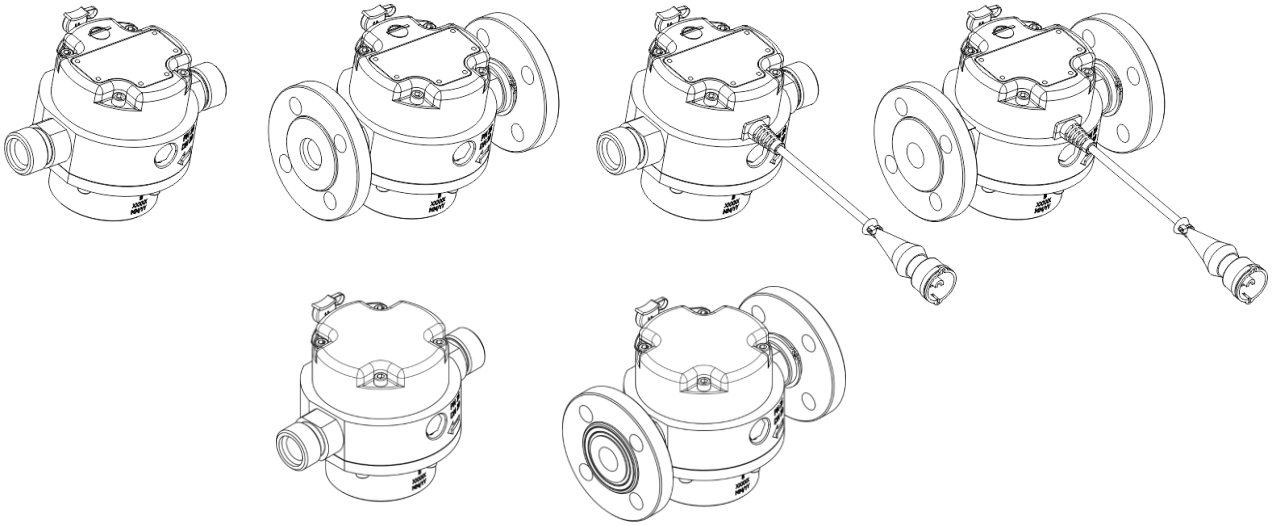
FUEL FLOW METERS



DFM Marine 1000/2000/4000

OPERATION MANUAL

Version 6.3

TECHNOTON
ADVANCED MACHINERY TELEMATICS

E28 10 R - 04 1550 E28 10R – 06 2434

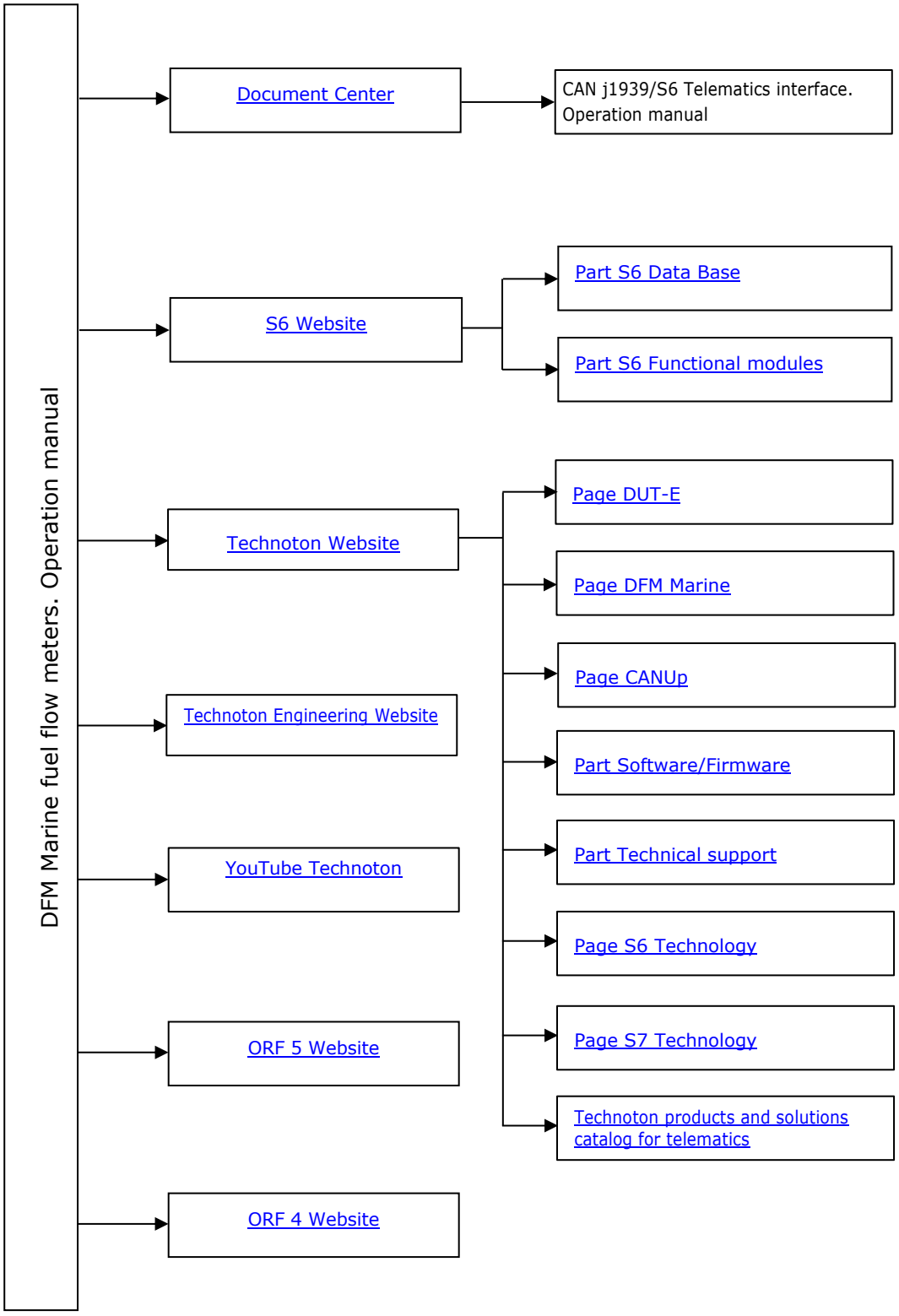
Contents

Revision history

Version	Date	Editor	Description of changes
1.0	08.2017	OD	Basic version.
2.0	09.2017	OD	• DFM Marine paired measurement modes are added – differential and summarization of fuel consumption. • DFM Marine CCAN data transfer protocol description is updated with new PGN. • Flowmeter FM (v.3) is updated with new PGN, which are displayed and/or edited with Service DFM Marine (v.1.6) software. • New screens of DFM Marine CCAN flow meters display are added. • Exterior of DFM Marine is changed. • Mounting holes placement schemes are added. • Dimensions and weight of DM Marine are updated. • Structure of external links of this manual is added.
3.0	10.2018	OD	• Information on DFM Marine CCAN operation over NMEA 2000 protocol is added. • Added description of configuration of new functional module – Display Marine. • Delivery set is updated. • Detailed information on electromagnetic compatibility is added. • E28 certificate of international E-mark standard is added. • Document terminology is updated (CAN j1939/S6 Telematics interface, S6 Technology and IoT Burger Technology). • Flow meter model codes are updated. • Added packaging information.
3.1	06.2019	OD	• Information on DFM Marine fuel flow meter is added (MK DFM M1000/M2000/M4000 mounting kits, the mud filter etc.). • Clarifications regarding the utilization/recycling procedure for DFM Marine are made.
3.2	12.2019	OD	• The list of messages and composition of data output from DFM Marine CAN fuel flow meters sent over CAN j1939/S6 interface has been updated. • Information about special version of DFM Marine for systems with a high temperature of measured fluid (up to +150 ° C) is added. • DFM Marine flow meters settings (firmware v.6.28 and higher) in Service DFM Marine software (v.2.8 and higher) are updated for differential measurement mode: - smoothing capacity (smoothing buffer); - displaying of graphs of differential instant flow rate and flow rate in feed and reverse fuel pipelines in one window. • DFM fuel flow meters Certificates of Conformity are added: - European RoHS Directive (Restriction of Hazardous Substances); - European 2014/30/EU Directive (Electromagnetic Compatibility). • Minimal requirements for PC for work with Service DFM Marine software are added. • The procedure for elimination of problems that arise sometimes in relation to running Service DFM Marine software in Windows 10 is described.
3.3	01.2020	OD	ABS (American Bureau of Shipping) approval certificate for DFM Marine is added.

Version	Date	Editor	Description of changes
4.0	02.2021	OD	• Improvement of the flow meters design (rotating flanges, vent valve, improved protection coating of the duralumin casing). • Changes in the flow meters dimensions and weight. • List of the flow meters outgoing messages via CAN j1939/S6 interface is updated. • Option to configure any network addresses for DFM Marine (firmware v.6.30 and higher) from the range 0…240 using the service software (v.3.02 and higher). • New DFM Marine CAN functional features for operation based on S6 Technology: - Uniting up to 240 pcs. of flow meters into a single network; - Joint use of up to 16 pairs of flow meters in "Differential"/"Summarization" modes of fuel consumption measurement etc.
5.0	07.2021	OD	Added information on the new model of DFM Marine fuel flow meters with S7 wireless interface.
6.0	06.2022	OD	• Wireless configuration of flow meters through the Android device using Service S6 DFM (Android) service mobile application (version 2.01) is introduced. • Data composition in output messages of DFM Marine CCAN and DFM Marine S7 flow meters is updated. • Information on "Service" mode for DFM Marine S7 wireless flow meters for their firmware update using Fuel Rate Monitor mobile application is updated. • Examples of connection schemes for DFM Marine CCAN flow meters by means of S6 Technology are provided. • E-mark certificate "Uniform provisions concerning the official approval of vehicles with regard to the electromagnetic compatibility, in accordance with UN/ECE Regulation #10" is added.
6.1	10.2023	OD	• Information on resetting clearable Counters of DFM Marine CCAN flow meters by means of S6 Technology with the help of PGN 63080 command is added. • List of the DFM Marine CAN flow meters outgoing messages via CAN j1939/S6 interface is updated. • Information on integration of readings from DFM Marine S7 wireless flow meters into NMEA 2000 ship communication bus using MasterCAN S7 NMEA data converteris added.
6.2	05.2025	OD	• Support for the Fuel Rate Monitor mobile application has been discontinued for iOS devices.
6.3	11.2025	OD	• Clarifications have been introduced regarding the autonomous operating time of DFM Marine S7 wireless flow meters powered by the built-in battery.

Structure of external links



Terms and Definitions

IoT Burger is the Technology of creating smart sensors and complex telematics IIoT devices operating in real time with built-in analytic features (further on – IoT Burger). The basis of IoT Burger is the software/hardware core, a set of ready-to-use universal Functional Modules, the database of standardized IoT parameters.

Particular features of IoT Burger:

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

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

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

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

DFM Marine fuel flow meters are designed using IoT Burger Technology.

S7 — Technology designed for wireless collection of data from unattended sensors in systems of industrial and automobile Telematics. S7 Technology is recommended for use in facilities where wiring is impossible or hard to install.

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

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

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

Advantages of S7 Technology:

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

DFM Marine S7 fuel flow meters are designed using S7 Technology.

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

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

DFM Marine CAN fuel flow meters are designed using S6 Technology.

PGN (Parameter Group Number) — is a combined group of S6 parameters, which has common name and number. Functional modules (FM) of the Unit can have input/output PGNs and setup PGNs.

SPN (Suspect Parameter Number) — informational unit of S6. Each SPN has determined name, number, extension, data type and numerical value. The following types of SPN exist: Parameters, Counters, Events. SPN can have a qualifier which allows qualification of parameter's value (e.g. – Onboard power supply limit/Minimum).

NMEA 2000 — is a high-level network protocol, which is defined by international standard of marine electronic equipment NMEA 2000 Standard. NMEA 2000 protocol allows to combine several units of marine equipment into a single network for data exchange. NMEA 2000 is based on data transfer protocol, which is used in CAN bus.

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

Analytical report — report generated in ORF 4 / ORF 5 on vehicle or group of vehicles operation for chosen time period (usually a day, week or month). Can be composed of numbers, tables, charts, mapped route of vehicle, diagrams.

Counter — cumulative numerical characteristics of Parameter. Counter is represented by a number, which can only grow in time. Examples of Counters: fuel consumption, engine operation time, total distance and other.

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

When the Event occurs, a terminal unit registers the time of occurrence, which is later mentioned in a report on the event. Thus, the Event is always attached to exact time and place of occurrence.

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

Onboard equipment (OE) — Telematics system elements, directly installed in Vehicle.

Onboard reports (the Reports) — information about vehicle which is returned to a user of Telematics system in accordance with inputted criteria. The Reports are generated by a terminal unit both periodically (Periodic reports) and on Event occurrence (Event report).

Parameter — time-varying or space characteristic of the Vehicle (SPN value). For example, speed, fuel volume in the tank, hourly fuel consumption, coordinates. Parameter is usually displayed in the form of graph, or averaged data.

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

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

Telematics system — complex solution for vehicle monitoring in real time and trip analysis. The main monitored characteristics of the vehicle: Route, Fuel consumption, Working time, technical integrity, Safety. In includes On-board report, Communication channels, Telematics service ORF 4 / ORF 5.

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

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

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

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

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

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

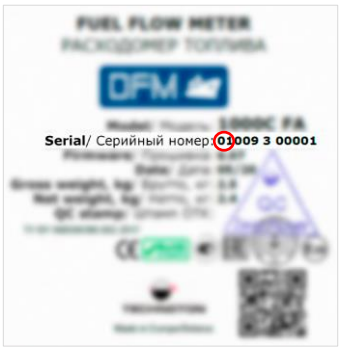
Any information related to the subscription fees for mobile applications provided in this document below is now outdated.

Introduction

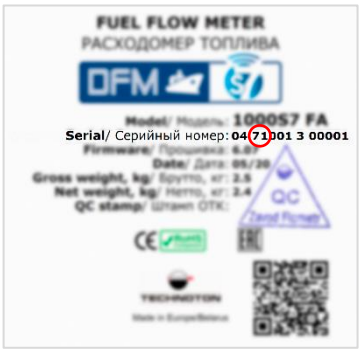
The Operation manual contains guidelines and rules which refer to **DFM Marine fuel flow meters** (hereinafter DFM Marine), developed by Technoton company, models codes:

- **01/02/03** — for DFM Marine 1000C/2000C/4000C;
- **10/11/12** — for DFM Marine 1000CK/2000CK/4000CK;
- **20/21/22** — for DFM Marine 1000CCAN/2000CCAN/4000CCAN;
- **70/71/72** — for DFM 1000S7/2000S7/4000S7.

DFM Marine C/CK/CCAN model code is defined by first two digits of its serial number, which is placed on measurement chamber's body and on packaging label:



DFM Marine S7 model code is defined by third and fourth digits of its serial number, which is placed on measurement chamber's body and on packaging label:



This document contains information on the design, operation principle, specifications, as well as recommendations on operation, mounting of DFM Marine flow meters; it also defines the procedure for their configuration using cable and wireless connection.

DFM **— high-precision tools for fuel consumption measurement in water transport, locomotives, powerful diesel generators, burners, quarry vehicles. May be used both as part of the Telematics system and autonomously.**

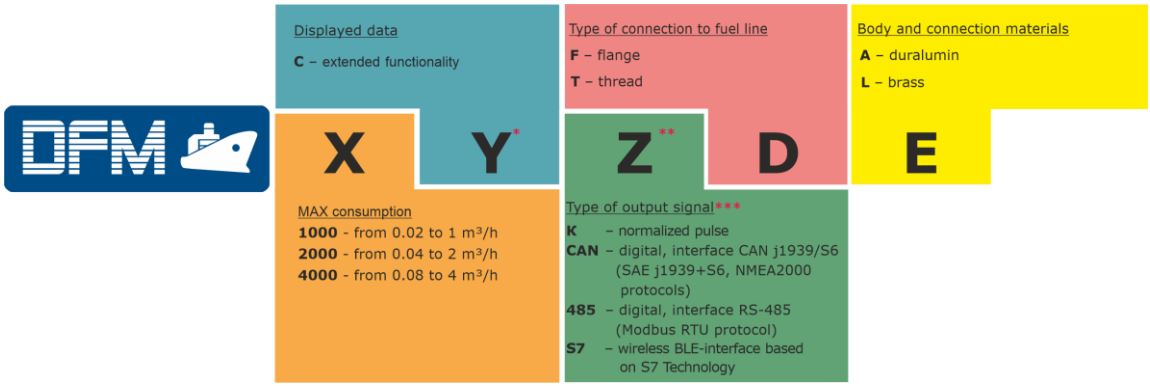
DFM Marine features:

- compliance with Units, Database and cabling system S6 Technology[1];
- IoT Burger Technology provides internal data processing (Parameter filtration and normalization, Events logging, Counters recording) for easier server operation and data traffic saving;
- recording real fuel consumption and operation time of fuel consumer – total and in different consumption modes: "Idle", "Optimal", "Overload", "Tampering" and "Interference";
- conformity to the Rules of American Bureau of Shipping;
- implementation of data transfer using NMEA 2000 marine equipment communication protocol allows to integrate the flow meter into ship automation systems[1];
- maximum information richness of output data and high reliability of data transmission over S6 Technology[1];

- unique self-diagnostics feature to monitor the stability and accuracy of data[1];
- thermal correction function with adjustable coefficient which ensures automatic correction of values to the ambient temperature[2];
- setting the boundaries of operation modes for hourly consumption[2];
- operability in fuel systems with high (up to +150 °C) temperature of measured liquid[3];
- uniting up to 240 pcs. of fuel flow meters based on S6 Technology to form a single network[4];
- application of flow meters in pairs using S6 Technology for differential measurement or Summarization of fuel consumption (up to 16 pairs within the single unit) without mutual calibration of each pair[4];
- wireless transmission of data using S7 Technology via Bluetooth Low Energy channel simultaneously to many receiving devices (Android-based smartphones/tablets, the Telematics terminal, the display in the driver's cabin)[5];
- operation in the «advertising» mode (BLE-radio) — continuous transmission of measurement results, with no need of integration with receiving devices[5];
- ultra-low power consumption ensures autonomous operation of the flow meter for up to 5 years from the built-in battery, without using any external power sources[5];
- convenient monitoring readings of the flow meter mounted in a remote location of a fuel system with difficult access to it[5];
- quick installation without laying the signal cable; no electric connection of the flow meter is required[5];
- explosion and fire safety without additional modules of spark protection[5];
- enhanced resistance to vandalism[5];
- integration of the flow meters' readings (up to 2 pcs.) into NMEA 2000 ship communication bus by using S7 Technology with the help of MasterCAN S7 NMEA data converter, with an option of calculating differential fuel consumption in the two fuel lines[5];
- protection against unauthorized interference in operation and data "tampering";
- resettable Counters of liquid consumption and operation time of flow meter;
- embedded battery allows data (Counters, Events) storage in the internal non-volatile memory of flow meter when external power supply is switched off;
- measuring chamber is made of high-strength anti-corrosion material – brass;
- installed in fuel line using thread or flange connection elements;
- rotating flange makes it easy to adjust sizes of holes for bolts during the flow meter mounting in fuel systems of sea vessels, railway locomotives and industrial facilities equipment;
- vent valve eliminates the formation of condensate inside the flow meter electronic unit which is essential for equipment operating in conditions of high level of humidity and significant temperature fluctuations;
- duralumin casing coated using the method of anodic oxidation provides reliable protection from mechanical damage;
- electronic part of DFM Marine can be disconnected without dismounting flow meter from the fuel line;
- straight segments of fuel line are not necessary for flow meter installation;
- accuracy of measurement is not decreasing when flow meter is operated in tough operation conditions;
- minimum fluid flow resistance;
- 100 % of DFM Marine are calibrated with a certified metrological test rig;
- high quality mounting accessories;
- conformity with European and national standards and directives;
- great experience in the flow meters use, high-quality technical support and documentation.

[1] For DFM Marine CCAN models.
[2] For DFM Marine with interface cable (DFM Marine CK/CCAN models).
[3] Special modification of DFM Marine. We can manufacture any model of the flow meter.
[4] For DFM Marine CCAN with the version of firmware not lower than 6.30, with using Service DFM Marine software, version from 3.02 and higher or Service S6 DFM (Android) mobile application, version from 2.01 and higher.
[5] For wireless flow meters (DFM Marine S7 models).

See figure 1 for identification codes for DFM Marine ordering:



* For wireless flow meters **Y** designation is not used.
** For autonomous flow meters **Z** designation is not used.
*** To obtain data via the RS-232 interface (Modbus RTU protocol), you can use the MasterCAN C 232/485 data converter with special firmware.

Figure 1 — DFM Marine order identification codes

Example of DFM Marine order identification codes:

"DFM Marine 1000C FL Fuel flow meter",
(max. flow rate — 1 m³/h, autonomous with display, with flange connection, material — brass).
"DFM Marine 2000CK TL Fuel flow meter",
(max. flow rate — 2 m³/h, with output normalized pulse, with thread connection, material — brass).
"DFM Marine 4000CCAN FA Fuel flow meter",
(max. flow rate — 4 m³/h, output interface — CAN j1939/S6, with flange connection, material — duralumin).
"DFM Marine 4000S7 TA Fuel flow meter",
(max. flow rate — 4 m³/h, wireless S7 interface, with thread connection, material — duralumin).

Summary table of technical characteristics of DFM Marine

Parameter, measurement units		**Model**		
		DFM Marine 1000	**DFM Marine 2000**	**DFM Marine 4000**
1) General specifications				
Nominal diameter (DN)	mm	15	20	25
	inch	1/2	3/4	1
Maximum flow rate (Q_{max})	m³/h	1	2	4
Minimum flow rate (Q_{min})	m³/h	0.02	0.04	0.08
Starting flow rate*	m³/h	0.01	0.02	0.04
Maximum inaccuracy rate**	%	±0.5		
Nominal volume of the measuring chamber	ml	30	75	150
Measurement chamber material		brass		
Body and connection materials		duralumin (A models) brass (L models)		
Type of connection to fuel line		flange type of connection (F models) thread type of connection (T models)		

Parameter, measurement units			Model		
			DFM Marine 1000	DFM Marine 2000	DFM Marine 4000
Ingress protection rating			IP54		
Maximum pressure of working fluid	flange type of connection	bar	25		
	thread type of connection		16		
Maximum temperature of working fluid		°C	+95 +150***		
Fluid kinematic viscosity		mm^2/s (cSt)	1.5…6.0		
Installation length	flange type of connection	mm	190	200	230
	thread type of connection		165	190	210
Distance of flange holes	flange type of connection	mm	65	75	85
Type of connection thread (BSP)	thread type of connection	inch	3/4	1	1 1/4
Maximum size of foreign particles in the working fluid		mm	0.25	0.40	0.40
Maximum weight		kg	1.7 (TA models) 2.2 (FA models) 2.7 (TL models) 4.3 (FL models)	2.7 (TA models) 3.3 (FA models) 4.4 (TL models) 6.3 (FL models)	4.4 (TA models) 5.1 (FA models) 7.1 (TL models) 9.3 (FL models)
2) <u>Electronic module specifications</u>					
Supply voltage range (only for models with interface cable DFM Marine CK/CCAN)		V	10…45		
Maximum current consumption at 12/24 V (only for models with interface cable DFM Marine CK/CCAN)		mA	50/25		
Estimated autonomous operation time until full battery discharge		month	36		
Temperature range of LCD display		°C	-20…+80		
System of units on LCD display			metric (m^3)/US (gallon)/metric (l)		
Output digital interfaces			CAN j1939/S6 (SAE j1939 and NMEA 2000 protocols)		
			RS 232/RS 485 (DFM COM and Modbus RTU protocols)***		
Normalized pulse output	U_{min} (min amplitude)	V	U_{min} ≤0.7 V		
	U_{max} (max amplitude)	V	U_{max} =U_{BATT}, but not more than 36 V, (U_{BATT} - voltage of on-board electrical system)		
	T (period)	ms	100…5400	135…6750	135…6750
	τ (duration)	ms	500 (if T>1 s) and 0.5·T (if T<1 s)		
	Pulse value	m^3/puls	0.000030	0.000075	0.000150
Service digital interface			K-Line (ISO 14230)		

Parameter, measurement units		Model		
		DFM Marine 1000	DFM Marine 2000	DFM Marine 4000
Wireless data transfer interface		Bluetooth 4.1		
Transmitter power (Tx Power)	dBm	+4		
Maximum distance between the flow meter and the receiving device	m	15 (in case of metal/concrete partitions) 45 (when mounted within line-of-sight range)		
Estimated time of operation using the inbuilt battery	months	up to 60****		
Temperature range of operation	°C	-40…+85		

* The value is indicated for reference only. Inaccuracy is not standardized for operation on the starting flow rate.

** If fuel consumption in the range from Q_{min} to $3 \cdot Q_{min}$ and in "Differential"/"Summarization" measurement mode, inaccuracy is not higher than ±1.0 %.

*** Under the order.

**** At a constant ambient temperature of +20 °C.
Under real operating conditions, when the temperature fluctuates, the flow meter's autonomous operating time may be reduced, but it is guaranteed to be at least 24 months.

Valid only for wireless type models DFM Marine S7.

For configuration of flow meters with interface cables using cable connection and PC (models DFM Marine CK/CCAN), S6 SK service adapter (purchased separately) and Service DFM Marine service software are used (the current version of the service software can be downloaded at https://www.jv-technoton.com/, section Software/Firmware).

For wireless configuration of flow meters with interface cables using Android devices (DFM Marine CK/CCAN models), S6 BT Adapter service adapter (purchased separately) and Service S6 DFM (Android) service mobile application are used. Its current version can be downloaded from Google Play, search request "Technoton".

For viewing indications of wireless fuel flow meters on the display of a smartphone/tablet (DFM Marine S7 models) by means of S7 Technology (Android platform), **Fuel Rate Monitor** application is used (see the User manual).

A user may also download the application from Google Play (search request "Technoton").

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

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

1 DFM Marine general information and technical specifications

1.1 Purpose of use and application area

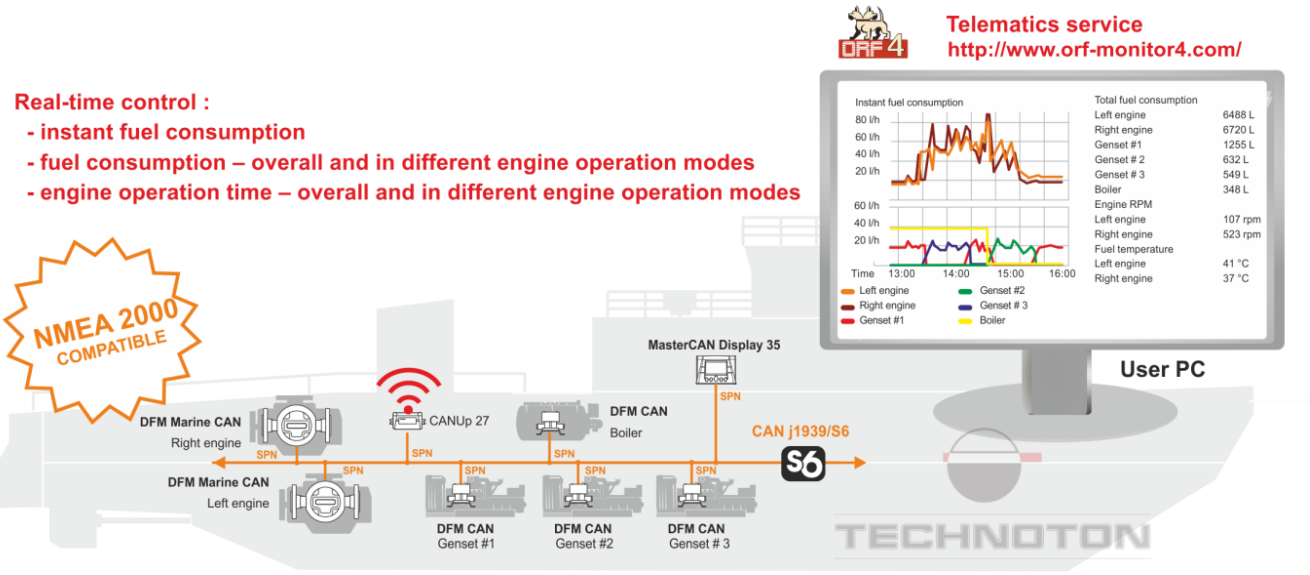
1.1.1 Fuel flow meters with interface cables and independently operating flow meters

DFM Marine C/CK/CCAN **fuel flow meters are designed for** (see figure 2):

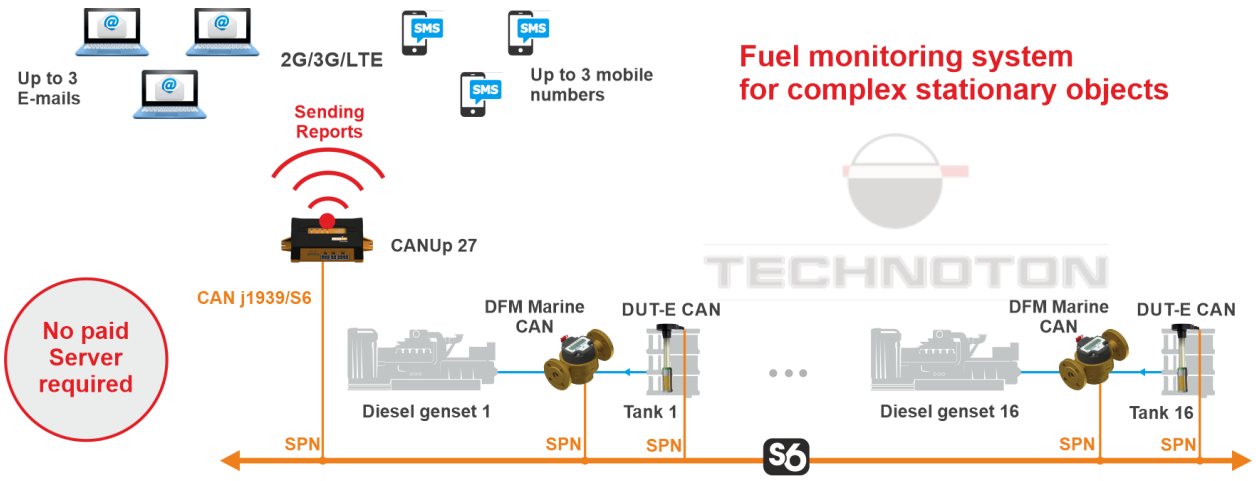
- fuel consumption measurement in fuel lines of powerful engines of vehicles and stationary units;
- monitoring operation time of fuel consumer.

Figure 2 — Purpose of DFM Marine fuel flow meters

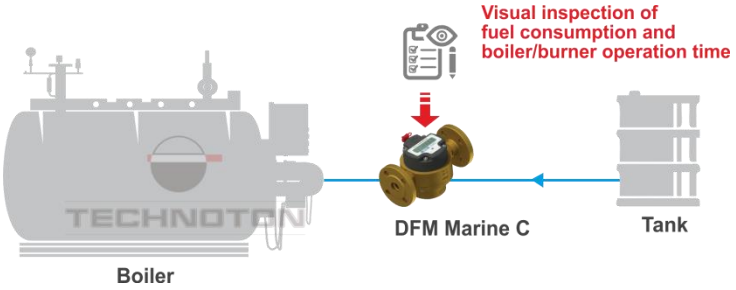
Application areas (see figure 3)
1) DFM Marine fuel flow meters can be used as part of Telematics system of complex mobile and stationary objects (ships, diesel locomotives, diesel generator sets, boiler equipment, etc.).



a) using DFM Marine CAN as part of the Telematics system on a complicated mobile facility



b) using DFM Marine CAN as part of the Telematics system on a complicated fixed facility



c) independent operation of DFM Marine C

Figure 3 — Examples of areas of application of DFM Marine fuel flow meters with interface cables and of independently operating fuel flow meters

DFM Marine CK/CCAN installed into a fuel line of fuel consumer, measures hourly (instant) fuel consumption and generates output signal, which is sent to Telematics unit.
Availability of CAN j1939/S6 interface allows to connect 240 pcs. of DFM Marine CCAN* flow meters and 16 pcs. of DUT-E CAN / DUT-E 2Bio fuel level sensor combined in a single network using S6 Technology to just one CAN-port of Telematics unit (for example, to CANUp 27 online telematic gateway).
Terminal unit gathers, registers, stores received signals and transfers them to telematic Server. Software installed on the Server generates Analytical reports, which allow time-related route control and Vehicle fuel consumption monitoring via web-browser (see figure 4).
DFM Marine **with CAN j1939/S6 interface** provide real-time control over extended set of information:

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

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* For DFM Marine CCAN with the version of firmware not lower than 6.30, with using Service DFM Marine software, version from 3.02 and higher or Service S6 DFM (Android) mobile application, version from 2.01 and higher.

