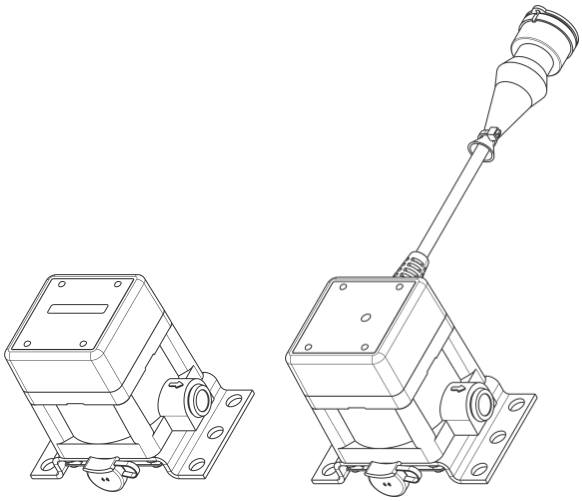
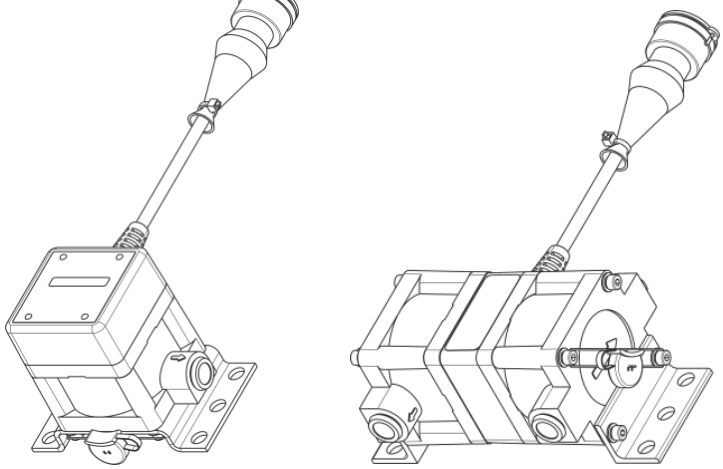
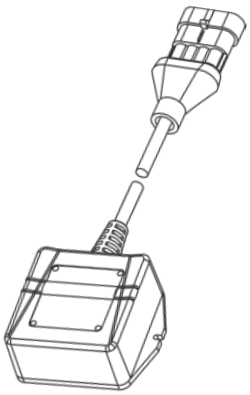
DFM FUEL FLOW METERS

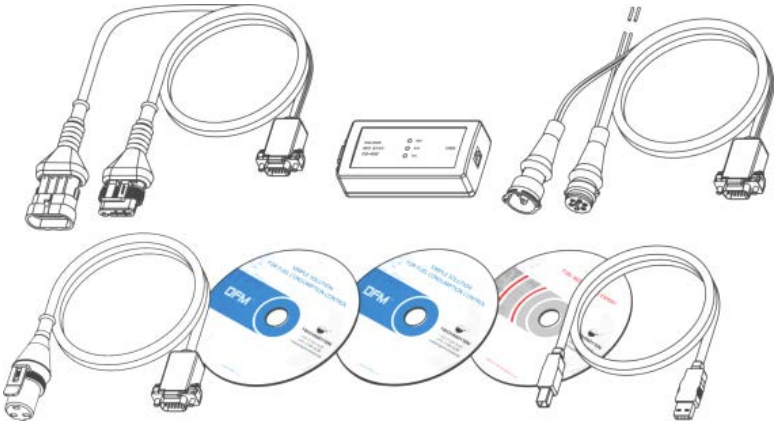


DFM i fuel consumption indicator



SK DFM service kit





OPERATION MANUAL

(includes Service DFM and Service S6 DFM software manuals)

Version 5.0

TECHNOTON

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Terms and Definitions

GPS is a US-made satellite geographical positioning system. Signals from GPS satellites enable the Customer's GPS receiver to calculate its current geographical coordinates, speed and its travel direction.

GLONASS is a Russian-made navigation system. Its basic difference from the GPS system is that the orbital rotation of GLONASS satellites is not synchronous with the rotation of the Earth and this provides for their greater stability.

CAN (Controller Area Network) is a digital bus-type interface that complies with ISO 11898-1:2003 International Standard.
Various high-level protocols such as J1939, CANopen, DeviceNet, CAN Kingdom etc. may be used to transmit data. CAN bus is designed to integrate various electronic control units and sensors into a single network both in industrial automation systems and in the automobile industry.
Vehicle CAN bus is widely used to obtain vehicle operation data in GPS/GLONASS vehicle tracking systems.

K-Line is a diagnostic interface for data exchange between electronic control units (ECU) and diagnostic port of the vehicle. Is used in ISO 9141 and ISO 14230 protocols which are the part of OBD-II standard.
According to ISO 9141 protocol L-Line is used to send requests to ECU and K-Line is used to receive diagnostic data from ECU. According to ISO 14230 protocol L-Line is not used while K-Line works for both directions (sending requests and receiving data from ECU).
K-Line is as well used for configuration of DUT-E AF and DUT-E CAN fuel level sensors, DFM fuel flow meters and other telematics hardware.

Modbus is an open communication protocol built on master-slave architecture. Is widely used for communication between electronic devices. Can be used for data transmission through serial RS-232, RS-485, RS-422 interfaces and TCP/IP networks.

PGN (Parameter Group Number) parameter group number that determines the contents of particular CAN bus message according to SAE J1939. PGN acronym is used for identification of CAN bus messages.

S6 is the vehicle onboard data bus developed by TECHNOTON to enable integrating the GPS/GLONASS-based vehicle monitoring system into the vehicle electrical equipment. It comprises a set of cables, interfaces and protocols. Physically, it is implemented on the basis of CAN 2.0B (ISO 11898-1:2003) and K-Line (ISO 9141). S6 bus data exchange protocol complies with SAE J1939 International Standard.
To get more details on S6 telematics bus visit http://s6.jv-technoton.com .

SPN (Suspect Parameter Number) is the number of particular parameter of CAN bus message according to SAE J1939. Each SPN has its determined name, number of data bytes, type of data, numerical value. SPN acronym is used for identification of parameters of CAN bus messages.

Protocol is a set of logic-level conventions that enables to establish a connection and carry out data exchange between two or more devices connected to this network. These conventions establish a uniform method of data transmission and elimination of errors.

Tracking device is an element of the vehicle tracking system performing the functions of reading data from standard and additional sensors mounted on the vehicle by the manufacturer, reception of signals of coordinates from navigation satellites and transmission of data to the Service Server.

Transport telematics (Vehicle telematics) is a satellite vehicle monitoring based on GPS/GLONASS navigation systems and technologies and hardware of cellular and/or radio communication and digital maps. Is used for optimization of logistics and in automated fleet operation systems.

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

Function module (FM) is a built-in hardware and software part of the devices which does not have its own housing (for example a part of a tracking device or DFM fuel flow meter with digital output interface)

S6 Unit is an element of vehicle on-board equipment compatible with S6 bus.

Introduction

The Operation Manual contains guidelines and rules which refer to **DFM fuel flow meters** (hereinafter DFM), **SK DFM service kit** (hereinafter SK DFM) and **DFM i fuel consumption indicator** (hereinafter DFM i), developed by JV Technoton, Minsk, Belarus.
The manual contains information on design, operation principle, specifications and instructions on installation, use and maintenance of DFM and DFM i. The manual defines SK DFM connection and usage guidelines as well as Service DFM utility (version 4.0 and higher) and Service S6 DFM utility (version 1.4 and higher) installation and use.

DFM® **is a precise tool for fuel consumption measurement. DFM can be used independently and as a part of GPS/GLONASS vehicle tracking system.**

DFM i records and displays data received from the fuel flow meter with pulse output.

SK DFM provides connection of DFM (DFM i) and PC for configuration and troubleshooting.

DFM features:

- **conformity with European and national automotive standards and directives**;
- **protected from unauthorized tampering and "cheating"*** ;
- **engine working time tracking** separately for different operation modes;
- **maximum information richness of output data****;
- **high reliability of data transmission over digital interfaces** **;
- **unique self-diagnostics feature to monitor the stability and accuracy of data****;
- **possibility of integration into on-board S6 telematics bus of vehicles *****;
- **built-in mud filter**;
- **minimum fluid flow resistance**;
- **100 % of DFM are verified** with a certified metrological test rig;
- **full set of high-quality mounting accessories**;
- **great operating experience**;
- **high-quality technical support**;
- **affordable price**.

---

* DFM AK/B/C/CK/D/A232/C232/D232/A485/C485/D485/ACAN/CCAN/DCAN.
** DFM A232/C232/D232/A485/C485/D485/ACAN/CCAN/DCAN.
*** DFM ACAN/CCAN/DCAN.

See Figure 1 for identification codes for DFM ordering:

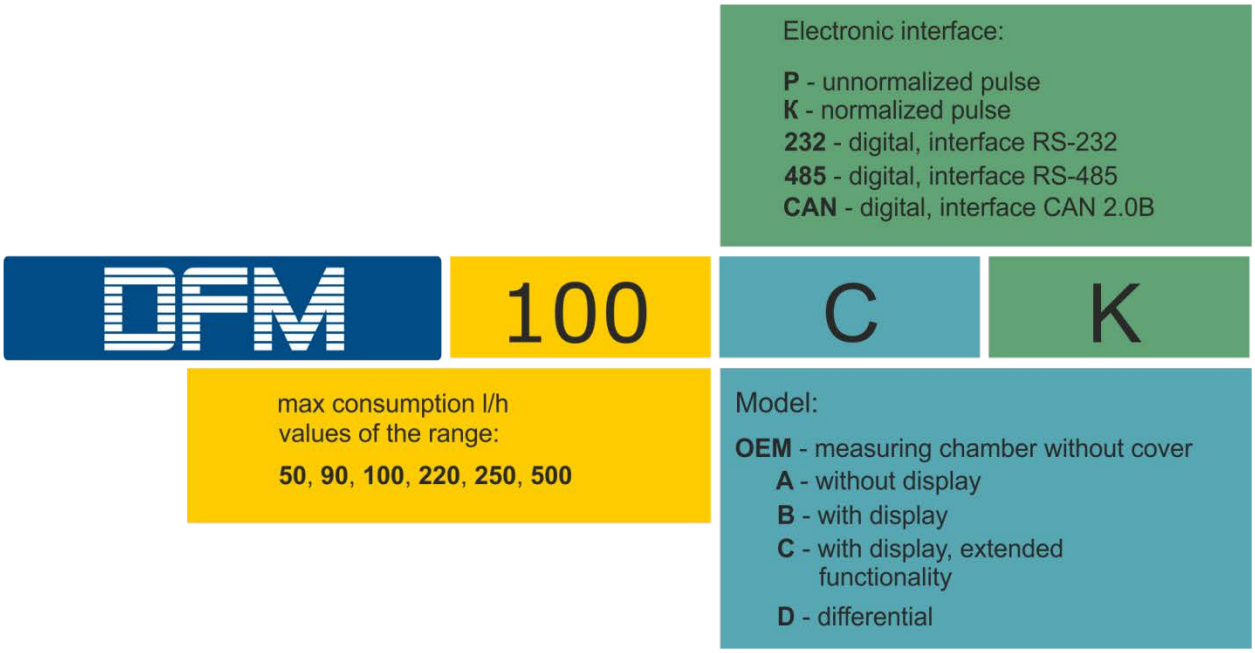


Figure 1 — DFM order identification codes

Example of DFM order identification codes:

"DFM 50B fuel flow meter",
(max. flow rate 50 l/h; model with display).

"DFM 100AK fuel flow meter",
(max. flow rate 100 l/h; no display; normalized pulse output).

"DFM 500C232 fuel flow meter",
(max. flow rate 500 l/h; built-in display; RS-232 output).

SK DFM service kit is required for configuration of DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN/D/D232/D485/DCAN series and DFM i. Service kit is optional and ordered separately.



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

DFM® is designed to measure fuel consumption of vehicles and stationary objects.

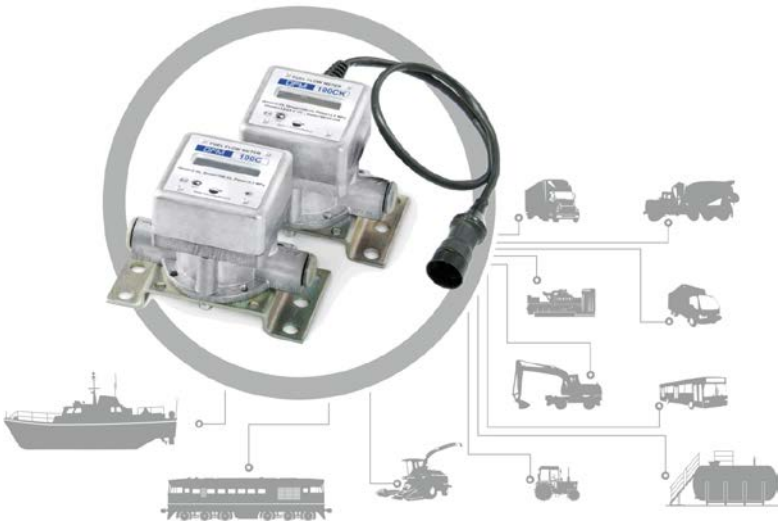
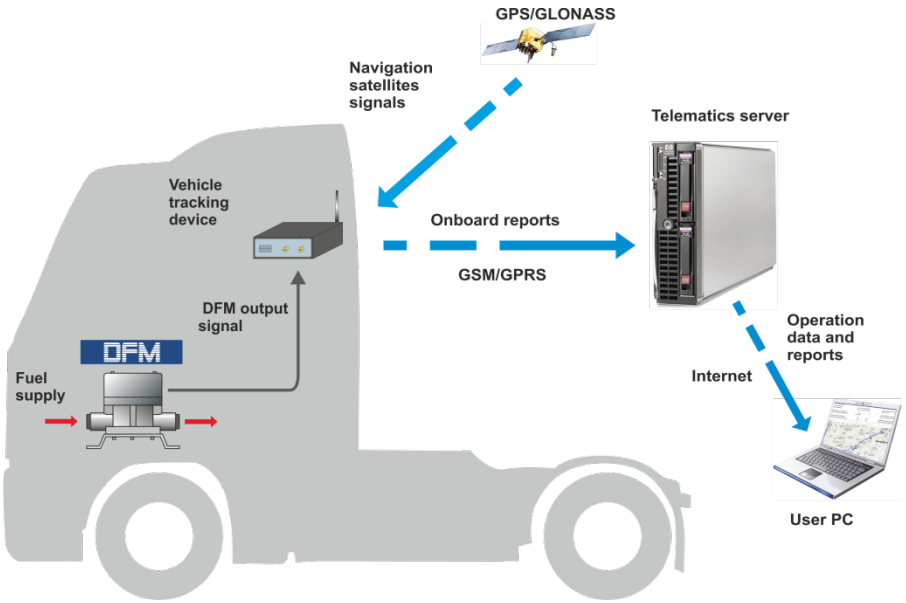
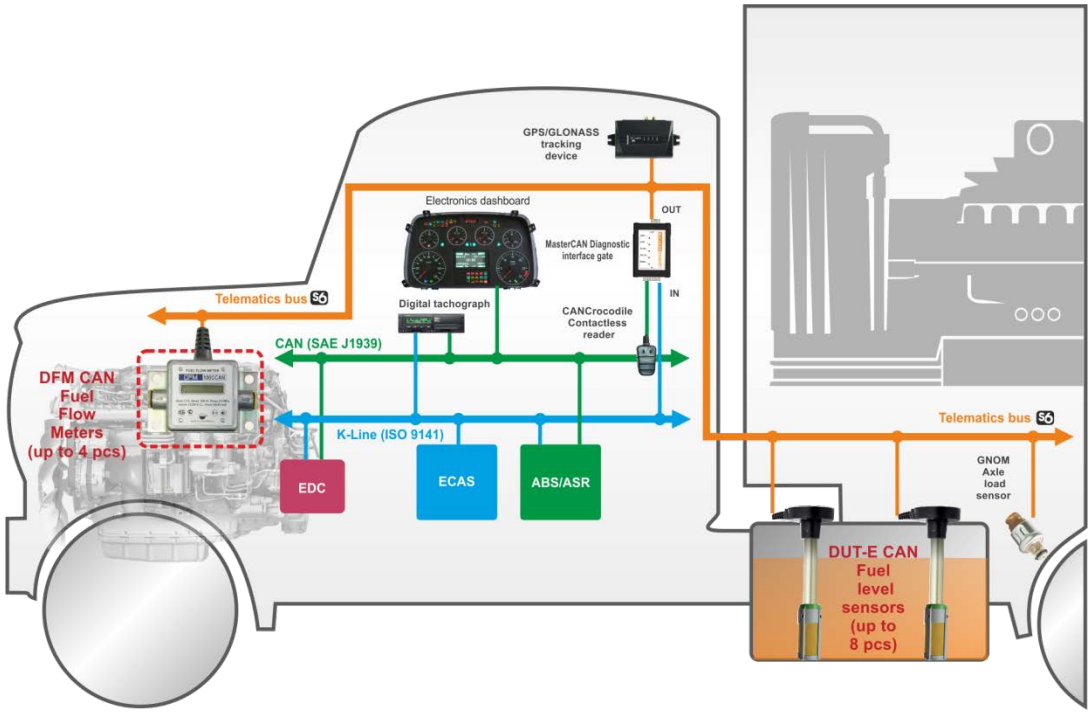


Figure 2 — DFM application

Application area — DFM fuel flow meters are used both autonomously and in GPS/GLONASS vehicle monitoring and fuel consumption control systems (see Figure 3) .



a) in GPS/GLONASS vehicle monitoring and fuel consumption control system



b) in S6 telematics bus *****

Figure 3 — DFM application

DFM are mounted into fuel supply line of the vehicle engine. DFM measure actual (instant) fuel consumption rate and generates an output signal to forward it to a vehicle tracking device (see Figure 3 a).

Tracking device records and processes DFM data for further transmission to the telematics server. Server software processes and analyzes the received data to generate analytical reports for a selected period of time.

DFM with pulse output provide data on fuel volume actually consumed by vehicle engine (total fuel consumption and average hourly consumption).

See Figure 4 for an example of instant fuel consumption diagram built on DFM data .

***** Only for DFM ACAN/CCAN/DCAN.

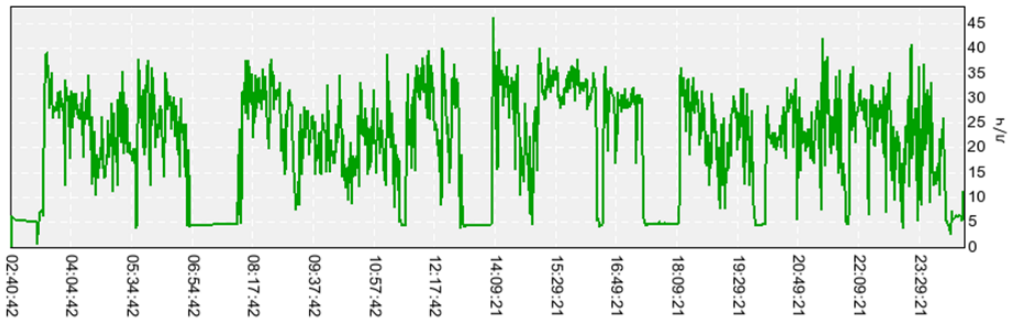


Figure 4 — Instant fuel consumption diagram built on DFM data

DFM with digital output interface besides total and instant fuel consumption rate provide real-time data on the following parameters:

- engine operation time — total and in each operation mode;
- fuel consumption — total and in each operation mode;
- flow meter specification data – serial number, production date, total operation time and operation time while powered from built-in battery;
- malfunctions;
- attempts of unauthorized impact on flow meter operation.

Using J1939 output protocol makes possible DFM CAN operation as a part of **telematics bus** together with DUT-E CAN fuel level sensors and other factory-built or additional equipment (see Figure 3 b). Tracking device with a single CAN interface port can receive data from up to 8 DUT-E CAN sensors and up to 4 DFM CAN meters. This feature makes possible monitoring of vehicle engine as well as engines of vehicle additional equipment.

Use of DFM provides vehicle owners with the following:

- **actual fuel consumption records;**
- **registration of machinery working time;**
- **normalizing of fuel consumption quotas;**
- **fuel theft detection and prevention;**
- **real-time monitoring and fuel consumption optimization;**
- **fuel consumption tests for engines.**

1.2 Exterior view and delivery set

DFM delivery set includes (see Figure 5):



1	DFM fuel flow meter	– 1 pc
2	iButton key*	– 1 pc
3	7.5m connection cable **	– 1 pc
4	Verification certificate	– 1 pc
5	Specification	– 1 pc

Figure 5 — DFM delivery set

* for DFM meters with built-in display

** for DFM meters with pulse interface output. Cable for DFM with RS-232, RS-485 and CAN 2.0B digital interfaces ordered separately (see Table 21).

1.3 DFM modifications

Following DFM **types** are available:

1) Single-chamber — measure volume of fuel passing through engine supply fuel line.
The following **modifications** of single-chamber meters are produced:

- autonomous meters with built-in display;
- fuel flow meters with display and interface cable:
  - with pulse output interface;
  - with digital output interfaces;
- fuel flow meters output interface cable:
  - with pulse output interface;
  - with digital output interfaces.

2) Dual-chamber (bidirectional or differential) fuel flow meters measure fuel consumption as the difference in volume of fuel flowing through the supply and return fuel lines.

The following modifications of dual-chamber meters with output interface are available:

- differential meters with pulse output
- differential meters with digital output interfaces

1.3.1 Single-chamber autonomous meters with built-in display

Single-chamber fuel flow meters with built-in readout display (**DFM B/C models**) (see Figure 6) — used for fuel consumption without any additional hardware and software.



Figure 6 — DFM B/C exterior view

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 Single-chamber meters with display and interface cable

Single-chamber DFM **fuel flow meters with display and interface cable** (**DFM CK/C232/C485/CCAN models**) (see Figure 7) can be used autonomously and as a part of automated vehicle monitoring and fuel consumption control systems.



Figure 7 — Single-chamber DFM fuel flow meter with display and 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**).
RS-232 (**DFM C232**), RS-485 (**DFM C485**), CAN 2.0B (**DFM CCAN**) digital interfaces contain fuel consumption data together with counters values, data on engine operation modes, flow meter settings and malfunctions, events.

1.3.3 Single-chamber meters with interface cable

Single-chamber DFM **fuel flow meters with interface cable** (**DFM AP/AK/A232/A485/ACAN models**) (see Figure 8) are used for fuel consumption measurement in automated vehicle monitoring and fuel consumption control systems *****.



Figure 8 — Single-chamber DFM fuel flow meter with interface cable

Fuel consumption data is sent to the pulse output (**DFM AP/AK**). RS-232 (**DFM A232**), RS-485 (**DFM A485**), CAN 2.0B (**DFM ACAN**) digital interfaces contain fuel consumption data together with counters values, data on engine operation modes, flow meter settings 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.

***** DFM AP/AK combined with DFM i indicator can be used as autonomous solution..

1.3.4 Dual-chamber differential meters with interface cable

Dual-chamber differential DFM **fuel flow meters with interface cable** (**DFM D/D232/D485/DCAN models**)(see Figure 9) are used for fuel consumption measurement in automated vehicle monitoring and fuel consumption control systems for vehicles with modern diesel engines EURO (TIER) 3/4/5 *****.



Figure 9 — Dual-chamber differential DFM fuel flow meter with interface cable

DFM D has two LED indicators on its body. 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 supply and return fuel lines. Data is sent out via pulse output interface (**DFM D**).
RS-232 (**DFM D232**), RS-485 (**DFM D485**), CAN 2.0B (**DFM DCAN**) digital interfaces contain fuel consumption data together with counters values, data on engine operation modes, flow meter settings and malfunctions, events

***** DFM D models can be used together with DFM i as autonomous solution.

1.4 Measurement range and accuracy

Table 1 — DFM measurement range and accuracy

Model	Starting flow rate**, l/h	Min flow rate, l/h	Max flow rate, l/h	Relative accuracy error, %, not more than
DFM 50AK DFM 50A232 DFM 50A485 DFM 50ACAN DFM 50B DFM 50C DFM 50CK DFM 50C232 DFM 50C485 DFM 50CCAN	0,5	1	50	±1
DFM 90AP		3	90	±2
DFM 100AK DFM 100A232 DFM 100A485 DFM 100ACAN DFM 100B DFM 100C DFM 100CK DFM 100C232 DFM 100C485 DFM 100CCAN		2	100	±1
DFM 220AP	2	8	220	±2
DFM 250AK DFM 250A232 DFM 250A485 DFM 250ACAN DFM 250B DFM 250C DFM 250CK DFM 250C232 DFM 250C485 DFM 250CCAN		5	250	±1
DFM 500AK DFM 500A232 DFM 500A485 DFM 500ACAN DFM 500C DFM 500CK DFM 500C232 DFM 500C485 DFM 500CCAN	5	10	500	
DFM 100D DFM 100D232 DFM 100D485 DFM 100DCAN	0,5*	10*	100*	±3***
DFM 250D DFM 250D232 DFM 250D485 DFM 250DCAN	2*	50*	250*	
DFM 500D DFM 500D232 DFM 500D485 DFM 500DCAN	5*	100*	500*	

* Flow rate per each measuring chamber for differential meters.
** 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.
*** Relative accuracy error of the differential consumption.

RECOMMENDATION: In case the average flow rate of the vehicle engine 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 a ring-type measuring chamber **1,** top cover **2** with a microprocessor board inside, bracket **3** and interface output cable with connector **4**.

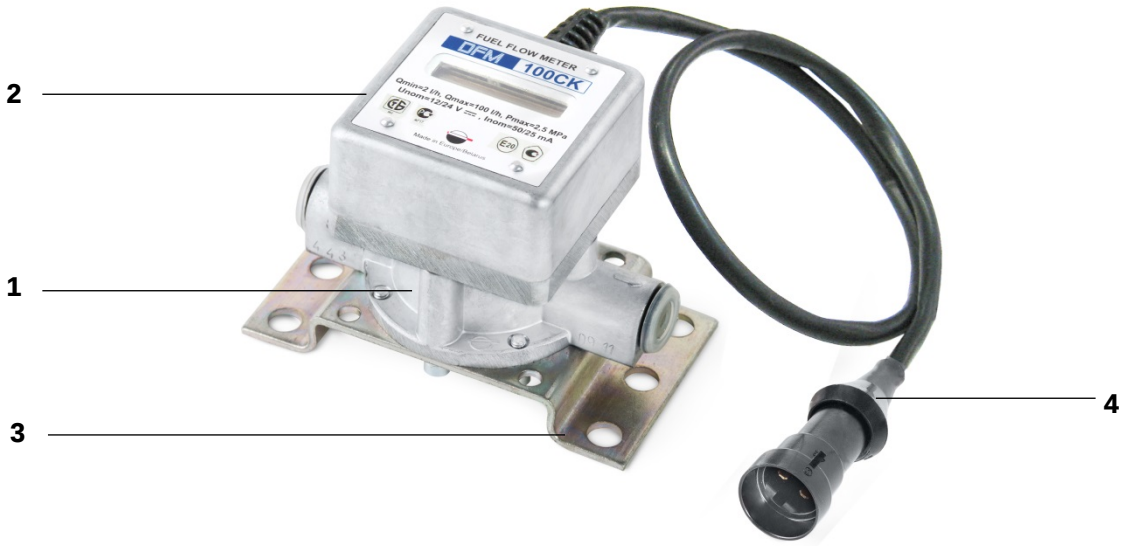


Figure 10 — DFM components

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 11).
Volume of fluid equal to the inner volume of the measuring chamber is pushed out during the full single turn of the ring (see animation on DFM fuel flow meter operational principle). DFM electronics generates one output impulse at the same time.

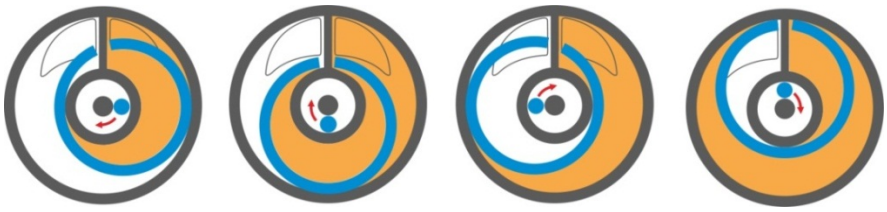


Figure 11 — DFM measuring chamber operation scheme

* Structure is shown in an instance of single-chamber DFM CK with built-in display and interface output.

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;
- measuring chamber is made of durable and lightweight zinc-aluminum (ZA) alloy;
- built-in mud filter effectively protects the chamber from clogging. Filter can be removed and cleaned without disassembling the body of the DFM;
- M14x1.5 and M16x1.5 threaded fittings allow DFM mounting on any automotive vehicles without any special adapters;
- 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 for following fluids flow measurement:

- diesel fuel (GOST 305, STB 1658);
- heating oil (GOST 10585);
- burner oil (GOST 10585, STB 1906);
- motor fuel (GOST 1667);
- biofuel (GOST R 52808, STB 1658);
- Other liquid fuels and mineral oils with kinematic viscosity of 1.5 to 6 mm^2/s.



ATTENTION:

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

2) When operating with fluids having kinematic viscosity over 6 mm2/s the upper limit of DFM capacity range will get lower than nominal one and the pressure drop will increase.

3) Impurities size should not exceed 0.08 mm.

4) 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

See Table 2 for DFM main specifications.

Table 2 — DFM main specifications

Parameter, measurement units	Value
Max pressure, bar	25
Nominal pressure, bar	2
Filtering degree of measured fluid, mm, not more than	0.08
Connection thread	M14x1.5 M16x1.5*
Pressure drop at maximum flow rate, nominal pressure, diesel fuel at 20 °C, bar, not more than	0.2**
Supply voltage range, V	from 10 to 50
Current consumption at 12 V, mA, not more than	50
Current consumption at 24 V, mA, not more than	25
Ambient operation temperature range, °C	from -40 to +80***
Environment relative humidity at 40 °C temperature, %, not more than	95
Vibration resistance	Max. acceleration to 100 m/s2 in the frequency range from 5 to 250 Hz (GOST 3940, GOST R 50607)
Resistance to aggressive environments	Oil and petrol resistance (GOST 3940, GOST R 52230)
Electromagnetic compatibility	• ESD Protection, severity level II (GOST 30378, GOST R 50607); • electromagnetic interference protection, severity level IV (STB ISO 7637-2, GOST 28751).
Overall dimensions	see Annex A
Weight	

* For DFM 500 series.
** See figure 12 for details.
*** Data is displayed in environment temperature range from -20 to +60 °C for flow meters with built-in display.

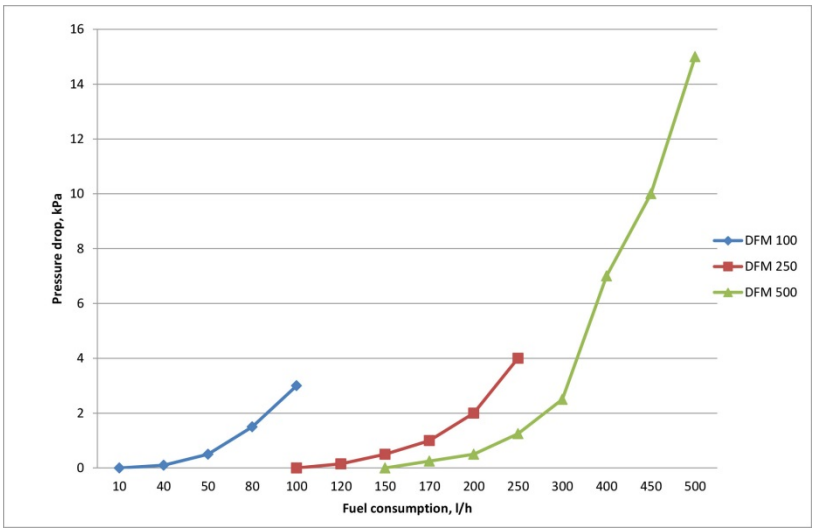


Figure 12 — Graphs of pressure drop on DFM depending on flow rate.

According to figure 12 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 — 0.15 bar.

1.6.3 Specifications of measuring chambers

Table 3 — Specifications of DFM measuring chambers

Flow meter capacity model	Nominal diameter (DN), mm	Nominal volume of the measuring chamber, ml	Operational life limit of the measuring chamber*, 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

***** Contact the service center for flow meter diagnostics and verification when it exceeds the operational life limit.

1.6.4 Power supply modes

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

- **External power supply** (**DFM AP/D/D232/D485/DCAN models**) DFM is powered from the external power source (e.g. vehicle onboard power supply).
- **Stand-alone power supply** (**DFM B/C models**) DFM is powered from the built-in lithium-silicon battery. Estimated DFM operation time until full battery discharge is not less than 24 months.
- **Combined power supply** (**DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN models**) — DFM 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 10V). Estimated DFM operation time in this mode is not less than 24 months.



ATTENTION: During the time when power supply from vehicle on-board power network is off **DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN** 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 5. 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 4 — 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
$Q>Q_{max}$

The impact of constant magnetic field for more than 5 seconds</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></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>

1.6.6 Displayed data

DFM models with built-in display have the following identification codes (see figure 1): **B, C, CK, C232, C485, CCAN**.

DFM B model has a **regular data set**. **DFM C/CK/C232/C485/CCAN** have extended data sets (see Table 5).

Display information switching is performed by 1-2 seconds light touch to the top cover of the fuel flow meter by iButton key (see Figure 13).

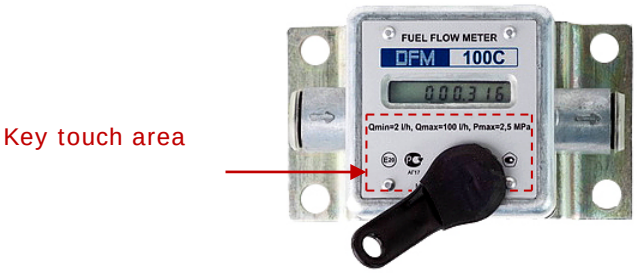


Figure 13 — Switching display screens

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 iButton. At the same time dots are shown on the display (see Figure 14).



Figure 14 — Display view in sleep mode

When the display is touched next time it wakes up and shows data again.

Table 5 — DFM display information screens

Screen No	Displayed data	Digit capacity	Units	Data set	
				regular*	extended**
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)	—	—	X.X	

* **DFM B display**.
** **DFM C/DFM CK/C232/C485/CCAN display**.

Screen 1 displays **Total Fuel Consumption** counter value (with 0.1 L step) accumulated since DFM release.

Screen 2 displays **Total Fuel Consumption counter value with higher digit capacity** (0.001 L), 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 and the Chamber Volume displays the firmware version installed on the fuel meter, as well as the exact volume of the measuring chamber.

1.6.7 DFM protection from tampering and intervention

In order to avoid false readings, meter damage or blocking DFM models with built-in display (**DFM B/C/CK/C232/C485/CCAN**) 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 displays dashes being in Tampering Mode (see Figure 15).

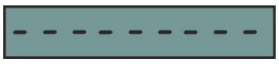


Figure 15 — Display view in Tampering Mode

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 displays vertical strokes in Interference mode (see Figure 16).



