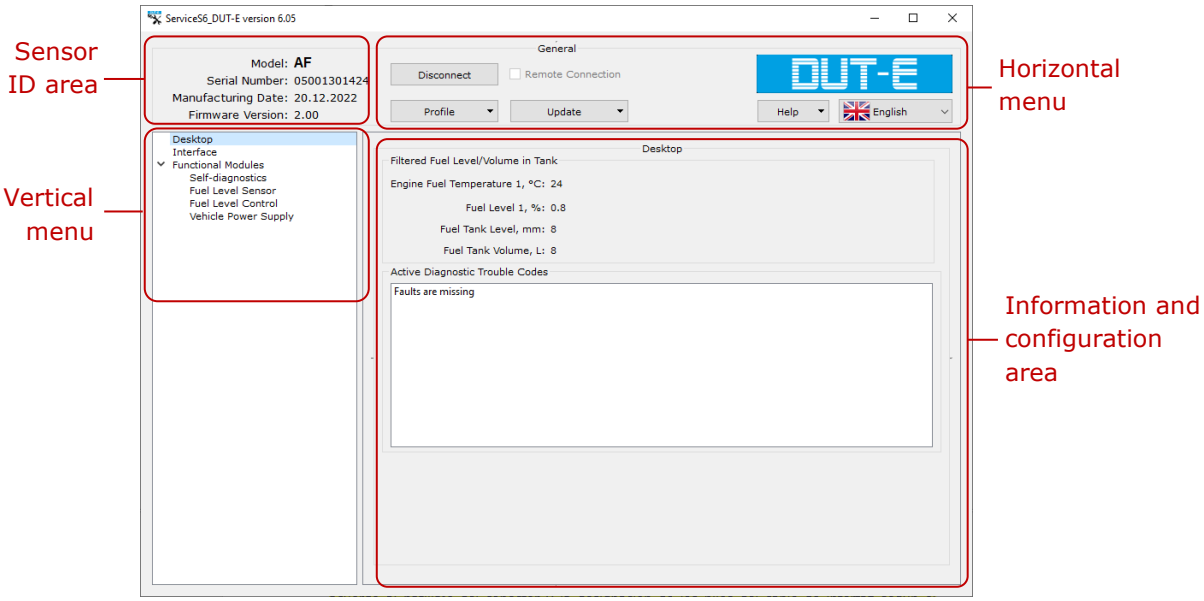


Figure 20 — Interface of Service S6 DUT-E

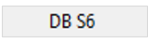
ATTENTION: At lower screen resolutions (less than 1024x768) Service S6 DUT-E window is automatically set to full screen. In this case scroll bars are used to display unseen areas.

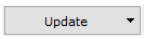
Sensor ID area provides information about the model, serial number, manufacturing date and firmware version of the connected sensor.

Horizontal menu provides the following:

- sensor is connected/disconnected;
- profile options (loading profile, saving profile, and printing profile);
- firmware update;
- update of S6 Database in the service software (in case there is access to Internet on the PC);
- selection of interface language;
- help and information about the manufacturer.

Vertical menu is used for selection of Function modules of DUT-E AF. Its current parameters and configuration are displayed in **Configuration and Information area**. Function modules of Service S6 DUT-E software are based on PGN and SPN messages from **S6 Database** (see annex B).

To update S6 Database in Service S6 DUT-E service software, press 

button in the dropdown menu 

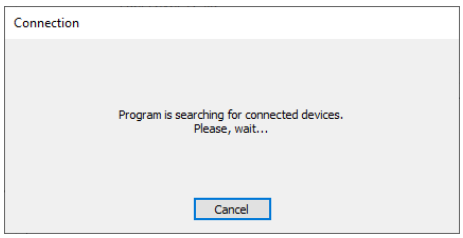
. The detailed description of S6 Database (further on — BD S6) can be found at http://s6.jv-technoton.com/ in S6 Data base section.

Information and Configuration area displays names (PGN) and parameters (SPN) of the messages. Each SPN holds the following: data range, discretion, measuring units.

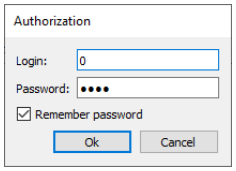
2.3.3 Authorization

To enable connection between DUT-E AF and PC, click the button Connect in **Horizontal menu**. Service S6 DUT-E software will search for the connected sensors (see figure 21 a).

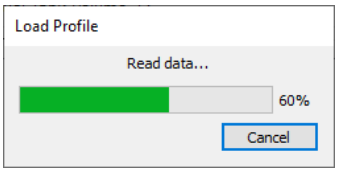
Enter Login and Password of the sensor into the appropriate fields of **Autorization** window. The default Login is **0**. The default password is **1111**. To save a new Password (to avoid entering the password again during connection next time), tick **Remember Password** (see figure 21 c).



a) search for the connected sensors to PC



b) user authorization



c) reading data from the sensor during the profile loading

Figure 21 — Enable connection between the sensor and PC

To recover the password (in case it is lost), you need to place the cursor into the **Login** or the **Password** field of the window **Authorisation** and press **Ctrl+F10** key combination.

Service S6 DUT-E Software will display a code to recover the current password of the Unit (see figure 22). This message is being sent to Technoton technical department by e-mail support@jv-technoton.com Together with password recovery request.

Requirements for DUT-E AF password request:

- scan copy of the request signed and selaed by the official representative of the company the sensor been purchased by should be attached;
- request should contain serial number and manufacturer date of the sensor;
- email should contain full name and contact e-mail of a person who should receive the recovered password.

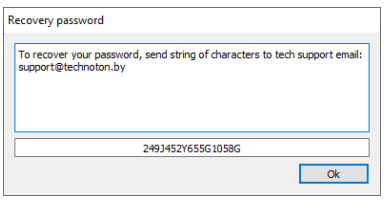


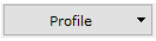
Figure 22 — Generating password recovery code

In case of incorrect Login and Password or incorrect connection to PC the warning error message will appear.

If Authorization is made successfully, then **Desktop** will appear automatically when you run the software (see figure 20). **Desktop** contains configuration and current parameters of Function modules of the connected sensor DUT-E AF (see annex B).

2.3.4 Operations with the sensor profile

Sensor **profile** is set of PGN (passport data, Counters and settings of Function modules of DUT-E AF).

It is possible to manage the profiles in both the sensor DUT-E AF connected and autonomous mode. The button 

with drop down menu is used to choose the options (see figure 23). The profile can be either saved as file on the PC disc, or loaded into the sensor memory, or, if necessary, printed or saved in pdf file.

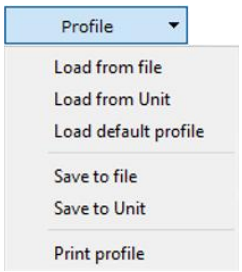
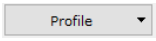


Figure 23 — View of Profile menu

Menu 

is divided into the following sections:

1) Load profile. The following options of profile loading are available in Service S6 DUT-E software:

- Load from file — for loading of previously saved DUT-E AF profile from the hard drive or removable disk. It is required to find and choose profile file in the appeared Open window (**DUT-E_*.prf**).
- Load from Unit — is used for loading profile from the connected sensor DUT-E AF.
- Load default profile — is used for loading profile with default factory settings. With this profile, it is possible to study utility operation without real DUT-E AF connection.
  By default, the profile is recorded in the file **DUT-E_AF_default.prf**, which is stored on the PC disk in one folder together with the software start-up file ServiceS6_DUT-E.exe.

ATTENTION: In autonomous mode only default profile or previously saved profile is available for loading.

2) Saving profile. Service S6 DUT-E has following profile saving options:

- Save to file — for saving profile to the hard drive or removable disk. This option is available only for profile loaded from file or sensor.
  Select the location and give the name to file according to format **DUT-E_*.prf**. Insert the name instead of *. Prefix **DUT-E_** and format **.prf** will be inserted automatically.
- Save to unit — is used for saving modified settings into profile of the connected sensor. It is available only during the time when there an active connection between PC and DUT-E AF.

If the modified settings were not saved into sensor and Disconnect button was pressed or Service S6 DUT-E is being closed there will appear a notification on profile settings saving. Pressing Yes will save all the unsaved parameters and settings DUT-E AF.

3) Print Profile. Profile file can be saved on a PC disk in **.pdf** format for later printing or viewing on the display. File name automatically generates DUT-E AF serial number and date when file was created.

RECOMMENDATION: It is recommended to attach the hardcopy of the profile to DUT-E AF specification to log the history of the settings and configurations.

2.4 Wireless configuration of sensor using Android devices

Wireless setup of DUT-E AF is conducted by means of its connection via Bluetooth to the smartphone/tablet based on the Android operating system (further on Android device) using S6 BT Adapter which is to be purchased separately.

ATTENTION:
1) To eliminate connection failures between the Unit and the Android device, you need to make sure that there are no sources of electromagnetic interference near your working place (radio telephones, video signal transmission units and other wireless devices operating within 2.4 or 5.0 GHz frequency bands, as well as running electric motors, powerful transformers and switching equipment, welding equipment, high-voltage lines etc.).
2) The maximum allowed distance between the S6 BT Adapter and the Android device depends on the quality of the Bluetooth connection of the Android device. To assure the stable data transmission, it is recommended that this distance should not exceed 10 m.

Before using S6 BT Adapter, please, download Service S6 DUT-E (Android) service mobile application (further on application) to the Android device from Google Play (search request "Technoton").

A description of S6 BT Adapter and the installation procedure for application are provided in the CAN j1939/S6 Telematics Interface Operation Manual CAN j1939/S6.

Please, see in annex B configurations of DUT-E AF that may be displayed and/or edited using application.

2.4.1 Wireless connection of the sensor to the Android device

ATTENTION: Prior to connecting DUT-E AF to the Android device, it is necessary to turn off electrical circuits of the Vehicle*. To do this, use the battery switch or remove the battery terminals.

Before starting to use service adapter, have a closer look on its elements to detect defects which can occur while service adapter was transported, stored or handled carelessly.

Avoid the following when connecting service adapter to DUT-E AF, mounted into the tank of the Vehicle:

- ingress of fuel and lubricants and moisture to the contact pins of adapter slots or connectors of service cables;
- potential damage of the adapter and cables by the rotating and heating elements of the engine.

* When configuring DUT-E AF installed on Vehicle.

The procedure for DUT-E AF wireless connection to the Android device (see figure 24) is as follows:

1) Connect the corresponding connector of the service cable to the connector of **S6** adapter.

2) Connect the service cable with the adapter to the interface cable connector of DUT-E AF sensor.
Note — During the wireless configuration of DUT-E AF you need to provide power supply for the sensor and the adapter either from the accumulator battery or from the power source. Power supply is provided through any of the free connectors of the connection.

3) Connect power supply and ground wires to Vehicle electrical system or battery.

4) Power on the vehicle (battery).

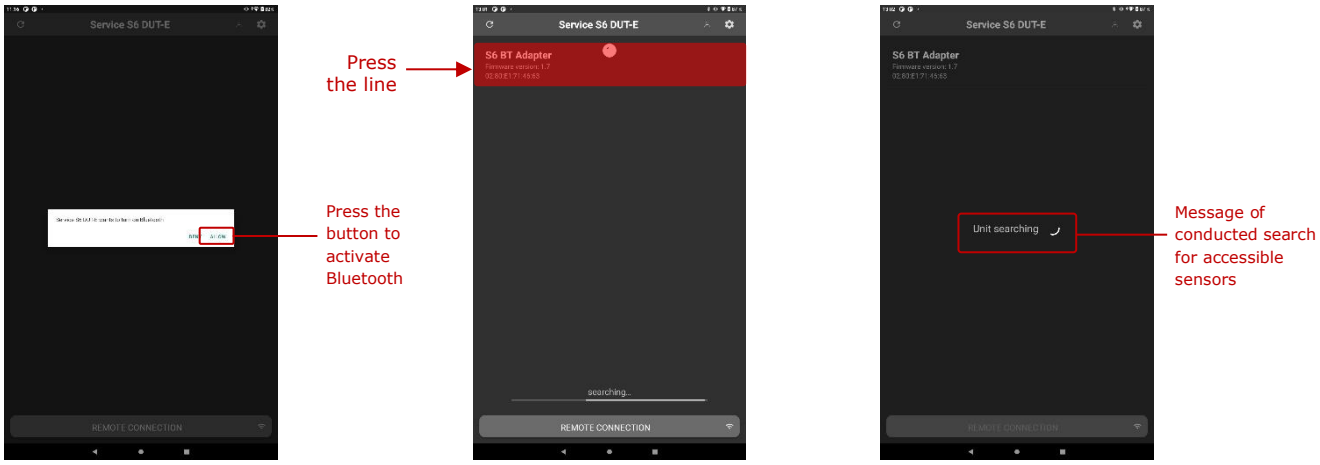
After the power supply is on, the green LED indicator **POWER** is lit. You will also see a blue blinking light of the **BT** LED indicator which means that S6 BT Adapter is available for connection with Android devices via the Bluetooth channel.

Figure 24 — Scheme of wireless connection of DUT-E AF to Android-based device using S6 BT Adapter

* For connecting power supply (battery) you can choose any of marked places.

Start application from the main menu of the Android device with  icon which is created in the process of its installation.

