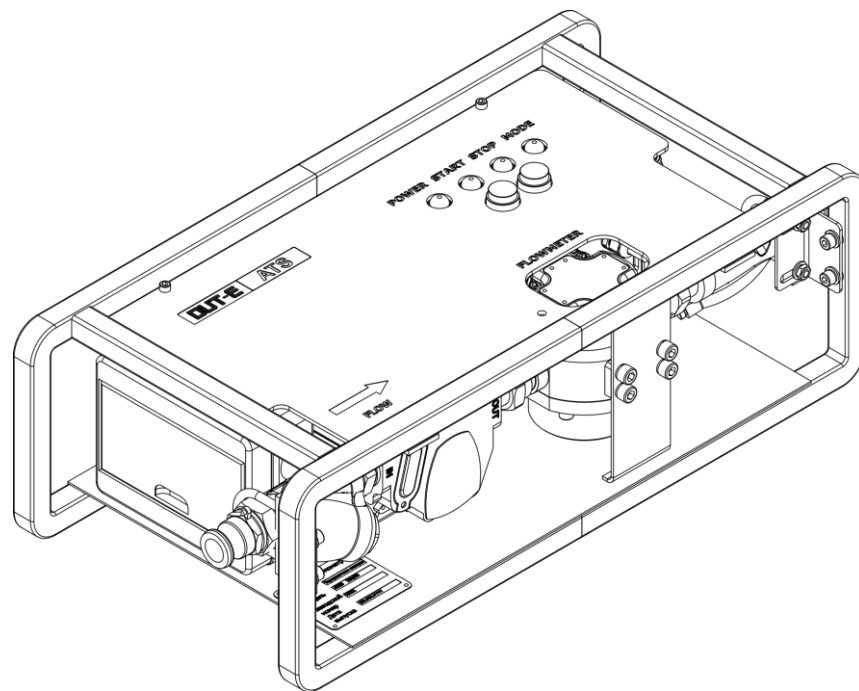




AUTOMATIC TANK CALIBRATION STATION



DUT-E ATS-5

OPERATION MANUAL

Version 3.1



TECHNOTON
ADVANCED MACHINERY TELEMATICS

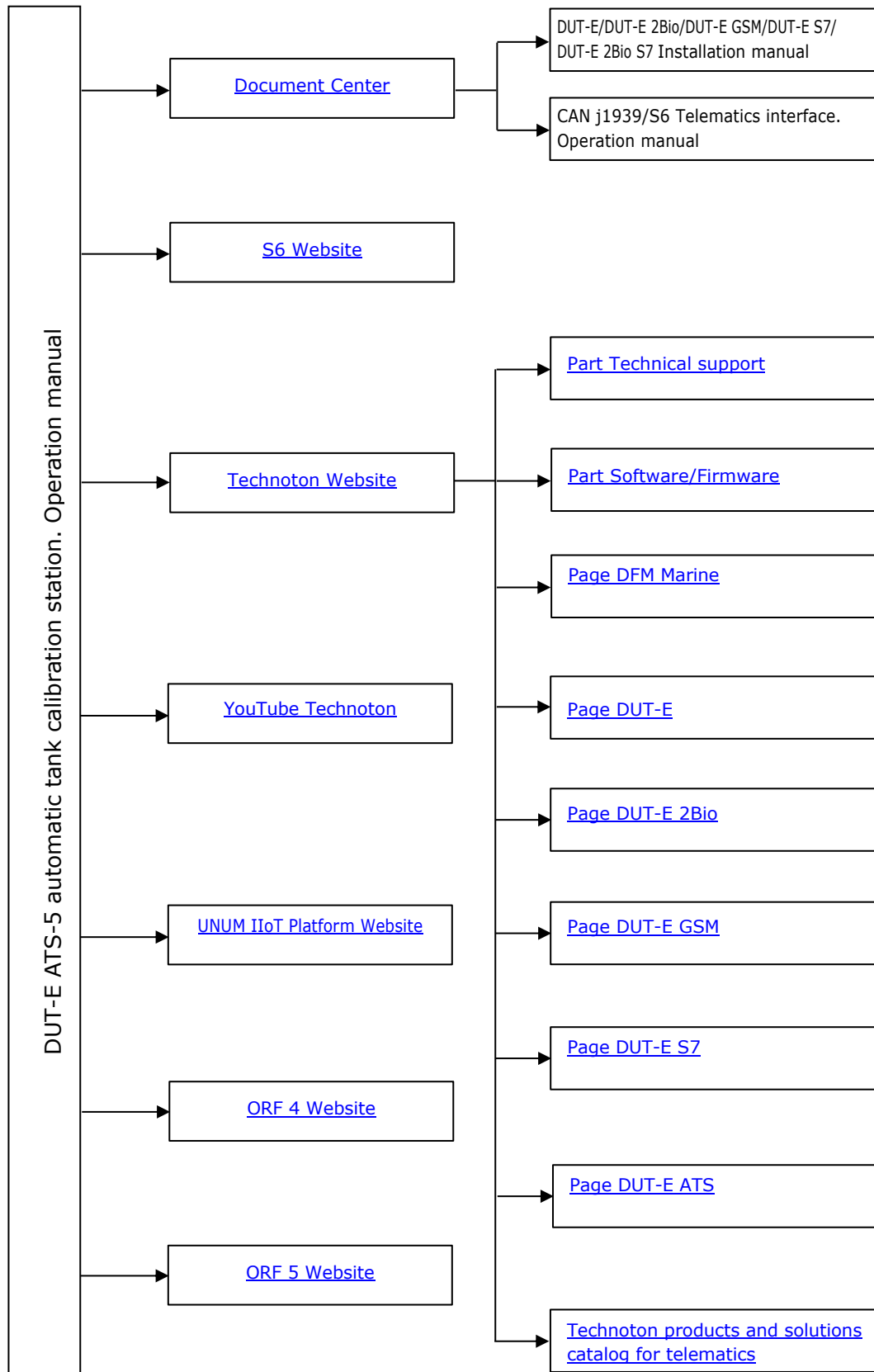
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Revision history

Version	Date	Editor	Description of changes
1.0	12.2020	OD	Basic version.
2.0	11.2021	OD	<ul style="list-style-type: none">• The Stations' external view is updated; their design is improved.• A new Station model is added (DUT-E ATS-4) that has the feature of supporting automatic tank calibration for all configurable models of "classic" DUT-E sensors.• Information on packing is added.
3.0	03.2025	OD	<ul style="list-style-type: none">• Information on the Product is updated and added.• The new improved DUT-E ATS-5 model of the Station is introduced; it is powered from the AC mains, has greater productive capacity and support of uninterrupted operation.• DUT-E ATS-3 and DUT-E ATS-4 outdated Station models are deleted etc.
3.1	11.2025	OD	<ul style="list-style-type: none">• The DUT-E ATS-5 station versions powered by 230 V, 60 Hz and 120 V, 60 Hz have been made obsolete.

Structure of external links



Terms and Definitions

S7 — Technology for wireless collection of data from autonomous sensors used in industrial and automotive telematics systems. S7 Technology is recommended for use on objects, where cabling is difficult or impossible.



S7 Technology uses Bluetooth 4.X Low Energy (BLE) as a communication channel.

S7 Technology ensures very low power consumption and long autonomous lifetime of smart sensors and other IoT devices.

Data transfer protocol of S7 Technology has transport layer (identical for all devices) and application layer (different for each product line of sensors). At the application layer, S7 Technology is fully compatible with wired S6 Technology.

Advantages of S7 Technology:

- ease of implementation of data transfer protocol;
- low energy consumption, ability of sensors to operate for several years in a fully autonomous mode;
- ability to collect data from multiple receivers simultaneously.

DUT-E ATS-5 automatic tank calibration station is designed based on S7 Technology.

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 standardized IoT parameters.



Particular features of IoT Burger:

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

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

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

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

DUT-E ATS-5 automatic tank calibration station is designed based on IoT Burger Technology.

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



Information on cabling system, service adapter and S6 software refer to [CAN j1939/S6 Operation manual](#).

DUT-E ATS-5 automatic tank calibration station is designed based on S6 Technology.

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).

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. It includes On-board report, Communication channels, Telematics service.

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

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

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

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

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

Unit is an element of vehicle on-board equipment compatible with S6 bus, which uses [S6 Technology](#) or [S7 Technology](#).

Introduction

Recommendations and rules set out in this Operation Manual are related to **DUT-E ATS-5 automatic tank calibration station** (further on — [Station](#)) developed by [Technoton](#) company.

This document contains general information on the station purpose, area of application, design and station specifications; it describes procedures for its designated use.

DUT-E ATS — portable station for professional installers of fuel level sensors (FLS) designed for quick and high-accuracy automatic calibration of tanks and fixed tanks (see figure 1).



Figure 1 — External view of DUT-E ATS-5 automatic calibration station

Station key features:

- Work with analog and digital fuel level sensors of any manufacturers (see [table 1](#)).
- Tank calibration table is recorded directly into the sensor memory (for all configurable “classical” Technoton-manufactured sensors as well as sensors based on [IoT Burger Technology](#)).
- High calibration accuracy — the error is **not more than $\pm 0,5\%$** of the tank volume.
- Calibration process is **4...6 times** faster (the rate is **3500 l/h**).
- Continuous uninterrupted calibration process; you can calibrate up to **80 000 l** of tanks capacity during one working day.
- Wireless monitoring the calibration process via Bluetooth from a smartphone/tablet using a free mobile application.
- “Human factor” does not affect calibration accuracy.
- Calibration modes that can be selected: automatic, semi-automatic, continuous.
- Saving points of the calibration table in the Station non-volatile memory prevents data loss in case of power cutoff or communication disruption during calibration.

- Option to select at once up to 5 pcs. of sensors with different interface for one tank calibration procedure – RS-232 / RS-485 / CAN / K-Line¹ / Bluetooth², analog / frequency output.
- Feature of self-diagnostics enables to monitor the Station quality of service in the process of calibration.
- Automatic Station switch off, in case pressure goes beyond the working range.
- The Station delivery set includes all necessary fuel hoses with quick couplings, a fueling nozzle with three feed rates, cable for sensors connection.
- Compact, light-weight design.
- Powered by a standard 230 V AC, 50 Hz mains supply.
- High-quality [technical support](#) and [documentation](#).

¹ Data reception via K-Line interface is accessible for Technoton-made sensors designed using [IoT Burger Technology](#) and for DUT-E AF.

² Wireless data reception via Bluetooth interface is available only for FLS designed based on S7 Technology.

Table 1 — Calibration results depending on fuel level sensors used

Supported FLS		Calibration results
Manufacturer Technoton	"Classic" configurable	DUT-E AF/232/485
	Based on IoT Burger Technology	DUT-E CAN DUT-E GSM DUT-E 2Bio CAN/232/485/AF/I
	Wireless, based on S7 Technology	DUT-E S7 / DUT-E 2Bio S7
	"Classic" non-configurable	DUT-E A5/A10
By other manufacturers	Analog/Frequency	Calibration table data are saved in the text file for their transfer manually to the Telematics terminal or the Server
	RS-232/ RS-485 interface (LLS protocol)	
	CAN interface (SAE j1939 protocol)	
* Recording the calibration table into the sensor is possible for all wireless sensors except DUT-E S7, model code 07.		



ATTENTION: This Manual is designed for personnel familiar with rules of repair and installation of equipment on Vehicles, who have professional knowledge in the field of vehicles electronic and electrical equipment.

In order to ensure the [Station](#) correct operation, you must strictly follow the Manufacturer recommendations specified in this document.

[The Manufacturer](#) guarantees Station 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 Station specifications that do not lead to a deterioration of the consumer qualities without prior customer notice.

1 General information and technical specifications

1.1 Purpose of use, application area and operation principle

DUT-E ATS is designed for high-rate, high-accuracy, automatic calibration of fuel tanks and fixed tanks equipped with:

1) Fuel level sensors manufactured by Technoton company: [DUT-E](#) (of any models) / [DUT-E 2Bio](#) (of any models) / [DUT-E GSM](#) / [DUT-E S7](#) / [DUT-E 2Bio S7](#).

2) FLS of any manufacturer with analog/frequency input or RS-232 (LLS protocol) / RS-485 (LLS protocol) / CAN (SAE j1939 protocol) interfaces.

Area of application: Integrators of [Telematics systems](#), equipment installation companies and professional individuals engaged in FLS installation on mobile and fixed equipment in different industries.

Carrying out the calibration procedure of the fuel tank/fixed tank to be equipped is the obligatory condition for correct FLS operation.

The aim of calibration is to create a table of dependence of fuel volume values on the fuel level in the tank for a specific fuel tank/fixed tank (further on – calibration table) (see figure 2). Without accurate tank calibration, FLS readings would have an additional error. The calibration table is used in the Telematics system for calculation of the current fuel volume.

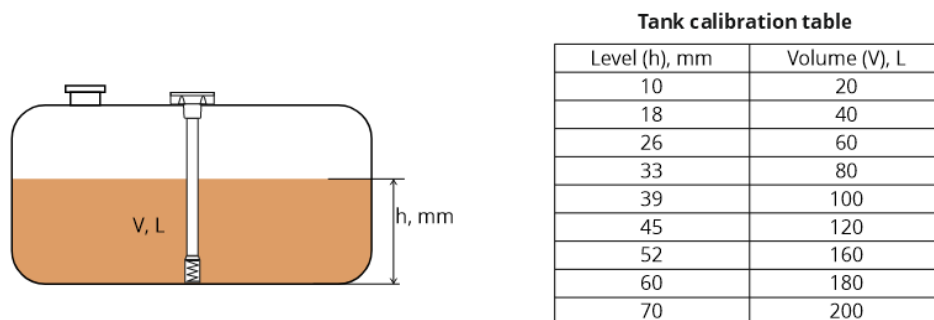


Figure 2 – Example of creating a tank calibration table

The calibration procedure traditionally conducted using either a measuring vessel, or at the fuel filling station (see figure 3) is a labor- and time-consuming sequence of filling the tank with fixed portions of fuel within the range from empty to full tank.

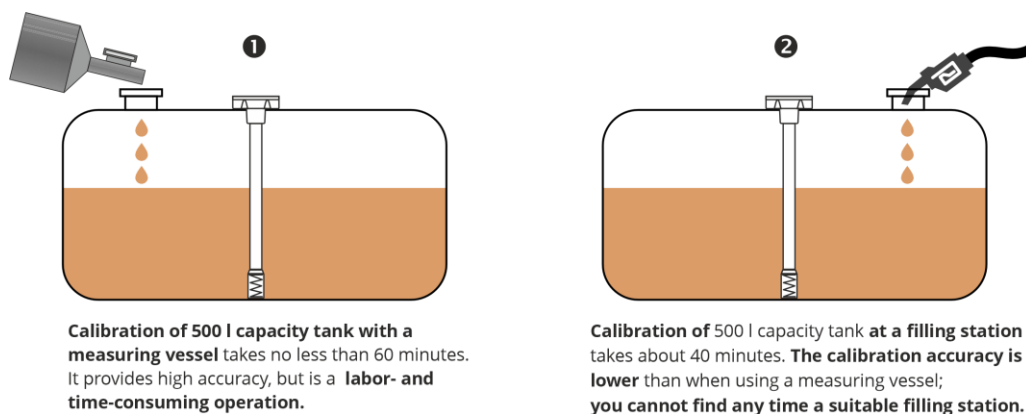


Figure 3 – Example of traditional calibration methods

Principle of operation (see figure 4): After the Station is started, the fuel pump automatically pumps fuel from the service tank through [DFM Marine CAN](#) fuel flow meter into the tank which is to be calibrated. In accordance with the volume value of the tank to be calibrated, which was set in advance in Service DUT-E ATS mobile application (further on – Service DUT-E ATS application), the tank is automatically divided into 57 calibration points. Values of the fuel volume (DFM Marine indications) and values of the fuel level in the tank corresponding to them (FLS indications) are transmitted in the continuous mode through the Bluetooth module to the Android device. The Station automatically generates the calibration table according to which it produces the graph of the fuel volume dependence on the fuel level in the tank. As soon as the tank which is being calibrated is filled, the calibration procedure completes automatically. The generated calibration table can be saved in the fuel sensor memory or in a file.