Figure 16 — Display view in Interference Mode

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

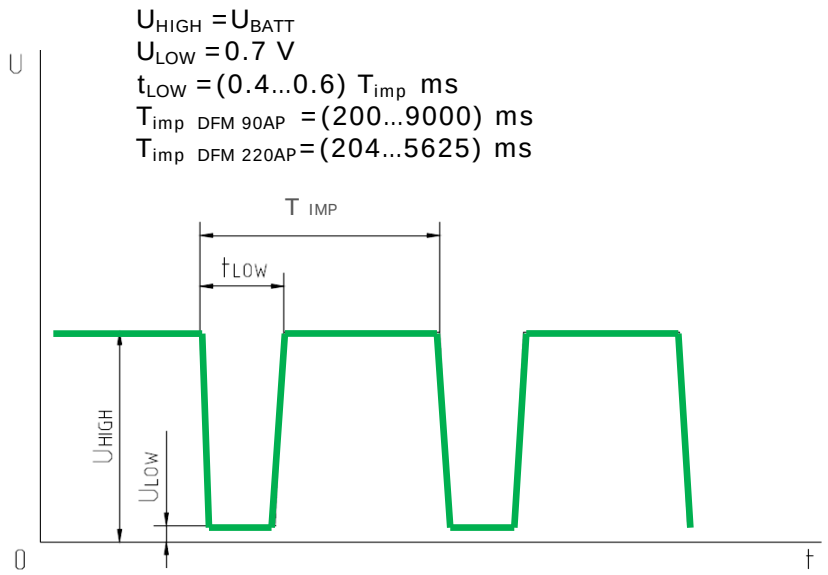
ATTENTION: Data on events of Tampering / Interference during the external power supply of **DFM A232/A485/ACAN/C232/C485/CCAN** is off is recorded into the internal memory and sent to output interface since the power supply is on.

3) Stand-alone power supply mode of **DFM AK/A232/A485/ACAN/CK/C232/C485/CCAN** when external power supply is off. Flow meter is powered by own battery.

4) Sealing. Original DFM accessories supplied by Technoton (fittings, valves, etc) have special **sealing holes**. Sealing of the mounting elements allows detecting unauthorized access to the fuel system.

1.6.8 DFM pulse output signal specifications

See Figure 17 for specifications of pulse output signal of DFM meters with unnormalized **pulse** (**DFM AP** model).
Number of output pulses generated by the meter for 1 liter of measured fuel flow is indicated in specification and sticker marking on meter's interface cable.

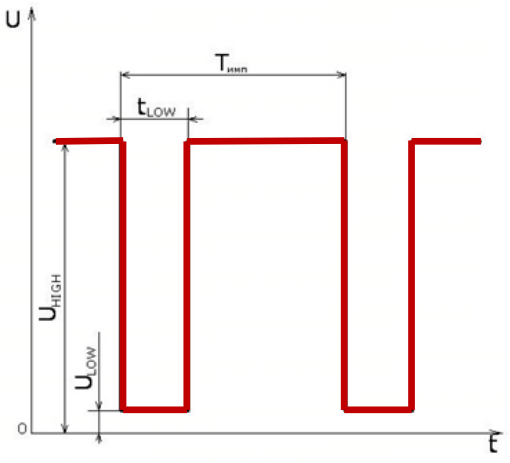


$U_{HIGH} = U_{BATT}$
$U_{LOW} = 0.7$ V
$t_{LOW} = (0.4...0.6)\ T_{imp}$ ms
$T_{imp\ DFM\ 90AP} = (200...9000)$ ms
$T_{imp\ DFM\ 220AP} = (204...5625)$ ms

Figure 17 — View of unnormalized pulse signal of DFM AP model

Fuel flow meters with **normalized pulse output** (**DFM AK/CK/D**) generate certain number $\mathbf{N}_{pulse/l}$ of output pulses for 1 liter of measured fuel flow (see Table 6). This number is indicated in product specification as well.

Normalized pulse signal view is shown in Figure 18.



$U_{HIGH} = U_{BATT}$
$U_{LOW} = 0.7$ V
t_{LOW} and T_{imp} (see Table 6)

Figure 18 — Normalized pulse signal view of DFM AK/CK/D models

Table 6 — Parameters of normalized pulse of DFM AK/CK/D models

Model	T_{imp}	t_{LOW}	$N_{pulse/liter}$
DFM 50AK/CK	from 360 to 18000 ms	from 180 to 9000 ms	200
DFM 100AK/CK/D	from 180 to 9000 ms	from 90 to 4500 ms	
	from 200 to 36000 ms	from 100 to 500 ms	
DFM 250AK/CK/D	from 180 to 9000 ms	from 90 to 4500 ms	80
	from 200 to 90000 ms	from 100 to 500 ms	
DFM 500AK/CK/D	from 144 to 7200 ms	from 72 to 3600 ms	50
	from 180 to 144000 ms	from 54 to 500 ms	

1.6.9 RS-232 and RS-485 output interfaces specifications and protocol

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

Data transfer from DFM to RS-232 and RS-485 interfaces is carried out in request/response mode according to Modbus protocol. Baudrate can be selected out of the following values: 2400; 4800; 9600; 19200; 38400; 57600; 115200 bit/s with the help of Service S6 DFM (see 3.7.5) (default baudrate is 9600 bit/s).

Up to four flow meters can be simultaneously connected to the tracking device under Modbus protocol. Unique decimal addresses from 0 to 255 are used for their identification in network (default address is 111).

See Annex E (table E.1) for the map of 16-bit registers of DFM output messages available under Modbus protocol.

DFM flow meters with RS-232 and RS-485 output interfaces also support data transfer under **DFM COM** protocol (see Annex F for details).

DFM A232/C232/D232 and DFM A485/C485/D485 configuration is made through K-Line interface with the help of SK DFM.

1.6.10 CAN output interface specifications and protocol

DFM ACAN / CCAN / DCAN output interface specifications correspond to specifications of **telematics bus** which is developed by Technoton for integration of transport telematics system with vehicle electrical equipment and consists of system of cables, interfaces and protocols.

DFM ACAN/CCAN/DCAN transfers data to S6 bus under CAN 2.0B protocol (ISO 11898-1:2003). Data exchange protocol corresponds with **SAE J1939** standard requirements.

DFM ACAN/CCAN/DCAN data is sent to S6 bus in automatic transmission mode (basic mode) or by request. Baudrate can be selected out of the following values: 100; 125; 250; 500; 1000 Kbit/s with the help of Service S6 DFM (see 3.7.5) (default baudrate 250 Kbit/s).

Up to four DFM ACAN/CCAN/DCAN units can be connected to S6 bus simultaneously. Unique decimal addresses (SA) from 111 to 114 should be set for each meter (default address 111).

DFM ACAN/CCAN/DCAN configuration is made through K-Line interface with the help of SK DFM.

DFM ACAN/CCAN/DCAN generate and transfer output messages according to Table 7.

Table 7 — messages of DFM ACAN/CCAN/DCAN data transfer protocol

Message ID	Short message description
PGN 62995	Unit Passport
PGN 62994	Unit Work Counters
PGN 65226	Active Diagnostic Trouble Codes (up to 20 malfunctions)
PGN 63026	Fuel Consumption Factors
PGN 63044	Calibration Table. Fuel Rate (DFM)
PGN 63065	Fuel Rate Mode Borders
PGN 65266	Fuel Economy (Liquid)
PGN 65257	Fuel Consumption (Liquid)
PGN 62981	Flowmeter. Parameters
PGN 62992	Flowmeter. Counters 1
PGN 62993	Flowmeter. Counters 2
PGN 64777	High Resolution Fuel Consumption (Liquid)
PGN 65244	Idle Operation
PGN 65101	Total Averaged Information
PGN 63064	Battery Voltage Mode Borders
PGN 62987	Vehicle Voltage
PGN 63086	Battery
PGN 65254	Time/Date
PGN 63011	Time Origin Settings
PGN 63051	Emergency Events List (15 latest events)
PGN 63055	Important Events List (15 latest events)
PGN 63056	Information Events List (15 latest events)
PGN 59904	Request
* See Annex G for detailed description	

1.7 DFM and tracking devices compatibility

Technoton guarantees full compatibility and joint accuracy of fuel consumption measurement of DFM and CKPT 45, CKPT 25, CKPT 21 and CKPT 31 tracking devices.

Technoton regularly conducts tests for compatibility and joint accuracy of DFM with different models of terminals (vehicle tracking devices) of popular brands. Table 7 shows the models of terminals compatible with DFM providing accuracy of joint measurement of fuel consumption not more than **±1 %.**

Table 8 — Vehicle tracking devices compatible with DFM

Tracking device			Analytical software (tracking platform)
Brand	**Name**	**Model**	
CKPT	CKPT	31	ORF-MONITOR
		25	
		45	
GALILEOSKY	GALILEOSKY	GPS	Wialon
		GLONASS	
Автограф	Autograf	GSM+	AutoGRAF
		GSM(GLONASS)	
TELTONIKA	Teltonika	FM4200	Wialon Hosting
		FM5300	
Ruptela	Ruptela	FM-Pro3	Trust-Track web server
mapon	MapOn	GBOX6	MapOn web server
ГЛОСАВ	GLOSAV	BK11-02	GLOSAV
LOCARUS	Locarus	702X	LocarusInformer
		702R	
		702S	
ВСЕ	BCE	Fm Light	Wialon
ritm	VOYAGER	2	RITM-PCN
simbiotecha	Simbiotecha	GATE-FM 200	Monitoring server software “Fuel control system” www.tracking.lt
СКАУТ	CKAУT	MT-530	Scout Explorer
		MT-600 GP PRO	
NAVISET	Naviset	GT-10	GPS-Trace Orange
EcoTelematics Group	NaviFleet	ET100	NaviFleet

Relevant information on the compatibility of specific tracking device and DFM models and recommendations for their connections and settings can be found at www.jv-technoton.com

1.8 DFM selection

IMPORTANT: Final decision on applicability of particular DFM model for a particular vehicle must be made by a trained installation specialist and should be based on results of vehicle inspection.

For detailed algorithm of selection proper DFM fuel flow meter model, mounting scheme, accessories and mounting kit check out animation video DFM fuel flow meters: selection of mounting scheme, accessories and mounting kit.

1.8.1 Selection depending on engine power / boiler output capacity

DFM selection depending on engine power (output capacity for boilers) is performed according to Table 9.

Table 9 — 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 50B** **DFM 50C** **DFM 50CK** **DFM 50C232** **DFM 50C485** **DFM 50CCAN**
from 80 to 150	from 400 to 800	**DFM 90AP** **DFM 100AK** **DFM 100A232** **DFM 100A485** **DFM 100ACAN** **DFM 100B** **DFM 100C** **DFM 100CK** **DFM 100C232** **DFM 100C485** **DFM 100CCAN**
from 150 to 300	from 800 to 1500	**DFM 220AP** **DFM 250AK** **DFM 250A232** **DFM 250A485** **DFM 250ACAN** **DFM 250B** **DFM 250C** **DFM 250CK** **DFM 250C232** **DFM 250C485** **DFM 250CCAN**
from 300 to 600	from 1500 to 3500	**DFM 500AK** **DFM 500A232** **DFM 500A485** **DFM 500ACAN** **DFM 500C** **DFM 500CK** **DFM 500C232** **DFM 500C485** **DFM 500CCAN**

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

Selection of the **differential** DFM depends on fuel flow rate in supply and return lines of the engine according to Table 10.

Table 10 — Selection of the differential DFM depending on fuel flow rate values in supply and return lines

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



IMPORTANT:

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

2) Installation of a differential DFM on the fuel system with high performance pump and engine with small fuel consumption is not recommended. For example, the booster pump performance is 300 l/h, fuel consumption in idle run mode is 5-6 l/h, and relative fuel measurement error in supply and return lines is 1 %, absolute error value of differential measurement is up to 6 l/h. That is comparable with the amount of fuel consumed by the engine.

3) Counter-indication to install a differential fuel flow meter is the fact of air bubbles presence in supply or return fuel lines.

2 DFM installation

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



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

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 arisen during transportation, storage or careless use:

- visible damages 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 detected.

2.2 Estimation of vehicle condition

Before DFM installation the vehicle condition must be estimated and conclusion made on possibility to install DFM.

Estimation of the vehicle includes the following sequence:

1) Start the engine and check its operation for 5-10 minutes at idle and 5-10 minutes in movement under load. The engine must run evenly, not stall under load, loss of power must not be felt.

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

3) 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.

4) 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.

5) 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%.

6) 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.

According to the results of the check a **Vehicle Inspection Report** should be filled in and signed (see Annex B).

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

2.3 General installation instructions



ATTENTION: This chapter provides particular cases of the engine operation scheme. Read carefully the technical documentation of the vehicle in order to make a decision on applicability of the meter on this particular vehicle.

The following is needed for DFM mounting:

- DFM;
- mounting kit (does not come with DFM delivery set, ordered separately);
- bracket (ordered separately), is optional and is not needed in some cases;
- automobile hand tool kit (sets of spanners, screwdrivers, etc.);
- purometer (ordered separately);
- glycerine filled manometer (ordered separately)

DFM can be mounted in any position: vertical, horizontal or tilted. Avoid sharp bends of cable and fuel pipes when mounting.



CAUTION: 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.**

The following **rules** must be observed when 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) DFM installation on the elements of the vehicle subject to heating or vibration in not recommended.

6) When connecting fuel pipes, flanges and threaded connections must be clean.

7) When installing, only **new** copper sealing washers from a mounting kit have to be used.

8) 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.

9) After DFM installation, it is necessary to remove air from the fuel system.



ATTENTION:

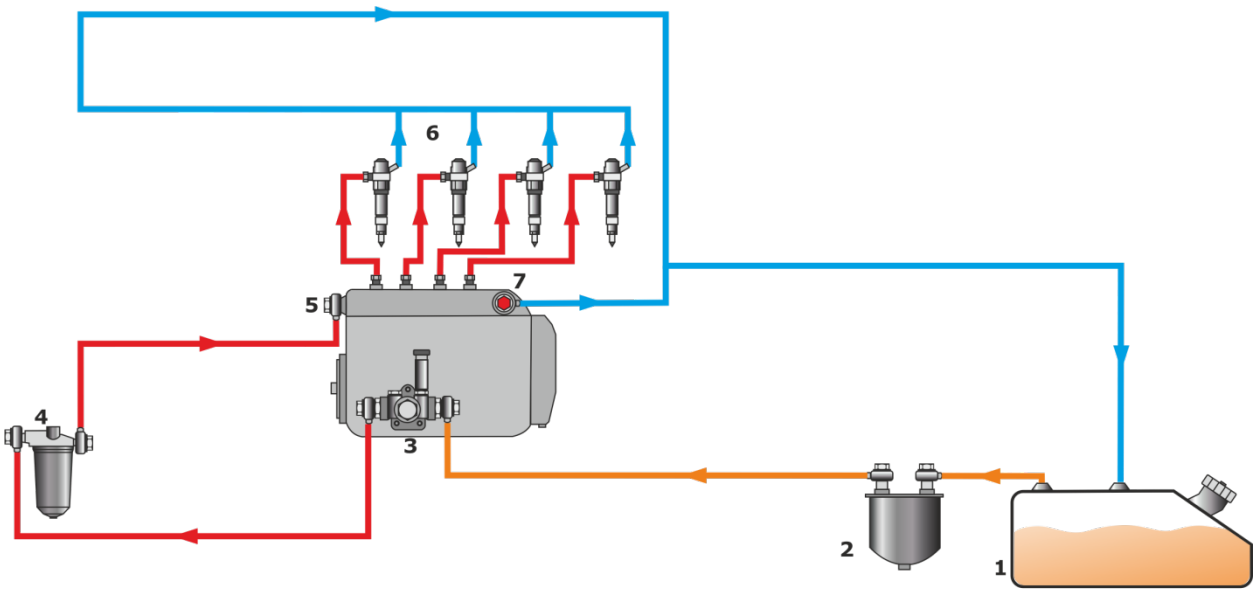
1) Only consumed volume of fuel should pass through DFM in case of using single-chamber meter. It is required to modify return fuel line of the fuel system in this case (see 2.4.2, 2.4.3).

2) If foam is present in the return 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 5.7).

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 19.



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 19 — 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.

One peculiarity of automobile operation is uneven fuel consumption. Besides that hydraulic shocks can cause errors in DFM work. In order to compensate hydraulic shocks at the fuel flow meter it is **recommended to install a non-return valve after the DFM**.

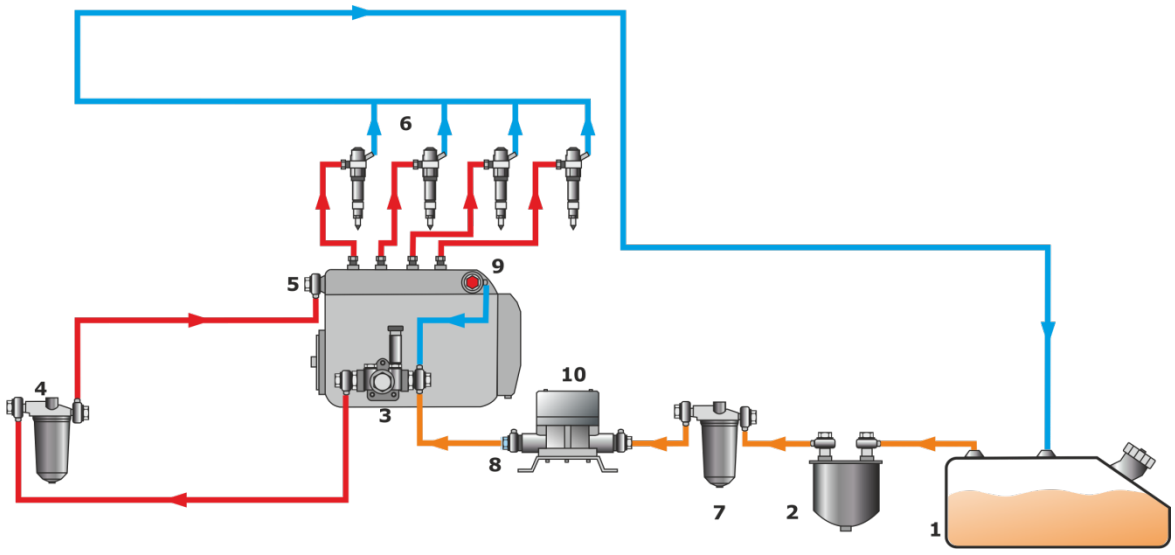
2.4.2 DFM installation before the pump

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 20) 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.

Figure 20 — DFM installation according to 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 return line.

In this particular case the return 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 return 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:

1) from the fuel tank through DFM flow meter;
2) from high pressure fuel pump return 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 atmosphere. At DFM output a 0.35-0.5 atmosphere 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:

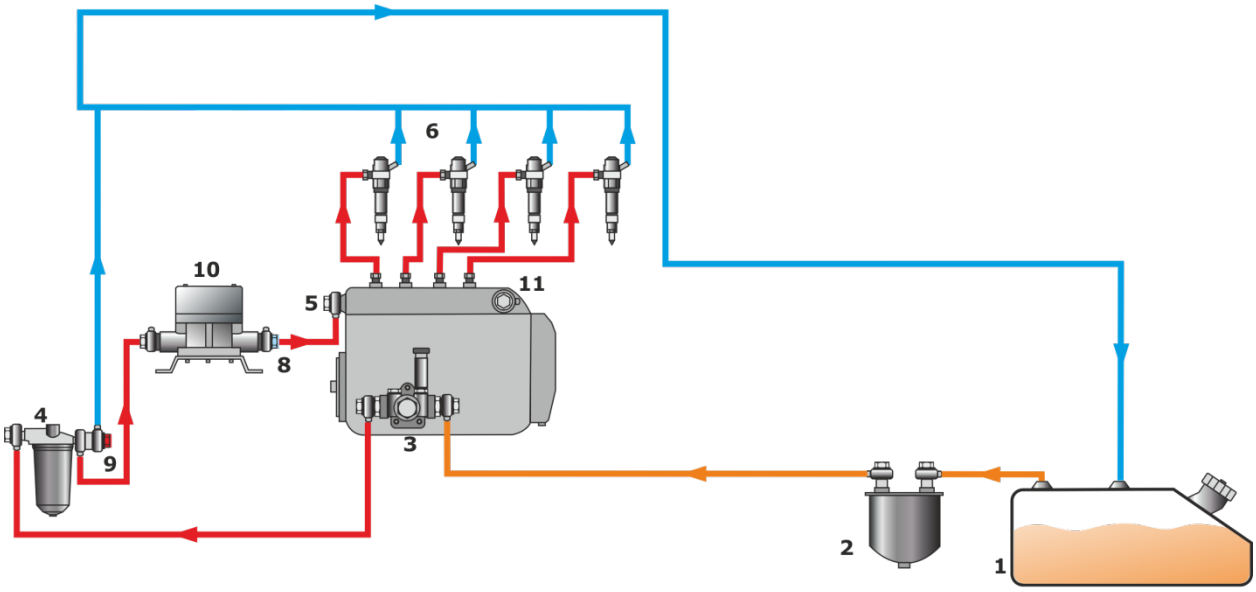
- requires installation of an additional fine filter and causes additional costs;
- additional load on the low pressure fuel pump;
- fuel in the tank is not warmed with return fuel flow (fuel heater installation is required in some cases).

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 21), 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** – Additional fine filter; **8** – Non-return valve; **9** – Bypass valve;
10 – DFM Fuel Flow Meter; **11** – Plug.

Figure 21 — DFM installation according to 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 return 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 atmosphere in the line between the fine filter and high pressure fuel pump input. Install a 0.35-0.5 atmosphere 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.

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 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).

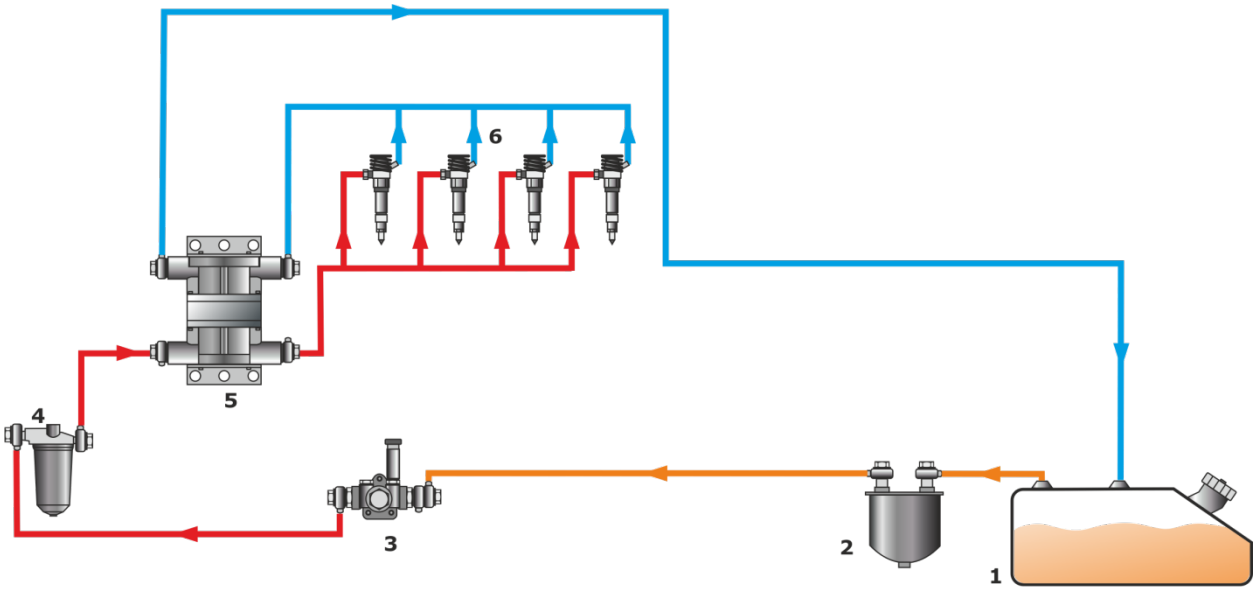
Fuel circulation in the fuel system doesn't change with differential measurement. Supply-flow chamber of differential DFM is to be installed in the gap of supply fuel line of the engine. Return-flow chamber is to be installed in the gap of the return line. Fuel consumption is calculated as a difference of measured values of fuel flows in straight-flow and return-flow chambers.

Particular cases of differential DFM installation scheme:

1) Installation of the supply chamber on unit injector fuel system (jerk system) is made after the low pressure fuel pump (**After the Pump scheme**) (see Figure 22 a).

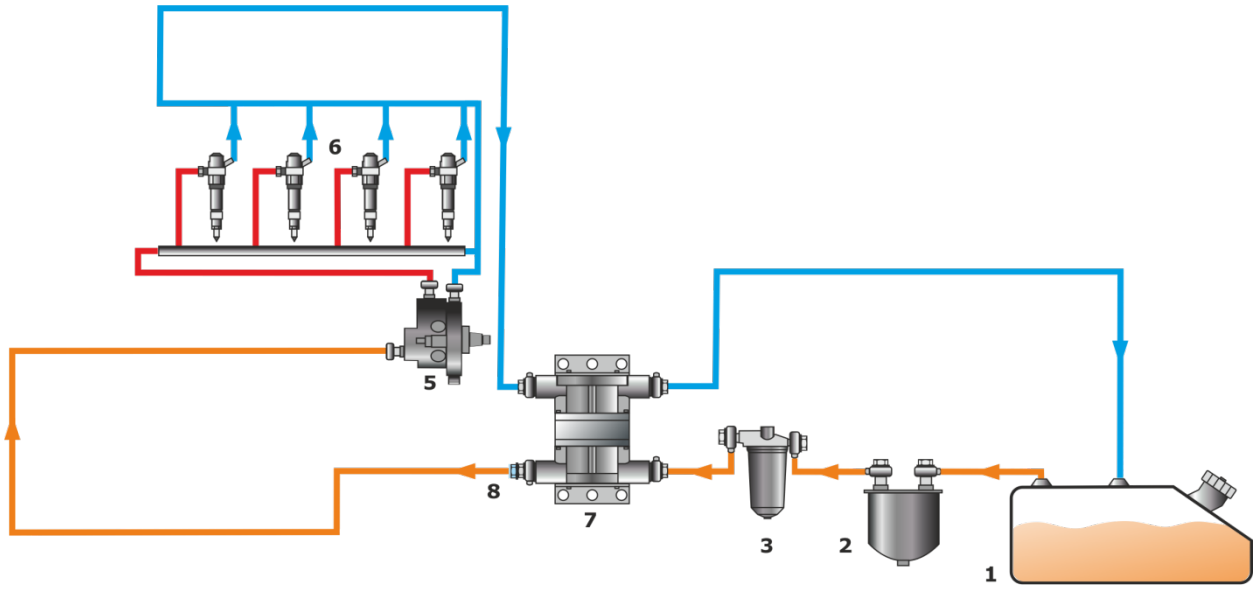
2) On Common Rail fuel system installation of the supply chamber is made before the low pressure fuel pump (**Before the Pump scheme**). In this case **additional fine filter** installation is required (see Figure 22 b).

Return-flow chamber of differential DFM in both cases is to be installed in return 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** – DFM Fuel Flow Meter; **6** – Unit injector.

a) Supply chamber installation after the pump



1 – Fuel tank; **2** – Rough filter; **3** – Fine filter; **5** – High pressure fuel pump;
6 – Injectors; **7**– DFM Fuel Flow Meter; **7** – Non-return valve.

b) Supply chamber installation before the pump

Figure 22 — Differential DFM installation scheme

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 increase load on the low pressure fuel pump.

Interactive animation video DFM fuel flow meters: selection of mounting scheme, 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

Fuel flow meters with interface cable (**DFM AP/AK/A232/A485/ACAN/CK/C232/ C485/CCAN/D/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** (ordered separately) when connecting DFM power supply (see Figure 24a). 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 sensor 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 23).

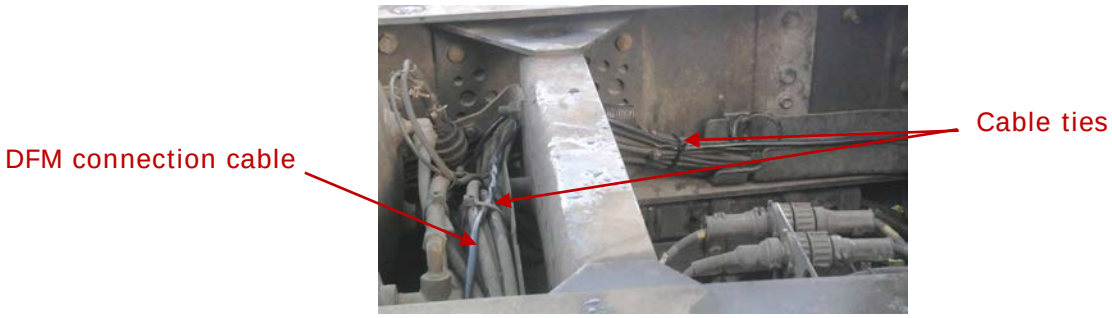


Figure 23 — Laying DFM connection cable

DFM electrical connection is made according to connector pinout and interface cable wire assignment (see Tables 11-13).

Terminals are recommended for electrical connection of power supply wires (see Figure 24) and **quick splice connectors** for output signal wire connection (see Figure 24).



a) fuse *b) terminals* *c) connectors*

Figure 24 —DFM connection accessories

Table 11 — Interface cable pinout and wire assignment of DFM AP/AK/CK/D

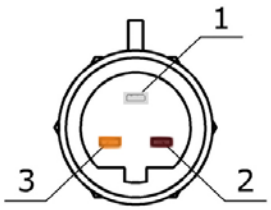
Connector view	Pin number	Wire Marking*	Wire color		Assignment
	1	OUT	White		Pulse output (see 1.6.8)
	2	GND	Brown		Ground
	3	VBAT	Orange		Power supply “+”
* wire marking is optional and can be missing					

Table 12 — Interface cable pinout and wire assignment of DFM A232/A485/C232/C485/D232/D485

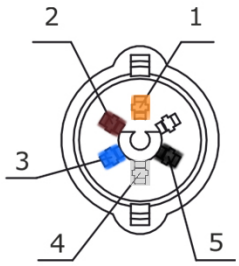
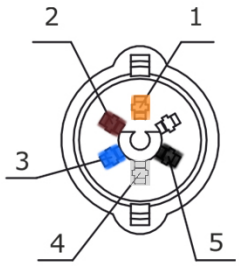
Connector view	Pin number	Wire color		Assignment
	1	Orange		Power supply “+”
	2	Brown		Ground
	3	Blue		Received data (232R) Data exchange (485A)
	4	White		Transmitted data (232T). Data exchange (485B)
	5	Black		K-Line (ISO 14230)

Table 13 — 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)

Check Annex H (Figures H.1 – H.4) for *DFM ACAN/CCAN/DCAN* and tracking devices connection options and required connection cables models.

3 DFM configuration with SK DFM service kit

All DFM fuel flow meters are calibrated and verified by the manufacturer with a diesel fuel and supplied ready for use. Number of pulses generated by DFM output for 1 liter of measured fuel is indicated in product specification.

When DFM is used as a part of GPS/GLONASS vehicle tracking and fuel monitoring system the interface output cable of the meter is connected to the pulse counter input of the tracking device (terminal). Number of pulses per liter taken from the specification is recorded to the correspondent setting of the tracking platform.

For a better performance of DFM AK/CK/D/A232 /A485/ACAN/C232/C485/CCAN/D232/D485/DCAN and DFM i indicators additional setup for particular operation conditions is available with the help of SK DFM service kit (ordered separately).

3.1 SK DFM application

SK DFM **service kit is designed for connection of DFM flow meters and** DFM i **indicators to a PC for configuration view of counter values, diagnostics and data exchange with a PC.**

SK DFM can be used with the following units:

- single-chamber fuel flow meters with normalized pulse output interface (DFM AK);
- single-chamber fuel flow meters with digital output interfaces (DFM A232/A485/ACAN);
- single-chamber fuel flow with display and output interface (DFM CK/C232/C485/CCAN);
- double-chamber differential fuel flow meters with output interface (DFM D/D232/D485/DCAN);
- DFM i fuel consumption indicators with firmware version 3.0 and higher.

Special service software should be installed on PC for SK DFM operation. Software is included into SK DFM delivery set:

1) Service DFM (for configuration of DFM AK/CK/D and DFM i);
2) Service S6 DFM
(for configuration of DFM A232/A485/ACAN/C232/C485/CCAND232/D485/DCAN).

Up-to-date version of the utility can be downloaded from www.jv-technoton.com

Service software functions:

- viewing flow meter specifications;
- checking and modifying flow meter settings;
- viewing values of counters;
- viewing events and malfunctions *****;
- configure thresholds for events detection *****;
- set up flow meter date and time *****;
- saving meter profile to PC;
- loading previously saved profiles to the meter;
- printing profiles;
- monitor flow meter output data;
- diagnostics of the meter;
- updating firmware of the meter.

***** Available in Service S6 DFM only.

3.2 Hardware requirements

To run Service DFM utility IBM-compatible PC is required (desktop or laptop):

- CPU - Intel or AMD with a minimum clock speed of 800 MHz;
- RAM - 256 MB (recommended 512 MB or more);
- USB port;
- CD-ROM / DVD-ROM;
- Screen resolution not less than 800x600;
- operating system - Windows XP/Vista/7/8/8.1, X86/X64.

3.3 Service kit delivery set

3.3.1 Exterior view and delivery set

SK DFM delivery set includes the following items (Figure 25):

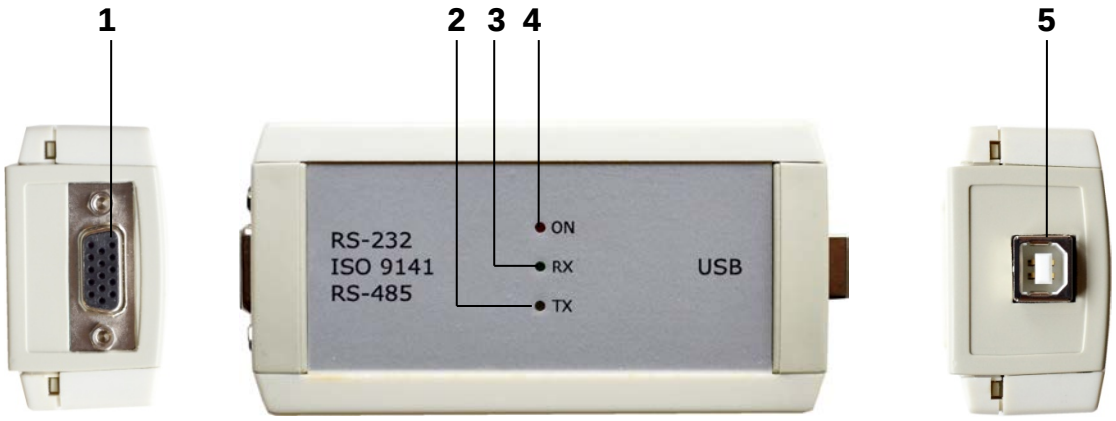


1	universal service adapter	– 1 pc.;
2	license certificate of Service DFM utility	– 1 pc.;
3	license certificate of Service S6 DFM utility	– 1 pc.;
4	CD Driver USB	– 1 pc.;
5	CD Service S6 DFM utility	– 1 pc.;
6	CD Service DFM utility	– 1 pc.;
7	SK DFM specification	– 1 pc.;
8	USB A-B cable	– 1 pc.;
9	CAN service cable	– 1 pc.;
10	DFM i service cable	– 1 pc.;
11	DFM service cable	– 1 pc.

Figure 25 — SK DFM delivery set

3.3.2 Universal service adapter

Universal service adapter (hereinafter adapter) is designed to transmit data between DFM/DFM i and PC.
B See Figure 26 for adapter exterior view.