S6 BT Adapter is ready for operation from the moment the power supply is on. If the S6 BT Adapter is connected correctly, after its initiation application will offer to allow the activation of Bluetooth. After Bluetooth activation, the adapter which is accessible for wireless connection will be displayed on the screen of the Android device; its firmware version and MAC address will also be displayed. Press the line **S6 BT Adapter**, to establish its connection with the Android device (see figure 25).



a) offer to allow Bluetooth connection *b) adapter selection from the list of accessible devices* *c) detection of accessible Units with the help of the adapter*

Figure 25 — Example of establishing a wireless connection between DUT-E AF and Android device

During the operation of S6 BT Adapter signals of LED indicators should comply with those indicated in table 4.

Table 4 – S6 BT Adapter LED-indicators' signal description

LED Indicator			Signal description
Marking	**Status**	**Light color**	
POWER		Green	Power supply is on
	No signal		Power off or power supply voltage is too low
K-Line		Red	Receiving data via K-Line interface
	No signal		Data are not received over K-Line interface
BT		Blue	S6 BT Adapter is initialized, but no connection with Andorid-based device (indicator is blinking each 1 s)
			Connection with S6 BT Adapter is established (blinking each 0.5 s)
			S6 BT Adapter is sending data over Bluetooth (blinking each 0.25 s)
	No signal		S6 BT Adapter is not initialized

2.4.2 Interface of application

The interface of application consists of **Information and Configuration Area** and **Tools Panel** (see figure 26).

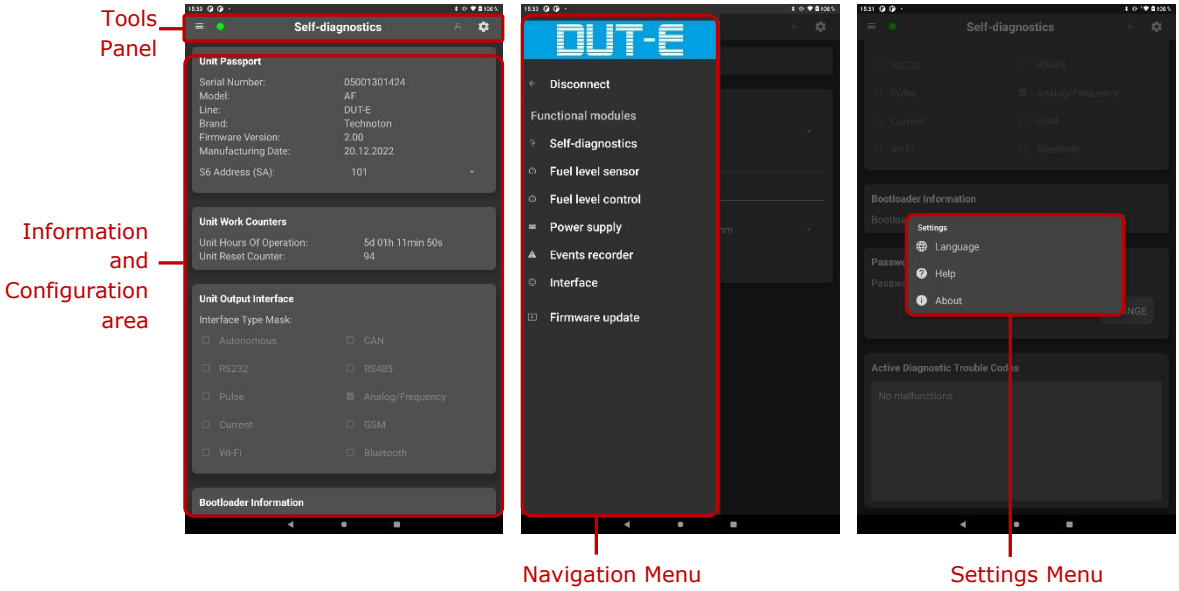


Figure 26 — Interface of Service S6 DUT-E service mobile application

In the **Information and Configuration** area current parameters and settings of the sensor Functional modules (FM) are displayed.

In the **Tools Panel** area there are the following elements for use during work with application:

- button to display the **Settings Menu** (selection of the interface language, help and software information);
- button to select operations with the sensor profile;
- name of the sensor FM which is configured;
- indicator of connection/disconnection with the sensor (green light — connected, red light — disconnected);
- icon to display the **Navigation Menu** (sensor disconnection from the Android device, selection of FM to be configured, settings of connection to external devices, sensor calibration, creation of the calibration table, diagnostics of malfunctions, configuration of indications summation, monitoring of Parameters, Counters, firmware update etc.).

During its work with the FM DUT-E AF, the application employs data (PGN and SPN) from S6 Database. The list of FM with SPN which are displayed and/or edited in the area **Information and settings** is provided in annex B.

2.4.3 Authorization

To establish a session of wireless connection between DUT-E AF and the Android device, establish connection with **S6 BT Adapter**. The application will automatically detect accessible sensors (see figure 25).

Enter the sensor password into the appropriate boxes of the **Authorisation** window. The password by default is **1111**. To save the password entered (to exclude its entering manually another time during the next session of work with the sensor), checkmark the box **Remember Password** (see figure 27).

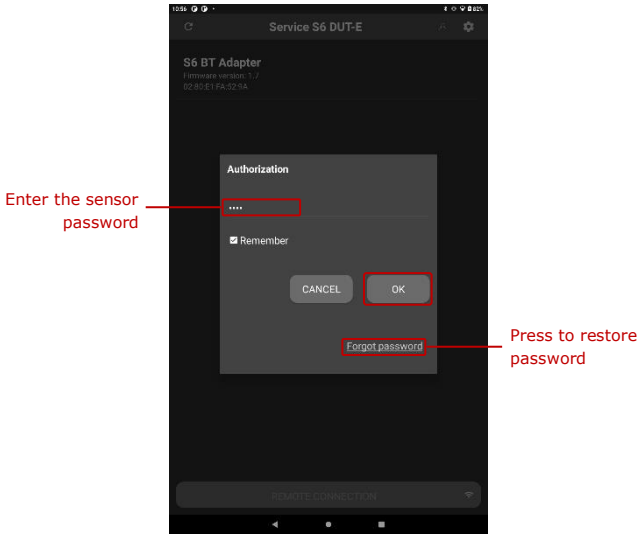


Figure 27 — Establishing a wireless communication session between DUT-E AF and the Android device

In case of incorrect entering the password or incorrect connection to the Android device, an error message will appear.

If the user authorisation has been conducted successfully, the loading of the of the connected DUT-E AF profile will start.

To restore the Unit password (in case it is lost), press the link **Forgot password**.

Application will provide a code to restore the password (see figure 28). This message is being sent to Technoton technical department by e-mail support@jv-technoton.com together with password recovery request.

Requirements for password recovery request:

- scan copy of the request signed and sealed by the official representative of the company the sensor been purchased by should be attached;
- request should contain serial number of the sensor;
- email should contain full name and contact e-mail of a person who should receive the recovered password.

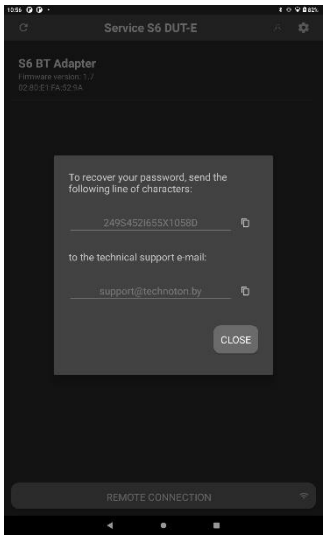


Figure 28 — Generated recovery code window

2.4.4 Operations with the sensor profile

Sensor **profile** is set of PGN (passport data, Counters and settings of Function modules of DUT-E AF).

ATTENTION: Any operations with the DUT-E AF profile in the service mobile application are possible only during a wireless connection session between the sensor and the Android device. If there is a need to edit the profile in the off-line mode, connect DUT-E AF to the PC using S6 SK and proceed in accordance with 2.3.4.

To perform any operations with the DUT-E AF profile, the menu **Profile** is used which is opened by pressing the appropriate button on the **Tools Panel** (see figure 29).

The **Profile** menu contains the following options for operations with the sensor profile:

- Load from file — is used to load the profile saved in the memory of the Android device before. In the window where the file is to be loaded you need to find and select the profile file (**DUT-E_*.prf**).
- Save to file — is used to save the changed settings of the profile in the Android device memory;
- Load from Unit — is used to load the profile from the sensor connected to the Android device;
- Save to Unit — is used to save the changed settings of the profile in the memory of the connected sensor.
- Load default profile — is used to load the profile with standard factory settings. By default, the profile is recorded in the file **DUT-E_AF_default.prf** which is stored in the memory of the Android device.
- Print profile — is used for the profile printout in pdf file.

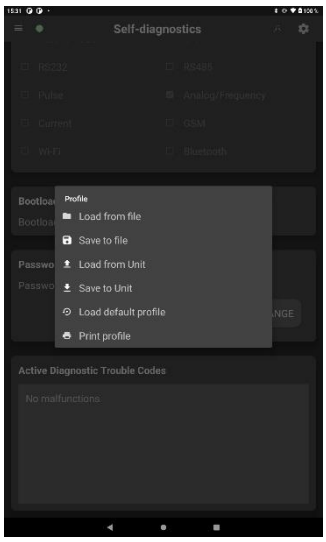


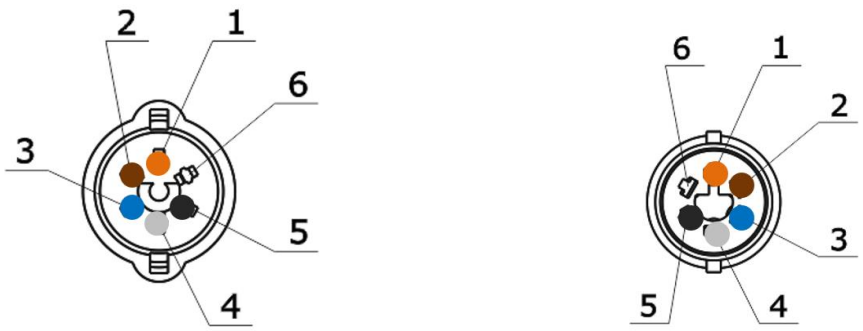
Figure 29 — View of Profile menu

2.5 Electrical connection

ATTENTION:
1) To ensure proper operation of DUT-E AF, it should be electrically connected by specialist, who finished official technical training and was certified for that.
2) When installing DUT-E AF it is obligatory to follow safety rules on carrying out repair works applicable to the machinery being equipped.

DUT-E AF is powered from the Vehicle onboard circuit.
In order to electrically connect the sensor, use **S6 SC-CW-700-RS (7.0 m) signal cable** (see the delivery set), in accordance with the pinout and designation of the connectors' contacts of the sensor interface cable and contacts of the signal cable connectors (see figure 30 and table 5).

IMPORTANT
1) Before mounting and connecting DUT-E AF switch off power supply of the vehicle electrical circuits. To do this switch off the battery switch or release the terminals of the wires connected to the battery.
2) Prior to electrical connection of the sensor pay special attention to checking Vehicle chassis ground. Resistance between any point of vehicle chassis and "-" terminal of the battery or between terminals of the chassis ground switch should not exceed 1 Ohm.
3) When connecting DUT-E AF to onboard electrical network of Vehicle, use **fuses** from delivery set in accordance to scheme of connection (see figure 31). Nominal fuse current is not more than 2 A.
4) Quick splice connectors (ordered separately) are recommended for electrical connection of signal cable wires (see figure 32).
5) It is **strongly recommended** to lay signal cable together with standard electrical Vehicle wiring with mandatory cable ties fixing of every 50 cm, at a positive ambient temperature (see figure 33).



a) DUT-E AF interface cable *b) S6 SC-CW-700-RS signal cable*

Figure 30 — Connector pinout

Table 5 — DUT-E AF interface cable and S6 SC-CW-700-RS signal cable connectors assignment

Pin number	Wire marking	Wire color*		Assignment
1	VBAT	Orange		Power supply "+"
2	GND	Brown		Ground "-"
3	OUT	Blue		Reserve
4	OUT	White		Output signal, see 1.4.2
5	KLIN	Black		Service interface, K-Line (ISO 14230)
* Manufacturer reserves the right to modify wire colors, that is why pay attention to its marking.				

