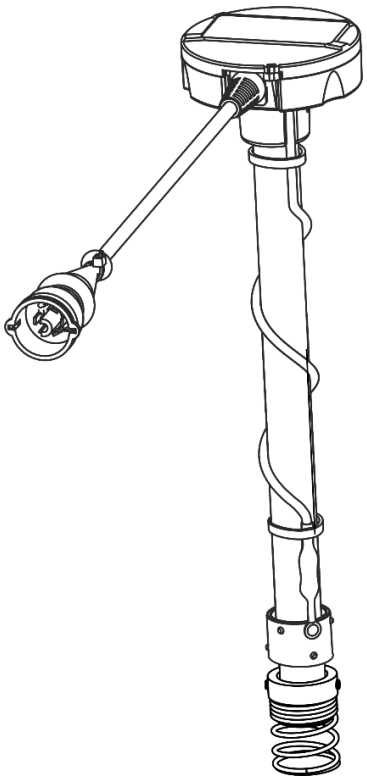
FUEL LEVEL SENSORS



DUT-E 2Bio CAN/232/485/AF/I

OPERATION MANUAL

Version 5.0

TECHNOTON
ADVANCED MACHINERY TELEMATICS

E28 10 R - 04 1549

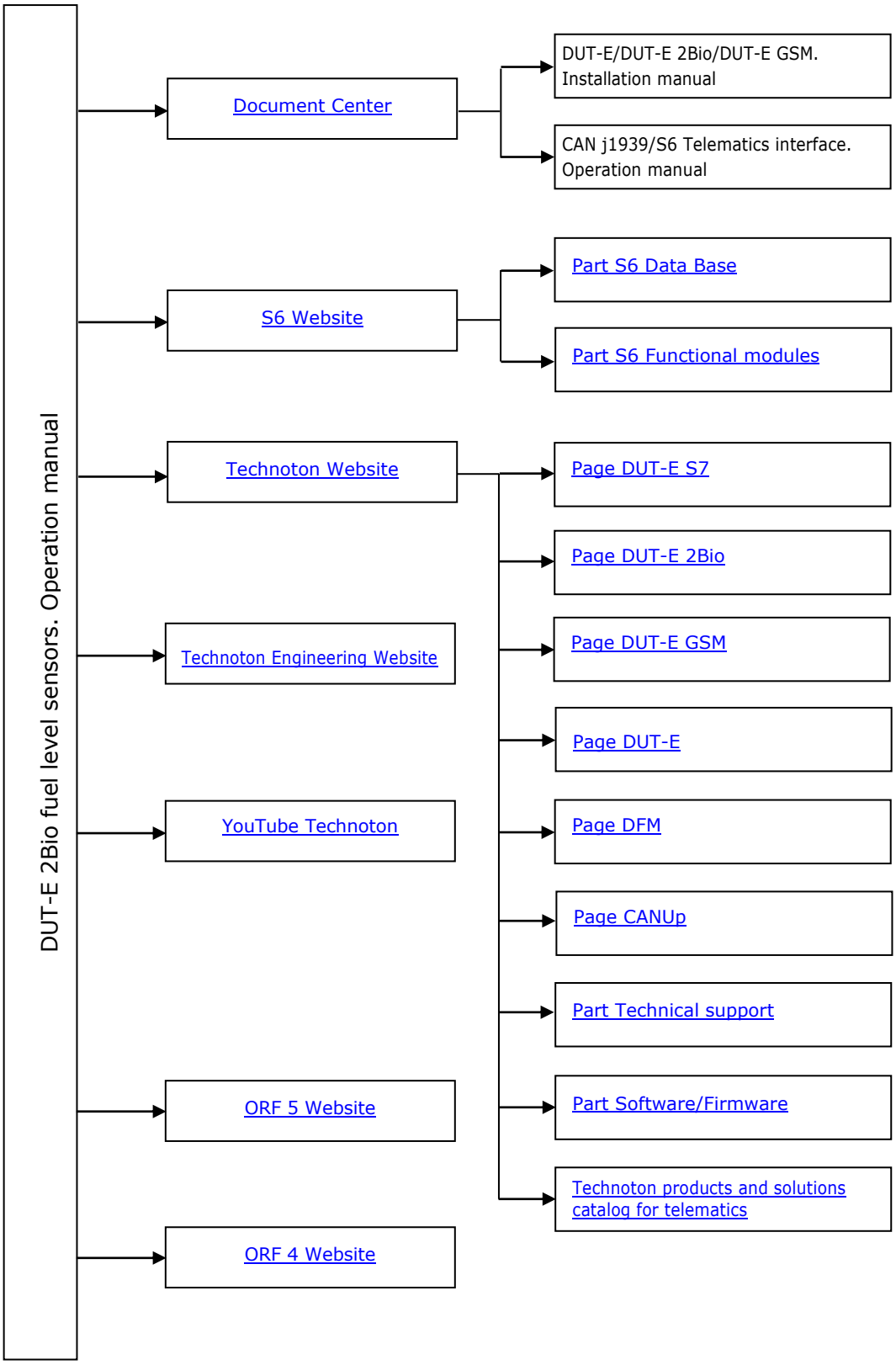
Contents

Revision history

Version	Date	Editor	Description of changes
1.0	08.2017	OD	Basic version
2.0	12.2017	OD	• DUT-E 2Bio connection sequence to Android-device via Bluetooth using S6 BT Adapter is added. • Sensor configuration procedure from Android-device using Service S6 DUT-E (Android) is described. • Document's terms and definitions are updated (S6 Technology and IoT Burger Technology). • External link structure of the Manual is updated. • Examples of connection schemes of DUT-E 2Bio to telematics units through S6 cabling system is updated.
3.0	07.2018	OD	• New models are added: - DUT-E 2 Bio 232; - DUT-E 2 Bio 485; - DUT-E 2 Bio AF; - DUT-E 2 Bio I. • Delivery set description is updated. • Electromagnetic compatibility information is added. • Document's terms and definitions are updated (CAN j1939/S6 Telematics interface).
3.1	03.2019	OD	• Feature of recognition of fuel type in use is added for DUT-E 2Bio CAN. • Updated list of DUT-E 2Bio CAN data transfer protocol messages. • Register map of DUT-E 2Bio 232/485 output messages according to Modbus protocol is updated. • SPN list of FM Fuel level sensor is updated.
3.2	08.2019	OD	• Description of DUT-E 2Bio additional electrode calibration procedure is added. • Data composition of DUT-E 2Bio CAN output messages is updated. • Sensor settings for updated versions of Service S6 DUT-E service software (version 5.4) and Service S6 DUT-E (Android) service mobile application (version 2.10) are updated.
3.3	11.2019	OD	• Information on Modbus RTU data transmission protocol for DUT-E 2Bio 232/485 sensors supplied with examples of "request-response" messages for reading data is added. • Minimal requirements for PC for work with Service S6 DUT-E service software are added.
4.0	06.2021	OD	• The range of DUT-E 2Bio CAN sensors network addresses is extended for work using S6 Technology to enable uniting up to 16 pcs. of sensors into a single network. • The list of the sensors output messages via CAN j1939/S6 interface is updated, malfunctions codes are added. • The feature of automatic identification of Fuelling"/"Discharging" Events is added for DUT-E 2Bio CAN. • Information on ASCII data transfer text protocol for DUT-E 2Bio 232/485 is added. • The formula to calculate the maximum admissible length extension of DUT-E 2Bio measuring probe is provided; requirements for tightening threaded connections during mounting additional KDC sections are specified. • Settings of the sensor Functional modules for Service S6 DUT-E software (version 5.16) are updated (FM Accelerometer, identification of Fuelling"/"Discharging" etc.). • Current certificates are updated (Certificate E28 of E-mark International Standard, Certificate of type approval of means of measurement, Certificate of conformity TR CU 018/2011 On safety of wheeled vehicles). • Diagrams of the sensor connection to the PC using S6 SK service adapter are updated etc.

Version	Date	Editor	Description of changes
5.0	05.2023	OD	• The certificates are updated. • Additional information on the product is provided. • Settings for Functional modules configuration with the help of Service S6 DUT-E (Android) service mobile application (version 3.00.05) and Service S6 DUT-E service software (version 6.05) are updated. • Recommendations regarding creation of the calibration table for a tank of greater volume than 6553 l are added. • Method of calculating the thermal correction coefficient is improved etc. • Examples of diagrams for the sensors connection to Terminals are added; diagrams of the sensors connection to the PC and Android device using service adapters are updated etc.

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.

All DUT-E 2Bio fuel level sensors are designed using IoT Burger Technology.

S6 — 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.

DUT-E 2Bio CAN fuel level sensor is designed using S6 Technology.

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 data overlapped 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 2Bio sensor, its model code 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 fuelling», «volume of fuel at the end of the fuelling», «volume of the fuelling» 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 characteristics of Parameter. Counter is represented by a number, which can only grow in time. Examples of Counters: fuel consumption, engine operation time, total distance and other.

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.

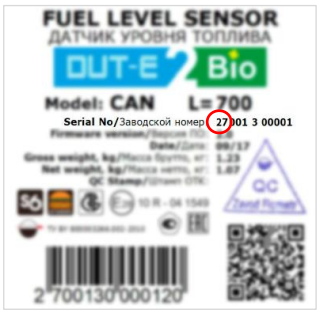
Vehicle an object controlled within Telematics system. Usually Vehicle means a truck, tractor or bus, sometimes a locomotive or river boat. From Telematics system point of view, stationary objects are also considered to be vehicles: diesel gensets, stationary tanks, boilers/burners.

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

Unit is an element of vehicle on-board equipment compatible with S6 bus, which uses S6 Technology.

Introduction

Recommendations and rules set out in this Operation Manual apply to **DUT-E 2Bio fuel level sensors** (further on — DUT-E 2Bio), Models codes: **27** (for DUT-E 2Bio CAN) , **17** (for DUT-E 2Bio 232), **20** (for DUT-E 2Bio 485), **34** (for DUT-E 2Bio AF), **35** (for DUT-E 2Bio I) manufactured by Technoton company.
The DUT-E 2Bio 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 2Bio. Besides, this document defines the procedure for wire-connected and wireless connection configuration of sensors.

DUT-E 2Bio — smart sensor as a part of Telematics systems is designed for precision fuel level measurement in all kinds of vehicle tanks and tanks of fixed installations regardless the variety of fuel or chemical composition of fuel used.

DUT-E 2Bio key features:

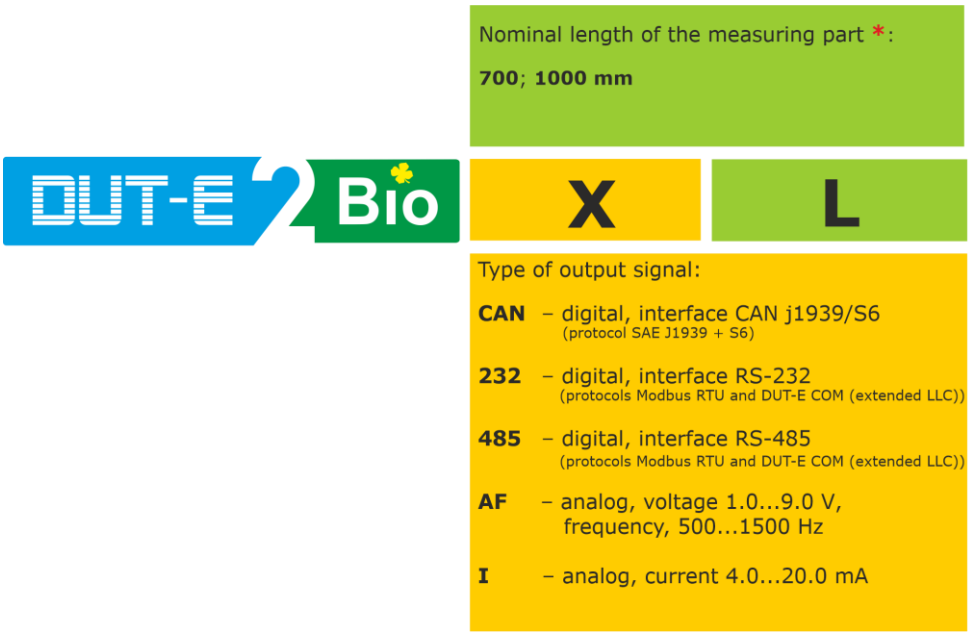
- compliance with Units, Database and cabling system S6 Technology;
- IoT Burger Technology provides maximal internal data processing (filtering and normalization of Parameters, identification of Events, maintenance of Counters recording, the tank calibration table is recorded into the sensor memory) "onboard" the sensor; it simplifies the Server operation and economizes traffic;
- unique function of automatic readings correction when fuel is changed from one type to another (diesel/biodiesel/kerosene/mineral oil) ensures stable measurement accuracy without tank re-calibration;
- uniting up to 16 fuel level sensors by means of S6 Technology to form a single network that would include the possibility of summation of readings of up to 8 sensors[1];
- internal feature of automatic identification of the "Fuelling"/"Discharging" Events[2];
- inbuilt accelerometer enables to monitor the Vehicle movement and its pitch angles, as well as to identify accurately facts of fuelling and discharging from the fuel tank[2];
- adjustable feature of automatic identification of the type of fuel in the tank in which the sensor is mounted[3];
- precision measurement of current fuel temperature by special thermosensor that is placed directly inside the fuel;
- automatic compensation of ambient temperatures effect on the electronic sensor modules;
- function of digital self-diagnostics for sensor quality control;
- wireless configuration by means of Android devices via Bluetooth using S6 BT Adapter (purchased separately).

[1] S6 Technology allows to use DUT-E 2Bio CAN to summarize data together from DUT-E CAN and DUT-E GSM sensors that have interface CAN j1939/S6.
[2] For DUT-E 2Bio CAN with the version of firmware not lower than 7.19, in case of using Service S6 DUT-E software, version from 5.16 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.
[3] For DUT-E 2Bio CAN with firmware version from 7.13 and higher.

DUT-E 2Bio has all the advantages of "classical" DUT-E fuel level sensor models:

- ergonomic bayonet mount allows to save installation time;
- shortening/extending length of measuring probe;
- thermal correction with adjustable coefficient allows automatic correction of measurements, depending on fuel temperature;
- bottom spring for better mounting rigidity;
- screen filter (purchased separately) for secure protection from water and mud;
- full set of mounting accessories and connection cable included;
- 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;
- sealing possibility to avoid unauthorized intrusion and tampering;
- ergonomic grooves in sensor's head ensure easy grip for locking sensor in bayonet fastening plate when installing sensor;
- 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 2Bio 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).
If L>1400 mm or wire length of the 3rd electrode >1700 mm, then the price increases by 10% + KDC cost

Figure 1 — DUT-E 2Bio order identification codes

Examples of DUT-E 2Bio ordering identification codes:

"Fuel level sensor DUT-E 2Bio CAN L=1000 mm"

(CAN j1939/S6 interface, measuring probe length 1000 mm).

For DUT-E 2Bio 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://www.jv-technoton.com/, section Software/Firmware).

For wireless configuration of DUT-E 2Bio 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 2Bio.

The Manufacturer guarantees DUT-E 2Bio 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 2Bio 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 2Bio

1.1 Purpose of use and application area, operation principle

DUT-E 2Bio is used for:

- accurate level measurement in fuel tanks of vehicles and stationary units (see figure 2);
- automatic compensation of changes in fuel dielectric constant when fuel is switched from one type to another, or chemical composition of fuel is significantly changed;
- automatic detection of fuel type change;
- automatic identification of the type of fuel used*;
- automatic identification of the Events "Fuelling"/"Discharging from the fuel tank"*;
- summation of readings of up to 8 sensors*;
- monitoring the onboard circuit tension;
- monitoring the Vehicle movement and its pitch angles*;
- precision measurement of current fuel temperature in the tank.

* Valid only for DUT-E 2Bio CAN sensors.

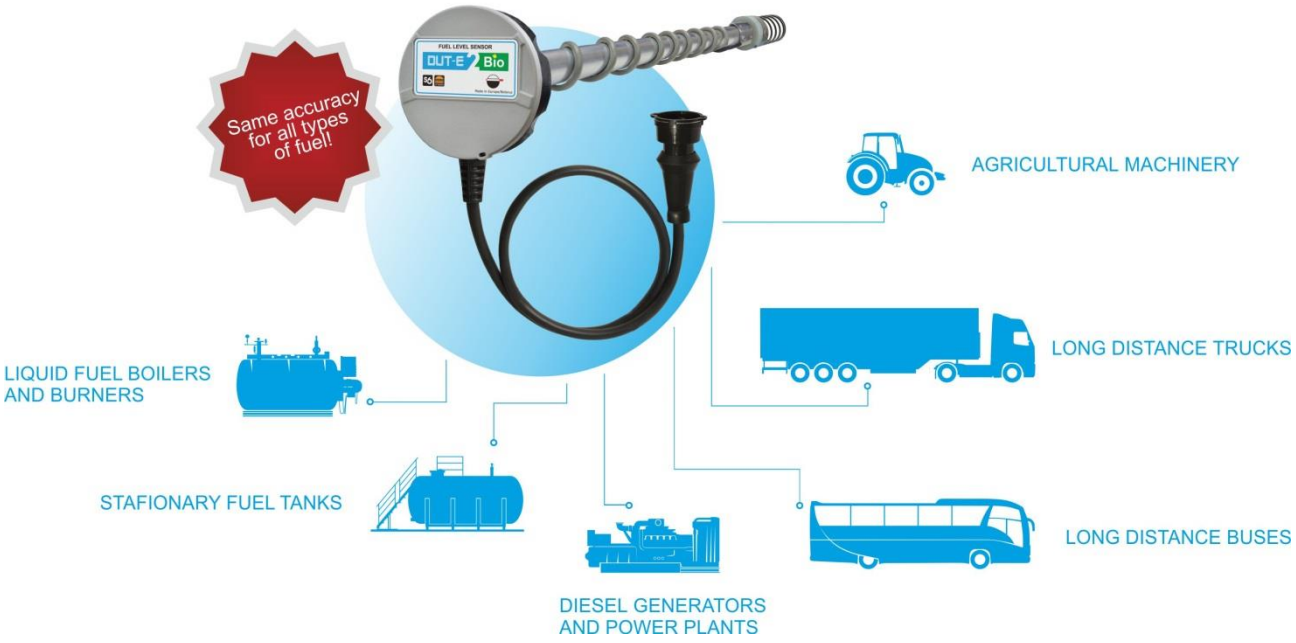


Figure 2 — Application area of DUT-E 2Bio

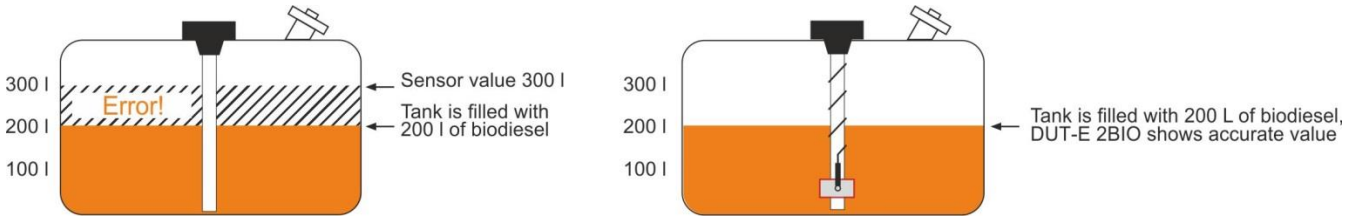
Different types of diesel fuel (mineral summer/winter fuel, biodiesel) or the same type of fuel but with additives, or diesel fuel that is used in different regions (for example, Russian Federation and countries of European Union) have different dielectric constant. When fuel is changed from one type to another, for example, from diesel fuel to biodiesel, difference in fuel readings of standard capacitive fuel level sensor can be more than 40 %. In such cases, to provide high accuracy of fuel volume measurement in the tank, it is necessary to renew long calibration procedure of the tank.

Operating principle:

As differs from the regular capacitive fuel level sensor, DUT-E 2Bio sensor has an additional electrode (see 1.3) that enables the operation of the **automatic correction feature, in case the dielectric permittivity of fuel is changed**.

In case dielectric properties of fuel change during the next fuelling of the Vehicle, the **differential** mechanism of measurement readings correction is automatically activated, in accordance with the difference of values of coefficients of the fuel dielectric permittivity — between the initial coefficient (at which the sensor calibration was carried out) and the coefficient of fuel the tank is currently filled with.

Example: When fuel is changed from diesel to biodiesel standard fuel level sensor shows significantly higher fuel volume in the tank (up to 30 %) (see figure 3 a). Fuel level sensor DUT-E 2Bio shows real fuel volume in the tank even if the fuel in the tank is changed from diesel to biodiesel (see figure 3 b).



a) use of standard fuel level sensor *b) use of fuel level sensor DUT-E 2Bio*

Figure 3 — Illustration of specifics of fuel volume measurement in tank of Vehicle when switching from regular diesel to biodiesel

IMPORTANT: Function of automatic correction of fuel dielectric constant allows to control fuel level in the tank with higher accuracy regardless the type of fuel (see figure 4).
Procedure of fuel tank re-calibration is not required with DUT-E 2Bio!

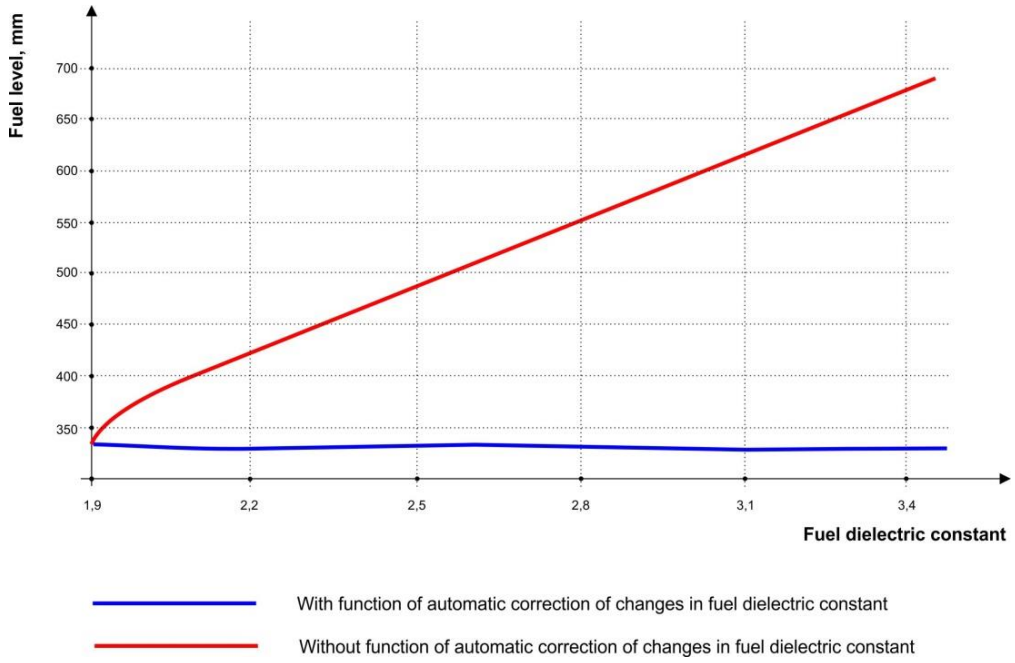


Figure 4 — Example of data comparison of corrected and uncorrected fuel levels

Application areas:

1) DUT-E 2Bio is used as an additional sensor for fuel monitoring within Telematics systems on Vehicles which are periodically refueled with different types/sorts of fuel (see figure 3).
The sensor measures fuel level in the tank and generates an output signal to forward it to a vehicle Tracking device. Tracking device records and processes the sensor data for further transmission to the telematics server. Server software processes and analyzes the received data to generate Analytical reports for a selected period of time. ORF 4 Telematics service allows convenient analysis of fuel volume inside tank of Vehicle (see figure 5).

RECOMMENDATION: ORF 4 / ORF 5 Vehicle monitoring web-server provides the best accuracy of reports on movement tracking and fuel consumption monitoring.
ORF 4 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.

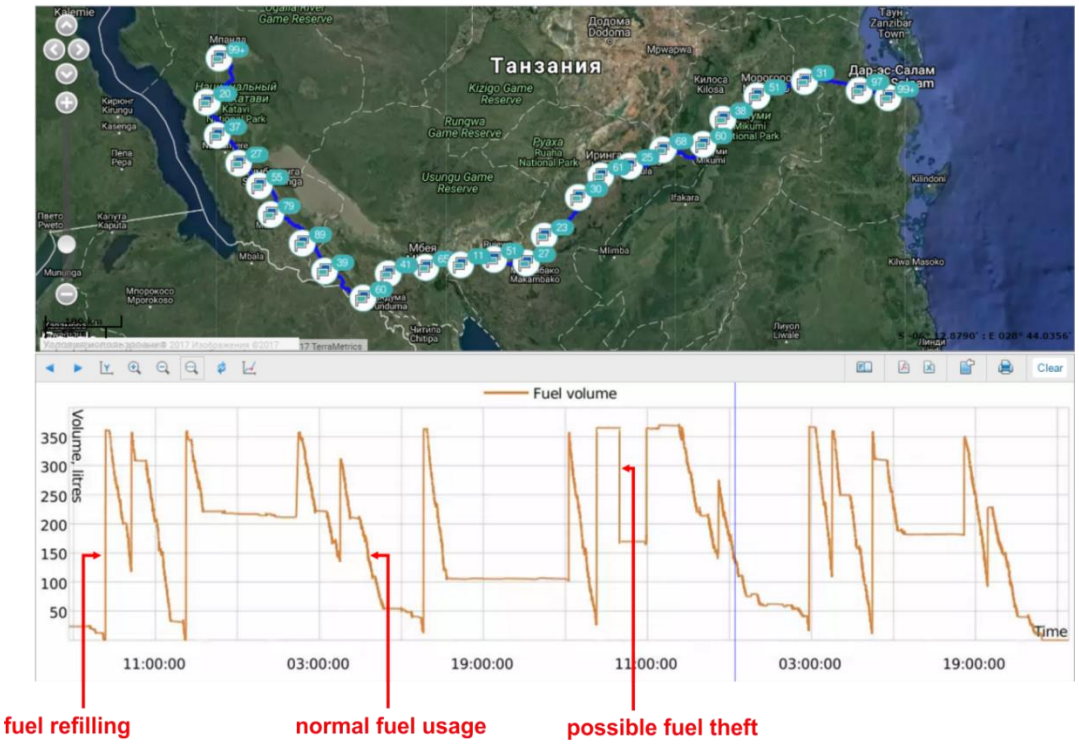


Figure 5 — Example of Analytical report generated in ORF 4 software, based on the DUT-E 2Bio data

2) DUT-E Bio is used for fuel monitoring of stationary objects (in tanks, storages, cisterns), including operation without Server (autonomous solution for fuel monitoring) (see figure 6).
Interface CAN j1939/S6 allows to connect by S6 Technology simultaneously up to 16 fuel level sensors DUT-E 2Bio CAN* to Online telematics gateway CANUp 27 Pro. Integrated application with fuel flow meters DFM CAN (up to 16 units) is convenient complex solution for fuel monitoring at fixed installations (diesel generators sets, boiling/burning equipment), which does not require Server and paying for services. CANUp 27 automatically sends Reports on Events to user directly by e-mail (up to 3 e-mail addresses) or as SMS messages (up to 3 phone numbers).

* For DUT-E 2Bio CAN with the version of firmware not lower than 7.19, in case of using Service S6 DUT-E software, version from 5.16 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.

DUT-E 2Bio CAN connected to Online telematics gateway CANUp 27 by S6 Technology makes possible to control in real time:

- fuel tank level and volume;
- total volume of fuel in up to 8 tanks and a separate volume of fuel in each tank;
- determine exact refueling amount;
- reveal fuel theft facts;
- fuel type in use;
- fuel temperature;
- sensor specification data (passport);
- presence of water in fuel;
- sensor malfunctions;
- the fact of movement and the Vehicle pitch angles.

