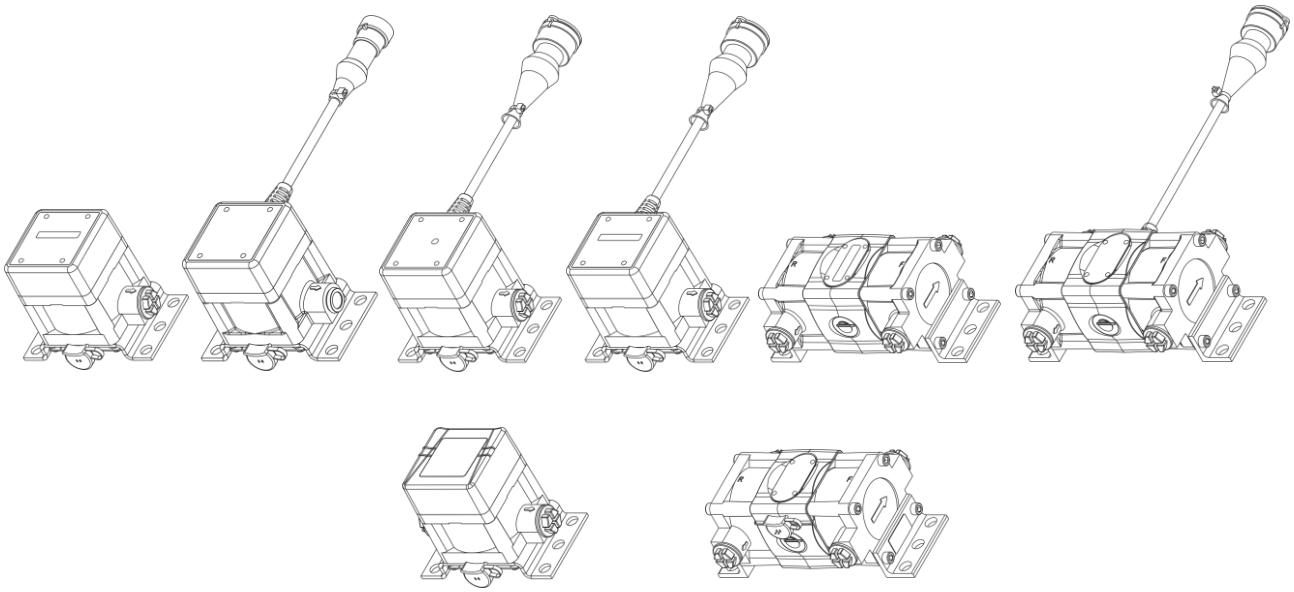
FUEL FLOW METERS



DFM 50/90/100/220/250/500/900
one-chamber and differential

OPERATION MANUAL

Version 11.0

TECHNOTON
ADVANCED MACHINERY TELEMATICS

E28 10 R - 04 1550 E28 10R – 06 2434

Contents

Revision history

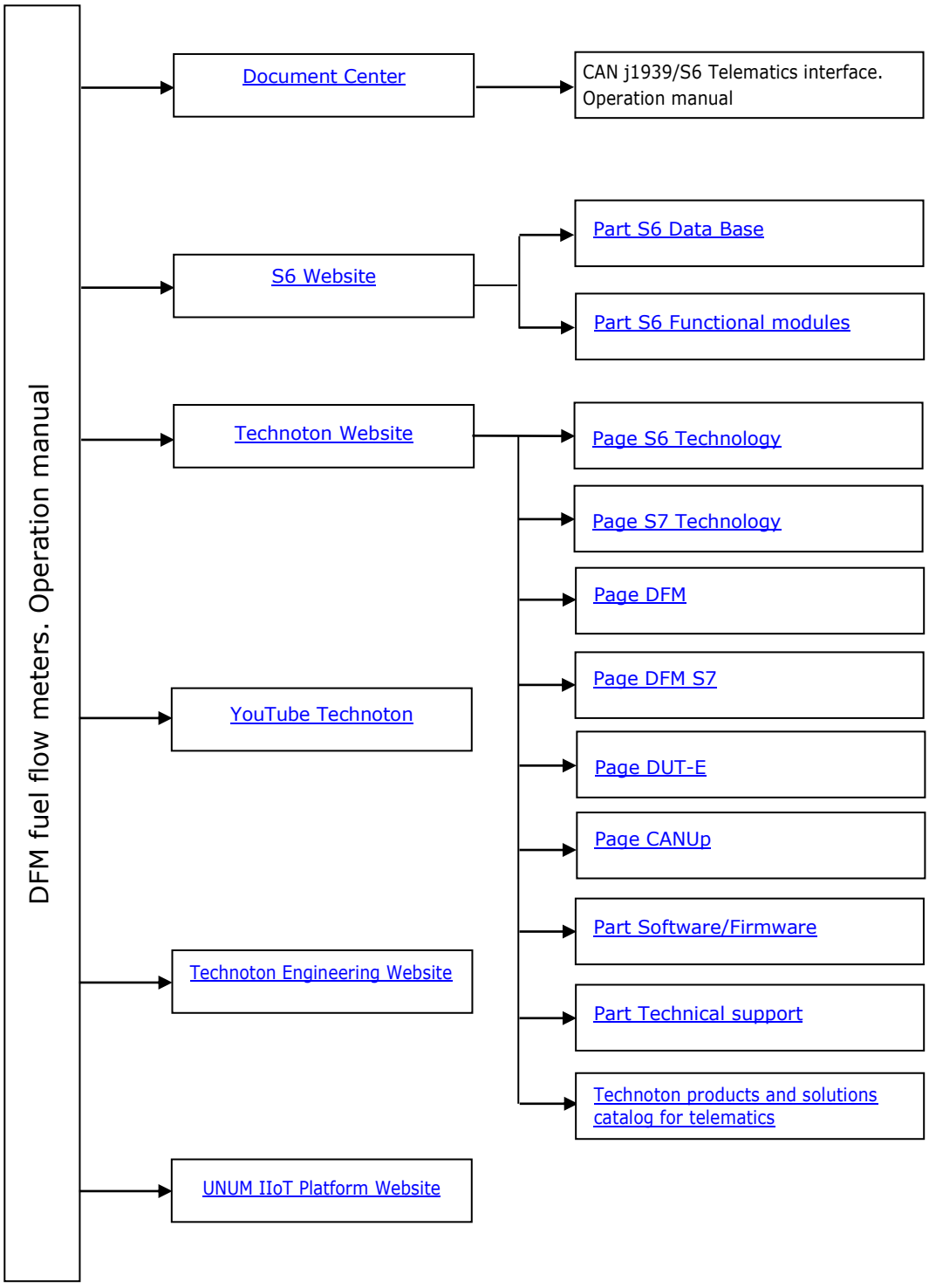
Version	Date	Editor	Description of changes
1.0	01.2007		Basic version.
6.2	12.2016	OD	• Concept of recommended re-calibration interval of DFM is introduced. Re-calibration interval of DFM is defined by volume of fuel went through measuring chamber of DFM. • Description of new version of flow meter available for order is added - DFM 250 HP and DFM 500 HP characterized by higher fuel consumption rate.
6.3	01.2017	OD	• DFM COM data transfer protocol updated.
6.4	06.2017	OD	• Clarifications in DFM order identification codes added. • Table of measurement range and accuracy is divided in two separate parts: for one-chamber and for differential flowmeters. • General installation instructions are amended with description of symbols on DFM body for proper installation into fuel lines.
7.0	03.2019	OD	• List of DFM CAN output messages according to SAE j1939 protocol updated. • Information on DFM CAN operation according to NMEA 2000 protocol added. • List of DFM 232/485 registers of output messages according to Modbus protocol supplemented with specificators descriptions. • Tables of SPN of Functional Modules for DFM fuel flow meters are updated. • Certificate E28 of E-mark International Standard added. • Procedure for DFM wireless connection to an Android device via Bluetooth using S6 BT Adapter added, as well as the flow meter configuration via the Android device using the Service S6 DUT-E (Android) mobile application. • New information screens added (resettable Counters of total fuel consumption and time of operation) for flow meters models with displays. • Feature of correcting the differential fuel consumption using the correction coefficients set by means of service software for specific modes of operation of DFM D added. • The flow meters model codes updated. • Detailed information on electromagnetic compatibility added. • Structure of external links for websites and documents added. • List of Telematics terminals compatible with DFM fuel flow meters updated. • Information on MK DFM mounting kits updated. • Document terminology updated (CAN j1939/S6 Telematics interface, S6 Technology and IoT Burger Technology).

Version	Date	Editor	Description of changes
7.1	11.2019	OD	• The list of output messages of DFM CAN fuel flow meters is updated; the data composition for PGN that are transmitted according to SAE j1939 and NMEA 2000 protocols is provided. • Information on Modbus RTU data transmission protocol for DFM 232/485 fuel flow meters with examples of Request/Response messages for data reading is added. • Minimal requirements for PC for work with Service S6 DFM service software are added. • The procedure for elimination of problems that arise sometimes in relation to running Service S6 DFM software in Windows 10 is described. • A Certificate of the Declaration of Conformity of DFM fuel flow meters to the RoHS Directive (Restriction of Hazardous Substances) is added.
8.0	06.2020	OD	• Improvement of design of differential DFM D models of flow meters (new casing cover made of polymer composite). • New functional capabilities of DFM CAN fuel flow meters during their operation according to S6 Technology: - Uniting up to 16 pcs. flow meters to form a network; - Application of single-chamber flow meters in pairs for operation in the “Differential”/“Summation” modes of measurement; - Summation of fuel consumption readings of up to 16 pcs. of flow meters using the Summator DFM Functional module. • The list of ouput messages and the data composition of DFM CAN fuel flow meters transmitted via CAN j1939/S6 interface are updated.
8.1	03.2021	OD	• List of output messages of the flow meters via CAN j1939/S6 interface is updated. • Two methods of DFM CAN connection to the PC using Service S6 DFM software (version from 2.05 and higher): - according to the specified network address; - by automatic search. • New functional features of DFM CAN fuel flow meters during their operation by means of S6 Technology: - uniting up to 240 pcs. flow meters into a single network; - joint use of up to 16 pairs of single-chamber flow meters in “Differential” / “Summation” modes of fuel consumption measurement. • Description of settings of connection to the external device via RS-232/RS-485 interfaces is added. • Special modification of DFM 100D HP flow meters with increased maximum fuel consumption is added. • Information on particularities of DFM mounting schemes in water and railway transport is added.

Version	Date	Editor	Description of changes
9.0	04.2022	OD	• Information on DFM S7 flow meter with wireless BLE interface which uses S7 Technology is added. • Data composition in messages from DFM S7 is updated. • Information on the flow meters configuration using Android device and Service S6 DFM (Android) (version 2.0) service mobile application is added. • Information on the flow meters configuration using Service S6 DFM (version 2.06) service software is updated. • Information on fuel flow meters with non-normalized pulse (DFM AP model) is added. • Information on the flow meters model codes is updated and added. • Tightening force values of thread connections during the flow meters mounting are indicated. • Recommendations for DFM 500 mounting procedures etc. are added.
9.1	09.2022	OD	• From DFM MK 20B/DFM MK 40B/DFM MK 45B mounting kits, NA 10-14 nipple adapter is excluded. • Information on "Service" mode for DFM S7 wireless flow meters for their firmware update using Fuel Rate Monitor mobile application is added.
10.0	09.2023	OD	• The flow meters' line of models, as well as their Model codes are updated; more information on the Product added. • New modifications with extra firm casings made of brass for single-chamber flow meters and for DFM 500HP differential flow meters with increased maximum consumption in measuring chambers are introduced. • Information on resetting clearable Counters of DFM ACAN/CCAN/DCAN flow meters by means of S6 Technology with the help of PGN 63080 command is added. • Changes in DFM COM protocol are made, notably, regarding ASCII data transfer in ASCII format for DFM 232 / DFM 485 flow meters with the version of firmware from 4.79 and higher. • Information on integration of readings from DFM S7 wireless flow meters into NMEA 2000 ship communication bus using MasterCAN S7 NMEA data converteris added. • The mounting schemes are updated, information on the flow meters' accessories is updated, etc.
10.1	05.2025	OD	• Support for the Fuel Rate Monitor mobile application has been discontinued for iOS devices.
10.2	11.2025	OD	• Clarifications have been introduced regarding the autonomous operating time of DFM S7 / DFM DS7 wireless flow meters powered by the built-in battery.

Version	Date	Editor	Description of changes
11.0	02.2026	OD	• A new size range of differential fuel flow meters in a reinforced brass housing has been introduced — DFM 900 D. • A configurable function for automatic CO_2 emissions calculation has been added to the Flowmeter FM. • A new Engine simulation FM has been introduced to emulate FMS messages transmitted by the standard engine control unit. • The list of output messages transmitted via the CAN j1939/S6 interface by DFM CAN flow meters has been updated. • The Modbus RTU register map for DFM 232/485 flow meters has been updated. • Wireless configuration of DFM using the S6 BT Adapter service adapter and the Service S6 DFM mobile app (Android) has been deprecated. • A procedure for remote connection to DFM CAN via CANUp 27 using a dedicated Server command has been introduced. • DFM model codes have been updated; product information has been revised, including: - DFM time synchronization using the Onboard Clock FM of CANUp 27; - a unified firmware for all DFM models; - updating the S6 Database of the Service S6 DFM service software via the Internet; - power-saving DFM firmware; - additions on installation, the DFM strainer (filter mesh), etc. • Certificates have been updated. • Information on flow meter accessories, etc.

Structure of external links



Terms and Definitions

IoT Burger is a Technology for creating smart sensors and complex real-time telematics IIoT devices with built-in analytics (hereinafter referred to as 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 processing 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 processing 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.

DFM fuel flow meters are designed using IoT Burger Technology.

S7 is a Technology for wireless data collection from autonomous sensors in transport and industrial Telematics systems. S7 Technology is recommended for use in facilities where wiring is impossible or hard to install.

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

S7 Technology provides ultra-low power consumption and a long period of independent operation for smart sensors and other IoT devices.

On the application level, S7 Technology is fully compatible with S6 Technology which uses cabling.

Advantages of S7 Technology:

- Simple design of data transmission protocol;
- Low power consumption, a potential for fully independent operation of sensors for several years;
- Option of data collection by several data recipients at one time.

DFM S7 fuel flow meters are designed using S7 Technology.

S6 is a Technology for integrating smart sensors and other IoT devices into a wired network for monitoring 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.

DFM CAN fuel flow meters are designed using S6 Technology.

Analytical report is a software tool of the UNUM IIoT Platform used for post-analysis of an Object based on Parameters, Counters, Events, and faults over a user-selected time period. Data in Reports can be presented as widgets such as lists, tables, and charts. Reports can be generated from data stored on the Server for the following periods: 1 day / 1 week / 1 month / last 3 months / custom (within the last 3 months).

CAN (Controller Area Network) is a serial digital bus-type communication interface compliant with the international standard ISO 11898-1:2003. Various higher-layer protocols can be used for data transmission over the CAN bus, including j1939, CANopen, DeviceNet, CAN Kingdom, etc. The CAN bus is used to integrate various electronic control units (ECUs), actuators, and sensors into a single network in the automotive industry or in industrial automation systems.

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.

Dashboards are UNUM IIoT Platform software tools intended for real-time monitoring of the Object's Parameters, Counters, Events, and faults. Data on Dashboards is visualized using various widgets such as gauges, charts, numeric indicators, lists, tables, and a map.

Event — relatively rare and sudden change in SPN. For example, applying the magnetic field to the fuel flow meter in order to falsify indications of the hourly fuel consumption is the "Interference" Event. An Event can have one or several characteristics. Thus, the "Interference" Event has the following characteristics: date/time and duration of the 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.

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

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

MODBUS RTU is an industrial communication protocol based on serial data transmission (RS-485/RS-232 interface). It is used for information exchange using the "master–slave" method between electronic devices in automation and monitoring systems.

Model code refers to digits indicating the product version. The model code of a fuel flow meter is determined by the first two characters of the serial number (for DFM B/C/CD/AP/AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN) or by the third and fourth characters (for DFM S7/DS7). The serial number is marked on the measuring chamber housing or on the packaging label. The functional capabilities of the flow meter differ depending on its Model code.

NMEA 2000 — is a high-level network protocol, which is defined by international standard of marine electronic equipment NMEA 2000 Standard. The NMEA 2000 protocol makes it possible to integrate multiple onboard marine instruments into a single network for data exchange. NMEA 2000 is based on data transfer protocol, which is used in CANbus.

Onboard equipment (OE) refers to UNUM IIoT Platform components installed directly on board the monitored Object.

Onboard reports (Reports) are a UNUM IIoT Platform software tool used to analyze the operation of an Object based on Parameters, Counters, Events, and faults over a user-selected time period. Data in Reports can be presented as widgets such as lists, tables, and charts.

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.
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.
Post-analysis is the analysis of an Object's operation performed by the user based on Reports for a selected time period.
Server (AVL Server) is a hardware and software system of the telematics service intended for processing and storing Operational data, and for generating and delivering Analytical reports to users via the Internet upon request.
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 is an integrated solution for real-time monitoring of monitored Objects and post-analysis of their operation. It includes onboard equipment, communication channels, and a telematics server.
Telematics terminal (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.
Unit is an element of vehicle on-board equipment compatible with S6 bus, which uses S6 Technology or S7 Technology.
UNUM IIoT Platform UNUM IIoT Platform is an Industrial Internet of Things (IIoT) platform intended for the development and subsequent operation of telematics services for Complex Machines across various industries (power generation, land, water and rail transport, agriculture, mining, etc.). It uses a specialized set of tools, including a standardized Parameter Database, data design and transmission technologies, IIoT onboard equipment, cloud software, and service hardware and software.
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.

Information regarding the change in the usage policy of mobile applications for monitoring readings from wireless S7 Technology Units

As of **April 1, 2024, the subscription fee** for all Technoton mobile applications **has been abolished**:

- Fuel Tanks Monitor
- Fuel Rate Monitor
- Axle Load Monitor

All these applications are available for **free** installation on your mobile devices and full use of their features.

Any information related to the subscription fees for mobile applications provided in this document below is now outdated.

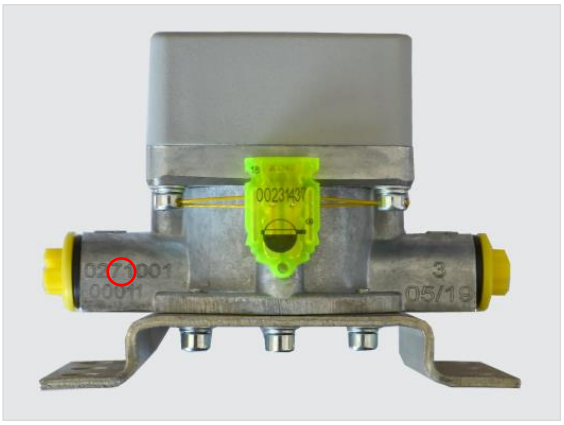
Introduction

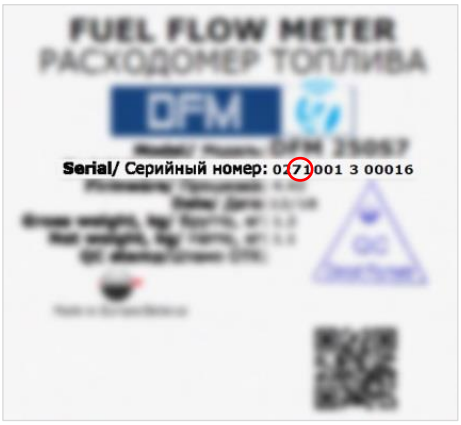
The Operation manual contains guidelines and rules which refer to **DFM fuel flow meters** (hereinafter DFM), developed by Technoton company, Models codes:

- **02/06/07/11/12/16/80** — for DFM 50C/100B/100C/250B/250C/500C/500HP C;
- **20/B4/21/C0/22/86/39** — for DFM 100CD/100HP CD/250CD/250HP CD/500CD/500HP CD/900CD;
- **03/04/05/08/09/10/13/14/17/18/19** — for DFM 50AK/50CK/90AP/100AK/100CK/ 220AP/250AK/250CK/500AK/500CK/500HP CK;
- **23/24/25/82/A1** — for DFM 100DK/250DK/500DK/500HP DK/900DK;
- **40/41/42/43/44/45/46/47/48** — for DFM 50A232/50C232/100A232/100C232/ 250A232/250C232/500A232/500C232/500HP C232;
- **26/27/28/83/A2** — for DFM 100D232/250D232/500D232/500HP D232/900D232;
- **50/51/52/53/54/55/56/57/58** — for DFM 50A485/50C485/100A485/100C485/ 250A485/250C485/500A485/500C485/500HP C485;
- **29/30/31/84/A3** — for DFM 100D485/250D485/500D485/500HP D485/900D485;
- **60/61/62/63/64/65/66/67/68** — for DFM 50ACAN/50CCAN/100ACAN/100CCAN/ 250ACAN/250CCAN/500ACAN/500CCAN/500HP CCAN;
- **32/33/34/85/A4** — for DFM 100DCAN/250DCAN/500DCAN/500HP DCAN/900DCAN;
- **70/71/72/73/75** — for DFM 50S7/100S7/250S7/500S7/500HP S7;
- **35/74/36/76/37/81/38** — for DFM 100DS7/100HP DS7/250DS7/250HP DS7/ 500DS7/500HP DS7/900DS7.

The model code for DFM B/C/CD/AP/AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/ D485/DCAN is determined by the first two characters of its serial number marked on the measuring chamber housing or on the packaging label:

The model code for DFM S7/DS7 is determined by the third and fourth characters of its serial number marked on the measuring chamber housing or on the packaging label:





The manual contains information on design, operation principle, specifications and instructions on installation, use and maintenance of DFM. Besides, this document defines the procedure for configuration of flow meters.

— Accurate instruments for measuring fuel consumption in water transport, locomotives, diesel generators, liquid-fuel boilers and burners, and mining equipment. They can be used as part of Telematics systems or as standalone devices.

DFM features:

- compatibility with Units, Database and cabling system S6 Technology[1];
- IoT Burger Technology provides internal data processing (Parameter filtration and normalization, Events logging, Counters recording) for easier server operation and data traffic saving;
- recording real fuel consumption and operation time of fuel consumer – total and in different consumption modes: "Idle", "Optimal", "Overload", "Tampering" and "Interference";
- conformity to the Rules of American Bureau of Shipping;
- maximum information richness of output data and high reliability of data transmission over S6 Technology[1];
- unique self-diagnostics feature to monitor the stability and accuracy of data[1];
- thermal correction function with adjustable coefficient which ensures automatic correction of values to the ambient temperature[2];
- setting the boundaries of operation modes for hourly consumption[2];
- feature of fuel consumption correction in accordance with modes of engine operation using correction coefficients ensures enhanced reliability of indications[3];
- summation of fuel consumption readings of up to 16 pcs. fuel flow meters[4];
- uniting up to 240 flow meters into a single network based on S6 Technology[5];
- employment of single-chamber flow meters in pairs by means of S6 Technology (up to 16 pairs within a single network) without mutual calibration of each pair for differential measurement or summation of fuel consumption indications[5];
- configurable function for automatic calculation of the engine's total and hourly CO_2 emissions[6];
- function for outputting data that simulates FMS messages from the standard engine control unit[7];
- ability to configure the flow meter remotely via the CANUp 27 telematics gateway using a dedicated Server command[7];
- wireless transmission of data using S7 Technology via Bluetooth Low Energy channel simultaneously to many receiving devices (Android smartphones/tablets, the Telematics terminal, the display in the driver's cabin)[8];
- operation in the «advertising» mode (BLE-radio) — continuous transmission of measurement results, with no need of integration with receiving devices[8];
- ultra-low power consumption ensures autonomous operation of the flow meter for up to 5 years from the built-in battery, without using any external power sources[8];
- convenient monitoring readings of the flow meter mounted in a remote location of a fuel system with difficult access to it[8];
- quick installation without laying the signal cable; no electric connection of the flow meter is required[8];

- explosion and fire safety without additional modules of spark protection[8];
- enhanced resistance to vandalism[8];
- integration of the flow meters' readings (up to 2 pcs.) into NMEA 2000 ship communication bus by using S7 Technology with the help of MasterCAN S7 NMEA data converter, with an option of calculating differential fuel consumption in the two fuel lines[8];
- protection against unauthorized interference in operation and data "tampering";
- resettable Counters of liquid consumption and operation time of flow meter;
- embedded battery allows data (Counters, Events) storage in the internal non-volatile memory of flow meter when external power supply is switched off;
- accuracy of measurement is not decreasing when flow meter is operated in tough operation conditions, shaking and vibrations;
- minimum fluid flow resistance;
- built-in strainer (filter mesh) for trapping large mechanical particles that may enter the fuel and interfere with the flow meter operation;
- 100 % of DFM are calibrated with a certified metrological test rig;
- casing cover which is made of polymer composite material[9] ensures: the enhancement of the flow meter endurance towards mechanical loads, the improvement of electrical insulation and protection from inside condensation, lower weight;
- extra firm casing made of brass provides reliable protection for the flow meter from corrosion and mechanical impact, when used in water transport and hard service conditions[10];
- unified firmware for all flow meter models;
- updating the Service S6 DFM service software via the Internet from the S6 Database;
- elaborate and high-quality elements for installation;
- conformity with European and national standards and directives;
- rich experience accumulated during the period of its use, high-quality technical support and documentation.

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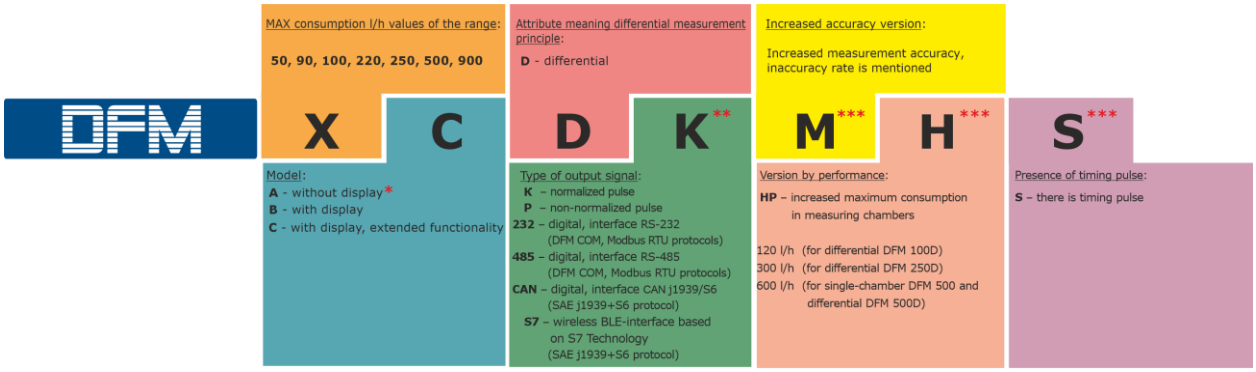
[1] For DFM CAN models.
[2] For all DFM models with an interface cable, except DFM AP.
[3] For flow meters with firmware version 4.55 or later, when using Service S6 DFM software version 1.24 or later.
[4] For DFM CAN with firmware version 4.63 or later, when using Service S6 DFM software version 1.27 or later.
[5] For DFM CAN with firmware version 4.69 or later, when using Service S6 DFM software version 2.05 or later.
[6] For DFM with an interface cable (except DFM AP) with firmware version 4.84 or later, when using Service S6 DFM software version 4.04 or later.
[7] For DFM CAN with firmware version 4.84 or later, when using Service S6 DFM software version 4.04 or later.
[8] For wireless flow meters DFM S7 / DFM DS7.
[9] For all differential fuel flow meters DFM D manufactured from 1 October 2019.
[10] Applicable only to flow meters with increased maximum flow rate DFM 500HP and to all DFM 900 D models.

See figure 1 for identification codes for DFM ordering.



* **A** symbol is not specified in the **C** designation for differential fuel flow meters.
** For autonomous models **K** designation is not used.
*** This designation is delivered upon special order.
M designation is valid only for single-chamber models, except DFM AP.
S designation timing pulse is present. The standard version – without the timing pulse (no designation).

Figure 1 — DFM order identification codes

Example of DFM order identification codes:

"Fuel flow meter DFM 100B",
(max. flow rate 100 l/h, model - autonomous with display).

"Fuel flow meter DFM 220AP",
(max. flow rate 220 l/h, model - without display, with output non-normalized pulse).

"Fuel flow meter DFM 250AK, 0.5 %",
(max. flow rate 250 l/h, model - without display, with output normalized pulse, increased measurement accuracy, inaccuracy is ±0.5%).

"Fuel flow meter DFM 500HP DK",
(max. flow rate 600 l/h, model - differential, higher maximum consumption rate, with output normalized pulse).

"Fuel flow meter DFM 500CD",
(max. flow rate 500 l/h, model - differential autonomous with display).

"Fuel flow meter DFM 500CCAN",
(max. flow rate 500 l/h, model - with display, output interface — CAN j1939/S6).

"Fuel flow meter DFM 100S7",
(wireless S7 interface, max. flow rate 100 l/h).

"Fuel flow meter DFM 250S7 0,5 %",
(wireless S7 interface, max. flow rate 250 l/h, increased measurement accuracy, inaccuracy is ±0.5%).

"Fuel flow meter DFM 900 DS7",
(wireless S7 interface, max. flow rate 900 l/h, differential).

IMPORTANT: All differential fuel flow meters **DFM 900D**, as well as all **DFM 500HP** flow meters with an increased maximum flow rate, are **manufactured with measuring chambers in a special housing made of a corrosion-resistant, high-strength material—brass**. These flow meters are recommended for use in water transport and in high-power machinery operating under harsh conditions.

For DFM with interface cable configuration (DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN models) a service adapter S6 SK (purchased separately) is used and software **Service S6 DFM** (you can download and/or update your software at https://www.jv-technoton.com/, in Software/Firmware category).

For presentation of indications of DFM S7 fuel flow meters that operate using S7 Technology on the display of a smartphone/tablet (Android platform), **Fuel Rate Monitor** mobile application is used (see User manual). A user can download the application from Google Play (search request "Technoton Engineering").

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

The Manufacturer guarantees DFM 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 DFM specifications that do not lead to a deterioration of the consumer qualities without prior customer notice.

1 DFM general information and technical specifications

1.1 Purpose of use and application area

1.1.1 Fuel flow meters with interface cables and independently operating flow meters

DFM B/C/CD/AP/AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN **fuel flow meters are designed for** (see figure 2):

- fuel consumption measurement in fuel lines of engines of Vehicles and stationary units;
- monitoring operation time of fuel consumer.

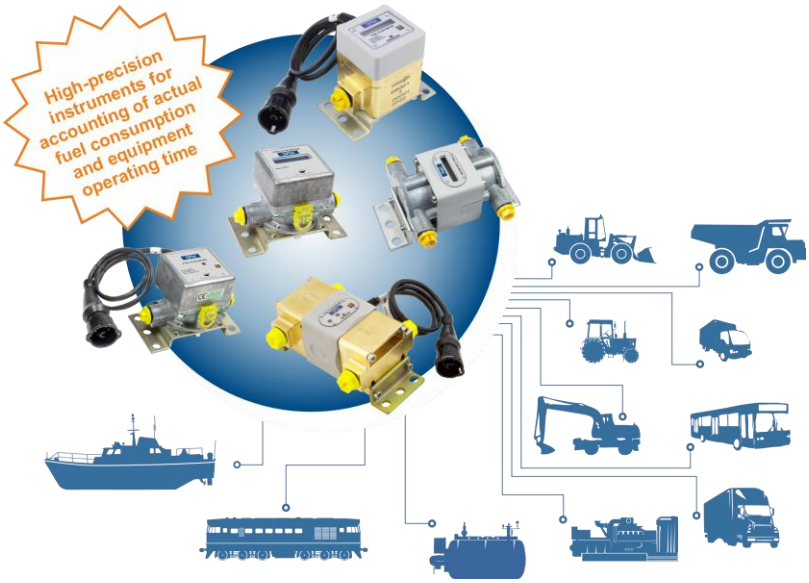
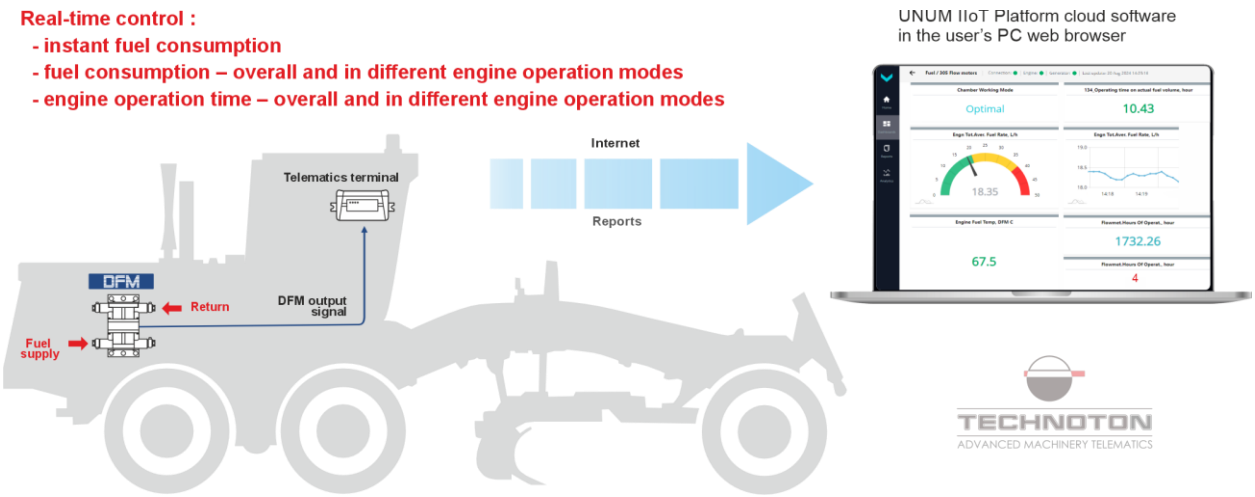


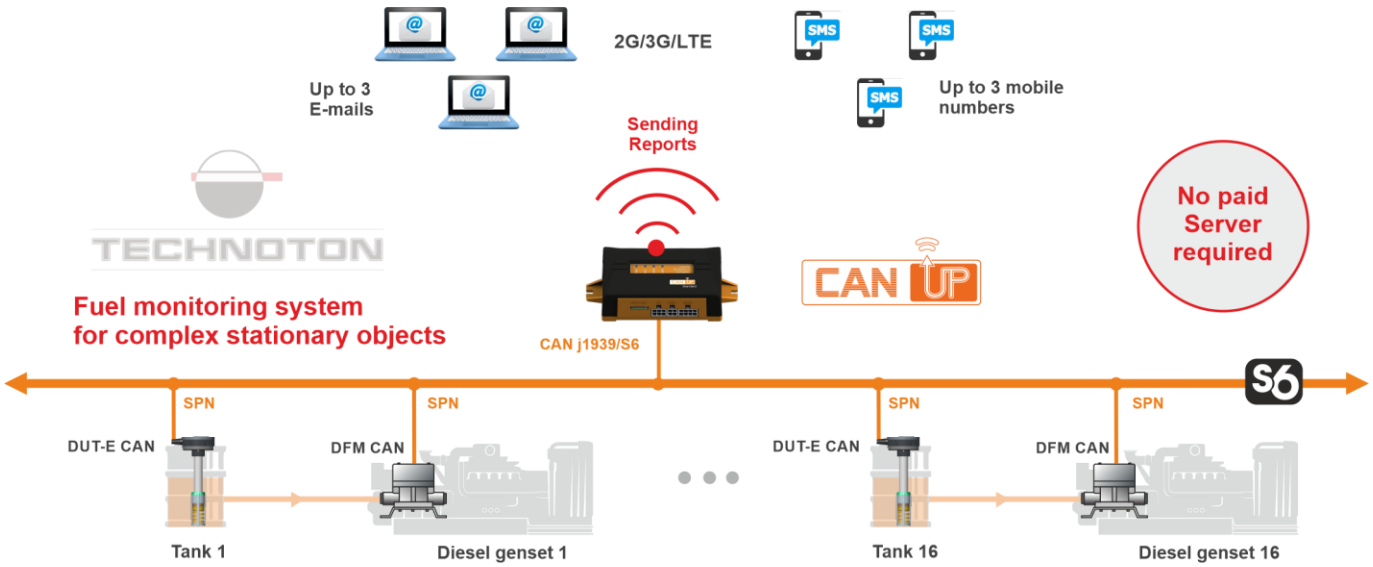
Figure 2 — Purpose of DFM fuel flow meters

Application areas (see figure 3):

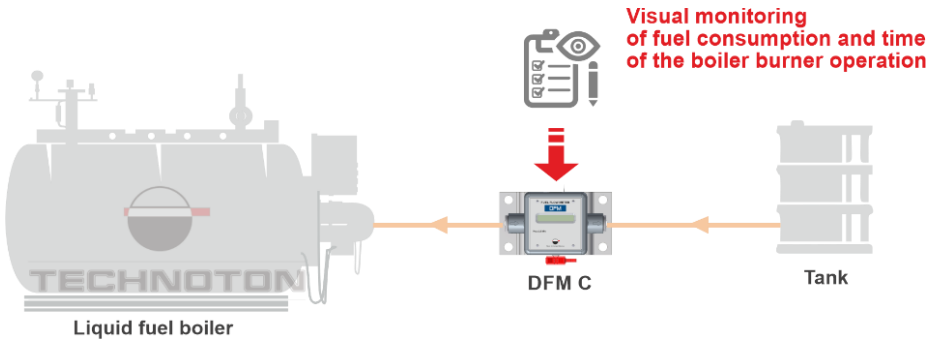
1) DFM fuel flow meters can be employed within the Telematics system on vehicles and tractors and on mobile/fixed equipment, including sophisticated equipment (locomotives, sea and river vessels, diesel generators, boiler equipment etc.).



a) example of DFM D employment as component of the Telematics system on Vehicles and tractors



b) example of using DFM CAN as part of Telematics system of a complex stationary object



c) example of autonomous DFM C operation

Figure 3 — Application areas of DFM fuel flow meters

DFM installed into a fuel line of fuel consumer, measures hourly (instant) fuel consumption and generates output signal, which is sent to Telematics unit (see figure 3 a).

The terminal collects, records, and stores the received signals and transmits them via the Internet to a telematics service (for example, based on the UNUM IIoT Platform).
UNUM IIoT Platform cloud software tools (Dashboards and Analytical reports) allow users to conveniently monitor actual fuel consumption and engine operating time in an Internet browser (see figure 4).

DFM with pulse output interface provide data on actual fuel consumption of engine (overall fuel consumption and average instant fuel consumption).

DFM with digital interfaces provide real-time control over extended set of information:

- instant fuel consumption;
- differential/summary fuel consumption in two fuel lines;
- engine operation time – overall and in different engine operation modes;
- fuel consumption – overall and in different engine operation modes;
- voltage in on-board power network;
- total operation time of flow meter and duration of power-supply from embedded battery;
- flow meter's malfunctions;
- evidence of interference to flow meter's operation.

The CAN j1939/S6 interface makes it possible to connect via S6 Technology, to one CAN input of the Terminal (for example, a CANUp 27 telematics gateway) within a single network, up to 240 DFM CAN* flow meters together with DUT-E CAN / DUT-E 2Bio fuel level sensors (up to 16 units).

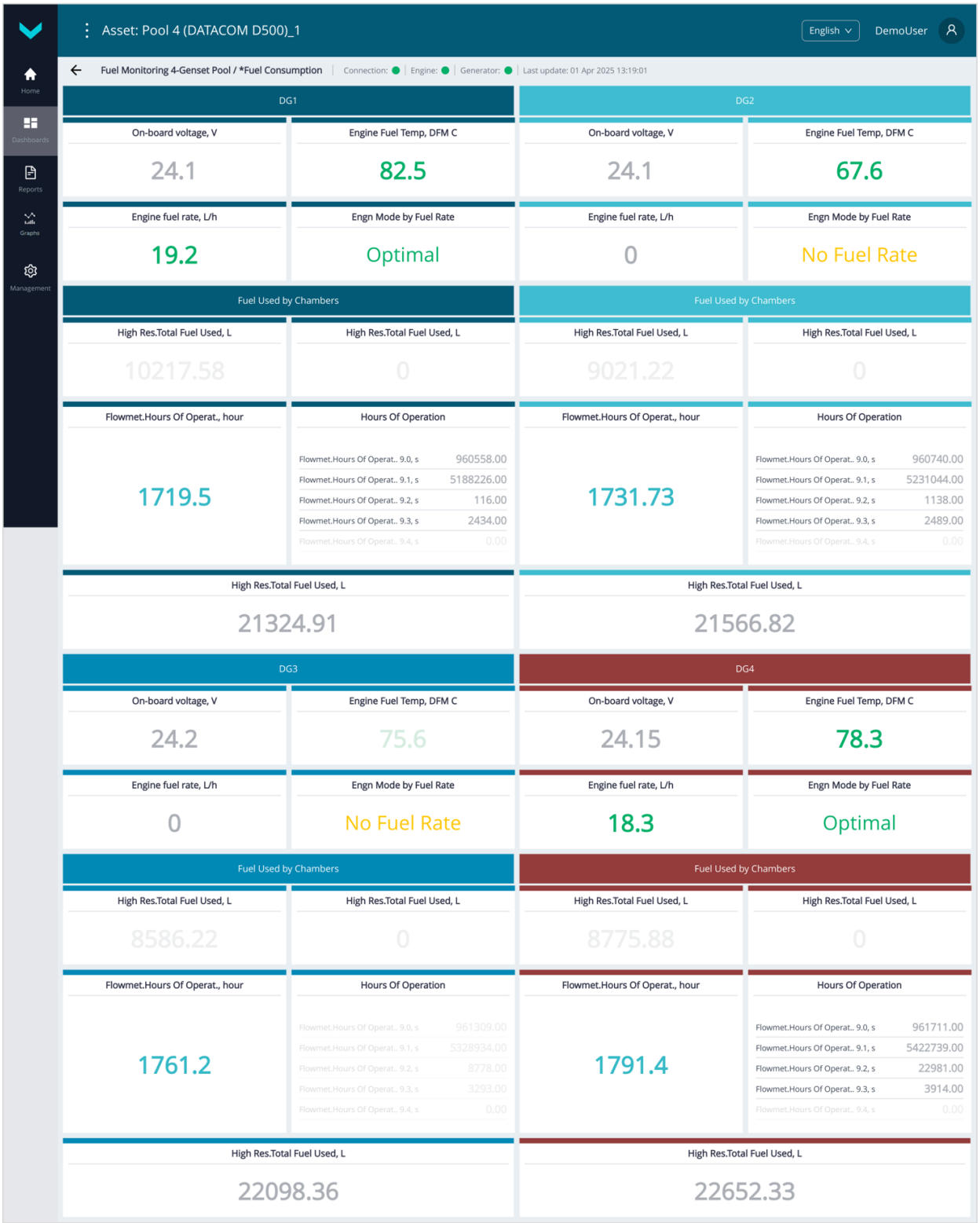
2) DFM fuel flow meters can be used autonomously (for example, in fuel oil boilers and burners).

When using **autonomous DFM** fuel consumption and vehicle operating time data (overall and in different engine operation modes) is displayed on the built-in LCD display (see figure 3 c).

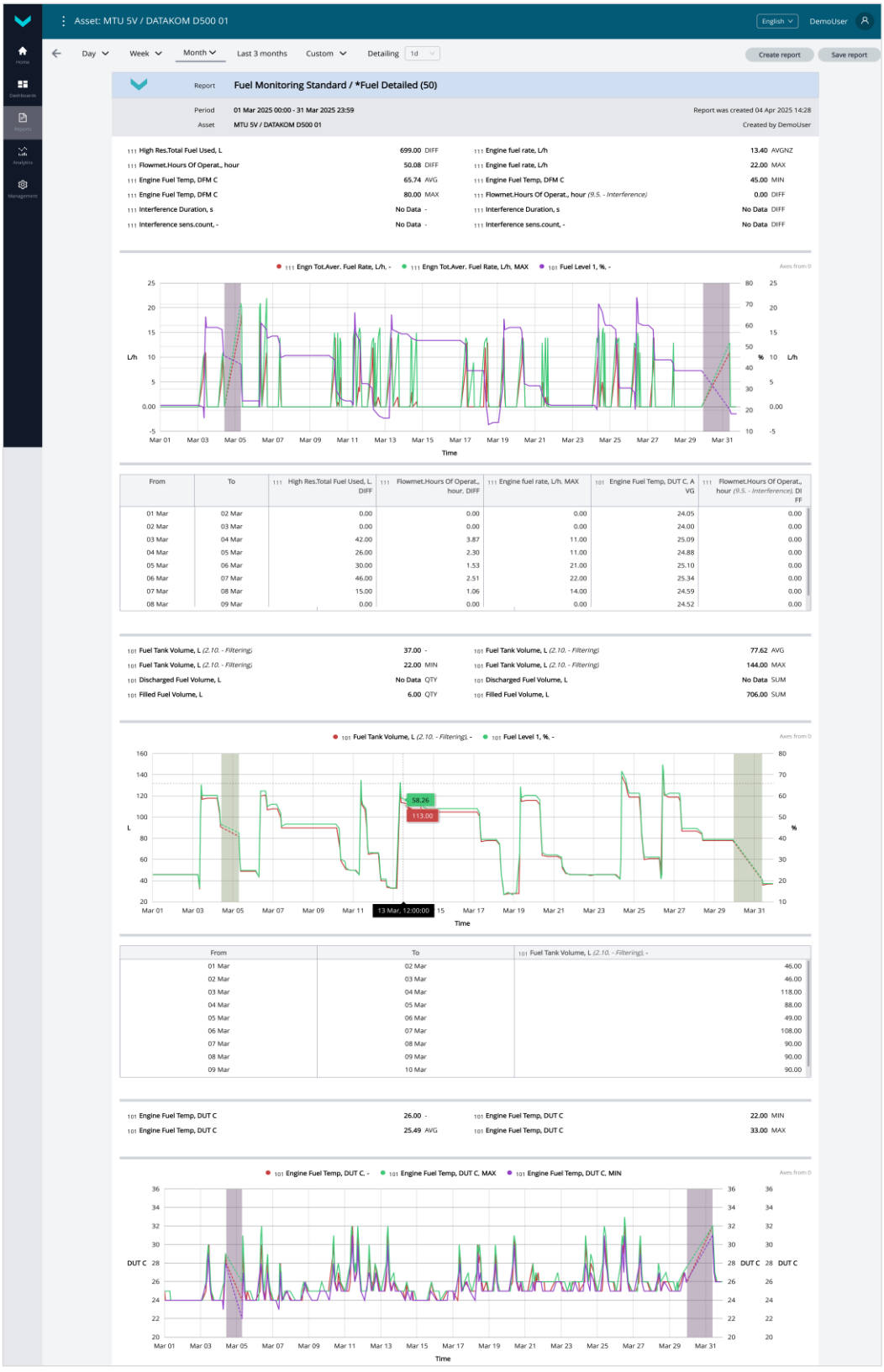
The use of DFM fuel flow meters makes it possible to effectively solve the following tasks:

- account of actual fuel consumption;
- account of actual equipment operation time;
- rate setting and optimization of fuel consumption;
- detection and prevention of fuel theft;
- testing fuel consumption by power units.

* For DFM CAN with the firmware version not lower than 4.69, in case of using Service S6 DFM software, version from 2.05 and higher.



a) Dashboard displaying real-time detailed information on fuel consumption and operating time of a pool of four diesel generators



b) [Analytical report](#) on detailed fuel consumption and engine operating time of a diesel generator for the "one month" period

Figure 4 — Examples of displaying information obtained in a telematics system based on the [UNUM IIoT Platform](#) using data from DFM CAN

1.1.2 Wireless fuel flow meters

DFM S7/DS7 **wireless fuel flow meters are designed for** (see figure 5):

- fuel consumption measurement in fuel lines of engines of Vehicles and stationary units;
- monitoring operation time of fuel consumer;
- wireless data transfer by means of S7 Technology.

Operating principle: DFM S7 wireless fuel flow meter has an inbuilt Bluetooth Low Energy module (BLE-module) which, due to a special data transmission algorithm, enables the flow meter operation with ultra-low power consumption. The BLE-module transmitter switches on automatically once in 5 s to transmit the current indications. This operating mode allows the flow meter to function completely autonomously for up to 5 years, without using any external power sources, powered solely by the built-in battery.
Data from DFM S7 can be received at a distance of up to 45 meters by unlimited number of various receiving devices (Telematics units, smartphones/tablets etc.), which are equipped with Bluetooth 4.X module.