**When used a pair of DFM Marine CAN.

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

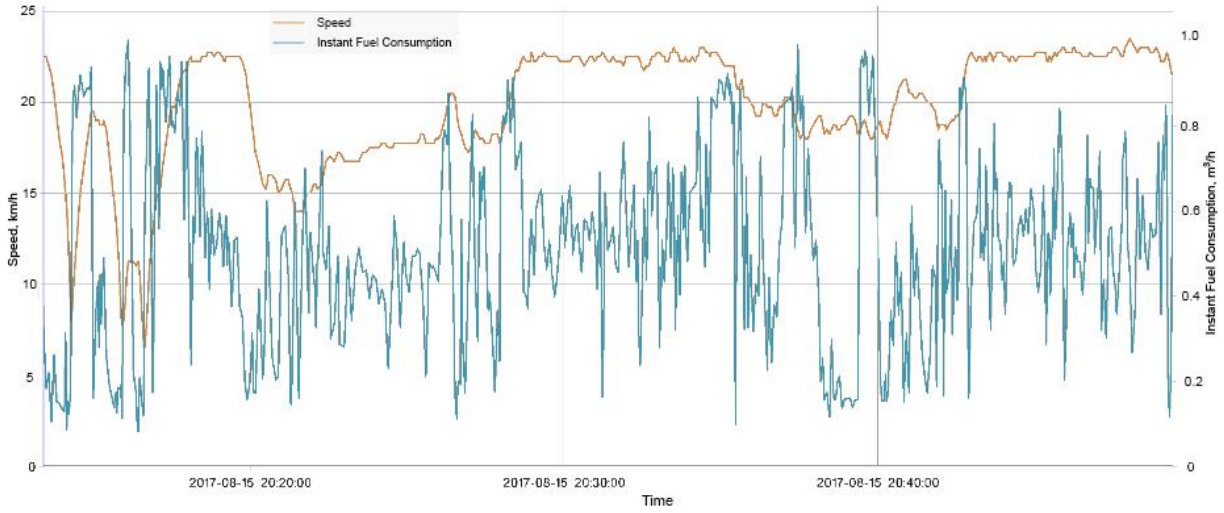


Figure 4 — Example of Analytical Report generated in ORF 4 software, based on the DFM Marine CAN data

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

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

1.1.2 Wireless fuel flow meters

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

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

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

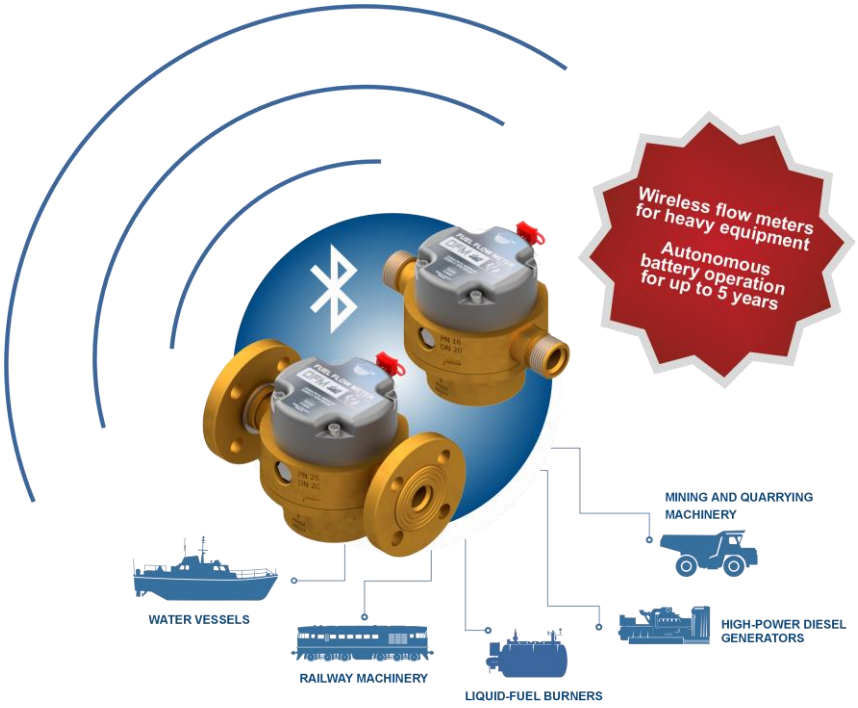


Figure 5 — Purpose of DFM Marine S7 wireless fuel flow meters

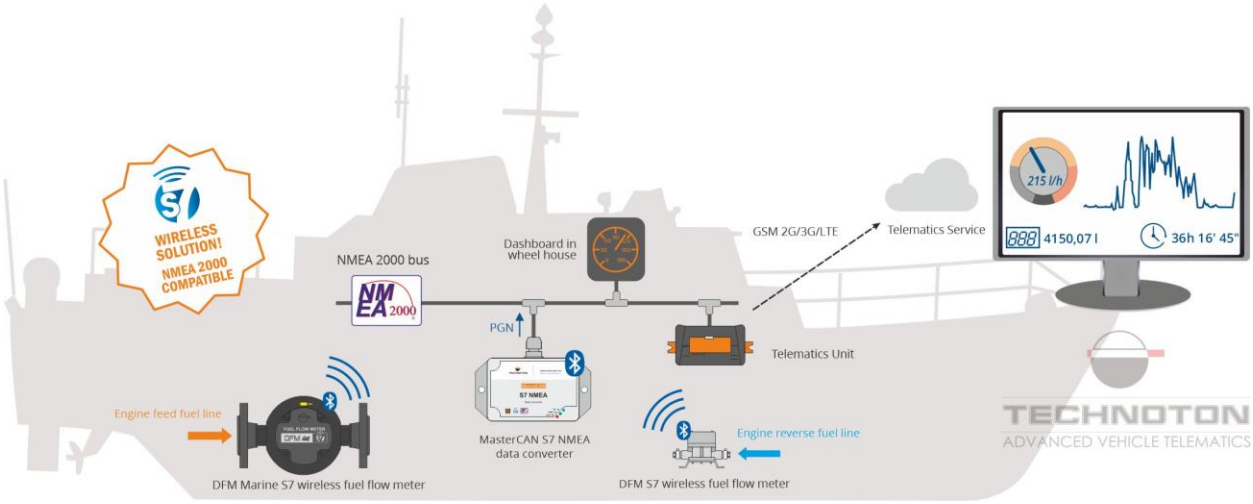
Application areas: DFM Marine S7 wireless flow meters are mounted in the fuel line of the engine (Fuel consumer) for monitoring fuel consumption and time of operation independently and/or as part of the Telematics system (including that without using services of the Server):

- in high power mobile equipment (vessels, locomotives, mining and quarry equipment etc.) (see figure 6 a);
- in complicated fixed facilities (diesel generator sets, liquid fuel boiler equipment etc.) (see figure 6 b).

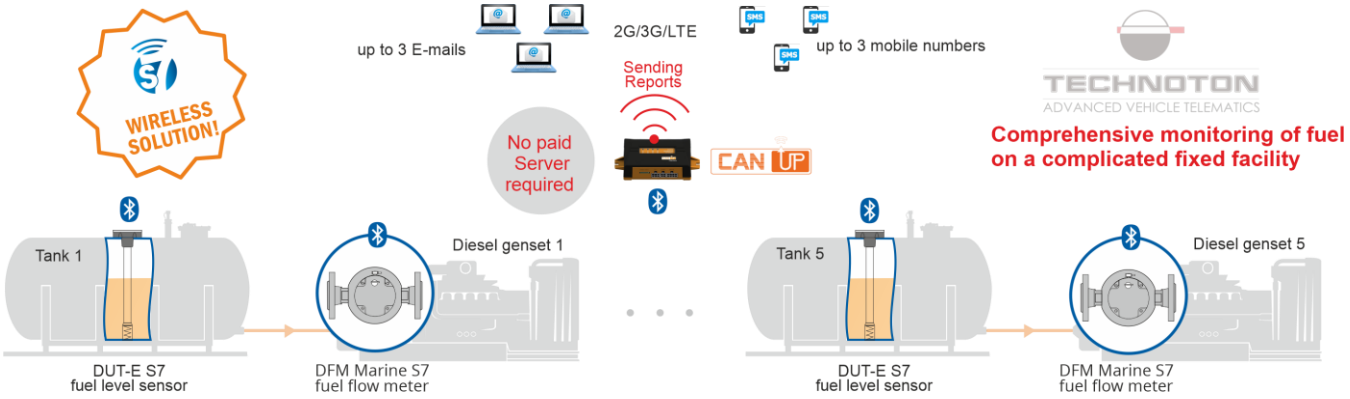
Due to the availability of the inbuilt BLE-module, up to 10 pcs. of wireless Units (e.g. DFM Marine S7 fuel flow meters together with DUT-E S7 fuel level sensors) may operate together at the same time by means of S7 Technology with CANUp 27 Pro Telematics gateway (see figure 6 b). In accordance with its settings, the gateway generates and transmits Onboard reports to the Telematics Server or directly to the user, without using the services of the Server (by e-mail or in the form of SMS messages).

The Onboard reports contain important performance Parameters of the equipment (e.g. instant and trip fuel consumption, total fuel consumption, RPMs, fuel level, engine operation time, engine temperature, oil pressure and level and other parameters). Server software processes and analyzes the received data to generate Analytical reports for a selected period.

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



a) wireless monitoring of fuel consumption and operation time of the vessel engine



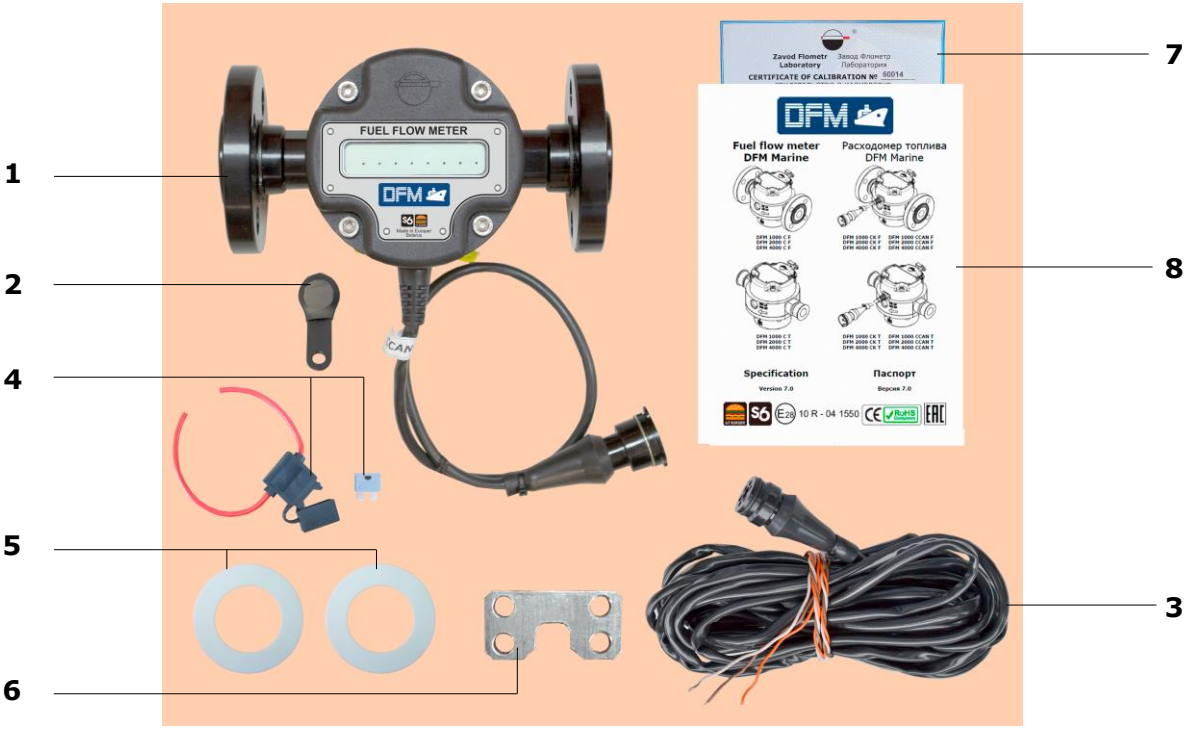
b) wireless monitoring of fuel consumption and operation time of the diesel generators set

Figure 6 — Examples of areas of application for DFM Marine S7

The application of DFM Marine fuel flow meters enables to solve efficiently issues of:

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

1.2 Exterior view and delivery set



1	DFM Marine fuel flow meter	– 1 pc.;
2	Magnetic key	– 1 pc.;
3	Signal cable CABLE DFM 98.20.003 (7.5 m)*	– 1 pc.;
4	Fuse with holder (2 A)**	– 1 pc.;
5	PTFE gasket***	– 2 pcs.;
6	Fastening bracket	– 1 pc.;
7	Calibration certificate	– 1 pc.;
8	Specification with a card containing description of informational screens and sample of flow meter operation journal	– 1 pc.

Figure 7 — DFM Marine C/CK/CCAN delivery set

* Only for DFM Marine CK meters with pulse interface output.
For DFM Marine CAN, S6 SC-CW-700 signal cable is purchased separately.
** Not applicable for autonomous DFM Marine C.
*** Supplied only with DFM Marine C/CK/CCAN with flange connection.

1	DFM Marine S7 fuel flow meter	– 1 pc.;
2	Magnetic key	– 1 pc.;
3	Specification with a card containing sample of flow meter operation journal	– 1 pc.;
4	Calibration certificate	– 1 pc.;
5	PTFE gasket*	– 2 pcs.;
6	Fastening bracket	– 1 pc.

Figure 8 — DFM Marine S7 delivery set

* Supplied only with DFM Marine S7 with flange connection.

1.3 DFM Marine models

DFM Marine fuel flow meters is represented by the following **models**:

1) By output interface:

- autonomous fuel flow meters with display;
- fuel flow meters with display and interface cable:
  - with pulse output (normalized pulse);
  - with digital CAN j1939/S6 interface.
- wireless fuel flow meters with data transfer via Bluetooth 4.X Low Energy (BLE).

2) By connection type to fuel line:

- flange – rotating flanges, according to DIN 2501;
- thread – male pipe thread, according to DIN 259, ISO R228.

3) By type of body and connection materials:

- duralumin;
- brass.

1.3.1 Autonomous fuel flow meters with display

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

*a) duralumin body, thread connection (**TA** modification)*

*b) duralumin body, flange connection (**FA** modification)*

*c) brass body, thread connection (**TL** modification)*

*d) brass body, flange connection (**FL** modification)*

Figure 9 — Exterior of autonomous fuel flow meters with display

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

1.3.2 Fuel flow meters with display and interface cable

Fuel flow meters with display and interface cable (**DFM Marine CK/CCAN** models) (see figure 10) can be used autonomously and as a part of the Telematics system.

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

*a) duralumin body, thread connection (**TA** modification)*

*b) duralumin body, flange connection (**FA** modification)*

*c) brass body, thread connection (**TL** modification)*

*d) brass body, flange connection (**FL** modification)*

Figure 10 — Exterior of fuel flow meters 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 Marine CK**).
In CAN j1939/S6 digital interface (**DFM Marine CCAN**) contain fuel consumption data together with Counters values, data on engine operation modes, flow meter Parameters and malfunctions, Events.

1.3.3 Wireless fuel flow meters

Wireless fuel flow meters (model **DFM Marine S7**) (see figure 11) can operate both independently, and as part of the Telematics system.

*a) duralumin body, thread connection (**TA** modification)*

*b) duralumin body, flange connection (**FA** modification)*

*c) brass body, thread connection (**TL** modification)*

*d) brass body, flange connection (**FL** modification)*

Figure 11 — Exterior of wireless fuel flow meters

The wireless flow meter continuously broadcasts in the "advertising" mode (BLE-radio) fuel consumption readings, data of Counters, information on Events, on modes of the engine operation, on the flow meter Parameters and malfunctions).
The data can be received by means of S7 Technology by all accessible devices within the range of the transmitting device of the flow meter BLE-module.

1.4 Measurement range and accuracy

Table 1 — Measurement range and accuracy of DFM Marine flow meters

Model (by size)	Starting flow rate, m^3/h	Minimum flow rate (Q_{min}), m^3/h	Maximum flow rate (Q_{max}), m^3/h	Relative accuracy error, %, not more than***
DFM Marine 1000	0.01*	0.02	1	±0.5**
DFM Marine 2000	0.02*	0.04	2	
DFM Marine 4000	0.04*	0.08	4	

* 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.

** In "Differential"/"Summarization" measurement mode, inaccuracy is not higher than ±1.0 % (depending on the proportion of fuel consumption in chamber of each flow meter used).

*** If fuel consumption in the range from Q_{min} to $3 \cdot Q_{min}$, the allowed inaccuracy is not more than ±1.0 %, for "Differential" and "Summarization" fuel consumption modes – not more than ±2.0 %.

RECOMMENDATION: In case the average flow rate in engine is close to the upper capacity limit of a certain DFM Marine model it is recommended to use DFM Marine 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 Marine operating life.

1.5 Unit structure and operation principle

DFM Marine consists* of the ring-type measuring chamber (**1**), the measuring "head" (**2**) with a display and the electronic module with the independent power supply battery located inside, the body with the connection (rotating flanges or fittings with male pipe thread) (**3**) and with vent valve (**4**), interface output cable (**5**) with connector (**6**) (see figure 12).

Note — The DFM Marine S7 measuring "head" does not have a display, but contains a BLE module for wireless data transmission using S7 Technology.

Figure 12 — DFM Marine components

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

The principle of DFM Marine operation is based on measurement of fuel volume that passes through its measuring chamber. Due to the pressure of fuel coming through the flow meter inlet fitting into the inlet hole of the measuring chamber, the ring slides along the inner surface of the chamber and at the same time along the jumper. The ring pushes the fluid out of the chamber through the outlet hole to the outlet fitting (see figure 13).

The volume of fluid equal to the chamber volume is pushed out during the full single turn of the ring. The flow meter electronic unit automatically adds the fuel volume increment to the accumulating Counter; this fuel volume is equal to the volume of the measuring chamber (see animation on DFM fuel flow meter operational principle).

Figure 13 — DFM Marine measuring chamber operation scheme

* Structure is shown in an instance of DFM Marine CCAN.

When using DFM Marine CK/CCAN as part of the Telematics system, the flow meter interface cable is connected to the respective input of the Terminal (recording device).

In the passport of a flow meter with pulse output (DFM Marine CK) the pulse value of the output signal **N** $_{m^3/imp}$ is indicated (i.e. the value of the measured volume of fuel corresponding to one flow meter output pulse). The passport indication of the pulse value is entered into the respective settings of the software at the Server.

Distinctive design features of DFM Marine fuel flow meters:

- DFM Marine 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 brass, which is durable and corrosion-proof;
- straight segments of fuel line at input and output of flow meter are not necessary for correct operation of measuring chamber;
- electronic part of DFM Marine can be disconnected without dismounting flow meter from the fuel line;
- large-size fuel flow passage reduces hydraulic friction of the fuel stream;
- DFM Marine sensitivity to hydraulic shocks in fuel line is decrease by improved magnetic scheme and broad configuration options (with service software), also allowing to achieve higher accuracy.

1.6 Technical specifications

1.6.1 Working fluids

DFM Marine can be used for following fluids flow measurement:

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

ATTENTION:

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

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

3) Foreign inclusions size in the liquid should not be more than **0.250 mm** (for DFM Marine 1000) and **0.400 mm** (for DFM Marine 2000 and DFM Marine 4000).

4) DFM Marine 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).

5) When measuring liquid **+95...+150 °C** and ambient temperature is **higher than +50 °C**, it is recommended to use **fan** (should be purchased separately) for cooling down flow meter's electronic unit.

1.6.2 Main specifications

Fuel flow meters with interface cable (DFM Marine CK/CCAN models) are supplied with electrical power from onboard vehicle power source.
Power is supplied for wireless (DFM Marine S7 model) and independent (DFM Marine C model) flow meters only from the inbuilt battery.

Table 2 — DFM Marine main specifications

Parameter, measurement units	Value		
	DFM Marine 1000	**DFM Marine 2000**	**DFM Marine 4000**
Maximum pressure for flange connection, bar	25		
Maximum pressure for thread connection, bar	16		
Type of male connection thread (BSP), inch	3/4	1	1 1/4
Distance of flange holes, mm	65	75	85
Kinematic viscosity range of the measured fluid, mm^2/s (cSt)	1.5…6.0		
Maximum temperature of working fluid, °C	+95*		
Supply voltage range, V	10…45		
Current consumption at 12 V/24 V, mA, not more than	50/25		
Ambient operation temperature range, °C	-20…+80		
Wireless data transfer interface	Bluetooth 4.1		
Transmitter power (Tx Power), dBm	+4		
Maximum distance between flow meter and receiving device, m	15 (in case there are metal/concrete partitions in the mounting location) 45 (when mounted within line-of-sight range)		
Data transfer interval, s	5		
Flow meter autonomous operating time from the built-in battery, years	up to 5***		
Ambient operation temperature range, °C	-40…+85		
Certificates of BLE module electromagnetic compatibility	FCC and IC (see E.2), CE / TELEC / BQE		
Vibration resistance	max. acceleration to 100 m/s^2 in the frequency range from 5 to 250 Hz		
Resistance to aggressive environments	oil and petrol resistance		
Electromagnetic compatibility**	see E.1		
Ingress protection rating	IP54		
Overall dimensions	see annex A		
Weight			

* Any model of flow meter can be made for measuring liquid with maximum temperature of +150 °C.
** For DFM Marine CK/CCAN models.
*** At a constant ambient temperature of +20 °C.
Under real operating conditions, when the temperature fluctuates, the flow meter's autonomous operating time may be reduced, but it is guaranteed to be at least 2 years.

Valid only for wireless DFM Marine S7 models.

1.6.3 Specifications of measuring chambers

Table 3 — Specifications of DFM Marine measuring chambers

Flow meter capacity model	Nominal diameter (DN), mm	Nominal volume of the measuring chamber, ml	Re-calibration interval, m³
DFM Marine 1000	15	30	1200*
DFM Marine 2000	20	75	2800*
DFM Marine 4000	25	150	5250*
* See 7			

1.6.4 Power supply modes

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

- **Stand-alone power supply** (**DFM Marine S7 / DFM Marine C** models) DFM Marine is powered from the built-in lithium-silicon battery.
  Estimated time of DFM Marine S7 operation until the complete battery discharge is no less than 60 months.
  Estimated DFM Marine C operation time until full battery discharge is not less than 36 months.

- **Combined power supply** (**DFM Marine CK/CCAN** models) — DFM Marine 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 8 V).
  Estimated DFM Marine operation time in this mode is not less than 36 months.

ATTENTION: During the time when power supply from vehicle on-board power network is off DFM Marine CK/CCAN automatically enable option of data readings recording into internal meter memory. When powered from internal battery this fuel flow meters 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 Marine fuel flow meters

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

WARNING: You can edit limits of operation modes for flow meters with interface cables using Service DFM Marine software or Service S6 DFM (Android) mobile application in settings of the submenu **Flow meter Marine FM** (see F.4).

1.6.6 Displayed data

Informational screens of DFM Marine's C/CK/CCAN display (see table 5) are switched when surface under the display is tapped with a magnetic key (see figure 14).

Figure 14 — Switching DFM Marine C/CK/CCAN display information screens

In order to save the charge of the built-in battery the DFM Marine display goes to sleep mode one minute after the last touch of the cover by the magnetic key. At the same time dots are shown on the display (see figure 15).

Figure 15 — DFM Marine C/CK/CCAN display view in sleep mode

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

In case there is a need of continuous viewing of readings on the flow meter display, uncheck **Enable Sleep Mode** box in the submenu **Display Marine FM** (when using Service DFM Marine software) (see F.2) or move left the slider contact **Sleep Mode**, (when using Service S6 DFM (Android) mobile application). After saving profile changes in the Unit, the flow meter display will not switch into the sleep mode anymore.

Keep in mind, that when "sleep" mode is switched off, current consumption of flow meter is increased. Long-term operation of flow meter from its built-in battery (without external power supply) will lead to shorter lifetime of the battery.

Table 5 — DFM Marine C/CK/CCAN display information screens

Screen No	Displayed data	Digit capacity	Units	
			Metric System of Measures	US System of Measures
1	"Total Fuel Consumption" Counter	0.0001	m³	gal
		0.1	l	
2	"Total Fuel Consumption" Counter with higher digit capacity	0.000001	m³	gal
		0.001	l	
3	"Engine Operation Time" Counter	0.1	h	h
4	"Engine Operation Time" in "Idle" Mode Counter	0.1	h	h
5	"Engine Operation Time" in "Optimal" Mode Counter	0.1	h	h
6	"Engine Operation Time" in "Overload" Mode Counter	0.1	h	h
7	"Engine Operation Time" in "Tampering" Mode Counter	0.1	h	h
8	"Engine Operation Time" Counter. Clearable	0.1	h	h
9	"Total Fuel Consumption" Counter. Clearable	0.0001	m³	gal
		0.1	l	
10	"Total Fuel Consumption" Counter. Tampering Mode	0.0001	m³	gal
		0.1	l	
11	"Interference Time" Counter	0.1	h	h
12	"Instant Fuel Consumption"	0.0001	m³/h	gal/h
		0.1	l/h	
13*	"Total Differential Fuel Consumption" Counter	0.0001	m³	gal
		0.1	l	
14*	"Instant Differential Fuel Consumption"	0.0001	m³/h	gal/h
		0.1	l/h	
15	"Battery Charge in Percentage of the Maximum"	1	%	%
16	"Temperature in the Measuring Chamber"	1	°C	°F
17	"Firmware Version"	-	X.X	

* Only for DFM Marine CCAN.

The required system of measurement units can be configured in the appropriate field of **Display Marine FM** submenu (see F.2) using the service software, or mobile application or **Desktop** window (see figure 34).

After saving profile changes to the Unit, data on the flow meter's display will be displayed in accordance with the specified system.

Screen 1 displays **"Total Fuel Consumption"** Counter value accumulated since DFM Marine release.

Screen 2 displays **"Total Fuel Consumption value with higher digit capacity"** Counter, accumulated since DFM Marine release. Reading accuracy is increased by one decimal.

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

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

Screen 7 displays the Counters readings of **"Engine Operation Time in "Tampering" Mode"** accumulated by DFM Marine as a total time of engine operation when consumption was higher that maximum possible (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 readings of **"Engine Operation Time. Clearable"**, which was accumulated as a total time of engine operation in all modes, including idling. Counter data could be reset using service software or service mobile application (only for the models DFM Marine CK/CCAN) or by applying a magnetic key (3…5) s to a switching zone of DFM Marine's cap when Screen 8 is active.

IMPORTANT: For the models DFM Marine CCAN, clearable Counters (Screens 8 and 9) can be also reset by sending PGN 63080 command by means of S6 Technology to the respective flow meter (see annex D).

Screen 9 displays the Counter readings of **"Total Fuel Consumption. Clearable"**, which was accumulated by DFM Marine since its production. Counter data could be reset using service s software or service mobile application (only for the models DFM Marine CK/CCAN) or by applying a magnetic key (3…5) s to a switching zone of DFM Marine's cap when Screen 9 is active.

Screen 10 displays the Counter readings of **"Total Fuel Consumption. "Tampering" Mode"** accumulated by DFM Marine 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 11 displays the Counter readings **"Interference Time"** accumulated by DFM Marine 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 12 "Instant Fuel Consumption" displays current value of fuel consumption. It can serve for a visual check of device operability and its correct installation.

Screen 13 displays **"Total Differential Fuel Consumption"** counter value, accumulated in differential mode (see 2.11) by DFM Marine installed in fuel supply line (Master Flow meter), while used in pair with DFM Marine installed in fuel reverse line (Slave Flow meter).

Note — When Slave-flow meter is disconnected, Counter increase is paused, and Master-flow meter's display will look like it has switched to "Tampering" mode (see figure 16).

Screen 14 "Instant Differential Fuel Consumption" displays current differential fuel consumption (a difference between fuel consumption in chamber of each flow meter) on display of DFM Marine installed in fuel feed line (Master Flow meter) and operating in pair with DFM Marine installed in fuel reverse line (Slave Flow meter) (see 2.11).

Note — If Slave Flow meter is disconnected, current differential fuel consumption will not be displayed. Master Flow meter's display will show screen similar to "Tampering" mode screen (see figure 16).

Screen 15 "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 16 "Temperature in the Measuring Chamber" displays current temperature value in the measuring chamber of the fuel flow meter.

Screen 17 "Firmware Version" displays the firmware version (X.X) installed on the fuel meter.

If needed, you may deactivate displaying any information screens that are not used in the submenu **Display Marine FM** (see F.2) using the service software or mobile application. To do that, in **Enabled screens** area uncheck the boxes near the corresponding screens. After saving the profile changes to the Unit, disabled informational screens will not appear on flow meter's display.

1.6.7 DFM Marine protection from tampering and intervention

In order to avoid false readings, meter damage or blocking DFM Marine 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 Marine 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 Marine C/CK/CCAN displays dashes being in "Tampering" Mode (see figure 16).

Figure 16 — DFM Marine C/CK/CCAN 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 Marine 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 Marine 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 Marine displays vertical strokes in "Interference" Mode (see figure 17).

Figure 17 — DFM Marine C/CK/CCAN display view in "Interference" Mode

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

ATTENTION: Indications of the Counters "Total fuel consumption in the "Tampering" mode" and "Time of interference" are accumulated and saved in the internal memory of DFM Marine flow meter throughout the whole period of its service life.
Data on Events during the external power supply of DFM Marine CK/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 for models **DFM Marine CK/CCAN** when external power supply is off. Flow meter is powered by own battery. Embedded battery ensures autonomous functioning within 36 months.

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

1.6.8 Pulse output signal specifications

Each pulse generated by flow meters with **normalized output pulse** (**DFM Marine CK** model) corresponds to the fuel volume value which is equal to the nominal volume of the measuring chamber of a specific flow meter (see 1.6.3) which is called **pulse value**.
The pulse value **N m^3/pulse** (see table 6) is indicated in the flow meter passport.

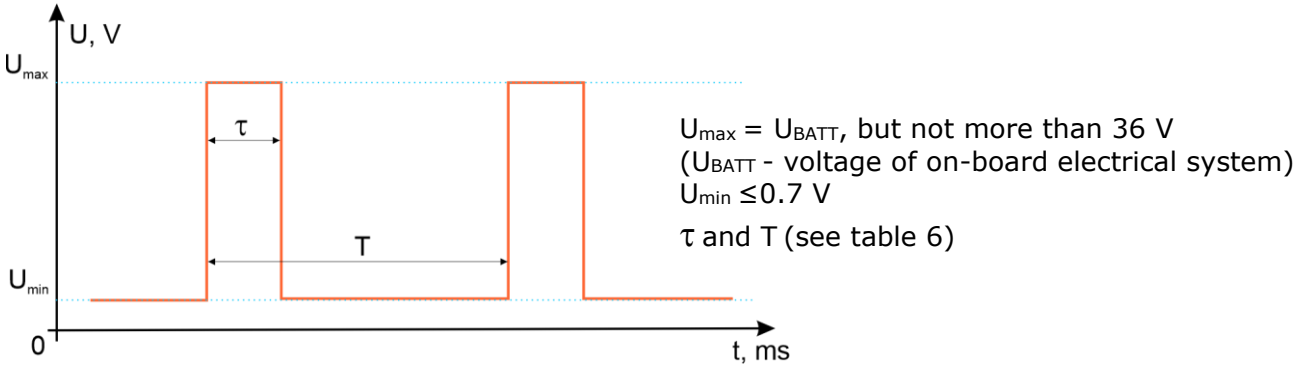


Figure 18 — Pulse output signal shape of DFM Marine CK models

Table 6 — Parameters of normalized pulse of DFM Marine CK models

Model	Pulse period, T, ms	Pulse duration τ, ms	Pulse value, N m^3/pulse
DFM Marine 1000CK	100…5400	0.5·T (if T<1 s) 500 (if T>1 s)	0.000030
DFM Marine 2000CK	135…6750		0.000075
DFM Marine 4000CK	135…6750		0.000150

1.6.9 CAN j1939/S6 digital interface specifications and protocols

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

The user configuration of CAN j1939/S6 is performed by means of K-Line interface (ISO 14230) using Service DFM Marine service software or Service S6 DFM (Android) service mobile application (see 2.8).

DFM Marine CCAN fuel flow meters support data transfer via SAE j1939 and NMEA 2000 protocols. The data composition of the flow meters output messages that are transmitted via CAN j1939/S6 interface is provided in annex D.

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

S6 Technology enables to connect at one time up to 240 pcs. of DFM Marine CCAN fuel flow meters to form a single network. The unique network address (SA) must be specified for each connected flow meter. The recommended ranges for addresses — 111…118 (basic range) and 151…158* (additional range) (default address is 111). In case you need, other addresses from 0…240* range are allowed to be selected.

Using PGN 63080 command, you can reset the Counters "Flowmeter. Engine Total Hours of Operation. Clearable" (PGN 63167) in the internal memory of DFM Marine CCAN flow meters via CAN j1939/S6 interface (see annex D for example).

IMPORTANT: The obligatory condition for correct data transfer by DFM Marine CCAN flow meters is the availability of two **120 Ohm** terminal resistors fixed at the ends of CAN 2.0B (SAE j1939) communication line between CAN LOW and CAN HIGH wires.

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* For DFM Marine CCAN with the version of firmware not lower than 6.30, with using Service DFM Marine software, version from 3.02 and higher or Service S6 DFM (Android) mobile application, version from 2.01 and higher.

1.6.10 Data composition of DFM Marine S7 output messages

DFM Marine S7 wireless fuel flow meter transmits data by means of S7 Technology, without integration with receiving devices and without acknowledgement of data reception.
The data in the form of Advertising packets are transmitted automatically with 5 s periodicity in the continuous data transfer mode. The structure of the data packet transmitted by DFM Marine S7 is provided in figure 19.

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

Figure 19 — Structure of data packet transmitted by DFM Marine S7

The application layer of the output messages protocol of DFM Marine S7 conforms with S6 Database (see table 7).

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

Table 7 — Data composition of DFM Marine S7 output messages

Field number	Length	Parameter	Name
1) Flowmeter Marine. Parameters PGN 63517 (0xF81D)			
1	4 bytes	SPN 521313	Engine Fuel Rate
5	4 bytes	SPN 521313/2.1	Engine Fuel Rate. Mean
9.1	4 bits	SPN 521181	Engine Mode by Fuel Rate
10	1 byte	SPN 174	Engine Fuel Temperature 1
11	2 bytes	SPN 521463/9.5	Flowmeter Hours Of Operation. Interference
13	4 bytes	SPN 521488	Unit DTCs Mask* (see table 9)
17	4 bytes	SPN 521493	Unit Events Mask* (see table 10)
21	1 byte	SPN 521061	Battery Charge Level
2) Flowmeter Marine. Total Consumption PGN 63518 (0xF81E)			
1	4 bytes	SPN 521314	High Resolution Engine Total Fuel Used
5	4 bytes	SPN 521314/9.0	High Resolution Engine Total Fuel Used. Idle
9	4 bytes	SPN 521314/9.1	High Resolution Engine Total Fuel Used. Optimal
13	4 bytes	SPN 521314/9.2	High Resolution Engine Total Fuel Used. Overload
17	4 bytes	SPN 521314/9.3	High Resolution Engine Total Fuel Used. Cheating
3) Flowmeter. Hours of operation PGN 63289 (0xF739)			
1	4 bytes	SPN 521171	Flowmeter Hours Of Operation
5	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle
9	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal
13	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload
17	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating

Field number	Length	Parameter	Name
4) MAC Address PGN 63558 (0xF846)			
1	6 bytes	SPN 521490	MAC Address
* All Events and malfunctions of the flow meter are recorded from the moment they appear till the moment they disappear, but during the time interval no less than 1 min.			

SPN values of the flow meter output message may be calculated according to the formula (1) using attributes from table 8.

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

Table 8 — Attributes for calculation of current values of DFM Marine S7 parameters

Parameter	Factor (Resolution)	Offset
SPN 521313	0.00001 m³/h	-21474.83647 m³/h
SPN 521181	1	0
SPN 521061	1 %	0 %
SPN 174	1 °C	-40 °C
SPN 521488	1	0
SPN 521314	0.00001 m³	0 m³
SPN 521171	1 s	0 s
SPN 521463	1 s	0 s

Table 9 — Numerical values of malfunction mask (DTCs Mask) DFM Marine S7

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

Table 10 — Digital values of Events mask of DFM Marine S7

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

1.7 DFM Marine and tracking devices compatibility

In case of operation as part of the Telematics system, DFM Marine CK/CCAN may be used together with Telematics terminals or other tracking devices whose inputs are compatible with parameters of DFM Marine output signals, according to 1.6.8 and 1.6.9.