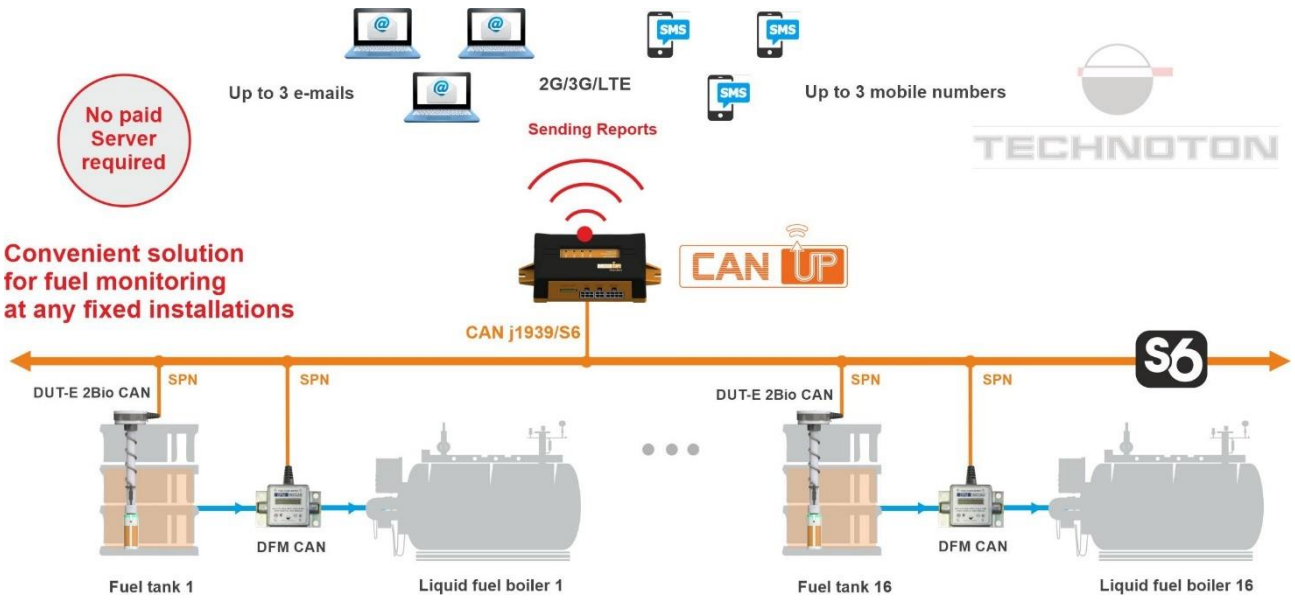
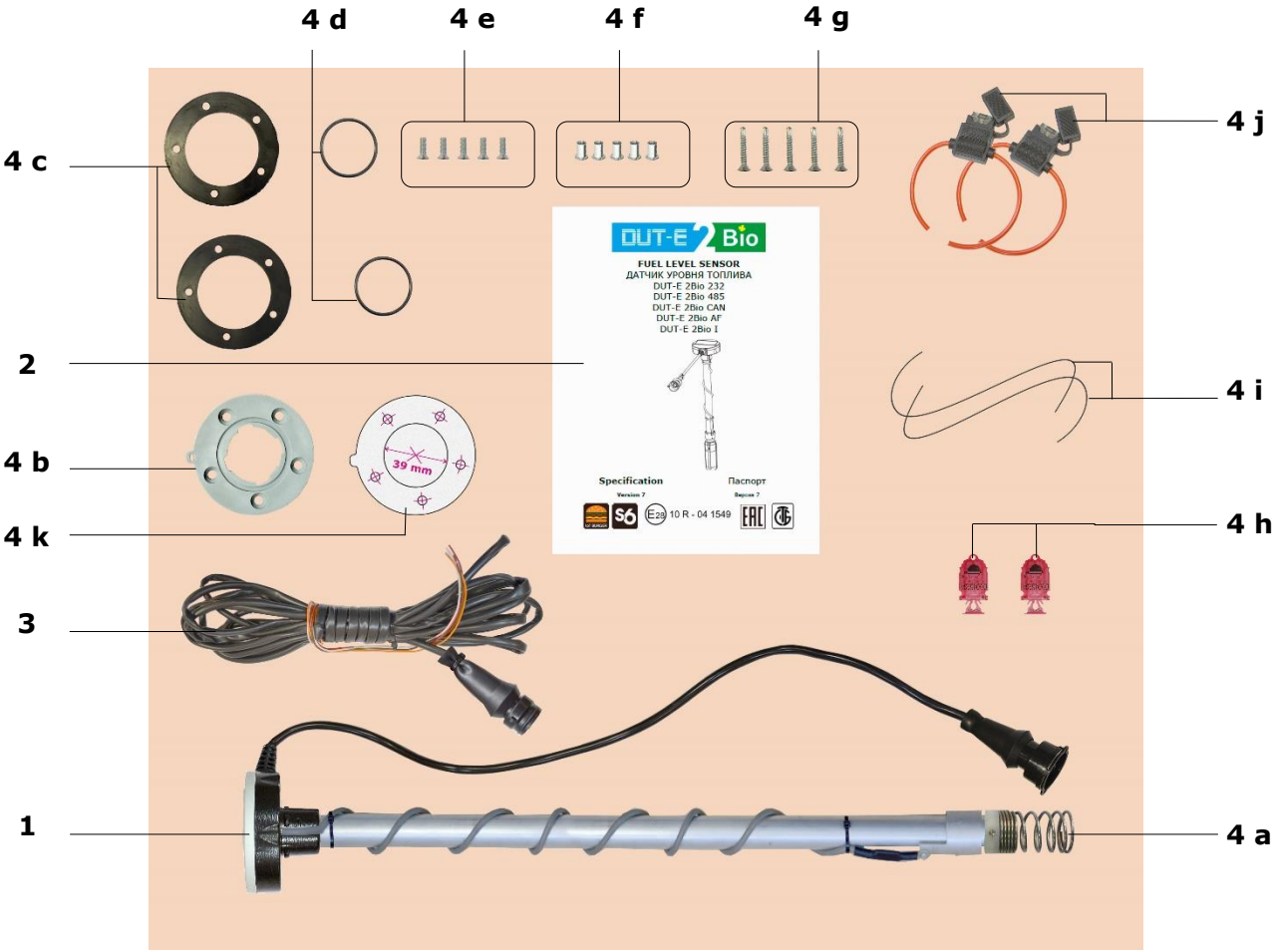


Figure 6 – Using DUT-E 2Bio CAN by S6 Technology on stationary objects

1.2 Exterior view and delivery set



1	- DUT-E 2Bio fuel level sensor	– 1 pc.;
2	- Specification with factory settings sheet	– 1 pc.;
3	- 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.

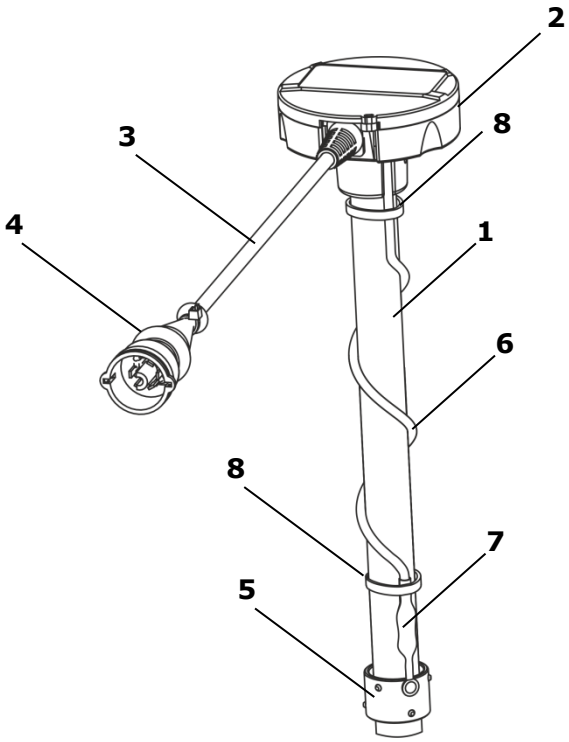
Figure 7 — DUT-E 2Bio delivery set

* Ordered separately for DUT-E 2Bio CAN (S6 SC-CW-700 or S6 SC-Mol-300/700, see annex H).

** 1 pc. is for initial DUT-E 2Bio 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 DUT-E 2Bio design



1 - measuring part of the sensor composed of two coaxial tubes that form condensate coating. Changes of sensor electrical capacity depend on the diving depth of measuring probe into fuel (dielectric liquid according to its properties);
2 - measuring «head», where electrical sensor module is built inside;
3 - interface cable of sensor;
4 - connector for electrical connection of sensor to onboard network and Telematics unit;
5 - additional electrode for function of automatic fuel correction in real time (when chemical composition or type of fuel is changed).
Additional electrode should always be immersed in fuel and its upper edge should be 9…10 cm from the end of main measuring probe.
6 - cable of additional electrode for connection with electrical sensor module;
7 - temperature sensor for precision measurement of current fuel temperature;
8 – cable ties for fixing the cable of additional electrode.

Figure 8 — Structure of DUT-E 2Bio

1.4 Technical specifications

DUT-E 2Bio is powered by on-board power supply of the Vehicle where it is installed.

DUT-E 2Bio can be used in the conditions of temperate and cold climate.

For resistance to mechanical impact DUT-E 2Bio is shake and shockproof.

1.4.1 Main specifications

Table 1 — DUT-E 2Bio main specifications

Parameter, measuring unit	Value
Working fluid	Summer/winter diesel/biodiesel/ kerosene/mineral oil*
Fuel level sensor operating principle	Capacitive
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	50/25 150/75**
Maximum trimming of the measuring probe***	to any the length required
Maximum length increase, mm, not more than***	6000****
Temperature range, °C	-40…+85
Ingress protection rating	IP55/IP57
Electromagnetic compatibility	see annex G
Weight, kg, not more than	1.0 (at L=1000 mm) 0.9 (at L=700 mm)
Overall dimensions, mm, not more than	see figure 9

* The sensor is allowed to operate using other types of fuel (e.g. gasoline). 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.

** For DUT-E 2Bio CAN.

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

**** For manufacturing upon special order. For standard product versions — according to formula 1.

1.4.2 Specifications of DUT-E 2Bio CAN output signal

Specifications of CAN j1939/S6 DUT-E 2Bio CAN digital interface correspond to S6 Technology. The data transfer protocol is based on SAE j1939 standard and meets its requirements.

The composition of DUT-E 2Bio CAN output data transmitted via CAN j1939/S6 interface is provided in annex C.

The configuration of CAN j1939/S6 interface parameters by the user is conducted via K-Line interface (ISO 14230) using Service S6 DUT-E service software or Service S6 DUT-E (Android) service mobile application (see 2.12).

Data transfer is conducted automatically and upon request. Baudrate can be selected from the range of fixed values: 100; 125; 250; 500; 1000 kbit/s (by default — 250 kbit/s).

S6 Technology enables to connect up to 16 pcs. fuel level sensors with CAN j1939/S6 interface at one time to form a single network S6 (DUT-E CAN / DUT-E 2Bio CAN / DUT-E GSM). For each connected sensor a unique network address (SA) must be specified from the ranges: basic — 101…108 (by default — 101) and additional — 91…98*.

S6 Technology enables to sum up readings of up to 8 pcs. DUT-E 2Bio CAN fuel level sensors (see 2.15). For each connected sensor you are to specify a unique network address from the range 101…108.

IMPORTANT: The obligatory condition for correct transfer of DUT-E 2Bio CAN data via CAN j1939/S6 interface is the availability of two **120 Ohms** terminal resistors at both ends of CAN 2.0B (SAE j1939) communication line between CAN LOW and CAN HIGH wires.

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* You may specify addresses from the range 91…98 only for sensors with the version of firmware not lower than 7.16, when using Service S6 DUT-E software, version from 5.12 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.

1.4.3 Specifications of DUT-E 2Bio 232/485 output signal

Digital interfaces of DUT-E 2Bio 232 and DUT-E 2Bio 485 sensors correspond to RS-232 and RS-485 standards respectively.

It is possible to connect simultaneously 1…4 DUT-E 2Bio 485* fuel level sensors to the Telematics terminal via RS-485 interface.

It is possible to connect no more than one DUT-E 2Bio 232 fuel level sensor to the Telematics terminal via RS-232 interface.

DUT-E 2Bio 232/485 sensors support the transmission of data:

- According to Modbus RTU protocol, in the «request-response» mode (see annex D).
- According to DUT-E COM Protocol (extended LLS) in the «request-response» modes and automatic deliverance (ASCII/ASCII EXT/HEX).

In accordance with DUT-E COM protocol, the data may be transmitted in the form of:

- dimensionless units, from 0 to 1000 (0 – empty tank, 1000 – full tank);
- fuel level in the tank, mm;
- volume of fuel, l;
- volume of fuel related to the full tank, %.

Examples of the sensor settings for data transfer according to ASCII text protocol with examples of data display are provided in annex E.

Besides the data on the fuel level in the tank, DUT-E 2Bio 232/485 transmit data on the current fuel temperature.

The selection of the required data transmission mode and the user configuration of parameters of DUT-E 2Bio 232/485 digital interface are conducted using Service S6 DUT-E service software or Service S6 DUT-E (Android) service mobile application (see 2.13).

You can configure the summarization of indications of up to 8 DUT-E 2Bio 232 sensors and of up to 4 DUT-E 2Bio 485 sensors (see 2.15). For each connected sensor you are to specify a unique network address from the range 101…108.

***** The maximum number of devices manufactured by Technoton (DUT-E 2Bio 485, DUT-E 485, DFM 485) simultaneously connected to the Telematics terminal by means of RS-485 interface — no more than 4 pcs, in any combination of types of devices.

1.4.4 Specifications of DUT-E 2Bio AF output signal

DUT-E 2Bio AF sensor has an analog or frequency output which is configured via K-Line interface (ISO 14230) using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (see 2.14).

Output signal of DUT-E 2Bio 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 2Bio 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 2Bio 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 2.15).

Table 2 — Specifications of DUT-E 2Bio 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.

1.4.5 Specifications of DUT-E 2Bio I output signal

DUT-E 2Bio I has current output signal, which is configured via K-Line interface (ISO 14230) using Service S6 DUT-E service software or Service S6 DUT-E (Android) service mobile application (see 2.14).

Output signal of DUT-E 2Bio I 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 bit.

Depending on configuration, DUT-E 2Bio I sensor's output can represent:

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

You can configure the summation of readings of up to 8 DUT-E 2Bio I fuel level sensors at a maximum (see 2.15). For each sensor a unique network address from 101 to 108 should be specified.

Table 3 — Specifications of DUT-E 2Bio I output signal

Parameter, measuring unit	**Value***
Range of current change, mA	4.0…20.0
Maximum input resistance of connected device, Ohm, not more than	(U_{PS}-5 V)/0.02**
* The values are applicable for sensor with standard measuring length. In case of changing probe length (cutting/extending) sensor calibration should be carried out. ** U_{PS} – power supply voltage (onboard network).	

1.4.6 Sensors and tracking devices compatibility

DUT-E 2Bio can be used together with Telematics terminals or other tracking devices whose inputs are compatible with parameters of the sensors' output signals, in accordance with 1.4.2, 1.4.3, 1.4.4, 1.4.5.

Technoton regularly conducts compatibility and mutual accuracy tests for sensors and different models of Terminals.

The table containing the up-to-date list of Declarations of compatibility of Telematics terminals from different manufacturers with DUT-E 2Bio sensors and other equipment produced by Technoton is available at https://www.jv-technoton.com/.

Recommendations on the equipment connection and configuration can be obtained at the Technoton Technical support service.

1.4.7 Overall dimensions

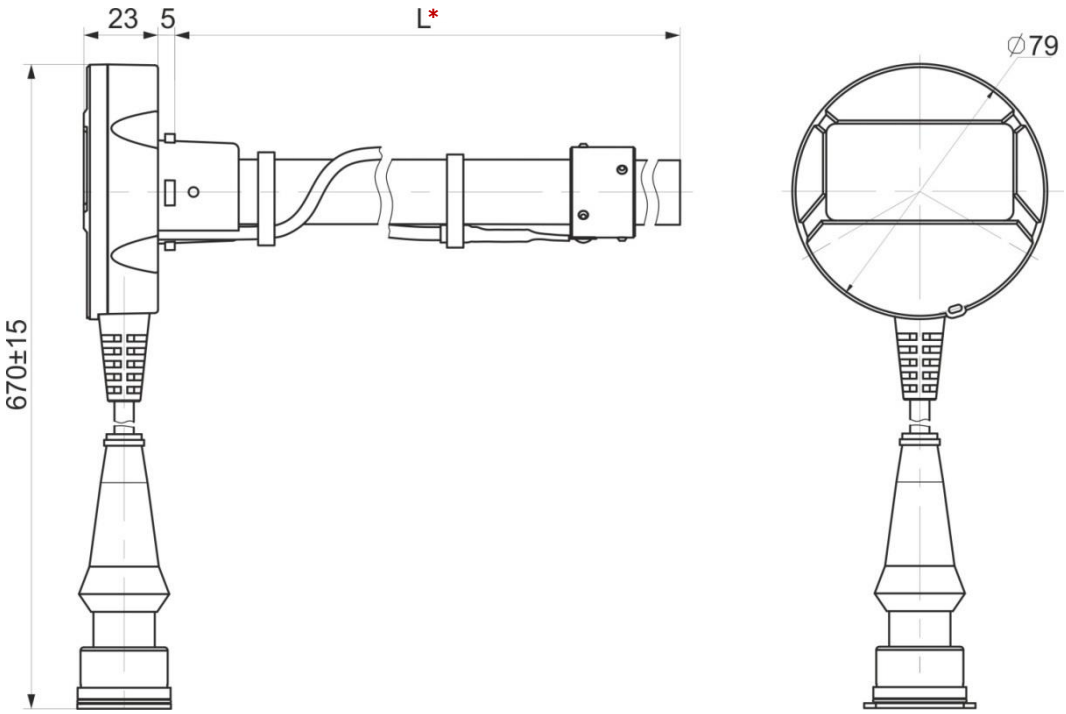


Figure 9 — DUT-E 2Bio overall dimensions

* Nominal measuring probe length: 700 or 1000 mm.

2 DUT-E 2Bio installation

For DUT-E 2Bio correct operation its mounting and configuration should be carried out by certified specialists who have passed corporate technical training.

ATTENTION: Strictly follow safety rules of automobile repair works as well as local safety rules of the customer company when mounting sensor.

Detailed recommendations on DUT-E 2Bio installation can be found in DUT-E/DUT-E 2Bio/ DUT-E GSM/DUT-E S7 installation manual.

In the DUT-E fuel level sensor installation video you can see the general order of sensor installation

2.1 Exterior inspection prior to works start

It is necessary to conduct DUT-E 2Bio 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 Probe cutting according to tank depth

ATTENTION: Cutting **the measuring probe to any length required** is allowed for DUT-E 2Bio, **with subsequent obligatory sensor calibration**.

DUT-E 2Bio cutting procedure instructions:

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 the lower cable tie that fix the cable of additional electrode. Slide additional electrode to the measuring "head" of the sensor to avoid damaging the additional electrode cable while cutting the sensor

3) Cut the measuring part of DUT-E 2Bio with metal hacksaw. Carefully clean sensor edges after cutting and wash in fuel. Equally wrap the cable of additional electrode around tubes of measuring probe and fix it with new cable tie.

IMPORTANT: When cutting DUT-E 2Bio, to ensure proper operation of automatic fuel correction function it is necessary to leave a distance of **9…10 cm** from upper part of third electrode to the cut of measuring tubes (see figure 10).

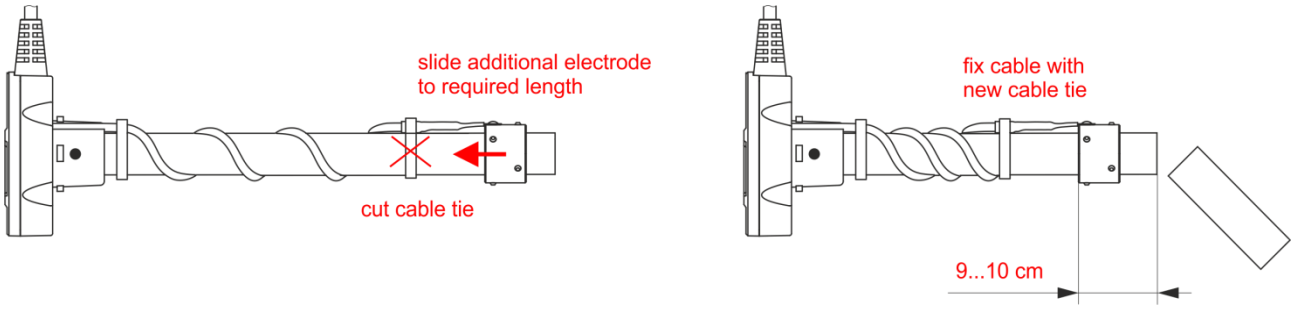


Figure 10 — Measuring tube cutting procedure for DUT-E 2Bio

4) DUT-E 2Bio require min/max calibration with the service software or the service mobile application after being cut (see 2.9).

2.3 Length extension

Length extension is performed by fastening KDC additional sections to the measuring probe of DUT-E 2Bio (see figure 11 and DUT-E Length extension with KDC video).

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

DUT-E 2Bio with the measuring probe extension to any length up to **6000 mm** can be manufactured upon special order.

The maximally allowed measuring probe length extension for **standard modifications** of DUT-E 2Bio limited by the additional electrode cable length is calculated according to the formula (1):

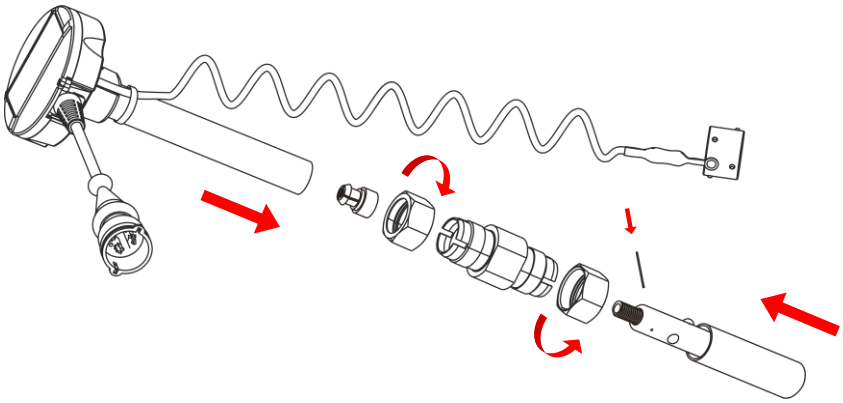
$$L_{max}=1,7 \cdot L \qquad (1)$$

where **L** – nominal length of the sensor measuring probe (see figure 9).

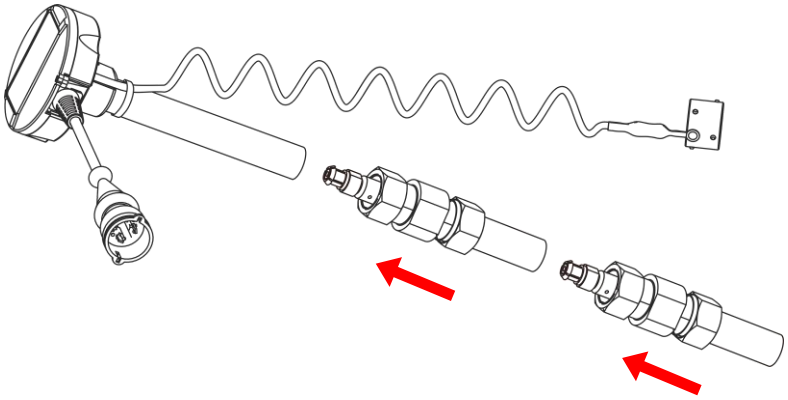
To increase the length of sensor take off additional electrode together with its cable from the measuring probe. After fixing the additional sections place additional electrode to the end of measuring probe and equally wrap the cable around the tubes.

IMPORTANT:
1) When fixing 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**.
2) For proper functioning of automatic fuel correction the distance between the upper edge of additional electrode and the end of DUT-E 2Bio measuring probe should be **not more than 10 cm**.

a) KDC exterior view



b) fastening order of one section



c) fastening order of two sections

Figure 11 — Fastening of additional section KDC

KDC additional sections can be cut to necessary size. Follow instructions of clause 2.2 when cutting the sections.

After extending the sensor probe length, you have to conduct its calibration using the service software or mobile application (see 2.9).

2.4 Screen-filter mounting

Screen filter (ordered separately) is mounted on the measuring probe tubes of DUT-E 2Bio to protect measuring probe electrodes from mud and water. Using the filter extends significantly faultless lifetime of the sensor (see DUT-E screen filter video).

Screen filter mounting order: Firstly, slide additional electrode upper by 9…10 cm from the end of measuring probe. Put on fixator, then put on bottom stop and fix it with two side screws. Put the screen filter over the bottom stop and fasten it with fixator locks (see figure 12).

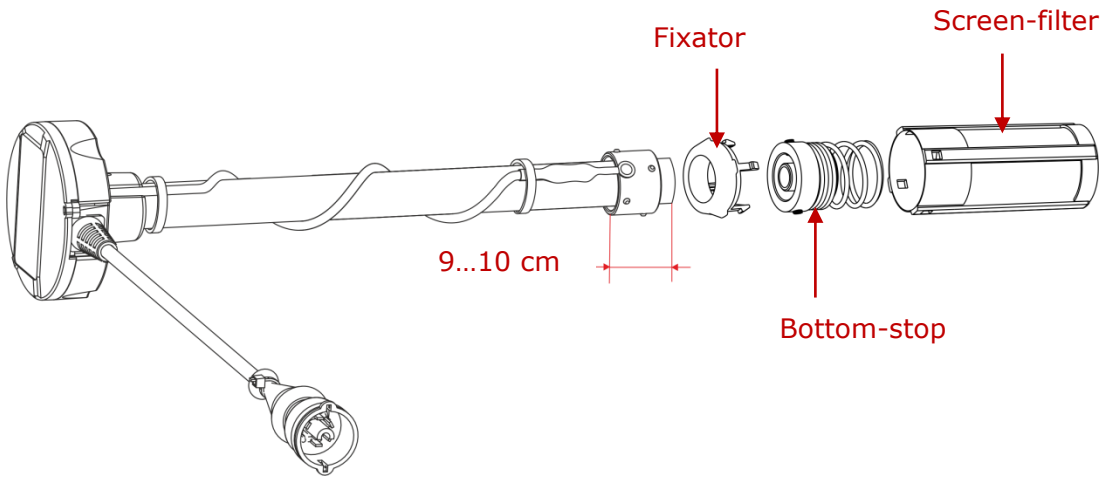


Figure 12 — Screen-filter mounting

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

2.5 Sensor configuration by means of cable connection to the PC

DUT-E 2Bio setup is conducted via K-Line 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 2Bio make sure there are no sources of electromagnetic enterference 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://www.jv-technoton.com/ (section Software/Firmware) and install it to PC:

- USB driver;
- Service S6 DUT-E software.

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 that meets the following minimal requirements is installed:
- Windows 7/10 operating system of X32/X64 bit depth;
- CPU — Intel Core i3, dual-core, 2.0 GHz;
- RAM — 4 Gb;
- availability of USB 2.0 port;
- display resolution 1366x768.

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

See annex B for DUT-E 2Bio settings, displayed and/or made by Service S6 DUT-E software.

2.5.1 Connecting sensor to PC

ATTENTION: Prior to connecting DUT-E 2Bio 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 2Bio, 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 2Bio installed on Vehicle. When configuring sensors connected by S6 Technology, power supply of onboard network (battery) can be turned on.

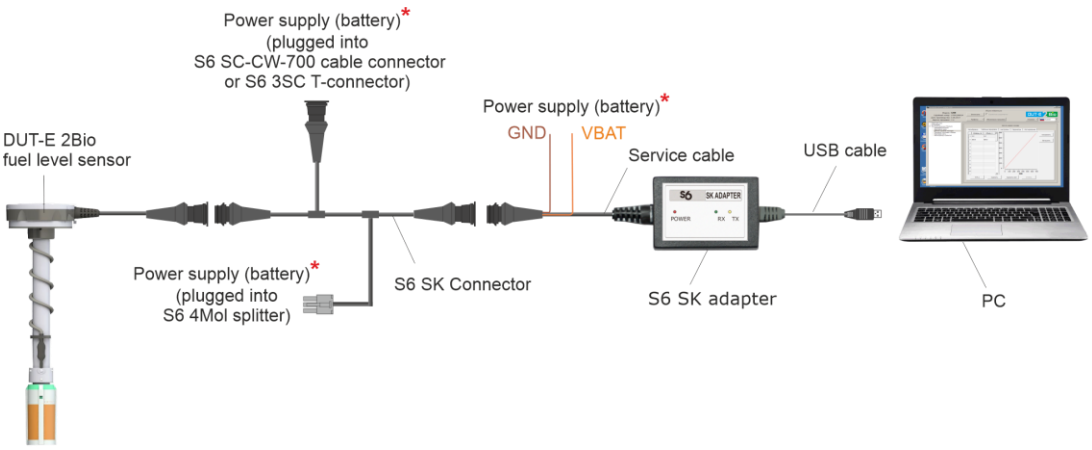
DUT-E 2Bio sensors are connected to PC according to the connection schemes (see figure 13) in the following order:

1) Connect the adapter to DUT-E 2Bio.
- 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 (see figure 13 a).
  Note — During the setup you need to provide power supply for the sensor and adapter either from the accumulator battery, or from the power source. Power supply is provided through any of the free connectors of the connection cord.
- During the configuration of DUT-E 2Bio CAN which operates within the network of Units based on S6 Technology we recommend to plug the connector of the adapter service cable into the break in S6 cable system using S6 SK connector instead of any S6 3SC T-connector. In this case, power for the Unit and adapter is supplied through S6 cable system (see figure 13 b).