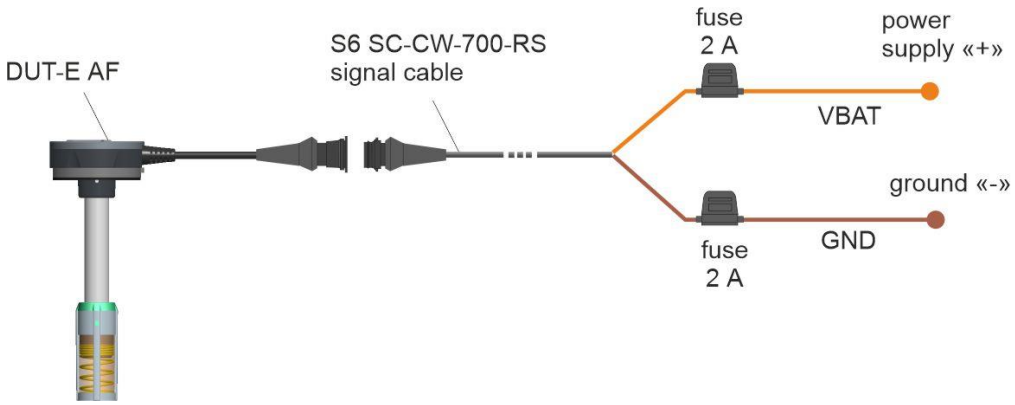


Figure 31 — DUT-E AF to onboard electrical network scheme of connection

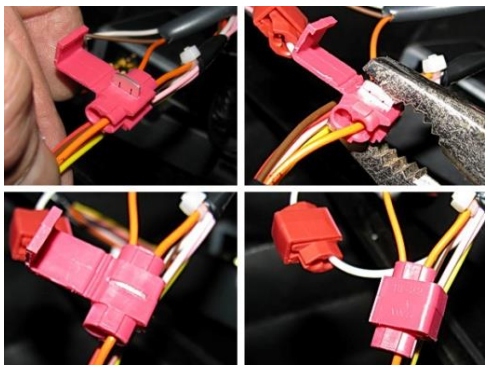


Figure 32 — Using connectors to connect wires of signal cable

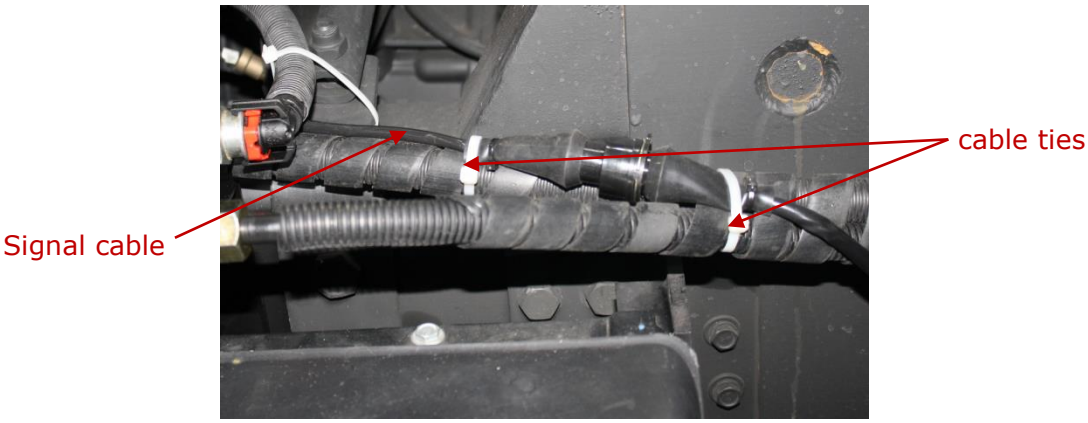


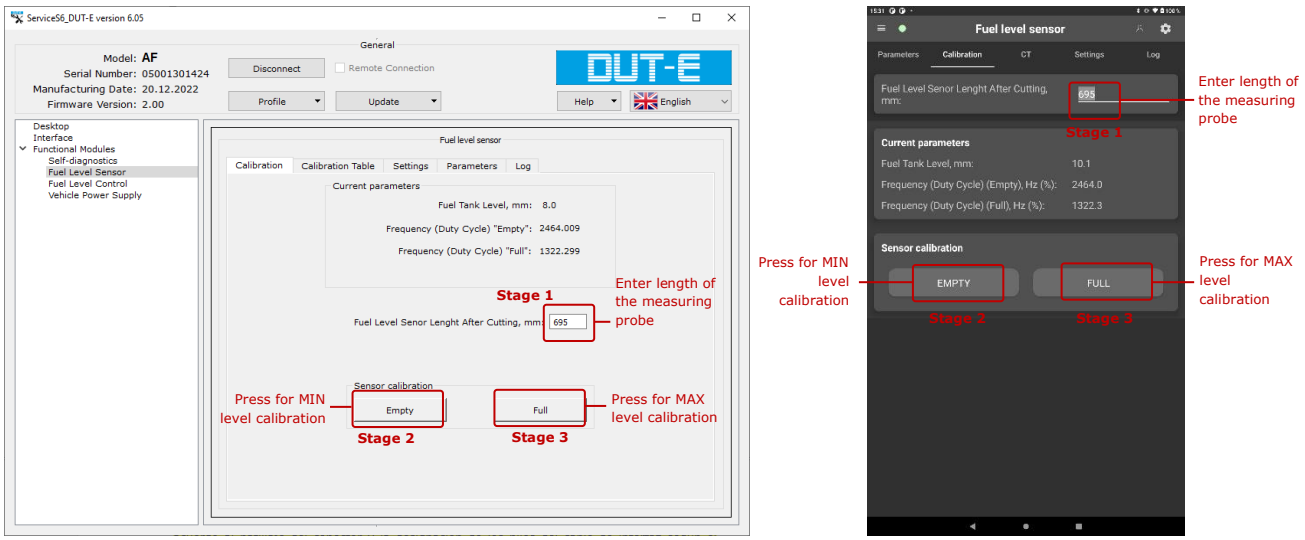
Figure 33 — Laying DUT-E AF signal cable

IMPORTANT: DUT-E AF body is electrically connected to Ground "-" (brown wire of the connection cable). Electrical isolation between the DUT-E AF body and the fuel tank is provided by the mounting plate made of dielectric plastic material.

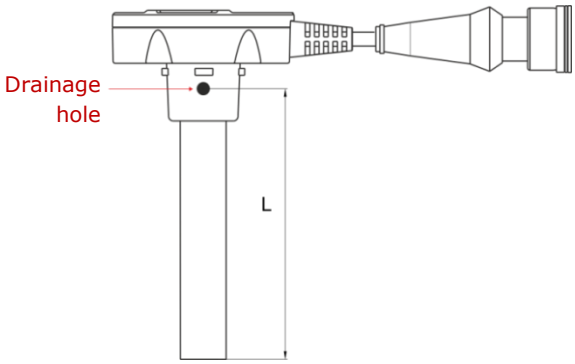
2.6 Sensor calibration

IMPORTANT:
1) Before installing DUT-E AF **in the tank, sensor calibration** for the specific fuel type is required!
2) Recalibration of the sensor is necessary **after cutting/extending** its measuring part.

Calibration is required for correct operation of DUT-E AF. In the process of calibration the minimal and maximal levels of the fuel measurement in the Vehicle tank are recorded into the memory of the sensor using Service S6 DUT-E service software or Service S6 DUT-E (Android) mobile application (Fuel Level Sensor FM, tab **Calibration**) (see figure 34).



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*



c) measuring probe length of sensor

Figure 34 — DUT-E AF sensor calibration

For DUT-E AF calibration make the following steps:

1) While using Service S6 DUT-E software, connect the sensor to the PC using S6 SK service adapter (see 2.3.1) and establish a communication session between DUT-E AF and PC (see 2.3.3).

In case of wireless sensor setting using Service S6 DUT-E (Android) application, connect DUT-E AF to the Android device using S6 BT Adapter (see 2.4.1). Establish the sensor connection with the Android device sensor via the Bluetooth channel (see 2.4.3).

2) Get the sensor out of the fuel tank and wait for (30…60) seconds so that all fuel run off the probe.

3) Measure sensor probe length **L** (mm) from ending of tubes to draining hole (see figure 34 c) and enter the measured value in **Fuel Level Sensor Length After Cutting, mm** field (Fuel level sensor FM submenu, **Calibration** or **Settings** tabs).

4) To calibrate minimum (lowest) point of level measurement, press **Empty** button.

ATTENTION: When calibrating sensor to minimum level, there should not be fuel residues on surface of tubes of probe.

5) Dip the probe's tubes with the additional electrode fully into the fuel. Wait for (3…5) seconds for sensor readings stabilization.

6) To calibrate maximum (highest) point of level measurement, press **Full** button.

7) Calibration is finished. Save profile to sensor's memory.

2.7 Fuel tank calibration table

DUT-E AF recalculates the measured value of fuel level into the fuel volume in the tank according to the calibration table. To create it, you need to conduct **the calibration procedure for a specific fuel tank** in which the sensor is mounted.

WARNINGS:
1) Without the calibration table recording into DUT-E AF internal memory, fuel volume readings in liters would be incorrect.
2) During summation of readings of several DUT-E AF, recording the calibration table into the internal memory of each sensor used is obligatory.

Calibration procedure is a sequence of fuel fillings by fixed portions from empty to full state of the fuel tank (see video Fuel level DUT-E installation).

IMPORTANT: To measure the volume of fuel portions it is necessary to use measuring reservoir with inaccuracy not more than **0.25 %**.

To make fuel tank calibration correctly, where the sensor is installed, it is required to follow the procedure:

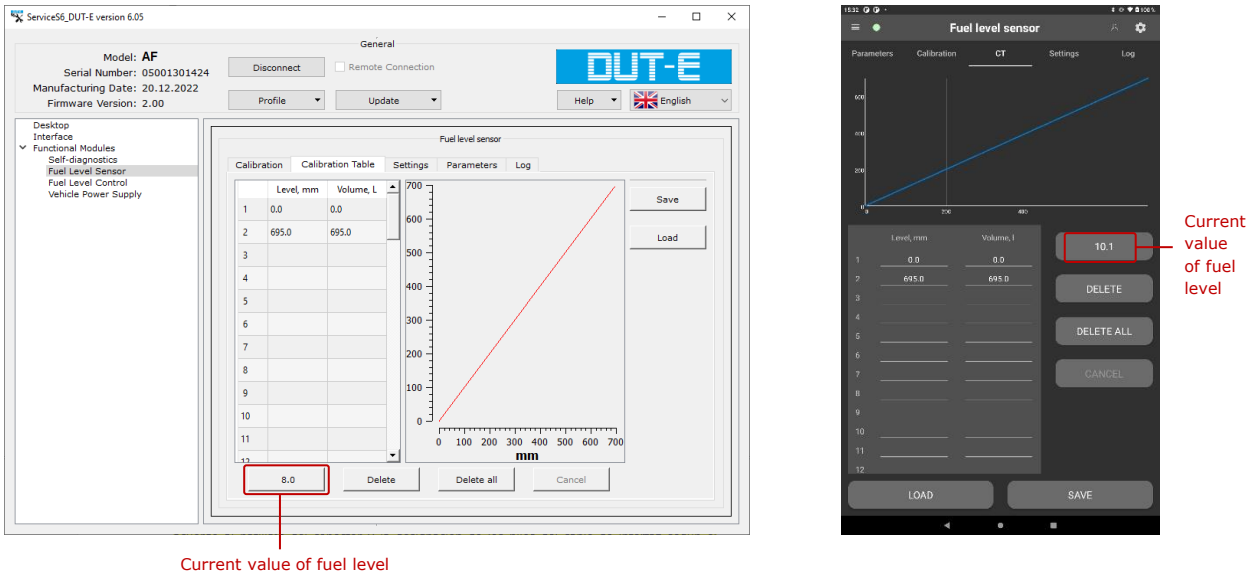
- vehicle being equipped should not be loaded and should be parked on even horizontal surface;
- fuel tank should be empty;
- vehicle's tires should by of standard size and type for this model (replacement of standard wheels by wheels of non-standard type and size after the calibration procedure is performed results in decreasing accuracy of measurement or another calibration is needed);
- pressure in tires should be within allowed range for this model;
- vehicle should not move, ignition is turned on, engine not running;
- between to consequent tank refilling operations, please, wait at least 60 seconds.

RECOMMENDATION: Tank calibration using DUT-E ATS automatic calibration station reduces the calibration error down to ±0,5 % of the tank volume; labor input and time needed for the tank calibration are reduced by 2…3 times (see DUT-E ATS Operation manual).

Calibration table is saved to internal memory of DUT-E AF using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile app (Fuel level sensor FM, **Calibration Table** or **CT** tab) (see figure 35).

To record the calibration table using Service S6 DUT-E service software, connect the sensor to the PC using S6 SK service adapter (see 2.3.1) and establish a communication session between DUT-E AF and PC (see 2.3.3).

In case of wireless sensor configuration using Service S6 DUT-E (Android) application, connect DUT-E AF to the Android device using S6 BT Adapter (see 2.4.1). Establish a connection between the sensor and the Android device via the Bluetooth channel (see 2.4.3).



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure 35 — Making fuel tank calibration table

The data is entered as a table of correspondence between measured fuel level value (**Fuel level (mm) field**) and fuel volume in the tank (**Volume (L) field**).

- Click **0.0** button to insert a new entry into the table. When refilling with new portion of fuel, every time this button will show the current value of fuel level in the tank. When clicking on this button, the value is automatically entered into the next field of the table **Level, mm**.

RECOMMENDATION: When creating the calibration table, we recommend to enter for its first point (0.0 mm level) the value of fuel volume which is equal to the fuel volume not used which is remaining in the tank. Because the end of the mounted sensor measuring probe is located 20…30 cm from the tank bottom, there are normally 10…30 l of fuel not used in the dead zone beyond the limit of monitoring.

- New entries are automatically sorted from low to high fuel level value. To delete an entry highlight it and click **Delete** button. Button **Delete all** is used for deleting all entries of calibration table.
- Clicking **Save** button will allow saving the table as a ***.ttr** file to PC disk or in the memory of the Android device.
- To load previously saved table from file click **Load** (for example, in case of replacement of fuel level sensor).
- Save profile to sensor's memory.