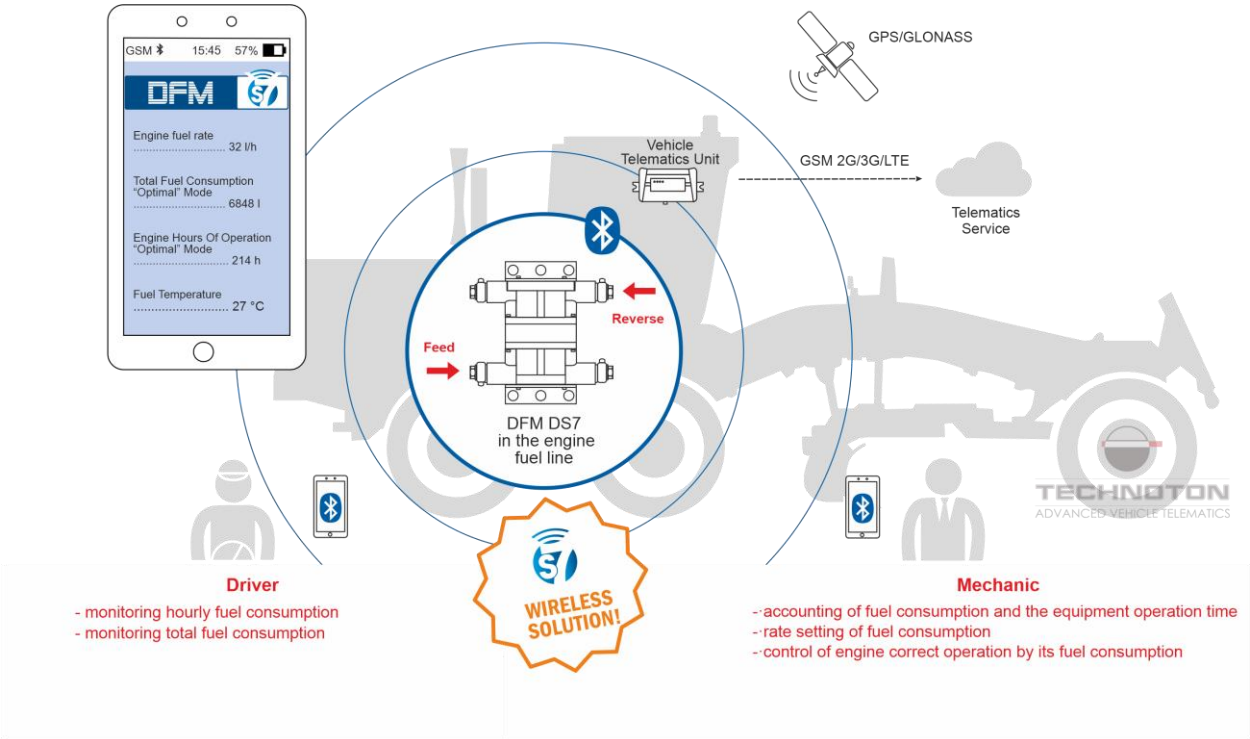
Figure 5 — Purpose of DFM S7 fuel flow meters

Application areas:
DFM S7 wireless flow meters are mounted in the fuel line of the engine (fuel consumer) for monitoring fuel consumption and time of operation independently and/or as part of the Telematics system (including that without using services of the Server):

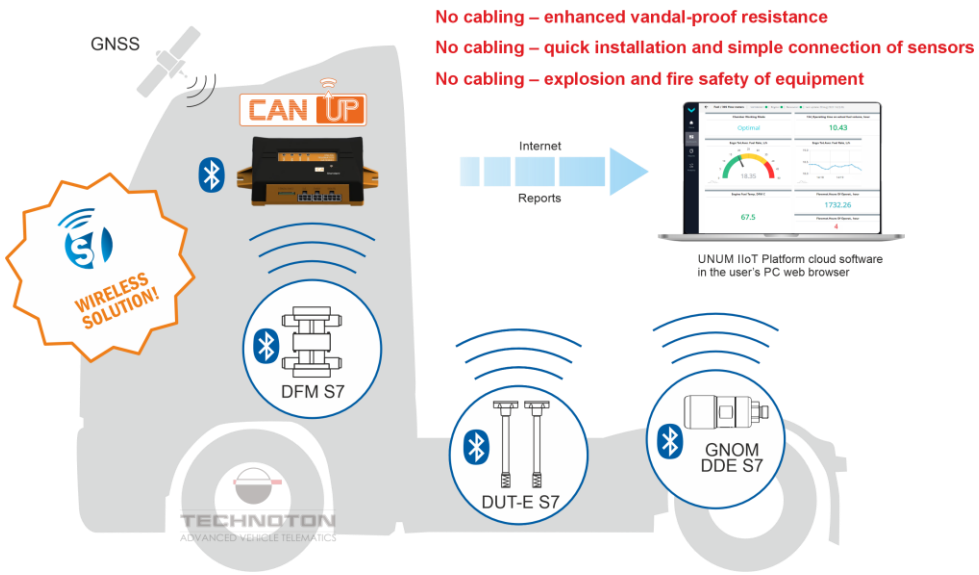
- on all types of vehicles and tractors (see figure 6 a, b);
- on different fixed objects (diesel generator sets, boiler equipment etc.) (see figure 6 c).
- in water transport (see figure 6 d);

Due to the availability of the inbuilt BLE-module, up to 10 pcs. of wireless Units (e.g. DFM S7 fuel flow meters together with DUT-E S7 fuel level sensors) may operate together at the same time by means of S7 Technology with CANUp 27 Pro Telematics gateway (see figure 6 b). In accordance with its settings, the gateway generates and transmits Onboard reports to the Telematics Server or directly to the user, without using the services of the Server (by e-mail or in the form of SMS messages). The Onboard reports contain important performance Parameters of the equipment (e.g. instant and trip fuel consumption, total fuel consumption, RPMs, fuel level, engine operation time, engine temperature, oil pressure and level and other parameters). Server software processes and analyzes the received data to generate Analytical reports for a selected period.

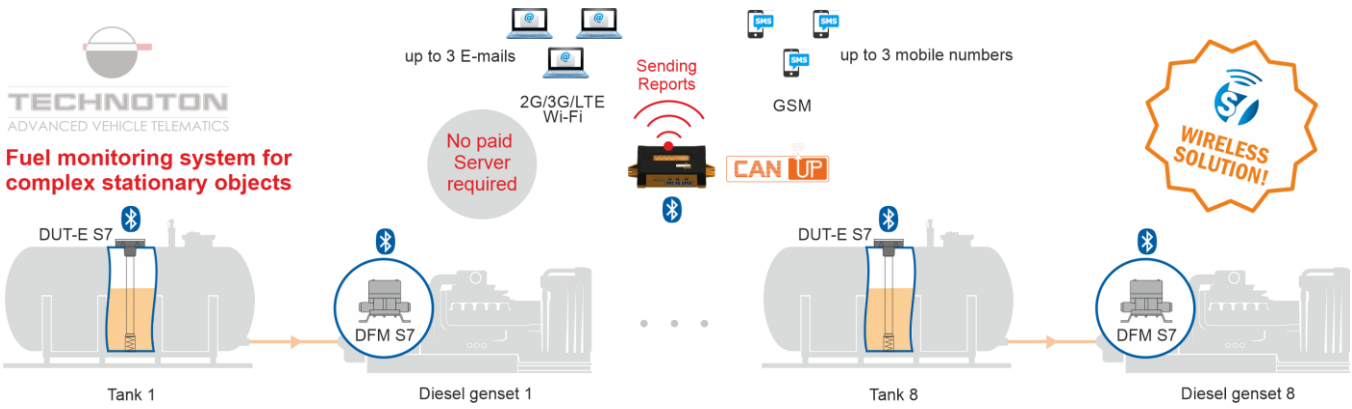
Wireless fuel flow meters can be used as components of water transport Telematics systems in combination with MasterCAN S7 NMEA data converter connected to NMEA 2000 ship data bus (see figure 6 d). MasterCAN S7 NMEA has the inbuilt BLE module which receives signals from DFM S7 / DFM Marine S7 fuel flow meters by means of S7 Technology in the non-stop mode within the range of 50 m. The converter automatically processes signals received from flow meters selected by the user (up to 2 pcs., when it operates together with the differential pair) and converts them into data (PGN), according to NMEA protocol. The converted useful data (fuel consumption and fuel temperature, consumer operation time) can be transferred to the Telematics terminal and/or to data display in the ship wheel house.



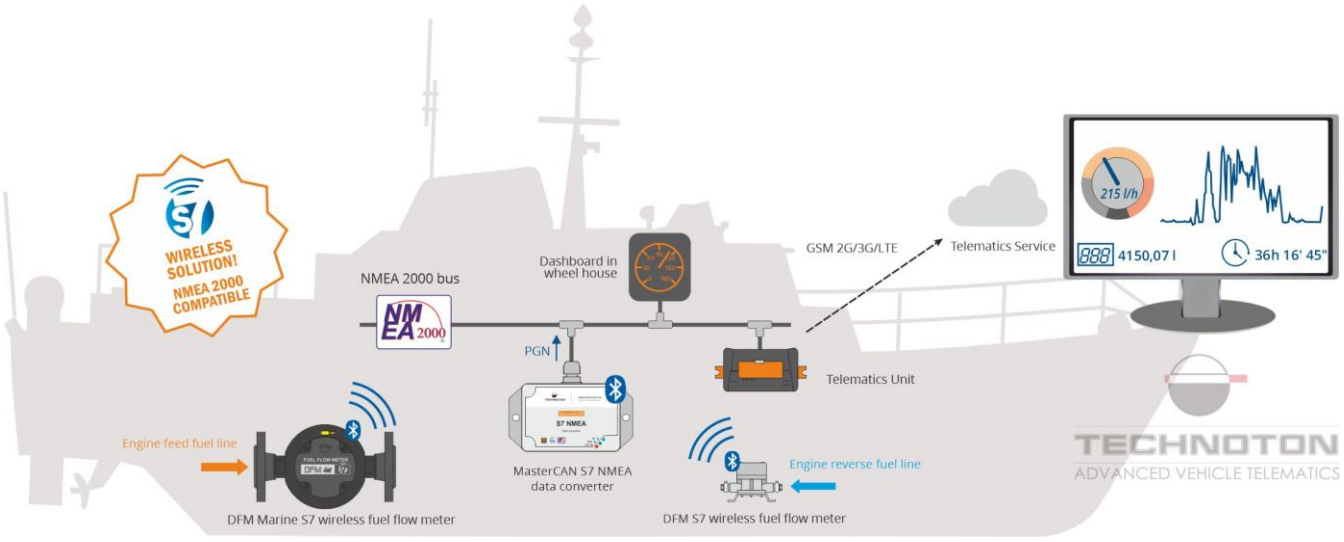
a) wireless monitoring of fuel consumption and the time of Vehicles and tractors operation



b) wireless monitoring of Vehicle operation parameters by means of S7 Technology



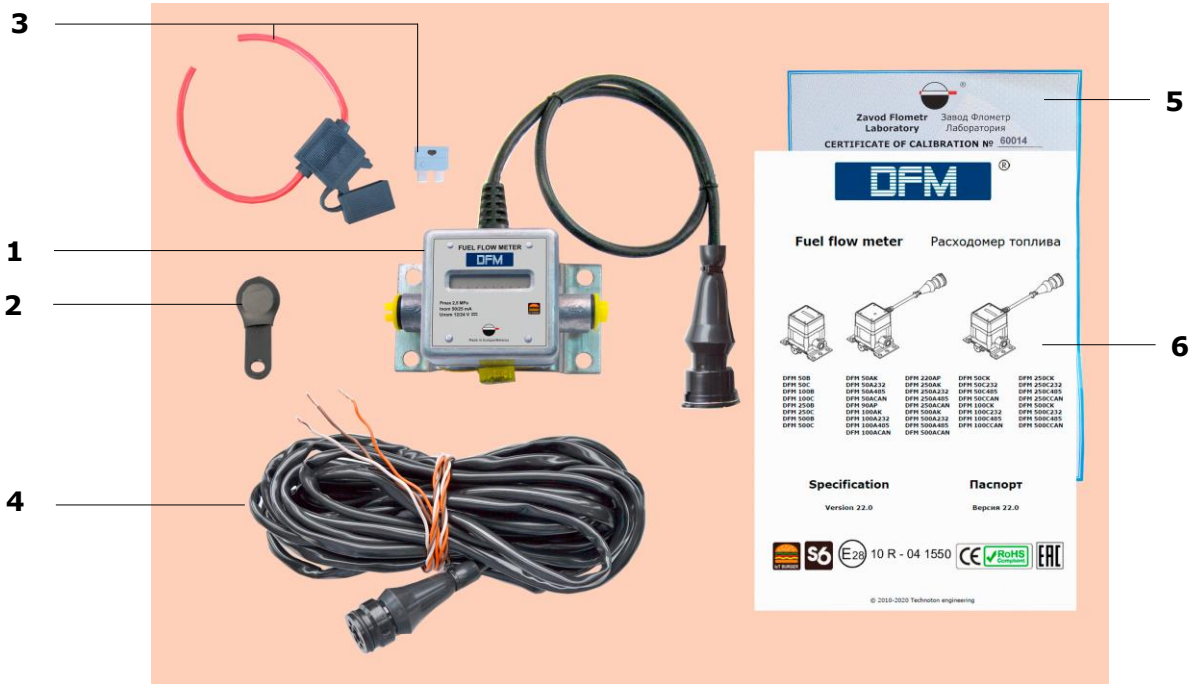
c) wireless monitoring of fuel consumption and operation time of fixed units by means of S7 Technology



d) wireless monitoring fuel consumption and the ship engine operation time

Figure 6 — Examples of areas of application for DFM S7

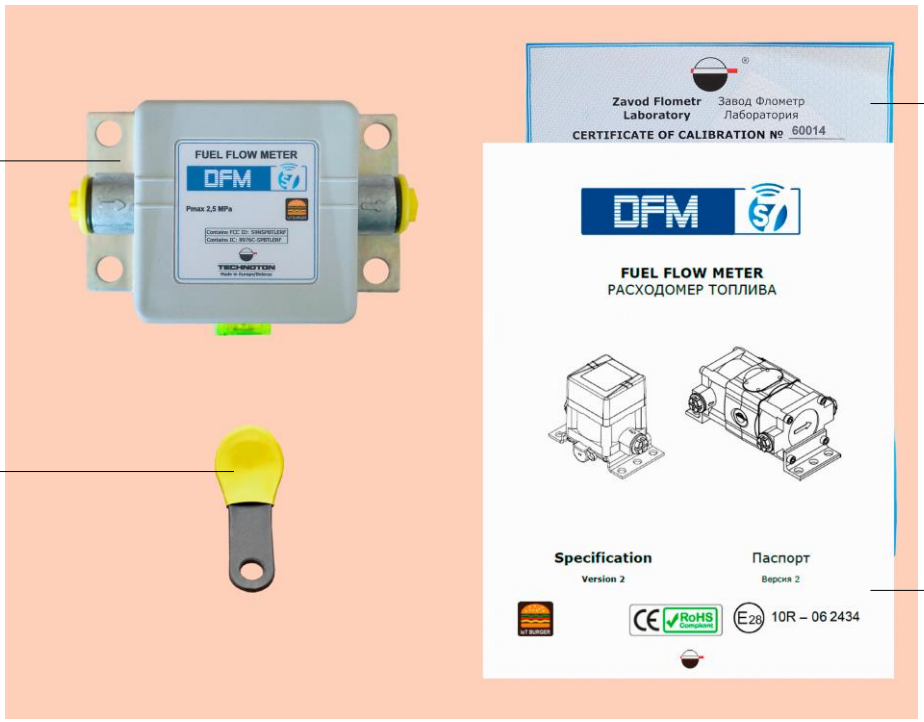
1.2 Exterior view and delivery set



1	DFM fuel flow meter	– 1 pc;
2	Magnetic key*	– 1 pc;
3	Fuse with holder (2 A)**	– 1 pc;
4	Signal cable (7.5 m)***	– 1 pc;
5	Calibration certificate	– 1 pc;
6	Specification	– 1 pc.

Figure 7 — DFM delivery set

* For DFM meters with built-in display.
** Not applicable for autonomous DFM fuel flow meters.
*** Only for DFM meters with pulse interface output.



1 DFM S7 fuel flow meter – 1 pc;
2 Magnetic key – 1 pc;
3 Specification – 1 pc;
4 Calibration certificate – 1 pc.

Figure 8 — DFM S7 delivery set

1.3 DFM models

DFM fuel flow meters are represented by the following **models**:

1) One-chamber — measure volume of fuel passing through engine supply fuel line.
The following **models of one-chamber meters** are produced:

- autonomous fuel flow meters with display (see 1.3.1);
- fuel flow meters with display and interface cable (see 1.3.2):
  - with pulse output (normalized pulse);
  - with digital output interfaces (CAN j1939/S6 / RS-232 / RS-485);
- fuel flow meters with output interface cable (see 1.3.3):
  - with pulse output (non-normalized pulse / normalized pulse);
  - with digital output interfaces (CAN j1939/S6 / RS-232 / RS-485).
- wireless fuel flow meters (Bluetooth 4.X Low Energy) (see 1.3.4).

2) Dual-chamber (bidirectional or differential) fuel flow meters measure fuel consumption as the difference in volume of fuel flowing through the feed and reverse fuel lines.
The following **models of dual-chamber meters** are produced:

- differential fuel flow meters with interface cable (see 1.3.5):
  - with pulse output (normalized pulse);
  - with digital output interfaces (CAN j1939/S6 / RS-232 / RS-485);
- differential autonomous fuel flow meters with display (see 1.3.6).
- wireless differential fuel flow meters (Bluetooth 4.X Low Energy) (see 1.3.7).

1.3.1 Autonomous fuel flow meters with display

Autonomous fuel flow meters with display (**DFM B/C** models) — are used in organizing fuel consumption monitoring system which does not need additional hardware or software (see figure 9).

Figure 9 — External view of an autonomous-type fuel flow meter with a display

Fuel consumption and vehicle operating time data is displayed on the built-in LCD display. Monitoring and recording is to be performed visually, copying out the data into a fuel timesheet, by a responsible person.

1.3.2 Fuel flow meters with display and interface cable

One-chamber fuel flow meters with display and interface cable (**DFM CK/C232/C485/CCAN** models) (see figure 10) can operate both as standalone devices and as part of a Telematics system.

Note — Type of output signal of a fuel flow meter with a display is specified on the label of its interface cable.

a) modification in the standard casing

b) modification in the extra firm casing made of brass (only for DFM 500HP CK/C232/C485/CCAN)

Figure 10 — External view of a fuel flow meter with a display and an interface cable

Fuel consumption and vehicle operating time data is displayed on the built-in LCD display. Fuel consumption data is sent to the pulse output as well (**DFM CK**).
CAN j1939/S6 (**DFM CCAN**), RS-232 (**DFM C232**), RS-485 (**DFM C485**) digital interfaces contain fuel consumption data together with Counters values, data on engine operation modes, flow meter Parameters and malfunctions, Events.

1.3.3 Fuel flow meters with interface cable

One-chamber fuel flow meters with interface cable (**DFM AP/AK/A232/A485/ACAN** models) (see figure 11) are designed to measure fuel consumption within the Telematics system.

Note — Type of output signal of the fuel flow meter is specified on the label of its interface cable.

a) DFM AP models *b) DFM AK/A232/A485/ACAN models*

Figure 11 — External view of a fuel flow meter with an interface cable

Fuel consumption data is sent to the pulse output (**DFM AP** and **DFM AK**). CAN j1939/S6 (**DFM ACAN**), RS-232 (**DFM A232**), RS-485 (**DFM A485**) digital interfaces contain fuel consumption data together with Counters values, data on engine operation modes, flow meter Parameters and malfunctions, Events.
These models do not have display but have a LED indicator. Flashing light signal indicates the correct operation of the flow meter measuring chamber.

1.3.4 Wireless fuel flow meters

Wireless fuel flow meters (**DFM S7** models) (see figure 12) are used to measure fuel consumption both as standalone devices and as part of a Telematics system.

Figure 12 — External view of wireless fuel flow meters

The flow meter continuously transmits readings of fuel consumption, data from Counters, information on Events, modes of engine operation, Parameters and on the flow meter malfunctions in the "advertising" mode (BLE-radio). Data can be received using S7 Technology by any device within BLE range of the flow meter.

.

1.3.5 Differential fuel flow meters with interface cable

Dual-chamber differential fuel flow meters with interface cable (**DFM DK/D232/D485/DCAN** models) (see figure 13) are designed for employment within the Telematics system. They are installed on automotive and agricultural machinery or stationary units with modern diesel engines equipped with Common Rail fuel injection systems or unit injectors.

Note — Type of output signal of the differential fuel flow meter is specified on the label of its interface cable.

a) modification in the standard casing

b) modification in the extra firm casing made of brass (only for DFM 500HP and DFM 900 DK/D232/D485/DCAN)

Figure 13 — External view of a differential fuel flow meter with an interface cable

Two LED indicators are located on the top of the housing cover of differential flow meters to indicate operation of the feed measuring chamber (**F** — green) and the reverse measuring chamber (**R** — red). A flashing signal from each of these indicators indicates proper operation of the corresponding measuring chamber.

Flashing light signal indicates the correct operation of each of the measuring chambers.

Differential meters calculate fuel consumption as the difference in volume of fuel flowing through the feed and reverse fuel lines. Data is sent out via pulse output interface (**DFM DK**).
CAN j1939/S6 (**DFM DCAN**), RS-232 (**DFM D232**), RS-485 (**DFM D485**) digital interfaces contain fuel consumption data together with Counters values, data on engine operation modes, flow meter settings Parameters and malfunctions, Events.

1.3.6 Differential autonomous fuel flow meters with display

Differential autonomous DFM D **fuel flow meters with display** (**DFM CD** models) (see figure 14) are used in organizing fuel consumption monitoring system which does not need additional hardware or software. They are installed on automotive and agricultural machinery or stationary units with modern diesel engines equipped with Common Rail fuel injection systems or unit injectors.

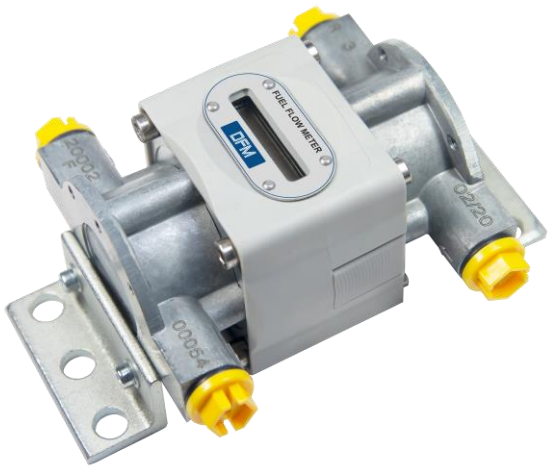
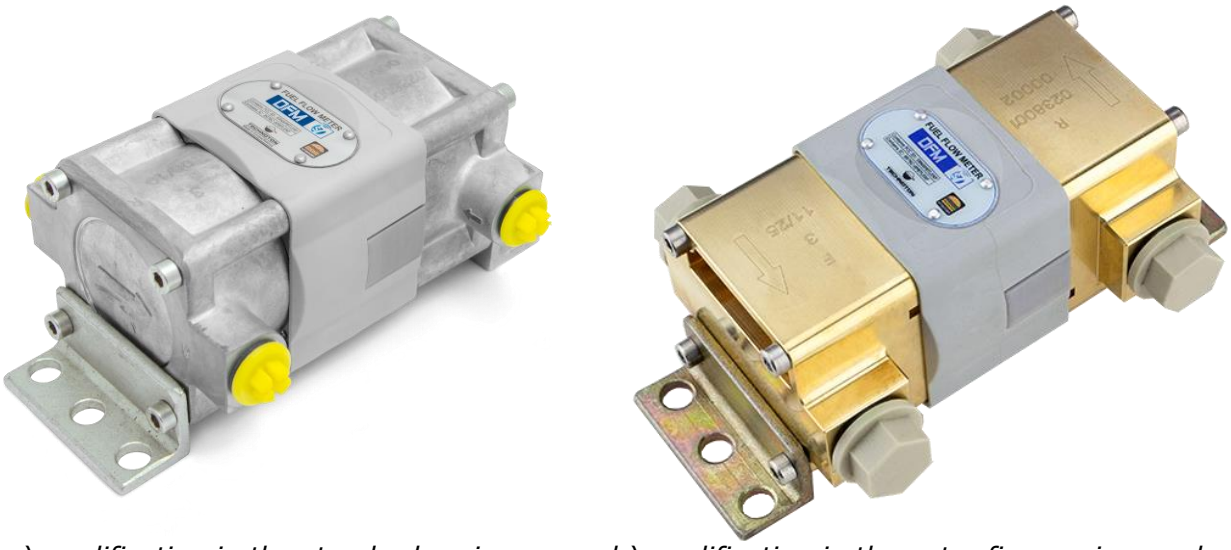


Figure 14 — External view of an autonomous-type differential fuel flow meter with a display

An autonomous differential flow meter is powered by the built-in battery and calculates fuel consumption as the difference between the flow rates in the engine feed and reverse fuel lines. Information on differential fuel consumption and Vehicle operating time is displayed on the flow meter display. Monitoring and recording of readings is performed visually by the responsible person, with the data entered into the fuel consumption log.

1.3.7 Wireless differential fuel flow meters

Wireless differential fuel flow meters (**DFM DS7** models) (see figure 15) are used to measure fuel consumption as the difference between the volumes flowing through the feed and reverse consumer fuel lines (differential consumption). They are installed on automotive and agricultural machinery or stationary units with modern diesel engines equipped with Common Rail fuel injection systems or unit injectors.



a) modification in the standard casing

b) modification in the extra firm casing made of brass (only for DFM 900 DS7)

Figure 15 — External view of wireless differential fuel flow meters

The flow meter continuously transmits in the "advertising" mode (BLE-radio) readings of fuel consumption for each chamber and of differential hourly fuel consumption, data from Counters, information on Events, modes of engine operation, Parameters of the flow meter malfunctions. Data can be received using S7 Technology Data can be received using S7 Technology by any device within BLE range of the flow meter.

1.4 Measurement range and accuracy

Table 1 — Measurement range and accuracy of one-chamber DFM fuel flow meters

Model (by size)	Starting flow rate, l/h	Minimum flow rate, l/h	Maximum flow rate, l/h	Relative accuracy error, %, not more than
DFM 50	0,5*	1	50	±1**
DFM 90		3	90	±2
DFM 100		2	100	±1**
DFM 220	2*	8	220	±2
DFM 250		5	250	±1**
DFM 500	3*	10	500***	

* Minimum threshold flow rate value when the meter starts operating. The value is indicated for reference only as accuracy is not standardized for operation on the starting flow rate.

** You can place a special order for single-chamber flow meters (except DFM AP) with enhanced measurement accuracy (see figure 1).

*** Flow meters with increased maximum fuel consumption in the chamber can be purchased upon special order (see figure 1).

Table 2 — Measurement range and accuracy of differential DFM D fuel flow meters

Model (by size)	Minimum differential consumption, l/h	Minimum flow rate per chamber, l/h	Maximum flow rate per chamber, l/h	Relative accuracy error, %, not more than
DFM 100 D	5	10	100*	±1…3**
DFM 250 D	10	50	250*	
DFM 500 D	20	100	500*	
DFM 900 D			900*	

* Dual-chamber flow meters with increased maximum fuel consumption in each chamber can be purchased upon special order (see figure 1).

** Depends on ratio of flow rate in feed chamber to flow rate in reverse chamber of DFM D.

RECOMMENDATION: In case the average flow rate in engine of Vehicle is close to the upper capacity limit of a certain DFM model it is recommended to use DFM with a higher measurement range. That will ensure absence of a fuel flow meter's influence on the fuel system as well as longer DFM operating life.

1.5 Unit structure and operation principle

DFM consists* of the ring-type measuring chamber (**1**), top cover (**2**) with electronic unit inside, bracket (**3**) and interface cable with connector (**4**) (see figure 16).

Figure 16 — DFM components

DFM is a direct volumetric fuel consumption measurement device with ring-type measuring chamber.

The principle of DFM operation is based on measurement of fuel volume that passes through its measuring chamber. Because of the pressure of the fuel coming to the measuring chamber through the inlet fitting the ring slides along the inner surface of the chamber and along the jumper at the same time. The ring pushes the fluid inside and outside itself out to the outlet fitting (see figure 17).
The volume of fluid equal to the volume of the measuring chamber is pushed out during the full single turn of the ring. The flow meter electronic unit automatically adds the fuel volume increment to the accumulating Counter; this fuel volume is equal to the volume of the measuring chamber (see animation on DFM fuel flow meter operational principle).

Figure 17 — DFM measuring chamber operation scheme

* The single-chamber model of DFM CCAN is taken as the device example.

When DFM is used within Telematics system, signal cable is connected to an appropriate input of telematic terminal (logging device).

Specification of flow meter with pulse output interface (DFM AP/AK/CK/DK) includes ratio which represent quantity of pulses per 1 litre, going through measurement chamber of DFM. This ratio should be entered to the respective setting menu of Server software.

Distinctive design features of DFM fuel flow meters:

- DFM structure provides fluid flow even in case the ring is blocked (e.g. as a result of clogging of the chamber).
- Special coating of the ring ensures its durability and wear resistance.
- The measuring chamber of DFM fuel flow meters is made, as standard, of a durable and lightweight ZAMAK alloy (zinc–aluminum–magnesium–copper).
  For DFM 500HP flow meters with increased capacity and for DFM 900D flow meters, the measuring chamber is made of brass.

  The built-in strainer (filter mesh) reduces the risk of measuring chamber blockage by trapping large mechanical particles that may potentially enter the fuel. The strainer can be removed and cleaned without disassembling the DFM housing.
- Increased nominal bore for minimum fuel flow hydraulic resistance.
- Improved magnetic circuit reduces sensitivity to hydraulic shocks in the engine fuel system.

1.6 Technical specifications

1.6.1 Working fluids

DFM can be used to measure the flow of the following fluids:

- diesel fuel;
- heating oil;
- burner oil;
- motor fuel;
- biofuel;
- other liquid fuels and mineral oils with kinematic viscosity of **1.5 to 6.0 mm^2/s (cSt)**.

ATTENTION:

1) All DFM units are tested/verified using diesel fuel. Indicate viscosity when ordering DFM for measuring different fluid type.

2) When operating with fluids having kinematic viscosity over 6.0 mm^2/s (cSt) the upper limit of DFM capacity range will get lower than nominal one and the pressure drop will increase.

3) DFM flow meters are made of petrol resistant materials. However the declared lifetime of the measuring chamber is not guaranteed when operating with petrol (see 1.6.3).

1.6.2 Main specifications

Flow meters with interface cables (DFM AP/AK/A232/A485/ACAN/CK/C232/C485/CCAN/ DK/D232/D485/DCAN models) are powered from the onboard circuit.
Wireless (DFM S7/DS7 models) and autonomous-type flow meters (DFM B/C/CD models) are powered only from the inbuilt battery.

Table 3 — DFM main specifications

Parameter, measurement units	Value
Max pressure, bar	25
Kinematic viscosity range of the measured fluid, mm^2/s (cSt)	1.5…6.0
Maximum temperature of the working fluid, °C	+85
Size of inclusions in the measured fluid, mm, not more than	0.08
Connection thread	M14x1.5 M16x1.5 [1] G 1/2" [2]
Pressure drop at maximum flow rate, nominal pressure, diesel fuel at 20 °C, bar, not more than	0.2 [3]
Supply voltage range, V	10…45
Current consumption at 12 V / 24 V, mA, not more than	50 / 25
Ambient operation temperature range, °C	-40…+85 [4]
Wireless data transfer interface	Bluetooth 4.1
Transmitter power (Tx Power), dBm	+4
Maximum distance between the flow meter and the receiving device, m	15 (in case there are metal/concrete partitions in the mounting location) 45 (when mounted within line-of-sight range)
Data transfer interval, s	5
Flow meter autonomous operating time from the built-in battery, years	up to 5 [5]
Certificates of BLE module electromagnetic compatibility	FCC and IC (see G.2), CE / TELEC / BQE
Vibration resistance	max. acceleration to 100 m/s^2 in the frequency range 5…250 Hz
Resistance to aggressive environments	Oil and petrol resistance
Electromagnetic compatibility	see annex G
Ingress protection rating	IP54
Overall dimensions	see annex A
Weight	

[1] For flow meters of the DFM 500 size range.
[2] For flow meters of the DFM 900 D size range.
[3] See figure 18 for details.
[4] Data on the display are shown within the range of ambient temperature -20…+60 °C.
[5] At a constant ambient temperature of +20 °C. Under real operating conditions, when the temperature fluctuates, the flow meter's autonomous operating time may be reduced, but it is guaranteed to be at least 2 years.

Trapping large mechanical particles (over 0.08 mm) that may potentially enter the fuel line is provided by an auxiliary flow meter element—the built-in DFM strainer (filter mesh).
The DFM strainer (filter mesh) is not intended to perform fuel filtration or to protect the fuel system as a substitute for the fine fuel filter!

Valid only for wireless models of flow meters DFM S7 / DS7.

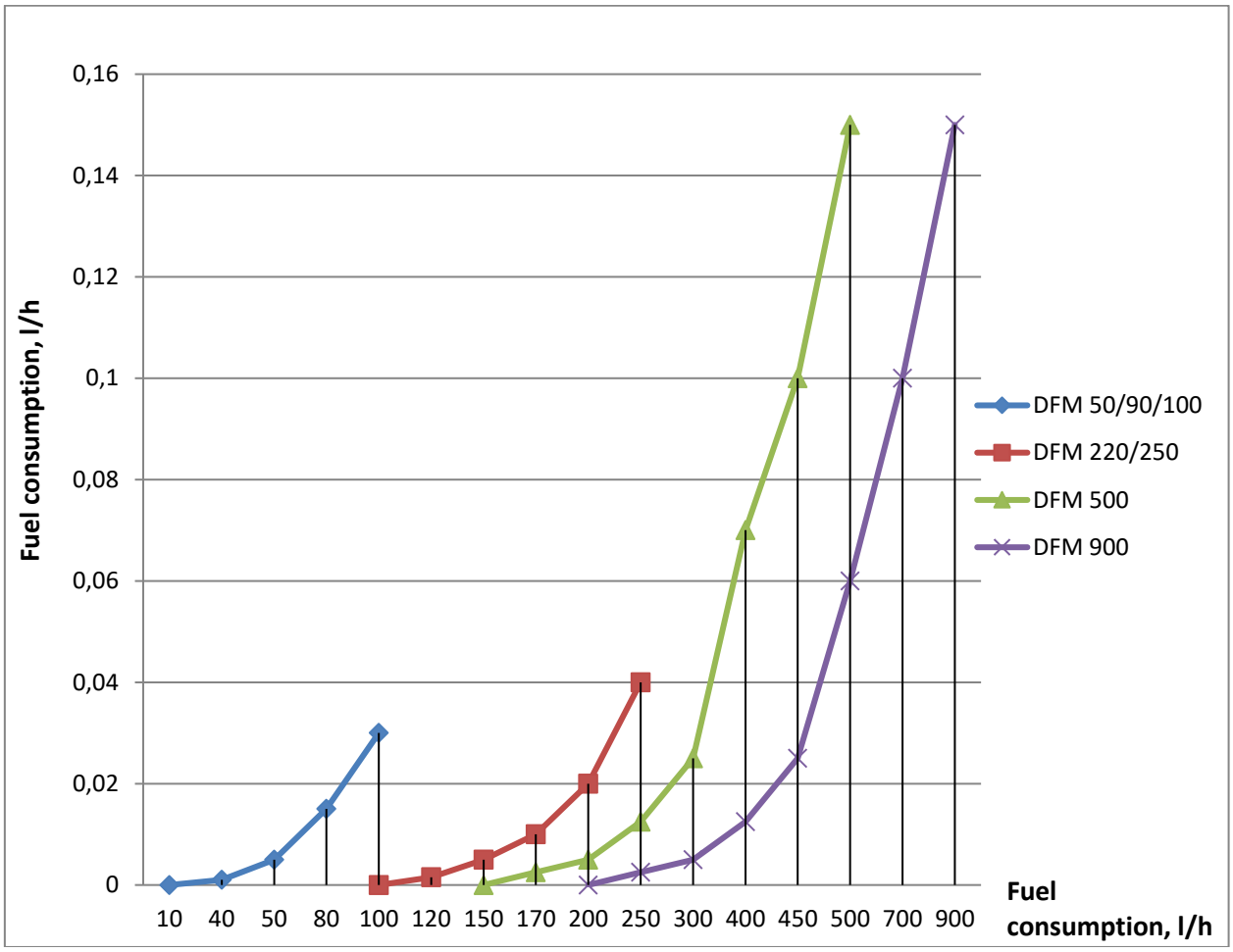


Figure 18 — Chart of pressure drop in DFM related to flow rate

According to figure 18 pressure drop on maximum flow rate does not exceed:

- for DFM 50/90/100 — 0.03 bar;
- for DFM 220/250 — 0.04 bar;
- for DFM 500/900 — 0.15 bar.

1.6.3 Specifications of measuring chambers

Table 4 — Specifications of DFM measuring chambers

Flow meter capacity model	Nominal diameter (DN), mm	Nominal volume of the measuring chamber, ml	Recommended re-calibration interval, l
DFM 50	6	5	100 000*
DFM 90			
DFM 100			
DFM 220	8	12,5	250 000*
DFM 250			
DFM 500	12	20	500 000*
DFM 900	15		900 000*
* See 8			

1.6.4 Power supply modes

DFM fuel flow meters can operate in the following power supply modes:

- **external power supply** (models **DFM AP**) — the flow meter is powered only from the external power source (e.g. from the Vehicle onboard circuit).
- **Stand-alone power supply** (**DFM B/C/CD/S7/DS7** models) flow meter is powered from the built-in battery. Estimated period of service life for DFM B/C/CD, until the battery is fully discharged — no less than 36 months; for DFM S7/DS7 — up to 60 months.
- **Combined power supply** (**DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN** models) — flow meter is powered from the external power source or built-in battery (in case external power is off). Power supply is switched to stand-alone mode in case of low level of external power supply (less than 10 V).
  The estimated operating time of the DFM with onboard power disconnected until complete battery discharge is at least 36 months.
  The estimated operating time of the DFM on the built-in battery can be increased up to 5 to 6 years when using **"power-saving" firmware** (version 4.90 or later).

ATTENTION: During the time when power supply from vehicle on-board power network is off DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN automatically enable option of data readings recording into internal meter memory. When powered from internal battery DFM CK/C232/C485/CCAN can display data according to table 6. Data transfer to the output interface starts only when external power supply from vehicle on-board network is provided.

1.6.5 Operation modes

Table 5 — Operation modes of DFM fuel flow meters

<table>
<tr><th colspan="3">Engine operation</th><th rowspan="2">Interference</th></tr>
<tr><td colspan="3">Normal consumption
$Q_0<Q\leq Q_{max}$</td><td rowspan="2">Tampering
$Q>Q_{max}$</td></tr>
<tr><td>Idle
$Q_0<Q<2.5Q_{min}$</td><td>Optimal
$2.5Q_{min}\leq Q<0.75Q_{max}$</td><td>Overload
$0.75Q_{max}\leq Q\leq Q_{max}$</td><td>The impact of constant magnetic field for more than 5 seconds</td></tr>
<tr><td colspan="4">Q — instant consumption;
Q_0 — starting flow rate;
Q_{min} — lower limit of the meter capacity range;
Q_{max} — upper limit of the meter capacity range.</td></tr>
</table>

WARNING: Operation mode boundaries of flow meters with interface cable can be (except DFM AP) adjusted via Service S6 DFM software at **Flowmeter FM** submenu (see H.3).

1.6.6 Displayed data

Display information (see table 6) switching is performed by (1…2) seconds light touch to the top cover of the fuel flow meter by magnetic key (see figure 19).

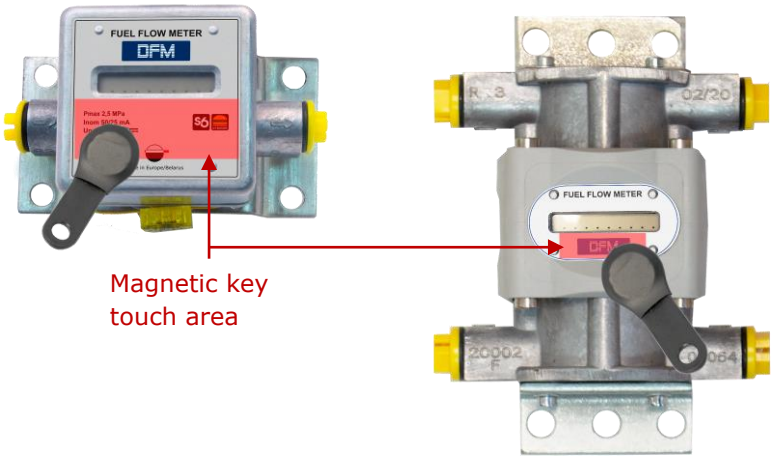


Figure 19 — Switching display DFM screens

In order to save the charge of the built-in battery the DFM display goes to sleep mode one minute after the last touch of the cover by the magnetic key.

In this case, the following is displayed (see figure 20):

- dots in all digits of the display — for flow meters with firmware earlier than v.4.90;
- a flashing segment of the least significant digit of the display — for flow meters with "power-saving" firmware (v.4.90 and later).

a) for firmware earlier than v.4.90

b) for firmware v.4.90 and later

Figure 20 — DFM display in sleep mode

IMPORTANT: Operating features of the **"power-saving" firmware**:
1) The DFM automatically enters sleep mode 20 s after the last touch with the magnetic key.
2) The DFM current consumption from the built-in battery is reduced by 2 to 3 times, which is especially relevant when there is no fuel flow through the measuring chamber.

When the magnetic key is touched again, the display "wakes up" and shows information again.

Table 6 — DFM display information screens

Screen No	Displayed data	Digit capacity	Units	Data set		
				DFM B	DFM C/CK/C232/ C485/CCAN	DFM CD
1	"Total Fuel Consumption" Counter	0.1	liters	+	+	+
2	"Total Fuel Consumption" Counter with higher digit capacity	0.001	liters	+	+	+
3	"Engine Operation Time" Counter	0.1	hours	-	+	+
4	"Engine Operation Time in "Idle" Mode" Counter	0.1	hours	-	+	+
5	"Engine Operation Time in "Optimal" Mode" Counter	0.1	hours	-	+	-
6	"Engine Operation Time in "Overload" Mode" Counter	0.1	hours	-	+	-
7	"Fuel Consumption in "Tampering" Mode" Counter	0.1	liters	+	+	+
8	"Interference Time" Counter	0.1	hours	+	+	+
9	"Instant Fuel Consumption"*	0.1	liters/hour	+	+	+
10	"Battery Charge in Percentage of the Maximum"	10	%	+	+	+
11	"Temperature in the Measuring Chamber"	1	°C	-	+	-
12	"Firmware Version"	—	—		X.X	
13	"Total "Negative" fuel consumption"	0.1	liters	-	-	+
14	"Instant consumption in feed chamber"	0.1	liters/hour	-	-	+
15	"Instant consumption in reverse chamber"	0.1	liters/hour	-	-	+
16	"Total Fuel Consumption. Clearable" Counter	0.1	liters	-	+	+
17	"Engine Operation Time. Clearable" Counter	0.1	hours	-	+	+

* For **DFM CD** — instant differential consumption.

Screen 1 displays **"Total Fuel Consumption"** Counter value (with 0.1 liter step) accumulated since DFM release.

Screen 2 displays **"Total Fuel Consumption value with higher digit capacity"** Counter (0.001 liter), accumulated since DFM release.

Screen 3 displays the Counter reading **"Engine Operation Time"** accumulated as the total time of engine operation in all modes including idle run.

Screens 4, 5, and 6 display the Counter readings of **"Engine Operation Time In "Idle", "Optimal" and in "Overload" Modes"** accumulated by DFM as a total engine operation time in corresponding modes (see 1.6.5).

Screen 7 displays the Counter readings of **"Fuel Consumption In "Tampering" Mode"** accumulated by DFM measured as the amount of fuel higher than maximum consumption (see 1.6.7). Value increase of this counter indicates the incorrect installation of the fuel flow meter or possible facts of fuel theft.

Screen 8 displays the Counter reading **"Interference Time"** accumulated by DFM as the total time of exposure to external factors (strong magnetic field). Increase of the values of this Counter may indicate an installation of the fuel flow meter near a source of strong electromagnetic radiation or deliberate attempts to lock the fuel meter (see 1.6.7).

Screen 9 "Instant Fuel Consumption" displays current value of fuel consumption. It can serve for a visual check of device operability and its correct installation.

Screen 10 "Battery Charge in Percentage of the Maximum" displays the value of remaining charge of integrated battery.

Note — When the environment temperature is below 10 °C, displayed value of remaining charge can decrease by (10…30) %.

Screen 11 "Temperature in the Measuring Chamber" displays current temperature value in the measuring chamber of the fuel flow meter.

Screen 12 "Firmware Version" displays the firmware version installed on the fuel meter.

Screen 13 "Total "negative" fuel consumption" displays total fuel consumption of Vehicle in situation, when fuel consumption in reverse chamber was higher than fuel consumption in feed chamber. The Counter is available only in differential DFM. "Negative" fuel consumption growth indicates higher volumes of foam caused by air presence in reverse fuel line while engine is operated on high RPM.

Screen 14 "Instant fuel consumption in feed chamber" displays instant consumption rate of fuel flowing through feed chamber of differential fuel flow meter.

Screen 15 "Instant fuel consumption in reverse chamber" displays instant consumption rate of fuel flowing through reverse chamber of differential fuel flow meter.

Screen 16 displays the Counter readings of "**Total Fuel Consumption. Clearable"**, which was accumulated by DFM since its production. Counter data could be reset using service software (only for the models DFM CK/C232/C485/CCAN) or by applying a magnetic key (3…5) s to a switching zone of DFM's cap when Screen 16 is active.

Screen 17 displays the Counter readings of **"Engine Operation Time. Clearable"**, which was accumulated as a total time of engine operation in all modes, including idling. Counter data could be reset using service software (only for the models DFM CK/C232/C485/CCAN) or by applying a magnetic key (3…5) s to a switching zone of DFM's cap when Screen 17 is active.

IMPORTANT: For the models DFM CCAN, clearable Counters (Screens 16 and 17) can be also reset by sending PGN 63080 command by means of S6 Technology to the respective flow meter (see annex F).

1.6.7 DFM protection from tampering and intervention

In order to avoid false readings, meter damage or blocking DFM have the following modes of protection against malicious acts of third parties:

1) "Tampering" Mode is to protect from tampering which has a purpose to increase fuel consumption Counters readings (e.g. blowing with air). "Tampering" usually causes a rapid increase of readings exceeding maximum flow rate limit. DFM electronics registers this increase and suspends fuel consumption counters. At the same time "Tampering" counter is activated. It records volume value that passes through the meter at the increased flow rate.

DFM B/C/CK/C232/C485/CCAN/CD displays dashes being in "Tampering" Mode (see figure 21).

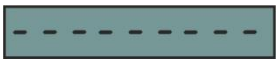


Figure 21 — Display view in "Tampering" Mode

The meter will automatically exit "Tampering" Mode in few seconds since back to normal operation conditions.

2) "Interference" Mode is made to protect DFM from magnetic field impact with the purpose to stop fuel counting or to tamper readings of fuel consumption. When exposed to external magnetic field, DFM registers an attempt of "Interference", and as the result increment of all the counters stops, and the time of exposure is recorded in a special "Interference Time" Counter.

DFM B/C/CK/C232/C485/CCAN/CD displays vertical strokes in "Interference" Mode (see figure 22).

Figure 22 — Display view in "Interference" Mode

The meter will automatically exit "Interference" Mode in few seconds since back to normal operation conditions.

ATTENTION: Data on Events of Tampering/Interference during the external power supply of DFM is off is recorded into the internal memory and sent to output interface since the power supply is on.

3) Stand-alone power supply mode of **DFM AK/A232/A485/ ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN** when external power supply is off. Flow meter is powered by own battery. Embedded battery ensures autonomous functioning within 36 months.

RECOMMENDATION: Sealing all connection in fuel line after DFM can help Vehicle owner to reveal unauthorized intervention in fuel line.
Valves, bolts and other elements in Technoton-branded mounting kits (see 4) for DFM has special holes for sealing.

1.6.8 DFM pulse output signal specifications

Flow meters with otput **non-normalized** pulse (models **DFM AP**) and with output **normalized pulse** output (models **DFM AK/CK/DK**) generate a definite number of pulses per 1 l of fuel $\mathbf{N_{pulse/l}}$ (see table 7).

The value of $\mathbf{N_{pulse/l}}$ is specified in the flow meter passport, while for model DFM AP it is also indicated on the label of the interface cable of each flow meter.

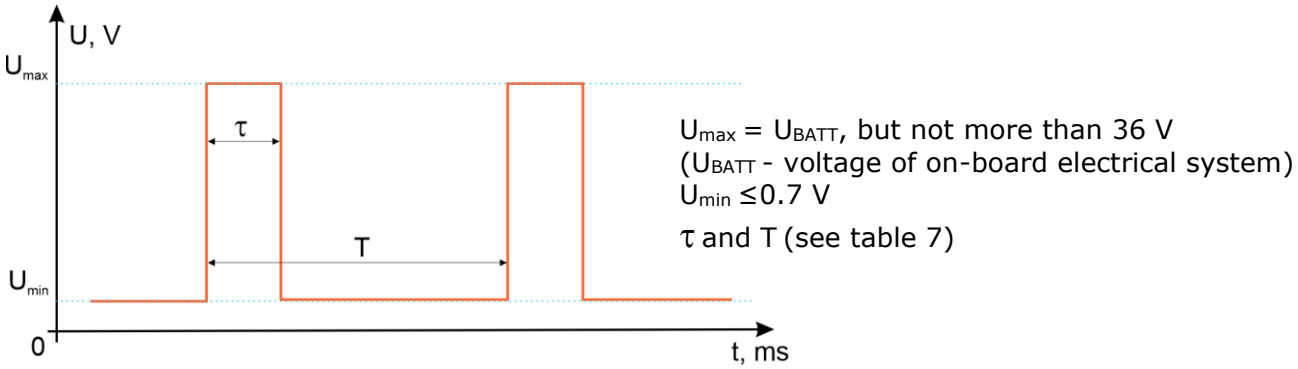


Figure 23 — Pulse output signal shape of DFM AP/AK/CK/DK models

Table 7 — Parameters of normalized pulse of DFM AP/AK/CK/DK models

Model	Period T, ms	Duration τ, ms	Number of impulses per 1 l, $N_{pulse/liter}$, pcs.
DFM 90AP	200…9000	(0.4…0.6)·T	195…204
DFM 220AP	204…5625		79…81
DFM 50AK/CK	360…18000	0.5·T (if T<1 s) 500 (if T>1 s)	200
DFM 100AK/CK	180…9000		
DFM 100DK	200…36000		
DFM 250AK/CK	180…9000		80
DFM 250DK	200…90000		
DFM 500AK/CK	144…7200		50
DFM 500DK	140…144000		
DFM 900DK	80…144000		

for non-normalized pulse.

for normalized pulse.

1.6.9 Specifications and protocols of RS-232 and RS-485 digital interfaces

Digital interfaces of **DFM A232/C232/D232** and **DFM A485/C485/D485** are physically implemented on the base of RS-232 and RS-485 standards respectively.

You can connect up to 255 pcs. of DFM 485 fuel flow meters at one time to the Telematics terminal via RS-485 interface.

It is possible to connect no more than one DFM 232 fuel flow meter to the Telematics terminal by means of RS-232 interface.

DFM 232/485 fuel flow meters support the transmission of data:

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

To identify DFM 232/485 fuel flow meters in the network, unique network addresses from 0 to 255 should be used (default address is 111).

The data transmission rate for DFM 232/485 may be selected from the following fixed values: 2400; 4800; 9600; 19200; 38400; 57600; 115200 bit/s (default — 9600 bit/s).

The selection of the data transmission protocol by the user as well as the configuration of DFM 232/485 parameters are conducted using Service S6 DFM service software via K-Line (ISO 14230) interface.

IMPORTANT: **The obligatory condition** for correct data transfer by DFM A485/C485/D485 flow meters is the presence of two **120 Ohms** terminal resistors between 485A and 485B wires at both ends of RS-485 communication line.

1.6.10 CAN j1939/S6 digital interface specifications and protocols

Specifications of CAN j1939/S6 **DFM ACAN/CCAN/DCAN** digital interface correspond to S6 Technology.

The user configuration of CAN j1939/S6 interface is conducted via K-Line (ISO 14230) interface using Service S6 DFM service software.

DFM CAN fuel flow meters support data transmission according to **SAE j1939** and **NMEA 2000*** protocols. The data composition of the flow meters output messages that are transmitted via CAN j1939/S6 interface is provided in annex F.

DFM CAN data is sent in automatic transmission mode and by request. Baud rate can be selected out of the following fixed values: 100; 125; 250; 500; 1000 kbit/s (default baud rate 250 kbit/s).

S6 Technology permits to connect at one time up to 240 pcs. DFM CAN fuel flow meters to form a single network. The unique network address (SA) must be specified for each connected flow meter. The recommended ranges for addresses — 111…118 (basic range) and 151…158** (additional range) (default address is 111). If needed, you may choose other addresses from the range 0…240***.