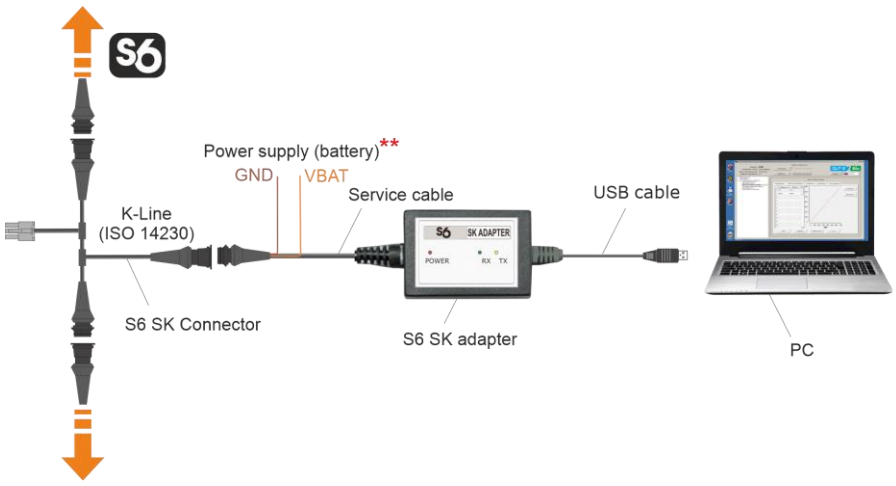
2) Plug the adapter to free USB port of PC with the USB cable.
Note – it is allowed to connect adapter to USB-port of your PC after turning on power supply of sensor and running Service S6 DUT-E software.

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

4) Power on the vehicle (battery).



a) connecting DUT-E 2Bio CAN/232/485/AF/I sensor using S6 SK



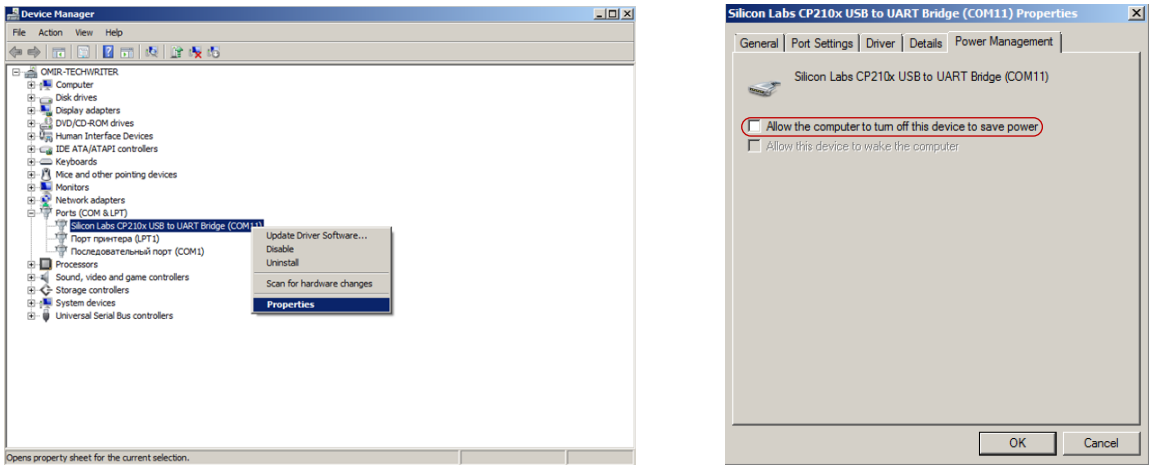
b) connecting DUT-E 2Bio CAN sensor using S6 SK via S6 Technology

Figure 13 – Schemes of DUT-E 2Bio connection to PC

* For connecting power supply (battery) you can choose any of marked places.
** No need to connect. Power supply (battery) is carried out though S6 cabling system.

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 14).

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 14 b).



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

Figure 14 — Setting up a virtual COM-port in the Device Manager

Service adapter is ready to use since the power is on. See table 4 for signal description of LED indicators located on the adapter.

Table 4 – 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 2Bio data is being received
	No signal		No data from DUT-E 2Bio
TX		Yellow	Data is being transmitted to DUT-E 2Bio
	No signal		No data to DUT-E 2Bio

2.5.2 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 15).

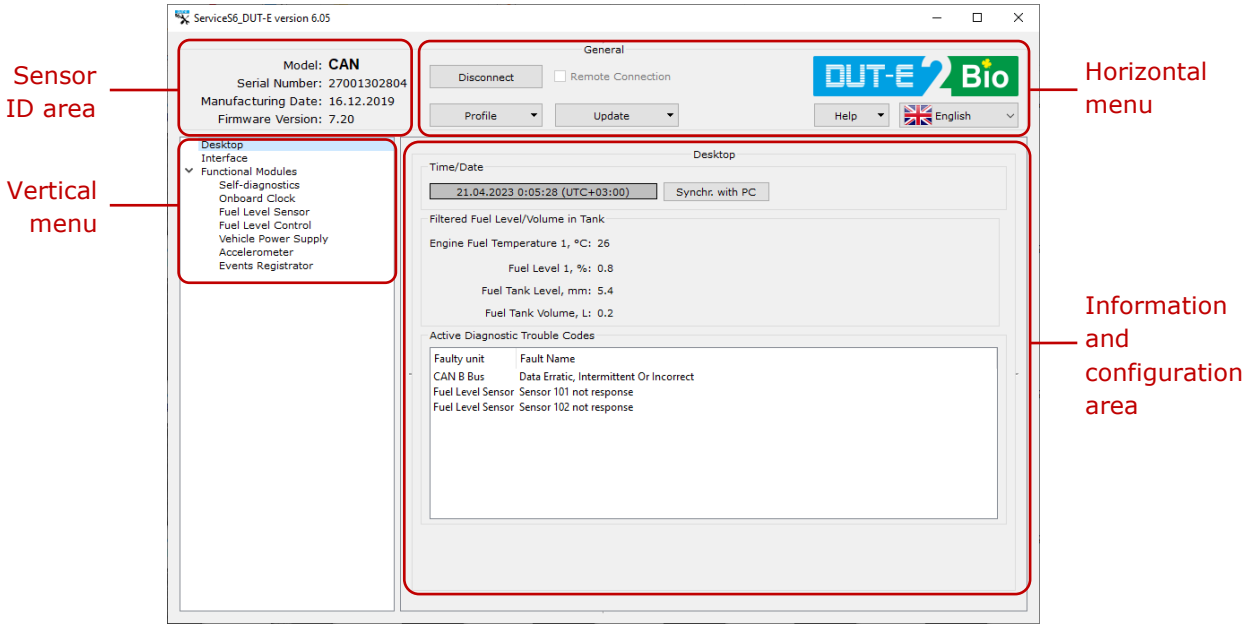


Figure 15 — Interface of Service S6 DUT-E

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 Internet access);
- selection of interface language;
- help and information about the manufacturer.

Vertical menu is used for selection of Function modules of DUT-E 2Bio. 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 DB S6 button in the dropdown menu Update. The detailed description of S6 Database (further on — BD S6) can be found at http://s6.jv-technoton.com/ in S6 Data base section.

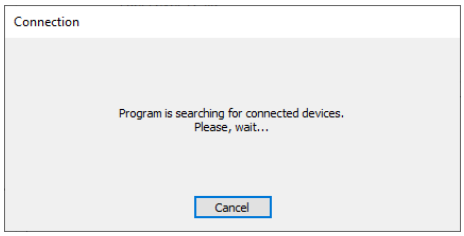
Information and Configuration area displays names (PGN) and parameters (SPN) of the messages. Each SPN holds the following: data range, discretion, measuring units.

2.5.3 Authorization

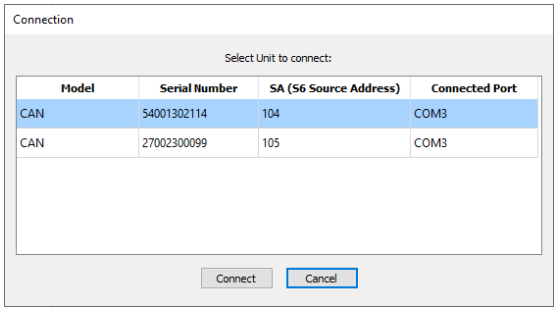
To enable connection between DUT-E 2Bio and PC, click the button Connect in **Horizontal menu**. Service S6 DUT-E software will search for the connected sensors (see figure 16 a).

When you connect Service adapter via S6 Technology, which contains more than one Unit, in the **Connection** window from the list choose the unit, that will be used with software and click the button Connect (see figure 16 b).

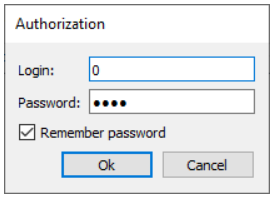
Enter Login and Password of the Unit into the appropriate fields of **Autorization** window. The default Login is **0**. The default password is **1111**. To save a new Password (to avoid entering the password again during connection next time), tick **Remember Password** (see figure 16 c).



a) search for the connected sensors to PC



b) selection of one of the Units connected to the bus S6 to work with software



c) user authorization

Figure 16 — 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 17). 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 2Bio 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.

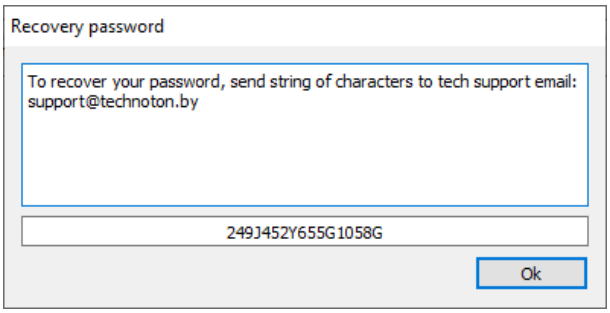


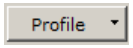
Figure 17 — Generating password recovery code

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 15). **Desktop** contains configuration and current parameters of Function modules of the connected sensor DUT-E 2Bio (see annex B).

2.5.4 Operations with the sensor profile

Sensor **profile** is set of PGN (passport data, counters and settings of Function modules of DUT-E 2Bio).

It is possible to manage the profiles in both the sensor DUT-E 2Bio connected and autonomous mode. The button 

with drop down menu is used to choose the options (see figure 18). 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.

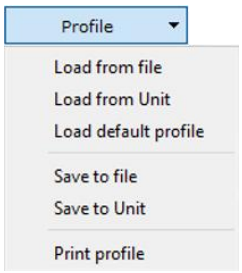
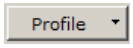


Figure 18 — View of Profile menu

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 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** (where * — type of output signal (CAN/232/485/AF/I) according to figure 1).
- Load from Unit — is used for loading profile from the connected sensor DUT-E 2Bio.
- 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 2Bio connection. The default file is stored in **DUT-E_*_default.prf** file, in the folder of installation 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 Unit.
  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 2Bio.

If the modified settings were not saved into Unit 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 2Bio.

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 2Bio serial number and date when file was created.

RECOMMENDATION: It is recommended to attach the hardcopy of the profile to DUT-E 2Bio specification to log the history of the settings and configurations.

2.6 Wireless configuration of sensor using Android devices

Wireless setup of DUT-E 2Bio 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 S6 application) to the Android device from Google Play (search request "Technoton").

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

Please, see in annex B configurations of DUT-E 2Bio that may be displayed and/or edited using S6 application.

2.6.1 Wireless connection of the sensor to the Android device

ATTENTION: Prior to connecting DUT-E 2Bio 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 2Bio, 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 2Bio installed on Vehicle.
When configuring sensors connected by S6 Technology, power supply of onboard network (battery) can be turned on.

The procedure for DUT-E 2Bio wireless connection to the Android device (see figure 19) is as follows:

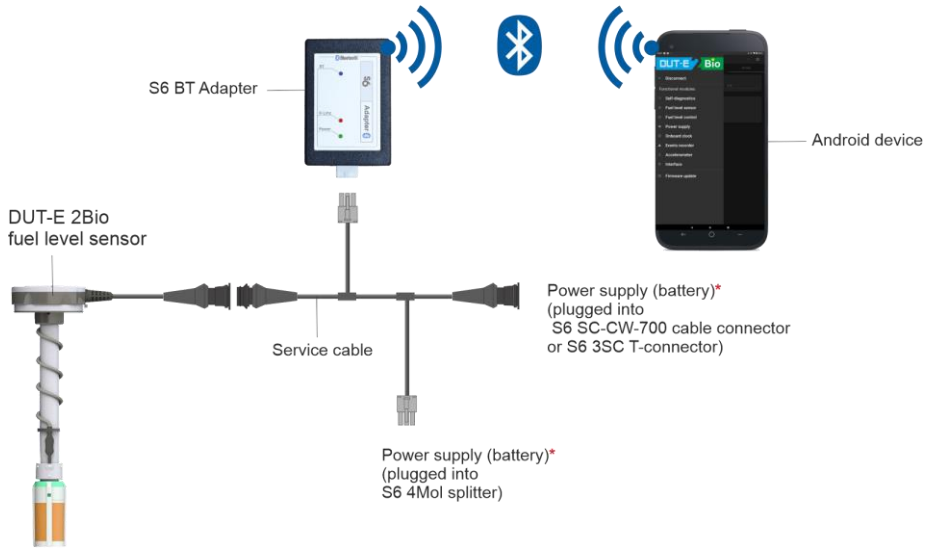
1) Connect the corresponding connector of the service cable to the connector of **S6** adapter.

2) Connect the adapter to DUT-E 2Bio:

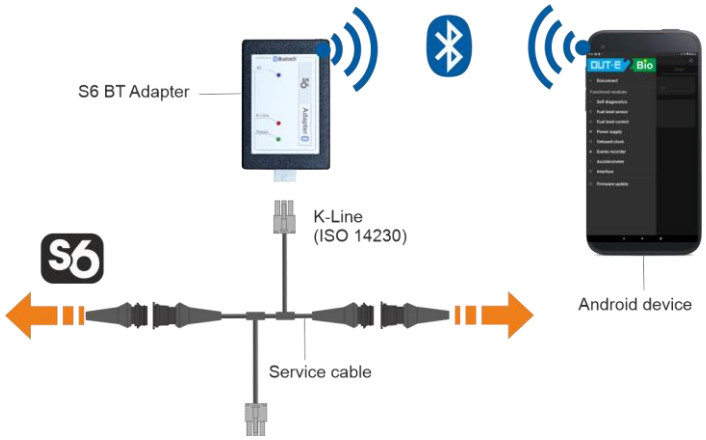
- The service cable connector is input to the interface cable connector of the sensor.
  Note — During the wireless configuration of DUT-E 2Bio you need to provide power supply for the sensor and the adapter either from the accumulator battery or from the power source. Power supply is provided through any of the free connectors of the connection cord (see figure 19 a).
- During wireless configuration of DUT-E 2Bio operating within the network of Units, according to S6 Technology, the service cable may be connected to the break in S6 cable system, instead of any S6 3SC T-connector. In this case, the sensor and adapter are powered through S6 cable system (see figure 19 b).

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.



a) connecting DUT-E 2Bio CAN/232/485/AF/I sensor using S6 BT Adapter



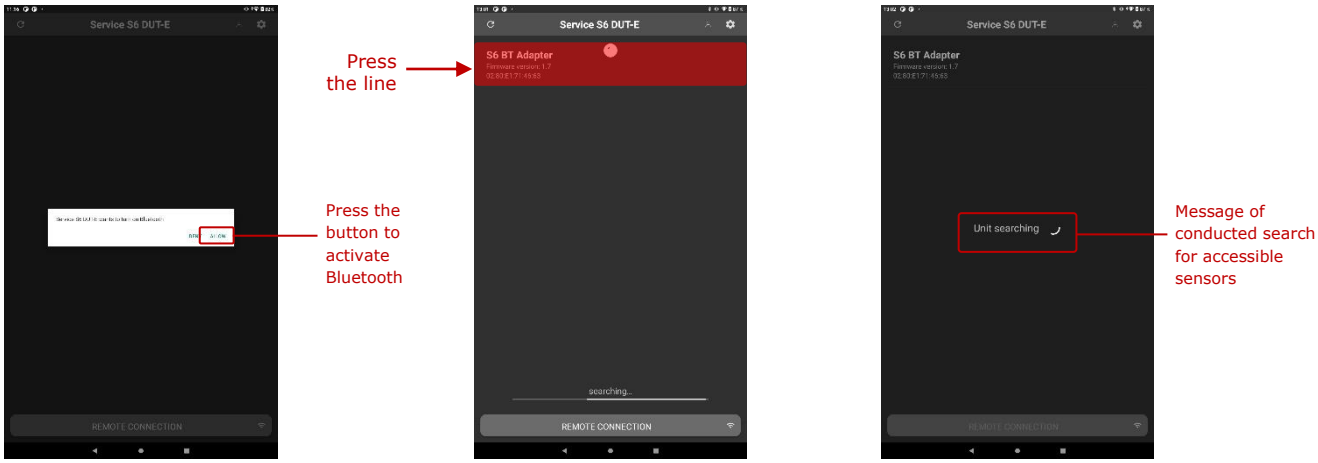
b) connecting DUT-E 2Bio CAN sensor using S6 BT Adapter via S6 Technology

Figure 19 — Schemes of wireless connection of DUT 2Bio to Android-based device

* 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 20).



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 20 — Example of establishing a wireless connection between DUT-E 2Bio and Android device

During the operation of S6 BT Adapter signals of LED indicators should comply with those indicated in table 5.

Table 5 – 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

2.6.2 Interface of S6 application

The interface of S6 application consists of **Information and Configuration Area** and **Tools Panel** (see figure 21).

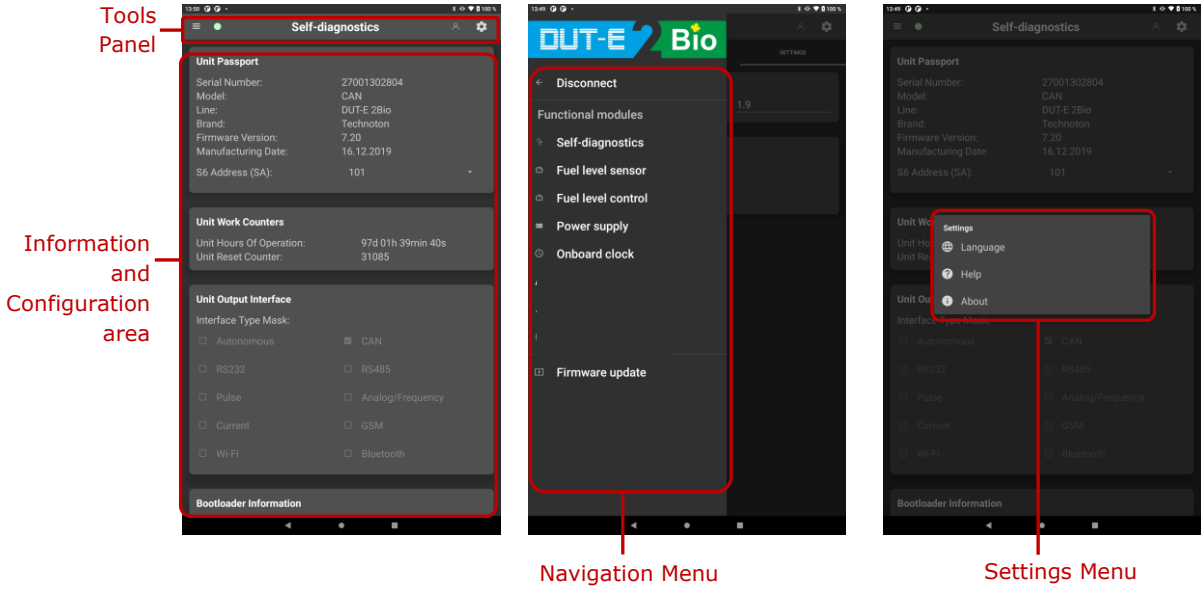


Figure 21 — Interface of Service S6 DUT-E service mobile application

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 S6 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.).

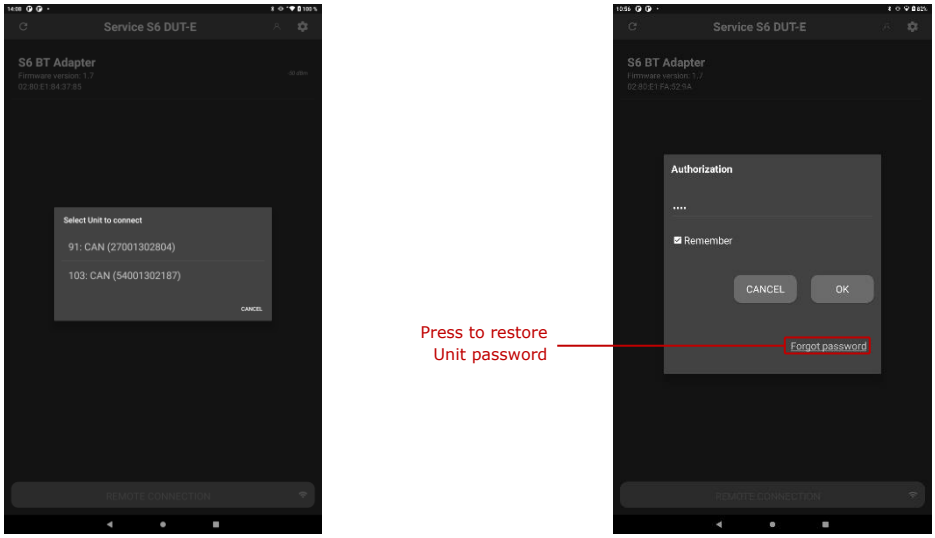
During its work with the FM DUT-E 2Bio, the application employs data (PGN and SPN) from S6 Database. The list of FM with SPN which are displayed and/or edited in the area **Information and settings** is provided in annex B.

2.6.3 Authorization

To establish a session of wireless connection between DUT-E 2Bio and the Android device, establish connection with **S6 BT Adapter**. The application will automatically detect accessible sensors (see figure 20).

While connecting S6 BT Adapter to the network consisting of several Units using S6 Technology, select the sensor required for use in the S6 application from the list displayed (see figure 22 a).

Enter the Unit 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 22 b).



a) select the required Unit for work with the application

b) enter the Unit password

Figure 22 — Establishing a wireless communication session between DUT-E 2Bio 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 2Bio 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 23). 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.

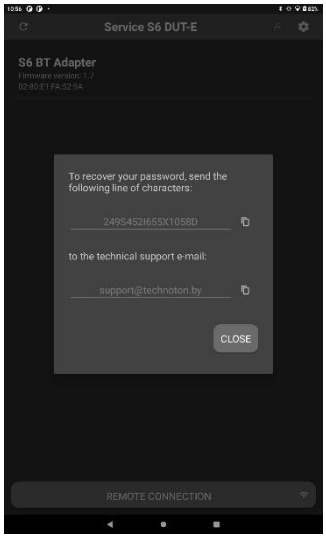


Figure 23 — Generated recovery code window

2.6.4 Operations with the sensor profile

Sensor **profile** is set of PGN (passport data, Counters and settings of Function modules of DUT-E 2Bio).

ATTENTION: Any operations with the DUT-E 2Bio Profile in the S6 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 2Bio to the PC using S6 SK and proceed in accordance with 2.5.4.

To perform any operations with the DUT-E 2Bio profile, the menu **Profile** is used which is opened by pressing the appropriate button on the **Tools Panel** (see figure 24).

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** (where * — type of output signal (CAN/232/485/AF/I) according to figure 1) .
- 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_*_default.prf** which is stored in the memory of the Android device.
- Print profile — is used for the profile printout in pdf file.

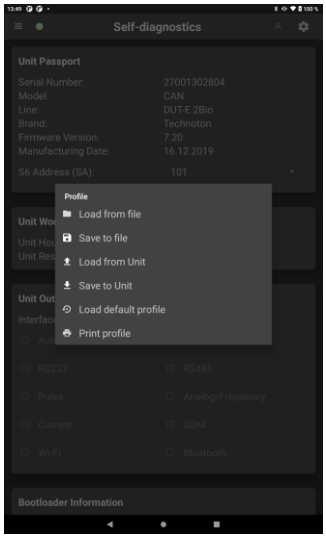


Figure 24 — View of Profile menu

2.7 Mounting

Recommendations on installation and fastening DUT-E 2Bio are the same as for “classical” DUT-E fuel level sensors and can be found in DUT-E/DUT-E 2Bio/DUT-E GSM/DUT-E S7 installation manual.

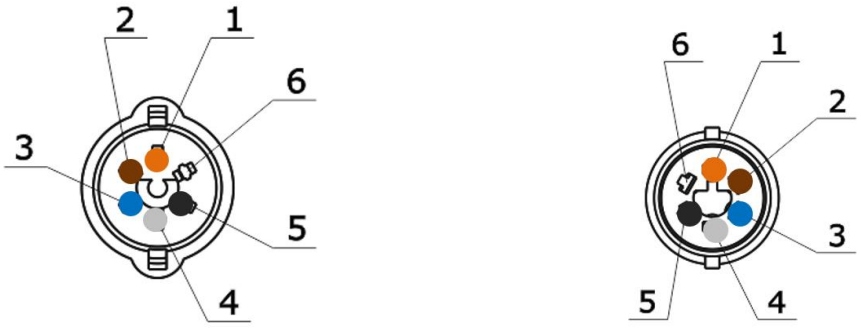
2.8 Electrical connection

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

DUT-E 2Bio is powered from the Vehicle onboard circuit.

In order to electrically connect the sensor, use **SC-CW-700-RS signal cable (7.0 m)*** (see the delivery set) in accordance with the pinout and designation of the connectors' contacts of the sensor (DUT-E 2Bio CAN/232/485/AF/I) interface cable (see figure 25 and table 6).

IMPORTANT:
1) Before mounting and connecting DUT-E 2Bio 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 2Bio to onboard electrical network of Vehicle, use **fuses** from delivery set in accordance to scheme of connection (see figure 26). 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 27).
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.



a) DUT-E 2Bio CAN/232/485/AF/I interface cable *b) SC-CW-700-RS signal cable*

Figure 25 — Connector pinout

* For DUT-E 2Bio CAN the signal cable (see annex H) is to be purchased separately.

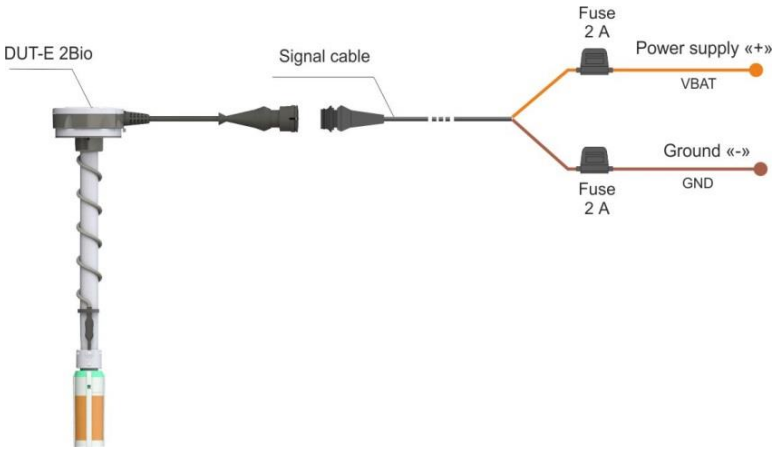


Figure 26 — DUT-E 2Bio CAN/232/485/AF/I to onboard electrical network scheme of connection

Table 6 — DUT-E 2Bio CAN/232/485/AF/I interface cable wires assignment

Pin number	Wire marking	Wire color***		Assignment
1	VBAT	Orange		Power supply "+"
2	GND	Brown		Ground "-"
3*	CANH/232TX/485B/OUT	Blue		CAN-High (SAE j1939)/ Data transmitted (RS-232)/ Exchange of data (RS-485)/ Output signal as described in 1.4.5
4**	CANL/232RX/485A/OUT	White		CAN-Low (SAE j1939)/ Data received (RS-232)/ Exchange of data (RS-485)/ Output signal as described in 1.4.4
5	KLIN	Black		K-Line (ISO 14230)

* Marking and designation of the wire are specified for DUT-E 2Bio CAN/232/485/I respectively.
** Marking and designation of the wire are specified for DUT-E 2Bio CAN/232/485/AF respectively.
*** Manufacturer reserves the right to modify wire colors, that is why pay attention to its marking

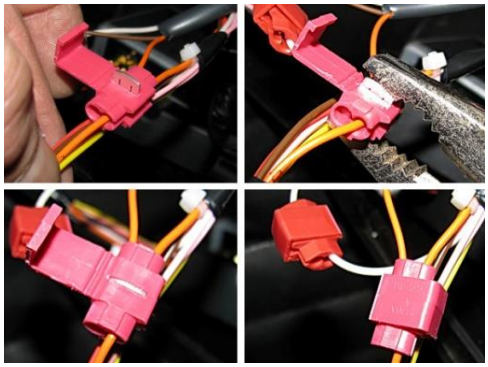


Figure 27 — Using connectors to connect wires of signal cable

Examples of DUT-E 2Bio CAN connection to Telematics terminals, with specification of models of cables which need to be ordered, are provided in annex I. See more examples in CAN j1939/S6 Telematics interface Operation Manual.

