FUEL LEVEL SENSORS

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

OPERATION MANUAL

Version 3.1

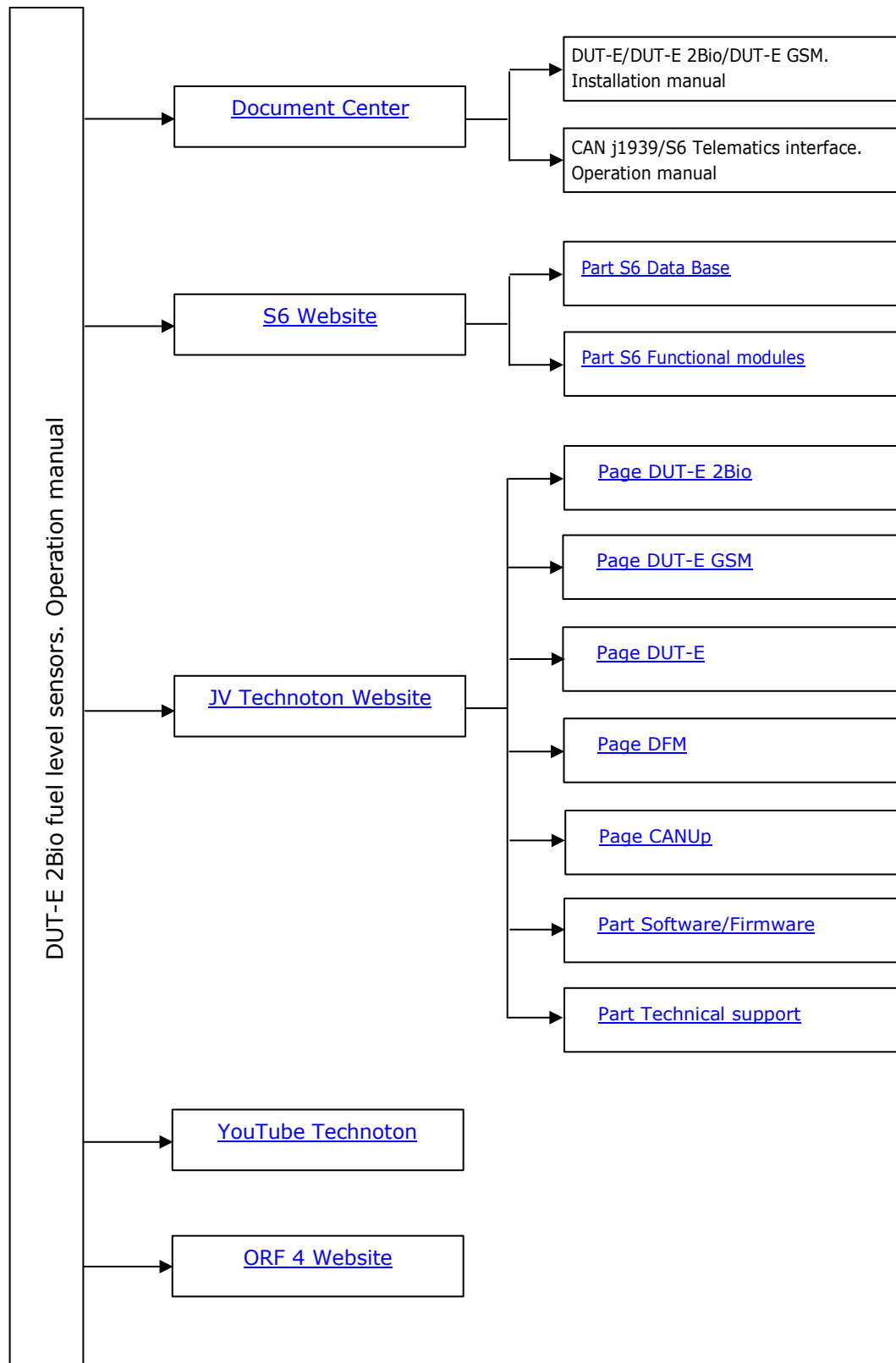# Contents

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.

