Technical documentation
Tytan®SAT DS520
Tytan®SAT DS520B

GSM/GPS/GLONASS device
for telemonitoring and supervision of vehicles
and technical appliances

Changes in document

DS520.IM.EN.0001.001	2016.05.16	- Document created
DS520.IM.EN.0001.002	2016.06.01	- Document reedited
DS520.IM.EN.0001.003	2016.07.13	- Description of SMS/GPRS remote commands (chap.10) has been changed - Tutorial for remote firmware upgrade (FTP) and configuration changes have been added (chap. 11 and 12) - Document reedited
DS520.IM.EN.0010.004	2016.11.17	- Changes related to implementation of power saving modes
DS520.IM.EN.0013.005	2017.01.02	- Changes in point 3.2.3 and chapter 5. Added description of further iButton scenarios, which report when IButton has been taken off from the reader - Corrected diagram of DS18B20 thermometer connection
DS520.IM.EN.0017.006	2017.06.12	- Additional analogue input mode (2.3, 6.4.1, 8.4.2, 8.4.3)
DS520.IM.EN.0202.007	2018.06.04	- Description of battery version added
DS520.IM.EN.0205.008	2018.08.21	- Corrected description of UPGRADE, GETCONFIG and SETCONFIG commands

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1. General characteristics

1.1 About

Tytan®SAT DS520 is GSM/GPRS device designed for real time tracking of vehicles and cargo or supervising technical objects. Device transmits location data (GPS/GLONASS position and speed) with current parameters and events registered in monitored objects to the external server using UDP or TCP protocol.

Due to analogue/digital inputs and 1-wire interface the device: a) measures data from sensors with analogue output signal (e.g. from fuel level sensors), b) authorises access to the vehicle via iButton identifiers, c) measures temperature via 1-wire sensors, d) monitors status of up to 5 switches (vehicle’s door and bonnet/tailgate). Due to digital outputs the device allows users to control 2 circuits remotely.

The device is supplied with non-volatile memory which prevents data loss in case of no GSM network coverage. In such cases, data are stored in non-volatile memory. Once connection is retrieved, data are re-sent to the server.

DS520B version is equipped with internal LiPo battery. It allows the device to operate in emergency conditions when power supply is lost.

1.2 Basic characteristics

- Power supply 12V/24V (voltage range 8-40V).
- Power consumption: average 14-36 mA (depending on configuration of transmission intervals).
- Power saving modes: GPS sleep and deepsleep – min. power consumption less than 2mA.
- Additional 350mAh LiPo battery (available only in DS520B version).
- Up to 24h (conditions dependent) of operation without power supply (only DS520B).
- 2 analogue inputs AI0/AI1, 0-10V/0-30V.
- 4 digital inputs DI2/DI3/DI4/DI5.
- 2 digital outputs OUT0/OUT1 (OC type).
- Built-in 3-axe accelerometer to detect drive condition without connecting ignition circuit.
- 1-wire interface: iButton identifiers (DS1990A) and DS18B20 digital temperature sensors.
- List of up to 500 authorised iButton identifiers.
- Immobiliser function.
- Quad-band GSM/GPRS modem Simcomm SIM800C.
- External GSM antenna.
- Built-in GPS/GLONASS receiver Tytan Digital Systems GPS/GLONASS 1537 with simultaneous observation of GPS and GLONASS satellites.
- External GPS/GLONASS antenna.
- 32-bit Microchip MX7 microcontroller, 512kB Flash ROM, 128kB RAM.
- Built-in 4Mb memory to store data. Capacity: up to 50000 reports.
- Remote configuration and firmware upgrades via GSM/GPRS using FTP protocol.
- Two LEDs signalling device operation.
- USB port for configuration and device diagnostics.

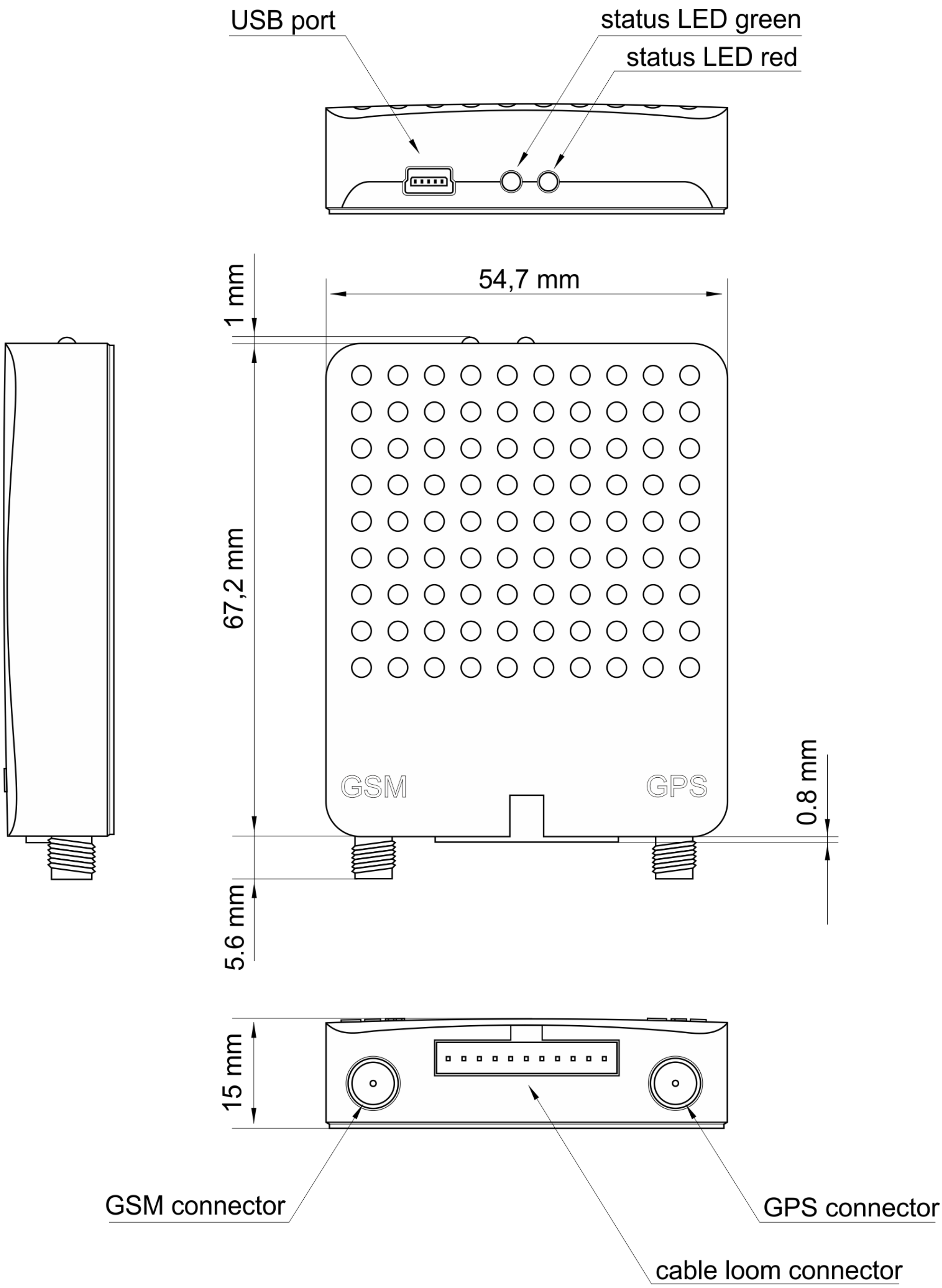
1.3 Package contents

A complete set of DS520 includes:

- DS520 unit
- dedicated 11-wire harness (loom)
- GSM antenna
- active GPS/GLONASS antenna

SIM card of miniSIM type is not included in the set. The picture shows it only to specify the card size.

1.4 View and dimensions



1.5 Functionality

Data transmission	Sending vehicle data via GPRS using UDP or TCP protocol in GSM network. Limiting data transfer by collecting larger amount of data into packets.
Telemetry	Data collection from GPS/GLONASS satellite navigation systems, analogue/digital inputs and 1-wire interface.
Vehicle location	Real-time transmission of vehicle geoposition, sampling grid dependent on time, distance and vehicle heading angle.
Vehicle mileage	Mileage calculated by the device on the basis of GPS coordinates, regardless of density of sampling positions. It is calculated incrementally among reports or globally for one journey.
Roaming	Separate reporting configurations for operation in GSM home network and roaming (intelligent roaming). Current country code and network provider name are transmitted to the server.
Event log memory	Data storage in non-volatile memory – prevents data loss in case of no GSM coverage (once coverage is retrieved, data stored in memory is re-sent to the server). Up to 50000 reports can be stored in memory (~85 hours of work with 10 reports generated every minute).
Remote firmware upgrades	Remote firmware upgrades via GSM/GPRS - OTA (over-the-air) using FTP protocol. Upgrade control via GPRS or SMS commands.
Remote configuration upgrades	Remote configuration reading and writing via GSM/GPRS - OTA (over-the-air) using FTP protocol. Configuration reading and writing control via GPRS or SMS commands.
Fuel	Fuel level readouts from two fuel level sensor circuits (OEM float type sensors and FLS with analogue output 0-10V).
Driver's identification	Optional driver's identification using iButtons (DS1990A).
Immobiliser	Optional immobiliser function that prevents unauthorised starting of the vehicle engine.
Installation	Low power consumption and compact easy to install housing. Optional simplified installation (power supply only, no ignition signal).
Virtual ignition signal	Drive signal detection from readouts of both vehicle acceleration and vibration and/or power voltage changes.
Device diagnostics	Advanced diagnostic tools for PC use, improving device installation and start-up.
Internal battery	Device emergency operation in case of power supply lost. Depending on configuration and conditions: from several minutes up to 24h.

1.6 Technical data

1.6.1 Electrical characteristics:

	Min.	Typ.	Max.	Unit
Power Supply				
Supply voltage	8		34	V
Power consumption – normal mode, voltage 12V		36	500	mA
Power consumption – GPS sleep mode, voltage 12V		15		mA
Power consumption – deepsleep mode (with accelerometer), voltage 12V		1.9		mA
Power consumption – deepsleep mode (w/o accelerometer), voltage 12V		1.2		mA
Average power consumption, deepsleep mode (w/o accelerometer), 1 transmission every 5 minutes, voltage 12V		9.1		mA
Average power consumption, deepsleep mode (w/o accelerometer), 1 transmission every 15 minutes, voltage 12V		3.9		mA
Battery type (DS520B only)	Lithium-Polimer (LiPo) LP303040			
Battery capacity (DS520B only)		320		mAh
Analogue inputs AI0/AI1				
Input voltage (range 0-10V)	0		10	V
Input resistance (range 0-10V)		100		kΩ
Input voltage (range 0-30V)	0		30	V
Input resistance (range 0-30V)		84		kΩ
A/D converter		12		bit
Digital inputs DI2/DI3/DI4/DI5				
Input voltage	0		30	V
Input resistance		22		kΩ
Input resistance to power supply		47		kΩ
Input resistance to ground		47		kΩ
Voltage threshold (Low state)		$^{1}/_{3}\ V_{supply}$		
Voltage threshold (High state)		$^{2}/_{3}\ V_{supply}$		
Digital outputs OUT0/OUT1				
Drain current (OFF state)			75	µA
Maximum output voltage (OFF state)			36	V
Maximum output current (ON state)	1.7		3.5	A
Electronic switch resistance(ON state)		250		mΩ
Protections				
Reverse polarity protection	reversable, electronic			
Device overcurrent protection	non-reversable, internal fuse 3A			
Output short-circuit protection	electronic 1.7A			
1-wire line overcurrent protection	electronic, reversable, fuse50mA			
1-wire overvoltage protection	electronic, 5.6V			

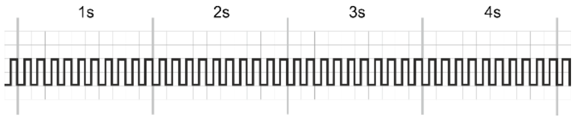
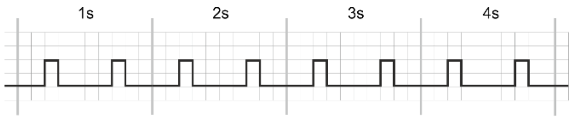
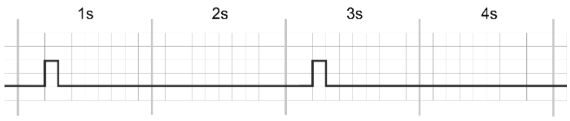
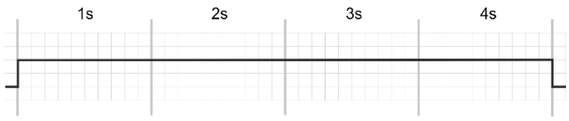
1.6.2 Mechanical features:

	Min.	Typ.	Max.	Unit
Temperature range				
Storage temperature	-35		65	°C
Operating temperature	-25		55	°C
Housing				
Length		75		mm
Width		54.7		mm
Height		15		mm
Weight (DS520)		52		g
Weight (DS520B)		60		g
Material	Poliamid PA66 + Fiber Glass			
Connectors & cables				
GPS connector	SMA			
GSM connector	SMA			
Cable loom connector	JST PHR-11			
Wires in cable loom	UL1007 26AWG 12/0.12CU+PVC1.3			
USB connector	mini USB			
SIM card connector	mini SIM, foldable			

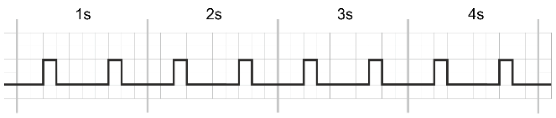
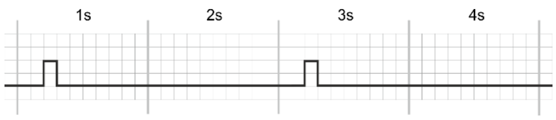
1.7 LED signals

The device signals operation using two LEDs: red and green. Red LED signals the communication has been established, i.e. DS520 is registered in GSM network and can transmit data to the server. Green LED informs if received GPS/GLONASS signal allows to find actual geographical position of the device.

RED LED – GSM/GPRS connection

 LED blinks approx. 10 times per second	**no GSM connection** - no SIM card, - SIM card invalid, - SIM card lock,
 LED flashes frequently (twice per second)	**no GSM connection** - logging into GSM network not possible (roaming), - sending GPRS data not possible, - no GSM signal coverage,
 LED flashes rarely (every two seconds)	**proper GSM/GPRS connection (OK)** - DS520 registered in GSM network, - GPRS data transmission to the server possible,
 LED lights up for 4 seconds	**data packet sent properly to the server (OK)** - the server has confirmed the receipt of report packet from DS520.