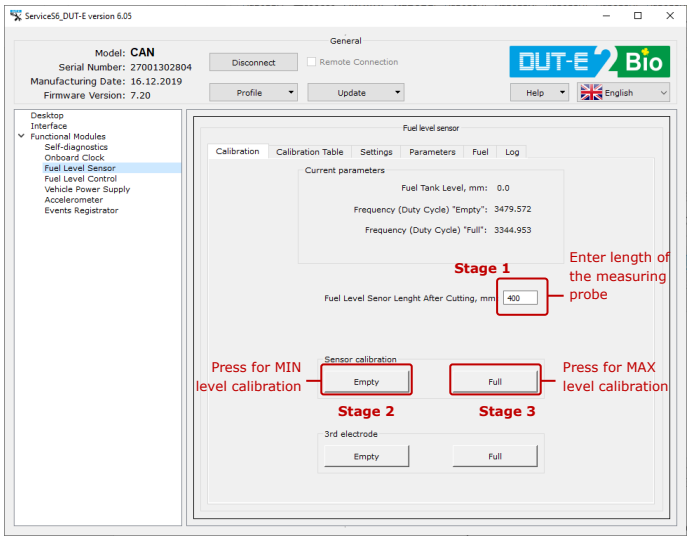
IMPORTANT: DUT-E 2Bio body is electrically connected to Ground "-" (brown wire of the connection cable). Electrical isolation between the DUT-E 2Bio body and the fuel tank is provided by the mounting plate made of dielectric plastic material.

2.9 Calibration

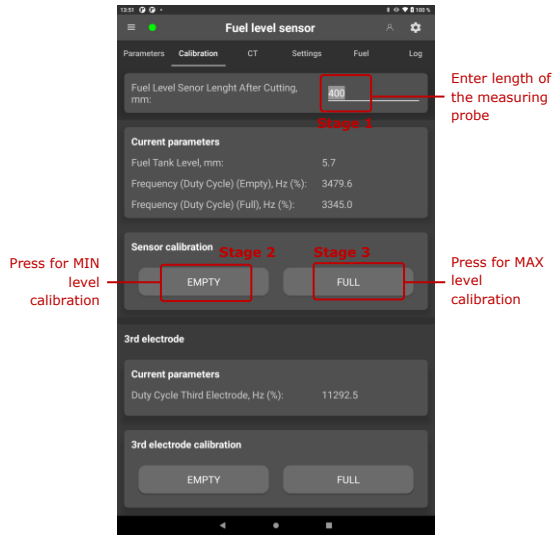
2.9.1 Sensor calibration

IMPORTANT:
1) Before you mount DUT-E 2Bio **in the tank, sensor calibration** for the specific type of fuel used **is obligatory**!
2) The sensor re-calibration is obligatory **after cutting/extension** of its measuring probe.

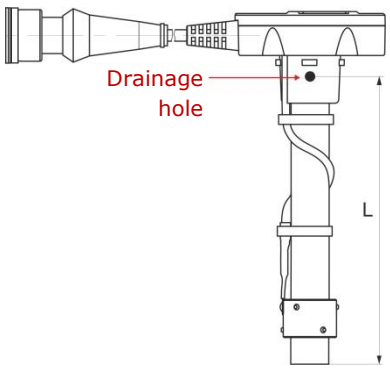
Calibration is required for correct operation of DUT-E 2Bio. In the process of calibration, the minimum and maximum levels of fuel in the tank of the Vehicle equipped are recorded using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (Fuel level sensor FM submenu, **Calibration** tab) (see figure 28).



a) in Service S6 DUT-E software



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



c) measuring probe length of sensor

Figure 28 — DUT-E 2Bio sensor calibration

For DUT-E 2Bio 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 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

In case of wireless sensor setting using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device using S6 BT Adapter (see 2.6.1). Establish the sensor connection with the Android device sensor via the Bluetooth channel (see 2.6.3).

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 28 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 (**Sensor Calibration** field).

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 (**Sensor Calibration** field).

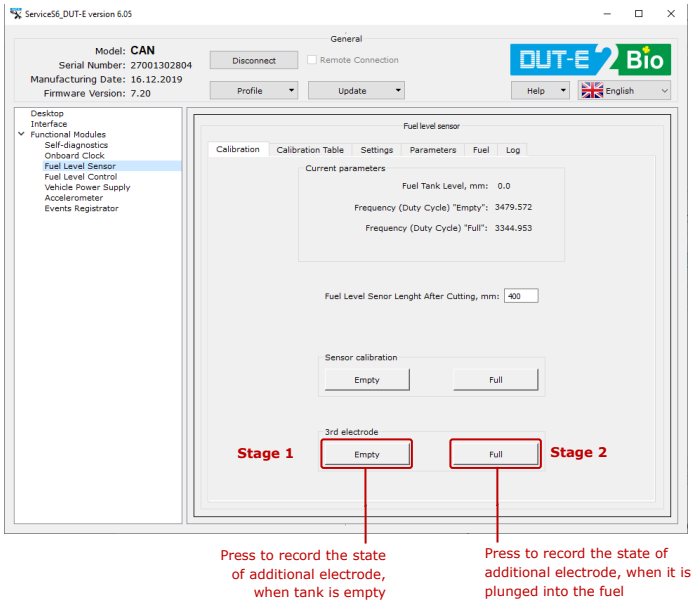
7) Calibration is finished. Save profile to sensor's memory.

2.9.2 Calibration of the additional electrode

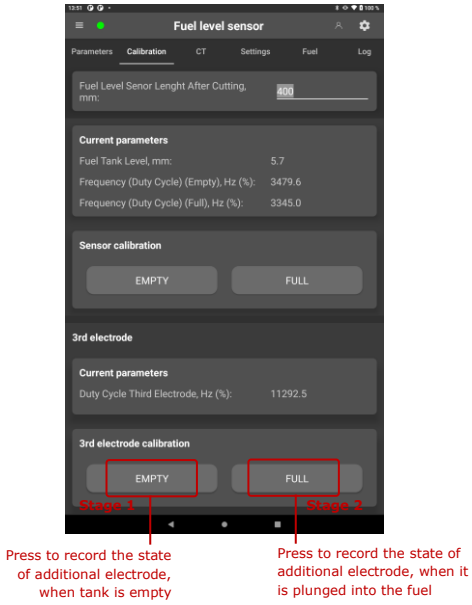
IMPORTANT: In order to receive correct measurement results with DUT-E 2Bio and for correct operation of the automatic fuel correction in conditions of a specific fuel tank, **by all means conduct the calibration procedure of the sensor additional electrode!** This procedure allows to eliminate the influence of the casing and the tank baffle plates on the frequency of DUT-E 2Bio measuring generator.

The calibration procedure for the additional electrode is possible only for DUT-E 2Bio CAN (firmware versions 7.14 and higher) and for DUT-E 2Bio 232/485/AF/I (firmware versions 1.20 and higher).

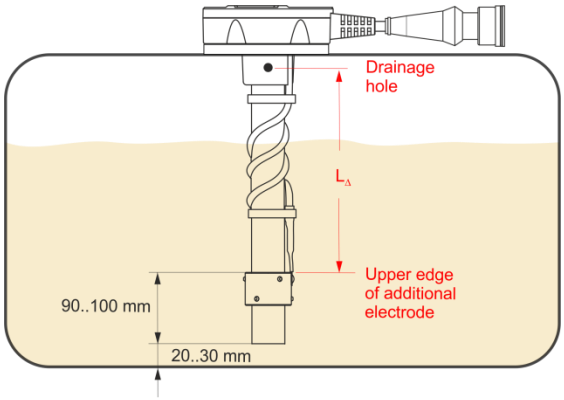
In the process of calibration, two states of the additional electrode — when the tank is empty, and when the electrode is plunged into the fuel, are recorded into the sensor memory using Service S6 DUT-E software (versions from 5.4 and higher) or Service S6 DUT-E (Android) mobile application (versions from 2.10 and higher) (Fuel level sensor FM submenu, **Calibration** tab) (see figure 29).



a) in Service S6 DUT-E software



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



c) allowed level of fuel in the tank during the calibration of the additional electrode for the maximum level

Figure 29 — Calibration of DUT-E 2Bio additional electrode

For calibration of DUT-E 2Bio additional electrode, you need to perform the following sequence of operations:

1) While using Service S6 DUT-E software, connect the sensor to the PC using S6 SK service adapter (see 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

In case of wireless sensor setting using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device using S6 BT Adapter (see 2.6.1). Establish the sensor connection with the Android device sensor via the Bluetooth channel (see 2.6.3).

2) Mount the sensor **in the specific fuel tank** in which it will operate according to its designated use.

3) To record the state of the additional electrode, when the tank is empty, you are to empty completely the tank of the Vehicle to be equipped.

Press **Empty** button in **3d electrode** field (when using Service S6 DUT-E software) or in **3d electrode calibration** field (when using Service S6 DUT-E (Android) application).

WARNING: During the recording of the state, when the tank is empty, the additional electrode must be dry and have no any remains of fuel on its surface.

4) To record the state of the additional electrode, when it is plunged into the fuel, you have to fill the tank with fuel to the any fuel level $\mathbf{L_{\Delta}}$ within the range from the additional electrode upper edge to the sensor drainage hole (see figure 29 c).

Press **Full** button in **3d electrode** field (when using Service S6 DUT-E software) or in **3d electrode calibration** field (when using Service S6 DUT-E (Android) application).

RECOMMENDATION: We recommend to record the state of the additional electrode, when it is plunged into the fuel, after the calibration procedure is completed, in the tank completely filled with fuel (see 2.10).

5) The calibration of the additional electrode is completed. Save the modified Profile in the sensor.

2.10 Fuel tank calibration table

DUT-E 2Bio recalculates the measured value of fuel level into the fuel volume in the tank according to the calibration table. To set up calibration table it is required to carry out **calibration of fuel tank**.

ATTENTION: Due to the unique DUT-E 2Bio function of automatic fuel correction **tank re-calibration is not required when dielectric constant of fuel is changed.**

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).

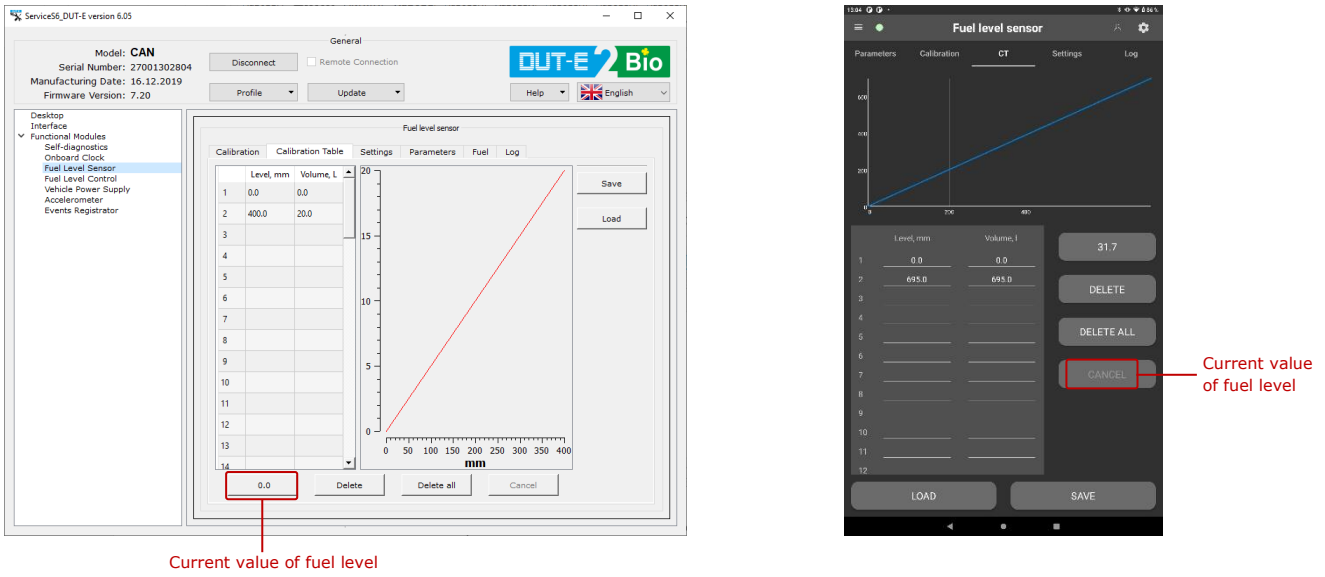
IMPORTANT: To measure the volume of fuel portions it is necessary to use measuring reservoir with inaccuracy not more than **0.25 %.**

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 2Bio using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile app (Fuel level sensor FM submenu, **Calibration Table** or **CT** tab respectively) (see figure 30).



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

Figure 30 — Making fuel tank calibration table

To record the calibration table using Service S6 DUT-E service software, connect the sensor to the PC using S6 SK service adapter (see 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

In case of wireless sensor configuration using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device using S6 BT Adapter (see 2.6.1). Establish a connection between the sensor and the Android device via the Bluetooth channel (see 2.6.3).

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: After the sensor mounting in the tank, the end of its measuring probe is located at a distance of 20…30 mm from the tank bottom. Some 10…30 l of the remaining fuel which is not consumed is usually left in this dead zone which is not accessible for monitoring. While creating the calibration table, we recommend to enter for its first point (level of 0.0 mm) the value of the fuel volume which is equal to the volume of not consumed fuel remaining in the tank.

- 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 J).

2.11 Adaptation of sensor to specific conditions of operation

Adaptation of DUT-E 2Bio 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 submenu, tab **Settings**) (see figure 31).

In case of using Service S6 DUT-E software, connect the sensor to the PC using S6 SK service adapter (see 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

In case of wireless sensor configuration using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device using S6 BT Adapter (see 2.6.1). Establish a connection between the sensor and the Android device via the Bluetooth channel (see 2.6.3).

There are the following settings for different conditions of the sensor operation:

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 (2):

$$K_{ther.corr.}=(-1)\cdot\frac{(V_{Tmax}-V_{Tmin})\cdot 100}{(T_{max}-T_{min})\cdot V_{Tmin}} \quad (2)$$

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).

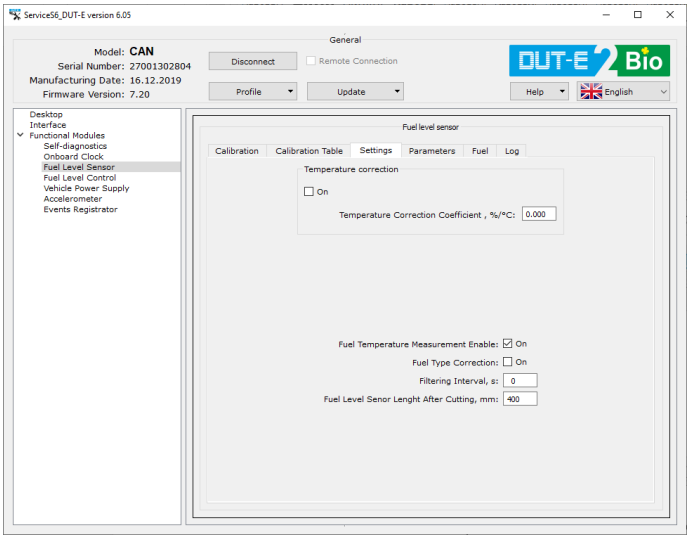
2) In the field **Filtering Interval, s** it is possible to set up time interval, preceding the data transmission, when fuel level value is smoothed during this interval. Parameter value range (by default it is 60 sec) is 0…300 with 1 s step.

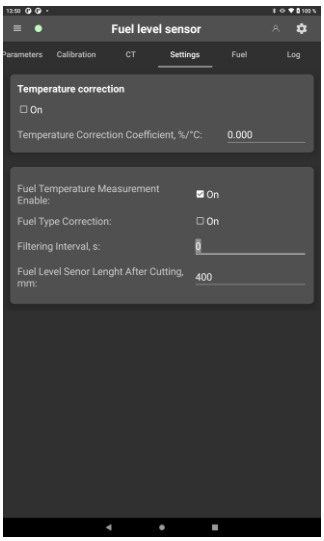
ATTENTION: Filtered information of fuel level in the tank transmitted by DUT-E 2Bio to Server is not instantaneous value. It is averaged value during some time interval. Filtration is important for DUT-E 2Bio mounted on vehicles operated on hilly surfaces (because of intense fluctuation of fuel level).

3) The field **Fuel Type Correction** is designed to activate the feature of automatic compensation of additional measurements error which appears due to the changing of the fuel dielectric permittivity in case a different grade of fuel is used or its chemical composition is changed.

4) The field **Fuel Temperature Measurement Enable** is designed to activate the feature of precise measurement of the current temperature of the fuel using the thermal sensor mounted on the additional electrode.

Save the changed Profile settings in the DUT-E 2Bio.





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

Figure 31 — Configurations for specific operation conditions

2.12 Connection parameters for CAN j1939/S6 interface

To connect DUT-E 2Bio CAN to external device by S6 Technology it is necessary to enter parameters of CAN j1939/S6 interface in submenu **Interface** in Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (see figure 32).

1) From **CAN Protocol Type** drop-down list, select **SAE 1939+S6** Data transfer protocol (SPN 521530) (installed by default).

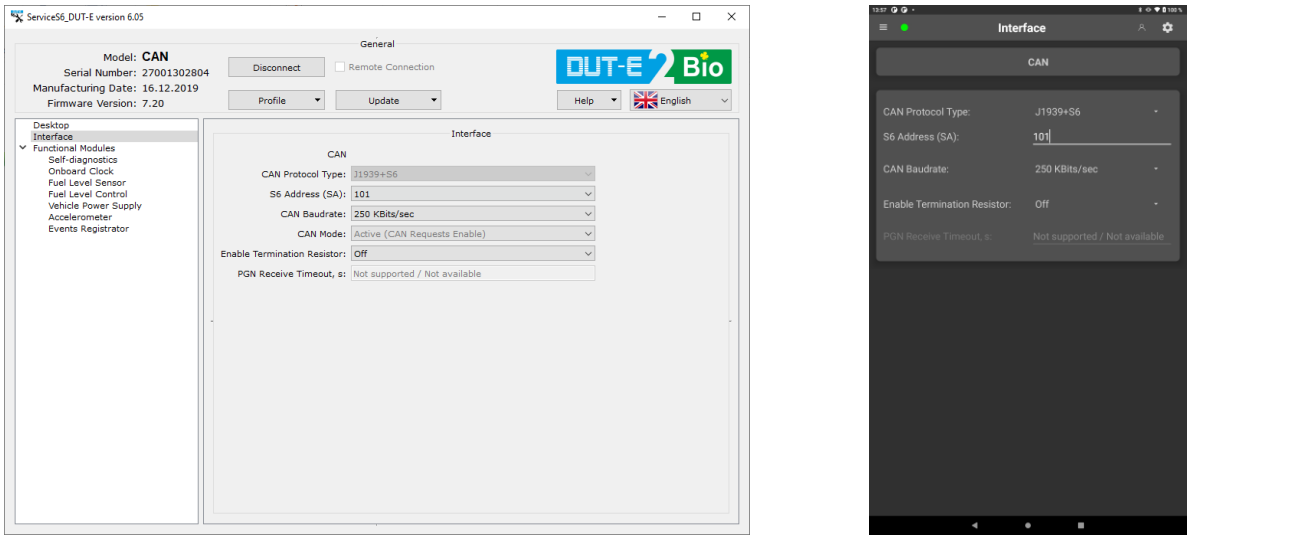
2) For the sensor identification within the network of several Units connected by means of S6 Technology, select the unique sensor network address in the dropdown list **S6 Address (SA)** (SPN 521188) from the range of fixed values*: **91**; **92**; **93**; **94**; **95**; **96**; **97**; **98**; **101**; **102**; **103**; **104**; **105**; **106**; **107**; **108** (by default — **101**).

Note — You can also change the sensor network address in the settings of Self-diagnostics FM submenu.

IMPORTANT: To be able to configure the summation of readings of several DUT-E 2Bio CAN, the sensors selected for summation (see 2.15) must be assigned network addresses only from 101…108 range.

3) From the dropdown list **CAN Baudrate** (SPN 521531) select Baudrate via CAN j1939/S6 interface from the range of fixed values: **100**; **125**; **250**; **500**; **1000 kbit/s** (by default — **250 kbit/s**).

4) Through **Enable Termination Resistor** (SPN 521533) drop-down list, turn on or off (by default - Off) built-in terminating resistor (120 Ohm) between the CAN LOW and CAN HIGH wires of DUT-E 2Bio CAN interface cable. Activation of the terminal resistor is the obligatory condition for correct data transfer via CAN 2.0B (SAE j1939) communication line.



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

Figure 32 — Configuration of the sensor connection parameters via CAN j1939/S6 interface

* You may specify addresses from the range 91…98 only for sensors with the version of firmware not lower than 7.16, when using Service S6 DUT-E software, version from 5.12 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.

2.13 Connection parameters for RS-232/RS-485 interface

To connect DUT-E 2Bio 232/485 to the external device, you should configure parameters of the RS-232/RS-485 in the **Interface** submenu (Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application) (see figure 33):

1) Select the data transfer protocol from the dropdown list **Output Protocol Type: Modbus** or **DUT-E COM** (by default — **DUT-E COM**).

For DUT-E COM protocol areas for additional settings are available:

a) In the field **RS Settings** you can select:

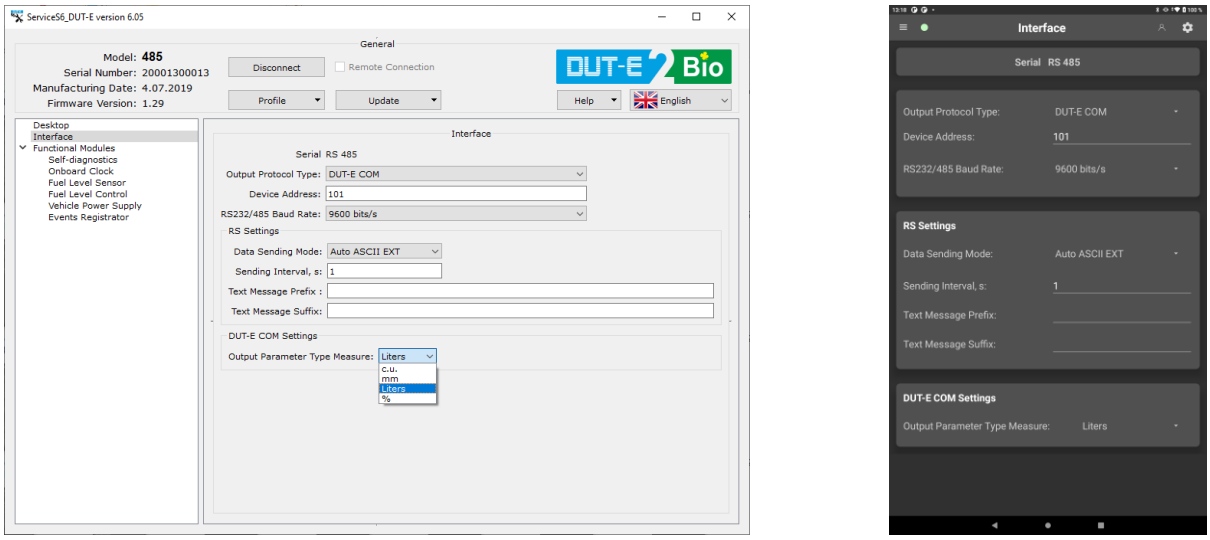
- Mode of the sensor outgoing messages transmission from the dropdown list **Data Sending Mode**:
  - **On Request** — automatic data transfer is off; only data transfer upon the terminal demand is on (mode by default);
  - **Auto HEX** — hexadecimal format of the automatic data output;
  - **Auto ASCII** — text format of the automatic data output;
  - **Auto ASCII EXT** — extended text format of the automatic data output. In case it is used, fields of additional parameters are available for editing:
  - **Text Message Prefix** and **Text Message Suffix** which respectively establish the beginning and the end of the transmitted data in the text format (32 characters at a maximum).
- In the field **Sending Interval, s** you can set the value of the time interval for which the sensor transmits data to the connected tracking device. The time interval values for the messages output may vary **from 1 to 255 s** (increment size 1 s). 1 s is set by default.

b) In the field **DUT-E COM Setting Mode** you can select from the drop-down list **Output Parametr Type Measure**:

- **y.e.** — fuel level in the tank in dimensionless units (0...1000 d.u.);
- **mm** — level of fuel in the tank (mm), step 0.1 mm;
- **Litres** — volume of fuel in the tank (l), step 0.1 l (parameter by default);
- **%** — volume of fuel in the tank (%), step 0.4 %.

2) In case of simultaneous connection of several sensors to the external device, set the unique network address in the box **Device Address** (SPN 521318) for each sensor. It is possible to use addresses **from 0 to 255** (by default — **101**);

3) Select the **RS232/485 Baud Rate** (SPN 521326) from the following range of values **2400**; **4800**; **9600**; **19200**; **38400**; **57600**; **115200 bit/s** (by default — **19200 bit/s**).



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

Figure 33 — Configuration of the sensor connection parameters via RS-232/RS-485

2.14 Parameters of analog output connection

Output signal of DUT-E 2Bio AF/I 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 34):

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

- **Analog / Frequency** – output signal of DUT-E 2Bio AF as per 1.4.4.

  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.
- **Current** – output signal of DUT-E 2Bio I as described in 1.4.5.

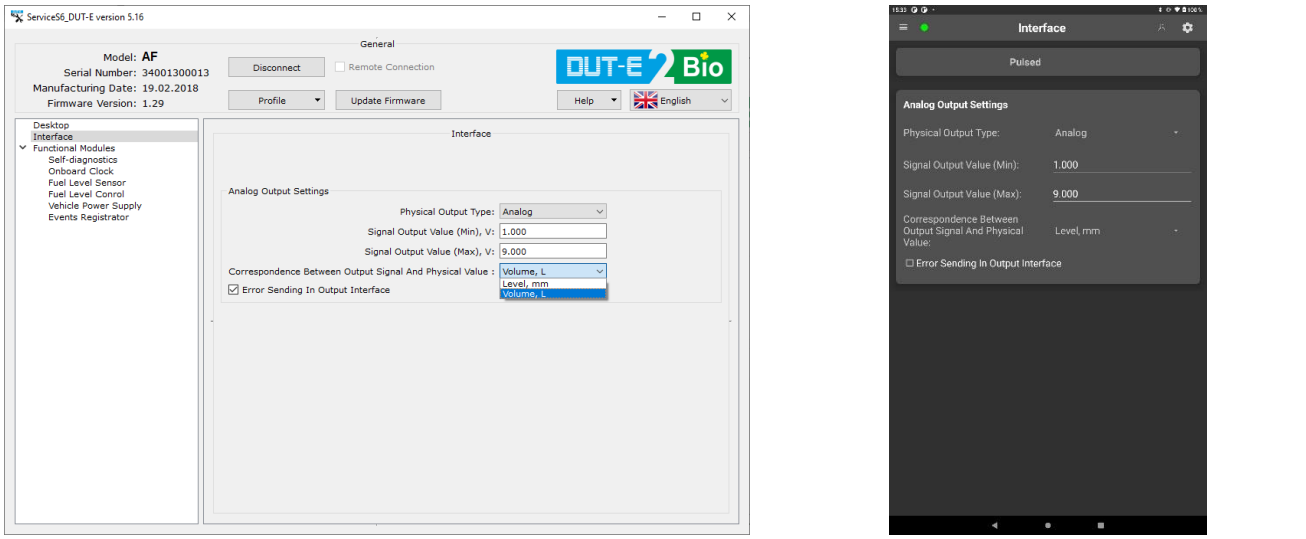
2) From **Correspondence Between Output Signal and Physical Value** dropdown list select necessary type of output data of sensor:

- **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 2Bio AF/I 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.
- Diagnostic states for current output signal:
  - **21.5 mA** – short circuit of measuring probe's tubes;
  - **0.5 mA** – sensor is not calibrated.