Using PGN 63080 command, you can reset the Counters "Flowmeter Hours Of Operation/Total Fuel Used. Clearable" (PGN 63261) in the internal memory of DFM ACAN/CCAN/DCAN flow meters via CAN j1939/S6 interface (see annex F for example).

IMPORTANT: The obligatory condition for correct data transfer by DFM ACAN/CCAN/DCAN flow meters is the presence of two **120 Ohms** terminal resistors between CAN LOW and CAN HIGH wires at both ends of CAN 2.0B (SAE j1939) communication line.

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* Preparation for implementation.

** You may specify addresses from 151…158 range only for DFM CAN flow meters with the version of firmware not lower than 4.63 using Service S6 DFM software, version from 1.27 and higher.

*** For DFM CAN with the firmware version not lower than 4.69, when using Service S6 DFM software, version 2.05 and higher.

1.6.11 Data composition of DFM S7 output messages

DFM S7 wireless fuel flow meter transmits data by means of S7 Technology, without integration with receiving devices and without acknowledgement of data reception.
The data in the form of Advertising packets are transmitted automatically with 5 s periodicity in the continuous data transfer mode. The structure of the data packet transmitted by DFM S7 is provided in figure 24.

Service field (AD0) (permanent values)			**Data field (AD1)** (variable values)					
Data length (AD Length) (1 byte)	**Data type (AD Type)** (1 byte)	**Data (Data)** (1 byte)	**Data length (AD Length)** (1 byte)	**Data type (AD Type)** (1 byte)	**Company identifier (Company ID)** (2 bytes)	**Unit firmware version (Soft Ver)** (1 byte)	**PGN number (PGN)** (2 bytes)	**PGN data (PGN Data)** (0…21 bytes)
0x02	0x01	0x06	0xXX	0xFF	0xFFFF / 0x0972*	0xXX	0xXXXX	…

* Only for flow meters with the version of firmware from 5.0 and higher.

Figure 24 — Structure of data packet transmitted by DFM S7

The application layer of the output message protocol of DFM S7 conforms with S6 Database (see table 8).

To display DFM S7 readings on the display of a smartphone/tablet, you may use **Fuel Rate Monitor** mobile application (see User manual).

Table 8 — Data composition of DFM S7 output messages

Field number	Length	Parameter	Name
1) Flowmeter. Parameters 2 PGN 63287 (0xF737)			
1	2 bytes	SPN 183	Engine Fuel Rate, l/h
3.1	4 bits	SPN 521181	Engine Mode by Fuel Rate
4	2 bytes	SPN 521027/18.0	Chamber Fuel Rate. Feed chamber
6	2 bytes	SPN 521027/18.1	Chamber Fuel Rate. Reverse chamber
8.1	4 bits	SPN 521028/18.0	Chamber Working Mode. Feed chamber
8.5	4 bits	SPN 521028/18.1	Chamber Working Mode. Reverse chamber
9	1 byte	SPN 174	Engine Fuel Temperature 1
10	2 bytes	SPN 521463/9.5	Flowmeter Hours Of Operation. Interference
12	4 bytes	SPN 521488	Unit DTCs Mask* (see table 10)
16	4 bytes	SPN 521493	Unit Events Mask* (see table 11)
20	1 byte	SPN 521061	Battery Charge Level
2) Flowmeter. Total Fuel Used PGN 63288 (0xF738)			
1	4 bytes	SPN 5054	High Resolution Engine Total Fuel Used
5	4 bytes	SPN 5054/9.0	High Resolution Engine Total Fuel Used. Idle
9	4 bytes	SPN 5054/9.1	High Resolution Engine Total Fuel Used. Optimal
13	4 bytes	SPN 5054/9.2	High Resolution Engine Total Fuel Used. Overload
17	4 bytes	SPN 5054/9.3	High Resolution Engine Total Fuel Used. Cheating

Field number	Length	Parameter	Name
3) Flowmeter. Hours Of Operation PGN 63289 (0xF739)			
1	4 bytes	SPN 521171	Flowmeter Hours Of Operation
5	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle
9	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal
13	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload
17	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating
4) Flowmeter. Chambers Counters PGN 63314 (0xF752)			
1	4 bytes	SPN 5054/18.0	High Resolution Engine Total Fuel Used. Feed chamber
5	4 bytes	SPN 5054/18.1	High Resolution Engine Total Fuel Used. Reverse chamber
9	4 bytes	SPN 5054/9.4	High Resolution Engine Total Fuel Used. Negative
13	4 bytes	SPN 5054/18.0/9.3	High Resolution Engine Total Fuel Used. Feed chamber. Cheating
17	4 bytes	SPN 5054/18.1/9.3	High Resolution Engine Total Fuel Used. Reverse chamber. Cheating
5) MAC Address PGN 63558 (0xF846)**			
1	6 bytes	SPN 521490	MAC Address
* All Events and malfunctions of the flow meter are recorded from the moment they appear till the moment they disappear, but during the time interval no less than 1 min. ** Only for flow meters with the version of firmware from 5.0 and higher.			

SPN values of the flow meter output message may be calculated according to the formula (1) using attributes from table 9.

Parameter value = SPN Content · Factor (Resolution) + Offset (1)

Table 9 — Attributes for calculation of current values of DFM S7 parameters (SPN)

Parameter	Factor (Resolution)	Offset
SPN 183	0.05 l/h	0 l/h
SPN 521181	1	0
SPN 521027	0.05 l/h	0 l/h
SPN 521028	1	0
SPN 174	1 °C	-40 °C
SPN 521488	1	0
SPN 5054	0.001 l	0 l
SPN 521171	1 s	0 s
SPN 521463	1 s	0 s

Table 10 — Numerical values of malfunction mask (DTCs Mask) DFM S7

Numerical value	Description of malfunction
1	Fuel temperature. Data missing or incorrect
32	Analog to digital converter launch error
265	Calibration missing
1024	Low battery charge (<10 %)
2097152	Real time clock. Clocking is off
16777216	Device operates in the manufacturing mode*
* This value is not a sign of any flow meter malfunction; it just indicates that its BLE module operates in "Manufacturing" mode (see 2.12).	

Table 11 — Digital values of Events mask of DFM S7

Numerical value	Designation of Event
1	Flow meter tampering
2	Interference into flow meter operation

1.7 DFM and Telematics terminals compatibility

During their operation within the Telematics system, DFM flow meters with interface cables can be used together with Telematics terminals or other tracking devices whose inputs are compatible with parameters of output signals, in accordance with 1.6.8, 1.6.9 and 1.6.10.

Wireless DFM S7 flow meters can be used together with Terminals and receiving devices (Android smartphones, tablets and other tracking devices) which have Bluetooth, version 4.X and higher.

Technoton regularly conducts tests for compatibility and joint accuracy of DFM with different models of Terminals (vehicle tracking devices).

A table containing the current list of Compatibility Declarations for telematics terminals from various manufacturers with flow meters and other Technoton products is available on the Technoton website (https://www.jv-technoton.com/).

Recommendations on connecting and setting up the equipment can be obtained from Technical support of Technoton (e-mail support@jv-technoton.com).

RECOMMENDATION: The best compatibility with DFM S7 wireless fuel flow meter during its operation using S7 Technology is provided by CANUp 27 Pro Telematics gateway. The procedure for connection of wireless Units to the Gateway please, see in CANUp 27 Operation Manual.

1.8 DFM selection

IMPORTANT: The final decision on the applicability this or that DFM model for a specific mobile or fixed fuel consumer should be taken by the installer personnel after the equipment examination and evaluation of its operability.

The detailed scheme for DFM selection, its installation layout, its accessories and mounting kit is shown in the interactive animated video DFM fuel flow meters: selection of installation layout, accessories and mounting kit.

1.8.1 Selection depending on engine power (boiler output capacity)

Table 12 — DFM Selection depending on the engine power (boiler output capacity)

Engine power*, kW	Boiler output*, kW	Recommended DFM model
up to 80	up to 400	**DFM 50AK** **DFM 50A232** **DFM 50A485** **DFM 50ACAN** **DFM 50C** **DFM 50CK** **DFM 50C232** **DFM 50C485** **DFM 50CCAN** **DFM 50S7**
80…150	400…800	**DFM 90AP** **DFM 100AK** **DFM 100A232** **DFM 100A485** **DFM 100ACAN** **DFM 100B** **DFM 100C** **DFM 100CK** **DFM 100C232** **DFM 100C485** **DFM 100CCAN** **DFM 100S7**
150…300	800…1500	**DFM 220AP** **DFM 250AK** **DFM 250A232** **DFM 250A485** **DFM 250ACAN** **DFM 250B** **DFM 250C** **DFM 250CK** **DFM 250C232** **DFM 250C485** **DFM 250CCAN** **DFM 250S7**
300…600	1500…3500	**DFM 500AK** **DFM 500A232** **DFM 500A485** **DFM 500ACAN** **DFM 500C** **DFM 500CK** **DFM 500C232** **DFM 500C485** **DFM 500CCAN** **DFM 500S7**
* Data is for reference only. To choose flow meter properly, it is necessary to know maximum and minimum fuel consumption in fuel feed line of fuel consumer.		

1.8.2 Selection depending on fuel flow rate in feed and return lines of the engine

Table 13 — Selection of the differential DFM D depending on fuel flow rate values in feed and return lines lines

Minimum flow rate, l/h	Maximum flow rate, l/h	Recommended differential fuel flow meters
10	100	**DFM 100DK** **DFM 100D232** **DFM 100D485** **DFM 100DCAN** **DFM 100CD** **DFM 100DS7**
50	250	**DFM 250DK** **DFM 250D232** **DFM 250D485** **DFM 250DCAN** **DFM 250CD** **DFM 250DS7**
100	500	**DFM 500DK** **DFM 500D232** **DFM 500D485** **DFM 500DCAN** **DFM 500CD** **DFM 500DS7**
100	900	**DFM 900DK** **DFM 900D232** **DFM 900D485** **DFM 900DCAN** **DFM 900CD** **DFM 900DS7**

Also, a pair of single-chamber DFM CAN flow meters connected to form a united network by means of CAN j1939/S6 interface (see 2.10) may be used for differential measurement of fuel consumption. One of the flow meters is installed in the feed fuel line, and the second one in the reverse fuel line. Flow meters are selected, depending on the fuel consumption range in the respective fuel line.

IMPORTANT:

1) Maximum and minimum fuel flow rate values in feed and return lines of the engine can be found in performance specification of the engine fuel pump.

2) When mounting differential DFM D in the fuel system with relatively low fuel consumption, but with high flow rate in the feed and return lines lines, the measurement error may increase.

3) The presence of air in the feed or reverse fuel lines is a contraindication for installation of a differential flow meter. The problem of removing air from the fuel is solved by installing a **deaerator** (see 4.4).

2 DFM installation

ATTENTION:
1) To ensure proper operation of DFM, it should be mounted, electrically connected and configured by specialist, who finished official technical training and was certified for that.
2) Officials, who carry out installation and operation, are responsible for proper installation and operation of DFM from the moment of its purchase.
3) When installing DFM it is mandatory to follow the safety rules for repair work and maintenance applicable to the machinery being equipped.

This section contains general recommendations on DFM mounting.

Check out DFM flow meter installation video for an example of mounting DFM on tractor.

2.1 Exterior inspection prior to works start

It is required to conduct DFM exterior inspection for the presence of the possible defects that may have occurred during transportation, storage or careless use:

- visible damage of the meter body, fittings, bracket, display, interface cable and connector;
- backlash of component parts or gaps between them.

Contact the supplier if any defects are detected.

2.2 Estimation of the fuel consumer condition

IMPORTANT:
1) Before starting installation of DFM, carefully read technical specification of the machinery unit (Vehicle/diesel generator/boiler/burner) being equipped, inspect the condition of its fuel and electric systems* and determine whether installation of the flow meter is possible.
2) Make sure that specifications of fuel system are within a range of main flow meter specification (kinematic viscosity of the liquid, consumption rate, pressure, operating temperature, nominal bore (DN)).
3) It is necessary to make sure that the standard fine fuel filter is in good condition.

Machinery unit condition inspection is carried out according to the following sequence:

1) Start the engine and check its operation for 5…10 minutes at idle and 5…10 minutes while driving under load. The engine must run evenly, not stall under load, no loss of power should be observed.

2) Check the return flow of the injectors. In case of significant return flow of the injectors measurement accuracy error will get higher because this returned volume gets back to tank and is double-counted by DFM. Injectors maintenance is recommended prior to DFM installation in this case.

3) Check pressure in the fuel line with a pressure gauge. Hydraulic resistance of a selected DFM working at nominal flow rate should not lower the pressure by more than 5 %.

4) Inspect all fuel pipes of the vehicle for damage and fuel leakage.

5) Check the quality of the chassis ground of the vehicle. Resistance between any point of chassis and the "-" clamp of the battery should not exceed 1 Ohm.

6) Check electric system voltage with a voltmeter. 12 V onboard power system should have voltage in the range from 10 to 18 V. 24 V onboard power system should have voltage in the range from 18 to 32 V.

7) Check and eliminate any external electromagnetic interference at the place of installation.

According to the results of the check a **Protocol of inspecting machinery unit** should be filled in and signed (see annex B).

The customer should eliminate any malfunctions recorded to the report before DFM installation.

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* It is allowed not to check the electrical system of the facility to be equipped, in case you mount wireless (model DFM S7/DS7) or autonomous-type (model DFM B/C/CD) flow meters.

2.3 General installation instructions

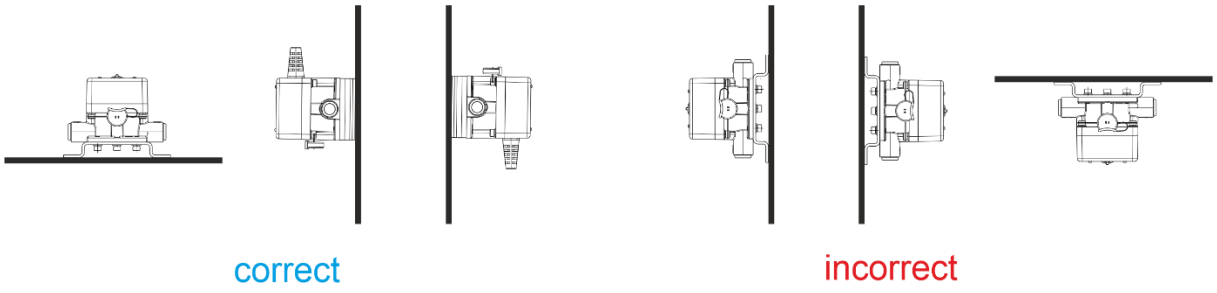
IMPORTANT:
1) Installation and electrical connection of DFM is strongly recommended at a positive ambient temperature.
2) Particular cases of engines operation layouts are described in this subsection. To take the decision on the flow meter applicability on the particular vehicle, study thoroughly the operating documentation for the vehicle on which the flow meter is to be mounted.

The following is needed for DFM mounting:

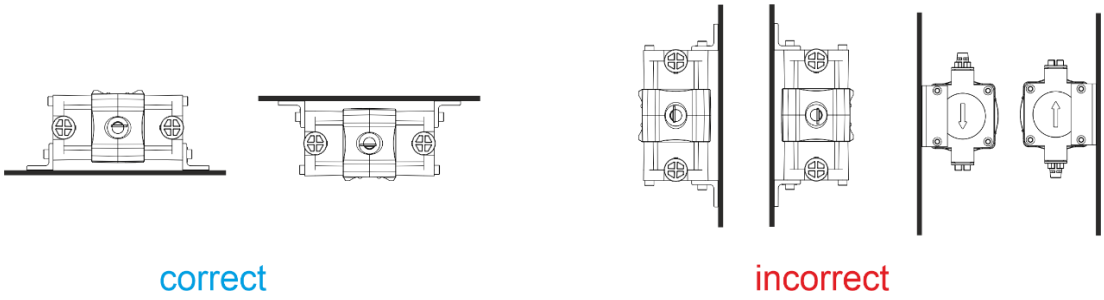
- automobile hand tool kit (sets of spanners, screwdrivers, etc.);
- mounting kit MK DFM (does not come with DFM delivery set, ordered separately);
- mounting plate (purchased separately). In some cases, the flow meter can be mounted without the mounting plate;
- pyrometer or contact thermometer (ordered separately);
- glycerin filled manometer (ordered separately);
- S6 SK* service adapter (to be purchased separately) and PC with installed Service S6 DFM service software;
- signal cable* (ordered separately for DFM CAN/232/485);
- mobile device (Android tablet or smartphone) with the installed Fuel Rate Monitor application**.

CAUTION:
1) In order to ensure the declared accuracy of measurement, one-chamber DFM flow meters should be installed only in "bracket directed down" and "bracket directed sideway" positions (see figure 25 a). Differential DFM should be installed only in "bracket directed down" and "bracket directed up" positions (see figure 25 b).
2) When fitting the mounting bracket of the DFM **vehicle frame drilling is prohibited!** If fitting of the mounting plate is impossible with bolts, spot welding is allowed.
3) Before installation, use a pressure gauge **to make sure there is no pressure in the fuel line!**
4) Avoid sharp bends of cable and fuel pipes when mounting.
5) Make sure you install fuel flow meter into fuel lines **strictly according to symbols on DFM body** (see figure 26).

* In case of mounting flow meters with interface cables, except DFM AP.
** In case of mounting DFM S7 wireless flow meters.

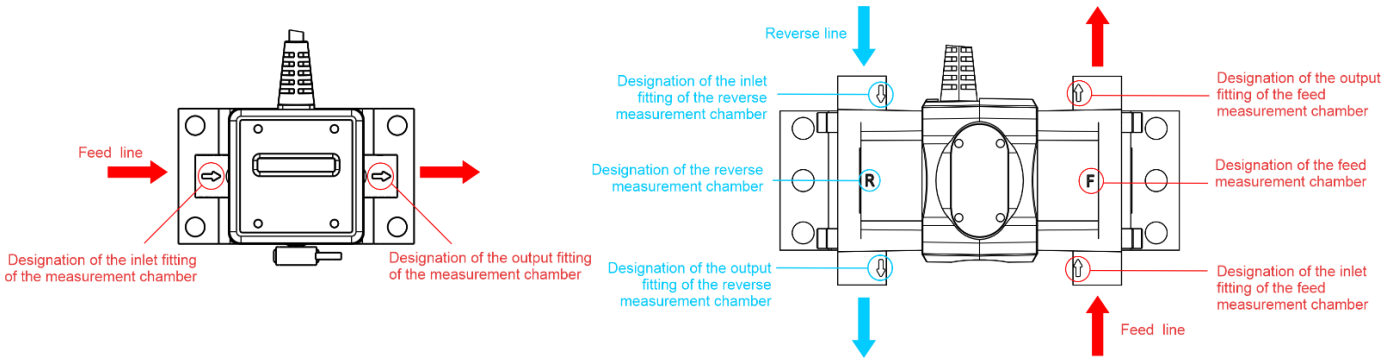


a) one-chamber



b) two-chamber

Figure 25 — Operational position of DFM in the vertical and horizontal planes



a) one-chamber *b) two-chamber*

Figure 26 — Symbols on DFM body for proper installation into fuel lines

The following rules must be observed when DFM mounting:

1) Vehicle fuel lines must be protected from any external damage.
2) It is prohibited to reduce internal dimension of the fuel pipes on bends.
3) Mounting of the fuel pipes of the vehicle should be made with buckles every 0.5 m.
4) Fuel pipes need to have some spare length in order to compensate length changes due to the temperature.
5) Tightening force of thread connections during mounting a flow meter must be:
- for thread M14 – 30…35 N·m;
- for thread M16 – 35…40 N·m.

6) It is not recommended to install the DFM in the following locations:
- on parts of the Object subject to strong vibration and heating;
- at the highest point of the pipeline (due to possible air accumulation);
- directly before a free discharge from a vertical pipeline.

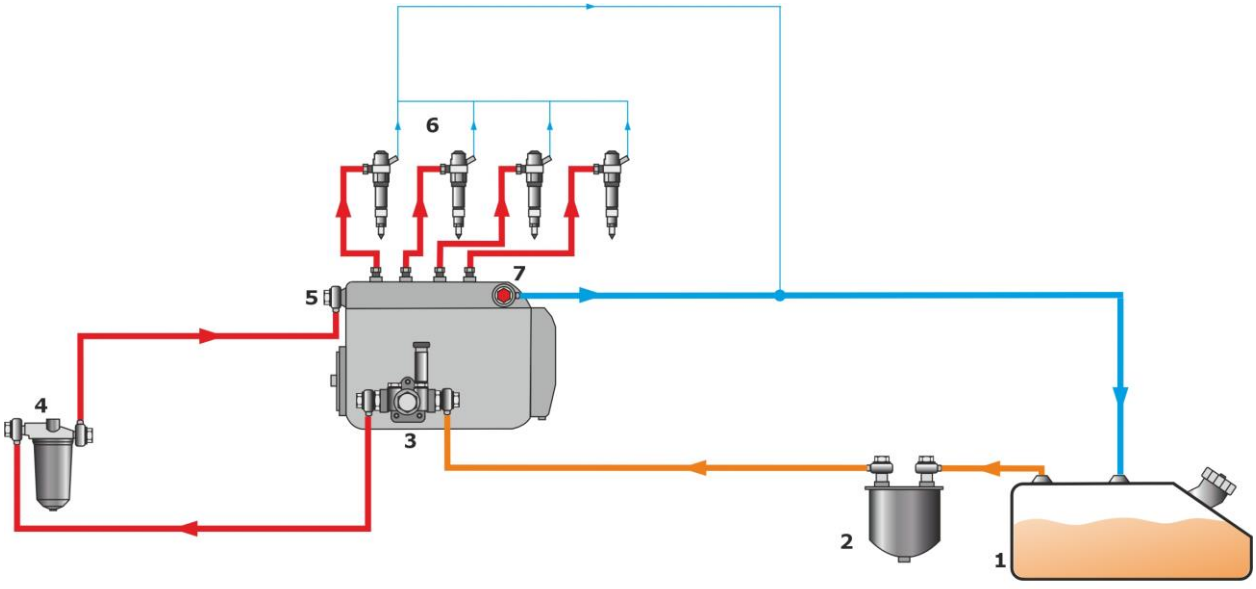
7) When connecting fuel pipes, flanges and threaded connections must be clean.
8) When installing, only **new** copper sealing washers from a mounting kit have to be used.
9) Rubber fuel pipes must be connected to the elements of the fuel system using drive type nipples or direct flow fittings and secured with hose clamps or with crimping coupling of necessary diameter.
10) After DFM installation, it is necessary to remove air from the fuel system.

ATTENTION:
1) Only consumed volume of fuel should pass through DFM in case of using one-chamber meter. It is required to modify reverse fuel line of the fuel system in this case (see 2.4.2, 2.4.3).
2) If foam is present in the reverse pipe, installation of fuel deaeration system is required. To eliminate air bubbles and prevent them from getting into the fuel line **deaerators** are used (see 4.4).
3) In case DFM is mounted in vessels and locomotives, **you have to provide an option of temporary switching over fuel supply to an accessory line - bypass** (see annex K).
4) During mounting DFM 500 / DFM 900 flow meters, due to their great weight and particularities of their design, as differs from lower-capacity models, you should follow recommendations, according to annex L.

2.4 Fuel flow meters mounting schemes

2.4.1 Typical diesel engine fuel system scheme

The most common scheme of the fuel system of diesel engine is shown in figure 27.



1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – High pressure fuel pump; **6** – Injectors; **7** – Bypass valve.

Figure 27 — Typical fuel system scheme

The low pressure fuel pump pumps significantly more fuel to the input of the high pressure fuel pump than the engine consumes in any of operation modes. Excess fuel from the high pressure fuel pump and injectors flows back to the fuel tank.

ATTENTION: When installing the DFM in the fuel system, keep in mind that the flow meter's built-in strainer (filter mesh) does not replace the standard fuel filtration provided by the fine fuel filter. The strainer is an auxiliary element of the flow meter intended for trapping large mechanical particles (over 0.08 mm) that may potentially enter the fuel line. The strainer reduces the risk of measuring chamber blockage and ensures continuity of the measurement process until flow meter maintenance is performed.

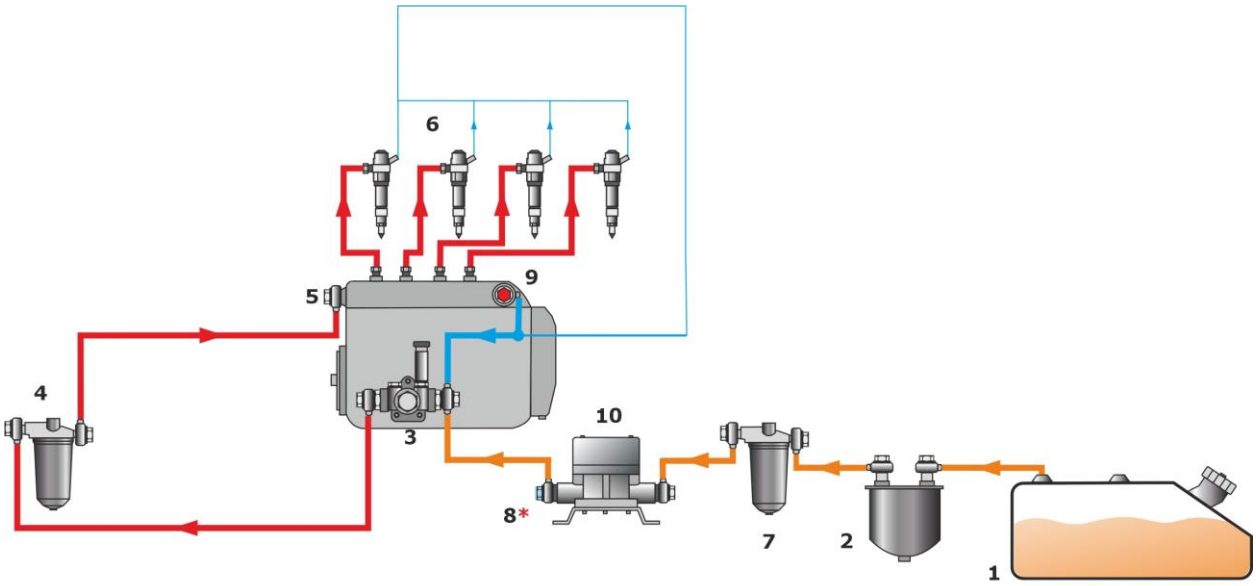
2.4.2 DFM installation before the pump

DFM installation according to before the pump scheme (on suction side) involves installation of a fuel flow meter in the part of the fuel system where the flow of fuel is carried out due to depression created by a low pressure fuel pump.

ATTENTION: DFM installation before the pump requires compulsory use of additional fine filter on the line from the tank to the DFM.

Particular case of DFM installation according to before the pump scheme:

In order to install a DFM in the fuel system with a low pressure fuel pump (see figure 28) according to this scheme, it is necessary to use the line between the rough filter and the low pressure fuel pump input.



1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – High pressure fuel pump; **6** – Injectors; **7** – Additional fine filter; **8** – Non-return valve; **9** – Bypass valve; **10** – DFM fuel flow meter.

* Is used only against hydro shocks (if any in the system).

Figure 28 — DFM installation on suction side (before the pump scheme)

When injectors operate correctly their return flow is less than 0.1 % of fuel consumption, and therefore this can be negligible.

In order to prevent measuring of the fuel returns back to the tank, it is necessary to make changes in the reverse line.

In this particular case the reverse line from the high pressure fuel pump has to be modified in such way that fuel could circulate in a small circle without fuel tank participation. It can be done by connecting reverse line of the high pressure fuel pump with low pressure fuel pump input.
Thus fuel from two lines flows to the low pressure fuel pump input: from the fuel tank through DFM flow meter and from high pressure fuel pump reverse line.

For proper operation of the modified fuel system install a **bypass valve** at the high pressure fuel pump output, which will support necessary constant pressure of **(1…1.5) bar**.

At DFM output a **(0.1…0.35) bar non-return valve** has to be installed which will prevent fuel flow in the opposite direction and will reduce fuel system's hydraulic shocks at the DFM.

After the fuel system is modified according to depression scheme, all excess fuel pumped by the low pressure fuel pump will be directed from the high pressure fuel pump output to low pressure fuel pump input.

Thus only the fuel that is consumed by the engine flows through the DFM.

RECOMMENDATION: One of advantages when excess fuel returns back to the tank is fuel heating in the tank. Therefore, when a vehicle is used in low temperature environment, it is not recommended to modify the fuel system. Use differential DFM flow meters instead or install a fuel heater.

Advantages of the scheme:

- minimal modification of the fuel system;
- simple installation;
- applicable for most engines.

Disadvantages of the scheme:

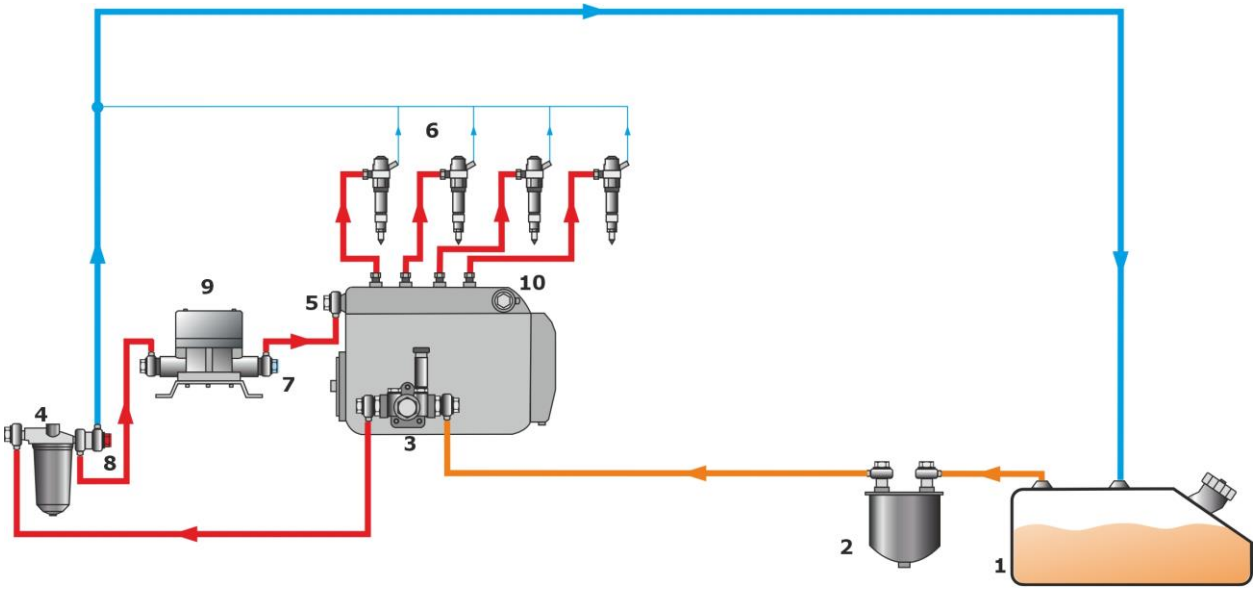
- requires installation of an additional fine filter and causes additional costs;
- additional load on the low pressure fuel pump;
- fuel in the tank is not warmed with return fuel flow (fuel heater installation is required in some cases).

2.4.3 DFM installation after the pump

DFM installation after the pump involves installation of flow meter in the line after the low pressure pump where fuel flows under pressure.

Particular case of DFM installation according to after the Pump scheme:

In order to install DFM according to pressure scheme in the fuel system with LPFP (see figure 29), it is necessary to use the line between fine filter and high pressure fuel pump input.



1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – High pressure fuel pump; **6** – Injectors; **7** – Non-return valve; **8** – Bypass valve; **9** – DFM fuel flow meter; **10** – Plug.

Figure 29 — DFM installation on pressure side (after the Pump scheme)

Return flow from the high pressure fuel pump has to be modified to fuel circulation in a small circle without fuel tank involvement i.e. the reverse line needs to be moved from high pressure fuel pump output to fine filter input, and high pressure fuel pump output needs to be plugged.

For correct operation of modified fuel system a **bypass valve** has to be installed at the fine filter input which will support necessary constant fuel pressure at **(1…1.5) bar** in the line between the fine filter and high pressure fuel pump input.

Install a **(0.1…0.35) bar non-return valve** at the DFM output to prevent fuel flow through the DFM in the opposite direction. This will decrease fuel system hydraulic shocks at the DFM.

Thus, excess fuel pumped by low pressure fuel pump will be dropped back to the fuel tank from fine filter's side; and only amount of fuel consumed by the engine will flow through the flow meter.

One of the features of diesel engines is its uneven fuel consumption. Additionally, water hammers (hydraulic shocks) inside fuel line can add extra inaccuracy.

ATTENTION: To compensate water hammer effects and to avoid back fuel flow through DFM, it is necessary to install return valve after the flow meter!

Advantages of the scheme:

- DFM is installed after a regular fine filter;
- fuel flows under pressure and doesn't overload the low pressure fuel pump;
- return fuel flow can heat fuel in the tank.

Disadvantages of the scheme:

- high pressure fuel pump cooling efficiency is slightly decreased;
- return flow fuel temperature is lower than with a regular fuel system.

2.4.4 Differential DFM D installation scheme

RECOMMENDATION: Differential fuel flow meters installation in fuel systems with high performance low pressure fuel pump and small fuel consumption is not recommended due to increase of measurement errors higher than allowed (see 1.4).

Fuel circulation in the fuel system doesn't change with differential measurement. Feed-flow chamber (marked with the letter **F** on the flow meter body, see figure 26 b) of differential DFM D is to be installed in the gap of feed fuel line of the engine. Return-flow chamber (marked with the letter **R** on the flow meter body, see figure 26 b) is to be installed in the gap of the reverse line. Fuel consumption is calculated as a difference of measured values of fuel flows in straight-flow and return-flow chambers.

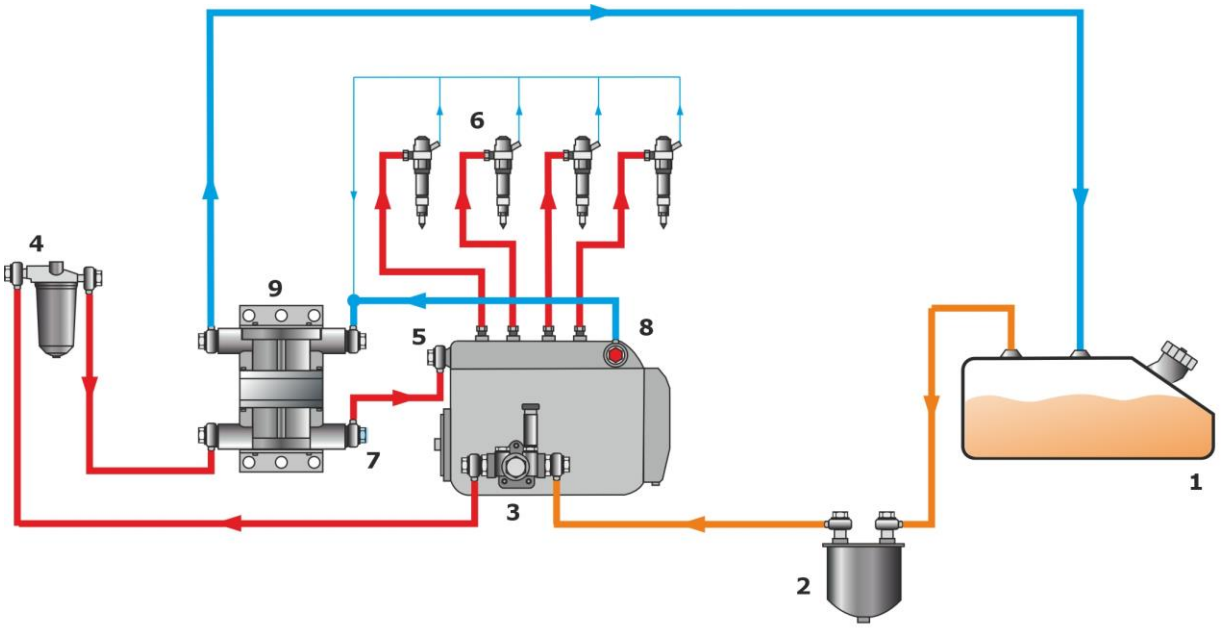
Particular cases of differential DFM D installation scheme:

1) In fuel system with plunger injection pump feed chamber can be installed into:
- a section after suction pump **(on pressure side)** (see figure 30 a).
- a section before suction pump **(on suction side)**. In this case it is onligatory to use additional fine fuel filter (see figure 30 b).

2) Installation of the feed chamber on unit injector fuel system (jerk system) is made after the low pressure fuel pump (**after the pump scheme**) (see figure 30 c).

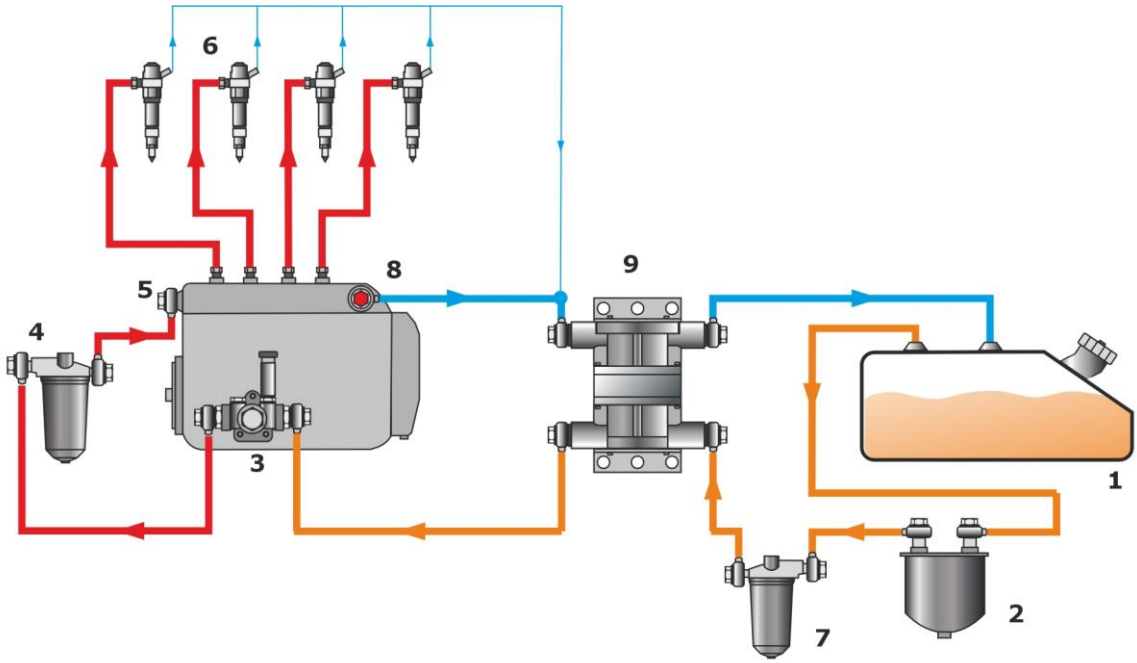
3) On Common Rail fuel system installation of the feed chamber is made before the low pressure fuel pump (**before the pump scheme**). In this case **additional fine filter** installation is required (see figure 30 d).

Reverse-flow chamber of differential DFM D in both cases is to be installed in reverse line between high pressure fuel pump output and the fuel tank.



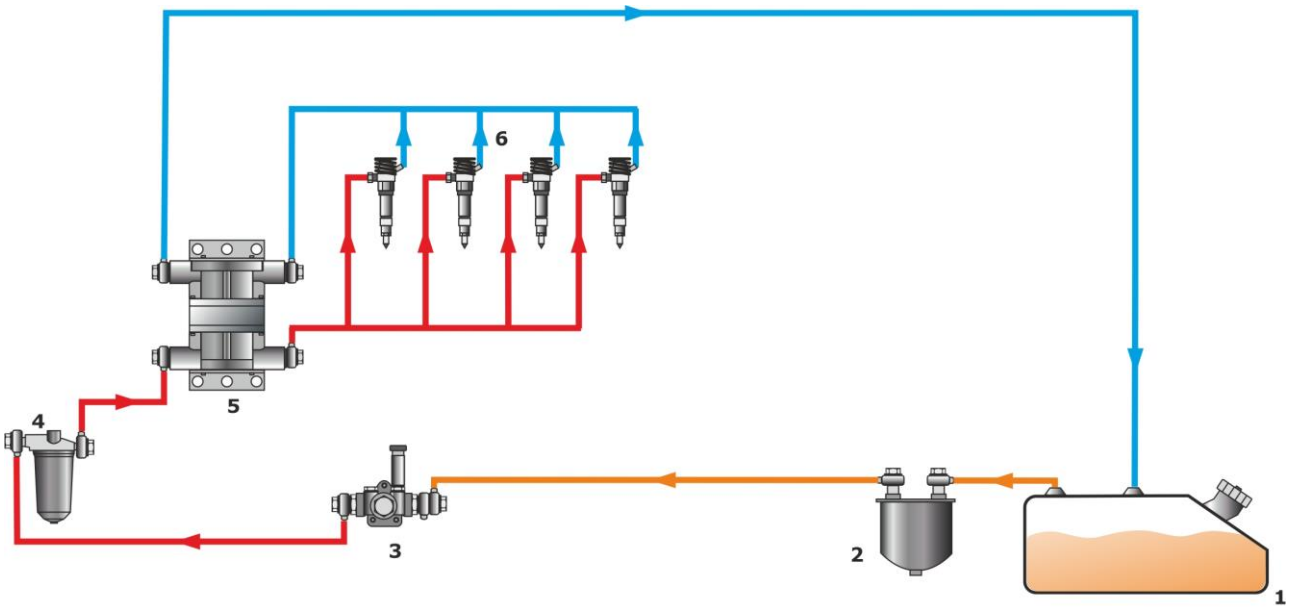
1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – High pressure fuel pump; **6** – Injectors; **7** – Non-return valve; **8** – Bypass valve; **9** – DFM D fuel flow meter.

a) feed chamber installation after the pump (in a fuel system with plunger injection pump)



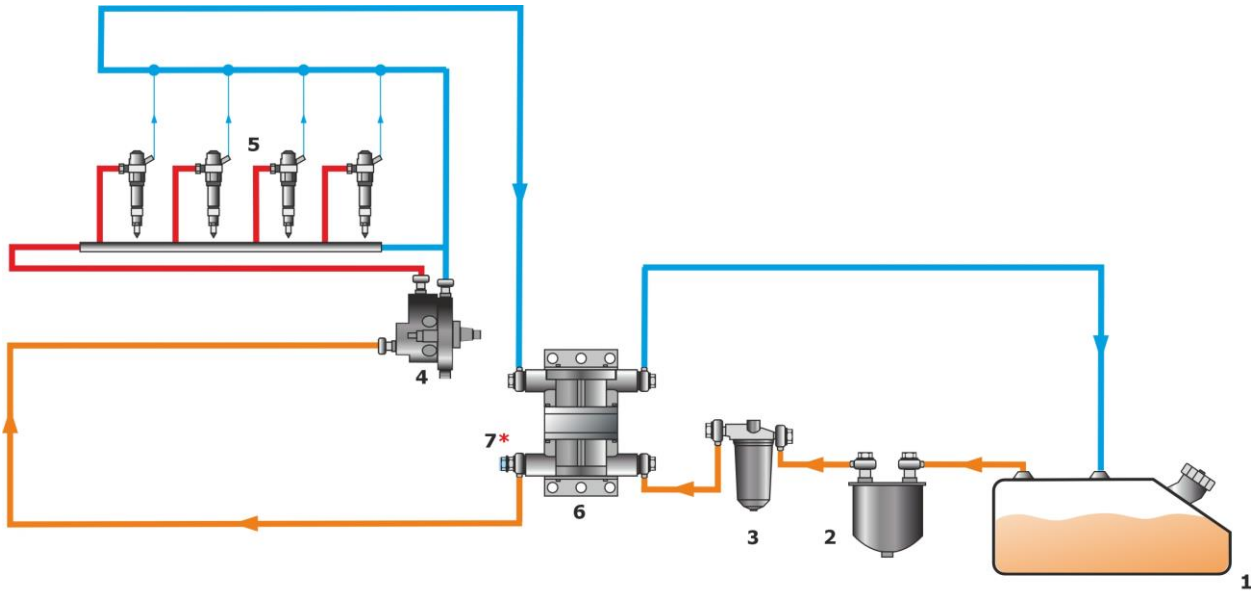
1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – High pressure fuel pump; **6** – Injectors; **7** – Additional fine filter; **8** – Bypass valve; **9** – DFM D fuel flow meter.

b) feed chamber installation before the pump
(in a fuel system with plunger injection pump)



1 – Fuel tank; **2** – Rough filter; **3** – Low pressure fuel pump; **4** – Fine filter; **5** – DFM D fuel flow meter; **6** – Unit injector.

c) feed chamber installation after the pump
(unit injector fuel system)



1 – Fuel tank; **2** – Rough filter; **3** – Fine filter; **4** – Common Rail high pressure fuel pump; **5** – Injectors; **6** – DFM D fuel flow meter; **7** – Non-return valve.

* Is used only against hydro shocks (if any in the system).

d) feed chamber installation before the pump (Common Rail fuel system)

Figure 30 — Differential DFM D installation scheme

ATTENTION:

1) In some cases, (e.g. big-size engine) it is more convenient to use a **pair of single-chamber DFM CAN flow meters** connected into a united network by means of CAN j1939/S6 interface (see 2.10) for differential measurement. The first flow meter (Master) is mounted into the break of the feed fuel line, while the other one (Slave) is mounted into the break of the reverse line, to the chambers "Feed" and "Reverse" of DFM D differential flow meter respectively, in accordance with figure 30. The differential consumption is defined as the difference between values of fuel consumption measured by the Master and Slave flow meters.

2) Also, you may employ DFM CAN single-chamber flow meters in pairs using S6 Technology for summation of consumption readings of fuel flowing through both the fuel lines. The first flow meter (Master) is mounted into the break of the first fuel line, while the other flow meter (Slave) is mounted into the break in the other fuel line. The total consumption is determined by means of summation of the fuel consumption values measured by the Master and Slave flow meters (see 2.10).

3) It is allowed to use a pair of DFM CAN of different types/sizes (see table 1).

Advantages of differential installation scheme:

- no changes in the fuel system;
- installation possible for engine during warranty period.

Disadvantages of differential installation scheme:

- higher cost;
- higher fuel consumption measurement error;
- additional fine filter and DFM D increase load on the low pressure fuel pump.

Interactive animation video DFM fuel flow meters: selection of installation layout, accessories and mounting kit helps to select DFM, its mounting scheme, mounting kit and other accessories depending on type of fuel pump and according to technical specifications of particular Vehicle.

2.5 Electrical connection

ATTENTION:
1) To ensure proper operation of DFM, it should be electrically connected by specialist, who finished official technical training and was certified for that.
2) When electrically connecting the DFM, it is necessary to strictly observe safety rules for repair work, as well as the safety requirements established at the enterprise.

Fuel flow meters with interface cable (**DFM AP/AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN**) are supplied with electrical power from onboard vehicle power source.

ATTENTION:
1) Before mounting and connecting DFM switch off power supply of the Vehicle electrical circuits. To do this switch off the battery switch or release the terminals of the wires connected to the battery.
2) It is recommended to use **fuses** (supplied within delivery set) when connecting DFM power supply. Nominal fuse current is not more than 2 A.
3) When connecting DFM to onboard power source it is necessary to connect feed "+" and chassis "-" wires to the same sockets where appropriate wires of recording and display devices (trackers) are connected.
4) Before starting electrical connection of the DFM special attention must be paid to the quality of the chassis ground. Resistance between any point of the chassis and the negative clamp of the battery must not exceed 1 Ohm.
5) It is **strongly recommended** to lay DFM connection cable together with standard electrical vehicle wiring with mandatory cable ties fixing of every 50 cm (see figure 31).

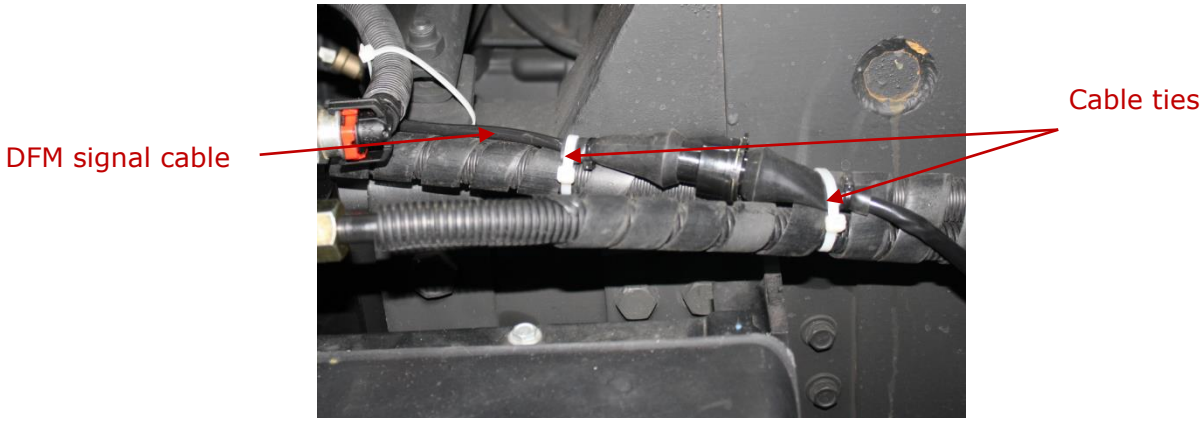


Figure 31 — Laying DFM signal cable

Electrical connection of DFM is carried out by connecting **signal cable** (see 4.2 and annex J) to telematic terminal (or data logger) in accordance with pinout and wires designation (see tables 14…17)

Quick splice **connectors** (ordered separately) are recommended for electrical connection of power supply wires (see figure 32).

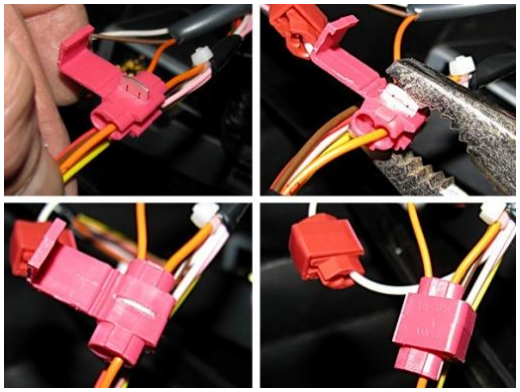


Figure 32 — Wiring connection made with the plastic connectors

Table 14 — Interface cable pinout and wire assignment of DFM AP

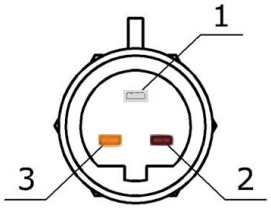
Connector view	Pin number	Wire color		Assignment
	1	White		Pulse output (see 1.6.8)
	2	Brown		Ground "-"
	3	Orange		Power supply "+"

Table 15 — Interface cable pinout and wire assignment of DFM AK/CK/DK

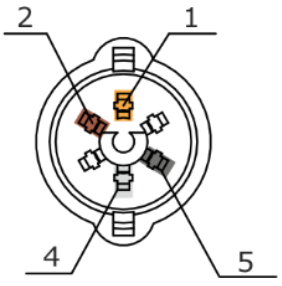
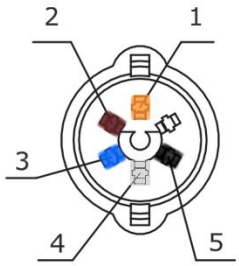
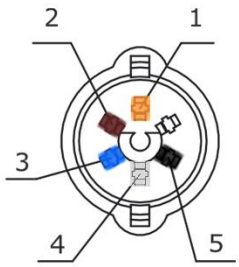
Connector view	Pin number	Wire color		Assignment
	1	Orange		Power supply "+"
	2	Brown		Ground "-"
	4	White		Pulse output (see 1.6.8)
	5	Black		K-Line (ISO 14230)

Table 16 — Interface cable pinout and wire assignment of DFM A232/A485/C232/C485/D232/D485

Connector view	Pin number	Wire color		Assignment
	1	Orange		Power supply "+"
	2	Brown		Ground "-"
	3	Blue		Transmitted data (232T). Data exchange (485B)
	4	White		Received data (232R) Data exchange (485A)
	5	Black		K-Line (ISO 14230)

WARNING: During electrical connection of DFM A485/C485/D485 fuel flow meters, **120 Ohms** terminal resistors fixed between 485A and 485B wires at both ends of RS-485 communication line **is the obligatory condition** for correct data transfer.