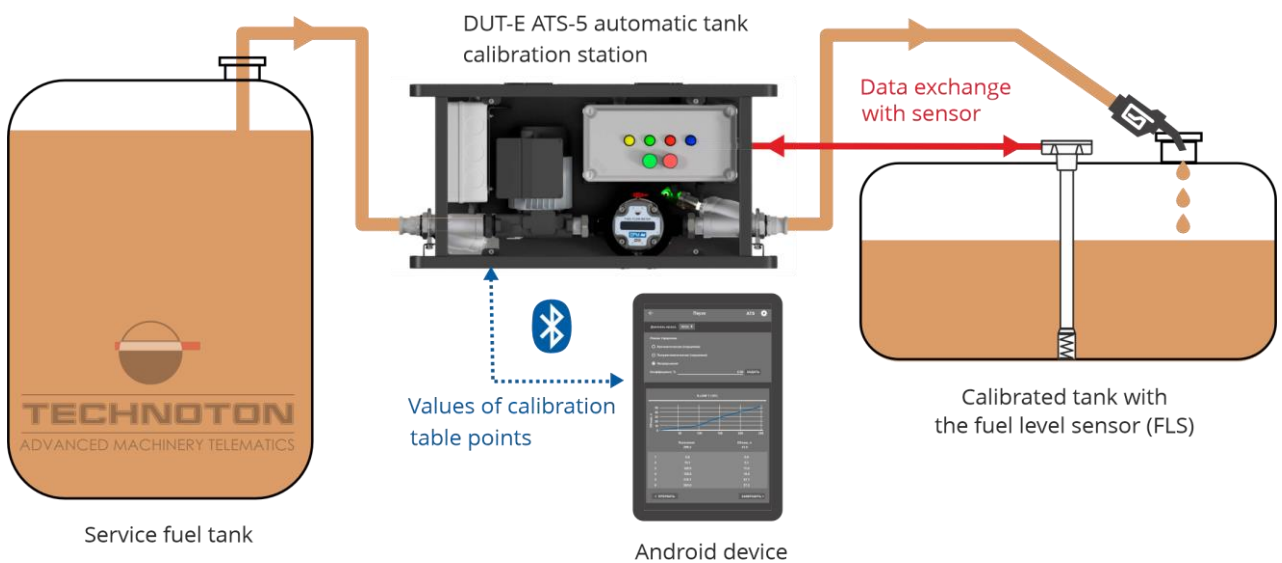


Figure 4 – Tank calibration using DUT-E ATS-5 automatic calibration station

Consumer benefits: using [DUT-E ATS-5](#) automatic calibration station ensures automation and continuity of the calibration process. Hence, the accuracy of values of volume measurements in points of the calibration table is enhanced, **labor costs of installer personnel and time needed for the calibration procedure are considerably lower** (see figure 5).












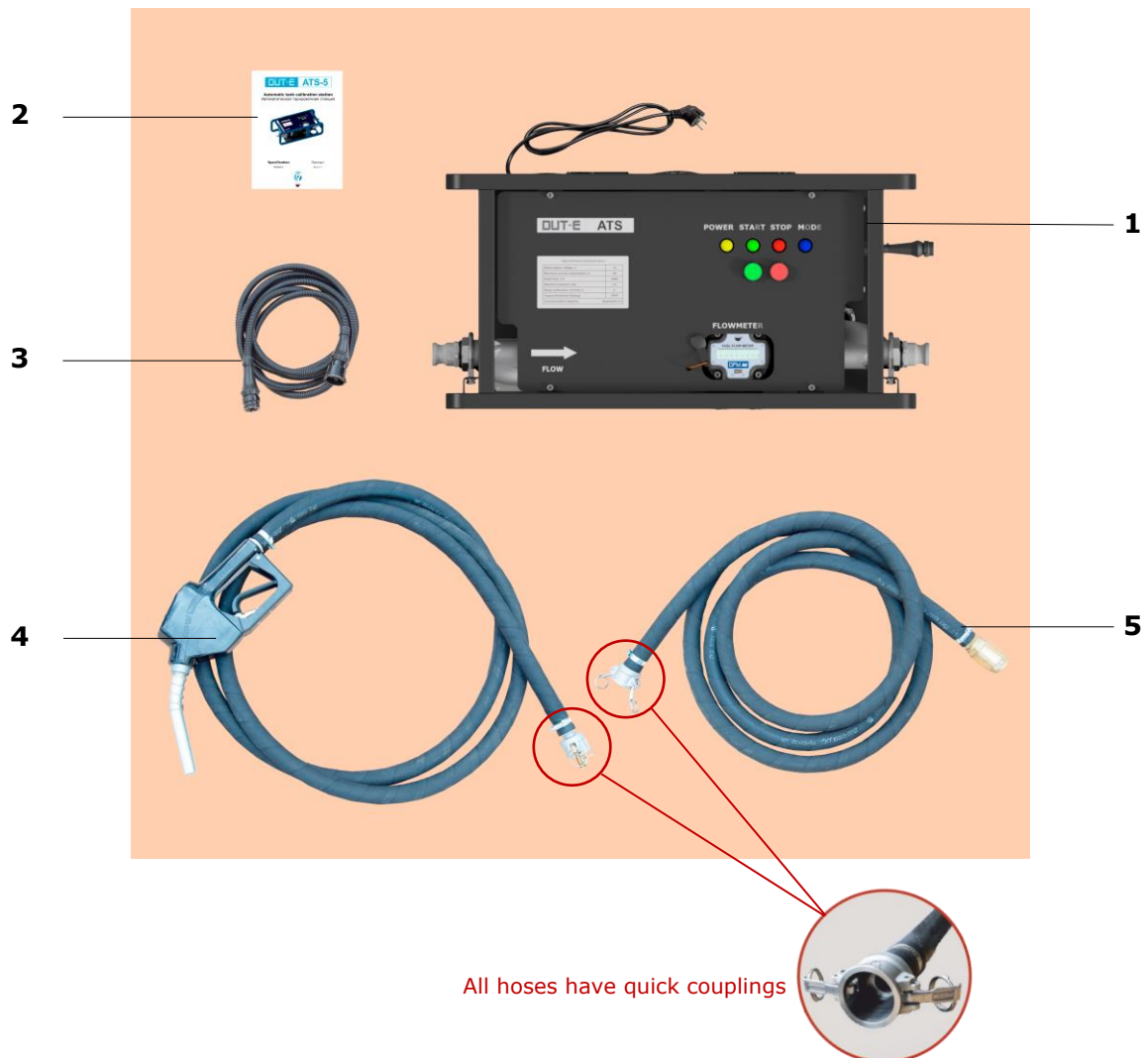
Approximate time for calibrating a 500 l tank	
DUT-E ATS-5, automatic mode:	 10 minutes
Installer, calibration at the filling station:	    40 minutes
Installer, calibration using a measuring vessel	      60 minutes

Figure 5 – Comparative duration of the tank calibration procedure using traditional methods compared to that when using DUT-E ATS-5

1.2 Delivery set

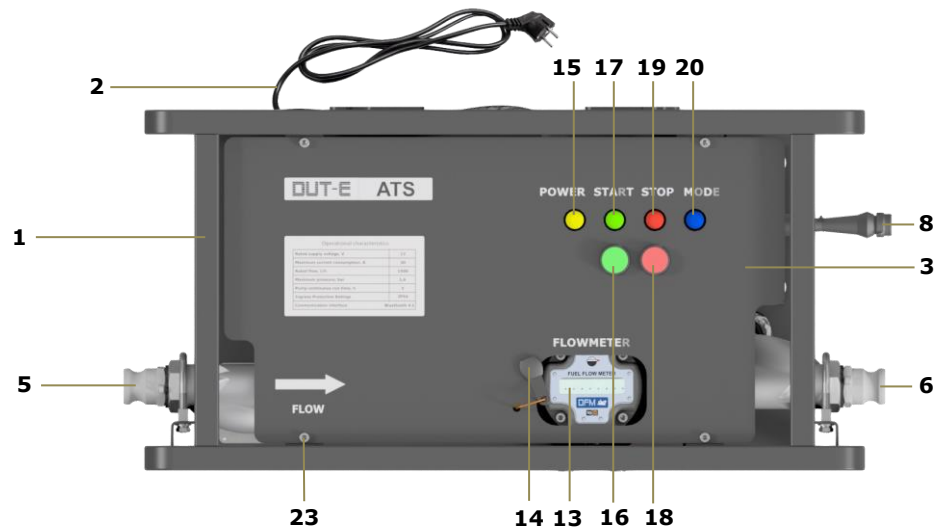


- | | | |
|----------|--|----------|
| 1 | - automatic tank calibration station | - 1 pc.; |
| 2 | - specification | - 1 pc.; |
| 3 | - S6 2SC-300 Extension cable (3 m) | - 1 pc.; |
| 4 | - fueling hose DN 25 (4 m)
with a fueling nozzle that has three fuel feed rates | - 1 pc.; |
| 5 | - suction hose DN 25 (4 m) | - 1 pc. |

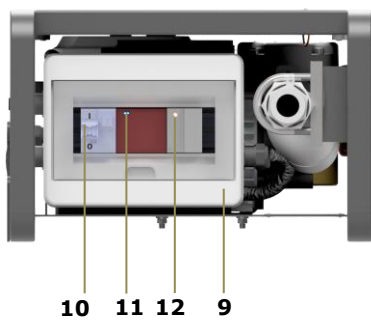
Figure 6 — Delivery set of DUT-E ATS-5 automatic tank calibration station

1.3 Station design

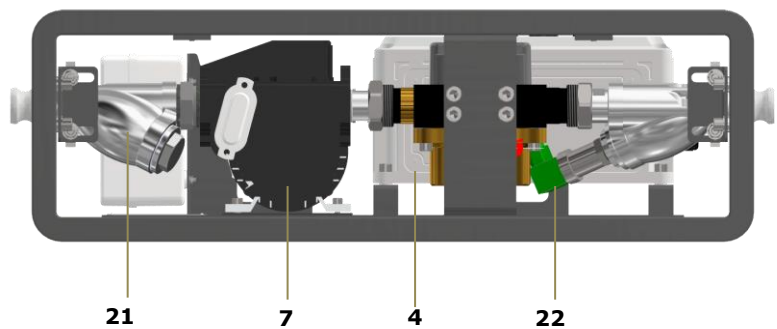
1.3.1 Composition



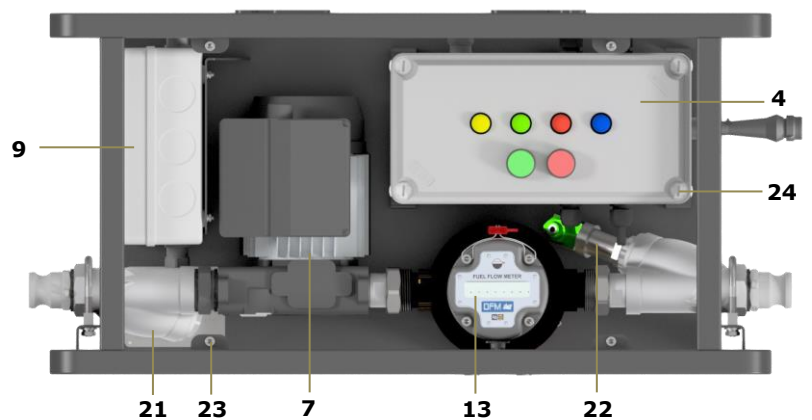
a) top view



b) right side view



c) front view



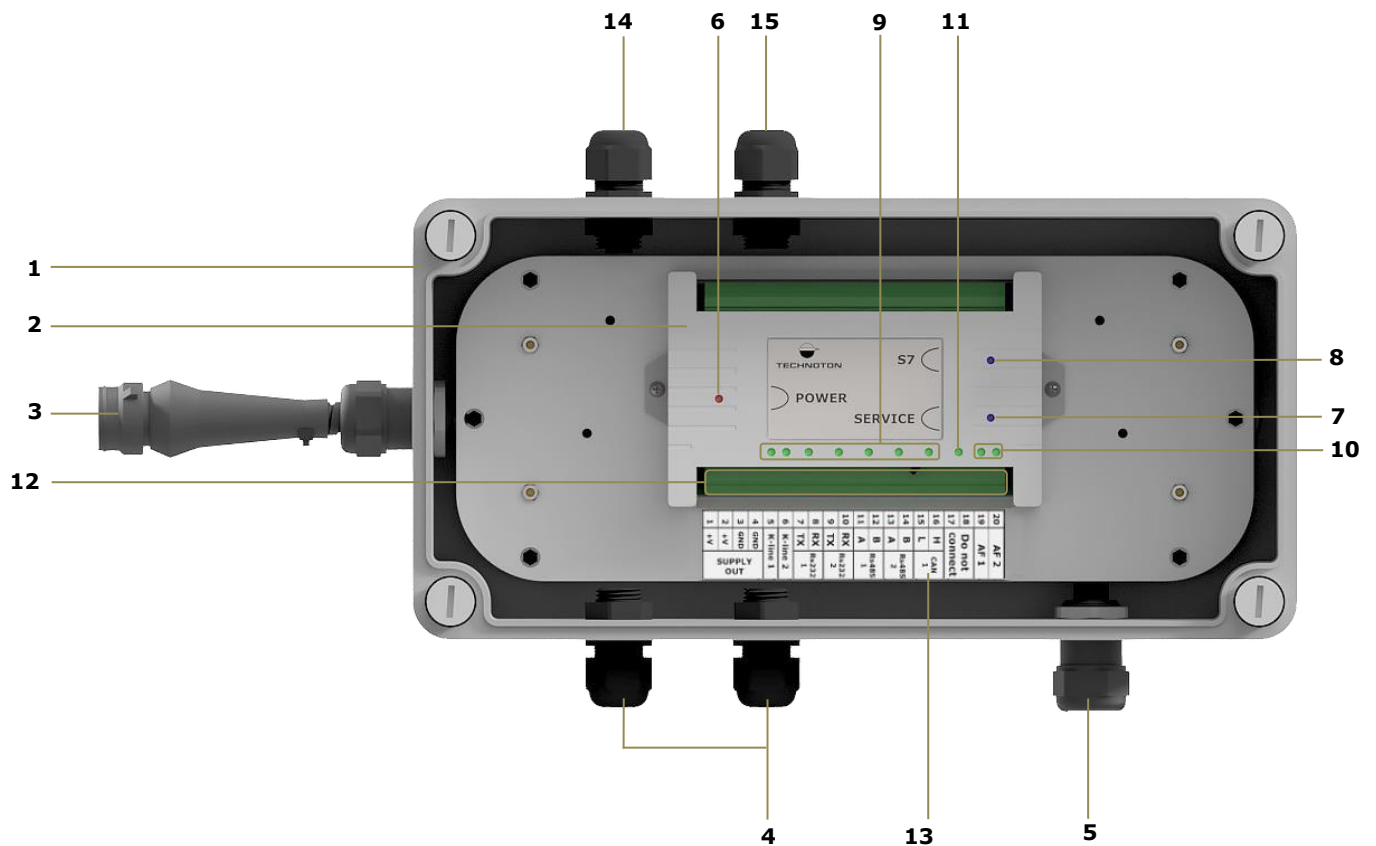
d) top view (control panel cover removed)

- 1 – frame for mounting basic components and for carrying the Station;
- 2 – power cable (2.5 m) for power supply connection from the AC mains;
- 3 – control panel;
- 4 – controller unit box (see [figure 8](#)), control panel buttons are located on its cover;
- 5 – fitting for quick coupler to connect the intake hose;
- 6 – fitting for quick coupler to connect the fuel filling hose;
- 7 – fuel pump for pumping fuel;
- 8 – **S6** connector to connect [Technoton](#)-manufactured sensors that comply with [IoT Burger Technology](#) via K-Line interface (see table 4);
- 9 – power unit;
- 10 – **I/O** toggle switch to switch on/off the power supply;
- 11 – power unit ON status indicator;
- 12 – fuel pump ON status indicator;
- 13 – LCD-display of [DFM Marine](#) inbuilt fuel flow meter for visual monitoring the volume of the pumped fuel and the rate of the fuel pumping;
- 14 – magnetic key to switch over information screens of DFM Marine LCD display;
- 15 – yellow* **POWER** light indicator for visual control that the power supply is ON;
- 16 – **START** button for starting the fuel pump;
- 17 – green* **START** light indicator for visual control of the fuel pump switching on;
- 18 – **STOP** button to stop the fuel pump;
- 19 – red* **STOP** light indicator for visual control the fuel pump is off;
- 20 – blue* **MODE** light indicator for visual monitoring the Station mode of operation;
- 21 – mud filter;
- 22 – pressure sensor for monitoring the current fuel pressure in the pipeline;
- 23 – screws (4 pcs.) to fix the control panel cover;
- 24 – screws (4 pcs.) to fix the cover of the controller unit box.