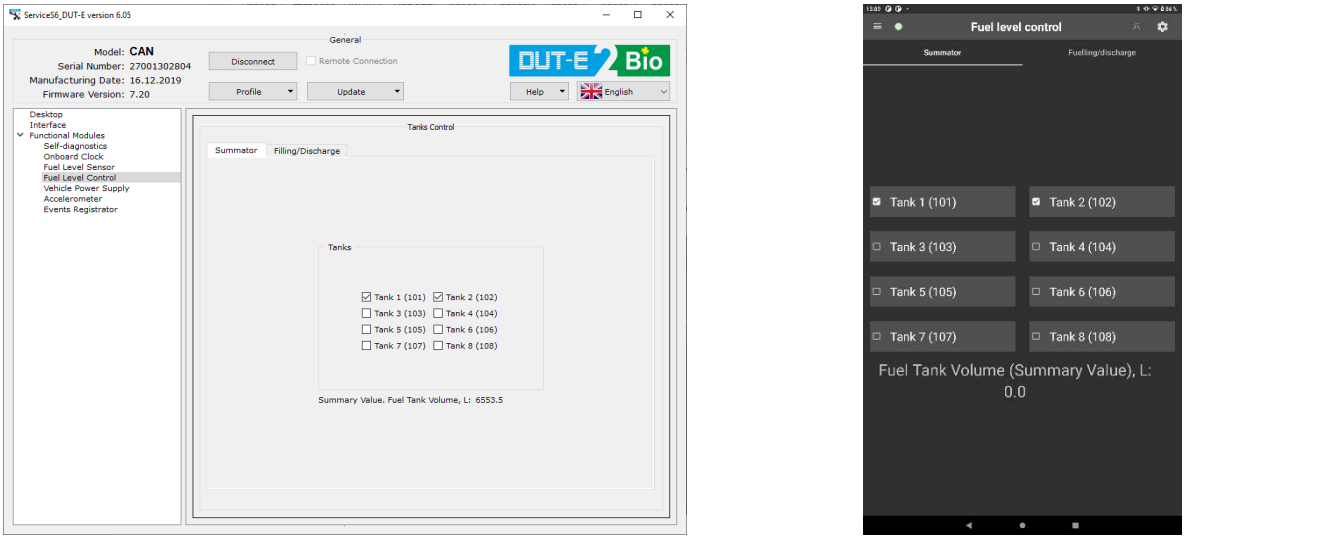
a) in Service S6 DUT-E software *b) in Service S6 DUT-E (Android) app*

Figure 34 — Connection settings of analog output parameters

2.15 Summation of data

The summation of the fuel volume values in the tanks is set in the settings of the Fuel level control FM submenu using Service S6 DUT-E software or Service S6 DUT-E (Android) application. In settings of sensor, which will send totalized signal (Master sensor), tick the boxes of sensors, which data should be totalized (Slave sensors). After saving Master sensor's Profile, **Summary Value. Fuel Tank Volume, l** field will show actual totalized value of fuel volume in selected tanks (see figure 35).

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 35 — Configuration of the fuel volume summation in several tanks

1) Summation of DUT-E 2Bio CAN readings

S6 Technology enables to sum up fuel volume readings from up to 8 DUT-E 2Bio CAN sensors. DUT-E 2Bio CAN can also operate together with other models of sensors that have CAN j1939/S6 interface (DUT-E GSM and DUT-E CAN) for summation of readings. The maximum number of sensors connected in any combination of the models used is 8.
You should specify a unique network address for each sensor connected using S6 Technology within a range from **101...108** (see 2.12).
Examples of DUT-E 2Bio CAN connection diagrams using S6 Technology for summation of the fuel volume in several tanks including the specification of cables which need to be ordered are provided in annex I (see other examples in CAN j1939/S6 Telematics interface Operation Manual).

2) Summation of DUT-E 2Bio 232/AF/I readings

You should specify a unique network address within a range from **101...108** for each sensor connected for summation of readings (see the Self-diagnostics FM submenu settings, field **S6 Bus Address (SA)**).

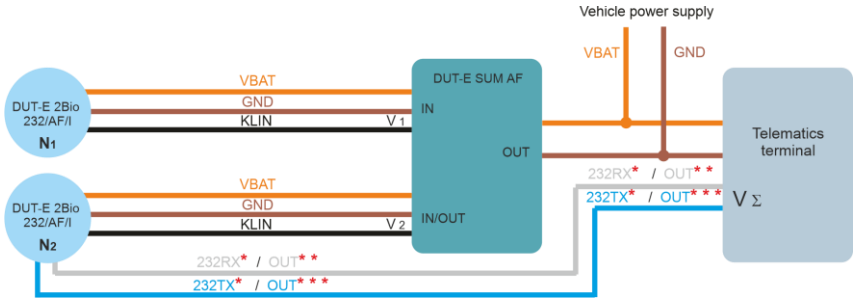
To measure the total volume of fuel in two or more tanks, we recommend to employ DUT-E SUM AF summator together with DUT-E 2Bio 232/AF/I sensors. The electric connection of summators is conducted in accordance with the diagrams provided in figure 36, in compliance with the summator cables designation, specified in table 7.

WARNING:
1) During the summation of DUT-E 2Bio 232/AF/I 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.

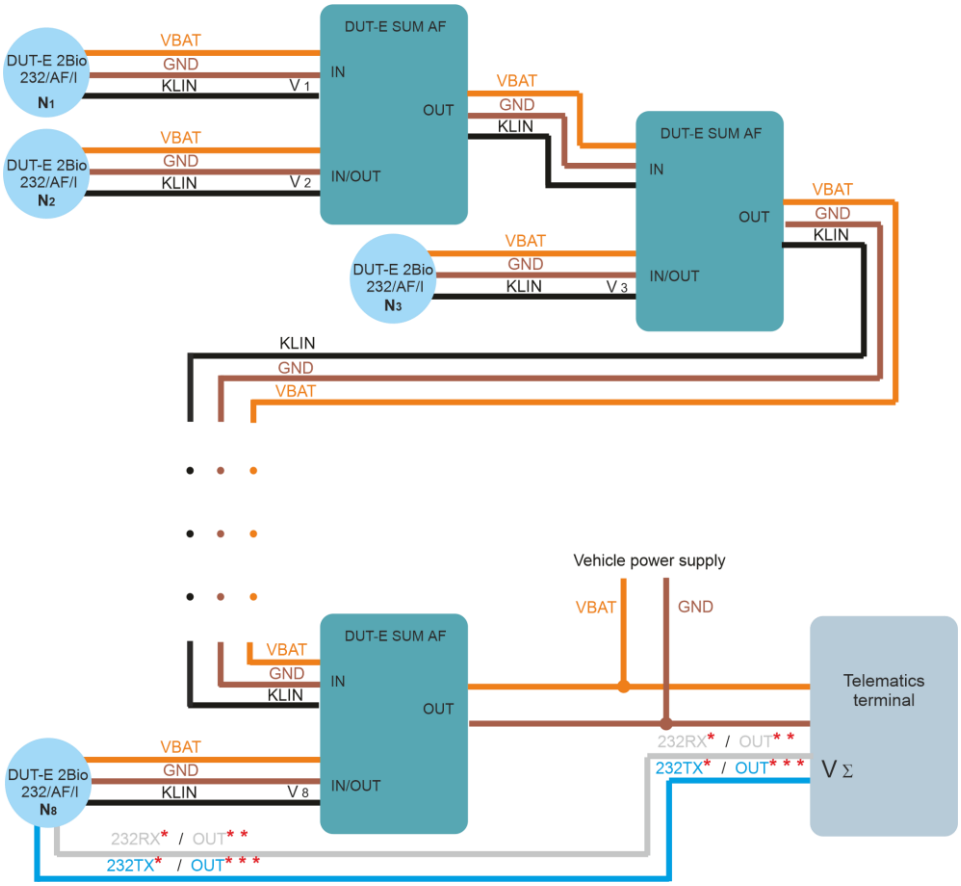
Table 7 — DUT-E SUM AF wires assignment

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.				

ATTENTION: When totalizing values of DUT-E 2Bio AF/I:
1) Type of totalized output signal corresponds to selected for Master sensor and does not depend on configurations of Slave sensors (see 2.14).
2) Output signal of Master sensor should be configured to send fuel volume in liters (see 2.14).
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.



a) connection of two sensors



b) connection of three or more sensors

Figure 36 — Connection diagrams for DUT-E 2Bio 232/AF/I connection for summation of readings

* Should be connected for DUT-E 2Bio 232.
** Should be connected for DUT-E 2Bio AF.
*** Should be connected for DUT-E 2Bio I.

3) Summation of DUT-E 2Bio 485 readings

You need to assign a unique service address to each of the sensors connected for summation of readings within a range from **101…108** (see the settings of Self-diagnostics FM submenu, the field **S6 (SA) Bus Address**).

WARNING: 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.

To measure the total volume of fuel in two or more tanks, together with DUT-E 2Bio 485 sensors, we recommend to employ suitable elements of S6 cable system which **do not have** 120 Ohms terminal resistors (see CAN j1939/S6 Telematics Interface Operation Manual).

Electric connection of sensors is carried out in accordance with the diagram provided in figure 37.

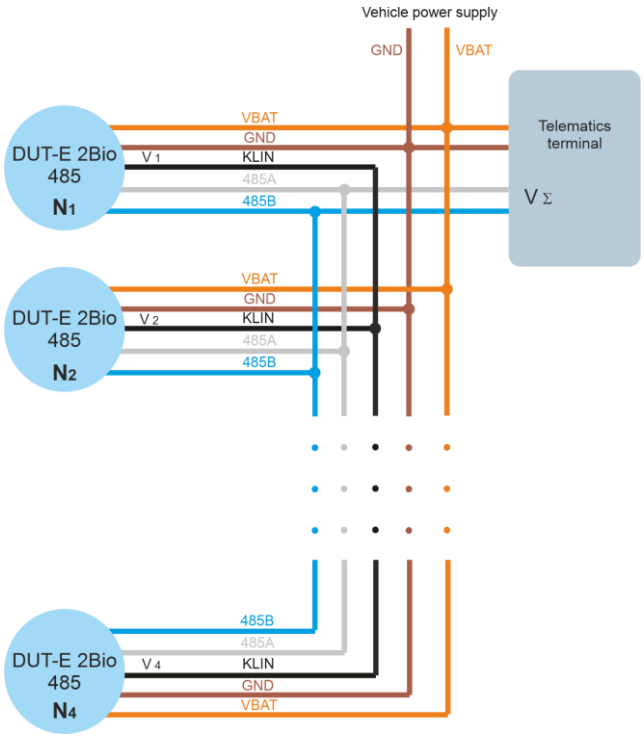


Figure 37 — Diagram of DUT-E 485 connection for summation of readings

2.16 Automatic recognition of fuel type

DUT-E 2Bio CAN, which have firmware version 7.13 and higher, have a feature of **automatic recognition of fuel type** in a fuel tank, where the sensor is installed. That feature is useful e.g. for detecting change of fuel type in Vehicle's tank and for monitoring fuel type currently transported in cistern of tanker truck.

Configuration of DUT-E 2Bio CAN for fuel type recognition is carried out using Fuel level sensor FM submenu (**Fuel** tab) of Service S6 DUT-E software (version 3.21 and higher) or Service S6 DUT-E (Android) mobile application (version 2.10 and higher).

IMPORTANT: While making configuration, **sensor should be place in the fuel tank**, where it will be used further.

The sequence of actions when setting up the sensor:

1) Connect the sensor to the PC using S6 SK service adapter (see 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

During the wireless sensor configuration using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device with S6 BT Adapter service adapter (see 2.6.1). Establish the sensor connection with the Android device via the Bluetooth channel (see 2.6.3).

2) Enable feature of automatic compensation of additional measurements error when fuel permittivity changes. To do that, tick **Fuel Type Correction** box on **Settings** tab (SPN 521312) (see 2.11).

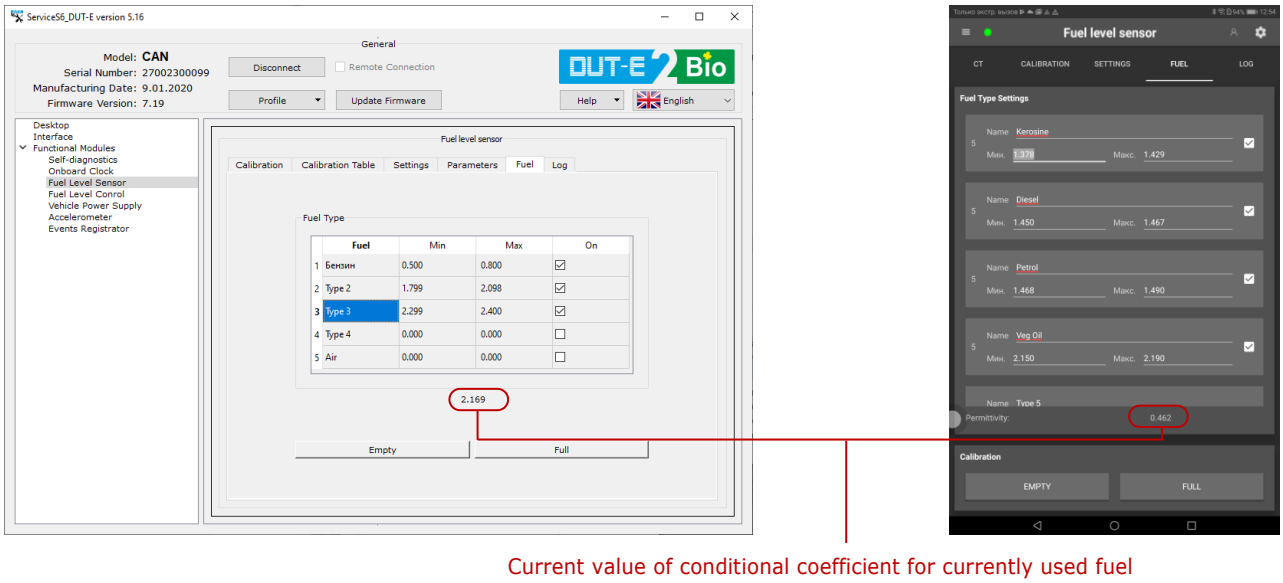
3) In **Fuel** tab, in **Fuel type** table (for Service S6 DUT-E software) or in the area **Fuel type settings** (for Service S6 DUT-E (Android) application) enter the following parameters for up to 5 possible types of fuel (see figure 38):

- **Fuel** — fields for entering names of all fuel types (SPN 521466), which will be filled in the tank and should be defined by the sensor;
- **Min** — fields for entering lower values of conditional coefficients' boundaries (SPN 521464/2.8) for each of five fuel types, depending on its conductivity (permittivity);
- **Max** — fields for entering upper values of conditional coefficients' boundaries (SPN 521464/2.7) for each of five fuel types, depending on its conductivity (permittivity);
- **On** — boxes of enabling the feature for those fuel types (SPN 521465), which should be recognized by the sensor.

Conditional coefficients' boundaries for specific fuel types are determined empirically by filling that specific fuel type in the fuel tank, where sensor is installed. Third measuring electrode of DUT-E 2Bio CAN should be fully immersed into fuel.

IMPORTANT: For correct recognition of fuel type by the sensor and avoiding uncertainties, make sure that entered values of conditional coefficients' boundaries are not intersecting.

Current value of conditional coefficient, which is displayed under **Fuel Type** table (for Service S6 DUT-E software) or under **Fuel type settings** area (for Service S6 DUT-E (Android) application), for the same fuel type can be changing depending on ambient temperature, fuel supplier, length of storage and other factors.



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

Figure 38 — Window in Service S6 DUT-E software for configuration of the automatic recognition of fuel type

DUT-E 2Bio CAN sensor sends output message (PGN 63292) via CAN j1939/S6 interface. In that message fuel type is defined depending on current SPN 521467 value as follows:

- **0** → "Fuel type is not recognized";
- **1** → "Type 1";
- **2** → "Type 2";
- **4** → "Type 3";
- **8** → "Type 4";
- **16** → "Type 5".

2.17 Automatic identification of "Fuelling"/"Fuel discharge" Events

In DUT-E 2Bio CAN sensor with the firmware version from 7.19 and higher the **adjustable feature of automatic identification of "Fuelling"/"Fuel discharge"** Events is implemented. The sensor configuration so as to identify the above Events is possible only using Service S6 DUT-E software (versions from 5.16 and higher) or Service S6 DUT-E (Android) application, version from 3.00.05 and higher (Fuel level control FM submenu, **Fuelling/Discharge** tab) (see figure 39).

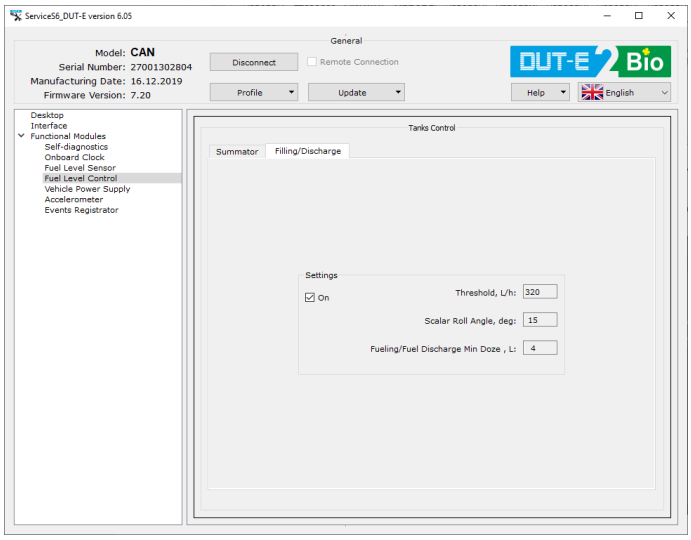
IMPORTANT: You are to perform the following **preliminary operations:**

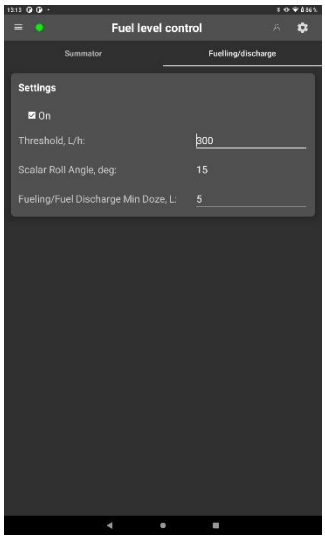
1) Mount DUT-E 2Bio CAN in a particular fuel tank for which you'll have to determine the Events of fuel discharge and fuelling further on.

2) Record the calibration table of the respective fuel tank into internal memory of DUT-E 2Bio CAN.

3) Conduct the calibration procedure of the inbuilt accelerometer of DUT-E 2Bio CAN (Accelerometer FM submenu, see B.6). The following conditions should be met for its correct execution:

- The Vehicle to be equipped should be unloaded and must stand on a flat horizontal site with its engine stopped.
- The Vehicle wheels must be of a standard type and size;
- The pressure in the tires must correspond to the value established for this Vehicle.





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

Figure 39 — Configuration of DUT-E 2Bio CAN for automatic identification of the Events "Fuelling"/"Fuel discharge"

The sequence of operations during the sensor configuration is as follows:

1) Connect the sensor to the PC using S6 SK service adapter (see 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

During the wireless sensor configuration using Service S6 DUT-E (Android) application, connect DUT-E 2Bio to the Android device with S6 BT Adapter service adapter (see 2.6.1). Establish the sensor connection with the Android device via the Bluetooth channel (see 2.6.3).

2) Activate the feature of automatic identification of Fuelling/Fuel discharge. For this purpose, tick the field **On** (SPN 521031) in the **Settings** space (**Fuelling/Discharge** tab).

3) In **Settings** space set three threshold values of nominal parameters based on which DUT-E 2Bio CAN will automatically identify Fuellings/Fuel discharges further on:

- **Threshold, l/h** (SPN 521030) — field to enter values of the maximum possible fuel consumption by the engine which is equipped.
  The exceeding of this set value is the criterion to determine Fuel discharge.
- **Scalar Roll Angle, deg** (SPN 521426) — field to enter the maximum possible roll angle of the Vehicle which is being equipped, in specific conditions of operation. Fuellings/Fuel discharges will be identified only in conditions of roll angles less than the set value. For roll angles exceeding the set value, the identification of Fuellings/Fuel discharges will be ignored.
  The non-exceeding of the set value of the roll angle is the criterion for identification of Fuelling/Fuel discharge.
- **Fuelling/Fuel Discharge Min Doze, l** (SPN 521423) — field to enter the minimum value of the fuel volume which is selected depending on the fuel tank volume of the Vehicle which is being equipped (e.g. for tanks of small volume the lower value of the minimum amount is specified).
  The exceeding of this set value is the criterion to determine Fuelling/Fuel discharge.

  Note — It should be noted that in case of selection of a too low value of the minimum dose, the shaking of fuel in the tank may be identified as a fake Fuelling/Fuel discharge Event, while selecting of a too high value of the minimim dose may result in a loss of data of Events.

IMPORTANT:
1) Threshold values of nominal parameters **are determined experimentally**, in the process of service of the Vehicle which is being equipped.
2) The sensor registers the "Fuelling"/"Fuel discharge" Events only in case all the three above-mentioned criteria are met.
3) During the summarization of indications of several sensors by means of S6 Technology automatic identification of "Fuelling"/"Fuel discharge" Events is conducted based on the total volume of fuel.

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 2Bio operation. Seals and cord are included into DUT-E 2Bio 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 2Bio 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.

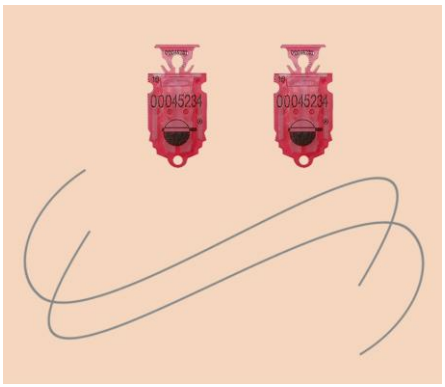


Figure 40 — Plastic seals and sealing cord*

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 2Bio 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 2Bio 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 2Bio 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 2Bio operability is tested using Service S6 DUT-E software or Service S6 DUT-E (Android) application (see the settings of Self-diagnostics FM submenu) by means of the sensor connection to the PC with a cable (see 2.5) or, respectively, by means of the sensor wireless connection to the Android device via Bluetooth (see 2.6).

In case of any malfunction first of all examine condition of Vehicle power supply system and power supply pins condition of the DUT-E 2Bio connector.

WARNING:

1) Severe contact corrosion of chassis ground connection switch or its malfunction can seriously affect DUT-E 2Bio output signal.

2) DUT-E 2Bio readings will be invalid if the measuring tubes are closed by conducting mud or water.

3) When cable of additional electrode is damaged automatic fuel correction will work according to the last dielectric constant of fuel which sensor automatically remembered. Meanwhile a message will appear in the field Self-diagnostics FM about such error.

6 Maintenance

6.1 General instructions

DUT-E 2Bio 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 2.9. Re-calibration of the fuel tank of Vehicle in this case is not required.

DUT-E 2Bio repair works are carried out only by certified **Regional Service Centers** (RSC). Full list of RSC can be found at https://www.jv-technoton.com/.

6.2 Demounting

Clean the tank surface nearby the mounting location before DUT-E 2Bio 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 2Bio cable connector.

Unfasten DUT-E 2Bio 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) During demounting don’t pull DUT-E 2Bio interface cable or cable of additionall electrode. Otherwise, Cable and/or electronic board can be damaged.

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

3) In case of repeated installation of DUT-E 2Bio – replace the old rubber gasket with a new one.

6.3 Examination

DUT-E 2Bio is demounted conduct a visual examination to detect the following defects:

- visible damages of the sensor head body, measuring probe, interface cable, connector plug, cable of additional electrode and temperature sensor;
- backlash of measuring unit tubes relative to each other and/or the body;
- incorrect location of the additional electrode with respect to the end of the measuring part (see figure 10);
- 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 2Bio 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 2Bio normal operation. Examine the space between two tubes of measuring part and between measuring part and additional electrode 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 2Bio head body, interface cable and its connector when washing the tubes.

7 Packaging

DUT-E 2Bio delivery sets come in cardboard boxes of the following shape (see figure 41).

Figure 41 — DUT-E 2Bio 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 2Bio box (see figure 42).

Figure 42 — DUT-E 2Bio packaging label

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

8 Storage

DUT-E 2Bio is recommended to be stored in dry enclosed areas.

DUT-E 2Bio 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 2Bio in the same room with substances that cause metal corrosion and/or contain aggressive impurities.

DUT-E 2Bio shelf life must not exceed 24 months.

9 Transportation

Transportation of DUT-E 2Bio is recommended in closed transport that provides protection for DUT-E 2Bio from mechanical damage and precipitation.

When transporting by air, DUT-E 2Bio 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 2Bio sensors should be sealed.

10 Utilization/re-cycling

DUT-E 2Bio 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 2Bio 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 2Bio 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 drain 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: _____/_____/

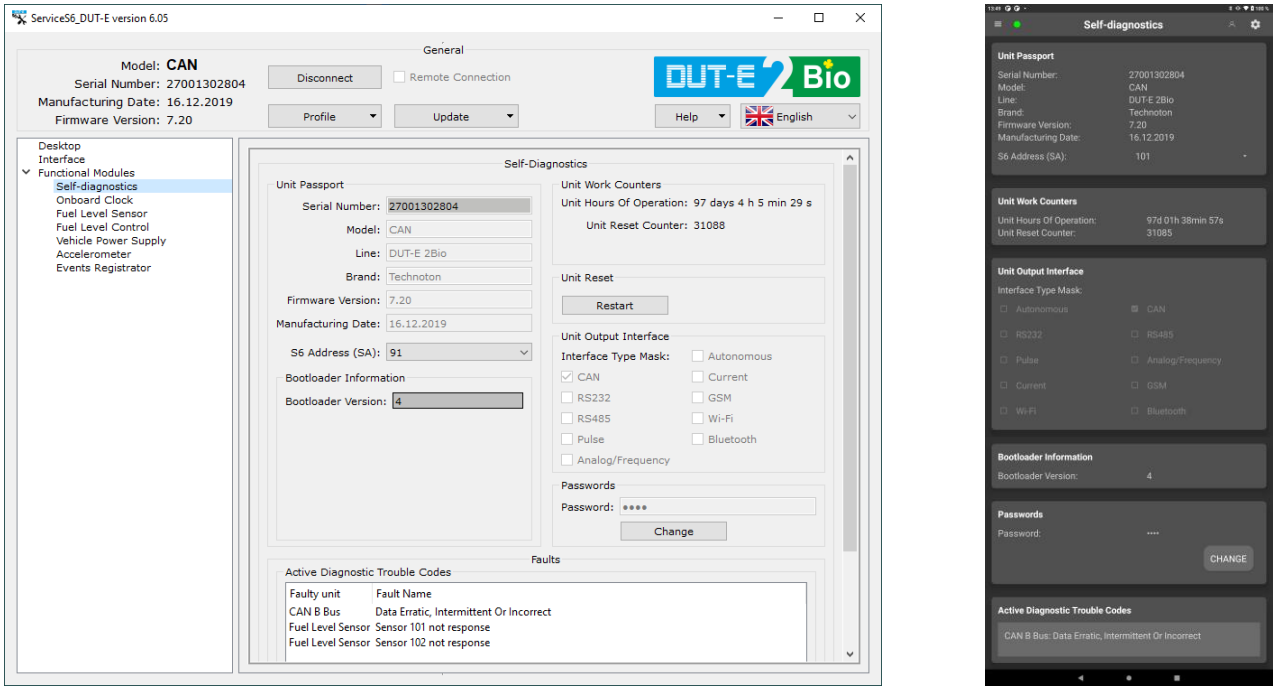
Annex B

SPN of DUT-E 2Bio Functional modules

Reception and treatment of data on the fuel level, monitoring of Counters, registration of Events, setup of Parameters and self-diagnostics of DUT-E 2Bio are ensured by the coordinated operation of its Functional modules (FM).
Parameter form (SPN) of FM DUT-E 2Bio matches with Data base (DB) S6 Technology.