Table 17 — Interface cable pinout and wire assignment of DFM ACAN/CCAN/DCAN

Connector view	Pin number	Wire color		Assignment
	1	Orange		Power supply "+"
	2	Brown		Ground "-"
	3	Blue		CAN-High (SAE j1939)
	4	White		CAN-Low (SAE j1939)
	5	Black		K-Line (ISO 14230)

WARNING: During electric connection of DFM ACAN/CCAN/DCAN fuel flow meters, **120 Ohms** terminal resistors fixed between CAN LOW and CAN HIGH wires at both ends of RS-485 communication line **is the obligatory condition** for correct data transfer.

Examples of connection schemes including the elements of S6 cabling system, which should be ordered for connecting **DFM ACAN/CCAN/DCAN** to registration and display devices, are given in the j1939/S6 Telematics Interface Operation Manual.

2.6 Flow meters configuration by means of cable connection to the PC

All DFM fuel flow meters are calibrated and verified by the manufacturer with a diesel fuel and supplied ready for use.
When connecting **DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN/DK/D232/D485/DCAN** to external device or it is necessary to adjust flow meters parameters to specific operation mode, you can configure it through K-line interface (ISO 14230).
In order to start configuration, it is necessary to connect DFM to PC via S6 SK service adapter. S6 SK description can be found in Cabling and accessories for Telematics interface CAN j1939/S6 manual.
Before connecting DFM to PC via service adapter, please download special software from http://www.jv-technoton.com/ (section Software/Firmware) and install it to your PC:

- USB driver;
- Service S6 DFM.

Note — Installation file name contains: ServiceS6_DFM_X_X_Setup.exe, where X_X — version of software.

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

See annex H for DFM settings, displayed and/or made by Service S6 DFM software.

2.6.1 Connection DFM to PC

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

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

When connecting service adapter to DFM, which is installed on Vehicle, avoid the following: ingress of fuel, oil or moisture to the pins of connector; damage of elements by rotating or heated parts of engine/vehicle.

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

* When configuring DFM installed on Vehicle. When configuring flow meters connected by S6 Technology, power supply of onboard network (battery) can be turned on.

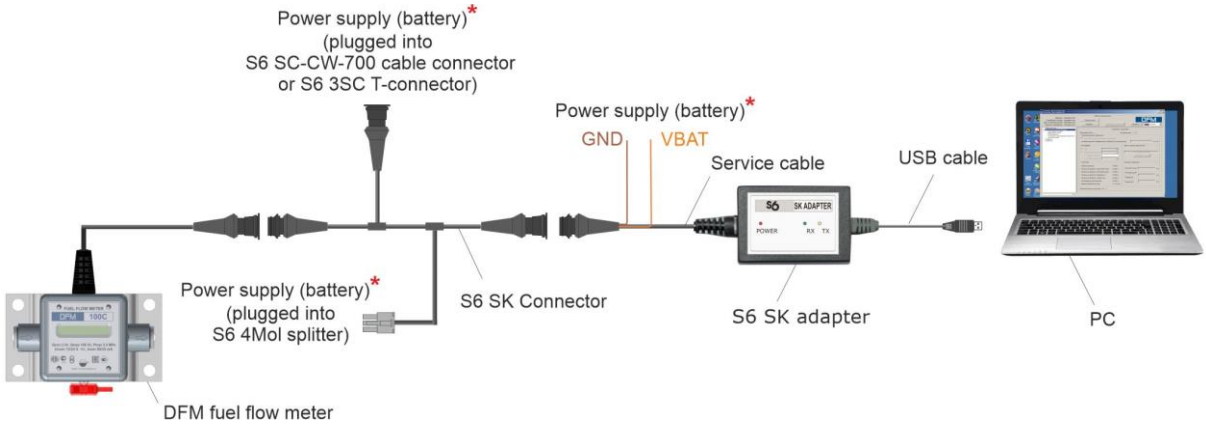
DFM meters are connected to PC according to the connection schemes (see figure 33) in the following order:

1) Connect the adapter to fuel flow meter:
- The connector of the service adapter is to be connected to the flow meter interface cable connector by means of the plug connector which is contained in the S6 SK supplied accessories kit (see figure 33 a).
  Note — During the DFM configuration you need to provide power supply for the flow meter and the adapter from the battery or from a power source. Power is supplied through one of the free input connectors of the connector or via power supply wires of the adapter service cable.
- During the configuration of DFM CAN which operates within the network of Units based on S6 Technology we recommend to plug the connector of the adapter service cable into the break in S6 cable system using S6 SK connector instead of any S6 3SC T-connector. In this case, power for the Unit and adapter is supplied through S6 cable system (see figure 33 b).

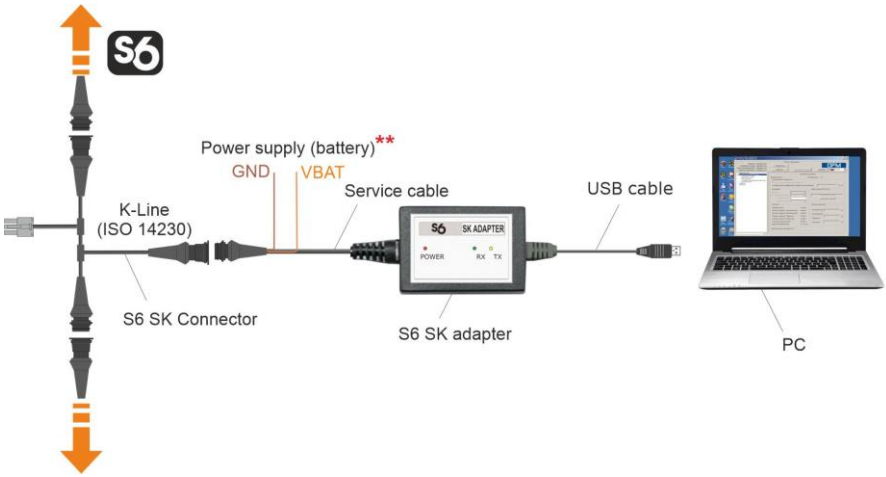
2) Plug the adapter to USB port of PC with the USB cable.
  Note – it is allowed to connect adapter to USB-port of your PC after turning on power supply of flow meter and running Service S6 DFM software.

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

4) Power on the vehicle (battery).



a) connecting DFM AK/A232/A485/ACAN/CK/C232/C485/ CCAN/DK/D232/D485/DCAN using S6 SK



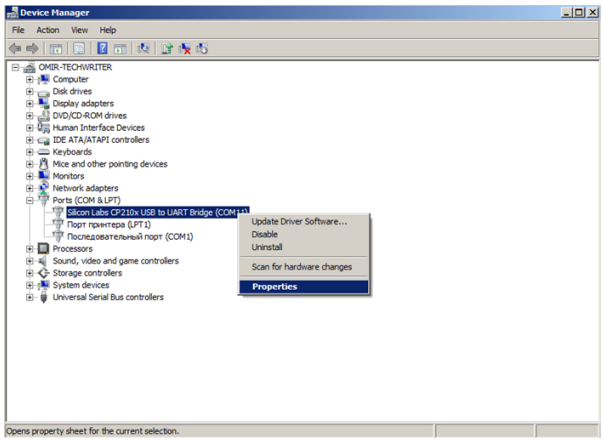
b) connecting DFM ACAN/CCAN/DCAN using S6 SK via S6 Technology

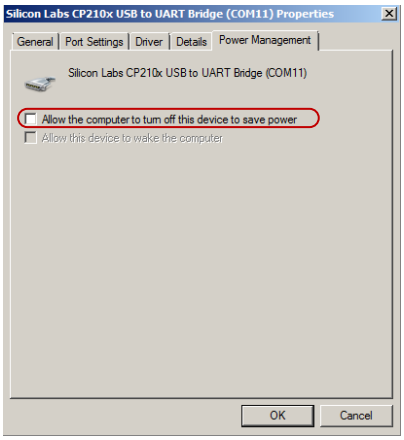
Figure 33 — Schemes of DFM connection to PC

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

Windows automatically detects adapter connected to PC's USB port as USB device and enables virtual COM port driver for it. The virtual COM port will be displayed in the list of ports of Windows Device manager (see figure 34 a).

ATENTION: To work with Service S6 DFM it is recommended:
1) It is recommended to use the same USB port of the PC for adapter connections.
2) Untick power save check box in virtual COM-port properties (see figure 34 b).





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

Figure 34 — Virtual COM-port configuration in Device manager

Service adapter is ready for operation straight after power supply connection. Check for a description of blinking LED-indicators placed on the top of the adapter in table 18.

Table 18 — Description of adapter's LEDs

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

2.6.2 User interface

Service S6 DFM is launched with a  label which is created during the installation process. Service S6 DFM user interface consists of **Horizontal menu**, **Vertical menu, Flow meter's ID area** and **Information and configuration area** (see figure 35).

ATTENTION: In case you face problems with starting Service S6 DFM software in Windows 10, you may need to set starting the software in the mode of compatibility with Windows 7. For this purpose, perform the following operations:
1) Click the right button of the mouse on the service software icon and select its **Properties**.
2) In **Compatibility** tab tick the field **Run this program in compatibility for** (**Compatibility mode** area).
3) Select Windows 7 from the dropdown list of operating systems.

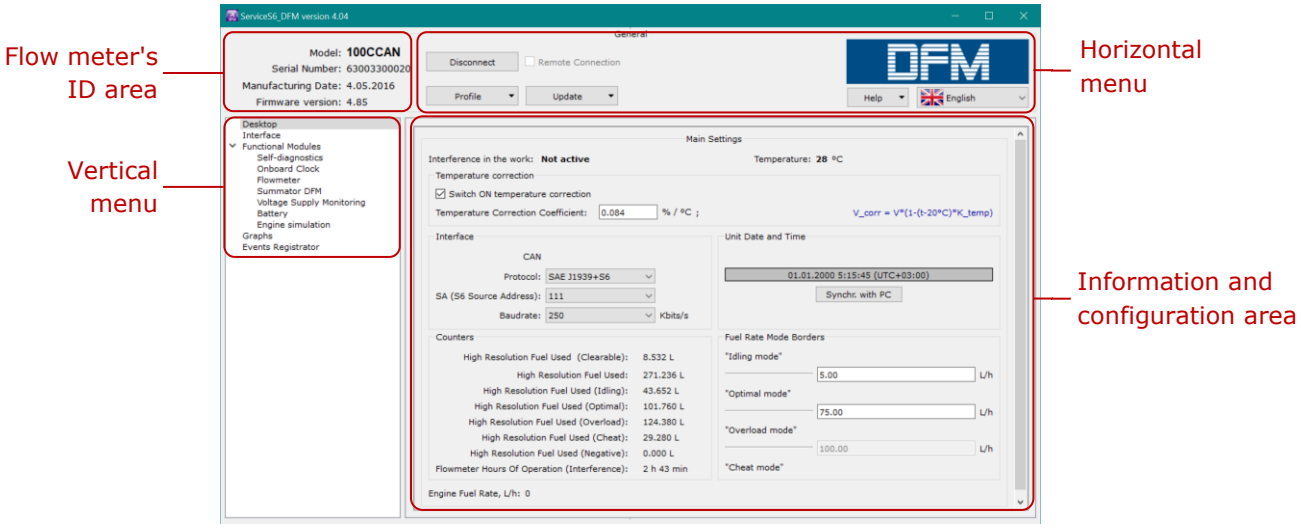


Figure 35 — Service S6 DFM software interface

Flow meter's ID area displays data on model, serial number, production date and firmware version of the connected meter.
Horizontal menu provides following options:

- connection/disconnection of the flow meter, establishing a remote connection;
- meter profile options (loading profile, saving profile, printing profile);
- updating the flow meter firmware and the S6 Database in the software;
- selection of interface language;
- viewing help file and information about the utility.

Vertical menu is used for selection of Functional modules (hereinafter FM) of the meter. The actual parameters of FM and settings are displayed at **Information and configuration area**.
Connectivity of software with FM is based on PGNs and SPNs (S6 Database) exchange. SPNs of DFM Functional module which are read and/or edited in **Information and configuration area** are listed in annex H.
To update the S6 Database in the software (only if the PC is connected to the Internet), use button DB S6 in the drop-down menu Update.
Vertical menu also contains entries on real-time diagnostics of measuring chambers and Events records.

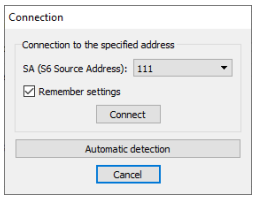
2.6.3 Authorization

To establish connection between PC and DFM push Connect at **Horizontal menu**. You may connect the flow meter to the PC in **Connection** window that opens (see figure 36 a) using one of the two methods:

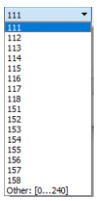
1) By the specified network address (if the address of the flow meter to be connected is known). To accomplish this, select the DFM network address in **Connection to the specified address** area from the dropdown list **SA (S6 Source Address)** from the recommended range of fixed values: **111**; **112**; **113**; **114**; **115**; **116**; **117**; **118**; **151**; **152**; **153**; **154**; **155**; **156**; **157**; **158**. If you don't find any suitable address among the offered addresses, you can enter manually the necessary network address of DFM by selecting it from the range of values **Other: [0...240]**. According to the address specified, Service S6 DFM software will search the flow meter with the address specified and connect to it (see figures 36 b, c). To save the flow meter address specified for the next working session, tick **Remember settings** field.

2) By means of automatic search (if the address of the flow meter to be connected is unknown). To accomplish this, press Automatic detection button. As soon as scanning of the virtual COM-port is completed (see 2.6.1), the window containing the list of all devices connected to the PC will appear, with the number of COM-port and network address (SA) specified for them (see figure 36 d). Lines with DFM flow meters to which connection is possible using Service S6 DFM software will be marked in green in this list. Select the flow meter you need for work in the software and press Connect button (see figures 36 e, f).

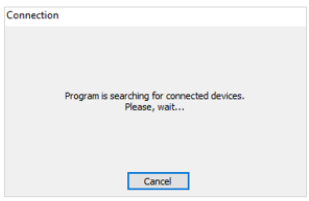
To load the profile of the selected flow meter, enter the login and password into the appropriate field of **Authorization** window. The default Login is **0**. The default password is **1111**. Tick **Remember password** checkbox to save the password for further launches (see figure 36 g).



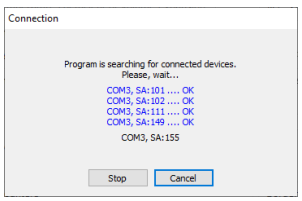
a) window for the flow meter connection to the PC



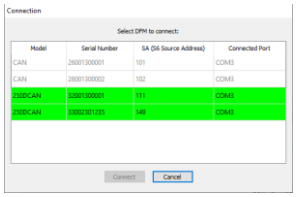
b) selection of the flow meter network address



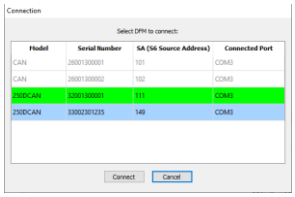
c) search of flow meters connected to the PC according to their specified address



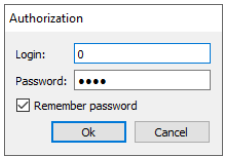
d) automatic scanning of the COM-port



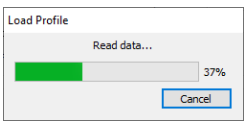
e) list of all devices connected to the PC COM-port



f) selection of the required flow meter for work with the software



g) user authorization



h) loading the flow meter profile

Figure 36 — Establishing connection between PC and DFM

To recover the password (in case it is lost), you need to place the cursor into the **Login** or the **Password** field of the window **Authorization** and press **Ctrl+F10** key combination. Service S6 DFM software will display a code to recover the current password of the Unit (see figure 37). This message is being sent to Technoton technical department by e-mail support@jv-technoton.com together with password recovery request.

Requirements for password recovery request:

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

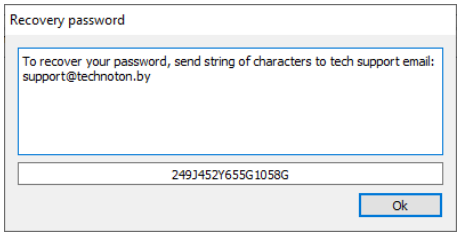
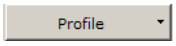


Figure 37 — Generated recovery code window

In case of entering incorrect login/password or in case of wrong connection to PC the software will show an error message.
In case of successful authorization with login and password the software will automatically prompt **Desktop** window (see figure 35), which displays currently connected DFM's configurations and parameter values of Functional modules (see annex H).

2.6.4 Operations with profile

Profile of DFM is represented by a set of PGNs (specifications, counters and configuration of Functional modules of DFM).

For managing DFM profiles in both meter connected mode and autonomous mode 

button with drop-down list is used (see figure 38). This button is placed at **Horizontal menu** of Service S6 DFM. Profile can be stored as a file to PC hard drive or loaded into the memory of the meter. It can be printed as well or to pdf file.

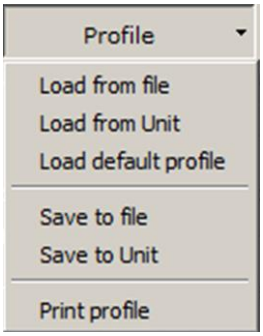
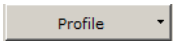


Figure 38 — Profile menu



menu has following entries:

1) Load profile. Service S6 DFM has following options of flow meter profile load:

- Load from file — for loading of previously saved profile from the hard drive or removable disk. Select the **DFM_*.prf** file of the flow meter profile in the appeared Open window.
- Load from Unit — used for loading profile from the connected flow meter.

ATTENTION: When there is an active connection between DFM and PC it is possible to load profile from file of only the same interface as connected Unit. Otherwise the warning message will appear (see figure 39).

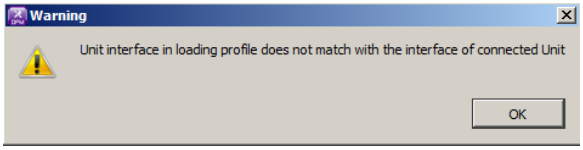


Figure 39 — Warning on interfaces incompatibility of profiles of loaded and connected Unit

- Load default profile — is used for loading profile with default factory settings. With this profile it is possible to study utility operation without real DFM connection. Default profile is stored in **DFM_default.prf** (for one-chamber flow meter) and **DFM_D_default.prf** (for two-chamber flow meter) files in the folder of Service S6 DFM.

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

---

* Maximum fuel consumption, modification and output signal type of the respective flow meter model is specified (e.g. **100CCAN** or **250AK** etc.).

2) Saving profile. Service S6 DFM has following profile saving options:

- Save to file — for saving profile to the hard drive or removable disk. This option is available only for profile loaded from file or Unit.
  Select the location and give a name to file according to format **DFM_*.prf**.
  Enter a name instead of an asterisk in the template. The prefix **DFM_** and the extension **.prf** will be inserted automatically.

ATTENTION: Saved profile then can be loaded only when DFM with the corresponding output interface is connected.

- Save to Unit — is used for saving modified settings into profile of the connected DFM. It is available only during the time when there is an active connection between PC and DFM.
  If the modified settings were not saved into Unit and Disconnect button was pressed or Service S6 DFM window is being closed there will appear a notification. Pressing Yes will save all the unsaved parameters and settings into DFM.

3) Print profile. This window allows selection of the printer and printing settings.

The printed copy will contain flow meter profile data as well as the date when it been printed.

RECOMMENDATION: It is recommended to attach the hardcopy of the profile to the meter's specification to log the history of the settings and configurations.

2.7 Configuration for connection to external terminal unit

Fuel flow meters with pulse output (normalized pulse) interface (**DFM AK/CK/DK**) does not require any output signal configuration.

2.7.1 Configuration of connection using CAN j1939/S6 interface

To connect flow meters with CAN j1939/S6 digital interface to an external device (**DFM ACAN/CCAN/DCAN**) you need to configure parameters of **CAN** output interface in the **Interface** submenu of the service software (see figure 40):

1) From the drop-down menu of **Protocol** (SPN 521530) list choose required data transfer protocol — **SAE 1939+S6** or **NMEA 2000*** (by default — **SAE 1939+S6**).

2) To identify the flow meter within the network of several Units connected by means of S6 Technology, select the flow meter unique network address in the dropdown list **SA (S6 Source Address)** (SPN 521188): from ranges of fixed values **111…118** and **151…158** (by default — **111**).
In case there is no suitable address among offered addresses, you can specify the necessary DFM network address manually, by selecting it from the range of values **Other: [0…240]****.

IMPORTANT: During the configuration of single-chamber DFM CAN for operation in pairs in "Differential" / "Summation" modes (see 2.10) any network address can be specified from **0…240** range of values for the Master flow meter, while network addresses for the Slave flow meters can be specified **only** from the ranges of recommended values **111…118** and **151…158**.

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

ATTENTION: After editing values of parameters of CAN j1939/S6 interface in **Desktop** window of the service software, values of respective parameters in **Interface** submenu will automatically change for same values and vice versa.

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* Preparation for implementation.

** For DFM CAN with the firmware version not lower than 4.69, when using Service S6 DFM software, version 2.05 and higher.

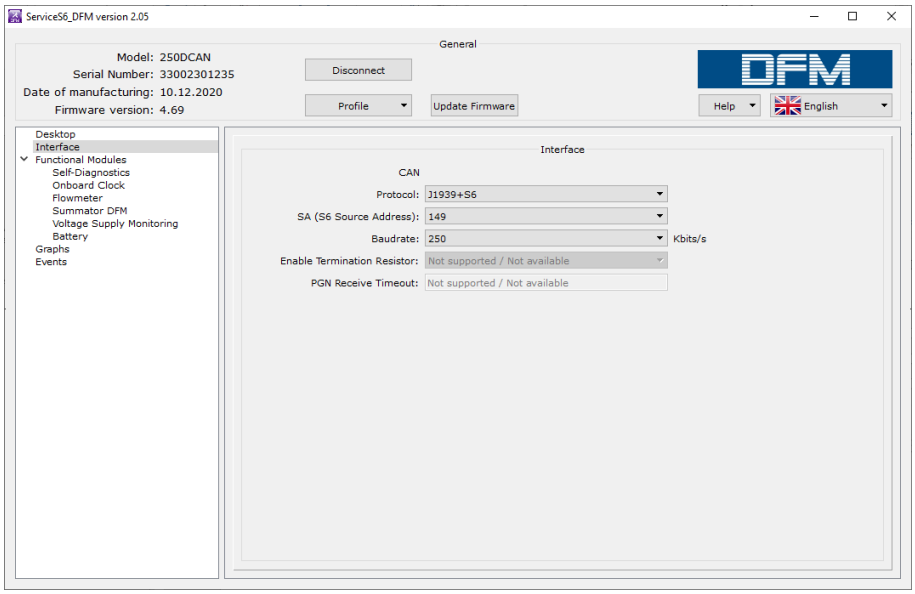


Figure 40 — Flow meter connection parameters settings via CAN j1939/S6 interface in the Service S6 DFM software

2.7.2 Configuration of connection using RS-232/RS-485 interface

In order to connect flow meters with RS-232 and RS-485 digital interfaces (**DFM A232/A485/C232/C485/D232/D485**) to the external device, you are to configure parameters of **Serial RS 232** output interface or **Serial RS 485** output interface in **Interface** submenu of the service software (see figure 41):

1) From the drop-down menu of **Protocol** (SPN 521315) list choose required data transfer protocol — **MODBUS** or **DFM COM** (by default — **MODBUS**).
For **DFM COM** protocol, several additional settings are available in **Operation modes** area:

- **Automatic transmission mode** drop-down list for selection of output data transmission mode:
  - Off — no automatic message transmission, fuel flow meter waits for tracking device request;
  - HEX — automatic message transmission in hexadecimal format (used by default);
  - ASCII — automatic message transmission in text format;
  - ASCII EXT — automatic message transmission in extended text format. Additional **Prefix** and **Postfix** configurable parameters are available for this mode to insert required header or ending of the message (max 32 symbols).
- **Message interval** time period the fuel flow meter automatically sends output message to the tracking device. Parameter value range is 1…255 seconds with 1 second step (by default — **1 s**).

2) In case you connect several DFM 232/DFM 485 at one time, set the network address for each flow meter in the field **Device Address** (SPN 521318). It is allowed to use addresses 0…255 (by default — **111**).

3) From the dropdown list **Baudrate** (SPN 521326) select Baudrate via the serial interface from the following range of fixed values: **2400**; **4800**; **9600**; **19200**; **38400**; **57600**; **115200 bit/s** (by default — **9600 bit/s**).

4) In the area **COM Port Settings** specify data exchange parameters via the flow meter serial interface:

- In the field **Data bits** (SPN 521285) specify the number of data bits which can be transferred between the start bit and stop bit (by default — **8 bits**).
- From the dropdown list **Stop bits** (SPN 521286) select the number of stop bits which is needed for correct identification of the bit end from the following range of values: **1**; **0.5**; **2**; **1.5** (by default — **1 bit**).
- From the dropdown list **Parity** (SPN 521287) select the method of monitoring parity from the following range of values: **None**; **Even**; **Odd** (by default — **None**).
- From the dropdown list **Flow control** (SPN 521288) select the mode of data stream management from the following range of values: **None**; **RTS** (request to send); **CTS** (clear to send); **RTS/CTS** (hardware protocol of data stream management) (by default — **None**).

ATTENTION: After editing values of parameters of RS-232 / RS-485 interface in **Desktop** window of the service software, values of respective parameters in **Interface** submenu will automatically change for same values and vice versa.

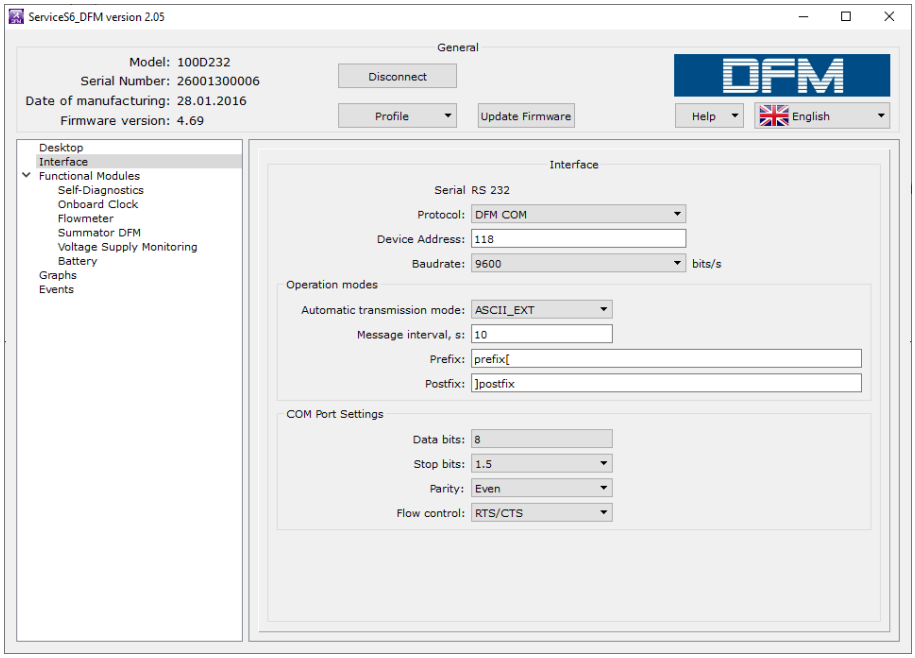


Figure 41 — Flow meter connection parameters settings via RS-232 / RS-485 interface in Service S6 DFM software

2.8 Operation check

To conduct an operation test of the mounted flow meter, you need to use **Graphs** submenu of the service software in which are displayed in real time (see figure 42):

- For one-chamber DFM flow meters:
  - graph of hourly (instant) consumption of fuel, which went through the only measuring chamber (SPN 183);
  - Current Counter values — Total fuel consumption (SPN 5054) and fuel consumption in "Tampering" mode (SPN 5054/9.3).

- For a pair of single-chamber DFM CAN during differential measurement*:

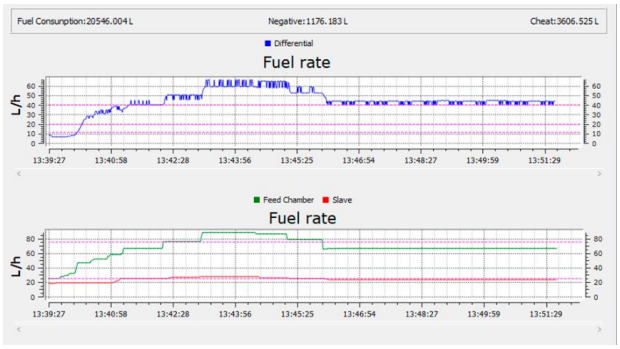
  - graphs of hourly (instant) consumption of fuel flowing through the measuring chambers of the Master flow meter (SPN 521027/18.0) and the Slave flow meter (SPN 521027/18.1) connected to the feed and return lines respectively;
  - graph of differential consumption of fuel flowing through the measuring chambers of the Master and Slave flow meters (SPN 183);
  - Current Counter values — Total fuel consumption (SPN 5054), "Negative" consumption (SPN 5054/9.4) and fuel consumption in "Tampering" mode (SPN 5054/9.3).

- For DFM D differential fuel flow meters:
  - graph of hourly (instant) consumption of fuel, which goes through feed chamber (green line) (SPN 521027/18.0) and through reverse chamber (SPN 521027/18.1) of the flow meter installed on feed and reverse fuel lines. Additionally, the result of two lines – difference in volumes of fuel going through each chamber of the flow meter (SPN 183);
  - Current Counter values — Total fuel consumption (SPN 5054), "Negative" consumption (SPN 5054/9.4) and fuel consumption in "Tampering" mode (SPN 5054/9.3).

Horizontal pink dotted lines display configured boundaries of operation modes (see 1.6.5). You can change configuration of operation modes boundaries in **Flowmeter FM** submenu (see H.3).

* Only for DFM CAN flow meters with the firmware version not lower than 4.63, when using Service S6 DFM software, version 1.27 and higher.

Example for a single-chamber DFM



Example for a pair of single-chamber DFM CAN during differential measurement

Example for a differential DFM D

Figure 42 — DFM operation test with Graphs window in Service S6 DFM software

2.9 Configuration for specific operation conditions

To enhance the accuracy of a flow meter readings in specific conditions of operation, you may specify the following settings with the help of the service software (submenu of **Flowmeter FM**):

1) Set up boundaries of operation modes of DFM, which are used to define current workload of Vehicle depending on its hourly consumption rate (SPN 521392):

- "Idle" – workload less than 10 % of maximal hourly consumption rate;
- "Optimal" – workload 10 to 75 % of maximal hourly consumption rate;
- "Overload" – workload 75 to 100 % of maximal hourly consumption rate.

You may find values of hourly fuel consumption in "Idle", "Optimal", "Overload" modes of operation for a specific type of engine in its operational documentation or define them experimentally.

In one-chamber flow meters a user can adjust only "Idle" (SPN 521392/9.0) and "Optimal" (SPN 521392/9.1) modes. Factory-set configuration for "Overload" mode (SPN 521392/9.2) could not be adjusted.

In differential fuel flow meters a user can adjust all boundaries of operation modes for differential consumption measurement. Factory-set configurations for "Feed" and "Reverse" chambers could not be adjusted (see figure 43).

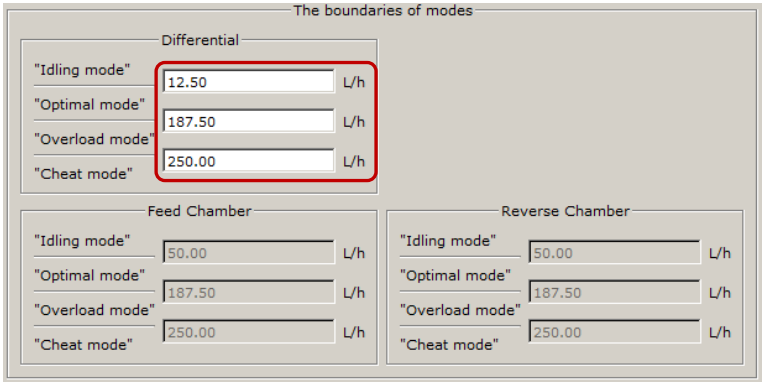


Figure 43 — Example of settings for limits of modes of operation for the differential DFM in Service S6 DFM software

2) Turn on temperature correction function (see figure 44), i.e. automatic correction of fuel volume consumption data adjusted to fuel temperature (SPN 521311).

Temperature correction function is used because volume of fuel changes when fuel temperature is going up/down.

After turning on temperature correction function a user can enter temperature correction coefficient of volumetric expansion (coefficient of volumetric expansion of oil products **β** in relation to temperature change by 1 °C) (SPN 521433).

The value of coefficient **β** is selected for the density of the oil product **ρ** at the temperature +20 °C, in accordance with properties of a specific type of fuel being used.

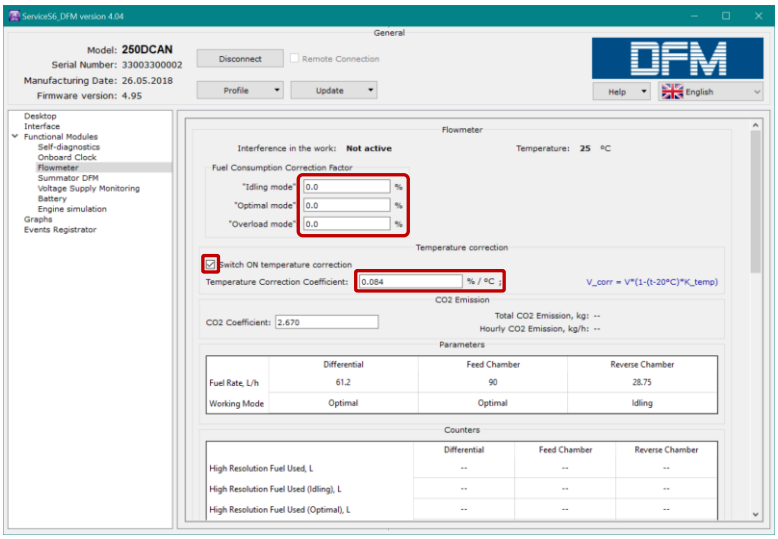


Figure 44 — Example of thermal correction and consumption correction coefficient configuration in Service S6 DFM software

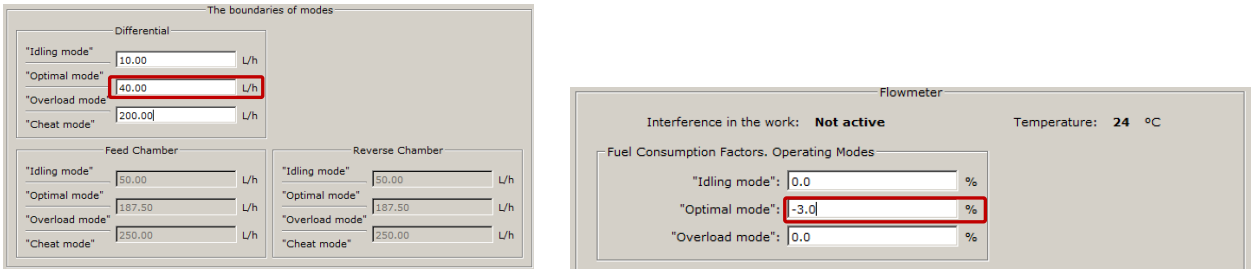
3) Set correction coefficients of fuel consumption, in accordance with modes of operation (PGN 63303) (see figure 44). This parameter makes it possible to improve the accuracy of DFM* fuel consumption measurement, in case of steady too low/too high indications in specific conditions of operation (in conditions of increased vibration level, presence of air in the fuel system, fuel losses in reverese lines from injectors).
Ranges of variation of correction coefficients values: -50…+50 %.
For correct implementation of this feature, you have to perform the following operations:

- Set limits for the flow meter modes of operation by which the current mode of the Vehicle operation is identified, depending on the differential hourly fuel consumption (SPN 521392).
- Test the flow meter measurement accuracy (measurement accuracy test) using testing procedure 3.
- Based on the test results, determine to which mode of the flow meter operation the value of average fuel consumption corresponded during the measurement accuracy test.
- If needed, enter the respective correction coefficient for the mode of operation used during the measurement accuracy test.
  Further on, the flow meter will calculate the fuel consumption value according to the correction entered for this mode of operation. This correction is not applicable for other modes.

---

* For single-chamber models of DFM flow meters with the version of firmware not lower than 4.74, while using the service software (versions from 2.06 and higher).
For differential models of flow meters DFM D with the version of firmware not lower than 4.55, when using the service software (versions from 1.24 and higher).

E.g. based on the results of the measurement accuracy test, the calculated measurement error is + 3 %. The average fuel consumption during the test was 20 l/h. Therefore, the calculated measurement error should be considered as corresponding to the "Optimal" mode of operation (see figure 45 a).
To correct the flow meter operation, you need to specify the value of the correction coefficient for the "Optimal" mode as equal to – 3 %. No correction is needed for other modes of operation ("Idle" and "Overload"). That is why, we leave the values of their correction coefficients equal to 0 % (see figure 45 b).



a) defining average fuel consumption during the measurement accuracy test

b) entering the correction coefficient

Figure 45 — Example of entering the fuel consumption correction coefficient for modes of differential DFM D operation

4) Enable the CO_2 emissions determination function (PGN 63026) (see figure 46). This function is intended for automatic calculation by the DFM electronic module* of total (SPN 521864) and hourly (SPN 521865) CO_2 emissions based on the engine's actual total and hourly fuel consumption values.
To determine total and hourly emissions, enter the value for the relevant fuel type in the **CO_2 Coefficient** (SPN 521863) field (by default, the coefficient value for diesel fuel is set to **2.670**). The function is available for editing in the settings of one-chamber and differential flow meters, including when one-chamber DFM flow meters are used in a differential measurement mode (Master mode).
CO_2 emissions monitoring makes it possible to objectively assess the environmental performance and efficiency of engine operation. For example, a high hourly CO_2 emissions value indicates that the current engine operating mode is overly energy-consuming or inefficient, or both. A high total CO_2 emissions value is a specific indicator of the carbon footprint and total fuel costs for the respective period. The total emissions value should be proportional to the useful work performed.

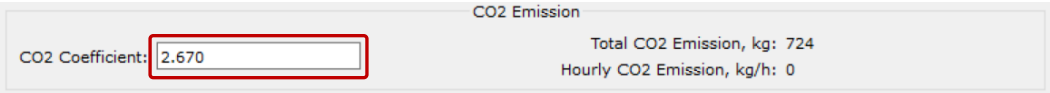


Figure 46 — Example of entering the CO_2 coefficient using the service software

* For flow meters with firmware version 4.84 or later when using service software version 4.04 or later.

2.10 Configuration of single-chamber DFM CAN for operation in pairs in the "Differential"/"Summation" modes

ATTENTION: For operation in the "Differential"/ "Summation" modes you may use a pair of single-chamber DFM CAN flow meters (with a version of firmware not lower than 4.63) connected into a network using S6 Technology.
To operate in "Differential"/"Summarization" mode power supply voltage of flow meters should not drop out of (10…45) V range.

Flow meters are configured in the submenu **Flowmeter FM** of the service software (versions from 1.27 and higher) in the following order (see H.3 and figure 47):

1) In the dropdown list **Master Mode (Differential Operation Mode** area) activate the Master mode (SPN 521268) for the leading flow meter (Master flow meter) and deactivate the Master mode for the led flow meter (Slave flow meter) in the pair being used.

IMPORTANT:
1) During the differential measurement DFM CAN is assigned the role of the Master flow meter which is mounted in the feed fuel line, while DFM CAN mounted in the reverse line is assigned the role of the Slave flow meter.
2) In the summation mode the Master flow meter and the Slave flow meter may be assigned at the discretion of the user.
3) Any network address from 0…240 range of values may be specified for the Master flow meter (see 2.7.1).
4) For Slave flow meters network addresses can be specified **only** from the ranges of recommended values 111…118 and 151…158 (see 2.7.1).

2) In **Calculation Mode** dropdown list enable mode of counting DFM CAN (SPN 521270):

- **Differential** – fuel consumption is calculated as a difference between fuel consumption measured by flow meter in feed and return lines.
- **Summing** – fuel consumption is calculated as a sum of fuel consumption measured by flow meter in first and second fuel lines.

ATTENTION: It should be noted that during work with the service software (versions from 2.05 and higher) the following values of Counters are displayed in **Desktop** window, depending on Master mode status:
1) Counters of differential fuel consumption (PGN 62992) (in Master mode activated).
2) Counters of fuel consumption for the fuel supply line (PGN 62993) (Master mode is off).

3) Enter a unique network address in **Slave Device Address** field for Slave-flow meter (SPN 521269). Elected address should not be the same as Master-flow meter has.

4) For Master flow meter, you may specify values of limits of hourly fuel consumptionin "Idle", and "Optimal" modes, as well as limits of differential hourly fuel consumption for "Idle", "Optimal", and "Overload" modes (PGN 63205) (similar to 2.9, setting **Set up boundaries of operation modes of DFM**).

5) If necessary, enter **Differential Fuel Rate Correction Coefficient** (SPN 521271) for Master-flow meter to increase accuracy of measurement (similar to 2.9, see **Configure consumption correction coefficient**).

6) To increase accuracy of differential measurement for complex objects, which have uneven flow rate in feed and return fuel lines (e.g. fuel pulsation, increased fuel system inertia, waterhammers etc.), **Smoothing Capacity** (smoothing buffer) of Master flow meter can be configured (SPN 521671).

The value of the attenuating buffer is selected experimentally from the range of conventional units **2...100**. Here, one conventional unit corresponds to the volume of Master flow meter measuring chamber. Thus, the selected value of the attenuating buffer will correspond to the conventional capacity that would be equal to the sum of the measuring chambers volumes.

In case of even flow rate in feed and return lines, it is recommended to enter minimum value of buffer (in majority of cases default value **5** is enough). When unevenness of flow rate in feed and return lines is growing, it is recommended to increase value of smoothing buffer.

WARNING: Keep in mind, that increasing smoothing buffer leads to:
1) Values of Counters of differential fuel consumption recalculated for Master flow meter may remain unchanged for several minutes during the initial period of engine operation.
2) After fuel supply is stopped, values of Counters in Master flow meter are stabilized not sooner than in 15 seconds.

To get recommendation on configuring smoothing buffer for particular case, contact Technoton technical support team.

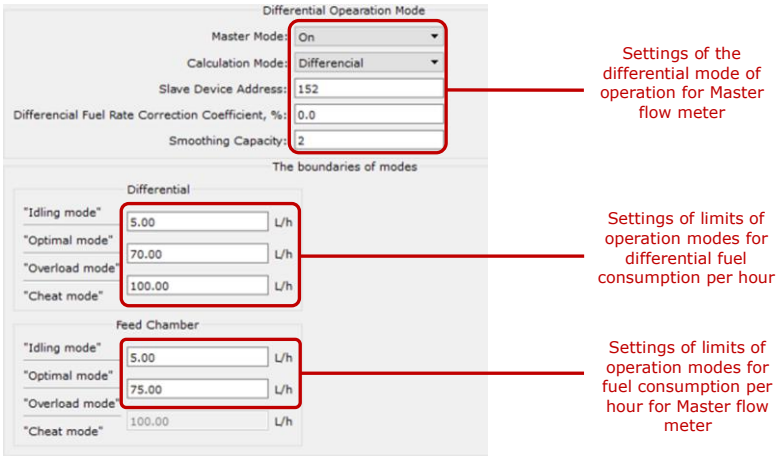


Figure 47 — Examples of configuring DFM CAN for "Differential" operation mode in Service S6 DFM software

2.11 Summation of fuel consumption readings

ATTENTION: For summation of fuel consumption in two or more fuel lines (16 at a maximum) you may use DFM CAN / DFM DCAN flow meters (firmware version not lower than 4.63) connected into a network using S6 Technology in any type/size combination (see tables 1 and 2).
Before, each flow meter is to be assigned the unique network address from the ranges of recommended values (111…118) or (151…158) (see 2.7.1).

The flow meter which is to provide the signal of the fuel consumption sum is configured in the submenu **Summator DFM FM** (see H.4 and figure 48) of the service software (versions from 1.27 and higher) in the following order:

1) Tick **DFM Summation Mode Enable** field (SPN 521689) in **DFM Summation Settings** area.

2) Tick those flow meters of the fields **DFM 1 (111)…DFM 16 (158)** whose readings you need to sum up.

IMPORTANT: During the summation of readings of the flow meters that operate in pairs in the "Differential" mode (see 2.10) you need to tick only the fields of the Master flow meters.

WARNING: In case output data from any of the selected flow meters are missing (e.g. due to disconnection or malfunction), the appropriate message specifying the flow meter number will be displayed in **Summation Errors** field.

3) After saving the flow meter Profile in the Unit, the value of the fuel consumption total shown by the Counters is to be displayed in the line **Fuel Consumption High Precision, L** for the selected flow meters (SPN 5054/2.11).

Examples of connection diagrams of DFM CAN flow meters using S6 Technology for summation of fuel consumption readings including the specification of cabling to be ordered are provided in CAN j1939/S6 Telematics interface Operation Manual.

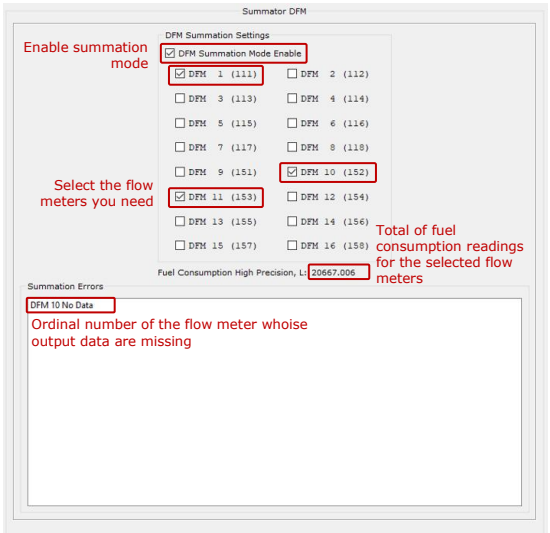


Figure 48 — Example of DFM CAN configuration for summation of the fuel volume readings in Service S6 DFM software

2.12 Activation of DFM S7 BLE-module

ATTENTION: Wireless transfer of readings from DFM S7 by means of S7 Technology to the tracking device (Telematics terminal, smartphone/tablet, data display etc.) is possible only **after activation of the flow meter BLE-module**.

Fuel Rate Monitor mobile application serves for readings presentation on the display of a smartphone/tablet by means of S7 Technology, as well as for firmware update of DFM S7 wireless fuel flow meters. You can install the application at Google Play application store (search request "Technoton") (see User manual).

DFM S7 has the following modes of operation determined by the status of its BLE-module activation:

1) "Storage" — the flow meter is in this mode from the moment it is manufactured. The BLE-module of DFM S7 is disabled, no data transmission at all.

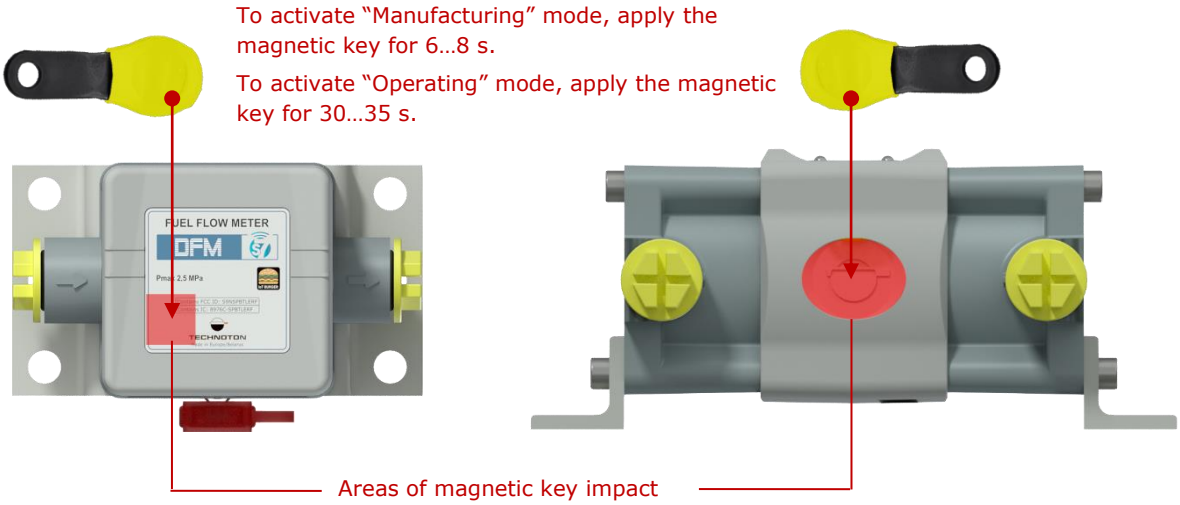
2) "Manufacturing" — in this mode, the BLE-module of DFM S7 is activated for data transmission only for the period of the flow meter testing or checking its operability with Fuel Rate Monitor application.
To activate this mode from "Storage" mode, apply the magnetic key (see the delivery set) **for 6..8 s** to the place on the flow meter casing where the flow meter electronic module is located (see figure 49).
After the period of **4 h**, or after a second touching the indicated place during **6...8 s** by the magnetic key, the BLE-module of DFM S7 will switch over again to "Storage" mode.

3) "Operating" — this mode is enabled immediately before mounting DFM S7 into the fuel line of the consumer. In the "Operating" mode, the BLE-module is enabled completely, without the possibility to return to the inactive state. After that, the flow meter is ready to transfer data by means of S7 Technology throughout the whole period of its service life.
To activate "Operating" mode from "Storage" mode, apply the magnetic key **for 30...35 s** to the location indicated on the flow meter electronic module.