* [The Manufacturer](#) reserves the right to change the color of indicators, therefore we recommend to be guided primarily by their designations according to the marking.

Figure 7 — Composition of [DUT-E ATS-5](#) automatic tank calibration station

1.3.2 Controller unit design



- 1 – plastic box with a removable cover on which the control panel buttons are located;
- 2 – controller unit inside which there are: the electronic module for reception and procession of data from FLS, the Bluetooth module for communication with the Android device and the non-volatile memory for saving points of the calibration table;
- 3 – **S6** connector for connection of sensors designed based on [IoT Burger Technology](#) by means of K-Line interface ([DUT-E CAN](#), [DUT-E 2Bio CAN/232/485/AF/I](#), [DUT-E GSM](#)) (see table 4);
- 4 – cable inputs for connection of various FLS to terminals of analog/frequency or interface (RS-232/RS-485/CAN) inputs of the Station controller unit;
- 5 – cable input for power supply wires of the controller unit and control unit;
- 6 – red **POWER** LED indicator for visual monitoring the controller unit power supply;
- 7 – blue **SERVICE** LED indicator for visual monitoring the operation of the Bluetooth-module;
- 8 – **S7** blue LED indicator for visual monitoring the reception of messages by means of [S7 Technology](#) from up to 15 pcs. [DUT-E S7](#) / [DUT-E 2Bio S7](#) wireless sensors;
- 9 – green LED indicators for visual monitoring data reception from sensors connected to the respective interfaces K-Line/RS-232/RS-485/CAN;
- 10 – green LED indicators for visual monitoring the analog/frequency signal reception from sensors connected to the respective AF inputs;
- 11 – green LED indicator for visual monitoring data reception from the inbuilt [DFM Marine](#) fuel flow meter by means of [S6 Technology](#);

- 12** – terminal block for connection of sensors to K-Line/RS-232/RS-485/CAN interfaces or to analog/frequency Station inputs, as well as for power supply connection;
- 13** – label with marked contacts of the terminal board of the controller unit (for details see table 2);
- 14** – cable input for wires from the pressure sensor;
- 15** – cable input for wires from the inbuilt DFM Marine fuel flow meter.












Figure 8 — Composition of the controller unit of [DUT-E ATS-5](#) automatic tank calibration station

Table 2 — Designation of contacts of the electronic control unit terminal block

Contact number	Marking		Circuit designation	Explication
	Terminal block	Connected contact		
20	AF 2		Analog / Frequency signal inputs	Physical signal inputs analog/frequency (2 pcs.). No more than one sensor with signals: analog (0.5...10) V or frequency (0.001...50) kHz may be connected to each input. The input impedance of each input is no less than 140 kOhms.
19	AF 1			
18	DO NOT CONNECT		Service contacts! To avoid damaging the station, do not disconnect the wires of these contacts!	
17				
16	H	CAN 1	CAN-High	CAN interface. No more than two sensors with CAN interface (SAE j1939 protocol) may be connected.
15	L		CAN-Low	
14	B	Rs485 2	Data exchange	RS-485 interfaces (2 pcs.). No more than one sensor with RS-485 interface (DUT-E COM / LLS protocol) may be connected to each interface.
13	A			
12	B	Rs485 1		
11	A			
10	RX	Rs232 2	Data received	RS-232 interfaces (2 pcs.). No more than one sensor with RS-232 interface (DUT-E COM / LLS protocol) may be connected to each interface.
9	TX		Data transmitted	
8	RX	Rs232 1	Data received	
7	TX		Data transmitted	
6	K-line 2		K-Line (ISO 14230)	K-Line interfaces (ISO 14230) (2 pcs.). Up to 8 pcs. of sensors DUT-E AF/CAN , DUT-E 2Bio CAN/232/485/AF/I, DUT-E GSM may be connected to every interface.
5	K-line 1			
4	GND	SUPPLY OUT	Ground “-”	Terminals of the sensors power supply circuit (2 pcs.). Voltage (9...15) V. Load current limitation 0.5 A for each circuit +V.
3	GND			
2	+V		Power “+”	
1	+V			



Table 3 – Indications of the controller electronic unit LED signals during the Station operation





Marking	LED Indicator		Signal description
	Status	Light color	
POWER		Red	Power is on.
	No signal		Power is off or the power supply voltage is less than the minimally allowed.
SERVICE		Blue	The Station Bluetooth module is initiated, but no connection with the Android device (the period of the indicator blinking – 1 s).
			Connection between the Station Bluetooth module and the Android device is established (the period of the indicator blinking – 0.5 s).
			Data transfer via the Station Bluetooth module is in progress (the period of the indicator blinking – 0.25 s).
	No signal		Station Bluetooth module is not initiated.
S7		Blue	Reception of messages from DUT-E S7 / DUT-E 2Bio S7 by means of S7 Technology (1 blinking – 1 message).
	No signal		No reception of messages from DUT-E S7 / DUT-E 2Bio S7 by means of S7 Technology .
K-Line 1/ K-Line 2		Green	Data reception via K-Line interface is in progress.
	No signal		No data reception via K-Line interface.
Rs232 1/ Rs232 2		Green	Data reception via RS-232 interface is in progress.
	No signal		No data reception via RS-232 interface.
Rs485 1/ Rs485 2		Green	Data reception via RS-485 interface is in progress.
	No signal		No data reception via RS-485 interface.
CAN 1		Green	Data reception via CAN interface is in progress
	No signal		No data reception via CAN interface.
CAN 2		Green	Data reception from the inbuilt DFM Marine fuel flow meter by means of S6 Technology is in progress.
	No signal		No data reception from the inbuilt DFM Marine fuel flow meter by means of S6 Technology.
AF 1/AF 2		Green	Data reception from the analog/frequency signal sensors is in progress.
	No signal		No data reception from the analog/frequency signal sensors.

1.3.3 S6 connector pinout

S6 connector serves to connect sensors designed using [IoT_Burger](#) Technology ([DUT-E CAN](#), [DUT-E 2Bio](#) CAN/232/485/AF/I and [DUT-E GSM](#)) to [Station](#).

Sensors are connected to the station by means of K-Line service interface using S6 2SC-300 cable from the [delivery set](#), in accordance with the designation of contacts of **S6** connector (see table 4).

Table 4 – Designation of **S6** connector contacts

Connector pinout	Contact Number	Wire color		Signal	
				Designation	Parameters
	1		Orange	Power "+"	Analog, voltage 9...15 V.
	2		Brown	Ground "-"	-
	5		Black	K-Line	Digital, ISO 14230 Standard.

1.4 Main specifications

Table 5 – Main specifications of DUT-E ATS-5 automatic tank calibration [station](#)

Parameter, measurement units	Value
Working fluid	Diesel fuel
Relative calibration error (of tank volume), %, not more than	$\pm 0,5^1$
Time of uninterrupted operation	Unlimited
Input interfaces for connection of cable-connected sensors	RS-232 (2 pcs.)/ RS-485 (2 pcs.)/ CAN (1 pc.)/ K-Line (2 pcs.)
Inputs of physical signals for sensors connection	Analog /Frequency (2 pcs.)
Wireless interface for communication with wireless sensors and the Android device	see 1.5
Calibration modes	see table 7
Power supply voltage from AC mains, V/Hz	230/50
Consumed power, W, not more than	400
Fuel pumping rate ² , l/h	3500 \pm 200
Ambient operation temperature range, °C	-10...+30 ³
Maximum hydraulic pressure in the fuel line, MPa	0.29
Pipe size diameter	DN 25
Weight together with hoses, kg, not more than	29 \pm 2
Overall dimensions, mm, not more than	see figure 9
<p>¹ For tanks of sophisticated shape the error value may reach ± 1.0 %.</p> <p>² In condition of the maximum pipe size set by the fueling nozzle switch of the fueling hose.</p> <p>³ The Station has automatic protection from overheating. However, to ensure reliable operation of the fuel pump, we recommend to limit the period of uninterrupted operation to 30 min. at the ambient air temperature above +40 °C.</p>	

1.5 Specifications of wireless interface

Table 6 – Specifications of wireless interface of DUT-E ATS-5 automatic tank calibration [station](#)

Parameter, measurement units	Value
Communication channel	Bluetooth 4.1
Transmission unit power (Tx Power), dBm	+4
Receiver sensitivity (Rx Power), dBm	-88
Maximum range, m	20 (when working on a Vehicle and inside a building) 50 (when working within line-of-sight range)
Compatible wireless fuel level sensors	DUT-E S7 / DUT-E 2Bio S7
Maximum number of accessible wireless sensors, pcs.	15
Data transmission interval, s	5
Certificates of BLE-module electromagnetic compatibility	CE, FCC, IC, TELEC, BQE

1.6 Calibration modes

Table 7 — Modes of the tank calibration when using DUT-E ATS-5 automatic tank calibration [station](#)

Name	Description	Application
“Automatic”	The fuel is pumped into the tank (or pumped out of the tank) in portions. After pumping each portion, the Station automatically switches off the pump. As soon as the level of fuel is stabilized, the Station automatically switches on the pump again (in case the user needs, he may switch on the pump manually). After each pump start, a new point appears in the calibration table.	This mode is recommended for calibration of fuel tanks of Vehicles and fixed tanks of sophisticated shape, with prolonged fuel distribution in the tank during their filling.
“Semi-automatic”	The fuel is pumped into the tank (or pumped out of the tank) in portions. After pumping each portion, the Station automatically switches off the pump. The user himself monitors the fuel level stabilization and starts the fuel pump again manually. After each pump start, a new point appears in the calibration table.	
“Continuous”	The fuel is continuously pumped into the tank (or pumped out of the tank). New points are automatically entered into the table after each portion of the same size.	This mode is recommended for calibration of fuel tanks of Vehicles and of simple-shaped fixed tanks with quick and uniform fuel distribution in the tank during their filling.
<p>Note — In the process of the fuel tank calibration procedure it is allowed to switch from one calibration mode to another, but only in the Station the “Pause” mode (see 3.2).</p>		

1.7 Overall dimensions

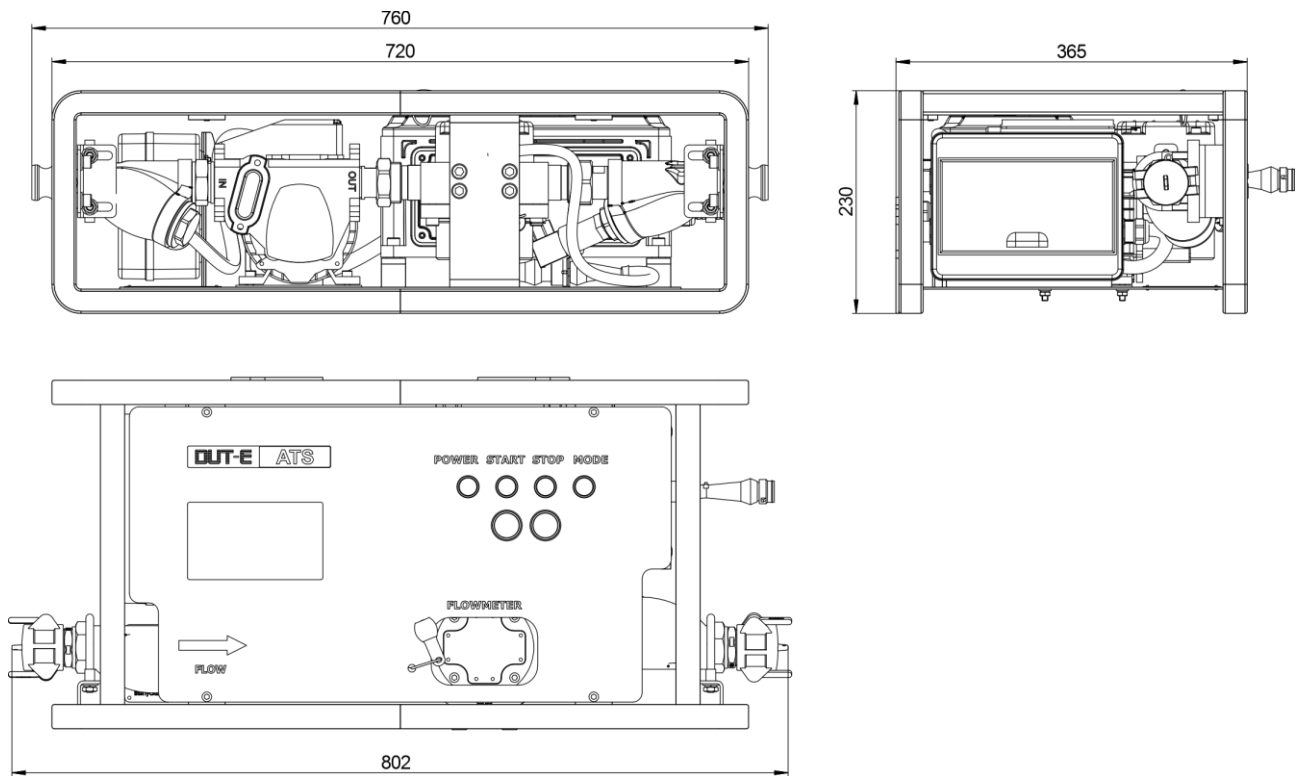


Figure 9 — Overall dimensions of DUT-E ATS-5 automatic tank calibration [station](#)

2 Preparation for Work



ATTENTION: When operating the [Station](#), you are to follow the safety rules:

- Electrical safety rules for operating electrical equipment with the voltage up to 1000 V.
- Safety rules for tractor and automobile repair works.
- General safety rules established at the Company.

To ensure the correct Station operation, we recommend to conduct automatic calibration procedure of the tank by certified installer personnel who have undergone a [training course](#) conducted by the Manufacturer company specialists.

