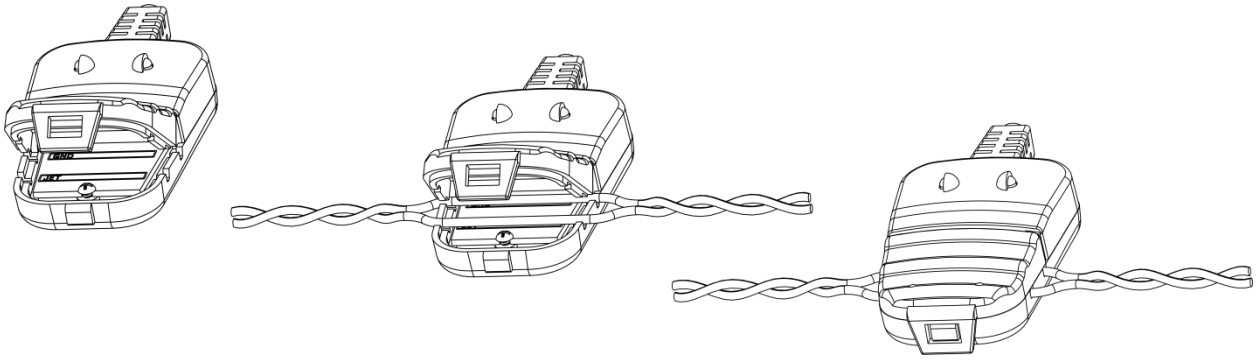
CONTACTLESS READERS

CANCrocodile/CANCrocodile Mini/ 1708Crocodile/NozzleCrocodile/Nozzle BMCrocodile

CONTACTLESS READER-CONVERTER

FMSCrocodile CCAN



OPERATION MANUAL

Version 4.0

TECHNOTON

ADVANCED MACHINERY TELEMATICS

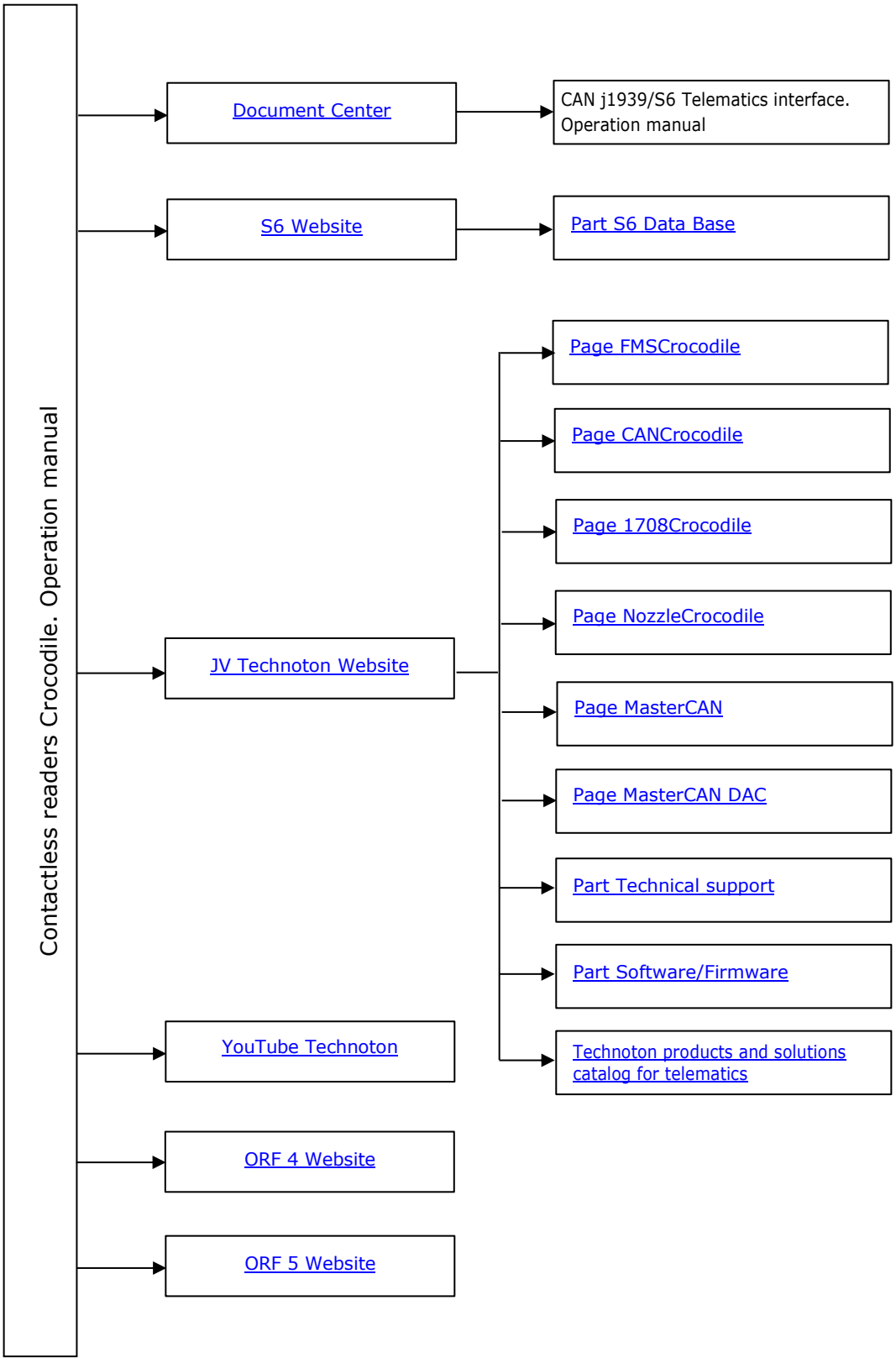
E20 10R-04 1536 CE

Content

Revision history

Version	Date	Editor	Description of changes
1.0	01.2012	OD	Basic version.
3.0	11.2016	OD	• Contactless readers Crocodile product line was extended by a new model – contactless reader-converter FMSCrocodile CCAN. • New case design for all Crocodile models. • Changes in delivery set of Crocodile. • Sealing process of Crocodile's case is described. • Coordinated operation of CANCrocodile and FSMCrocodile CCAN with digital to analog converter MasterCAN DAC15 is described.
3.1	01.2020	OD	• CANCrocodile 12/24 A++ (power-saving, low current consumption) version is added. • Information about using 1708Crocodile for contactless reading of signals from RS-485 wires is added. • Acceptable level of CANbus message losses is clarified for CANCrocodile and FMSCrocodile produced after 01.07.2017 (when maximum baud rate of reading was increased to 1000 kb/s). • Delivery set of NozzleCrocodile and NozzleCrocodile BM is altered. • Information about embedded termination resistors 120 Ohm in CANCrocodile and FMSCrocodile is added. • Information about compatibility of CANCRocodile and FMSCrocodile with CAN bus of semi-trailers (ISO 11992-2 standard) is added. • CE conformity certificate for electromagnetic compatibility requirements in the EU is added for all Crocodile devices. • External sources and videography links are added.
4.0	08.2022	OD	• CANCrocodile Mini modification is added. • Clarification regarding Nozzle BMCrocodile application. • Correction of Nozzle BMCrocodile / Nozzle BMCrocodile method of calibration. • List of FMSCrocodile CCAN output messages update etc.

Structure of external links



Terms and Definitions

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.

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).

CAN (Controller Area Network) — Serial digital communication bus-type interface which meets ISO 11898-1:2003 International standard.
Different high-level protocols can be used for transfer of data in CAN-bus: j1939, CANopen, DeviceNet, CAN Kingdom etc.
CAN-bus serves to unite into a single network different actuating electronic devices and sensors in the automobile-producing industry or in systems of industrial automation.

j1708 is a digital bus-type interface. Bus j1708 is used in some modern vehicles to transmit and exchange data between the engine controller and other electronic devices. The level of data presentation complies with SAE j1587 International Standard.

FMS — special set of PGN containing basic parameters from onboard data buses of trucks. Complies with FMS-Standard Interface description of the world leading producers of trucks.

Telematics — special set of Telematics PGN developed by Technoton; it accumulates basic data of vehicle performance. Meets requirements of SAE j1939/71 standard.

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.

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

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

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).

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

Telematics terminal (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.

Introduction

Recommendations and rules set out in this Operation Manual apply to **contactless readers CANCrocodile/CANCrocodile Mini /1708Crocodile/NozzleCrocodile/Nozzle BMCrocodile** and **contactless reader-converter FMSCrocodile CCAN** (hereinafter Crocodile) manufactured by JV Technoton, Minsk, Republic of Belarus.

This document contains information on Crocodile design, principle of operation, specifications as well as recommendations on its installation, connection and exploitation.

— is toos for Telematics systems which allows to read Vehicle's operation data without interfering into the integrity of Vehicle's electronics systems.

Distinctive features of Crocodile:

- contactless data obtaining through wires insulation without interfering into its integrity;
- reliable protection of vehicle's electronic systems from exposure to active requests sent through CAN interface by connected Telematics unit;
- powered from Vehicle's onboard power supply – does not require an additional equipment (power supply unit);
- power-saving version with ultra-low current consumption when reading messages from vehicle's CAN bus*;
- easy to install and operate;
- light indication of operation modes;
- compact design for convenient connection to wires of CAN-bus in hard-to-reach locations of a vehicle**;
- safe data integration from one or several informational Vehicle buses to Telematics interface CAN j1939/S6;
- simplifies setting-up of telematics terminal by sifting unnecessary data***;
- automatic Counter of trip fuel consumption, incremental on hourly consumption data from CANbus***;
- setting-up is not needed;
- possibility to use for contactless reading of signals from RS-485 bus****;
- used for petrol and LPG (liquid pressured gas) consumption monitoring on a light commercial Vehicles*****;
- case sealing excludes unauthorized interference into operation;
- protected against reverse polarity;
- compliance with automobile standards of EEU and EU countries.
- high-quality technical support and documentation.

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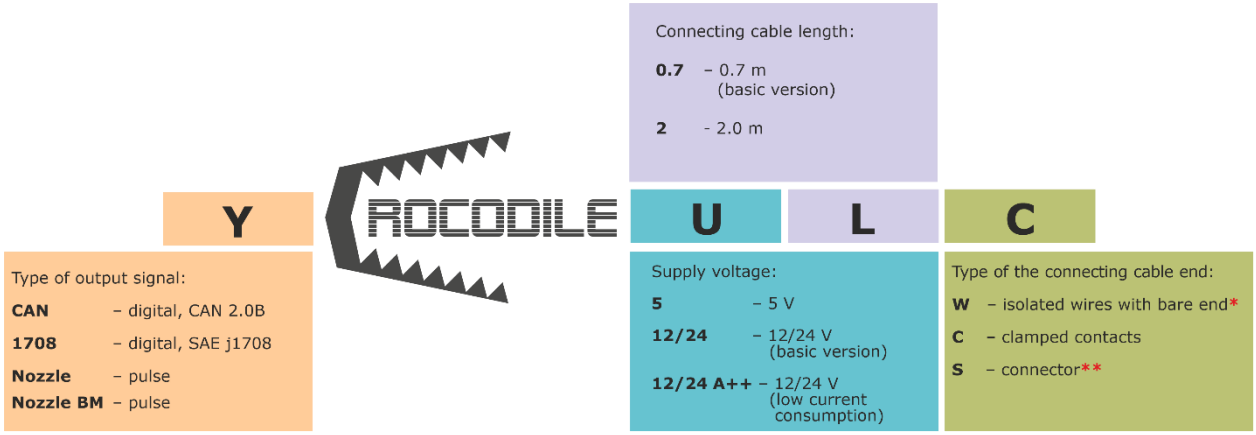
* CANCrocodile.
** CANCrocodile Mini.
*** FMSCrocodile CCAN.
**** 1708Crocodile.
***** NozzleCrocodile/Nozzle BMCrocodile.