1 – RS-232/ISO 9141/RS-485 socket for DFM/DFM i connection;
2 – TX yellow LED indicator of data transmitted to DFM/DFM i;
3 – RX green LED indicator of data received from DFM/DFM i;
4 – ON red LED indicator of power supply;
5 – USB B port for PC connection.

Figure 26 — Adapter exterior view

3.3.3 USB A-B Cable

USB A-B cable is used for connection of PC and adapter (see Figure 27)

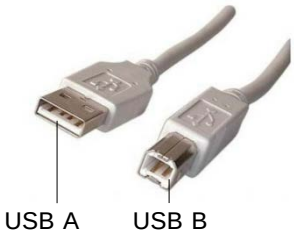
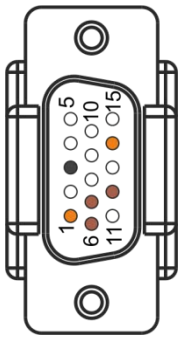
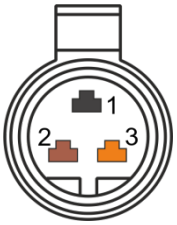


Figure 27— USB A-B cable connectors

3.3.4 DFM service cable

DFM service cable is used to connect adapter to DFM AK/CK/D.
See Table 14 for pinout of DFM service cable.

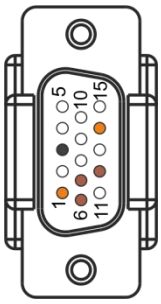
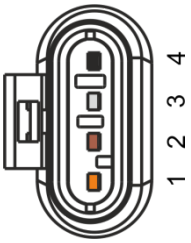
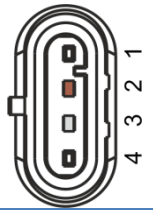
Table 14 — DFM service cable pinout

View	Pin number	Wire			Signal	
		Marking	Color		Assignment	Type
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	3	KLIN		Black	K-Line	Serial, ISO14230 standard
	6	GND		Brown	Ground	-
	7	GND		Brown	Ground	-
	12	SEL2		Brown	K-Line selection	Discrete
	14	VEE		Orange	Power supply	Analog, Voltage 0...32 V
	1	KLIN		Black	K-Line	Serial, ISO14230 standard
	2	GND		Brown	Ground	-
	5	VBAT		Orange	Power supply	Analog, Voltage 0...32 V

3.3.5 DFM i service cable

DFM i service cable is used to connect adapter to DFM i fuel consumption indicator (readout display)*.
See Table 15 for pinout of DFM i service cable.

Table 15 — DFM i service cable pinout

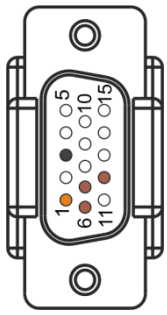
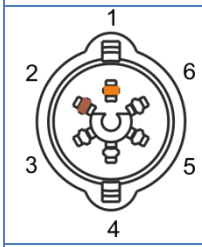
View	Pin number	Wire			Signal	
		Marking	Color		Assignment	Type
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	3	KLIN		Black	K-Line	Serial, ISO14230 standard
	6	GND		Brown	Ground	-
	7	GND		Brown	Ground	-
	12	SEL2		Brown	K-Line selection	Discrete
	14	VEE		Orange	Power supply	Analog, Voltage 0...32 V
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	2	GND		Brown	Ground	-
	3	PULSE IN		White	Pulse input	Pulse, pulse duration 0.5...500 ms
	4	KLIN		Black	K-Line	Serial, ISO14230 standard
	2	GND		Brown	Ground	-
	3	PULSE IN		White	Pulse input	Pulse, pulse duration 0.5...500 ms

* Indicators with firmware version 3.0 or higher can be connected. SK DFM utility 4.0 or higher required.

3.3.6 CAN service cable

CAN service cable is used to connect adapter to DFM A232/A485/ACAN/C232/C485/CCAN/D232/D485/DCAN.
See Table 16 for pinout of CAN service cable.

Table 16 — CAN service cable pinout

View	Pin number	Wire			Signal	
		Marking	Color		Assignment	Type
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	3	KLIN		Black	K-Line	Serial, ISO14230 standard
	6	GND		Brown	Ground	-
	7	GND		Brown	Ground	-
	12	SEL2		Brown	K-Line selection	Discrete
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	2	GND		Brown	Ground	-
	1	VBAT		Orange	Power supply	Analog, Voltage 0...32 V
	2	GND		Brown	Ground	-
	5	KLIN		Black	K-Line	Serial, ISO14230 standard

3.4 Software installation

The following software should be installed on PC before starting work with SK DFM:

- USB driver creating virtual COM port (CD Driver USB);
- Service DFM utility (CD Service DFM).
- Service DFM S6 utility (CD Service S6 DFM).

3.4.1 USB driver installation

ATTENTION: SK DFM will not operate correctly without prior USB driver installation.

Insert CD Driver USB into CD-ROM (DVD-ROM) and run installation file CP210x_VCP_Win_XP_S2K3_Vista_7.exe.
Welcome to the InstallShield Wizard window will appear (Figure 28).

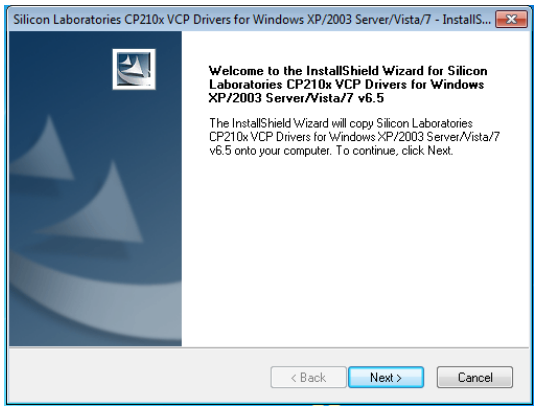


Figure 28 — Welcome to the InstallShield Wizard window

Push Next > button to start the first leg of USB driver installation. Then just follow installation wizard instructions.

You can see installation status in Setup Status window (see Figure 29).

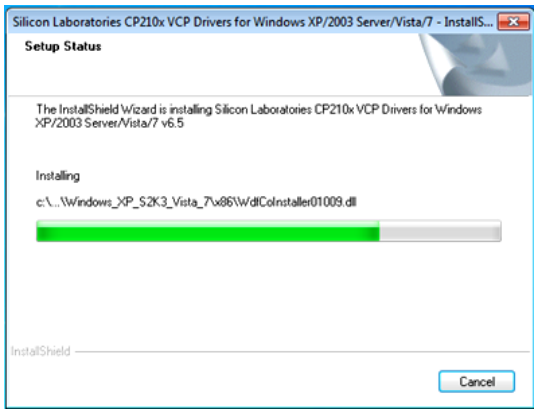


Figure 29 — Setup Status window

When the first leg is finished check Launch the CP210xVCP box in InstallShield Wizard Complete window (see Figure 30) and push Finish.

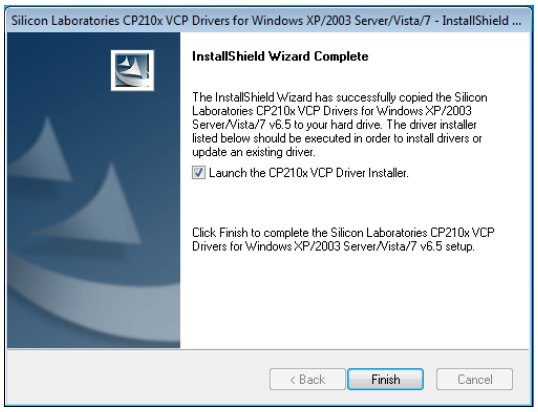


Figure 30 — InstallShield Wizard Complete window

Silicon Laboratories CP210x USB to UART Bridge Driver Installer window will appear. Push Install and USB driver installation will be continued (see Figure 31).

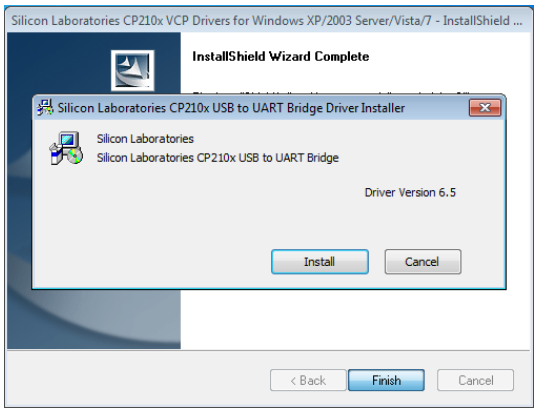


Figure 31 — Silicon Laboratories CP210x USB to UART Bridge Driver Installer window

Successful installation notification window will appear as soon as installation is finishes (see Figure 32).

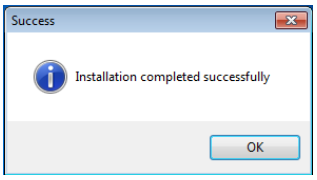


Figure 32 — Successful installation notification window

3.4.2 Service DFM utility installation

Insert CD Service DFM into CD-ROM (DVD-ROM) and run installation file ServiceDFM_v_X_X_Setup.exe.

Note — X_X corresponds to the version of utility. The latest version described in the present manual is 4.0.

Select installer language out of the drop-down list (see Figure 33).

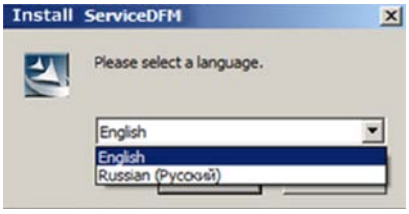


Figure 33 — Installer language selection

Push Next > button to start installation of the utility (see Figure 34) and follow the instructions.



Figure 34 — Service DFM installation wizard window

The following window will indicate the process of installation of Service DFM files (Figure 35).

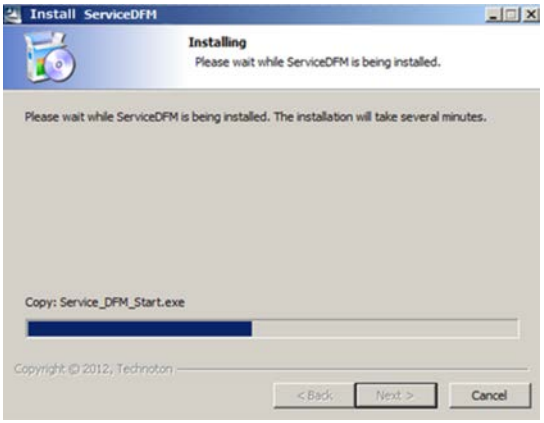


Figure 35 — Installation progress

Since the installation of Service DFM utility is finished PC is ready for SK DFM connection and operation (see Figure 36).



Figure 36 — Successful completion of Service DFM installation

3.4.3 Service S6 DFM utility installation

Insert CD Service S6 DFM into CD-ROM (DVD-ROM) and run installation file ServiceS6_DFM_X_X_Setup.exe.

Note — X_X corresponds to the version of utility. The latest version described in the present manual is 1.4.

Select installer language out of the drop-down list (see Figure 37).

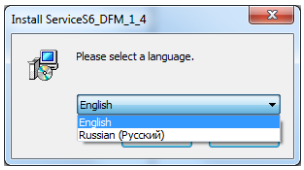


Figure 37 — Installer language selection

Push Next > button to start installation of the utility (see Figure 38) and follow the instructions.

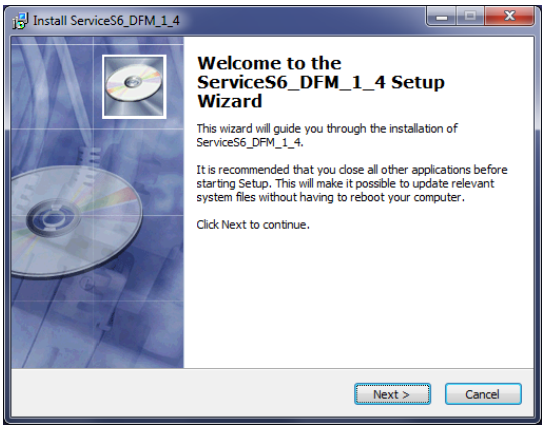


Figure 38 — Service S6 DFM installation wizard window

The following window will indicate the process of installation of Service S6 DFM files (Figure 39).

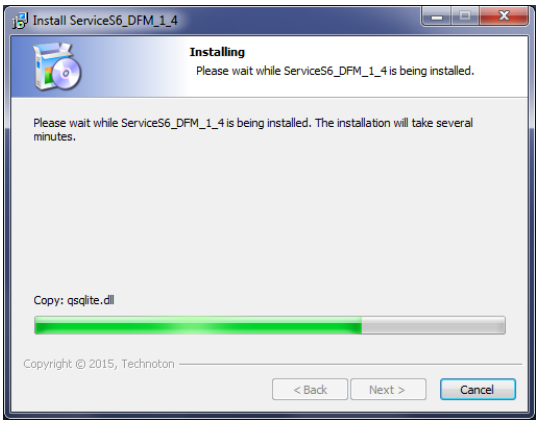


Figure 39 — Installation progress

Since the installation of Service S6 DFM utility is finished PC is ready for SK DFM connection and operation with DFM A232/A485/ACAN/C232/C485/CCAN D232/D485/DCAN (see Figure 40).

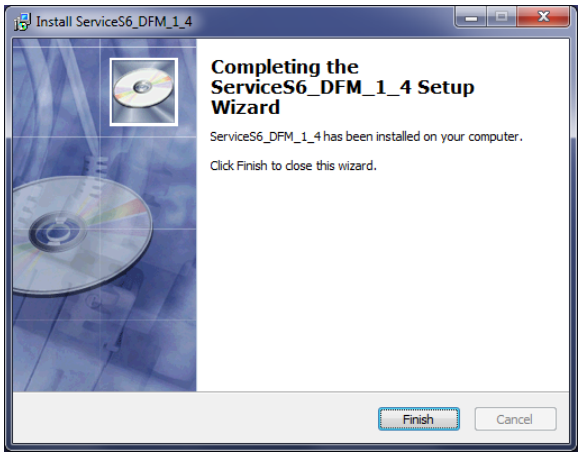


Figure 40 — Successful completion of Service S6 DFM installation

3.5 SK DFM connection

3.5.1 Exterior inspection prior to connection

It is necessary to conduct SK DFM exterior inspection for the presence of the possible defects arisen during transportation, storage or careless use:

- visible damages of the adapter body and connectors;
- connector and insulation damages of service cables and USB A-B cable.

Contact the supplier if any defects detected.

3.5.2 Operation restrictions

Avoid the following when connecting SK DFM to the meter mounted on the vehicle:

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



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

3.5.3 Connecting DFM to PC



ATTENTION: Power down the electrical system of the vehicle prior to DFM connecting to the PC. Use the battery switch or take off the battery contact terminals.

DFM meters and DFM i* indicators are connected to PC through SK DFM according to the connection schemes (see Figure 41).

Follow the instructions:

1) Plug DFM connector or S6 3SC** connector to RS-232/ISO 9141/RS-485 adapter slot with DFM service cable. Use the service cable for a corresponding DFM model (see 3.3.4, 3.3.6).

Note — use DFM i service cable to connect DFM i indicator (see 3.3.5).

2) Plug the adapter to USB port of PC with the USB A-B cable ***.

3) Connect power supply wires to vehicle on-board voltage network or power supply unit.

Note

1 Power is supplied from USB port of the PC for DFM meters and DFM i fuel counter. SK DFM is ready to work since the moment of connection to USB port of PC.

2 When configuring the indicator in case you need to check the data records on engine working time in different modes, switch on the battery to supply DFM with power.

3 When configuring DFM A232/A485/ACAN/C232/C485/CCAN/D232/D485/DCAN additional power supply is required from the vehicle battery or power supply unit (see Figure 41 b).

4 When configuring DFM ACAN/CCAN/DCAN integrated into S6 telematics bus the additional power supply is provided through cable input of S6 bus (see Figure 41c).

4) Switch on power supply (battery).

Red LED indicator with ON marking lights since SK DFM is connected to PC. If the meter is not connected to the adapter or if Service DFM utility is not launched, then the indicator will turn off 15 seconds later.

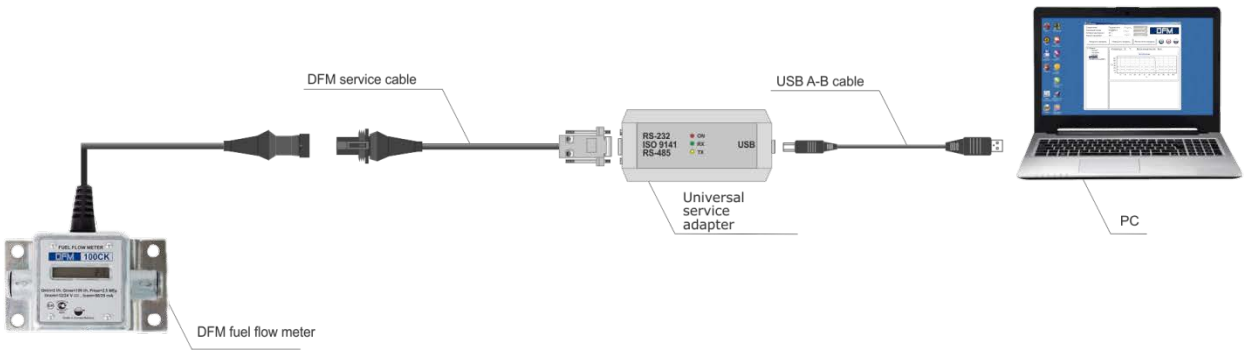
In case the red Led indicator does not light make sure USB A-B cable is connected properly or reinstall USB driver (see 3.4.1).

---

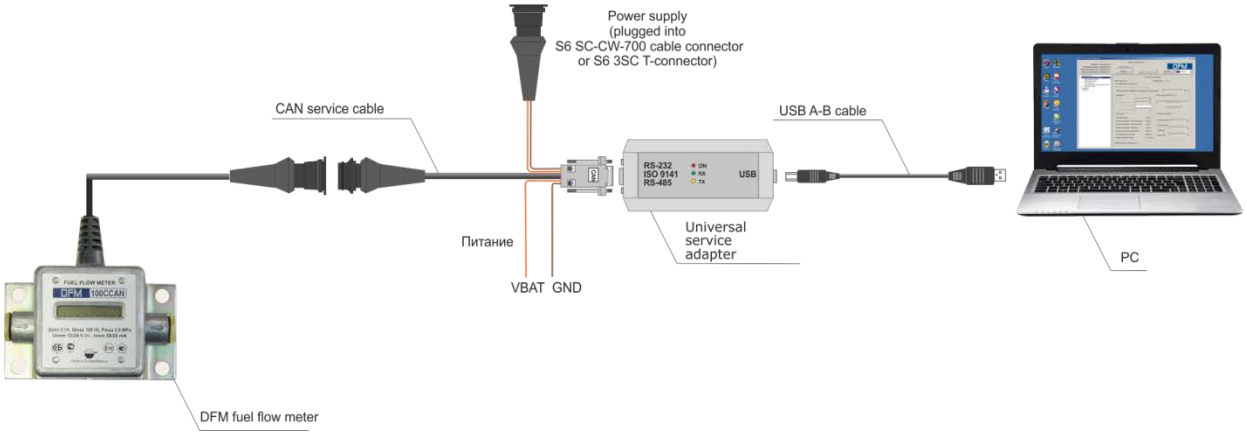
* Indicators with firmware version 3.0 or higher can be connected.
Service DFM utility 4.0 or higher required.

** When configuring DFM ACAN/CCAN/DCAN integrated into S6 telematics bus.

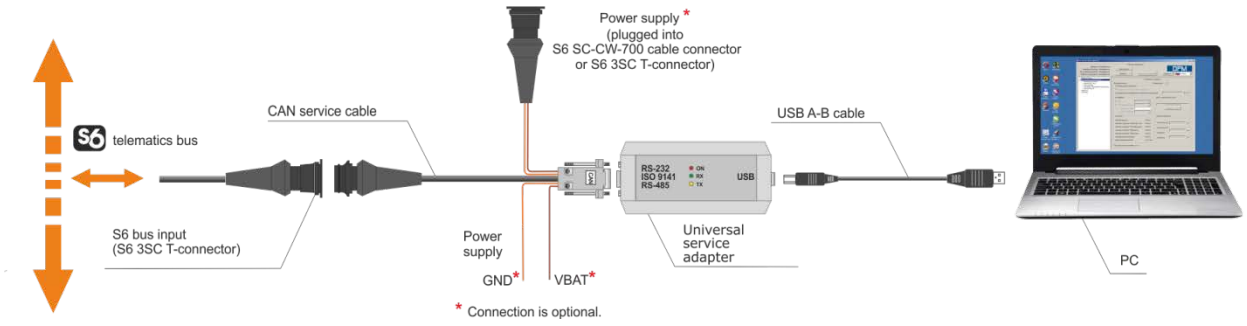
*** Connecting the adapter to the PC's USB port is allowed both before and after DFM service utility launch.



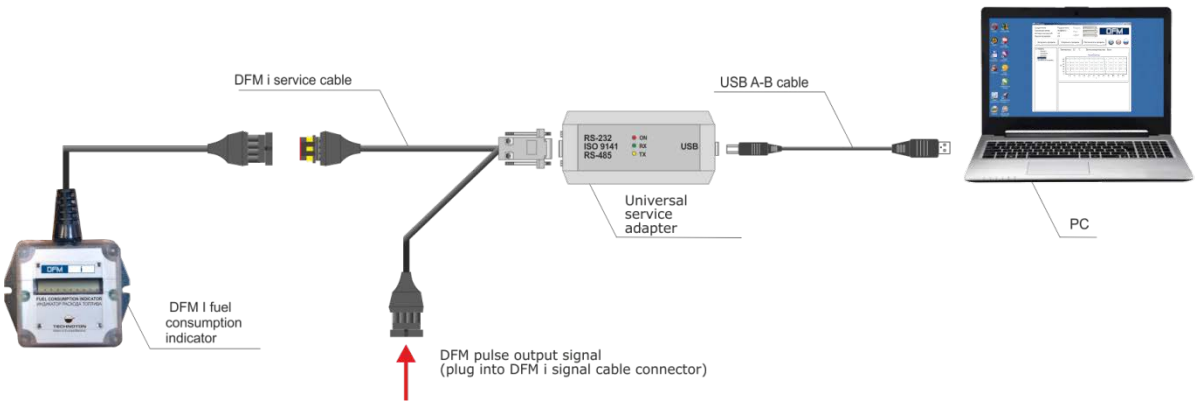
a) configuring DFM AK/CK/D



b) configuring DFM A232/A485/ACAN/C232/C485/CCAN/D232/D485/DCAN



c) configuring DFM ACAN/CCAN/DCAN integrated into S6 telematics bus



d) configuring DFM i

Figure 41 — SK DFM connection schemes

3.6 Service DFM utility operation

3.6.1 User interface

Service DUT-E user interface consists of **Horizontal menu**, **Vertical menu**, **Connection status area** and **Information and configuration area** (see Figure 42).

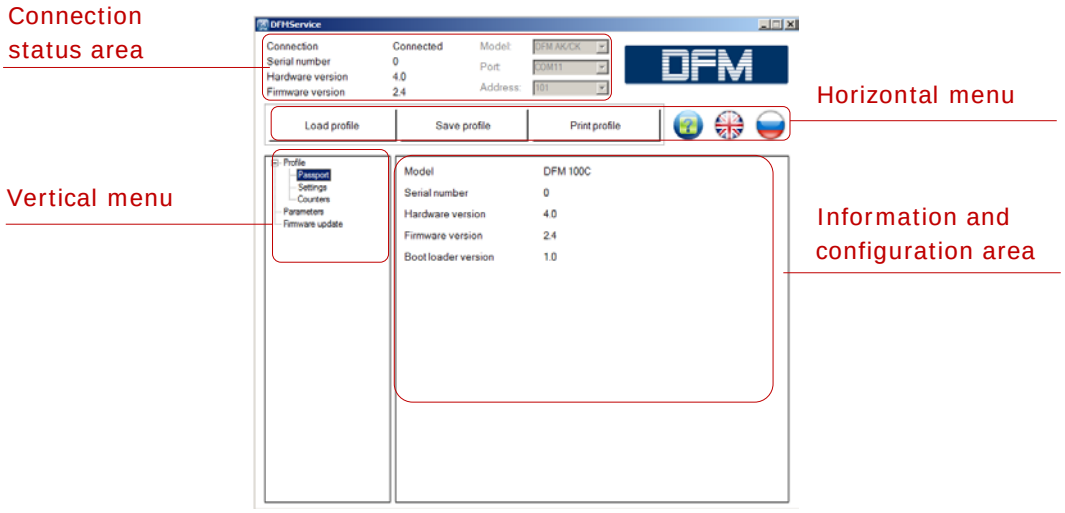


Figure 42 — Service DFM user interface

The top left area is **Connection status area** which displays current connection status of the meter (Connected/Disconnected), serial number, hardware and firmware version of the connected meter.

Horizontal menu located under Connection status area provides following options:

- meter profile options (loading profile, saving profile, printing profile);
- selection of interface language;
- viewing help file and information about the utility.

Vertical menu is located at the bottom left side of the window and used for selection of sensor profile entries which are displayed in **Information and configuration area** at the right side of the window.
Vertical menu also contains diagnostics and firmware update entries.

3.6.2 Utility launch and initial setup

Service DFM is launched with a 

label which is created during the installation process.

Before the adapter is connected to USB port of the PC the window of the utility will look according to Figure 43.

Connection status area will display: Connection– Disconnected, Serial number – Unknown, Hardware version – Unknown, firmware version – Unknown.

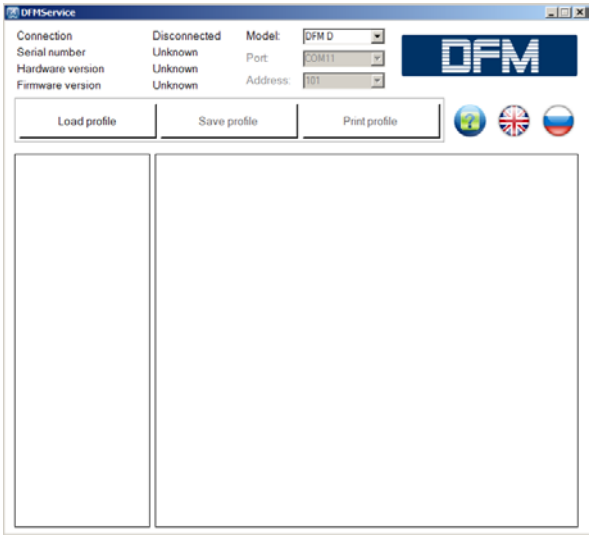


Figure 43 — Service DFM window

Initial setup includes:

- selection of the virtual COM port of the PC;
- selection of the interface language.

ATTENTION: Virtual COM port number can be determined only if:
1) USB driver is installed (see 3.4.1)
2) Adapter is connected to the USB port of the PC.

Virtual COM port opening error message will appear when the Service DFM utility is launched with no adapter connected to USB port of PC (see Figure 44).

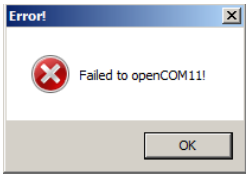


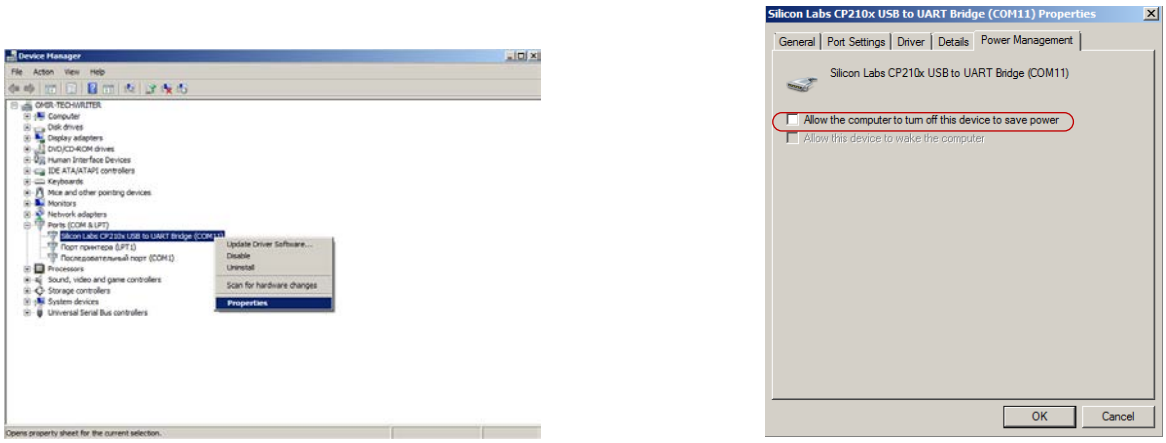
Figure 44 — Virtual COM port opening error message

The number of virtual COM port is displayed at Silicon Laboratories CP210x USB to UART Bridge entry located in Ports (COM and LPT) list of Windows device manager (see Figure 45).
Device manager can be launched the following way:

- Windows XP — Start → Control Panel → System.
  Select Hardware tab and click Device manager button.
- Windows Vista/Windows 7 — Start → Control Panel → Device manager.

Note — Virtual port COM11 is used in screenshots for present manual.

ATTENTION: to work with Service DFM it is recommended:
1) It is recommended to use the same USB port of the PC for SK DFM connections.
2) Untick power save check box in virtual COM-port properties (see Figure 45).



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

Figure 45 — Virtual COM-port configuration in Device manager

Select the proper COM port from the drop-down list in Connection status area of the window (see Figure 46).

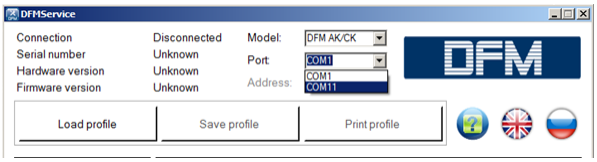


Figure 46 — Virtual COM port selection

Interface language is set with the click on one of the two buttons in the Horizontal Menu.

Since interface language is selected Service DFM will automatically restart.

ATTENTION: Virtual COM port and language settings are saved in Service DFM configuration file. No need to reconfigure these settings during the following launches.

3.6.3 Flow meter connection

After the initial setup of Service DFM is made select model of the connected flow meter in **Model** drop-down list at Connection status area (see Figure 47). Then plug DFM service cable to the interface cable connector of the flow meter.

ATTENTION: When connecting DFM i select DFM AK/CK from **Model** drop-down list. The further operation with DFM i is similar to operation with DFM AK/CK.

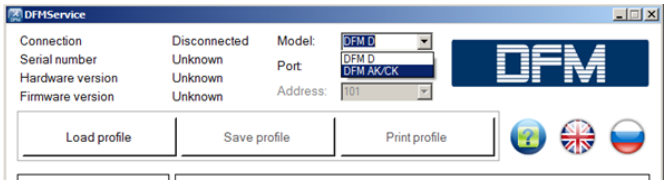


Figure 47 — Selection of the flow meter model

In 2-5 seconds the new window should appear indicating that the process of meter memory reading is finished (see Figure 48).

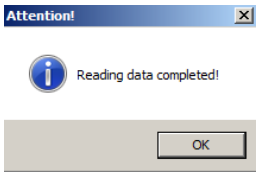


Figure 48 — Memory reading finished

After clicking OK button Service DFM utility will load the profile of the connected flow meter. Connection status will change to Connected. Serial number, hardware and firmware versions will be displayed (see Figure 49).

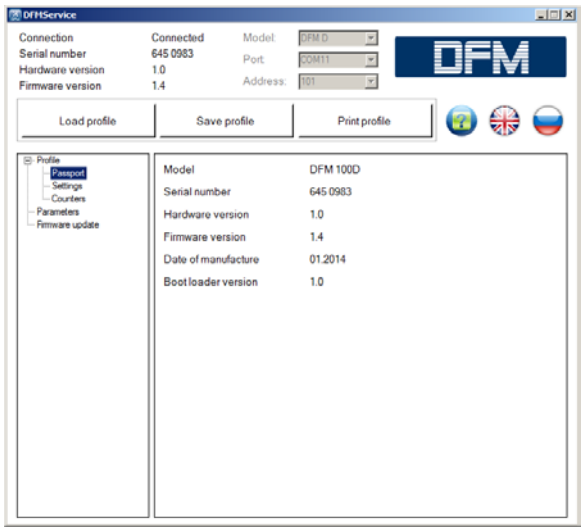


Figure 49 — Service DFM window after flow meter connection and profile loading

Signal values of LEDs located on the adapter body, when working with a profile of the connected DFM or DFM i shall conform to Table 17.

Table 17 – LED signal description

LED indicator		Signal description
Marking	**Status and light color**	
ON		Power supply is on (from USB)
	No signal	Power supply is off (supply voltage is below the minimum required)
RX		DFM data is being received
	No signal	No data from DFM
TX		Data is being transmitted to DFM
	No signal	No data to DFM

In case of an interruption of the working session without prior closing of the utility window (for example, if you accidentally disconnect USB cable or DFM/DFM i service cable), Service DFM will display connection error message (see Figure 50). After the cables are reconnected the connection of PC with the flow meter will be automatically restored.

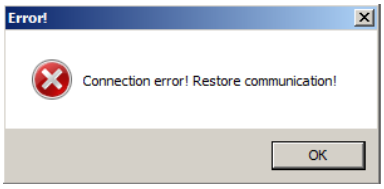


Figure 50 — DFM/DFM i Connection error message

3.6.4 Flow meter profile

Service DFM utility is designed for managing DFM profile (hereinafter profile). Profile is a set of passport (specification) data, settings and counters of the flow meter.
It is possible to manage the profiles in both meter connected mode and autonomous mode with no meter connected. In autonomous mode it is possible to work with previously saved profiles.
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.



ATTENTION: The present manual describes Service DFM operation mode with connected meter. Some functions and setting are not available in the autonomous mode.

3.6.5 Load profile

Click 

button of the Horizontal menu to load profile from DFM. The following options available (see Figure 51):

- **Load profile from file** — for loading of previously saved profile from the hard drive or removable disk. Select the ***.prf** file of the flow meter profile in the appeared Open window.
- **Load default profile** — for loading of profile with default factory settings of the selected flow meter model for utility evaluation purpose with no flow meter connection.
- **Load profile from device** — for loading of profile from the connected meter.

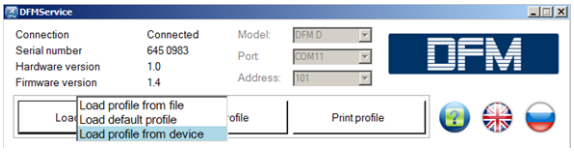


Figure 51 — Profile loading

3.6.6 Save profile

Click Save profile button of the Horizontal menu to save the results of the work with profile. The following options available (see Figure 52):

- **Save profile to file** — for saving profile to the hard drive or removable disk. Select the location and give a name to ***.prf** file in the appeared Save window. Saved profile can be then loaded to other DFM flow meters of the same model.
- **Save profile to device —** for saving the changes of the profile settings into the memory of the connected flow meter.

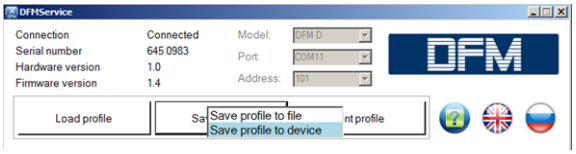


Figure 52 — Profile saving

Access authorization is used to protect from unauthorized configuration of the connected flow meter*.