DFM Marine S7 can be used with receiving device (Android smartphones, tablets, Telematics units, GPS trackers and other devices for data receiving, logging and displaying), which have Bluetooth 4.X and high.

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

https://www.jv-technoton.com/ web-page contain a table with up-to-date list of Compatibility declarations of Technoton products and Telematic units of various manufacturers.

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

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

1.8 DFM Marine selection

IMPORTANT: Final decision on possibility to use particular model of DFM Marine should be made by installation specialist after inspection of the engine/burner, where flow meter will be installed.

1.8.1 Selection depending on engine power (boiler output capacity)

Table 11 — DFM Marine selection depending on the engine power (boiler output capacity)

Engine power*, kW	Boiler output*, kW	Recommended DFM model
600…3600	3500…10 000	**DFM Marine 1000**
3600…7300	10 000…20 000	**DFM Marine 2000**
7300…14 700	20 000…40 000	**DFM Marine 4000**
* Data is for reference purpose only. To choose flow meter properly, it is necessary to know maximum and minimum fuel consumption in fuel feed line of fuel consumer.		

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

For differential fuel consumption measurement, a pair of DFM Marine CCAN, connected through CAN j1939/S6 interface (see 2.11). The first flow meter is installed in feed line, the second flow meter in reverse line. Flow meters are selected depending on the flow range in the relevant fuel line (see table 12).

Table 12 — Selection of DFM Marine depending on fuel flow rate values in feed and reverse lines

Minimum flow rate, m^3/h	Maximum flow rate, m^3/h	Recommended models
0.02	1	**DFM Marine 1000**
0.04	2	**DFM Marine 2000**
0.08	4	**DFM Marine 4000**

IMPORTANT:
1) Maximum and minimum fuel flow rate values in feed and reverse lines of the engine can be found in performance specification of the engine fuel pump.
2) During the use of differential measurement for monitoring fuel consumption by the engine with relatively low fuel consumption, but with great consumption in the feed and reverse lines, the measurement error may grow.
3) Counter-indication to install a differential fuel flow meter is the fact of air bubbles presence in feed or reverse fuel lines. A task of removing air from fuel is resolved by installation of **deaeration device (deaerator)**.

2 DFM Marine installation

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

This section contains general recommendations on DFM Marine mounting.

2.1 Exterior inspection prior to works start

It is required to conduct DFM Marine 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 the fuel consumer condition

IMPORTANT:
1) Before staring installation of DFM Marine, carefully read technical specification of the machinery unit (Vehicle/diesel generator/boiler/burner) being equipped, inspect the condition of its fuel and electric systems* and make a conclusion whether it's possible tom ka installation of the flow meter.
2) Make sure, that specifications of fuel system are within a range of main flow meter specification (kinematics viscosity of the liquid, consumption rate, pressure, operating temperature, nominal bore (DN)).

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

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

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

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

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

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

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

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

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

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

* It is allowed not to carry out the electric circuit check of the object to be equipped, in case of mounting wireless (model DFM Marine S7) or independent operation (model DFM Marine C) flow meters.

2.3 General installation instructions

IMPORTANT:
1) Installation and electrical connection of DFM Marine is strongly recommended at a positive ambient temperature.
2) For proper selection of installation place, carefully read technical documentation for the machinery unit.

The following is needed for DFM Marine mounting:

- Hand tools (spanner and socket wrench sets, screwdrivers).
- MK DFM M mounting kit (purchased separately) — only for mounting DFM Marine with thread connection (TA / TL modifications;
- Mounting elements including bolt and flange connectors, O-rings, mounting consumables.
  Note – Appropriate materials are purchased separately for each particular installation case, takin in account type and size of fuel tubes, installation and operation conditions.
- Mud filter (purchased separately).
- Pyrometer or contact thermometer (purchased separately).
- Glycerin filled manometer (purchased separately).
- S6 SK* service adapter (purchased separately) and the PC with the installed Service DFM Marine service software (in case of configuration by means of cable connection) or S6 BT Adapter* service adapter (purchased separately) and the Android device with the installed Service S6 DFM (Android) service mobile application (in case of wireless configuration);
- Signal cable* (see annex I).
- Mobile device (Android tablet or a smartphone) with the installed Fuel Rate Monitor application**.

The following rules must be observed when DFM Marine mounting:

1) Fuel flow meter should be installed in an easy accessible place, reachable for data reading from display and technical maintenance of the device.

2) **Before installation, smoothly close shut-off valves and using a manometer make sure that there is no pressure inside the fuel line!**

3) Prepare fuel tubes and flow meter installation place, taking in account its dimensions. Use additional intermediate element for fuel line, if necessary.

4) To ensure declared accuracy of measurement, it is allowed to install fuel flow meter **in "head up"** position only. Flow meter can be slightly **(up to ±30 degrees**) inclined up or down from its horizontal axis. **Installation of flow meter heading down is not allowed** (see figure 20).

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* In case of mounting flow meters with interface cables (model DFM Marine CK/CCAN).
** In case of mounting wireless flow meters (model DFM Marine S7).

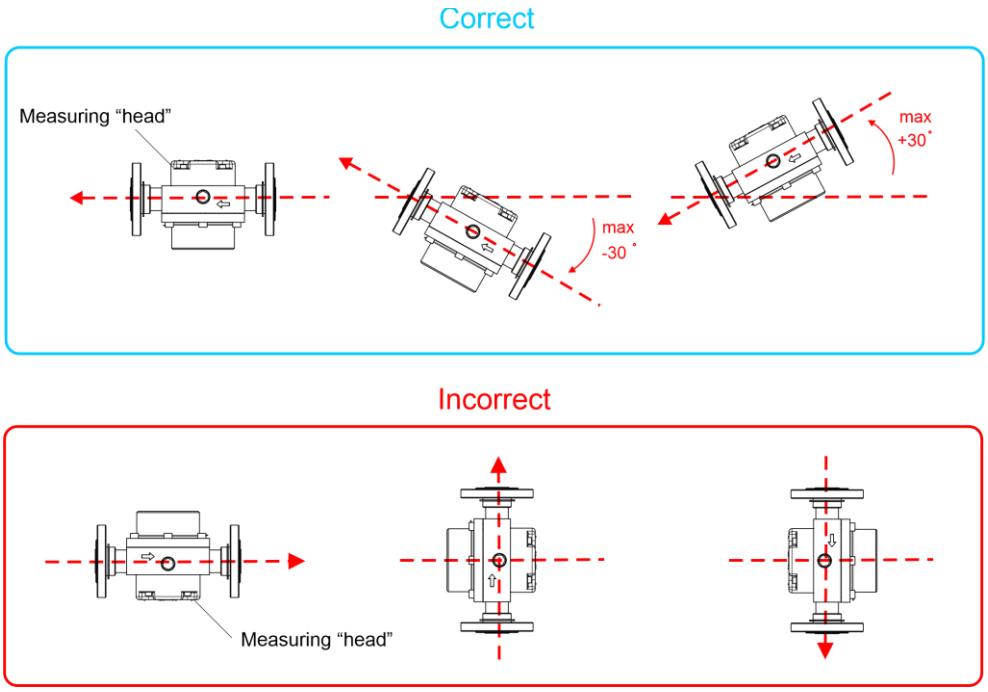


Figure 20 — DFM Marine operating position relatively to horizontal plane

5) To prevent the damaging of DFM Marine measuring chamber, be sure to mount the protecting mud filter in the fuel line right before the fuel flow meter. The mud filter should be mounted in the horizontal position, with its cap down (see figure 21).

The diameter of the mud filter holes — **no more than 0.6 mm**.

It is forbidden to mount DFM Marine without the mud filter!
To detain mechanical impurities or tiny metal particles contained in the fuel, we recommend to use the mud filter with magnetic inserts (see 8.2).

a) filter with a flange connector

b) filter with a thread connector

c) example of the filter connection to the fuel flow meter

Figure 21 — Mud filter

6) Tightening forces of threaded connections when installing flow meter is:

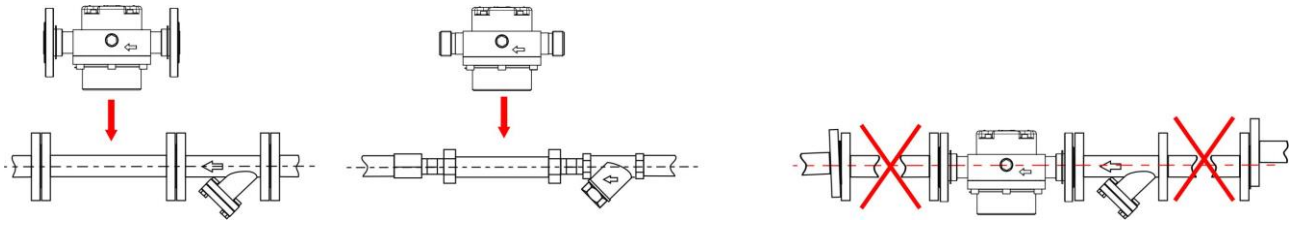
- for M6 thread – 6 N·m;
- for M8 thread – 16 N·m;
- for M12 thread – 47 N·m.

7) **DFM Marine should be installed in a way, that provides fuel flow inside the fuel line will be in the same direction, as the pointing arrow on the body of DFM Marine.**

For proper operation of measuring chamber of DFM Marine, it is not obligatory to have straight fuel line sections before and after the flow meter.
When connecting flow meter to the fuel line, make sure that flanges and threads clean of mud and dirt.

Use new tightening materials (washers and gaskets) only!

When installing DFM Marine with a threaded connection, it is recommended to use duralumin **mounting plate** from the delivery set (see annex H). Mounting holes on DFM Marine body are described in annex A.
Flanges and threads should be connected precisely, without excessive effort, also make sure they are not skewed (see figure 22).



a) with flange connection *b) with thread connection* *c) skewed fuel line*

Figure 22 — Flow meter installation in fuel line

8) After DFM Marine installation make sure that fuel system is tight and let air out of it. Measuring chamber of flow meter should always contain fuel without air in it.

9) Maximum allowed pressure drop after the flow meter is **not more than 0.5 bar**. If a pressure drop after the fuel flow meter is more than 0.5 bar, it is recommended to select DFM Marine of bigger size, which has bigger nominal bore (DN).

10) **To avoid water hammers (hydraulic shocks) in fuel line, valves should be opened and closed smoothly.**

ATTENTION:
1) To avoid exceeding upper boundary of operating temperature range of DFM Marine, measuring head of installed flow meter should be isolated from heat sources.
2) If you spot foam or air bubbles in reverse fuel line of the machinery, it is necessary to additionally install **de-aeration system**.
3) While mounting DFM Marine on vessels and locomotives, **you need to provide an option of temporary switching over fuel supply to the supporting line — bypass** (see 2.4).

2.4 Example schemes of flow meter installation into fuel line

1) Using shut-off return valve

One of the features of diesel engines is its uneven fuel consumption. Additionally, water hammers (hydraulic shocks) inside fuel line can add extra inaccuracy. To compensate water hammer effects and to avoid back fuel flow through DFM Marine, it is necessary to install **return valve** after the flow meter (see figure 23).

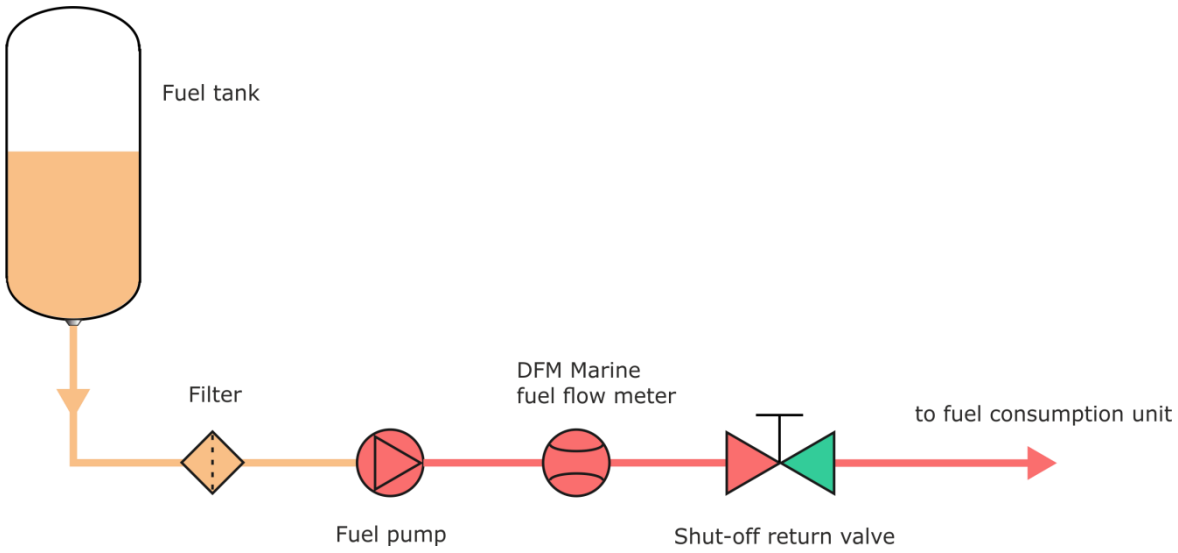


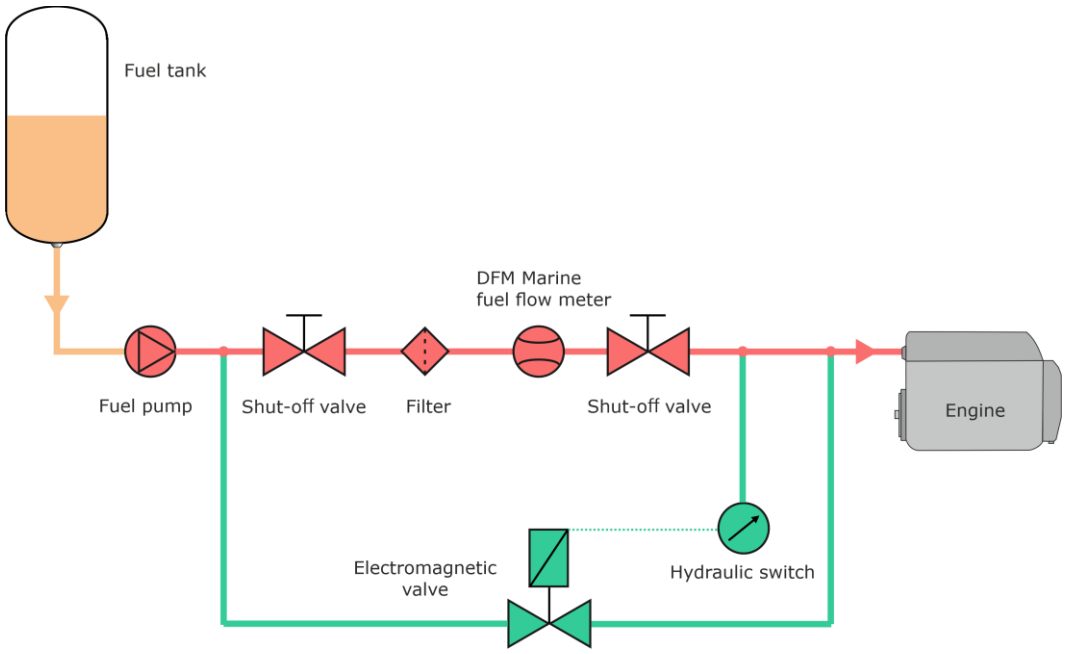
Figure 23 — Using shut-off return valve to increase accuracy and protect DFM Marine against water hammers

2) Additional details for installation on vessels and locomotives

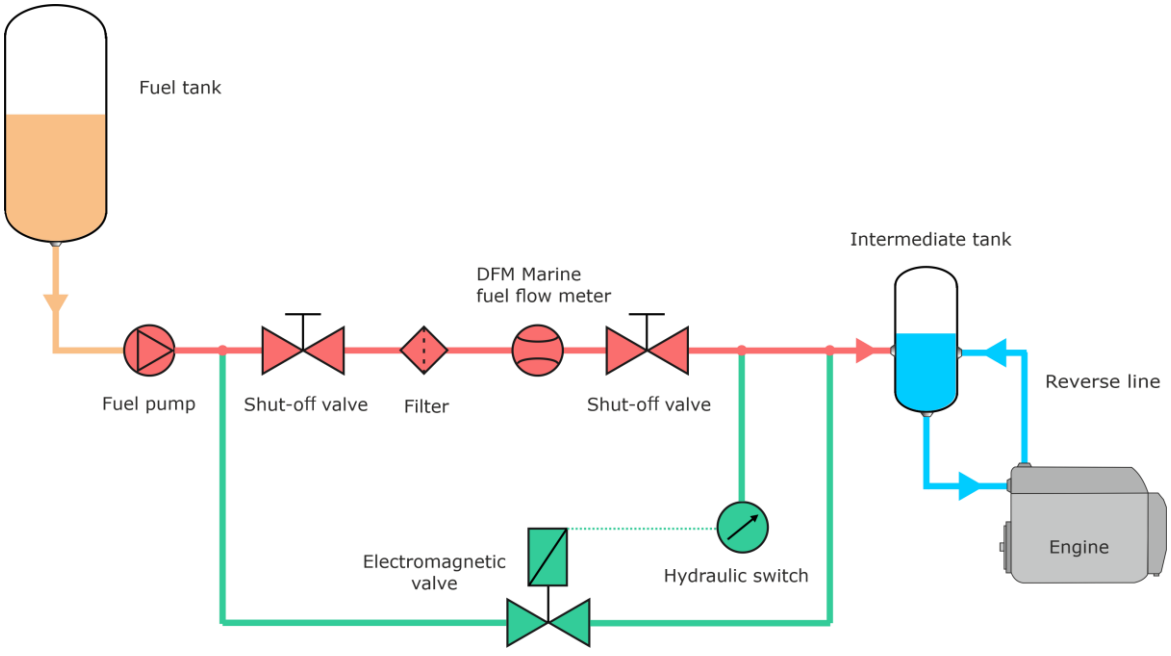
When installing DFM Marine on vessels and locomotives it is very important that fuel feed will be uninterruptable in case of hard clogging of mud filter or during flow meter maintenance. So, **it is necessary to ensure temporary redirection of fuel feed through additional bypass fuel tubes.**

When pressure in fuel line drops below specific value, hydraulic switch cuts off fuel feed though main tube and automatically opens electromagnetic valve on bypass tube. From this point, fuel is supplied through bypass tube in full amount, but without consumption measurement. If you see air bubbles in fuel going through feed and/or reverse line, it is recommended to connect both lines through intermediate fuel tanks to de-aerate the fuel (see figure 24).

If one machinery unit has several engines, you will need to install DFM Marine to fuel feed system of each engine.



a) standard scheme



b) scheme with intermediate tank

Figure 24 — Examples of DFM Marine installations schemes for vessels, using automatic fuel feed redirection through bypass tube

3) Flow meter installation on suction side

DFM Marine installation on suction side of fuel system assumes that fuel flow meter will be installed before fuel pump, where fuel flows due to underpressure created by pump.
To implement scheme of installation on suction side, it might be necessary to modify reverse line of fuel system.

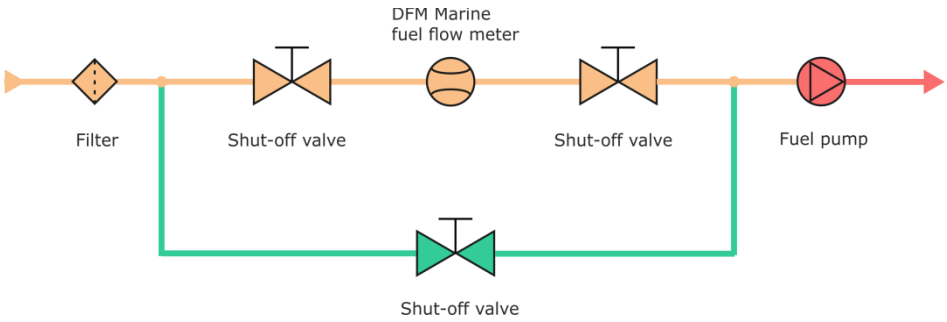


Figure 25 — Example of DFM Marine installation on suction side, using bypass tube

4) Flow meter installation on pressure side

DFM Marine installation on pressure side assumes, that flow meter will be installed in fuel system after the pump, where fuel flows due to pressure created by pump.
To implement scheme of installation on pressure side, it might be necessary to modify reverse line of fuel system.

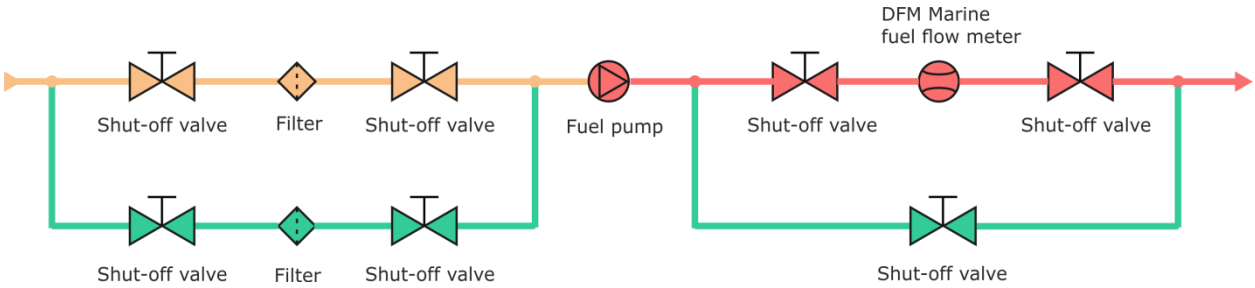


Figure 26 — Example of DFM Marine installation on pressure side, using bypass tube

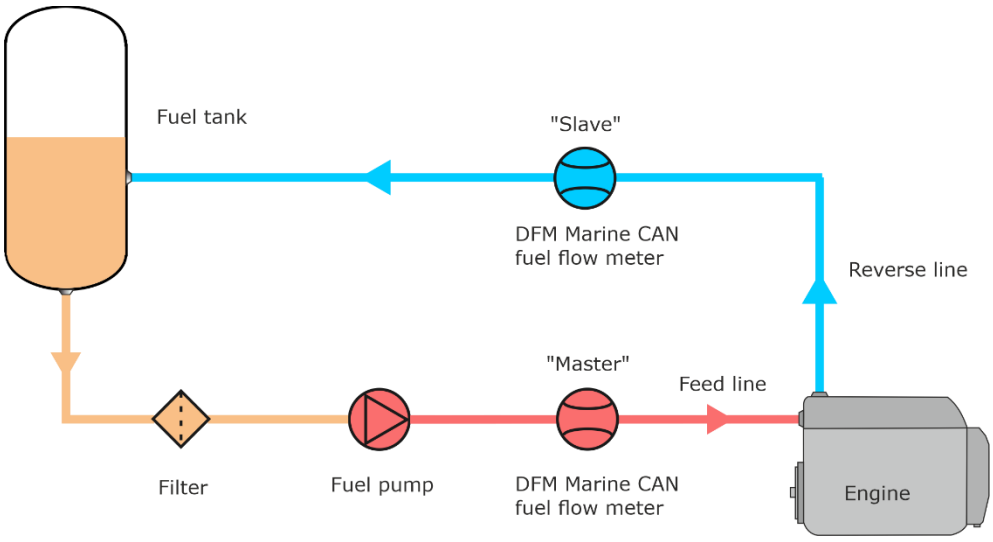
5) DFM Marine installation according to "Differential" and "Summarization" schemes

ATTENTION:
1) To use "Differential" and "Summarization" installation schemes you will need to use a pair of **DFM Marine CAN** flow meters, which are connected into a united network by means of CAN j1939/S6 interface (see 2.11).
2) It is allowed to use a pair of flow meters which have different fuel flow rates (e.g. DFM Marine 4000 for feed line and DFM Marine 2000 for reverse line).

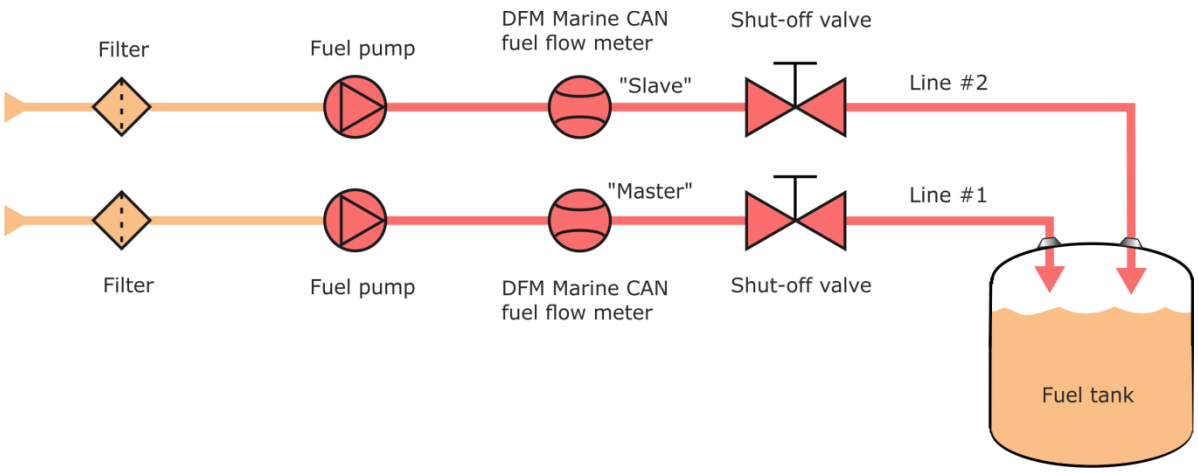
When using "Differential" installation scheme, fuel circulation in fuel system is not changed. The first flow meter (Master) is installed in feed line, the second flow meter (Slave) in reverse line. Differential consumption is defined as difference between measurements of those two DFM Marine CAN flow meters (see figure 27 a).

RECOMMENDATION: Do not use "Differential" scheme if fuel pump capacity is much higher than fuel consumption by engine. In this case the inaccuracy could be higher than acceptable.

DFM Marine CAN fuel flow meters can be also used to summarize consumption of fuel, which goes through two lines (e.g. when stationary tank is refilled). First flow meter (Master) is installed in line #1, second flow meter (Slave) is installed in line #2. Summarized fuel consumption is defined by aggregation of fuel consumption data from both DFM Marine CAN flow meters (see figure 27 b).



a) "Differential" installation scheme



b) "Summarization" installation scheme

Figure 27 — Examples of schemes when a pair of DFM Marine is installed

6) Fuel line ventilation scheme

When cleaning fuel line from mud/dirt with air, it is necessary to ensure that the air will not go through measuring chamber of the flow meter. Before using air, close shut-off valves before and after DFM Marine. After cleaning the tubes, rinse valves with fuel to remove small pieces of dirt.

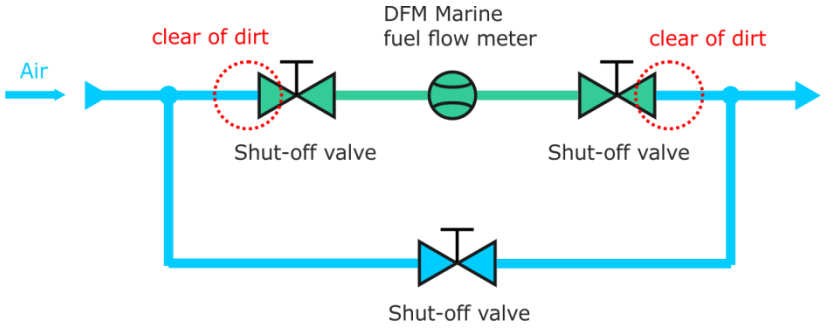


Figure 28 — Scheme of cleaning fuel tubes with air

7) Fuel dispensing scheme

When dispensing fuel, the valve is installed between flow meter and fuel line outlet. Short segment of fuel line between valve and outlet will provide higher accuracy. Taking in account possible water hammers, open and close valves smoothly.

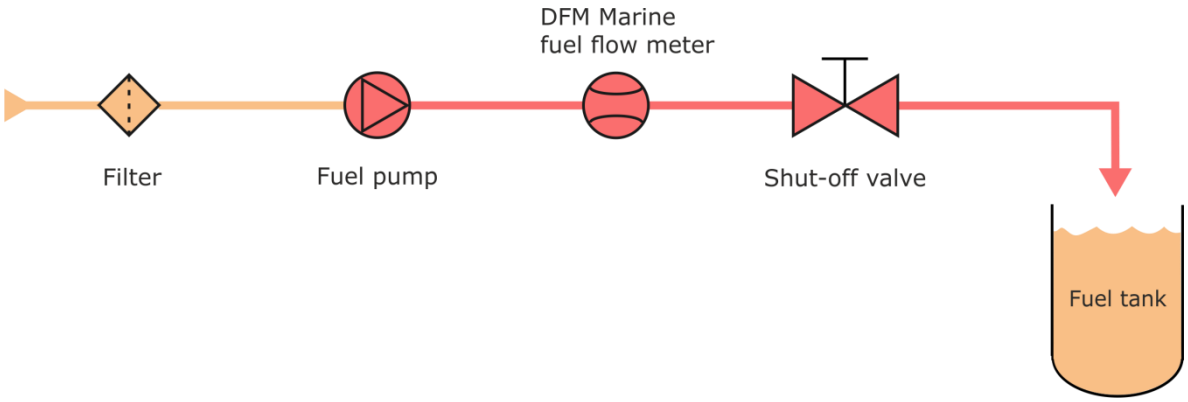


Figure 29 — Fuel dispensing scheme

2.5 Electrical connection

ATTENTION:

1) To ensure proper operation of DFM Marine, it should be electrically connected by specialist, who finished official technical training and was certified for that.

2) When installing DFM Marine it is obligatory to follow safety rules on carrying out repair works applicable to the machinery being equipped.

Flow meters with interface cables (model **DFM Marine CK/CCAN**) are powered from the external power source (Vehicle onboard circuit).

IMPORTANT:

1) Before mounting and connecting DFM Marine CK/CCAN switch off power supply of the Vehicle electrical circuits. To do this switch off the battery switch or release the terminals of the wires connected to the battery.

2) It is recommended to use **fuses** (supplied within delivery set) when connecting DFM Marine CK/CCAN power supply. Nominal fuse current is not more than 2 A.

3) When connecting DFM Marine CK/CCAN 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 Marine CK/CCAN connection cable together with standard electrical vehicle wiring with mandatory cable ties fixing of every 50 cm, at a positive ambient temperature (see figure 30).

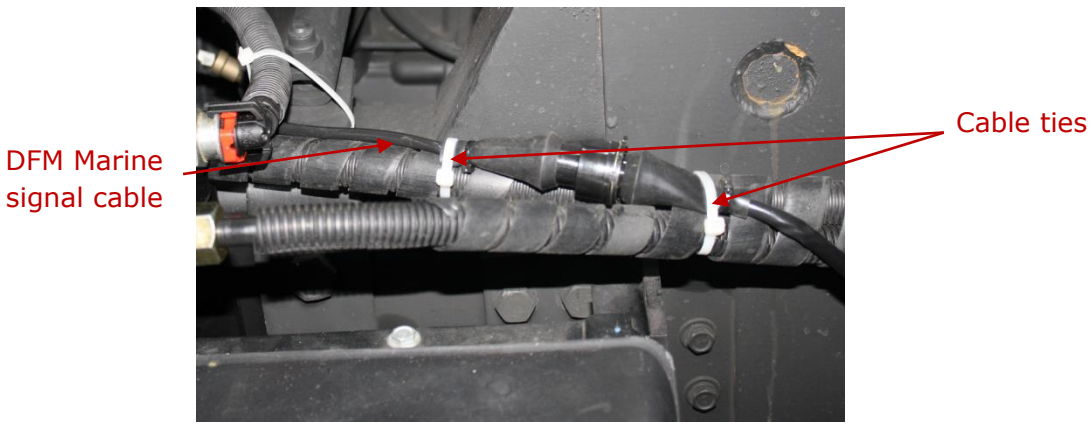


Figure 30 — Laying DFM Marine CK/CCAN signal cable

Electrical connection of DFM Marine CK/CCAN is carried out by connecting **signal cables** (see table 13) in accordance with pinout and wires designation (see tables 14 and 15).

Quick splice connectors (ordered separately) are recommended for electrical connection of power supply wires (see figure 31).

Table 13 — Cables for electrical connection of DFM Marine with interface cable

View	Component name	Description
	S6 SC-CW-700 (signal cable) (see annex I)	It is designed to connect DFM Marine CCAN fuel flow meters having CAN j1939/S6 interface to recording and display devices and to external power supply. 7 meters long. Equipped with 2 terminating resistors (120 Ohm). If needed, one of the terminal resistors may be disabled. Not included into DFM Marine CCAN delivery set.
	CABLE DFM 98.20.003 (signal cable) (see annex I)	Used for DFM Marine CK flow meter with pulse output interface connection to recording and display devices and to external power supply. Length – 7.5 m. The cable is included in delivery set of DFM Marine CK with pulse output interface.

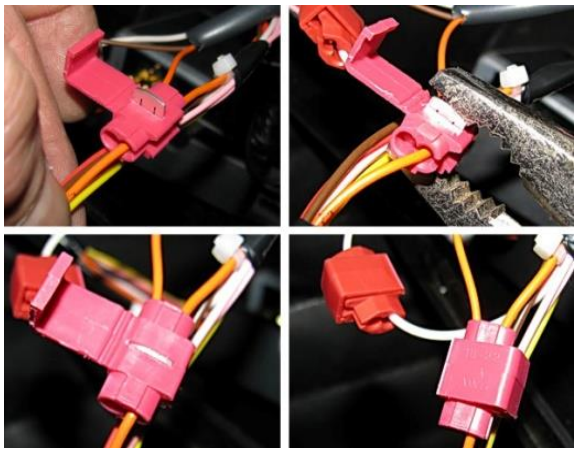


Figure 31 — Wiring connection made with the plastic connectors

Table 14 — Interface cable pinout and wire assignment of DFM Marine CK

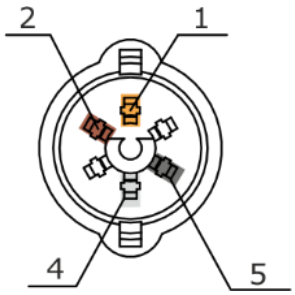
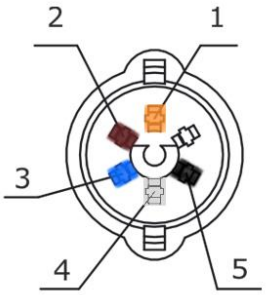
Connector view	Pin number	Wire color		Assignment
	1	Orange		Power supply “+”
	2	Brown		Ground
	4	White		Pulse output (see 1.6.8)
	5	Black		K-Line (ISO 14230)

Table 15 — Interface cable pinout and wire assignment of DFM Marine CCAN

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)

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

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

All DFM Marine fuel flow meters are calibrated by the manufacturer with a diesel fuel and supplied ready for use.