GREEN LED – GPS/GLONASS position

 LED flashes frequently (twice per second)	**determining GPS/GLONASS position not possible** - GPS/GLONASS signal level too weak for accurate geographical position, - GPS/GLONASS antenna damaged, disconnected or covered with metal elements,
 LED flashes rarely (every two seconds)	**GPS/GLONASS fixed position (OK)** - DS520 registered in GSM network properly, - GPRS data transmission to the server possible.

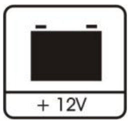
WARNING!

- In normal operation both LEDs should flash infrequently (every 2 seconds).

- After power supply is connected (after restart) both LEDs light up continuously for 15 seconds.

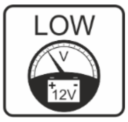
2. Device description

2.1 Power supply



Power voltage / power consumption

The device can be used in vehicles with either 12V or 24V power supply. Power voltage is monitored and its value is sent to the server by default. The power supply circuit is protected against reverse polarity voltage. DS520B version is equipped with internal 350mAh LiPo battery.



Power saving modes / power consumption

The device has 3 modes for energy management: normal mode, GPS sleep mode and deepsleep mode. In DS520B different energy management mode can be configured for operation with and without power supply (chapter 2.7).

Normal mode

In normal mode the device consumes on average approx. 36 mA. Maximum value of the current spikes during transmission does not exceed 500mA. GPS receiver is enabled constantly. GSM modem is enabled constantly. GPRS session is not closed between sending reports. The device responds immediately to SMS commands.

GPS sleep mode

In GPS sleep mode during parking the device disables GPS receiver under certain conditions, so that power consumption is reduced to 14 mA. Conditions for disabling GPS receiver: ignition switch (GLOBAL_IGNITION) is OFF, time to generate next report exceeds 120 seconds, GPS position is known and fixed. GPS receiver is enabled 60 seconds before the scheduled generating of next report to ensure time that is required to re-establish position. When ignition (GLOBAL_IGNITION) is detected as switched on the GPS receiver is immediately enabled. GSM modem is enabled constantly. GPRS session is not closed between sending reports. The device responds immediately to SMS commands. The measurable results are reached when time condition exceeds 5 minutes.

Deepsleep mode

In deepsleep mode during parking the device, under certain conditions, disables GPS receiver and GSM modem and also makes processor asleep, so that power consumption is reduced to 1.2 mA. Conditions for entering deepsleep mode: ignition switch (GLOBAL_IGNITION) is OFF, time to generate next report exceeds 120 seconds, USB cable disconnected. The device wakes up 60 seconds before the scheduled generation of next report in order to ensure time limit required to re-establish GPS position, start up GSM modem and establish GPRS connection. Additionally, the device wakes up (depending on configuration) in the following cases: power supply voltage has been detected at the ignition signal wire; accelerometer vibrations have been detected; increase of power supply voltage has been detected.

Enabling the deepsleep mode results in meaningful power savings. The longer time between reports when the ignition is switched off, the greater power savings are. If reports are set to be transmitted every 5 minutes, the average current value is about 9mA. If reports are set to be transmitted every 15 minutes, the average current value is about 4mA.

WARNING!

(a) Waking up the device from deepsleep mode causes opening a new GPRS session and, depending on GPRS service provider tariff charging system, can cause data transfer rounding to full tariff units. Therefore entering

deepsleep mode is reasonable when time between reports during parking reaches from a dozen to several tens of minutes.
(b) The device wakes up from deepsleep mode by detecting ignition signal (GLOBAL_IGNITION). It is required to connect analogue ignition signal wire or enable accelerometer based virtual ignition signal.
(c) Due to GSM modem deactivation the device receives and responds to SMS commands only after waking up from deepsleep mode. Hence, when time between reports reaches 15 minutes the device can respond to SMS command after approx. 15-20 minutes.
(d) When GPS sleep and deepsleep modes are used, GPS trace accuracy is decreased for a short period of time after the device wakes up.

Detection of voltage changes - virtual ignition

The device can be optionally configured to detect engine operating from power voltage changes (the effect of charging car battery by engine alternator) - generation of so-called virtual ignition signal. The ignition switch-on signal appears when the voltage exceeds the set (upper) threshold for a time longer than 5 seconds. If the voltage drops below a given (lower) threshold for longer than 5 seconds, the ignition switch-on signal disappears.

2.2 Modem / GPS/GLONASS receiver

Modem

The device is supplied with Simcomm built-in industrial GSM modem SIM800C with the following parameters:

- Quad-band 850/900/1800/1900MHz
- GPRS multi-slot class 12/10, mobile station class B
- Complied with GSM phase 2/2+: Class 4, Class 1
- SMS and GPRS handling

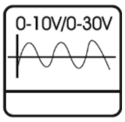
GPS/GLONASS receiver

The device is also supplied with GPS/GLONASS receiver manufactured on Digital Systems' request:

- designation: Tytan Digital Systems GPS/GLONASS 1537
- handles systems of GPS, Glonass, Galileo, QZSS
- operates on the basis of simultaneous observation of GPS and GLONASS satellites
- protocol NMEA 0183 v3.01 (GGA,GSA,GSV,RMC,VTG)
- 32 simultaneous channels
- high sensitivity: 161dBm

Both modem and GPS receiver require the use of external antennas, connected by SMA connector. External antenna has significant advantage - it allows device installation in the safe place inside the vehicle, not limited by the signal quality. Device can be installed inside metal containers, while external antennas can be put in different places according to environmental conditions.

2.3 Analogue and digital inputs



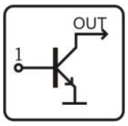
2 measuring analogue inputs AI0/AI1, 0-10V/0-30V

High impedance inputs, non-polarized (without pull-up and pull-down), designed to measure voltage 0-10V or 0-30V. Measurement is taken with high resolution (10bit). It is possible to configure the measurement range (0-10V or 0-30V).
Most commonly the inputs are used to connect 2 fuel level sensors with standardized analogue output signal 0-10 V or OEM fuel level sensor.
Signal of both inputs is averaged in period of 10-120s, using complex and non-linear filtering algorithms. It allows to eliminate signal fluctuations caused by changes of fuel level while driving.
Each input has a peak voltage detection function. It allows to handle fuel tank senders with pulsed polarisation circuits - no need to use external analogue filters. If detector is enabled, calculated peak voltage (for every second) is then averaged according to programmed parameters.
Analogue input value is transmitted to the server provided that data transmission from analogue inputs and a given analogue input have been enabled.
There is an additional analogue input mode for the sensors powered from ignition circuit. Such sensors give 0V signal when ignition is off. In this mode, the voltage is measured only if the ignition is on (starts few seconds after ignition on detection). If the ignition is off the device transmits to server last valid value of voltage, measured before the ignition was switched off.

4 universal digital polarized inputs (DI2/DI3/DI4/DI5)
dedicated ignition signal input DI5

The device is supplied with 4 universal digital inputs. Inputs are polarized inside the device up to half of power supply voltage using approx. 50kΩ resistor. Depending on the operation mode (INPUT+ or INPUT-) input detects positive signal (voltage greater than 2/3 of power supply voltage) or ground signal (voltage lower than 1/3 of power supply voltage). This solution allows to connect different signals from vehicles as well as various additional sensors of both types, NO and NC.
Digital input has additional configurable options which refer to generating and sending reports to the server (point 3.2.2), which means it can generate reports or force immediate data transmission to the server at the following state changes: off→on and on→off.
Digital input value is transmitted to the server provided that data transmission from digital inputs has been enabled and operation mode for digital input has been configured.
DI5 input is by default designed to operate as ignition input.

2.4 Digital outputs



2 digital outputs OUT0, OUT1

The outputs are connected to the device’s ground, using intelligent electronic keys with anti-short circuit control up to 1.7A. Outputs are controlled from the server using GPRS or SMS commands. They can also operate independently with regards to their functions in the device (immobiliser function - NC immobiliser relay control).

2.5 Accelerometer

Virtual ignition signal (vehicle motion detection)

The device has a built-in 3-axe accelerometer, to detect vehicle motion and vibrations. The accelerometer is used to generate the virtual ignition signal. The “ignition ON" condition is enabled in configuration programmer if the vibrations appear for longer than 10 seconds. The “ignition off” condition is detected if the vibrations are absent for at least 20 seconds.

2.6 Digital interfaces and supported protocol

1-Wire bus/iButton interface

The device has an interface to work with **1-wire bus** systems - iButton identifiers (dedicated casings made of stainless steel), digital temperature sensors(e.g. DS1820) and RFID readers equipped with 1-wire interface. Software enables both identification of people and cargo, and temperature measurement from up to four sensors.

The line designed to connect the reader is reinforced against surges and short-circuits and allows 1-wire bus polarization in case circuits with greater power consumption are applied.DS520 enables immobiliser function thanks to use of iButtons as described in chapter5.

USB interface

USB interface enables device configuration and firmware upgrades. It allows monitoring real time values of measured data, using dedicated PC software.

2.7 Power supply from internal battery (only DS520B)

Battery

The device is equipped with internal 320mAh LiPo battery and integrated charging and protection circuits. The battery allows the device to operate in emergency conditions when power supply is lost.

Power saving modes for battery operation

Different power saving modes can be configured for both operation with power supply and operation without power supply (from internal battery). It allows the device to operate in "normal" power saving mode when power supply is present and to go in "deepsleep" mode automatically when power supply is lost.

Consequently, when power supply is present, no GPS localisation delay and high GPS trace accuracy are maintained. When power supply is lost and the device is powered from internal battery, maximum power saving is achieved and greater battery operation time is reached.

Report generation criteria for device operation with battery

Report generation criteria described in section 3.1. are configured separately for operation in different conditions. Two sets of report generation criteria refer to DS520 (without battery): for roaming and home network. For DS520B (with battery) these 2 sets are valid for operation with power supply.
Moreover, 2 additional sets can be configured: for operation from internal battery (without power supply) in home network and for operation from internal battery (without power supply) in roaming network.
Separate settings for operation with and without power supply allows maximising battery operation time at a cost of trace accuracy.

Internal battery device operation time

Device operation time when powered from internal battery depends on several factors. Generally, the internal battery allows the device to operate in emergency only. It is designed to uphold device operation in order to enable sending information of power supply loss to the server. Such information mostly means sabotage to tracker circuit. Battery allows the device to send approx. 30 transmissions. While keeping full tracker functionality, the device operation time is several dozens of minutes.. When power saving modes are used and report generation criteria are power-saving optimised it allows reaching 24h of device battery operation in standby mode.

Server events and data concerning battery operation

DS520B device sends some information concerning battery to the server. Battery charge level (in percent) and information about battery charging are sent. Every change of power supply (from external power to internal battery and vice versa) generates a report that is immediately sent to the server (point 3.2.5). If external power supply is present, every start and finish of battery charging process also generates a report. If the device is in deepsleep mode, these events wake up the device in order to send these reports to the server.

3. Data transmission to the server

Basic unit of data is so called "report", which is a record of data with GPS position of the vehicle and additional data. Reports can be sent individually to the server (one record per one transmission) or can be packed into packets containing several reports; one packet is sent with one transmission.
Every packet contains all data which have been acquired by the device.
Data from analogue and/or digital inputs, iButton identifiers and/or temperature sensor serial numbers that are supposed to be transmitted by the device are set in configuration programmer – parameters which name consists of two parts: curly braces with data identifier and designation staring with “Sending …”, e.g. {C10} Sending authorised iButton ID.
If the device is configured to send data which are not available in the vehicle, the device:
- does not send these data at all (recommended setting - the length of report is variable, depending on data availability in different vehicles),
- sends reports with special data value that means "data not valid/data not present", e.g. 2^8-1, 2^{16}-1, 2^{32}-1. This setting guarantees fixed length of the report however it is not recommended.

3.1 Basic criteria for report generation (time-angle-distance)

The device generates the report if any of basic report generation criteria is met:
- distance travelled since last report is greater than configured threshold (default 250m),
- vehicle heading angle since last report is changed more than configured threshold (default 25°),
- time from last report is greater than configured threshold (default 60s/300s).

Time is configured separately for ignition ON (DRIVE) and ignition OFF (PARKING) states. The configured time criteria for report generation are the timeouts of data transmission to the server.
Default settings are as below:
- distance 250m,
- angle 25°,
- 60 seconds (ignition ON),
- 300 seconds (ignition OFF).

For default settings, packet generation and its transmission to the server appears every minute when ignition is ON or every 5 minutes when ignition is OFF.
In case angle, distance (or other) criteria have appeared more frequently than time criterion, one packet contains several reports. Otherwise, one packet (one transmission to the server) contains one report.
The criteria described above (distance/angle/time when IGN ON/time when IGN OFF) are configured separately for 2 roaming situations:
- local network (no roaming),
- roaming – the device is outside the local network.

3.2 Additional reports generation and transmission when special events appear

Apart from report generation due to meeting basic criteria: time-angle-distance, the device generates and transmits reports when special events appear.
Depending on the event and the configuration the device:
- generates a report –exact moment (time) the event has appeared is stored but the report is sent to the server with the nearest data packet transmission (transmission timeout refers to section 4.1).
- generates a report and transmits data to the server immediately – exact moment (time) the event has appeared is stored and the server is informed about the event at once.

3.2.1 Reports generated by change of ignition state

The change of ignition state can be configured to generate a report or to generate a report and force its immediate transmission (and other reports waiting for transmission) to the server. By default it is recommended to generate and transmit the report immediately when the change of ignition state appears.

3.2.2 Reports generated by change of digital inputs

The digital inputs can be configured independently in that way that their state changes(when input signal appears or disappears) force the device to generate a report so that exact moment (time) of input state change is stored. Events of input signal detection or loss can be configured to force immediate event data transmission to the server which is essential when the input is used as a PANICK/ATTACK/HIJACK button.
By default both report generation options for digital input are disabled. It is **advised neither** to generate reports **nor** to force immediate transmission for change of digital inputs state. The only exception is when the digital input is used as a PANIC/ATTACK/HIJACK button handled by the server. In such case when report generation and immediate transmission is enabled, the report on triggering that input is immediately sent to the server.

3.2.3 Reports generated by iButton identifiers

The device can be configured (separately) to transmit authorised iButton identifiers. According to the selected iButton scenario (chapter 5) the authorised iButtons are listed and saved in the device. If the device has been configured to enable transmission of iButton identifiers, touching iButton against the reader generates a report.
It is worth mentioning that due to their specific role in the system (driver's identification) iButton identifiers are remembered and stored until ignition is switched off for at least 30 seconds.
If ignition is switched on in up to 30 seconds after the iButton was touched against the reader, the iButton ID will be sent to the server constantly until ignition is switched off. When other iButton is touched against the reader a new report is generated and a new ID is saved. Turning ignition off for more than 30 seconds causes that iButton ID is removed from iButton memory and not sent to the server any more. This solution applies when iButton is used for driver's identification during the

whole journey. In iButton handling scenarios number 3 and 4, the 30 seconds delay is changed to 10 seconds. End of authorisation generates report without iButton ID and triggers immediate transmission.