2.1 Electrical safety rules

DUT-E ATS-5 automatic calibration station is powered from AC 230 V, 50 Hz mains. Therefore, when operating the Station, you are **to follow strictly the following electrical safety rules:**

- The Station must be powered only from a fault-free, well-grounded receptacle.
- Whenever the Station is powered from an independent power source, use only a serviceable generator with appropriate output voltage and stable current characteristics. Make sure the generator is grounded and equipped with the system of voltage stabilization.
- Before connection, check the integrity of the power cable and plug.
- It is forbidden to use the Station in humid and damp environment. Humidity penetration inside the unit may provoke short-circuit and an electric shock.
- Don't touch live parts of the equipment during the Station operation.
- All Station maintenance operations must be conducted only with the power supply switched off.
- Use only the original Station power unit.
- The use of inappropriate AC adapters and extension cords is not allowed.
- Don't leave the switched-on Station unattended.
- Station repair by unauthorized personnel is not allowed. In case any malfunctions are detected, you are to contact the [Regional service center](#).



WARNING: Non-observance of the above requirements may result in the electric shock, fire, equipment damage and emergency situations!

2.2 Exterior inspection

Before you start the tank calibration, you should examine the Station components for any damages arisen during transportation, storage or careless use:

- damages of the fuel flow meter, fuel pump, cooler, fuel lines, hoses;
- damage of electrical connectors and insulation of connection components and of the power cable.

Contact the product supplier if there any defects.

2.3 Operational restrictions

During the Station operation, to eliminate any failures in the communication line between the [Station](#) and the Android device, you must make sure there are no sources of electromagnetic interference close to the operating Station location (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.).



ATTENTION: The maximum allowed distance between the Station and the Android device depends on the quality of the Bluetooth module installed in the Android device. To ensure high-quality data transmission, we recommend that this distance should not exceed **20 m**.

2.4 Connecting Station power supply

To connect DUT-E ATS-5 power supply, you need to connect the power cable plug to the **fault-free and grounded** receptacle of the AC mains 230 V, 50 Hz.



ATTENTION: The Station is equipped with the power cable and receptacle that has Europlug-type grounding which complies with CEE 7/7 Standard. If you need to use a receptacle of a different standard, its replacement by the user is allowed, on condition of observance of correct connection and grounding. Such a replacement does not affect the Station warranty maintenance conditions.

To switch on the Station power supply, open the cover of its power unit (see [figure 7](#)) and set **I/O** toggle switch to the upper position (**I**). The power unit indicator is lit; it indicates the power supply is on (see figure 10).

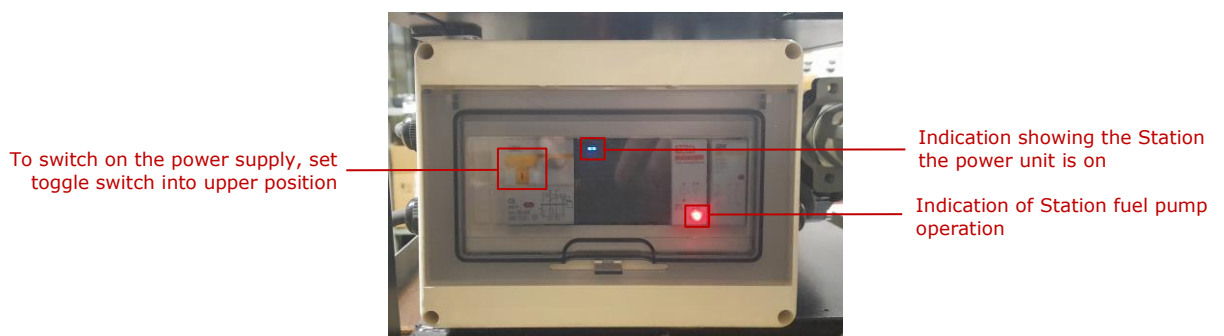


Figure 10 – Switching on the Station power supply



IMPORTANT: When you connect the Station to the AC mains, you must strictly observe **the electrical safety rules**, according to [2.1](#).

In case the Station is powered by the generator, you need to ground the generator using any of the following **grounding conductors**:

- metal rod no less than 15 mm in diameter, no less than 1500 mm long (see figure 11).
- metal pipe no less than 50 mm in diameter, no less than 1500 mm long.
- galvanized steel sheet of no less than 1000x500 mm size.

The grounding conductor used must be buried in the soil to reach the depth of humid soil. The reliable contact of the grounding wire and the grounding conductor itself must be ensured. The opposite end of the grounding wire must be connected with the generator grounding terminal. The impedance of the ground loop must be no more than 4 Ohms. The ground loop must be located close to the generator.




Figure 11 – Example of grounding the Station power supply generator using a metal rod

3 Designated use

3.1 Requirements necessary to perform the fuel tank calibration procedure

Before you start the fuel tank calibration procedure, you need to perform the following operations:

- Mount the sensor in the fuel tank (for mounting [Technoton](#) sensors, see [DUT-E CAN / DUT-E 2Bio / DUT-E GSM / DUT-E S7 / DUT-E 2Bio S7 Installation instructions](#)).
- Install from  (search request "Technoton engineering") Service DUT-E ATS mobile application on your smartphone/tablet, in order to configure the Station and monitor the calibration process.
Note — Any smartphone/tablet based on Android operating system (further on — Android device), version from 5.0 and higher can be used.



WARNING: It should be borne in mind that before the calibration starts, the Station evaluates the actual fuel level in the tank, and, in accordance with it, it selects the calibration mode. If the fuel level in the tank is lower than 50 %, the calibration method automatically selected will be the "fill-up" mode. If the tank is filled more than 50 %, the "drainage" method will be selected.

- Service tank filled with fuel should be available (e.g. IBC container); its volume should be no less than 110 % of volume of the tank which is to be calibrated.
- The Vehicle must be unloaded and parked on a site with flat horizontal surface.
- The fuel tank must be either fully filled with the known volume of fuel (in case of "fuel discharge" calibration), or completely empty (in case of "fill-up" calibration).
- The vehicle wheels must be of standard size (replacement by wheels of non-standard type and size after the calibration procedure is conducted results in decreasing measurements accuracy or another calibration is needed).
- The tire pressure should match with the prescribed for this Vehicle.
- The Vehicle should not move, engine off.

RECOMMENDATION:





1) For electrical connecting FLS of different producers to the [Station](#), we recommend to obtain appropriate adapters.

2) Connect adapter wires to the power supply terminals, analog/frequency/interface (RS-232/RS-485/CAN) inputs (see [table 2](#)) through cable inputs in the controller unit box (see [figure 7](#)). To get access to the terminals of wires connection, you need to unscrew four fixing screws and remove the control panel cover. Then, unscrew four fixing screws on the controller unit box and **carefully** move aside the cover of the control panel on which buttons are located.

3.2 Modes of Station operation

Table 8 — Modes of DUT-E ATS-5 automatic tank calibration [station](#) operation

Designation of operation mode	Status of fuel pump	Type of signal of MODE blue* indicator	Station user response
"Preparation"	OFF/ON	No signal	1) Pumping the fuel (if needed) from the fuel tank to the service tank (in case of "fill-up" calibration) or vice versa (in case of "fuel discharge" calibration). 2) Deaeration of the Station fuel lines. 3) Configuration of calibration parameters in Service DUT-E ATS mobile application: <ul style="list-style-type: none"> - sensor (sensors) selection; - entering the value of the sensor measuring probe length, in case the sensor is connected after its measuring probe cutting/extension; - sensor calibration "Empty"/"Full" (in case the sensor was not calibrated during its mounting in the tank); - entering the volume value of the tank which is to be calibrated.
"Calibration"	ON		Starting the Station fuel pump for automatic creation of the fuel tank calibration table.
"Pause"	OFF		Pause of the Station fuel pump.
"Checking results"	OFF	No signal	Editing the calibration table and its saving in the file or in the Unit .
<p>* The Manufacturer reserves the right to change the color of indicators, therefore we recommend to be guided primarily by their designations according to marking.</p>			

3.3 Operating instructions for tank calibration using the Station

3.3.1 Preparation operations



ATTENTION: Both “fuel discharge”, and “fill-up” automatic tank calibration procedures are possible using the Station. The difference is that in case of “fill-up” calibration, the fuel tank must be completely emptied before, while in case of “fuel discharge” calibration the tank must be completely filled with fuel. In both cases, the procedure of using the station is identical.

This document contains the description of the Station operating procedure, taking the “fill-up” calibration as an example.

Remove plugs from the intake and fueling fittings of the Station and connect appropriate hoses to them; connect the Station power cable to the power grid (see [2.4](#)).

1) Switching on the Station power supply



IMPORTANT: Before you switch on the [Station](#), verify that the ON/OFF button on the fuel pump is pressed to **I** position.

Switch on the Station power supply by setting **I/O** toggle switch on its power unit to the upper (**I**) position.

After the power supply is on, the yellow **POWER** light indicator on the control panel is on, and the Station operability test will start automatically. Short blinking of the green (**START**) and blue (**MODE**) indicators at the end of the test indicates the station serviceability.

After the red **STOP** indicator is on, the Station is ready for use.

2) Pumping fuel

If you need to discharge fuel from the tank, insert the suction hose into its filling neck and put the fuelling nozzle into the filling hole of the service tank (see figure 12).

In order to start pumping the fuel, open the fuelling nozzle, then press **START** button on the Station control panel. The red **STOP** indicator will go out, the green **START** indicator will light instead. This will indicate the fuel pump is started.



RECOMMENDATIONS: During the fuel pumping we recommend to monitor visually:

- 1) Hermeticity, also take care that there should be no signs of leakage from the fuel lines and fuel hoses.
- 2) Hydraulic pressure in the Station pipeline system is controlled automatically by the pressure sensor (see [figure 7](#)). Whenever pressure goes beyond the range **(0.35...2.4) bar**, the Station automation switches off the fuel pump.

Fuel pumping will end automatically, as soon as sucking of air into the suction hose starts, after the tank is completely empty. The green **START** indicator will go out, and the yellow **POWER** indicator will light instead. This will indicate the fuel pump is off.

To finish pumping before the tank is empty, you may press **STOP** button on the Station control panel or close the fuelling nozzle trigger.

3) Deaeration of the Station fuel lines



IMPORTANT: Before you start the tank calibration, **be sure to deaerate the system of the Station fuel lines!**

To deaerate the fuel lines, insert the fuelling nozzle into the service tank to which the suction hose is connected (see figure 13). Open the fuelling nozzle and press **START** button. The yellow **POWER** indicator will go out; the green **START** indicator will light instead. This will indicate the fuel pump is started.

You are to deaerate the fuel lines for **no less than 10 s.** After that, having compulsively closed the fuelling nozzle make sure the fuel pump is off (there should be no noise of its electric motor).



WARNINGS:

- 1) You must not use the [Station](#), in case the fuel pump is not switched off automatically, when the fuelling nozzle is closed.
- 2) During the fuel pump operation, no bending of suction and filling hoses is allowed.

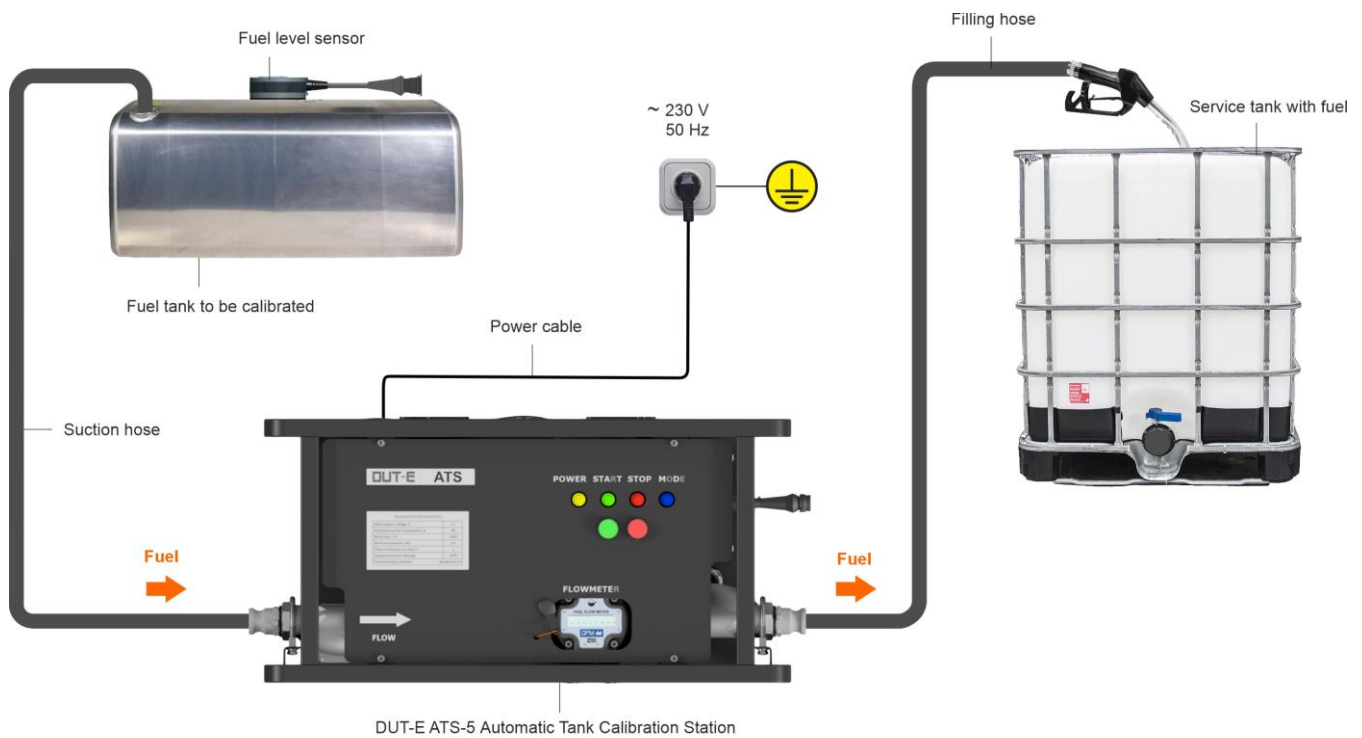


Figure 12 — Scheme of the Station connection for pumping fuel from the Vehicle fuel tank into the service tank