Structure of external links

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DUT-E 2Bio fuel level sensors. Operation manual
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- **Document Center**
  - DUT-E/DUT-E 2Bio/DUT-E GSM. Installation manual
  - CAN j1939/S6 Telematics interface. Operation manual

- **S6 Website**
  - Part S6 Data Base
  - Part S6 Functional modules

- **JV Technoton Website**
  - Page DUT-E 2Bio
  - Page DUT-E GSM
  - Page DUT-E
  - Page DFM
  - Page CANUp
  - Part Software/Firmware
  - Part Technical support

- **YouTube Technoton**

- **ORF 4 Website**

Terms and Definitions

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 Iota 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, GSM 2G/3G 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 manufactured after 01.09.2017 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.

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

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 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 (USA), GLONASS (Russia), Galileo (EU), BeiDou (China).

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, used for processing and storage of Operational data, formation and transmission of Analytical reports through Internet by request of ORF 4 users.

Event — relatively rare and sudden change in SPN. For example, the attempt to falsify values of "Instant fuel consumption" counter by applying electromagnetic field to fuel flow meter will be recognized as "Interference" Event. An Event can have one or several characteristics. "Interference" Event has the following: date/time and duration of interference. When the Event occurs, a terminal unit registers the time of occurrence, which is later mentioned in a report on the event. Thus, the Event is always attached to exact time and place of occurrence.

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.

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**, **17**, **20**, **34**, **35** manufactured by JV Technoton, Minsk, Republic of Belarus.

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:
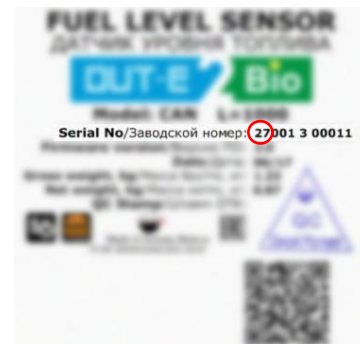
The manual contains information on design, operation principle, specifications and instructions on installation, use and maintenance of DUT-E 2Bio. Besides, this document defines the procedure for wire-connected and wireless connection configuration of sensors.

DUT-E 2 Bio — **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 internal data processing (Parameter filtration and normalization, Events logging, Counters recording) for easier server operation and data traffic saving;
- 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;
- 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;
- summation of readings from up to 8 fuel level sensors connected in single network by S6 Technology*****;
- configurable feature of automatic recognition of fuel type in use******;
- function of digital self-diagnostics for sensor quality control;
- wireless configuration by means of Android devices via Bluetooth using S6 BT Adapter.

* S6 Technology allows to use DUT-E 2Bio CAN to summarize data together from DUT-E GSM and DUT-E CAN sensors that have interface CAN j1939/S6.

** 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:

- conformity with European and national automotive standards;
- ergonomic bayonet mount allows to save installation time;
- shortening/extending length of measuring probe;
- adjustable temperature correction for automatic measurement correction based on ambient temperature;
- bottom spring for better mounting rigidity;
- screen filter 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.

See figure 1 for identification codes for DUT-E 2Bio ordering.