3.2.4 Reports concerning internal battery (DS520B only)

Device with internal battery (DS520B) generates additional reports with every change of power supply (from external power to internal battery and vice versa). Moreover, if external power supply is present, every start and finish of battery charging process generates additional report. The reports generated by battery events are immediately sent to the server. If the device is in deepsleep mode, these events wake up the device in order to send these reports to the server.

3.2.5 Time cut-off between transmissions when special events appear

Regardless of whether ignition is switched on or off, in the case of the following events:
- change of the digital input (unless immediate data transmission is enabled),

transmission time is configured same as when ignition is on, i.e. shorter one from two preprogrammed periods of time is enabled. As a result, a packet of reports describing the sequence of e.g. opening and closing next doors of the vehicle is transmitted to the server no later than after 60 seconds, instead of 5 minutes delay as for the state when ignition is off. This solution reduces server connection timeout to a reasonable value when waiting for significant events data, with no need for immediate transmission (which would increase data transfer). On request the manufacturer may switch this function off.

4. Installation procedure

General

- The installer must fulfil all the general requirements concerning safety at work during car service procedures.

- Before installing DS520 the negative terminal of the battery must be disconnected. If for some reasons disconnecting the battery is impossible, during the installation the cable loom must be disconnected from the device.

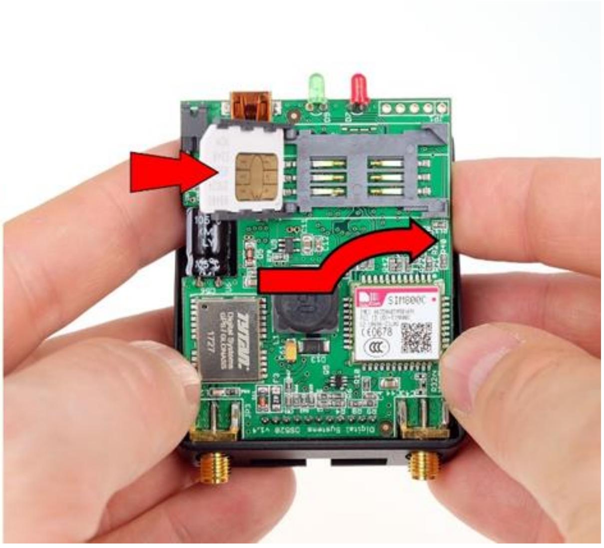
- The sections4.1-4.4 present all the operations necessary to install Tytan®SAT DS520device in the vehicle: mounting the SIM card in DS520, installation of DS520 unit in the vehicle, installation of GSM antenna, installation of GPS/GLONASS antenna. Verification of device operation is described in the following chapters.

4.1 Installation/changing of SIM card in DS520

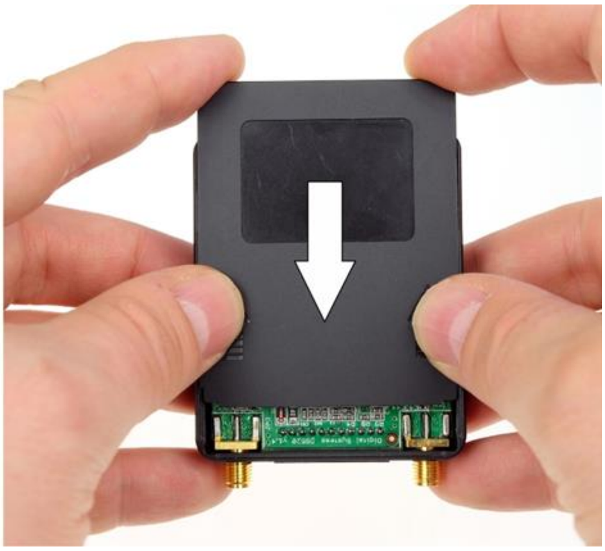
Before installation of DS520 device in the vehicle, it must be checked if SIM card provided by GSM operator is installed in the device.

In order to install or change SIM card:
- touch metal antenna connector in order to discharge the possible electrostatic voltage,
- slightly press and shift lower lid of the device case in the direction showed by the arrow,
- remove the lower lid of the case,

- shift SIM card holder in the direction marked by the "OPEN >" sign,
- open the SIM card holder,
- insert SIM card as shown in the picture,

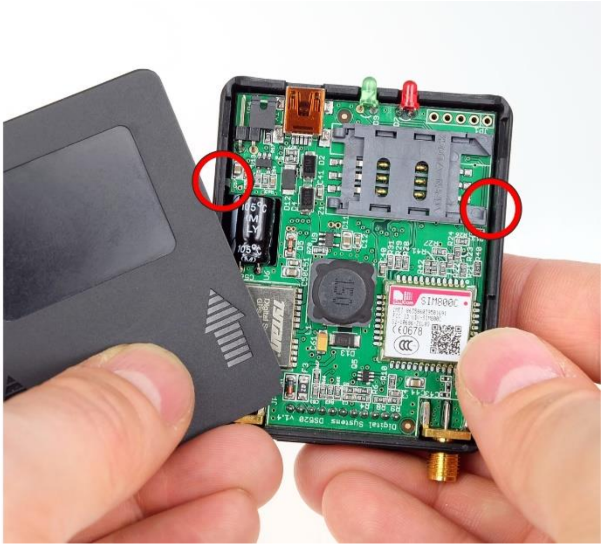
- close the SIM card holder,
- shift the SIM card holder in the direction marked by the "<LOCK" sign,
- place the lower lid back on the case. Check if guiding pins enter recessed tunnels of the case,
- shift the lower lid in the direction opposite to the arrow on the lid. The lid should click.

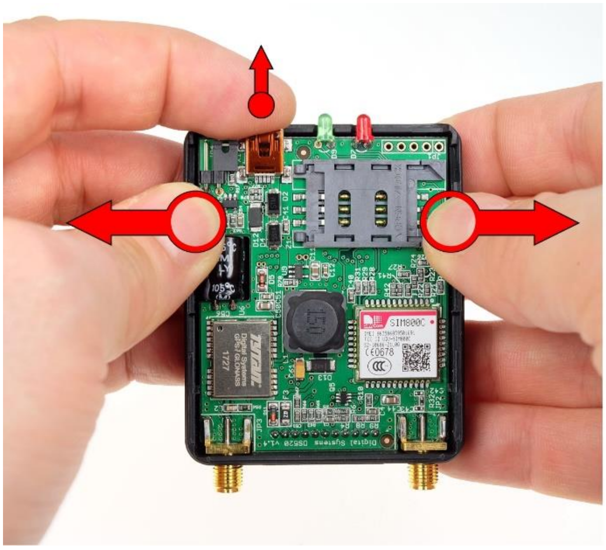
4.2 Connection/disconnection of internal battery (DS520B only)

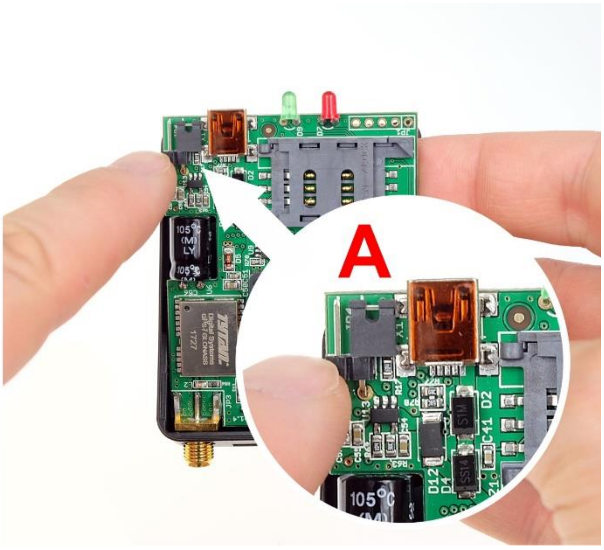
DS520B is equipped with internal battery to maintain device operation when power supply is lost. Battery circuit has a jumper that connects and breaks battery circuit.
For transport purposes, battery is disconnected from the tracker.
During installation the battery must be connected to the device by use of the jumper.

In order to connect or disconnect the battery from the device:
- touch metal antenna connector in order to discharge the possible electrostatic voltage,
- slightly press and shift lower lid of the device case in the direction showed by the arrow,
- remove the lower lid of the case,
- press the hooks on the sides of circuit board (marked in the photo with red circles),

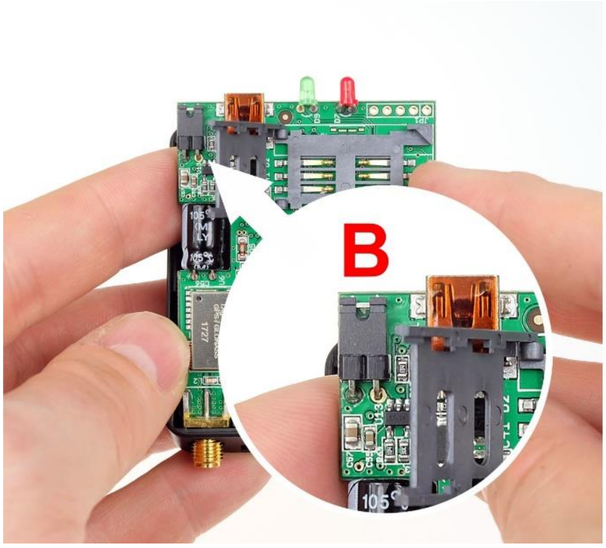


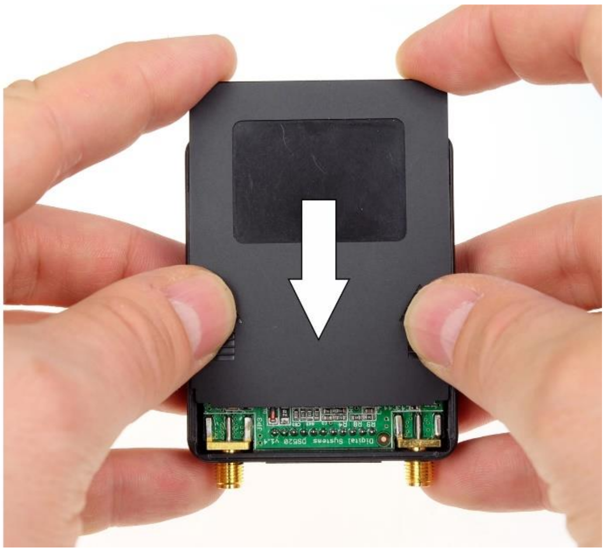
- slightly pull the circuit board from the case e.g. using USB connector (do not pull the circuit board LEDs!). The goldpin connector with the jumper should be above the case edge.





- move the jumper to position A (battery disconnected) or position B (battery connected),
- press the circuit board to its place in the case. Make sure the hooks clicked.

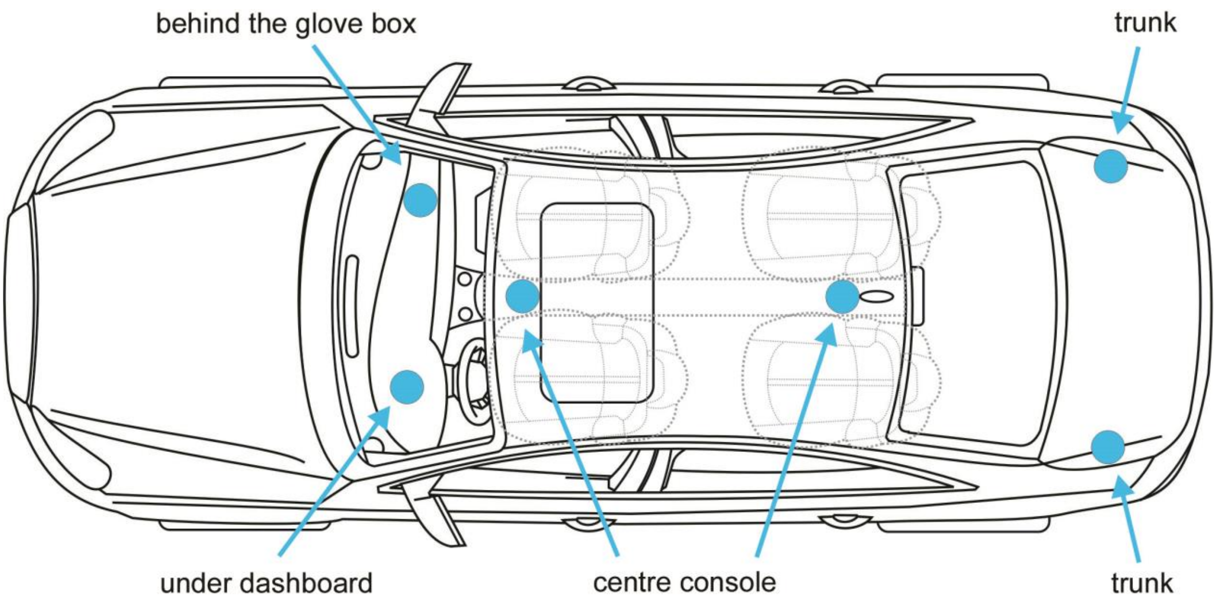




- place the lower lid back on the case. Check if guiding pins enter recessed tunnels of the case,
- shift the lower lid in the direction opposite to the arrow on the lid. The lid should click.

4.3 Mounting of DS520 unit in the vehicle

- It is advised to mount the unit inside the vehicle, in a well-hidden place, not accessible for the unauthorised person, e.g. under dashboard, behind the glove box, in the front or rear centre console, in the trunk etc.