When DFM Marine with interface cable (**DFM Marine CK/CCAN**) is connected to external device or it is necessary to adjust DFM Marine parameters to specific operation mode, you can configure it through K-line interface (ISO 14230).

In order to start configuration, it is necessary to connect DFM Marine to PC via S6 SK service adapter. S6 SK description can be found in Cabling and accessories for j1939/S6 Telematics Interface Operation Manual.

Before connecting DFM Marine to PC via service adapter, please download special software from https://www.jv-technoton.com/ (section Software/Firmware) and install it to your PC:

- USB driver;
- Service DFM Marine.

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

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

See annex F for DFM Marine CK/CCAN settings, displayed and/or made by service software.

2.6.1 Connection DFM Marine to PC

ATTENTION: To avoid any service adapter faults in communication between PC and fuel flow 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.).

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

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

ATTENTION: Before starting the procedure of DFM Marine connection to the PC, you need to de-energize electrical circuits of the unit to be equipped (e.g. during configuration of the flow meter mounted on a mobile object, turn off the battery switch). While configuring flow meters connected by means of S6 Technology, it is allowed not to cut off their external power supply.

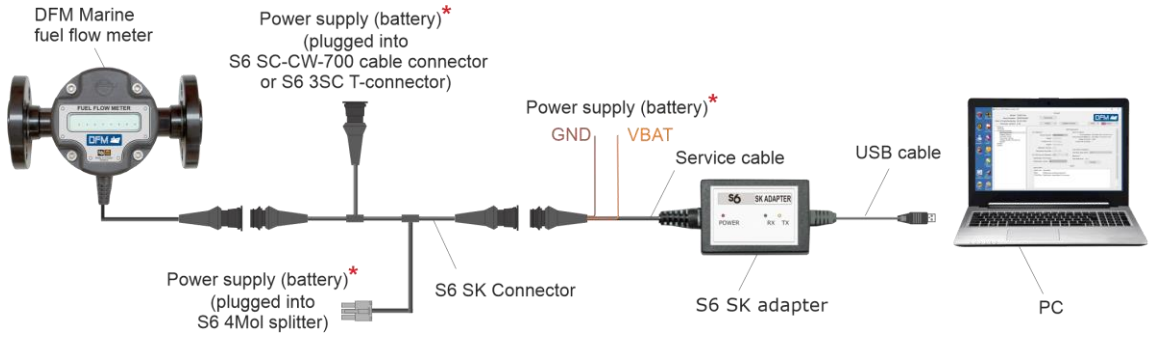
DFM Marine meters are connected to PC according to the connection schemes (see figure 32) in the following order:

1) Connect the adapter to DFM Marine.
- The connector of the service adapter is to be connected to the flow meter interface cable connector by means of the plug connector which is contained in the S6 SK supplied accessories kit (see figure 32 a).
  Note — During the DFM Marine configuration you need to provide power supply for the flow meter and the adapter from the battery or from a power source. Power is supplied through one of the free input connectors of the connector or via power supply wires of the adapter service cable.
- During the configuration of DFM Marine CCAN operating within a network of Units by means of S6 Technology we recommend to connect the adapter service cable connector to the break in S6 cable system, using S6 SK connector, instead of any S6 3SC T-connector. In this case, power supply for the flow meter and adapter is provided through S6 cable system (see figure 32 b).

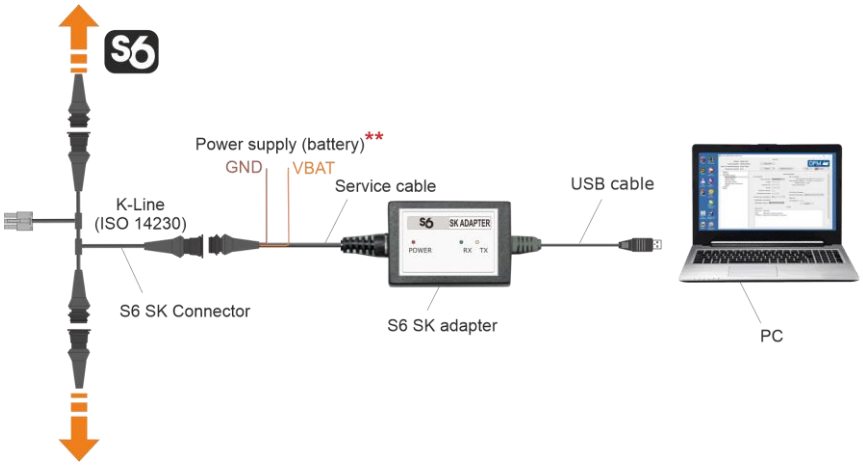
2) Plug the adapter to USB port of PC with the USB cable.
Note – it is allowed to connect adapter to USB-port of your PC after turning on power supply of flow meter and running Service DFM Marine software.

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

4) Power on the vehicle (battery).



a) connecting DFM Marine CK/CCAN using S6 SK



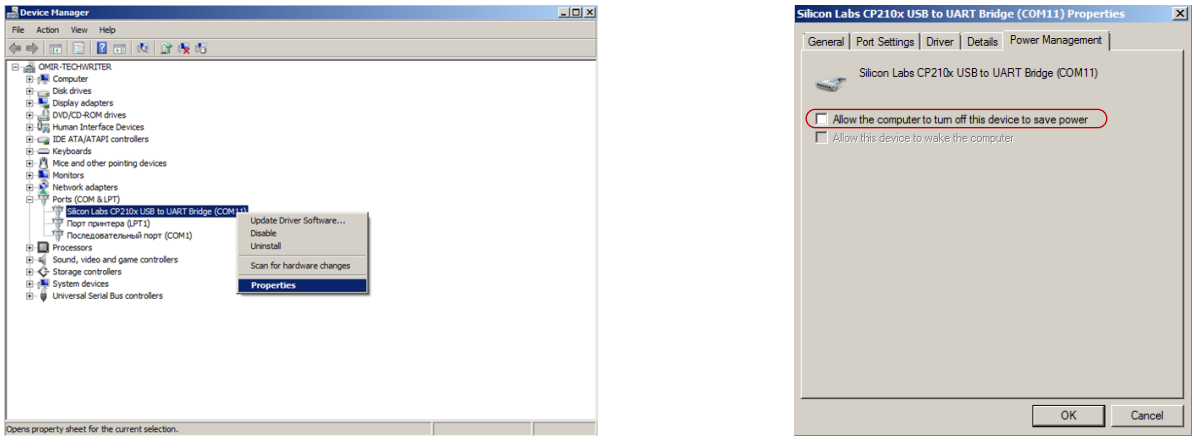
b) connecting DFM Marine CCAN using S6 SK via S6 Technology

Figure 32 — Schemes of DFM Marine connection to PC

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

Windows automatically detects adapter connected to PC's USB port as USB device and enables virtual COM port driver for it. The virtual COM port will be displayed in the list of ports of Windows Device manager (see figure 33 a).

ATENTION: To work with Service DFM Marine it is recommended:
1) It is recommended to use the same USB port of the PC for adapter connections.
2) Untick power save check box in virtual COM-port properties (see figure 33 b).



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

Figure 33 — Virtual COM-port configuration in Device manager

Adapter is ready for operation straight after power supply connection. Check for a description of blinking LED-indicators placed on the top of the adapter in table 16.

Table 16 – Adapter LED signals description

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

2.6.2 User interface

Service DFM Marine is launched with a  label which is created during the installation process. Service DFM Marine user interface consists of **Horizontal menu**, **Vertical menu, Flow meter's ID area** and **Information and configuration area** (see figure 34).

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

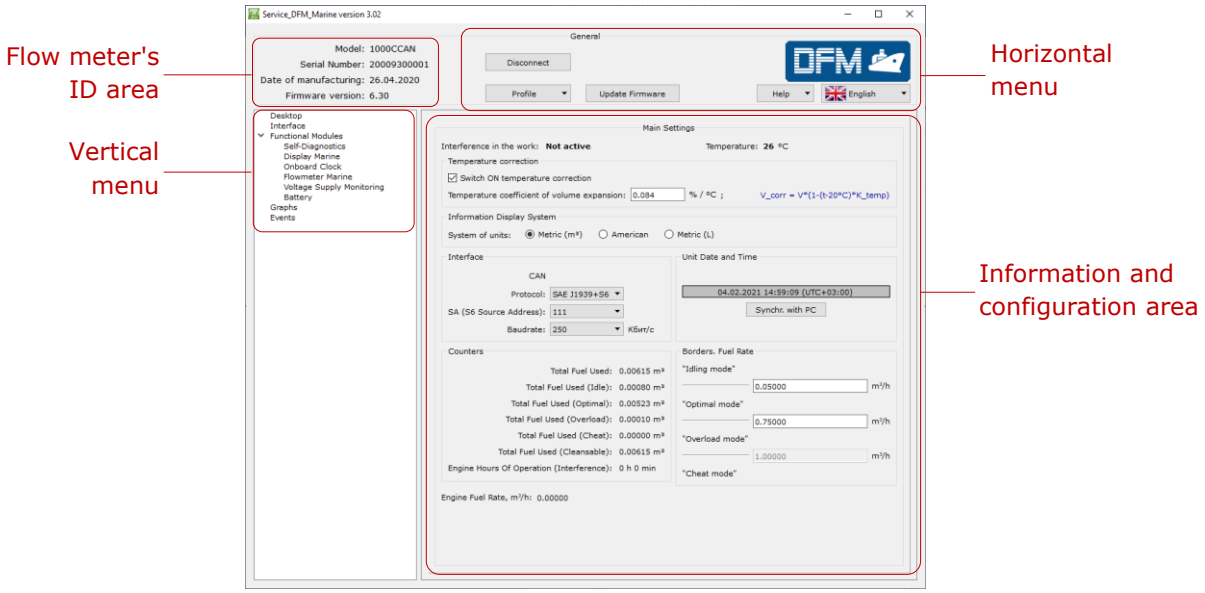


Figure 34 — Service DFM Marine software interface

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

- connection/disconnection of the flow meter;
- meter profile options (loading profile, saving profile, printing profile);
- updating firmware of the flow 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 flow meter. The actual parameters of FM and settings are displayed at **Information and configuration area**.
Connectivity of software with FM is based on PGNs and SPNs (S6 Database) exchange. SPNs of DFM Marine Functional Module which are read and/or edited in **Information and configuration area** are listed in annex F.
Vertical menu also contains entries on real-time diagnostics of measuring chambers and events records.

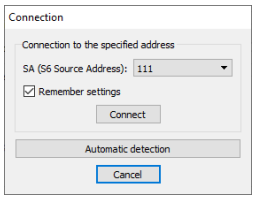
2.6.3 Authorization

To establish connection between PC and DFM Marine push Connect at **Horizontal menu**. In the appearing **Connection** window (see figure 35 a) you may connect the flow meter to the PC using one of the two methods:

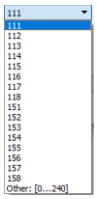
1) By the specified network address (if you know the address of the flow meter to be connected). For this purpose, select the DFM Marine network address from the dropdown list **SA (S6 Source Address)** in **Connection to the specified address** area, from the range of fixed values: **111**; **112**; **113**; **114**; **115**; **116**; **117**; **118**; **151**; **152**; **153**; **154**; **155**; **156**; **157**; **158**. You may also specify DFM Marine network address manually, by selecting it from the range **Other: [0…240]**. The Service DFM Marine software will conduct a search according to the address specified and connect to the flow meter with the specified address (see figures 35 b, c). To save the specified flow meter address for the next working session, tick the field **Remember settings**.

2) By means of automatic search (in case the address of the flow meter to be connected is unknown). For this purpose, press Automatic detection button. After the scanning of the virtual COM-port is completed (see 2.6.1), the window containing the list of all devices connected to the PC will appear, with the COM-port number and the network address (SA) specified) (see figure 35 d). The lines of DFM Marine flow meters to which you can connect using Service DFM Marine software will be highlighted in green in this list. Select the flow meter you need for work using the software and press Connect button (see figures 35 e, f).

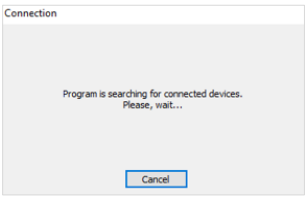
To load the profile of the selected flow meter, enter the login and password into the appropriate field of **Authorization** window(see figure 35 g). The default Login is **0**. The default password is **1111**. Tick **Remember password** checkbox to save the password for further launches.



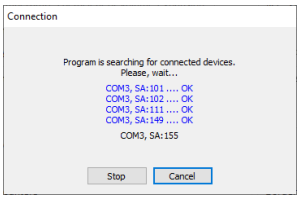
a) window for the flow meter connection to the PC



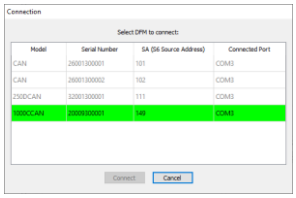
b) selection of the flow meter network address



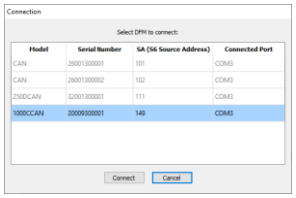
c) search of flow meters connected to the PC according to their specified address



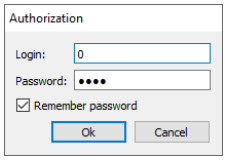
d) automatic scanning of the COM-port



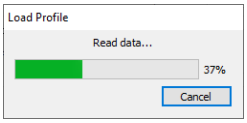
e) list of all devices connected to the PC COM-port



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



g) user authorization



h) loading the flow meter profile

Figure 35 — Establishing connection between PC and DFM Marine

To recover the password (in case it is lost), you need to place the cursor into the **Login** or the **Password** field of the window **Authorization** and press **Ctrl+F10** key combination. Service DFM Marine software will display a code to recover the current password of the Unit (see figure 36). This message is being sent to Technoton technical department by e-mail support@jv-technoton.com together with password recovery request.

Requirements for password recovery request:

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

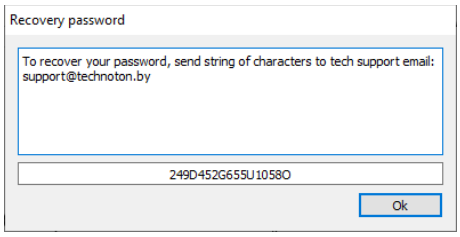
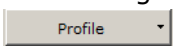


Figure 36 — Generated recovery code window

In case of entering incorrect login/password or in case of wrong connection to PC the software will show an error message.
In case of successful authorization with login and password the software will automatically prompt **Desktop** window (see figure 34), which displays currently connected DFM Marine's configurations and parameter values of Functional modules.

2.6.4 Operations with profile

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

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

button with drop-down list is used (see figure 37). This button is placed at **Horizontal menu** of Service DFM Marine. Profile can be stored as a file to PC hard drive or loaded into the memory of the meter. It can be printed as well or to pdf file.

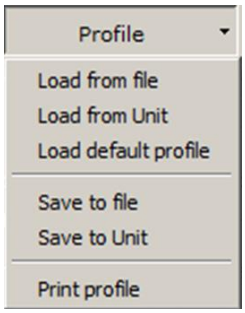
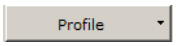


Figure 37 — Profile menu



menu has following entries:

1) Load profile. Service DFM Marine 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 Marine 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 38).

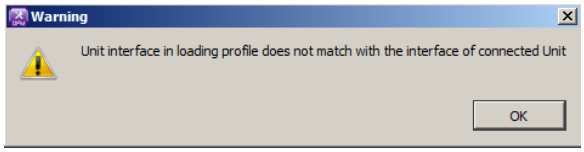


Figure 38 — Warning on interfaces incompatibility of profiles of loaded and connected Unit

- 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 Marine connection. Default profile is stored in **DFM_*_default.prf** file in the folder of Service DFM Marine.

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

* Maximum fuel consumption and output signal type (see figure 1) of the respective flow meter model is specified (e.g. **1000CAN** or **2000K** etc.).

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

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

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

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

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

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

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

2.7 Wireless configuration of flow meters using Android devices

Wireless configuration of DFM Marine that have interface cables (models **DFM Marine CK/CCAN**) is conducted by means of their connection via Bluetooth to the smartphone/tablet based on the Android operating system (further on – Android device), version 4.4 or a later version using S6 BT Adapter service adapter (purchased separately).

ATTENTION:
1) To eliminate connection failures between the Unit and the Android device, you need to make sure that there are no sources of electromagnetic interference near your working place (radio telephones, video signal transmission units and other wireless devices operating within 2.4 or 5.0 GHz frequency bands, as well as running electric motors, powerful transformers and switching equipment, welding equipment, high-voltage lines etc).
2) The maximum allowed distance between the S6 BT Adapter and the Android device depends on the quality of the Bluetooth connection of the Android device. To assure the stable data transmission, it is recommended that this distance should not exceed 10 m.

Before using S6 BT Adapter, please, download Service S6 DFM (Android) service mobile application (further on S6 application) to the Android device from Google Play (search request "Technoton").

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

Please, see in annex F configurations of DFM Marine that may be displayed and/or edited using S6 application.

2.7.1 Wireless connection DFM Marine to the Android device

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

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

ATTENTION: Before starting the procedure of DFM Marine connection to the Android device, you need to de-energize electrical circuits of the unit to be equipped (e.g. during configuration of the flow meter mounted on a mobile object, turn off the battery switch). While configuring flow meters connected by means of S6 Technology, it is allowed not to cut off their external power supply.

The procedure for DFM Marine wireless connection to the Android device (see figure 39) is as follows:

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

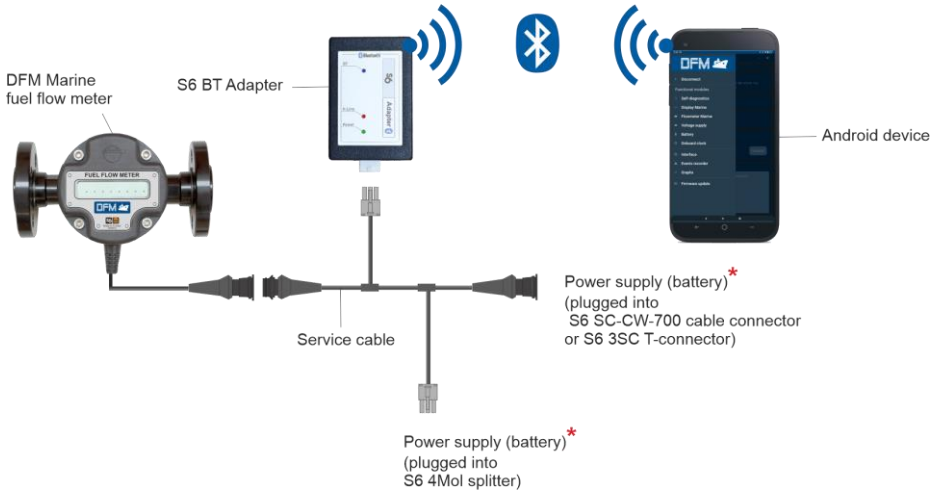
2) Connect the adapter to DFM Marine:

- The service cable connector is input to the interface cable connector of the flow meter. Note — During the wireless configuration of DFM Marine you need to provide power supply for the flow meter and the adapter either from the accumulator battery or from the power source. Power supply is provided through any of the free connectors of the connection cord (see figure 39 a).
- During wireless configuration of DFM Marine CCAN operating within the network of Units, according to S6 Technology, the service cable may be connected to the break in S6 cable system, instead of any S6 3SC T-connector. In this case, the flow meter and adapter are powered through S6 cable system (see figure 39 b).

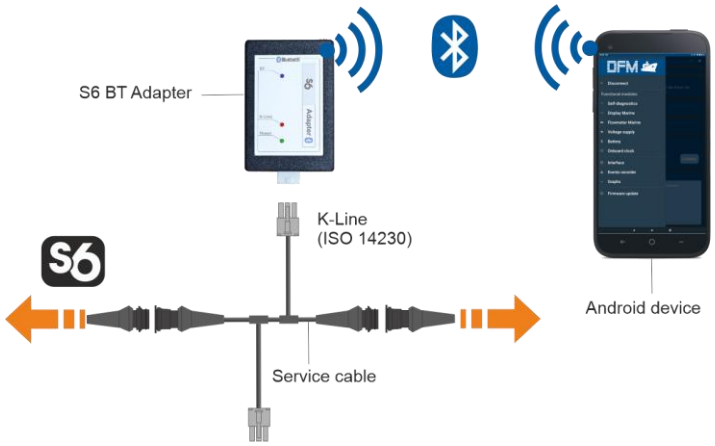
3) Connect power supply and ground wires to Vehicle electrical system or battery.

4) Power on the vehicle (battery).

After the power supply is on, the green LED indicator **POWER** is lit. You will also see a blue blinking light of the **BT** LED indicator which means that S6 BT Adapter is available for connection with Android devices via the Bluetooth channel.



a) connecting DFM Marine CK/CCAN using S6 BT Adapter

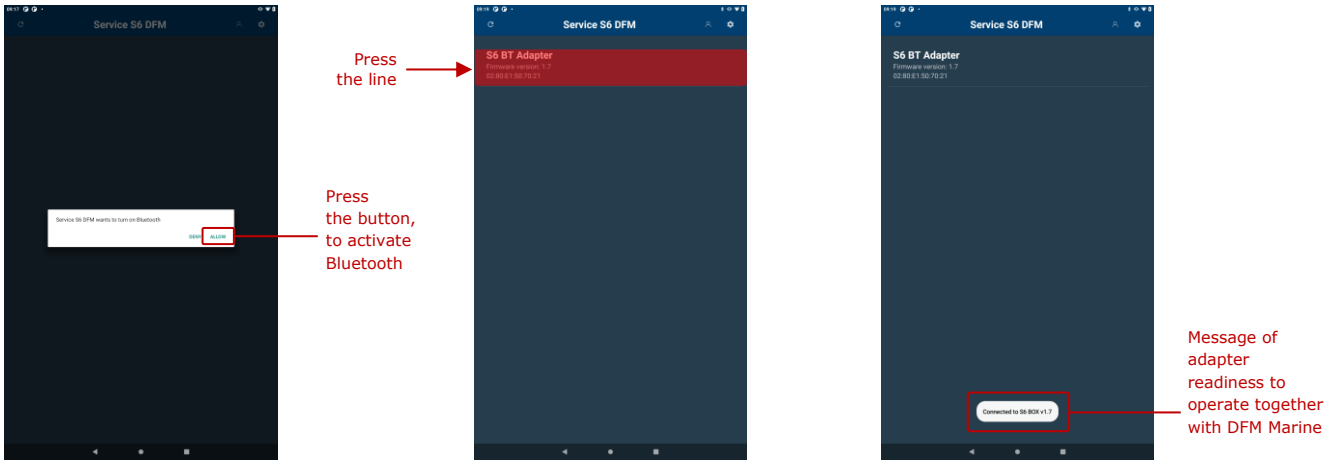


b) connecting DFM Marine CCAN using S6 BT Adapter via S6 Technology

Figure 39 — Schemes of wireless connection of DFM Marine to Android device

* For connecting power supply (battery) you can choose any of marked places.

S6 application is started from the main menu of the Android device by pressing  , icon that was created in the process of its installation.
S6 BT Adapter starts operating from the moment the power supply is on. After S6 application is started, it will automatically offer to activate Bluetooth. After Bluetooth is activated, the adapter which is accessible for wireless connection will be on the display; also, its firmware version and MAC address will be displayed. Press **S6 BT Adapter** line, to establish connection with the Android device (see figure 40).



a) offer to allow Bluetooth connection

b) selecting adapter from the list of accessible devices

c) message of established connection between the adapter and the Android device

Figure 40 — Example of establishing connection between S6 BT Adapter and the Android device

During the operation of S6 BT Adapter signals of LED indicators should comply with those indicated in table 17.

Table 17 – LED-indicators' signal description.
S6 BT Adapter – wireless configuration of DFM Marine

LED Indicator			Signal description
Marking	**Status**	**Light color**	
POWER		Green	Power supply is on
	No signal		Power off or power supply voltage is too low
K-Line		Red	Receiving data via K-Line interface
	No signal		Data are not received over K-Line interface
BT		Blue	S6 BT Adapter is initialized, but no connection with Andorid-based device (indicator is blinking each 1 s)
			Connection with S6 BT Adapter is established (blinking each 0.5 s)
			S6 BT Adapter is sending data over Bluetooth (blinking each 0.25 s)
	No signal		S6 BT Adapter is not initialized

2.7.2 Interface of S6 application

The interface of S6 application consists of **Information and Configuration Area** and **Tools Panel** (see figure 41).

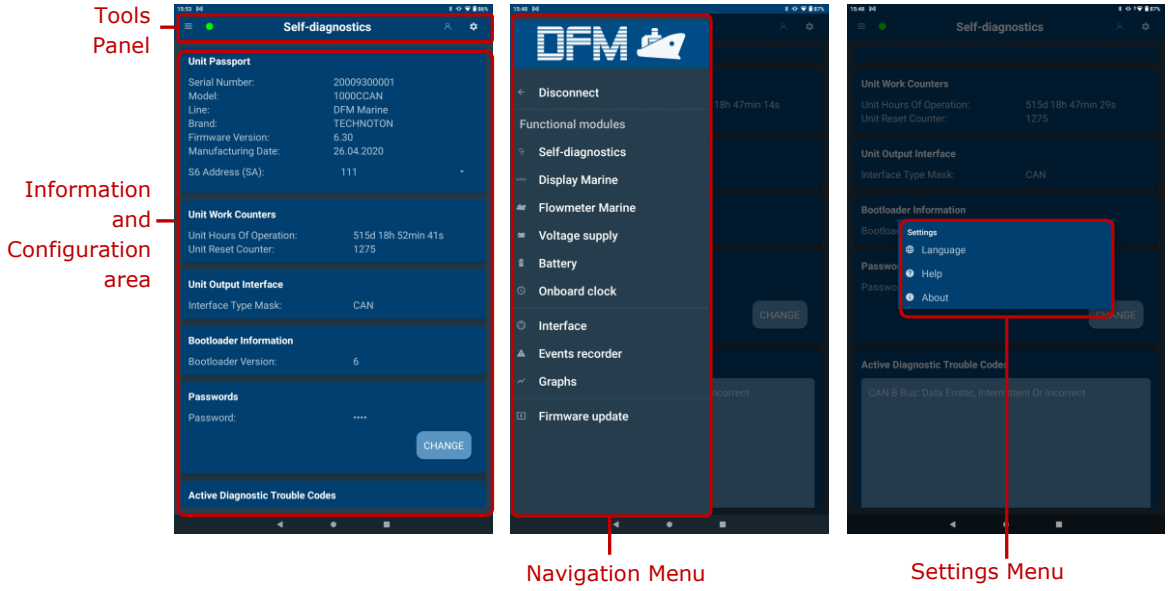


Figure 41 — Interface of Service S6 DFM (Android) service mobile application

In the **Information and Configuration** area current parameters and settings of the flow meter Functional modules (FM) are displayed.

In the **Tools Panel** area there are the following elements for use during work with S6 application:

- button to display the **Settings Menu** (selection of the interface language, help and software information);
- button to select operations with the flow meter profile;
- name of the flow meter Functional module which is to be configured;
- indicator of connection/disconnection with the flow meter (green light — connected, red light — disconnected);
- icon to open **Navigation menu** (selection of FM, configuration of Parameters, viewing Counters, creation of differential pairs of flow meters and groups for Summarization of indications, diagnostics of malfunctions, firmware update, the flow meter disconnection etc.).

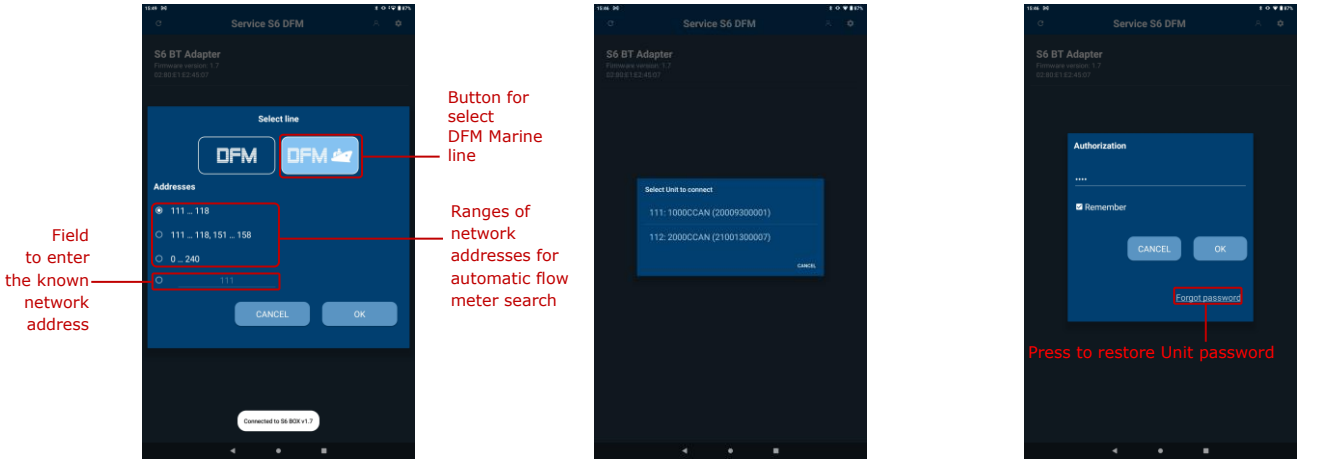
During work with the flow meter FM, S6 application uses data (PGN) from S6 Database. The list of DFM Marine FM containing SPN that are displayed and/or edited in **Data and settings** area is provided in annex F.

2.7.3 Authorization

To start a session of wireless communication between DFM Marine and the Android device, establish connection with **S6 BT Adapter** (see figure 40). Then, select the line of DFM Marine fuel flow meters and enter the network address of the needed flow meter in the **Addresses** window (if you know the address), for connection with the Android device. If you don't know the flow meter network address, select the optimal option from the offered fixed ranges for automatic address search (see figure 42 a).

In case S6 BT Adapter is connected to the network of several Units using S6 Technology, select the required DFM Marine for work with S6 application from the list in the window **Select Unit to connect** (see figure 42 b).

Enter the Unit password into the appropriate boxes of the **Authorization** window. The password by default is **1111**. To save the password entered (to exclude its entering manually another time during the next session of work with the flow meter), checkmark the box **Remember** (see figure 42 c).



a) select DFM Marine line and specify Unit network address *b) select the required Unit for work with the application* *c) enter Unit password*

Figure 42 — Establishing a wireless communication session between DFM Marine and the Android device

In case of incorrect entering the password or incorrect connection to the Android device, an error message will appear.

If the user authorisation has been conducted successfully, the loading of the of the connected DFM Marine profile will start.

To restore the Unit password (in case it is lost) press the link **Forgot password** (see figure 42 c).

S6 application will provide a code to restore the password (see figure 43). This message is being sent to Technoton technical department by e-mail support@jv-technoton.com together with password recovery request.

Requirements for password recovery request:

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

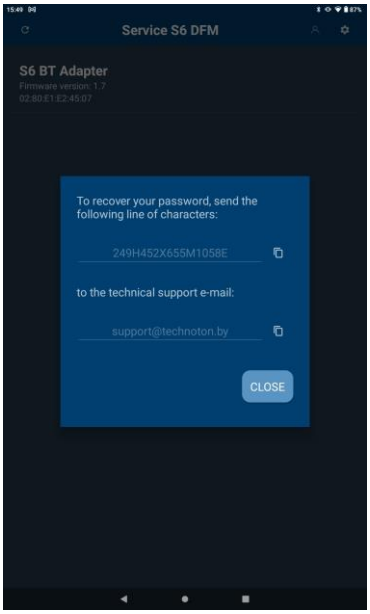


Figure 43 — Generated recovery code window

2.7.4 Operations with profile

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

ATTENTION: Any operations with the DFM Marine profile in the S6 service mobile application are possible only during a wireless connection session between the flow meter and the Android device. If there is a need to edit the profile in the off-line mode, connect DFM Marine to the PC using S6 SK and proceed in accordance with 2.6.4.

To perform any operations with the DFM Marine profile, the menu **Profile** is used which is opened by pressing the appropriate button on the **Tools Panel** (see 2.7.2).

Profile menu (see figure 44) contains the following options for operations with the flow meter profile:

- Load from file — is used to load the profile saved before in the memory of the Android device. You are to find and select the profile file (**DFM_*.prf**) in the window for file loading.
- Save to file — is used to save changed profile settings in the memory of the Android device.
- Load from Unit — is used to load the profile from the flow meter connected to the Android device.
- Save to Unit — is used to save changed profile settings in the memory of the connected flow meter.
- Load default profile — is used to load the profile with standard factory settings. By default, the profile is recorded in the files **DFM_*_default.prf** which are stored in the memory of the Android device, in the folder containing the installed application.
- Print profile — is used for the profile printout in pdf file.

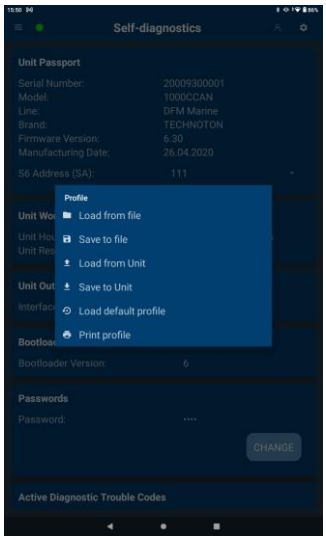


Figure 44 — View of Profile menu

* Maximum fuel consumption and output signal type (see figure 1) of the respective flow meter model is specified (e.g. **1000CAN** or **2000K** etc.).