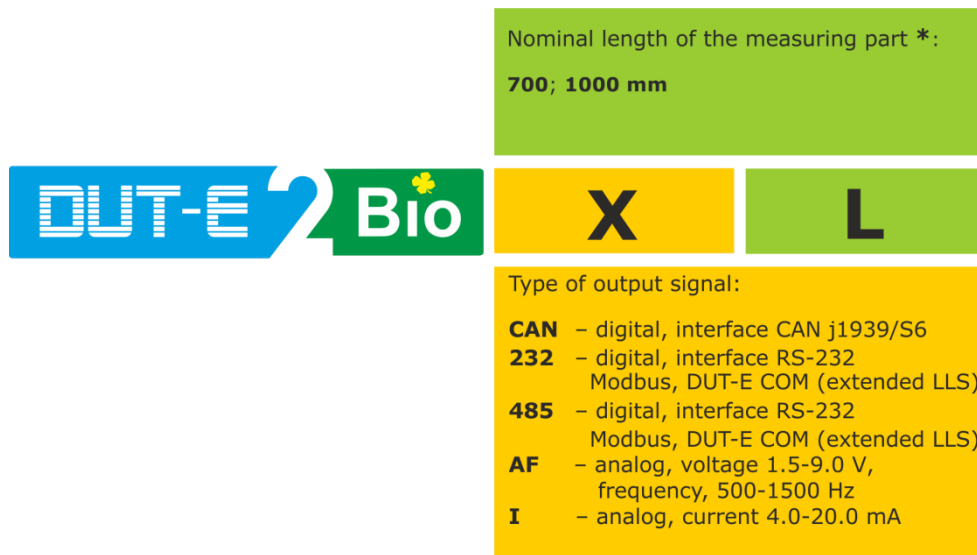Figure 1 — DUT-E 2Bio order identification codes

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).

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* Per special order, DUT-E 2Bio CAN/AF/232/485 can be manufactured with any custom measuring probe length up to 1400 mm. For orders less than 200 pieces in calendar quarter, 10 % extra fee is applied.

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 2 Bio is used for:

- accurate level measurement in fuel tanks of vehicles and stationary units (see figure 2);
- events registration of fuel re-filling or fuel drainage from the tank;
- 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;
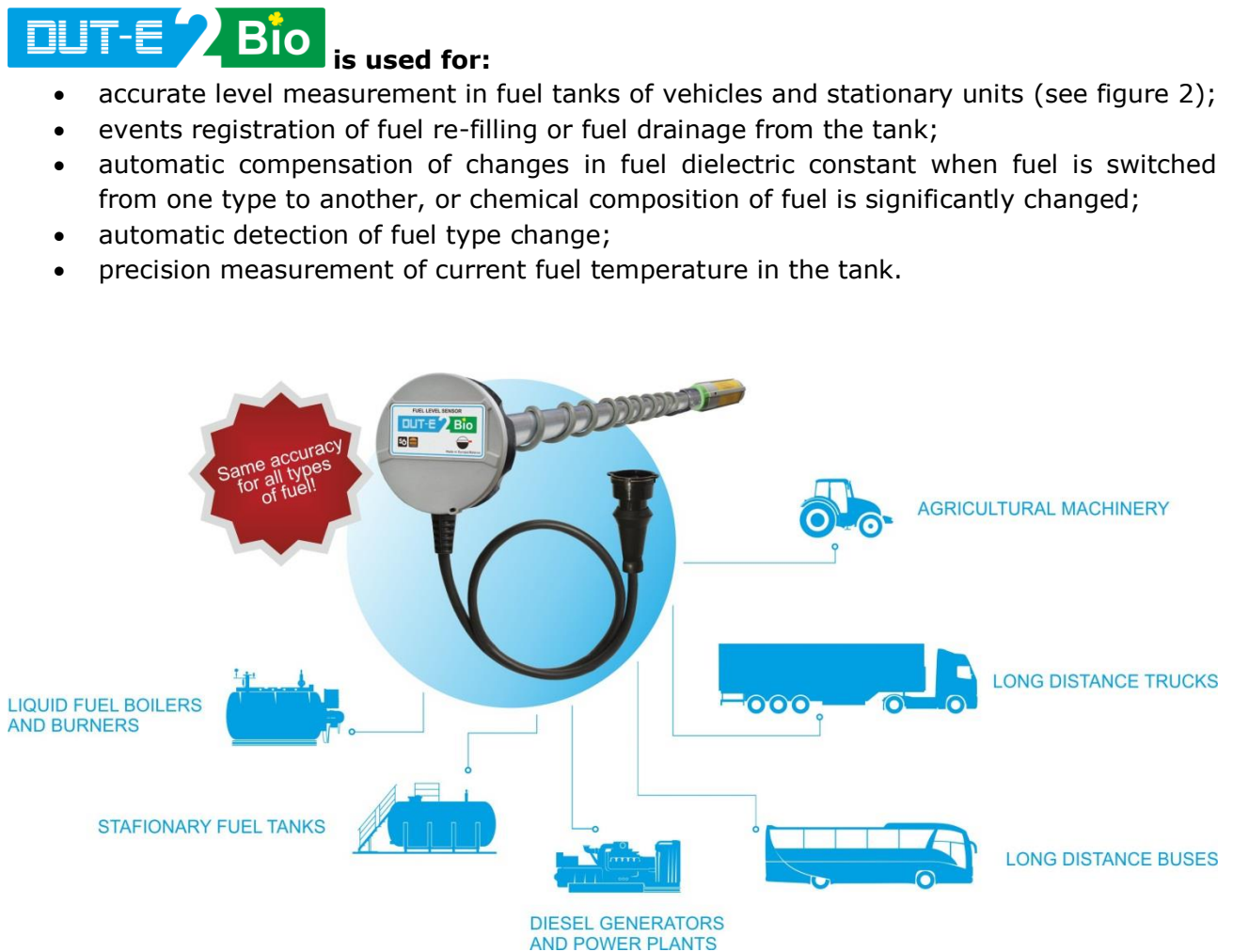- precision measurement of current fuel temperature in the tank.