Contactless readers modifications:

- CANCrocodile / CANCrocodile Mini— designed for secure Vehicle's operation data obtaining from onboard CAN bus.
- 1708Crocodile — designed for secure Vehicle's operation data obtaining from onboard j1708 bus. Its use is also allowed for secure data reception from wires of RS-485 bus.
- NozzleCrocodile — designed for monitoring of actual petrol and LPG (liquid pressured gas) engine fuel consumption. Fuel consumption information is based on injector (nozzle) impulses of the engine equiped with electronically controlled injectors.
- Nozzle BMCrocodile — designed for monitoring of actual petrol and LPG (liquid pressured gas) engine fuel consumption of TOYOTA engines. Fuel consumption information is based on injector (nozzle) impulses of the engine equiped with electronically controlled injectors.

See figures 1 and 2 for identification codes for Crocodile ordering:



* Basic version of NozzleCrocodile / Nozzle BMCrocodile / 1708Crocodile.

** Basic version of CANCrocodile / CANCrocodile Mini.

Figure 1 — CANCrocodile/CANCrocodile Mini/1708Crocodile/NozzleCrocodile/Nozzle BMCrocodile order identification codes

Contactless reader-converter modification:

- FMSCrocodile CCAN — for safe gathering of data from Vehicle's CANbus and processing information on fuel consumption and basic operation parameters of Vehicle for Telematics system.

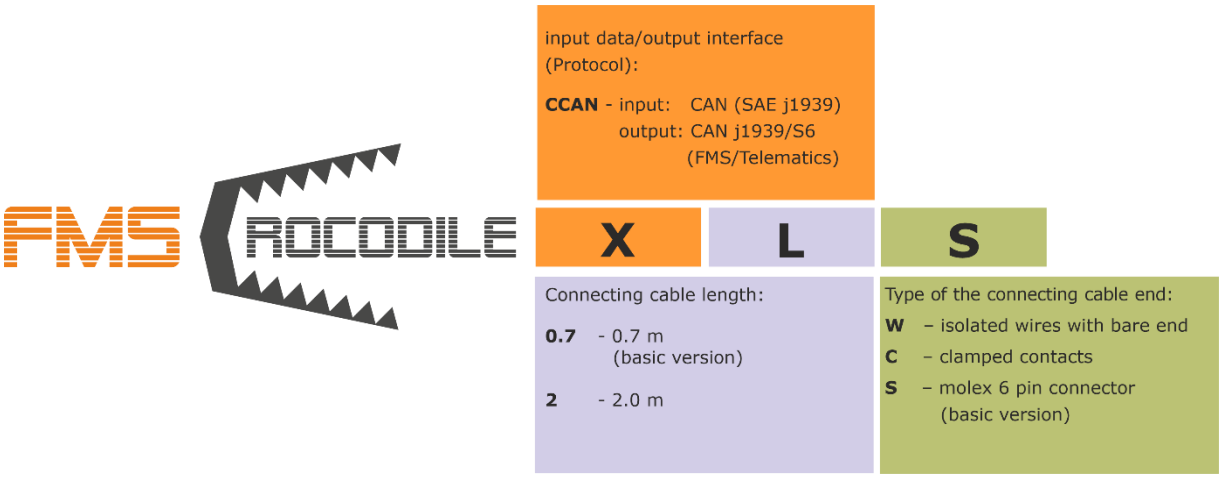


Figure 2 — FMSCrocodile CCAN order identification codes

ATTENTION: While making an order, it is allowed not to specify the identification codes that correspond to basic version of Crocodile.

Examples of Crocodile ordering identification codes:

"Contacless reader CANCrocodile U12/24 A++ L2 C",
(output interface — CAN 2.0B; nominal supply voltage — 12/24 V (low current consumption); length of connecting cable — 2 m; end of connecting cable — clamped contacts);

"Contacless reader CANCrocodile Mini",
(output interface — CAN 2.0B; nominal supply voltage — 12/24 V; length of connecting cable — 0.7 m; end of connecting cable — molex 6 pin connector).

"Contacless reader NozzleCrocodile",
(output interface — impulse; nominal supply voltage — 12/24 V;
length of connecting cable — 0.7 m; end of connecting cable — isolated wires with bare end).

"Contactless reader-converter FMSCrocodile CCAN L2",
(input data — CAN (SAE j1939), output interface — CAN j1939/S6 (FMS/Telematics);
length of connecting cable — 2 m; end of connecting cable — molex 6 pin connector).

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

To ensure the proper functioning of Crocodile, certified professionals who are trained by the manufacturer should carry out its installation and setup.

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

1 General information and technical specifications

1.1 Purpose of use and application area

1) Contactless readers, depending on its version, are designed for:

- Contactless data reading from CAN bus and generating the output signal with information package that matches data of the connected bus (CANCrocodile / CANCrocodile Mini);
- contactless reading from j1708 bus and generating the output signal with information package that matches data of the connected bus (1708Crocodile);
- Contactless reading of the engine/ LPG nozzle control impulses and converting them into normalized impulses that number is proportional to the volume of consumed fuel (NozzleCrocodile).
- Contactless reading of TOYOTA engine nozzle control impulses and converting them into normalized impulses that number is proportional to the volume of consumed fuel (Nozzle BMCrocodile).

2) Contactless reader-converter FMSCrocodile CCAN is designed for Contactless data reading from CAN bus, signal processing, transformation and transmission of ready for use information: FMS messages and Telematics messages

Application area: Crocodile are used in Telematics systems where they serves as a device for information receipt about the fuel consumption, operating modes of the engine, sensor status, malfunctioning of the Vehicle (see figure 3).

CANCrocodile, **CANCrocodile Mini** and **FMSCrocodile CCAN** are installed on all types of the Vehicle equipped with CAN bus.

1708Crocodile are installed on all types of the Vehicle equipped with j1708 bus*.

NozzleCrocodile and **Nozzle BMCrocodile** are installed on the Vehicles equipped with a petrol/LPG engine with electronically controlled nozzles in the fuel injection system.

Crocodile output signal is received by tracking device that collects, records, stores and transfers received signals to the Vehicle tracking system server. Software installed on the server is processing and analyzing received data and then making reports that contain information on fuel consumption, operating modes of the engine, sensors status and troubleshooting of the Vehicle (see figures 6 and 7).

* 1708Crocodile can be used in industrial networks built on RS-485 interface.

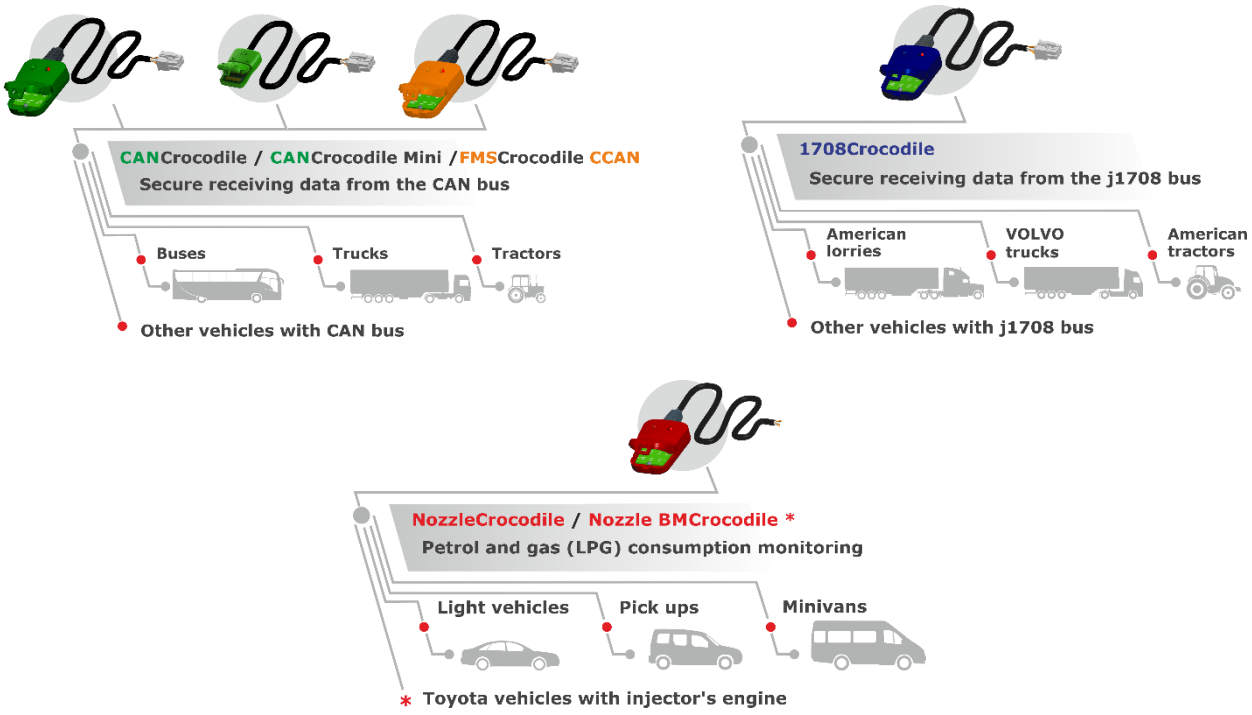


Figure 3 — Application area of Crocodile

CANCrocodile / CANCrocodile Mini and FMSCrocodile are compatible with any type of Telematics units, which have CAN-port.
1708Crocodile is compatible with all types of Tracking devices which have an input for connection of bus j1708*.
NozzleCrocodile and Nozzle BMCrocodile are compatible with all types of Tracking devices which have an input for connection of pulse fuel flow meter.

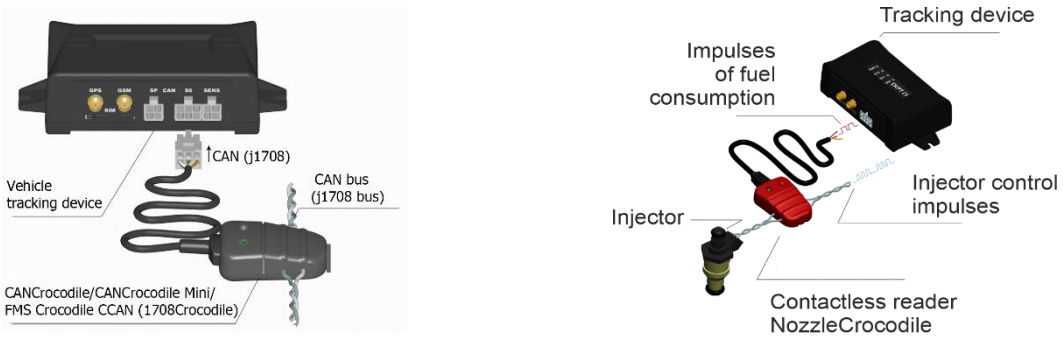


Figure 4 — Secure data obtaining use of Crocodile

FMSCrocodile CCAN is a ready-to-use product for safe integration of data from one or several CAN-buses into CAN j1939/S6 Telematics interface. That allows to monitor vast amount of vehicle operation parameters using just one CAN-port of Telematics unit (see figure 5).

* 1708Crocodile is compatible with any Telematics unit, which have RS-485-port, for reading RS-485 interface data.