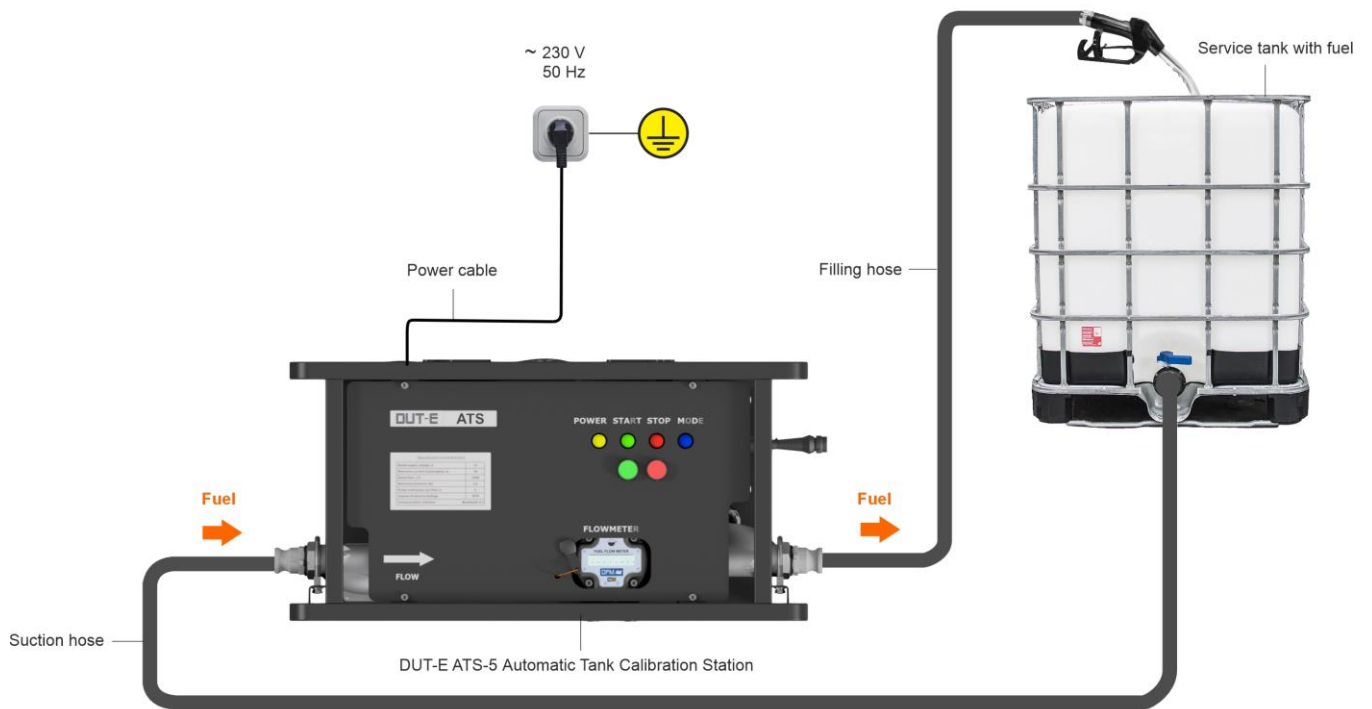


Figure 13 — Scheme of the Station connection for the fuel lines deaeration

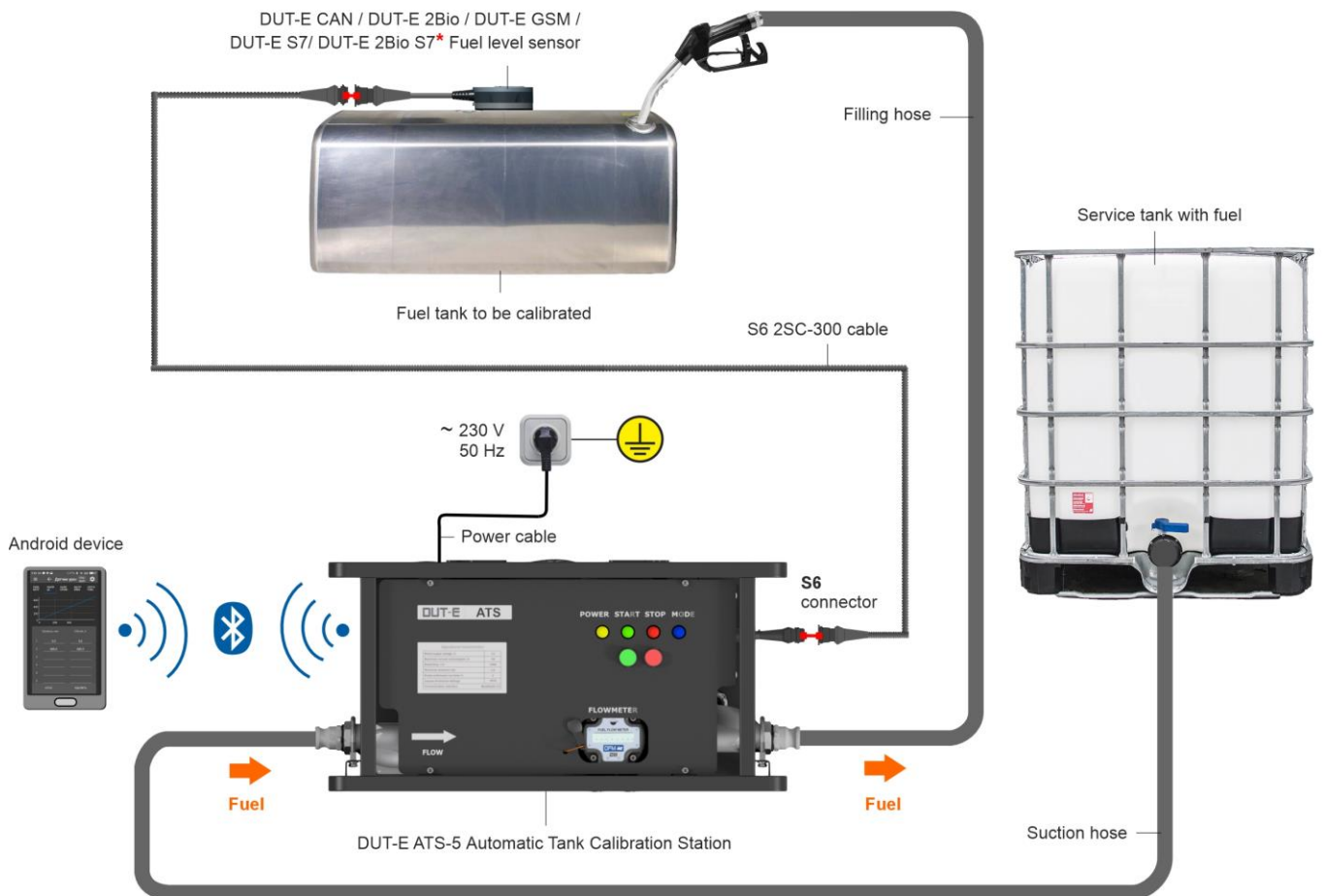
3.3.2 Typical schemes of equipment connection to the Station

IMPORTANT: During the FLS connection to the [Station](#) it should be borne in mind that:



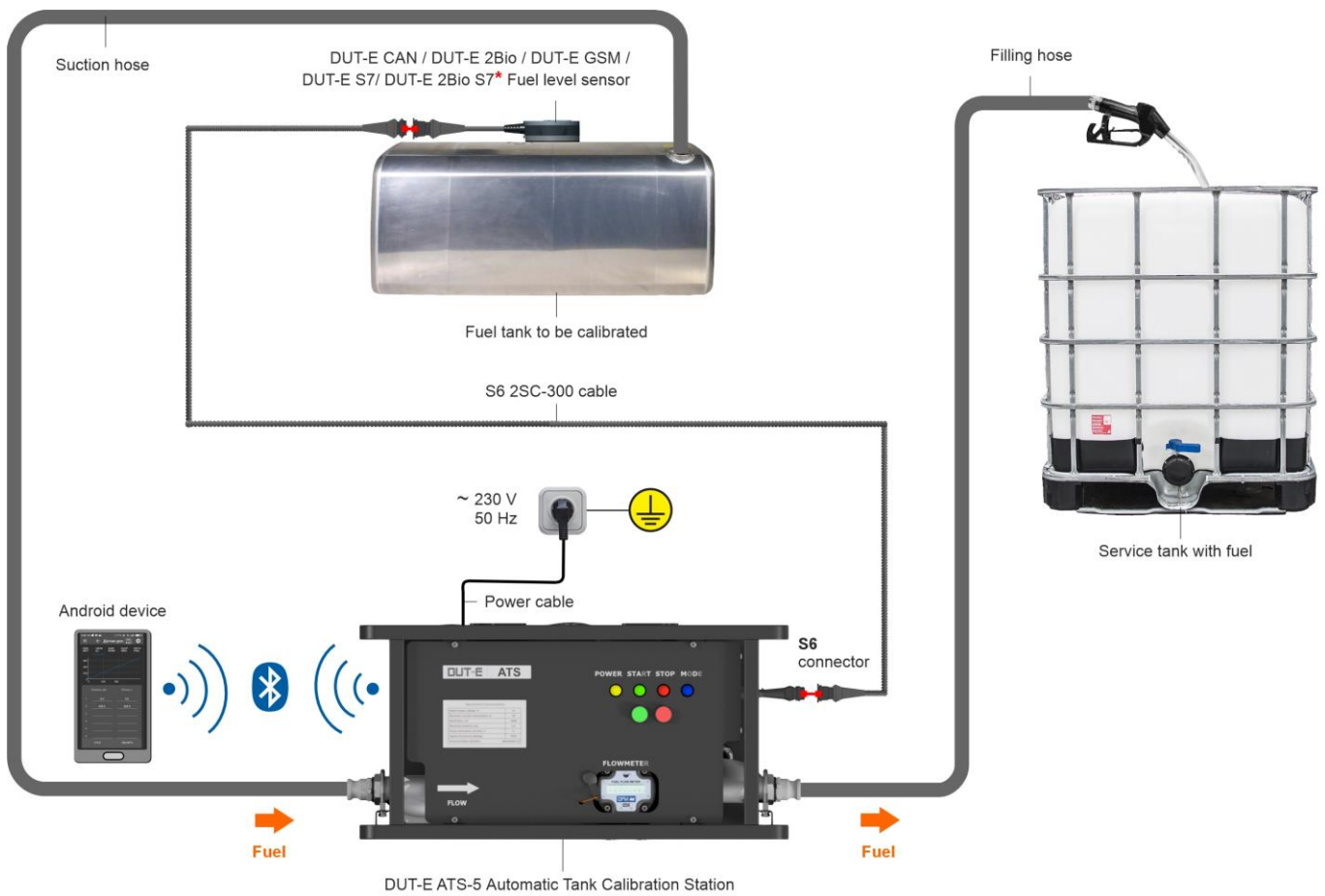
1) Only sensors designed based on [IoT Burger](#) Technology ([DUT-E CAN](#), [DUT-E 2Bio CAN/232/485/AF/I](#), [DUT-E GSM](#)) are allowed to be connected to **S6** connector (see [1.3.3](#)).

2) In order to connect other Technoton-produced FLS and sensors of other manufacturers, the user is to make appropriate adapters. Connect the adapter wires to the power supply terminals, analog/frequency/interface (RS-232/RS-485/CAN) inputs (see [table 2](#)) through cable inputs in the controller unit box (see [figure 7](#)). To get access to the terminals of wires connection, you need to unscrew four fixing screws and remove the control panel cover. Then, unscrew four fixing screws on the controller unit box and **carefully** move aside the cover of the control panel on which buttons are located.



* For DUT-E S7 / DUT-E 2Bio S7 electrical connection to the Station is not required.

a) scheme for the fuel tank calibration, according to "fill-up" procedure




* For DUT-E S7 / DUT-E 2Bio S7 electrical connection to the Station is not required.

b) scheme for the fuel tank calibration, according to "drainage" procedure

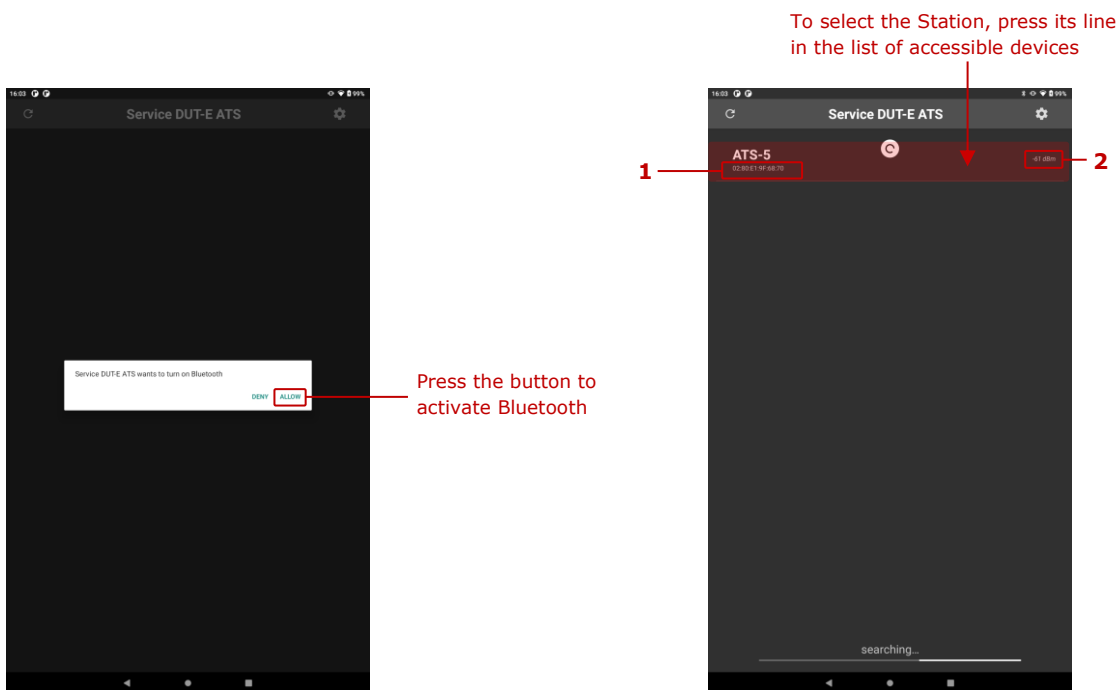
Figure 14 — Typical schemes for equipment connection to the Station

3.3.3 Tank calibration procedure – “Preparation” mode



Start Service DUT-E ATS mobile application by clicking on  icon from the main menu of the Android device. If necessary, confirm all requested authorizations (enabling Bluetooth, access to geolocation, access to files) that are necessary for the application operation. After you confirm all proposed confirmations, the application is ready for work and starts the automatic search and identification of accessible devices, with displaying the following data for each of them (see figure 15):

- MAC-address of the BLE-module **(1)**;
- Level of signal received from the Station (RSSI) **(2)**.



a) offer to allow the Bluetooth connection

b) selecting the Station from the list of accessible devices

Figure 15 — Example of establishing connection between the Android device and the Station using Service DUT-E ATS application

To establish connection between the Android device and the Station, press its line in the list of accessible devices. When you establish connection with the Station for the first time, the window of **Preparation** mode will open in Service DUT-E ATS application. In this window, you are to configure the [Universal ACS](#) Functional module (**FM**) (see the complete list of [SPN](#) in [annex A](#)) in the following order:

1) Configure the interface/station input to which the sensor of the tank to be configured is connected

In the area **Select sensors** open the tab of the needed interface/input (see figure 16).

By pressing  button, open **Interface settings** window in which you are to specify data transfer parameters for the respective interface/input:

- **For interfaces K-LINE 1 / K-LINE 2:**
 - from the dropdown list **Protocol** select the data transfer protocol: **S6** (for models [DUT-E CAN](#) / [DUT-E 2Bio](#) CAN/232/485/AF/I / [DUT-E GSM](#)) or **DUT-E COM** (for model DUT-E AF);
 - from dropdown list **Baudrate** select data transmission rate (only in case you select **DUT-E COM** protocol).
- **For interfaces RS-232 1 / RS-232 2 / RS-485 1 / RS-485 2:**
 - from the dropdown list **Protocol** select the required data transmission protocol:
 - **DUT-E COM** — data transfer upon request, in accordance with [DUT-E COM protocol](#) (extended LLS), with an option to configure the sensor and save the calibration table in its internal memory (for models DUT-E 232/485).
 - **LLS HEX (request)** — hexadecimal data transmission format upon request;
 - **LLS HEX (auto)** — hexadecimal format of automatic data output;
 - **LLS ASCII (auto)** — text format of automatic data output;
 - for protocols apart from DUT-E COM, specify the sensor network address in **Address** field from 0...255 range.
 - from dropdown list **Baudrate** select data transmission rate.