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: Unlike the standard capacitive fuel level sensor, DUT-E 2Bio has additional electrode (see 1.3) that ensures **automatic correction of changes in fuel dielectric constant**.

Differential correction mechanism automatically turns on if dielectric constant of fuel is changed during new tank re-fuelling. It means that sensor will correct fuel measurement results according to the difference between dielectric constant values of fuel – initial type of fuel (on which fuel level sensor was calibrated) and fuel that was currently placed into the tank.

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).
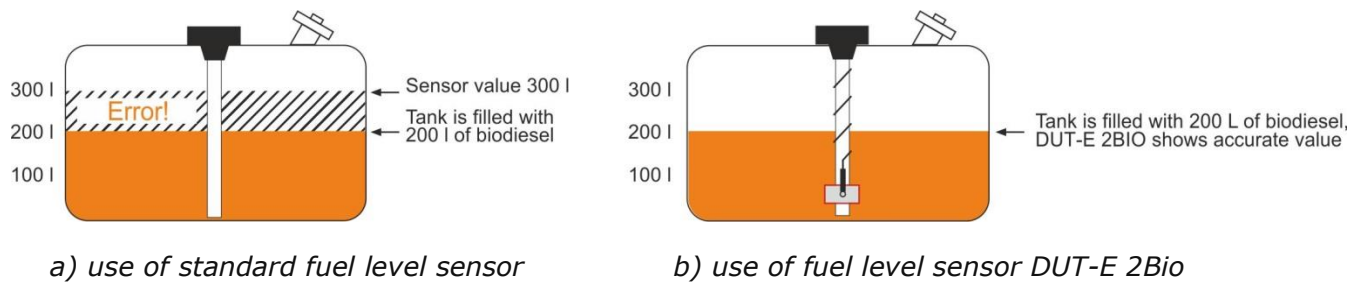