B.1 Self-diagnostics FM

Self-diagnostics FM — is designed for user authorization, identification of DUT-E 2Bio passport data, accounting of the operation period and active malfunctions, as well as for the Unit reset by using software.



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

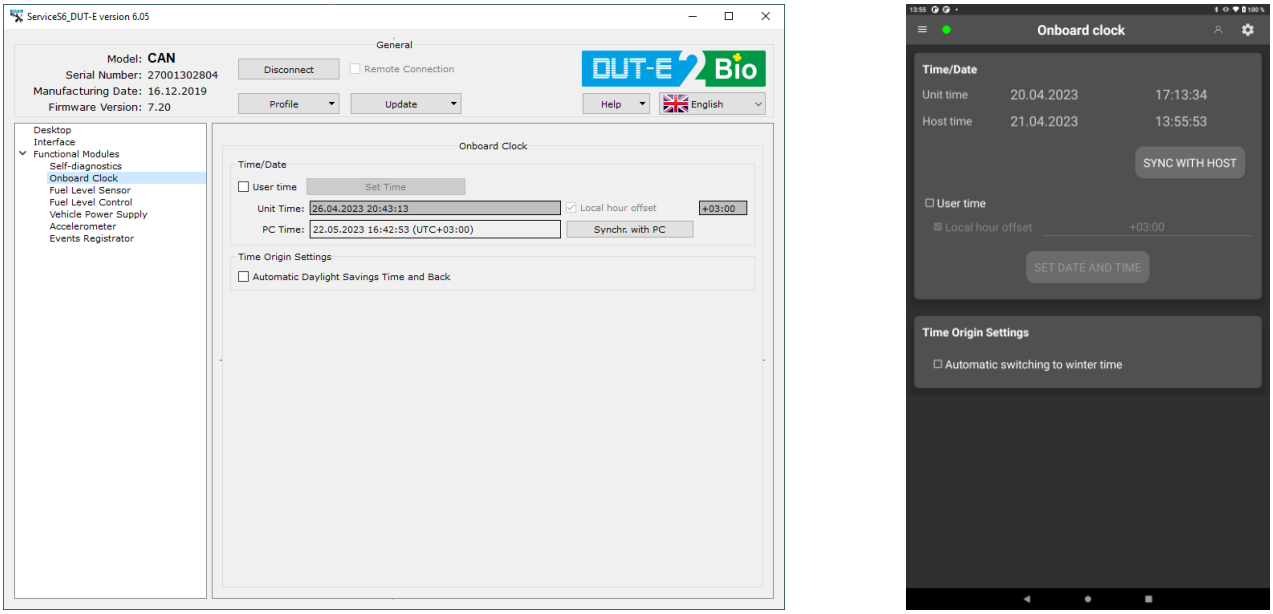
Table B.1 — Self-diagnostics FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

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 2Bio has the following format: AABBB C DDDDD, where: AA – code of DUT-E 2Bio model; BBB – digits that reflect changes product changes; C – Manufacturer code; DDDDD – sequential number. Setting is not available for editing.

SPN	Name	Factory value	Unit of measure	Clarification
521345	Model	On the fact	No	Model – this is version of the sensor inside of DUT-E 2Bio product line. Each model has its own functional and constructive features. For example, DUT-E 2Bio CAN characteristic – data transfer via CAN j1939/S6 interface. Setting is not available for editing.
521123	Line	DUT-E 2Bio	No	Name of the product line. The line represents a group of similar products – fuel level sensors produced under general trademark DUT-E 2Bio. 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 2Bio. 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	Network address sensor which is connected via S6 Technology. Value of the network address can be selected by the user from the ranges: 91…98* and 101…108.
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	pcs.	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 2Bio 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 2Bio working performance. In case of lack of active malfunctions, the following message is displayed "No malfunctions".
Unit Reset PGN 63206				
521272	Reset Enable	No	No	Button for Unit restart (reset) using software, i.e restart without disconnection from external power source.
Bootloader information PGN 63009				
521122	Bootloader Version	On the fact	No	Displays current version of the bootloader used for the correct start of service software, as well as when updating firmware of the Unit.
* You may specify addresses from the range 91…98 only for sensors with the version of firmware not lower than 7.16, when using Service S6 DUT-E software, version from 5.12 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.				

B.2 Onboard clock FM

Onboard clock FM — designed for generation of signals of time and its transmission to other functional modules DUT-E 2Bio.



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

Figure B.2 — Example of the window of settings of Onboard clock FM

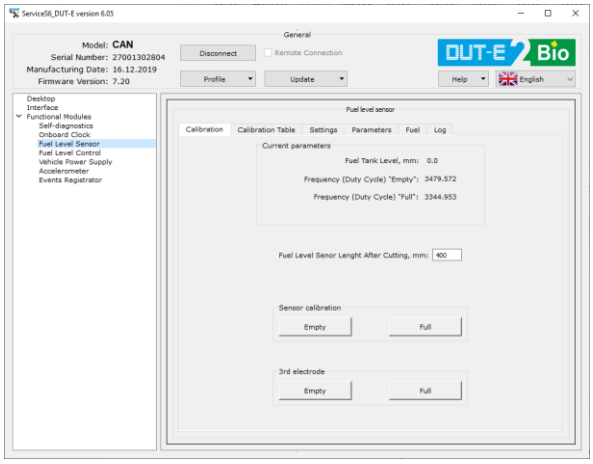
Table B.2 — Onboard clock FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software or Service S6 DUT-E (Android) app

SPN	Name	Factory value	Unit of measure	Range	Clarification
				Time/Date PGN 65254	
959	Seconds	On the fact	s	0…62.5	Present time — seconds*.
960	Minutes	On the fact	Min	0…250	Present time — minutes*.
961	Hours	On the fact	h	0…250	Present time — hours*.
963	Month	On the fact	month	0…250	Present date — month*.
962	Day	On the fact	d	0…62.5	Present date — day*.
964	Year	On the fact	year	1985…2235	Present date — year*.
1601	Local minute offset	0	min	0…59	Time displacement (in minutes) in relation to Coordinated Universal Time that matches with local time (Time zone). Enabled and accessible for editing, in case the current time is set manually and is synchronized with the PC or with the Android device.
1602	Local hour offset	+3	h	-24…+24	Time displacement (in hours) in relation to Coordinated Universal Time that matches with local time (Time zone). Enabled and accessible for editing, in case the current time is set manually and in case it is synchronized with the PC or th Android device.
				Time Origin Settings PGN 63011	
521350	Automatic Daylight Savings Time and Back	Off	No	On/Off	Enabling/disabling of automatic present time switching to winter/summer.
* By default, time is set in UTC format (Coordinated Universal Time standard) and displayed according to local displacement. Used during Events registration. The current time is accessible for the user for editing manually or by means of synchronization of date/time with the PC or Android device clock.					

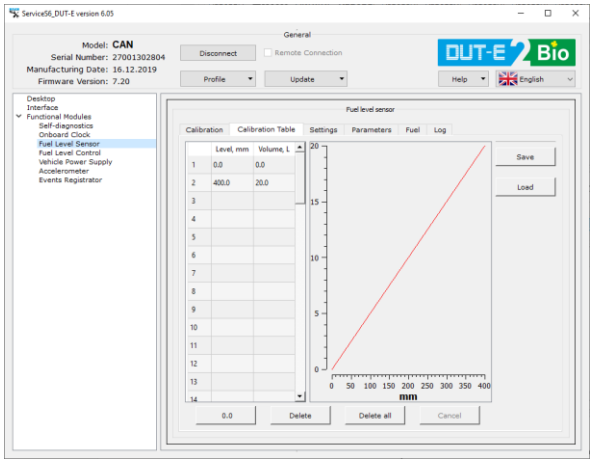
B.3 Fuel level sensor FM

Fuel level sensor FM is designed for:

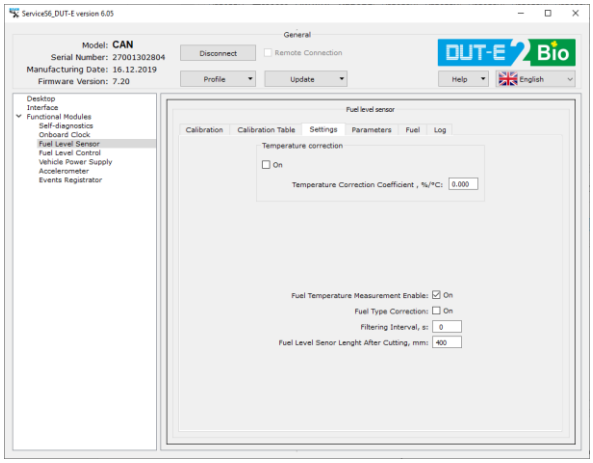
- measurement of current values of the fuel level, volume and temperature in the Vehicle tank;
- calibration of the sensor and the additional electrode;
- generation of the tank calibration table;
- filtering and thermal correction of measurement readings;
- configuration and automatic identification of the fuel type.



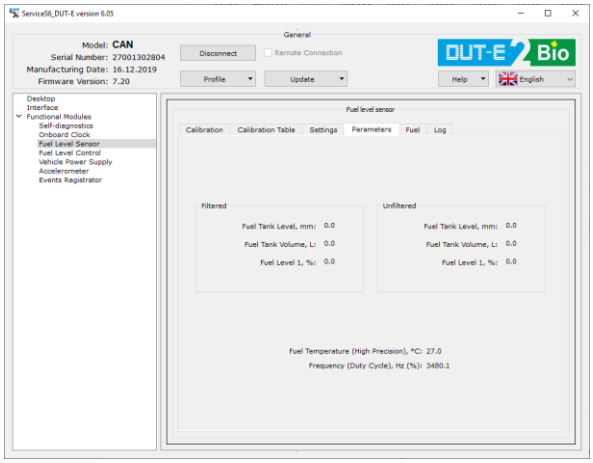
Calibration *tab*



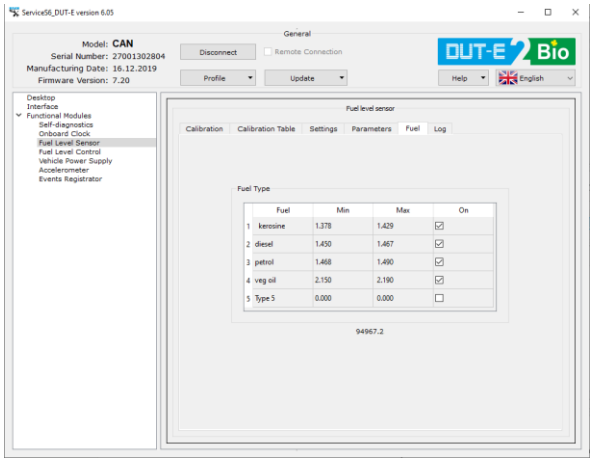
Calibration Table *tab*



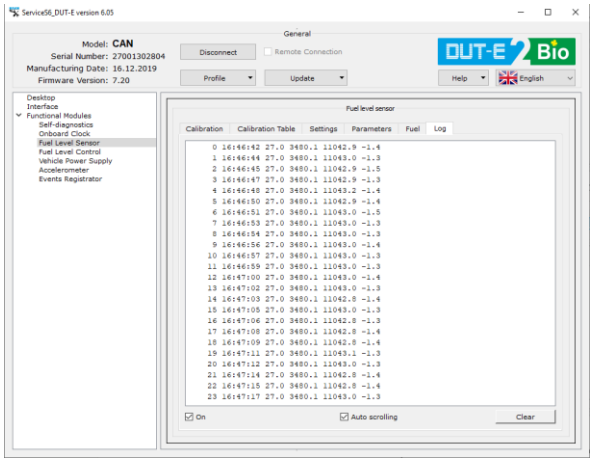
Settings *tab*



Parameters *tab*

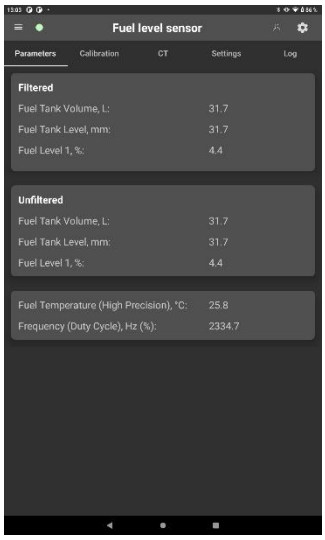


Fuel *tab*

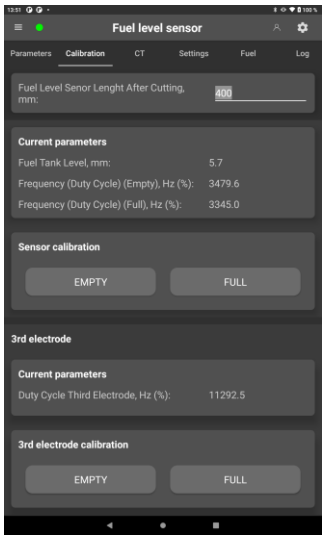


Log *tab*

a) in Service S6 DUT-E software

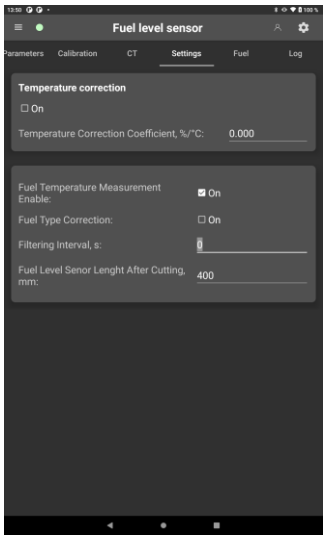


Parameters *tab*



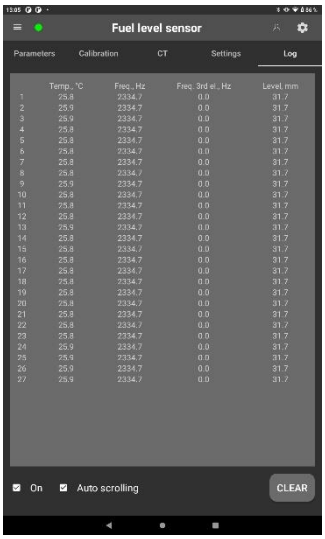
Calibration *tab*

CT *tab*



Settings *tab*

Fuel *tab*



Log *tab*

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

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

Table B.3 — 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 2Bio 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 2Bio 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
Third Electrode Calibration Params PGN 63074					
521094/22.0	Calibration Frequency/ 22.0 Empty	On the fact	%	0…4294967	Frequency of DUT-E 2Bio measuring generator signal evaluating the state of the additional electrode, when the tank is empty.
521094/22.1	Calibration Frequency/ 22.1 Full	On the fact	%	0…4294967	Frequency of DUT-E 2Bio measuring generator signal evaluating the state of the additional electrode, when it is plunged into the fuel.
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 – 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	0.084	%/°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 2Bio 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.
521312	Fuel Type Correction	Off	No	On/Off	Field for activation/deactivation of function of automatic compensation of additional measurement inaccuracy that happens as a consequence of dielectric constant change after changing type of fuel or chemical composition.
Fuel Type* PGN 63292					
521467	Fuel Type	Type 1…Type 5	No	0…255	Displays current fuel type (highlighted in red), which is defined by the sensor in accordance with specified settings.
521464	Permittivity	On the fact	No	0…4294967	Displays current value of conditional coefficient of fuel type depending on its electrical conductivity (permittivity).
Fuel Type Settings* PGN 63291					
521466	Name	Type 1…Type 5	No	0…255	Fields for entering names of each of the five types of fuel, which could be filled into the fuel tank and which should be determined by the sensor. Up to 16 any alphanumeric characters can be used in the name.

SPN	Name	Factory value	Unit of measure	Range	Clarification
521464/2.8	Permittivity/ 2.8 Min	0.000	No	0…4294967	Fields for entering lower values of conditional coefficients' boundaries for each of five fuel types, depending on its conductivity (permittivity).
521464/2.7	Permittivity/ 2.7 Max	0.000	No	0…4294967	Fields for entering upper values of conditional coefficients' boundaries for each of five fuel types, depending on its conductivity (permittivity).
521465	Permittivity Consider	Off	No	On/Off	Fields for selecting fuel types, which should be automatically defined by the sensor.

— Essential settings, required for DUT-E 2Bio performance.

* For DUT-E 2Bio CAN with firmware version from 7.13 and higher and Service S6 DUT-E software version from 3.21 and higher or Service S6 DUT-E (Android) mobile application version 2.10 and higher.

B.4 Fuel level control FM

Fuel level control FM designed to receive data on the measured total volume of fuel in two or more tanks of the Vehicle via CAN j1939/S6 interface (for DUT-E 2Bio CAN) or K-Line interface (for DUT-E 2Bio 232/485/AF/I)), as well as for configuration and automatic identification of "Fuelling"/ "Discharging" Events*.

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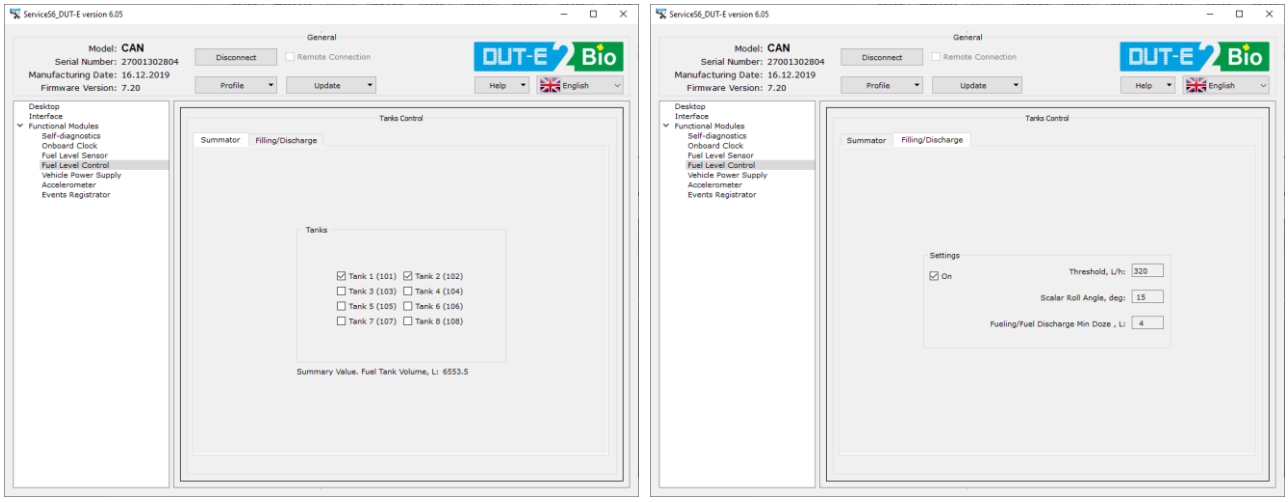
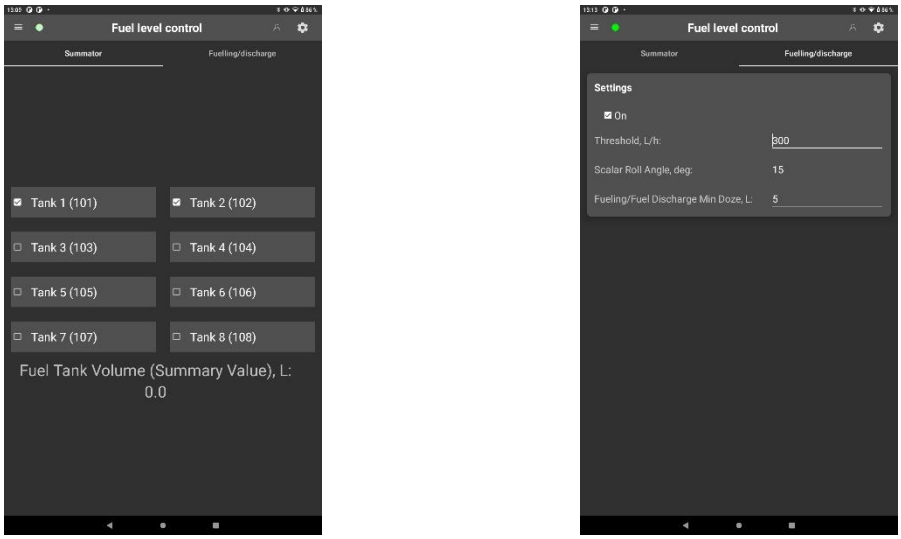
* The feature of automatic identification of "Fuelling"/"Discharging" Events is available only for DUT-E 2Bio CAN.



***Summator** tab* ***Filling/Discharge** tab*

a) in Service S6 DUT-E software



***Summator** tab* ***Filling/Discharge** tab*

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

Figure B.4 — Example of the window of settings of Fuel level control FM

Table B.4 — 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.
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.
Fuelling/Fuel Discharge* PGN 63268					
521423	Fueling/ Fuel Discharge Min Doze	5	l	0…6425.5	Field to enter the minimum value of the fuel volume which is selected depending on the volume of the fuel tank of the Vehicle which is equipped (e.g. for tanks of small volume, a lower value of the minimal amount is specified). The exceeding of this set value is the criterion to determine Fuelling/Fuel discharge.
521426	Scalar Roll Angle	15	degrees	0…360	Field to enter the maximum possible banking angle of the Vehicle is being equipped, in specific conditions of operation. Fuellings/Fuel discharges will be identified only in conditions of roll angles less than the set value. For roll angles exceeding the set value, the identification of Fuelings/Fuel discharges will be ignored. The non-exceeding of the set value of the roll angle is the criterion for identification of Fuelling/Fuel discharge.

SPN	Name	Factory value	Unit of measure	Range	Clarification
Fueling/Discharging Settings* PGN 63103					
521031	Fueling/ Discharging Detect	Off	-	On/Off	Field to enable/disable the feature of automatic identification of Fuellings/Fuel discharges.
521030	Threshold	300	l/h	0…3212.75	Field to enter the maximum possible fuel consumption by the engine of the Vehicle which is equipped. The exceeding of this set value is the criterion to determine Fuel discharge.

* Only for DUT-E 2Bio CAN with the version of firmware not lower than 7.19, when using Service S6 DUT-E software, version from 5.16 and higher or Service S6 DUT-E (Android) application, version from 2.26 and higher.

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.

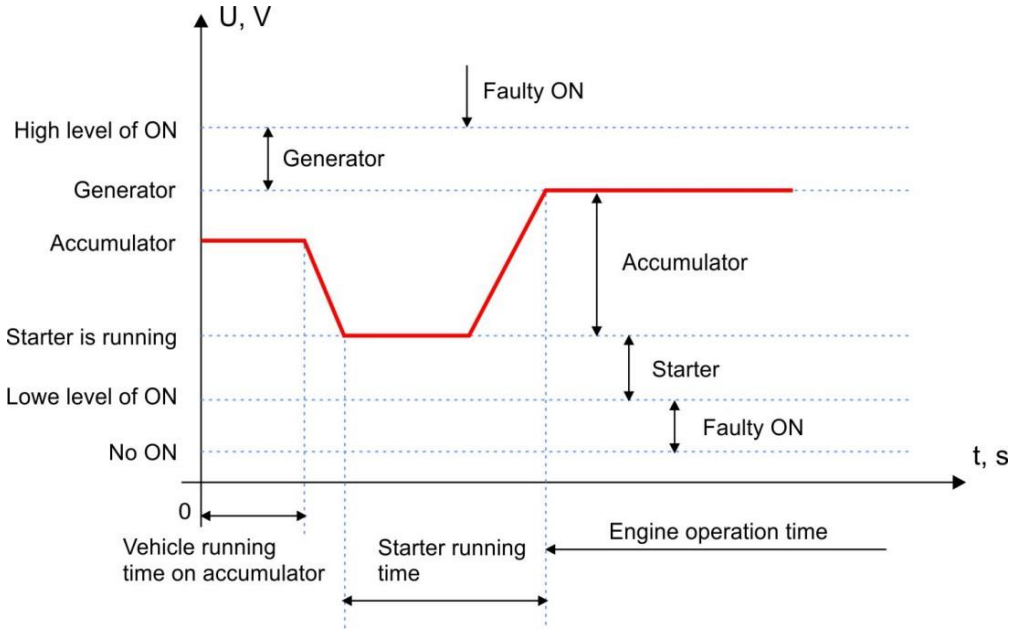
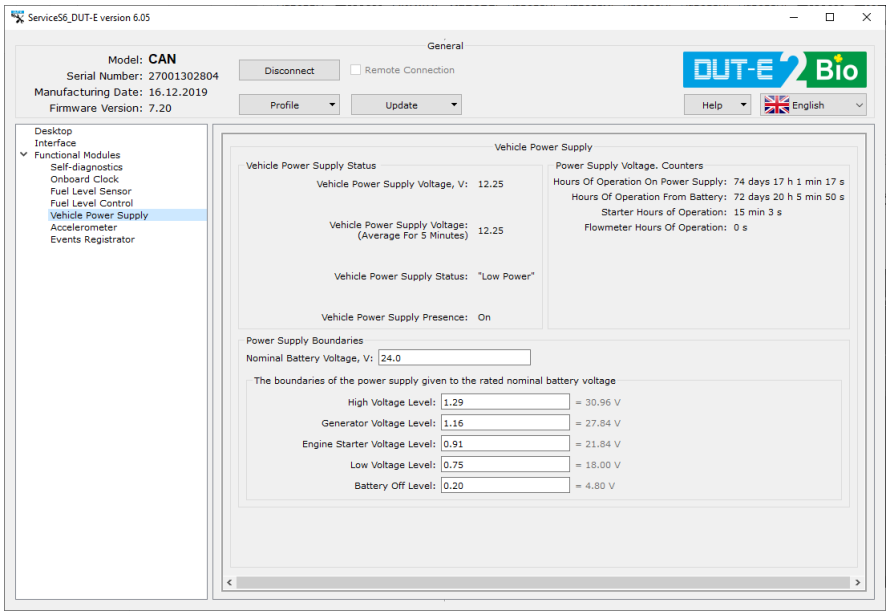
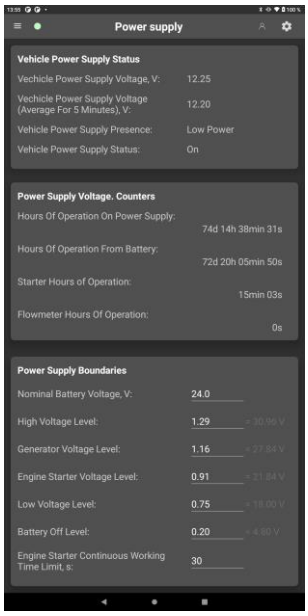


Figure B.5 — Operation modes on onboard network (ON) voltage level





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

Figure B.6 — Example of the window of settings of Vehicle power supply FM

Table B.5 — 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.5 and B.6).
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.5 and B.6).
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).
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.5 and B.6). Entered value of voltage is used as a threshold for recording "Faulty ON" Event.
521064	Generator Voltage Level	1.16	-	0…1.99	Field for entering value of voltage level of generator, i.e. when engine of Vehicle is running (1.16•U_{nom}) (see figures B.5 and B.6).
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.5 and B.6).
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.5 and B.6).
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.5 and B.6).
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.5 and B.6). 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.

B.6 Accelerometer FM

Accelerometer FM* — is designed to identify current values of the Vehicle linear accelerations in three rectangular axes of Cartesian coordinate system and to calculate root-meansquare values of these accelerations, to identify the Vehicle movement and its banking angles.