ATTENTION:

1) The number of calibration points is proportional to the measurement accuracy of fuel volume. The recommended number of calibration pints is **not less than 15**. The maximum possible number of calibration points in sensor is **60**.

2) The maximum possible fuel volume value that can be entered into the calibration table is limited by the value of **6553 l**.

3) When creating the calibration table for the tank of **6553 l** capacity and higher, we recommend **to divide by 10** fuel volume values in each calibration point. Each of these values has **to be multiplied by 10** respectively at the Server for their correct displaying (see detailed recommendations in annex E).

2.8 Adaptation of sensor to specific conditions of operation

Adaptation of DUT-E AF to specific conditions of operation is conducted using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (Fuel level sensor FM, tab **Settings**) (see figure 36).

While using Service S6 DUT-E software, connect the sensor to the PC using S6 SK service adapter (see 2.3.1) and establish a communication session between DUT-E AF and PC (see 2.3.3).

In case of wireless sensor setting using Service S6 DUT-E (Android) application, connect DUT-E AF to the Android device using S6 BT Adapter (see 2.4.1). Establish the sensor connection with the Android device sensor via the Bluetooth channel (see 2.4.3).

1) Function **Thermal correction** compensate the thermal expansion/contraction of the fuel.

ATTENTION: Thermal expansion/contraction of the fuel caused by the temperature deviation, alters the volume of fuel in the tank. As consequence, the sensor transmits a significant increase or decrease of fuel level to the tracking device.

Automatic thermal compensation is disabled by default. To enable it, tick the checkbox **On** in **Temperature correction** tab, then insert the required coefficient value into the field **Temperature correction Coefficient**, **%/°C**. To turn off the thermal compensation insert the coefficient value **0.0**, or untick the checkbox **On**.

Thermal correction coefficient $K_{ther.corr.}$ is defined, **when the feature of thermal correction is disabled**, according to formula (1):

$$K_{ther.corr.}=(-1)\cdot\frac{(V_{Tmax}-V_{Tmin})\cdot 100}{(T_{max}-T_{min})\cdot V_{Tmin}} \quad (1)$$

where T_{min} and T_{max} — respectively the minimum and the maximum measured values of fuel temperature in the tank during 24 hours;

V_{Tmin} and V_{Tmax} — measured values of fuel volume in the tank with minimum and maximum fuel temperature respectively.

IMPORTANT:

1) It is recommended to determine Values V_{Tmin}, V_{Tmax}, T_{min}, T_{max} by data on Server.

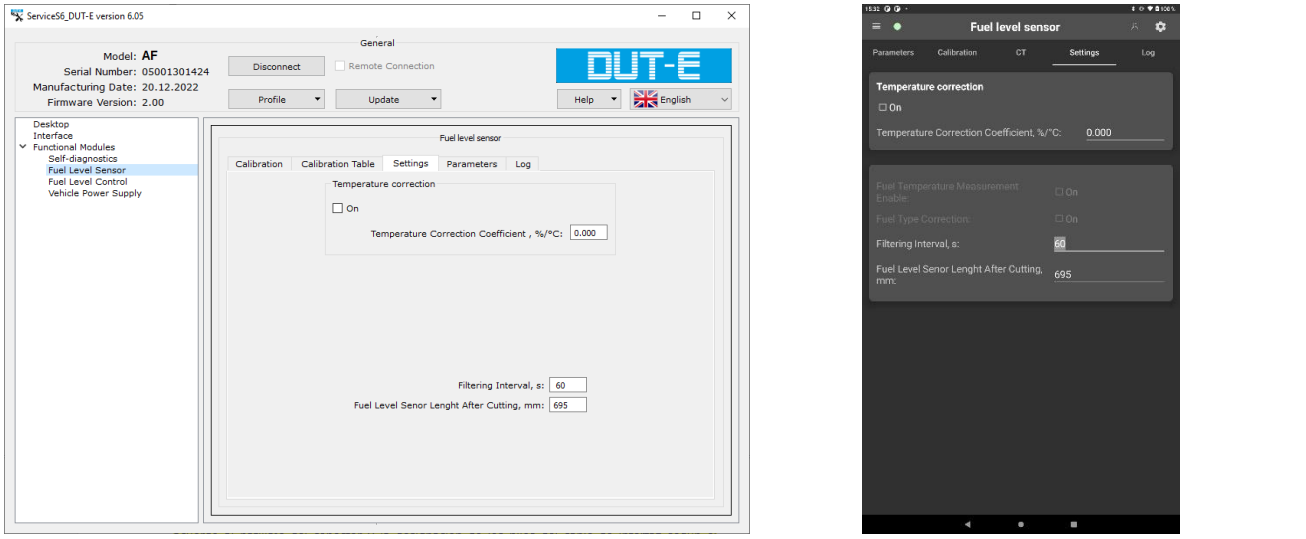
2) When measuring values V_{Tmin}, V_{Tmax}, T_{min}, T_{max} during 24 hours follow the requirements:

- thermal correction feature must be off in the sensor which is being configured;
- Vehicle is not moving with engine off.
- Ambient temperature should correspond to normal operating conditions of the Vehicle.
- Tank should be filled with fuel not less than 10 % of the total fuel volume.
- There should be the same fuel volume in the tank (refueling or draining is not allowed).

2) In the field **Filtering Interval, s** it is possible to set up time interval, preceding the data transmission, when fuel level value is smoothed during this interval. Parameter value range (by default it is 60 sec) is 0…300 with 1 s step.

ATTENTION: Filtered information of fuel level in the tank transmitted by DUT-E AF to Server is not instantaneous value. It is averaged value during some time interval. Filtration is important for DUT-E AF mounted on vehicles operated on hilly surfaces (because of intense fluctuation of fuel level).

Save profile to sensor's memory.



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure 36 — Configurations for specific operation conditions

2.9 Parameters of output connection

Output signal of DUT-E AF should be configured for proper connection to an external device. To do that, go to **Interface** submenu, **Analog Output Settings** area (Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application) and apply configurations in accordance to the requirements to parameters of input signal of connected external device (see figure 37):

1) From **Physical Output Type** dropdown list select necessary type of output signal:

- **Analog / Frequency** – output signal of DUT-E AF as per 1.4.2.

  During the output analog signal configuration you need to:

  - Signal Output Value (Min), V — from **(1.0…9.0) V** range, specify the value of voltage which corresponds to the lower limit of the input signal range of the device to be connected.

  - Signal Output Value (Max), V — from **(1.0…9.0) V** range, specify the value of voltage which corresponds to the upper limit of the input signal range of the device to be connected.

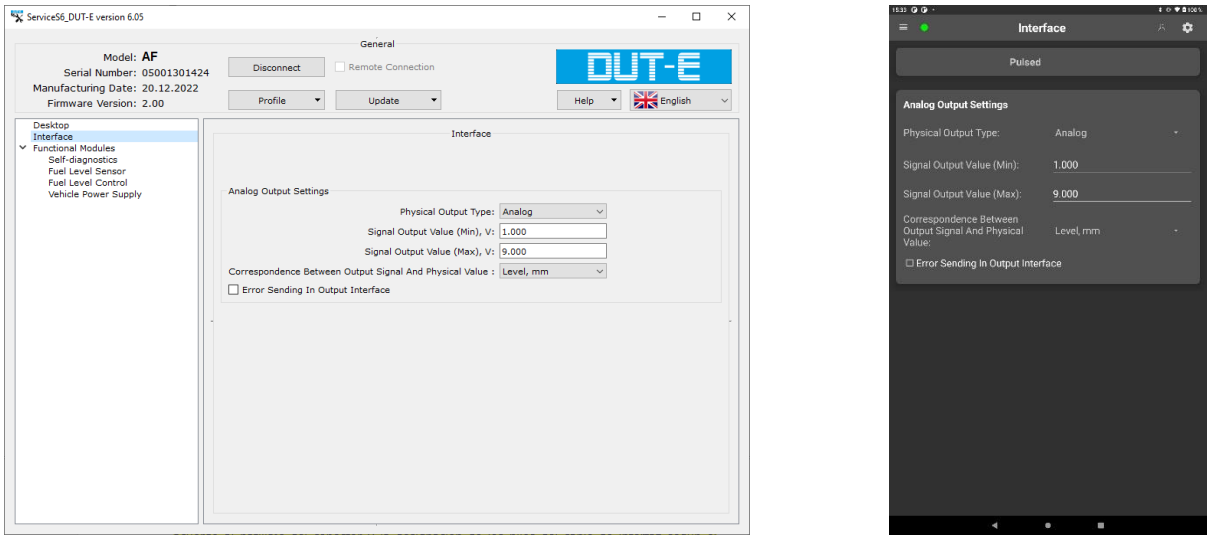
2) From **Correspondence Between Output Signal and Physical Value** dropdown list select necessary type of output data of sensor:

- **Level, mm** – output signal corresponds to fuel level in tank;
- **Volume, L** – output signal corresponds to fuel volume in tank.

IMPORTANT: Values of DUT-E AF output signal which correspond to the fuel volume in liters would be correct only in case the calibration table of the monitored tank is recorded in advance into the sensor internal memory.

3) In **Error Sending In Output Interface** field you can tick the box for turning on sensor diagnostics, which is carried out using special values of output signal:

- diagnostic states for voltage output signal:
  - **9.5 V** – short circuit of measuring probe's tubes;
  - **0.5 V** – sensor is not calibrated.
- diagnostic states for frequency output signal:
  - **1600 Hz** – short circuit of measuring probe's tubes;
  - **400 Hz** – sensor is not calibrated.



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

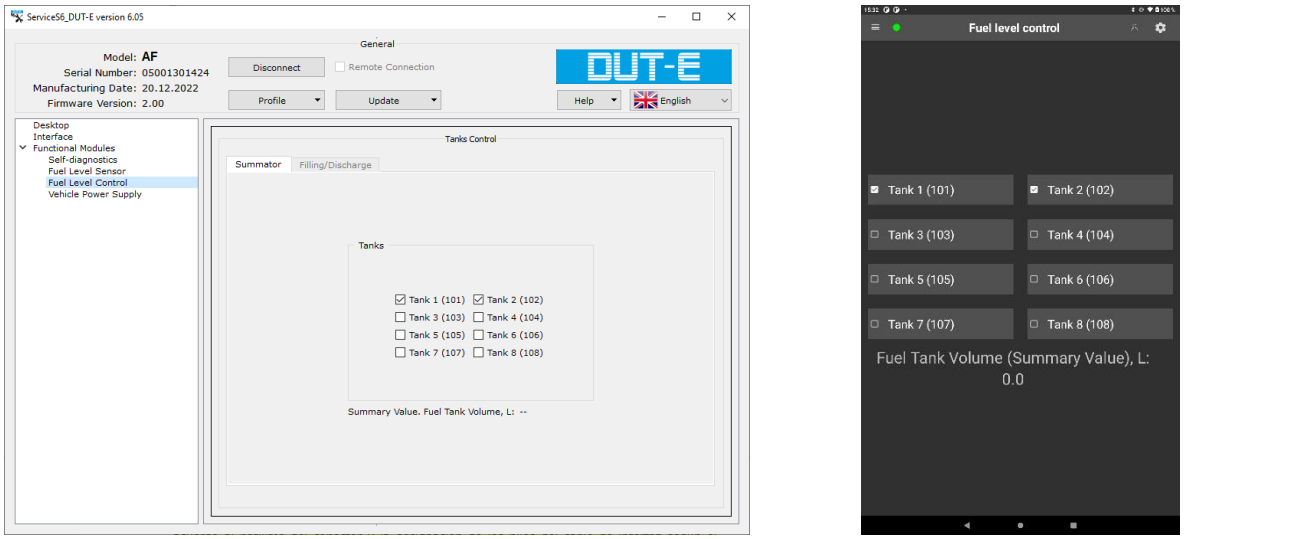
Figure 37 — Connection settings of output

2.10 Summation of data

Summation of values of fuel volume in tanks is activated in the settings of Fuel Level Control FM submenu using Service S6 DUT-E software or Service S6 DUT-E (Android) application.

For DUT-E AF which is to produce the summing signal (Master sensor), in the settings, you need to tick fields of all sensors whose readings need to be summed up (Slave sensors). After Master sensor profile is saved, the current total value of fuel volume in the selected tanks will be displayed in the line **Summary Value. Fuel Tank Volume, l** (see figure 38).

IMPORTANT: In order to receive the correct summing signal, you need to record in advance the calibration table of the respective fuel tank into the internal memory of each sensor used.