a) use of standard fuel level sensor   b) use of fuel level sensor DUT-E 2Bio

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).
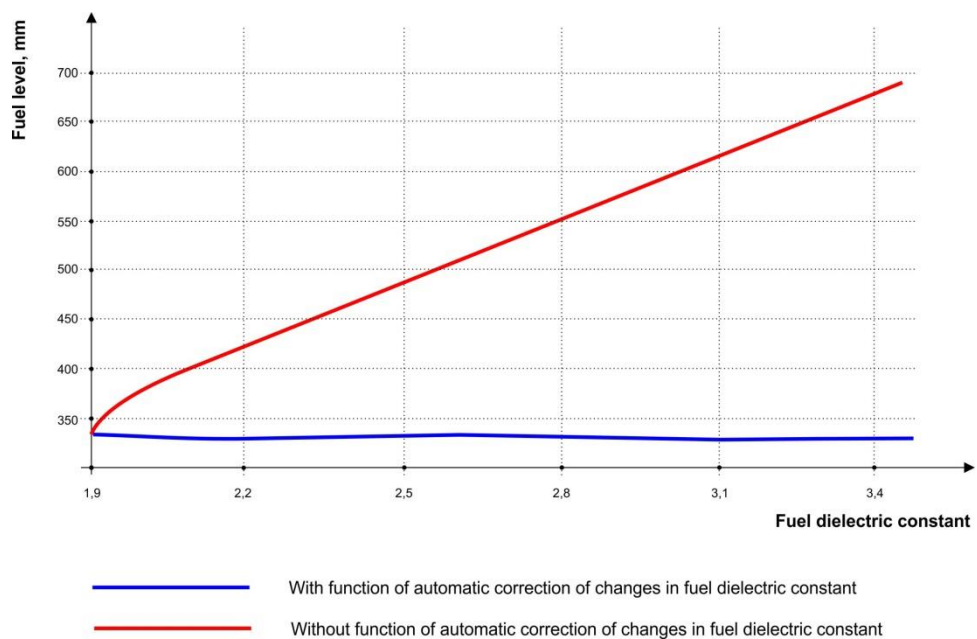**Procedure of fuel tank re-calibration is not required with DUT-E 2Bio!**

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 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.
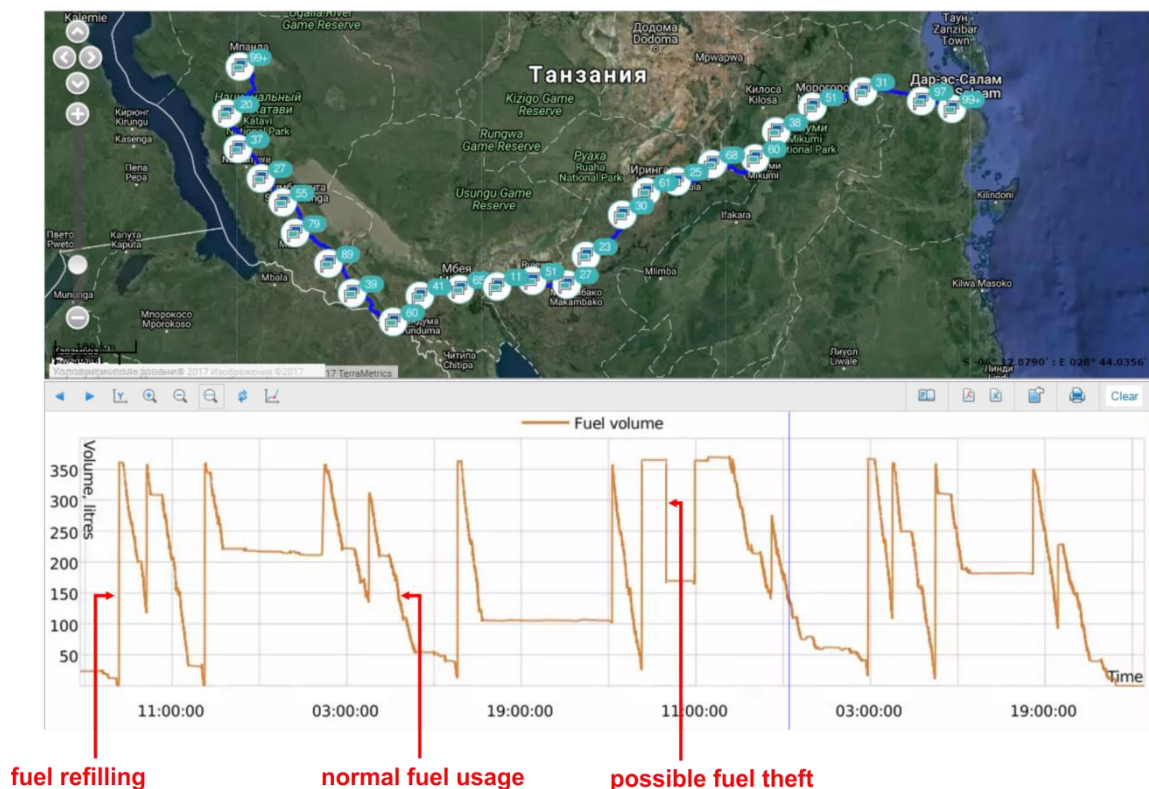