4) "Service" — this mode serves to update the inbuilt firmware of DFM S7 flow meter.

- To switch over DFM S7 into "Service" mode from "Storage" mode, you need to apply the magnetic key **for 6...8 s** to the location indicated on the flow meter electronic module. "Service" mode is activated only for 20 s during which you are to establish communication between the flow meter and the mobile device, for further firmware update.
  In case the communication with the mobile device is not established during 20 s after switching DFM S7 into "Service" mode, the flow meter will automatically switch back into the "Operating" mode.
- To switch over DFM S7 into "Service" mode from "Operating" mode, you need to apply the magnetic key **30...35 s** to the location indicated on the flow meter electronic module. "Service" mode is activated only for **20 s** during which you are to establish communication between the flow meter and the mobile device, for further firmware update.
  If the communication with the mobile device is not established after switching DFM S7 into "Service" mode, the flow meter will automatically switch back into "Operating" mode.

WARNING: You should note that after its firmware update, DFM S7 **always switches over into "Storage" mode**, irrespective of the initial mode in which it was before the firmware update.



a) for one-chamber flow meter *b) for differential (two-chamber) flow meter*

Figure 49— Activation of DFM S7 BLE-module

IMPORTANT: As soon as mounting of DFM S7 is completed, you need to **make sure by all means** that the flow meter is switched into "Operating" mode (see Operation manual).

WARNINGS:

1) To eliminate connection failures between the DFM S7 and the mobile device, you need to make sure that there are no sources of electromagnetic interference near your working place (radio telephones, video signal transmission units and other wireless devices operating within 2.4 or 5.0 GHz frequency bands, as well as running electric motors, powerful transformers and switching equipment, welding equipment, high-voltage lines etc).

2) The maximum allowed distance between the DFM S7 and the smartphone/tablet depends on the quality of the Bluetooth connection of the mobile device. To assure the stable data transmission, it is recommended that this distance should not exceed 15 m.

2.13 Remote connection to DFM CAN using a control command from the UNUM IIoT Platform Server

Using a control command from the UNUM IIoT Platform Server or via SMS through a CANUp 27 Pro LTE / Pro Wi-Fi / Genset telematics gateway ready to receive such commands, it is possible to establish a remote connection to DFM CAN flow meters connected to the gateway via S6 Technology using the ServiceS6 DFM service software.

After a remote connection to DFM CAN is established, remote configuration / data viewing / diagnostics are available. Remote firmware update of flow meters is not supported.

IMPORTANT:
1) Remote connection is available for DFM CAN with firmware version 4.84 or later when using ServiceS6 DFM service software version 4.04 or later.
2) PC which will be used for remote connection to CANUp 27 should have:
- open network port for external connections;
- static IP address on the Internet (provided by your Internet Service Provider).

3) To ensure stable operation of in-built communication module of CANUp 27 during remote configuration, it is necessary to provide:
- supply voltage within its limits — range 9…45 V;
- stable Internet connection to the remote Unit.

To connect by means of a control command from the Server of UNUM IIOT Platform to a remote DFM CAN, perform the following operations:

1) Connect the CANUp 27 to a telematics service based on the UNUM IIoT Platform (see details in the document CANUp 27 telematics gateways. Operation manual).
2) In the window of Dashboards templates management (**Management** tab) of telematics service enter and create a Template with **Command** widget (see details in the document UNUM IIoT Platform. Industry Solution Administrator Guide).
The **Command** widget has a button to send a preset Server command, to enable remote access to a Unit. While configuring the widget, you need to fill all obligatory fields marked with* (see figure 50):

- **Select command*** — choose the command for remote connection (**206.Remote connection**) from the dropdown list;
- **Command name*** — enter the name of the button to execute the remote connection command;
- **DA***— enter the network address of remote connection command destination (for CANUp 27 — **100**);
- **IP Address/Domain*** — specify the IP address of the PC from which the remote connection will be executed;
- **Port*** — specify the PC open network port from which the remote connection will be executed.
- **Bus Address*** — specify the network address via CAN j1939/S6 interface for the Unit which is to be remotely connected (for CANUp 27 — **100**).

IMPORTANT: To establish a remote connection to the required DFM CAN via CANUp 27 when configuring the widget, you must first **determine the specific network address** of the flow meter. This address must then be entered in the required **Bus Address*** field of the Dashboard template widget for remote access to the corresponding Unit.

3) Assign a name to the created Dashboard template and link it to the needed Asset.

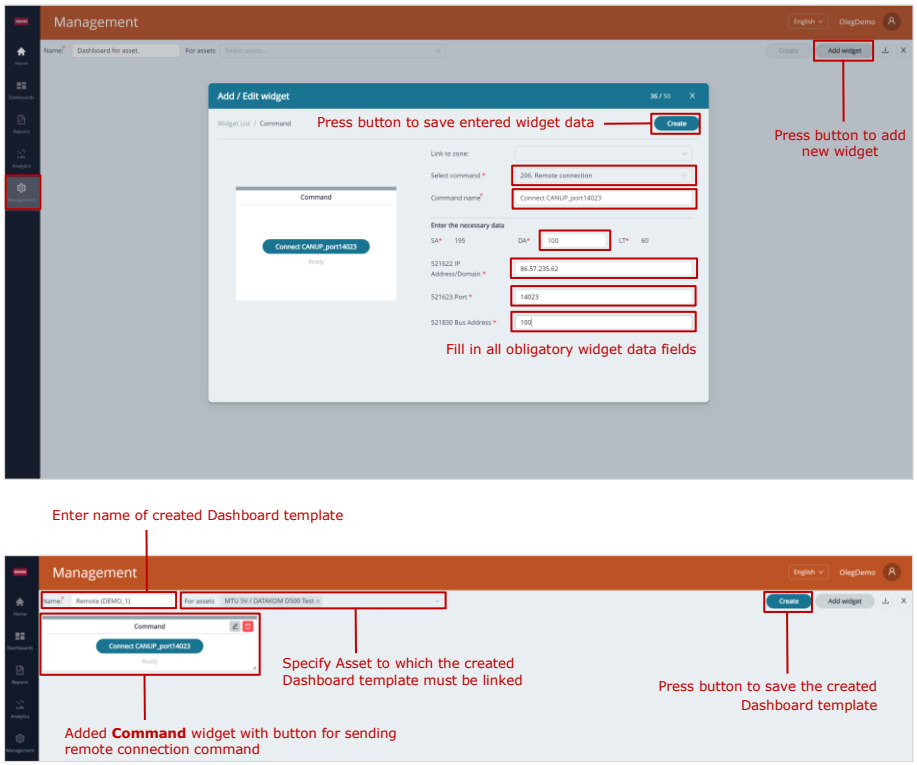


Figure 50 — Creation of a Dashboard template with a widget of a remote connection command

4) In the **Horizontal menu** of ServiceS6 DFM software tick **Remote connection** field and press Connect button (see figure 51 a).

5) After the window which displays Units with which remote connection can be established appears, it is followed by the **Connection settings** window in which you are to enter the selected PC network port from which the remote connection will be executed.

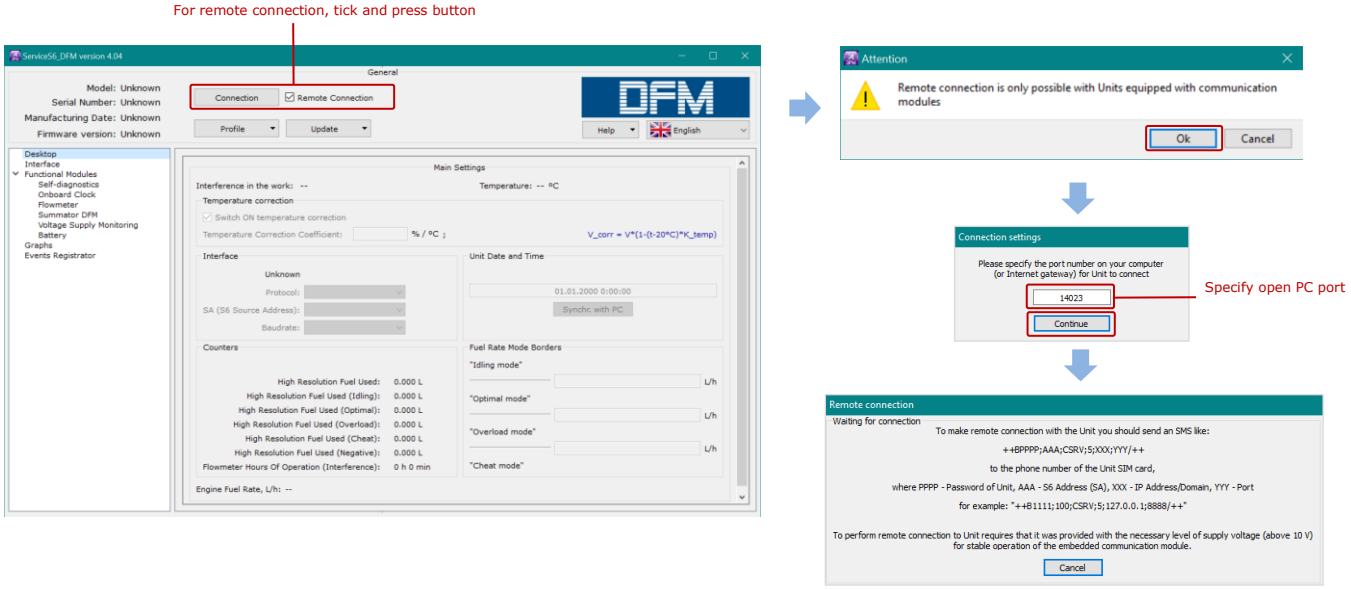
6) After **Remote connection** window appears in the service software, open the appropriate Dashboard of remote connection in UNUM IIOT Platform. By pressing the **Command** widget button, enable the remote connection command (see figure 51 b). This command initiates the Internet connection for the needed DFM CAN connected to the gateway.

Completed successfully message under **Command** widget button notifies of successful connection initiation, while Not completed message indicates unsuccessful initiation.

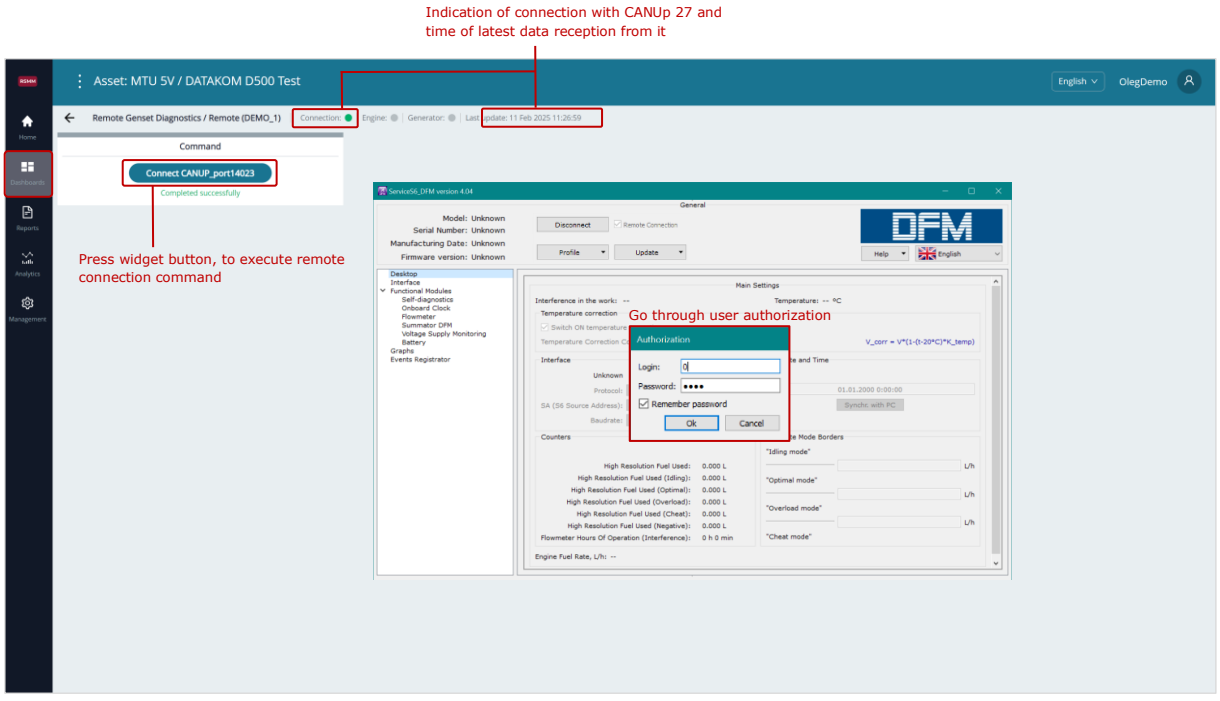
IMPORTANT: Before sending the command, make sure that the corresponding Object is connected to the UNUM IIoT Platform Server (green indicator Connection: is on) and data is being transmitted to the Server.

The maximum waiting time for connection to the remote DFM CAN after the command from Server is sent is **30 s**. If no connection is established during that time, you are to repeat the attempt, to get connected.

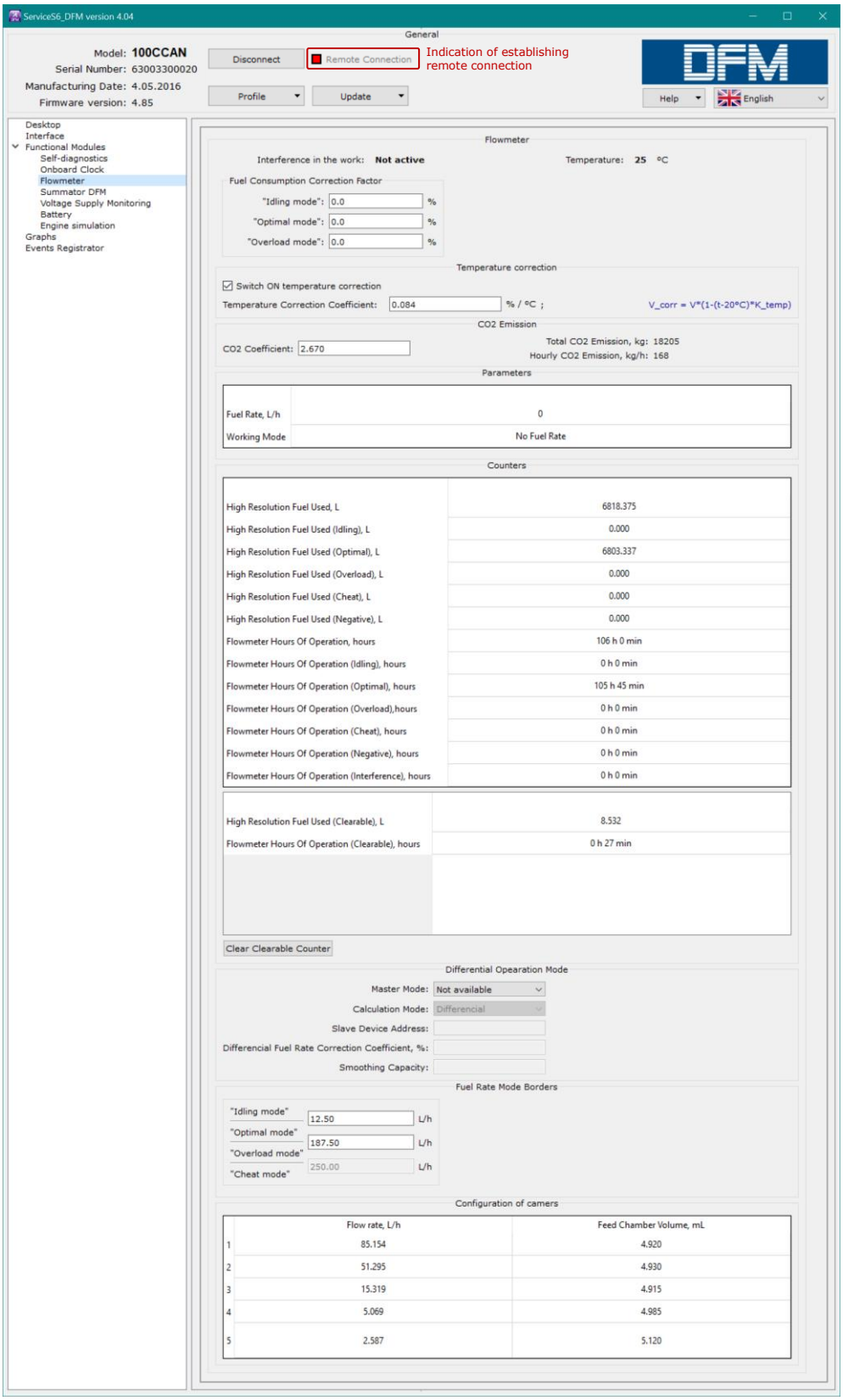
7) After the remote connection to the Unit is established, go through authorization (similar to 2.6.3). As soon as loading of the Unit profile is completed, the **Remote connection** field will change its color to red; settings and current values of Functional modules parameters of the remote Unit will be displayed in the service software (see examples in figures 51 c).



a) example of enabling remote connection and configuration of the PC network port in the service software



b) example of establishing a communication session between the PC and remote DFM CAN



c) examples of windows with indications of fuel consumption of a remote DFM CAN flow meter

Figure 51 — Establishing a remote connection to the DFM CAN flow meter via a CANUp 27 operating with it in the same network using a [UNUM IIoT Platform](#) Server command

3 Measurement accuracy check

ATTENTION: To determine measurements accuracy of DFM flow fuel meter mounted on the vehicle it is required to carry out a test.
Measurement accuracy check is an obligatory procedure, which defines relative inaccuracy of fuel consumption measurement on equipped Vehicle.

3.1 Test conditions

Tests must be conducted in presence and under control of representatives of all interested parties.

Only people who have studied DFM and recording devices operational documentation and who have experience with testing equipment are allowed to conduct the tests.

Install the DFM fuel flow meter and connect it to recording and display devices. Conduct all works in accordance with the installation manuals for fuel flow meters and recording and display devices.

Conditions of the test:

- tests are conducted on properly operating (fault-free) Vehicles. Before starting the test, remove air from the fuel system and warm up the engine to operating temperature;
- fuel must not contain any mud or other impurities;
- the engine must run at medium speed (RPM);
- duration of the tests — until running out of up to at least 2/3 of the average hourly fuel consumption by the consumer;
- engine shutdown is not allowed during the test;
- to measure the volume of fuel in tank during the tests, it is necessary to use the certified measuring instruments (measuring ruler or a measuring capacitance).

3.2 Conducting the tests

1) Pour fuel into Tank 1. The amount of fuel must be enough to eliminate air from the fuel system and warm up the engine (see figure 52).

2) Use a verified measuring container to fill Tank 2 with testing fuel in the amount of 10 liters.

3) Connect fuel pump inlet with Fuel line 1.

4) Put the other end Fuel line 1 into Tank 1.

5) Put reverse Fuel line 2 in to Tank 1.

6) Disconnect the injectors reverse line from the fuel tank and put it into Tank 1.

7) Use manual pump of the fuel pump to pump through the fuel system in order to remove air.

8) Start the engine and let it warm up to operating temperature. At the same time make sure there is no air coming out from reverse Fuel line 2.

9) Simultaneously close inlets of Fuel pipes 1 and 2 and stop the engine.

10) Move Fuel pipes 1 and 2 from Tank 1 into Tank 2 (the air must not get into the hoses).

11) Close inlet of injectors reverse Fuel pipe 3 and move it from Tank 1 into empty Tank 3.

12) Record the initial readings of the DFM according to the readings of a tracking device or the DFM display.

13) Record the time when the test was started.

14) Start the engine and set medium run.

15) Let the engine run until Tank 2 is empty. At the same time air cannot be let into Fuel pipe 1.

16) Stop the engine.

17) Measure the fuel left in Tank 2 (V_{remain}) with a verified container.

18) Use a verified container to measure **actual fuel consumption** from Tank 2 (V_m=10 l–V_{remain}).

19) By difference of initial and final DFM readings determine **measured fuel consumption** ($V_{measured}$).

20) Calculate the **relative measurement error of fuel consumption** by the formula:

$$\delta = \frac{V_{measured} - V_m}{V_m} \cdot 100\%$$

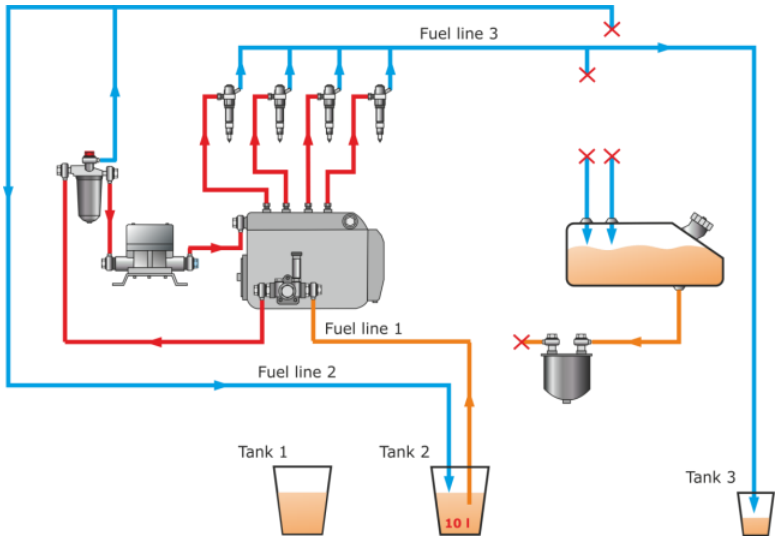
where $V_{measured}$ – measured fuel consumption, l;

V_m – actual fuel consumption, l.

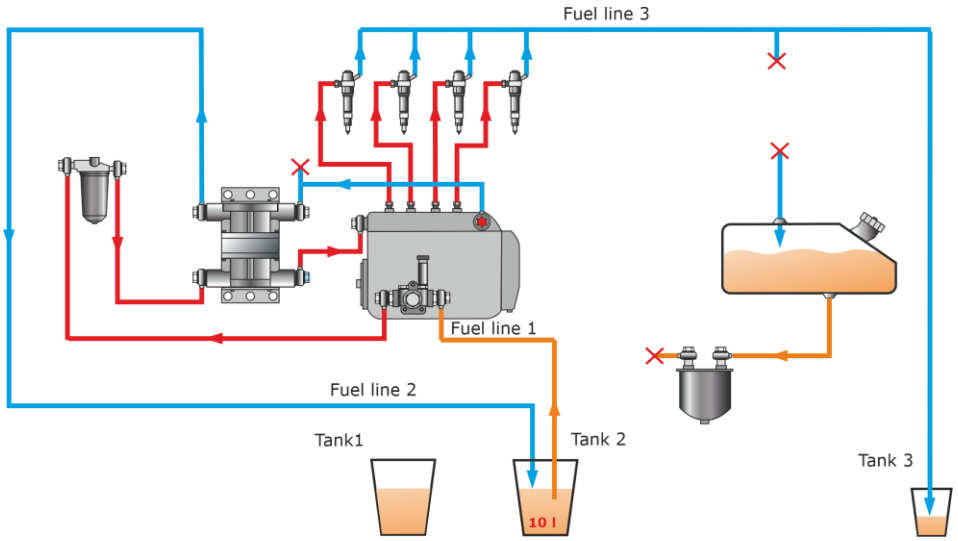
21) Use a verified container to determine **actual fuel amount from the injectors reverse line** ($V_{inj.return}$).

22) Determine the **proportion of the reverse flow from the injectors in overall fuel** consumption for a tested vehicle by the formula: $\frac{V_{inj.return}}{V_m} \cdot 100\%$.

23) Record the result into the protocol. See annex C for protocol template.



a) for one-chamber flow meter



b) for two-chamber flow meter

Figure 52 — Examples of Fuel system schemes during testing

IMPORTANT:

When carrying out accuracy test of DFM flow meter, you can use the values from "Total fuel consumption" Counter (see H.3), at the same time:

- **keep in mind**, that there is a 12 s time lag in DFM with display between the moment when values appearing on the display of flow meter and sent to output interface of flow meter (see table 6).
- **It is not recommended** to use data from "Total fuel consumption" Counter when signal transmission is set to **HEX** (see 2.7.2) data format because the step of increasing values in the Counter is 1 l in this mode.
- **It is possible** to use data from "Total fuel consumption" Counter when signal transmission is set to **ASCII** (see 2.7.2) data format because the step of increasing values in the Counter is 0.005 l in this mode.

4 Accessories

To install, connect, and operate DFM fuel flow meters Technoton offers **high quality accessories.**

4.1 Mounting kits

The DFM mounting kits (further on — MK DFM) are designed for quick and firm DFM flow meters connection to the engine fuel system using pipes of 8 and 10 mm in diameter.

MK DFM use only high quality components designed for use in the fuel system of Vehicles.

MK DFM distinctive features

- No burrs and shavings which can be found in kits from other manufacturers. **No clogging and fuel system malfunction!**
- Increased nominal bore to preserve the pressure in the fuel system. **The engine does not lose power!**
- Made of high-strength metals, resistant to wear and corrosion. Hot stamping and groove manufacture technology used. **Lifetime of the kit elements significantly increases!**
- Threaded connections of the kit elements meet the standards of the fuel systems of leading automakers. **Elements are mounted easily and quickly!**
- Special valves are included into each kit. Specifications of the valves conform fuel system requirements. **No engine failure due to jamming of the valve!**
- Fittings, valves, banjo bolts have holes for sealing. **No fuel thefts and unauthorized tampering into fuel system!**

Table 19 — MK DFM application

Kit name	Application
DFM MK 20B	All-purpose, for mounting DFM 50/90/100/220/250 one-chamber flow meters using 8 mm fuel pipe
DFM MK 40B	All-purpose, for mounting DFM 50/90/100/220/250 one-chamber flow meters using 10 mm fuel pipe
DFM MK 45B	All-purpose, for mounting DFM 500 single-chamber flow meters using 10 mm fuel pipe
DFM MK 90B	To install DFM 50/90/100/220/250 one-chamber flow meters on D243, D245 and D260 engines using 8 mm fuel pipe
DFM MK 100B	To install DFM 50/90/100/220/250 one-chamber flow meters on YaMZ, KAMAZ engines using 8 mm fuel pipe
DFM MK DIFF11B	For mounting DFM 100D and DFM 250D differential flow meters using 10 mm fuel pipe
DFM MK DIFF21B	For mounting DFM 500D differential flow meters using 10 mm fuel pipe

MK DFM sets (see table 20) are selected on the basis of many years of experience of installing fuel flow meters on various types of machinery.
There are differences in compositions of MK DFM for differential and one-chamber flow meters depending on an installation scheme and engine features of a Vehicle.

Table 20 — MK DFM components

View	Component name	Description	Kit name						
			DFM MK 20B	DFM MK 40B	DFM MK 45B	DFM MK 90B	DFM MK 100B	DFM MK DIFF11B	DFM MK DIFF21B
	Banjo bolt BB 14	To couple the fuel line and the flow meter to the units of the fuel supply system of the engine (high pressure fuel pump or fine fuel filter)	3	3	2	2	3	8	4
	Banjo bolt BB 16		-	-	1	-	-	-	4
	Banjo bolt double BB 14/2	To couple two branches of the fuel line to the units of the fuel supply system of the engine (high pressure fuel pump or fine fuel filter)	1	1	1	1	-	-	-
	Banjo fitting BF 14/8	For connection of 8 mm fuel pipe to mounting elements	8	-	-	6	4	-	-
	Banjo fitting BF 14/10	For connection of 10 mm fuel pipe to mounting elements	-	8	6	-	-	8	4
	Banjo fitting BF 16/10		-	-	2	-	-	-	4
	Non-return valve K10	To eliminate hydraulic shocks influence on the measurement accuracy of the flow meter (white valve)	1	1	-	1	1	2	-
	Non-return valve K15		-	-	1	-	-	-	2

View	Component name	Description	Kit name						
			DFM MK 20B	DFM MK 40B	DFM MK 45B	DFM MK 90B	DFM MK 100B	DFM MK DIFF11B	DFM MK DIFF21B
	Bypass valve K20	To release excessive pressure in the fuel line at the output of the booster pump	1	1	1	-	-	-	-
	Bolt plug BP14	To plug the high pressure fuel pump hole to the reverse line	1	1	1	1	1	-	-
	Nipple adapter NA 14-14	To connect the fuel line with a reverse fuel line through the bypass valve	1	1	1	1	-	-	-
	Nipple adapter NA 14-20	To reverse the reverse fuel line from the fine filter via the bypass valve	1	1	1	-	1	-	-
	Nipple adapter double NA 10-14/2	For joining two fuel lines with heater line	1	1	1	-	-	-	-
	Nipple adapter double NA 10-16/2	For joining two fuel lines with heater line	-	-	1	-	-	-	-
	Copper washer CW 14-19	To seal connections	16	16	12	14	11	16	8
	Copper washer CW 16-21	To seal connections	-	-	4	-	-	-	8
	Copper washer CW 20-26	To seal connections on the fine filter of YaMZ engines	1	1	1	-	1	-	-
	Hose clamp HC 10-16	To fix 8 mm fuel hose onto the banjo fitting or filter	8	8	8	6	4	8	8

View	Component name	Description	Kit name						
			DFM MK 20B	DFM MK 40B	DFM MK 45B	DFM MK 90B	DFM MK 100B	DFM MK DIFF11B	DFM MK DIFF21B
	Bolt B8x16	To mount the flow meter to the bracket	4	4	4	4	4	4	4
	Nut N8	To mount the flow meter to the bracket	4	4	4	4	4	4	4
	Washer W8	To mount the flow meter to the bracket	4	4	4	4	4	4	4
	Lock washer WL8.65	To mount the flow meter to the bracket	4	4	4	4	4	4	4

ATTENTION: The Manufacturer reserves the right to modify the MK DFM sets and replace components with equivalent ones without prior customer notice.

4.2 Connecting cables

Table 21 — Connection cables for electrical connection of DFM with interface cable

View	Component name	Description
	S6 SC-CW-700 signal cable (see annex J)	It is designed to connect fuel flow meters having CAN j1939/S6 or RS-485 interface to recording and display devices and to external power supply. 7 meters long. Equipped with 2 terminating resistors (120 Ohm). If needed, one of the terminal resistors may be disabled. Not included into delivery set.
	S6 SC-CW-700-RS signal cable (see annex J)	It is designed to connect fuel flow meters having RS-232/ RS-485 interface or pulse output (normalized pulse) to recording and display devices and to external power supply. 7 meters long. Not included into delivery set.
	CABLE DFM 98.20.003 signal cable (see annex J)	It is designed to connect fuel flow meters having pulse output (normalized pulse) to recording and display devices and to external power supply. Length – 7.5 m. The cable is included in delivery set of DFM AK/CK/DK.
	CABLE DFM 98.20.001 signal cable (see annex J)	It is designed to connect fuel flow meters having pulse output (non-normalized pulse) to tracking devices and to the external power supply. Length – 7.5 m. The cable is included in delivery set of DFM AP.
Note – Designations of models of additional cables and other S6 system components which may be needed for connection of DFM CAN using S6 Technology are provided in j1939/S6 Telematics Interface Operation Manual.		

4.3 Additional accessories

Additional accessories may be required for DFM mounting and maintenance depending on fuel system configuration and selected mounting scheme (see table 22).

Table 22 — DFM additional accessories

View	Marking	Name	Description
	KP2	Fixing rack for DFM	All-purpose, for single-chamber DFM, 150x105 mm. Fixed by bolts
	BB 14	Banjo bolt	M14, with a hole for sealing
	BB 16		M16, with a hole for sealing
	K10	Non-return valve	(0.25…0.5) bar, white, M14x1.5, with a hole for sealing
	K15		(0.25…0.5) bar, white, M16x1.5, with a hole for sealing
	K20	Bypass valve	(1.0…1.5) bar, red, M14x1.5, with a hole for sealing
	BF 14/8	Banjo fitting	For tube Ø 8 mm to M14 bolt
	BF 16/10		For tube Ø 10 mm to M16 bolt
	HC 10-16	Hose clamp	For tube Ø 8 and 10 mm, with a hole for sealing
	NA 1/4-14	Adapter fitting	Inch thread/metric thread (mm) adapter. For the deaerator
	FT 240-1117010	Fuel fine filter	For mounting as additional fine filter, when the flow meter is mounted according to “before the pump” scheme
	FUB dn10x3	Fuel tube	Bundle 8 m, for Ø 10 mm fuel tube, (-30...+100) °C

4.4 Deaerators

Air bubbles which come into the fuel supply system from the fuel tank or feed fuel line can lead to engine (boiler) operation malfunctions and even engine stop. Also cause an increase of harmful emissions. DFM measurement is not correct if there is a lot of foam in the fuel line.

Technoton recommends to purchase and mount **DFM DA 250 deaerator** or **GE 0.6 gas eliminator of a fluid meter** (see the detailed description in the deaerators operation manuals), to delete air bubbles from the fuel and to prevent their penetration into the fuel system (see figure 53).

a) DFM DA 250 deaerator

b) GE 0.6 gas eliminator of a fluid meter

Figure 53 — Deaerators external view

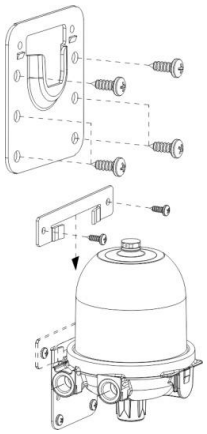
Distinctive features of deaerators:

- increases flow meter accuracy;
- decreases engine (boiler) malfunction possibility;
- increases service life of the fuel system;
- provides an effective and stable combustion of fuel;
- improves the environmental parameters of the combustion process and reduces emissions.

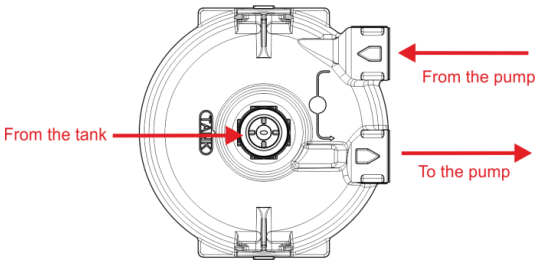
Table 23 — Technical characteristics of deaerators

Parameter, units	Values	
	DFM DA 250 deaerator	**GE 0.6 gas eliminator of a fluid meter**
Fuel types	diesel (EN 590), biodiesel (EN 14214)	
Maximum fuel consumption, l/h, not more than	250	1000 (effective flow rate up to 600)
Maximum operating temperature, °C	+85	
Maximum working pressure, MPa	0.6	2.5
Fuel lines connection	female thread 1/4”	male thread 3/4”
Overall dimensions, mm, not more than	136 x 95 x 97	354 x 170 x 120

IMPORTANT:
1) The deaerator is to be mounted in the strictly vertical position in the engine compartment of a Vehicle/Diesel generator or near the boiler burner.
2) During mounting the deaerator **it is forbidden to drill the vehicle frame!** The deaerator mounting elements are screwed with self-tapped screws to the side wall of the engine compartment of the asset to be equipped. In case the deaerator cannot be mounted using self-tapped screws, spot weld is allowed.
3) The space between deaerator and heated and moving parts of the engine or unisolated boiler parts should not be less than **30 cm**.

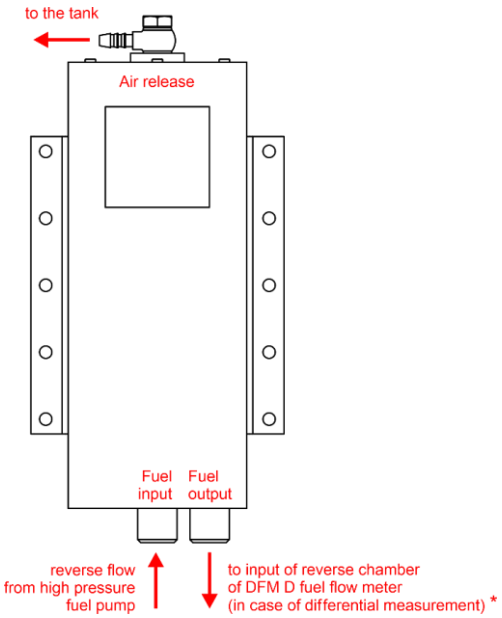


fastening



fuel lines connection

a) DFM DA 250 mounting



* To the low pressure fuel pump, in the connection scheme "before the pump", using the single-chamber DFM flow meter.

b) connecting the fuel lines to GE 0.6

Figure 54 — Installation of deaerators

Check out the interactive animation video for cases when deaerator is required as well as for examples of deaerator mounting schemes for various types of fuel supply systems DFM fuel flow meters: selection of installation layout, accessories and mounting kit.

5 Registered Events control

To monitor Events recorded by DFM and saved in its internal memory, connect the flow meter to the PC (see 2.6.3).
Select **Events** submenu (in the service software) (see figure 55) in which lists of **Important Events** and **Information Events** are displayed (total of 15 recent Events of each type).

1) Important Events include:

- flow meter tampering (indicating total tampered volume);
- interference in flow meter operation (indicating total interference time);
- low level of supply voltage (indicating voltage value);
- high level of supply voltage (indicating voltage value).

2) Information Events include:

- ignition switched ON;
- ignition switched OFF.

Max 15 events are displayed for each of the lists. Each event has an indication of event name, date and time of occurrence and additional information, if any.

Events are displayed in chronological order starting with the oldest. Upon reaching the maximum number of displayed events new events overwrite the previous ones.

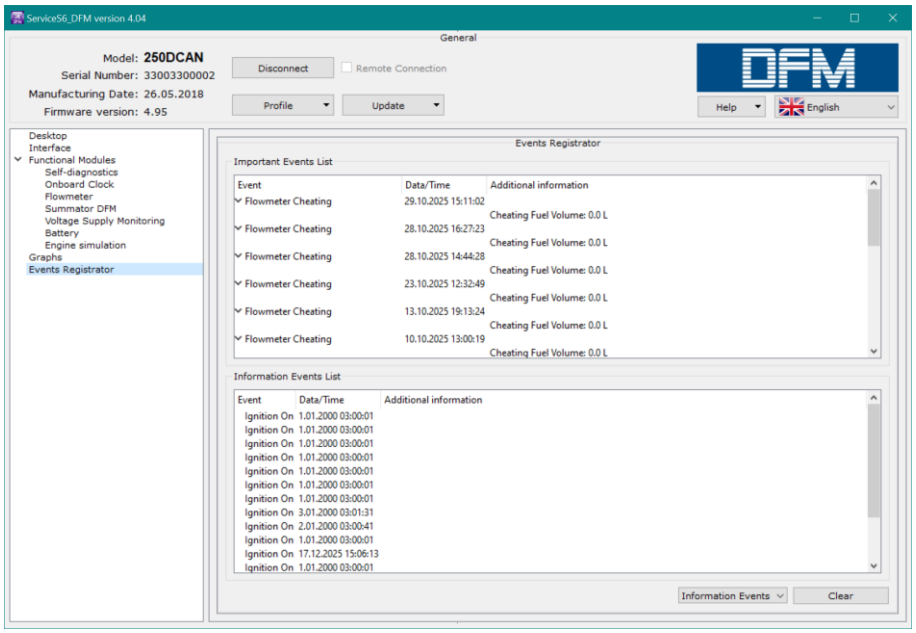


Figure 55 — Browsing through Events registered by DFM in Service S6 DFM software

You can delete all registered Events from DFM by clicking **Clear** button. Important Events cannot be deleted by the user.

6 Diagnostics and troubleshooting

Contact your DFM supplier in case of malfunction.

DFM repair works can be carried out only by certified regional service centers. Full list of service centers can be found at https://www.jv-technoton.com/.

Limited troubleshooting may be self-conducted (see table 24).

Table 24 — DFM malfunctions, which can be removed without full dismounting of the device

Malfunction	Model	Possible cause	Troubleshooting
No output signal*	**DFM AP/AK/CK/DK/ A232/C232/D232/ A485/C485/D485/ ACAN/CCAN/DCAN/ S7/DS7**	Incorrect connection	Check flow meter connection to the tracking device/data logger
		No connection with tracking device or with mobile device	Check S7 Technology connection to tracking device or to mobile device***
Fuel does not flow through the meter	**All models DFM**	Unsatisfactory condition of the engine's standard fuel filtration system	Replace the fine fuel filter, remove and clean the strainer (filter mesh)
Fuel consumption readings are higher than real consumption rate	**All models DFM**	Wrong fuel flow meter model selection or error in the mounting scheme	Study the technical documentation of the engine and check the mounting scheme
		Hydraulic shocks in the fuel system	Install a non-return valve into the fuel line on the meter's outlet side**. Check valve's operational performance in case it is already installed

* Differential DFM D can stop sending output signals in case of negative consumption.
** When installing differential DFM D, non-return valve should be mounted after feed chamber of flow meter.
***Relevant only for DFM wireless flow meters DFM S7/DS7.

7 Verification

Whenever you use DFM as a measuring tool for commercial accounting of fuel consumption, you may need to verify it in the system of national regulation for measuring equipment, in accordance with the legislation of a specific country the flow meter owner belongs to.

8 Maintenance

1) To ensure measurement accuracy, DFM flow meters are re-calibrated.

IMPORTANT: Re-calibration of flow meters with subsequent calibration (proving) and maintenance (if required) is performed at Regional Service Centers (RSCs).

The recommended re-calibration interval is determined by the increment of the "High Resolution Engine Total Fuel Used" Counter (SPN 5054 see H.3)* since previous calibration and equal to:

- for DFM 50/DFM 90/DFM 100 — 100 000 l;
- for DFM 220/DFM 250 — 250 000 l;
- for DFM 500 — 500 000 l;
- for DFM 900 — 900 000 l.

---

* Re-calibration interval is defined by increase of "High resolution engine total fuel used/18.0 Feed chamber" Counter (SPN 5054/18.0 see H.3) for differential fuel flow meters.

2) At least once a year, perform an external inspection and a functional check of the DFM. To ensure proper operation of the DFM measuring chamber, it is recommended to periodically remove and clean the **built-in strainer (filter mesh)** in fuel (see figure 56).

WARNINGS:

1) If sludge deposits are regularly found on the cells of the DFM strainer (filter mesh), this is a **sign of faulty/inefficient operation of the standard fuel filtration system** (for example, the need to replace the fine fuel filter).

2) The DFM strainer (filter mesh) **is not intended for fuel filtration or for protecting the fuel system as a substitute for the standard fine fuel filter**. It is an auxiliary DFM element intended to protect the measuring chamber in case large mechanical particles enter the fuel (for example, metal chips and burrs when using low-quality installation kits or after work on the fuel line).

3) Faulty/inefficient operation of the standard fine fuel filter, in addition to causing failure of the engine fuel system, may also lead to damage of the DFM measuring chamber and **may affect warranty service eligibility** (see Warranty conditions).

Figure 56 — The built-in DFM strainer (filter mesh)

RECOMMENDATION: When you remount DFM, replace used copper washers with new ones.

9 Packaging

DFM delivery sets is supplied in a cardboard box made of three-layer corrugated cardboard (figure 57)

Figure 57 — DFM packaging

Label sticker with information on the product name, certificates, serial number, firmware version, manufacture date, weight as well as Quality Control seal and QR code is stuck on two sides of the DFM box (see figure 58).

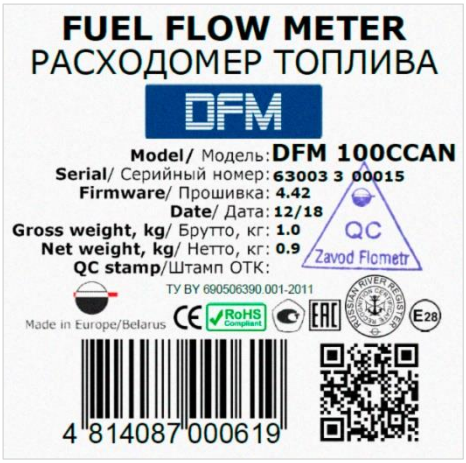


Figure 58 — DFM packaging label

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

10 Storage

DFM is recommended to be stored in dry enclosed areas.

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

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

DFM shelf life must not exceed 24 months.

11 Transportation

Transportation of DFM is recommended in closed transport that provides protection from mechanical damage and precipitation.

When transporting by air, DFM 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 DFM should be sealed.

12 Utilization/re-cycling

DFM does not contain precious metals in amount that should be recorded.