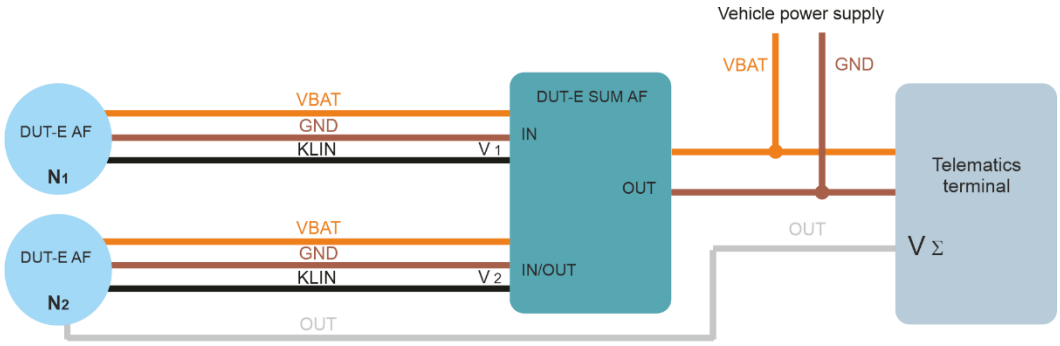
a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure 38 — Configuration of the fuel volume summation in several tanks

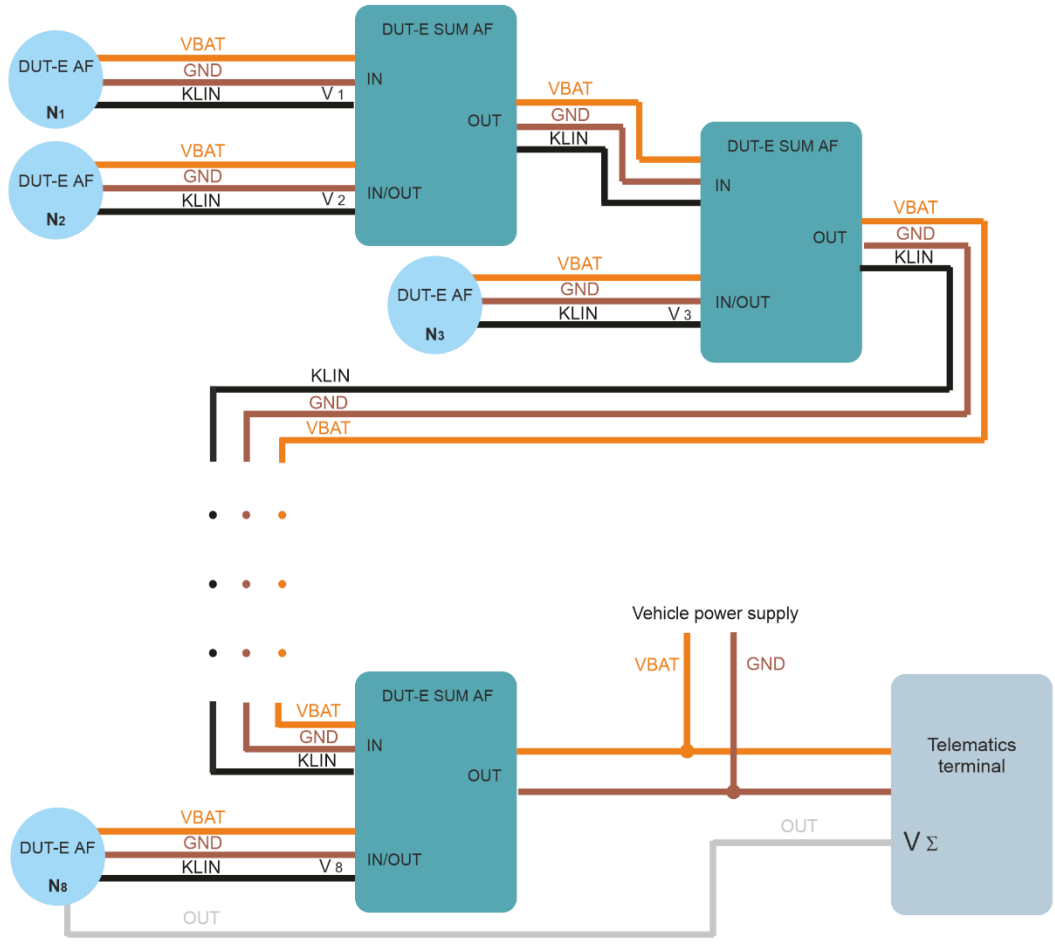
In order to measure the total fuel volume in two and more tanks, you should use DUT-E SUM AF summator together with DUT-E AF sensors. Summators are electrically connected according to diagrams provided in figure 39, in accordance with the designation of the summator wires provided in table 6.

Each of DUT-E AF sensors that are connected for readings summation is to be assigned a unique service address within **101...108** range (settings of Self-diagnostics FM submenu, field **Address at S6 (SA) Bus** (see B.1)).

ATTENTION:
1) During the summation of DUT-E AF readings **it is not allowed** to use elements of S6 cable system for the sensors connection.
2) To ensure correct data transfer in the summation mode, **you must disconnect** the sensor from Service S6 DUT-E service software or from Service S6 DUT-E (Android) mobile application after the sensor configuration.



a) connection of two DUT-E AF



b) connection of three and more DUT-E AF (summators cascading)

Figure 39 — Diagrams of sensors connection to the Telematics terminal during their readings summation

Table 6 — DUT-E SUM AF wires assignment

Wire number	Wire marking	Wire color*		Assignment
1	VBAT	Orange		Power supply "+"
2	GND	Brown		Ground "-"
3	KLIN	Black		K-Line (ISO 14230)
* Manufacturer reserves the right to modify wire colors, that is why pay attention to its marking.				

WARNINGS: When summation of DUT-E AF readings:
1) Output signal of Master sensor should be configured to send fuel volume in liters (see 2.9).
2) The type of the total output signal corresponds to Master sensor signal and does not depend on the type of Slave sensors signals (see 2.9).
3) Simultaneous operation of several Master sensors is only possible with those Teleamtics units, which are able to be configured for distinguishing unique service addresses (SA) of all Master and Slave sensors (e.g. CANUp 27).
4) If connection of one of Slave sensors breaks down, Master sensor uses last received value from that Slave sensor. That value will be used until the connection to Slave sensor is restored.

3 Sealing

It is required to seal the sensor and cable connector with sealing cords and disposable plastic seals to prevent fuel thefts or unauthorized interference into DUT-E AF operation. Seals and cord are included into DUT-E AF delivery set (see figure 40).

ATTENTION: Security sealing of sensors cable connector should be carried out after the configuration and calibration are finished.

To seal the sensor put the sealing cord through the special holes of the mounting plate and DUT-E AF body. Then put the ends of the cord through the holes in the center of the plastic seal body. Latching the seal will lock the cord. Seal removal will be impossible without its damaging.

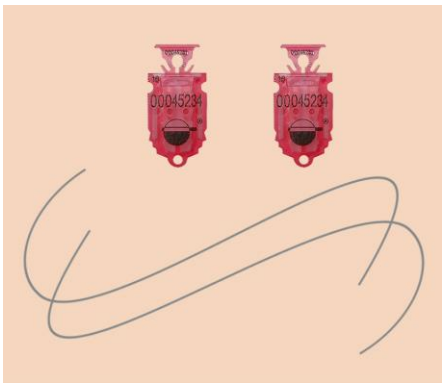


Figure 40 — Plastic seals and sealing cord*

WARNING: Sealing rope should not touch the fuel tank body!

* Design of the seal supplied within the delivery set can differ from the one displayed in figure 40.

4 Measurement accuracy check

4.1 Basic principles

DUT-E AF accuracy check test is conducted to determine the reduced and absolute error of fuel volume measurement on the particular vehicle fuel tank.

The procedure of DUT-E AF accuracy check requires filling/draining of the fuel tank and comparing sensor data with the actual amounts of filling/draining.

Fuel drain is carried with manual or mechanical pump.

Calibrated measuring containers must be used to determine the exact amount of drained/refilled fuel.

ATTENTION: The amount of any fuel filling/draining during the accuracy test should not be less than 20 % of total tank capacity.

4.2 Check tests procedure

Check tests should be carried out in the following order:

1) Drain a fixed volume of fuel.

2) Determine the exact amount of drained fuel with the calibrated measuring container.

3) Record the data into the Check test report.

4) Wait for the fuel getting still in the tank (for stable DUT-E AF readings).

5) Refuel the tank with the previously drained fuel.

6) Record the data into the Check test report.

7) When analyzing accuracy errors, "Drain" and "Refill" parameters are estimated as a percentage relative to the total tank capacity.

See annex A for check test report template and error calculation formula.

5 Diagnostics and troubleshooting

DUT-E AF operability is tested using Service S6 DUT-E software or Service S6 DUT-E (Android) application (see the settings of Self-diagnostics FM, B.1) by means of the sensor connection to the PC with a cable (see 2.3) or, respectively, by means of the sensor wireless connection to the Android device via Bluetooth (see 2.4).

In case of any malfunction first of all examine condition of Vehicle power supply system and power supply pins condition of the DUT-E AF connector.

WARNING:
1) Severe contact corrosion of chassis ground connection switch or its malfunction can seriously affect DUT-E AF output signal.
2) DUT-E AF readings will be invalid if the measuring tubes are closed by conducting mud or water.

6 Maintenance

6.1 General instructions

DUT-E AF visual inspection and operation check is recommended at least once per year.

IMPORTANT: It is recommended to check sensor's calibration for minimum and maximum fuel levels in the tank (provided that the tank has not lost its shape and was not replaced). In case of incorrect readings, recalibrate the sensor according to 2.6. Re-calibration of the fuel tank of Vehicle in this case is not required.

DUT-E AF repair works are carried out only by certified **Regional Service Centers** (RSC). Full list of RSC can be found at https://jv-technoton.com/.

6.2 Demounting

Clean the tank surface nearby the mounting location before DUT-E AF demounting.

Prepare a clean napkin to clean the fuel from the sensor probe.

Cut the sealing cord carefully, with no damage to connection cable.

Disconnect DUT-E AF cable connector.

Unfasten DUT-E AF by turning its body counterclockwise.

Mount the fuel tank plug (be ordered separately) for protection from any possible clogging through mounting opening.

Remove screen-filter and bottom stop from the end of measuring tubes.

ATTENTION:

1) To avoid any cable/PCB damage do not pull the interface cable when demounting DUT-E AF.

2) Screen-filter dismantling should be done carefully to avoid breaking latches of fixator.

3) In case of repeated installation of DUT-E AF – replace the old rubber gasket with a new one.

6.3 Examination

Since DUT-E AF is demounted conduct a visual examination to detect the following defects:

- visible damages of the sensor head body, measuring probe, interface cable, cable;
- backlash of measuring unit tubes relative to each other and/or the body;
- presence of mud or paraffin between the tubes of the measuring probe;
- damage of the plastic mounting plate and traces of fuel leaks through the rubber gasket of the mounting plate.

Contact RSC (see 6.1) or Manufacturer if the defects detected.

6.4 Cleaning

During DUT-E AF operation mud or paraffin formation is possible on the surface of the measuring probe pipes. Pollution of the cavity between the pipes of the measuring probe can lead to significant increase of accuracy error.

ATTENTION: Mud coating inside the inner measuring tube does not affect DUT-E AF normal operation. Examine the space between the tubes for mud and paraffin.

To clean the tubes wash them with the clean fuel. If there is paraffin in the cavity between the tubes, it is necessary to slightly warm the measuring part with a heat gun to remove it. It is also recommended to wash the screen filter as well.

ATTENTION: Avoid fuel getting on DUT-E AF head body, interface cable and its connector when washing the tubes.

7 Packaging

DUT-E AF delivery sets come in cardboard boxes of the following shape (see figure 41).

Figure 41 — DUT-E AF packaging

Label sticker with information on the product name, certificates, serial number, firmware version, manufacture date, implemented technologies, certificates, weight as well as Quality Control seal and QR code is stuck on two sides of the DUT-E AF box (see figure 42).

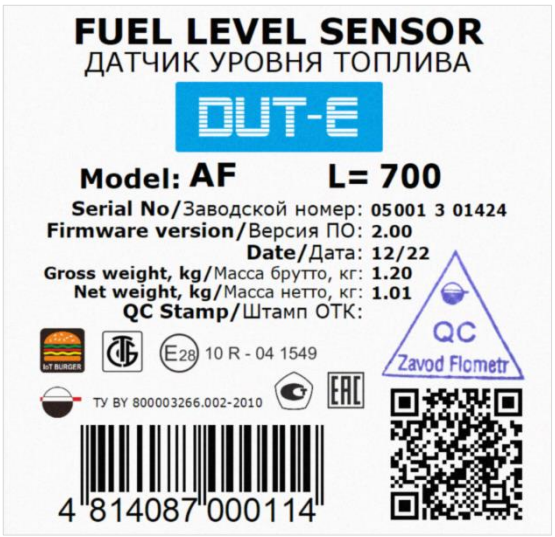


Figure 42 — DUT-E AF packaging label

Note — Label design and contents can be modified by the Manufacturer.

8 Storage

DUT-E AF is recommended to be stored in dry enclosed areas.

DUT-E AF storage is allowed only in original packaging at temperature range from -50 to +40 °C and relative humidity up to 100 % at 25 °C.

Do not store DUT-E AF in the same room with substances that cause metal corrosion and/or contain aggressive impurities.

DUT-E AF shelf life must not exceed 24 months.

9 Transportation

Transportation of DUT-E AF is recommended in closed transport that provides protection for sensor from mechanical damage and precipitation.

When transporting by air, DUT-E AF must be stored in heated pressurized compartments.

Air environment in transportation compartments should not contain acid, alkaline and other aggressive impurities.