2.8 Configuration for connection to external terminal unit

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

To connect flow meters with CAN j1939/S6 digital interface to an external device (**DFM Marine CCAN**) you need to configure parameters of **CAN** output interface in the **Interface** submenu of the service software or S6 application (see figure 45):

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

2) To identify the flow meter within the network of several Units connected by means of S6 Technology, select the flow meter unique network address in the dropdown list **SA (S6 Source Address)** (SPN 521188):

- when using the service software — from ranges of fixed values **111…118** and **151…158** (by default — **111**). In case there is no suitable address among offered addresses, you can specify the necessary DFM Marine CCAN network address manually, by selecting it from the range of values **Other: [0…240]***.
- In case of using S6 application — from ranges of fixed values **0…240** (by default — **111**).

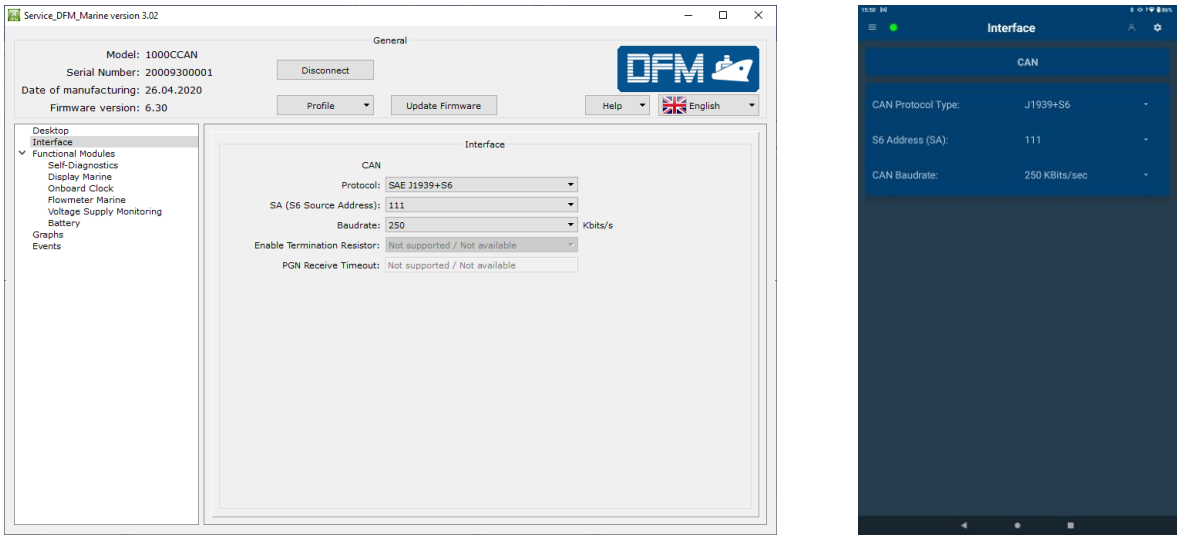
IMPORTANT: During the configuration of DFM Marine CCAN for operation in pairs in "Differential" / "Summarization" modes (see 2.11) any network address can be specified from **0…240** range of values for the Master flow meter, while network addresses for the Slave flow meters can be specified **only** from the ranges of recommended values **111…118** and **151…158**.

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

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

---

* For DFM Marine CCAN with the firmware version not lower than 6.30, when using Service DFM Marine software, version 3.02 and higher.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

Figure 45 — Flow meter connection parameters settings when using CAN j1939/S6 interface

2.9 Operation check

To conduct an operation test of the mounted flow meter, you need to use **Graphs** submenu of the service software or of S6 application in which are displayed in real time (see figure 46):

- for one flow meter:

  - graph of hourly (instant) consumption of fuel, which went through the only measuring chamber (blue line) (SPN 521313);
  - current Counters values — total fuel consumption (SPN 521314) and fuel consumption in "Tampering" mode (SPN 521314/9.3).

- for a pair of DFM Marine CCAN during differential measurement*:

  - graphs of hourly (instant) consumption of fuel passing through the measuring chambers of Master and Slave flow meters (SPN 521313) connected, respectively, to the feed and reverse fuel lines.

    Note — In Service S6 DFM (Android) application the graph of hourly fuel consumption for Slave flow meter is not displayed.

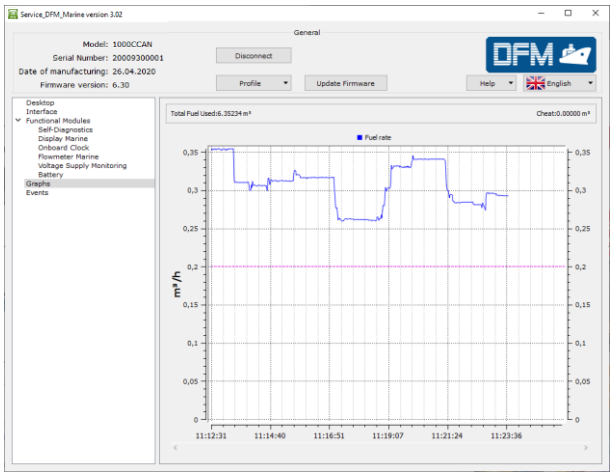
  - graph of differential hourly (instant) consumption of fuel flowing through the measuring chambers of the Master and Slave flow meters (SPN 521313/2.15) (see 2.11).

  - current values of the Counters — of total fuel consumption (SPN 521314) and fuel consumption in "Tampering" mode (SPN 521314/9.3) for Master flow meter.

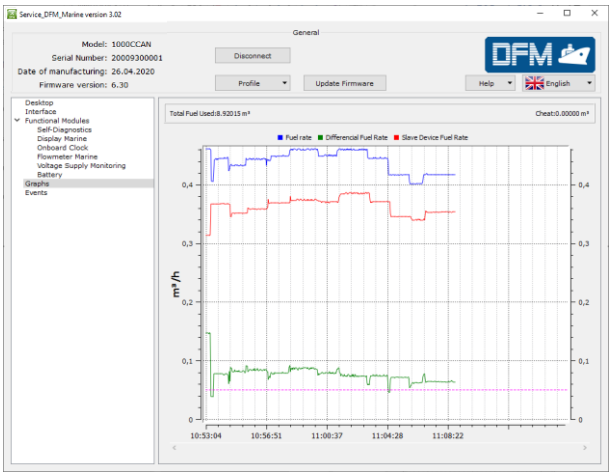
Horizontal pink dashed lines in graphs in the service software indicate modes of operation specified for the fuel consumer which correspond to the current value of instant fuel consumption (see 1.6.5). You can edit values of the modes limits in the appropriate fields of **Flowmeter Marine FM** submenu (see F.4) or in the **Desktop** window of the service software (see 2.6.2).

---

* For DFM Marine CCAN with the version of firmware not lower than 6.30, with using Service DFM Marine software, version from 3.02 and higher or Service S6 DFM (Android) mobile application, version from 2.01 and higher.

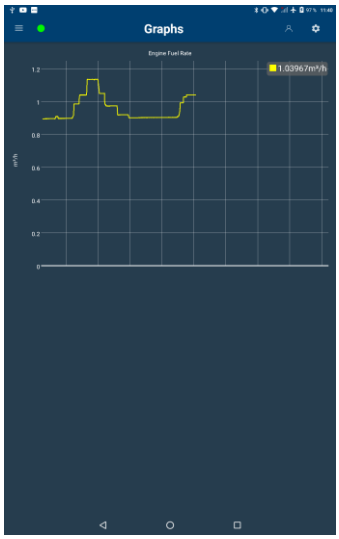


graph example of one flow meter

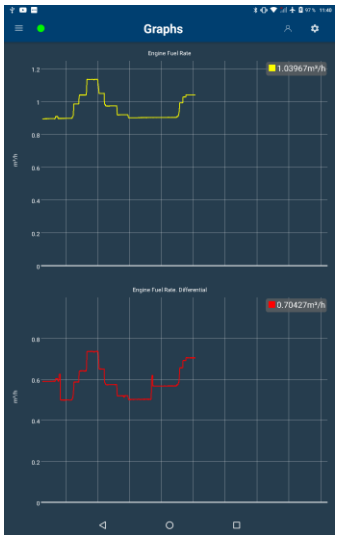


graph example of differential measurement

a) in Service DFM Marine software



graph example of one flow meter



graph example of differential measurement

b) in Service S6 DFM (Android) app

Figure 46 — DFM Marine operation test with Graphs submenu

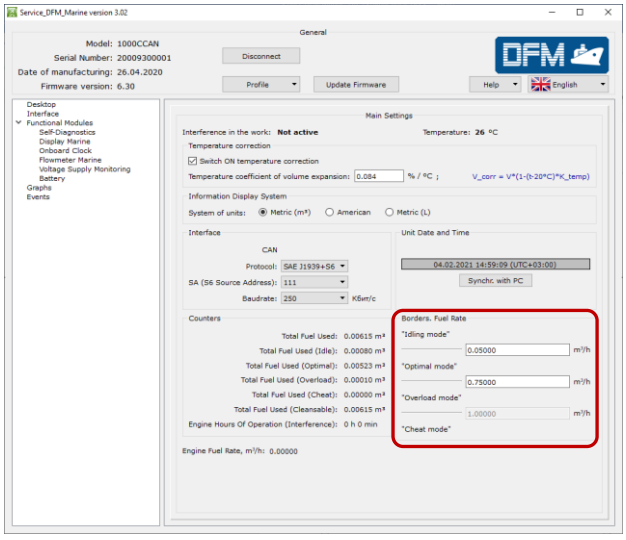
2.10 Configuration for specific operation conditions

To enhance the accuracy of DFM Marine CK/CCAN indications in specific conditions of operation using the service software (submenu **Flowmeter Marine FM** or **Desktop** window) or S6 application (submenu **Flowmeter Marine FM**, **Settings** and **Limits** tabs), you can specify the following flow meter settings (see F.4):

1) Borders. Fuel Rate (see figure 47), which are used to define current workload of Vehicle depending on its hourly consumption rate (PGN 63163):

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

In flow meters a user can adjust only "Idle" (SPN 521317/9.0) and «Optimal» (SPN 521317/9.1) modes. Factory-set configuration for "Overload" mode (SPN 521317/9.2) could not be adjusted.
You can find values of hourly fuel consumption in modes of operation of a specific fuel consumer (engine) in its technical documentation or define them experimentally.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

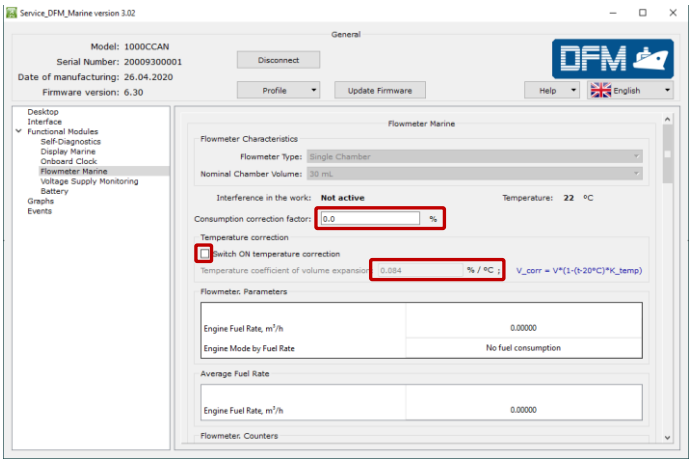
Figure 47 — Example of flow rate boundaries configurations for DFM Marine

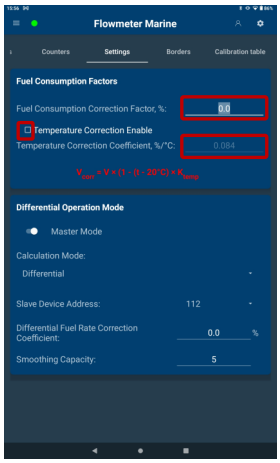
2) Turn on temperature correction function (see figure 48), i.e. automatic correction of fuel volume consumption data adjusted to fuel temperature (SPN 521311).
Temperature correction function is used because volume of fuel changes when fuel temperature is going up/down.
After turning on temperature correction function a user can enter temperature correction coefficient of volumetric expansion (coefficient of volumetric expansion of oil products **β** in relation to temperature change by 1 °C) (SPN 521433).
The value of coefficient **β** is selected for the density of the oil product **ρ** at the temperature +20 °C, in accordance with properties of a specific type of fuel being used.

3) Configure consumption correction factor (SPN 521434) (see figure 48). This parameter allows increasing accuracy of fuel consumption measurement if a user constantly detects derivation (values are too high/low) of measured consumption related to specific conditions of operation (increased vibration of Vehicle, air presence in fuel lines, higher fuel flow in reverse line of nozzles).

Ranges of variation of correction coefficients values: -10…+10 % (in the service software) and -100…+100 % (in S6 application).

For example, if fuel flow meter shows 3 % higher results of measurement, it is necessary to enter consumption correction coefficient equal minus 3 %. If fuel flow meter shows 2 % lower results of measurement, it is necessary to enter consumption correction coefficient equal plus 2 %.





a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

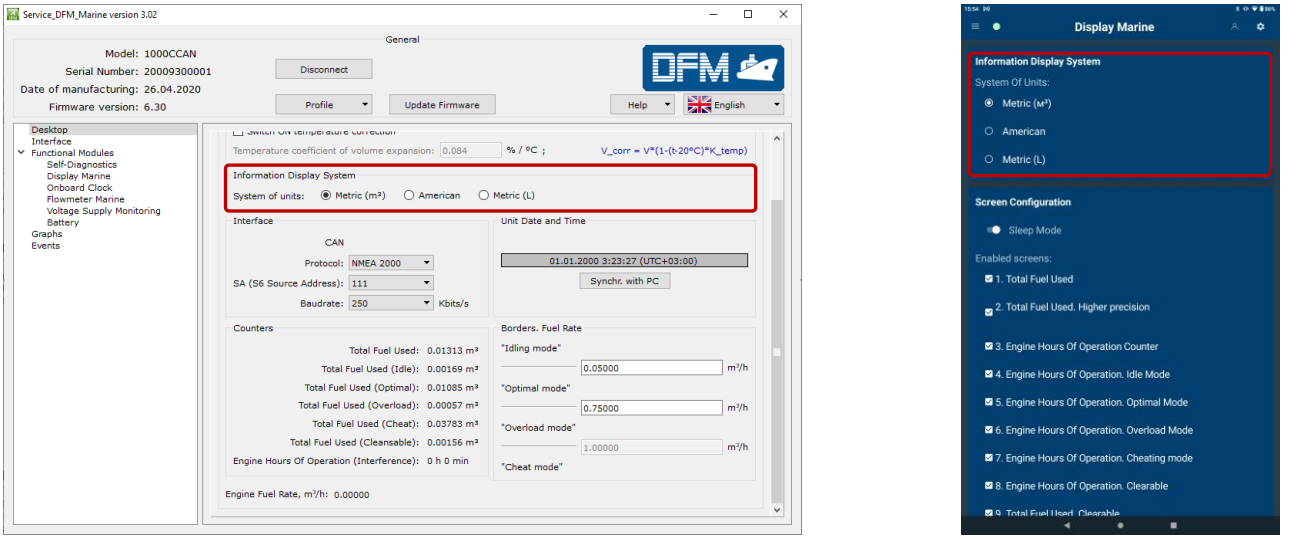
Figure 48 — Example of temperature correction and correction coefficient configuration

4) Configure system of units (see figure 49), i.e. necessary measurement units for displaying measurement results on the display of DFM Marine (SPN 521332):

- metric (m^3);
- metric (l);
- US (gallon).

Note – You can also specify the system of units of data presentation in the appropriate area of **Display Marine FM** submenu (see F.2) of the service software or of S6 application.

ATTENTION: You should note that in the submenu of the **Flowmeter Marine FM** (see F.4) all internal Parameters and Counters are always displayed in the metric system (m^3) and do not depend on the system of units specified for display of indications.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

Figure 49 — Examples of configuring the system of data presentation on the flow meter display

2.11 Configuration of DFM Marine CCAN for operation in pairs in the modes "Differential / "Summarization"

ATTENTION: For work in the modes "Differential" / "Summarization" you may use any pair of DFM Marine CCAN flow meters (the recommended version of firmware — no less than 6.30) connected by means of S6 Technology to form a network.
To operate in "Differential"/"Summarization" mode power supply voltage of flow meters should not drop out of (10…45) V range.

The flow meters are configured in the submenu of **Flowmeter Marine FM** (see F.4 and figure 50) of the service software (versions from 3.02 and higher) or in the submenu of **Flowmeter Marine FM** (**Settings** and **Limits** tabs) of S6 application (versions from 2.01 and higher) in the following order:

1) Enable Master mode (SPN 521268) for the Master flow meter of the pair which is used:
- if you use the service software — select **Enable** from the dropdown list **Work in Master mode** (**Differential mode of operation** area).
- If you use S6 application — move right the slider contact **Work in Master mode** (**Settings** tab, **Differential mode of operation** area).

Make sure that Master mode is disabled for the Slave flow meter of the pair which is being used.

IMPORTANT:
1) During differential measurement the flow meter which is designated as Master flow meter is the one mounted in the feed fuel line, while the flow meter designated as Slave flow meter is the one mounted in the reverse fuel line.
2) In Summarization mode the Master flow meter and Slave flow meter may be designated at the user discretion.
3) Any network address from the range of values 0…240 can be specified for the Master flow meter (see 2.8).
4) Network addresses **only** from the ranges of values 111…118 and 151…158 may be specified for Slave flow meters (see 2.8).

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

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

ATTENTION: You should note that depending on the Master mode status, the following values of the Counters are displayed in the Desktop window (in case of work with the service software) or in the submenu of the **Flowmeter Marine FM** (Counters tab):
1) Counters of differential fuel consumption (PGN 62992) (in Master mode activated).
2) Counters of fuel consumption for the fuel supply line (PGN 62993) (Master mode is off).

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

4) In the area **Borders. Differential Fuel Rate** for Master flow meter enter values of limits of differential hourly fuel consumption for the modes "Idle", "Optimal", "Overload" (PGN 63205) (similar to 2.10, the setting **Borders. Fuel Rate**).

5) If necessary, enter **Differential Fuel Rate Correction Coefficient** (SPN 521271) for Master-flow meter to increase accuracy of measurement (similar to 2.10, the setting **Configure Consumption Correction Factor**).

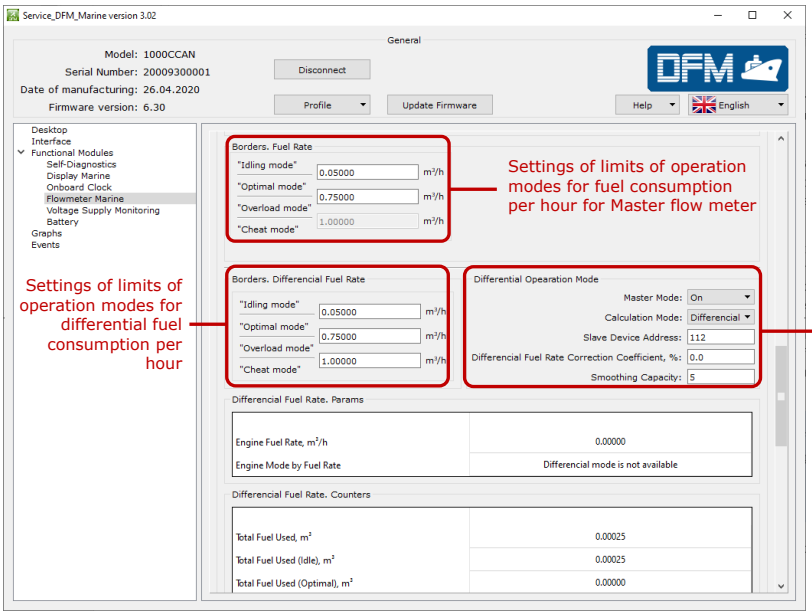
6) To increase accuracy of differential measurement for complex objects, which have uneven flow rate in feed and return fuel lines (e.g. fuel pulsation, increased fuel system inertia, water hammers etc.), **Smoothing Capacity** (smoothing buffer) of Master flow meter can be configured (SPN 521671).

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

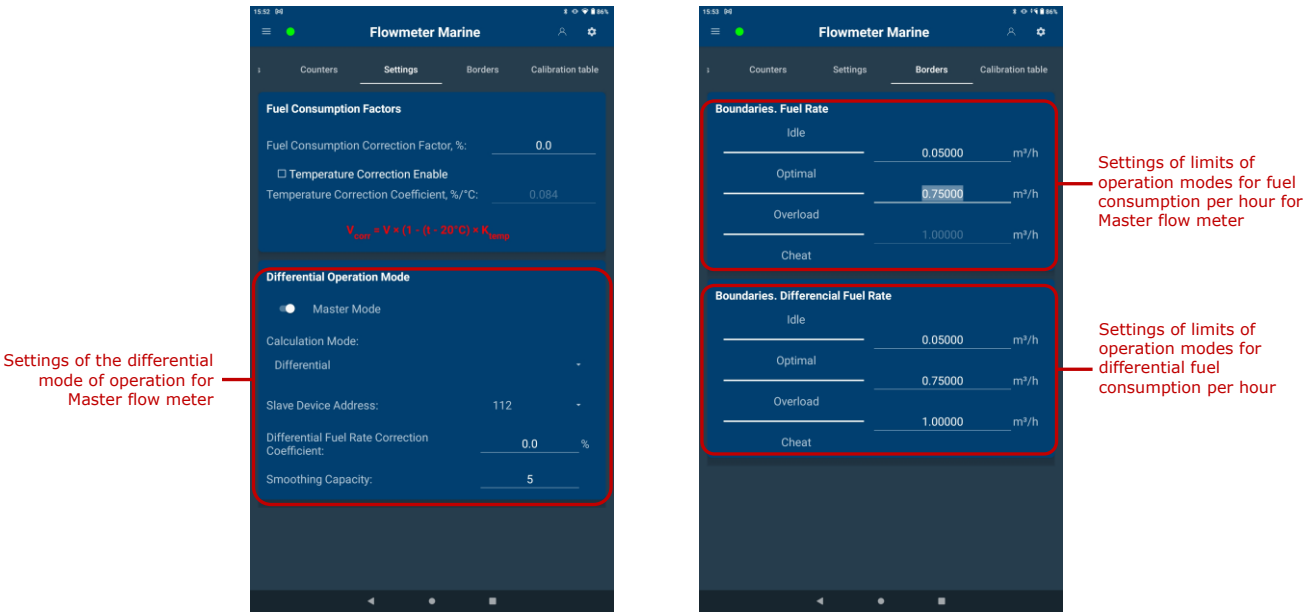
In case of even flow rate in feed and reverse lines, it is recommended to enter minimum value of buffer (in majority of cases default value **5** is enough). When unevenness of flow rate in feed and reverse lines is growing, it is recommended to increase value of smoothing buffer.

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

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



a) in Service DFM Marine software



b) in Service S6 DFM (Android) app

Figure 50 — Examples of configuring DFM Marine CCAN for "Differential" / "Summarization" operation mode

2.12 Activation of DFM Marine S7 BLE-module

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

Fuel Rate Monitor mobile application serves to provide indications on the display of a smartphone/tablet using S7 Technology and firmware update of DFM Marine S7 wireless fuel flow meters. You can download the application from the application store Google Play (search request "Technoton") (see User manual).

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

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

2) "Manufacturing" — in this mode, the BLE-module of DFM Marine S7 is activated for data transmission only for the period of the flow meter testing or checking its operability with Fuel Rate Monitor application.
To activate this mode from "Storage" mode, apply the magnetic key (see the delivery set) **for 6..8 s** to the Technoton logo () placed on the side of the flow meter measuring "head" (see figure 51).

After the period of **4 h**, or after a second touching the indicated place during **6...8 s** by the magnetic key, the BLE-module of DFM Marine S7 will switch over again to "Storage" mode.

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

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

- To switch over DFM Marine S7 into "Service" mode from "Storage" mode, you need to apply the magnetic key **for 6...8 s** to the location indicated on the flow meter measuring "head". "Service" mode is activated only for 20 s during which you are to establish communication between the flow meter and the mobile device, for further firmware update.

  In case the communication with the mobile device is not established during 20 s after switching DFM Marine S7 into "Service" mode, the flow meter will automatically switch back into the "Operating" mode.

- To switch over DFM Marine S7 into "Service" mode from "Operating" mode, you need to apply the magnetic key **30...35 s** to the location indicated on the flow meter measuring "head". "Service" mode is activated only for **20 s** during which you are to establish communication between the flow meter and the mobile device, for further firmware update.

  If the communication with the mobile device is not established after switching DFM Marine S7 into "Service" mode, the flow meter will automatically switch back into "Operating" mode.

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

RECOMMENDATION: After the mounting of DFM Marine S7 is completed, you must **make sure by all means** that the flow meter is switched over to "Operating" mode (see the User manual).

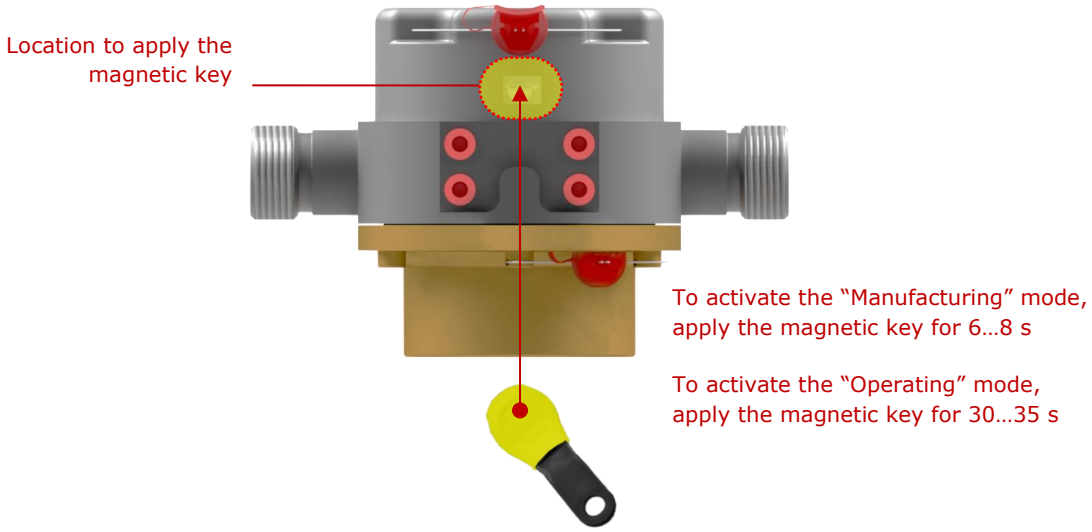


Figure 51 — Activation of DFM Marine S7 BLE-module

WARNINGS:

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

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

3 Measurement accuracy check

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

3.1 Test conditions

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

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

Install the DFM Marine 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.
During testing DFM Marine S7, you are to establish the connection of the flow meter with the tracking device or with the mobile device, in accordance with the operation documentation, by means of S7 Technology.

Conditions of the test:

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

3.2 Conducting the tests

DFM Marine measurement accuracy check sequence:

1) Measure precise volume of fuel, which is contained in fuel tank on the beginning of procedure ($V_{initial}$) (see figure 52).

2) Start the engine and set the average speed.

3) Record the time when the test was started.

4) Based on indications on DFM Marine display (during testing DFM Marine S7 — on the display of the mobile device), record the initial fuel consumption readings (V_0).

5) Let engine consume at least 10 % of tank volume, while engine running time should not be less than 1 hour.

6) Stop the engine.

7) Measure volume of fuel remaining in tank (V_{remain}).

8) Record the final fuel consumption readings (V_1) from DFM Marine display (during testing DFM Marine S7 — from the display of the mobile device).

9) Calculate **real fuel consumption** ($V_m = V_{initial} - V_{remain}$).

10) By difference of initial (V_0) and final (V_1) DFM Marine readings determine **measured fuel consumption** ($V_{measured}=V_1 - V_0$).

11) 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, m^3;
V_m – actual fuel consumption, m^3.

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

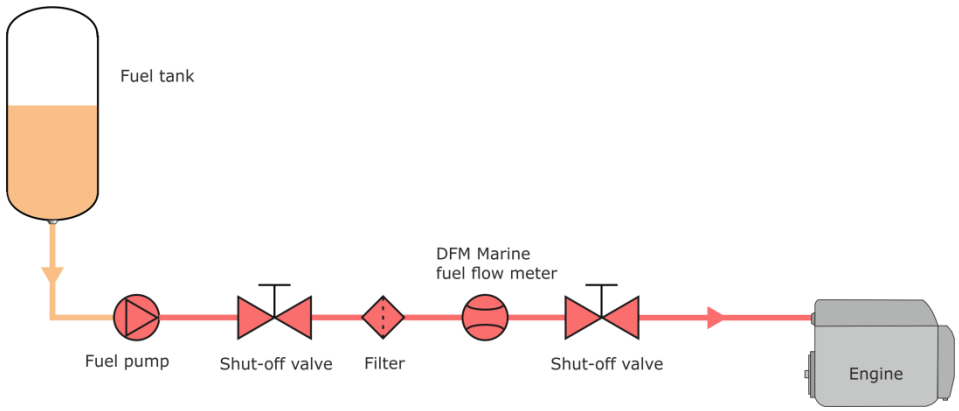


Figure 52 — Example of a fuel system diagram for measurement accuracy check

IMPORTANT: When carrying out accuracy test of DFM Marine flow meter, you can use the values from "Total Fuel Used" Counter (see F.4), at the same time: **keep in mind**, that there is a 12 s time lag in DFM Marine with display between the moment when values appearing on the display of flow meter (see table 5) and sent to output interface of flow meter.

4 Registered Events control

To monitor Events recorded by DFM Marine that have interface cables and saved in its internal memory, connect the flow meter to the PC (see 2.6.3) or establish its connection with the Android device (see 2.7.3).
Select **Events** submenu (in the service software) or **Events Recorder** (in S6 application) (see figure 53) in which lists of **Important Events** and **Information Events** are displayed (total of 15 recent Events of each type).

1) Important Events include:

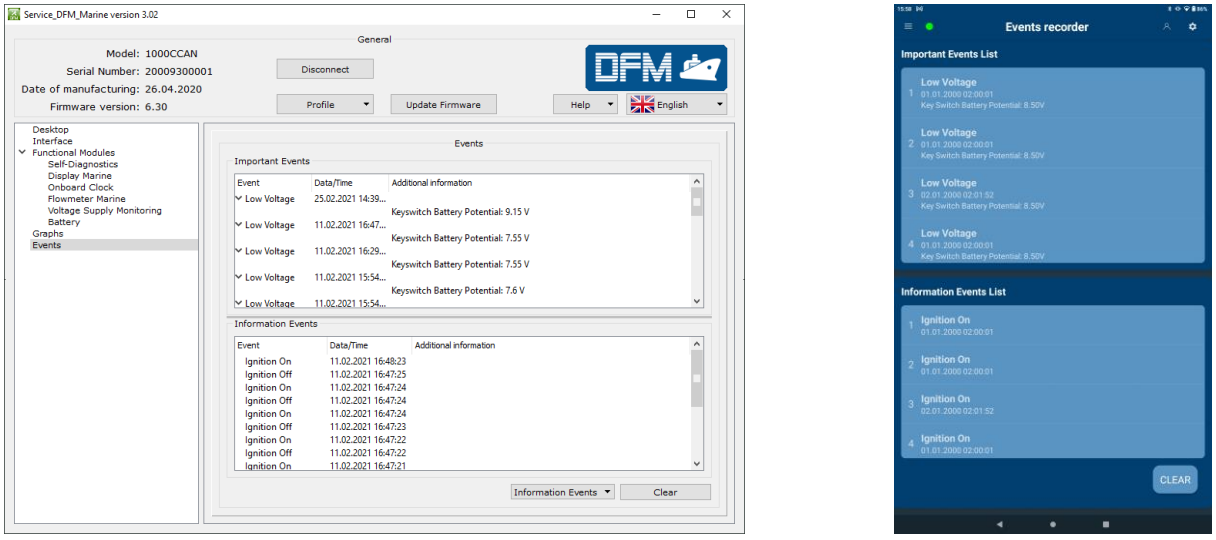
- flow meter tampering (indicating total tampered volume);
- interference in flow meter operation (indicating total interference time);
- low level of supply voltage (indicating voltage value);
- high level of supply voltage (indicating voltage value).

2) Information Events include:

- ignition switched ON;
- ignition switched OFF.

Max 15 events are displayed for each of the lists. Each event has an indication of event name, date and time of occurrence and additional 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) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

Figure 53 — Browsing thorugh Events registered by DFM Marine

You can delete all registered Event from DFM Marine by clicking **Clear** button. Important Events cannot by deleted by use.

By using S7 Technology, the Fuel Rate Monitor mobile application (see details in User manual) enables to view notifications on the Events "Tampering" and "Interference" on the display of a smartphone/tablet that are recorded in accordance with indications of DFM Marine S7 wireless fuel flow meters.

The following data are displayed for the Events:

- date and time of the Event occurrence;
- volume of fuel tampered (for "Tampering" Event);
- period of interference (for "Interference" Event);
- flow meter number (during the flow meter operation within the differential pair or group).

5 Diagnostics and troubleshooting

Contact your DFM Marine supplier in case of malfunction.

DFM Marine repair works can be carried out only by certified Regional Service Centers (RSC). Full list of service centers can be found at https://www.jv-technoton.com/.

Limited troubleshooting may be self-conducted (see table 18).

Table 18 — DFM Marine malfunctions, which can be removed without full dismounting of the device

Malfunction	Model	Possible cause	Troubleshooting
Output data missing	**DFM Marine CK/CCAN/S7**	Incorrect connection to the tracking device	Check the flow meter connection to the tracking device
		No connection with the tracking device or with the mobile device*	Check the flow meter connection by means of S7 Technology with the tracking device or with the mobile device*
		Fuel filter clogging	Remove and clean the fuel filter
Fuel does not flow through the meter	**DFM Marine C/CK/CCAN/S7**	Fuel filter clogging	Remove and clean the fuel filter
Fuel consumption readings are higher than real consumption rate		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.
* Relevant only for DFM Marine S7 wireless flow meters.			

6 Verification

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

7 Maintenance

To ensure measurement accuracy it is recommended to re-calibrate DFM Marine. **Re-calibration interval** is defined by increase of "Total Fuel Used" Counter (see F.4, SPN 521314) since previous calibration and equal to:

- for DFM Marine 1000 — 1200 m^3;
- for DFM Marine 2000 — 2800 m^3;
- for DFM Marine 4000 — 5250 m^3.

IMPORTANT: Re-calibration with subsequent verification of flow meters is done in Regional Service Centers (RSC).

It is recommended to perform visual inspection and DFM Marine operation check at least once a year. In order to provide DFM Marine operability, it is recommended to remove and clean the mud filter from time to time.

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

8 Accessories

Technoton offers to purchase **high quality accessories** for mounting DFM Marine fuel flow meters.