Enter flow meter **password** to pass authorization check (see Figure 53). Password (access code) is a combination of four digits from 0 to 9 indicated in the attachment of the sensor specification (pink paper sheet).

ATTENTION: If the password of the flow meter been lost contact Technoton technical support via e-mail support@technoton.by
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.

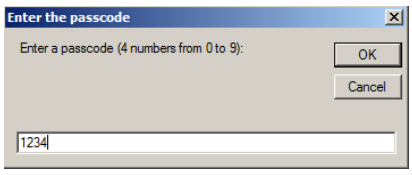


Figure 53 — Entering flow meter password

Invalid password entering will cause error message (see Figure 54).



Figure 54 — Invalid password message

After the profile is saved into the flow meter memory Service DFM utility will display a correspondent message (see Figure 55).

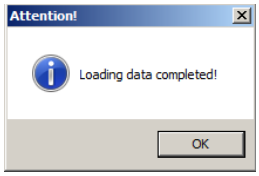


Figure 55 — Data uploading is finished

***** Access authorization is required only for DFM D series. It is not required for DFM AK/CK and DFM i.

3.6.7 Print profile

Click Print profile button of Horizontal menu to print DFM profile. Select printer and printing settings in the **Print** window (see Figure 56).

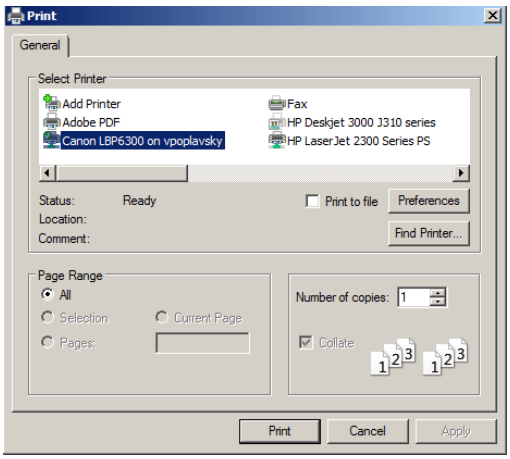


Figure 56 — Print window

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 DFM specification to log the history of the settings and configurations.

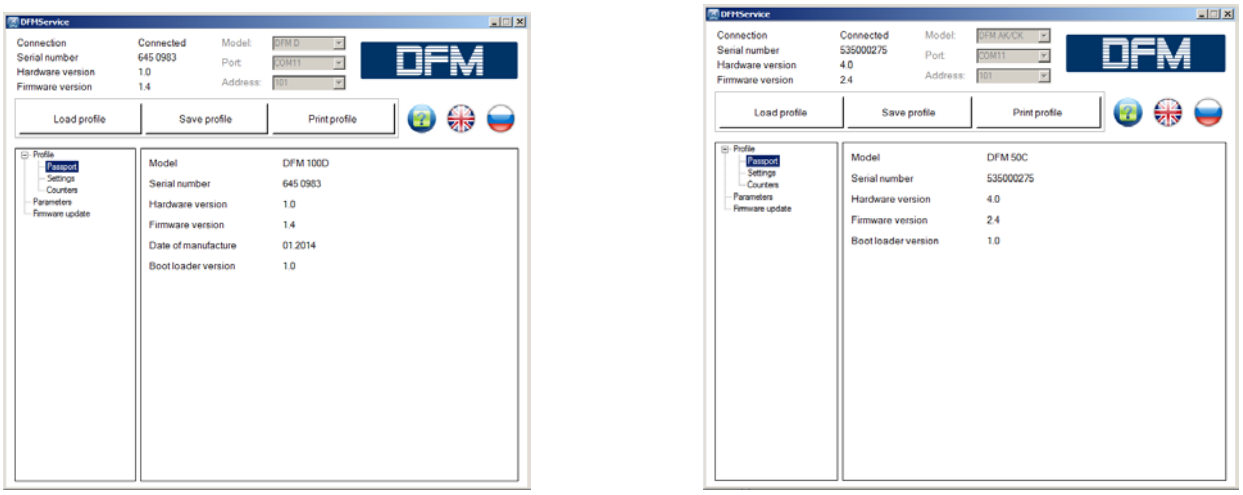
See Annex D (Figures D.1 and D.2) for examples of printed profiles of DFM D and DFM AK/CK flow meters

3.6.8 Vertical menu description. Profile - Passport

After loading the profile of DFM **Passport** submenu displays the following information on connected DFM (see Figure 57):

- model;
- serial number;
- hardware version;
- firmware version;
- date of manufacture*;
- bootloader version.

The user cannot edit these values. Information on serial number, hardware version and firmware version is also displayed in **Connection status area** of Service DFM window.



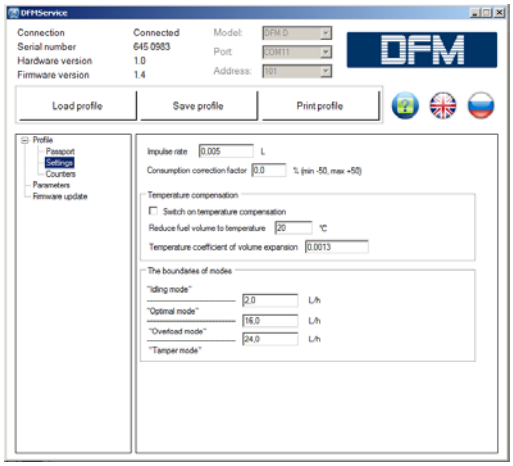
a) for DFM D *b) for DFM AK/CK and DFM i*

Figure 57 — Profile-Passport submenu

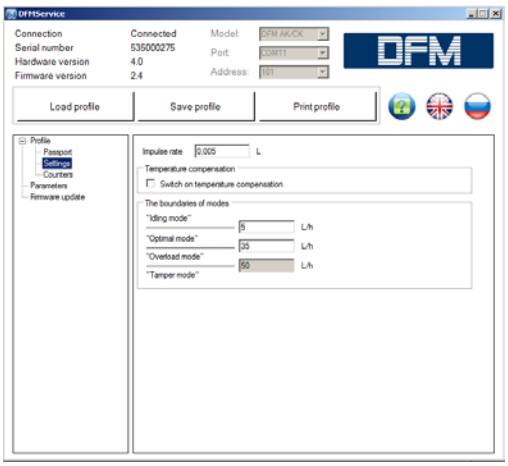
***** Only for DFM D.

3.6.9 Vertical menu description. Profile – Settings

Settings submenu is used for displaying and editing DFM settings (see Figure 58).



a) for DFM D



b) for DFM AK/CK and DFM i

Figure 58 — Profile-Settings submenu

Settings submenu contains the following configurable parameters:

- **Impulse rate** setting configures the amount of consumed fuel which for the DFM generates a single normalized output impulse. One output impulse corresponds to the normalized volume of consumed fuel which is equal to the nominal volume of the measuring chamber of the flow meter (see Table 3);
- **Consumption correction factor** setting is available for DFM D only. It allows adjusting the flow meter readings. This feature can be useful when there is a constant underestimation/overestimation of the flow meter in specific conditions (e.g., strong vibration);

  Example — if it is found out that flow meter has a constant error overestimating the real value by 3 % the-n enter -3 % correction value. In the flow meter underestimates the real values by 2 %, enter +2 % correction coefficient.
- **Switch on temperature compensation** setting enables fuel consumption readings correction according to the fuel temperature;
- **Reduce fuel volume to temperature** setting is available for DFM D only. Used to set a temperature value at which fuel volume data is recalculated. Flow meter measurement accuracy error is normalized at nominal operating temperature of fuel equal to +20 °C;
- **Temperature coefficient of volume expansion** setting is available for DFM D only. It enables the coefficient of volumetric expansion of oil products **β** when the temperature changes by 1 °C;
  Volume change is due to the fact that fuel density **ρ** changes when fuel temperature changes. The value of the coefficient **β** is selected from Table 18 for density of the oil product **ρ** at a temperature of +20 °C.

- **The boundaries of modes** sets the flow rate (actual consumption rate) value for different engine operation modes (see 1.6.5).

  Separation of data according to operational modes allows taking into account the actual engine wear and maintenance savings without fear of sudden breakdown.

Table 18 — Selection of oil products volumetric expansion coefficient

ρ, kg / m³	β, 1/°C	ρ, kg / m³	β, 1/°C
690.0 - 699.9	0.00130	850.0 - 859.9	0.00081
700.0 - 709.9	0.00126	860.0 - 869.9	0.00079
710.0 - 719.9	0.00123	870.0 - 879.9	0.00076
720.0 - 729.9	0.00119	880.0 - 889.9	0.00074
730.0 - 739.9	0.00116	890.0 - 899.9	0.00072
740.0 - 749.9	0.00113	900.0 - 909.9	0.00070
750.0 - 759.9	0.00109	910.0 - 919.9	0.00067
760.0 - 769.9	0.00106	920.0 - 929.9	0.00065
770.0 - 779.9	0.00103	930.0 - 939.9	0.00063
780.0 - 789.9	0.00100	940.0 - 949.9	0.00061
790.0 - 799.9	0.00097	950.0 - 959.9	0.00059
800.0 - 809.9	0.00094	960.0 - 969.9	0.00057
810.0 - 819.9	0.00092	970.0 - 979.9	0.00055
820.0 - 829.9	0.00089	980.0 - 989.9	0.00053
830.0 - 839.9	0.00086	990.0 - 999.9	0.00052
840.0 - 849.9	0.00084	—	—

3.6.10 Vertical menu description. Profile - Counters

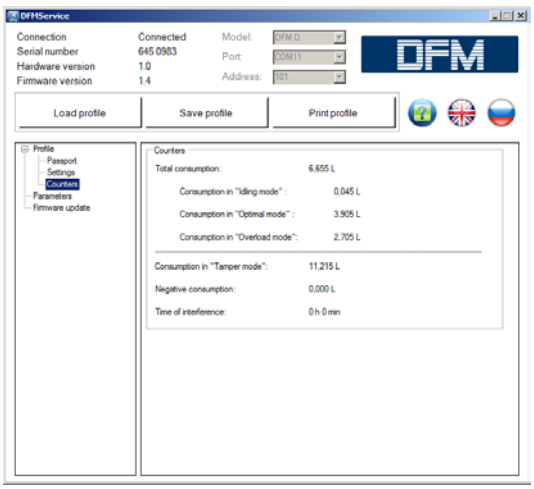
Counters submenu (see Figure 59) displays the following parameters:

- **Total consumption** — total fuel consumption in all engine operation modes including “Idling mode”;
- **Time** — total engine operation time in all operation modes including “Idling mode”. This counter is available for DFM AK/CK and DFM i models only;
- **Consumption in “Idling mode”** — fuel consumption in “Idling mode” of engine operation;
- **Time in “Idling mode”** — engine working time in “Idling mode”. This counter is available for DFM AK/CK and DFM i models only;
- **Consumption in “Optimal mode”** — fuel consumption in “Optimal mode” of engine operation;
- **Time in “Optimal mode”** — engine working time in “Optimal mode”. This counter is available for DFM AK/CK and DFM i models only;
- **Consumption in “Overload mode”** — fuel consumption in “Overload mode” of engine operation;
- **Time in “Overload mode”** — engine working time in “Overload mode”. This counter is available for DFM AK/CK and DFM i models only.
- **Consumption in “Tamper mode”** — fuel consumption volume that exceeded the upper capacity limit of the installed flow meter model.

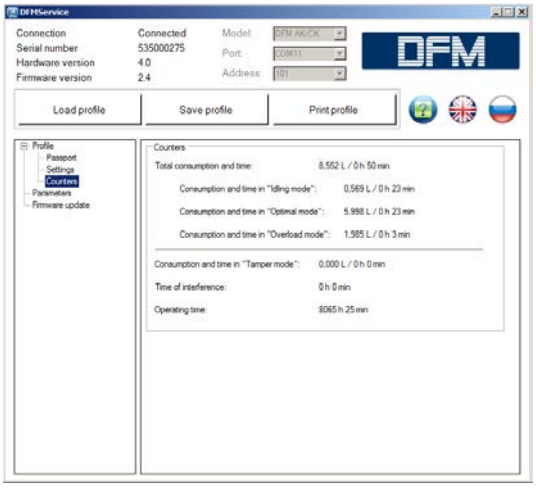
  Increase of this counter value indicates incorrect installation of the meter or possible drain of fuel (theft).
- **Time in “Tamper mode”** — time during which there been an excess of the upper capacity limit of the installed flow meter model. This counter is available for DFM AK/CK and DFM i models only;
- **Negative consumption** — fuel consumption volume during the periods when return fuel flow is higher than supplied fuel flow. This counter is available for DFM D models only.

  Increase of this counter value indicates excessive foam in the return line at high engine RPM. This happens because of air presence in return fuel line caused by depressurization (air leakage) in vehicle fuel system.
- **Time of interference** — total time of external factors affect the normal work of the flow meter.

  Increase of this counter value may indicate a flow meter installed near a source of strong magnetic field or deliberate attempts to block the flow meter.
- **Operating time** — total flow meter operation time since production This counter is available for DFM AK/CK models only.



a) for DFM D



b) for DFM AK/CK and DFM i

Figure 59 — Profile-Counters submenu

ATTENTION: Values of internal DFM counters displayed in **Counters** submenu are updated once per 6 minutes. That is why it is not recommended to use data of internal counters when conducting measurement accuracy test (see 4).
For DFM B/C/CK values from the built-in display can be used when conducting accuracy test because display data is updated instantly (see Table 5).

3.6.11 Vertical menu description. Parameters

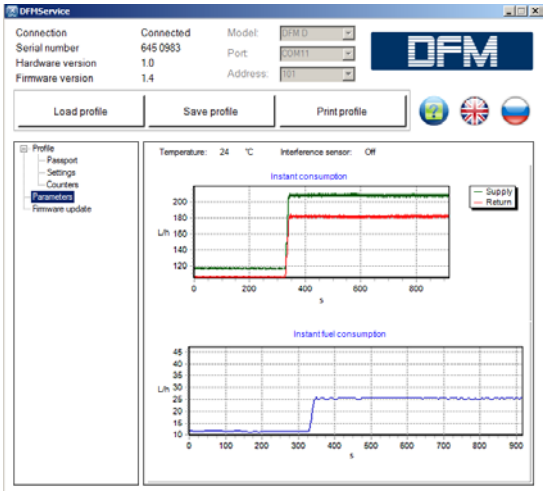
Parameters submenu displays the following operational parameters of DFM (see Figure 60):

- **Temperature** — temperature of the fuel flowing through the meter;
- **Interference sensor** — determines external factors affecting the normal work of the flow meter (for DFM i this parameter is not applicable).

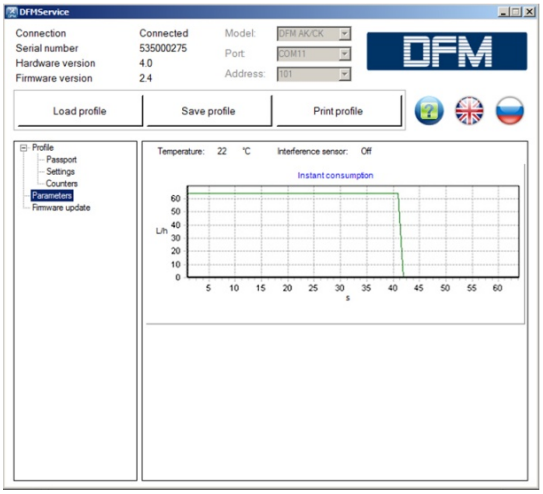
For DFM AK/CK and DFM i **Instant consumption** field displays real-time diagram of instant fuel flow rate measured by the meter (see Figure 60 a).
For DFM D models **Instant consumption** field displays two following real-time diagrams (see Figure 60 b):

1) **Supply** (green line) — instant flow rate measured in supply fuel line;
2) **Return** (red line) — instant flow rate measured in return fuel line.

Also for DFM D models **Fuel consumption** field displays real-time diagram of difference between supply and return flow rates measured by correspondent measuring chambers of the meter (differential consumption). See Figure b.



a) for DFM D



b) for DFM AK/CK and DFM i

Figure 60 — Parameters submenu

3.6.12 Vertical menu description. Firmware update

Firmware update submenu (see Figure 61) is used for upgrading internal software (firmware) of DFM flow meter.

ATTENTION: Before starting firmware update process check the information attachment of the firmware file to make sure the file matches the type and hardware version of the flow meter!

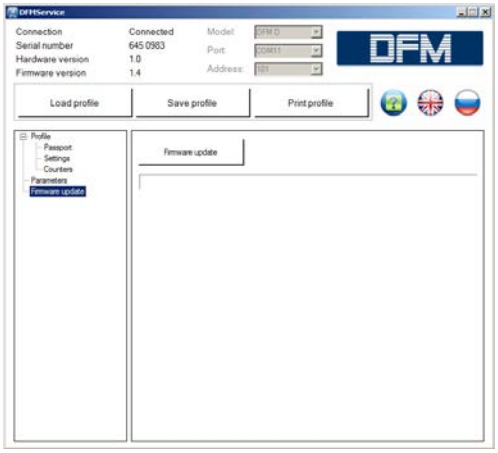


Figure 61 — Firmware update submenu

To update the firmware of the flow meter follow the instructions:

1) Click Firmware update button at Information and configuration area of the window.
2) Select firmware file (***.cod**) from the hard drive or removable disk in **Open** window (see Figure 62).
3) Click Open button to start the update process.

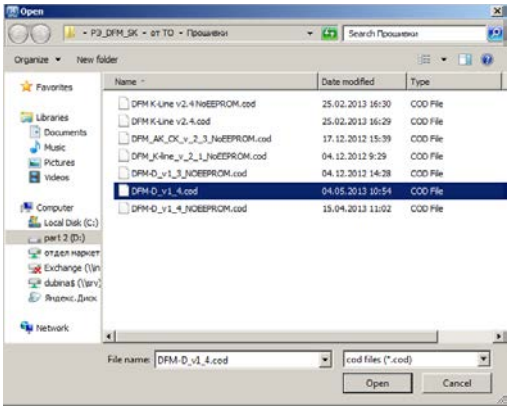


Figure 62 — Firmware file opening

ВНИМАНИЕ: Before the end of the update process and automatic Service DFM restart it is **ABSOLUTELY FORBIDDEN** to:

1) Disconnect DFM from the adapter.
2) Disconnect the adapter from the PC.
3) Power down the PC.
4) Run any resource-intensive applications on the PC

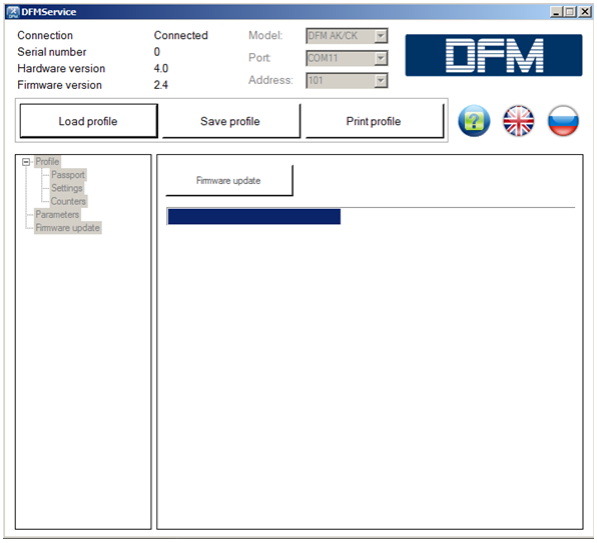


Figure 63 — Firmware file uploading to the flow meter

B Service DFM will display the new firmware version at **Connection status area** in case the update is successful. DFM is ready for further operation.

If the firmware update process has not been completed correctly causing flow meter failure follow the instructions for **emergency firmware update**:

1) Shut down Service DFM.

2) Disconnect DFM interface cable from the DFM service cable.

3) Run Service DFM.

4) Load the profile of the meter from a file (see 3.6.5).

5) Open firmware update submenu and click Firmware update button.

6) Select firmware file (***.cod**) from the hard drive or removable disk in **Open** window (see Figure 62).

Launch firmware update process clicking Open button.

7) Connect DFM service cable to the connector of DFM interface cable and wait for the completion of the update process.

In case of successful emergency update the flow meter is ready for further operation after automatic restart of Service DFM utility.

If the emergency update process also fails it is recommended to contact Technoton technical support team at support@technoton.by

3.6.13 Utility shutdown and DFM disconnection

When configuration is made follow the instructions to disconnect the flow meter:

1) Save the results of the work (see 3.6.6).
2) Shutdown Service DFM utility clicking  at the top of the window.
3) Disconnect DFM service cable from the meter's interface cable connector.

SK DFM can now be used for the next meter connection.

3.7 Service S6 DFM utility operation

3.7.1 User interface

Service S6 DFM user interface consists of **Horizontal menu**, **Vertical menu, Flow meter Passport area** and **Information and configuration area** (see Figure 64).

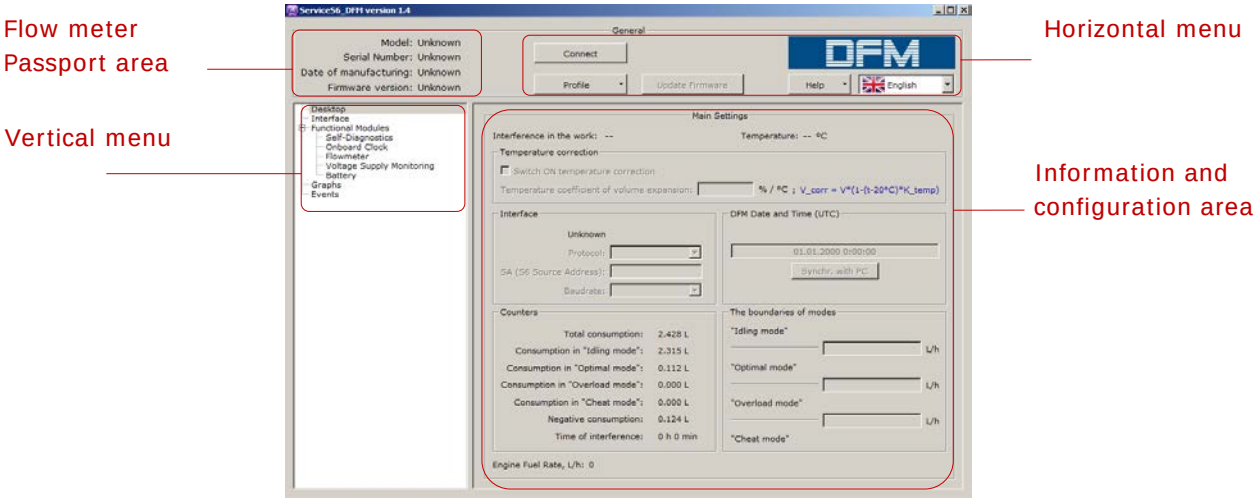


Figure 64 — Service S6 DFM user interface

Flow meter Passport 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;
- meter profile options (loading profile, saving profile, printing profile);
- updating firmware of the meter;
- 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 (PGN*****) and settings are displayed at **Information and configuration area**.
Vertical menu also contains entries on real-time diagnostics of measuring chambers and events records.

***** For DFM ACAN/CCAN/DCAN.

3.7.2 Utility launch and initial setup

Service S6 DFM is launched with a 

label which is created during the installation process.

Before the adapter is connected to USB port of the PC the window of the utility will look according to Figure 65. **Flow meter Passport area** displays the following information: Model — Unknown, Serial number — Unknown, Date of manufacturing — Unknown, Firmware version — Unknown.

Initial setup includes selection of the interface language (English/Russian/Belarusian) out of drop-down list in **Horizontal menu**.

The selected language will be saved in Service S6 DFM configuration file for the next launches.

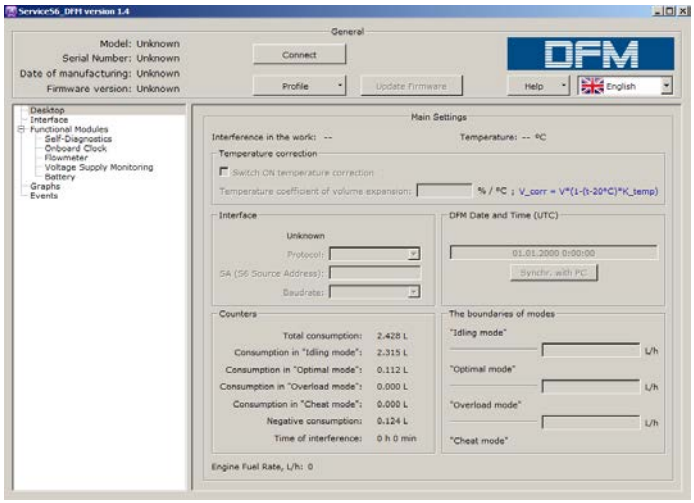


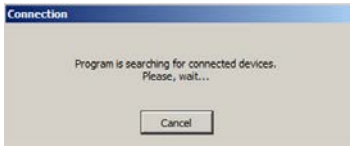
Figure 65 — Service S6 DFM window with no DFM connected

3.7.3 User authorization

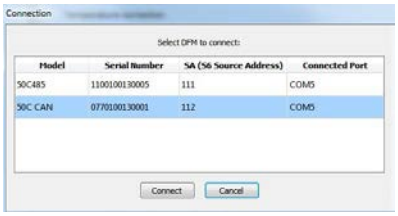
To establish connection with DFM push Connect at **Horizontal menu**. Service S6 DFM will run a search of connected meters (see Figure 66 a).

Note — When connecting SK DFM to S6 telematics bus which has more than one DFM CAN select the required flow meter out of the list in **Connection** window and push Connect button (see Figure 66 b).

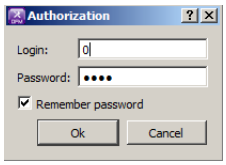
Enter installer's login and password in the fields of **Authorization** window. Default login is 0. Default 1111. Tick **Remember password** checkbox to save the password for further launches (see Figure 66 c).



a) search of connected meters



b) selecting one of several DFM CAN connected to S6 bus



c) user authorization

Figure 66 — Establishing connection between PC and DFM

For password recovery (if it was lost) press Ctrl+F10 in the password field of **Authorization**. Service S6 DFM will generate restore code (see Figure 67). Send the restore code to Technoton support via e-mail support@technoton.by together with 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.

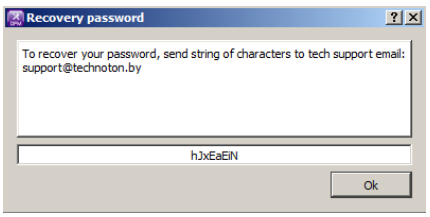


Figure 67 — Generated recovery code window

During the user authorization the utility checks COM-ports of the PC to identify one with connected adapter. Since the port is automatically identified the authorization data is sent to DFM. If login data is not correct or connection is incorrect error message will appear (see Figure 68).

In case of correct authorization the initial **Desktop** window with connected meter profile details will load (see Figure 74).

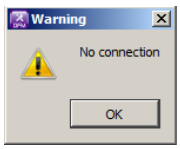


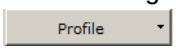
Figure 68 — Error message

ATTENTION: to work with Service S6 DFM it is recommended:
1) It is recommended to use the same USB port of the PC for SK DFM connections.
2) Untick power save check box in virtual COM-port properties (see Figure 45).

Since the connection between DFM and PC is established the signal values of adapter LEDs will conform Table 17.

3.7.4 Working with DFM profile

Service S6 DFM utility is designed for managing DFM **profile**. Profile is a set of passport (specification) data, settings and counters of the flow meter.

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

button with drop-down list is used (see Figure 69). 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.

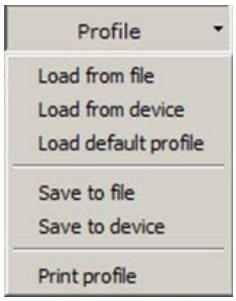
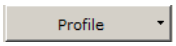


Figure 69 — Profile menu



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 70).

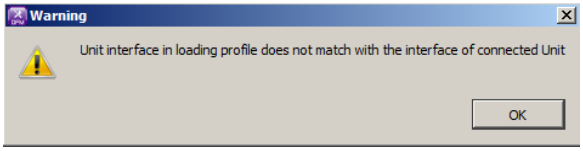


Figure 70 — Warning on interfaces incompatibility of profiles of loaded and connected Unit

- 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** file in the folder of Service S6 DFM.

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

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**.

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

- Sace 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.
  When this command is selected a progress window will display the process of profile saving (see Figure 71 a). The confirmation message will appear when the process is successfully finished (see Figure 71 b).



a) data saving progress *b) successful saving message*

Figure 71 — Saving profile to 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 (see Figure 72). Pressing Yes will save all the unsaved parameters and settings into DFM.

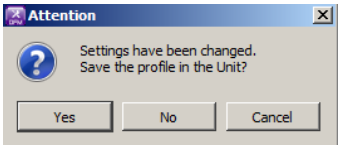


Figure 72 — Notification on DFM settings saving

3) Print profile. This window allows selection of the printer and printing settings (see Figure 73).

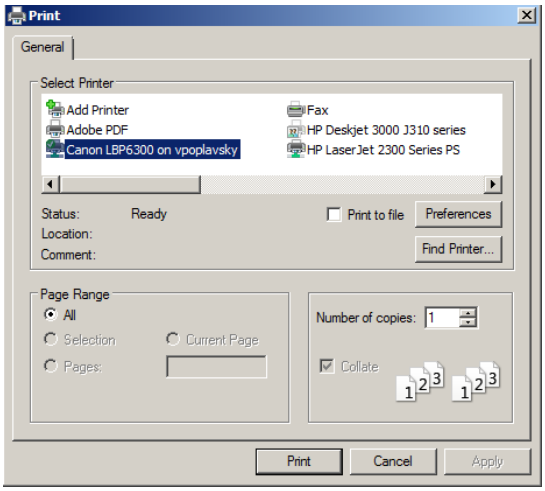


Figure 73 — Print window

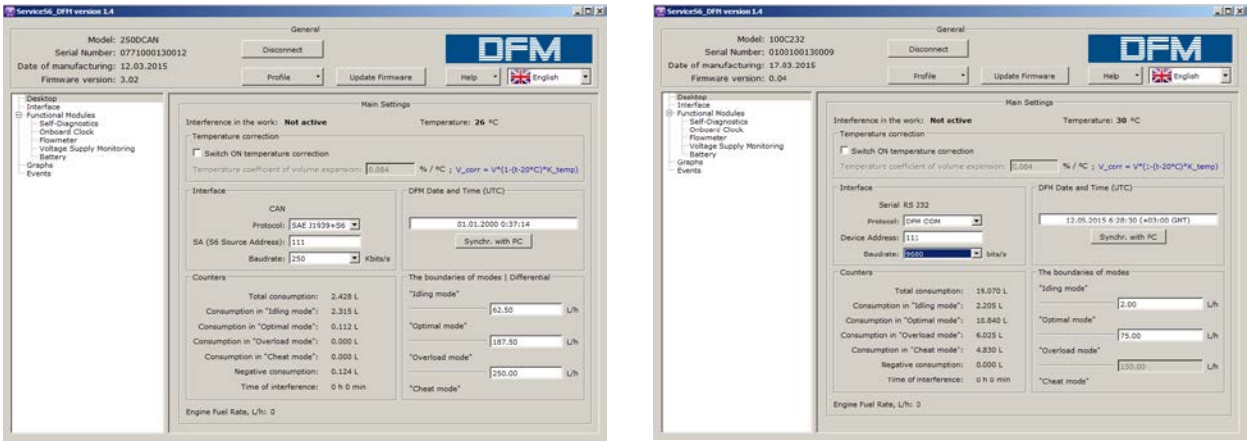
The printed copy will contain flow meter profile data as well as the date when it been printed.

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.

See Annex D (Figures D.3) for example of printed profile of DFM C232 flow meter.

3.7.5 Flow meter settings - Desktop

If the authorization is successful (see 3.7.3) **Desktop** window will automatically load which contains profile data of the connected DFM (see Figure 74).



a) for DFM ACAN/CCAN/DCAN *b) for DFM A232/C232/D232/A485/C485/D485*

Figure 74 — Desktop window

Flow meter Passport area will display DFM model, serial number, manufacturing date and firmware version. Update Firmware button of **Horizontal menu** will become active and Connect button will change to Disconnect. LEDs of the adapter will blink according to Table 17.

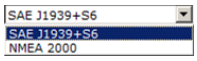
Information and configuration area is split to sections which display main settings and actual FM parameter values of the connected meter:

1) Main settings displays:

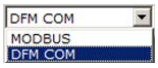
- **Interference in the work** shows if there any interference on flow meter operation: **No** stands for absence of interference; **Yes** means interference detected;
- **Temperature** indicates temperature of fuel passing through the flow meter;
- **Switch ON temperature correction** checkbox enables correction of fuel volume readings depending on the temperature of fuel.
  If the parameter is ON configuring of **Temperature coefficient of volume expansion** will become active (coefficient of volumetric expansion of oil products **β** when the temperature changes by 1 °C). Volume change is due to the fact that fuel density **ρ** changes when fuel temperature changes.
  The value of the coefficient **β** is selected from Table 18 for density of the oil product **ρ** at a temperature of +20 °C.

2) Interface entry displays:

- Type of the digital output interface of the connected: **CAN** or **Serial**.
- **Protocol** — data transfer protocol is defined automatically and displayed in the drop-down list. For **CAN** interface: **SAE 1939+S6** or **NMEA 2000** (see Figure 75 a). For **Serial** interface: **MODBUS** or **DFM COM** (see Figure 75 b).



a) for DFM ACAN/CCAN/DCAN

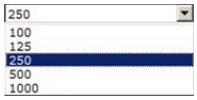


b) for DFM A232/C232/D232/A485/C485/D485

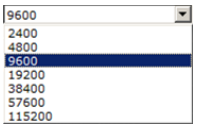
Figure 75 — Selection of data transfer protocol

ATTENTION: Data transfer protocol of CAN interface cannot be changed with the utility.

- **Address** for indicating of network address when several flow meters are used simultaneously (for DFM A232/C232/D232 or DFM A485/C485/D485). Available address range from 0 to 255 (by default — 111);
- **SA (S6 Source Address)** — decimal identification address of DFM when several flow meters are used simultaneously (for DFM ACAN/CCAN/DCAN). Each flow meter connected to S6 bus should have unique address from 111 to 114 (by default — 111);
- **Baudrate** for selection of data exchange speed. For **CAN** interface baudrate is selected out of the available values: 100; 125; 250; 500; 1000 Kbit/s (by default — 250 Kbit/s) (see Figure 76 a).
  For **Serial** interface baudrate is selected out of the available values: 2400; 4800; 9600; 19200; 38400; 57600; 115200 bit/s (by default — 9600 bit/s) (see Figure 76 b).



a) for DFM ACAN/CCAN/DCAN



b) for DFM A232/C232/D232/A485/C485/D485

Figure 76 — Baudrate selection

3) Unit Date and Time (UTC) section displays current FM ONBOARD CLOCK of the flow meter. Current date and time can be set or automatically synchronized with PC clock pressing Synchr. with PC button.

4) Counters section displays fuel consumption counters for various flow meter operation modes interference time counter (see 3.7.8).

5) The boundaries of modes section sets the flow rate (actual consumption rate) value for different engine operation modes (see 1.6.5 and 3.6.9).