Shipping containers with packed DUT-E AF sensors should be sealed.

10 Utilization/re-cycling

DUT-E AF does not contain harmful substances and ingredients that are dangerous to human health and environment during and after the end of life and recycling.

DUT-E AF does not contain precious metals in amount that should be recorded.

Contacts

Distribution, technical support and service

sales@jv-technoton.com

support@jv-technoton.com

Annex A

Template of check test report

Report

Date: _____

DUT-E AF model and serial number	
Vehicle type, model, registration number	
Tracking/displaying device model and serial number	

Drainage volume	According to calibrated container V_M, liters	
	According to tracking device V_{track}, liters	
Accuracy error	Absolute error $\Delta = V_{track} - V_M$, liters	
	Normalized to total tank volume $\delta = \frac{V_{track} - V_M}{V_{total\_volume}} \cdot 100\%$	

Refueling volume	According to calibrated container V_M, liters	
	According to tracking device V_{track}, liters	
Accuracy error	Absolute error $\Delta = V_{track} - V_M$, liters	
	Normalized to total tank volume $\delta = \frac{V_{track} - V_M}{V_{total\_volume}} \cdot 100\%$	

Resume:

The results of measurement **match**/**do not match** specifications.

The results of refueling measurement **match**/**do not match** specifications.

Comments: _____

representative of the CUSTOMER: _____/_____/

representative of the CONTRACTOR: _____/_____/

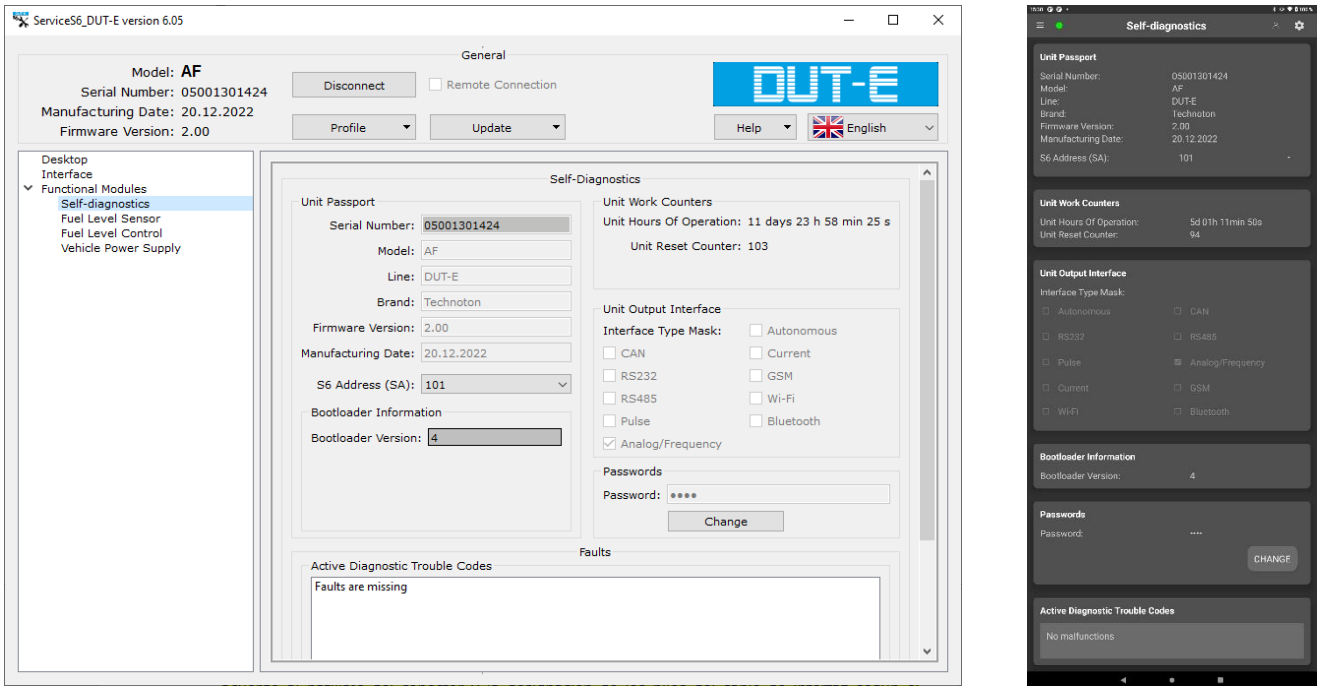
Annex B
Sensor parameters configured and displayed with the help of service software and mobile application

The reception of data on the fuel level, the configuration of Parameters, the maintenance of Counters and self-diagnostics are ensured by the well-concerted operation of Functional modules (FM) of DUT-E AF.

The format of parameters (SPN) of FM DUT-E AF corresponds to S6 Database (DB).

B.1 Self-diagnostics FM

Self-diagnostics FM — is designed for user authorization, DUT-E AF, passport data identification, operation time record, active malfunctions registration.



a) in Service S6 DUT-E software

b) in Service S6 DUT-E (Android) app

Figure B.1 — Example of the window of settings of Self-diagnostics FM

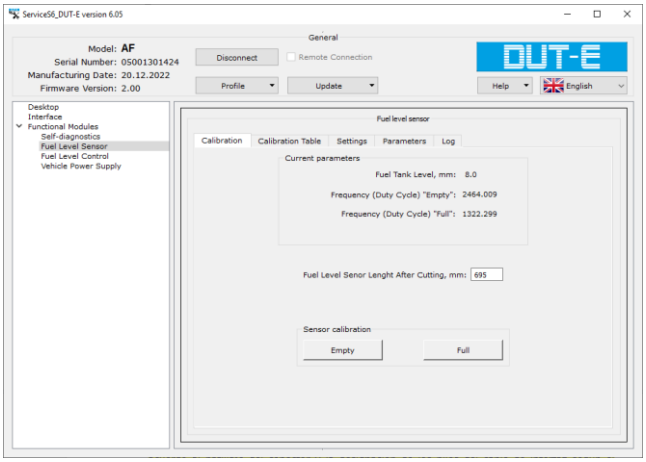
Table B.1 — Self-diagnostics FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

SPN	Name	Factory value	Unit of measure	Clarification
Unit passport PGN 62995				
521120	Serial number	On the fact	No	Serial number is a set of numbers that is used for identification of specific sensor. Serial number DUT-E AF has the following format: AABBB C DDDDD, where: AA – code of model inside of DUT-E product line; BBB – digits that reflect changes product changes; C – Manufacturer code; DDDDD – sequential number. Setting is not available for editing.
521345	Model	AF	No	Model – this is version of the sensor inside of DUT-E product line. Each model has its own functional and constructive features. E.g. DUT-E AF particularity – analog/frequency output signal. Setting is not available for editing.
521123	Line	DUT-E	No	Name of the product line. The line represents a group of similar products – fuel level sensors produced under general trademark DUT-E. Setting is not available for editing.
521344	Mark	Technoton	No	Name of sensor Manufacturer. Setting is not available for editing.
521121	Firmware Version	On the fact	No	Version of built in Software DUT-E AF. Setting is not available for editing.
521125	Date Of Production	On the fact	No	Date (day, month, year) of sensor production. Setting is not available for editing.
521188	Address at S6 (SA) Bus	101	No	Each of DUT-E AF sensors that are connected for readings summation is to be assigned a unique service address within 101…108 range.
Unit Work Counters PGN 62994				
521116	Unit Hours Of Operation	On the fact	s	Counter of summarized working time of the sensor since its production moment. The user cannot reset the value of this counter. It can be reset by the Manufacturer or RSC only.
521118	Number Of Unit Restarts	On the fact	No	Counter of sensor's processor restarts at a time when the power is On or there is an impact of conducted interferences of the vehicle's on-board network. Restarts accounting is carried out since production date of the sensor. The user cannot reset the value of this counter. It can be reset by the Manufacturer or RSC only.
Passwords PGN 63017				
521593/3.3	Password/ 3.3 Installer	1111	No	Password is entered for user authorization while establishing connection session between DUT-E AF and service Software for configuring the sensor. Password is a specific combination of four digits. By default, used: Login – 0, password – 1111. User can change password of the sensor. After entering and confirming the new password is recorded into internal memory of the sensor.
Active diagnostic trouble codes PGN 65226				
521044	Fault identifier (SID+FMI)	On the fact	No	List of current sensor malfunctions are displayed at the settings field (in case of its presence — up to 10). For each active malfunction is indicated following: - faulty nod; - malfunction name. This setting allows to monitor DUT-E AF working performance. In case of lack of active malfunctions, the following message is displayed "No malfunctions".
Unit Output Interface PGN 63168				
521438	Interface Type Mask	AF	No	Interface of connected DUT-E AF is displayed (analog/frequency). Depending on the interface, the service software automatically loads settings of the sensor Functional modules. This setting is the manufacturing setting and is inaccessible for editing by the user.
Bootloader information PGN 63009				
521122	Bootloader Version	On the fact	No	Displays the current version of the loader used for correct starting the inbuilt Unit software (firmware), as well as for the Unit firmware update.

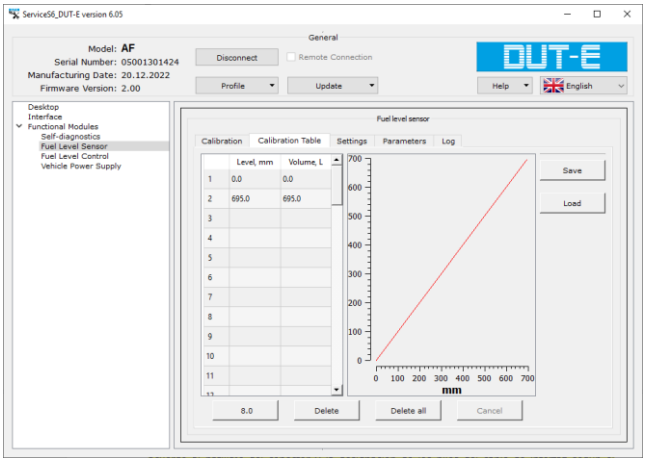
B.2 Fuel level sensor FM

Fuel Level Sensor FM — is designed for:

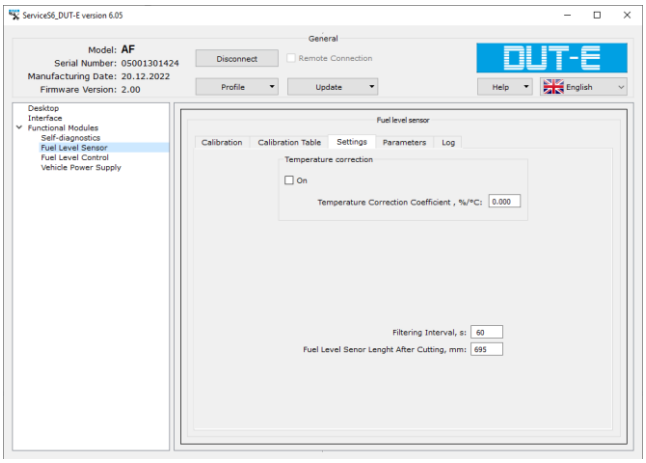
- generation of analog/frequency signal corresponding to the current value of fuel level or volume in the Vehicle tank;
- sensor calibration;
- creation of the tank calibration table;
- filtering and thermal correction of measurements readings.