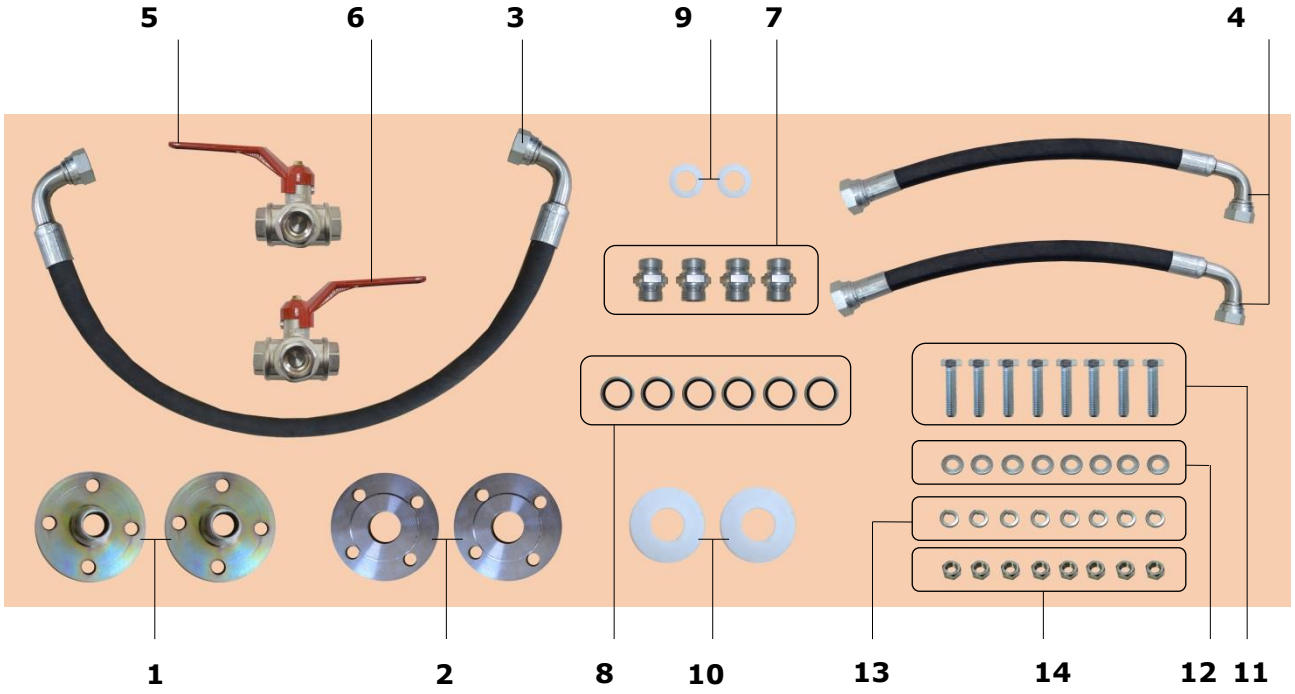
8.1 Mounting kits

MK DFM M1000/M2000/M4000 mounting kits (further on — MK DFM M) are designed for quick and secure mounting of DFM Marine fuel flow meters with thread connection (models **DFM Marine TA/TL**) in the fuel system of the fuel consumer (see figure 54).

Figure 54 — MK DFM M1000 mounting kit assembly with DFM Marine 1000 TA fuel flow meter

Paricularities of MK DFM M

- thoroughly elaborated mounting kit with a minimum of thread connections;
- only high-quality components that can be employed in the fuel system of any fuel consumers, including water and railway transport, are used;
- armored hoses made of oil-and-petrol resistant rubber are hermetic, reliable and have a long period of service life in severe operating conditions;
- thanks to the employment of flexible connections, it is allowed to mount the flow meter without its precise positioning along the fuel line;
- special ball valves provide convenient switching over the fuel feed to bypass without stopping the fuel consumer operation, in case of the fuel flow meter maintenance;
- fittings, thread connections and flanges are manufactured, in compliance with international standards.



1	Threaded flange	– 2 pcs.;
2	Welded flange	– 2 pcs.;
3	Rubber hose 90-90	– 1 pc.;
4	Rubber hose 0-90	– 2 pcs.;
5	"T" ball valve	– 1 pc.;
6	«L» ball valve	– 1 pc.;
7	Adapter	– 4 pcs.;
8	Ring	– 6 pcs.;
9	Fluorine washer	– 2 pcs.;
10	Fluorine washer between the flanges	– 2 pcs.;
11	M12x50 bolt	– 8 pcs.;
12	Washer	– 8 pcs.;
13	Lockwasher	– 8 pcs.;
14	M12 nut	– 8 pcs.

Figure 55 — MK DFM M delivery set

ATTENTION: the Manufacturer reserves the right to modify the MK DFM M contents as well as to replace any components by similar ones, without prior customer notice.

Table 19 — Specifications of MK DFM M

Parameter, measurement units	Value		
	MK DFM M1000	**MK DFM M2000**	**MK DFM M4000**
Applicability for the flow meters mounting	DFM Marine 1000 TA/TL	DFM Marine 2000 TA/TL	DFM Marine 4000 TA/TL
Maximum pressure of working fluid, bar	16		
Working temperature range for the rubber hoses, °C	-10…+100		
Nominal diameter (DN), mm	15	20	25
Male connection thread (BSP) of adapters and threaded flanges, inches	1/2	3/4	1
Female connection thread (BSP) of "T"/ "L" ball valves and coupling nuts of 90-90 hose, inches	1/2	3/4	1
Female connection thread (BSP) of coupling nuts of 90-90 hoses, inches	3/4	1	1 1/4
	1/2	3/4	1
Center-to-center spacing of the flanges holes, mm	65	75	85
Length of hoses 0-90, mm	212	284	358
Length of hose 90-90, mm	584	758	926

MK DFM M should be assembled, in accordance with the diagram shown in figure 56, based on general instructions for DFM Marine flow meters installation (see 2.3).

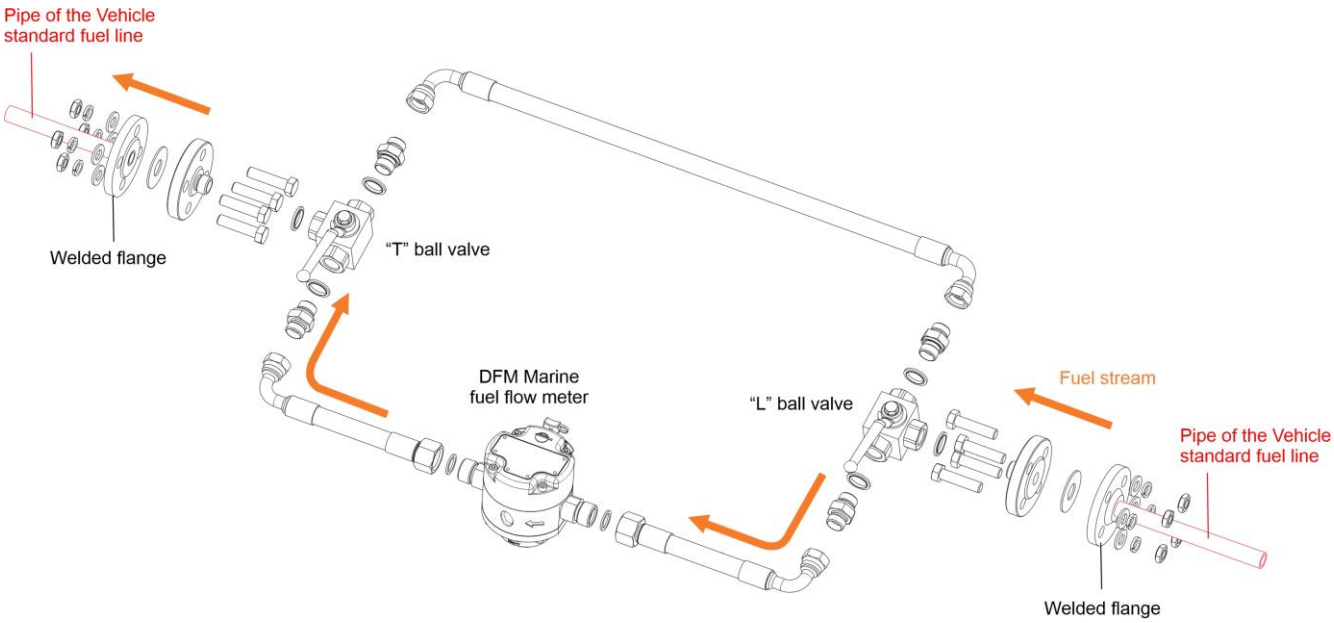
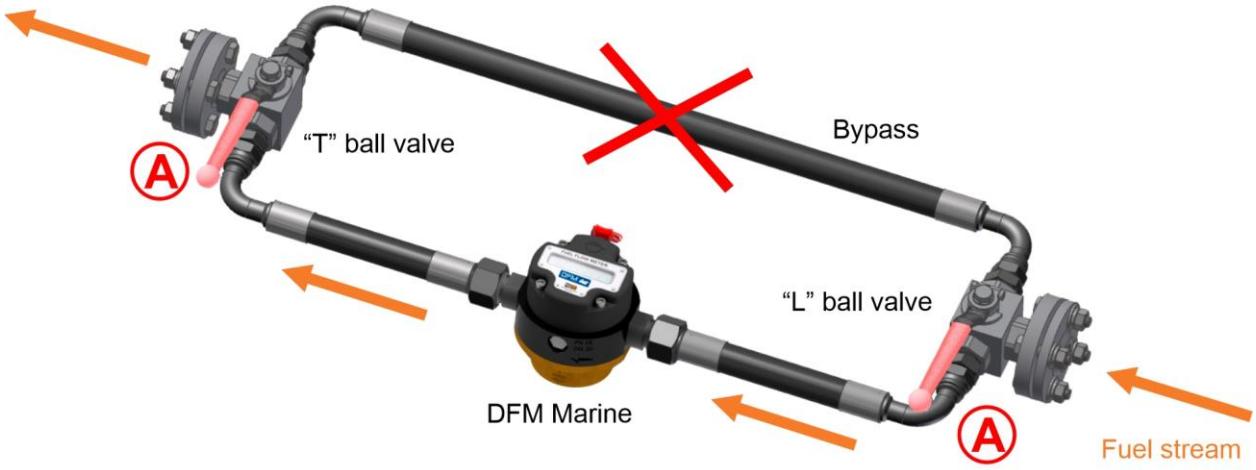
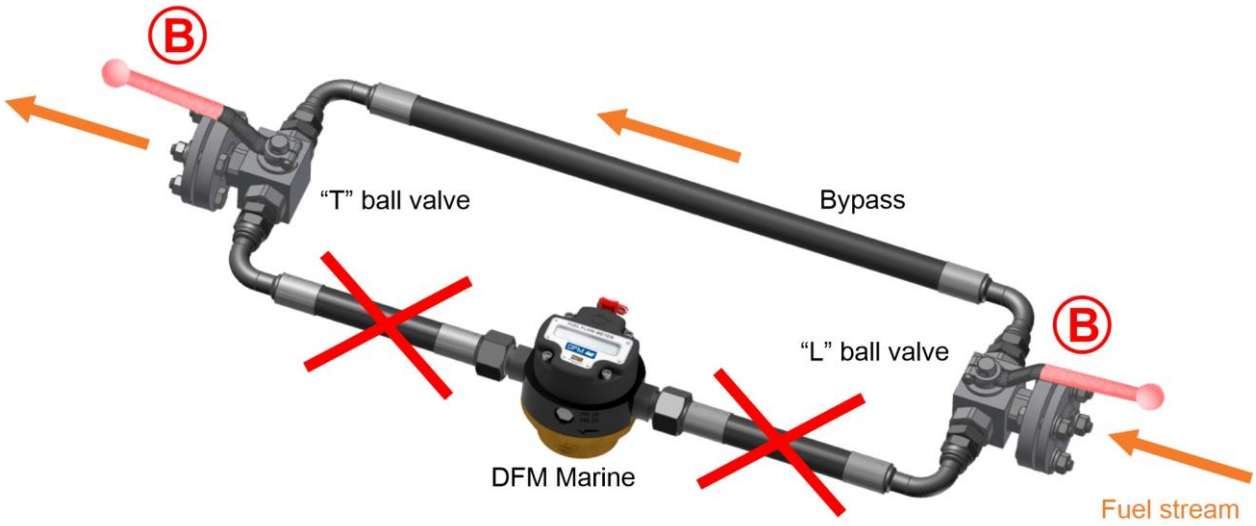


Figure 56 — Diagram of MK DFM M assembly

It is convenient to switch over the fuel stream from the flow meter to the bypass and vice versa by turning "T" and "L" handles of the ball valves.
During the operation of DFM Marine measuring chamber "T" and "L" handles of the ball valves are set in the **A position**. In this case, the bypass is shut and all the fuel flows only through the flow meter measuring chamber (see figure 57 a).
In case maintenance is needed for DFM Marine, "T" and "L" handles of the ball valves are set in the **B position**. In this case, the passage for the fuel stream to the measuring chamber is blocked, and all the fuel flows only through the bypass (see figure 57 b).



a) fuel flows only through the flow meter



b) fuel flows only through the bypass

Figure 57 — Switching over the fuel stream using "T" and "L" ball valves

8.2 Additional accessories

During the installation of DFM Marine fuel flow meter on the Vehicle you may need additional components, depending on the fuel system configuration and the selected scheme of the flow meter installation (see table 20).

Table 20 — Additional accessories for DFM Marine

External view	Name	Model designation	Purpose	Note
	**Mud filter**	Mud filter 1000 F	Filter to protect the measuring chamber of DFM Marine 1000 F from mud	DN=15 mm, P_{max} = 16 bar, cell size of the filtering element – 0.6 mm, with a magnetic element
		Mud filter 2000 F	Filter to protect the measuring chamber of DFM Marine 2000 F from mud	DN=20 mm, P_{max} = 16 bar. Cell size of the filtering element – 0.6 mm, with a magnetic element
		Mud filter 4000 F	Filter to protect the measuring chamber of DFM Marine 4000 F from mud	DN=25 mm, P_{max} = 16 bar. Cell size of the filtering element – 0.6 mm, with a magnetic element
		Mud filter 1000 T	Filter to protect the measuring chamber of DFM Marine 1000 T from mud	DN=20 mm, P_{max} = 16 bar. Cell size of the filtering element – 0.6 mm, with a magnetic element. The delivery set includes the adapter and the sealing ring
		Mud filter 2000 T	Filter to protect the measuring chamber of DFM Marine 2000 T from mud	DN=25 mm, P_{max} = 16 bar. Cell size of the filtering element – 0.6 mm, with a magnetic element. The delivery set includes the adapter and the sealing ring
		Mud filter 4000 T	Filter to protect the measuring chamber of DFM Marine 4000 T from mud	DN=32 mm, P_{max} = 16 bar. Cell size of the filtering element – 0.6 mm, with a magnetic element. The delivery set includes the adapter and the sealing ring

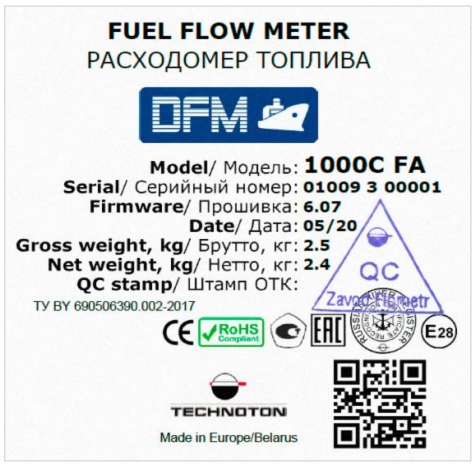
External view	Name	Model designation	Purpose	Note
	**Fitting** Manufactured of (material): **L** – brass; **A** – duraluminum; **S** – steel	G1/2"	Matching counterpart to mount DFM Marine in the fuel line	Male thread BSP G1/2-A, P_{max}=16 bar, In accordance with ISO 228-1
		G3/4"		Male thread BSP G3/4-A, P_{max}=16 bar, In accordance with ISO 228-1
		G1"		Male thread BSP G1-A, P_{max}=16 bar, In accordance with ISO 228-1
	**Flange** Manufactured of (material): **L** – brass; **A** – duraluminum; **S** – steel	DN 15		DN=15 mm, P_{max}=25 bar, In accordance with EN 1092-1
		DN 20		DN=20 mm, P_{max}=25 bar, In accordance with EN 1092-1
		DN 25		DN=25 mm, P_{max}=25 bar, In accordance with EN 1092-1

9 Packaging

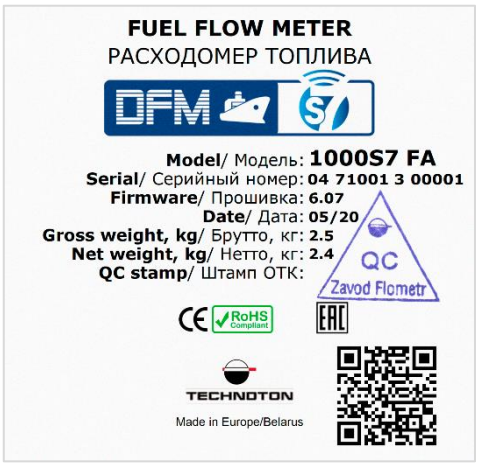
DFM Marine delivery set is placed in a sealed plywood box (see figure 58).

Figure 58 — DFM Marine packaging

Label sticker with information on the product name, serial number, firmware version, manufacture date, weight as well as Quality Control seal and QR code is stuck on two sides of the DFM Marine box (see figure 59).



a) DFM Marine C/CK/CCAN



b) DFM Marine S7

Figure 59 — DFM Marine packaging label

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

10 Storage

DFM Marine is recommended to be stored in dry enclosed areas.

DFM Marine 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 Marine in the same room with substances that cause metal corrosion and/or contain aggressive impurities.

DFM Marine shelf life must not exceed 24 months.

11 Transportation

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

When transporting by air, DFM Marine must be stored in heated pressurized compartments.

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

Shipping containers with packed DFM Marine should be sealed.

12 Utilization/re-cycling

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

The inbuilt lithium-thionyl chloride battery of DFM Marine contains harmful substances and components that are hazardous to human health and environment.

Battery must not be disposed of together with general domestic waste.
The Buyer is responsible for the disposal of battery by means of its delivery to the hazardous waste collecting center, this will ensure safety for human health and environment.

Technoton bears no responsibility for any non-compliance with the above disposal and recycling requirements for battery.

Contacts

Distribution, technical support and service

TECHNOTON

9001:2015
certified quality

DAkkS Deutsche Akkreditierungsstelle D-ZM-16065-01-01

sales@jv-technoton.com

support@jv-technoton.com

Annex A
Overall dimensions and weight

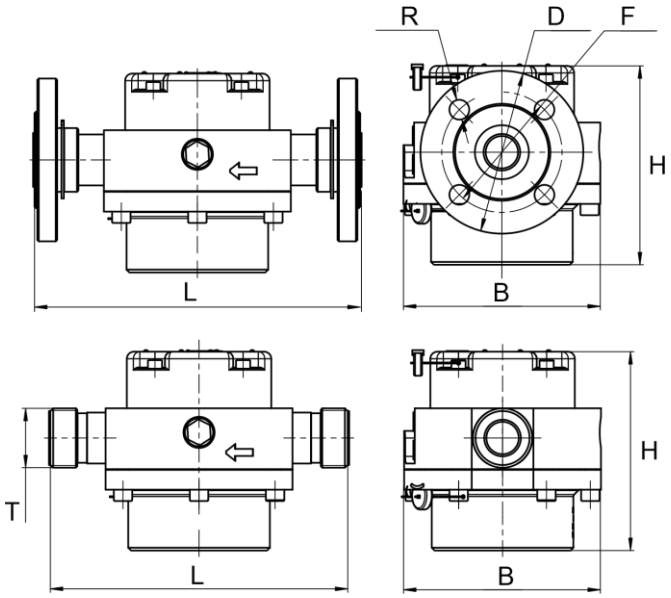
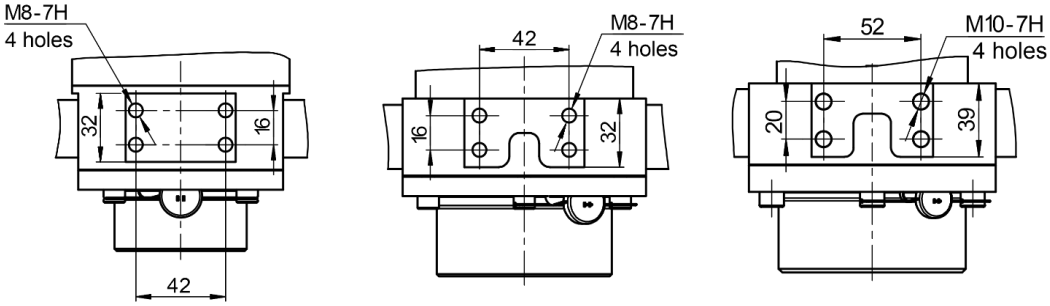


Figure A.1 — DFM Marine overall dimensions

Table A.1— DFM Marine overall dimensions

Model	Type of connection	T, inch	D, mm	F, mm	R, mm	L, mm	B, mm	H, mm
DFM Marine 1000	male pipe thread	BSP G3/4	-	-	-	165	102	117
	rotating flange	-	Ø94	Ø65	Ø14 (4 holes	190		
DFM Marine 2000	male pipe thread	BSP G1	-	-	-	190	120	123
	rotating flange	-	Ø105	Ø75	Ø14 (4 holes)	200		
DFM Marine 4000	male pipe thread	BSP G1 1/4	-	-	-	210	139	141
	rotating flange	-	Ø115	Ø85	Ø14 (4 holes)	230		



a) for DFM Marine 1000 *b) for DFM Marine 2000* *c) for DFM Marine 4000*

Figure A.2 — Mounting holes placement scheme

Table A.2— DFM Marine weight

Model	Weight, kg, not more than
DFM Marine 1000C FA	2.2
DFM Marine 1000C TA	1.7
DFM Marine 1000C FL	4.3
DFM Marine 1000C TL	2.7
DFM Marine 1000CK FA	2.2
DFM Marine 1000CK TA	1.7
DFM Marine 1000CK FL	4.3
DFM Marine 1000CK TL	2.7
DFM Marine 1000CCAN FA	2.2
DFM Marine 1000CCAN TA	1.7
DFM Marine 1000CCAN FL	4.3
DFM Marine 1000CCAN TL	2.7
DFM Marine 1000S7 FA	2.1
DFM Marine 1000S7 TA	1.6
DFM Marine 1000S7 FL	4.2
DFM Marine 1000S7 TL	2.6
DFM Marine 2000C FA	3.2
DFM Marine 2000C TA	2.7
DFM Marine 2000C FL	6.2
DFM Marine 2000C TL	4.4
DFM Marine 2000CK FA	3.3
DFM Marine 2000CK TA	2.7
DFM Marine 2000CK FL	6.3
DFM Marine 2000CK TL	4.4
DFM Marine 2000CCAN FA	3.3
DFM Marine 2000CCAN TA	2.7
DFM Marine 2000CCAN FL	6.3
DFM Marine 2000CCAN TL	4.4
DFM Marine 2000S7 FA	3.1
DFM Marine 2000S7 TA	2.1
DFM Marine 2000S7 FL	6.1
DFM Marine 2000S7 TL	4.1
DFM Marine 4000C FA	5.1
DFM Marine 4000C TA	4.4
DFM Marine 4000C FL	9.3
DFM Marine 4000C TL	7.1
DFM Marine 4000CK FA	5.1
DFM Marine 4000CK TA	4.4
DFM Marine 4000CK FL	9.3
DFM Marine 4000CK TL	7.1
DFM Marine 4000CCAN FA	5.1
DFM Marine 4000CCAN TA	4.4
DFM Marine 4000CCAN FL	9.3
DFM Marine 4000CCAN TL	7.1
DFM Marine 4000S7 FA	5.0
DFM Marine 4000S7 TA	4.3
DFM Marine 4000S7 FL	9.2
DFM Marine 4000S7 TL	7.0

Annex B
Protocol of inspecting machinery unit

_____/_____/20_____
Day Month Year

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

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

Requirement	Conforms/ Does not conform	Notes
Leakage resistance of the fuel system		Measurement accuracy and DFM Marine 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 Marine 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 Marine 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 Marine performance is not guaranteed in case of significant resistance/oxidation of the switch. Maintenance or replacement is recommended

representative of the CUSTOMER: representative of the CONTRACTOR:

_____ _____

name, signature name, signature

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

Annex C
Template of check test report

_____/ _____ /20____
Day Month Year

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

Fuel consumption	Actual fuel consumption. according to calibrated container V_m, m^3	
	Fuel consumption measured According to DFM Marine reading $V_{measured}$, m^3	
Relative error of fuel consumption measurement	$\delta = \frac{V_{measured} - V_m}{V_m} \cdot 100\%$	

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

Table D.1 — Data composition in DFM Marine CCAN outgoing messages, that are transmitted via SAE j1939 protocol

Field number	Length	Parameter	Description	Rules of output
Flowmeter. Engine total hours of operation PGN 63157 (0xF6B5)				1000 ms
1	4 bytes	SPN 521314	Total Fuel Used	
5	4 bytes	SPN 521171	Flowmeter Hours Of Operation	
Flowmeter. Parameters PGN 63159 (0xF6B7)				1000 ms
1	4 bytes	SPN 521313	Engine Fuel Rate	
5.1	4 bits	SPN 521181	Engine Mode by Fuel Rate	
Flowmeter. Counters PGN 63160 (0xF6B8)				On request
1	4 bytes	SPN 521314	Total Fuel Used	
5	4 bytes	SPN 521314/9.0	Total Fuel Used. Idle	
9	4 bytes	SPN 521314/9.1	Total Fuel Used. Optimal	
13	4 bytes	SPN 521314/9.2	Total Fuel Used. Overload	
17	4 bytes	SPN 521314/9.3	Total Fuel Used. Cheating	
21	4 bytes	SPN 521314/28.0	Total Fuel Used. Clearable	
25	4 bytes	SPN 521171	Flowmeter Hours Of Operation	
29	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle	
33	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal	
37	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload	
41	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating	
45	4 bytes	SPN 521171/28.0	Flowmeter Hours Of Operation. Clearable	
49	4 bytes	SPN 521171/9.5	Flowmeter Hours Of Operation. Interference	
High resolution fuel consumption (liquid) PGN 63161 (0xF6B9)				1000 ms
1	4 bytes	SPN 521316	High Resolution Engine Trip Fue	
5	4 bytes	SPN 521331	Total Engine Fuel. High Resolution	
Average fuel rate PGN 63162 (0xF6BA)				1000 ms
1	4 bytes	SPN 521313/2.1	Engine Fuel Rate. Mean	
Flowmeter. Engine total hours of operation (clearable) PGN 63167 (0xF6BF)				1000 ms
1	4 bytes	SPN 521314/28.0	Total Fuel Used. Clearable	
5	4 bytes	SPN 521171/28.0	Flowmeter Hours Of Operation. Clearable	
Flowmeter. Engine total hours of operation in Idle PGN 63170 (0xF6C2)				1000 ms
1	4 bytes	SPN 521314/9.0	Total Fuel Used. Idle	
5	4 bytes	SPN 521171/9.0	Flowmeter Hours Of Operation. Idle	
Flowmeter. Engine total hours of operation in Optimal mode PGN 63171 (0xF6C3)				1000 ms
1	4 bytes	SPN 521314/9.1	Total Fuel Used. Optimal	
5	4 bytes	SPN 521171/9.1	Flowmeter Hours Of Operation. Optimal	

Field number	Length	Parameter	Description	Rules of output
Flowmeter. Engine total hours of operation in Overload mode PGN 63172 (0xF6C4)				1000 ms
1	4 bytes	SPN 521314/9.2	Total Fuel Used. Overload	
5	4 bytes	SPN 521171/9.2	Flowmeter Hours Of Operation. Overload	
Flowmeter. Engine total hours of operation in Cheating mode PGN 63173 (0xF6C5)				1000 ms
1	4 bytes	SPN 521314/9.3	Total Fuel Used. Cheating	
5	4 bytes	SPN 521171/9.3	Flowmeter Hours Of Operation. Cheating	
Flowmeter. Total hours of operation in Interference mode PGN 63174 (0xF6C6)				1000 ms
1	4 bytes	SPN 521171/9.5	Flowmeter Hours Of Operation. Interference	
5	4 bytes	SPN 521267	Interference sensor occurrence count	
Differencial fuel rate. Params PGN 63196 (0xF6DC)				1000 ms
1	4 bytes	SPN 521313/2.15	Engine Fuel Rate. Differencial	
5.1	4 bytes	SPN 521181/2.15	Engine Mode by Fuel Rate. Differencial	
Differencial fuel rate. Counters PGN 63197 (0xF6DD)				On request
1	4 bytes	SPN 521314/2.15	Total Fuel Used. Differencial	
5	4 bytes	SPN 521314/9.0/2.15	Total Fuel Used. Idle. Differencial	
9	4 bytes	SPN 521314/9.1/2.15	Total Fuel Used. Optimal. Differencial	
13	4 bytes	SPN 521314/9.2/2.15	Total Fuel Used. Overload. Differencial	
17	4 bytes	SPN 521314/9.3/2.15	Total Fuel Used. Cheating. Differencial	
21	4 bytes	SPN 521314/28.0/2.15	Total Fuel Used. Clearable. Differencial	
25	4 bytes	SPN 521314/9.4/2.15	Total Fuel Used. Negative. Differencial	
29	4 bytes	SPN 521171/2.15	Flowmeter Hours Of Operation. Differencial	
33	4 bytes	SPN 521171/9.0/2.15	Flowmeter Hours Of Operation. Idle. Differencial	
37	4 bytes	SPN 521171/9.1/2.15	Flowmeter Hours Of Operation. Optimal. Differencial	
41	4 bytes	SPN 521171/9.2/2.15	Flowmeter Hours Of Operation. Overload. Differencial	
45	4 bytes	SPN 521171/9.3/2.15	Flowmeter Hours Of Operation. Cheating. Differencial	
49	4 bytes	SPN 521171/28.0/2.15	Flowmeter Hours Of Operation. Clearable. Differencial	
53	4 bytes	SPN 521171/9.4/2.15	Flowmeter Hours Of Operation. Negative. Differencial	
Flowmeter. Global Counters PGN 63506 (0xF812)				1000 ms
1	4 bytes	SPN 521313	Engine Fuel Rate	
5	4 bytes	SPN 521674	Global Fuel Used	
Flowmeter. Global Counters. Slave PGN 63507 (0xF813)				1000 ms
1	4 bytes	SPN 521313	Engine Fuel Rate	
5	4 bytes	SPN 521674	Global Fuel Used	
Differencial fuel rate. Engine total hours of operation PGN 63198 (0xF6DE)				1000 ms
1	4 bytes	SPN 521314/2.15	Total Fuel Used. Differencial	
5	4 bytes	SPN 521171/2.15	Flowmeter Hours Of Operation. Differencial	
Differencial fuel rate. Engine total hours of operation (clearable) PGN 63199 (0xF6DF)				1000 ms
1	4 bytes	SPN 521314/28.0/2.15	Total Fuel Used. Clearable. Differencial	
5	4 bytes	SPN 521171/28.0/2.15	Flowmeter Hours Of Operation. Clearable. Differencial	

Field number	Length	Parameter	Description	Rules of output
Differential fuel rate. Engine total hours of operation in Idle PGN 63200 (0xF6E0)				1000 ms
1	4 bytes	SPN 521314/9.0/2.15	Total Fuel Used. Idle. Differencial	
5	4 bytes	SPN 521171/9.0/2.15	Flowmeter Hours Of Operation. Idle. Differencial	
Differencial fuel rate. Engine total hours of operation in Optimal mode PGN 63201 (0xF6E1)				1000 ms
1	4 bytes	SPN 521314/9.1/2.15	Total Fuel Used. Optimal. Differencial	
5	4 bytes	SPN 521171/9.1/2.15	Flowmeter Hours Of Operation. Optimal. Differencial	
Differencial fuel rate. Engine total hours of operation in Overload mode PGN 63202 (0xF6E2)				1000 ms
1	4 bytes	SPN 521314/9.2/2.15	Total Fuel Used. Overload. Differencial	
5	4 bytes	SPN 521171/9.2/2.15	Flowmeter Hours Of Operation. Overload. Differencial	
Differencial fuel rate. Engine total hours of operation in Cheating mode PGN 63203 (0xF6E3)				1000 ms
1	4 bytes	SPN 521314/9.3/2.15	Total Fuel Used. Cheating. Differencial	
5	4 bytes	SPN 521171/9.3/2.15	Flowmeter Hours Of Operation. Cheating. Differencial	
Differential opearation mode PGN 63204 (0xF6E4)				On request
1.1	2 bits	SPN 521268	Master Mode	
1.3	2 bits	SPN 521270	Calculation Mode	
2	1 byte	SPN 521269	Slave Device Address	
3	2 bytes	SPN 521271	Differencial Fuel Rate Correction Coefficient	
5	1 byte	SPN 521671	Smoothing Capacity	
Borders. Differencial fuel rate PGN 63205 (0xF6E5)				On request
1	4 bytes	SPN 521317/9.0/2.15	Fuel Rate Mode Border. Idle. Differencial	
5	4 bytes	SPN 521317/9.1/2.15	Fuel Rate Mode Border. Optimal. Differencial	
9	4 bytes	SPN 521317/9.2/2.15	Fuel Rate Mode Border. Overload. Differencial	
Differencial fuel rate. Engine total hours of operation in negative mode PGN 63207 (0xF6E7)				1000 ms
1	4 bytes	SPN 521314/9.4	Total Fuel Used. Negative	
5	4 bytes	SPN 521171/9.4	Flowmeter Hours Of Operation. Negative	
Fuel consumption factors PGN 63026 (0xF632)				On request
1	2 bytes	SPN 521433	Temperature Correction Coefficient	
3	2 bytes	SPN 521434	Lliquid Consumption Correction Coefficient	
5.1	2 bits	SPN 521311	Temperature Correction Enable	
Calibration table. Fuel rate (DFM) PGN 63044 (0xF644)				On request
1	1 byte	SPN 521355	Array Elements Count	
2	2 bytes	SPN 521232	Impulse Period	
4	2 bytes	SPN 521231	Chamber Volume	
Request PGN 59904 (0xEA00)				1000 ms
1	3 bytes	SPN 2540	Parameter Group Number (RQST)	
Borders. Fuel rate PGN 63163 (0xF6BB)				On request
1	4 bytes	SPN 521317/9.0	Fuel Rate Mode Border. Idle	
5	4 bytes	SPN 521317/9.1	Fuel Rate Mode Border. Optimal	
9	4 bytes	SPN 521317/9.2	Fuel Rate Mode Border. Overload	