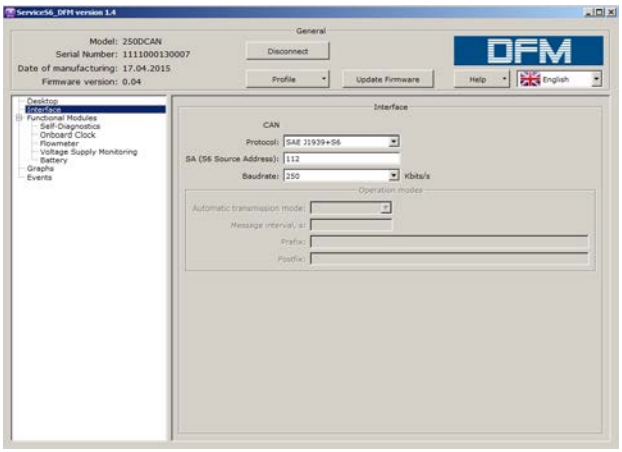
6) Engine fuel rate displays actual value hourly fuel consumption.



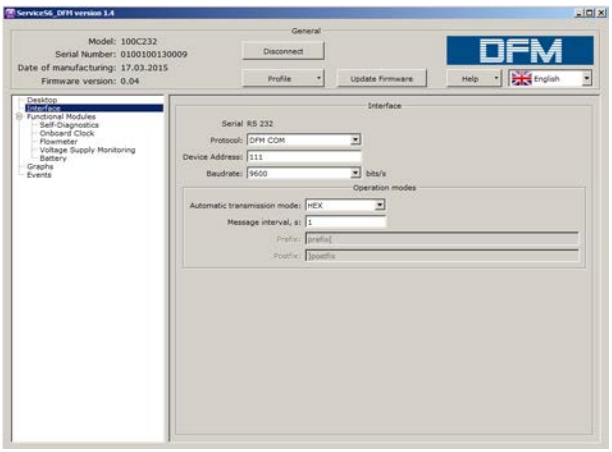
ATTENTION: Parameters modified in Desktop window are automatically modified in corresponding windows of FM setting entries and vice versa.

3.7.6 Flow meter settings - Interface

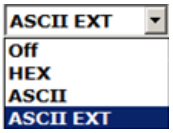
Interface entry is used for DFM interface configuration according to operation conditions and requirements of connected tracking device (see Figure 77).



a) for DFM ACAN/CCAN/DCAN



b) for DFM A232/C232/D232/A485/C485/D485



c) Automatic transmission mode drop-down list

Figure 77 — Interface window

Interface displays output interface type of the connected DFM (**CAN** or **Serial RS 232/RS 485**) and:

1) For DFM ACAN/CCAN/DCAN:

- **Protocol** drop-down list displays data transfer protocol under CAN interface: **SAE 1939+S6** or **NMEA 2000** (see Figure 75 a);

ATTENTION: Data transfer protocol of CAN interface cannot be changed with the utility.

- **SA (S6 Source Address)** decimal identification address of DFM when several flow meters are used simultaneously (for DFM ACAN/CCAN/DCAN). Each flow meter connected to S6 bus should have unique address from 111 to 114 (by default — 111);
- **Baudrate** for selection of data exchange speed. Baudrate is selected out of the available values: 100; 125; 250; 500; 1000 Kbit/s (by default — 250 Kbit/s) (see Figure 76 a).

2) for DFM A232/C232/D232/A485/C485/D485:

- **Protocol** drop-down list for selection of data transfer protocol under RS-232/RS-485: **MODBUS** or **DFM COM** (see Figure 75 b)
- **Address** for indicating of network address when several flow meters are used simultaneously. Available address range from 0 to 255 (by default — 111);
- **Baudrate** for selection of data exchange speed out of available values: 2400; 4800; 9600; 19200; 38400; 57600; 115200 bit/s (by default — 9600 bit/s) (see Figure 76 b)

The following settings are vailable for DFM COM protocol:

- **Automatic transmission mode** drop-down list for selection of output data transmission mode (see Figure 77 c):
  - Off — no automatic message transmission, sensor 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 sensor automatically send output message to the tracking device. Parameter value range is 1…255 seconds with 1 seconds step. Default value is 1 second.

3.7.7 Flow meter settings-FM Self-Diagnostics

FM Self-Diagnostics entry (see Figure 78) is used for DFM identification, operation time register and performance monitoring.

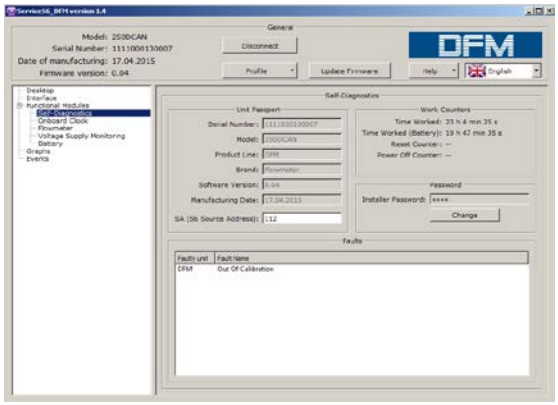


Figure 78 — FM Self-Diagnostics window

Left side of **FM Self-Diagnostics** window displays electronic **Unit Passport**: serial number, model, product line, firmware version, manufacturing date and SA (S6 Source Address).
Only **SA (S6 Source Address)** field is editable since the user is authorized. SA values can be set according to 3.7.5. Default value is 111.
Right side of **FM Self-Diagnostics** window displays **Work Counters** of the Unit: total Time worked, time worked from built-in battery, Reset (restart) counter*****, number of Power Offs*****.
Password field is used to modify installer's password. **Password change** dialogue window will appear when Change button is pressed (see Figure 79 a).

***** Not implemented in described version of the software.

Password change will show a notification if the inserted values are not correct (see Figure 79 b). Pressing OK button will save new password into DFM.



a) password change window *b) incorrect password notification*

Figure 79 — Installer's password change

Bottom of **FM Self-Diagnostics** window displays messages on malfunctions (DTC) of the flow meter if there any, indicating failure unit and type of malfunction. If there are no malfunctions it displays "no malfunctions" message.

See a full list of possible DTC at **ECU / DFM faul codes** page of http://s6.jv-technoton.com.

3.7.8 Flow meter settings-FM Onboard Clock

FM Onboard Clock entry (see Figure 80) is used for displaying and configuration of date and time which is used by DFM for registering events.

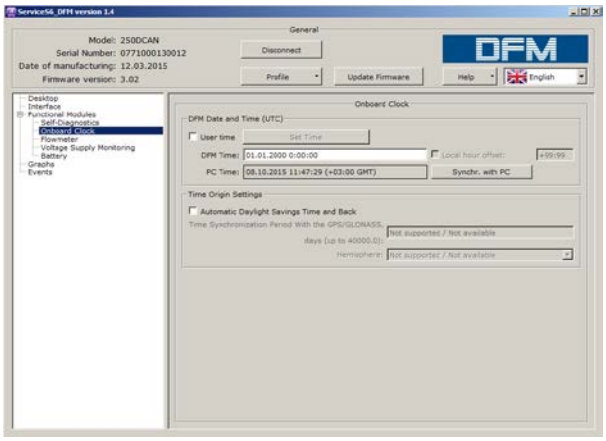


Figure 80 — FM Onboard Clock window

Unit time field of **Unit Date and Time (UTC)** section displays and sets current DFM time which is used for events registering. Unit time is set in UTC format (Coordinated Universal Time standard).
Following options of time setting are available:

- synchronization with PC;
- setting manually.

For synchronization with PC press Synchr. with PC button. In case of successful synchronization Unit Time and PC Time values will be the same.

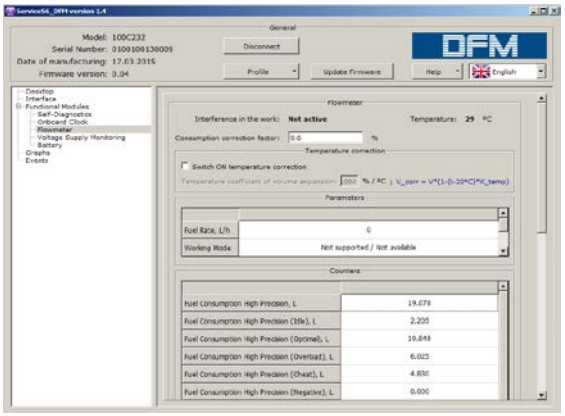
For manual setting tick **User Time** checkbox. Then insert **Unit Time** and **Local hour offset** if necessary and press Set Time.
To insert **Local hour offset** tick the corresponding checkbox.
If no offset is used untick the checkbox. Field will be inactive and display +99:99 value in this case.

Automatic Daylight Savings Time and Back can be enabled with ticking a checkbox at **Time Origin Settings** area if required.

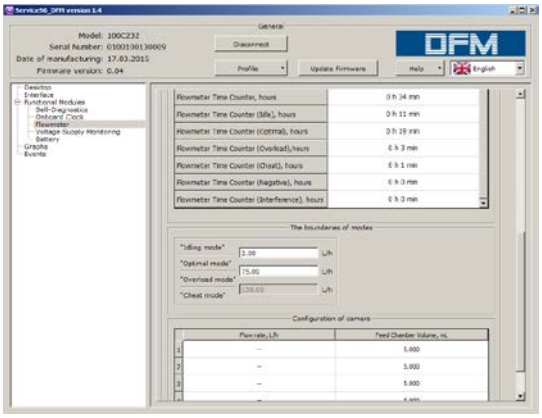
Settings of **Time synchronization Period With GPS/GLONASS** and **Hemisphere** are not supported in this version of software.

3.7.9 Flow meter settings-FM Flowmeter

FM Flowmeter entry (see Figure 81) is used for displaying and configuration of flow meter settings.

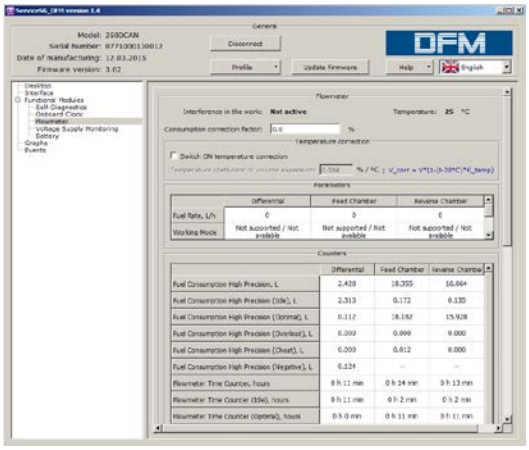


upper window area

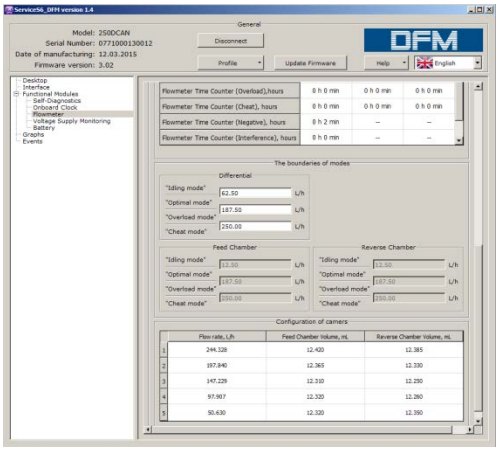


lower window area

a) for single-chamber meters (DFM A232/A485/ACAN/C232/C485/CCAN)



upper window area



lower window area

b) for differential meters (DFM D232/D485/DCAN)

Figure 81 — FM Flowmeter window

Information and configuration area of **FM Flowmeter** window includes areas and tables which display actual values of parameters, settings and counters of the connected meter. Scroll bars are used because of the large size of **FM Flowmeter** window.

1) Flowmeter area displays following parameters:

- **Interference in the work** shows if there any interference on flow meter operation: **No** stands for absence of interference; **Yes** means interference detected;
- **Temperature** indicates temperature of fuel passing through the flow meter;
- **Consumption correction factor** — this setting allows to enter an adjustment for flow meter readings. This could be required when a constant understatement/ overstatement of readings is detected for particular operation conditions (e .g. high vibration level);

  Example. It was determined that a flow meter overstates actual values by 3%. Correction factor of -3% should be inserted. Or if the flow meter understates real values by 2 the correction factor should be +2%.

- **Switch ON temperature correction** checkbox enables correction of fuel volume readings depending on the temperature of fuel.
  If the parameter is ON configuring of **Temperature coefficient of volume expansion** will become active (coefficient of volumetric expansion of oil products **β** when the temperature changes by 1 °C). Volume change is due to the fact that fuel density **ρ** changes when fuel temperature changes.
  The value of the coefficient **β** is selected from Table 18 for density of the oil product **ρ** at a temperature of +20 °C.

2) Parameters table displays the following real-time values:

for single-chamber meters (DFM A232/A485/ACAN/C232/C485/CCAN)

- instant fuel flow rate of fuel passing through the measuring chamber of the meter;
- working mode of the fuel consumer (engine) according to values of instant consumption rate (see 1.6.5).

for differential meters (DFM D232/D485/DCAN)

- column **Supply chamber**
  - instant fuel flow rate of fuel passing through the measuring chamber connected to the supply fuel line;
  - working mode of the fuel consumer (engine) according to values of instant consumption rate (see 1.6.5).

- column **Return chamber**
  - instant fuel flow rate of fuel passing through the measuring chamber connected to the return fuel line;
  - working mode of the fuel consumer (engine) according to values of instant consumption rate (see 1.6.5).

- column **Differential**

  - differential fuel consumption rate of fuel passing through the both chambers of the meter;
  - working mode of the fuel consumer (engine) according to values of instant consumption rate (see 1.6.5).

3) Counters table displays the following real-time counter values:

- **Fuel consumption, L** — total fuel consumption in all engine operation modes including “Idling mode”.
- **Fuel consumption (Idle), L** — fuel consumption in “Idling mode” of engine operation.
- **Fuel consumption (Optimal), L** — fuel consumption in “Optimal mode” of engine operation.
- **Fuel consumption (Overload), L** — fuel consumption in “Overload mode” of engine operation.
- **Fuel consumption (Cheat), L** — fuel consumption volume that exceeded the upper capacity limit of the installed flow meter model. Increase of this counter value indicates incorrect installation of the meter or possible drain of fuel (theft).
- **Fuel consumption (Negative), L** — fuel consumption volume during the periods when return fuel flow is higher than supplied fuel flow. This counter is available for DFM D232/D485/DCAN.

  Increase of this counter value indicates excessive foam in the return line at high engine RPM. This happens because of air presence in return fuel line caused by depressurization (air leakage) in vehicle fuel system.
- **Flowmeter Time Counter, hours** — total engine operation time in all operation modes including “Idling mode”.
- **Flowmeter Time Counter (Idle), hours** — engine working time in “Idling mode”;
- **Flowmeter Time Counter (Optimal), hours** — engine working time in “Optimal mode”.
- **Flowmeter Time Counter (Overload), hours** — engine working time in “Overload mode”.
- **Flowmeter Time Counter (Cheat), hours** — time during which there been an excess of the upper capacity limit of the installed flow meter model.
- **Flowmeter Time Counter (Negative), hours** — time during the periods when return fuel flow is higher than supplied fuel flow. This counter is available for DFM D232/D485/DCAN.
- **Flowmeter Time Counter (Interference), hours** — total time of external factors affect the normal work of the flow meter.

  Increase of this counter value may indicate a flow meter installed near a source of strong magnetic field or deliberate attempts to block the flow meter.

4) Configurable fields of **The boundaries of modes** area set the flow rate (actual consumption rate) values for different engine operation modes (see 1.6.5). Split of data according to operational modes allows taking into account the actual engine wear and maintenance savings without fear of sudden breakdown.

- for single-chamber meters (DFM A232/A485/ACAN/C232/C485/CCAN) only **Idle mode** and **Optimal mode** are editable. Factory setting for **Overload mode** is not availble.
- for differential meters (DFM D232/D485/DCAN) all boundaries of differential consumption are editable. Separate factory settings of spply and return chamber mode boundaries are not configurable.

5) Lower part of **FM Flowmeter** window displays Calibration Table. values of this table are individual for each meter and are set by the manufacturer during calibration process. Cannot be edited by the user.

3.7.10 Flow meter settings-FM Voltage Supply Monitoring

FM Voltage Supply Monitoring (see Figure 82) window displays actual voltage of vehicle on-board power supply network, ignition key state, Ignition ON Time counter.

In the fields of **Battery Voltage Mode Borders** area upper and lower levels of DFM power supply range is set. If vehicle supply voltage gets out of the range during DFM operation, meter will automatically register it in the event list (see 3.7.13).

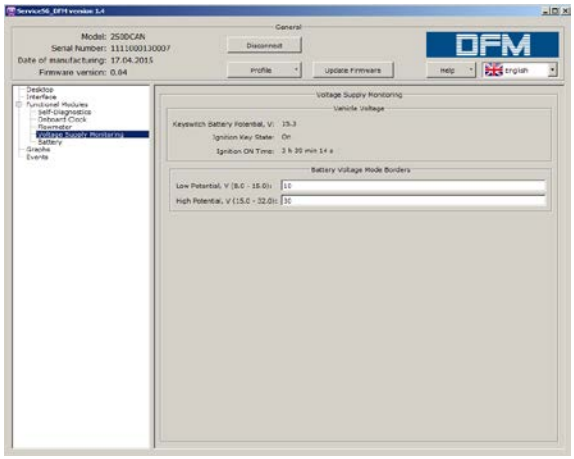


Figure 82 — FM Voltage Supply Monitoring window

3.7.11 Flow meter settings-FM Battery

FM Battery (see Figure 83) displays actual parameter values of DFM built-in battery.

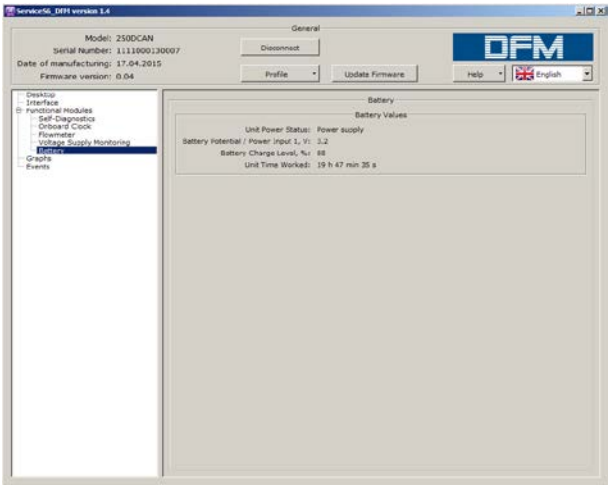


Figure 83 — FM Battery window

Battery Values area displays Unit power status, battery voltage and charge level and a counter of DFM working time when supplied from battery.

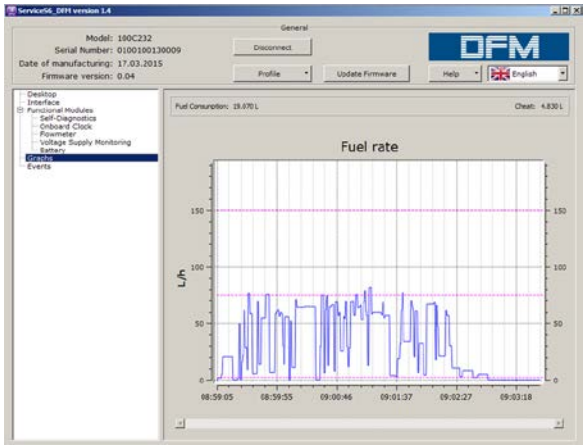
Note — Service S6 DFM connection with DFM is only possible when meter is supplied from the external power supply (vehicle on-board network or stationary power supply unit). That is why Unit Power Status will be always displayed as On-board.

3.7.12 Graphs

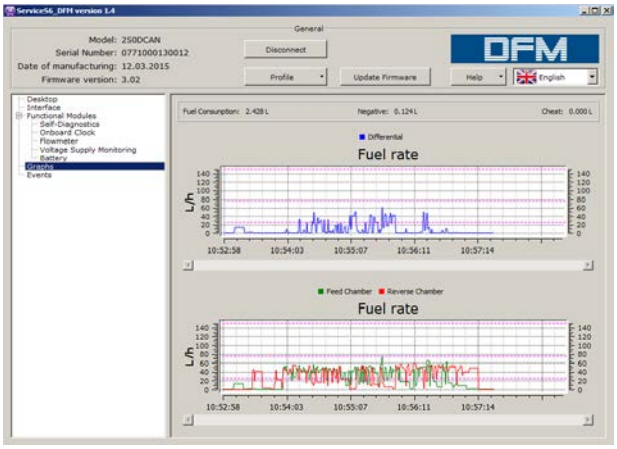
Graphs window displays real-time data (see Figure 84):

- for single-chamber meters (DFM A232/A485/ACAN/C232/C485/CCAN):
  - actual values of **Fuel Consumption** and **Cheat** counters (see 3.7.9, Counters table of FM Flowmeter window);
  - graph of instant fuel consumption rate (blue).
- for differential meters (DFM D232/D485/DCAN):
  - actual values of **Fuel Consumption**, **Negative** and **Cheat** (see 3.7.9, Counters table of FM Flowmeter window);
  - graph of instant fuel flow rate passing through supply measuring chamber (green line) and return chamber (red line) of the flow meter. Graph of difference between the flow (differential consumption) is displayed as well (blue line).

Note — Horizontal pink dotted lines on the graphs represent configured boundaries of fuel consumer operation modes (see 3.7.9, The boundaries of modes area of FM Flowmeter window).



a) for single-chamber meters (DFM A232/A485/ACAN/C232/C485/CCAN)



b) for differential meters (DFM D232/D485/DCAN)

Figure 84 — Graphs window

3.7.13 Events

Upper area of **Events** window displays a list of the latest **Important Events** and lower area displays a list of **Information Events** registered by DFM and saved in its internal memory (see Figure 85a).

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 info (if there 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.



a) events list *b) deleting event*

Figure 85 — Events window

1) Important Events:

- 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:

- ignition switched ON;
- ignition switched OFF.

Events can be deleted with a drop-down list option (see Figure 85b). It is possible to delete all the events or only important/information events. Select required event list and press Clear to delete. No events message will be displayed after that.

3.7.14 Firmware update

Update Firmware button of **Horizontal menu** is used for firmware update of the connected flow meter.

To update the Update Firmware firmware of the flow meter follow the instructions:

1) Click button.

2) Select firmware file **(*.blf3)** from the hard drive or removable disk (see Figure 86).

3) Click Open button to start the update process.

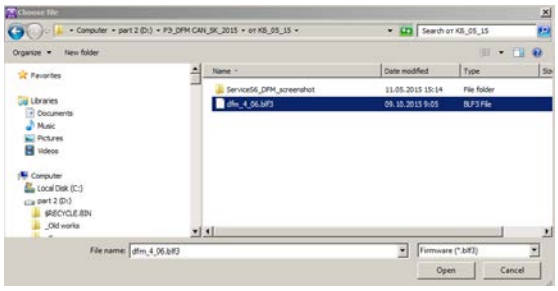


Figure 86 — Firmware file opening

Service S6 DFM will firstly check the firmware file for integrity and compatibility with the flow meter model and then uploading progress window will appear (see Figure 87). If there any error notification window will appear (see Figure 88).

Click Abort button to cancel firmware update.

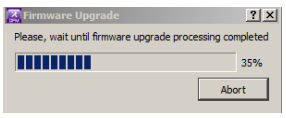


Figure 87 — Firmware file uploading to DFM

ATTENTION: Before the end of the update process and automatic Service S6 DFM restart it is **ABSOLUTELY FORBIDDEN** to:

1) Disconnect DFM from the adapter.

2) Disconnect the adapter from the PC.

3) Power down the PC.

4) Run any resource-intensive applications on the PC.

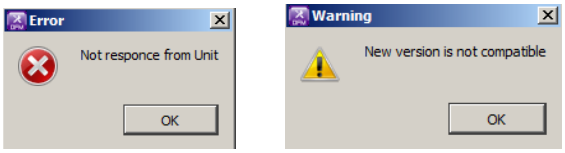


Figure 88 — Error notifications

As soon as the firmware update is succesfully finished a corresponding notification window will appear (see Figure 89) and Service S6 DFM will automatically break the connection of DFM and PC.

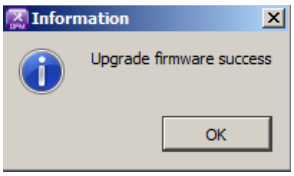


Figure 89 — Notification on successful DFM firmware update

DFM is ready for further operation. Next time the connection is established the new firmware version will be displayed.

Restart the update process if the firmware update process has not been completed correctly causing failure of the current firmware. Built-in bootloader will be activated and DFM operation will be restored. If this update attempt also fails it is recommended to contact Technoton technical support team at support@technoton.by.

3.7.15 Multi-language interface building

User interface of Service S6 DFM software includes English and Russian languages by default. However, user has an option of self-made translation addition.
Service S6 DFM installation folder contains **Language** folder with **ServiceS6_DFM_xx.qm** files of interface languages. Where **xx** stands for language code according to ISO 639 (e.g. **en** for English, **ru** for Russian, **be** for Belarusian, de for German, etc.). ServiceS6_DFM_v_X_X_Setup.exe (X_X stands for version) installation file includes two language files by default (English and Russian).

Service S6 DFM scans Language folder for language files during each launch. Since language files are found the list of supported interface languages is generated. Language names are displayed in English.
List of languages is displayed at the right area of **Horizontal menu** (see Figure 64). If no language files found English is set automatically. If the language is changed by the user the setting is recorded into **ServiceS6_DFM.ini** configuration file. The utility will start with the latest selected language any following launch.

Language folder contains **ServiceS6_DFM.ts** XML-file which contains a list of initial terms in English.

Qt Linguist utility is used for a creation of new translations (download link http://qt-apps.org/content/show.php/Qt+Linguist+Download?content=89360).
When **ServiceS6_DFM.ts** file is opened with the utility the user is prompted to select the initial and required translation languages (see Figure 90).

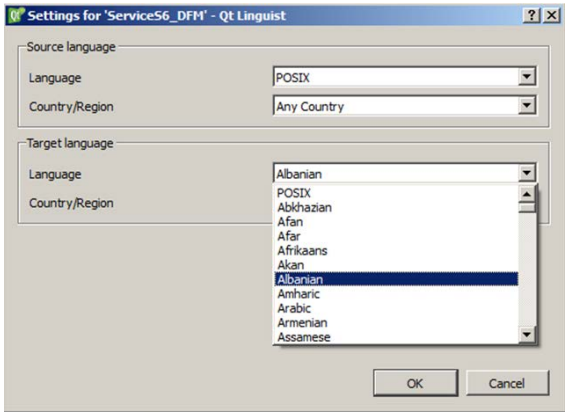


Figure 90 — Qt Linguist language selection

Qt Linguist processes **ServiceS6_DFM.ts** file and creates a list of terms and phrases for translation. Figure 91 displays utility window with **ServiceS6_DFM.ts** opened.

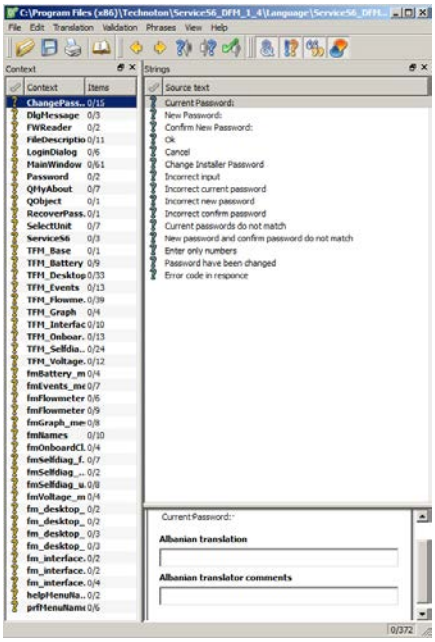


Figure 91 —Qt Linguist window

Qt Linguist main window is divided into three separate floating size windows. Initially all the terms and phrases that require translation are marked with a question mark ( ). When the line from the left **Context** window is selected, right **Source text** window will display a list of corresponding phrases for translation. User should insert own translation into the field in the bottom of the window (See Figure 91, 92). Mind punctuation when working with the utility. Click button to confirm a translation or use Ctrl+Enter shortcut. Repeat the process with all the lines until they get marked with (green) or (yellow).

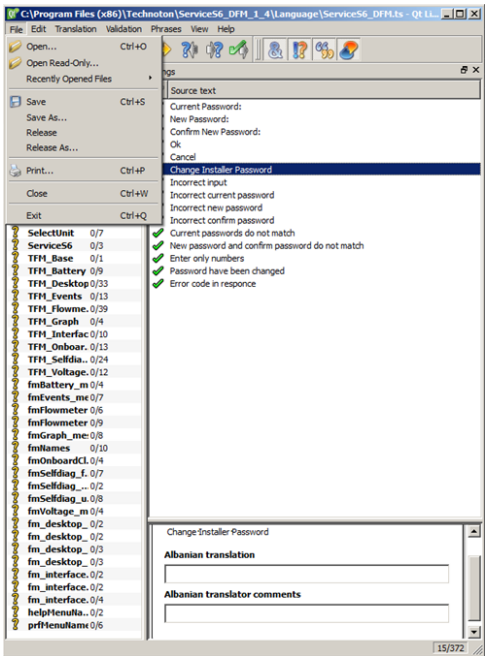


Figure 92 — Qt Linguist window with a fully confirmed translation

When the translation is finished select menu **File → Save As…** of **Qt Linguist** utility to save the result. For a correct recognition of language translation use **ServiceS6_DFM_xx.ts** filename format. Where **xx** stands for language code according to ISO 639. You can check language code viewing language field of saved **ts**-file.
When the translation is finished **ts**-file should be converted to **qm**-file. Select menu **File → Release as…**. Filename will be the same as saved **ts**-file has but with ***.qm** extensions.
Copy compiled **qm**-file into **Language** folder of Service S6 DFM. After restart the new language will be available in the language selection list.

3.7.16 Utility shutdown and DFM disconnection

When configuration is made follow the instructions to disconnect the flow meter:

1) Save the results of the work (see 3.7.4).
2) Shutdown Service S6 DFM utility clicking  at the top of the window.
3) Disconnect CAN service cable from the meter's interface cable connector

SK DFM can now be used for the next meter connection.

3.8 SK DFM disconnection

When work is done follow the instructions to disconnect SK DFM form the PC:

1) Disconnect USB A-B cable from USB port of the PC.
2) Disconnect USB A-B B cable from USB port of the adapter.
3) Disconnect DUT-E service cable from RS-232/ISO 9141/RS-485 port of the adapter.

3.9 Uninstalling service software

To uninstall Service DFM utility follow the instructions:

1) Select menu of Windows:
   Start → All Programs → Service DFM vX.X (for Service DFM)
   Start → All Programs → ServiceS6_DFM_X_X (for Service S6 DFM).
2) Run 

Uninstall shortcut in the selected folder.
3) Follow the instructions of the uninstallation wizard.

All the files related to utility will be deleted from the PC when the uninstallation process finishes.

4 Measurement accuracy check

To determine measurements accuracy of DFM flow fuel meter mounted on the vehicle it is required to carry out a test.

4.1 Test conditions

Representatives of the parties should attend the test.

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

Tests are conducted on properly operating (fault-free) vehicles.

Conditions of the test:

1) Engine run time - not less than 1 hour.
2) The engine must run at medium speed (RPM).
3) Engine shutdown is not allowed during the test.
4) Only verified measurement containers can be used to determine the amount of the fuel. The containers must be clean.
5) Fuel must not contain any mud or other impurities.

4.2 Preparation for 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.

4.3 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 93).

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 return Fuel line 2 in to Tank 1.

6) Disconnect the injectors return 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 return 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 return 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 return line** ($V_{inj.return}$).

22) Determine the **proportion of the return 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.

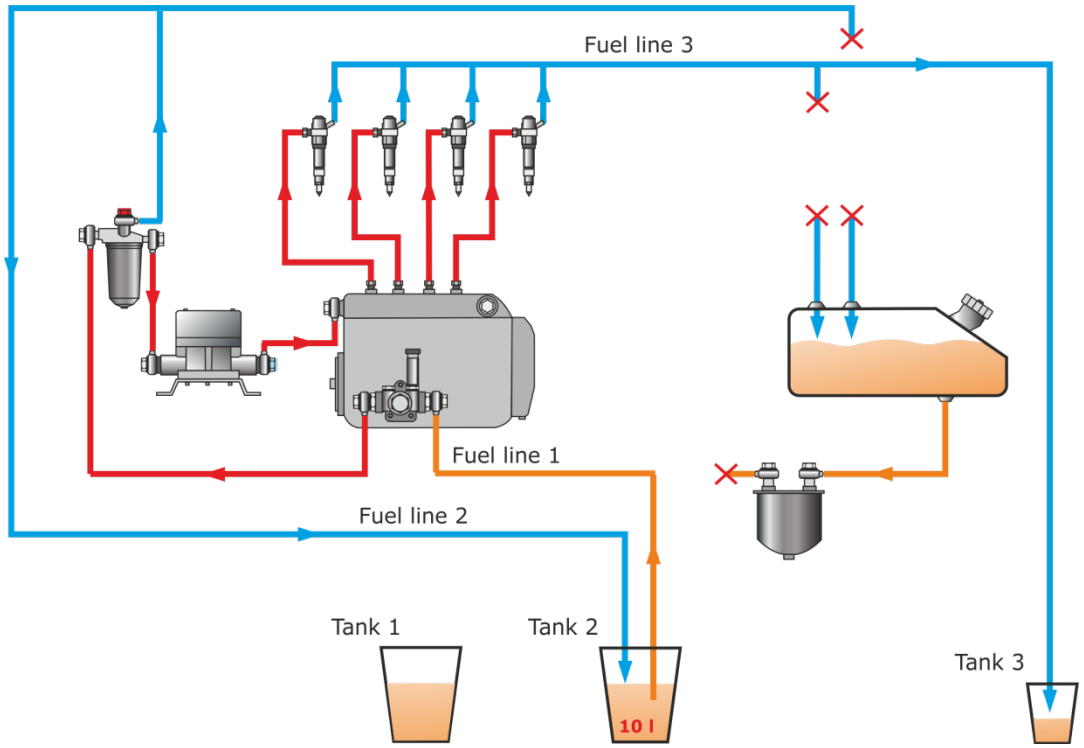


Figure 93 — Fuel system scheme during test

5 Accessories

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

5.1 Mounting kits

DFM mounting kits (hereinafter MK DFM) are designed to connect fuel flow meters to the engine fuel system using fuel pipes with diameters of 8 mm and 10 mm.

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!**

Selection of proper MK DFM is made according to Table 19.

Table 19 — MK DFM application

Kit name	Application
DFM MK20	Universal, to install single-chamber flow meters using Ø 8 mm pipe
DFM MK40	Universal, to install single-chamber flow meters using Ø 10 mm pipe
DFM MK45	Universal, to install DFM 500 single-chamber flow meters using Ø 10 mm pipe
DFM MK90	To install single-chamber flow meters on D243, D245 and D260 engines using Ø 8 mm pipe
DFM MK100	To install single-chamber flow meters on YaMZ, KAMAZ engines using Ø 8 mm pipe
DFM MK DIFF10	To install differential fuel flow meters DFM 100D and DFM 250D using Ø 10 mm pipes
DFM MK DIFF20	To install DFM 500D differential fuel flow meters using Ø 10 mm 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 single-chamber flow meters depending on an installation scheme and engine features of a vehicle.