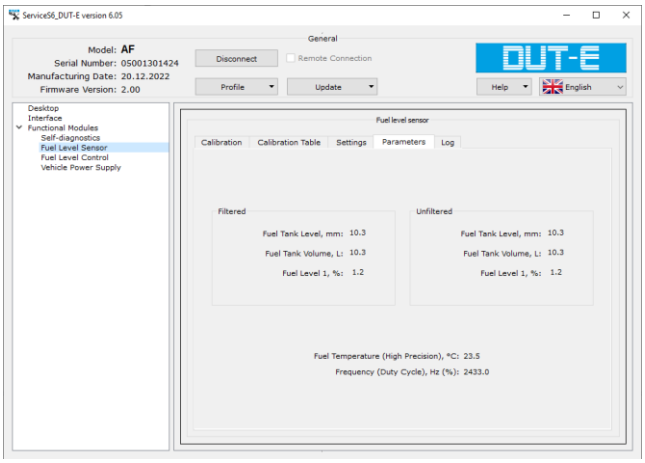
***Calibration** tab*



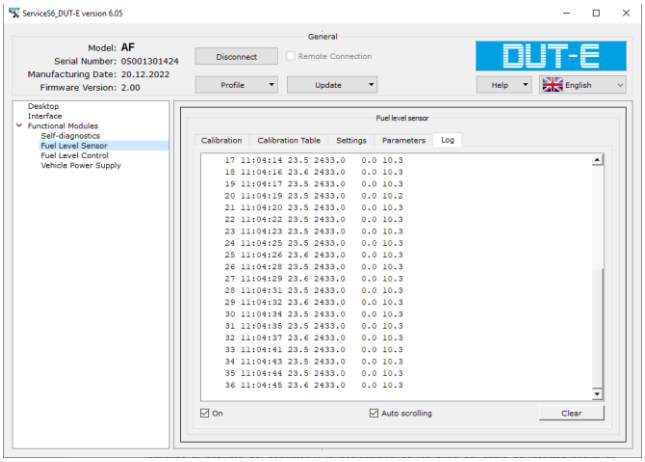
***Calibration Table** tab*



***Settings** tab*

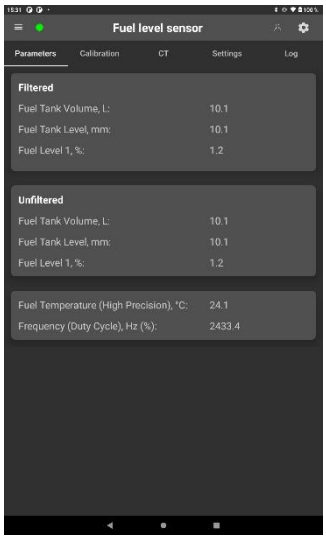


***Parameters** tab*

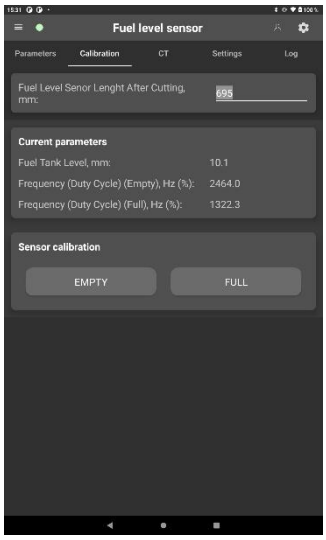


***Log** tab*

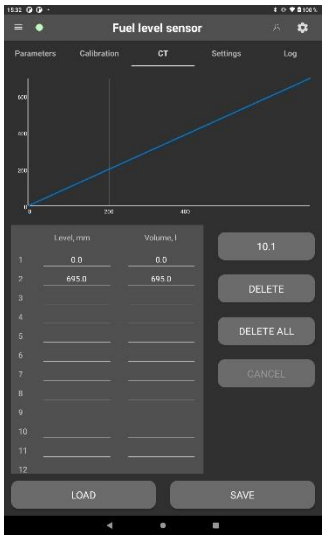
a) in Service S6 DUT-E software



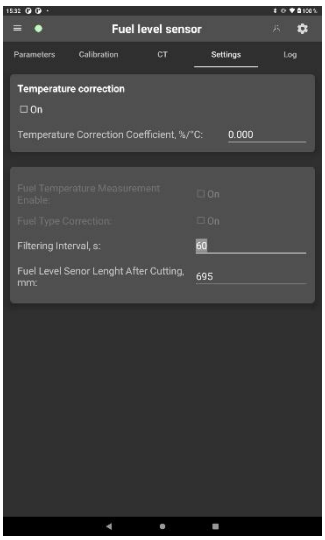
Parameters *tab*



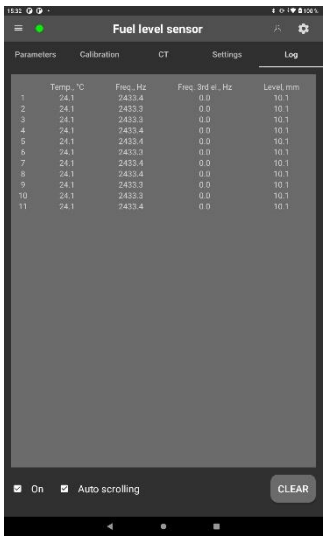
Calibration *tab*



CT *tab*



Settings *tab*



Log *tab*

b) in Service S6 DUT-E (Android) app

Figure B.2 — Example of the window of settings of Fuel level sensor FM

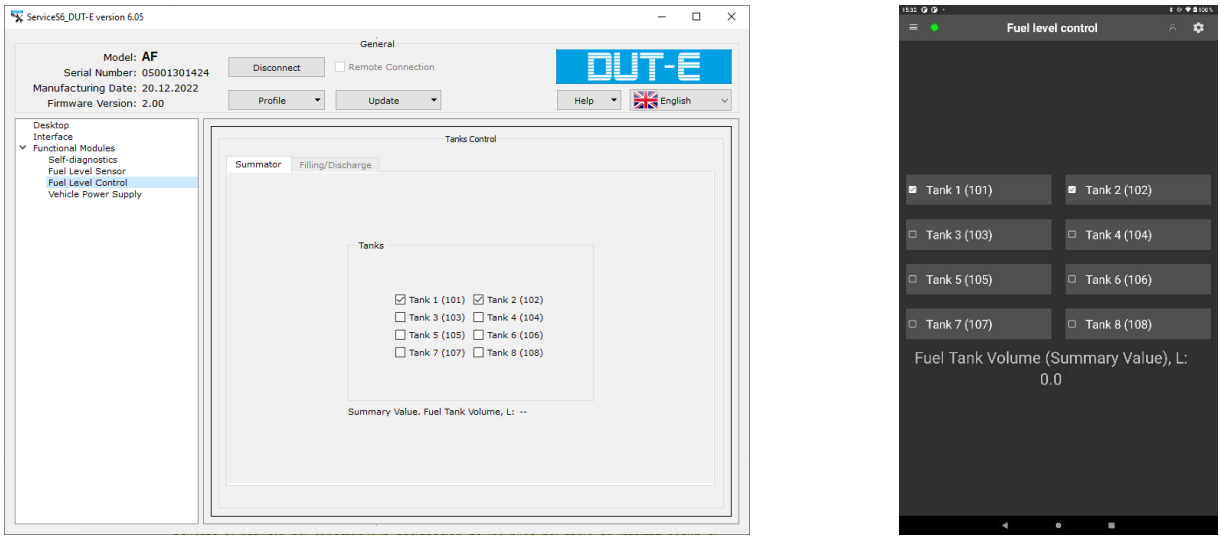
Table B.2 — Fuel level sensor FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

SPN	Name	Factory value	Unit of measure	Range	Clarification
Calibration Settings PGN 63076					
521440/22.0	Frequency (Duty Cycle)/ 22.0 Empty	On the fact	%	0…4294967	This setting displays duty cycle of signal of measuring generator DUT-E AF for empty fuel tank. Based on this value we can estimate if the sensor has been calibrated correctly to minimum fuel level.
521440/22.1	Frequency (Duty Cycle)/ 22.1 Full	On the fact	%	0…4294967	This setting displays duty cycle of signal of measuring generator DUT-E AF for full fuel tank. Based on this value we can estimate if the sensor has been calibrated correctly to maximum fuel level.

SPN	Name	Factory value	Unit of measure	Range	Clarification
Calibration Table. Fuel Tank 1 PGN 63036					
521355	Array Elements Count	2	pcs.	1…60	Number of points of calibration table, created during the fuel tank normalization process. The maximum possible number of calibration points in sensor is 60. Recommended number of calibration points – no less than 15.
521023	Fuel Tank Level	On the fact	mm	0…6425.5	Values of fuel level in the tank corresponding with points of calibration table.
521024	Fuel Tank Volume	On the fact	l	0…6425.5	Values of fuel volume of the tank corresponding with points of calibration table.
Filtered Fuel Level/Volume in Tank PGN 62982					
521023/2.10	Fuel Tank Level/ 2.10 Filtering	On the fact	mm	0…6425.5	Displays the value of the fuel level in Vehicle tank filtered according to the preset time interval.
521024/2.10	Fuel Tank Volume/ 2.10 Filtering	On the fact	l	0…6425.5	Displays the value of the fuel volume in Vehicle tank filtered according to the preset time interval.
174	Engine Fuel Temperature 1	On the fact	°C	-40…210	This setting displays present value of fuel temperature in the vehicle's tank.
Dash Display PGN 65276					
96	Fuel Level 1	On the fact	%	0…100	This setting displays value (in %) of present fuel level in the tank in relation to the level of full vehicle's tank.
FM Fuel Level Sensor Settings PGN 63029					
521433	Temperature Correction Coefficient	0	%/°C	-32…32	Field for entering temperature correction coefficient that provides temperature compensation of fuel expansion/compression inside of vehicle's fuel tank.
521444	Filtering Interval	60	s	0…64255	Field for entering time interval value during which DUT-E AF calculates smoothed fuel level of vehicle's fuel tank before transmitting out coming data to the Server.
521093	Fuel Level Senor Lenght After Cutting	On the fact	mm	0…64255	Field for entering of sensor's measuring length for what calibration table has been made before installation into the vehicle's fuel tank.
521311	Temperature Correction Enable	Off	No	On/Off	Field for activation/ deactivation of temperature correction function that provides compensation of fuel expansion/compression inside of the vehicle's fuel tank.
Pulse-width Modulation Duty Cycle PGN 63489					
521442	Fuel Temperature (High Precision)	On the fact	°C	-273…1734.97	This setting displays present value measured with high precision temperature of fuel inside of vehicle's tank.
— Essential settings, required for DUT-E AF performance.					

B.3 Fuel level control FM

Fuel Level Control FM — is designed to receive data on measured total volume of two and more Vehicle tanks via K-Line interface (ISO 14230).



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure B.3 — Example of the window of settings of Fuel level control FM

Table B.3 — Fuel level control FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

SPN	Name	Factory value	Unit of measure	Range	Clarification
Total Fuel Volume In Tanks PGN 63152					
521024/2.11	Fuel Tank Volume/ 2.11 Summary Value	On the fact	l	0…6425.5	Displays the value of total fuel volume in tanks, selected for summation.
Summation Settings DUT PGN 63149					
521259/27.0	Fuel Level Sensor Summation Enable/ 27.0 DUT 1	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 101), which is set in Tank 1 of the Vehicle.
521259/27.1	Fuel Level Sensor Summation Enable/ 27.1 DUT 2	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 102), which is set in Tank 2 of the Vehicle.
521259/27.2	Fuel Level Sensor Summation Enable/ 27.2 DUT 3	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 103), which is set in Tank 3 of the Vehicle.
521259/27.3	Fuel Level Sensor Summation Enable/ 27.3 DUT 4	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 104), which is set in Tank 4 of the Vehicle.

SPN	Name	Factory value	Unit of measure	Range	Clarification
521259/27.4	Fuel Level Sensor Summation Enable/ 27.4 DUT 5	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 105), which is set in Tank 5 of the Vehicle.
521259/27.5	Fuel Level Sensor Summation Enable/ 27.5 DUT 6	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 106), which is set in Tank 6 of the Vehicle.
521259/27.6	Fuel Level Sensor Summation Enable/ 27.6 DUT 7	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 107), which is set in Tank 7 of the Vehicle.
521259/27.7	Fuel Level Sensor Summation Enable/ 27.7 DUT 8	Off	-	On/Off	A field for turning on / off summation of fuel volume measured by the fuel level sensor (network address 108), which is set in Tank 8 of the Vehicle.

B.5 Vehicle Power Supply FM

Vehicle Power Supply FM — is designed for monitoring: the availability of the onboard circuit and its voltage, current onboard circuit mode, time of Vehicle operation in different onboard circuit modes of operation, time of starter operation, allowed time for starter uninterrupted operation*.

* In preparation for introduction.

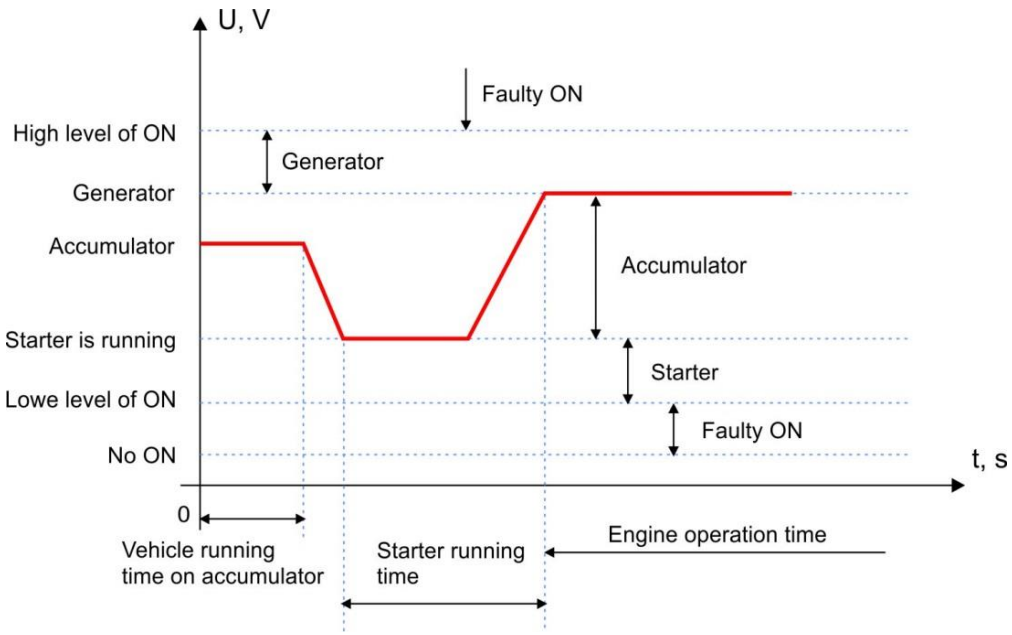
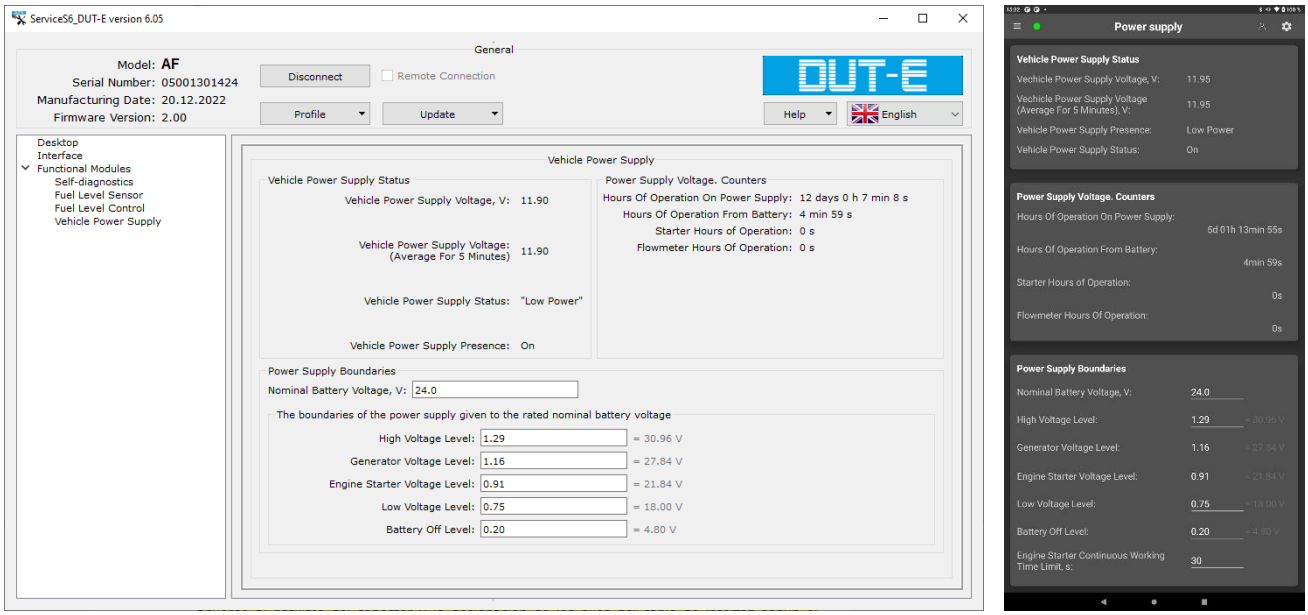