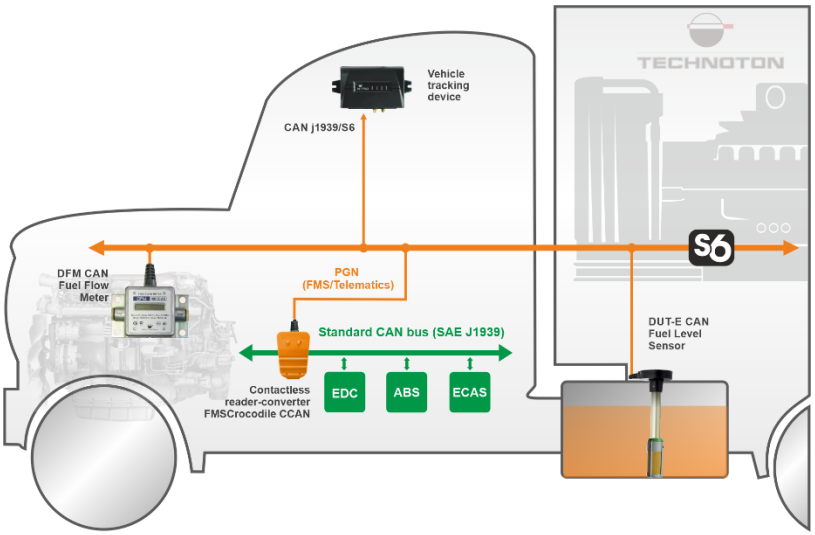


Figure 5 — Secure integration of standard onboard bus CAN and CAN j1939/S6 Telematics interface use of FMSCrocodile CCAN

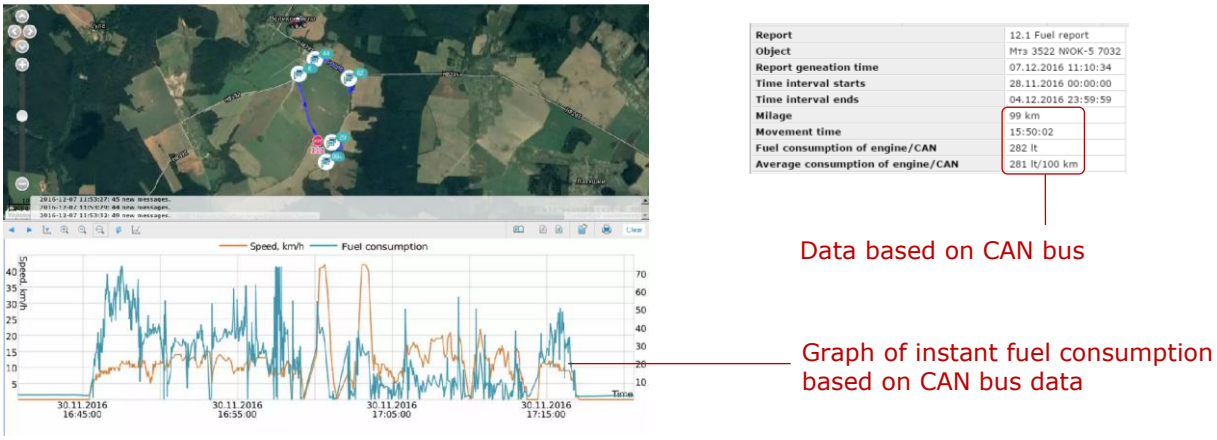


Figure 6 — Example of report generated in ORF 4 software, based on the FMSCrocodile CCAN data

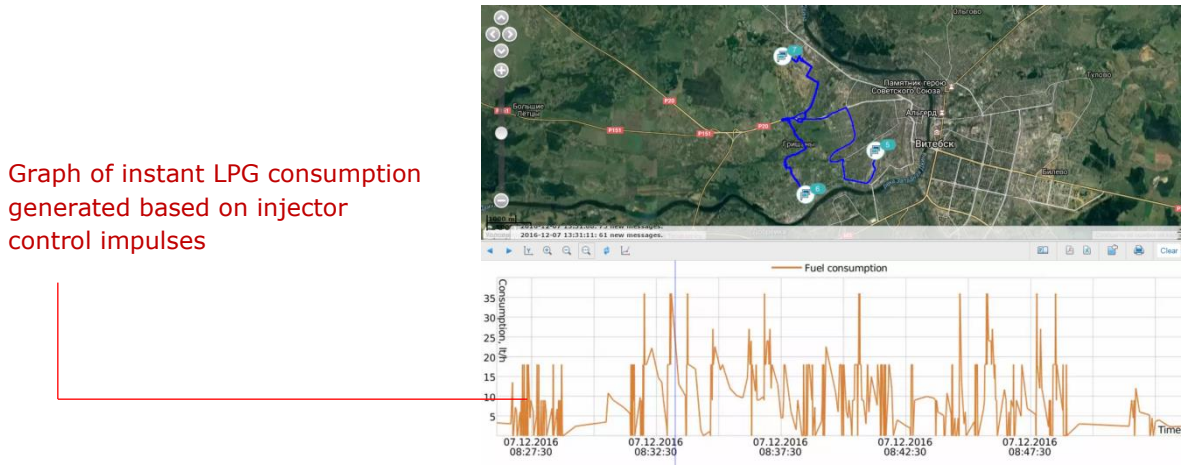


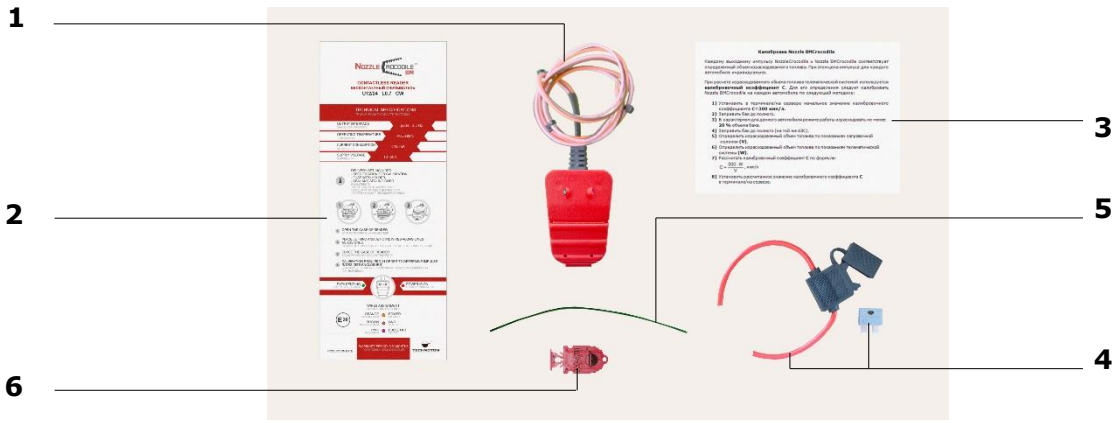
Figure 7 — Example of report generated in ORF 4 software, based on the NozzleCrocodile data

ATTENTION: The information package transmitted via CAN bus (j1708 bus) may differ depending on the producer, model and manufacture year of the Vehicle

1.2 Delivery set

1	Contactless reader	– 1 pc.;
2	Blister pack insert with main technical specifications and brief operation manual of Crocodile	– 1 pc.;
3	Sealing cord	– 1 pc.;
4	Plastic seal	– 1 pc.

Figure 8 — CANCrocodile/CANCrocodile Mini/1708Crocodile/FMSCrocodile CCAN delivery set



1	Contactless reader	– 1 pc.;
2	Blister pack insert with main technical specifications and brief operation manual of Crocodile	– 1 pc.;
3	Specification for calibration	– 1 pc.;
4	Fuse with holder (2 A)	– 1 pc.;
5	Sealing cord	– 1 pc.;
6	Plastic seal	– 1 pc.

Figure 9 — NozzleCrocodile/Nozzle BMCrocodile delivery set

1.3 Technical specifications

1.3.1 Main exploitation specifications

Table 1 —Crocodile main exploitation specifications

Parameter, unit of measurement	Models				
	CANCrocodile	**CANCrocodile Mini**	**1708Crocodile**	**NozzleCrocodile, Nozzle BMCrocodile**	**FMSCrocodile CCAN**
Acceptable level of message losses,%, not more	1*		1	—	1*
Power supply voltage range for version **U5**, V	4.5…5.5	—	4.5…5.5		—
Maximal current consumption for version **U5** at supply voltage 5 V, mA, not more	200	—	200	100	—
Power supply voltage range for version **U12/24**, V	10…45				
Maximal current consumption for version **U12/24** at supply voltage 12/24 V, mA, not more	30/15	5/3	30/15	30/20	40/20
Power supply voltage range for version **U12/24 A++**, B	10…45	—			
Maximal current consumption for version **U12/24 A++** at supply voltage 12/24 V, mA, not more	10**/5**	—			
Temperature range, °C	-40…+85				
Ingress protection rating	IP30				
Overall dimensions, mm, not more than	see figure 10				
Weight, kg, not more than	0.1				
Compatibility	SAE j1939 ISO 11992-2 CAN Open DeviceNet NMEA 2000		SAE j1587 RS-485	—	SAE j1939 ISO 11992-2

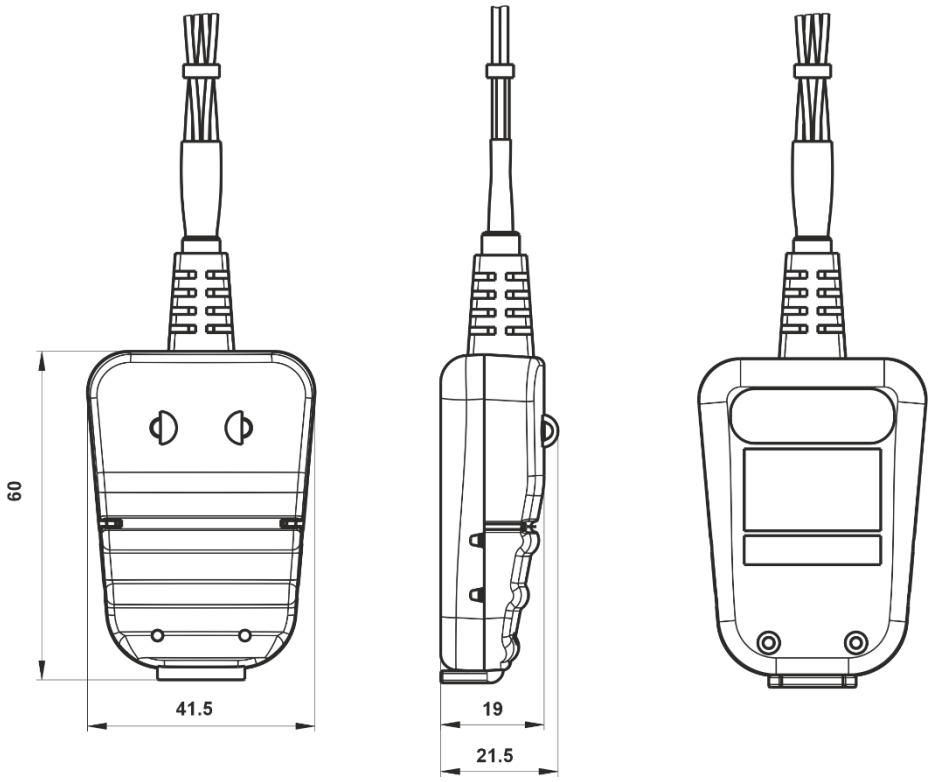
* Stated value of accepted message losses level is for (250…500) kbit/s data sending.

Messages are transmitted without losses at baud rate up to 250 kbit/s (for CANCrocodile / FMSCrocodile CCAN) and from 125 kbit/s (for CANCrocodile Mini).

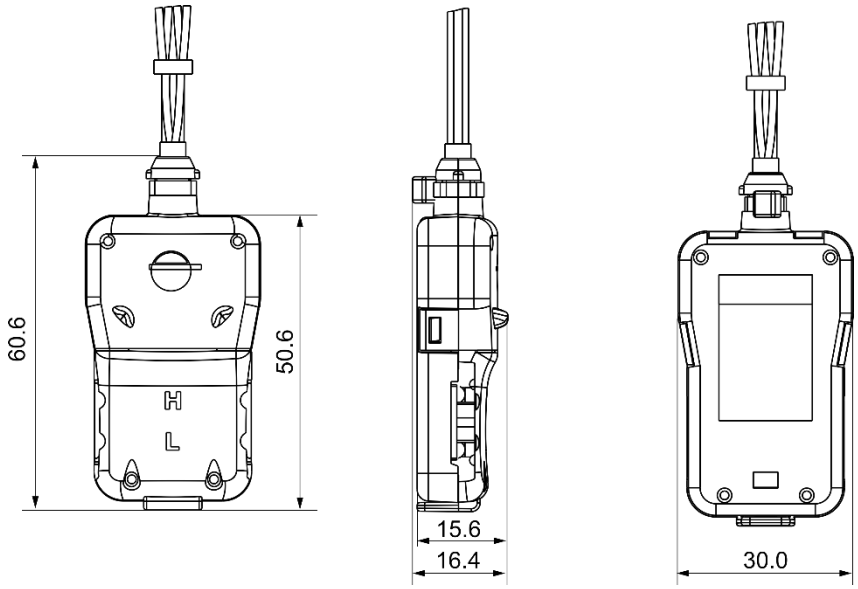
In (500…1000) kbit/s baud rate range message losses level depends on network traffic and at 100% traffics is lower than 5 %.