Field number	Length	Parameter	Description	Rules of output
Flowmeter characteristics PGN 63165 (0xF6BD)				On request
1.1	2 bits	SPN 521333	Flowmeter Type	
1.3	4 bits	SPN 521230	Nominal Chamber Volume	
Information display system PGN 63166 (0xF6BE)				On request
1.1	2 bits	SPN 521332	System Of Units	
Vehicle voltage PGN 62987 (0xF60B)				1000 ms
1	3 bytes	SPN 158	Keyswitch Battery Potential	
3.1	2 bits	SPN 521049	Ignition Key State	
4	4 bytes	SPN 521053	Ignition ON Time	
Unit work counters PGN 62994 (0xF612)				On request
1	4 bytes	SPN 521116	Unit Hours Of Operation	
5	4 bytes	SPN 521116/16.1	Unit Hours Of Operation. Battery	
9	4 bytes	SPN 521118	Unit Reset Counter	
13	4 bytes	SPN 521119	Unit Power Off Counter	
Unit passport PGN 62995 (0xF613)				On request
1	16 bytes	SPN 521123	Line	
17	16 bytes	SPN 521344	Mark	
33	16 bytes	SPN 521345	Model	
49	16 bytes	SPN 521120	Serial number	
65	8 bytes	SPN 521121	Firmware version	
73	4 bytes	SPN 521125	Date of production	
77	1 byte	SPN 521188	Address at S6 (SA) bus	
List Of Importnant Events PGN 63055 (0xF64F)				On request
1	4 bytes	SPN 521166	SPN Events	
5	1728 bytes	SPN 521357	Data	
List Of Informative Events PGN 63056 (0xF650)				On request
1	4 bytes	SPN 521166	SPN Events	
5	1728 bytes	SPN 521357	Data	
Battery voltage mode borders PGN 63064 (0xF658)				On request
1	2 bytes	SPN 521391/2.8	Battery Voltage Mode Border. Min	
3	2 bytes	SPN 521391/2.7	Battery Voltage Mode Border. Max	
Battery PGN 63086 (0xF66E)				5000 ms
1.1	2 bites	SPN 21129	Unit Power Status	
2	2 bytes	SPN 167	Charging System Potential (Voltage)	
4	1 byte	SPN 521061	Battery Charge Level	
5	4 bytes	SPN 521116/16.1	Unit Hours Of Operation. Battery	
Active diagnostic trouble codes PGN 65226 (0xFECA)				1000 ms
3	3 bytes	SPN 521044	Malfunction code (SID+FMI)	
Previously active diagnostic trouble codes PGN 65227 (0xFECB)				On request
3	3 bytes	SPN 521044	Malfunction code (SID+FMI)	

Field number	Length	Parameter	Description	Rules of output
Time/Date PGN 65254 (0xFEE6)				On request
1	1 byte	SPN 959	Seconds	
2	1 byte	SPN 960	Minutes	
3	1 byte	SPN 961	Hours	
4	1 byte	SPN 963	Month	
5	1 byte	SPN 962	Day	
6	1 byte	SPN 964	Year	
7	1 byte	SPN 1601	Time Displacement In Minutes	
8	1 byte	SPN 1602	Time Displacement In Hours	
Time origin settings PGN 63011 (0xF623)				On request
1.1	2 bytes	SPN 521350	Automatic Daylight Savings Time and Back	
6	1 byte	SPN 1601	Time Displacement In Minutes	
7	1 byte	SPN 1602	Time Displacement In Hours	
CAN Settings PGN 63054 (0xF64E)				On request
1.1	4 bytes	SPN 521530	CAN Protocol Type	
2.1	3 bytes	SPN 521531	CAN Baudrate	
2.4	2 bits	SPN 521533	Enable Termination Resistor	
Engine temperature 1 PGN 65262 (0xFEEE)				1000 ms
2	1 byte	SPN 174	Engine Fuel Temperature 1	
Unit Passport Abbreviated PGN 63523 (0xF823)				10000 ms
1	2 bytes	SPN 521716	Unit Firmware Version	
3	2 bytes	SPN 521717	Unit Bootloader Version	
5	2 bytes	SPN 521718	Unit Hardware Version	
Bootloader Information PGN 63009 (0xF621)				On request
1	8 bytes	SPN 521122	Bootloader Version	
High Resolution Fuel Consumption (Liquid) PGN 64777 (0xFD09)				1000 ms
5	4 bytes	SPN 5054	High Resolution Engine Total Fuel Used	
Fuel Economy (Liquid) PGN 65266 (0xFEF2)				100 ms
1	2 bytes	SPN 183	Engine Fuel Rate	
Fuel Consumption (Liquid) PGN 65257 (0xFEE9)				On request
5	4 bytes	SPN 250	Engine Total Fuel Used	
Fuel Rate PGN 63570 (0xF852)				1000 ms
1	2 bytes	SPN 521795	Engine Fuel Rate	
3	2 bytes	SPN 521795/2.15	Engine Fuel Rate. Differential	
5	4 bytes	SPN 247	Engine Total Hours of Operation	

Table D.2 — Messages of DFM Marine CCAN, that are transmitted via NMEA 2000 protocol

Message format*	Brief message transcript
PGN 127489	Engine Parameters, Dynamic
PGN 127497	Trip Fuel Consumption, Engine
PGN 130316	Temperature, Extended Range
PGN 123159	Flowmeter. Parameters
PGN 123160	Flowmeter. Counters
* Information on structure and parameters of messages of DFM Marine CCAN sending data using NMEA 2000 protocol can be obtained from Technoton's technical support: support@jv-technoton.com.	

You can reset the Counters "Flowmeter. Engine Total Hours of Operation. Clearable" (PGN 63167) that are stored in the internal memory of DFM Marine CCAN by using S6 Technology. To perform this, you need to send the message "FM Command" (PGN 63080) to the network address of the respective flow meter.

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

Command structure:

0x18 0x68 0xF6 0x6D 0x50 0x03 0x00 0x6F 0xBF 0xF6 0x00 0x00, where

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

Data Field:
0x – prefixes of the hexadecimal number system;
50 – command code for resetting the clearable Counters (80);
03 – data size (lower byte);
00 – data size (high byte);
6F – network address of the flow meter whose Counters must be reset;
BF – flow meter clearable Counters (PGN 63167 (0xF6BF)) (lower byte);
F6 – flow meter clearable Counters (PGN 63167 (0xF6BF)) (high byte);
00 – meaningless data;
00 – meaningless data.

Annex E
Electromagnetic compatibility specifications

E.1 Interference protection

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

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

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

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

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

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

E.2 Electromagnetic compatibility of BLE-module of DFM Marine S7

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

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

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

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

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

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

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

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

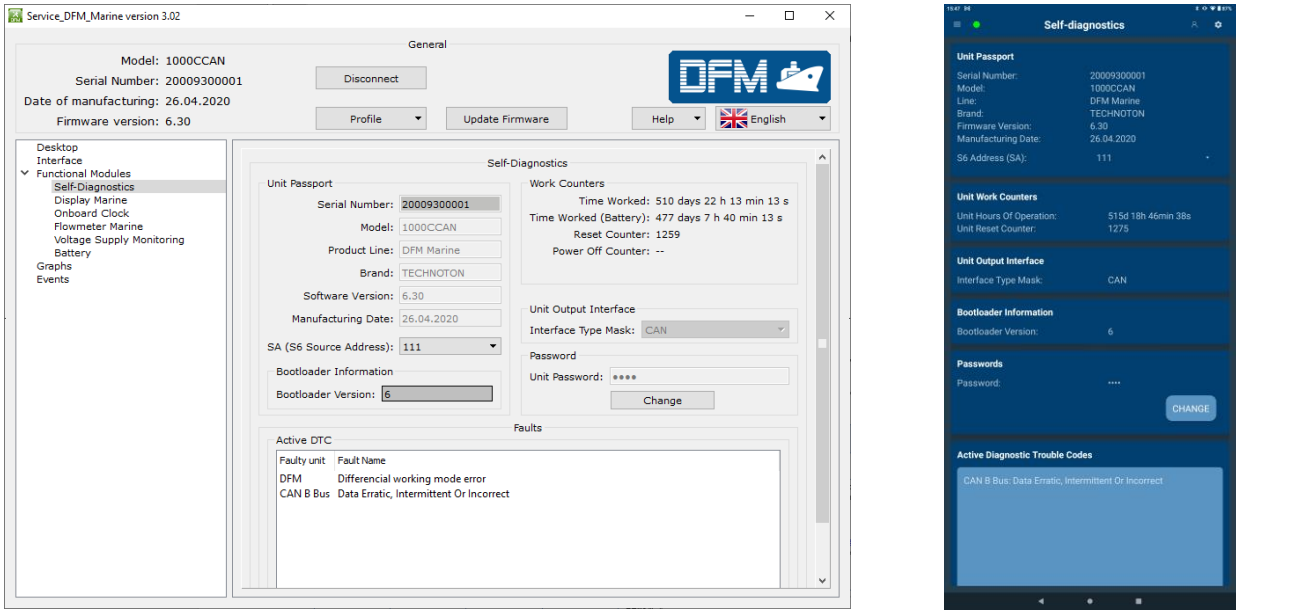
Annex F
SPN of DFM Marine Functional modules

Hourly (instant) fuel consumption measurement, Counters, Events registration, Parameters configuration and self-diagnostics of DFM Marine is ensured by coordinated operation of its Functional Modules (FM).

SPN format of DFM Marine FM is in accordance with Data base S6 (DB).

F.1 Self-diagnostics FM

Self-diagnostics FM — designed for user authorization, identification of DFM Marine passport data, operation time recording and also active malfunctions.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

Figure F.1 — Example of the window of settings of Self-diagnostics FM

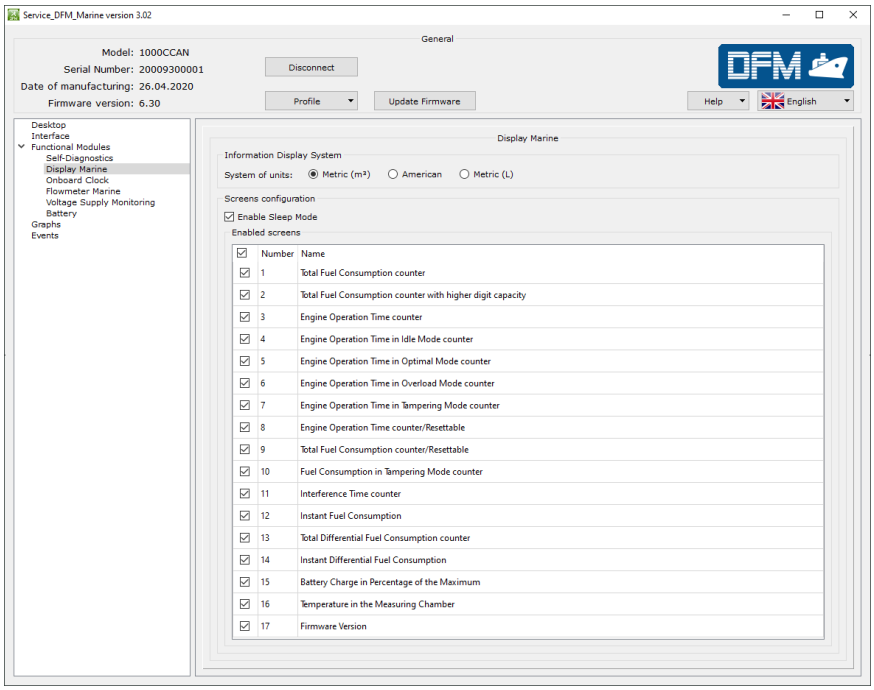
Table F.1 — Self-diagnostics FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

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

SPN	Name	Factory value	Unit of measure	Clarification
521345	Model	On the fact	No	Model – this is version of the sensor inside of DFM Marine product line. Each model has its own functional and constructive features (see 1.3). Setting is not available for editing.
521123	Line	DFM Marine	No	Name of the product line. The line represents a group of similar products – fuel flow meters produced under general trademark DFM Marine. Setting is not available for editing.
521344	Brand	TECHNOTON	No	Name of DFM Marine Manufacturer. Setting is not available for editing.
521121	Firmware version	On the fact	No	Version of built in Software DFM Marine. Setting is not available for editing.
521125	Manufacturing date	On the fact	No	Date (day, month, year) of DFM Marine production. Setting is not available for editing.
521188	S6 address (SA)	111	No	Network DFM Marine address at Telematics interface CAN j1939/S6. Value of the network address may be selected by the user from the range 0…240*. The recommended ranges for addresses — 111…118 and 151…158.
Unit work Counters PGN 62994				
521116	Unit hours of operation	On the fact	s	Counter of summarized working time of the DFM Marine since its production moment. The user cannot reset the value of this counter. It can be reset by the Manufacturer or RSC only.
521118	Unit reset counter	On the fact	pc.	Counter of DFM Marine processor restarts at a time when the power is On or there is an impact of conducted interferences of the vehicle's on-board network. Restarts accounting is carried out since production date of the DFM Marine. The user cannot reset the value of this counter. It can be reset by the Manufacturer or RSC only.
Passwords PGN 63017				
521593/3.3	Password/ 3.3 Installer	1111	No	Password is entered for user authorization while establishing connection session between fuel flow meter and service Software for configuring the DFM Marine. Password is a specific combination of four digits. By default, used: Login – 0, password – 1111. User can change password of the DFM Marine. After entering and confirming the new password is recorded into internal memory of the DFM Marine.
Active diagnostic trouble codes PGN 65226				
521044	Fault identifier (SID+FMI)	On the fact	No	List of current DFM Marine malfunctions are displayed at the settings field (in case of its presence — up to 10). For each active malfunction is indicated following: - faulty nod; - malfunction name. This setting allows to monitor DFM Marine working performance. In case of lack of active malfunctions, the following message is displayed "No malfunctions".
Unit output interface PGN 63168				
521438	Interface Type Mask	On the fact	No	Shows type of connected unit's interface (CAN/Pulse). Depending on interface type, service software loads Unit's Functional Modules configurations. Setting is not available for editing.
* For DFM Marine CCAN with the firmware version not lower than 6.30, in case of using Service DFM Marine software, versions from 3.02 and higher or Service S6 DFM (Android) application, version 2.01 and higher.				

F.2 Display Marine FM

Display Marine FM — designed for selecting measurement unit system of data on DFM Marine's display, switching ON/OFF Sleep Mode and informational screens.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

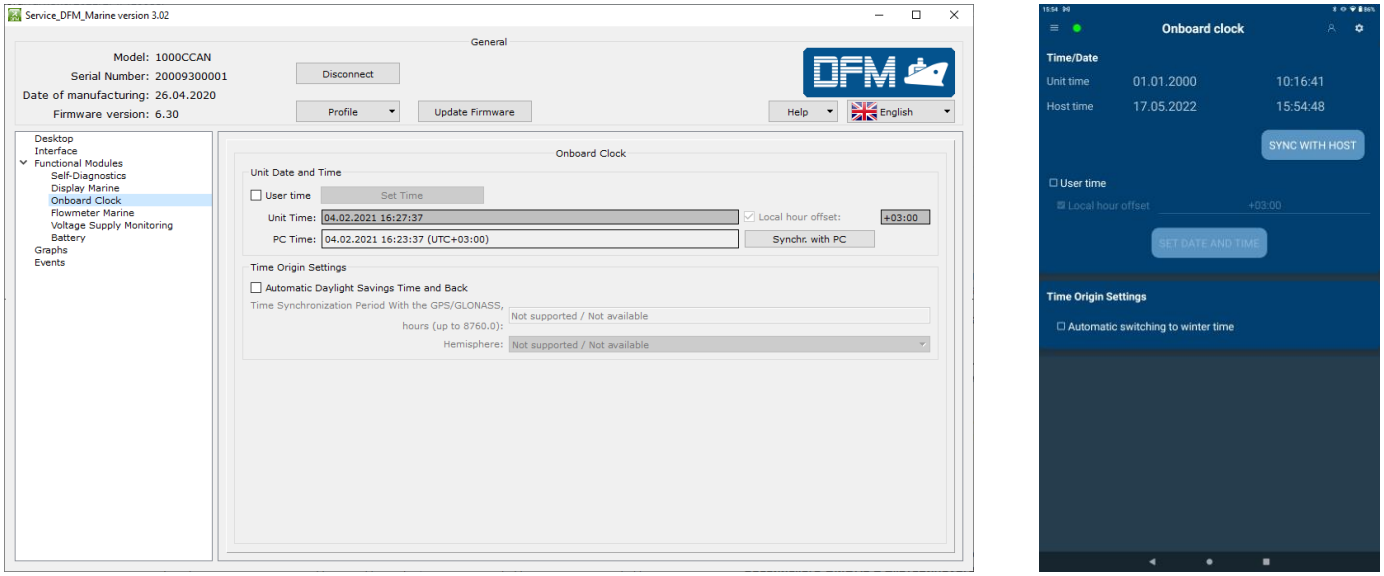
Figure F.2 — Example of the window of settings of Display Marine FM

Table F.2 — Display Marine FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

SPN	Name	Factory value	Unit of measure	Clarification
Information Display System PGN 63166				
521332	System Of Units	Metric	m^3	The area for selecting necessary system of showing instant fuel consumption and all fuel consumption Counters on the display flow meter. In DFM Marine, you can select one of the following display systems: • metric (in m^3); • metric (in liters); • US (gallons).
Screen Configuration PGN 63276				
521455	Sleep Mode	On	No	Field for switching on/off automatic transition of the flow meter to "sleep" mode after 1 min from the moment of last touch of display with magnetic key. When "sleep" mode is turned on, it allows to save the charge of built-in battery of DFM Marine. For continuous display of data on flow meter's display, "sleep" mode should be switched off. Keep in mind, this operation mode leads to a decrease in of built-in battery's lifetime.
521454	Screens Mask	On	No	Fields of switching on/off any of 17 informational screens of DFM Marine.

F.3 Onboard clock FM

Onboard Clock FM — designed for generation of signals of time and its transmission to other functional modules DFM Marine.



a) in Service DFM Marine software *b) in Service S6 DFM (Android) app*

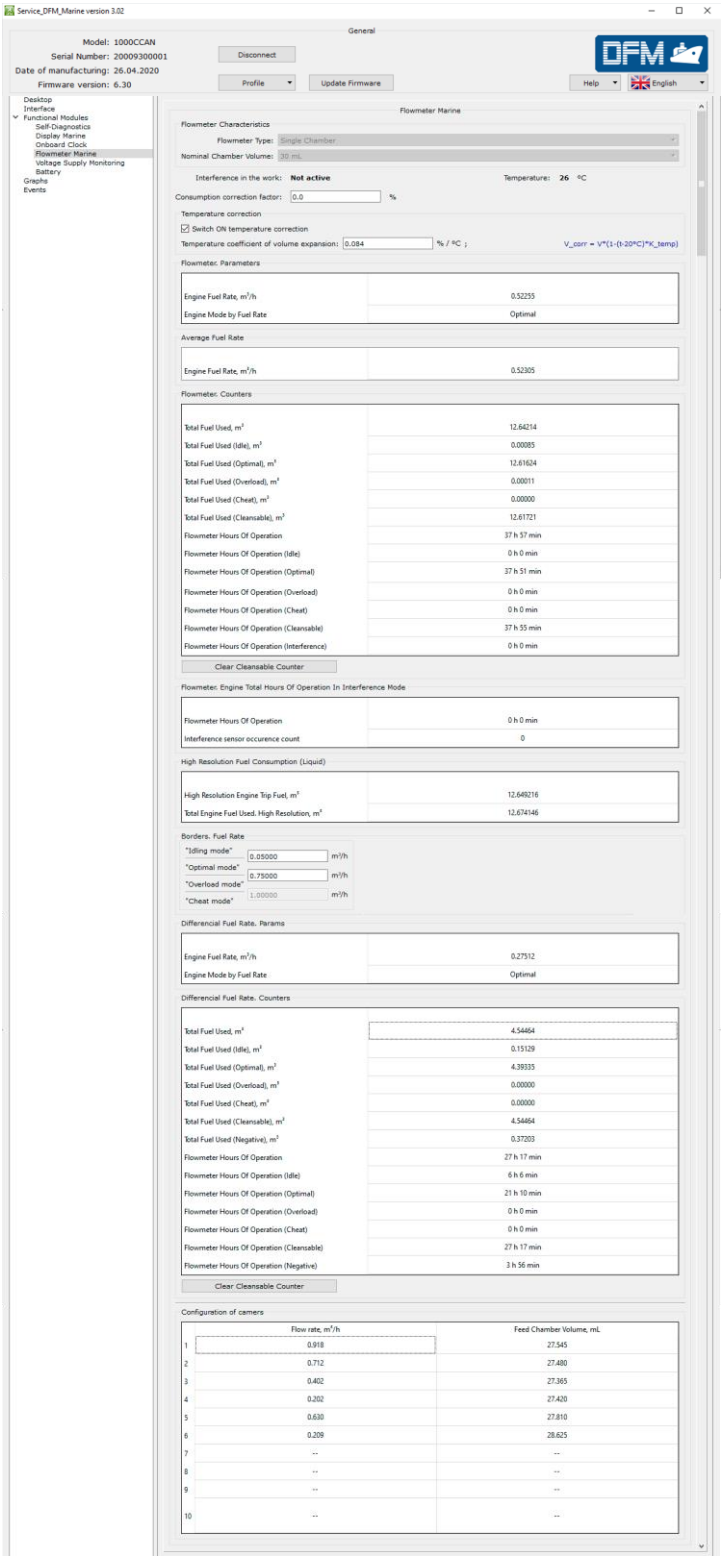
Figure F.3 — Example of the window of settings of Onboard Clock FM

Table F.3 —Onboard Clock FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

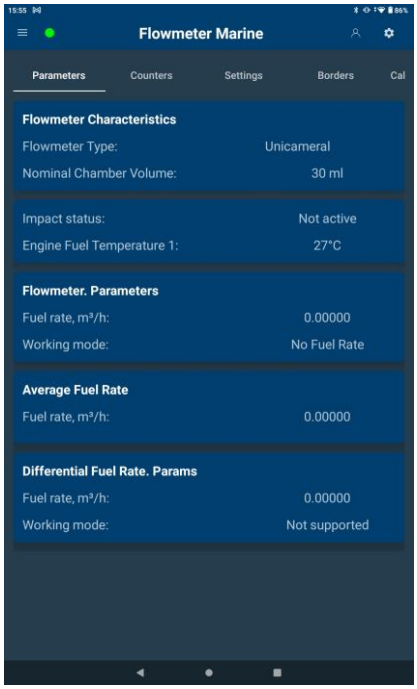
SPN	Name	Factory value	Unit of measure	Range	Clarification
Time/Date PGN 65254					
959	Seconds	On the fact	s	0…62.5	Present time — seconds*.
960	Minutes	On the fact	min	0…250	Present time — minutes*.
961	Hours	On the fact	h	0…250	Present time — hours*.
963	Month	On the fact	month	0…250	Present date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

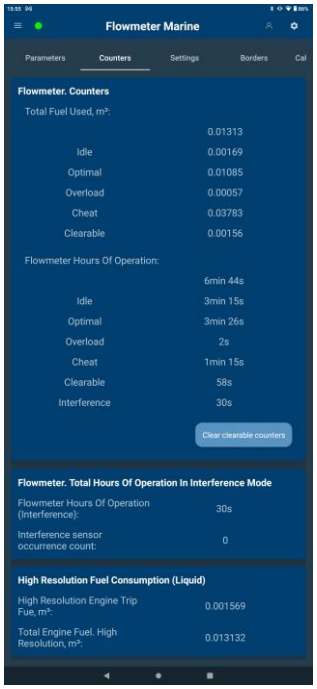
F.4 Flowmeter Marine FM

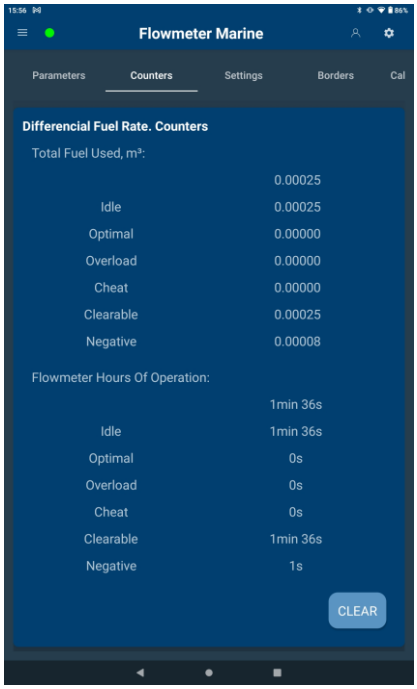
Flowmeter Marine FM — shows hourly (instant) fuel consumption, total fuel consumption and engine operation time – in total and in several operation modes.

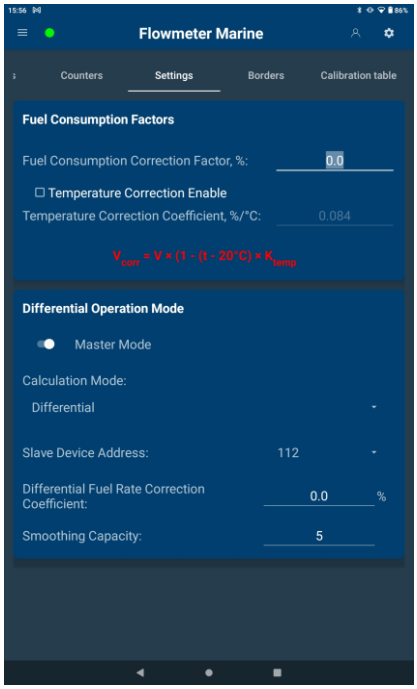


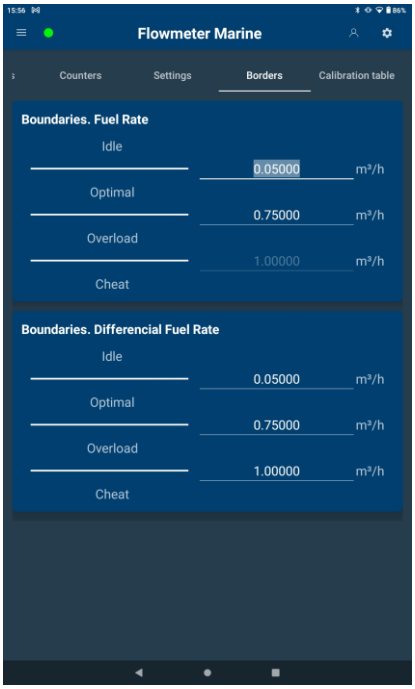
a) in Service DFM Marine software

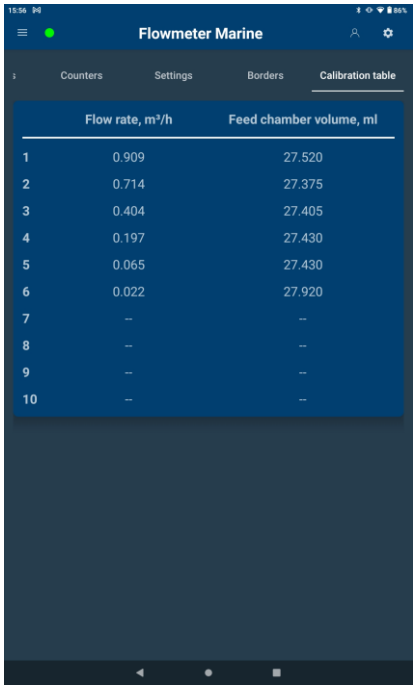












b) in Service S6 DFM (Android) app

Figure F.4— Example of the window of settings of Flowmeter Marine FM (when operating in Master mode)

Table F.4 — Flowmeter Marine FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

SPN	Name	Factory value	Unit of measure	Clarification
Flowmeter. Parameters PGN 63159				
521313	Engine Fuel Rate	On the fact	m^3/h	Hourly rate consumption of fuel, going through measuring chamber of DFM Marine.
521181	Engine Mode by Fuel Rate	On the fact	No	Current operation mode of fuel consumer, correspondent to hourly rate of fuel consumption.
Average fuel rate PGN 63162				
521313/2.1	Engine Fuel Rate / 2.1 Mean	On the fact	m^3/h	Value of instant (hourly) consumption of fuel, which goes through measuring chamber of flow meter, averaged 30 s interval. This parameter provides possibility of handy instant fuel consumption monitoring when fuel consumer works unevenly.
Flowmeter. Counters PGN 63160				
521314	Total Fuel Used	On the fact	m^3	Overall fuel consumption of the Vehicle in all operation modes including "Idle". The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.0	Total Fuel Used/ 9.0 Idle	On the fact	m^3	Overall fuel consumption of the Vehicle in "Idle" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.1	Total Fuel Used/ 9.1 Optimal	On the fact	m^3	Overall fuel consumption of the Vehicle in "Optimal" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.2	Total Fuel Used/ 9.2 Overload	On the fact	m^3	Overall fuel consumption of the Vehicle in "Overload" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.3	Total Fuel Used/ 9.3 Cheat	On the fact	m^3	Overall fuel consumption, which was higher than configured highest boundary of fuel consumption rate for installed flow meter. Increasing numbers on the Counter can mean either possible fuel line intervention or incorrect installation of fuel flow meter. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/28.0	Total Fuel Used/ 28.0 Clearable	On the fact	m^3	Overall fuel consumption of the Vehicle in all operation modes including "Idle". Counter is growing since the moment of previous reset by User. This Counter is useful for precise fuel dosing.
521171	Engine Hours Of Operation	On the fact	s	Overall vehicle's engine operation time in various operation modes, including operation time in "Idle" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.0	Engine Hours Of Operation/9.0 Idle	On the fact	s	Overall vehicle's engine operation time in "Idle" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.1	Engine Hours Of Operation/ 9.1 Optimal	On the fact	s	Overall vehicle's engine operation time in "Optimal" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.2	Engine Hours Of Operation/ 9.2 Overload	On the fact	s	Overall vehicle's engine operation time in "Overload" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.3	Engine Hours Of Operation/ 9.3 Cheat	On the fact	s	Overall vehicle's engine operation time when fuel consumption was higher than configured highest boundary of fuel consumption rate for installed flow meter. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/28.0	Engine Hours Of Operation/ 28.0 Clearable	On the fact	s	Overall vehicle's engine operation time in various operation modes, including operation time in "Idle" mode. Counter is growing since the moment of previous reset by user. This Counter is useful for precise fuel dosing.

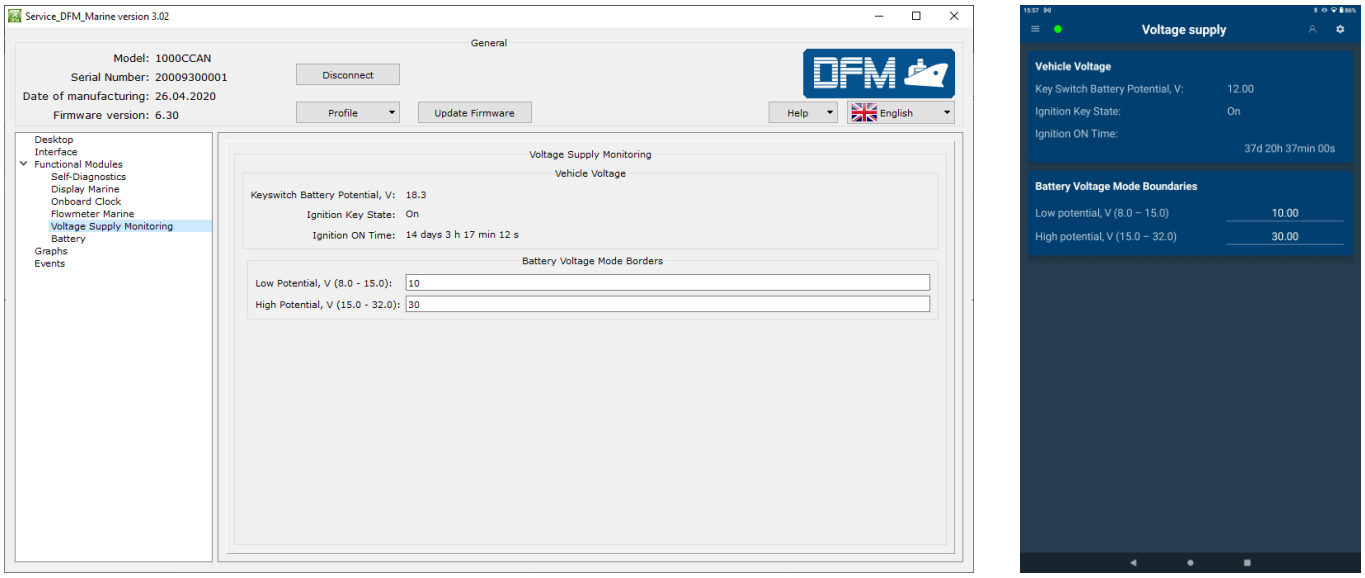
SPN	Name	Factory value	Unit of measure	Clarification
521171/9.5	Engine Hours Of Operation/ 9.5 Interference	On the fact	s	Overall time of external factors influence (e.g. magnetic field), which prevent normal functioning of DFM Marine. The Counter is increasing from the date of flow meter production and cannot be reset by user.
Flowmeter. Engine total hours of operation in interference mode PGN 63174				
521171/9.5	Engine Hours Of Operation/ 9.5 Interference	On the fact	s	Overall time of external factors influence (e.g. magnetic field), which prevent normal functioning of DFM Marine. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521267	Interference sensor occurrence count	On the fact	pcs.	Counter for recording quantity of interference attempts (e.g. with magnetic field), which are aimed to stop flow meter.
High Resolution Fuel Consumption (Liquid) PGN 63161				
521316	High Resolution Engine Trip Fuel	On the fact	m^3	Fuel consumption with higher accuracy, which is increasing since turning on ignition, and reset on turning off ignition. Counter is not available in current FW version.
521331	Total Engine Fuel Used. High Resolution	On the fact	m^3	Total fuel consumption with higher accuracy, which is increasing since the moment of flow meter manufacture. Counter cannot be reset by User.
Borders. Fuel Rate PGN 63163				
521317/9.0	Fuel Rate Mode Border/ 9.0 Idle	On the fact	m^3/h	"Idle" operation mode boundary setting – less than 10 % of maximal hourly consumption rate of fuel, going through the measurement chamber of DFM Marine. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user.
521317/9.1	Fuel Rate Mode Border/ 9.1 Optimal	On the fact	m^3/h	"Optimal" operation mode boundary setting – 10 to 75 % of maximal hourly fuel consumption rate. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user.
521317/9.2	Fuel Rate Mode Border/ 9.2 Overload	On the fact	m^3/h	"Overload" operation mode boundary setting – 75 to 100 % of maximal hourly fuel consumption rate. The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. Not available for editing by user.
Fuel Consumption Factors PGN 63026				
521311	Temperature correction enable	Off	On/Off	Function of automatic volumetric fuel consumption measurement correction depending on fuel temperature, which allows to increase accuracy of DFM Marine. A use can turn on/off the function.
521433	Temperature correction coefficient	0.084	%/°C	Setting-up coefficient of volumetric expansion of fuel depending on fuel temperature change may increase accuracy of measurements by DFM Marine. The setting can be adjusted by user only after turning on function of temperature correction (see 2.6.7)
521434	Correction coefficient	0.0	%	Setting-up correction coefficient of consumption may increase accuracy of fuel consumption measurement when constant over/undermeasurement during specific conditions of operation (high vibration, air in fuel lines, higher return flow from nozzles) is detected. The setting is available for editing by user (see 2.6.7)
Differential operation mode PGN 63204				
521268	Master Mode	Off	No	Enabling Master mode for primary flow meter (fuel feed line) and disabling Master (reverse fuel line) from a pair, which is used in differential mode (see 2.6.8).
521270	Calculation Mode	Differential	No	Selecting necessary mode of flow meter: Differential – fuel consumption is calculated as a difference between fuel consumption measured by flow meter in feed and reverse lines. Summing – fuel consumption is calculated as a sum of fuel consumption measured by flow meter in first and second fuel lines.