Figure 5 — Example of Analytical report generated in ORF 4 software, based on the DUT-E 2Bio data

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 8 fuel level sensors DUT-E 2Bio CAN to Online telematics gateway CANUp 27. Integrated application with fuel flow meters DFM CAN (up to 8 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. CAN UP 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).

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);
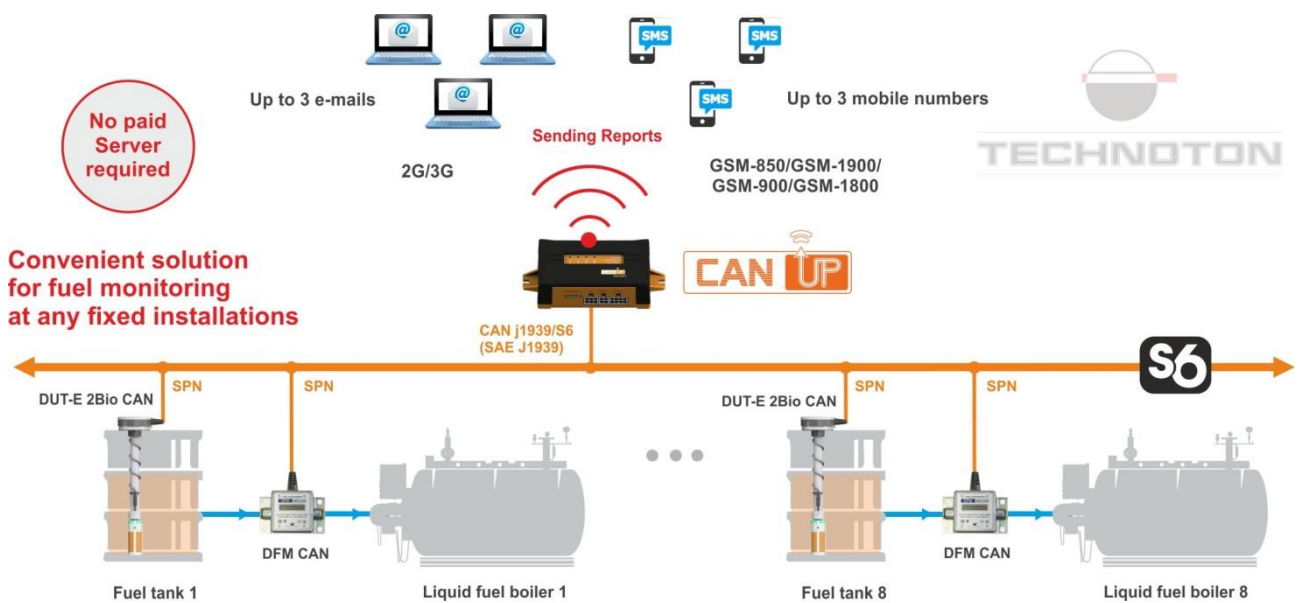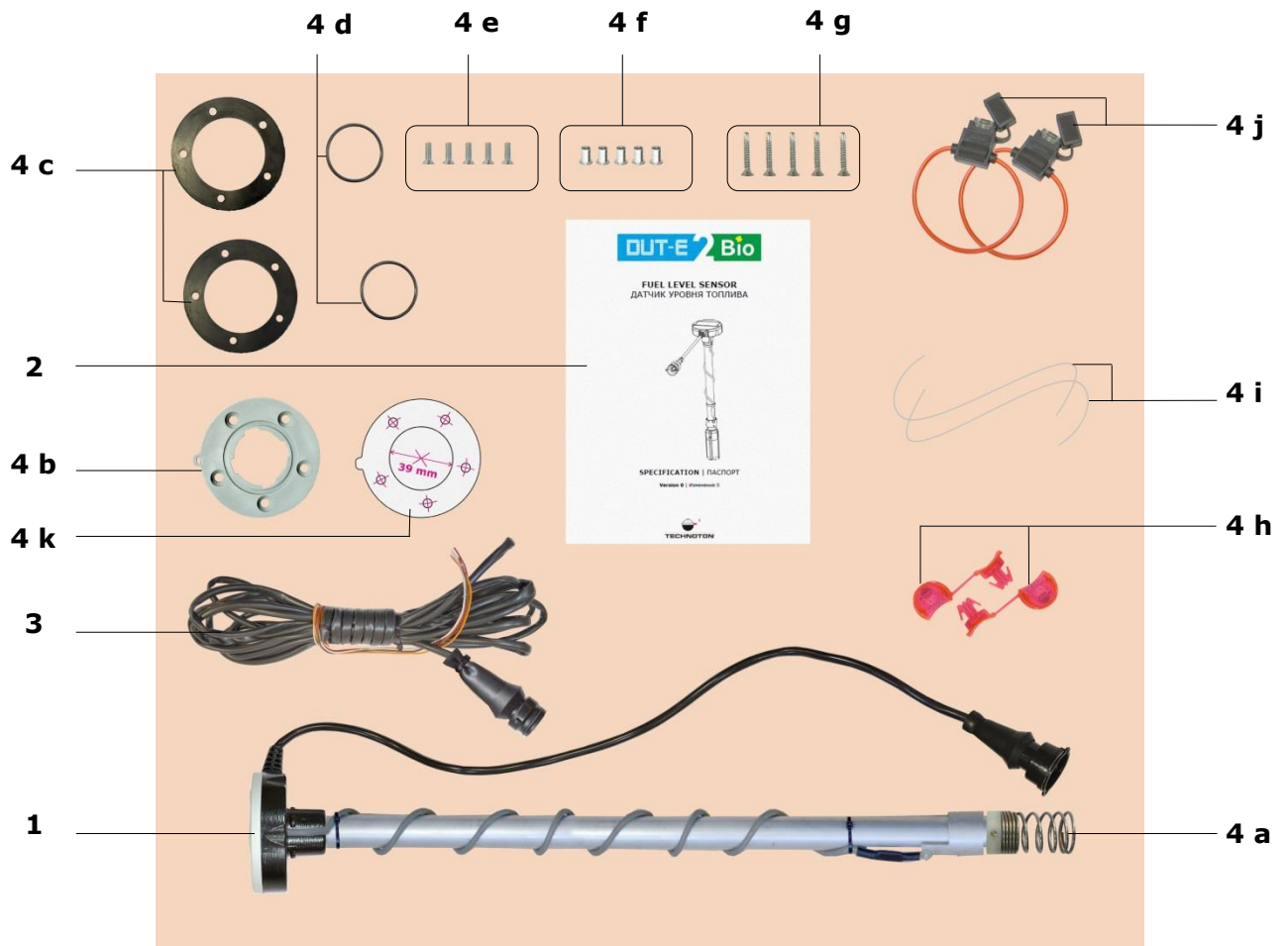- presence of water in fuel;
- sensor malfunctions.

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 (7.5 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

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* Ordered separately for DUT-E CAN (S6 SC-CW-700 or S6 SC-Mol-300/700).
** 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.