** Current consumption in standby mode is lower. For details see 1.3.7.

1.3.2 Overall dimensions



a) CANCrocodile/1708Crocodile/ NozzleCrocodile/Nozzle BMCrocodile/FMSCrocodile CCAN



b) CANCrocodile Mini

Figure 10 — Overall dimensions

1.3.3 Output interface of CANCrocodile

CANCrocodile / CANCrocodile Mini output interface — CAN 2.0B, according to international standard SAE j1939.

1.3.4 Output interface of 1708Crocodile

1708Crocodile output interface— j1708, according to international standard SAE j1587.

Note – When reading data from RS-485 bus, output interface of 1708Crocodile corresponds to RS-485 standard.

1.3.5 Output signal specifications of NozzleCrocodile and Nozzle BMCrocodile

NozzleCrocodile / Nozzle BMCrocodile output signal specifications presented at table 2.

Table 2 — Output signal specifications of NozzleCrocodile and Nozzle BMCrocodile

Parameter, unit of measurement	Value
Type of signal	Impulse
Frequency, Hz, no more then	10
Amplitude, V	from 0 to U_{PS}*
* U_{PS} – voltage of Vehicle power supply source.	

NozzleCrocodile output signal is voltage pulses which amplitude varies from 0 V up to the value of the on-board network voltage. Every pulse of NozzleCrocodile output signal is formed as a result of consumption of a certain fuel amount. Type of NozzleCrocodile output signal is shown at figure 11.

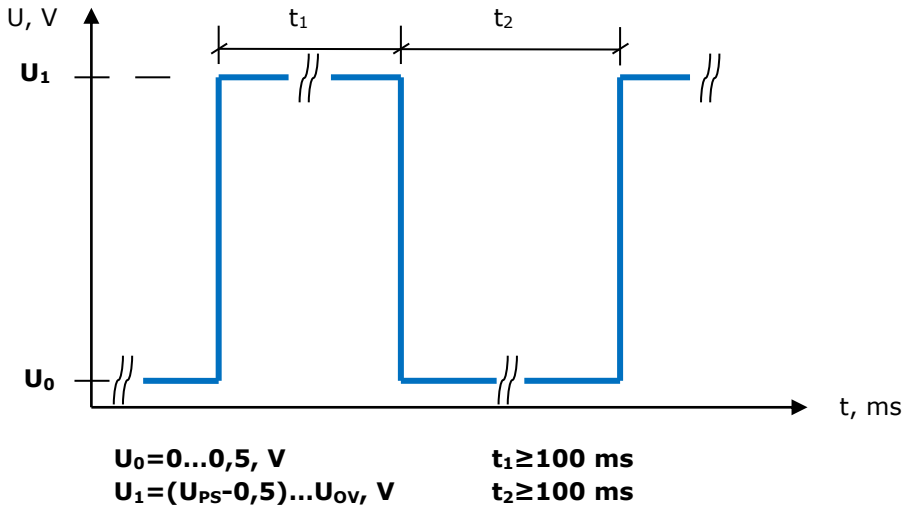


Figure 11 — NozzleCrocodile / Nozzle BMCrocodile output signal type

1.3.6 Output interface of FMSCrocodile CCAN

FMSCrocodile CCAN output interface — CAN j1939/S6. Specifications of CAN j1939/S6 interface correspond to S6 Technology. Data transfer protocol meets requirements of SAE j1939 standard and S6 Database (see http://s6.jv-technoton.com/).

FMSCrocodile CCAN transfers Telematics messages into CAN j1939/S6 interface (see table 3), as well as FMS-messages (see table 4).

To identify FMSCrocodile CCAN by its output interface, Unit has a fixed unique network address (SA) — 122.

More detailed description of FMS messages are described in FMS-Standard Interface description document. Actual version of the document can be downloaded from the web site of developer http://www.fms-standard.com.

Table 3 — Data composition in Telematics output messages of FMSCrocodile CCAN contactless reader/converter

Field number	Length	Parameter	Description	Rules of output
Message 1 PGN 63233 (0xF701)				1000 ms
1	2 bytes	SPN 190	Engine speed	
3	2 bytes	SPN 183	Engine Fuel Rate	
5	1 byte	SPN 110	Engine Coolant Temperature	
6	1 byte	SPN 100	Engine Oil Pressure	
7	1 byte	SPN 513	Actual Engine - Percent Torque	
8	1 byte	SPN 111	Engine Coolant Level	
Message 2 PGN 63234 (0xF702)				1000 ms
1	2 bytes	SPN 184	Engine Instantaneous Fuel Economy	
3	1 byte	SPN 98	Engine Oil Level	
4	2 bytes	SPN 171	Ambient Air Temperature	
6	1 byte	SPN 96	Fuel Level 1	
Message 3 PGN 63235 (0xF703)				1000 ms
1	4 bytes	SPN 250	Engine Total Fuel Used	
5	4 bytes	SPN 247	Engine Total Hours of Operation	

Table 4 — List of output FMS-messages of FMSCrocodile CCAN contactless reader/converter

PGN	Description
61440 (0xF000)	Electronic Retarder Controller 1
61443 (0xF003)	Electronic Engine Controller 2
61444 (0xF004)	Electronic Engine Controller 1
61445 (0xF005)	Electronic Transmission Controller 2
64777 (0xFD09)	High Resolution Fuel Consumption (Liquid)
64932 (0xFDA4)	PTO Drive Engagement
64933 (0xFDA5)	Door Control 2
64977 (0xFDD1)	FMS-standard Interface Identity/Capabilities
65102 (0xFE4E)	Door Control 1
65110 (0xFE56)	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Information
65112 (0xFE58)	Air Suspension Control 4
65131 (0xFE6B)	Driver's Identification
65132 (0xFE6C)	Tachograph
65136 (0xFE70)	Combination Vehicle Weight
65198 (0xFEAE)	Air Supply Pressure
65216 (0xFEC0)	Service Information
65217 (0xFEC1)	High Resolution Vehicle Distance
65237 (0xFED5)	Alternator Information
65253 (0xFEE5)	Engine Hours, Revolutions
65254 (0xFEE6)	Time/Date
65257 (0xFEE9)	Fuel Consumption (Liquid)
65258 (0xFEEA)	Vehicle Weight
65260 (0xFEEC)	Vehicle Identification
65262 (0xFEEE)	Engine Temperature 1
65265 (0xFEF1)	Cruise Control/Vehicle Speed 1
65266 (0xFEF2)	Fuel Economy (Liquid)
65269 (0xFEF5)	Ambient Conditions
65276 (0xFEFC)	Dash Display

Notes

1 The composition of output PGN depends on the content of data received from the onboard CAN-bus. These data may differ depending on the producer, model and year of the Vehicle manufacturing.

2 FMSCrocodile CCAN automatically updates the Counter of fuel consumption for the trip and stores it in its internal memory, until the power supply is off, calculating it according to the Parameter "Hourly fuel consumption" (SPN 183). The minimum increment of the fuel consumption counter update for the trip — 0.5 l.

In case there is a standard PGN 65257 in the onboard CAN-bus, its parameters "Fuel volume consumed for the trip" (SPN 182) and/or "Fuel consumption by the engine" (SPN 250) are also transferred to the output CAN j1939/S6 interface.

The value of fuel consumption for the trip of SPN 182 calculated by the FMSCrocodile CCAN is always transferred in PGN 65257 from Unit address, irrespective of the availability of a similar PGN in a standard CAN-bus.

1.3.7 CANCrocodile power-saving version

In order to save vehicle's battery charge when reading CAN bus data from vehicles, which are used with engine switched off for long time (e.g. carsharing) it is recommended to use low current consumption version of the device – **CANCrocodile U12/24 A++**.

After the engine is switched off – there is no data in CAN bus. CANCrocodile U12/24 A++ will automatically switch to standby mode. At this occasion its current consumption will be **not more than 1/0.5 mA** for 12/24 V network respectively.

After switching vehicle's engine on, data transfer in CAN bus will be started. CANCrocodile U12/24 A++ will automatically switch to operation mode and start reading data. Current consumption depends on network traffic and increases/decreases accordingly. When CAN bus load is in 1 to 100 % range, current consumption of CANCrocodile U12/24 A++ will be changing in (**2.5…10**)/(**1.25…5) mA** range for 12/24 V networks respectively.

1.3.8 Compatibility of Crocodile with Terminals

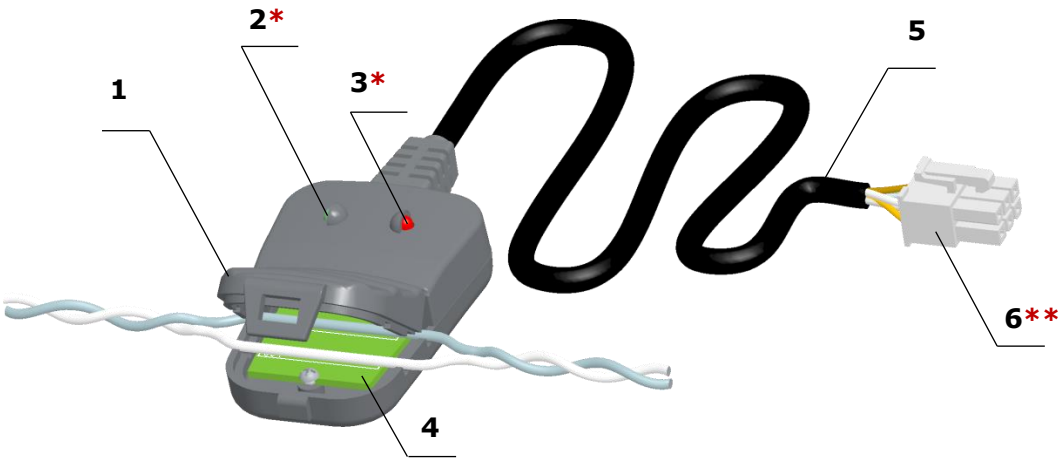
During their operation as components of the Telematics system, Crocodile contactless readers can be used together with Telematics terminals or other tracking devices whose inputs comply with parameters of output signals, in accordance with 1.3.3, 1.3.4, 1.3.5 and 1.3.6.

Technoton regularly conducts compatibility and mutual accuracy tests of contactless readers with different models of Terminals.

A table containing the current list of Declarations of compatibility of Telematics terminals from different producers with contactless readers and other Technoton-produced equipment is provided at https://jv-technoton.com/.

Recommendations on connecting and setting up the equipment can be obtained from Technical support of Technoton.

1.4 Unit structure and operation principle of Crocodile



1 – casing;

2 – data transfer LED indicator (green);

3 – power on LED indicator (red);

4 - electronic board;

5 - connecting cable;

6 - connector for power supply and the receiving device (tracker).

Figure 12 — Crocodile structure

* For FMSCrocodile: **2** stands for red LED (power on), **3** – green LED (data transfer). LED indicators in CANCrocodile Mini modification are located inside its casing. For CANCrocodile U12/24 A++ LEDs are not provided/functional.

** Delivered for versions **S** (see figure 1).

The principle of Crocodile operation is based on reading the electromagnetic field that is formed around the wires during the signal passing.

CANCrocodile / CANCrocodile Mini and 1708Crocodile form the digital output signal that has data package identical to the signal of the connected bus (CAN or j1708 respectively). This signal can contain information about operating modes of the engine, fuel consumption, sensor status, malfunctioning of the Vehicle.

NozzleCrocodile / Nozzle BMCrocodile convert read-out engine nozzle control pulses into normalized pulses that number is proportional to the volume of consumed fuel. Nozzle BMCrocodile has a noise filtering function. Noise is common for nozzle control pulses of TOYOTA engines.

FMSCrocodile CCAN reads data from on-board CANbus over j1939 protocol, analyses gathered data, sorts out the information on Vehicle operation parameters, transforms information and transmits data packages (PGN) to output interface (see 1.3.6).