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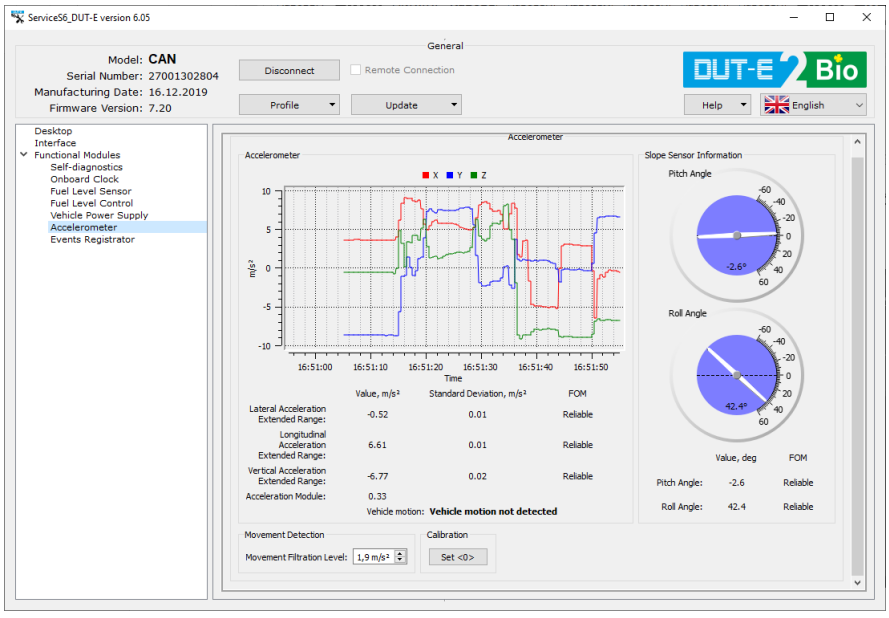
* Accelerometer FM valid only for DUT-E 2Bio CAN with the firmware version not lower than 7.15 in case of using Service S6 DUT-E software, version from 5.16 and higher or Service S6 DUT-E (Android) application, version from 3.00.05 and higher.

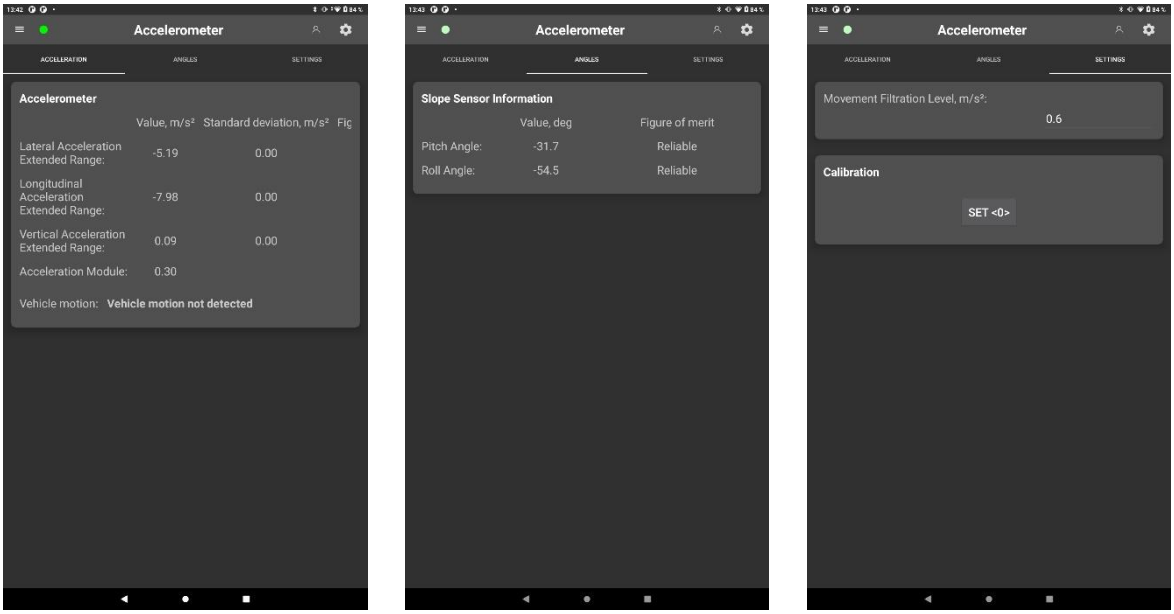
After DUT-E 2Bio CAN mounting on the Vehicle you need to calibrate the inbuilt accelerometer, i.e. to specify zero values of pitch angle and banking angle by pressing Set <0> **button!**

For correct conducting the calibration of the accelerometer, the following conditions must be met:

- the Vehicle should not be loaded and stand on the flat horizontal surface, engine off;
- the Vehicle wheels must be of standard size;
- the tire pressure should match with the prescribed for this Vehicle;



a) in Service S6 DUT-E software



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

Figure B.7 — Example of the window of settings of Accelerometer FM

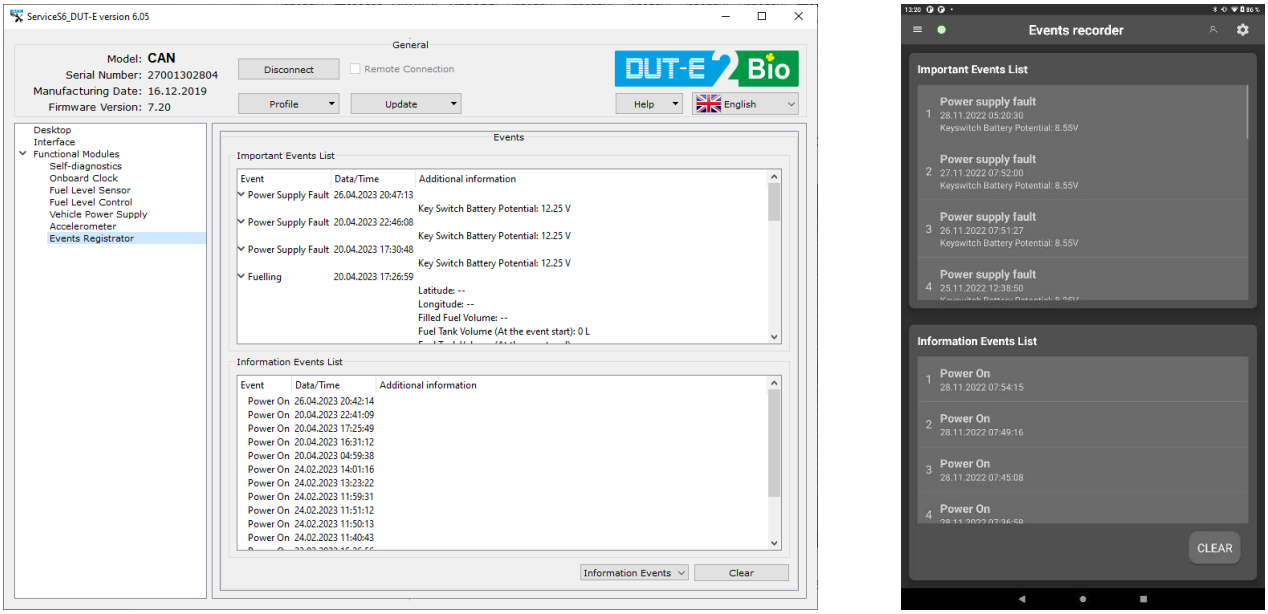
Table B.6 — Accelerometer FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software

SPN	Name	Factory value	Unit of measure	Range	Clarification
				Accelerometer PGN 63155	
5347	Lateral Acceleration Extended Range	On the fact	m/s²	-320…322.55	Current value of the Vehicle transverse linear acceleration is displayed (along Y axis of the Cartesian coordinate system) and the diagram of its changing with time.
5347/2.3	Lateral Acceleration Extended Range / 2.3 Standard Deviation	On the fact	m/s²	-320…322.55	Value of the Vehicle mean-square deviation calculated based on the current data of the Vehicle transverse linear acceleration is displayed. You can estimate the reliability of the measured values of the Vehicle transverse linear acceleration by the value of mean-square deviation.
5350	Lateral Acceleration Extended Range Figure of Merit	On the fact	No	Reliable/ Unreliable	Estimate of reliability of the measured values of the Vehicle transverse linear acceleration is displayed. If the transverse linear acceleration is less than 5 m/s², the acceleration data are reliable, while in case the transverse linear acceleration is more than 5 m/s², the data are unreliable.
5348	Longitudinal Acceleration Extended Range	On the fact	m/s²	-320…322.55	Current value of the Vehicle longitudinal axis linear acceleration is displayed (along X axis of the Cartesian coordinate system) and the diagram of its changing with time.
5348/2.3	Longitudinal Acceleration Extended Range / 2.3 Standard Deviation	On the fact	m/s²	-320…322.55	Value of the Vehicle mean-square deviation calculated based on the current data of the Vehicle longitudinal linear acceleration is displayed. You can estimate the reliability of the measured values the Vehicle longitudinal linear acceleration by the value of mean-square deviation.
5351	Longitudinal Acceleration Extended Range Figure of Merit	On the fact	No	Reliable/ Unreliable	Estimate of reliability of measured values of the Vehicle longitudinal linear acceleration is displayed. If the longitudinal linear acceleration is less than 5 m/s², the acceleration data are reliable, while in case of longitudinal linear acceleration more than 5 m/s², the acceleration data are unreliable.

SPN	Name	Factory value	Unit of measure	Range	Clarification
5349	Vertical Acceleration Extended Range	On the fact	m/s^2	-320…322.55	Current mean value of the Vehicle vertical linear acceleration is displayed (along Z axis of the Cartesian coordinate system) and the diagram of its changing with time.
5349/2.3	Vertical Acceleration Extended Range / 2.3 Standard Deviation	On the fact	m/s^2	-320…322.55	Value of the Vehicle mean-square deviation calculated based on the current data of the Vehicle vertical linear acceleration is displayed. You can estimate the reliability of the measured values the Vehicle vertical linear acceleration by the value of mean-square deviation.
5352	Vertical Acceleration Extended Range Figure of Merit	On the fact	No	Reliable/ Unreliable	Estimate of reliability of measured values of the Vehicle vertical linear acceleration is displayed. If the vertical linear acceleration is less than 5 m/s^2, the acceleration data are reliable, while in case of vertical linear acceleration more than 5 m/s^2, the acceleration data are unreliable.
521384	Acceleration Module	On the fact	m/s^2	-320…322.55	Automatically calculated total value of the Vehicle linear acceleration in three axes of coordinates (X, Y, Z) is displayed; this value is equal to square root of the sum of squares of the Vehicle linear accelerations in each axis. If this value exceeds the specified level of the Movement Filtering (SPN 521341), the Unit automatically identifies the Vehicle current status in relation to the Vehicle movement.
1611	Vehicle motion	On the fact	No	Vehicle motion not detected/ Vehicle motion detected	Vehicle current status in relation to the Vehicle movement is displayed (the Vehicle is moving/not moving).
Movement Detection PGN 63247					
521341	Movement Filtration Level	0.3	m/s^2	-12.5…12.5	Field in which the user may specify threshold value of acceleration with which the value of the sum of the Vehicle linear accelerations in the three coordinates axes (X, Y, Z) must be compared. According to the results of the comparison, the Unit automatically identifies the Vehicle current status in relation to movement.
Slope Sensor Information PGN 61459					
3318	Pitch Angle	On the fact	deg	-64…64.51	Displays the current value of the grade angle in relation to the transverse axis of coordinates (Y axis).
3319	Roll Angle	On the fact	deg	-64…64.51	Displays the current value of the grade angle in relation to the longitudinal axis of coordinates (X axis).
3323	Pitch Angle Figure Of Merit	On the fact	No	Reliable/ Unreliable	Estimate of reliability of measurement of the Vehicle banking angle. If the value of the pitch angle is less than 60°, its value is considered reliable.
3324	Roll Angle Figure Of Merit	On the fact	No	Reliable/ Unreliable	Estimate of reliability of measurement of the Vehicle banking angle. If the value of the banking angle is less than 60°, its value is considered reliable.

B.7 Events registrator FM

Events registrator FM — designed for registration of 15 important and 15 informative latest Events.



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

Figure B.8 — Example of the window of settings of Events registrator FM

Table B.7 — Events registrator FM. Displayed and/or editable SPN with the help of Service S6 DUT-E software

SPN	Name	Factory value	Unit of measure	Clarification
Important Events List PGN 63055				
521166	Event SPN	No	No	Displayed list of an important Events (up to 15)*. For example, important Event is Power supply fault (with indicated voltage value). User cannot erase list of important Events.
Information Events List PGN 63056				
521166	Event SPN	No	No	Displayed list of informative Events (up to 15)*. For example, informative Events is Ignition On/Off. User can erase list of informative Events.
* For each Event the following data are specified: designation, date/time of occurrence, as well as additional information (if any). Events are displayed in chronological sequence, starting from the most recent. As soon as the maximum number of Events displayed is reached, new Events overwrite the earliest Events. The user cannot clear the list of important Events				

Detailed parameters description (SPN), structure and content of messages (PGN) of FM DUT-E 2Bio are placed at the following web site http://s6.jv-technoton.com/ (to access S6 DB registration is required).

Annex C
Data composition in DUT-E 2Bio CAN output messages transmitted via CAN j1939/S6 interface

Table C.1 — Data composition of DUT-E 2Bio CAN outgoing messages

Field number	Length	Parameter	Description	Rules of output
Output data Self-diagnostics FM (version 10)				
Unit Work Counters PGN 62994 (0xF612)				On request
1	4 bytes	SPN 521116	Unit Hours Of Operation	
5	4 bytes	SPN 521116/16.1	Unit Hours Of Operation. Battery	
9	4 bytes	SPN 521118	Unit Reset Counter	
13	4 bytes	SPN 521119	Unit Power Off Counter	
Unit DTCs PGN 63169 (0xF6C1)				On request
1	4 bytes	SPN 521488	Unit DTCs Mask	
Unit. Restart Counters PGN 63280 (0xF730)				On request
1	4 bytes	SPN 521118/30.0	Unit Reset Counter. Software	
5	4 bytes	SPN 521118/30.1	Unit Reset Counter. Hardware	
Active Diagnostic Trouble Codes PGN 65226 (0xFECA)				1000 ms
3	3 bytes	SPN 521044	Fault Identifier (SID+FMI) (see table C.2)	
6.1	7 bits	SPN 1216	Occurrence Count	
6.8	1 bit	SPN 1706	SPN Conversion Method	
Previously Active Diagnostic Trouble Codes PGN 65227 (0xFECB)				On request
3	3 bytes	SPN 521044	Fault Identifier (SID+FMI) (see table C.2)	
6.1	7 bits	SPN 1216	Occurrence Count	
6.8	1 bit	SPN 1706	SPN Conversion Method	
Unit Passport PGN 62995 (0xF613)				On request
1	16 bytes	SPN 521123	Line	
17	16 bytes	SPN 521344	Brand	
33	16 bytes	SPN 521345	Model	
49	16 bytes	SPN 521120	Serial Number	
65	8 bytes	SPN 521121	Firmware Version	
73	4 bytes	SPN 521125	Manufacturing Date	
77	1 byte	SPN 521188	S6 Address (SA)	
Output data Onboard clock FM (version 4)				
Time/Date PGN 65254 (0xFEE6)				On request
1	1 byte	SPN 959	Seconds	
2	1 byte	SPN 960	Minutes	
3	1 byte	SPN 961	Hours	
4	1 byte	SPN 963	Month	
5	1 byte	SPN 962	Day	
6	1 byte	SPN 964	Year	
7	1 byte	SPN 1601	Time Displacement In Minutes	
8	1 byte	SPN 1602	Time Displacement In Hours	

Field number	Length	Parameter	Description	Rules of output
Output data Fuel level sensor FM (version 7)				
Filtered Fuel Level/Volume in Tank PGN 62982 (0xF606)				1000 ms
1	2 bytes	SPN 521023/2.10	Fuel Tank Level. Filtering	
3	2 bytes	SPN 521024/2.10	Fuel Tank Volume. Filtering	
5	2 bytes	SPN 521025	Tank Fuel Rate	
7	1 byte	SPN 174	Engine Fuel Temperature 1	
Fuel Level/Volume in Tank PGN 63087 (0xF66F)				1000 ms
1	2 bytes	SPN 521023	Fuel Tank Level	
3	2 bytes	SPN 521024	Fuel Tank Volume	
5	1 byte	SPN 96	Fuel Level 1	
Tank Fuel Level PGN 63148 (0xF6AC)				1000 ms
1	4 bytes	SPN 521032	Fuel Volume. High Resolutions	
5	2 bytes	SPN 521033	Tank Volume	
Fuel Type PGN 63292 (0xF73C)				1000 ms
1	1 byte	SPN 521467	Fuel Type	
2	4 bytes	SPN 521464	Permittivity	
Pulse-width Modulation Duty Cycle PGN 63489 (0xF801)				On request
1	4 bytes	SPN 521440	Frequency (Duty Cycle)	
5	4 bytes	SPN 521443	Duty Cycle Third Electrode	
9	2 bytes	SPN 521442	Fuel Temperature (High Precision)	
11	2 bytes	SPN 521023	Fuel Tank Level	
Dash Display PGN 65276 (0xFEFC)				1000 ms
2	1 byte	SPN 96	Fuel Level 1	
7	1 byte	SPN 38	Fuel Level 2	
Output data Fuel level control FM (version 1)				
Total Fuel Volume In Tanks PGN 63152 (0xF6B0)				1000 ms
1	2 bytes	SPN 521024/2.11	Fuel Tank Volume. Summary Value	
3	1 byte	SPN 96/2.11	Fuel Level 1. Summary Value	
4	2 bytes	SPN 521033	Tank Volume	
Output data Vehicle power supply FM (version 3)				
Power Supply Voltage. Counters PGN 62976 (0xF600)				On request
1	4 bytes	SPN 521170	Starter Hours of Operation	
5	4 bytes	SPN 521171	Flowmeter Hours Of Operation	
9	4 bytes	SPN 521173	Hours Of Operation On Power Supply	
13	4 bytes	SPN 521172	Hours Of Operation From Battery	
Vehicle Voltage PGN 62987 (0xF60B)				1000 ms
1	2 bytes	SPN 158	Key Switch Battery Potential	
3.1	2 bits	SPN 521049	Ignition Key State	
4	4 bytes	SPN 521053	Ignition ON Time	
Vehicle Power Supply Status PGN 63089 (0xF671)				1000 ms
1	2 bytes	SPN 521055	Vechicle Power Supply Voltage	
3	2 bytes	SPN 521055/2.9	Vechicle Power Supply Voltage. Average For 5 Minutes	
5.1	3 bits	SPN 521056	Vehicle Power Supply Status	

Field number	Length	Parameter	Description	Rules of output
5.4	2 bits	SPN 521076	Vehicle Power Supply Presence	
5.6	2 bits	SPN 521049/16.2	Ignition Key State. Ignition switch terminal 15	
Output data Accelerometer FM (version 3)				
Slope Sensor Information PGN 61459 (0xF013)				100 ms
1	2 bytes	SPN 3318	Pitch Angle	
3	2 bytes	SPN 3319	Roll Angle	
5	2 bytes	SPN 3322	Pitch Rate	
7.1	2 bits	SPN 3323	Pitch Angle Figure of Merit	
7.3	2 bits	SPN 3324	Roll Angle Figure of Merit	
7.5	2 bits	SPN 3325	Pitch Rate Figure of Merit	
7.7	2 bits	SPN 3326	Pitch and Roll Compensated	
8	1 byte	SPN 3327	Roll and Pitch Measurement Latency	
Acceleration Sensor PGN 61485 (0xF02D)				100 ms
1	2 bytes	SPN 5347	Lateral Acceleration Extended Range	
3	2 bytes	SPN 5348	Longitudinal Acceleration Extended Range	
5	2 bytes	SPN 5349	Vertical Acceleration Extended Range	
7.1	2 bits	SPN 5350	Lateral Acceleration Extended Range Figure of Merit	
7.3	2 bits	SPN 5351	Longitudinal Acceleration Extended Range Figure of Merit	
7.5	2 bits	SPN 5352	Vertical Acceleration Extended Range Figure of Merit	
7.7	2 bits	SPN 5353	Support Variable Transmission Repetition Rate for Acceleration Sensor	
Accelerometer PGN 63155 (0xF6B3)				On request
1	2 bytes	SPN 5347	Lateral Acceleration Extended Range	
3	2 bytes	SPN 5348	Longitudinal Acceleration Extended Range	
5	2 bytes	SPN 5349	Vertical Acceleration Extended Range	
7	2 bytes	SPN 5347/2.3	Lateral Acceleration Extended Range. Standard Deviation	
9	2 bytes	SPN 5348/2.3	Longitudinal Acceleration Extended Range. Standard Deviation	
11	2 bytes	SPN 5349/2.3	Vertical Acceleration Extended Range. Standard Deviation	
13.1	2 bits	SPN 5350	Lateral Acceleration Extended Range Figure of Merit	
13.3	2 bits	SPN 5351	Longitudinal Acceleration Extended Range Figure of Merit	
13.5	2 bits	SPN 5352	Vertical Acceleration Extended Range Figure of Merit	
13.7	2 bits	SPN 1611	Vehicle motion	
14	2 bytes	SPN 521384	Acceleration Module	
Output data Events registrator FM (version 2)				
Important Events List PGN 63055 (0xF64F)				On request
1	4 bytes	SPN 521166	Event SPN	
5	1728 bytes	SPN 521357	Data	
Information Events List PGN 63056 (0xF650)				On request
1	4 bytes	SPN 521166	Event SPN	
5	1728 bytes	SPN 521357	Data	
"Fuelling" Event SPN 521200*				On the fact, but not less than 600 s
1	4 bytes	SPN 521300	Event Date/Time	
2	4 bytes	SPN 584	Latitude	
3	4 bytes	SPN 585	Longitude	

Field number	Length	Parameter	Description	Rules of output
4	2 bytes	SPN 521301	Filled Fuel Volume	
5	2 bytes	SPN 521024/17.0	Fuel Tank Volume. At the Event start	
6	2 bytes	SPN 521024/17.1	Fuel Tank Volume. At the Event end	
"Fuel Discharge" Event SPN 521201*				On the fact, but not less than 600 s
1	4 bytes	SPN 521300	Event Date/Time	
2	4 bytes	SPN 584	Latitude	
3	4 bytes	SPN 585	Longitude	
4	2 bytes	SPN 521302	Discharged Fuel Volume	
5	2 bytes	SPN 521024/17.0	Fuel Tank Volume. At the Event start	
6	2 bytes	SPN 521024/17.1	Fuel Tank Volume. At the Event end	

* Transmitted in Important Events List (PGN 63055, Event SPN field SPN 521166).
— Unstructured Data fields (SPN 521357).

Table C.2 — Malfunctions codes of DUT-E 2Bio CAN sensor

Numerical designation of malfunction code		Malfunction code description
SID	FMI	
1231	2	CAN-bus. Data Erratic, Intermittent Or Incorrect
520192	25	Analog to digital converter (ADC). Starting error
523000	4	Fuel Level Sensor. Measuring Generator Fault. Measuring Tube Shorting
523000	13	Fuel Level Sensor. Calibration Error
523000	14…21	Fuel Level Sensor. No response from Slave sensor with the respective network address (SA) from 101…108 range during the summation of readings
523000	22	Fuel Level Sensor. Measuring Generator Fault. Third Electrode. Measuring Tube Shorting
523000	27	Temperature sensor of 3d electrode is faulty (indications higher than the normal working range)
523001	24	Real-time Clock. Clocking Off
523007	2	FRAM. Data Erratic, Intermittent Or Incorrect
523042	7	Accelerometer. Mechanical System Not Responding Or Out Of Adjustment

Annex D

Modbus RTU data transmission protocol and table of registers of DUT-E 2Bio 232/485 output messages

Modbus RTU protocol for transmission of data of DUT-E 2Bio 232/485 fuel level sensors is based on Master-Slave architecture.
The table of registers of DUT-E 2Bio 232/485 output messages that are accessible according to Modbus RTU protocol (table of data Holding Registers) is provided in table D.1.
For reading Parameters from the table of registers, you need to employ the standard feature of Modbus RTU protocol — **3 (0x03) Read Holding Registers**.
DUT-E 2Bio 232/485 output messages transmitted by means of Modbus RTU protocol contain:

- Device unique network address (Slave ID) from the range of 0…255 (101 by default).
- Function code (FCode=3).
- Data (Data).
- Checksum (CRC).

The data in DUT-E 2Bio 232/485 output messages are presented as unsigned whole number — **unsigned int**.
The volume of data in each register — **2 bytes**.
The request execution timeout — **1000 ms**.
To read the register, the Telematics terminal (Master device) sends to DUT-E 2Bio 232/485 address (Slave device) a request containing the code of function 3 (Read Holding Registers), the address of the requested register (Reg Addr) and the number of registers to be read (Reg Count). In response to the request, DUT-E 2Bio 232/485 sends a data packet containing its network address (Slave ID), the number of function of the protocol (FCode=3), the number of bytes in the data field (Bytes Count) and the data field (DATA) containing the value of the requested register. For reading of several serial registers, the address of the first register and the total number of registers to be read should be specified in the request (see figure D.1).

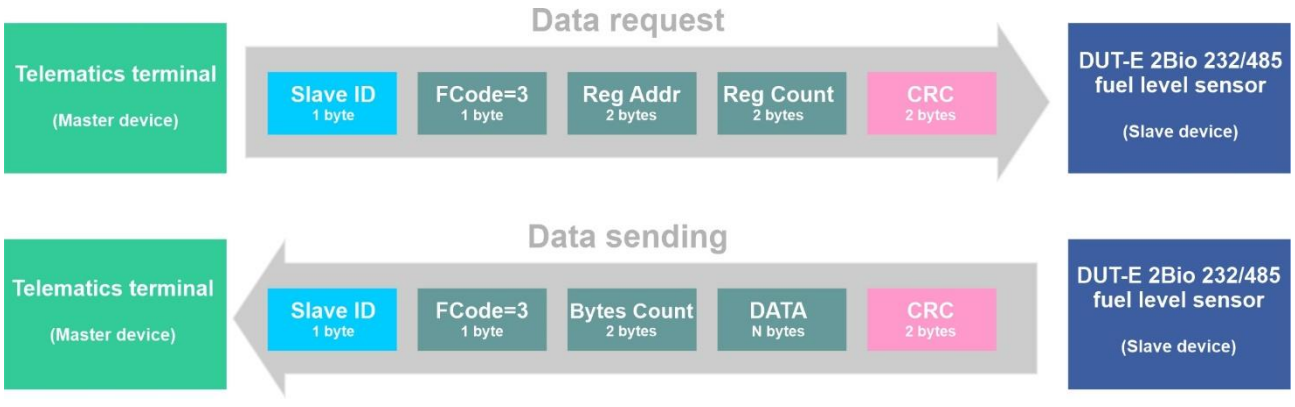


Figure D.1 — Scheme of data exchange according to ModBus RTU protocol between DUT-E 2Bio 232/485 sensor and the Telematics terminal

Example 1: Read the value of SPN 521024 "Volume of fuel in the tank, l" from the register

Reg Addr	Data	
	1 byte (high byte)	1 byte (low byte)
4	02	46

The Request structure: 0x65 0x03 0x00 0x04 0x00 0x01 0xCD 0xEF, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the requested sensor: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
00 04 – address of the requested register: Reg Addr=4;
00 01 – number of registers to be read: Reg Count=1;
CD EF – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

The Response structure: 0x65 0x03 0x02 0x02 0x46 0x49 0x1E, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the sensor from which data are to be read: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
02 – number of bytes in the data field: Bytes Count=2;
02 46 – data field of register 4 (2 bytes): Data=0246;
49 1E – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification: 246 (Hex)=582 (Dec) · 0,1 + 0 = 58,2 l,
where 0.1 l – factor (resolution); 0 l – offset for calculation of values of SPN 521024.

Example 2: Read the value of SPN 174 "Fuel temperature, °C" from the register

Reg Addr	Data	
	1 byte (high byte)	1 byte (low byte)
3	00	40

The Request structure: 0x65 0x03 0x00 0x03 0x00 0x01 0x7C 0x2E, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the requested sensor: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
00 03 – address of the requested register: Reg Addr=3;
00 01 – number of registers to be read: Reg Count=1;
7C 2E – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

The Response structure: 0x65 0x03 0x02 0x00 0x40 0xC8 0x7C, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the sensor from which data are to be read: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
02 – number of bytes in the data field: Bytes Count=2;
00 40 – data field of register 3 (2 bytes): Data=0040;
C8 7C – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification: 40 (Hex)=64 (Dec) · 1 - 40 = 24 °C,
where 1 °C – factor (resolution); -40 °C – offset for calculation of values of SPN 174.

Example 3: Read the value of SPN 521116 "Unit operation time, s" from the register

Reg Addr	Data		Note
	1 byte (high byte)	1 byte (low byte)	
8	AF	43	High word
9	00	1A	Low word

The Request structure: 0x65 0x03 0x00 0x08 0x00 0x02 0x4D 0xED, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the requested sensor: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
00 08 – address of the first from the requested registers: Reg Addr=8;
00 02 – number of registers to be read: Reg Count=2;
4D ED – field of checksum (CRC) calculated according crc16 algorithm (2 bytes).