SPN	Name	Factory value	Unit of measure	Clarification
521269	Slave Device Address	112	No	Enter a unique network address for Slave-flow meter (from 111…118 and 151…158 ranges). Elected address should not be the same as Master-flow meter has.
521271	Differential Fuel Rate Correction Coefficient	0.0	No	Setting-up correction coefficient of consumption may increase accuracy of fuel consumption differential measurement when constant over/undermeasurement during specific conditions of operation (high vibration, air in fuel lines, higher return flow from nozzles) is detected. The setting is available for editing by user
521671	Smoothing Capacity	5	No	Smoothing Capacity (buffer) is used for increasing accuracy of differential measurement in cases of uneven flow rate in feed/reverse lines. Value of smoothing buffer is selected experimentally from 2…100 range. In case of even flow rate in fuel lines it is not recommended to alter value of smoothing buffer (which is"5" by default. When unevenness of flow rate in feed and reverse lines is growing, it is recommended to increase value of smoothing buffer.
Borders. Differential fuel rate PGN 63205				
521317/9.0/2.15	Fuel Rate Mode Border/9.0 Idle/ 2.15 Differential	On the fact	m^3/h	"Idle" operation mode boundary setting – less than 10 % of maximal hourly consumption rate of fuel (differential mode), going through measuring chambers of Master-flow meter (fuel feed line) and Slave-flow meter (fuel reverse line). The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user.
521317/9.1/2.15	Fuel Rate Mode Border/ 9.1 Optimal/ 2.15 Differential	On the fact	m^3/h	"Optimal" operation mode boundary setting – 10 to 75 % of maximal hourly fuel consumption rate (differential mode going through measuring chambers of Master-flow meter (fuel feed line) and Slave-flow meter (fuel reverse line). The setting is used for defining current vehicle operation mode depending on hourly fuel consumption rate. The setting is available for editing by user.
521317/9.2/2.15	Fuel Rate Mode Border/ 9.2 Overload/ 2.15 Differential	On the fact	m^3/h	"Overload" operation mode boundary setting – 75 to 100 % of maximal hourly fuel consumption rate (differential mode), going through measuring chambers of Master-flow meter (fuel feed line) and Slave-flow meter (fuel reverse line). Not available for editing by user.
Differential fuel rate. Params PGN 63196				
521313/2.15	Engine fuel rate/ 2.15 Differential	On the fact	m^3/h	Differential hourly (instant) fuel consumption, going through measuring chambers of Master-flow meter (fuel feed line) and Slave-flow meter (fuel reverse line).
521181/2.15	Engine mode by fuel rate/ 2.15 Differential	On the fact	No	Current fuel consumer operation mode, corresponding to the value of differential hourly fuel consumption mode.
Differential fuel rate. Counters PGN 63197				
521314/2.15	Total fuel used/ 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of the Vehicle in all operation modes including "Idle". The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.0/2.15	Total fuel used/ 9.0 Idle / 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of the Vehicle in "Idle" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.1/2.15	Total fuel used/ 9.1 Optimal / 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of the Vehicle in "Optimal" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.2/2.15	Total fuel used/ 9.2 Overload/ 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of the Vehicle in "Overload" operation mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521314/9.3/2.15	Total fuel used/ 9.3 Cheat/ 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode), which was higher than configured highest boundary of fuel consumption rate for installed flow meter. Increasing value of this Counter may point on improper installation of flow meter or possible events of fuel theft. The Counter is increasing from the date of flow meter production and cannot be reset by user.

SPN	Name	Factory value	Unit of measure	Clarification
521314/28.0/2.15	Total fuel used/ 28.0 Clearable/ 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of the Vehicle in all operation modes including "Idle". Counter is growing since the moment of previous reset by user. This Counter is useful for precise fuel dosing.
521314/9.4/2.15	Total fuel used/ 9.4 Negative/ 2.15 Differential	On the fact	m^3	Overall fuel consumption (differential mode) of Vehicle, when fuel consumption in reverse fuel line was higher than in direct fuel line. The Counter is incremented only in differential measurement. "Total "Negative" fuel consumption" Counter increasing numbers can mean increased volume of foam in reverse fuel line when Vehicle is operated at higher RPMs. The reason of foam volume growing is air presence in reverse fuel line cause by not tight hose connections or specifics of fuel system of Vehicle. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/2.15	Engine hours of operation/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) in various operation modes, including operation time in "Idle" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.0/2.15	Engine hours of operation/ 9.0 Idle/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) in "Idle" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.1/2.15	Engine hours of operation/ 9.1 Optimal/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) in "Optimal" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.2/2.15	Engine hours of operation/ 9.2 Overload/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) in "Overload" mode. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.3/2.15	Engine hours of operation/ 9.3 Cheat/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) when fuel consumption was higher than configured highest boundary of fuel consumption rate for installed flow meter. The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/28.0/2.15	Engine hours of operation/ 28.0 Clearable/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time (differential mode) in various operation modes, including operation time in "Idle" mode. Counter is growing since the moment of previous reset by user. This Counter is useful for precise fuel dosing.
521171/9.5/2.15	Engine hours of operation/ 9.5 Interference/ 2.15 Differential	On the fact	s	Overall time of external factors influence (e.g. magnetic field), which prevent normal functioning of DFM Marine (differential mode). The Counter is increasing from the date of flow meter production and cannot be reset by user.
521171/9.4/2.15	Engine hours of operation/ 9.4 Negative/ 2.15 Differential	On the fact	s	Overall vehicle's engine operation time when fuel consumption in reverse fuel line was higher than in direct fuel line (differential mode). Counter is increasing during differential measurement. Increasing value of negative consumption points on foaming in reverse line when engine is working on high RPM. Cause of foaming is air in reverse fuel line, which appears because of depressurization or special features of Vehicle's fuel system. The Counter is increasing from the date of flow meter production and cannot be reset by user.
Flowmeter characteristics PGN 63165				
521333	Flowmeter type	On the fact	No	Factory setting of flow meter type: one-chamber or differential. Cannot be modified by user.
521230	Nominal chamber volume	On the fact	ml	Factory setting of measurement chamber nominal volume from range: 5, 12.5, 20, 30, 75, 150 ml. Cannot be modified by user.
Calibration Table. Fuel Rate (DFM) PGN 63044				
521355	Array elements count	10	pcs.	Quantity of points in calibration table made by Manufacturer during calibration process. The setting cannot be altered by user.
521232	Impulse period	On the fact	ms	The period of the output pulse signal (see 1.6.8) is set during the calibration of the flow meter by the manufacturer.
521231	Chamber volume	On the fact	ml	Fuel flow meter's measurement chamber(s) volume (see. 1.6.3). The setting cannot be altered by user.

F.5 Voltage supply monitoring FM

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



a) in Service S6 DFM software *b) in Service S6 DFM (Android) app*

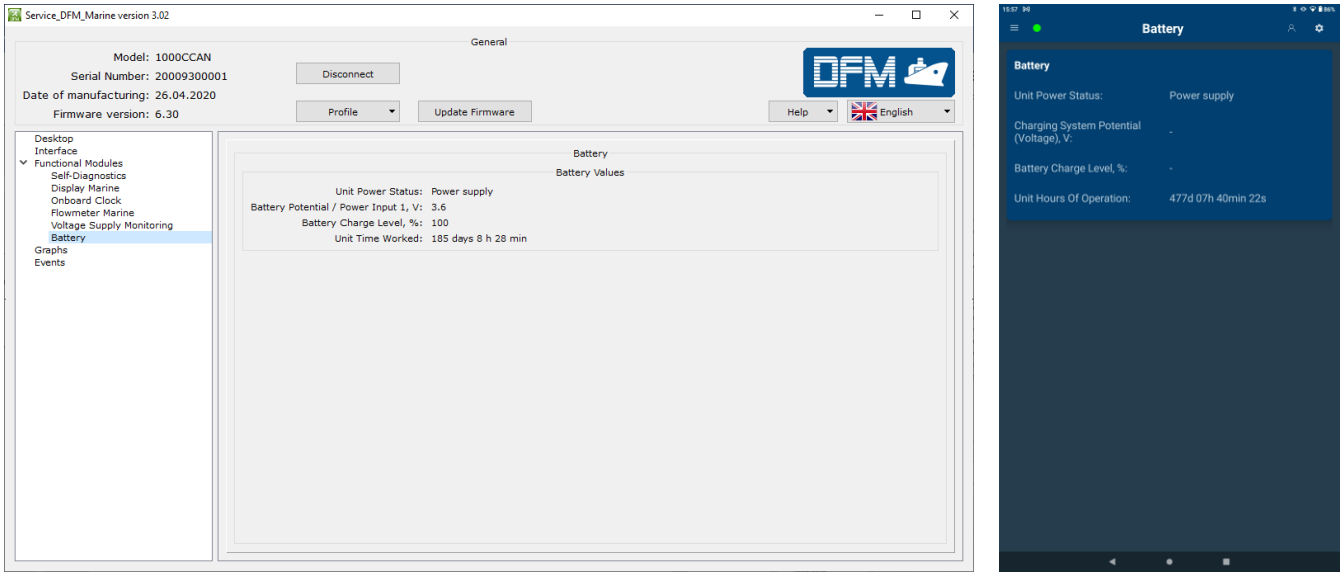
Figure F.5 — Example of the window of settings of Voltage supply monitoring FM

Table F.5 — Voltage supply monitoring FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

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

F.6 Battery FM

Battery FM — designed for power supply status check, built-in battery condition and total DFM Marine operation time from the battery.



a) in Service S6 DFM software *b) in Service S6 DFM (Android) app*

Figure F.6 — Example of the window of settings of Battery FM

Table F.6 — Battery FM. SPNs, displayed and/or editable in Service DFM Marine software or in Service S6 DFM (Android) app

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

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

Annex G
DFM Marine firmware upgrade

ATTENTION:
1) DFM Marine firmware update using Service DFM Marine software or Service S6 DFM (Android) application is possible only for flow meters **with interface cables** (model DFM Marine CK/CCAN).
2) The firmware update of DFM Marine S7 wireless fuel flow meters can be performed only using **Fuel Rate Monitor** mobile application (see User manual). After the firmware update, the flow meter always switches over into "Storage" mode (see 2.12).
3) DFM Marine firmware update should be done **only** for implementation of improvements, recommended by Manufacturer.

To upgrade DFM Marine firmware the following actions should be made:

1) In case you use Service DFM Marine software, connect flow meter to PC with the help of service adapter S6 SK (2.6.1) and establish connection session between DFM Marine and PC (see 2.6.3).
In case you use Service S6 DFM (Android) service application, establish a wireless connection between the flow meter and the Android device using S6 BT Adapter service adapter (see 2.7.1). Establish a communication session between the flow meter and the Android device via the Bluetooth channel (see 2.7.3).

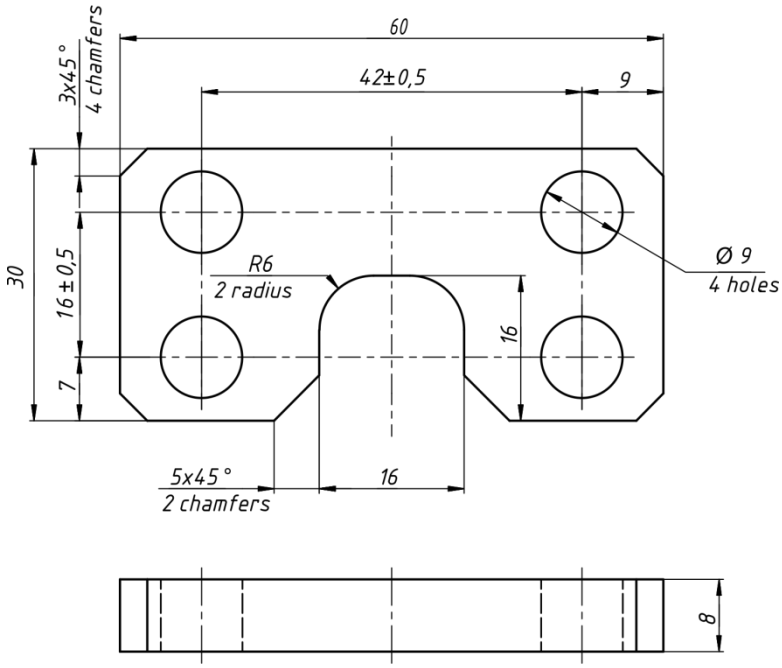
ATTENTION: When re-uploading firmware, power supply voltage of DFM Marine should not drop out of 10…45 V range.

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

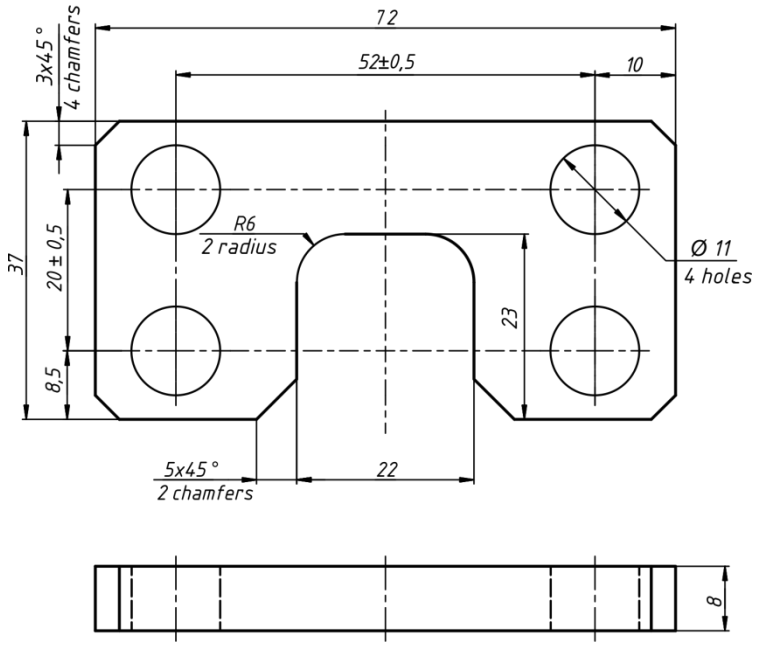
ATTENTION: To avoid DFM Marine failure, before the end of the firmware upgrade process **is forbidden**:
- to switch off PC (in case you use Service DFM Marine software) or the Android device (in case you use Service S6 DFM (Android);
- to switch off the power supply for the Unit;
- to disconnect the Unit from the service adapter and the adapter from the PC or the Android device;
- to connect to the Unit using S6 SK service adapter (cable) and S6 BT Adapter service adapter (wireless) at one time;
- Run any resource-intensive applications on the PC (in case you use Service DFM Marine software).

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

Annex H
DFM Marine mounting plate drawing



a) for DFM Marine 1000/2000 installation



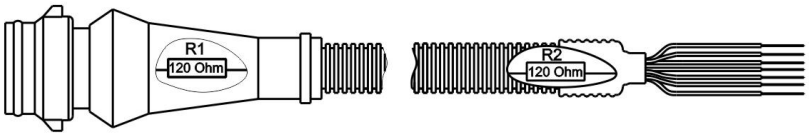
b) for DFM Marine 4000 installation

Figure H.1 — Mounting plate

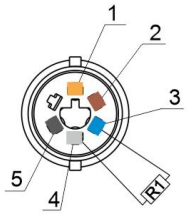
Annex I

Signal cables

S6 SC-CW-700 Cable



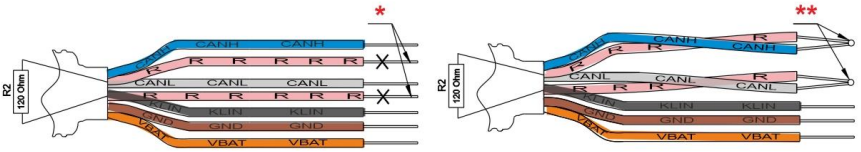
Cable length 700±5 cm.



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

Connecting

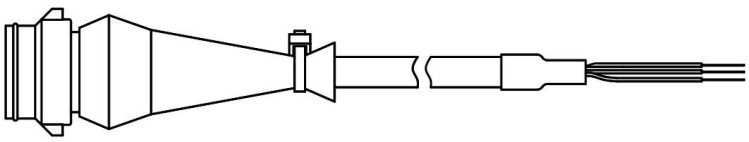
without built-in terminal resistor R2 | with built-in terminal resistor R2



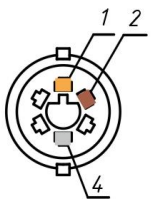
* Do not connect R2 resistor wires (pink, identification mark R), insulate.

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

CABLE DFM.98.20.003 Cable



Cable length 750±5 cm.



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

Annex J
Examples of connection schemes for DFM Marine CCAN

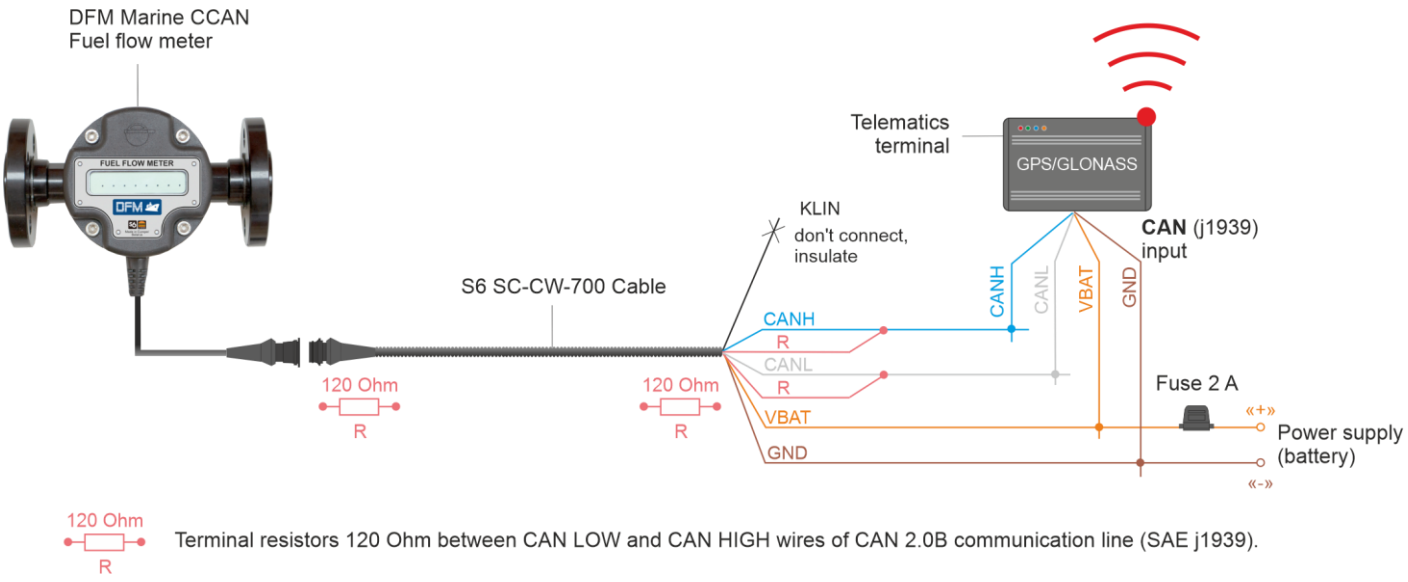


Figure J.1 — Example of DFM Marine CCAN connection to the Telematics terminal incompatible with S6 cable system

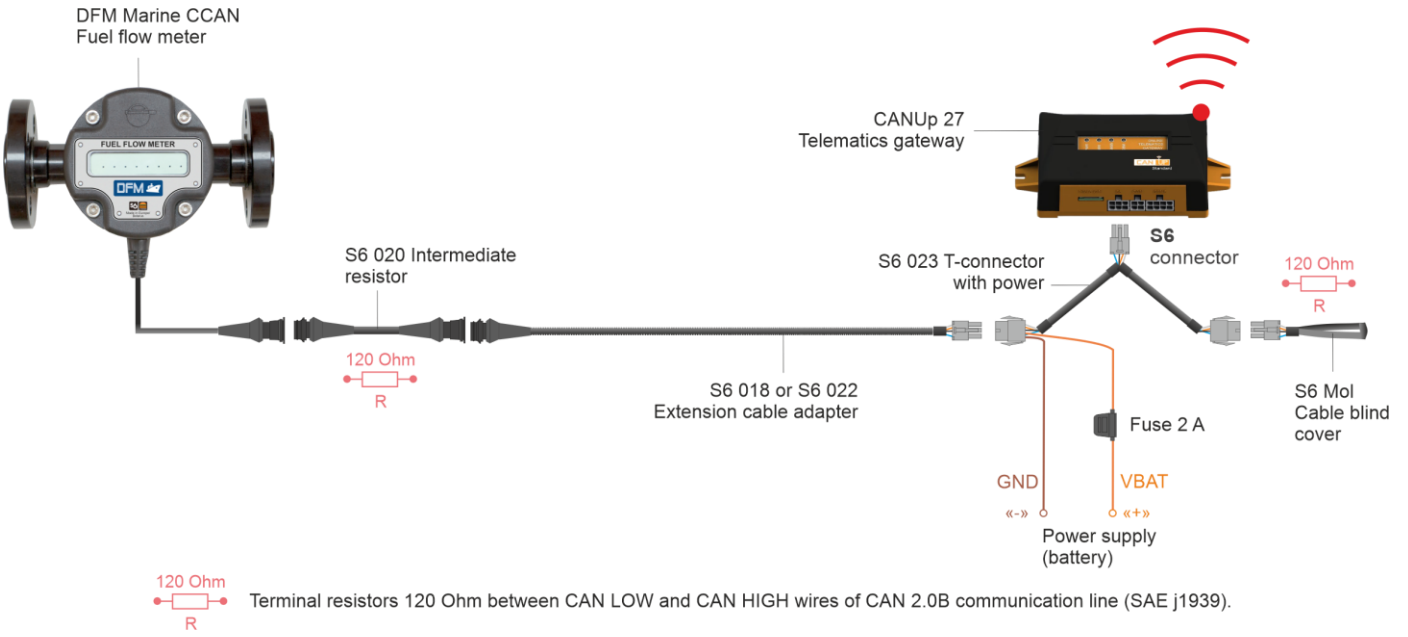


Figure J.2 — Example of DFM Marine CAN connection to the Telematics terminal which is compatible with S6 cable system

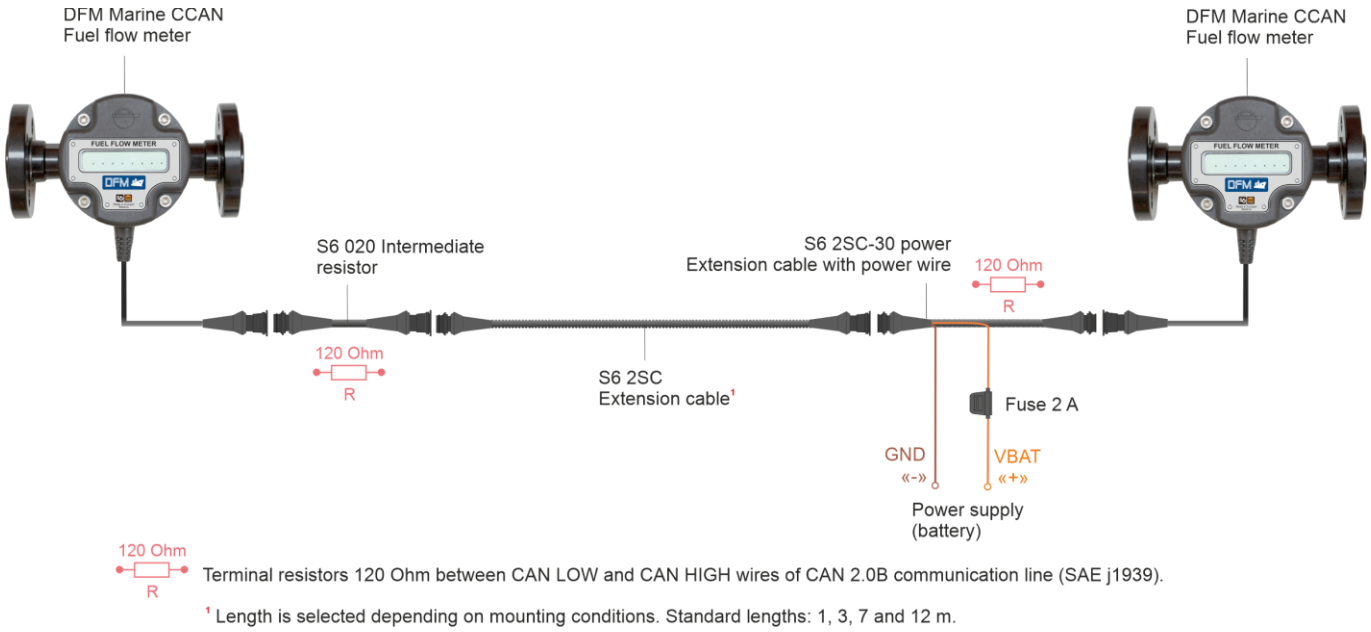


Figure J.3 — Example of independent connection of a pair of DFM Marine CCAN flow meters for differential measurement/Summarization of fuel consumption indications

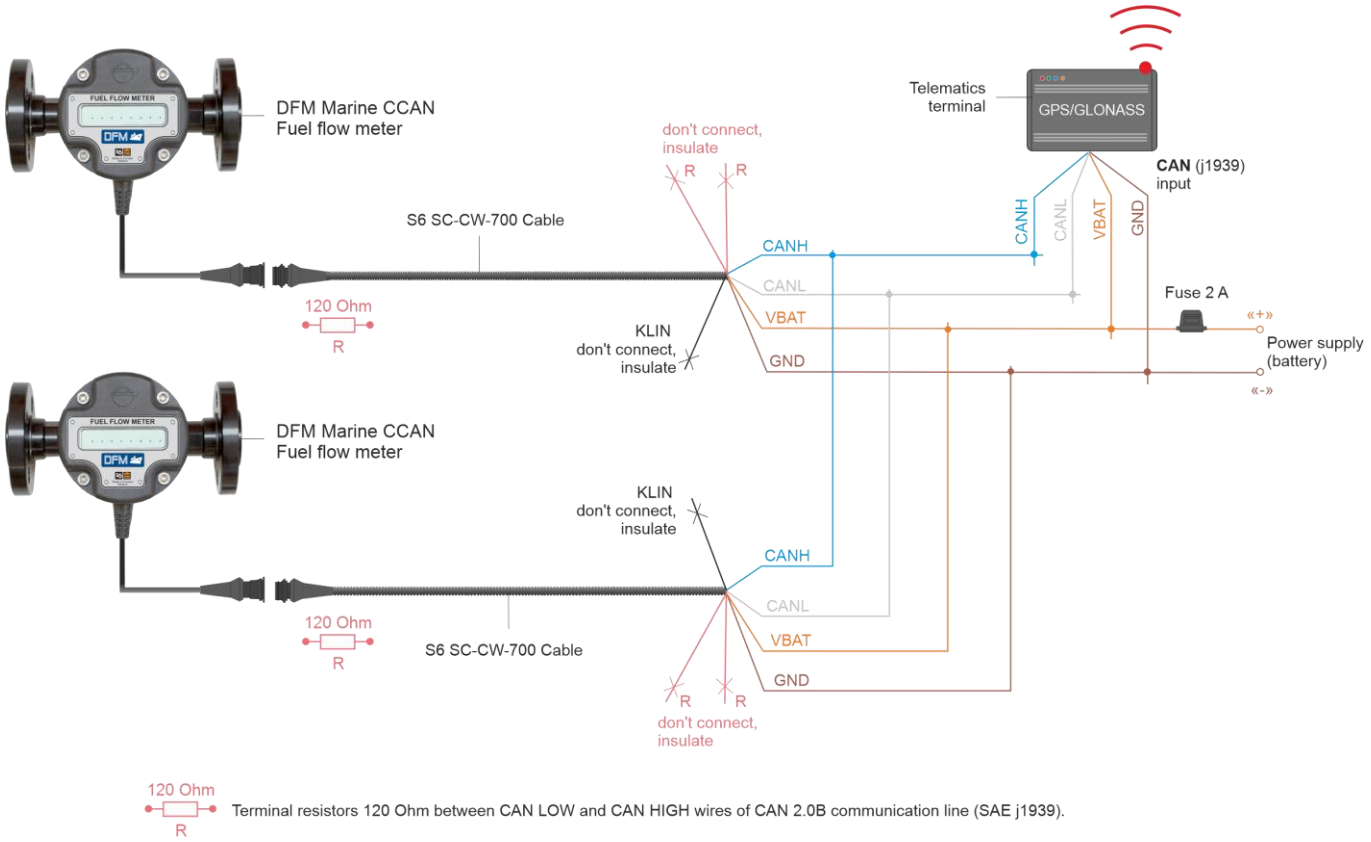


Figure J.4 — Example of connection of a pair of DFM Marine CCAN flow meters to the Telematics terminal incompatible with S6 cable system, for differential measurement/Summarization of fuel consumption indications

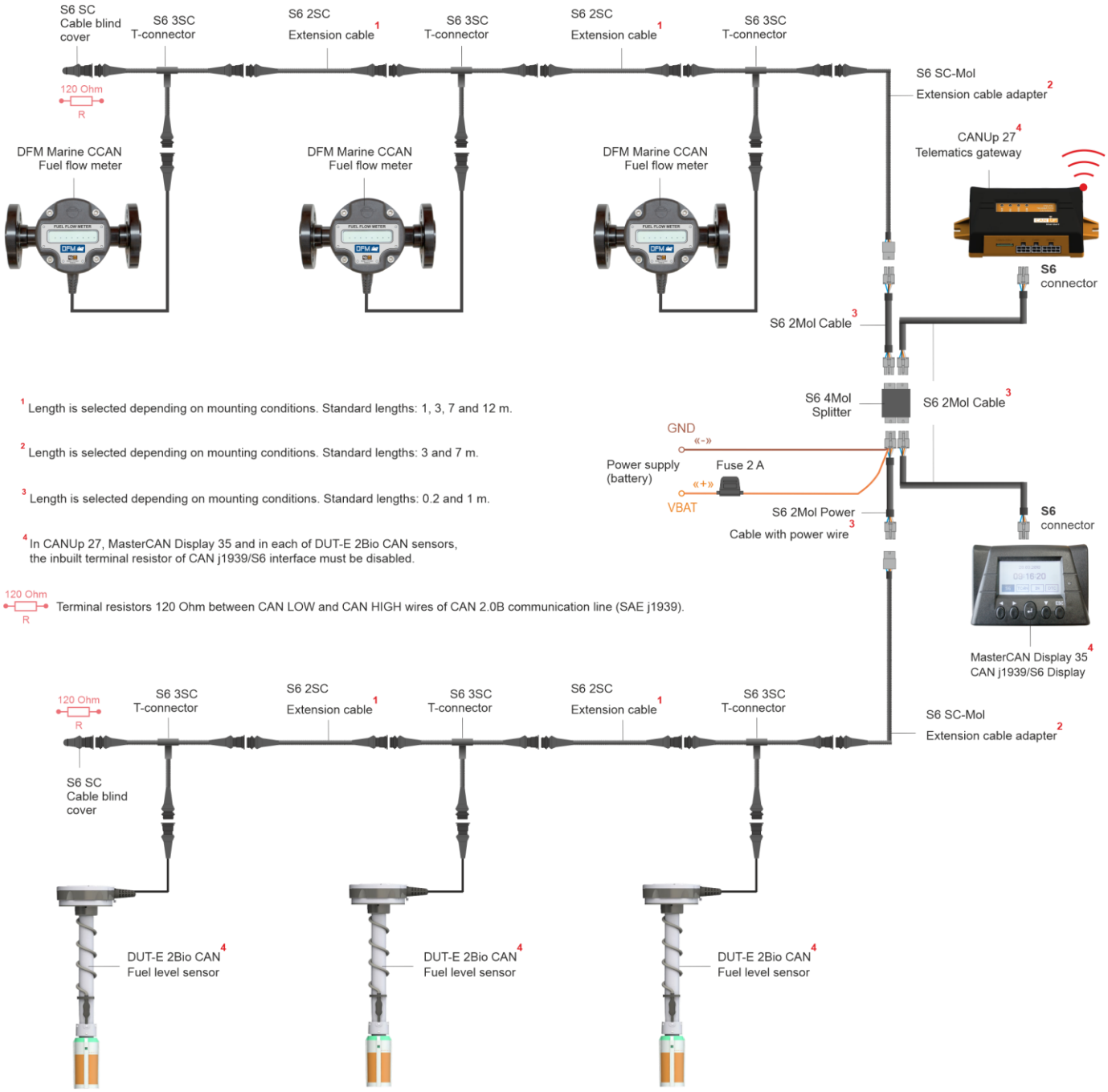


Figure J.5 — Example of connection of several DFM Marine CCAN flow meters to the Telematics terminal and to CAN-display, together with DUT-E 2Bio CAN fuel level sensors (e.g. for monitoring compartments of a fueling truck tank)

Annex K
Videos

1) DFM Marine Fuel Flow Meter video.

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

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

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

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

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

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

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

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

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

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

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