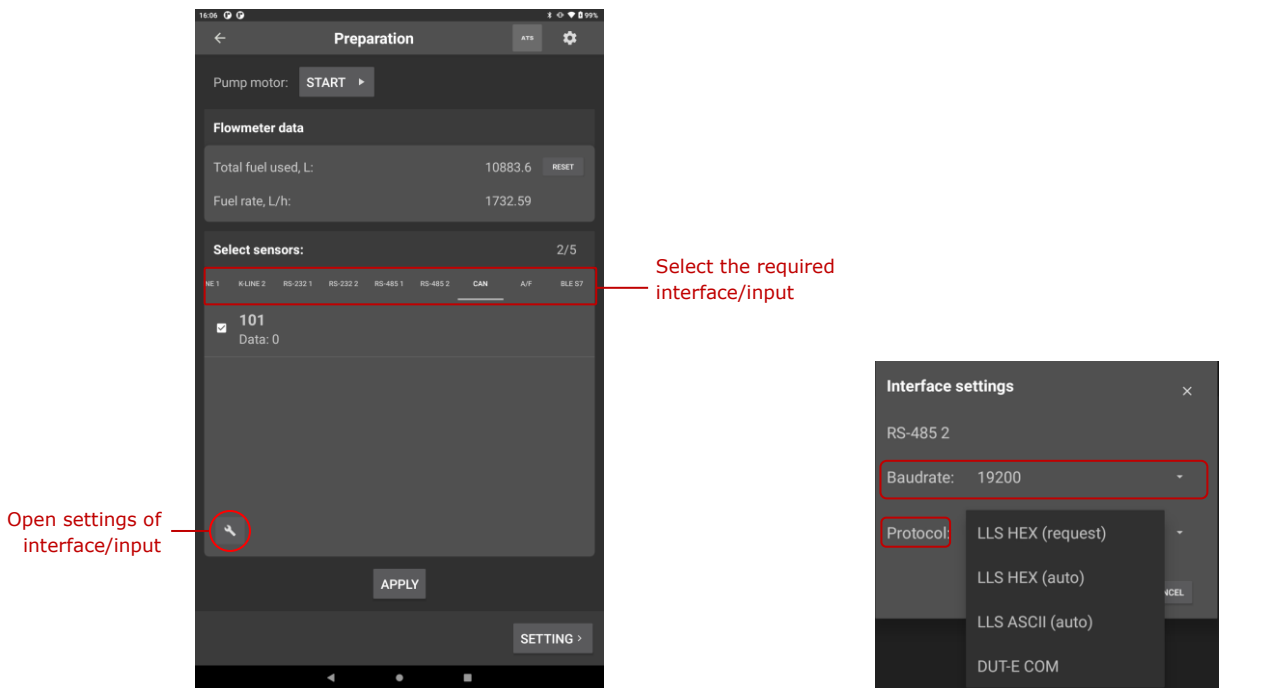
IMPORTANT



1) For correct data transfer by means of RS-232 and RS-485 interfaces, don't use the automatic data output mode in ASCII format.

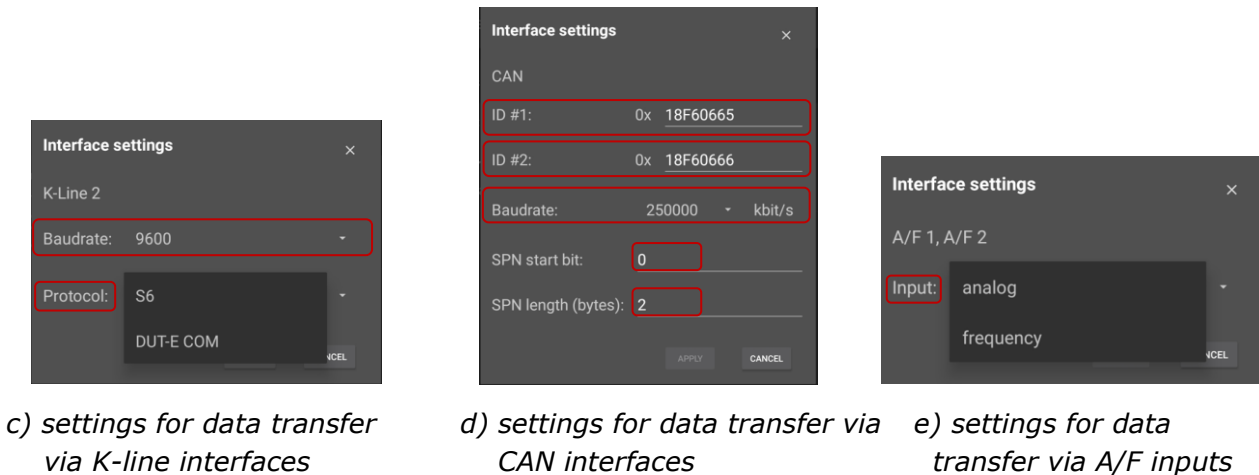
2) For "classic" [Technoton](#)-made sensors with RS-232 and RS-485 interfaces, (DUT-E 232 and DUT-E 485 models), you are to specify their output data transfer **in millimeters** during their initial configuration using the service adapter.

- **For A/F input:** from the dropdown list **Input** select the mode of operation — **analog** or **frequency**.



a) selection of settings for sensor connection to the interface/input

b) settings for data transfer via RS-232 / RS-485 interfaces



c) settings for data transfer via K-line interfaces

d) settings for data transfer via CAN interfaces

e) settings for data transfer via A/F inputs

Figure 16 — Example of settings for sensor connection to the Station

- **For interface CAN:**
 - in **ID #1** and **ID #2** fields specify the 4 byte identifier of CAN-message in the hexadecimal format (by default — [PGN 62982](#)) which contains indications of fuel level for each of the sensors connected to the Station via CAN interface (see figure 17).
 - in the field **SPN start byte** specify the start bit number for SPN of fuel level indications, in accordance with S6 Database ([SPN 521023](#)) (by default — 0).
 - in the field **SPN length (bytes)** specify the SPN length for fuel level indications, in accordance with S6 database ([SPN 521023](#)) (by default — 2 bytes).
 - from dropdown list **Baudrate** select data transmission rate.

Service field	Data field	
Priority (1 byte)	PGN (2 bytes)	SA (1 byte)
0x18	F606	65
0x18	F606	66

Figure 17 – Composition of ID #1 and ID #2 identifiers by default

2) Select the sensor which is installed in the tank to be calibrated

The tab of the selected interface/input contains the list of all accessible sensors.

In the area **Select sensors** tick the required sensor and press **APPLY** button, to confirm your choice (see figure 18).



ATTENTION: You can select altogether **up to 5 pcs.** of sensors with different interfaces for one procedure of tank calibration.

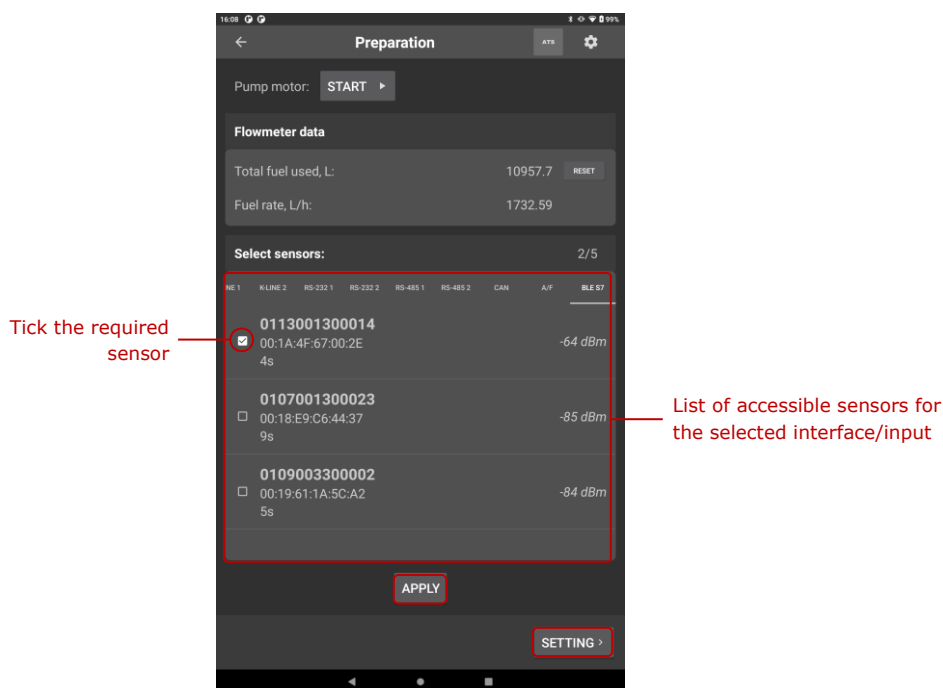


Figure 18 – Example of selecting the required sensor

3) Specify the Station settings

Press **SETTING >** button, enter the tank volume (in litres) in the appropriate field of **ATS settings** area (see figure 19 a) and press **SET** button.

Before starting calibration, the Station automatically calculates **57 equal portions** to be added into the tank, based on the specified tank volume.

Select the required calibration mode, in accordance with [1.6](#).

RECOMMENDATIONS: The value of the tank volume is specified:



1) In case of the “fill-up” tank calibration, a little bigger volume than the actual tank volume is specified (if the precise tank volume is unknown).

All calibration points in which values of volume exceed the specified tank volume will not be included into the calibration table

2) In case of “fuel discharge” calibration — the calibrated volume precisely corresponds to the actual tank volume.

To define the final fuel level during automatic calibration, you may set the limit for the current fuel level fluctuation in relation to the level variation range in **Coefficient, %** field.

In accordance with the specified coefficient, the Station will admit the possibility of automatic recording the next point into the calibration table and will proceed with pumping fuel into the tank.



ATTENTION: The coefficient value is chosen experimentally. For tanks of sophisticated shape, with prolonged period of fuel distribution inside the tank, we recommend to reduce the coefficient value to **(0.05...0.1) %**.

This setting is applicable only for **“Automatic”** mode of calibration.

4) Specify the sensor calibration settings



ATTENTION: In case the sensor calibration values (“Empty”/“Full”) were recorded earlier into the memory of the selected sensor (**only** [DUT-E CAN](#), [DUT-E 2Bio CAN/232/485/AF/I](#), [DUT-E GSM](#)), you don't have to specify the calibration settings again after its extension/cutting.

“Empty”/“full” calibration settings of the sensor are configured in the area **Fuel level sensor settings** (see figure 19 b) in the following order:

- Select sensor from the list **Sensors for calibration**.
- Measure the length of the sensor measuring probe (in mm) (see figure 19 c). Enter its value into the appropriate field and press **SET** button.
Note — This setting is valid only for [Technoton](#)-made sensors designed based on [IoT Burger](#) Technology and for “classic” configurable models [DUT-E AF/232/485](#).
- Specify values of the sensor indications for the “Empty” and “Full” tank. You can enter values manually into the appropriate fields and press **SET** button.

You can also specify calibration settings for actual sensor indications by pressing **EMPTY** **FULL** buttons.



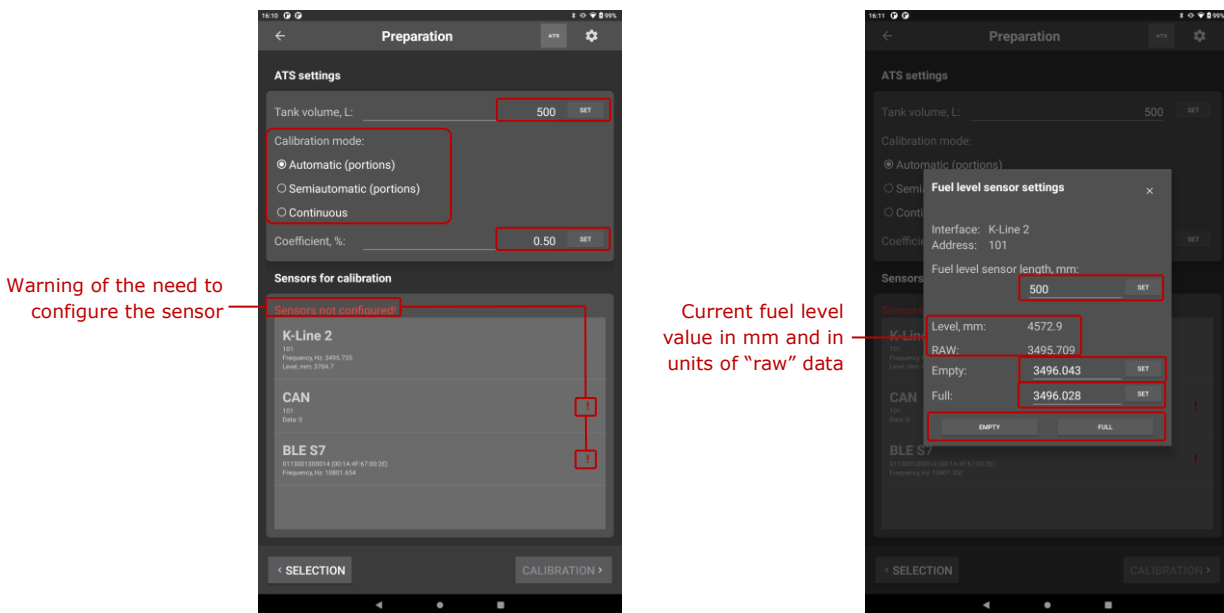
ATTENTION: For all sensors, with the exception of Technoton-made sensors designed based on IoT Burger Technology, you must specify “Empty” and “Full” values in units of raw data (RAW) (e.g. if the sensor indications variation range is from 0.0 to 650.0 mm, but the RAW indication displayed is from 0 to 6500, it is values indicated in RAW that you are to specify in the calibration settings).

⚠ WARNINGS: Specified calibration settings “empty”/“full” are saved in the sensor memory for models based on [IoT Burger Technology](#) ([DUT-E GSM](#), [DUT-E CAN](#), [DUT-E 2Bio](#) CAN/232/485/AF/I), connected to the Station through **S6** connector during the tank calibration (see [1.3.3](#)) and for all models of configurable “classical” [Technoton](#) sensors (DUT-E AF/232/485).

In order to calibrate the sensor for empty tank (minimal level of fuel), remove it from the fuel tank, pause for (30...60) s to release the remains of fuel from the measuring probe pipes and press **EMPTY** button.

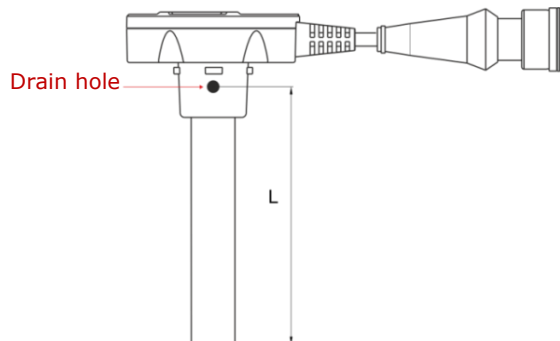
⚠ WARNING: When calibrating sensor to minimum level, there should not be fuel residues on surface of tubes of probe.

In order to calibrate the sensor for full tank (maximum level of fuel), plunge the pipes of the measuring probe fully into the fuel, pause for (3...5) s to stabilize the sensor indications and press **FULL** button.



a) example of the Station settings

b) example of “Empty”/“Full” sensor settings



c) example of determining the length of DUT-E sensors measuring probes

Figure 19 — Configuration of calibration parameters

3.3.4 Tank calibration procedure – “Calibration” and “Pause” modes

As soon as the [Station](#) configuration is completed, press **CALIBRATION >** button to start the calibration procedure itself. The Station will switch into “**Pause**” mode (blinking signal of **MODE** blue indicator), until **START ▶** button in Service DUT-E ATS application or **START** button on the control panel are pressed.

To switch on “**Calibration** / “**Pause**” mode, you are to press **START ▶** / **STOP ||** button (in Service DUT-E ATS application) or **START** / **STOP** button (on the Station control panel), respectively.

After the fuel pump is switched on, pumping of fuel starts from the utility tank to the main tank. The station will switch into “**Calibration**” mode (**MODE** blue indicator is steadily on).