Signal values of Crocodile LED indicators are defined according to table 5.

Table 5 – Signal values of Crocodile LED indicators

LED indicator		**Signal value**		
Colour	**Status**	**CANCrocodile, FMSCrocodile CCAN**	**1708Crocodile**	**NozzleCrocodile Nozzle BMCrocodile**
Green		Messages receipt from CAN bus	Messages receipt from j1708 bus	Pulses transmission
	Off	No messages in CAN bus	No messages in j1708 bus	No pulse transmission
Red		Power is on		
	Off	No power (supply voltage is lower than normal)		

2 Connection of Crocodile

ATTENTION: Strictly follow safety rules of automobile repair works as well as local safety rules of the customer company when mounting Crocodile.
Before Crocodile installation it is recommended to study carefully the electrical circuit diagram and the Operating Manual of the Vehicle on which Crocodile is mounted.

2.1 Exterior inspection prior to connection

It is required to conduct Crocodile exterior inspection for the presence of the possible defects of body or connectors arisen during transportation, storage or careless use.

Contact the supplier if any defects detected.

2.2 Recommendations for search of CAN bus wires

To connect CANCrocodile / CANCrocodile Mini / FMSCrocodile CCAN to CAN onboard bus, you must find and identify wires CAN-H (CAN HIGH) and CAN-L (CAN LOW).

Physically, CAN bus most often is a twisted (stranded) pair of wires (30 windings per running meter) with splitters to connect electronic control units (further on – ECU) that have terminating resistors of 120 Ohms nominal impedance located at the ends of the bus. The resistors may be mounted separately or may be integrated into the ECU. As a rule, there is no SHLD wire.

Example: DEUTSCH company manufactures CAN buses made of special three-conductor cable (CAN-H, CAN-L, and signal GND) with 7 to 12 mm external coating diameter, special splitters, and terminating elements – terminating resistors designed to match wave impedance during the transmission of messages in the bus and to suppress interference (see figure 13).

Figure 13 — Examples of CAN bus elements

There may be from one to six and more CAN buses on the Vehicle of EURO-3 Environmental Standard. They may be defined as M-CAN, T-CAN, I-CAN, H-CAN, A-CAN, EBS-CAN etc.

The following CAN buses are of interest for fuel consumption monitoring — T-CAN and M-CAN.

T-CAN and M-CAN may have the following features:

- Availability of OBD II connector for diagnostics (see figure 14);
- the color and cross-section of stranded pairs of wires;
- connection of stranded pairs of wires to contacts at OBD II and ECU connectors.

Example: If there is an OBD II diagnostics connector on the Vehicle and a pair of stranded wires of orange color one of which has a black band, and the other has a brown one, and this pair of stranded wires matches the OBD II diagnostics connector, so this may be the CAN bus you are looking for. In this case, the orange wire with the black band is CAN-H, while the wire with the brown band is CAN-L.

Figure 14 — Examples of OBD II diagnostics connector

Contacts of the ABS/ASR ECU system corresponding to CAN bus are identified according to figure 15.

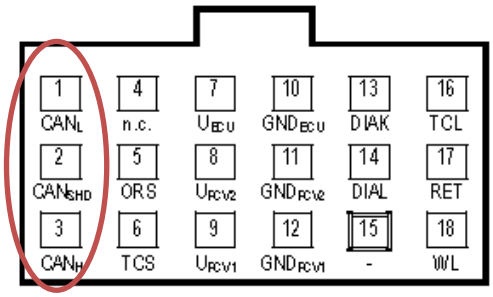


Figure 15 — Identification of CAN bus in the ABS/ASR ECU connector ABS/ASR ECU

WARNING: Features of CAN bus may be different for different Vehicle manufacturers. Besides, those features may be different for the same manufacturer depending on the particular design features of the Vehicle and its configuration (the engine, fuel supply system, the link between the engine EDC and the throttle pedal, availability or absence of the electronic dashboard, digital tachograph, etc).

Initial diagnostics and assessment of CAN bus serviceability may be carried out using a multimeter by means of the following traditional methods:

- continuity test of CAN-L and CAN-H wires;
- short circuit and impedance check (full impedance depending on the terminating resistors and input impedance of ECUs connected to the bus) between CAN-L and CAN-H wires;
- measurement of voltages in CAN-L and CAN-H wires in the recessive mode (the ignition is off, the battery disconnect switch is on) and in the dominant mode (the ignition is on and engine has been started).

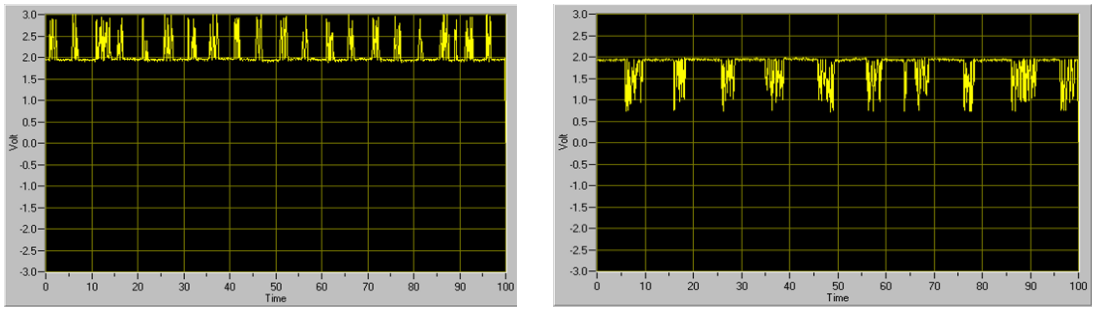
The impedance check should be carried out with the whole onboard circuit off (the battery disconnect switch is off). The control impedance value must be no more than 60 Ohms.

The serviceability check of CAN bus is carried out with the ignition and engine on, by pressing and releasing the throttle pedal between the wires of the stranded pair of wires. The control voltage value must be from 1.2 to 3.0 V.

CAN-H and CAN-L can be identified according to the following voltage values:

- recession mode — about 2.5 V (on both CAN-L and CAN-H);
- dominant mode — less than 2.5 V (on CAN-L) and more than 2.5 V (on CAN-H).

Example of oscilloscope pictures of signals from CAN-high and CAN-low are presented at figure 16.



a) CAN-H *b) CAN-L*

Figure 16 — Oscilloscope pictures of signals from CAN-high and CAN-low

2.3 Recommendations for search of j1708 bus wires

To connect 1708Crocodile to j1708 onboard bus, we need to use the oscilloscope to identify j1708.A and j1708.B wires.

The signal of j1708 bus is a differential-mode signal, the voltage amplitude at j1708.A and j1708.B wires varies from 0 to 5 V.

2.4 Recommendations for search of nozzle's control wire

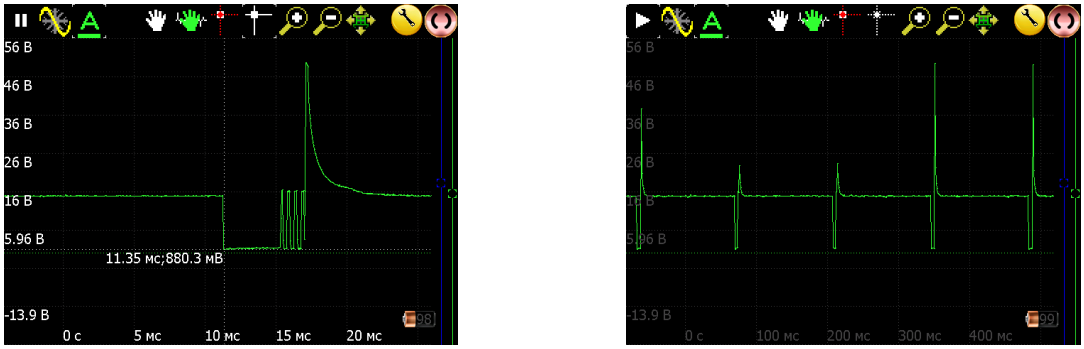
NozzleCrocodile / Nozzle BMCrocodile is recommended to install on the nozzle control wire of the first engine cylinder.

Detection of nozzle control wire is carried out by means of oscilloscope. However, various Vehicles have their own unique features for connection of the oscilloscope signal gauge that depending on wire access can be connected to:

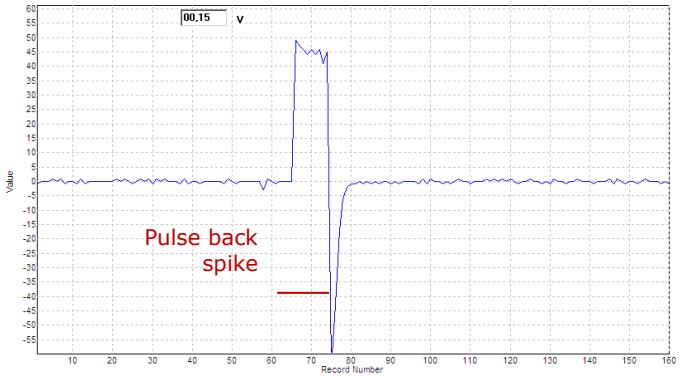
- injector connection input;
- injector control unit;
- wire harness of the injector.

Oscilloscope patterns of control pulse signals of the petrol engine injector with electronically controlled fuel injection system look like it is shown at figure 17.

IMPORTANT: As a rule, after a command pulse from TOYOTA engine injector is triggered, a typical back spike of great amplitude takes place (see figure 17 c). Such a spike causes interference of operation of a normal NozzleCrocodile. In this case, for correct reading of injector pulses, you need to employ a special modification of the contactless reader with an interference compensation feature— **Nozzle BMCrocodile**.



a) single pulse *b) idle mode*



c) for TOYOTA engines

Figure 17 — Examples of oscillograms of injector control impulses

2.5 Operating limitations

Crocodile installation should be done in a dry location protected from aggressive impact of the environment.

Crocodile should not be mounted near heating and cooling devices (e.g. the climate control system). Also, it is not recommended to mount Crocodile close to the power electrical circuits.

A suitable location to mount Crocodile on Vehicle is inside driver's cabin. During installation, you need to make sure that under the automobile hood the Crocodile housing and its wires are located at least 30 cm far from engine rotating parts and surfaces.

2.6 Electrical connection

Crocodile is powered directly from the Vehicle onboard circuit or through the Terminal of the monitoring system.

ATTENTION:

1) Before starting Crocodile installation, it is needed to disconnect electrical circuit of the Vehicle. To do this, we shall use the battery disconnect switch or remove contact terminals from it.

2) It is recommended to use fuses when connecting Crocodile power supply (see figure 18 a). Nominal fuse current is not more than 2 A.

3) Crocodile power supply "+" and Ground "-" wires should be connected to the same points of Vehicle electric circuit as correspondent wires of the tracking device.

4) Prior to electrical connection of the Crocodile pay special attention to Checking Vehicle chassis ground. Resistance between any point of Vehicle chassis and "-" terminal of the battery or between terminals of the chassis ground switch should not exceed 1 Ohm.

To connect Crocodile power supply wires, it is recommended to use terminals (see figure 18 b), while connecting signal wires, it is recommended to use connectors as shown at figure 18 c.

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

Figure 18 — Terminal and connector accessories for Crocodile connection

CANCrocodile / CANCrocodile Mini and FMSCrocodile CCAN electrical connection is made according to pin-out of the connector* and interface cable wires assignment (see table 6).

ATTENTION: CANCrocodile and FMSCrocodile CCAN have embedded 120 Ohm termination resistor, which ensures correct data transfer through CAN (j1939). When connecting CANCrocodile/FMSCrocodile to a Telematics device, which has no embedded termination resistor, put **S6 CW plug** (purchased separately) between CAN Low and CAN High wires, on the end connected to a telematics unit.

1708Crocodile electrical connection is made according to pin-out of the connector* and interface cable wires assignment (see table 7).

NozzleCrocodile and Nozzle BMCrocodile electrical connection is made according interface cable wires assignment (see table 8).

* Delivered for versions **S** (see figure 1).