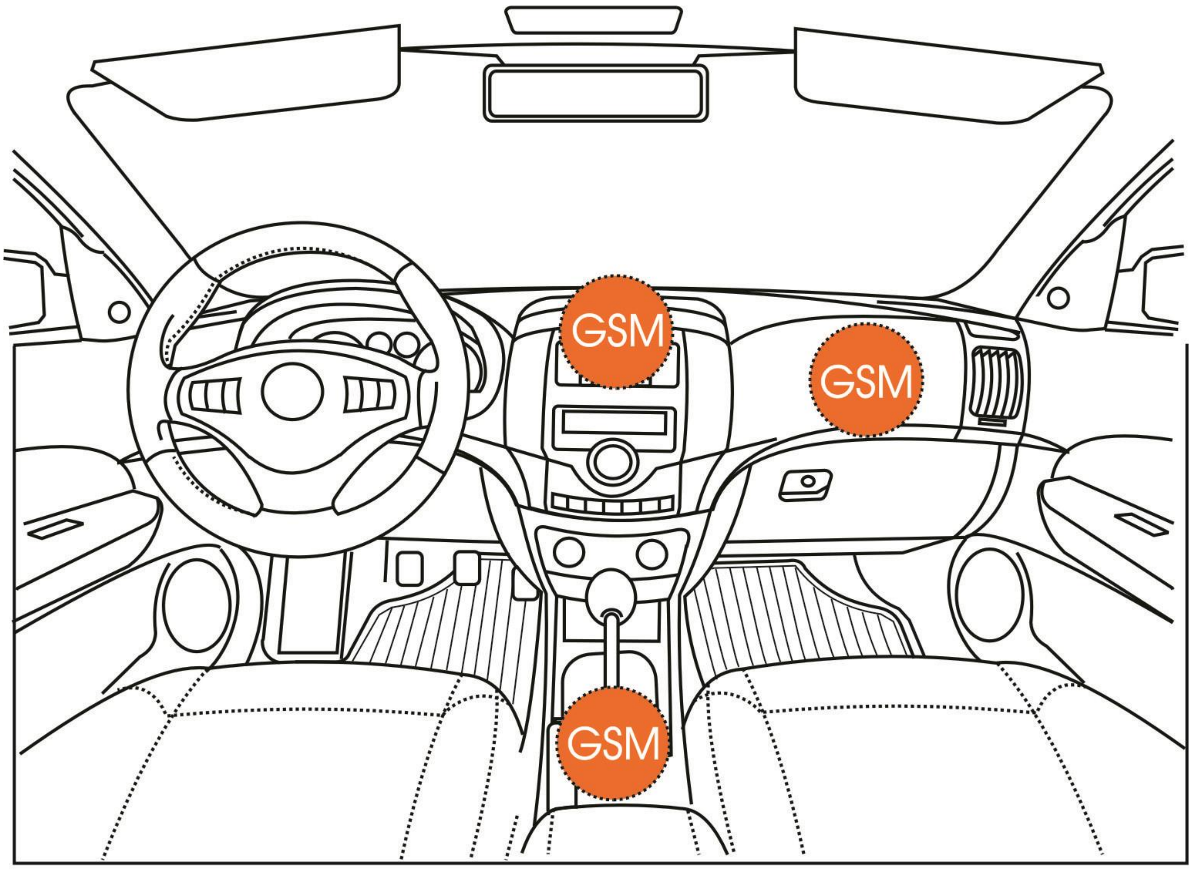
- The device must not be exposed to contact with water, petrol, grease, oil, and other chemical substances.
- The device is not waterproof.
- Due to external GSM and GPS/GLONASS antennas, the mounting place of DS520 unit is not restricted by the radio frequency transmission properties: it can be mounted behind the metal shielding objects in the vehicle.
- If the internal vibration and vehicle motion sensor is used, **<u>DS520 unit must be rigidly assembled to the vehicle</u>**: inner part of the dashboard, body, bracket. **<u>It cannot be assembled to elastic cable looms, moving elements or elastic ventilation ducts</u>**.
- Consider the limitation of main cable loom connection and GPS/GLONASS and GSM antenna cables when choosing the mount localisation.
- After choosing the mount localisation and performing the installation, please do not assemble back the disassembled vehicle parts, until the device is tested.

4.4 Mounting of GSM antenna

- The device is equipped with a stripe self-adhesive GSM antenna:

- The GSM antenna can be glued to the de-greased surface with its own self-adhesive tape.
- The GSM antenna should be installed inside the vehicle and should not be visible by any unauthorised person.
- The GSM antenna must not be covered by any metal elements of the dashboard. It must not be glued to the metal elements of the vehicle.

- It is advised to mount the GSM antenna e.g. to the internal part of dashboard or centre console, far from the metal brackets. Due to GSM signal strength, the mounting place selection does not influence its performance much.

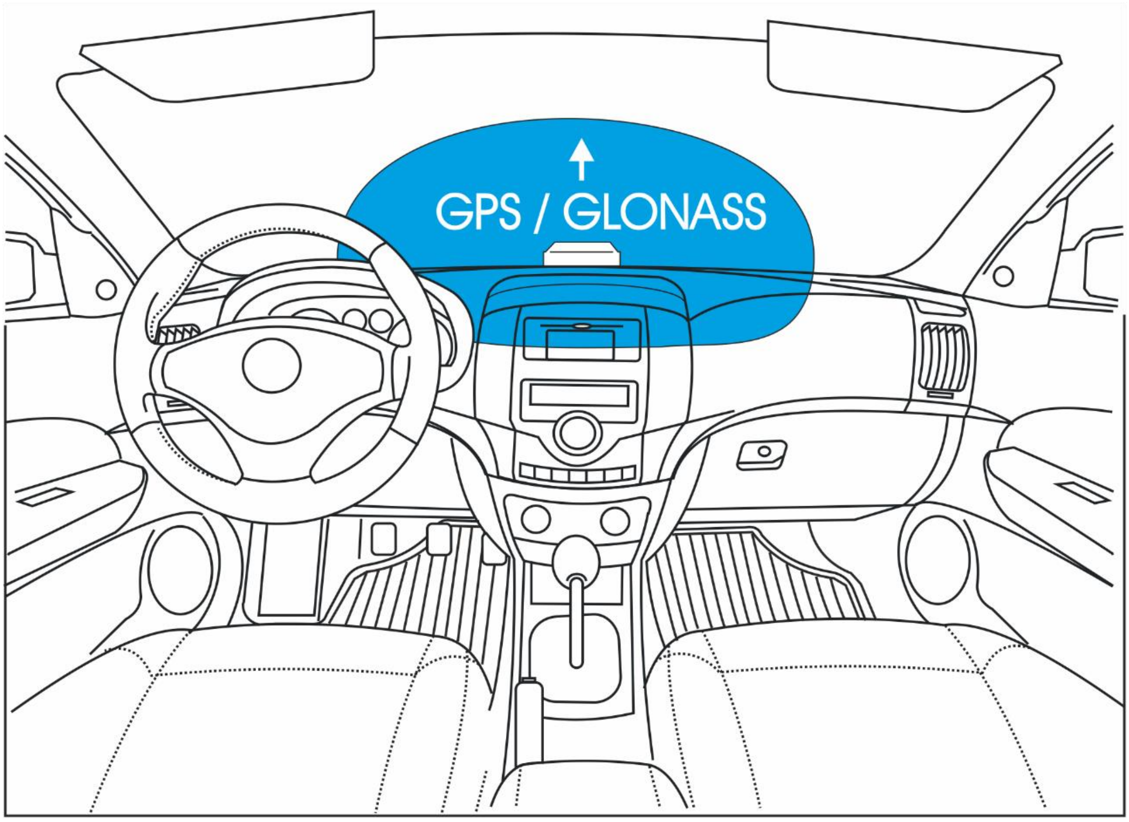


- The GSM antenna cable must be laid and secured using cable ties or isolation tape.
- The GSM antenna cable must be connected by the nut to the "GSM" marked metal connector of DS520 unit.

4.5 Mounting of GPS/GLONASS antenna

- The device is equipped with an active GPS/GLONASS antenna shown in the pictures below:

- The GPS/GLONASS antenna must be installed horizontally (as much as possible) with its top part facing the sky. The upper halfsphere over the antenna must not be covered with metal elements.
- It is advised to install the GPS/GLONASS antenna in the middle of the dashboard, to have the windshield in the sphere above the antenna.



- The GPS/GLONASS antenna must not be installed near the windscreen pillars as they can limit the accuracy or disturb GPS/GLONASS location when GPS/GLONASS signal level becomes low.
- The GPS/GLONASS antenna may be mounted with its magnet in the lower part to the metal elements of the vehicle.
- The GPS/GLONASS antenna cable must be laid and secured using cable ties or isolation tape.
- The GPS/GLONASS antenna cable must be connected by the nut to the "GPS" marked metal connector of DS520 unit.

5. Driver's identification/immobiliser function

5.1 Driver's identification via iButtons (DS1990A)

DS520 allows driver's identification via DS1990A iButtons. Connecting iButton reader to DS520 is shown in section 6.3. Instead of DS1990A iButtons also RFID readers equipped with 1-wire interface can be alternatively connected to DS520.
Driver's identification is accomplished according to the one of 4 scenarios of iButton operation.

5.1.1 Scenario no.1 - authorisation by any iButton

Every iButton DS1990A is treated as a key that authorises the driver and can authorise immobiliser function. iButton ID is sent to the server. After touching the iButton against the reader, its ID is stored as long as ignition is switched on and for 30 seconds from switching ignition off. This enables driver's identification before starting the vehicle, driver's ID is stored for the whole journey. The scenario is oriented for identification of drivers on the server side.

5.1.2 Scenario no.2 - authorisation only by authorised iButton

Only iButton which serial number (ID) is stored in the list saved in DS520 is treated as a key that authorises the driver and can authorise immobiliser function. iButton ID is then sent to the server. The list of up to 500 authorised iButtons can be programmed in DS520. After touching the iButton against the reader, the device verifies if the iButton is listed (in other words – if it is an authorised iButton). After touching the authorised iButton, its ID is stored as long as ignition is switched on and for 30 seconds from switching ignition off. This enables driver's identification before starting the vehicle, driver's ID is stored for the whole journey. DS520 programmer has tools to add iButton serial numbers to the list automatically. Moreover, when ignition is switched off, touching the unauthorised iButton against the reader "deletes" authorisation. For safety reasons touching iButton while driving does not delete authorisation. The scenario is oriented for immobiliser function – preventing unauthorised person from starting the vehicle, even if the DS520 is not connected to the server.

5.1.3 Scenario no.3 - authorisation by any iButton / ID sent only if iButton is in the reader

The iButton scenario no.3 is similar to the scenario no.1; every iButton is treated as authorised. The difference is that the iButton is not stored for the time the ignition is on – the authorisation ends 10 seconds after the iButton is taken out of the reader. The scenario is oriented for iButton readers that latch or hold the iButton in the reader and the iButtons mechanically attached to the driver. If the iButton is taken out from the reader, even during drive, it is signalled immediately to the server. WARNING! If the iButton is taken out of the reader while the ignition is on, the vehicle is not stopped. The vehicle will be immobilised after the ignition is switched off and on again.

5.1.4 Scenario no.4 - authorisation only by authorised iButton / ID sent only if iButton is in the reader

The iButton scenario no.4 is similar to the scenario no.2; only iButton from the list is treated as authorised. The difference is that the iButton is not stored for the time the ignition is on – the authorisation ends 10 seconds after the iButton is taken out of the reader. The scenario is oriented for immobiliser function – preventing unauthorised person from starting the vehicle, when iButton readers that latch or hold the iButton are used and the iButtons are mechanically attached to the driver. If the iButton is taken out from the reader, even during drive, it is signalled immediately to the server. WARNING! If the iButton is taken out of the reader while the ignition is on, the vehicle is not stopped. The vehicle will be immobilised after the ignition is switched off and on again.

5.1.5 Data transmission to the server

iButton serial number is transmitted to the server as [C10] data as long as the iButton is stored in DS520 memory according to the rules described for both scenarios (generally speaking: for the whole time when ignition is switched on and up to 30 seconds from switching ignition off). Data are transmitted to the server as described in point 3.2.3.

5.2 Immobiliser function – engine locking system

DS520 has immobiliser function that prevents vehicle engine from running unless authorised iButton DS1990A is touched against the reader. According to the selected scenario, immobiliser function is authorised by any iButton or only by iButton from the list. In order to immobilise the engine a relay with normally open contacts (NC – contacts 30 and 87a) should be used acc. to the wiring diagram shown in point 6.3.2. The relay is normally closed in de-energized state and permits engine operation. The relay is controlled by DS520 output if ignition is switched on, when immobiliser is not authorised. Then the relay contacts are normally opened and as a result the vehicle cannot be started. When ignition is switched on, the function does not allow to immobilise the vehicle.
In order to use the immobiliser function please follow the below steps:
- select one of iButton scenarios,
- program one of DS520 outputs in *immobiliser relay* mode,
- connect the immobiliser relay according to wiring diagram shown in point 6.3.2 (for output OUT0),
- program other DS520 output in *immobiliser buzzer* mode for sound signalisation,
- connect buzzer or LED according to wiring diagram shown in point 6.3.2 (for output OUT1).

Immobiliser operates regardless of whether transmission of authorised iButton serial numbers have been disabled in the programmer or not.

WARNING!
Please use a relay adapted to vehicle power supply voltage - this is essential for 24V vehicles! –and also adapted to the current flowing in the vehicle immobilised circuit.

5.2.1 Use of immobiliser function for iButton scenario no.1 and no.3

Immobiliser function for iButton scenario no.1 and no.3 is used only to "force" the driver to use **any** iButton before driving starts - no matter whether the iButton is listed or not, only when the iButton is touched against the reader DS520 will enable the vehicle start. As a result, before every journey the iButton with driver's ID must be touched against the reader. The server recognizes if the vehicle start has been done by an authorised driver based on the iButton ID, but it does not affect the possibility of the vehicle start. WARNING! For the immobiliser function with iButton scenario no.3, if the iButton is taken out of the reader while the ignition is on, the vehicle is not stopped. The vehicle will be immobilised after the ignition is switched off and on again.

5.2.2 Use of immobiliser function for iButton scenario no.2 and no.4

Immobiliser function for iButton scenario no.2 and no.4 allows the vehicle start only when the authorised iButton (programmed in DS520) is touched against the reader. It is then a classic immobiliser that prevents unauthorised persons from starting the vehicle. WARNING! For the immobiliser function with iButton scenario no.4, if the iButton is taken out of the reader while the ignition is on, the vehicle is not stopped. The vehicle will be immobilised after the ignition is switched off and on again.

5.2.3 Emergency bypass of immobiliser function to start a vehicle

In case there is neither unauthorised iButton (scenario no. 1) nor authorised iButton (scenario no.2), DS520 does not permit to start the vehicle. In such situation, there is a possibility of emergency immobiliser bypass using remote control of DS520 outputs via SMS commands or GPRS commands handling by the server cooperating with DS520.

In order to bypass immobiliser function please follow the below steps:
- Switch on ignition. With long beepDS520 signals that the immobiliser has not been authorised (if buzzer has been enabled). The immobiliser relay is enabled - the vehicle start is not possible.
- In order **to disable output OUT0** send SMS command to DS520 or send GPRS command from the server to DS520. The immobiliser relay is disabled - the vehicle can be started.
WARNING! Switching ignition off and on again causes re-immobilisation of the vehicle and requires immobiliser function bypass procedure to be repeated.

5.3 Sound signalisation of iButton/immobiliser operation

Touching iButton against the reader and immobiliser operation can be signaled by buzzer or LED connected to DS520 second output - according to wiring diagram shown in point 6.3.2 (for output OUT1). The output has to be programmed in *immobiliser buzzer* mode.