RECOMMENDATIONS: During the fuel tank calibration procedure we recommend to monitor visually:



- 1) Hermeticity and any signs leakage from fuel lines and hoses.
- 2) Hydraulic pressure in the Station pipeline system is controlled automatically by the pressure sensor (see [figure 7](#)). Whenever the pressure goes beyond the range **(0.35...2.4) bar**, the Station automation switches off the fuel pump.

In “**Calibration**” mode, the Station continuously reads out fuel volume indications from [DFM Marine](#) flow meter and fuel level indications measured by FLS. Based on these values, the Station automatically generates points of the calibration table which are displayed in Service DUT-E ATS application in the form of a calibration chart.

The first point is entered into the calibration table, as soon as the tank is filled with fuel till the level corresponding to the sensor sensitivity threshold. The last point is entered into the calibration table after the fuel tank is filled and the pump is automatically shut off. The generated calibration table comprises **57** points (see [figure 20](#)).

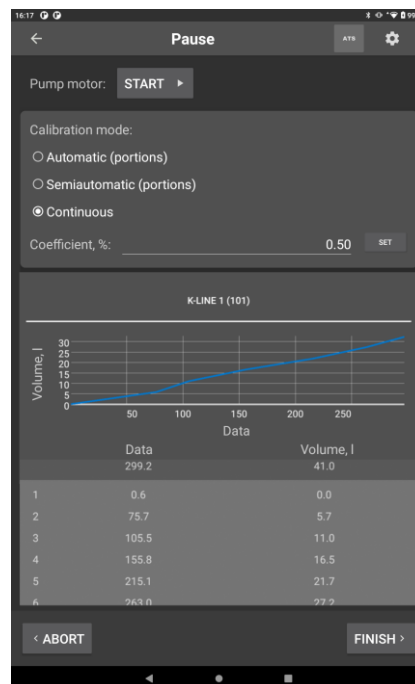



Figure 20 — Example of automatic generation of the calibration table and the respective graph in “Calibration” mode



IMPORTANT: In the process of tank calibration, if necessary, switching over from one calibration mode to the other is allowed in “**Pause**” mode (blinking blue **MODE** indicator).

If you need to abort calibration, before it is finished, press  button in “**Pause**” mode and confirm the appropriate offer (see figure 21). After that, the Station will pass into “**Preparation**” mode of operation. In this mode, the final calibration table will be inaccessible.

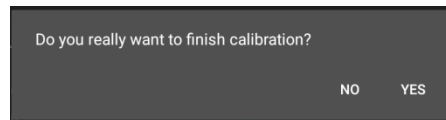


Figure 21 — Example of offer to complete the calibration




IMPORTANT: In the process of the Station operation in “**Calibration**” mode:

- 1)** The Station always automatically switches over to “**Pause**” mode, in case air is captured by the fuelling hose or during the fuelling nozzle shutoff, as soon as the tank is filled.
- 2)** In case of communication disruption between the [Station](#) and the Android device (in case of Bluetooth cutoff, Android device deactivation, going beyond the range of reception), as soon as the communication is restored, the table (including its calibration points created during the disconnection period) will be displayed again on the screen of the Android device.
- 3)** In case of incidental or emergency power supply disconnection, the operation of its fuel pump is stopped. Consequently, the process of the calibration table automatic generation will be suspended. All the calibration points created will be saved in the Station non-volatile memory. As soon as the power supply is restored, the Station will switch over into “**Pause**” mode (blinking of **MODE** blue indicator). By pressing **START** button, the process of the calibration table automatic generation will be continued, starting from the last saved point, without any loss of data.
- 4)** In case you calibrate small tanks, (up to 300 l), we recommend set the minimal pipe size on the fueling nozzle of the filling hose.

In any calibration mode (see [1.6](#)), the procedure of the calibration table creation is considered completed, if the number of points in the table has reached **57 pcs.** and if automatically or manually the fuel supply is cut off from the fuelling hose by the fuelling nozzle.



WARNING: In case the pump motor was stopped by the user from the Station **control panel** in “**Automatic**” mode of calibration, the pump will not start again automatically after the fuel level stabilization. In this case, the user should start the pump manually, using any method (from the Station control panel or from Service DUT-E ATS application).

In case you need to stop the calibration procedure, before it is completed, you may switch into “**Pause**” mode any time and press  button. After that, the Station will switch into “**Checking the results**” mode of operation. In this mode, all points of the calibration table that were created, before the process was stopped, will be accessible.





WARNINGS: The calibration time may be longer

- 1)** in case several sensors (up to 5 pcs.) with the same interface or with different interfaces are mounted in the tank.
- 2)** In case of using [DUT-E S7](#) / [DUT-E 2Bio S7](#) wireless sensors.

3.3.5 Tank calibration procedure – “Checking the results” mode

As soon as the process of the calibration table generation is completed, the [Station](#) will automatically switch into “**Checking the results**” mode (see figure 22).

In “**Checking the results**” mode you may, if necessary, edit the final calibration table, as well as save it in the sensor itself using  button or save it in the memory of the Android device by pressing  button.

The calibration table may be saved in special files compatible with the service software of the respective sensors: ***.ttr** (for sensors designed based on IoT Burger Technology) and ***.ttd** (for configurable “classic” [Technoton](#)-made sensors).

The calibration table files are automatically saved in the following application installation folders in the memory of the Android device:

- for Android operating system below version 8 **\Service ATS\files**
- for Android operating system, version 8 and higher **\Android\data\com.service_ats\files**

Calibration tables of tanks equipped with [DUT-E S7](#) wireless sensors (model code 13) / [DUT-E 2Bio S7](#) can be saved in the special ***.ats7**, file which is compatible with [Fuel Tanks Monitor](#) application. Using this application, save the sensor profile, with the calibration table entered into the memory of the mobile device you are using. Then, after switching into “Service” mode, record the profile saved in the mobile device into the sensor internal memory (see details in the document “[Fuel Tanks Monitor mobile application. User manual](#)”).



You may also save the calibration table in ***.txt** text file.

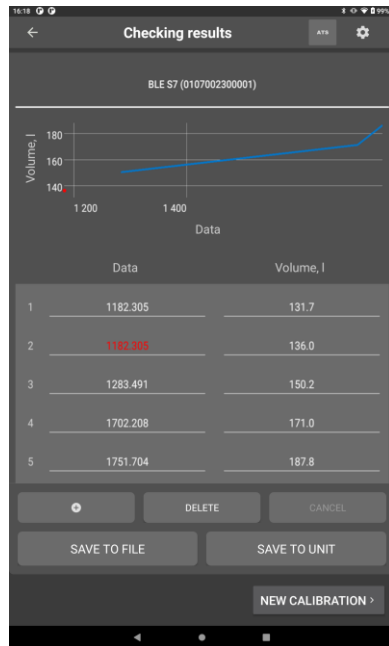
IMPORTANT:



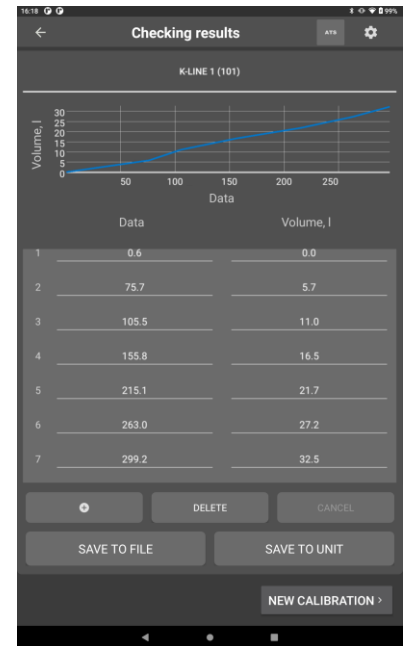
1) The Station enables you to save tanks calibration tables in the sensor internal memory for models designed using [IoT Burger Technology](#) ([DUT-E GSM](#), [DUT-E CAN](#), [DUT-E 2Bio CAN/232/485/AF/I](#)), connected through **S6** connector to the Station during the tank calibration (see [1.3.3](#)), as well as for all models of “classical” configurable [Technoton](#) sensors (DUT-E AF/232/485).

2) If the tank volume exceeds **6425.5 l**, its calibration table cannot be saved in the respective sensor **itself** (except wireless models), but it can be saved in a file.

In case incorrect calibration points are generated, their values in the table and in the graph are marked in red. You may delete such points from the table using  button or edit the table by adding correct points using  button.



a) display of incorrect calibration points



b) final calibration table with a graph

Figure 22 — Examples of displaying the results of the calibration procedure

Before starting the calibration procedure for the next tank, press **NEW CALIBRATION >** button. Whenever you do it, the data of the calibration table for the preceding calibration data will be lost, unless you save it. (see figure 23)

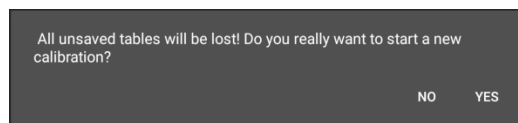


Figure 23 — Warning of a loss of data not saved, when a new calibration procedure is started



WARNINGS: During calibration of tanks equipped with “classical” [Technoton](#) sensors (DUT-E AF/232/485), the calibration table recorded into the internal memory of the respective sensor is automatically reduced by the application to 30 calibration points.



3.3.6 Quality control of the Station operation

WARNING: Values of the calibration table points displayed in Service DUT-E ATS application would be incorrect in case of short circuit of the measuring probe of the FLS mounted in the tank to be calibrated. The short circuit may be caused by electrically conductive dirt or water.

In any [Station](#) mode of operation, when pressing **ATS** button in the upper right side of the window of Service DUT-E ATS application (**ATC Diagnostics** tab), current data on the Station operation and its performance indicators will be displayed (see figure 24).

UPDATE button serves to start the procedure of updating the firmware of the Station controller unit.

Table 9 – Messages of signals of the Station performance indicators

Signal type	Signal color	Signal values
	Green	No active malfunctions in the Station.
	Red	The following Station active malfunctions leading to the fuel pump cutoff are detected: <ul style="list-style-type: none"> - DFM Marine inbuilt flow meter is switched off; - triggering the sensor of maximum pressure; - low fuel consumption during the fuel pumping; - FLS switching off.

Note — The red light of **Pump motor** indicator indicates the Station fuel pump off status, while the green light indicates that the pump is running.

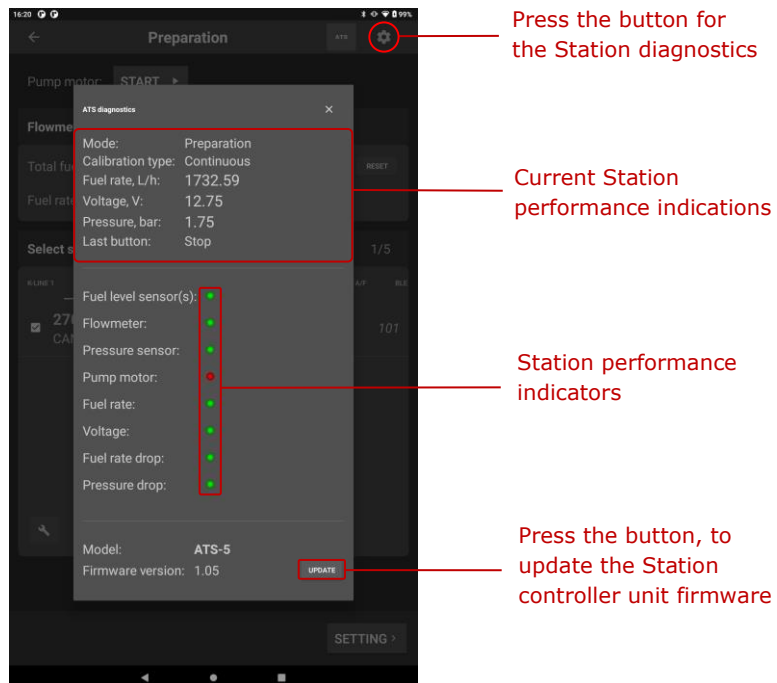


Figure 24 — Quality control of the Station performance in Service DUT-E ATS application

A list of possible Station malfunctions and methods of troubleshooting see in chapter [4](#). A typical example of DUT-E ATS-5 automated calibration station employment on a facility by a team of installers is provided in [annex B](#).

3.3.7 Completion of work

Switch off the [Station](#) power supply by setting **I/O** toggle switch in the lower position (**O**) and remove the power cable plug from the AC mains.

Make sure the fueling nozzle is shut and disconnect the hoses. Release carefully the remains of fuel from the Station fuel lines to the service tank prepared for this purpose in advance.

Attach the caps to the Station fittings used for connection of sucking/filling hoses.

4 Diagnostics and troubleshooting of any possible problems

In case of any malfunctions in the [Station](#) operation, you are to contact the Product supplier. The Station is to be repaired only by Regional Certified Service Centers (further on — [RSC](#)). The full list of RSC can be found at <https://www.jv-technoton.com/>.

Some malfunctions are allowed to be eliminated by the user himself (see table 10).

To assure high accuracy of calibration, we recommend to conduct re-calibration of the inbuilt [DFM Marine](#) fuel flow meter once in a while. The flow meter **inter-calibration interval** is determined by the increment of the "Total fuel consumption" [Counter](#) (SPN 521314) from the moment of the previous flow meter calibration; it is **5250 m³**. Re-calibration of the flow meter removed from the Station, as well as its subsequent verification are performed in the Regional Service Centre.

Table 10 — Station malfunctions allowed to be eliminated by the user himself

Type of malfunction	Possible causes	Method of solving the problem
High fuel pressure (more than 2.4 bar).	Pinched hose, manometer out of order, fuelling nozzle closed.	Automatic pump shutoff (STOP red indicator is on). As soon as START button is pressed, the pump is on for a few seconds. If pressure has not become normal during this period, the pump automatically shuts off and STOP red indicator will be on. You should note that the fuel pump has its own pressure relive valve which prevents exceeding the maximum allowed pressure in the system. If this malfunction is repeated again, we do not recommend further Station designated use, until its cause is identified and eliminated.
Low fuel pressure (below 0.35 bar), penetration of air into fuel lines, fuel line disruption.	Air in the fuel system, pump out of order, mechanical damaging.	Automatic pump shutoff (STOP red indicator is on). When START button is pressed, the pump does not switch on, until the module gets cool enough. If this malfunction is repeated again, we do not recommend further Station designated use, until its cause is identified and eliminated.
Fuel pump overheating.	High ambient temperature, pinched hose, fuelling nozzle closed, pump out of order, Station power supply does not meet the Station power supply requirements, cooler is inoperative, temporary overload, mud filter clogging.	
Control module overheating.	High consumption current of the pump, hermeticity of casing damaged, faulty circuit board of control module, temporary overload.	

Type of malfunction	Possible causes	Method of solving the problem
Fuse blown.	Short circuit in the control module or in the pump, control module malfunction, pump out of order, maximum allowed voltage surpassed, incorrect connection of "+" and "-" wires.	Replace the fuse. If this malfunction is repeated again, we do not recommend further Station designated use, until its cause is identified and eliminated.
Heating and pitting of power cable clips.	Loose contact between the power cable clips and the power source.	Ensure the proper clips contact, scrape off the oxidized contacts and remove the scale, degrease the contacts avoiding any leakage. If this malfunction is repeated again, we do not recommend further Station designated use, until its cause is identified and eliminated.
Fuel pumping speed below normal, too long period of pumping.	Filter is clogged, insufficient voltage of power source, hose is pinched, fuelling nozzle is defective, pump is out of order.	Identify and eliminate the cause. As a rule, too low fuel consumption is accompanied by the pump overheating and too low/too high pressure. Actions to be taken in such cases are described above.

5 Packaging

The Station delivery set is shipped in the plywood box (see figure 25).