Table 6 — CANCrocodile / CANCrocodile Mini / FMSCrocodile CCAN cable wires assignment

Connector Pinout	Pin number	Wire			Signal	
		Marking	Color		Circuit designation	Signal parameters
	1	VBAT	Orange		Power Supply "+"	Analog, voltage 10…45 V
	2	GND	Brown		Ground "-"	—
	3	CANH	Blue		CAN HIGH	Digital, SAE j1939 Standard
	4	CANL	White		CAN LOW	

Table 7 — 1708Crocodile cable wires assignment

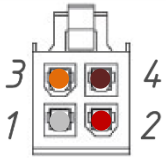
Connector Pinout	Pin number	Wire			Signal	
		Marking	Color		Circuit designation	Signal parameters
	1	j1708.A	White		j1708.A/485A	Digital, SAE j1587/ RS-485 Standard
	2	j1708.B	Red		j1708.B/485B	
	3	VBAT	Orange		Power Supply "+"	Analog, voltage 10…45 V
	4	GND	Brown		Ground "-"	—

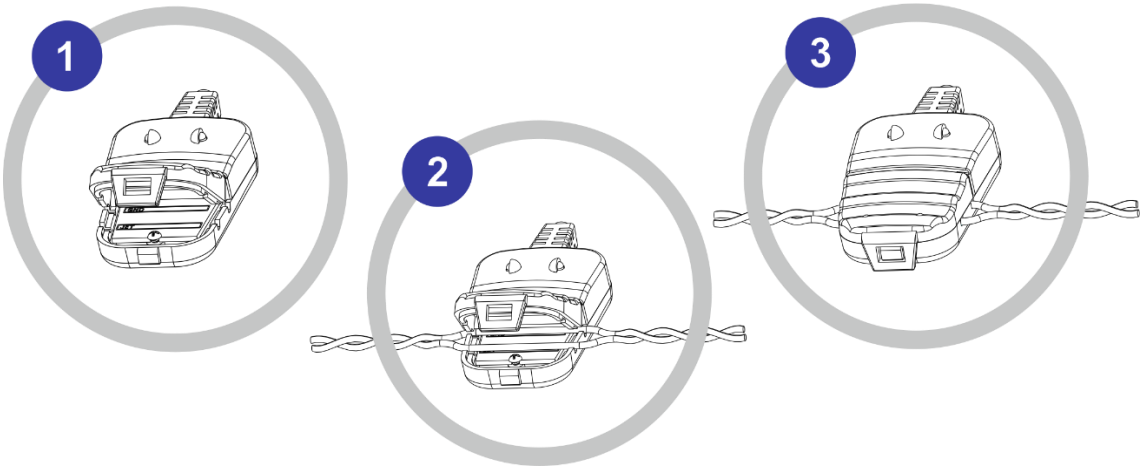
Table 8 — NozzleCrocodile / Nozzle BMCrocodile cable wires assignment

Wire			Signal	
Marking	Color		Circuit designation	Signal parameters
VBAT	Orange		Power Supply "+"	Analog, voltage 10…45 V
GND	Brown		Ground "-"	—
T701	Pink		Output signal	Pulse (see 1.3.5)

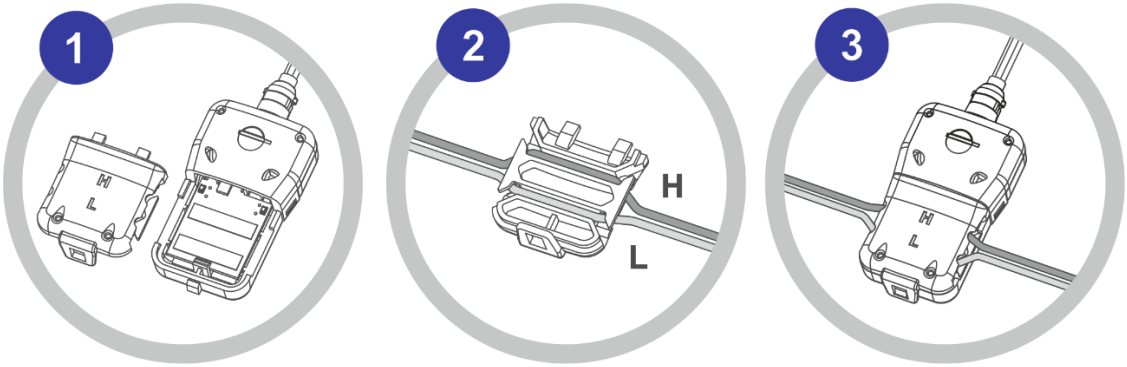
After the electrical connection of Crocodile is completed, switch on the battery (ignition).

2.7 Contactless connection to the Vehicle wires

To connect Crocodile, fulfill the steps in accordance with figure 19.



a) for CANCrocodile/FMSCrocodile/1708Crocodile/NozzleCrocodile/Nozzle BMCrocodile



b) for CANCrocodile Mini

1 — open the Crocodile casing.

2 — place carefully the appropriate wires into the grooves along the lines, in accordance with the marking.

3 — close the casing, till the locks are fixed.
Crocodile is ready for operation.

Figure 19 — Steps for Crocodile contactless connection

RECOMMENDATION: To reduce Nozzle BMCrocodile sensitivity towards the impact of electromagnetic interference, connect wires using **the method of Ivashkevich**. The idea of this method is that instead of JET GND wire, the brown GND wire (chassis ground «-») of the connection cable is laid into the appropriate groove of the reader casing. As a rule, the method of Ivashkevich ensures more steady reading of the injector command pulses within the entire frequency range of the engine rpm.

Examples of Crocodile connection on a Vehicle are presented at figure 20.

Figure 20 — Examples of Crocodile connection

2.8 Sealing

To prevent unauthorized access to Crocodile, secure its case by using sealing rope and seal from delivery set (see figure 21).

Sealing should be done when Crocodile's case is opened. Put the rope through special holes in the case and through two holes placed in the center of the seal. Close Crocodile's case and click the seal. After clicking the seal, the rope will be permanently fixed making Crocodile's case opening not possible without damaging seal.

*Figure 21 — Seal Crocodile**

* The seal may look different from the one shown on figure 21

3 Functioning check

If the connection is done correctly, the Crocodile starts its operation as soon as it is powered on (ignition is on). When you disconnect the power supply (turn off the ignition), Crocodile will be switched off.

If Crocodile connection is made correctly, signal values of red and green LED indicators located on Crocodile body shall comply with table 5.

ATTENTION: When injector wires are connected with Nozzle Crocodile or Nozzle BMCrocodile correctly, the blinking frequency of the green LED indicator is increasing while speed of the engine is increasing.
If blinking frequency of the green LED indicator is not changing, you should check nozzle's wires connection and might need to swap it.

For CANCrocodile U12/24 A++ LEDs are not provided. Therefore, the presence of CAN bus messages in the output interface of CANCrocodile U12/24 A++ will mean, that the device was connected correctly.

4 NozzleCrocodile and Nozzle BMCrocodile calibration

Certain volume of consumed fuel corresponds to each output pulse of NozzleCrocodile and Nozzle BMCrocodile.

For calculation of fuel volume consumption by the Telematics system, the injector **pulse value** is used; its value is individual for each vehicle.

To define the pulse value **C**, you need to calibrate NozzleCrocodile and Nozzle BMCrocodile for a specific vehicle according to the following method:

1) Specify the initial pulse value $\mathbf{C_0=0.003\ l/pulse}$ in the respective Terminal or Server settings.

2) Fuel the tank to its full capacity.

3) Use **no less than 20 l of fuel** in the operation mode which is typical for this type of Vehicle.

4) Fuel the tank to its full capacity (at the same gas station).

5) Measure the volume of fuel used, according to the readings of the fuel-filling column **(V)**.

6) Measure the volume of fuel used, according to the readings of the Telematics system **(W)**.

7) Calculate the pulse value **C** according to the formula:

$$\mathbf{C=\frac{0.003 \cdot V}{W}\ ,\ l/pulse}$$

8) Specify the calculated pulse value **C** in the respective Terminal or Server settings.

5 Using CANCrocodile / CANCrocodile Mini and 1708Crocodile together with MasterCAN data converters

CANCrocodile / CANCrocodile Mini and 1708Crocodile, together with MASTERCAN data converters can be applied as the ready solution for integration of data from CAN and j1708 onboard data buses into the Telematics system. Besides, MasterCAN interfaces, together with Crocodile, are convenient to use for collection of data from sensors or peripheral devices of one or several standard onboard buses and for transfer of data into CAN j1939/S6 Telematics interface (see figure 22).

MasterCAN filters data read by Crocodile from the vehicle onboard buses, filters out unnecessary data and generates output messages containing the equipment performance parameters that are most important for the Telematics system.

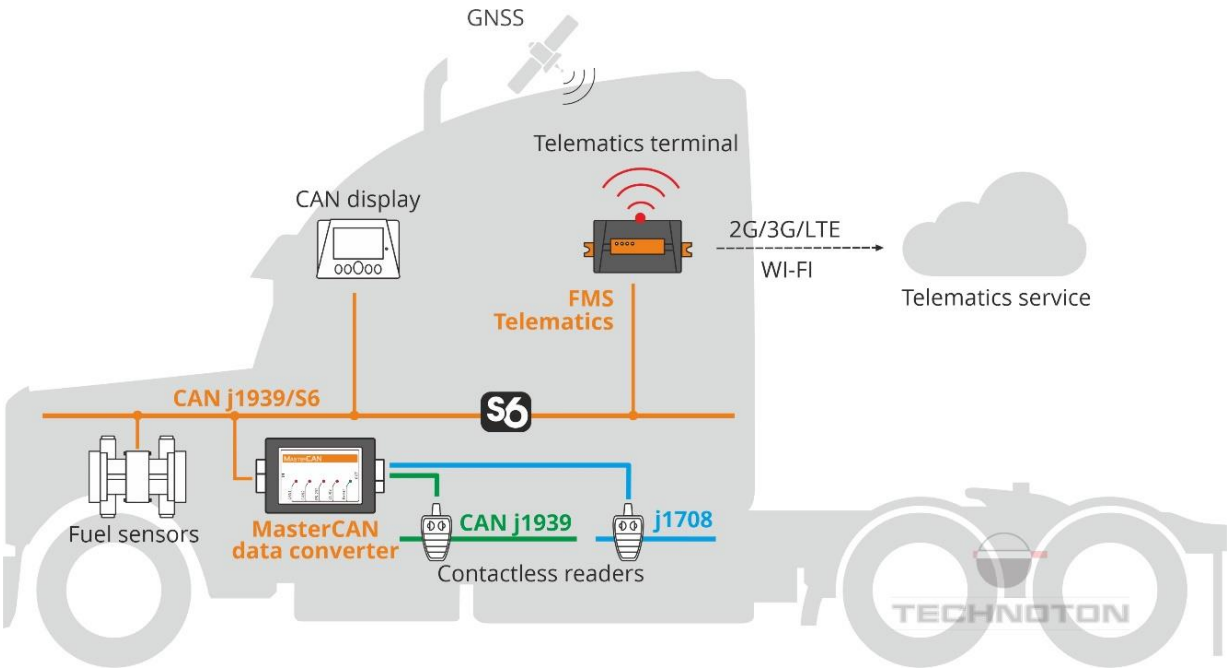


Figure 22 — Using Crocodile contactless readers together with MasterCAN data converters for integration of data from CAN and j1708 onboard buses into the Telematics system

MasterCAN modifications:

- MasterCAN CC — are used for filtering out FMS messages from the onboard CAN bus (SAE j1939/71), transferring them and the generated special Telematics messages into CAN j1939/S6 Telematics interface;
- MasterCAN C 232/485 — are used for converting FMS messages from the onboard CAN bus (SAE j1939/71) into RS-232 and RS-485 interfaces (ASCII / Modbus RTU / DUT-E COM);
- MasterCAN V-GATE — are used for data conversion from CAN (SAE j1939/71) and j1708 (SAE j1587) onboard buses, transfer of FMS messages and the generated special Telematics messages into CAN j1939/S6 Telematics interface, as well as for transfer of messages into RS-232 interface (ASCII / Modbus RTU / DUT-E COM).