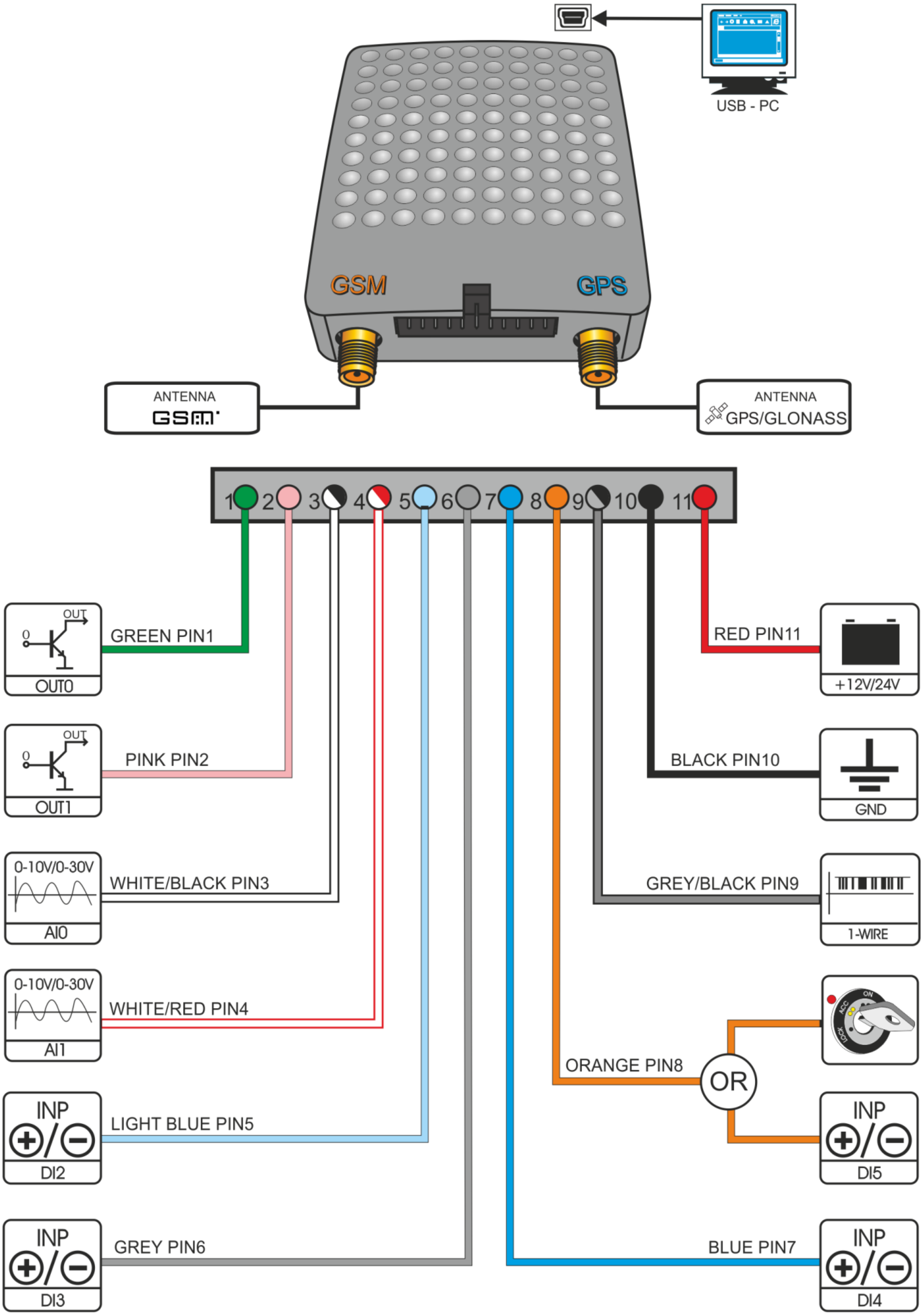
Signalisation of immobiliser operation and iButton readout:

Short buzzer sound (short LED flash)	- touching iButton (any iButton in scenario no. 1 or only authorised iButton in scenario no. 2) against the reader to authorise the immobiliser, - switching ignition on when the immobiliser is authorised properly.
Long buzzer sound (long LED flash)	- only scenario no.2: touching unauthorised iButton (not listed nor programmed in DS520) against the reader which does not authorise the immobiliser, - switching ignition on when the immobiliser is not authorised.

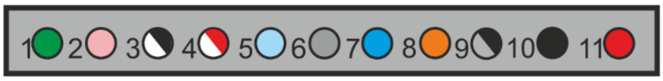
WARNING!
Please use a buzzer adapted to vehicle power supply voltage. When LED is connected, please use an appropriate LED current-limiting resistor. This is essential for 24V vehicles!

6. DS520 connection diagrams

6.1 General diagram



6.2 DS520 diagram connector description

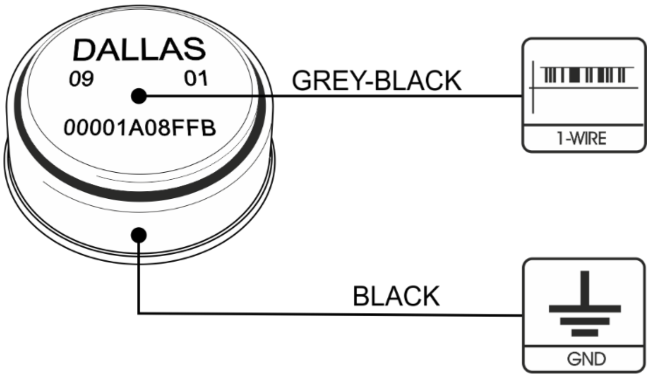


.	Line name	Comment	I/O	Line parameters
1	Digital output OUT0	Programmable digital output: - GPRS commands control - SMS commands control - independent function of immobiliser –NC immobiliser relay control		Output switched to ground via smart power solid state relay with overcurrent protection. Maximum current: I_{max} = 1.7A Maximum voltage: U_{max} = 40V Maximum resistance: R_{max} = 250mΩ
2	Digital output OUT1	Programmable digital output : - GPRS commands control - SMS commands control - buzzer control to confirm iButton readouts		
3	Analogue input AI0	Analogue inputs for measurement purposes with range selection 0-10V/0-30V. Non-polarized, high impedance inputs. Non-linear averaging filtration 10-120seconds. Peak voltage detector.	I	Voltage: 0V < U_{in}< 40V Measuring range: 0-10V/0-30V Impedance: R_{in} = 100/85kΩ
4	Analogue input AI1			
5	Digital input DI2	Digital inputs, polarized for ½ power supply voltage (simultaneous pull-up and pull-down). Positive signal detection (U_{in}>$^2/_3$ U_{POWER_SUPPLY}) Ground signal detection (U_{in}<$^1/_3$ U_{POWER_SUPPLY})	I	Voltage: 0V < U_{in}< 40V, Polarization to 1/2 power supply voltage $R_{pull-up}$ = 47kΩ $R_{pull-down}$ = 47kΩ
6	Digital input DI3			
7	Digital input DI4			
8	Digital input DI5	Digital inputs, polarized for ½ power supply voltage (simultaneous pull-up and pull-down). Positive signal detection (U_{in}>$^2/_3$ U_{POWER_SUPPLY}) Ground signal detection (U_{in}<$^1/_3$ U_{POWER_SUPPLY}) Recommended function: ignition signal input.	I	Voltage: 0V < U_{in}< 40V, Polarization to 1/2 power supply voltage $R_{pull-up}$ = 47kΩ $R_{pull-down}$ = 47kΩ
9	1-wire bus – signal	Overvoltage and overcurrent protected signal wire, adapted to 1-wire bus high current polarisation required for 2-wire connection of DS18B20 temperature sensors.	I/O	Overvoltage and overcurrent protected line.
10	Ground		I	
11	Power supply	Vehicle's main power supply.	I	8V <U_{zas}<40V, I_{max}=200mA, $I_{av\ 12v}$= 33mA (with GPS/GLONASS receiver) $I_{av\ 12v}$= 18mA (with GPS/GLONASS receiver)

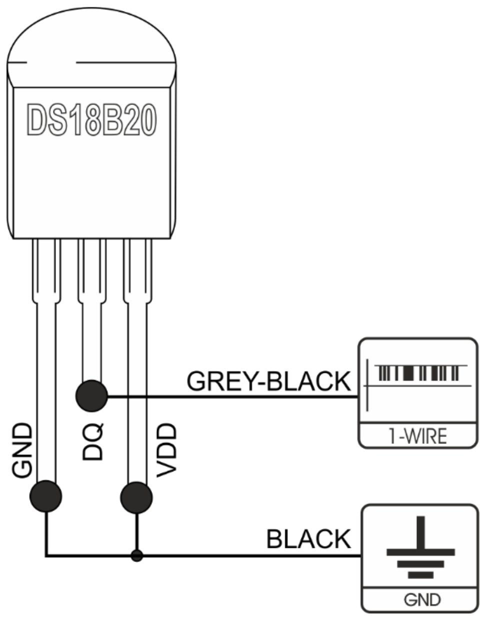
6.3 Connection of 1-wire devices/immobiliser function

DS520 allows to connect 1-wire bus devices produced by Dallas Semiconductors: iButton identifiers (e.g. DS1990A) and temperature probes produced on the basis of Dallas digital temperature sensors DS18B20.

Connection of 1-wire bus and ground cable to DS1990A iButton is shown in the below picture:



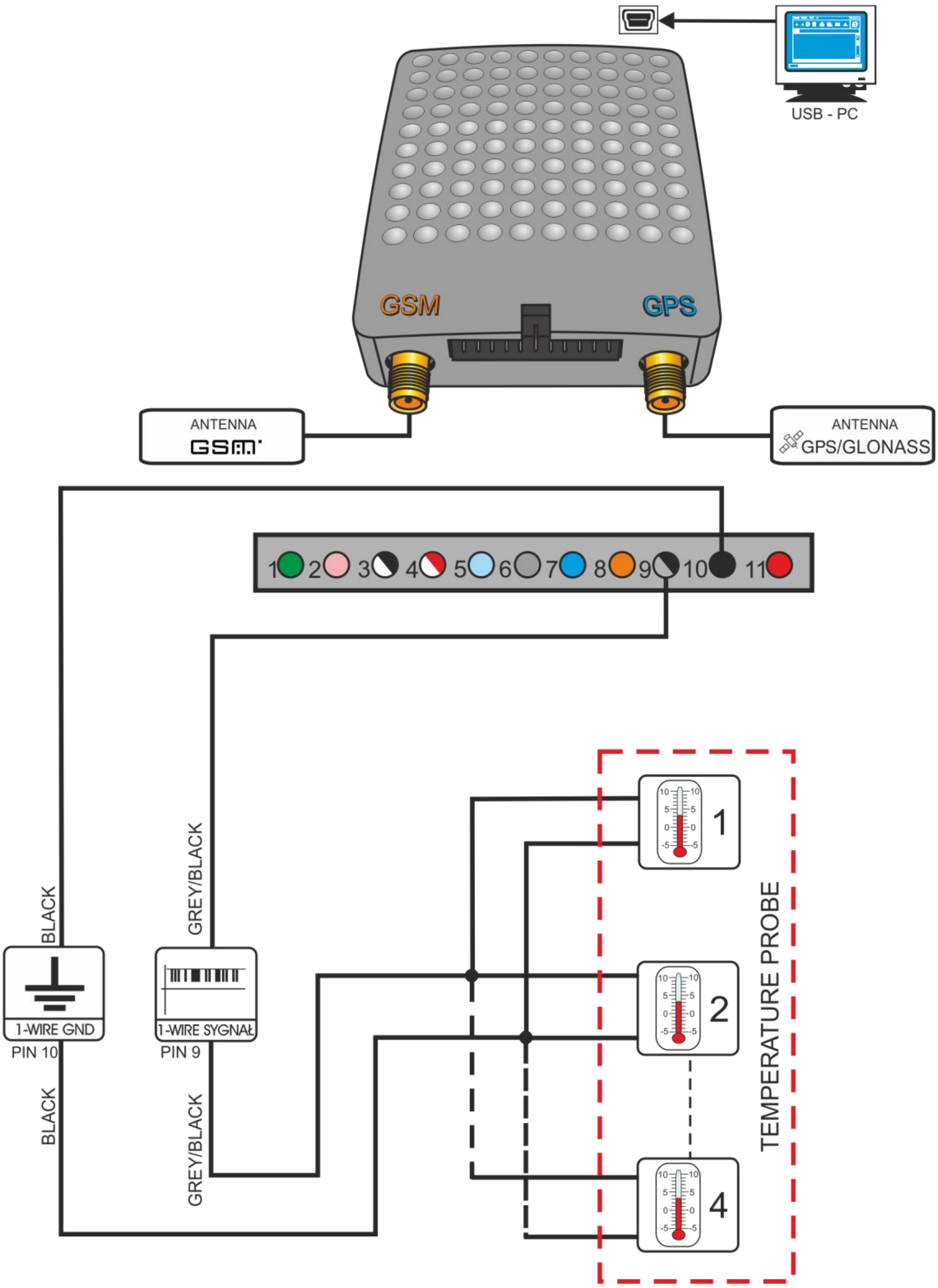
Connection of 1-wire bus and ground cable to DS18B20 temperature sensor is shown in the below picture:



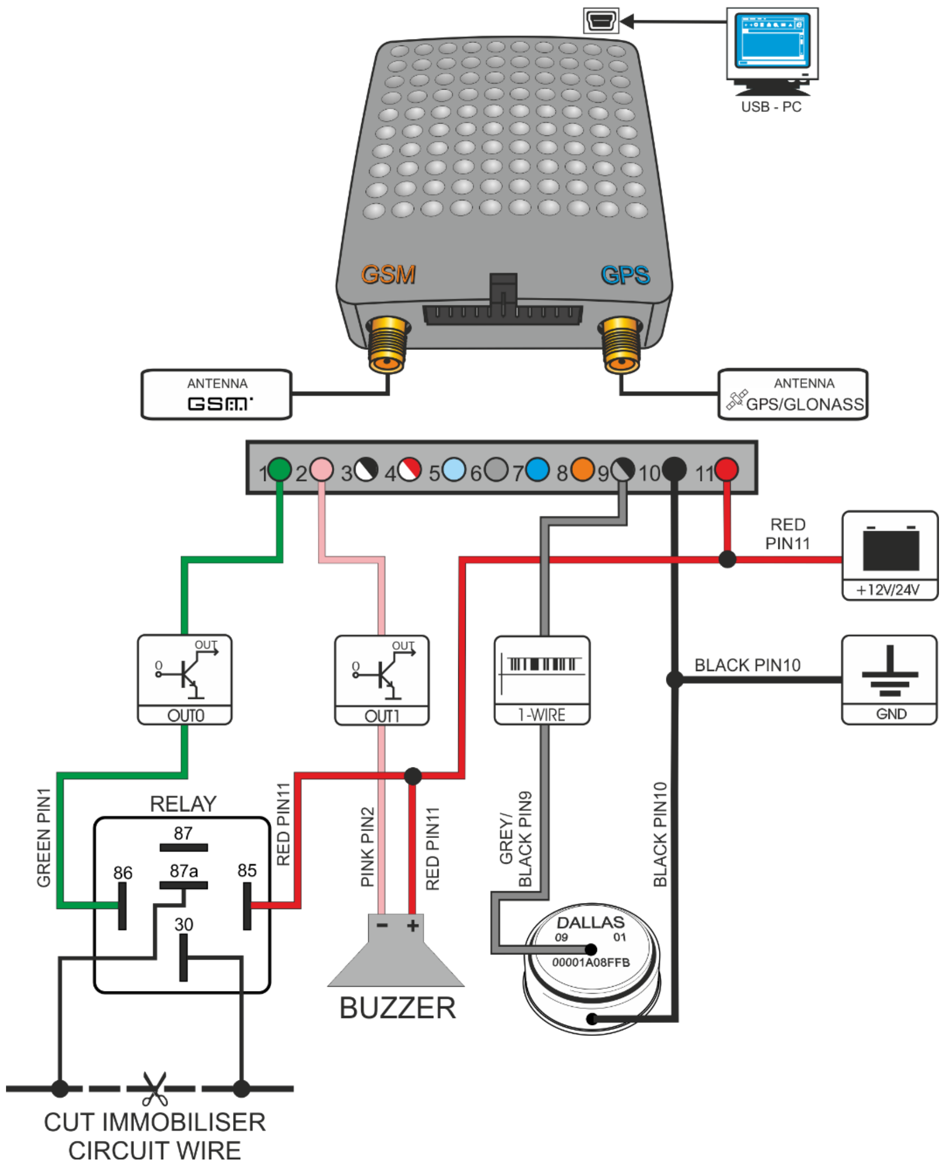
It is required to use so-called 2-wire connection – DS520 provides necessary polarity of the 1-wire line for temperature sensor proper operation.