The inbuilt lithium-thionyl chloride battery of DFM 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

Technoton's quality management system is certified for compliance with ISO 9001:2015

sales@jv-technoton.com

support@jv-technoton.com

Annex A
Overall dimensions and weight

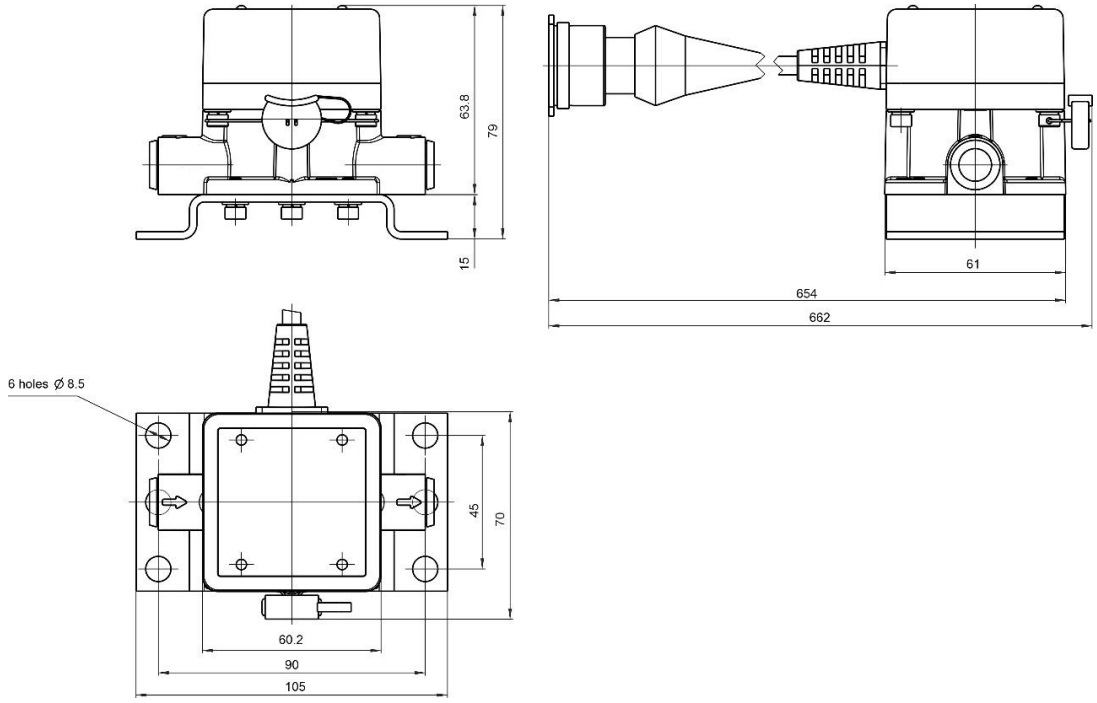


Figure A.1 — DFM 50AK/CK/A232/A485/ACAN/C232/C485/CCAN and DFM 100AK/CK/A232/A485/ACAN/C232/C485/CCAN overall dimensions

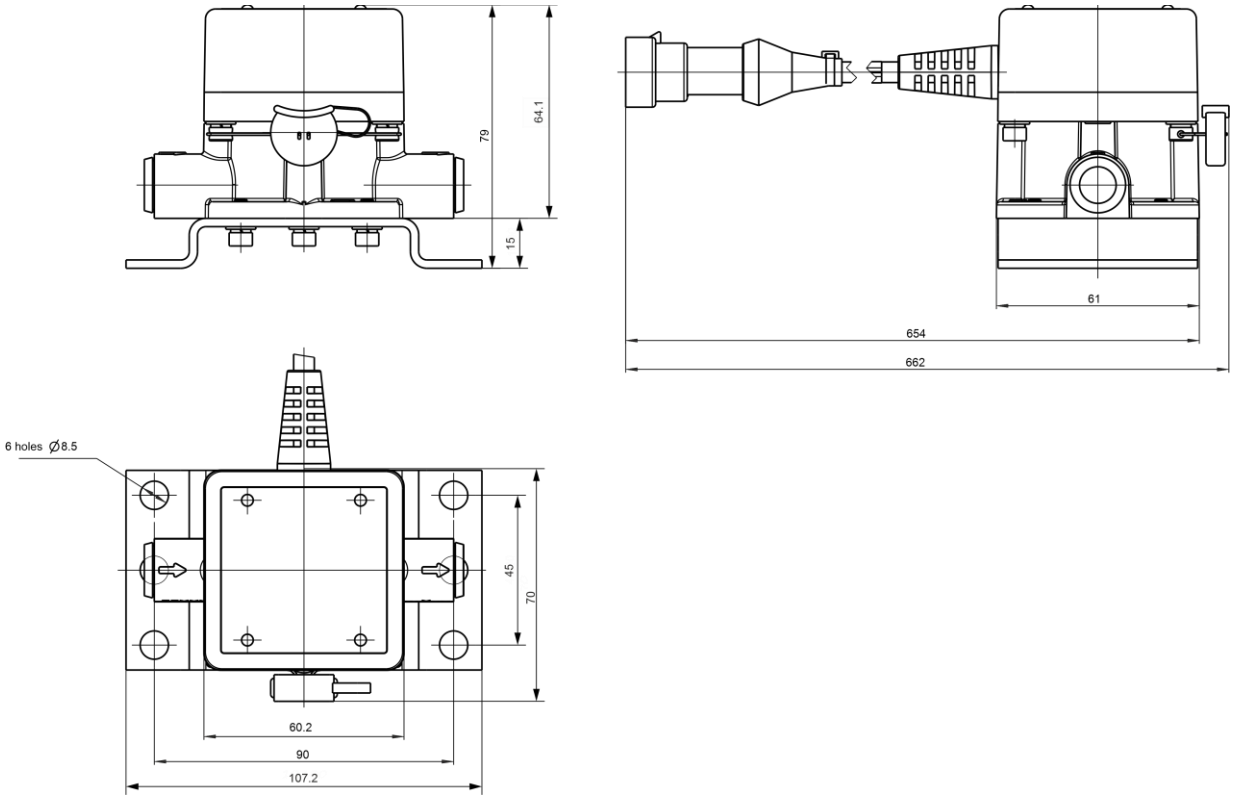


Figure A.2 — DFM 90AP overall dimensions

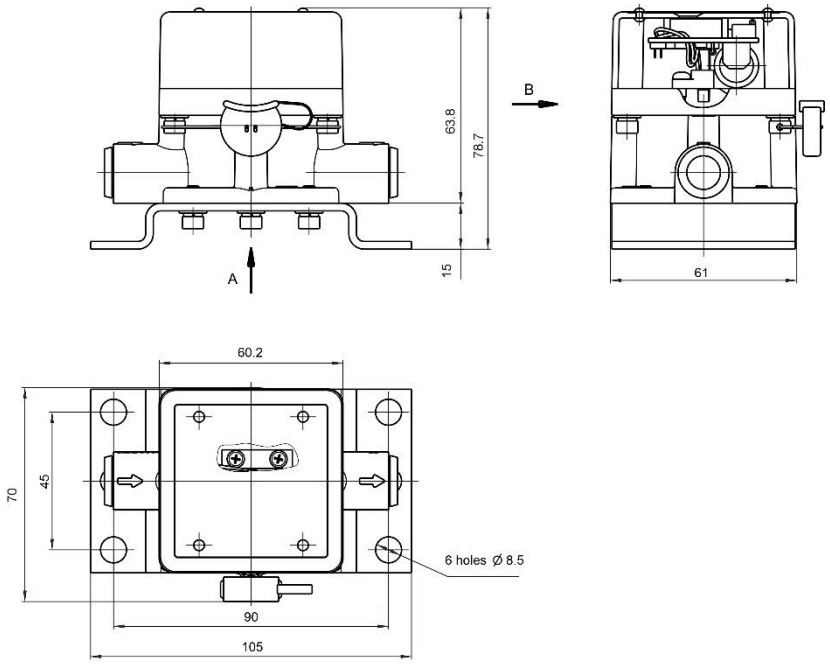


Figure A.3 — DFM 50C and DFM 100B/C overall dimensions

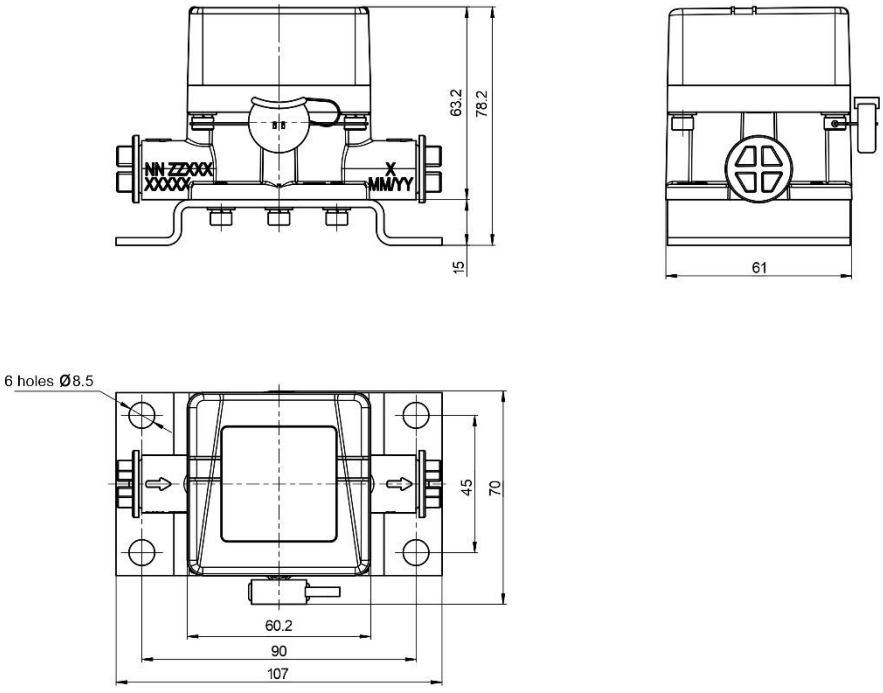


Figure A.4 — DFM 50S7/DFM 100S7 overall dimensions

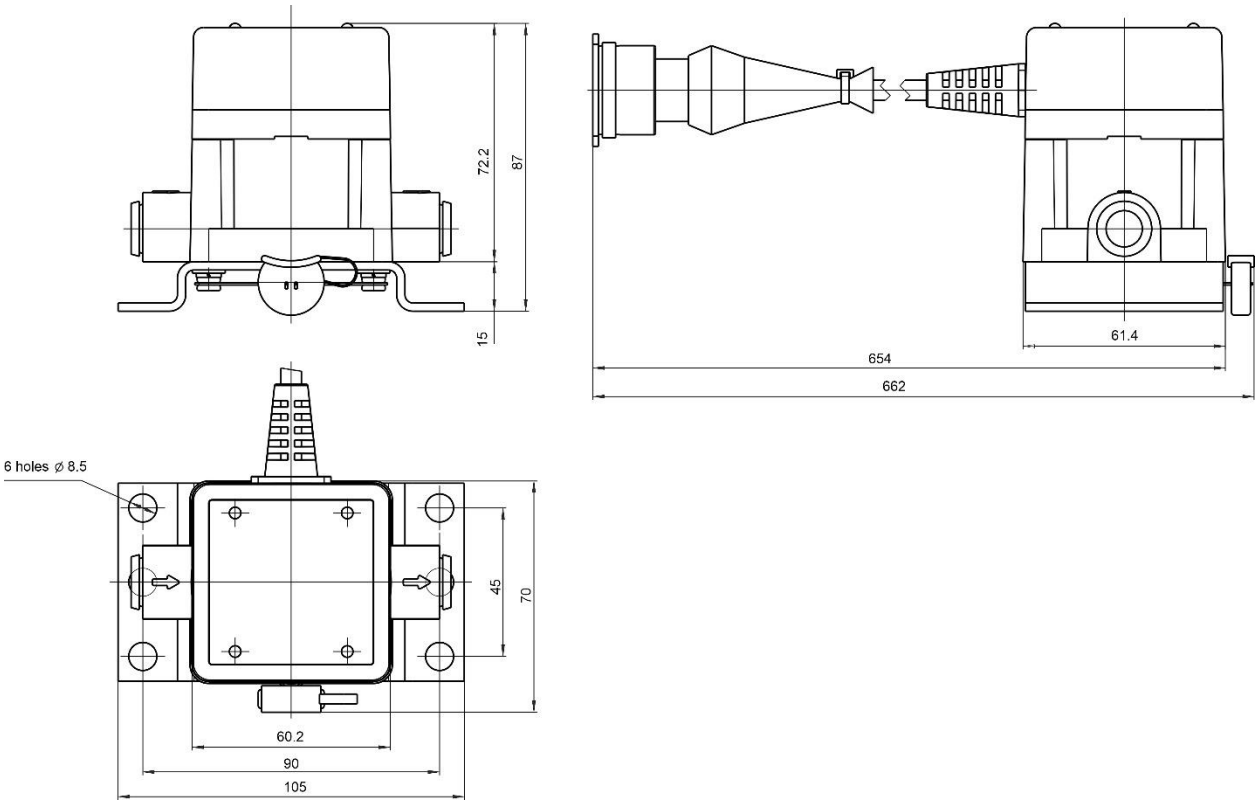


Figure A.5 — DFM 250AK/CK/A232/A485/ACAN/C232/C485/CCAN overall dimensions

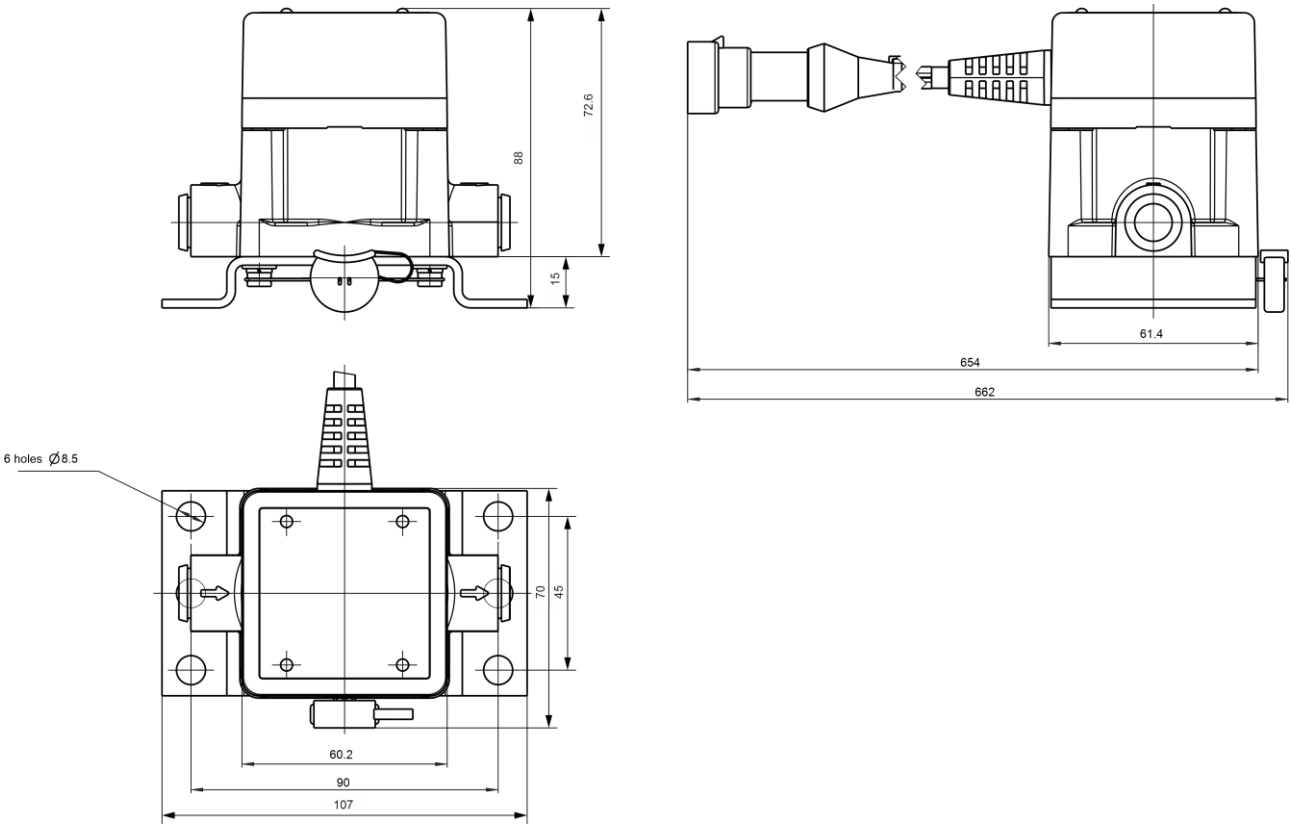


Figure A.6 — DFM 220AP overall dimensions

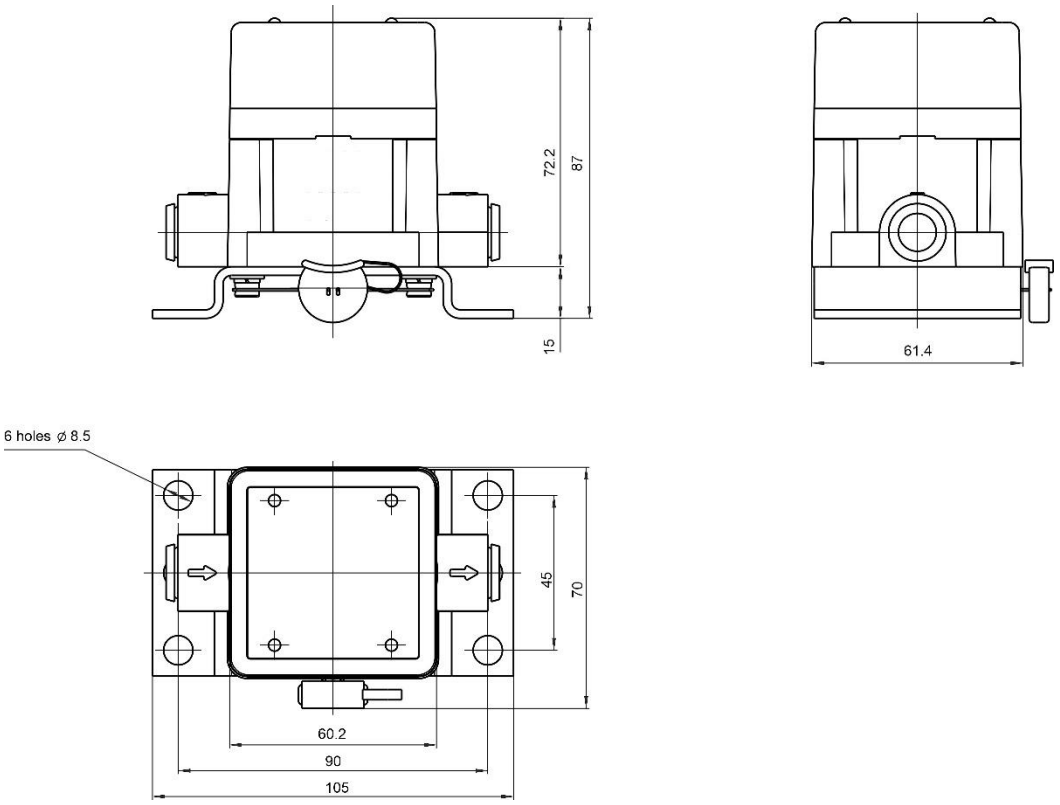


Figure A.7 — DFM 250B/C overall dimensions

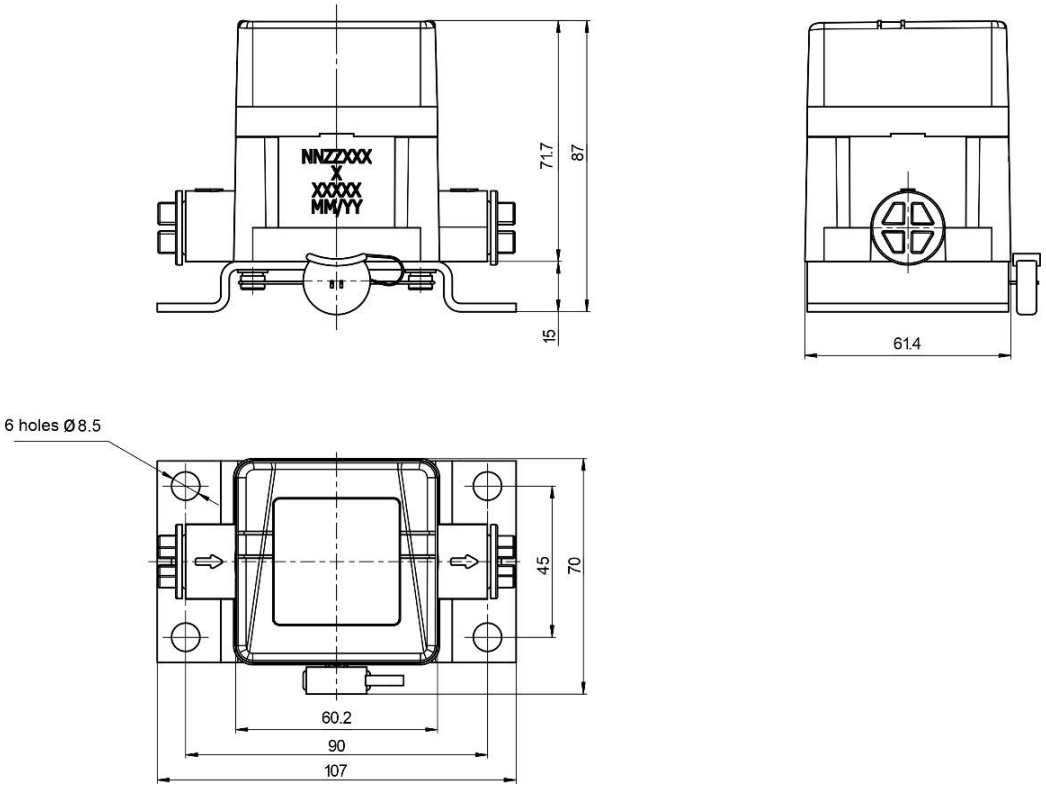


Figure A.8 — DFM 250S7 overall dimensions

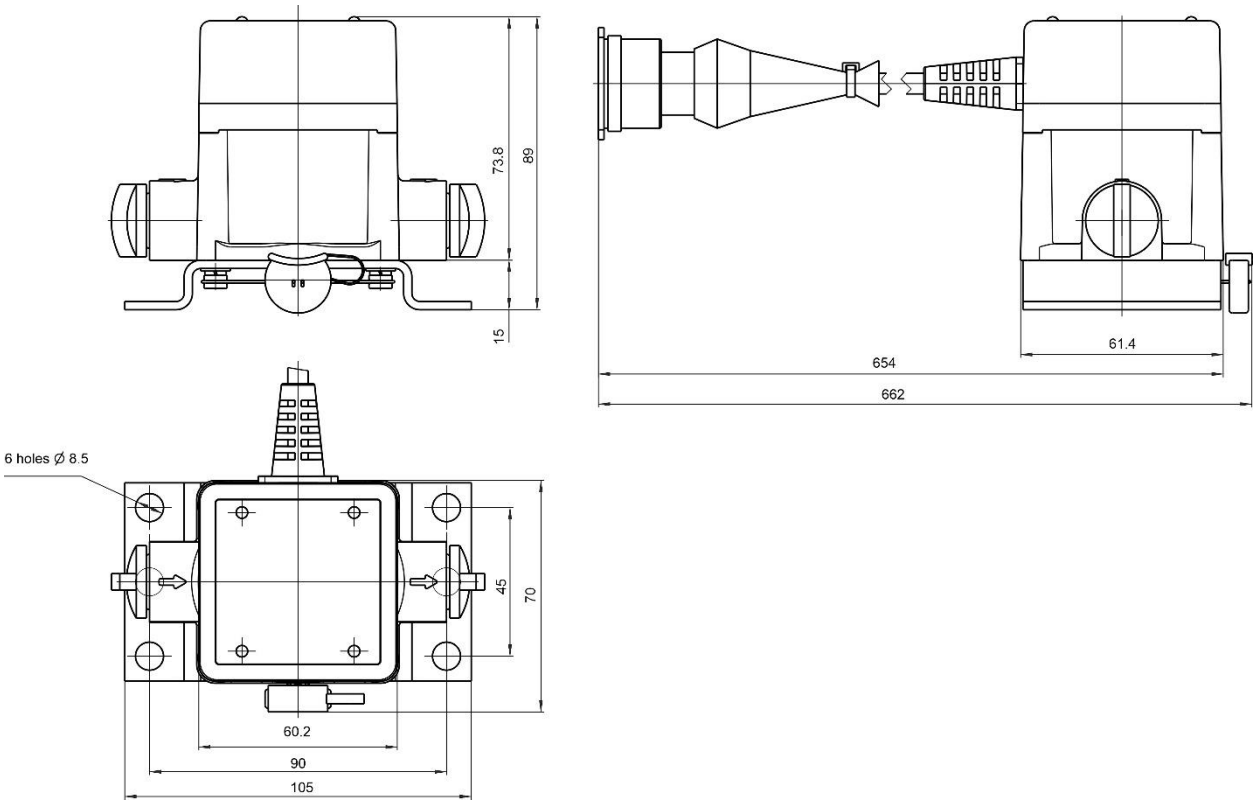


Figure A.9 — DFM 500AK/CK/A232/A485/ACAN/C232/C485/CCAN overall dimensions

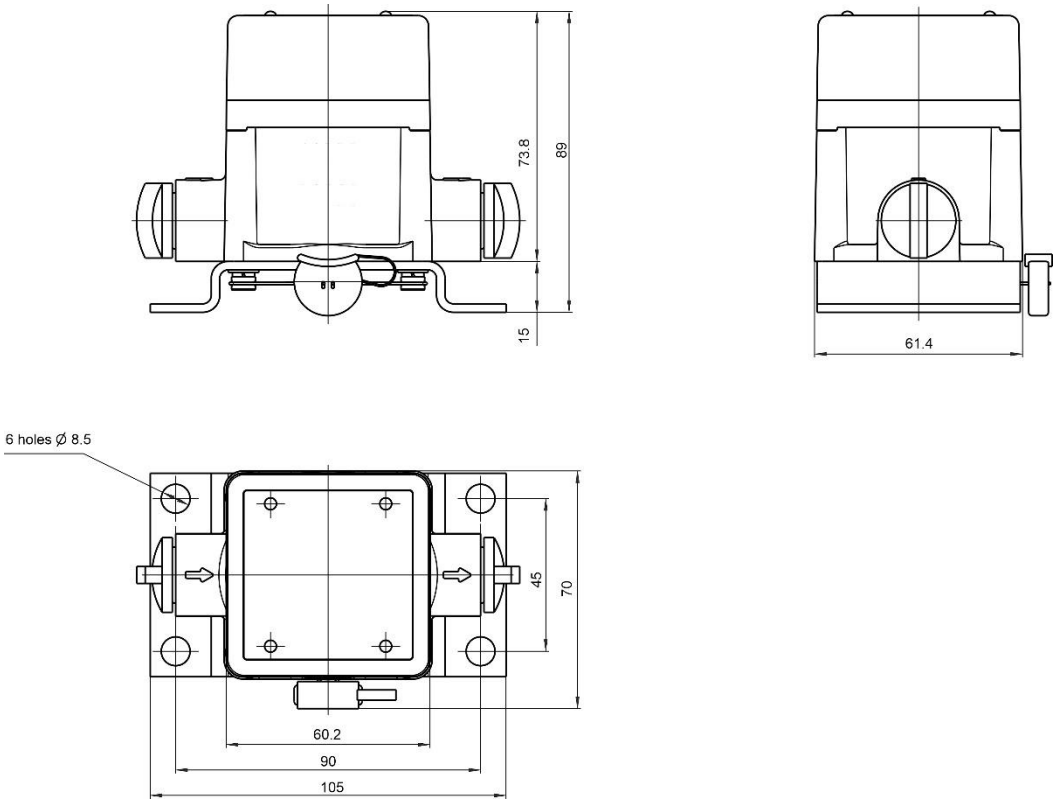


Figure A.10 — DFM 500C overall dimensions

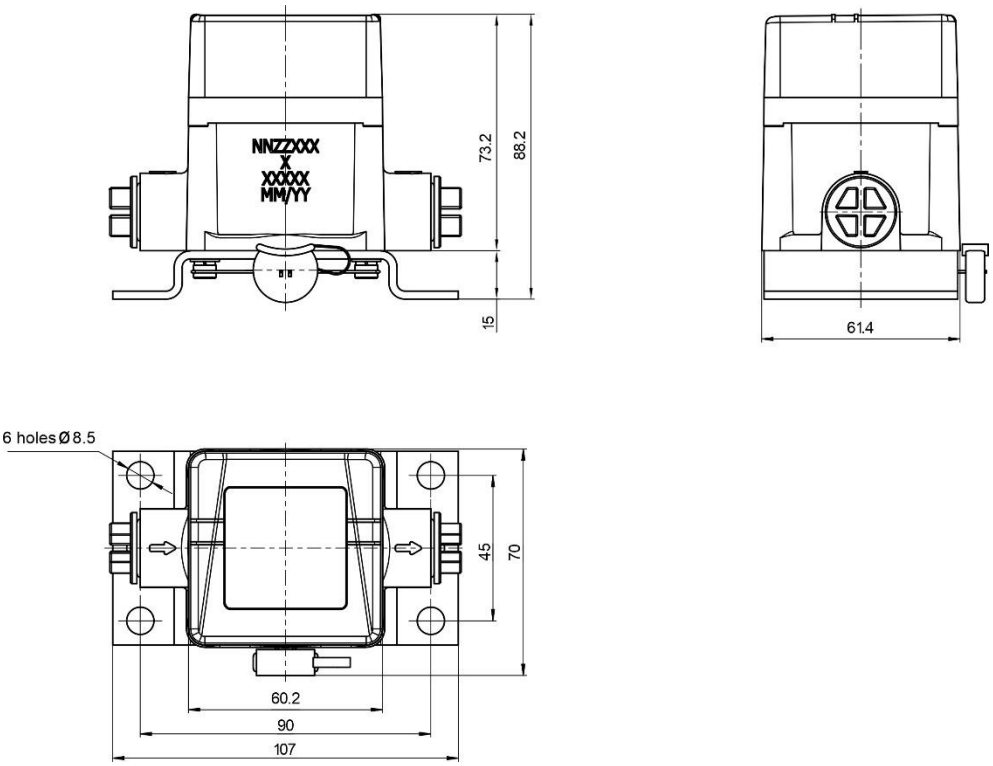


Figure A.11 — DFM 500S7 overall dimensions

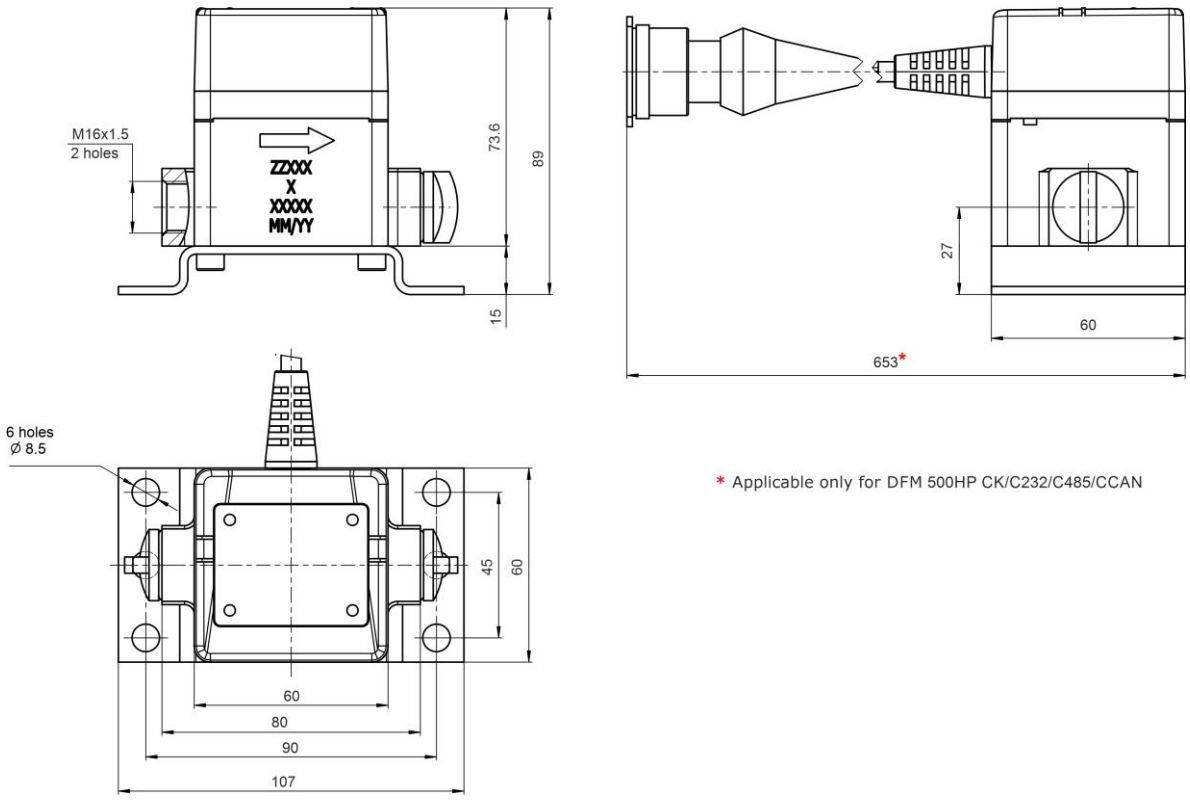


Figure A.12 — DFM 500HP CK/C232/C485/CCAN, DFM 500HP C and DFM 500HP S7 overall dimensions

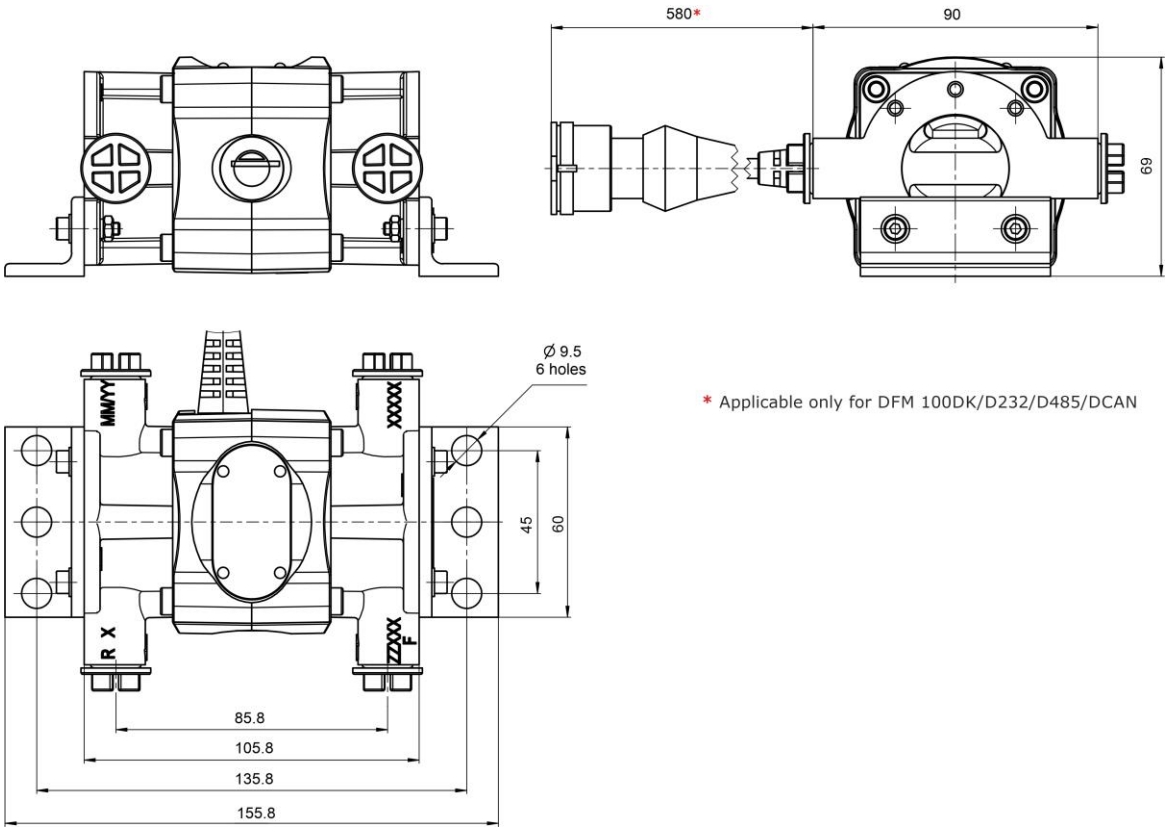


Figure A.13 — DFM 100DK/D232/D485/DCAN, DFM 100CD and DFM 100DS7 overall dimensions

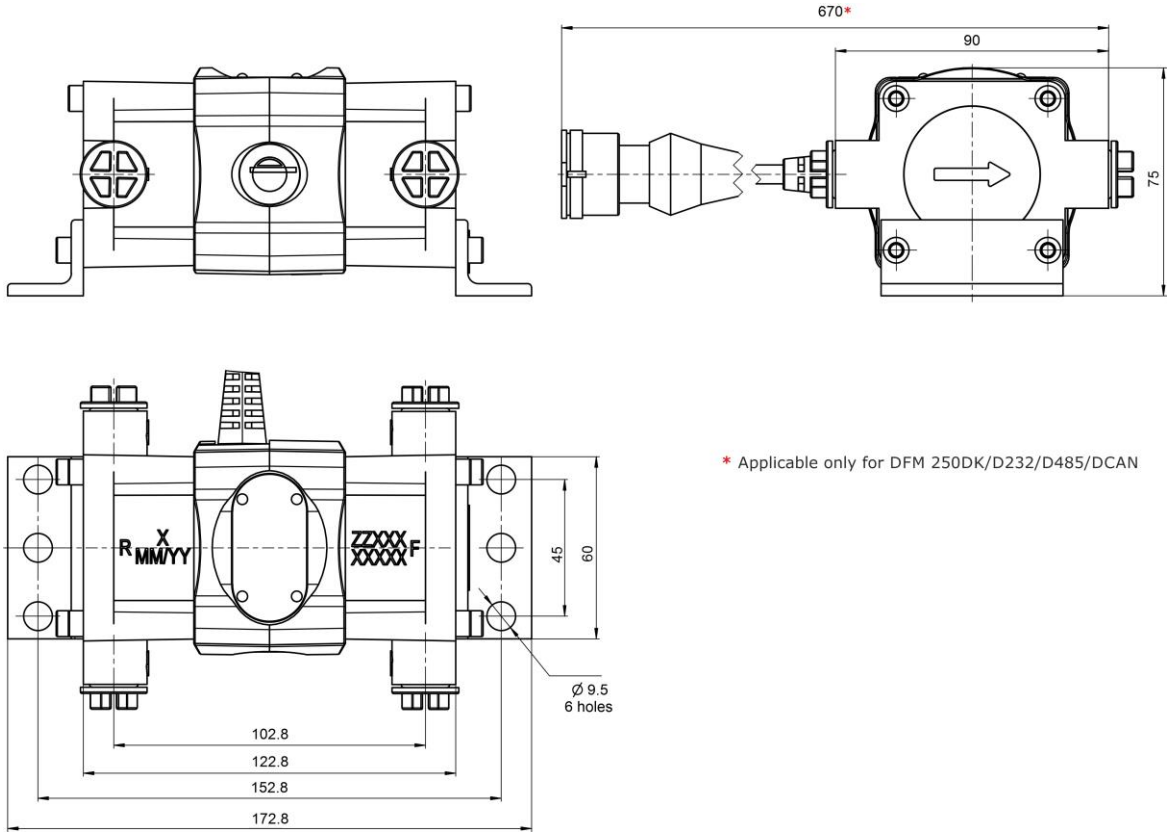


Figure A.14 — DFM 250DK/D232/D485/DCAN, DFM 250CD and DFM 250DS7 overall dimensions

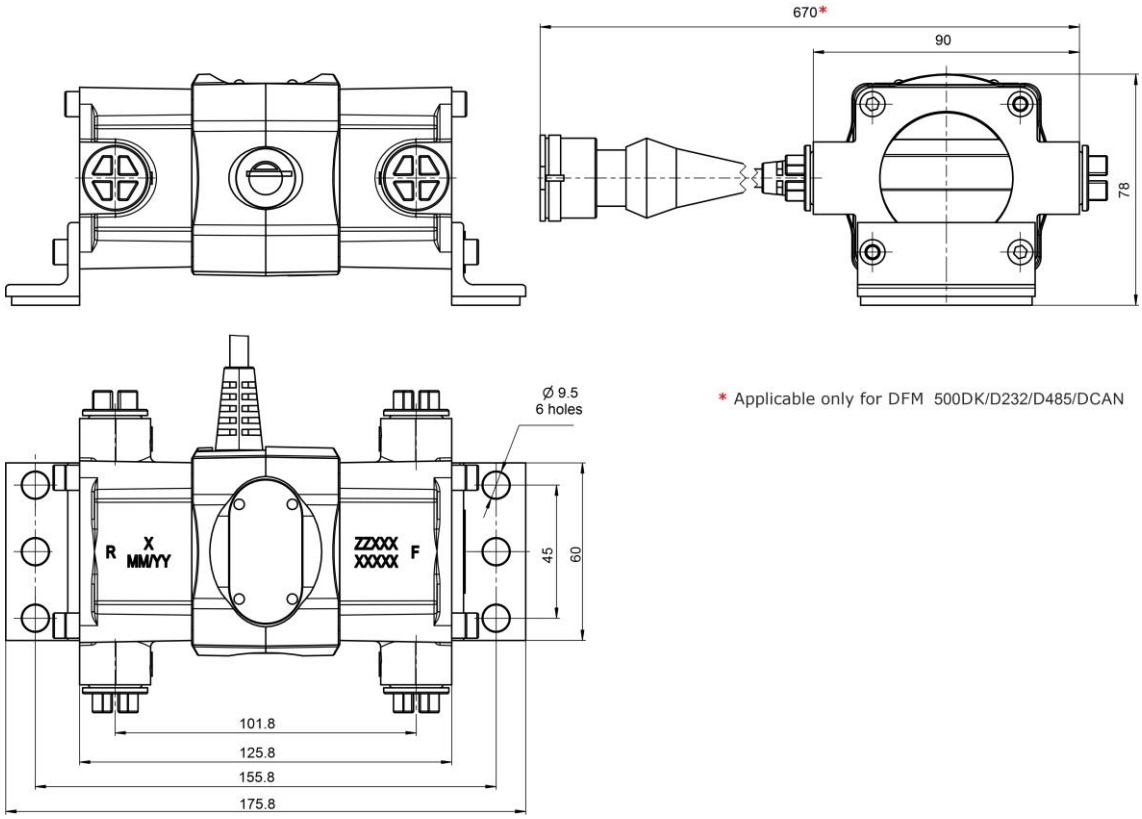


Figure A.15 — DFM 500DK/D232/D485/DCAN, DFM 500CD and DFM 500DS7 overall dimensions

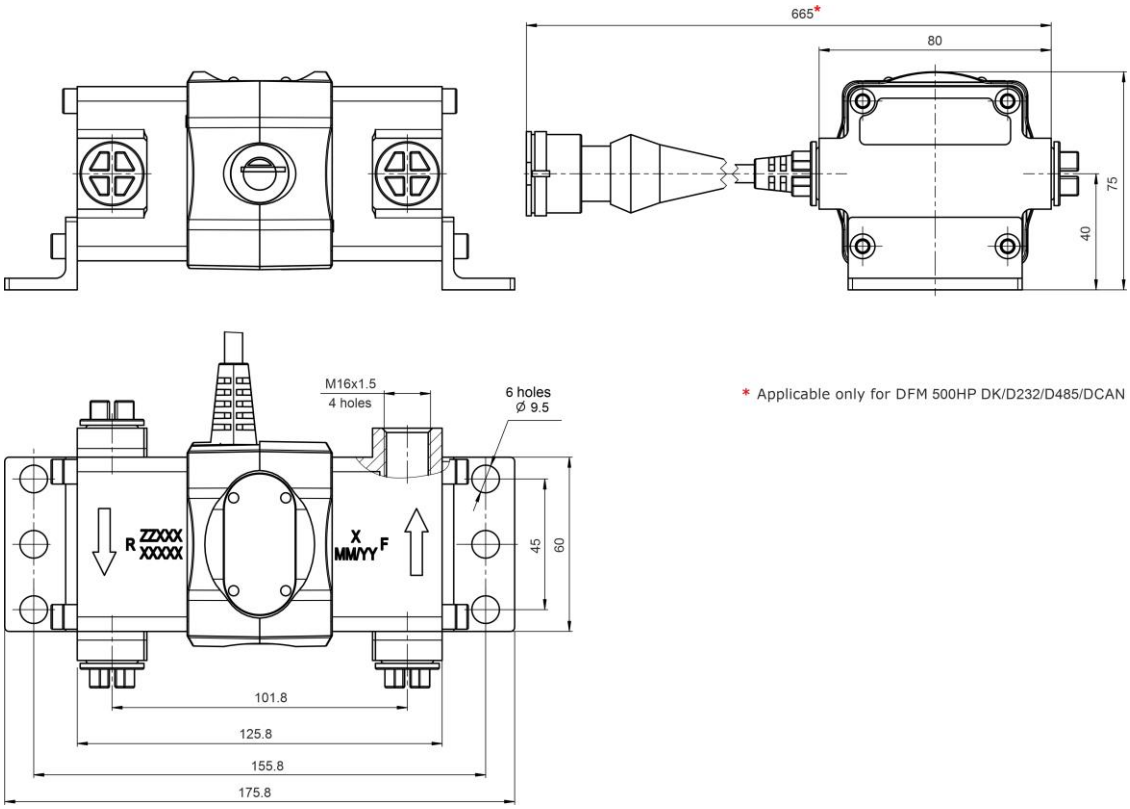


Figure A.16 — DFM 500HP DK/D232/D485/DCAN, DFM 500HP CD and DFM 500HP DS7 overall dimensions

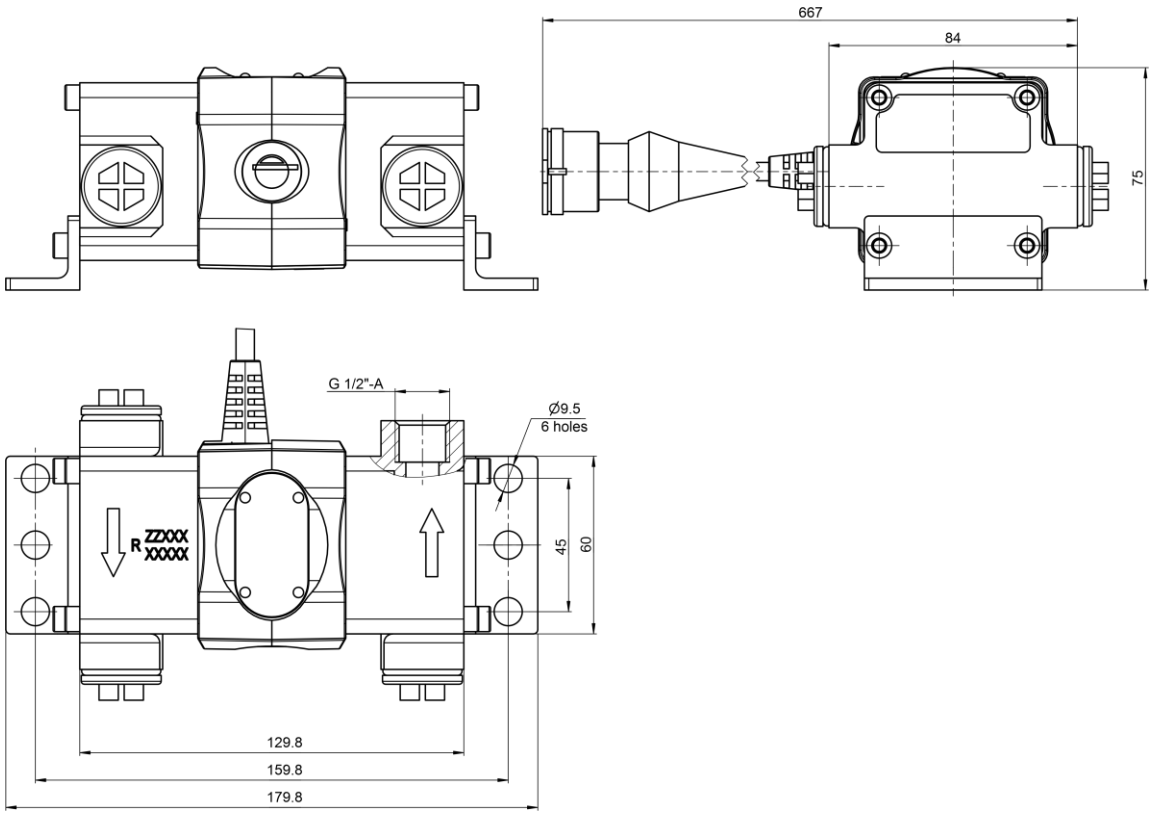


Figure A.17 — DFM 900DK/D232/D485/DCAN overall dimensions

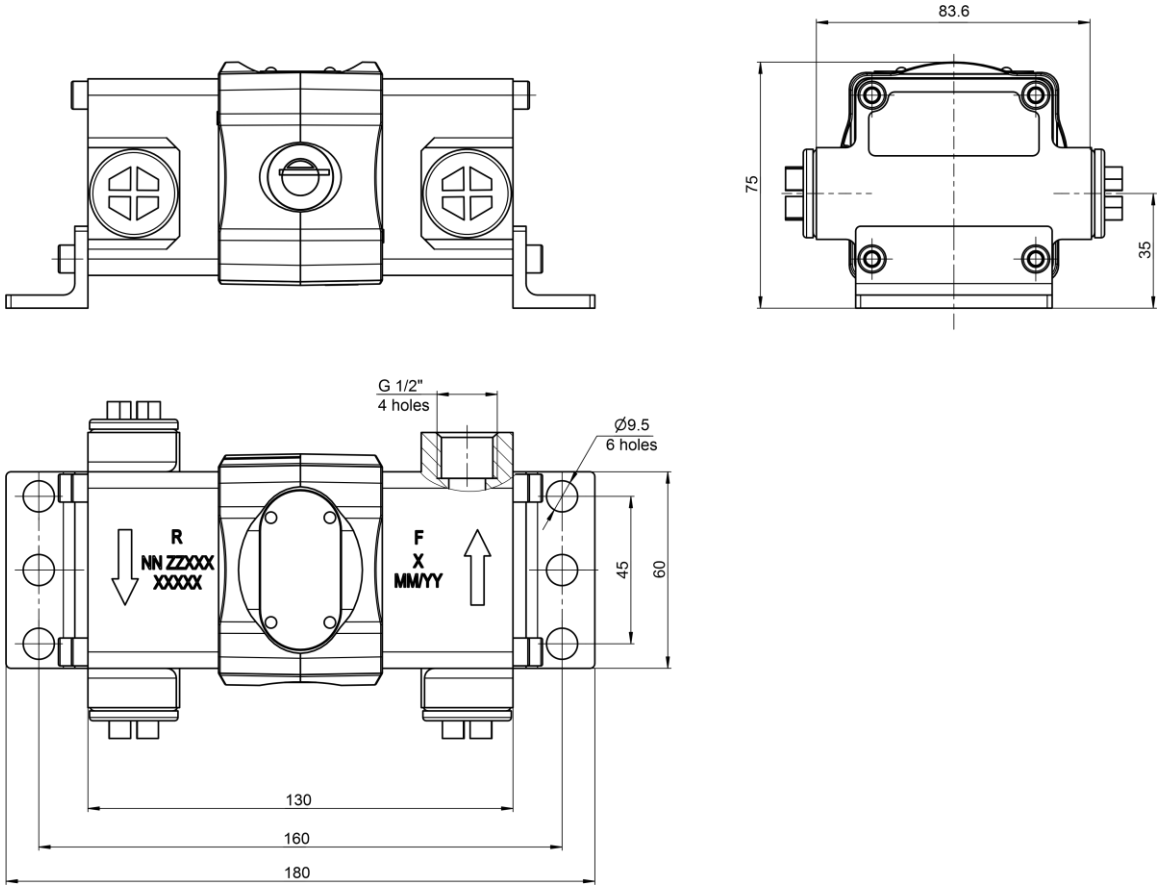


Figure A.18 — DFM 900 CD and DFM 900 DS7 overall dimensions

Table A.1 — DFM weight

Model	Weight, kg, not more than
DFM 50AK **DFM 50A232** **DFM 50A485** **DFM 50ACAN** **DFM 50C** **DFM 50CK** **DFM 50C232** **DFM 50C485** **DFM 50CCAN** **DFM 50S7** **DFM 90AP** **DFM 100AK** **DFM 100A232** **DFM 100A485** **DFM 100ACAN** **DFM 100B** **DFM 100C** **DFM 100CK** **DFM 100C232** **DFM 100C485** **DFM 100CCAN** **DFM 100S7**	0.87
DFM 220AP **DFM 250AK** **DFM 250A232** **DFM 250A485** **DFM 250ACAN** **DFM 250B** **DFM 250C** **DFM 250CK** **DFM 250C232** **DFM 250C485** **DFM 250CCAN** **DFM 250S7**	1.16
DFM 500AK **DFM 500A232** **DFM 500A485** **DFM 500ACAN** **DFM 500C** **DFM 500CK** **DFM 500C232** **DFM 500C485** **DFM 500CCAN** **DFM 500S7**	1.2
DFM 500HP CK **DFM 500HP C232** **DFM 500HP C485** **DFM 500HP CCAN** **DFM 500HP C** **DFM 500HP S7**	1.25
DFM 100DK **DFM 100D232** **DFM 100D485** **DFM 100DCAN** **DFM 100CD** **DFM 100DS7**	1.4
DFM 250DK **DFM 250D232** **DFM 250D485** **DFM 250DCAN** **DFM 250CD** **DFM 250DS7**	1.9
DFM 500DK **DFM 500D232** **DFM 500D485** **DFM 500DCAN** **DFM 500CD** **DFM 500DS7**	1.97
DFM 500HP DK **DFM 500HP D232** **DFM 500HP D485** **DFM 500HP DCAN** **DFM 500HP CD** **DFM 500HP DS7**	2.4
DFM 900 DK **DFM 900 D232** **DFM 900 D485** **DFM 900 DCAN** **DFM 900 CD** **DFM 900 DS7**	2.6

Annex B
Protocol of inspecting machinery unit

_____/ _____ /20____
Date Month Year

We, the undersigned representatives of the Customer
_____,
and representatives of the Contractor
_____,
have conducted vehicle (installation) inspection

Machinery unit type _____
Brand, model _____
Registration number _____
for conformity to DFM installation requirements, and have concluded the following:

Requirement	Conforms/ Does not conform	Notes
Leakage resistance of the fuel system		Measurement accuracy and DFM performance is not guaranteed in case of a leakage in the fuel system. Fuel system repair is recommended to eliminate leaks
Pressure of the fuel supply system		DFM performance is not guaranteed in case of an insufficient pressure in the fuel system. Maintenance of the fuel pump is recommended.
Injectors reverse flow rate		Injectors reverse flow being higher than normal can significantly affect measurement accuracy. Injectors maintenance or replacement is recommended.
Onboard voltage*		DFM performance is not guaranteed in case of insufficient power supply voltage. Maintenance of the onboard power supply network and/or generator.
Chassis ground switch condition*		DFM performance is not guaranteed in case of significant resistance/oxidation ot the switch. Maintenance or replacement is recommended.

representative of the CUSTOMER:

_____

name, signature

representative of the CONTRACTOR:

_____

name, signature

* It is allowed not to check during mounting wireless flow meters (models DFM S7/DS7) or autonomous-type flow meters (models DFM B/C/CD).

Annex C
Template of check test report

_____/ _____ /20____
Date Month Year

Vehicle type, model, registration number	
DFM model, serial number	

Fuel consumption	Actual fuel consumption. according to calibrated container V_m, liters	
	Fuel consumption measured According to DFM reading $V_{measured}$, liters	
Relative error of fuel consumption measurement	$\delta = \frac{V_{measured} - V_m}{V_m} \cdot 100\%$, %	
Actual fuel amount from injectors reverse line	$V_{inj.return}$, liters	
Proportion of the reverse flow from the injectors in overall fuel consumption	$\frac{V_{inj.return}}{V_m} \cdot 100\%$, %	

Resume:

Fuel consumption measurement **corresponds /does not correspond** to the technical specification.

Comments:

_____

_____

_____

representative of the CUSTOMER:

_____

name, signature

representative of the CONTRACTOR:

_____

name, signature

Annex D

Modbus RTU data transmission protocol and table of registers of DFM 232/485 output messages

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

- Device unique network address (Slave ID) from the range of 0…255 (default address 111).
- Function code (FCode=3).
- Data (Data).
- Checksum (CRC).