Table 9 — MasterCAN modifications input/output interfaces (protocols)

MasterCAN modifications	Input interface (protocol)	Output Interface (Protocol)
	CAN (SAE j1939/71)	CAN (j1939/S6)
	CAN (SAE j1939/71)	RS-232/RS-485 (Modbus RTU/ASCII/ DUT-E COM (extended LLS))
	CAN (SAE j1939/71) j1708 (SAE j1587)	CAN (j1939/S6) RS-232 (Modbus RTU/ASCII/ DUT-E COM (extended LLS))

Template schemes of connection of tracking device with CANCrocodile (1708Crocodile) and MasterCAN for secure data obtaining from onboard data buses CAN (j1708) are presented at annex A.

The content of output PGN, configuration procedure and other detailed information on MasterCAN is provided in the document MasterCAN data converters. Operation manual.

6 Usage of FMSCrocodile CCAN and CANCrocodile combined with j1939 i/o module MasterCAN DAC15

CANCrocodile / CANCrocodile Mini / FMSCrocodile CCAN combined with MASTERCAN DAC15 **j1939 i/o module** (digital to analog converter) can be used as an out-of-the-box solution for integration of Vehicle CAN bus essential data into Vehicle Telematics system through analog inputs of the tracking device (see figure 23).

This solution is used within Telematics systems, where analog On-board equipment is used along with CAN bus.

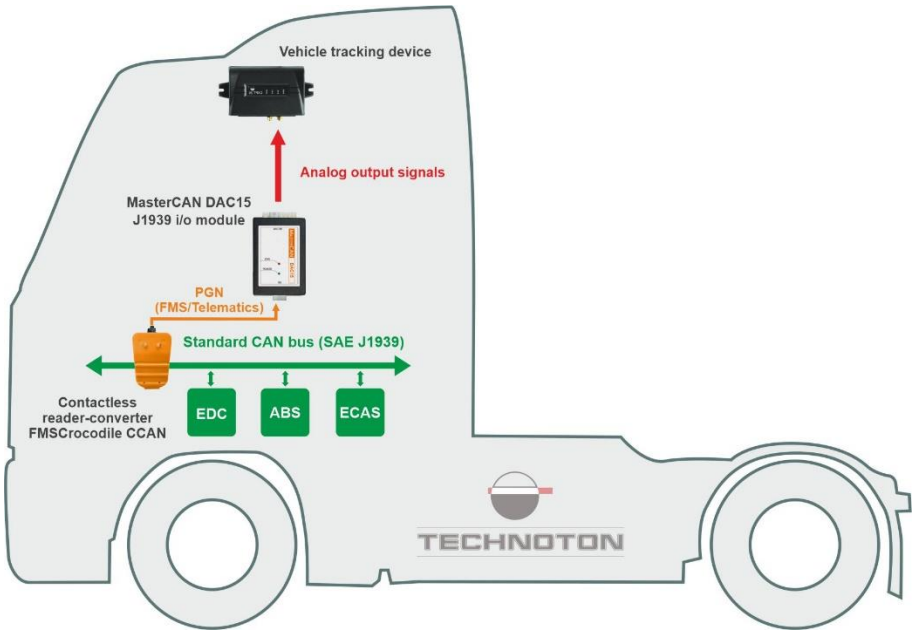


Figure 23 – Converting CANbus data to analog signals

MasterCAN DAC15 is equipped with:

- configurable digital CAN j1939/S6 interface;
- single adjustable analog input for voltage/frequency signal;
- five adjustable analog outputs:
  - voltage/frequency signal;
  - current signal;
  - discrete signal (2 pcs.);
  - resistive signal.

MasterCAN DAC15 digital output interface specifications correspond to specifications of CAN j1939/S6 Telematics interface. S6 bus data exchange protocol complies with SAE j1939 standard.

Table 10 — Analog signals of MasterCAN DAC15 specification

Signal type, measurement units	Value
Analog input	
Voltage, V	0.5…9
Frequency, kHz	0.01…10
Analog outputs	
Voltage, V	0.5…9
Frequency, kHz	0.01…10
Current, mA	4…20
Discrete 1, V	0 (level 0) U_{PS} (level 1)*
Discrete 2, V	0 (level 0) 10 (level 1)
Resistive, kOhm	0.015…50
* U_{PS} – voltage of Vehicle power supply source.	

Necessary input/output analog signal type selection and signal adjustment is carried out through Service S6 MasterCAN software (you can download software at https://www.jv-technoton.com/, in Software/Firmware section).

MasterCAN DAC15 converting digital data (PGN) of automotive interface CAN to analog inputs of telematics terminal or dashboard and (or) analog output signals of automotive sensors to CAN j1939/S6 ports of telematics terminal.

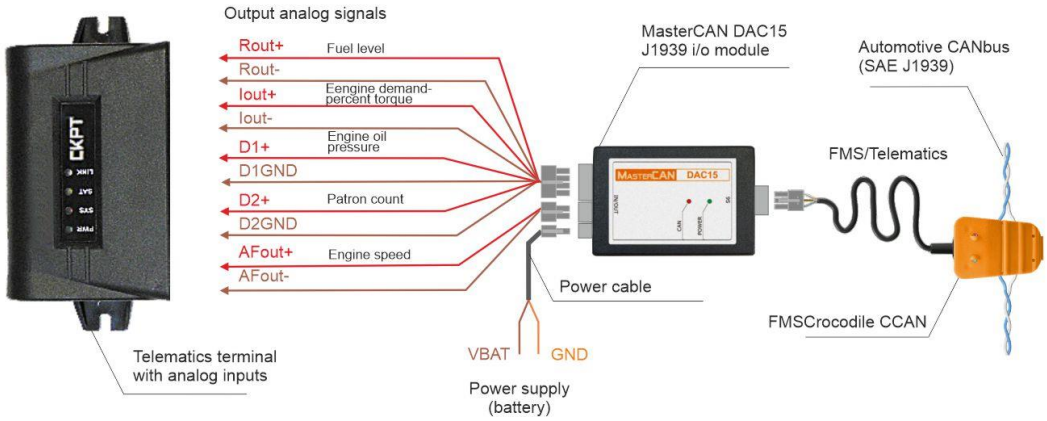


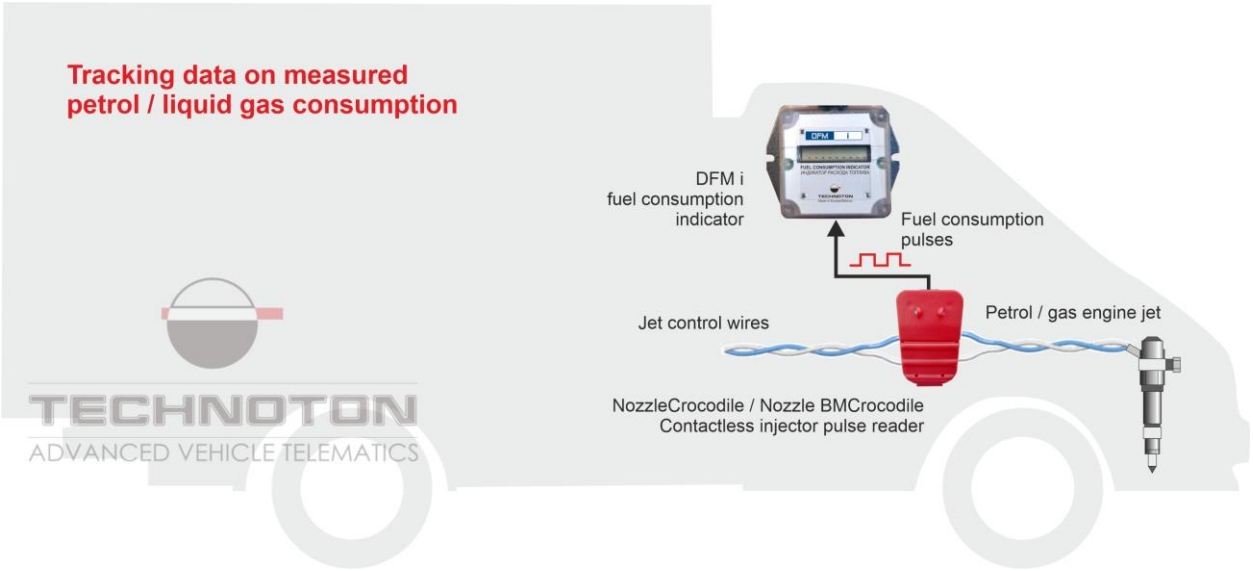
Figure 24 — Example connecting FMSCrocodile CCAN for CANbus data conversion to analog inputs of telematics terminal

Detailed information useful information about MasterCAN DAC15 is presented in MasterCAN DAC Operation manual.

7 Usage of NozzleCrocodile / Nozzle BMCrocodile combined with DFM i fuel consumption indicator

NozzleCrocodile and Nozzle BMCrocodile are conveniently used with DFM i **fuel consumption indicator** for registering and displaying information about petrol/LPG fuel consumption (see figure 25). DFM i is developed by JV Technoton.

a) DFM i exterior view



b) using DFM i together with NozzleCrocodile/Nozzle BMCrocodile contactless reader in LCV

Figure 25 — DFM i fuel consumption indicator

DFM i can be installed in the cabin or other place of the Vehicle, convenient for visual checking of parameters.

Table 11 — Main technical specifications of DFM i

Parameter, measuring unit	Value
Registering consumption range, l/h	from 0.5 to 1000
Output signal	pulse
Calibration factor, ml/pulse	configurable, from 0.1 to 50.0
Input impedance, k Ohm, no less then	50
Operation temperature range, °C	from - 20 to + 60
Dimensions (without cable), mm, no more then	75x60x30
Weight, kg, no more then	0.3

DFM i fuel consumption indicator and NozzleCrocodile / Nozzle BMCrocodile connection scheme is presented at figure 26.

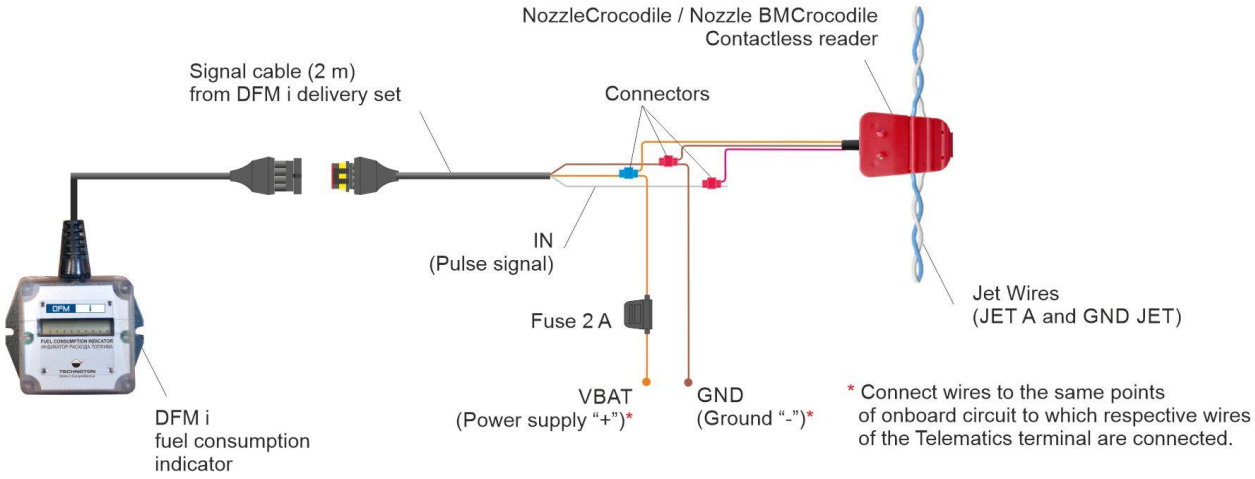


Figure 26 — Connection scheme of DFM i fuel consumption indicator and NozzleCrocodile / Nozzle BMCrocodile

Detailed specifications of DFM i fuel consumption indicator, the procedure for its configuration and connection, as well as the description of data shown on the data display are provided in the document DFM i fuel consumption indicator. Operation manual.