Scenarios of iButton operation (driver's identification or immobiliser function) are described in chapter 5.
Rules of iButton ID transmission to the server is described in point 3.2.3.
Wiring diagrams of iButtons and temperature probes are shown in points 6.3.1-6.3.3.

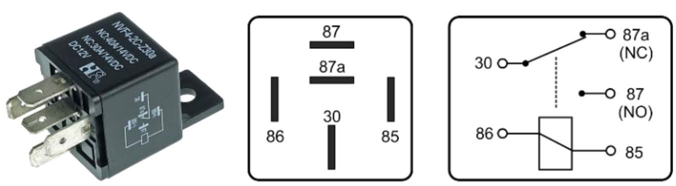
6.3.1 Connection of DS18B20 temperature sensors



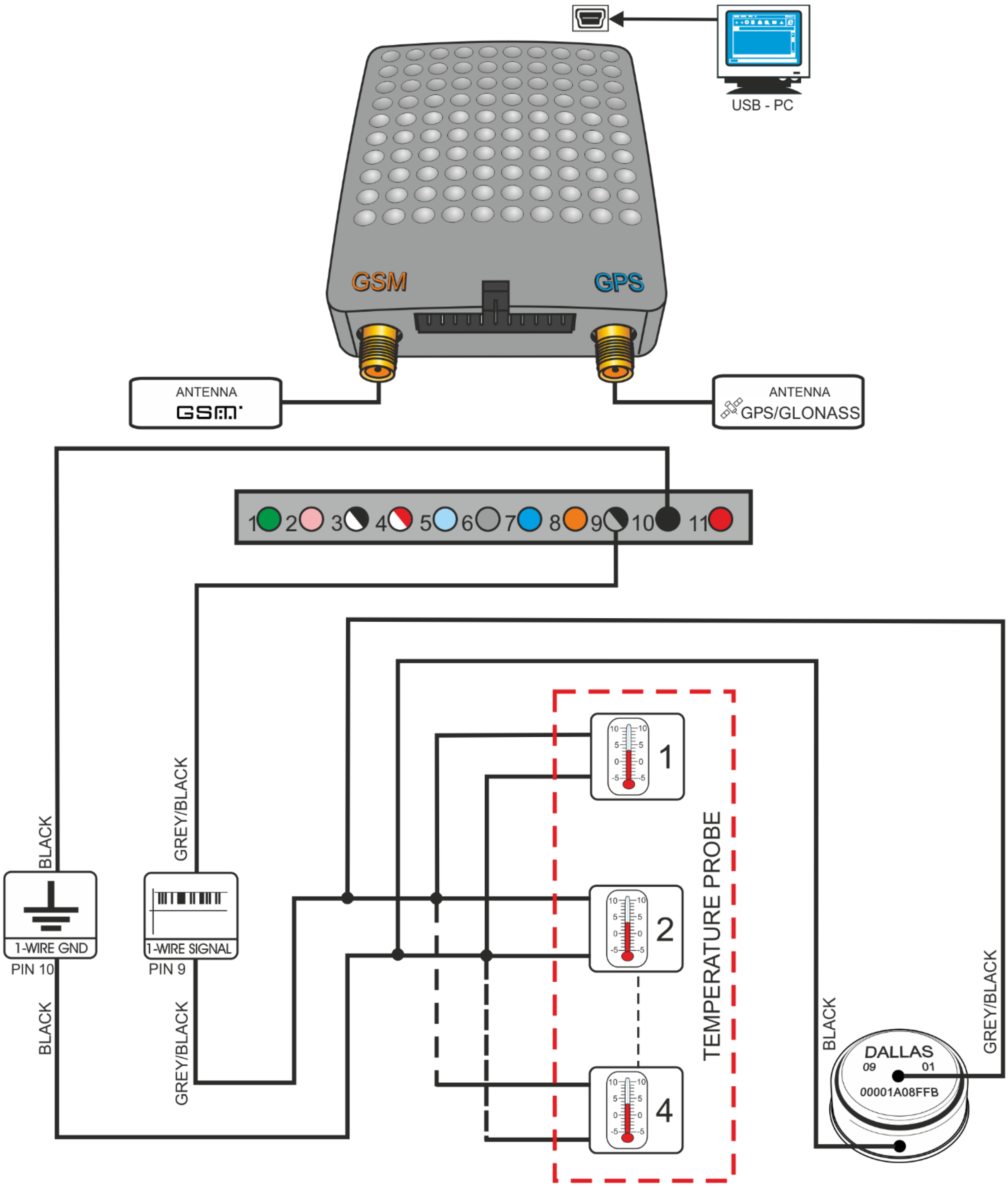
6.3.2 Connections for immobiliser operation (iButton reader, immobiliser relay, buzzer)



Description of typical relay terminals:



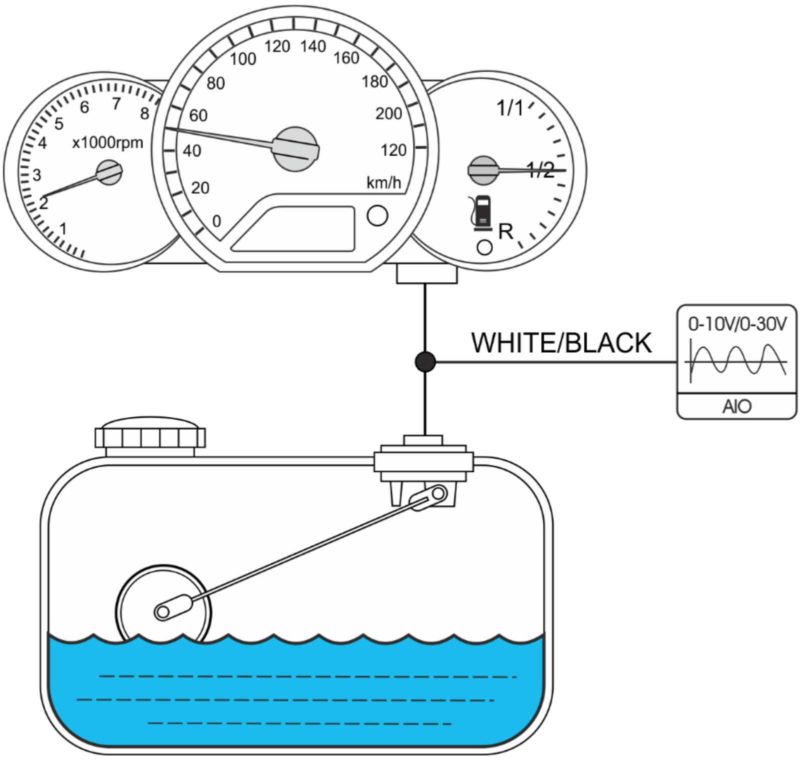
6.3.3 Connection of DS18B20 temperature sensors and iButton reader



6.4 Connection of analogue signals (voltage measurement)

6.4.1 Connection of OEM float type sensor circuit

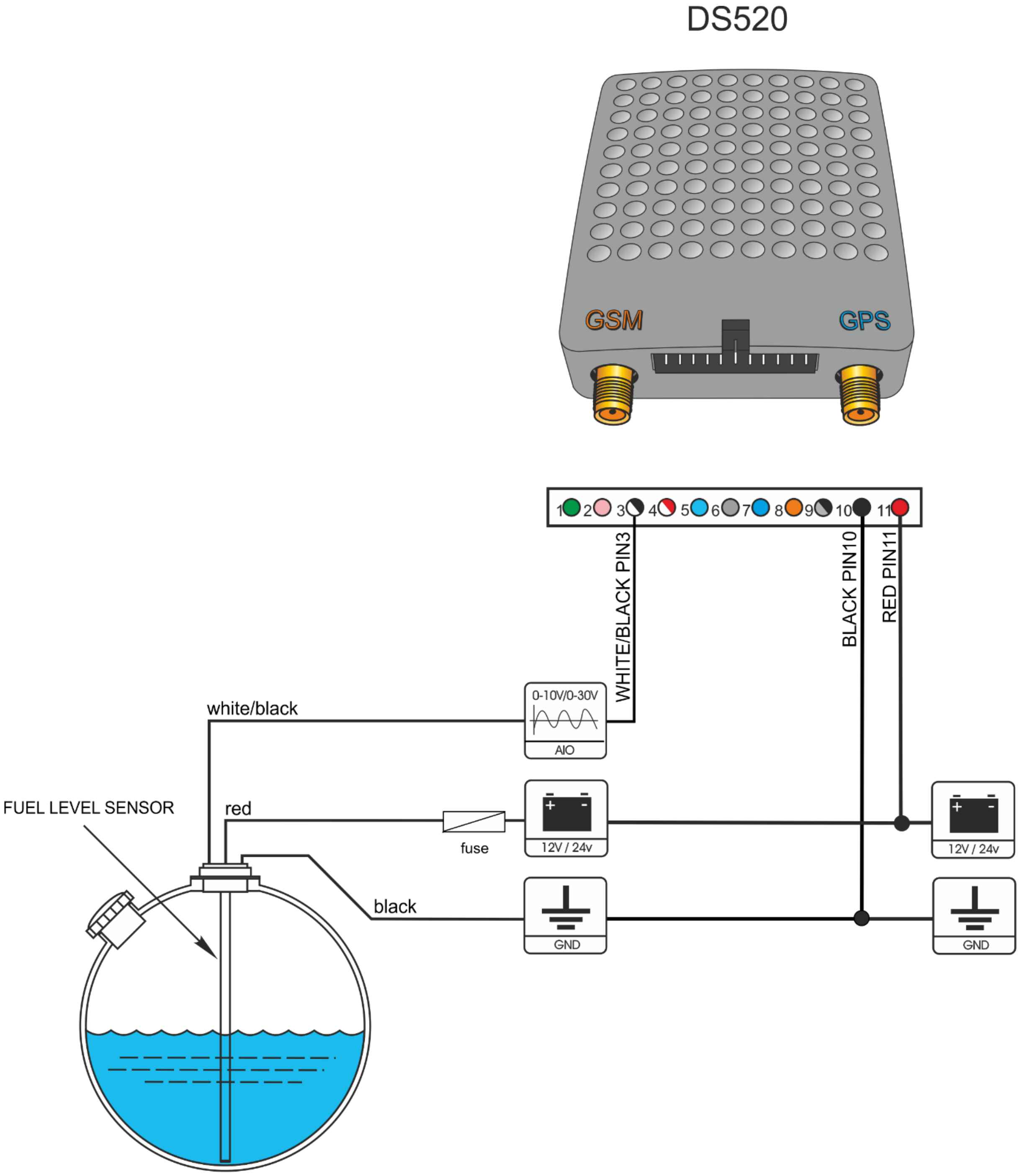
Signal from OEM float type sensor circuit has to be connected to analogue input programmed in "voltage measurement only when ignition" mode. In this mode, the voltage is sent to the server only if the ignition is on – the float type sensor is powered from vehicle installation. That prevents from sending value 0V when the ignition is off. If the float type sensor is powered when the ignition is off, “voltage measurement” mode should be selected.



The range of voltage changes concerning fuel level differs for different vehicles - most commonly it is 0-5V. If peak voltage value does not exceed 10V, the input measuring range should be set to 0-10V. If peak voltage value exceeds 10V, then voltage measuring input should be set in range 0-30V. Set signal averaging time to 180 seconds. The measured momentary and averaged voltage can be seen in the *Diagnostics* tab. If voltage during parking is not stable (jumps) or is measured with error, probably the waveform is keyed – the square wave signal can be seen on the oscilloscope connected to AIx input. In this case, the option *Peak voltage detector* has to be enabled in the input configuration window.
WARNING! Peak voltage detector can be enabled simultaneously only for one of the inputs.

6.4.2 Connection of digital fuel level sensor (FLS) with analogue output 0-10V

It is possible to connect two digital fuel level sensors with analogue output 0-10V to inputs AI0 and AI1.
Below the wiring diagram for single FLS is shown.



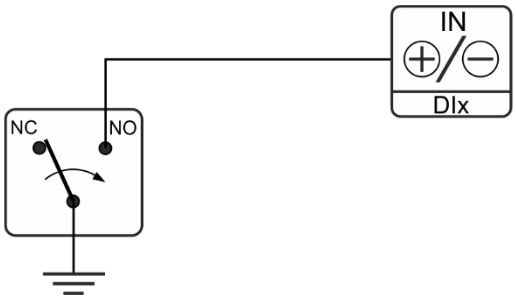
Most of the fuel level sensors on the market operate according to their own fuel level averaging algorithms. For this reason, in DS520 programmer the minimal signal averaging time has to be set to 10 seconds and peak voltage detector should not be enabled.

6.5 Connection of digital signals (On/Off)

Below the connection of On/Off digital signals' pushbuttons and switches to DS520, for 4 combinations of NO (normally open) and NC (normally closed) switches as well as the connection to ground and to power supply voltage are presented.