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

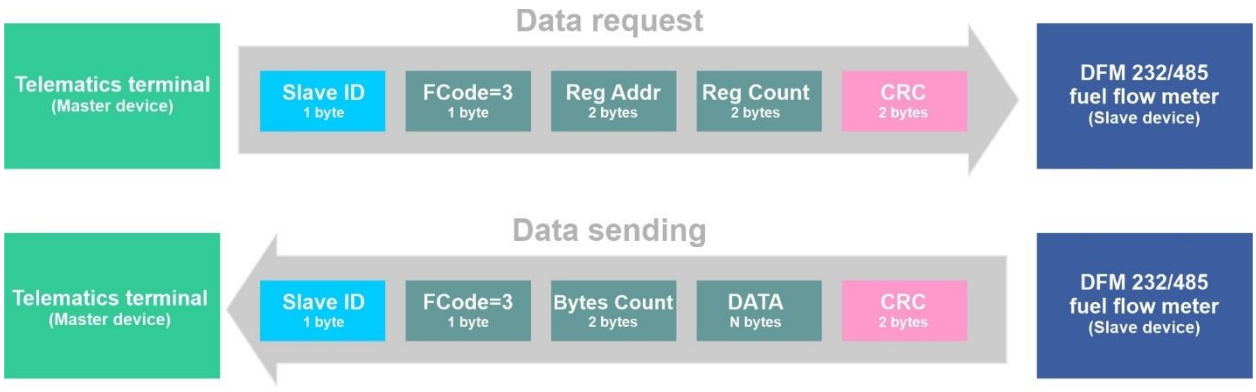


Figure D.1 — Scheme of data exchange according to Modbus RTU protocol between DFM 232/485 fuel flow meter and the Telematics terminal

Example 1: Read the value of SPN 183 "Engine Fuel Rate, l/h"

Reg Addr	Data	
	1 byte (high byte)	1 byte (low byte)
0	04	85

The Request structure: 0x6F 0x03 0x00 0x00 0x00 0x01 0x8C 0x84, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the requested flow meter: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
00 00 – address of the requested register: Reg Addr=0;
00 01 – number of registers to be read: Reg Count=1;
8C 84 – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

The Response structure: 0x6F 0x03 0x02 0x04 0x85 0x92 0xEE, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the flow meter from which data are read: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
02 – number of bytes in the data field: Bytes Count=2;
04 85 – data field of register 0 (2 bytes): Data=0485;
92 EE – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification: 485 (Hex)=1157 (Dec) · 0.05 + 0 = 57.85 l/h,
where 0.05 l/h – factor (resolution); 0 l/h – offset for calculation of values of SPN 183.

Example 2: Read the value of SPN 174 "Engine Fuel Temperature 1, °C"

Reg Addr	Data	
	1 byte (high byte)	1 byte (low byte)
3	00	44

The Request structure: 0x6F 0x03 0x00 0x03 0x00 0x01 0x7C 0x84, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the requested flow meter: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
00 03 – address of the requested register: Reg Addr=3;
00 01 – number of registers to be read: Reg Count=1;
7C 84 – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

The Response structure: 0x6F 0x03 0x02 0x00 0x44 0x51 0xBE, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the flow meter from which data are read: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
02 – number of bytes in the data field: Bytes Count=2;
00 44 – data field of register 3 (2 bytes): Data=0044;
51 BE – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification: 44 (Hex)=68 (Dec) · 1 - 40 = 28 °C,
where 1 °C – factor (resolution); -40 °C – offset for calculation of values of SPN 174.

Example 3: Read the value of SPN 5054 "High Resolution Engine Total Fuel Used, l"

Reg Addr	Data		Note
	1 byte (high byte)	1 byte (low byte)	
4	00	01	High word
5	13	28	Low word

The Request structure: 0x6F 0x03 0x00 0x04 0x00 0x02 0x8D 0x44, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the requested flow meter: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
00 04 – address of the first from the requested registers: Reg Addr=4;
00 02 – number of registers to be read: Reg Count=2;
8D 44 – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

The Response structure: 0x6F 0x03 0x04 0x00 0x01 0x13 0x28 0x29 0x1B, where
0x – prefixes of the hexadecimal system of numeration;
6F – network address of the flow meter from which data are read: Slave ID=111;
03 – number of the function of reading registers: FCode=3;
04 – number of bytes in the data field: Bytes Count=4;
00 01 – data field of register 4 (2 bytes): Data=0001;
13 28 – data field of register 5 (2 bytes): Data=1328;
29 1B – field of checksum (CRC) calculated according to crc16 algorithm (2 bytes).

Conversion of data for verification: 11328 (Hex)=70440 (Dec) · 0.001 + 0 = 70.440 l, where 0.001 l – factor (resolution); 0 l – offset for calculation of values of SPN 5054.

Table D.1 — Map of 16-bit registers of DFM 232/485 output messages via the Modbus RTU protocol

Register address	Register contents	Corresponding SPN (SAE j1939)*	Specifier
0	Engine Fuel Rate	183	
1	Engine Total Fuel Used (high word)	250	
2	Engine Total Fuel Used (low word)	250	
3	Engine Fuel Temperature 1	174	
4	High Resolution Engine Total Fuel Used (high word)	5054	
5	High Resolution Engine Total Fuel Used (low word)	5054	
6	Engine Total Idle Fuel Used (high word)	236	
7	Engine Total Idle Fuel Used (low word)	236	
8	Engine Total Idle Hours (high word)	235	
9	Engine Total Idle Hours (low word)	235	
10	Engine Total Average Fuel Rate	1834	
11	Engine Mode by Fuel Rate	521181	
12	Chamber Fuel Rate in Feed chamber	521027	18.0 Feed chamber
13	Chamber Fuel Rate in Reverse chamber	521027	18.1 Reverse chamber
14	Chamber Working Mode. Feed chamber	521028	18.0 Feed chamber
15	Chamber Working Mode. Reverse chamber	521028	18.1 Reverse chamber
16	High Resolution Engine Total Fuel Used (high word)	5054	9.0 Idle
17	High Resolution Engine Total Fuel Used (low word)	5054	9.0 Idle
18	High Resolution Engine Total Fuel Used (high word)	5054	9.1 Optimal
19	High Resolution Engine Total Fuel Used (low word)	5054	9.1 Optimal
20	High Resolution Engine Total Fuel Used (high word)	5054	9.2 Overload
21	High Resolution Engine Total Fuel Used (low word)	5054	9.2 Overload
22	High Resolution Engine Total Fuel Used (high word)	5054	9.3 Cheating
23	High Resolution Engine Total Fuel Used (low word)	5054	9.3 Cheating
24	High Resolution Engine Total Fuel Used (high word)	5054	9.4 Negative
25	High Resolution Engine Total Fuel Used (low word)	5054	9.4 Negative
26	Engine hours of operation (high word)	521171	
27	Engine hours of operation (low word)	521171	
28	Engine hours of operation (high word)	521171	9.0 Idle
29	Engine hours of operation (low word)	521171	9.0 Idle
30	Engine hours of operation (high word)	521171	9.1 Optimal
31	Engine hours of operation (low word)	521171	9.1 Optimal
32	Engine hours of operation (high word)	521171	9.2 Overload
33	Engine hours of operation (low word)	521171	9.2 Overload
34	Engine hours of operation (high word)	521171	9.3 Cheating
35	Engine hours of operation (low word)	521171	9.3 Cheating
36	Engine hours of operation (high word)	521171	9.4 Negative
37	Engine hours of operation (low word)	521171	9.4 Negative
38	Engine hours of operation (high word)	521171	9.5 Interference
39	Engine hours of operation (low word)	521171	9.5 Interference
40	High Resolution Engine Total Fuel Used (high word)	5054	18.0 Feed chamber
41	High Resolution Engine Total Fuel Used (low word)	5054	18.0 Feed chamber

Register address	Register contents	Corresponding SPN (SAE j1939)*	Specifier
42	High Resolution Engine Total Fuel Used (high word)	5054	9.0 Idle, 18.0 Feed chamber
43	High Resolution Engine Total Fuel Used (low word)	5054	9.0 Idle, 18.0 Feed chamber
44	High Resolution Engine Total Fuel Used (high word)	5054	9.1 Optimal, 18.0 Feed chamber
45	High Resolution Engine Total Fuel Used (low word)	5054	9.1 Optimal, 18.0 Feed chamber
46	High Resolution Engine Total Fuel Used (high word)	5054	9.2 Overload, 18.0 Feed chamber
47	High Resolution Engine Total Fuel Used (low word)	5054	9.2 Overload, 18.0 Feed chamber
48	High Resolution Engine Total Fuel Used (high word)	5054	9.3 Cheating, 18.0 Feed chamber
49	High Resolution Engine Total Fuel Used (low word)	5054	9.3 Cheating, 18.0 Feed chamber
50	Flowmeter Chamber Time Counter (low word)	521189	9.0 Idle
51	Flowmeter Chamber Time Counter (high word)	521189	9.0 Idle
52	Flowmeter Chamber Time Counter (low word)	521189	9.0 Idle, 18.0 Feed chamber
53	Flowmeter Chamber Time Counter (high word)	521189	9.0 Idle, 18.0 Feed chamber
54	Flowmeter Chamber Time Counter (low word)	521189	9.1 Optimal, 18.0 Feed chamber
55	Flowmeter Chamber Time Counter (high word)	521189	9.1 Optimal, 18.0 Feed chamber
56	Flowmeter Chamber Time Counter (low word)	521189	9.2 Overload, 18.0 Feed chamber
57	Flowmeter Chamber Time Counter (high word)	521189	9.2 Overload, 18.0 Feed chamber
58	Flowmeter Chamber Time Counter (low word)	521189	9.3 Cheating, 18.0 Feed chamber
59	Flowmeter Chamber Time Counter (high word)	521189	9.3 Cheating, 18.0 Feed chamber
60	High Resolution Engine Total Fuel Used (high word)	5054	18.1 Reverse chamber
61	High Resolution Engine Total Fuel Used (low word)	5054	18.1 Reverse chamber
62	High Resolution Engine Total Fuel Used (high word)	5054	9.0 Idle, 18.1 Reverse chamber
63	High Resolution Engine Total Fuel Used (low word)	5054	9.0 Idle, 18.1 Reverse chamber
64	High Resolution Engine Total Fuel Used (high word)	5054	9.1 Optimal, 18.1 Reverse chamber
65	High Resolution Engine Total Fuel Used (low word)	5054	9.1 Optimal, 18.1 Reverse chamber
66	High Resolution Engine Total Fuel Used (high word)	5054	9.2 Overload, 18.1 Reverse chamber
67	High Resolution Engine Total Fuel Used (low word)	5054	9.2 Overload, 18.1 Reverse chamber
68	High Resolution Engine Total Fuel Used (high word)	5054	9.3 Cheating, 18.1 Reverse chamber
69	High Resolution Engine Total Fuel Used (low word)	5054	9.3 Cheating, 18.1 Reverse chamber
70	Flowmeter Chamber Time Counter (low	521189	18.1 Reverse chamber

Register address	Register contents	Corresponding SPN (SAE j1939)*	Specifier
	word)		
71	Flowmeter Chamber Time Counter (high word)	521189	18.1 Reverse chamber
72	Flowmeter Chamber Time Counter (low word)	521189	9.0 Idle, 18.1 Reverse chamber
73	Flowmeter Chamber Time Counter (high word)	521189	9.0 Idle, 18.1 Reverse chamber
74	Flowmeter Chamber Time Counter (low word)	521189	9.1 Optimal, 18.1 Reverse chamber
75	Flowmeter Chamber Time Counter (high word)	521189	9.1 Optimal, 18.1 Reverse chamber
76	Flowmeter Chamber Time Counter (low word)	521189	9.2 Overload, 18.1 Reverse chamber
77	Flowmeter Chamber Time Counter (high word)	521189	9.2 Overload, 18.1 Reverse chamber
78	Flowmeter Chamber Time Counter (low word)	521189	9.3 Cheating, 18.1 Reverse chamber
79	Flowmeter Chamber Time Counter (high word)	521189	9.3 Cheating, 18.1 Reverse chamber
80	Engine Total Average Fuel Rate	1834	
81	Reserve	-	
82	High Resolution Engine Total Fuel Used (high word)	5054	28.0 Clearable
83	High Resolution Engine Total Fuel Used (low word)	5054	28.0 Clearable
84	Engine hours of operation (high word)	521171	28.0 Clearable
85	Engine hours of operation (low word)	521171	28.0 Clearable
86	Total CO2 Emission (high word)	521864	
87	Total CO2 Emission (low word)	521864	
88	Hourly CO2 Emission (high word)	521865	
89	Hourly CO2 Emission (low word)	521865	
…			
200	Command Code	521167	

* Detailed parameters description (SPN) are placed at the following web site http://s6.jv-technoton.com/ (to access S6 DB registration is required).

For flow meters with firmware version 4.84 and later.

Register 200 is used to send register write commands. Commands for clearing resettable Counters (registers 82 to 85) are supported.

Annex E
DFM COM data transfer protocol

E.1 Application

The present protocol is used for data exchange of DFM 232 and DFM 485 fuel flow meters designed by Technoton.

E.2 General info

Data exchange on physical and channel level is implemented according to ANSI/TIA-485-A and TIA/EIA 232-F standards.

Addressing on RS-485 bus is based on flow meter network address. Default factory address value is 111.

Master-slave operation mode of DFM is supported. Only one flow meter in the bus can be configured as the Master.

Data exchange interval between bytes should not exceed 100 ms.

E.3 Session

The following data exchange options are available through DFM settings:

1) Automatic data transmission. Interval of data transmission can be configured. This is a default data transmission mode set on the factory. Interval is 1 second by default.

2) Request-Response data exchange mode. Flow meter acts as Slave. Time intervals should be observed during data exchange.

Table E.1 — Time intervals

Time intervals	Min, ms	Max, ms
Time between Request and Response	1	300
Time between Response and next Request	3	500

E.4 Automatic data transmission

Three formats of automatic data transmission are available:

1) HEX — data is transferred in hexadecimal format (HEX).

Table E.2 — Format of automatic data transmission message

0x3e	Adr	Fmt	Data	CS
1 byte	1 byte	0x06	5 bytes	1 byte

Adr field contains flow meter address. **Fmt** field has constant value of 0x06 which defines Response message.

Data field values are listed in table E.5.

See E.6 for **CS** checksum calculation instructions.

2) ASCII — data is transferred in character mode (ASCII character codes).

For example, Q=10000.250, B=60.55, A=58.65, F=81.55, R=20.00 h=14563, t=20<CR><LF>

where

Q – high resolution total fuel consumption value (in liters);
B – instant value of hourly fuel consumption rate (in liters per hour);
A* – average hourly fuel consumption over the recent 30 seconds (in liters per hour);
F* - hourly fuel consumption in “Feed” chamber (in liters per hour);
R* - hourly fuel consumption, high resolution in “Reverse” chamber (in liters per hour);
h* – flow meter hours of operation (in seconds);
t - current temperature value (ºC) or malfunction code (see table E.6).

3) ASCII-EXT — data is transferred in character mode (ASCII character codes) together with Prefix and Postfix:

For example, <prefix>10000.250< postfix ><CR><LF>

<prefix> is a message header, max 32 characters

<postfix> is message footer max 32 characters

Characters transmitted between Prefix and Postfix stand for a total fuel consumption counter value in liters.

Prefix and Postfix are set with Service S6 DFM configuration utility.

* These data can be provided only by DFM 232 / DFM 485 flow meters having the firmware version from 4.79 and higher.

E.5 Request-Response data exchange mode

1) Request

Table E.3 — Request format

0x31	Adr	Fmt	Data	CS
1 byte	1 byte	1 byte	from 0 to 128 bytes	1 byte

Adr field contains address of the flow meter the request is addressed to.

Address byte value 255 means Request broadcast to all the possible addresses.

Fmt field defines Request type. Types are listed in table E.5.

Data field values are listed in table E.5.

See E.6 for **CS** checksum calculation instructions.

2) Response

Table E.4 — Response format

0x3e	Adr	Fmt	Data	CS
1 byte	1 byte	1 byte	from 0 to 128 bytes	1 byte

Adr field contains address of the flow meter sending the Response.

Fmt field defines Request type the Response is sent on.

Data field values are listed in table E.5.

See E.6 for **CS** checksum calculation instructions.

Table E.5 — Requests and Responses

#	Request					Response – Data field		
	Fmt		Data					
	Value	Description	Type	Description	Resolution step	Type	Description	Resolution step
1	0x06	Reading parameters	-	-	-	S8 U16 U16	Temperature Total fuel consumption Hourly fuel consumption rate	1 °C 1 l 0.1 l/h
2	0x23	Reading operation parameters	-	-	-	U8 U16 U8 U32 U32 U32 U32 U32 U32 U32 U32 U32 U32 U32	Fuel temperature Hourly fuel consumption rate Engine operation mode according to flow rate High resolution total fuel consumption High resolution total fuel consumption in Idle mode High resolution total fuel consumption in Optimal mode High resolution total fuel consumption in Overload mode High resolution total fuel consumption in Cheat (Tampering) mode Engine working time Engine working time in Idle mode Engine working time in Optimal mode Engine working time in Overload mode Engine working time in Cheat (Tampering) mode Engine working time in Interference mode	1 °C 0.05 l/h 1 0.001 l 0.001 l 0.001 l 0.001 l 0.001 l 1 s 1 s 1 s 1 s 1 s 1 s
	Types: U8 – unsigned 8-bit value S8 – signed 8-bit value U16 – unsigned 16-bit value U32 – unsigned 32-bit value							

Malfunction code will be transmitted through temperature field value if there any malfunction of DFM is self-detected (see table E.6).

Table E.6 — Malfunction codes of DFM

Code	Malfunction description
136	DFM error
137	Battery charge level is less than 10 %
138	Interference Event
139	Cheat (tampering) Event

E.6 Checksum

Checksum is calculated with a polynomial for each byte of the message (excluding checksum) a^8+a^5+a^4+1.

CRC can be calculated using an algorithm (C programming language):

1)

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

2)

```
U8 CRC8 (U8 b, U8 crc)
{
	U8 i = 8;
	do {
		if ( (b ^ crc) & 0x01) {
		crc = ( (crc ^ 0x18) >> 1 ) | 0x80;
	} else {
		crc >>= 1;
	}
	b >>= 1;
	} while (--i);
	return crc;
}
```

3) Table method described in Dallas APPLICATION NOTE 27: Understanding and Using Cyclic Redundancy Checks with Dallas Semiconductor iButton Products.

Annex F
Data composition in the flow meters output messages that are transmitted via CAN j1939/S6 interface

Table F.1 — Data composition in DFM ACAN/CCAN/DCAN outgoing messages, that are transmitted via SAE j1939 protocol

Field number	Length	Parameter	Description	Rules of output
Flowmeter. Parameters PGN 62981 (0xF605)				1000 ms
1	2 bytes	SPN 183	Engine fuel rate	
3.1	4 bits	SPN 521181	Engine mode by fuel rate	
4	2 bytes	SPN 521027/18.0	Chamber fuel rate. Feed chamber	
6	2 bytes	SPN 521027/18.1	Chamber fuel rate. Reverse chamber	
8.1	4 bits	SPN 521028/18.0	Chamber working mode. Feed chamber	
8.5	4 bits	SPN 521028/18.1	Chamber working mode. Reverse chamber	
Flowmeter. Counters 1 PGN 62992 (0xF610)				On request
1	4 bytes	SPN 5054	High Resolution Engine Total Fuel Used	
5	4 bytes	SPN 5054/9.0	High Resolution Engine Total Fuel Used. Idle	
9	4 bytes	SPN 5054/9.1	High Resolution Engine Total Fuel Used. Optimal	
13	4 bytes	SPN 5054/9.2	High Resolution Engine Total Fuel Used. Overload	
17	4 bytes	SPN 5054/9.3	High Resolution Engine Total Fuel Used. Cheating	
21	4 bytes	SPN 5054/9.4	High Resolution Engine Total Fuel Used. Negative	
25	4 bytes	SPN 521171	Flowmeter Hours Of Operation	
29	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle	
33	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal	
37	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload	
41	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating	
45	4 bytes	SPN 521171/9.4	Flowmeter Hours Of Operation. Negative	
49	4 bytes	SPN 521171/9.5	Flowmeter Hours Of Operation. Interference	
Flowmeter. Counters 2 PGN 62993 (0xF611)				On request
1	1 byte	SPN 174	Engine Fuel Temperature 1	
2	4 bytes	SPN 5054/18.0	High Resolution Engine Total Fuel Used. Feed chamber	
6	4 bytes	SPN 5054/9.0/18.0	High Resolution Engine Total Fuel Used. Idle. Feed chamber	
10	4 bytes	SPN 5054/9.1/18.0	High Resolution Engine Total Fuel Used. Optimal. Feed chamber	
14	4 bytes	SPN 5054/9.2/18.0	High Resolution Engine Total Fuel Used. Overload. Feed chamber	
18	4 bytes	SPN 5054/9.3/18.0	High Resolution Engine Total Fuel Used. Cheating. Feed chamber	
22	4 bytes	SPN 521189/18.0	Flowmeter Chamber Time Counter. Feed chamber	
26	4 bytes	SPN 521189/9.0/18.0	Flowmeter Chamber Time Counter. Idle. Feed chamber	
30	4 bytes	SPN 521189/9.1/18.0	Flowmeter Chamber Time Counter. Optimal. Feed chamber	
34	4 bytes	SPN 521189/9.2/18.0	Flowmeter Chamber Time Counter. Overload. Feed chamber	
38	4 bytes	SPN 521189/9.3/18.0	Flowmeter Chamber Time Counter. Cheating. Feed chamber	
42	4 bytes	SPN 5054/18.1	High Resolution Engine Total Fuel Used. Reverse chamber	
46	4 bytes	SPN 5054/9.0/18.1	High Resolution Engine Total Fuel Used. Idle. Reverse chamber	
50	4 bytes	SPN 5054/9.1/18.1	High Resolution Engine Total Fuel Used. Optimal. Reverse chamber	
54	4 bytes	SPN 5054/9.2/18.1	High Resolution Engine Total Fuel Used. Overload. Reverse chamber	

Field number	Length	Parameter	Description	Rules of output
58	4 bytes	SPN 5054/9.3/18.1	High Resolution Engine Total Fuel Used. Cheating. Reverse chamber	
62	4 bytes	SPN 521189/18.1	Flowmeter Chamber Time Counter. Reverse chamber	
66	4 bytes	SPN 521189/9.0/18.1	Flowmeter Chamber Time Counter. Idle. Reverse chamber	
70	4 bytes	SPN 521189/9.1/18.1	Flowmeter Chamber Time Counter. Optimal. Reverse chamber	
74	4 bytes	SPN 521189/9.2/18.1	Flowmeter Chamber Time Counter. Overload. Reverse chamber	
78	4 bytes	SPN 521189/9.3/18.1	Flowmeter Chamber Time Counter. Cheating. Reverse chamber	
Total Fuel Used/Hours Of Operation In Idle Mode PGN 63106 (0xF682)				1000 ms
1	4 bytes	SPN 5054/9.0	High Resolution Engine Total Fuel Used. Idle	
5	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle	
Total Fuel Used/Hours Of Operation In Optimal Mode PGN 63107 (0xF683)				1000 ms
1	4 bytes	SPN 5054/9.1	High Resolution Engine Total Fuel Used. Optimal	
5	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal	
Total Fuel Used/Hours Of Operation In Overload Mode PGN 63108 (0xF684)				1000 ms
1	4 bytes	SPN 5054/9.2	High Resolution Engine Total Fuel Used. Overload	
5	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload	
Total Fuel Used/Hours Of Operation In Cheat Mode PGN 63109 (0xF685)				1000 ms
1	4 bytes	SPN 5054/9.3	High Resolution Engine Total Fuel Used. Cheating	
5	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating	
Total Fuel Used/Hours Of Operation In Negative Mode PGN 63110 (0xF686)				1000 ms
1	4 bytes	SPN 5054/9.4	High Resolution Engine Total Fuel Used. Negative	
5	4 bytes	SPN 521171/9.4	Flowmeter Hours Of Operation. Negative	
Engine Total Hour Of Operation In Interference Mode PGN 63111 (0xF687)				1000 ms
1	4 bytes	SPN 521171/9.5	Flowmeter Hours Of Operation. Interference	
5	4 bytes	SPN 521267	Interference sensor occurrence count	
Total Fuel Used (Feed Chamber) 1 PGN 63112 (0xF688)				1000 ms
1	4 bytes	SPN 5054/18.0	High Resolution Engine Total Fuel Used. Feed Chamber	
5	4 bytes	SPN 521189/18.0	Flowmeter Chamber Time Counter. Feed Chamber	
Total Fuel Used (Feed Chamber) 2 PGN 63113 (0xF689)				1000 ms
1	4 bytes	SPN 5054/9.0/18.0	High Resolution Engine Total Fuel Used. Idle. Feed Chamber	
5	4 bytes	SPN 521189/9.0/18.0	Flowmeter Chamber Time Counter. Idle. Feed Chamber	
Total Fuel Used (Feed Chamber) 3 PGN 63114 (0xF68A)				1000 ms
1	4 bytes	SPN 5054/9.1/18.0	High Resolution Engine Total Fuel Used. Optimal. Feed Chamber	
5	4 bytes	SPN 521189/9.1/18.0	Flowmeter Chamber Time Counter. Optimal. Feed Chamber	
Total Fuel Used (Feed Chamber) 4 PGN 63115 (0xF68B)				1000 ms
1	4 bytes	SPN 5054/9.2/18.0	High Resolution Engine Total Fuel Used. Overload. Feed Chamber	
5	4 bytes	SPN 521189/9.2/18.0	Flowmeter Chamber Time Counter. Overload. Feed Chamber	
Total Fuel Used (Feed Chamber) 5 PGN 63116 (0xF68C)				1000 ms
1	4 bytes	SPN 50549.3/18.0	High Resolution Engine Total Fuel Used. Cheating. Feed Chamber	
5	4 bytes	SPN 521189/9.3/18.0	Flowmeter Chamber Time Counter. Cheating. Feed Chamber	
Total Fuel Used (Reverse chamber) 1 PGN 63117 (0xF68D)				1000 ms
1	4 bytes	SPN 5054/18.1	High Resolution Engine Total Fuel Used. Reverse chamber	
5	4 bytes	SPN 521189/18.1	Flowmeter Chamber Time Counter. Reverse chamber	
Total Fuel Used (Reverse chamber) 2 PGN 63118 (0xF68E)				1000 ms
1	4 bytes	SPN 5054/9.0/18.1	High Resolution Engine Total Fuel Used. Idle. Reverse chamber	
5	4 bytes	SPN 521189/9.0/18.1	Flowmeter Chamber Time Counter. Idle. Reverse chamber	

Field number	Length	Parameter	Description	Rules of output
Total Fuel Used (Reverse chamber) 3 PGN 63119 (0xF68F)				1000 ms
1	4 bytes	SPN 5054/9.1/18.1	High Resolution Engine Total Fuel Used. Optimal. Reverse chamber	
5	4 bytes	SPN 521189/9.1/18.1	Flowmeter Chamber Time Counter. Optimal. Reverse chamber	
Total Fuel Used (Reverse chamber) 4 PGN 63120 (0xF690)				1000 ms
1	4 bytes	SPN 5054/9.2/18.1	High Resolution Engine Total Fuel Used. Overload. Reverse chamber	
5	4 bytes	SPN 521189/9.2/18.1	Flowmeter Chamber Time Counter. Overload. Reverse chamber	
Total Fuel Used (Reverse chamber) 5 PGN 63121 (0xF691)				1000 ms
1	4 bytes	SPN 5054/9.3/18.1	High Resolution Engine Total Fuel Used. Cheating. Reverse chamber	
5	4 bytes	SPN 521189/9.3/18.1	Flowmeter Chamber Time Counter. Cheating. Reverse chamber	
Engine Hours Of Operation/Total Fuel Used PGN 63236 (0xF704)				1000 ms
1	4 bytes	SPN 521171	Flowmeter Hours Of Operation	
5	4 bytes	SPN 5054	High Resolution Engine Total Fuel Used	
Flowmeter Hours Of Operation/Total Fuel Used. Clearable PGN 63261 (0xF71D)				1000 ms
1	4 bytes	SPN 5054/28.0	High Resolution Engine Total Fuel Used. Clearable	
5	4 bytes	SPN 521171/28.0	Flowmeter Hours Of Operation. Clearable	
High Resolution Fuel Consumption (Liquid) PGN 64777 (0xFD09)				1000 ms
1	4 bytes	SPN 5053	High Resolution Engine Trip Fuel	
5	4 bytes	SPN 5054	High Resolution Engine Total Fuel Used	
Total Averaged Information PGN 65101 (0xFE4D)				1000 ms
1	2 bytes	SPN 1834	Engine Total Average Fuel Rate	
3	2 bytes	SPN 1835	Engine Total Average Fuel Economy	
Idle Operation PGN 65244 (0xFEDC)				On request
1	4 bytes	SPN 236	Engine Total Idle Fuel Used	
5	4 bytes	SPN 235	Engine Total Idle Hours	
Fuel Consumption (Liquid) PGN 65257 (0xFEE9)				On request
1	4 bytes	SPN 182	Engine Trip Fuel	
5	4 bytes	SPN 250	Engine Total Fuel Used	
Engine temperature 1 PGN 65262 (0xFEEE)				1000 ms
2	1 byte	SPN 174	Engine Fuel Temperature 1	
Fuel Economy (Liquid) PGN 65266 (0xFEF2)				100 ms
1	2 bytes	SPN 183	Engine Fuel Rate	
Vehicle Voltage PGN 62987 (0xF60B)				1000 ms
1	3 bytes	SPN 158	Keyswitch Battery Potential	
3.1	2 bites	SPN 521049	Ignition Key State	
4	4 bytes	SPN 521053	Ignition ON Time	
Unit Passport PGN 62995 (0xF613)				On request
1	16 bytes	SPN 521123	Line	
17	16 bytes	SPN 521344	Mark	
33	16 bytes	SPN 521345	Model	
49	16 bytes	SPN 521120	Serial number	
65	8 bytes	SPN 521121	Firmware version	
73	4 bytes	SPN 521125	Date of production	
77	1 byte	SPN 521188	Address at S6 (SA) bus	
Unit Work Counters PGN 62994 (0xF612)				On request
1	4 bytes	SPN 521116	Unit Hours Of Operation	

Field number	Length	Parameter	Description	Rules of output
5	4 bytes	SPN 521116/16.1	Unit Hours Of Operation. Battery	
9	4 bytes	SPN 521118	Unit Reset Counter	
13	4 bytes	SPN 521119	Unit Power Off Counter	
Time Origin Settings PGN 63011 (0xF623)				On request
1.1	2 bites	SPN 521350	Automatic Daylight Savings Time and Back	
6	1 byte	SPN 1601	Time Displacement In Minutes	
7	1 byte	SPN 1602	Time Displacement In Hours	
Fuel Consumption Factors PGN 63026 (0xF632)				On request
1	2 bytes	SPN 521433	Temperature Correction Coefficient	
3	2 bytes	SPN 521434	Liquid Consumption Correction Coefficient	
5.1	2 bites	SPN 521311	Temperature Correction Enable	
Calibration Table. Fuel Rate (DFM) PGN 63044 (0xF644)				On request
1	1 byte	SPN 521355	Array Elements Count	
2	2 bytes	SPN 521232	Impulse Period	
4	2 bytes	SPN 521231	Chamber Volume	
List Of Importnant Events PGN 63055 (0xF64F)				On request
1	4 bytes	SPN 521166	SPN Events	
5	1728 bytes	SPN 521357	Data	
List Of Informative Events PGN 63056 (0xF650)				On request
1	4 bytes	SPN 521166	SPN Events	
5	1728 bytes	SPN 521357	Data	
Battery voltage mode borders PGN 63064 (0xF658)				On request
1	2 bytes	SPN 521391/2.8	Battery Voltage Mode Border. Min	
3	2 bytes	SPN 521391/2.7	Battery Voltage Mode Border. Max	
Fuel Rate Mode Borders PGN 63065 (0xF659)				On request
1	2 bytes	SPN 521392/9.0	Fuel Rate Mode Border. Idle	
3	2 bytes	SPN 521392/9.1	Fuel Rate Mode Border. Optimal	
5	2 bytes	SPN 521392/9.2	Fuel Rate Mode Border. Overload	
7	2 bytes	SPN 521392/9.0/18.0	Fuel Rate Mode Border. Idle. Feed chamber	
9	2 bytes	SPN 521392/9.1/18.0	Fuel Rate Mode Border. Optimal. Feed chamber	
11	2 bytes	SPN 521392/9.2/18.0	Fuel Rate Mode Border. Overload. Feed chamber	
13	2 bytes	SPN 521392/9.0/18.1	Fuel Rate Mode Border. Idle. Reverse chamber	
15	2 bytes	SPN 521392/9.1/18.1	Fuel Rate Mode Border. Optimal. Reverse chamber	
17	2 bytes	SPN 521392/9.2/18.1	Fuel Rate Mode Border. Overload. Reverse chamber	
Battery PGN 63086 (0xF66E)				5000 ms
1.1	2 bites	SPN 21129	Unit Power Status	
2	2 bytes	SPN 167	Charging System Potential (Voltage)	
4	1 byte	SPN 521061	Battery Charge Level	
5	4 bytes	SPN 521116/16.1	Unit Hours Of Operation. Battery	
Fuel consumption factors. Operating modes PGN 63303 (0xF747)				On request
1	2 bytes	521434/9.0	Liquid Consumption Correction Coefficient. Idle	
3	2 bytes	521434/9.1	Liquid Consumption Correction Coefficient. Optimal	
5	2 bytes	521434/9.2	Liquid Consumption Correction Coefficient. Overload	
Active diagnostic trouble codes PGN 65226 (0xFECA)				1000 ms
3	3 bytes	SPN 521044	Malfunction code (SID)	

Field number	Length	Parameter	Description	Rules of output
Previously active diagnostic trouble codes PGN 65227 (0xFECB)				On request
3	3 bytes	SPN 521044	Malfunction code (SID)	
Time/Date PGN 65254 (0xFEE6)				On request
1	1 byte	SPN 959	Seconds	
2	1 byte	SPN 960	Minutes	
3	1 byte	SPN 961	Hours	
4	1 byte	SPN 963	Month	
5	1 byte	SPN 962	Day	
6	1 byte	SPN 964	Year	
7	1 byte	SPN 1601	Time Displacement In Minutes	
8	1 byte	SPN 1602	Time Displacement In Hours	
Differential Opearation Mode PGN 63204 (0xF6E4)				On request
1.1	2 bits	SPN 521268	Master Mode	
1.3	2 bits	SPN 521270	Calculation Mode	
2	1 byte	SPN 521269	Slave Device Address	
3	2 bytes	SPN 521271	Differential Fuel Rate Correction Coefficient	
5	1 byte	SPN 521671	Smoothing Capacity	
Total Fuel Consumption PGN 63515 (0xF81B)				1000 ms
1	4 bytes	SPN 5054/2.11	High Resolution Engine Total Fuel Used. Summary Value	
5	2 bytes	SPN 521687	Summation Error Mask	
DFM Summation Settings PGN 63516 (0xF81C)				On request
1.1	1 bit	SPN 521688/34.0	DFM Summation Enable. DFM 1	
1.2	1 bit	SPN 521688/34.1	DFM Summation Enable. DFM 2	
1.3	1 bit	SPN 521688/34.2	DFM Summation Enable. DFM 3	
1.4	1 bit	SPN 521688/34.3	DFM Summation Enable. DFM 4	
1.5	1 bit	SPN 521688/34.4	DFM Summation Enable. DFM 5	
1.6	1 bit	SPN 521688/34.5	DFM Summation Enable. DFM 6	
1.7	1 bit	SPN 521688/34.6	DFM Summation Enable. DFM 7	
1.8	1 bit	SPN 521688/34.7	DFM Summation Enable. DFM 8	
2.1	1 bit	SPN 521688/34.8	DFM Summation Enable. DFM 9	
2.2	1 bit	SPN 521688/34.9	DFM Summation Enable. DFM 10	
2.3	1 bit	SPN 521688/34.10	DFM Summation Enable. DFM 11	
2.4	1 bit	SPN 521688/34.11	DFM Summation Enable. DFM 12	
2.5	1 bit	SPN 521688/34.12	DFM Summation Enable. DFM 13	
2.6	1 bit	SPN 521688/34.13	DFM Summation Enable. DFM 14	
2.7	1 bit	SPN 521688/34.14	DFM Summation Enable. DFM 15	
2.8	1 bit	SPN 521688/34.15	DFM Summation Enable. DFM 16	
3.1	2 bits	SPN 521689	DFM Summation Mode Enable	
Unit Passport Abbreviated PGN 63523 (0xF823)				1000 ms
1	2 bytes	SPN 521716	Unit Firmware Version	

Field number	Length	Parameter	Description	Rules of output
3	2 bytes	SPN 521717	Unit Bootloader Version	
5	2 bytes	SPN 521718	Unit Hardware Version	
Bootloader Information PGN 63009 (0xF621)				On request
1	8 bytes	SPN 521122	Bootloader Version	
Flowmeter. Global Counters PGN 63508 (0xF814)				1000 ms
1	4 bytes	SPN 521675	High Resolution Engine Global Fuel Used	
5	2 bytes	SPN 183	Engine Fuel Rate	
CO2 Emission PGN 63593 (0xF869)				1000 ms
1	4 bytes	SPN 521864	Total CO2 Emission	
5	4 bytes	SPN 521865	Hourly CO2 Emission	
Differential Fuel Rate. CO2 Emission PGN 63594 (0xF86A)				1000 ms
1	4 bytes	SPN 521864	Total CO2 Emission	
5	4 bytes	SPN 521865	Hourly CO2 Emission	

- For flow meters with the firmware version from 4.32 and higher.
- For flow meters with the firmware version from 4.46 and higher.
- The number of calibration points – 5. The length of PGN is variable: for a single-chamber flow meter — 21 bytes, for a differential flow meter — 41 bytes.
- The PGN length of 210 bytes allows transmission of up to 15 Events, and the blank space for data is filled with values 0xFF.
  The following Events are considered important:
  SPN 521216 – tampering the flow meter;
  SPN 521217 – interference into the flow meter operation.
  The following Events are considered to be information Events:
  SPN 521204 – turning on the ignition;
  SPN 521205 – turning off the ignition;
  SPN 521223 – the on-board circuit voltage is too high;
  SPN 521224 - the on-board circuit voltage is too low.
  The description of SPN of unstructured data is provided in S6 Database.
- PGN length — 8 bytes:
  2 bytes — low limit of the on-board circuit (step - 0.05 V, range of data from 0 V to 3212.75 V);
  2 bytes — high limit of the on-board circuit (step - 0.05 V, range of data from 0 V to 3212.75 V);
  4 bytes — spare.
- For differential fuel flow meters with the firmware version not lower than 4.55, with the use of Service S6 DFM service software, version from 1.24 and higher.
- The length of PGN is variable, depending on the number of malfunctions (no more than 20, at a maximum).
- Only for DFM CAN single-chamber flow meters (firmware version not lower than 4.63) in the "Differential"/"Summation" mode using Service S6 DFM software version 1.27 and higher.
- For DFM CAN single-chamber and differential flow meters (firmware version not lower than 4.63) in the "Differential"/"Summation" mode using Service S6 DFM software version 1.27 and higher.
- For DFM CAN flow meters with the version of firmware not lower than 4.69.
- For DFM CAN flow meters with firmware version 4.84 and later.

You can reset the Counters "Flow meter Hours of Operation/Total Fuel Used. Clearable" (PGN 63261) that are stored in the internal memory of DFM ACAN/CCAN/DCAN by using S6 Technology. To perform this, you need to send the message "FM Command" (PGN 63080) to the network address of the respective flow meter.

Example: Using CAN j1939/S6 interface, reset the clearable Counters of DFM CAN flow meter (network address SA=111) by means of the command from MasterCAN Display 35 display (network address SA=109).

Command structure:

0x18 0x68 0xF6 0x6D 0x50 0x03 0x00 0x6F 0x1D 0xF7 0x00 0x00, where

CAN ID:
0x – prefixes of the hexadecimal number system;
18 – message priority;
68 – Counters reset command (PGN 63080 (0xF668)) (lower byte);
F6 – Counters reset command (PGN 63080 (0xF668)) (high byte);
6D – network address of the command source Unit.

Data Field:
0x – prefixes of the hexadecimal number system;
50 – command code for resetting the clearable Counters (80);
03 – data size (lower byte);
00 – data size (high byte);
6F – network address of the flow meter whose Counters must be reset;
1D – flow meter clearable Counters (PGN 63261 (0xF71D)) (lower byte);
F7 – flow meter clearable Counters (PGN 63261 (0xF71D)) (high byte);
00 – meaningless data;
00 – meaningless data.

Annex G
Electromagnetic compatibility specifications

G.1 Interference protection

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

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

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

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

Table G.3— DFM own radio interference field strength as per UNECE Regulation No.10 (Revision 4)

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

G.2 Electromagnetic compatibility of BLE-module of DFM S7

BLE-module installed in DFM S7 is certified (RED: No 0051-RED-0011 REV.0) and found to comply with:

- FCC Rules Part 15 (marking on flow meter — Contains FCC ID: S9NSPBTLERF);
- IC Rules, RSS-210 (marking on flow meter — Contains IC: 8976C-SPBTLERF).

WARNING: Any changes or modifications of BLE-module, which are not approved by the party responsible for compliance with FCC and IC certificates, may deprive the user of the flow meter of the right to operate it.

1) BLE-module complies with the restrictions for Class B digital device in accordance with Part 15 of the FCC Rules and RSS-210 of the IC Rules.

These restrictions are used for providing protection from harmful interference when operating in residential premises. BLE-module generates and can transmit/receive radio frequency energy. If it is not installed and is not used in accordance with the instructions, it may cause harmful interference to radio communication. There is no guarantee that interference will not occur in a particular installation. If BLE-module creates harmful interference to the reception of radio or television signals, what can be determined by turning BLE-module on and off, it is recommend for a user to try to eliminate the interference in one or more of the following ways:

- change the direction or location of the receiving antenna;
- increase the distance between the equipment and the receiver;
- plug the equipment into an outlet on a circuit different from that to which receiver is connected;
- contact the dealer or an experienced radio / television technician for a help.

2) BLE-module complies with the restrictions for Class A digital device in accordance with Part 15 of the FCC Rules and RSS-210 of the IC Rules.

These restrictions are designed to provide reasonable protection against harmful interference when the BLE-module is operated in a commercial environment. BLE-module generates and can transmit / receive radio frequency energy. If it is not installed and is not used in accordance with the instructions, it may cause harmful interference to radio communication. Operation of BLE-module in a residential area may cause harmful interference in which case the user will be required to correct the interference at his own expense.

Annex H
SPN of DFM Functional modules

Hourly (instant) fuel consumption measurement, Counters, Events registration, Parameters configuration and self-diagnostics of DFM is ensured by coordinated operation of its Functional modules (FM).
SPN format of DFM FM is in accordance with Data base S6 (DB).

H.1 Self-diagnostics FM

Self-diagnostics FM is intended for user authorization, password change (for the installer access level), reading the electronic passport, assigning a unique network address, accounting of operating time, and monitoring active faults of the Unit.

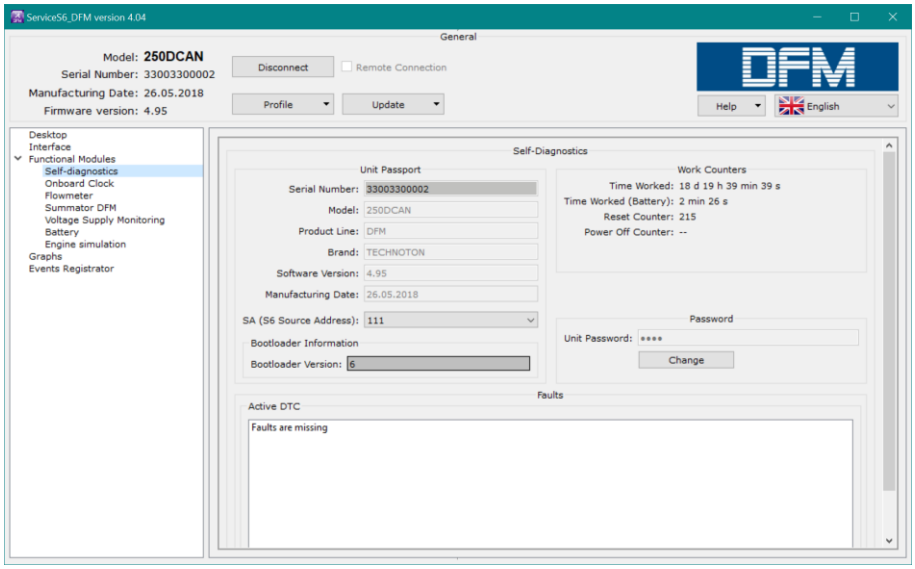


Figure H.1 — Example of the window of settings of Self-diagnostics FM in Service S6 DFM software

Table H.1 — Self-diagnostics FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Clarification
Unit passport PGN 62995				
521120	Serial number	On the fact	No	Serial number is a set of numbers that is used for identification of specific DFM. Serial number of DFM has the following format: AABBB C DDDDD, where: AA – code of DFM model; BBB – digits that reflect changes product changes; C – Manufacturer code; DDDDD – sequential number. SPN is not available for editing.

SPN	Name	Factory value	Unit of measure	Clarification
521345	Model	On the fact	No	Model – this is version of the flow meter inside of DFM product line. Each model has its own functional and constructive features (see 1.3). SPN is not available for editing.
521123	Line	DFM	No	Name of the product line. The line represents a group of similar products – fuel flow meters produced under general trademark DFM. SPN is not available for editing.
521344	Brand	TECHNOTON	No	Name of DFM Manufacturer. SPN is not available for editing.
521121	Firmware version	On the fact	No	Version of built in Software DFM. SPN is not available for editing.
521125	Manufacturing date	On the fact	No	Date (day, month, year) of DFM production. SPN is not available for editing.
521188	S6 address (SA)	111	No	Network address DFM address at Telematics interface CAN j1939/S6. Value of the network address may be selected by the user from the range 0…240*. The recommended ranges for addresses — 111…118 and 151…158.
Unit work Counters PGN 62994				
521116	Unit hours of operation	On the fact	s	Counter of summarized working time of the DFM since its production moment. The user can not reset the value of this counter. It can be reset by the Manufacturer or RSC only.
521118	Unit reset counter	On the fact	pc.	Counter of DFM's processor restarts at a time when the power is On or there is an impact of conducted interferences of the vehicle's on-board network. Restarts accounting is carried out since production date of the DFM. The user can not reset the value of this counter. It can be reset by the Manufacturer or RSC only.
Passwords PGN 63017				
521593/3.3	Password/ 3.3 Installer	1111	No	Password is entered for user authorization while establishing connection session between fuel flow meter and service Software for configuring the DFM. Password is a specific combination of four digits. By default used: Login – 0, password – 1111. User can change password of the DFM. After entering and confirming the new password is recorded into internal memory of the DFM.
Active diagnostic trouble codes PGN 65226				
521044	Fault identifier (SID+FMI)	On the fact	No	List of current DFM malfunctions are displayed at the settings field (in case of its presence — up to 10). For each active malfunction is indicated following: - faulty nod; - malfunction name. This setting makes it possible to monitor DFM operability. In case of lack of active malfunctions the following message is displayed "No malfunctions".
* For DFM CAN with the firmware version not lower than 4.69, in case of using Service S6 DFM software, versions from 2.05 and higher.				

H.2 Onboard clock FM

Onboard Clock FM is intended for generating date/time signals, setting the date/time and distributing them to other Functional modules of the Unit, and for automatic time synchronization with a CANUp 27 telematics gateway operating via S6 Technology.

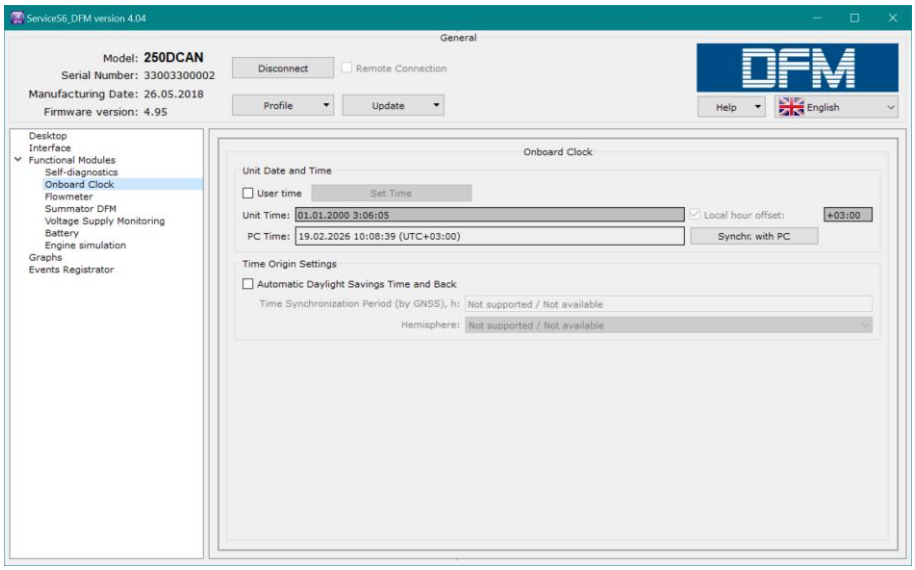


Figure H.2 — Example of the window of settings of Onboard Clock FM in Service S6 DFM software

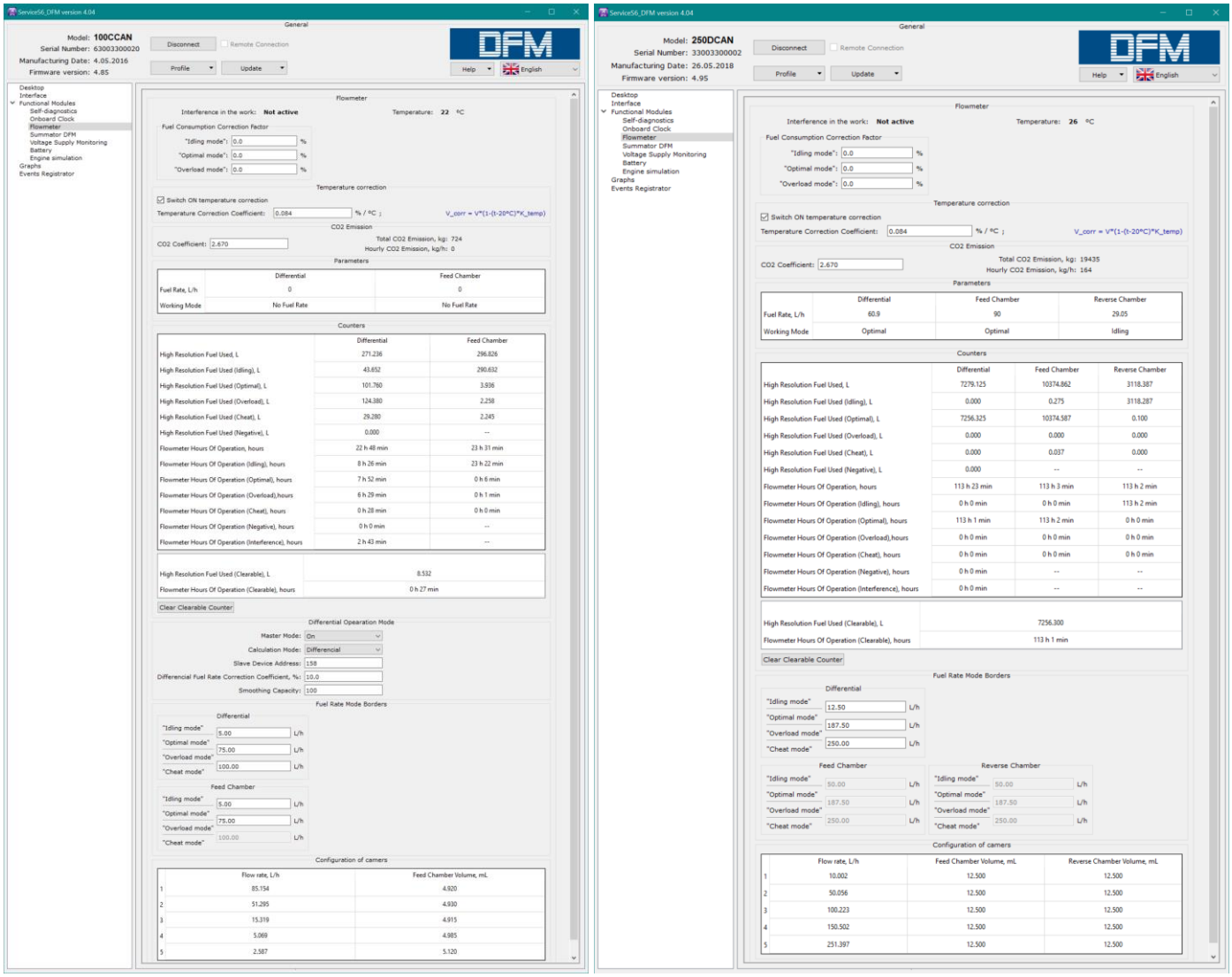
Table H.2 — Onboard clock FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Range	Clarification
Time/Date PGN 65254					
959	Seconds	On the fact	s	0…62.5	Present time — seconds*.
960	Minutes	On the fact	min	0…250	Present time — minutes*.
961	Hours	On the fact	h	0…250	Present time — hours*.
963	Month	On the fact	month	0…250	Present date — month*.
962	Day	On the fact	d	0…62.5	Present date — day*.
964	Year	On the fact	year	1985…2235	Present date — year*.
1601	Local minute offset	0	min	0…59	Time displacement (in minutes) in relation to Coordinated Universal Time that matches with local time (Time zone). It is activated and available for editing when configuring prese time manually and when synchronizing time with PC.
1602	Local hour offset	+3	h	-24…+24	Time displacement (in hours) in relation to Coordinated Universal Time that matches with local time (Time zone). It is activated and available for editing when configuring prese time manually and when synchronizing time with PC.
Time origin settings PGN 63011					
521350	Automatic daylight savings time and back	Off	No	On/Off	Daylight saving time automatic adjustment ON/OFF.
* Used during Events registration. Present time is available for user for editing manually or synchronizing of date/time with the clock in computer. By default, time is set in UTC format (Coordinated Universal Time standard) and displayed according to local displacement.					