Table 20 — MK DFM components

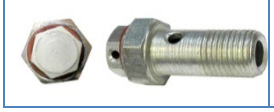
View	Component name	Description	Kit name						
			DFM MK20	DFM MK40	DFM MK45	DFM MK90	DFM MK100	DFM MK DIFF10	DFM MK DIFF20
1	2	3	4	5	6	7	8	9	10
	Banjo bolt BB 14	To couple the fuel line and the flow meter to the units of the fuel supply system of the engine (high pressure fuel pump or fine fuel filter)	3	3	2	2	3	6	4
	Banjo bolt BB 16		-	-	1	-	-	-	2
	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 ø 8mm fuel pipe to mounting elements	8	-	-	6	4	-	-
	Banjo fitting BF 14/10	For connection of ø 10mm 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

Table 20 continued

1	2	3	4	5	6	7	8	9	10
	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 return line	1	1	1	1	1	-	-
	Nipple adapter NA 14-4	To connect the fuel line with a return fuel line through the bypass valve	1	1	-	1	-	-	-
	Nipple adapter NA 14-20	To reverse the return fuel line from the fine filter via the bypass valve	1	1	1	-	1	-	-
	Nipple adapter NA 10-14	To connect the fuel line and heater tube	1	1	1	-	-	-	-
	Nipple adapter double NA 10-14/2	For joining two fuel lines with heater line	1	1	1	1	-	-	-
	Nipple adapter double NA 10-16/2	For joining two fuel lines with heater line	1	1	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 ø 8 mm fuel hose onto the banjo fitting or filter	8	-	-	6	4	-	-

Table 20 continued

1	2	3	4	5	6	7	8	9	10
	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.

5.2 Connecting cables

Connecting cables are used for electrical connection of DFM meters. See Table 21.

Table 21 — DFM connecting cables

View	Name (order code)	Purpose and description
	Cable 076-01 (sensors cable)	Designed to connect a flow meter to recording and display devices and to external power supply 7 meters long. Supplied with all fuel flow meters with pulse output.
	Cable 084 (076-01 cable extender)	Designed to increase the length of 076-01 cable. 3 meters long. Not included into delivery set.
	S6 SC-CW-700 (signal cable)	Designed to connect DFM CAN to recording and display devices and to external power supply. 7 meters long. Not included into delivery set.
	SC-CW-700-RS (signal cable)	Designed to connect DFM 232/485 to recording and display devices and to external power supply. 7 meters long. Not included into delivery set.

5.3 DFM i fuel consumption indicator

5.3.1 Application and features

DFM i fuel consumption indicator (see Figure 94) is designed for recording and displaying data on fuel consumption and engine working time.



Figure 94 — DFM i fuel consumption indicator

DFM i can be used in combination with fuel flow meters designed by Technoton (e.g. **DFM AP, DFM AK, DFM D**) or third-party flow meters with pulse output (see 5.3.5). DFM i can be mounted inside the driver's cabin or any other place of the vehicle which is convenient for visual data reading. DFM i is used when data reading from the flow meter itself is limited or impossible.

DFM i features:

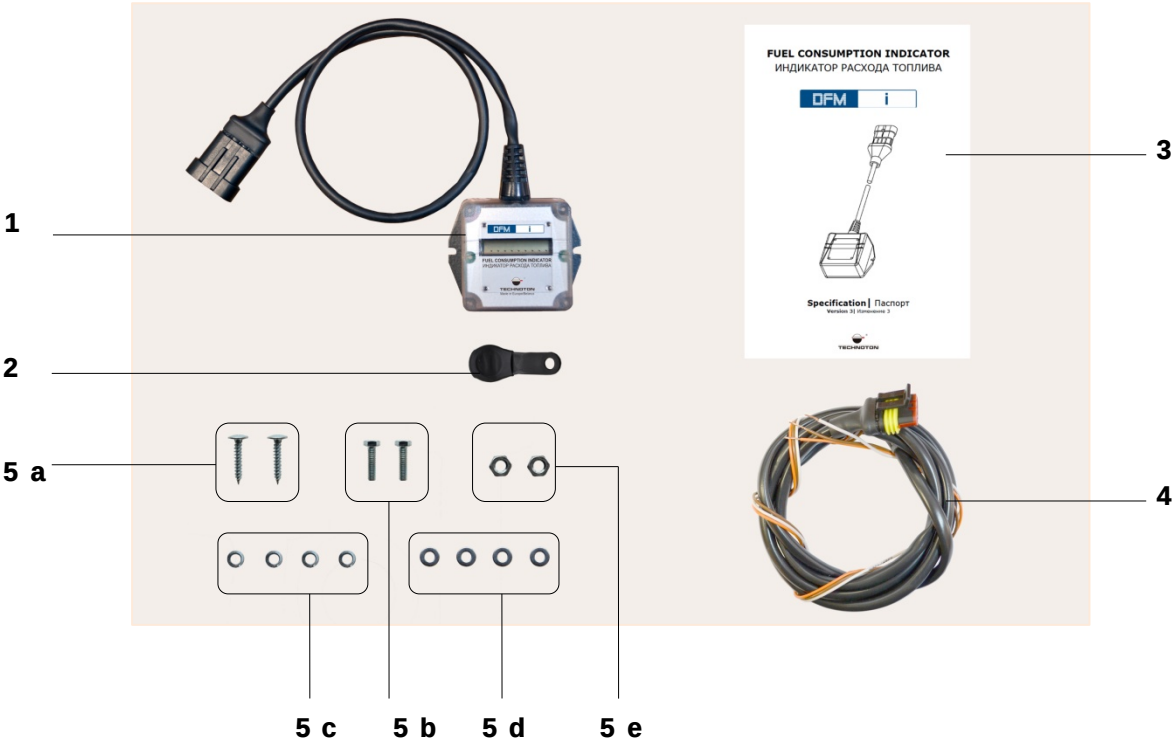
- **light and compact design;**
- **stand-alone power supply from the built-in battery*;**
- **compatibility with flow meters of various manufacturers;**
- **recording total fuel consumption;**
- **recording engine operation time (total and in various mode);**
- **convenient viewing of parameter values in the driver's cabin;**
- **protection from tampering;**
- **contactless switching of data display modes;**
- **affordable cost.**

DFM i can be used in automobiles, tractors, stationary engines and other units operated in temperate and cold climates.

***** DFM i with firmware version 3.0 and higher can be powered from the external power supply as well.

5.3.2 DFM i Exterior view and delivery set

DFM i delivery set includes (see Figure 95):



1	DFM i fuel consumption indicator *****	– 1 pc.;
2	iButton key	– 1 pc.;
3	Specification	– 1 pc.;
4	Signal cable (2 m)	– 1 pc.;
5	Mounting kit 1 pc. including:	
	a) self-tapping screw 4.2x25	– 2 pcs.;
	b) screw M4x16	– 2 pcs.;
	c) lockwasher 4	– 4 pcs.;
	d) washer 4	– 4 pcs.;
	e) nut M4	– 2 pcs.

Figure 95 — DFM i delivery set

* Cable of DFM i units with firmware version lower than 3.0 does not have connector.

5.3.3 General specifications

See Table 22 for DFM i general technical specifications.

Table 22 — DFM i general specifications

Parameter	Value
Power supply mode	see 5.3.6
Impedance of the measuring input	not less than 50 kOhm
Operation temperature range	from -20 to +60 °C
Weight	not more than 0.3 kg

See Figure 96 for DFM i overall and mounting dimensions.

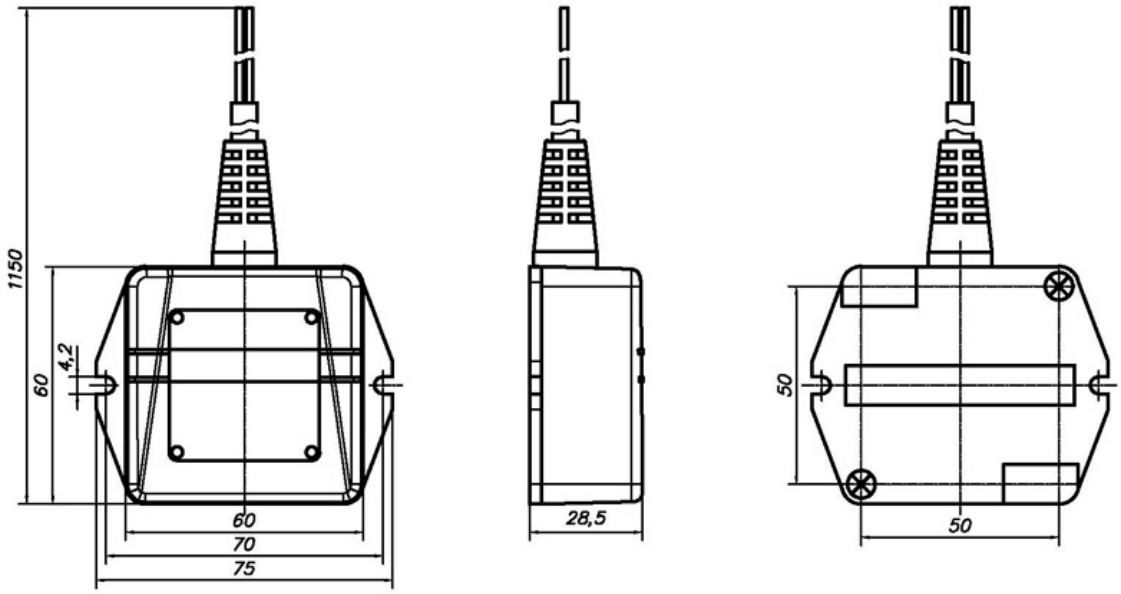


Figure 96 — DFM i overall and mounting dimensions

5.3.4 Modifications

See Table 23 for specifications of DFM i models.

Table 23 — Specifications of DFM i models

Model	Lower limit of the flow rate range, l/h	Upper limit of the flow rate range, l/h
DFM i	0.5	1000
DFM i5	1	100
DFM i12.5	5	250
DFM i20	10	500

5.3.5 Input signal specifications

DFM i can operate with fuel flow meters which have pulse output signal corresponding to the characteristics according to Figure 97 and Table 24.

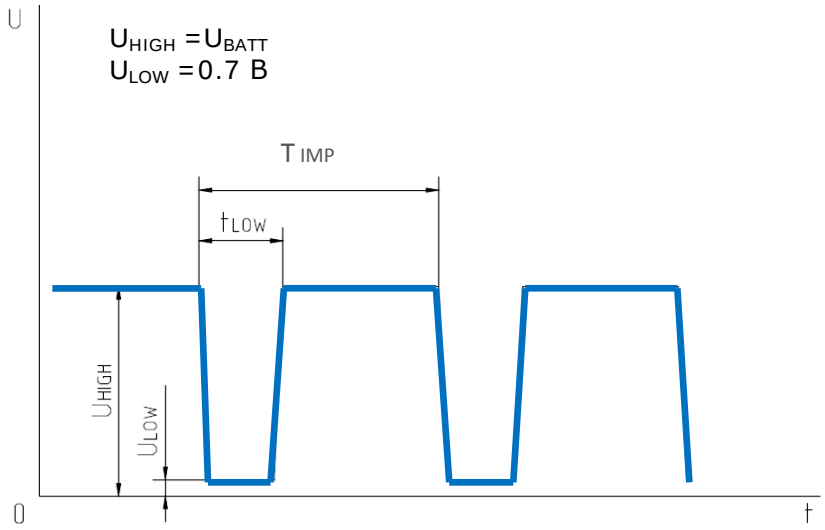


Figure 97 — DFM i input signal specification

Table 2 — DFM i input signal specification

Model	Pulse rate, ml/pulse	T_{IMP}, ms	t_{LOW}, ms
DFM i	Configurable, from 0.1 to 50.0	from 4 to 9000	(0.4...0.6) T_{IMP}
DFM i5	5	from 180 to 9000	
DFM i12.5	12.5		
DFM i20	20	from 180 to 2400	

5.3.6 Power supply modes

DFM i operates in a combined power supply mode. *
DFM operates autonomously being powered from the built-in lithium-silicon battery (3.6V). It can be powered from vehicle power supply if connected to vehicle onboard power supply network (4…50V). DFM i will automatically switch into stand-alone power supply mode if the voltage of the vehicle supply system is less than 4V.
Estimated DFM operation time until full battery discharge is not less than 24 months.

* Only for DFM i version 3.0 and higher.
DFM i with firmware version lower than 3.0 operate only in stand-alone mode.

5.3.7 Recording engine operation mode

Depending on the instant consumption value DFM i determines the following engine operation modes (see Table 25):

- **Idle** – operating in idling mode;
- **Optimal** – operating at moderate load;
- **Overload** – operating at high and maximum load;
- **Tampering** – fuel consumption is higher than maximum possible rate.

Recording engine operation modes allows to eliminate downtime and unauthorized use of the vehicle, to monitor its economic running mode and provide well-timed maintenance.

Table 25 — Engine operation modes determined by DFM i

<table>
<tr><th colspan="4">Engine operation</th></tr>
<tr><td colspan="3">Normal consumption
$0<Q\leq Q_{max}$</td><td rowspan="2">Tampering
$Q>Q_{max}$</td></tr>
<tr><td>Idle
$0<Q<2.5Q_{min}$</td><td>Optimal
$2.5Q_{min}\leq Q<0.75Q_{max}$</td><td>Overload
$0.75Q_{max}\leq Q\leq Q_{max}$</td></tr>
<tr><td colspan="4">Q — registered instant consumption value;
Q_{min} — lower limit of the flow rate range;
Q_{max} — upper limit of the flow rate range.</td></tr>
</table>

5.3.8 Displayed data

DFM i displays the data on the built-in LCD display. Switching the data screens (see Table 26) is performed by a light touch of the top cover of DFM i with iButton key (see Figure 98).

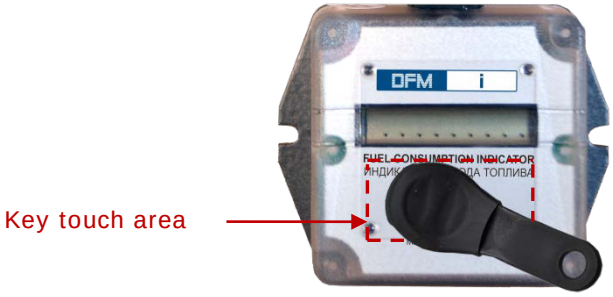


Figure 98 — Switching DFM i data screens

In order to save the charge of the built-in battery DFM i display goes to sleep mode one minute after the last touch of the cover by the iButton. At the same time dots are shown on the display (see Figure 99).



Figure 99 — DFM i display view in sleep mode

The following touch of the key wakes up the display. Data is displayed the following way (see Figure 66):

- Operation information is displayed for 0.5 second – the number of the data screen in the left and measuring units of the parameter or comment in the right;
- Parameter value is displayed for 1.5 seconds.

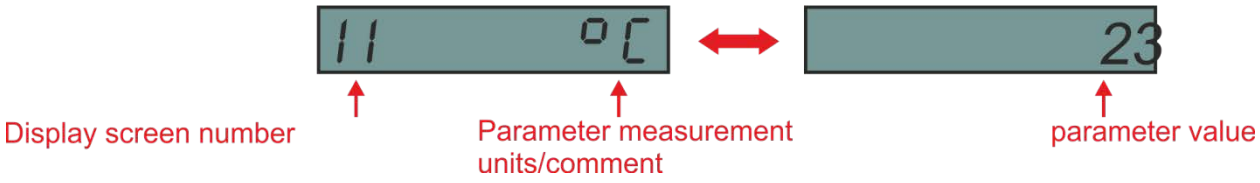


Figure 100 — DFM i data display

Table 26 — DFM i data screens

Screen No	Displayed data	Digit capacity	Units
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
9	Instant Fuel Consumption	0.1	liters/hour
10	Battery Charge in Percentage of the Maximum	10	%
11	Temperature inside the body Instant Fuel Consumption	1	°C
12	Firmware Version (X.X)	X.X	

Screen 1 displays **Total Fuel Consumption** counter value (with 0.1 L step) accumulated since DFM i release.

Screen 2 displays **Total Fuel Consumption counter value with higher digit capacity** (0.001 L), 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 i as a total engine operation time in corresponding modes.

Screen 7 displays the counter readings of **Fuel Consumption In Tampering Mode** accumulated by DFM i measured as the amount of fuel higher than maximum consumption. Increase of this counter value indicates the incorrect installation of the fuel flow meter or possible facts of fuel theft.

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 inside of the indicator body displays current inside temperature of the indicator body.

Screen 12 Firmware Version displays the firmware version of the indicator.

DFM i **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 i 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 i displays dashes being in Tampering Mode (see Figure 101).

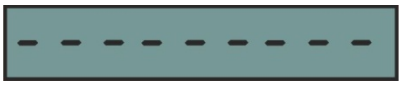


Figure 101 — DFM displays dashes being in Tampering Mode

DFM i will automatically exit Tampering mode in few seconds since the connected flow meter is back to normal operation conditions.

5.3.9 Mounting and connection

It is required to conduct DFM i exterior inspection for the presence of the possible body, cable or connector defects arisen during transportation, storage or careless us.
Contact the supplier if any defects detected.

Choose a dry place, protected from the corrosive effects of the environment for DFM i mounting. DFM i should not be fixed close to heating and cooling elements (for example, the climate control system). It is not recommended to install DFM i close to power electrical circuits. A suitable place to install DFM i is the driver's cab. When installed in the engine compartment is necessary to provide not less than 30 cm distance between the body of DFM i and its cable from rotating parts and surfaces of the engine.

Mounting kit elements are recommended for DFM i installation (see 5.3.2).

DFM i with firmware version 3.0 and higher can operate in both stand-alone and onboard power supply mode (see 5.3.6). Follow the DFM electrical connection instructions when connecting DFM i (see 2.5).

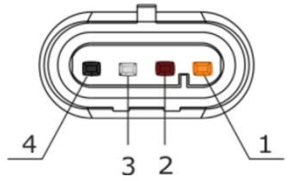
Electrical connection of DFM i with firmware version lower than 3.0 is done according to wire assignment shown in Table 27.

Table 27 — DFM i wire assignment (unit firmware version lower than 3.0)

Wire marking	Wire color		Assignment
T701	White		Flow meter pulse signal (see 5.3.5)
GND	Brown		Ground
* Manufacturer reserves the right to modify wire colors.			

Electrical connection of DFM i with firmware version 3.0 and higher is done according to wire assignment shown in Table 28.

Table 28 — DFM i pinout (unit firmware version 3.0 and higher)

View	Pin number	Wire marking	Wire color		Assignment
	1	VBAT	Orange		Power supply “+”
	2	GND	Brown		Ground
	3	T701	White		Flow meter pulse signal (see 5.3.5)
	4	KLIN	Black		Serial, ISO9141 standard
***** Manufacturer reserves the right to modify wire colors.					

5.4 APU 5 automated test installation

APU 5 automated test installation (see Figure 102) is a stationary reference means of measurement designed for calibration, verification and testing of single-chamber and differential meters in conditions of a service center.

The test installation uses volumetric measurement method and serves for calibration and verification of fuel flow meters made by JV Technoton and other manufacturers in the conditions of a service center



Figure 102 — APU 5 automated test installation

Table 29 — APU 5 technical specifications

Parameter, units of measurement	**Value**
Kinematic viscosity range, mm²/s	from 1.5 to 6.0
Calibration (working) liquid	diesel fuel
Maximum relative error of volume measurement, %	± 0,3
Flow rate range, l/h Range I Range II	 from 1 to 100 from 100 to 500
Flow rate setting maximum error, % Range I Range II	 ±10 ± 5
Number of simultaneously verified fuel flow meters, pcs	single-chamber - 2 differential - 1
Interfaces, pcs.	Pulse input - 2 K-Line - 2 J-tag - 2
Max pressure, MPa	0.5
AC power supply voltage, V frequency, Hz	 220 50
Power consumption, W, not more than	1000
Overall dimensions, mm, not more than	1300x700x2000
Weight, kg, not more than	100

5.5 PPU 1 portable test rig

PPU 1 portable test rig (see Figure 103) is designed to verify DFM fuel flow meters in field conditions.



Figure 103 — PPU 1 portable test rig

Table 30 — PPU 1 technical specifications

Parameter, unit of measurement	**Value**
Working liquid	Diesel fuel
Flow rate range, l/h	From 2 to 80
Number of simultaneously verified flow meters	1
Overall dimensions (without hoses), mm	not more than 250x220x900
Weight, kg	not more than 5.0

5.6 Additional accessories

Additional accessories may be required for DFM mounting and maintenance depending on fuel system configuration and selected mounting scheme (see Table 31).

Table 31 — DFM additional accessories

View	Marking	Name	Application	Note
1	2	3	4	5
	TC 8	T-joint	To join/separate fuel flows	For ø 8 mm pipe
	TC 10			For ø 10 mm pipe
	BV 8	Ball valve	To control flow separation in a semi-differential scheme	For ø 8 mm pipe
	BV 10			For ø 10 mm pipe
	TR 10-2	Double fitting	To join/separate fuel flows and connecting fuel hose to fuel system units	For ø 10 mm pipe
	K5	Flow-dividing valve	To separate fuel flows in semi-differential DFM installation scheme	0.3-0.5 Bar, M14x1.5 thread , with a sealing hole
	KP2	DFM mounting bracket	Additional bracket for fastening DFM to the vehicle	Universal, 150x105 mm, fixed with bolt connection
	KT	iButton key	To read out DFM data from the built-in display	—
	CRYSTAL seal	Plastic seal	Sealing fuel connectors, valves etc. in order to prevent interference into the fuel system	—

Table 31 continued

1	2	3	4	5
	FT 240-1117010	Fine fuel filter	To install as an additional fine fuel filter	Used when meter is mounted according “before pump” scheme
	FUB dn8x3	Fuel hose	To connect fuel system parts	Coil 10 m, for ø 8 mm pipe, (-30...+70) °C
	FUB dn10x3			Coil 8 m, for ø 10 mm pipe, (-30...+70) °C
	GMM-06	Glycerin-filled manometer pressure gauge	To check pressure in fuel line before and after meter installation	With adapter for a ø 10 mm pipe
	PP 201	Instant fuel flow heater	To heat the fuel flowing through the line	12 V, up to 150 l/h, automatic control
	PP 202			24 V, up to 420 l/h, automatic control
	NTP 101	Fuel tank heater	To heat the fuel in the tank	Attachment for the fuel intake, 12 V, up to 420 l/h
	NTP 102			Attachment for the fuel intake, 24 V, up to 420 l/h
	D-19	Spiral wrap hose	For additional protection of cables and fuel lines	PVC coating 50m coil, Ø 19 mm
	CoTube9.8	Split corrugated tubing	Fast assembly plastic tube for DFM cable protection	50m coil, Ø 9.8 mm

5.7 DFM DA 250 deaerator

Air bubbles which come into the fuel supply system from the fuel tank or supply 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 **DFM DA 250 deaerator** (hereinafter deaerator) to eliminate air bubbles and prevent them from getting into the fuel line (see Figure 104).



Figure 104 — DFM DA 250 deaerator

DFM DA 250 features:

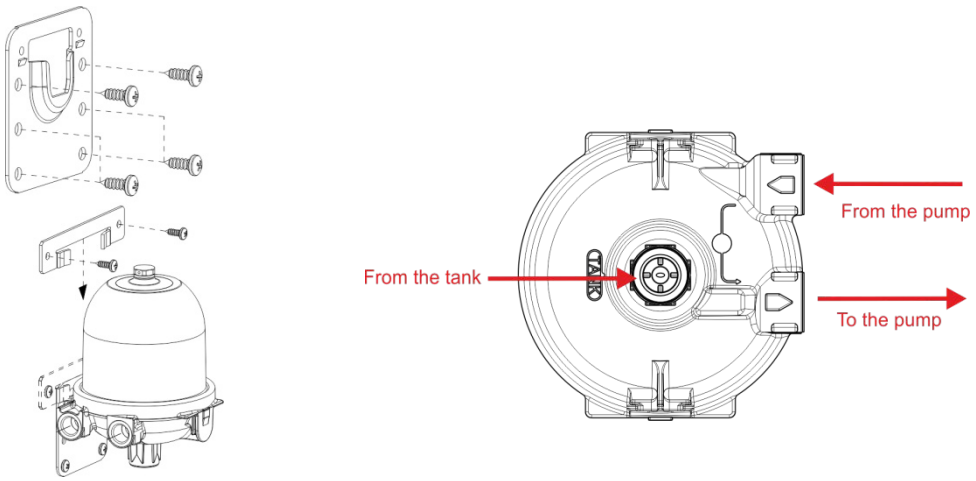
- **increases flow meter accuracy;**
- **decreases engine (boiler) malfunction possibility;**
- **increases service life of the fuel system;**
- **provides an effective and stable combustion of fuel;**
- **improves the environmental parameters of the combustion process and reduces emissions;**
- **mounting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

Table 32 — DFM DA 250 technical specifications

Parameter, units	Value
Fuel types	diesel, biodiesel fuel
Max flow rate, liters/hour	250
Max deaeration capacity, liters/hour	8
Max operating temperature, °C	+85
Min/max operation pressure in the supply fuel line, bar	-0.6/0
Connection to the fuel pump	1/4” female thread
Connection to the tank	1/4” female thread
Overall dimensions, mm	not more than 136 x 95 x 97

IMPORTANT:
1) Deaerator should be installed in the engine compartment of a vehicle or near the burner in the boiler in upright position.
2) The ambient temperature should not exceed 85°C.
3) The space between deaerator and heated and moving parts of the engine or unisolated boiler parts should not be less than 30cm.

Deaerator is mounted using the mounting kit elements according to Figure 105a. Fuel lines are connected according to Figure 105b).



a) fastening *b) fuel lines connection*

Figure 105 —DFM DA 250 mounting

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 mounting scheme, accessories and mounting kit.

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 www.jv-technoton.com

Limited troubleshooting may be self-conducted (see Table 33).

Table 33 — DFM malfunctions which can be self-eliminated

Malfunction	Model	Possible cause	Troubleshooting
No output signal	**DFM AP / AK / CK / D / A232 / C232 / D232 / A485 / C485 / D485 / ACAN / CCAN / DCAN**	Incorrect connection	Check DFM connection to the tracking device/data logger
		Fuel filter clogging	Remove and clean the fuel filter
Fuel does not flow through the meter	**DFM B / C / CK / C232 / C485 / CCAN /**	Fuel filter clogging	Remove and clean the fuel filter
Fuel consumption readings are higher than real consumption rate	**DFM AP / AK / B / C / CK / D / A232 / C232 / D232 / A485 / C485 / D485 / ACAN / CCAN / DCAN**	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.

7 Verification

At product release each DFM flow meter passes departmental metrological verification on metrologically certified automated test rigs.

Verification certificate confirming DFM metrological verification is included into delivery set of each DFM.

8 Maintenance

It is recommended to perform visual inspection and DFM operation check at least once a year.

In order to provide DFM operability, it is recommended to remove and clean the mud filter from time to time (see Figure 106).



Figure 106 — Mud filter

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

9 Packaging

DFM, SK DFM and DFM i delivery sets come in cardboard boxes of the following shape (Figure 107):



a) DFM *b) SK DFM* *c) DFM i*

Figure 107 — Packaging

Label sticker with information on the product name, serial number, hardware version, firmware version, manufacture date, weight and Quality Control seal is stuck on two sides of the DFM packaging box (207x165x90 mm). See Figure 108a.
Label sticker with information on the product name, serial number, hardware version, Service DFM software version, manufacture date, weight and Quality Control seal is stuck on two sides of the SK DFM packaging box (230x160x60 mm). See Figure 108b.
Label sticker with information on the product name, serial number, hardware version, firmware version, manufacture date, weight and Quality Control seal is stuck on two sides of DFM i packaging box (230x160x60 mm). See Figure108.



a) DFM *b) SK DFM* *c) DFM i*

Figure 108 — Packaging labels

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 for DFM from mechanical damage and precipitation.

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

Shipping containers with packed DFM sensors should be sealed.

12 Utilization / re-cycling

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

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

Contacts

Distribution, technical support and service

JV Technoton

Tel/fax: +375 17 223-78-20

marketing@technoton.by

support@technoton.by

Manufacturer

Zavod Flometr

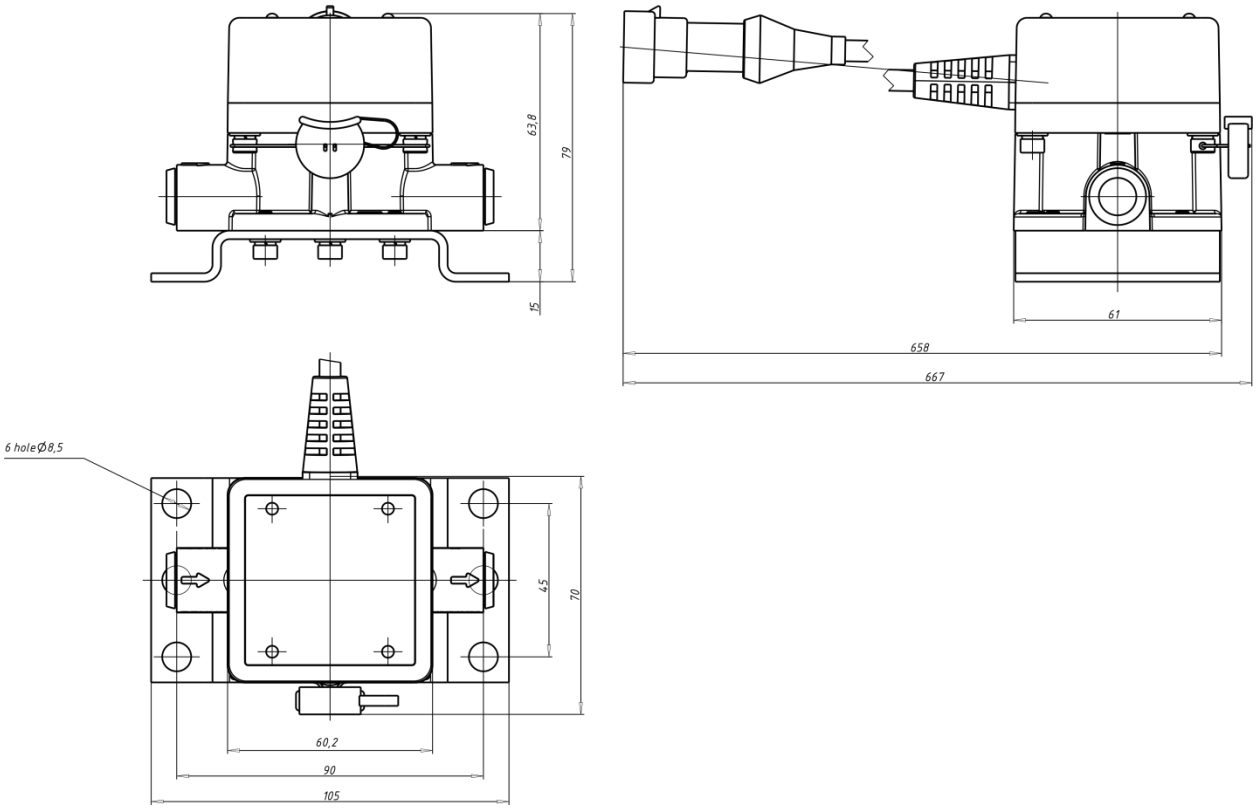
Tel/fax: +375 1771 3-99-89

office@flowmeter.by

Annex A

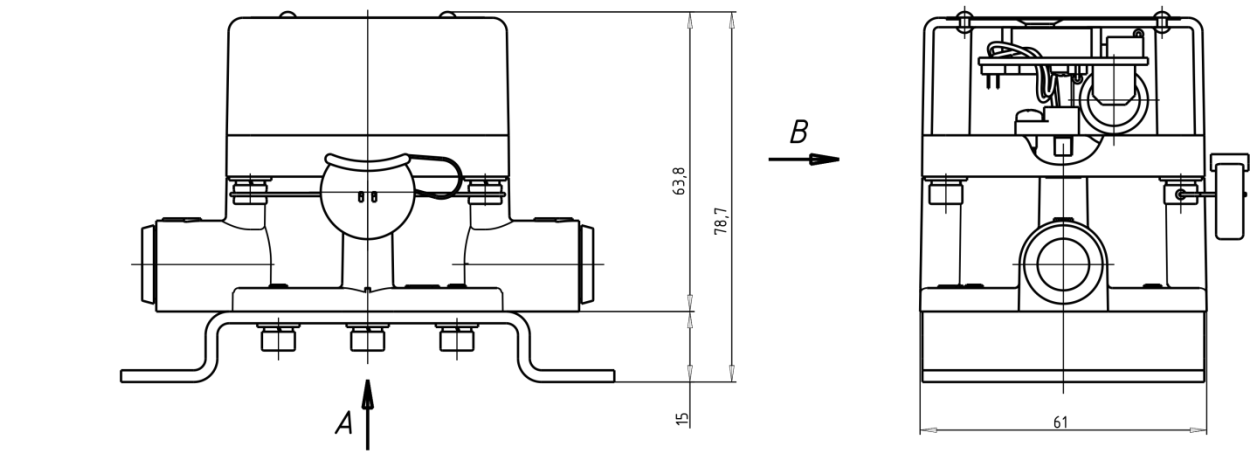
Overall dimensions and weight

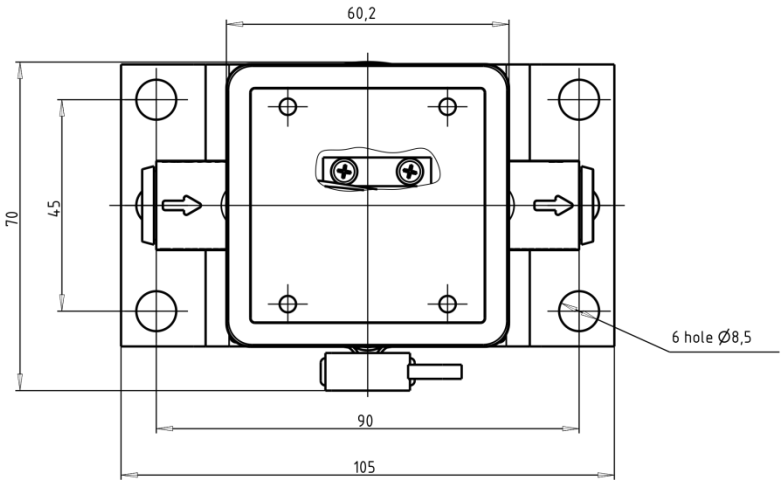
DFM 50(100)B(C)DFM 50(100)B(C)M 50(100)AK(CK), 90AP