8 Disconnection of Crocodile

ATTENTION: Before you start Crocodile installation, you need to disconnect electrical circuit of the Vehicle. To do this, you shall use the battery disconnect switch or remove contact terminals from it.

To switch off the Crocodile, you need to fulfill the following steps:

1) Disconnect Crocodile connecting cable (wire) from the tracking device. If Crocodile is powered from the onboard power supply, you need to disconnect Crocodile power ("+" and "-" wires) from the onboard power supply.
2) Open the Crocodile casing.
3) Remove carefully the Vehicle wires from the grooves of the Crocodile casing.

After dismounting, you can use Crocodile on another Vehicle.

9 Packing

Crocodile are supplied in blister package, except **L2** version, which is supplied in cardbox.

Figure 27 — CANCrocodile blister pack example

Reverse side of the insert in Crocodile blister package (see figure 28) contains user information:

- general information and technical specifications;
- brief connection instructions;
- assignment of LED indicators;
- assignment of interface cable wires;
- warranty period;
- valid Certificates.

Figure 28 — Information on the inserts of Crocodile's blister package

10 Storage

Crocodile is recommended to be stored in dry enclosed areas or other premises with natural ventilation, without simulated climatic conditions and unheated warehouses.

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

11 Transportation

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

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

12 Utilization/re-cycling

Crocodile does not contain harmful substances and ingredients that are dangerous to human health and environment during and after the end of life and recycling.
Crocodile does not contain precious metals in amount that should be recorded.

Contacts

Manufacturer

Tel: +375 17 240-39-73

https://jv-technoton.com/

https://s6.jv-technoton.com/

E-mail: marketing@technoton.by

Technical support

E-mail: support@technoton.by

Annex A
Template schemes of safe tracking device connection to the Vehicle's data buses CAN (j1708)

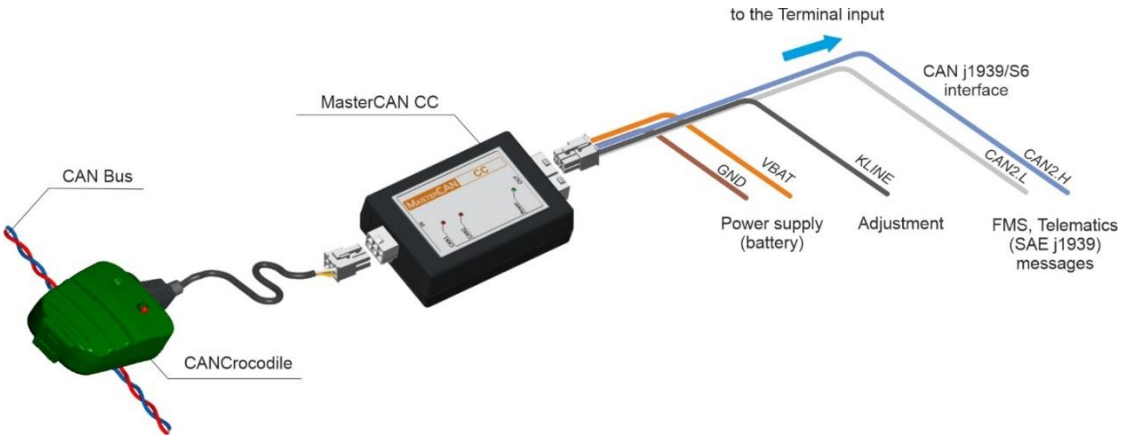


Figure A.1 — Telematics data obtaining from onboard CAN bus via CAN 2.0B interface

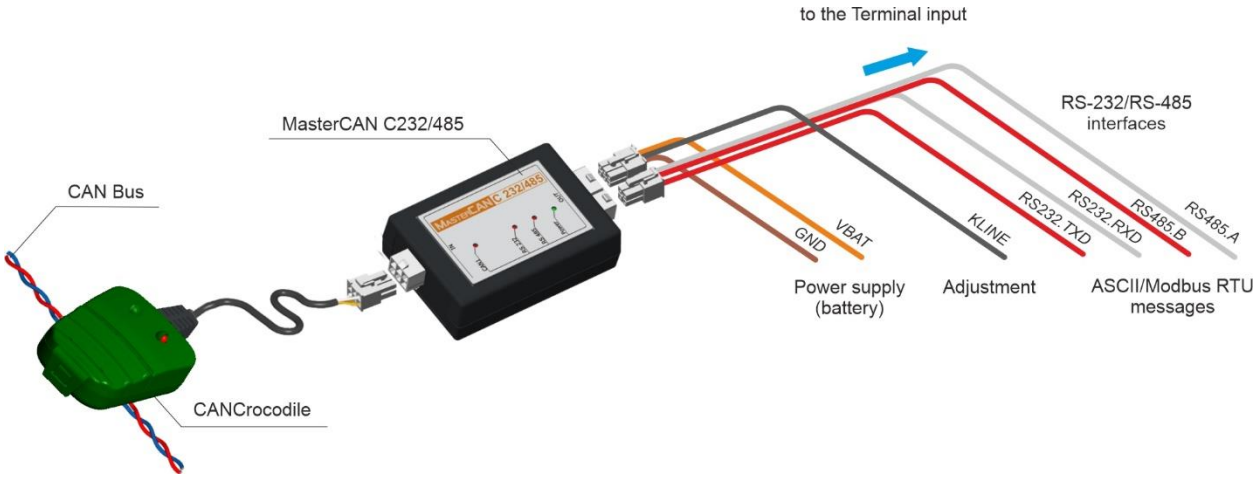


Figure A.2 — Telematics data obtaining from onboard CAN bus via RS-232/RS-485 interface

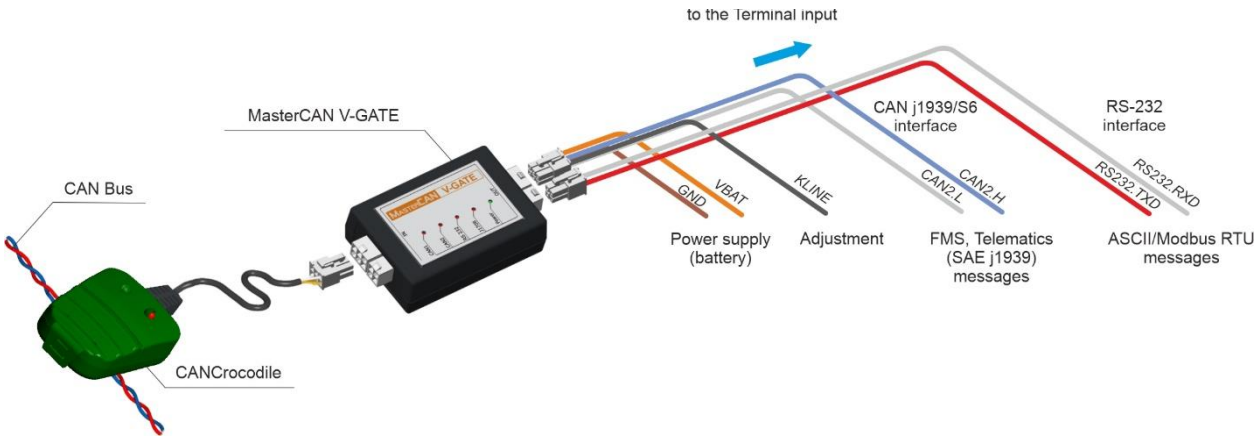


Figure A.3 — Telematics data obtaining from onboard CAN bus via CAN 2.0B and RS-232 interface

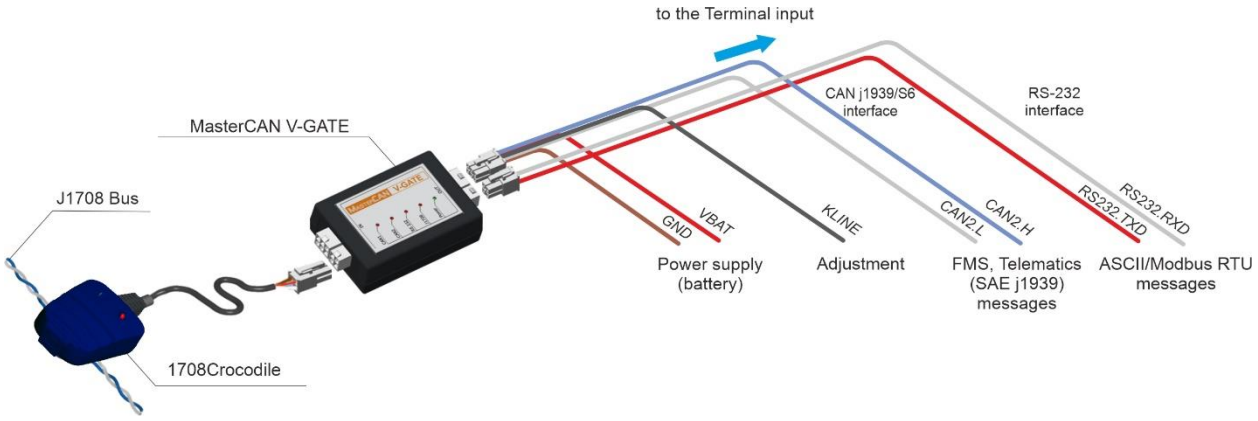


Figure A.4 — Telematics data obtaining from onboard j1708 bus via CAN 2.0B and RS-232 interface

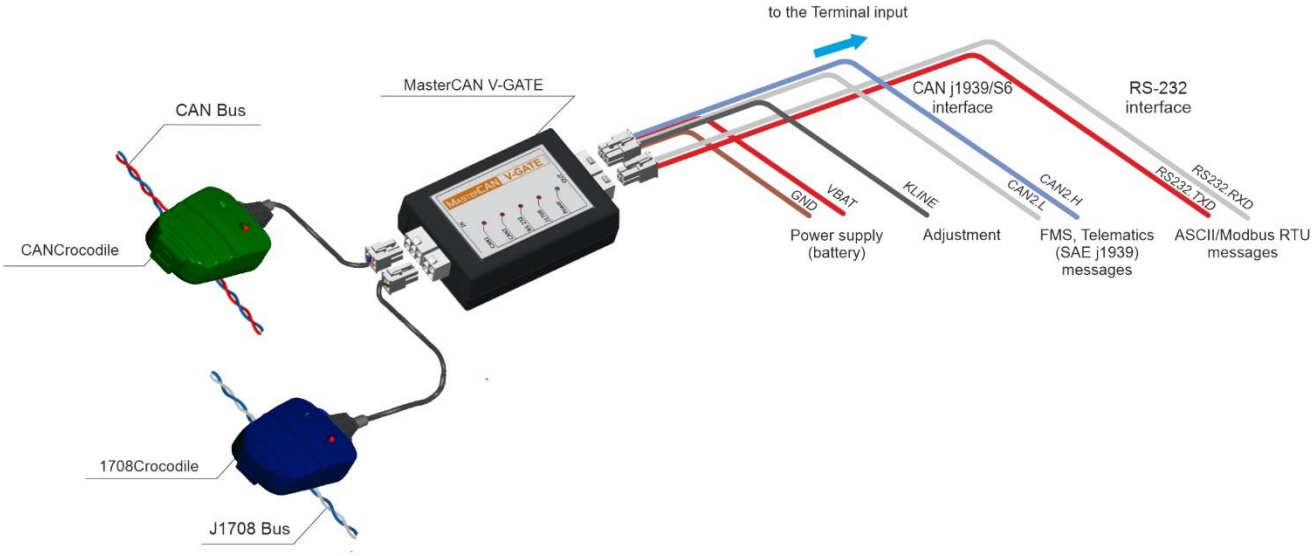


Figure A.5 — Telematics data obtaining from onboard CAN and j1708 buses via CAN 2.0B and RS-232 interfaces

Annex B
Videography

Animation “Crocodile contactless reader”:

Check out the link: https://www.youtube.com/watch?v=3jfKYQ-U3-k

Other Technoton videos are on the YouTube channel which is regularly updated:

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