6.5.1 NO (normally open) pushbutton switched to ground

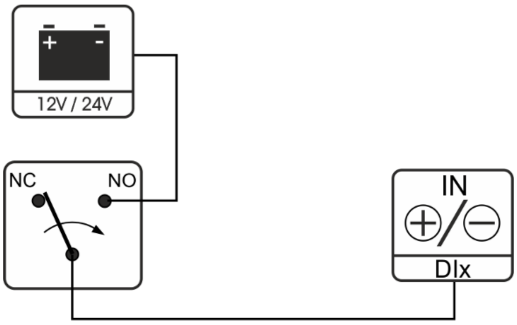
Pushbutton/switch is connected between DIx input and ground.
Set digital input operation mode „*input-*" in the configuration programmer.



Switch in rest state (disconnected):	Pressed pushbutton (connected):
- DIx input is not switched to ground, - on DIx input line there is voltage that equals to half power supply voltage (shown in *Diagnostics* tab), - in *Signal monitor* DIx input lamp does not light up, - „0" input state is transmitted to the server.	- DIx input is switched to ground, - on DIx input line there is voltage close to 0V (shown in *Diagnostics* tab), - in *Signal monitor* DIx input lamp lights up, - „1" input state is transmitted to the server.

6.5.2 NO (normally open) pushbutton switched to power supply voltage

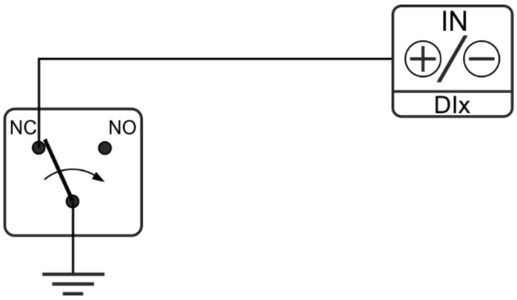
Pushbutton/switch is connected between DIx input and DS520 power supply voltage.
Set digital input operation mode „*input+*" in the configuration program.



Switch in rest state (disconnected):	Pressed pushbutton (connected):
- DIx input is not connected to power supply voltage, - on DIx input line there is voltage that equals to half power supply voltage (shown in *Diagnostics* tab), - in *Signal monitor* DIx input lamp does not light up, - „0" input state is transmitted to the server.	- DIx input is connected to power supply voltage, - on DIx input line there is voltage close to 0V (shown in *Diagnostics* tab), - in *Signal monitor* DIx input lamp lights up, - „1" input state is transmitted to the server.

6.5.3 NC (normally closed) pushbutton switched to ground

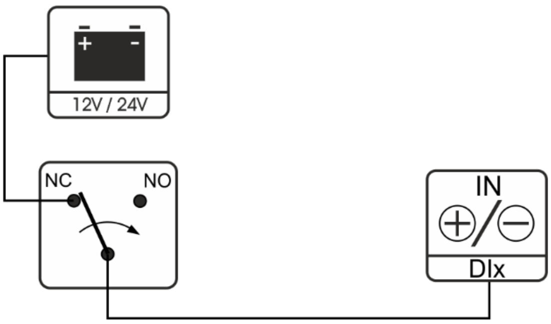
Pushbutton/switch is connected between DIx input and ground.
Set digital input operation mode „*input-*” in the configuration program.



Switch in rest state (disconnected): - DIx input is switched to ground, - on DIx input line there is voltage close to power supply voltage(shown in *Diagnostics* tab*)*, - in *Signal monitor* DIx input lamp lights up, - „1” input state is transmitted to the server.	Pressed pushbutton (connected): - DIx input is not switched to ground, - on DIx input line there is voltage that equals to half power supply voltage (shown in *Diagnostics* tab*)*, - in *Signal monitor* DIx input lamp does not light up, - „0” input state is transmitted to the server.

6.5.4 NC (normally closed) pushbutton switched to power supply voltage

Pushbutton/switch is connected between DIx digital input and power supply voltage.
Set digital input operation mode „*input+*” in the configuration program.



Switch in rest state (disconnected): - DIx input is connected to power supply voltage, - on DIx input line there is voltage close to power supply voltage (shown in *Diagnostics* tab*)*, - in *Signal monitor* DIx input lamp lights up, - „1” input state is transmitted to the server.	Pressed pushbutton (connected): - DIx input is not connected to power supply voltage, - on DIx input line there is voltage that equals to half power supply voltage (shown in *Diagnostics* tab*)*, - in *Signal monitor* DIx input lamp does not light up, - „0” input state is transmitted to the server.

WARNING! For NC switches in standby mode the input state marked with “1” is transmitted to the server. When the pushbutton is pressed the input state marked with “0” is sent. Please keep it in mind when report generation and immediate data transmission are configured for the digital input.

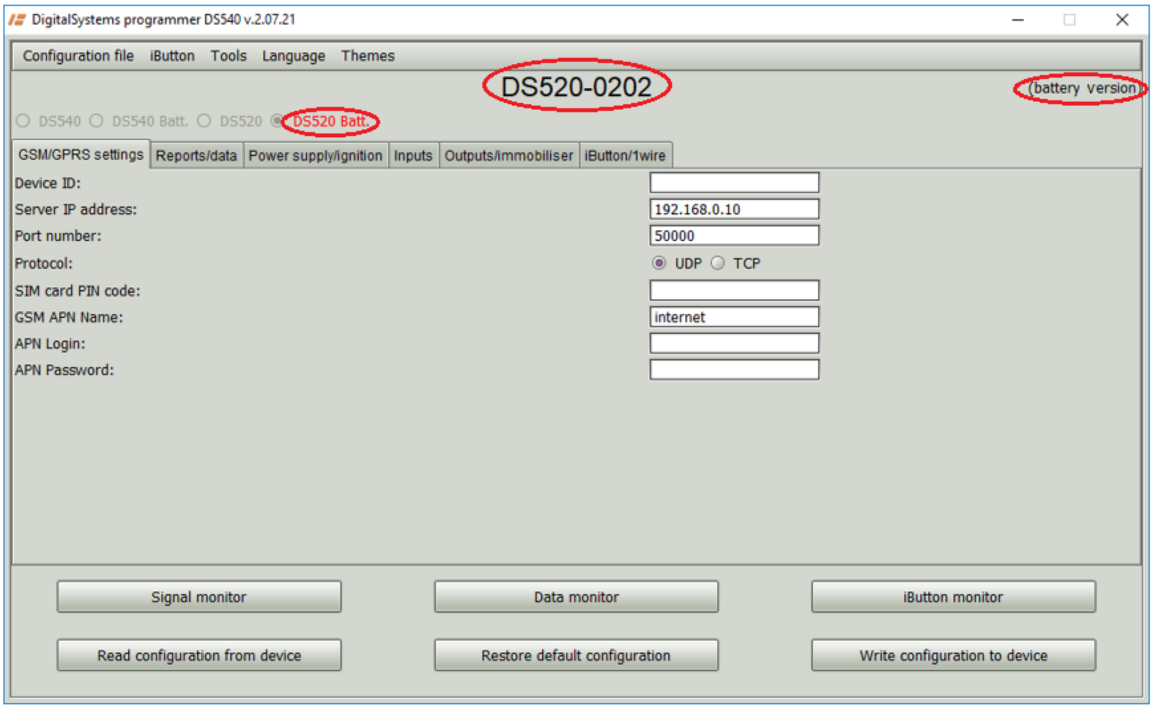
7. Software for DS520 configuration and testing

The dedicated software allows to edit configuration when DS520 device is either connected via USB cable (read and write configuration to/from the device) or not connected (read and write configuration to/from a file on computer disk).

In case DS520 is not connected, the software allows to:
- read a device configuration file *.cfg from computer disk,
- edit configuration,
- manage the list of authorised iButtons: read and write an additional iButton file, delete the list of iButtons,
- write a device configuration file *.cfg to computer disk.
- select language of the programmer: Menu→Language→,,,
- select look of the programmer: Menu→Themes→,,,

In case DS520 is connected via USB cable, the software allows to:
- read configuration fromDS520,
- write current configuration from the programmer to DS520,
- changeDS520firmware,
- force the device to reset: Menu→Tools→Device Reset
- use the built-in diagnostic tools – signal monitors and parameters read by DS520 from the vehicle.

Connection to DS520 via USB cable is signalised by displaying DS520 firmware type and version:



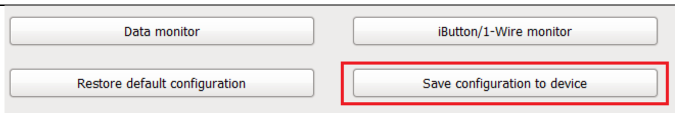
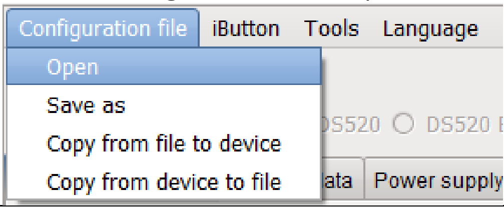
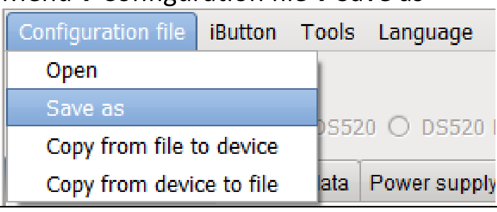
Diagnostic tools allow to verify proper device configuration, installation and operation:
- Signal monitor - displays the status of on/off signals, e.g. ignition signal,
- Data monitor - displays numeric data: power supply voltage, signal level, etc.
- 1-wire monitor - displays the list of 1-wire devices connected in a given moment.

WARNING! Particular parameters of DS520 configuration are described in chapter 8.

7.1 Configuration management

In case DS520 is not connected, the type of the device needs to be selected in drop-down window. In case DS520 is connected via USB cable, selection is automatic.

The configuration can be read and written in *.cfg files, which allows editing them also when DS520 is not connected via USB cable. The pre-prepared files can be sent by e-mail to the installer or can be remotely uploaded to the device.
After configuration is read from either the computer disk or DS520, configuration settings are displayed on the screen. Meaning of specified tabs and fields are described in chapter 8.
After making changes in configuration, it can be written back to the computer disk but first of all it should be written to the device. PC software verifies if configuration has been saved correctly.

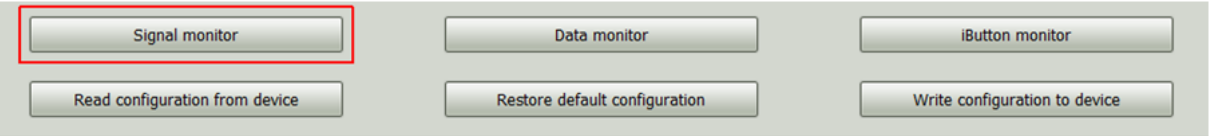
Load configuration from the device and display it in the programmer.	
Save configuration from the programmer to the device.	
Open configuration from the computer disk and display it in the programmer.	Menu→Configuration file→ Open 
Save configuration from the programmer to the computer disk.	Menu→Configuration file→Save as 
Write configuration directly from computer disk to device (without displaying in the programmer and without possibility of modification)	Menu→Configuration file→Copy from file to device The option allows writing the configuration directly from the file on computer disk to the tracker without the possibility of modification in the programmer window. Used for service and diagnostic purposes.
Write configuration from device directly on computer disk (without displaying in the programmer and possibility of modification)	Menu→Configuration file→Copy from device to file The option allows writing directly on the computer disk the configuration read from the device without the possibility of modification in the programmer window. Used for service and diagnostic purposes.

Buttons *Read configuration from device* and *Write configuration to device* work only when DS520 is connected to the computer.

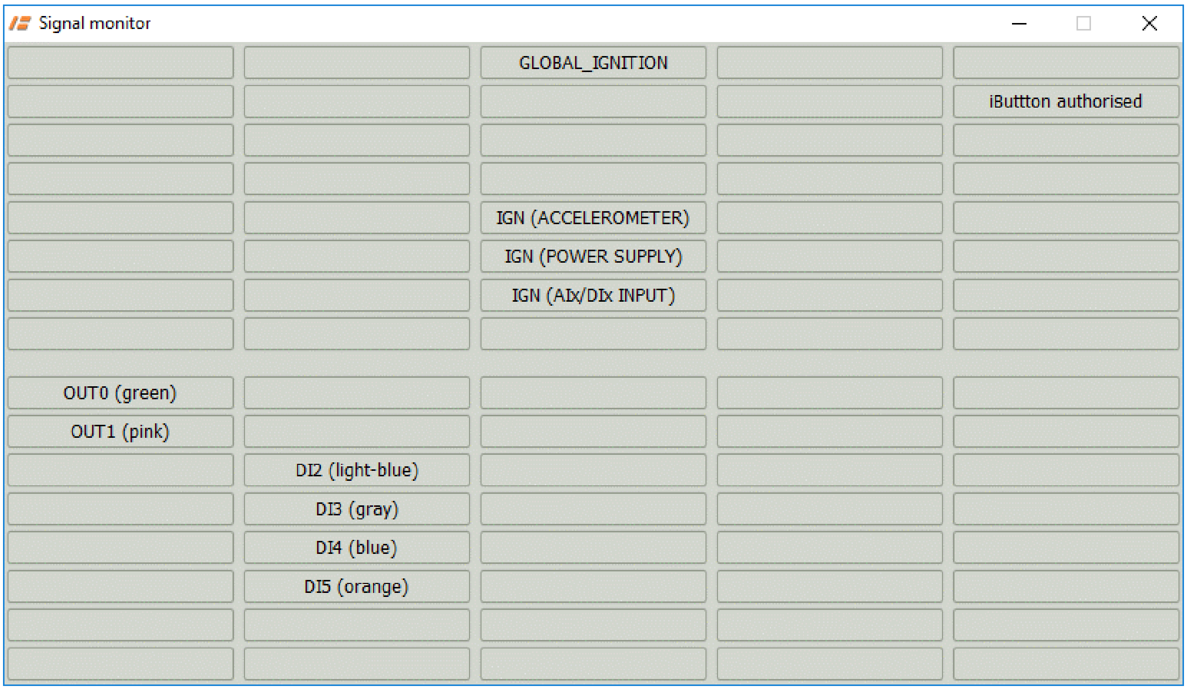
In case of the already configured devices, please preserve the given procedure:
read configuration file from the device --> write configuration file to the disk --> modify configuration --> save copy of configuration file to the disk --> write configuration file to the device

7.2 Signal monitor

When *Signal monitor* button is pressed



a panel that allows to check the presence of input signals and the state of outputs is displayed.



Third column (upper row) shows ignition signals.

Control lamp	Meaning
GLOBAL_IGNITION	Ignition switch state which is used for DS520 operation, i.e. generation of reports and distinction between drive and parking. The signal (acc. to the device configuration) is the sum of three signals: ignition signal generated by accelerometer, ignition signal generated from power supply voltage and signal from ignition analogue input.
IGN (ACCELEROMETER)	State of virtual ignition algorithm which detects engine start-up on the basis of vehicle vibration and both radial and transverse acceleration measured by built-in accelerator.
IGN (POWER SUPPLY)	State of algorithm which detects switching ignition on by increased power supply voltage.
IGN (DIx INPUT)	Ignition switch state which is read using DI2/DI3/DI4/DI5 input configured in IGNITION+ or IGNITION- mode.