The Response structure: 0x65 0x03 0x04 0x00 0x1A 0xAF 0x43 0xC2 0x33, where
0x – prefix of the hexadecimal system of numeration;
65 – network address of the sensor from which data are to be read: Slave ID=101;
03 – number of the function of reading registers: FCode=3;
04 – number of bytes in the data field: Bytes Count=4;
00 1A – data field of register 9 (2 bytes): Data=001A;
AF 43 – data field of register 8 (2 bytes): Data=AF43;
C2 33 – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification:
1AAF43 (Hex)= 1748803 (Dec)=1748803 s=20 days 5 h 46 min 43 s.

Table D.1 — Table of DUT-E 2Bio 232/485 output messages registers, in accordance with Modbus RTU protocol

Register address	Register contents	SPN	Specificator
0	Fuel tank level	521023	2.10 Filtering
1	Fuel level	521448	
2	Fuel level 1	96	
3	Engine fuel temperature 1	174	
4	Fuel tank volume	521024	
5	Fuel tank volume	521024	2.11 Summary Value
6	Fuel level 1	96	2.11 Summary Value
7	Frequency (duty cycle)	521440	
8	Unit hours of operation (low word)	521116	
9	Unit hours of operation (high word)	521116	
10*	Unit hours of operation (low word)	521116	16.1 Battery
11*	Unit hours of operation (high word)	521116	16.1 Battery
12	Unit reset counter (low word)	521118	
13	Unit reset counter (high word)	521118	
14*	Unit power off counter (low word)	521119	
15*	Unit power off counter (high word)	521119	
16	Vechicle power supply voltage	521055	
17	Vechicle power supply voltage	521055	2.9 Average For 5 Minutes
18	Vehicle power supply status	521056	
19	Vehicle power supply presence	521076	
20	Starter hours of operation (low word)	521170	
21	Starter hours of operation (high word)	521170	
22	Flowmeter hours of operation (low word)	521171	
23	Flowmeter hours of operation (high word)	521171	
24	Vehicle hours of operation on power supply (low word)	521173	
25	Vehicle hours of operation on power supply (high word)	521173	
26	Vehilce hours of operation from battery (low word)	521172	
27	Vehilce hours of operation from battery (high word)	521172	
28*	Normal engine starts counter (low word)	521002	
29*	Normal engine starts counter (high word)	521002	
30*	Cold engine starts counter (low word)	521003	
31*	Cold engine starts counter (high word)	521003	
32*	Incorrect engine start counter (low word)	521239	
33*	Incorrect engine start counter (high word)	521239	
34*	Engine start failures counter (low word)	521007	
35*	Engine start failures counter (high word)	521007	
36*	Exceeding starter continuous working time counter (low word)	521006	

Register address	Register contents	SPN	Specificator
37*	Exceeding starter continuous working time counter (high word)	521006	
38*	Total engine starts counter (low word)	521001	
39*	Total engine starts counter (high word)	521001	
40	Error code (Error codes in accordance with DUT-E COM protocol)	see DUT-E COM protocol	
* Reserve address.			
Note — Command for reading registers: 0x03 Read Holding registers.			

Annex E

ASCII text data transfer protocol for DUT-E 2Bio 232/485

ASCII text protocol (American Standard Code for Information Interchange) is used for automatic data transfer by DUT-E 2Bio 232/485 digital fuel level sensors, according to TIA/EIA 232-F and ANSI/TIA-485-A standards.

The data transfer interval is specified within the range 1…255 s (by default — 1 s) using Service S6 DUT-E software or Service S6 DUT-E (Android) mobile application (see figure E.1).

ASCII text protocol is a code for interpretation of decimal digits, Latin and national alphabets, punctuation characters and command characters. The protocol allows to convert numerical values (names) needing description into simple letter characters.

1) According to ASCII text protocol, DUT-E 2Bio 232/485 sensor transfers the following three parameters in the form of characters (ASCII code) at set intervals (see figure E.2):

F – value of the current of the sensor measuring generator frequency, Hz;

t – value of the sensor temperature, °C;

Note — For transfer of the data value of fuel temperature measured by the temperature sensor of the additional electrode, you need to tick **Fuel Temperature Measurement Enable** field (submenu Fuel level sensor FM, tab **Settings**, see B.3).

N – current sensor readings in units preset using the service software or mobile application (conventional units/mm/liters/%) (see figure E.1).

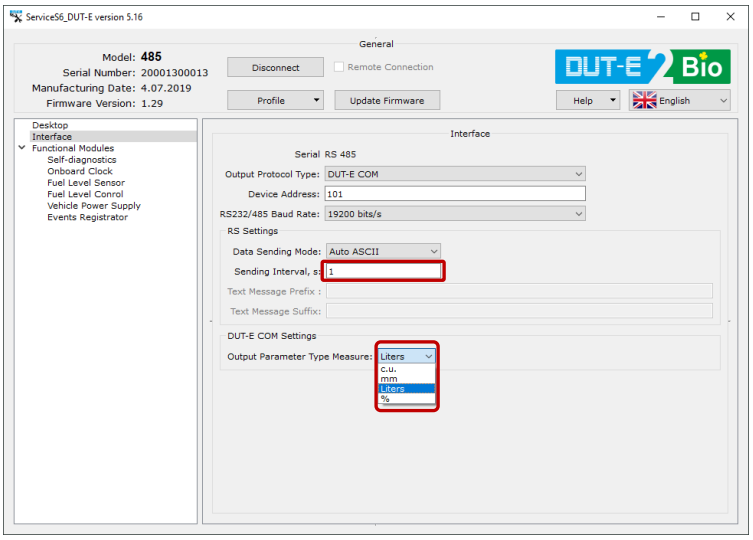


Figure E.1 — Example of DUT-E 2Bio 485 sensor settings made using the service software for data transfer, according to ASCII text protocol

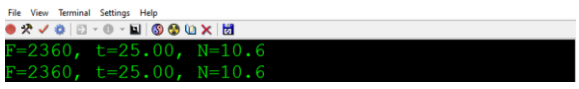


Figure E.2 — Example of display of parameters transferred by DUT-E 2Bio 485 with the set period of data transfer, according to ASCII text protocol, in the software that registers data of COM-port

2) According to ASCII EXT extended text protocol, DUT-E 2Bio 232/485 sensor displays one parameter at set intervals in the form of characters (ASCII code) — current data readings in units preset using the service software or mobile application (conventional units/mm/liters/%) (see figure E.3).

The parameter value is placed between two special words specified by the user, up to 32 characters long (e.g. **Prefix [** and **]Postfix**) which indicate, respectively, the beginning and the end of the line containing the parameter which is transferred (see figure E.4).

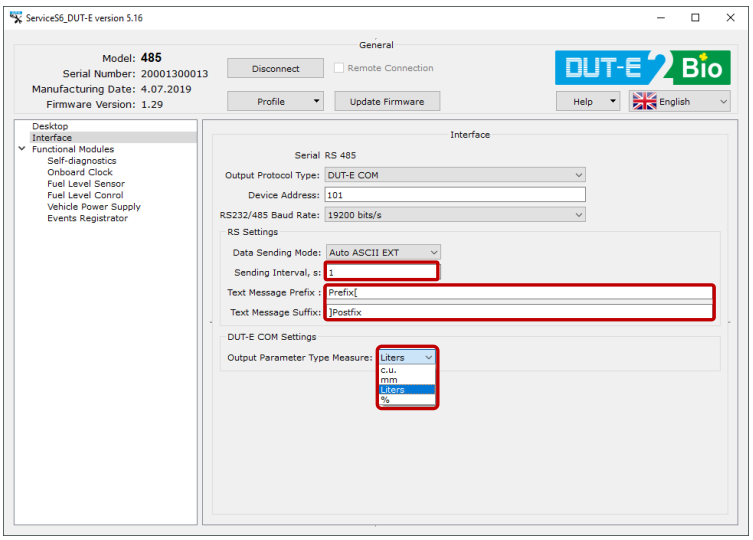


Figure E.3 — Example of DUT-E 2Bio 485 sensor settings made using the service software for data transfer, according to ASCII EXT extended text protocol

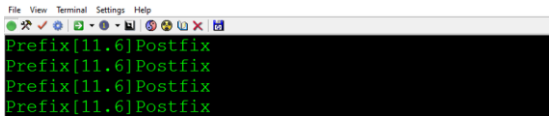


Figure E.4 — Example of display of the parameter transferred by DUT-E 2Bio 485 with the set period of data transfer, according to ASCII EXT extended text protocol, in the software that registers data of COM-port

Annex F

DUT-E 2Bio firmware upgrade

WARNING: DUT-E 2Bio 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 2.5.1) and establish a communication session between DUT-E 2Bio and PC (see 2.5.3).

In case you use Service S6 DUT-E (Android), connect the sensor to the Android device using S6 BT Adapter service adapter (see 2.6.1). Establish a connection between the sensor and the Android device via the Bluetooth channel (see 2.6.3).

WARNING: When re-uploading firmware, power supply voltage of DUT-E 2Bio 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 2Bio 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 2Bio 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 2Bio 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 Unit;
- to disconnect the Unit from the service adapter and the adapter from the PC or the Android device;
- to connect to the Unit 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 2Bio 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 2Bio 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 2Bio operability. If the repeated attempt fails, we recommend to consult Technoton Technical Support Service by e-mail support@jv-technoton.com.

Annex G
Electromagnetic compatibility specifications of DUT-E 2Bio

Table G.1 — Protection of power circuits of DUT-E 2Bio 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 G.2 — Protection of signal circuits of DUT-E 2Bio against conductive, capacitive and inductive interference as described in ISO 7637-3:2002

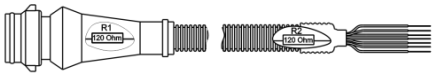
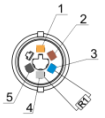
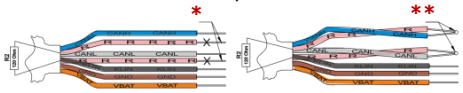
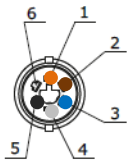
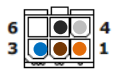
Test pulse	Test level	U_S tested level, V for supply voltage	
		12 V	24 V
Pulse “a” of short duration	IV	-60	-80
Pulse “b” of short duration	IV	+40	+80
Positive pulse of long duration (DCC)	IV	+30	+45
Negative pulse of long duration (DCC)	IV	-30	-45
Positive pulse of long duration (ICC)	IV	+6	+10
Negative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

Table G.3— DUT-E 2Bio 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 H
DUT-E 2Bio CAN signal cables

Table H.1 — DUT-E 2Bio CAN signal cables

Name and exterior	Design	Purpose of use and description
S6 SC-CW-700 Cable 	  Pin / Wire color / Circuit 1 orange VBAT 2 brown GND 3 blue CANH 4 white CANL 5 black KLIN 6 - - **Connecting** without built-in terminal resistor R2 | with built-in terminal resistor R2  * Do not connect R2 resistor wires (pink, identification mark R), insulate. ** Connect electrically one of the R2 resistor wires (pink, identification mark R) with CANH wire, and the other - with CANL wire.	Designed to connect the sensor to tracking devices, as well as to the external power supply. Length: 7 m. It has 2 pcs. of 120 Ohms inbuilt terminal resistors at both ends of CANH and CANL wires.
S6 SC-Mol-300 **S6 SC-Mol-700** **Extension cable adapter** 	 **XS1**  **XS1, XP1** Pin / Circuit 1 VBAT 2 GND 3 CANH 4 CANL 5 KLIN 6 - **XP1** 	It is designed to connect the sensor to the section of cable system located inside the cabin by means of S6 Technology through Molex connector. Versions of 3m and 7 m length are available.

Annex I
Examples of diagrams for DUT-E 2Bio CAN connection to Telematics terminals

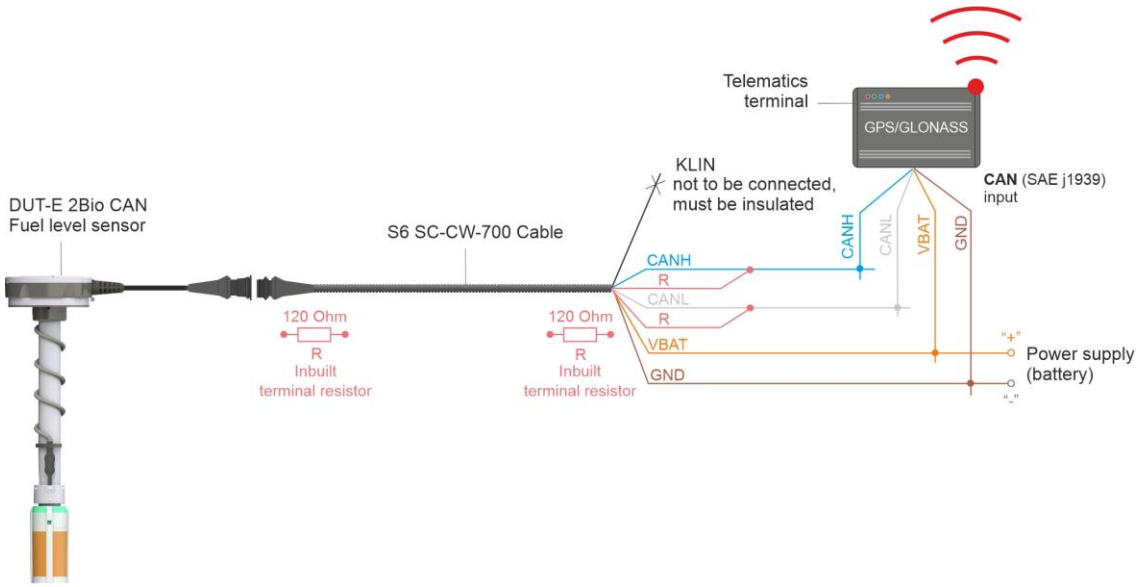


Figure I.1 — Example of connection for one DUT-E 2Bio CAN to the Terminal which is incompatible with S6 cable system

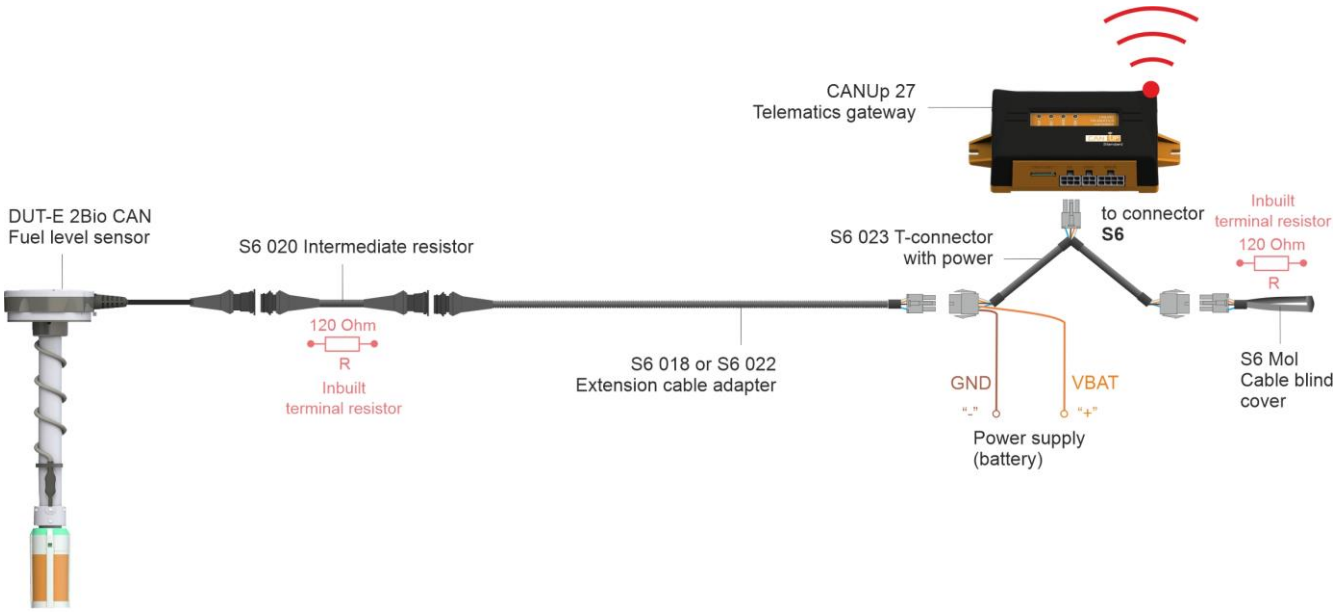


Figure I.2 — Example of connection for one DUT-E 2Bio CAN to the Terminal which is compatible with S6 cable system

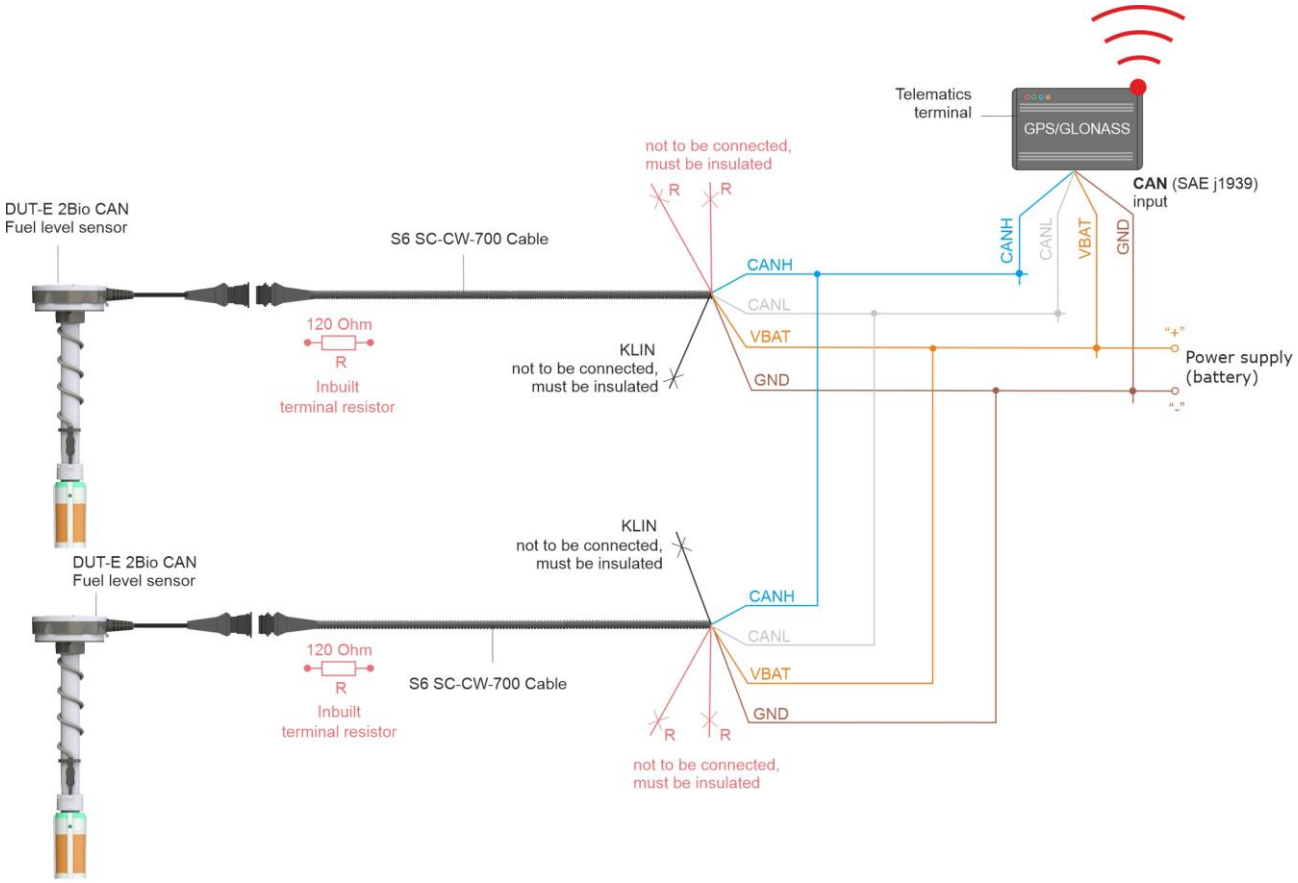
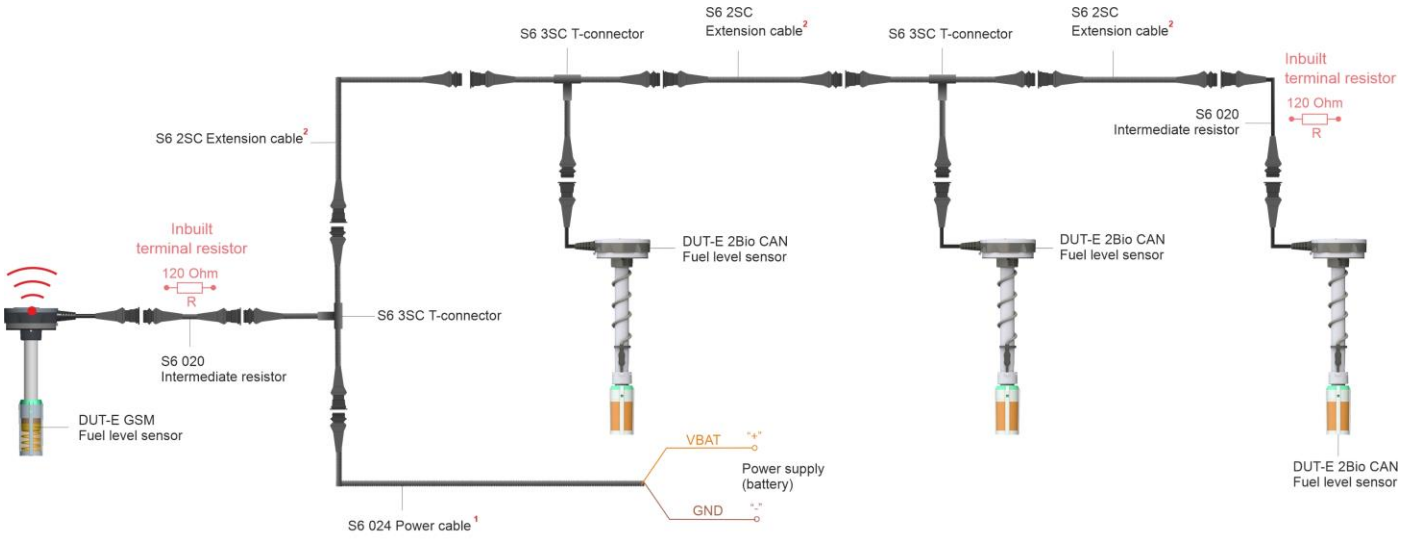


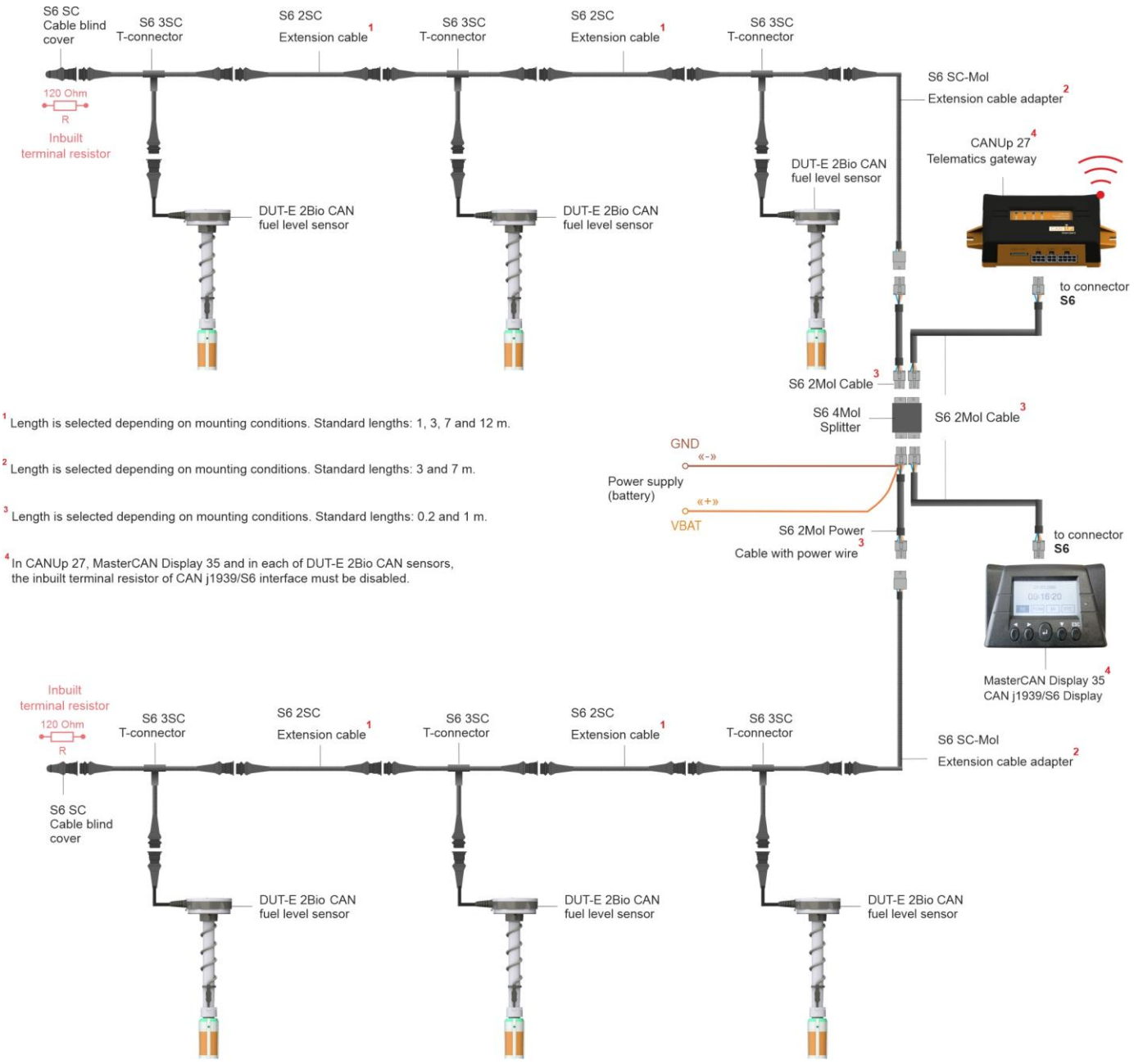
Figure I.3 — Example of connection for two DUT-E 2Bio CAN to the Terminal which is incompatible with S6 cable system



[1] Cable is included into DUT-E GSM delivery set. Length: 7.5 m.

[2] The length is selected according to installation conditions. Standard lengths are 1, 3, 7 and 12 m.

Figure I.4 — Connection of DUT-E 2Bio CAN and DUT-E GSM sensors for monitoring fuel in several tanks



[1] Length is selected depending on mounting conditions. Standard lengths: 1, 3, 7 and 12 m.

[2] Length is selected depending on mounting conditions. Standard lengths: 3 and 7 m.

[3] Length is selected depending on mounting conditions. Standard lengths: 0.2 and 1 m.

[4] In CANUp 27, MasterCAN Display 35 and in each of DUT-E 2Bio CAN sensors, the inbuilt terminal resistor of CAN j1939/S6 interface must be disabled.

Figure I.5 — Example of connection of several DUT-E 2Bio CAN to the Terminal and CAN display which are compatible with S6 cable system

Annex J
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**).

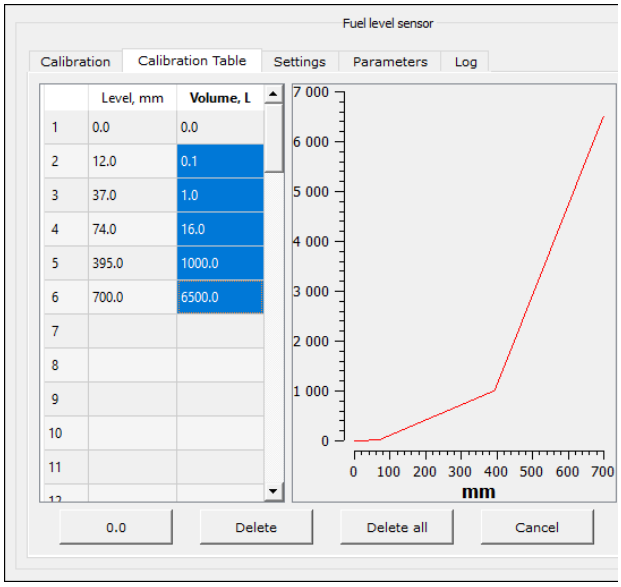
The actual position of the decimal divider of the whole and fractional parts is ignored in volume values.

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 J.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 K
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