Figure 25 — Packed DUT-E ATS-5 automatic tank calibration station

A label containing the information on the product name, model, serial number, date of manufacturing, weight, as well as QC stamp and QR code is stuck on two sides of the Station packing (see figure 26).



Figure 26 — Label on the packed DUT-E ATS-5 automatic tank calibration station

Note — Label design and contents can be modified by the [Manufacturer](#).

6 Storage

[Station](#) is recommended to be stored in dry enclosed areas.

Station storage is allowed only in original packaging at temperature range from -50 to +40 °C and relative humidity from 98 % at 25 °C.

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

After the Station has been stored in conditions of low ambient temperature, it needs to be warmed during 2 hours at room indoor temperature before use.

Station shelf life must not exceed 24 months.

7 Transportation

Transportation of [Station](#) is recommended in closed transport that provides protection for Station from mechanical damage and precipitation.

When transporting by air, Station 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 Station sensors should be sealed.

8 Utilization/re-cycling

[Station](#) does not contain precious metals in amount that should be recorded.

The inbuilt lithium-thionyl chloride battery (located inside [DFM Marine](#)) contains harmful substances and components that are hazardous to human health and environment.

Battery must not be disposed of together with general domestic waste.

The Buyer is responsible for the disposal of battery by means of its delivery to the hazardous waste collecting center; this will ensure safety for human health and environment.

[Technoton](#) bears no responsibility for any non-compliance with the above disposal and recycling requirements for battery.

Contacts

Distribution, technical support and service



9001:2015
certified quality



sales@jv-technoton.com

support@jv-technoton.com



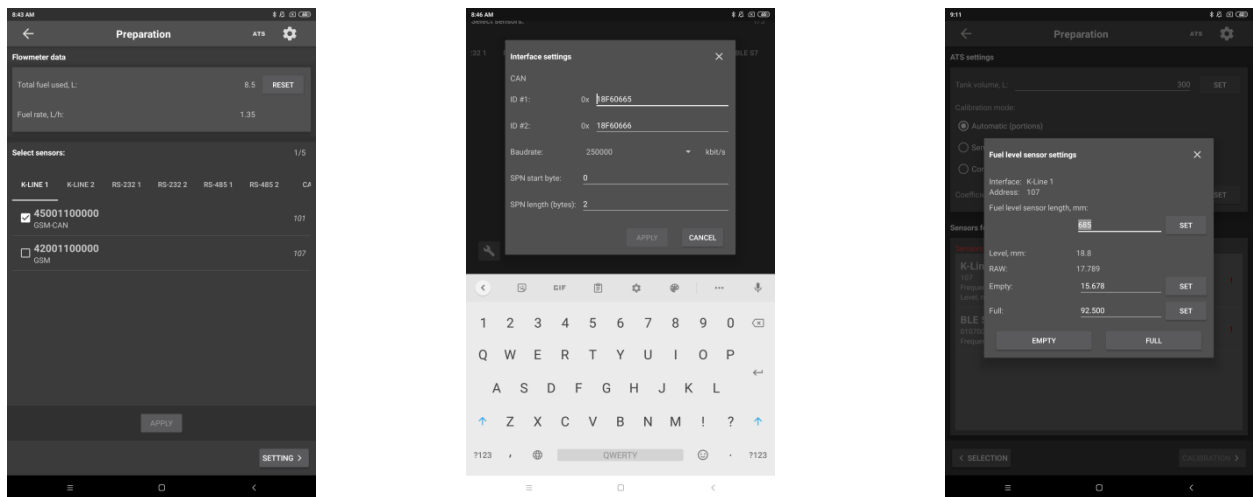
Annex A

SPN of Universal ACS Functional module

Universal ACS FM is designed to:

- receive fuel level readings via RS-232 / RS-485 / CAN (SAE j1939) / K-Line (ISO 14230) / Bluetooth interfaces from up to 5 pcs. of fuel level sensors mounted in the tank and fuel volume values corresponding to them from [DFM Marine](#) fuel flow meter which is inbuilt into the [Station](#);
- generate the calibration table and its saving in the sensor or in a file;
- switch off the fuel pump motor, as soon as the calibration is completed or in emergency situation;
- diagnostics of the Station active malfunctions.

[SPN](#) format of ATS FM is in accordance with [Data base S6](#) (DB).



a) "Preparation" mode



b) "Calibration" mode

c) "Checking results" mode

d) "ATS diagnostics" tab

Figure A.1 — Examples of windows of Universal ATS FM in Service DUT-E ATS mobile application

Table A.1 — Universal ATS FM. Displayed and/or editable SPN with the help of Service DUT-E ATS mobile application

SPN	Name	Factory value	Unit of measure	Range	Clarification
Fuel Level Sensor List. KLINE 1 PGN 63510 Fuel Level Sensor List. KLINE 2 PGN 63511					
521355	Array Elements Count	On the fact	pcs.	1...8	Number of sensors accessible via K-Line (ISO 14230) Station interface. It is possible to connect up to 8 pcs. of sensors designed based on IoT Burger Technology (DUT-E CAN, DUT-E 2Bio CAN/232/485/AF/I, DUT-E GSM) or DUT-E AF.
521120	Serial Number	On the fact	No	No	Serial number of the fuel level sensor is displayed. Serial number is a set of numbers that is used for identification of specific sensor. Serial number of sensor has the following format: AABBB C DDDDD, where: AA - code of DUT-E/DUT-E 2Bio/DUT-E GSM model; BBB - digits that reflect changes product changes; C - Manufacturer code; DDDDD - sequential number. SPN is not available for editing.
521345	Model	On the fact	No	No	Model of the sensor connected is displayed. Model - This is version of the sensor inside of DUT-E CAN/DUT-E 2Bio/DUT-E GSM product line. Each model has its own functional and constructive features. E.g. the particularity of DUT-E CAN is data transmission via digital CAN j1939/S6 interface . SPN is not available for editing.
521188	S6 Address (SA)	On the fact	No	No	Network address DUT-E CAN/DUT-E 2Bio/DUT-E GSM which is connected via S6 Technology . Network address value can in range: 91...98 and 101...108. SPN is not available for editing.
Available Bluetooth Device List PGN 63279					
521355	Array Elements Count	On the fact	pcs.	1...15	Number of sensors accessible via the Station Bluetooth interface. The Station BLE-module enables to detect using S7 Technology up to 15 pcs. of DUT-E S7 / DUT-E 2Bio S7 wireless sensors.
521490	MAC Address	On the fact	No	0...281474976710655	The setting displays the unique identifier (MAC address) of BLE-module of DUT-E S7 / DUT-E 2Bio S7 wireless sensor. Based on MAC address, the mobile application generates the serial number of a specific Unit and also determines the status of its accessibility for work based on S7 Technology. The data are inaccessible for editing.
521178	Received Signal Strength Indicator (RSSI)	On the fact	dBm	-125...0	The setting displays the current level of the signal strength (by the logarithmic scale) received from DUT-E S7 / DUT-E 2Bio S7 wireless sensor. The range displayed: from -125...0 dBm. The data are inaccessible for editing.
521084	Timeout	On the fact	s	0...64255	The setting displays the length of the time interval after the reception of the latest message from DUT-E S7 wireless sensor. The data are inaccessible for editing.
Automatic Calibration Station. Universal PGN 63512					
521355	Array Elements Count	On the fact	pcs.	1...5	Number of sensors selected for the fuel tank calibration.
521679/27.0	Fuel Level. Row Data/ 27.0 DUT 1	On the fact	No	0...4294967295	Current fuel level value in the tank to be calibrated in units of "raw" data (RAW), according to readings of the 1 st sensor.
521679/27.1	Fuel Level. Row Data/ 27.1 DUT 2	On the fact	No	0...4294967295	Current fuel level value in the tank to be calibrated in units of "raw" data (RAW), according to readings of the 2 nd sensor.
521679/27.2	Fuel Level. Row Data/ 27.2 DUT 3	On the fact	No	0...4294967295	Current fuel level value in the tank to be calibrated in units of "raw" data (RAW), according to readings of the 3 rd sensor.
521679/27.3	Fuel Level. Row Data/ 27.3 DUT 4	On the fact	No	0...4294967295	Current fuel level value in the tank to be calibrated in units of "raw" data (RAW), according to readings of the 4 th sensor.

SPN	Name	Factory value	Unit of measure	Range	Clarification
521679/27.4	Fuel Level. Row Data/ 27.4 DUT 5	On the fact	No	0...4294967295	Current fuel level value in the tank to be calibrated in units of "raw" data (RAW), according to readings of the 5 th sensor.
521279	Total Fuel Used. High Resolution	On the fact	Recalculate: m ³ → l	0...42949.7	In "Preparation" mode, is displayed the current value of Counter of total volume of fuel pumped through the Station from the moment the user reset it using "Reset" button of the mobile application. The counter is convenient for monitoring the volume of fuel pumped from the fuel tank to the utility tank.
521313	Engine Fuel Rate	On the fact	Recalculate: m ³ /h → l/h	-21474.8...21474	In "Preparation" mode, the current value of the hourly (instant) fuel consumption during its pumping through the Station from the fuel tank into the utility tank is displayed (or vice versa).
521680	ATS Errors Mask. Extended	On the fact	No	No	Current status of the Station serviceability is displayed (see 3.3.6), according to the following criteria: - 0x0001 – flow meter is switched off; - 0x0002 – FLS1 is switched off; - 0x0004 – FLS2 is switched off; - 0x0008 – FLS3 is switched off; - 0x0010 – FLS4 is switched off; - 0x0020 – FLS5 is switched off; - 0x0040 – maximum pressure sensor has been triggered; - 0x0080 – thermostatic switch is triggered; - 0x0100 – pump motor is stopped; - 0x0200 – low fuel rate; - 0x0400 – voltage error; - 0x0800 – control unit error; - 0x1000 – fuel rate fall (ATS-5); - 0x2000 – pressure fall (ATS-5).
521035	ATS Working Status	On the fact	No	No	Current mode of the Station operation is displayed. The Station can operate in the following modes (see. 3.2): - "Preparation"; - "Calibration"; - "Pause"; - "Results check".
521641	Calibration Mode	On the fact	No	No	Current mode of the fuel tank calibration is displayed (see. 1.6): - "Automatic"; - "Semi-automatic"; - "Continuous".
Calibration Table. Fuel Tank 1 PGN 63036					
521355	Array Elements Count	2	pcs.	1...57	Number of points of the calibration table created in the process of the automatic fuel tank calibration.
521023	Fuel Tank Level	On the fact	mm	0...6425.5	Fuel level values in the Vehicle tank corresponding to points of the calibration table.
521024	Fuel Tank Volume	On the fact	l	0...6425.5	Values of fuel volume in the tank corresponding to points of the calibration table.
Fuel Level Sensor. Settings And Data PGN 63513					
521355	Array Elements Count	On the fact	pcs.	1...5	Number of sensors available for selection for analog/frequency or interface (RS-232/RS-485/CAN/K-Line) inputs (see table 2), as well as via wireless Bluetooth Station interface.
521681	Interface Number	On the fact	No	0...255	Number of analog/frequency or interface (RS-232/RS-485/CAN/K-Line) input or wireless Bluetooth Station interface from which the sensor is selected.
521490	MAC Address	On the fact	No	00:00:00:00:00:00 ... FF:FF:FF:FF:FF:FF	Sensor MAC address itself of DUT-E S7 / DUT-E 2Bio S7 sensor selected by the user for connection by means of S7 Technology is not displayed in the list of authorized Units. However, based on MAC address, the software generates the serial number of a specific Unit and also identifies its accessibility status for work using S7 Technology . The data are not accessible for editing.
521679/22.0	Fuel Level. Row Data/ 22.0 Empty	On the fact	No	0...4294967295	Fuel level value in units of "raw data" (RAW) of the selected sensor* which corresponds to the empty tank to be calibrated. Using this value, you can specify the sensor calibration for the minimum fuel level.

SPN	Name	Factory value	Unit of measure	Range	Clarification
521679 /22.1	Fuel Level. Row Data/ 22.1 Full	On the fact	No	0..4294967295	Fuel level value in units of "raw data" (RAW) of the selected sensor* which corresponds to the full tank to be calibrated. Using this value, you can specify the sensor calibration for the maximum fuel level.
521679 /32.1	Fuel Level. Row Data/ 32.1 Millimeters (mm)	On the fact	mm	0..4294967295	Fuel level value (in millimeters) corresponding to the current readings of the selected sensor.
521679 /32.2	Fuel Level. Row Data/ 32.2 Conventional Units (c.u.)	On the fact	c.u.	0..4294967295	Fuel level value (in conventional units) corresponding to the current readings of the selected sensor.
521093	Fuel Level Senor Lenght After Cutting	On the fact	mm	0..64255	Field in which the user is to specify the value of the measuring probe length of the connected sensor**.
<p>* With the exception of sensors designed based on IoT Burger Technology.</p> <p>** Applicable only for sensors designed based on IoT Burger Technology.</p>					

Annex B

Typical example of Station employment by a team of installers on a facility

Baseline data:

Team of FLS installers (2 persons) (installer 1 and installer 2).

Facility: Road transport company.

Vehicles equipped: 5 trucks with 1000 l fuel tanks that are not empty.

Equipment used:

- [DUT-E ATS-5](#) automatic tank calibration station — 1 pc.;
- Empty service tank (IBC #1) — 1 pc.;
- Service tank filled with 1200 l of fuel (IBC #2), — 1 pc.;
- Android-base tablet — 1 pc.;
- Tank for FLS calibration — 1 pc.;
- Toolkit for FLS installation — 1 pc.;
- Service company utility vehicle for the team and equipment transportation to the facility — 1 pc.

Order of operations:

1) The team arrives at the facility. The necessary equipment and tools are unloaded (installer 1 and installer 2).

The Station external examination, power supply and hoses connection are performed, as well as the Station fuel lines deaeration (installer 1).

The first Vehicle to be equipped is examined, with drawing up an Act of Examination (installer 2).

Estimated time needed — **up to 30 min.**

2) Using the Station, the Customer fuel is discharged from the tank of the first Vehicle to the empty IBC#1 (installer 1).

After the fuel discharge the technology break for the Station is foreseen.

FLS is prepared for mounting, the marking of the first Vehicle tank is performed, also FLS cutting, calibration, mounting, laying the signal cable (installer 2; installer 1 joins installer 2 after the fuel discharge).

Estimated time needed — **from 40 min to 1 h** (depending on the Customer fuel volume which is discharged from the tank of the first Vehicle)

3) Using the [Station](#) installer 1 carries out:

- Automatic “fill-up” calibration of the first Vehicle tank using the Provider fuel from IBC#2;
- Provider fuel pumping from the calibrated tank of the first Vehicle back to IBC#2;
- Customer fuel pumping from IBC#1 to the calibrated tank of the first Vehicle;
- Customer fuel pumping from the tank of the second Vehicle to the empty IBC#1;

Power cable connection and sealing of FLS on the first Vehicle (installer 1).

The second Vehicle to be equipped is examined, with drawing up an Act of Examination. FLS is prepared for mounting; marking and drilling of the second Vehicle tank are performed (after its fuel discharge). Measuring probe cutting, sensor calibration, mounting in the second Vehicle tank are performed, as well as laying the signal cable (installer 2).

Estimated time needed — **up to 2 h** (depending on the Customer fuel volume returned to the tank of the first Vehicle and discharged from the tank of the second Vehicle).

4) Technology break for the team — **15 min.**

For all other Vehicles to be equipped at the facility the operations described in **2-4** are similar. The method of the Station employment described above is typical and may have some particularities depending on conditions of a particular facility.

Annex C

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/UCq7EF3DHrgl7fOWB2ynsR-A>