Annex A continued

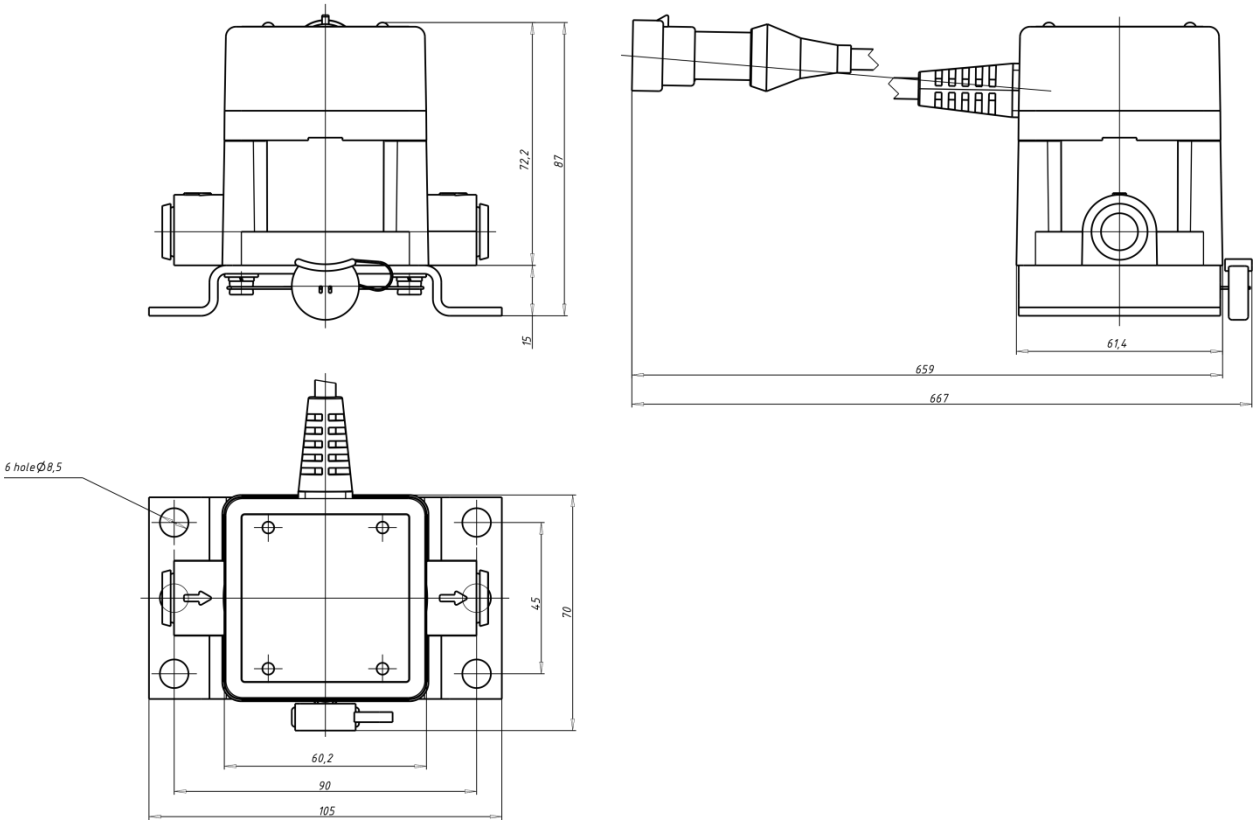
DFM 50(100)B(C)





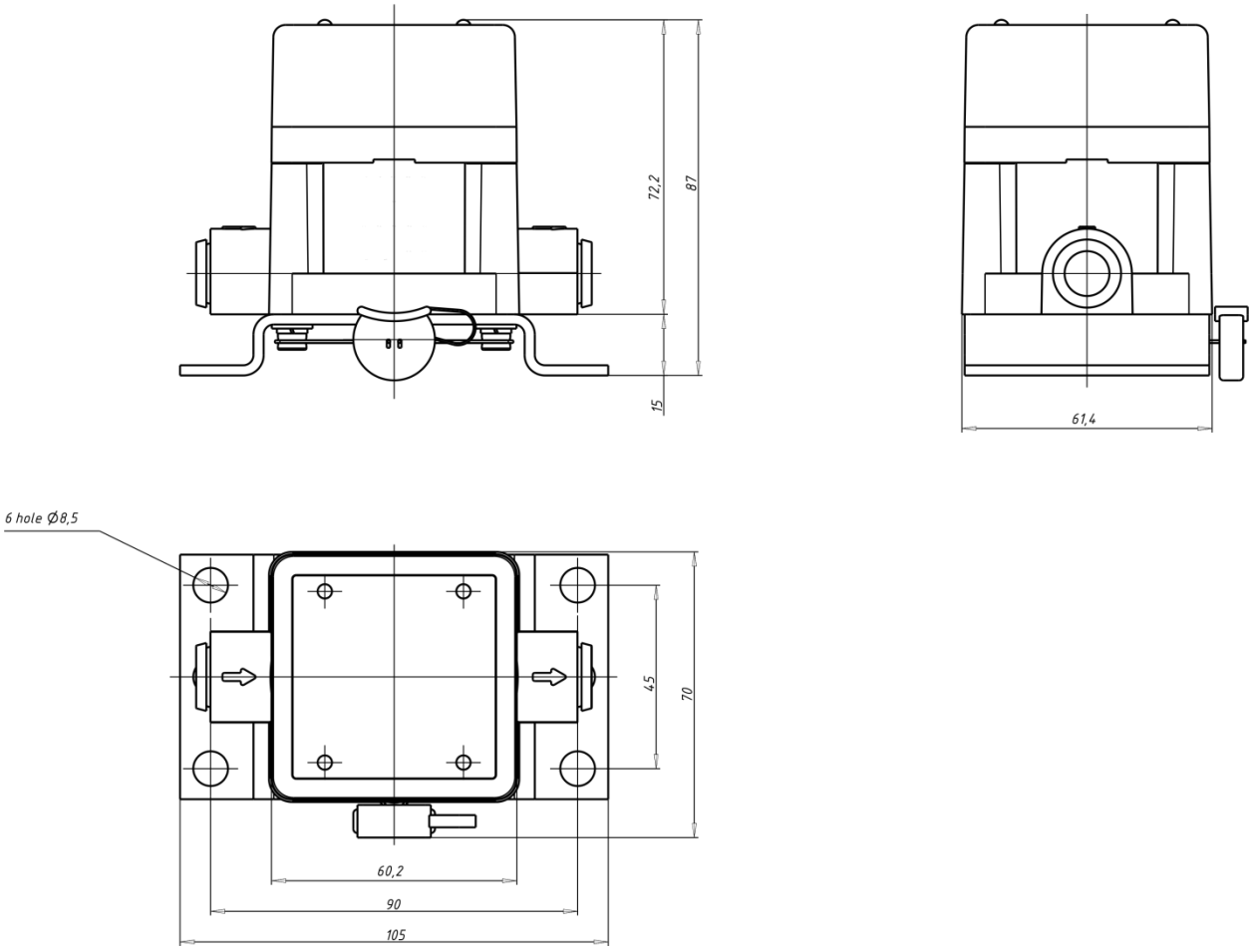
Annex A continued

DFM 250AK(CK), 220AP



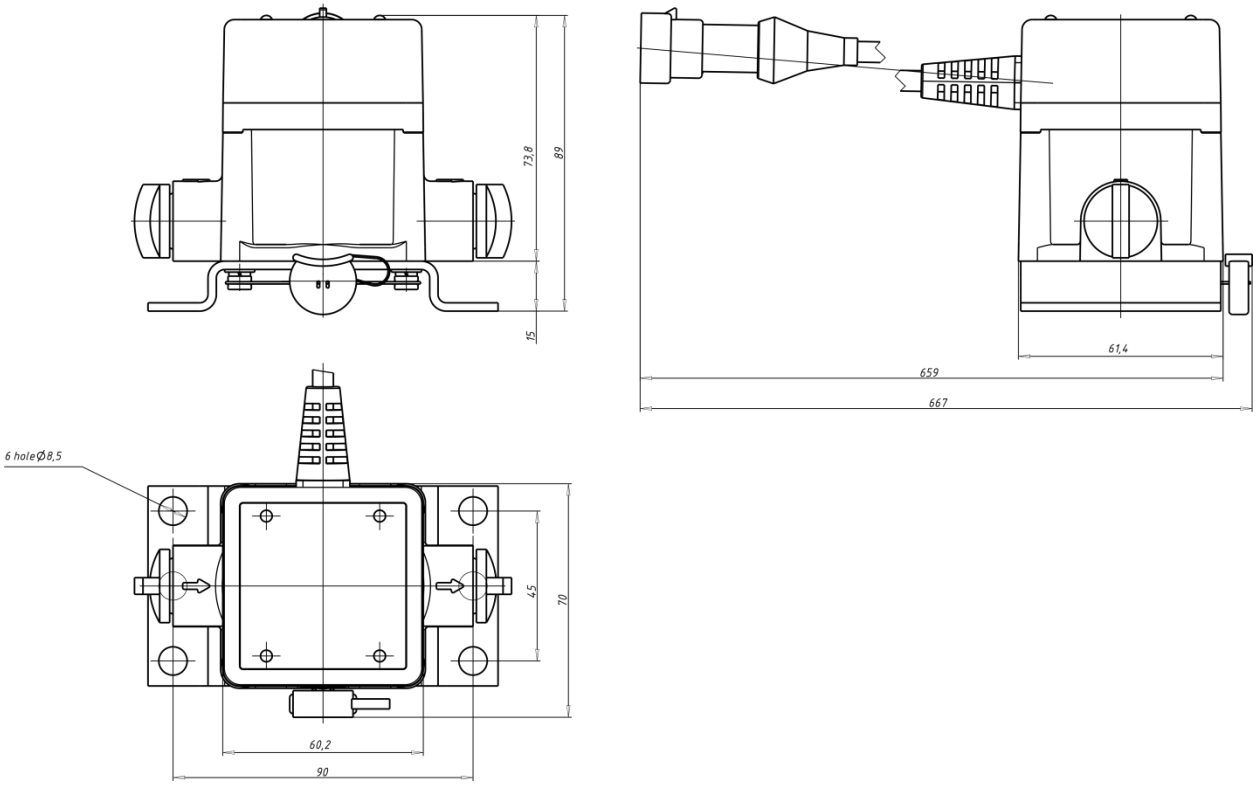
Annex A continued

DFM 250B(C)



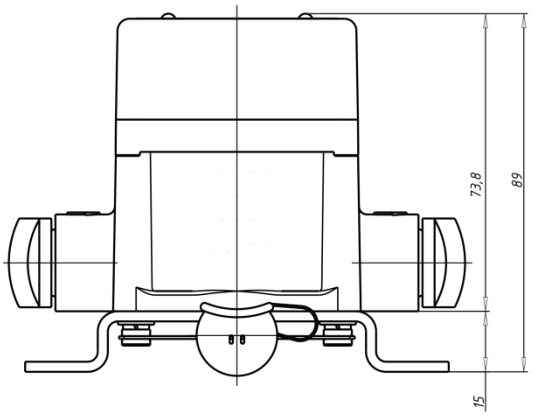
Annex A continued

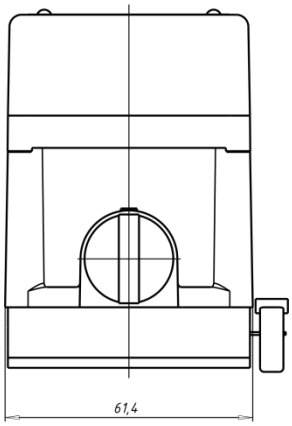
DFM 500AK(CK)

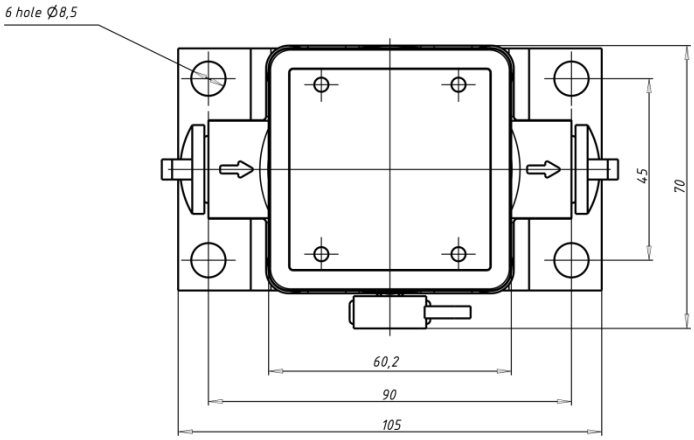


Annex A continued

DFM 500B(C)

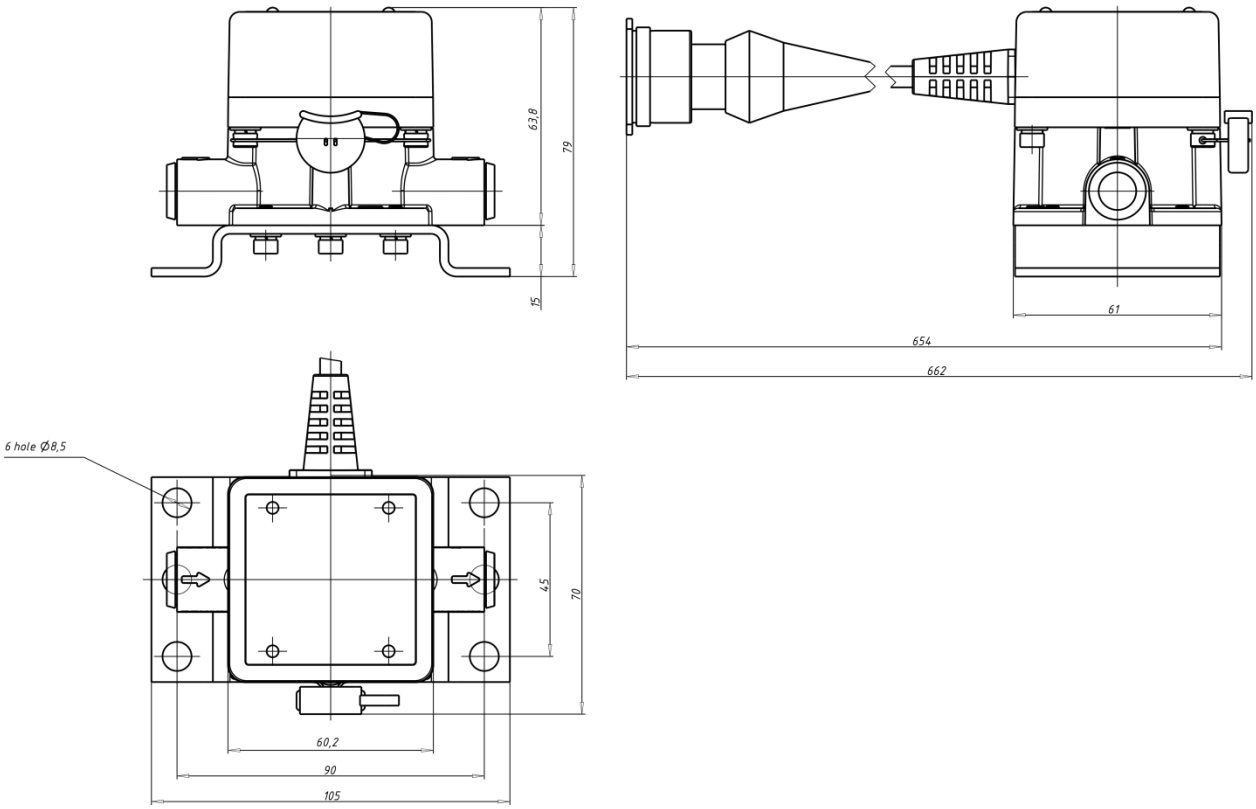






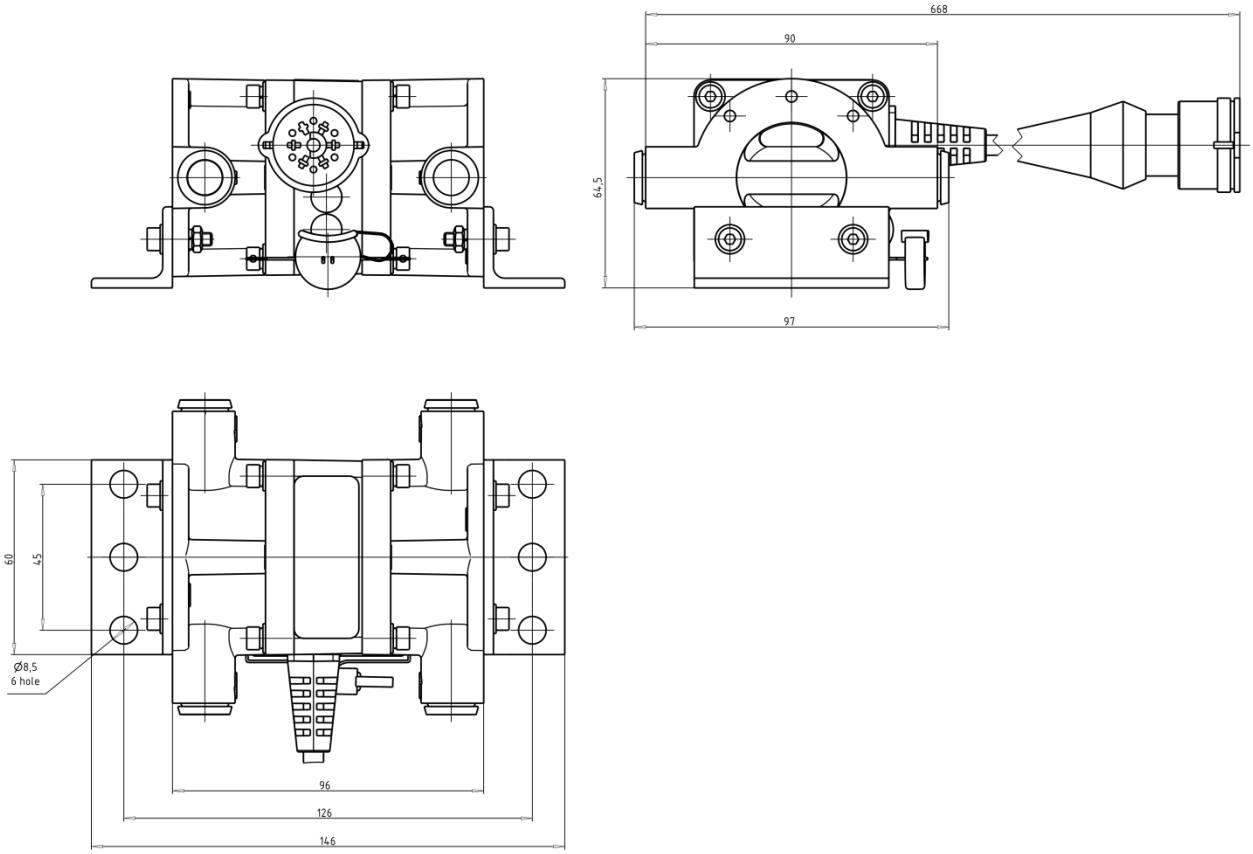
Annex A continued

DFM 50(100)A(C)232(485)CAN



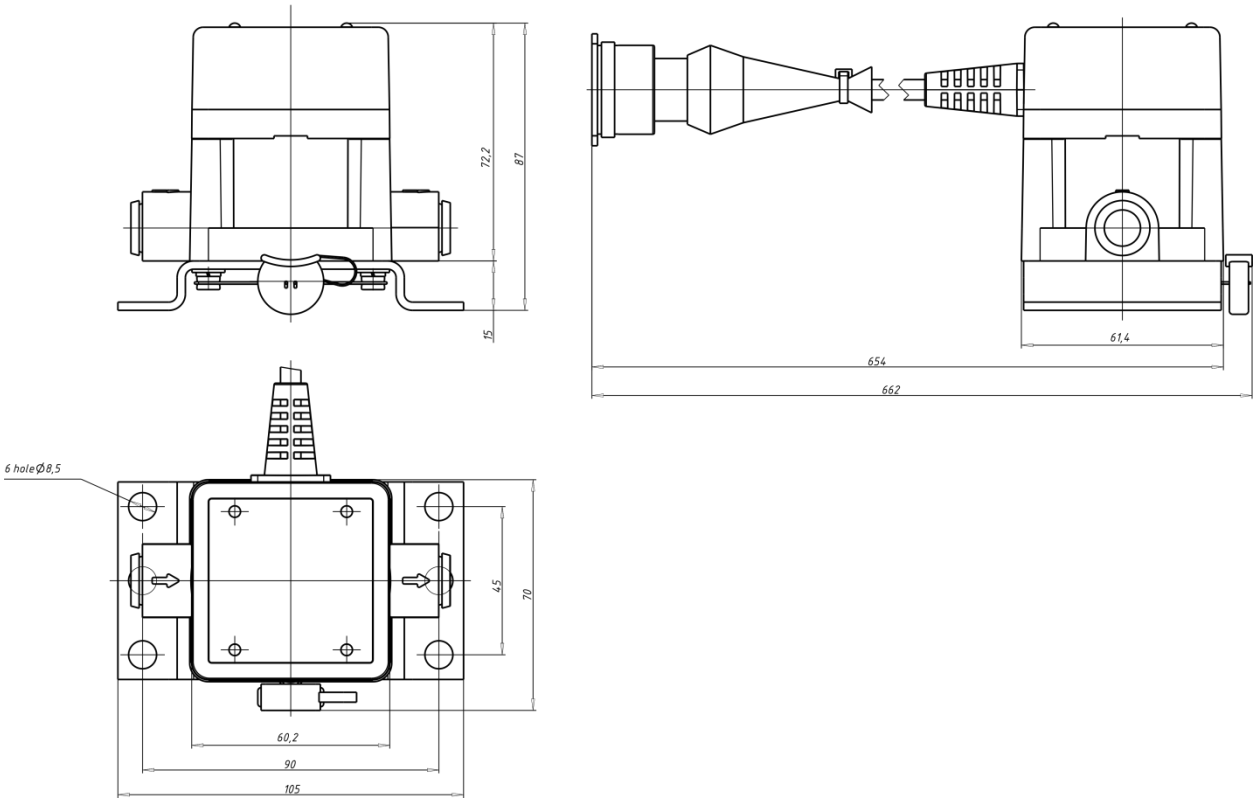
Annex A continued

DFM 100D232(485)CAN



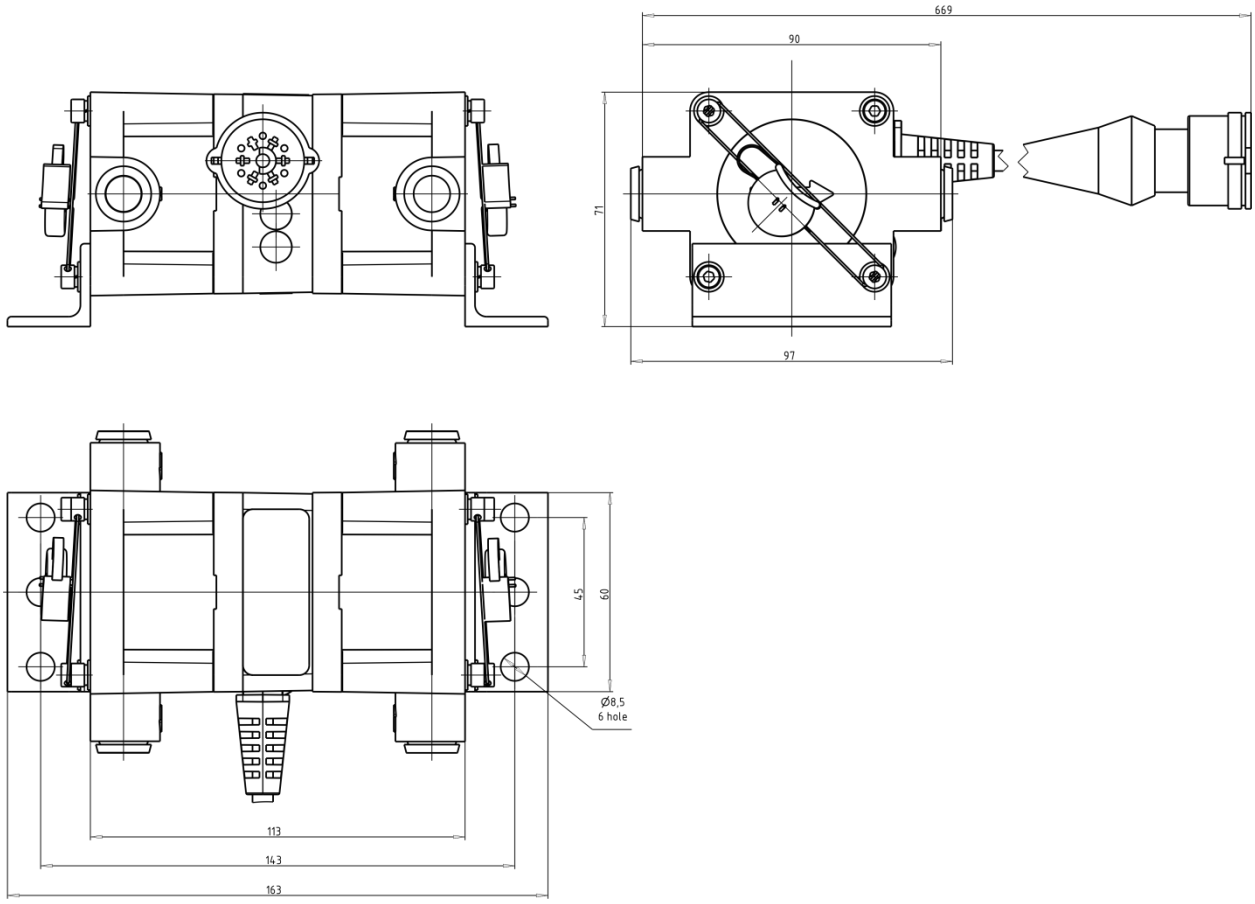
Annex A continued

DFM 250A(C)232(485)CAN



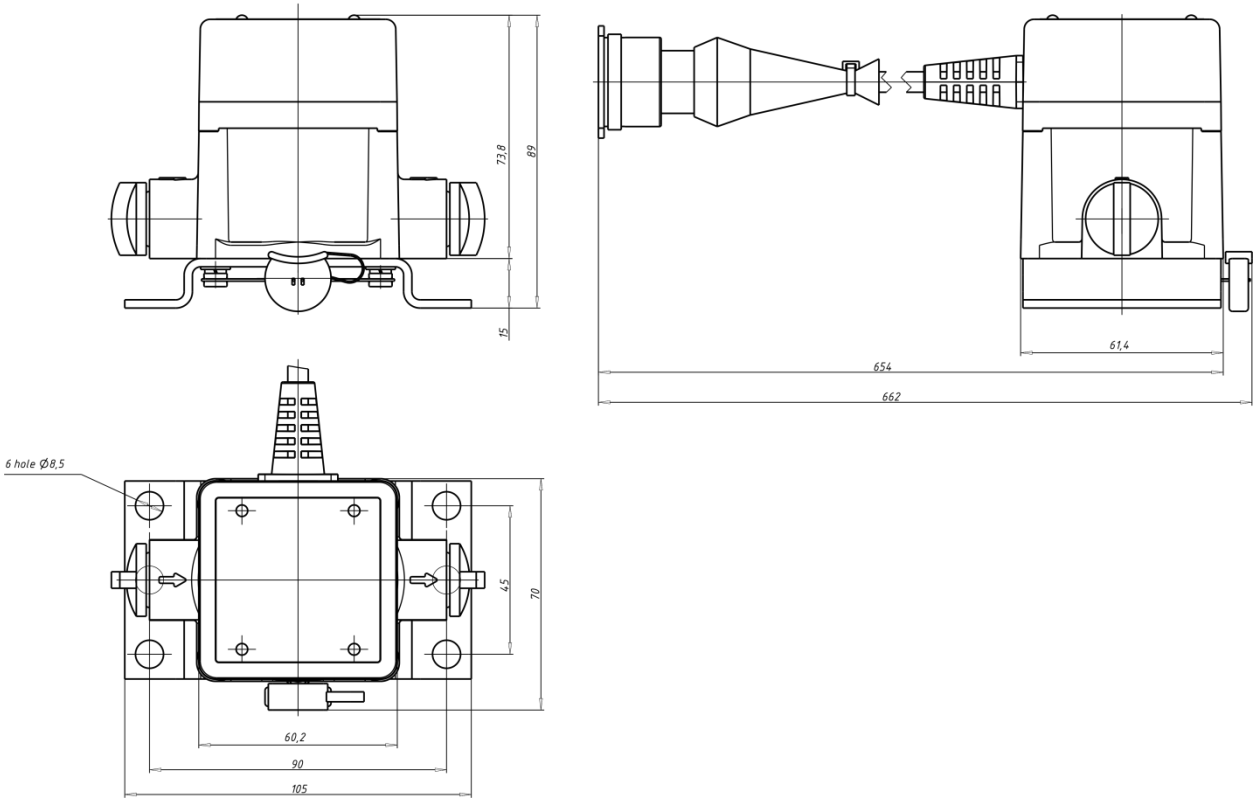
Annex A continued

DFM 250D232(485)CAN



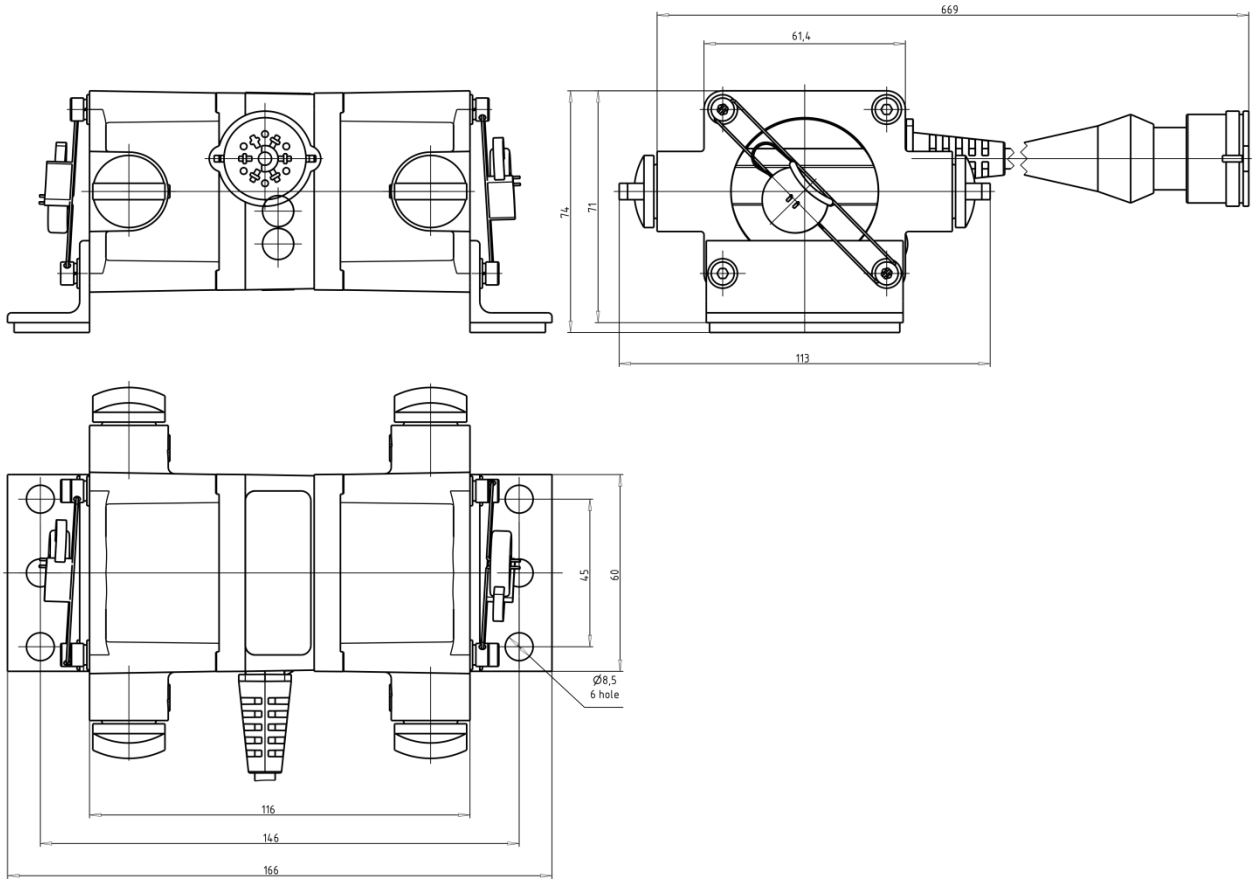
Annex A continued

DFM 500A(C)232(485)CAN



Annex A continued

DFM 500D232(485)CAN



Annex A continued

Table A.1 — DFM weight

Model	Weight, kg
DFM 50AK **DFM 50A232** **DFM 50A485** **DFM 50ACAN** **DFM 50B** **DFM 50C** **DFM 50CK** **DFM 50C232** **DFM 50C485** **DFM 50CCAN**	0.8
DFM 90AP	
DFM 100AK **DFM 100A232** **DFM 100A485** **DFM 100ACAN** **DFM 100B** **DFM 100C** **DFM 100CK** **DFM 100C232** **DFM 100C485** **DFM 100CCAN**	
DFM 220AP	1.2
DFM 250AK **DFM 250A232** **DFM 250A485** **DFM 250ACAN** **DFM 250B** **DFM 250C** **DFM 250CK** **DFM 250C232** **DFM 250C485** **DFM 250CCAN**	
DFM 500AK **DFM 500A232** **DFM 500A485** **DFM 500ACAN** **DFM 500C** **DFM 500CK** **DFM 500C232** **DFM 500C485** **DFM 500CCAN**	1.5
DFM 100D **DFM 100D232** **DFM 100D485** **DFM 100DCAN**	1.7
DFM 250D **DFM 250D232** **DFM 250D485** **DFM 250DCAN**	2.4
DFM 500D **DFM 500D232** **DFM 500D485** **DFM 500DCAN**	3.3

Annex B

Vehicle inspection report

_____/ _____ /20___
Date Month Year

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

Vehicle 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 return flow rate		Injectors return 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

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 return line	$V_{inj.return}$, liters	
Proportion of the return 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

DFM flow meter profile

Fuel flow meter DFM profile 22.07.2014 10:47:16

Passport:

Model: DFM 250D
Serial number: 745 6226
Hardware version: 1.0
Firmware version: 1.4
Date of manufacture: 01.2014
Boot loader version: 1.0

Impulse rate: 0,0125 L
Consumption correction factor: 0,0 % (min -50, max +50)

Temperature compensation:

Switch on temperature compensation: Off
Reduce fuel volume to temperature: 20 °C
Temperature coefficient of volume expansion: 0,0013

The boundaries of modes:

"Idling mode"
---------- 10,0 L/h
"Optimal mode"
---------- 60,0 L/h
"Overload mode"
---------- 100,0 L/h
"Tamper mode"

Counters:

Total consumption: 39,572 L
Consumption in "Idling mode" : 0,624 L
Consumption in "Optimal mode" : 37,074 L
Consumption in "Overload mode": 1,874 L
Consumption in "Tamper mode": 0,299 L
Negative consumption: 0,000 L
Time of interference: 0 h 0 min

Figure D.1 — DFM D flow meter profile instance

Annex D continued

Fuel flow meter DFM profile 22.07.2014 10:42:35

Passport:

Model: DFM 50C
Serial number: 535000275
Hardware version: 4.0
Firmware version: 2.4
Boot loader version: 1.0

Impulse rate: 0,005 L

Temperature compensation:

Switch on temperature compensation: Off

The boundaries of modes:

"Idling mode"
---------- 5 L/h
"Optimal mode"
---------- 35 L/h
"Overload mode"
---------- 50 L/h
"Tamper mode"

Counters:

Total consumption and time: 8,562 L / 0 h 51 min
Consumption and time in "Idling mode": 0,579 L / 0 h 25 min
Consumption and time in "Optimal mode": 5,998 L / 0 h 23 min
Consumption and time in "Overload mode": 1,985 L / 0 h 3 min
Consumption and time in "Tamper mode": 0,000 L / 0 h 0 min
Time of interference: 0 h 0 min
Operating time: 11059 h 17 min

Figure D.2 — DFM AK/CK flow meter profile instance

Annex D continued

Fuel flow meter profile

09.10.2015 14:13:10

Unit Passport:

ECU Line: DFM 100DCAN
Brand: Flowmeter
Serial number: 0770100130011
Firmware Version: 3.02
Manufacturing Date: 12.03.2015
S6 Address (SA): 111

Fuel Consumption Factors:

Correction Coefficient: 0.0 %
Temperature Correction Permit: Off
Temperature Correction Coefficient : 0.0840 %/°C

Fuel Rate Mode Borders:

"Idle"
25.000 L/h
"Optimal"
75.000 L/h
"Overload"
100.000 L/h
"Cheat:"

Flowmeter. Counters 1:

High Resolution Engine Total Fuel Used: 1.016 L
High Resolution Engine Total Fuel Used. Idle: 0.951 L
High Resolution Engine Total Fuel Used. Optimal: 0.065 L
High Resolution Engine Total Fuel Used. Overload: 0.000 L
High Resolution Engine Total Fuel Used. Cheat: 0.000 L
High Resolution Engine Total Fuel Used. Negative: 0.111 L

Engine hours of operation: 00:12
Engine hours of operation. Idle: 00:12
Engine hours of operation. Optimal: 00:00
Engine hours of operation. Overload: 00:00
Engine hours of operation. Cheat: 00:00
Engine hours of operation. Negative: 00:00
Engine hours of operation. Interference: 00:01

Figure D.3 — DFM C232 flow meter profile instance

Annex E

Register map of DFM output messages under Modbus protocol

See Table E.1 for Register map of DFM output messages under Modbus protocol.
Check http://s6.jv-technoton.com for detailed data on SPN (J1939)

Table E.1 — Register map of DFM output messages under Modbus protocol

Register address	Register contents	Corresponding SPN (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 Supply chamber	521027	18.0
13	Chamber Fuel Rate in Return chamber	521027	18.1
14	Chamber Working Mode. Supply chamber	521028	18.0
15	Chamber Working Mode. Return chamber	521028	18.1
16	High Resolution Engine Total Fuel Used (high word)	5054	9.0
17	High Resolution Engine Total Fuel Used (low word)	5054	9.0
18	High Resolution Engine Total Fuel Used (high word)	5054	9.1
19	High Resolution Engine Total Fuel Used (low word)	5054	9.1
20	High Resolution Engine Total Fuel Used (high word)	5054	9.2

Table E.1 continued

Register address	Register contents	Corresponding SPN (J1939)	Specifier
21	High Resolution Engine Total Fuel Used (low word)	5054	9.2
22	High Resolution Engine Total Fuel Used (high word)	5054	9.3
23	High Resolution Engine Total Fuel Used (low word)	5054	9.3
24	High Resolution Engine Total Fuel Used (high word)	5054	9.4
25	High Resolution Engine Total Fuel Used(low word)	5054	9.4
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
29	Engine hours of operation (low word)	521171	9.0
30	Engine hours of operation (high word)	521171	9.1
31	Engine hours of operation (low word)	521171	9.1
32	Engine hours of operation (high word)	521171	9.2
33	Engine hours of operation (low word)	521171	9.2
34	Engine hours of operation (high word)	521171	9.3
35	Engine hours of operation (low word)	521171	9.3
36	Engine hours of operation (high word)	521171	9.4
37	Engine hours of operation (low word)	521171	9.4
38	Engine hours of operation (high word)	521171	9.5
39	Engine hours of operation (low word)	521171	9.5
40	High Resolution Engine Total Fuel Used (low word)	521172	18.0
41	High Resolution Engine Total Fuel Used (high word)	521172	18.0
42	High Resolution Engine Total Fuel Used (low word)	521172	18.0, 9.0
43	High Resolution Engine Total Fuel Used (high word)	521172	18.0, 9.0
44	High Resolution Engine Total Fuel Used (low word)	521172	18.0, 9.1
45	High Resolution Engine Total Fuel Used (high word)	521172	18.0, 9.1
46	High Resolution Engine Total Fuel Used (low word)	521172	18.0, 9.2
47	High Resolution Engine Total Fuel Used (high word)	521172	18.0, 9.2
48	High Resolution Engine Total Fuel Used (low word)	521172	18.0, 9.3
49	High Resolution Engine Total Fuel Used (high word)	521172	18.0, 9.3

Table E.1 continued

Register address	Register contents	Corresponding SPN (J1939)	Specifier
50	Flowmeter Chamber Time Counter (low word)	521189	18.0
51	Flowmeter Chamber Time Counter (high word)	521189	18.0
52	Flowmeter Chamber Time Counter (low word)	521189	18.0, 9.0
53	Flowmeter Chamber Time Counter (high word)	521189	18.0, 9.0
54	Flowmeter Chamber Time Counter (low word)	521189	18.0, 9.1
55	Flowmeter Chamber Time Counter (high word)	521189	18.0, 9.1
56	Flowmeter Chamber Time Counter (low word)	521189	18.0, 9.2
57	Flowmeter Chamber Time Counter (high word)	521189	18.0, 9.2
58	Flowmeter Chamber Time Counter (low word)	521189	18.0, 9.3
59	Flowmeter Chamber Time Counter (high word)	521189	18.0, 9.3
60	High Resolution Engine Total Fuel Used (low word)	521172	18.1
61	High Resolution Engine Total Fuel Used (high word)	521172	18.1
62	High Resolution Engine Total Fuel Used (low word)	521172	18.1, 9.0
63	High Resolution Engine Total Fuel Used (high word)	521172	18.1, 9.0
64	High Resolution Engine Total Fuel Used (low word)	521172	18.1, 9.1
65	High Resolution Engine Total Fuel Used (high word)	521172	18.1, 9.1
66	High Resolution Engine Total Fuel Used (low word)	521172	18.1, 9.2
67	High Resolution Engine Total Fuel Used (high word)	521172	18.1, 9.2
68	High Resolution Engine Total Fuel Used (low word)	521172	18.1, 9.3
69	High Resolution Engine Total Fuel Used (high word)	521172	18.1, 9.3
70	Flowmeter Chamber Time Counter (low word)	521189	18.1
71	Flowmeter Chamber Time Counter (high word)	521189	18.1
72	Flowmeter Chamber Time Counter (low word)	521189	18.1, 9.0
73	Flowmeter Chamber Time Counter (high word)	521189	18.1, 9.0
74	Flowmeter Chamber Time Counter (low word)	521189	18.1, 9.1
75	Flowmeter Chamber Time Counter (high word)	521189	18.1, 9.1
76	Flowmeter Chamber Time Counter (low word)	521189	18.1, 9.2
77	Flowmeter Chamber Time Counter (high word)	521189	18.1, 9.2
78	Flowmeter Chamber Time Counter (low word)	521189	18.1, 9.3
79	Flowmeter Chamber Time Counter (high word)	521189	18.1, 9.3

Annex F

DFM COM data transfer protocol

F.1 Application

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

F.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 according to flow meter network address. Default factory address value is 111.

Master-slave operation mode of DFM is supported. The only one flow meter in the bus can be defined as Master.

Data exchange interval between bytes should not exceed 100 ms.

F.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 1second by default.

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

Table F.1 — Time intervals

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

Annex F continued

E.4 Automatic data transmission

Three formats of automatic data transmission are available:

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

Table F.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 F.5.

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

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

For example, Q=10000.250 B=60.5 t=20<CR><LF>

Q is high resolution total fuel consumption value, liters;

B is instant value of hourly fuel consumption rate, liters/hour;

t – actual temperature value, °C.

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.

Annex F continued

E.5 Request-Response data exchange mode

1) Request

Table F.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 F.5.

Data field values are listed in Table F.5.

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

2) Response

Table F.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 F.5.

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

Annex F continued

Table F.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 Transmitted parameter • Total fuel consumption • High resolution total fuel consumption Hourly fuel consumption rate	1 °C 1 L. 0.001 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
3	0x13	Set automatic transmission interval	U8	0..255	1s	U8	0x00 – no errors 0x01 - error	
4	0x17	Set automatic transmission mode after restart (power supply restart)	U8	0 – OFF 1 – HEX 2 – ASCII 3 – ASCII EXT		U8	0x00 – no errors 0x01 - error	
5	0x24	Read structure of settings of output signal value ranges	-		-	U16 U16 U16 U16 U16 U16 U16 U8 U8	Not used Not used Not used Not used Not used Not used Not used Not used Parameter selection on digital interface	

Annex F continued

Table F.5 continued

#	Request					Response – Data field		
	Fmt		Data					
	Value	Description	Type	Description	Resolution step	Type	Description	Resolution step
6	0x25	Set structure of settings of output signal value ranges	U16 U16 U16 U16 U16 U16 U16 U8 U8	Not used Not used Not used Not used Not used Not used Not used Not used Parameter selection on digital interface	1	U8	0x00 – no errors 0x01 - error	
7	0x07	Enable automatic data transmission. Transmission is stopped when device receives any other valid request or if power supply is switched off.	-	-	-	U8	0x00 – no errors 0x01 - error	
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 F.6).

Table F.6 — Malfunction codes of DFM with firmware version 2.9 and higher.

Code	Malfunction description
255	DFM error
254	Battery charge level is less than 10 %
253	Interference event
252	Cheat (tampering) event

Annex F continued

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;
}
```

Annex F continued

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 G

Message format of DFM CAN data transfer protocol

See Table G.1 for parameters, structure and contents of data transfer protocol messages of DFM with CAN output interface.
For detailed information on PGN (J1939) visit http://s6.jv-technoton.com

Table G.1 — Message description DFM CAN communication protocol

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
1	**PGN 62995** Unit Passport	On request	45	6	62995 (0xF613)	1	16 bytes	Serial number of the Unit	—	521120
						17	8 bytes	Firmware Version of the Unit	—	521121
						25	8 bytes	Harware version of the Unit	—	521123
						33	8 bytes	Settings version of the Unit	—	521124
						41	4 bytes	Manufacturing Date of the Unit	—	521125
						45	1 byte	S6 Address (SA)	—	521188
2	**PGN 62994** Unit Work Counters	On request	16	6	62994 (0xF612)	1	4 bytes	Unit Time Worked	—	521116
						5	4 bytes	Unit Time Worked	16.1 Battery	521116
						9	4 bytes	Unit Reset Counter	—	521118
						13	4 bytes	Unit Power Off Counter	—	521119
3	**PGN 65226 *** Active Diagnostic Trouble Codes	1000 ms	6	6	65226 (0xFECA)	1.1	2 bits	Malfunction Indicator Lamp	—	1213
						1.3	2 bits	Red Stop Lamp	—	623
						1.5	2 bits	Amber Warning Lamp	—	624
						1.7	2 bits	Protect Lamp	—	987
						2.1	2 bits	Flash Malfunction Indicator Lamp	—	3038
						2.3	2 bits	Flash Red Stop Lamp	—	3039
						2.5	2 bits	Flash Amber Warning Lamp	—	3040
						2.7	2 bits	Flash Protect Lamp	—	3041
						3	3 bytes	Fault Identifier (SID)	—	521044
						6.1	7 bits	Occurrence Count	—	1216
						6.8	1 bit	SPN Conversion Method	—	1706

***** PGN length is variable and depends on the number of malfunctions (maximum up to 20 malfunctions).

Table G.1 continued

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
4	**PGN 63026** Fuel Consumption Factors	On request	8	6	63026 (0xF632)	1	2 bytes	Temperature Correction Coefficient	—	521433
						3	2 bytes	Correction Coefficient	—	521434
						5.1	2 bits	Temperature Correction Permit	—	521311
						8	1 byte	Reserved_8	—	524000
5	**PGN 63044 *** Calibration Table. Fuel Rate (DFM)	On request	5	6	63044 (0xF644)	1	1 byte	Array Elements Count	—	521355
						2	2 bytes	Impulse Period	—	521232
						4	2 bytes	Chamber Volume	—	521231
6	**PGN 63065** Fuel Rate Mode Borders	On request	18	6	63065 (0xF659)	1	2 bytes	Fuel Rate Mode Border	9.0 Idle	521392
						3	2 bytes	Fuel Rate Mode Border	9.1 Optimal	521392
						5	2 bytes	Fuel Rate Mode Border	9.2 Overload	521392
						7	2 bytes	Fuel Rate Mode Border	9.0 Idle, 18.0 Feed chamber	521392
						9	2 bytes	Fuel Rate Mode Border	9.1 Optimal, 18.0 Feed chamber	521392
						11	2 bytes	Fuel Rate Mode Border	18.0 Feed chamber, 9.2 Overload	521392
						13	2 bytes	Fuel Rate Mode Border	18.1 Reverse chamber, 9.0 Idle	521392
						15	2 bytes	Fuel Rate Mode Border	18.1 Reverse chamber, 9.1 Optimal	521392
						17	2 bytes	Fuel Rate Mode Border	9.2 Overload, 18.1 Reverse chamber	521392
7	**PGN 65266** Fuel Economy (Liquid)	100 ms	8	6	65266 (0xFEF2)	1	2 bytes	Engine Fuel Rate	—	183
						3	2 bytes	Engine Instantaneous Fuel Economy	—	184
						5	2 bytes	Engine Average Fuel Economy	—	185
						7	1 byte	Engine Throttle Valve 1 Position	—	51
						8	1 byte	Engine Throttle Valve 2 Position	—	3673
8	**PGN 65257** Fuel Consumption (Liquid)	On request	8	6	65257 (0xFEE9)	1	4 bytes	Engine Trip Fuel	—	182
						5	4 bytes	Engine Total Fuel Used	—	250

***** Number of calibration points is 5. PGN length is variable: for single-chamber meter is 21 byte, for dual-chamber meter is 41 byte.

Table G.1 continued

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
9	**PGN 62981** Flowmeter. Parameters	1000 ms	8	6	62981 (0xF605)	1	2 bytes	Engine Fuel Rate	—	183
						3.1	4 bits	Engine Mode by Fuel Rate	—	521181
						4	2 bytes	Chamber Fuel Rate	18.0 Feed chamber	521027
						6	2 bytes	Chamber Fuel Rate	18.1 Reverse chamber	521027
						8.1	4 bits	Chamber Working Mode	18.0 Feed chamber	521028
						8.5	4 bits	Chamber Working Mode	18.1 Reverse chamber	521028
10	**PGN 62992** Flowmeter. Counters 1	On request	52	6	62992 (0xF610)	1	4 bytes	High Resolution Engine Total Fuel Used	—	521172
						5	4 bytes	High Resolution Engine Total Fuel Used	9.0 Idle	521172
						9	4 bytes	High Resolution Engine Total Fuel Used	9.1 Optimal	521172
						13	4 bytes	High Resolution Engine Total Fuel Used	9.2 Overload	521172
						17	4 bytes	High Resolution Engine Total Fuel Used	9.3 Cheat	521172
						21	4 bytes	High Resolution Engine Total Fuel Used	9.4 Negative	521172
						25	4 bytes	Engine hours of operation	—	521171
						29	4 bytes	Engine hours of operation	9.0 Idle	521171
						33	4 bytes	Engine hours of operation	9.1 Optimal	521171
						37	4 bytes	Engine hours of operation	9.2 Overload	521171
						41	4 bytes	Engine hours of operation	9.3 Cheat	521171
						45	4 bytes	Engine hours of operation	9.4 Negative	521171
						49	4 bytes	Engine hours of operation	9.5 Interference	521171

Table G.1 continued

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
11	**PGN 62993** Flowmeter. Counters 2	On request	81	6	62993 (0xF611)	1	1 byte	Engine Fuel Temperature 1	—	174
						2	4 bytes	High Resolution Engine Total Fuel Used	18.0 Feed chamber	521172
						6	4 bytes	High Resolution Engine Total Fuel Used	9.0 Idle 18.0 Feed chamber	521172
						10	4 bytes	High Resolution Engine Total Fuel Used	9.1 Optimal 18.0 Feed chamber	521172
						14	4 bytes	High Resolution Engine Total Fuel Used	9.2 Overload 18.0 Feed chamber	521172
						18	4 bytes	High Resolution Engine Total Fuel Used	9.3 Cheat 18.0 Feed chamber	521172
						22	4 bytes	Flowmeter Chamber Time Counter	18.0 Feed chamber	521189
						26	4 bytes	Flowmeter Chamber Time Counter	9.0 Idle 18.0 Feed chamber	521189
						30	4 bytes	Flowmeter Chamber Time Counter	9.1 Optimal 18.0 Feed chamber	521189
						34	4 bytes	Flowmeter Chamber Time Counter	9.2 Overload 18.0 Feed chamber	521189
						38	4 bytes	Flowmeter Chamber Time Counter	9.3 Cheat 18.0 Feed chamber	521189
						42	4 bytes	High Resolution Engine Total Fuel Used	18.1 Reverse chamber	521172
						46	4 bytes	High Resolution Engine Total Fuel Used	9.0 Idle 18.1 Reverse chamber	521172
						50	4 bytes	High Resolution Engine Total Fuel Used	9.1 Optimal 18.1 Reverse chamber	521172
						54	4 bytes	High Resolution Engine Total Fuel Used	9.2 Overload 18.1 Reverse chamber	521172
						58	4 bytes	High Resolution Engine Total Fuel Used	9.3 Cheat 18.1 Reverse chamber	521172
						62	4 bytes	Flowmeter Chamber Time Counter	18.1 Reverse chamber	521189
						66	4 bytes	Flowmeter Chamber Time Counter	9.0 Idle 18.1 Reverse chamber	521189
						70	4 bytes	Flowmeter Chamber Time Counter	9.1 Optimal 18.1 Reverse chamber	521189
						74	4 bytes	Flowmeter Chamber Time Counter	9.2 Overload 18.1 Reverse chamber	521189
						78	4 bytes	Flowmeter Chamber Time Counter	9.3 Cheat 18.1 Reverse chamber	521189

Table G.1 continued

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
12	**PGN 64777** High Resolution Fuel Consumption (Liquid)	1000 ms	8	6	64777 (0xFD09)	1	4 bytes	High Resolution Engine Trip Fuel	—	5053
						5	4 bytes	High Resolution Engine Total Fuel Used	—	5054
13	**PGN 65244** Idle Operation	On request	8	6	65244 (0xFEDC)	1	4 bytes	Engine Total Idle Fuel Used	—	236
						5	4 bytes	Engine Total Idle Hours	—	235
14	**PGN 65101** Total Averaged Information	On request	8	7	65101 (0xFE4D)	1	2 bytes	Engine Total Average Fuel Rate	—	1834
						3	2 bytes	Engine Total Average Fuel Economy	—	1835
						8	1 byte	Reserved_8	—	524000
15	**PGN 63064 *** Battery Voltage Mode Borders	On request	0	6	63064 (0xF658)	1	150 byte	Battery Voltage Mode Border	—	521391
16	**PGN 62987** Vehicle Voltage	1000 ms	8	6	62987 (0xF60B)	1	2 bytes	Keyswitch Battery Potential	—	158
						3.1	2 bits	Ignition Key State	—	521049
						4	4 bytes	Ignition ON Time	—	521053
						8	1 byte	Reserved_8	—	524000
17	**PGN 63086** Battery	5000 ms	8	6	63086 (0xF66E)	1.1	2 bits	Unit Power Status	—	521129
						2	2 bytes	Battery Potential / Power Input 1	—	168
						4	1 byte	Battery Charge Level	—	521061
						5	4 bytes	Unit Time Worked	16.1 Battery	521116
18	**PGN 63011** Time Origin Settings	On request	8	6	63011 (0xF623)	1.1	2 bits	Automatic Daylight Savings Time and Back	—	521350
						1.3	2 bits	Hemisphere	—	521351
						2	1 byte	Local hour offset	—	1602
						3	4 bytes	Time Synchronization Period (With the GPS/GLONASS)	—	521353
						8	1 byte	Reserved_8	—	524000

***** PGN length is 8 byte: 2 bytes — lower level of vehicle voltage (resolution: 0.05 V, data range: 0 V to 3212.75 V); 2 bytes - upper level of vehicle voltage (resolution: 0.05 V, data range: 0 V to 3212.75 V); 4 bytes - reserved.

Table G.1 continued

№	Message name	Message parameters				Message content				
		Broadcast interval	Data length	Default priority	Parameter group number (PGN)	Initial position	Length	Valuable data of the message	Specifier	Suspect Parameter Number (SPN)
19	**PGN 63051 *** Emergency Events List	On request	210	6	63051 (0xF64B)	1	4 bytes	Event SPN **	—	521166
						5	—	Unstructured Data *****	—	521357
20	**PGN 63055 *** Important Events List	On request	210	6	63055 (0xF64F)	1	4 bytes	Event SPN ***	—	521166
						5	—	Unstructured Data *****	—	521357
21	**PGN 63056 *** Information Events List	On request	210	6	63056 (0xF650)	1	4 bytes	Event SPN ****	—	521166
						5	—	Unstructured Data *****	—	521357
22	**PGN 65254** Time/Date	On request	8	6	65254 (0xFEE6)	1	1 byte	Seconds	—	959
						2	1 byte	Minutes	—	960
						3	1 byte	Hours	—	961
						4	1 byte	Month	—	963
						5	1 byte	Day	—	962
						6	1 byte	Year	—	964
						7	1 byte	Local minute offset	—	1601
						8	1 byte	Local hour offset	—	1602
23	**PGN 59904** Request	1000 ms	0	6	59904 (0xEA00)	1	3 bytes	PGN	—	521150

***** PGN length is 210 byte, transmission of up to 15 events. The blank data area is filled with 0xFF values.
****** DFM flow meter does not generate emergency events.
******* Important Events List includes following SPN:
521216 - Flowmeter Cheating;
521217 - Interference in Flowmeter Operation.
******** Information Events List includes following SPN:
521204 - Ignition On;
521205 - Ignition Off;
521223 - High Voltage;
521224 - Low Voltage.
********* Check data base for description of SPN at http://s6.jv-technoton.com/en/events.html

Annex H

DFM CAN connection options

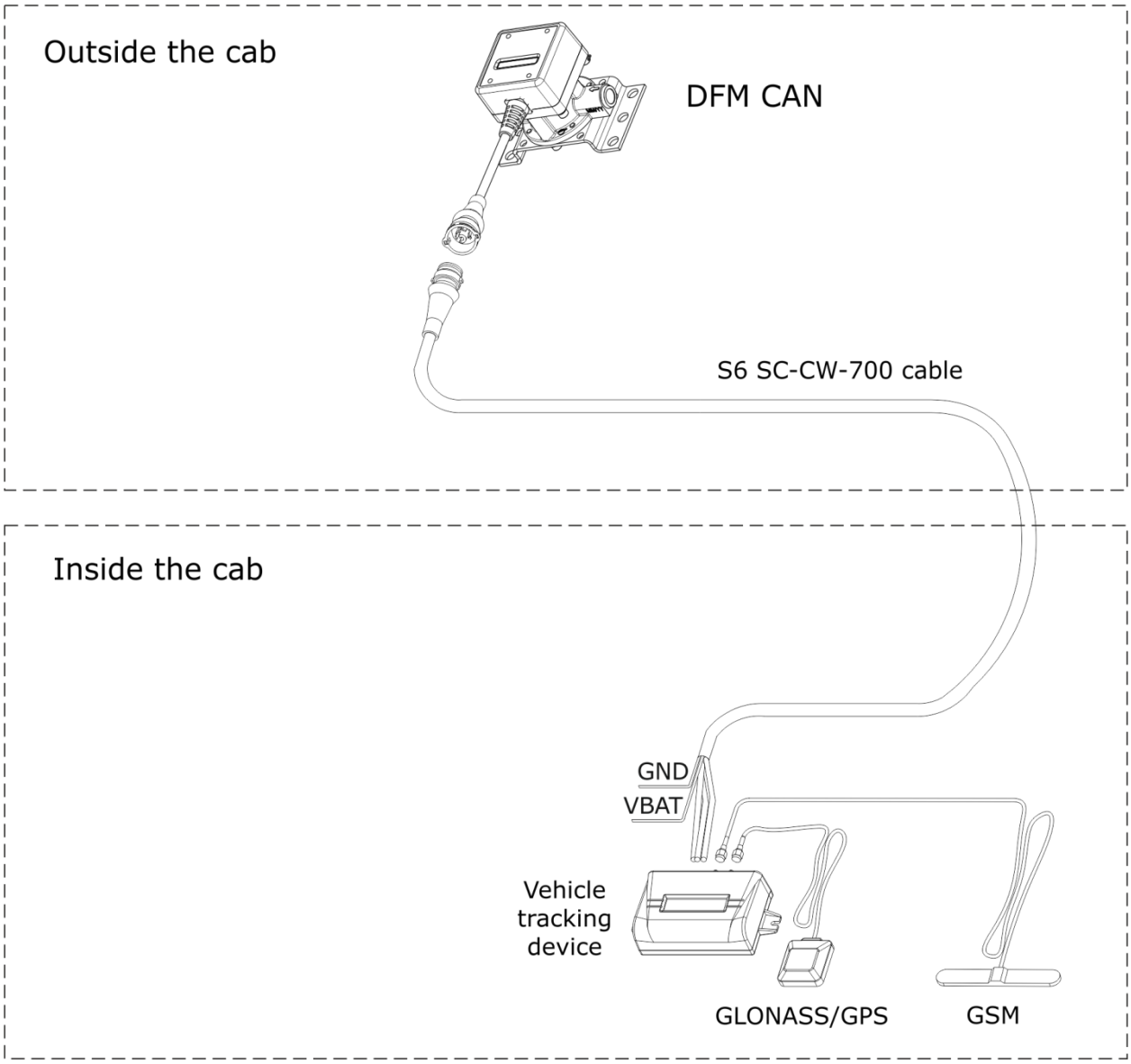


Figure H.1 — Connection of single DFM CAN to recording and display unit non-compatible with S6 cable system

Annex H continued

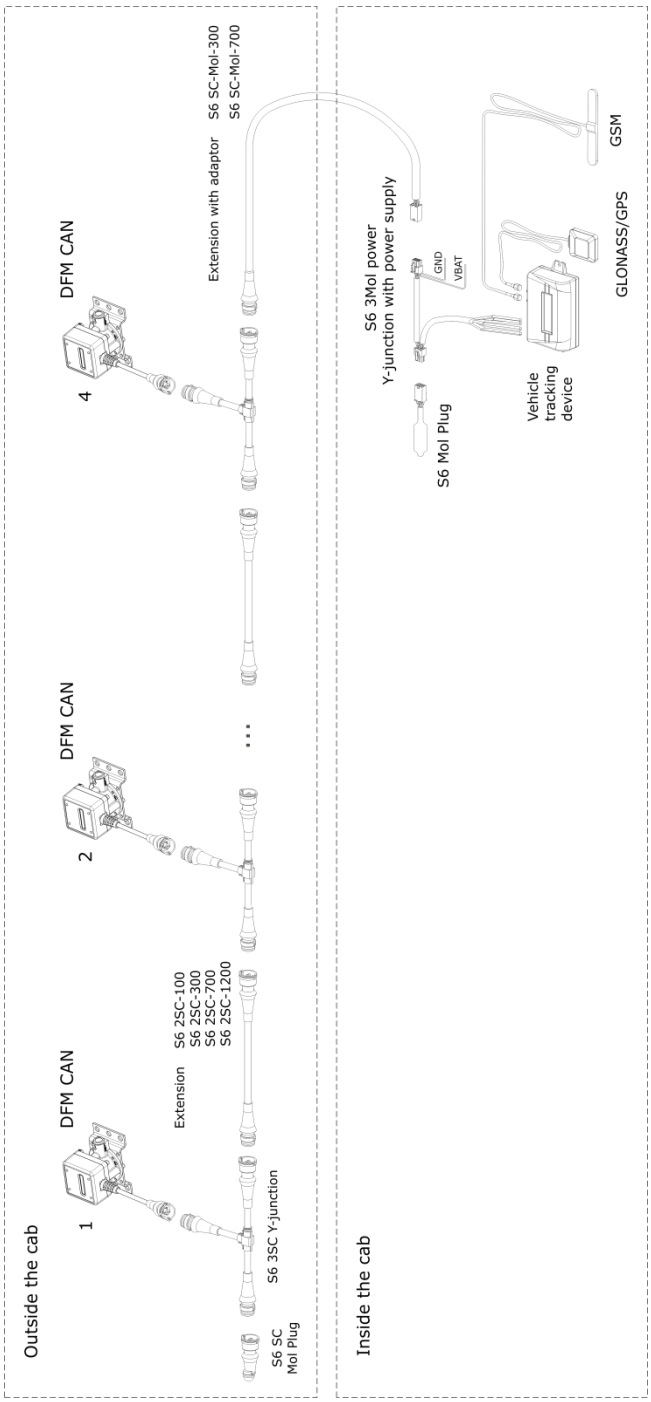


Figure H.2 — Connection of several DFM CAN to recording and display unit non-compatible with S6 cable system

Annex H continued

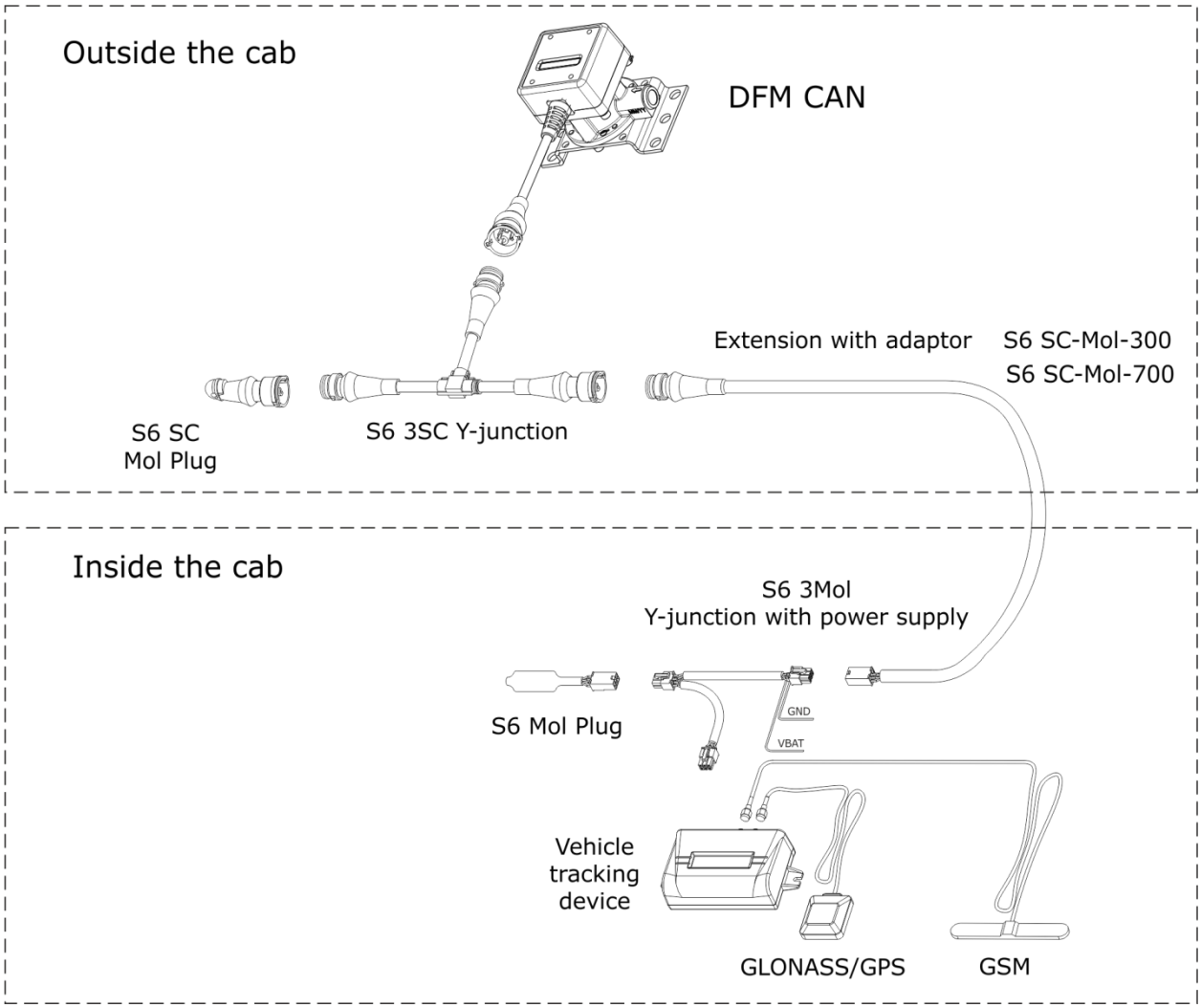


Figure H.3 — Connection of single DFM CAN to recording and display unit compatible with S6 cable system

Annex H continued

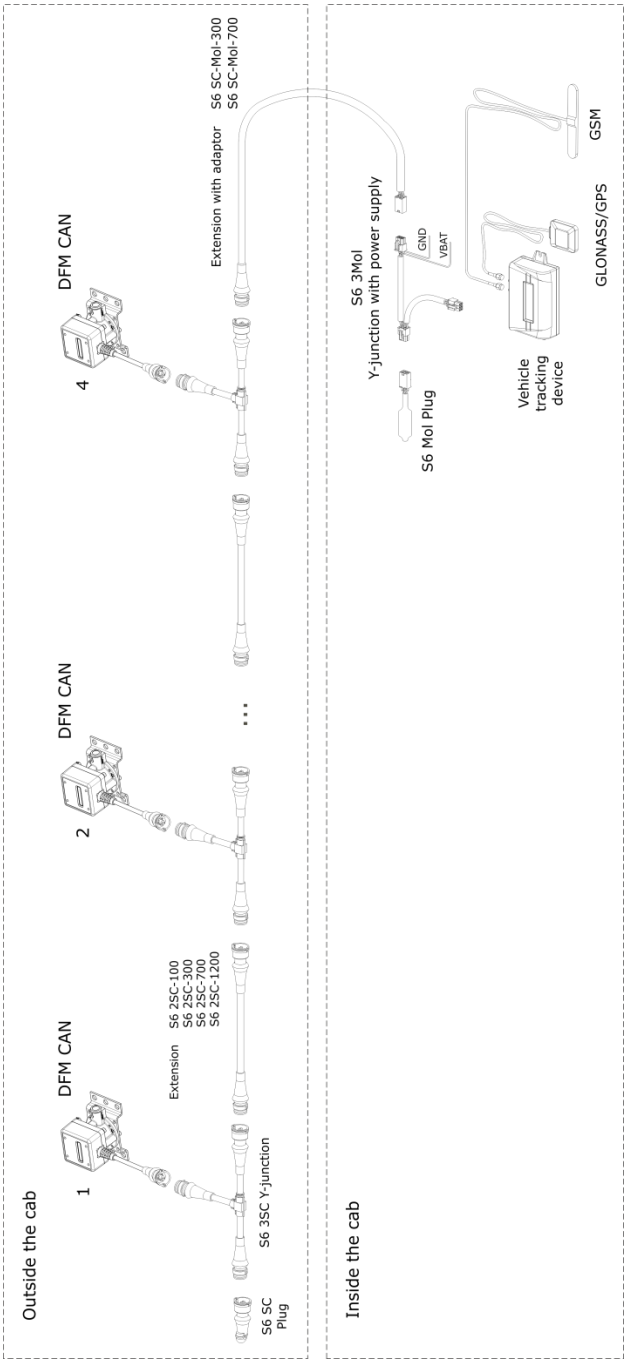


Figure H.4 — Connection of several DFM CAN to recording and display unit compatible with S6 cable system

Annex I

Videos

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

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

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

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

3) Interactive flash animation **DFM fuel flow meter features**

Link: http://www.jv-technoton.com/data/editor/dfm_fuel_flow_meter.swf

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

Link: http://www.jv-technoton.com/data/editor/flash/DFM_choose_an_installation_scheme.swf

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

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

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