H.3 Flowmeter FM

Flowmeter FM is intended for:

- measuring engine fuel consumption—total and by operating modes;
- measuring instantaneous (hourly) fuel consumption;
- measuring differential instantaneous fuel consumption and instantaneous consumption in the feed and reverse chambers (when using a differential flow meter);
- measuring engine operating time—total and by operating modes;
- measuring fuel temperature;
- accounting for attempts of unauthorized interference with the flow meter;
- setting the monitored boundaries of flow meter operating modes in accordance with the engine operating modes;
- temperature correction of measurement results;
- setting a fuel consumption correction factor;
- calculating the engine's total and hourly CO_2 emissions in accordance with the specified coefficient.



a) for one-chamber flow meter (when operating in Master mode)

b) for differential flow meter

Figure H.3 — Example of the window of settings of Flowmeter FM in Service S6 DFM software

Table H.3 — Flowmeter FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Clarification
Flowmeter. Parameters PGN 62981				
183	Engine fuel rate	On the fact	l/h	Hourly rate consumption of fuel, going through measuring chamber of DFM (applicable for one-chamber). For differential DFM – hourly rate of differential consumption of fuel, going through both measuring chambers.
521181	Engine mode by fuel rate	On the fact	No	Current operation mode of fuel consumer, correspondent to hourly rate of fuel consumption (applicable for one-chamber DFM). For differential DFM - current operation mode of fuel consumer, correspondent to hourly differential rate of fuel consumption.
521027/18.0	Chamber fuel rate/18.0 Feed chamber	On the fact	l/h	Rate of instant consumption of fuel, going through "Feed" chamber of differential flow meter.
521028/18.0	Chamber working mode/18.0 Feed chamber	On the fact	No	Current operation mode of fuel consumer, correspondent to hourly rate of fuel consumption in "Feed" chamber of differential fuel flow meter.
521027/18.1	Chamber fuel rate/18.1 Reverse chamber	On the fact	l/h	Rate of instant consumption of fuel, going through "Reverse" chamber of differential flow meter.
521028/18.1	Chamber working mode/ 18.1 Reverse chamber	On the fact	No	Current operation mode of fuel consumer, correspondent to hourly rate of fuel consumption in "Reverse" chamber of differential fuel flow meter.
Flowmeter. Counters 1 PGN 62992				
5054	High resolution engine total fuel used	On the fact	l	Counter of total fuel consumption by the Vehicle within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.0	High resolution engine total fuel used/ 9.0 Idle	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.1	High resolution engine total fuel used/9.1 Optimal	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.2	High resolution engine total fuel used/9.2 Overload	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.3	High resolution engine total fuel used/9.3 Cheat	On the fact	l	Counter of total fuel consumption by the Vehicle which exceeded the upper limit set for this particular flow meter model. Increasing numbers on the Counter can mean either possible fuel line intervention or incorrect installation of fuel flow meter. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.4	High resolution engine total fuel used/9.4 Negative	On the fact	l	Counter of total fuel consumption by the Vehicle in case the amount of fuel coming back through the reverse line exceeded fuel consumption in the feed line. The Counter can be found only in differential fuel flow meters. "Total "Negative" fuel consumption" Counter increasing numbers can mean increased volume of foam in reverse fuel line when Vehicle is operated at higher RPMs. The reason of foam volume growing is air presence in reverse fuel line cause by not tight hose connections or specifics of fuel system of Vehicle.
521171	Engine hours of operation	On the fact	s	Counter of total time of the flow meter operation within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.0	Engine hours of operation/9.0 Idle	On the fact	s	Counter of total time of the flow meter operation within the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.

SPN	Name	Factory value	Unit of measure	Clarification
521171/9.1	Engine hours of operation/ 9.1 Optimal	On the fact	s	Counter of total time of the flow meter operation within the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.2	Engine hours of operation/ 9.2 Overload	On the fact	s	Counter of total time of the flow meter operation within the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.3	Engine hours of operation/ 9.3 Cheat	On the fact	s	Counter of total time of the flow meter operation during which the upper limit of fuel consumption set for the mounted flow meter model was exceeded. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.4	Engine hours of operation/ 9.4 Negative	On the fact	s	Counter of total time of the flow meter operation during which the amount of fuel coming back through the reverse line exceeded fuel consumption in the feed line. This counter is foreseen only for differential models of DFM. The Counter can be found only in differential fuel flow meters. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.5	Engine hours of operation/ 9.5 Interference	On the fact	s	Counter of total time of external factors impact (e.g. strong magnetic field) impeding the flow meter operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
Flowmeter. Counters 2 PGN 62993				
174	Engine fuel temperature 1	On the fact	°C	Current temperature of fuel in measurement chamber.
5054/18.0	High resolution engine total fuel used/ 18.0 Feed chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Feed" chamber of the differential flow meter within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.0/18.0	High resolution engine total fuel used/ 9.0 Idle/ 18.0 Feed chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Feed" chamber of the differential flow meter in the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.1/18.0	High resolution engine total fuel used/ 9.1 Optimal/ 18.0 Feed chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Feed" chamber of the differential flow meter in the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.2/18.0	High resolution engine total fuel used/ 9.2 Overload/ 18.0 Feed chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Feed" chamber of the differential flow meter in the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.3/18.0	High resolution engine total fuel used/ 9.3 Cheat/ 18.0 Feed chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Feed" chamber of the differential flow meter which exceeded the upper limit set for the mounted flow meter model. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/18.1	High resolution engine total fuel used/ 18.1 Reverse chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Reverse" chamber of the differential flow meter within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.0/18.1	High resolution engine total fuel used/ 9.0 Idle/ 18.1 Reverse chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Reverse" chamber of the differential flow meter in the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.

SPN	Name	Factory value	Unit of measure	Clarification
5054/9.1/18.1	High resolution engine total fuel used/ 9.1 Optimal/ 18.1 Reverse chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Reverse" chamber of the differential flow meter in the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.2/18.1	High resolution engine total fuel used/ 9.2 Overload/ 18.1 Reverse chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Reverse" chamber of the differential flow meter in the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
5054/9.3/18.1	High resolution engine total fuel used/ 9.3 Cheat/ 18.1 Reverse chamber	On the fact	l	Counter of total fuel consumption by the Vehicle in the "Reverse" chamber of the differential flow meter which exceeded the upper limit set for the mounted flow meter model. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/18.0	Flowmeter chamber time counter/ 18.0 Feed chamber	On the fact	s	Counter of total time of the "Feed" chamber operation of the differential flow meter within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.0/18.0	Flowmeter chamber time counter/ 9.0 Idle / 18.0 Feed chamber	On the fact	s	Counter of total time of the "Feed" chamber operation of the differential flow meter in the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.1/18.0	Flowmeter chamber time counter/ 9.1 Optimal/ 18.0 Feed chamber	On the fact	s	Counter of total time of the "Feed" chamber operation of the differential flow meter in the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.2/18.0	Flowmeter chamber time counter/ 9.2 Overload/ 18.0 Feed chamber	On the fact	s	Counter of total time of the "Feed" chamber operation of the differential flow meter in the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.3/18.0	Flowmeter chamber time counter/ 9.3 Cheat/ 18.0 Feed chamber	On the fact	s	Counter of total time of the "Feed" measuring chamber operation of the differential flow meter during which the fuel consumption exceeded the upper limit set for the mounted flow meter model. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/18.1	Flowmeter chamber time counter/ 18.1 Reverse chamber	On the fact	s	Counter of total time of the "Reverse" chamber operation of the differential flow meter within the whole range of loads, including the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.0/18.1	Flowmeter chamber time counter/ 9.0 Idle/ 18.1 Reverse chamber	On the fact	s	Counter of total time of the "Reverse" chamber operation of the differential flow meter in the "Idle" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.1/18.1	Flowmeter chamber time counter/ 9.1 Optimal/ 18.1 Reverse chamber	On the fact	s	Counter of total time of the "Reverse" chamber operation of the differential flow meter in the "Optimal" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521189/9.2/18.1	Flowmeter chamber time counter/ 9.2 Overload/ 18.1 Reverse chamber	On the fact	s	Counter of total time of the "Reverse" chamber operation of the differential flow meter in the "Overload" mode of engine operation. The Counter is increasing from the date of flow meter production and cannot be reset by user.

SPN	Name	Factory value	Unit of measure	Clarification
521189/9.3/18.1	Flowmeter chamber time counter/ 9.3 Cheat/ 18.1 Reverse chamber	On the fact	s	Counter of total time of the "Reverse" measuring chamber operation of the differential flow meter during which the fuel consumption exceeded the upper limit set for the mounted flow meter model. The Counter is increasing from the date of flow meter production and cannot be reset by user.
Flowmeter hours of operation/total fuel used. Clearable PGN 63261				
5054/28.0	High resolution engine total fuel used/ 28.0 Clearable	On the fact	l	Resettable Counter of total fuel consumption by the Vehicle within the whole range of loads, including the "Idle" mode of engine operation. The Counter indications increment from the moment of its previous reset by the user. This Counter may be useful for measuring out precise portions of fuel.
521171/28.0	Flowmeter hours of operation / 28.0 Clearable	On the fact	s	Resettable Counter of total time of the flow meter operation within the whole range of loads, including the "Idle" mode of engine operation. The Counter indications increment from the moment of its previous reset by the user. This Counter may be useful for measuring out precise portions of fuel.
Differential Opearation Mode* PGN 63204				
521268	Master Mode	Off	No	Activation of Master mode for the Master flow meter (feed fuel line) and deactivation of the Slave flow meter (reverse fuel line) of the pair of the flow meters used in the differential mode of operation (see 2.10).
521270	Calculation Mode	Differential	No	Selection of the required mode of the flow meter readings calculation: - differential — the fuel consumption is calculated as the difference in consumption measured by the flow meters in the feed and reverse fuel lines; - summation — the fuel consumption is calculated as the total of consumption measured by the flow meter in the two fuel lines.
521269	Slave Device Address	112	No	Entering the unique network address for the Slave flow meter (reverse fuel line) from the range of values (111…118) or (151…158). The selected address must not coinside with the network address of the Master flow meter.
521271	Differential Fuel Rate Correction Coefficient	0.0	No	The fuel consumption correction coefficient makes it possible to improve the accuracy of differential fuel consumption measurement when a constant underestimation/overestimation of readings is identified under specific operating conditions (intense vibration, presence of air in the fuel system, losses of fuel in the reverse lines of the injectors). The setting is accessible for the user for editing.
521671	Smoothing Capacity	5	No	The damping buffer is used to enhance the accuracy of the differential measurement in cases of uneven fuel consumption in the feed/reverse fuel lines. The buffer value is selected experimentally from the range (2…100). In case of uneven fuel consumption in the fuel lines, we do not recommend to change the value of the damping buffer specified by default (5). In case the uneven fuel consumption is increasing, the value of the damping buffer must be higher.
Fuel rate mode borders PGN 63065				
521392/9.0	Fuel rate mode border/ 9.0 Idle	On the fact	l/h	"Idle" operation mode boundary setting – less than 10 % of maximal hourly consumption rate of fuel, going through the measurement chamber of DFM (applicable for one-chamber fuel flow meters). For differential fuel flow meters – less than 10 % of maximal hourly differential consumption rate of fuel, going through both chambers. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user in one-chamber and differential fuel flow meters DFM.
521392/9.1	Fuel rate mode border/ 9.1 Optimal	On the fact	l/h	"Optimal" operation mode boundary setting – 10 % to 75 % of maximal hourly fuel consumption rate. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user in one-chamber and differential fuel flow meters DFM.

SPN	Name	Factory value	Unit of measure	Clarification
521392/9.2	Fuel rate mode border/ 9.2 Overload	On the fact	l/h	"Overload" operation mode boundary setting – 75 % to 100 % of maximal hourly fuel consumption rate. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user in one-chamber and differential fuel flow meters DFM.
521392/9.0/18.0	Fuel rate mode border/ 9.0 Idle/ 18.0 Feed chamber	On the fact	l/h	Factory setting of "Idle" operation mode boundary for "Feed" chamber of differential fuel flow meter. The setting cannot be altered by user.
521392/9.1/18.0	Fuel rate mode border/ 9.1 Optimal/ 18.0 Feed chamber	On the fact	l/h	Factory setting of "Optimal" operation mode boundary for "Feed" chamber of differential fuel flow meter. The setting cannot be altered by user.
521392/9.2/18.0	Fuel rate mode border/ 9.2 Overload/ 18.0 Feed chamber	On the fact	l/h	Factory setting of "Overload" operation mode boundary for "Feed" chamber of differential fuel flow meter. The setting cannot be altered by user.
521392/9.0/18.1	Fuel rate mode border/ 9.0 Idle/ 18.1 Reverse chamber	On the fact	l/h	Factory setting of "Idle" operation mode boundary for "Reverse" chamber of differential fuel flow meter. The setting cannot be altered by user.
521392/9.1/18.1	Fuel rate mode border/ 9.1 Optimal/ 18.1 Reverse chamber	On the fact	l/h	Factory setting of "Optimal" operation mode boundary for "Reverse" chamber of differential fuel flow meter. The setting cannot be altered by user.
521392/9.2/18.1	Fuel rate mode border/ 9.2 Overload/ 18.1 Reverse chamber	On the fact	l/h	Factory setting of "Optimal" operation mode boundary for "Overload" chamber of differential fuel flow meter. The setting cannot be altered by user.
Fuel consumption factors PGN 63026				
521311	Temperature correction enable	Off	On/Off	A function for automatic correction of volumetric fuel consumption measurement depending on fuel temperature, making it possible to improve the accuracy of DFM readings. A use can turn on/off the function.
521433	Temperature correction coefficient	0.084	%/°C	Setting-up coefficient of volumetric expansion of fuel depending on fuel temperature change may increase accuracy of measurements by DFM. The setting can be adjusted by user only after turning on function of temperature correction.
521434	Correction coefficient	0.0	%	Setting-up correction coefficient of consumption may increase accuracy of fuel consumption measurement when constant over/undermeasurement during specific conditions of operation (high vibration, air in fuel lines, higher return flow from nozzles) is detected. The setting is available for editing by user.
521863	CO_2 Coefficient***	2.670	No	An input field for the coefficient used by the DFM electronic module to automatically calculate the engine's total and hourly CO_2 emissions. The setting is available for editing in one-chamber and differential flow meters, including when one-chamber DFM flow meters are used in a differential measurement mode.
Fuel consumption factors. Operating modes** PGN 63303				
521434/9.0	Liquid Consumption Correction Coefficient/ 9.0 Idle	0.0	%	Setting the correction coefficient for the "Idle" mode of operation. It makes it possible to improve the accuracy of fuel consumption measurement in case of revealing steady decreased/increased indications in the "Idle" mode of operation. This setting is accessible for editing by the user.

SPN	Name	Factory value	Unit of measure	Clarification
521434/9.1	Liquid Consumption Correction Coefficient/ 9.1 Optimal	0.0	%	Setting the correction coefficient for the "Optimal" mode of operation. It makes it possible to improve the accuracy of fuel consumption measurement in case of revealing steady decreased/increased indications in the "Optimal" mode of operation. This setting is accessible for editing by the user.
521434/9.2	Liquid Consumption Correction Coefficient/ 9.2 Overload	0.0	%	Setting the correction coefficient for the "Overload" mode of operation. It makes it possible to improve the accuracy of fuel consumption measurement in case of revealing steady decreased/increased indications in the "Overload" mode of operation. This setting is accessible for editing by the user.
Calibration table. Fuel rate (DFM) PGN 63044				
521355	Array elements count	5	pcs.	Quantity of points in calibration table made by Manufacturer during calibration process. The setting cannot be altered by user.
521231	Chamber volume	On the fact	ml	Fuel flow meter's measurement chamber(s) volume (see. 1.6.3). The setting cannot be altered by user.
CO2 Emission PGN 63593				
521864	Total CO2 Emission***	On the fact	kg	The value of the engine total CO_2 emissions Counter automatically calculated based on total fuel consumption for all load ranges (SPN 5054) in accordance with the specified coefficient (SPN 521863). The Counter increments from the time the DFM leaves production and cannot be reset by the user.
521865	Hourly CO2 Emission***	On the fact	kg/h	The value of the engine hourly CO_2 emissions automatically calculated based on hourly fuel consumption (SPN 183) in accordance with the specified coefficient (SPN 521863).

* These settings are valid only for DFM CAN with the firmware version not lower than 4.63, when using the service software version 1.27 and higher.
** These settings are valid only for DFM with the firmware version not lower than 4.74, when using the service software version 2.06 and higher.
*** These settings are valid only for DFM with the firmware version not lower than 4.84, when using the service software version 4.04 and higher.

H.4 Summator DFM FM

Summator DFM FM is intended to receive data via S6 Technology on the measured total fuel consumption in two or more (up to 16) fuel lines.

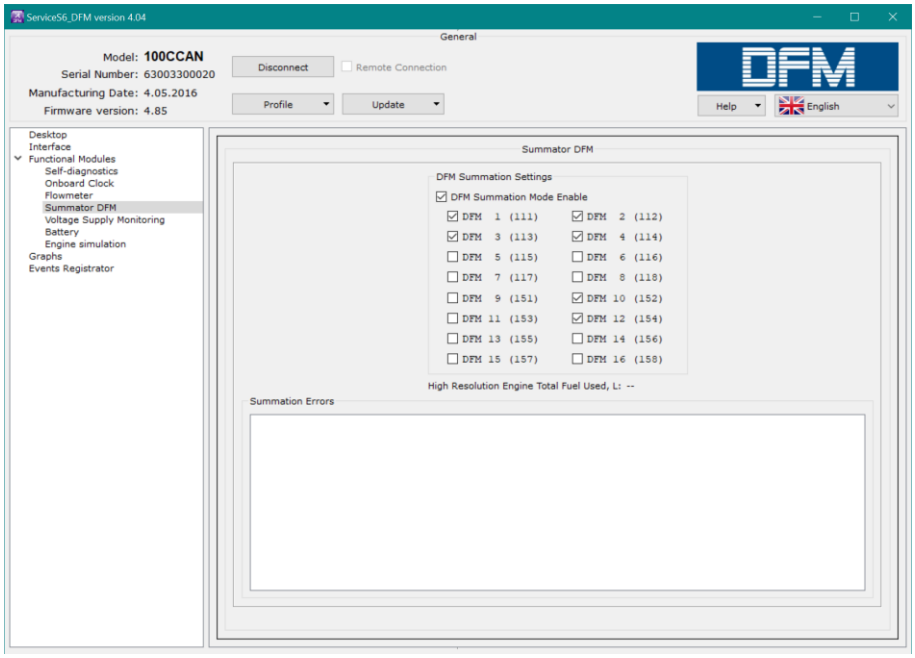


Figure H.4 — Example of the window of settings of Summator DFM in Service S6 DFM software

Table H.4 — Summator DFM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Range	Clarification
Total Fuel Consumption PGN 63515					
5054/2.11	High Resolution Engine Total Fuel Used / 2.11 Summary Value	On the fact	l	0…4211080	Displays the total of values of the Counters of total fuel consumption for the selected DFM CAN flow meters connected by means of S6 Technology. The total fuel consumption is displayed only in case the summation mode is activated.
521687	Summation Error Mask	No	No	0…65535	Bit mask to identify the numbers of the flow meters selected for summation, the output data of which are missing: 2^0- no data from DFM 1; 2^1- no data from DFM 2; 2^2- no data from DFM 3; 2^3- no data from DFM 4; 2^4- no data from DFM 5; 2^5- no data from DFM 6; 2^6- no data from DFM 7; 2^7- no data from DFM 8; 2^8- no data from DFM 9; 2^9- no data from DFM 10; 2^{10}- no data from DFM 11; 2^{11}- no data from DFM 12; 2^{12}- no data from DFM 13; 2^{13}- no data from DFM 14; 2^{14}- no data from DFM 15; 2^{15}- no data from DFM 16.

SPN	Name	Factory value	Unit of measure	Range	Clarification
DFM Summation Settings PGN 63516					
521689	DFM Summation Mode Enable	Off	-	On/Off	Field to enable/disable the mode of summation of readings of the Counters that show the total fuel consumption of DFM CAN flow meters connected by means of S6 Technology.
521688/34.0	DFM Summation Enable / 34.0 DFM 1	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 111) mounted in the fuel line 1.
521688/34.1	DFM Summation Enable / 34.0 DFM 2	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 112) mounted in the fuel line 2.
521688/34.2	DFM Summation Enable / 34.0 DFM 3	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 113) mounted in the fuel line 3.
521688/34.3	DFM Summation Enable / 34.0 DFM 4	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 114) mounted in the fuel line 4.
521688/34.4	DFM Summation Enable / 34.0 DFM 5	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 115) mounted in the fuel line 5.
521688/34.5	DFM Summation Enable / 34.0 DFM 6	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 116) mounted in the fuel line 6.
521688/34.6	DFM Summation Enable / 34.0 DFM 7	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 117) mounted in the fuel line 7.
521688/34.7	DFM Summation Enable / 34.0 DFM 8	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 118) mounted in the fuel line 8.
521688/34.8	DFM Summation Enable / 34.0 DFM 9	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 151) mounted in the fuel line 9.
521688/34.9	DFM Summation Enable / 34.0 DFM 10	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 152) mounted in the fuel line 10.
521688/34.10	DFM Summation Enable / 34.0 DFM 11	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 153) mounted in the fuel line 11.
521688/34.11	DFM Summation Enable / 34.0 DFM 12	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 154) mounted in the fuel line 12.
521688/34.12	DFM Summation Enable / 34.0 DFM 13	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 155) mounted in the fuel line 13.
521688/34.13	DFM Summation Enable / 34.0 DFM 14	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 156) mounted in the fuel line 14.
521688/34.14	DFM Summation Enable / 34.0 DFM 15	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 157) mounted in the fuel line 15.
521688/34.15	DFM Summation Enable / 34.0 DFM 16	Off	-	On/Off	Field to activate/deactivate the summation of readings of the total fuel consumption Counter of DFM CAN flow meter (network address 158) mounted in the fuel line 16.

H.5 Voltage supply monitoring FM

Voltage Supply Monitoring FM is intended to monitor the onboard circuit tension and the Vehicle ignition key position, as well as to set lower and upper limits of fluctuation range of Unit power supply.

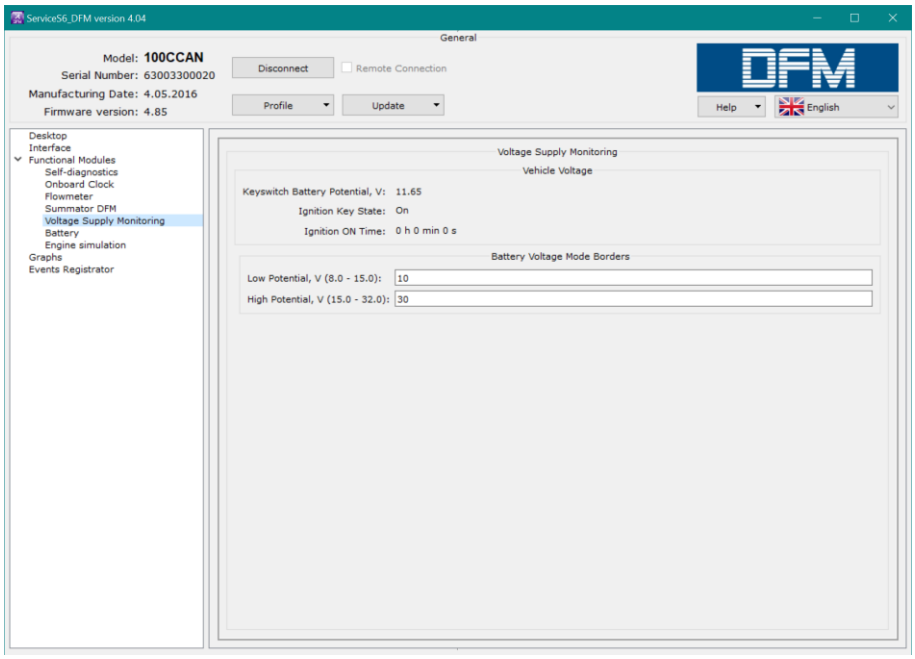


Figure H.5 — Example of the window of settings of Voltage supply monitoring FM in Service S6 DFM software

Table H.5 — Voltage supply monitoring FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Range	Clarification
Vehicle voltage PGN 62987					
158	Keyswitch battery potential	On the fact	V	0…3212.75	Setting displays present onboard voltage of ignition key on the Vehicle.
521049	Ignition key state	On the fact	No	On/Off	Setting displays present status of ignition key of the vehicle (On/Off).
521053	Ignition on time	On the fact	s	0…4211080000	Counter of summarized time when the ignition key is On since the moment of DFM installation on the vehicle. The user can not reset the value of this counter. It can be reset by the Manufacturer or RSC only.
Battery voltage mode borders PGN 63064					
521391/2.8	Battery voltage mode border/ 2.8 Min	10.0	V	8.0…15.0	Value of the lower level of onboard voltage range of DFM. This setting is available for editing by user. Set value of the voltage is used as a threshold while registering an important Event “Low level of onboard power supply”.
521391/2.7	Battery voltage mode border/ 2.7 Max	30.0	V	15.0…32.0	Value of the upper level of onboard voltage range of DFM. This setting is available for editing by user. Set value of the voltage is used as a threshold while registering an important Event “High level of onboard power supply”.

H.6 Battery FM

Battery FM is intended to monitor the current power status, the state of the built-in battery, and the total autonomous operating time of the DFM on the battery.

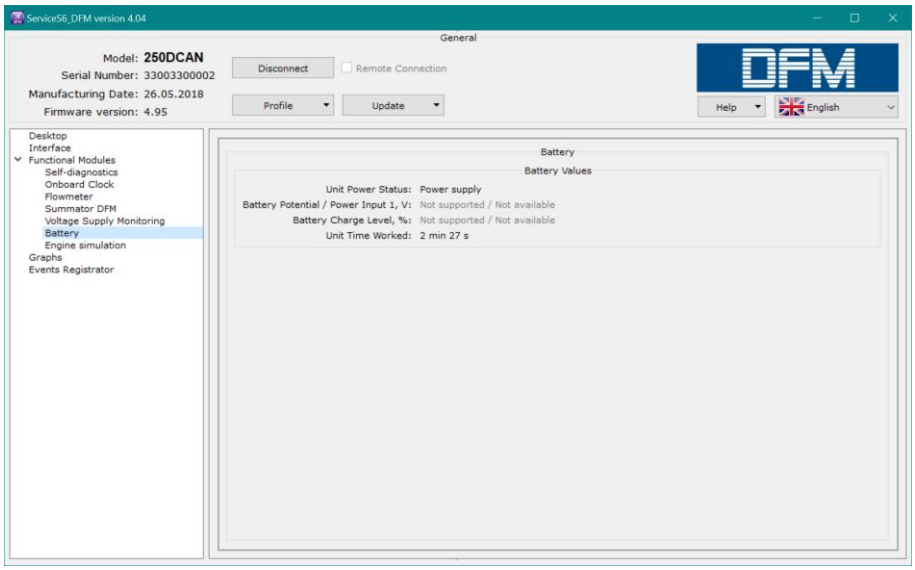


Figure H.6 — Example of the window of settings of Battery FM in Service S6 DFM software

Table H.6 — Battery FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Clarification
Battery PGN 63086				
521129	Unit power status	On the fact	No	Current power-supply status of DFM: - powered from embedded power source; - powered from on-board electrical system; - power is off; - power-supply status is not available/not supported by this device. While working with service software, data exchange between PC and fuel flow meter is possible only if flow meter is power-supplied from external source and power-supply status of DFM will always be displayed as "powered from on-board electrical system".
167	Charging system potential (voltage)	On the fact	V	Current voltage of embedded battery of DFM. When working with service software, this setting will always be displayed as "not available/not supported by this device".
521061	Battery charge level	On the fact	%	Current charge of embedded battery of DFM. When working with service software, this setting will always be displayed as "not available/not supported by this device".
521116/16.1	Unit hours of operation/ 16.1 Battery	On the fact	s	Counter of total operation time of DFM from embedded battery since installation to Vehicle. The Counter cannot be reset by user. Reset is possible in Regional Service Centers.

H.7 Engine simulation FM

Engine simulation FM is intended to generate and transmit to the CAN j1939/S6 interface a configured list of output FMS messages (PGNs) with specified network addresses and transmission schedule.

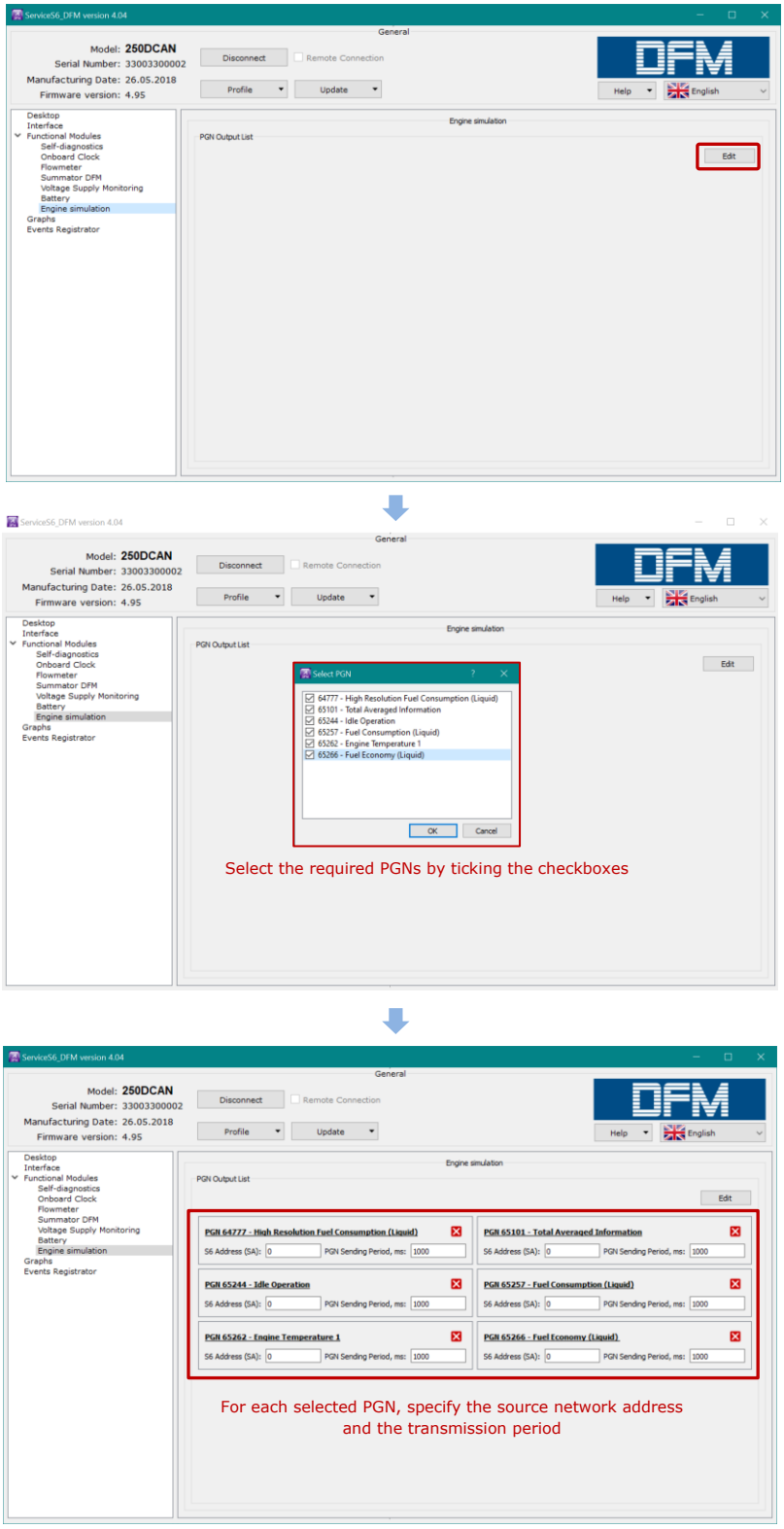


Figure H.7 — Example of the window of settings of Engine simulation DFM in Service S6 DFM software

Table H.6 — Engine simulation FM. Displayed and/or editable SPN with the help of Service S6 DFM software

SPN	Name	Factory value	Unit of measure	Range	Clarification
				PGN Output List PGN 63592	
521355	Array Elements Count	No	pcs.	1…6	The number of FMS messages that can be selected from the provided PGN list. The maximum number of items in the list is 6. The message list is not editable.
521150	PGN	No	No	0…65535	Select output PGNs from the provided list of FMS messages containing key engine parameters: PGN 64777 — High resolution fuel consumption (liquid); PGN 65101 — Total averaged information; PGN 65244 — Idle operation; PGN 65257 — Fuel consumption (liquid); PGN 65262 — Engine temperature 1; PGN 65266 — Fuel economy (liquid).
521188	S6 Address (SA)	0	No	0…255	Specify a unique network address (SA) of the data source from which the respective PGN must be transmitted to the CAN j1939/S6 interface.
521362	PGN Sending Period	1000	ms	500…30000	Specify the transmission period (ms) for sending the respective PGN to the CAN j1939/S6 interface.

IMPORTANT: Parameters (SPNs) in the simulated FMS messages that cannot be calculated by the DFM CAN electronic module are transmitted to the CAN j1939/S6 interface with the value **FF**.

Detailed parameters description (SPN), structure and content of messages (PGN) of FM DFM are placed at the following web site http://s6.jv-technoton.com/en (to access S6_DB registration is required).

Annex I
DFM firmware upgrade

ATTENTION:
1) DFM firmware update using Service S6 DFM software is possible **only for models with the interface cable** (except DFM AP). **Firmware file (*.blf3) is unified for all flow meter models**.
2) The firmware update of DFM S7 wireless fuel flow meters can be conducted only with the help of **Fuel Rate Monitor** mobile application (see "User manual"). After the firmware update, the flow meter always switches over into "Storage" mode (see 2.12).
3) DFM firmware update should be done **only** for implementation of improvements, recommended by Manufacturer.

To upgrade DFM firmware the following actions should be made:

1) In case you use Service S6 DFM software, connect flow meter to PC with the help of service adapter S6 SK (2.6.1) and establish connection session between DFM and PC (see 2.6.3).

ATTENTION: When re-uploading firmware, power supply voltage of DFM should not drop out of (10…45) V range.

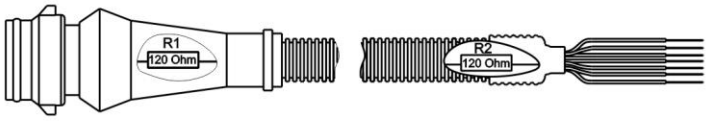
2) Start the firmware update procedure by pressing Update firmware button in Service S6 DFM software.
3) Select the firmware file **(*.blf3)** on the PC disc.
4) Start loading the firmware file into the DFM memory.
After firmware file integrity and compatibility check by Service S6 DFM software window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

ATTENTION: To avoid DFM failure, before the end of the firmware upgrade process **is forbidden**:
- to switch off PC;
- to switch off the power supply for the Unit;
- to disconnect the Unit from the service adapter and the adapter from the PC;
- Run any resource-intensive applications on the PC (in case you use Service S6 DFM software).

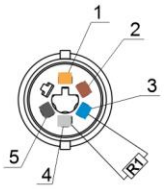
Service S6 DFM software will display appropriate message in case the firmware update is successful. DFM is ready for further operation.
In case of any error occur that leaded to the damage of present DFM firmware check all cables and adapter connections and retry. In this case the internal firmware loader is activated and will try to fix DFM operation performance. Contact Technoton technical support at support@jv-technoton.com if another try is also unsuccessful.

Annex J
Signal cables

S6 SC-CW-700 Cable



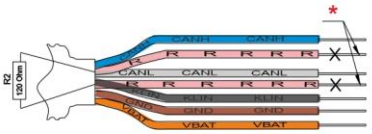
Cable length 700±5 cm.



Pin	Wire color	Circuit
1	orange	VBAT
2	brown	GND
3	blue	CANH / 485A
4	white	CANL / 485B
5	black	KLIN
6	-	-

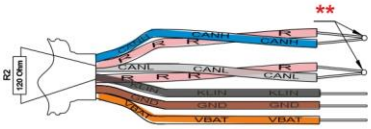
Connecting

without built-in terminal resistor R2

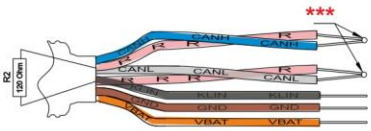


* Do not connect R2 resistor wires (pink, identification mark R), insulate.

with built-in terminal resistor R2

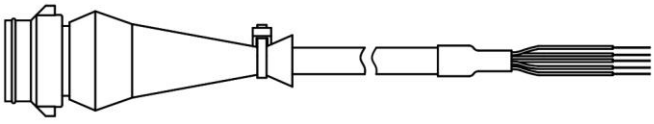


** When connecting **DFM CAN**
Connect electrically one of the R2 resistor wires (pink, identification mark R) with CANH wire, and the other - with CANL wire.

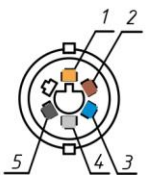


*** When connecting **DFM 485**
Connect electrically one of the R2 resistor wires (pink, identification mark R) with 485A wire, and the other - with 485B wire.

S6 SC-CW-700-RS Cable

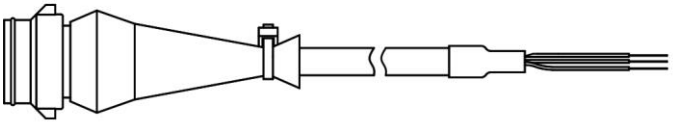


Cable length 700±5 cm.



Pin	Wire color	Circuit
1	orange	VBAT
2	brown	GND
3	blue	TX/B
4	white	RX/A/Imp
5	black	KLIN
6	-	-

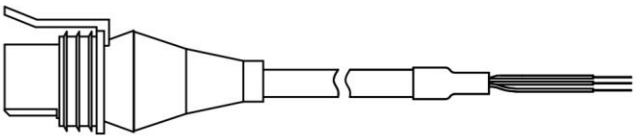
CABLE DFM.98.20.003 Cable



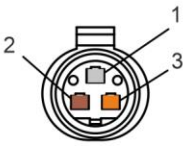
Cable length 750±5 cm.

Pin	Wire color	Circuit
1	orange	VBAT
2	brown	GND
3	-	-
4	white	Imp
5	-	-
6	-	-

CABLE DFM.98.20.001 Cable



Cable length 750±5 cm.



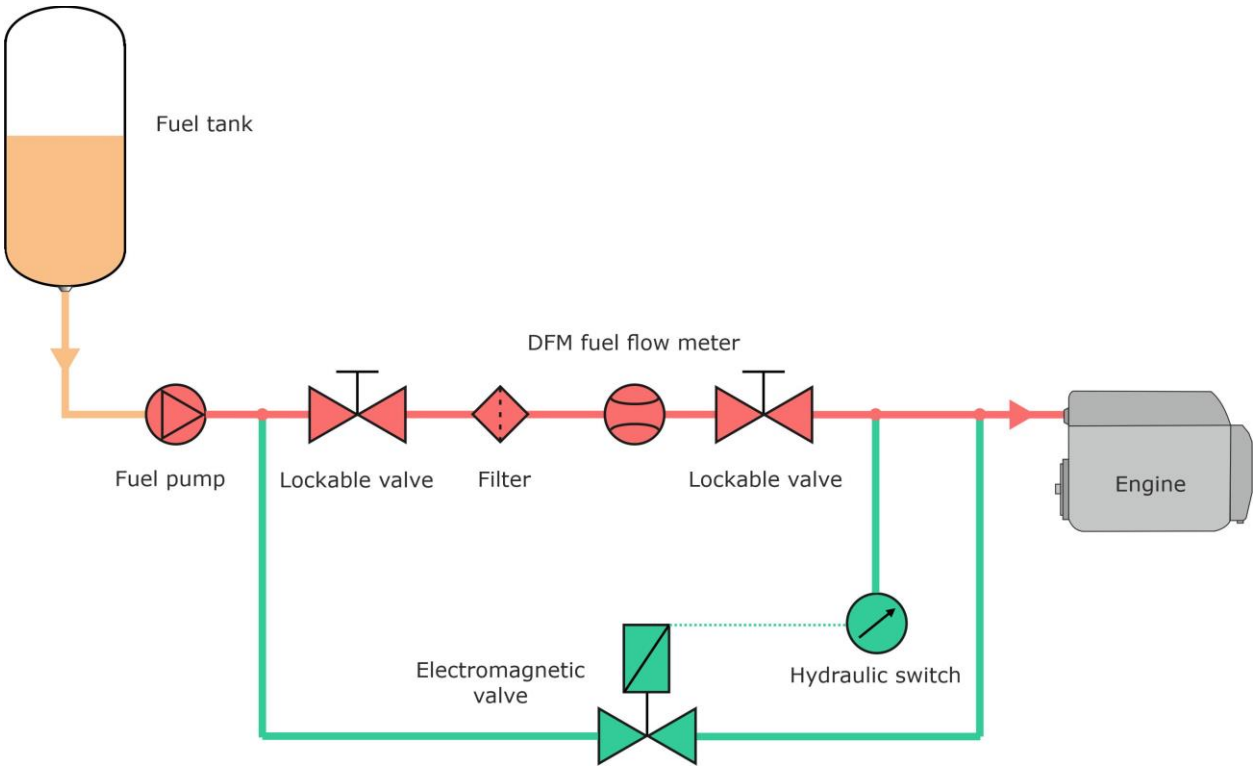
Pin	Wire color	Circuit
1	orange	VBAT
2	brown	GND
3	white	Imp

Annex K
Particularities of DFM mounting schemes in water and railway transport

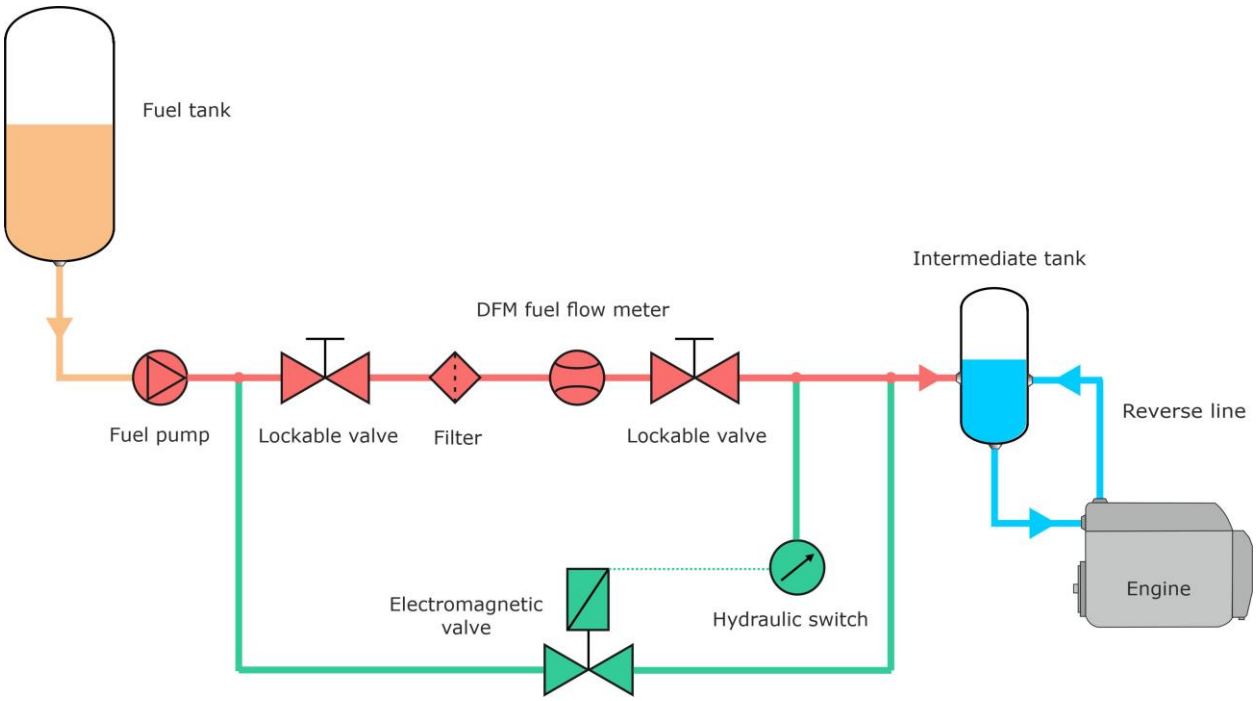
When mounting DFM in water and railway transport, it is very important that fuel supply to the consumer should not be stopped in case of the mud filter clogging or during the flow meter maintenance. Therefore, **you must ensure the possibility of temporary switching over the fuel supply to the accessory line – bypass**.

In case of the pressure fall in the fuel system below the set value, the fuel supply hydraulic switch on the main fuel line is triggered and the electromagnetic valve on the accessory line is automatically opened. From this moment on, fuel supply to the consumer is entirely provided through the bypass, but without measuring fuel consumption. In case there is air bubbling in the fuel, we recommend to connect the feed and return lines through a special intermediate tank that has a system of valves and floats (see figure K.1).

In case several engines are used in one Vehicle, a separate DFM is to be mounted in the fuel system of each engine.



a) standard scheme



b) scheme with an intermediate tank

Figure K.1 — Examples of DFM mounting schemes in vessels with automatic switching over fuel supply to the bypass

Annex L
Recommendations for mounting DFM 500 / DFM 900

DFM 500 / DFM 900 flow meters are different in design from DFM models of lower capacity. The difference is due to minimization of the flow meter dimensions and the need to sustain high accuracy of measurement.

When mounting the flow meter, it is very important to avoid deforming mechanical strains (loads) on its casing and the impact of vibration.

As a rule, the engine of the Vehicle or facility to be equipped is the source of vibration. Therefore, **it is strictly forbidden to mount the flow meter right on the engine and on elements attached to it!** The most suitable location to mount the flow meter is the Vehicle load-bearing frame or heavy parts of equipment that are least of all subject to vibration, when the engine is on or during movement.

During mounting DFM 500 / DFM 900 you should pay special attention to fuel lines connected to the flow meter. Normally, high-pressure hoses are used as fuel lines. They are made of fanged rubber with 1…2 layers of steel braiding. High-pressure hoses are designed for use in conditions of excessive pressure (150…220) bar. Therefore, as a rule, they are squeezed with steel sleeves by a hydraulic press.

High-pressure hoses that are longer than 20 sm are rather heavy, thus being the source of dual load on the flow meter casing (twisting action due to the fuel lines weight) and point vibration due to swaying and resonant amplification of the engine vibration).

Please, follow the recommendations outlined below, while mounting DFM 500 / DFM 900 flow meters:

1) Secure the connected fuel lines directly near the flow meter to the same surface (for example, the vehicle frame) on which the flow meter is installed. No mechanical strain is allowed in the place where the hoses are connected to the flow meter. In order to relieve any possible strain after fixing each hose to the frame, loosen its fixing to the flow meter, then tighten it again.

2) Special attention should be paid to fixing differential flow meters. Holes in their mounting brackets are of slightly greater diameter, than bolts used. This is specially designed, so as to prevent any tension or compression stress during their fixing to the frame surface. You should drill holes for mounting flow meter as accurately, as possible. Use 4 bolts for fixing the unit.

3) During mounting differential flow meter, by all means make sure there is no mechanical strain of the flow meter caused by mismatching holes in the mounting brackets and holes on the surface where the flow meter is to be mounted.

Annex M

Videography

1) DFM Marine Fuel Flow Meter video.

Link: https://www.youtube.com/watch?v=9lC4_RzfLik

2) DFM Fuel Flow Meter Installation video (DFM installation on tractor. After pump (pressure side) scheme).

Link: https://www.youtube.com/watch?v=ATscYhBsD3c

3) DFM fuel flow meter operation principle video (fuel flow measurement principle of DFM measuring chamber).

Link: https://www.youtube.com/watch?v=RXjvwyy1zlY

4) Interactive flash animation **Fuel Consumption Monitoring. DFM Fuel Flow Meter**

Link: https://www.youtube.com/watch?v=IOCQCNgGG7Uf

5) Interactive animation video **DFM fuel flow meter: selection of mounting scheme, accessories and mounting kit**

Link: DFM fuel flow meters: selection of installation layout, accessories and mounting kit

6) Check out YouTube channel for other **Technoton videos** at:

https://www.youtube.com/channel/UCq7EF3DHrgl7fOWB2ynsR-A