Figure B.4 — Operation modes on onboard network (ON) voltage level



a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure B.5 — Example of the window of settings of Vehicle power supply FM

Table B.4 — Vehicle power supply FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

SPN	Name	Factory value	Unit of measure	Range	Clarification
Vehicle Power Supply Status PGN 63089					
521055	Vehicle Power Supply Voltage	On the fact	V	0…3212.75	Shows current value of ON voltage.
521055/2.9	Vehicle Power Supply Voltage/ 2.9 Average For 5 Minutes	On the fact	V	0…3212.75	Shows average value of ON voltage within previous 5 minutes.
521056	Vehicle Power Supply Status	On the fact	No	Off/ Lowe level/ Accumulator/ Starter/ Generator/ High level	Shows current mode of ON in accordance with user-defined borders of ON voltage levels of Vehicle (see figures B.4 and B.5).
521076	Vehicle Power Supply Presence	On the fact	No	On/Off	Displays the current state of the board (On/Off) in accordance with the user-set voltage level of the TC system trip (see figures B.4 and B.5).
Power Supply Boundaries PGN 63067					
521075	Nominal Battery Voltage	24	V	0…60	Field for entering a nominal value of accumulator voltage of Vehicle (U_{nom}=12V/24V) (see figures D.5 and D.6).
521063	High Voltage Level	1.29	-	0…1.99	Field for entering value of high voltage level of onboard network (1.29•U_{nom}) (see figures B.4 and B.5). Entered value of voltage is used as a threshold for recording "Faulty ON" Event.
521064	Generator Voltage Level	1.10	-	0…1.99	Field for entering value of voltage level of generator, i.e. when engine of Vehicle is running (1.10•U_{nom}) (see figures B.4 and B.5).
521065	Engine Starter Voltage Level	0.91	-	0…1.99	Field for entering value of voltage level starter is running, i.i when Vehicle's engine is starting (0.91•U_{nom}) (see figures B.4 and B.5).
521067	Low Voltage Level	0.75	-	0…1.99	Field for entering value of low voltage level of ON (0.75•U_{nom}). Entered value of voltage is used as a threshold for recording "Faulty ON" Event. (see figures B.4 and B.5).
521068	Battery Off Level	0.20	-	0…1.99	Field for entering value of voltage level when ON switches off (0.20•U_{nom}). (see figures B.4 and B.5).
521074*	Engine Starter Continuous Working Time Limit	30	s	5…30	Field for entering value of starter's permissible time of continuous operation, above which the starter may fail (see figures B.4 and B.5). Entered value is used as a threshold for recording "Exceeding permissible time of continuous operation of starter" Event.
Power Supply Voltage. Counters PGN 62976					
521173	Hours Of Operation On Power Supply	On the fact	s	0…4211081215	Counter of total operating time of Vehicle from onboard network since sensor installation to the Vehicle**.
521172	Hours Of Operation From Battery	On the fact	s	0…4211081215	Counter of total operating time of Vehicle from accumulator since sensor installation to the Vehicle**.
521170	Starter Hours Of Operation	On the fact	s	0…4211081215	Counter of total operating time of starter since sensor installation to the Vehicle**.
521171	Flowmeter Hours Of Operation	On the fact	s	0…4211081215	Counter of total operating time of Vehicle's engine since sensor installation to the Vehicle**.

* In preparation for introduction.
** The user cannot reset the Counter by himself. Counter can be reset by the Manufacturer of RSC.

Detailed parameters description (SPN), structure and content of messages (PGN) of FM DUT-E AF are placed at the following web site http://s6.jv-technoton.com/ (to access S6 DB registration is required).

Annex C

Sensor firmware upgrade

WARNING: DUT-E AF firmware update should be carried out **only** for implementing improvements, recommended by the Manufacturer.

To upgrade firmware the following actions should be made:

1) In case you use Service S6 DUT-E software, connect the sensor to the PC using S6 SK service adapter (see 2.3.1) and establish a communication session between the sensor and PC (see 2.3.3).

In case you use Service S6 DUT-E (Android), connect the sensor to the Android device using S6 BT Adapter service adapter (see 2.4.1). Establish a connection between the sensor and the Android device via the Bluetooth channel (see 2.4.3).

WARNING: When re-uploading firmware, power supply voltage of DUT-E AF should not drop out of (10…45) V range.

2) Start the firmware update procedure.
3) Select the firmware file **(*.blf3)** on the PC disc or in the memory of the Android device.
4) Start loading the firmware file into the DUT-E AF memory.
After firmware file integrity and compatibility check by Service S6 DUT-E software or Service S6 DUT-E (Android) mobile app window of firmware uploading into DUT-E AF memory will appear. In case of any errors the Software will send warning message. To cancel firmware upgrade it is needed to press **Stop** button.

WARNING: To avoid DUT-E AF failure, before the end of the firmware upgrade process **is forbidden**:

- to switch off PC (in case you use Service S6 DUT-E software) or the Android device (in case you use Service S6 DUT-E (Android);
- to switch off the power supply for the sensor;
- to disconnect the Unit from the service adapter and the adapter from the PC or the Android device;
- to connect to the sensor using S6 SK service adapter (cable) and S6 BT Adapter service adapter (wireless) at one time;
- Run any resource-intensive applications on the PC (in case you use Service S6 DUT-E software).

After the successful completion of the firmware update procedure, the appropriate message will appear. DUT-E AF is ready for further operation. During the next communication session between the sensor and the PC or the Android device the new firmware version will be displayed in the software or in the mobile application, respectively.

If the DUT-E AF firmware update has been completed incorrectly and the current version of the inbuilt software has been damaged, the firmware update procedure has to be repeated. In this case, the inbuilt firmware loader is activated which enables to recover DUT-E AF operability. If the repeated attempt fails, we recommend to consult Technoton Technical Support Service by e-mail support@jv-technoton.com.

Annex D

Electromagnetic compatibility specifications

Table D.1 — Protection of power circuits of DUT-E AF against conductive, capacitive and inductive interference as described in ISO 7637-2:2002

Test pulse	Test level	U_S tested level, V for supply voltage	
		12 V	24 V
1	IV	-100	-600
2a	IV	+50	+50
2b	IV	+10	+20
3a	IV	-150	-200
3b	IV	+100	+200
4	IV	-7	-16
5	III	+65	+123

Table D.2 — Protection of signal circuits of DUT-E AF against conductive, capacitive and inductive interference as described in ISO 7637-3:2002

Test pulse	Test level	U_S tested level, V for supply voltage	
		12 V	24 V
Pulse "a" of short duration	IV	-60	-80
Pulse "b" of short duration	IV	+40	+80
Positive pulse of long duration (DCC)	IV	+30	+45
Negative pulse of long duration (DCC)	IV	-30	-45
Positive pulse of long duration (ICC)	IV	+6	+10
Negative pulse of long duration (ICC)	IV	-6	-10

Table D.3— DUT-E AF own radio interference field strength as per UNECE Regulation No.10 (Revision 4)

Tested bandwidth, MHz	Quasi-peak value of field strength of radio interference, dB µV/m		Average value of field strength of radio interference, dB µV/m	
	Horizontal polarization	Vertical polarization	Horizontal polarization	Vertical polarization
30…34	27	25	20	20
34…45	23	21	16	18
45…60	18	18	13	14
60…75	17	16	10	9
75…100	11	13	7	8
100…130	12	14	7	9
130…170	22	16	18	12
170…225	24	18	18	13
225…300	32	24	27	11
300…400	19	21	13	14
400…525	22	24	16	15
525…700	24	27	23	23
700…850	34	32	25	27
850…1000	35	33	27	26

Annex E
Method of recording the calibration table for tanks of great capacity

For calibration of tanks (fixed tanks) of 6553.5 l capacity and higher, you need to change digit capacity of fuel volume values in all points of the calibration (column **Volume, l**).

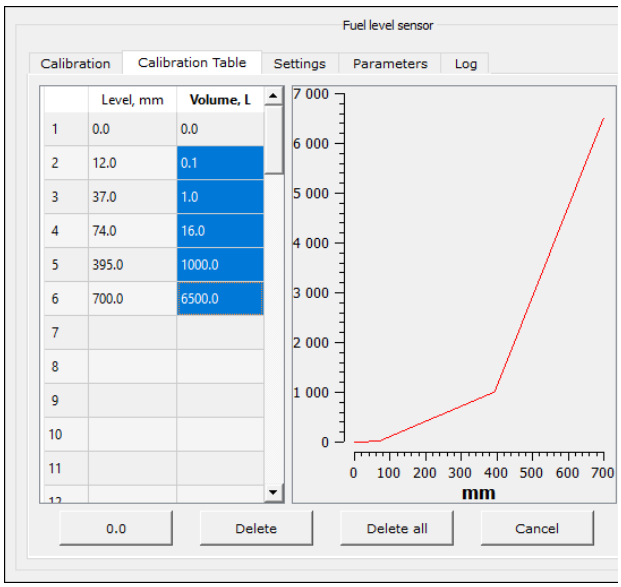
The actual position of the decimal divider of the whole and fractional parts is ignored in volume values.

The discreteness of volume measurement in calibration points is changed from 0.1 liter to 1.0 liter.

The maximum possible volume value in the calibration table — 65535 l.

After the transfer of fuel volume data to the Server or to the tracking device, you don't have to multiply the value by 0.1 coefficient.

WARNING: For calibration of a tank (fixed tank) of greater than 6553.5 l capacity, you need to send fuel level values to the Server **in millimeters.** It is sufficient to create the calibration table only at the Server. No need to record the calibration table into the sensor memory.



Actual fuel volume values	Modified fuel volume values for recording into the calibration table
0 liter	0.0
1 liter	0.1
10 liters	1.0
160 liters	16.0
10000 liters	1000.0
65000 liters	6500.0

Figure E.1 — Example of recording of fuel volume values with changed discreteness into the calibration table with the help of Service S6 DUT-E software

Annex F
Videography

1) Video clip **DUT-E ATS-1 automatic tank calibration station**.

Check out the link: https://youtu.be/uFF1mG-iz6A

2) Animation **Wireless fuel level sensor DUT-E S7**.

Check out the link: https://youtu.be/MnbGXn9JX_g

3) Animation **DUT-E 2Bio fuel level sensor**.

Check out the link: https://www.youtube.com/watch?v=WR1556gaN7o

4) Animation **DUT-E GSM fuel level sensor**.

Check out the link: https://www.youtube.com/watch?v=ixBaKMzKtG8

5) Video clip **DUT-E 485 fuel level sensor installation**.

Check out the link: https://www.youtube.com/watch?v=X0gUSF3dRWk

6) Video clip **Length extension of measurement part DUT-E Using measuring sections KDC**

Check out the link: https://www.youtube.com/watch?v=dWuY_JJfhFw

7) Video clip **Filter Screen of DUT-E fuel level sensor**

Check out the link: https://www.youtube.com/watch?v=B5dcYxGfSqQ

8) Other Technoton videos are on the YouTube channel which is regularly updated:

https://www.youtube.com/channel/UCq7EF3DHrgI7fOWB2ynsR-A