Fifth column (bottom row) shows the ignition signal.

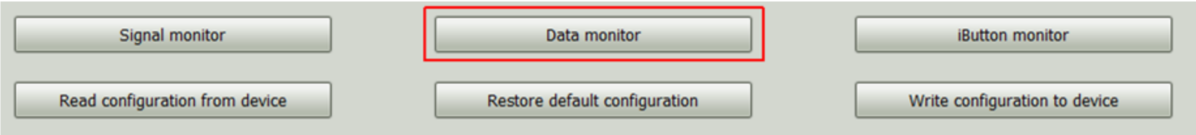
Control lamp	Meaning
iButton authorised	Control lamp indicates that the reader has confirmed iButton DS1990A meeting iButton authorisation condition as per scenario no.2. Control lamp lights as long as iButton serial number is remembered and stored by the device – as described in chapter 5.

Sixth and seventh columns (bottom row) show the state of inputs/outputs.

Control lamp	Meaning
OUT0	Control lamp indicates that OUT0 output (green wire) is enabled, i.e. grounded.
OUT1	Control lamp indicates that OUT1 output (pink wire) is enabled, i.e. grounded.
DI2 DI3 DI4 DI5	Control lamp indicates that DI2/DI3/DI4/DI5 digital input detects active state (input trigger). The lamp signals: - positive voltage for input in mode INPUT+ and other (+), - connection to ground in mode INPUT- and other (-).

7.3 Measurement data monitor

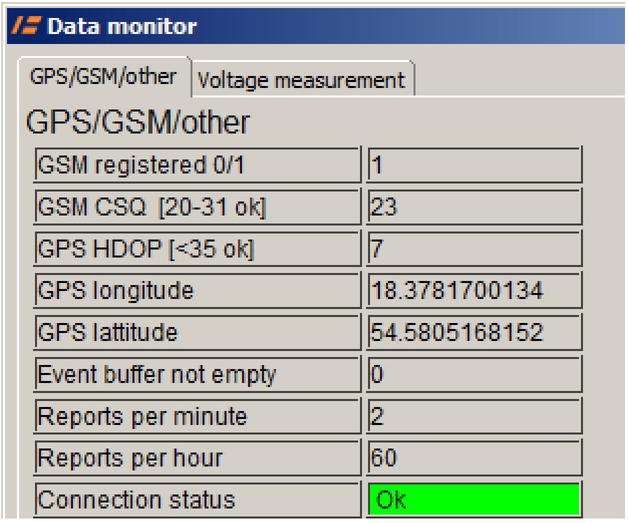
When *Data monitor* button is pressed



a panel that allows to preview live data and operation parameters is displayed. The panel is divided into separate tabs for the clarity.

7.3.1 GPS/GSM/other

The tab presents GSM data, GPRS connection status and GPS/GLONASS signal.



The table describes the data, the correct value of data and its description:

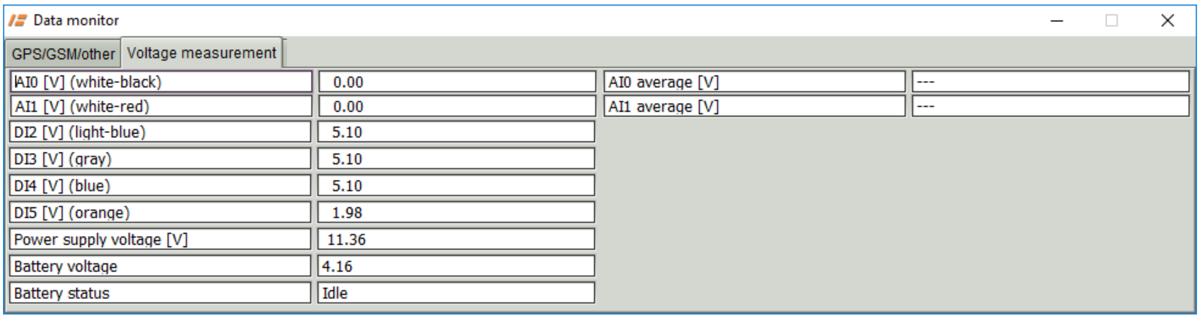
Name	Definition	Correct value	Description
GSM registered	GSM network device registration status	1	The value 1 shows that DS520 is registered in GSM network and the SIM card is operating correctly. The value 0 shows that the device is not registered in GSM network, e.g. no SIM card, SIM card invalid, logging into GSM network not possible (roaming), no GSM signal coverage etc. The parameters correspond to presence of DS520 in GSM network, not the data connection.
GSM CSQ	GSM signal level	20-35	The level of GSM signal: 0-10 weak signal 10-20 good signal 20-35 very good signal 99 - no GSM signal available
GPS HDOP	GPS signal quality	from 1 to 35 99-GPS/GLONASS localisation not possible GPS sleep mode	The parameter describes the quality of GPS/GLONASS signal. The smaller the value is (closer to 1), the GPS/GLONASS quality is better. GPS receiver is disabled in order to save power.
GPS longitude GPS latitude	Coordinates read from GPS receiver	---	Latitude and longitude should correspond to the actual geographical position of the device GPS/GLONASS antenna receiver.
Event buffer not empty	Buffer of data waiting to be transmitted to the server is not empty.	0	The flag is set if the device has prepared location and/or telemetric data (named 'report') to be sent to the server. The data are placed in the buffer and wait for the transmission session to send them to the server. The transmission session appears every minute during drive or every 5 minutes when parked.
Reports per minute Reports per hour	Counters of data (reports) being prepared to be sent to the server during last minute and last hour.	---	The counters are designed to check if the device operates properly - for test purposes of technical consultants. Generally, the device prepares certain number of reports when drive or parked. Moreover, the reports are prepared when dedicated events appear (see chapter 3).
Connection status	Status of data connection to the server.	**Ok**	**The most important parameter**: it shows if the device has correctly finished last attempt to transmit data to the server. **Ok** - data transmission to the server has been correct and acknowledged by the server. **Wait** - the device waits for the acknowledge of data reception from the server. **Fail** - the data transmission to the server has not been correct.

Below the meaning of GSM parameters' combinations is listed:

GSM registered	***GSM CSQ (signal level)***	**Meaning**
1	20-31	proper signal, DS520 is registered in GSM network,
1	1-20	too weak GSM signal – GSM antenna should be fixed in a place with a better GSM signal coverage,
0	99	DS520 cannot register to GSM network (invalid SIM card) or no GSM signal coverage in a given place,
0	0	problem with SIM card logging into GSM network, e.g. due to damaged or missing SIM card contact.

7.3.2 Voltage measurement

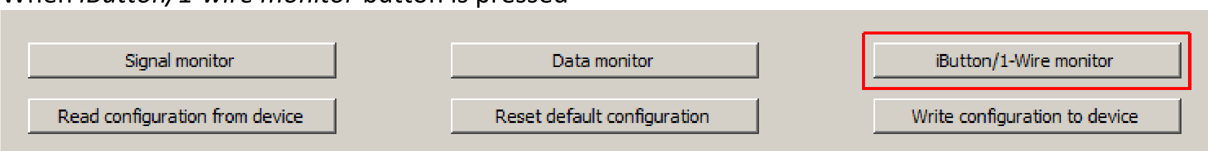
The tab presents voltage [V] measured by DS520 on analogue and digital input lines. Moreover, the panel presents power supply voltage. For DS520B devices (with internal battery), the panel shows the battery voltage and charging status. For analogue lines that are configured for voltage measurement (AIx), averaged voltage is additionally displayed, which is, in fact, the data sent to the server. The averaging time is set in DS520 configuration programmer.



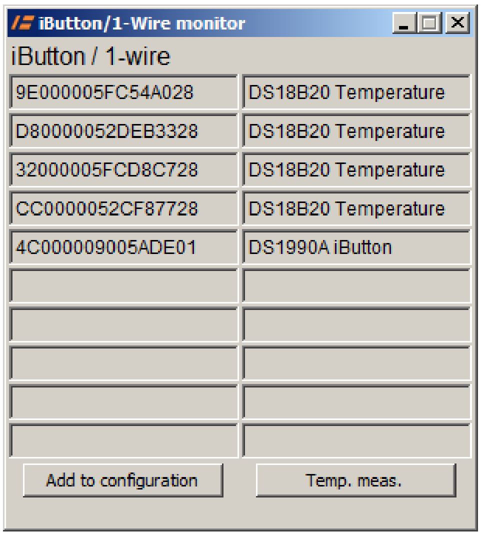
Warning!
Due to the way the inputs are polarized (described in sections 2.3 and 6.4), voltage for disabled digital inputs is equal to half of the measured power supply voltage.

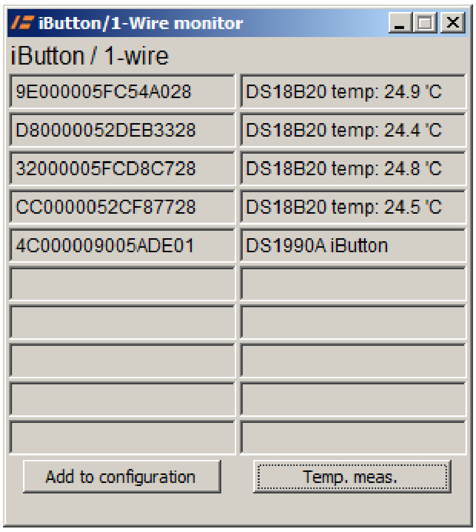
7.4 iButton/1-wire monitor

When *iButton/1-wire monitor* button is pressed



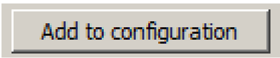
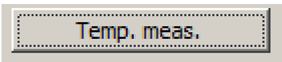
a control panel for iButtons and 1-wire temperature sensors is displayed.





In the left column the serial numbers of the 1-wire devices connected to DS520 (i.e. iButtons and DS18B20 digital temperature sensors) are displayed.

In the right column the type of 1-wire bus (*DS1990A iButton* for iButtons and *DS18B20 temperature* for temperature probes) is displayed. The panel is automatically refreshed, i.e. displayed data are updated when devices are connected or disconnected. In case of DS18B20, instead of the type of 1-wire bus, temperatures measured by DS18B20 digital temperature sensors in the previous command for measurement may be displayed.

	The *Add to configuration* button is used to add currently displayed iButton or temperature sensor serial numbers. WARNING! Changes are accepted only if the configuration is written to the device!
	The *Temp. meas.* button sends the command to the digital temperature probes to measure temperature (the measurement is not done constantly, it requires the button to be pressed). The result is displayed on the panel.

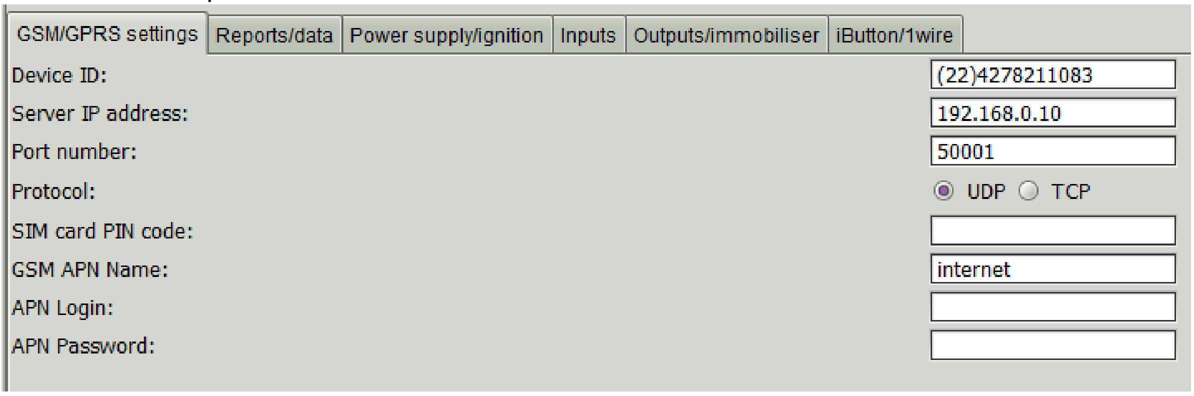
WARNING! iButton/1-wire monitor "captures" the signals read from 1-wire bus; as long as it is opened, the data read from iButton/1-wire devices are not transmitted to DS520 main application. For further checking of DS520 operation, the panel must be closed.

8. Parameters of DS520 configuration

The chapter describes meaning of particular configuration programmer parameters and their impact on DS520 operation.
Parameters which name begins with *"Sending…"*enable or disable specific types of transmitted data, e.g. voltages measured by analogue inputs, signals from digital inputs etc.
Parameters' default values are shown in the below screenshots.

8.1 GSM/GPRS settings

The tab contains parameters related to data transmission to the server and GPRS connection.



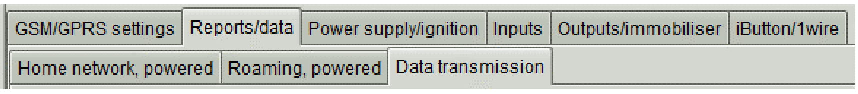
Device ID	After reading the device configuration (section 7.1) DS520 serial number which can be found on the name plate is displayed in the window. This number (excluding prefix (22) is used as DS520 unique identifier to the server–in the example above: device ID is 32331.
Data server IP address	Data server IP address where DS520 sends data packets to. (Data transfer value is determined by tracking platform provider.)
Port	Server port the device connects to. (Data transfer value is determined by tracking platform provider.)
Protocol type	Select whether DS520 should use TCP or UDP protocol. (Data transfer value is determined by tracking platform provider.)
SIM card PIN code	It is advised to disable the PIN code request for SIM card inserted into DS520 or to set the default PIN code: 6789. In this case, the field should be left blank. If the SIM card asks for a PIN code and it is a PIN code other than 6789, it needs to be entered in this field. **WARNING!** **If SIM card requests a PIN code other than 6789, it can be inserted into DS520 only after writing the configuration and disconnecting both wire harness and USB cable!** Value of this field depends on SIM card provider: tracking platform provider or GSM network operator.

GSM access point name (APN)	Access point name for GSM operator’s GPRS packet network offered by inserted SIM card. In most SIM cards with so-called open APN (i.e. with general access to the Internet) the name is *internet*. In case of SIM cards supplied by tracking platform provider, the name usually differs from *internet* and is given by the provider by default.
GSM APN login	Login to GSM access point. In most SIM cards with open APN, this field is left blank or the login is *internet*. In case of SIM cards supplied by tracking platform provider, the user should receive APN login from the provider. In case of no login, this field should be left blank.
GSM APN password	Password to GSM access point. In most SIM cards with open APN, this field is left blank or the password is *internet*. In case of SIM cards supplied by tracking platform provider, the user should receive APN password from the provider. In case of no password, this field should be left blank.

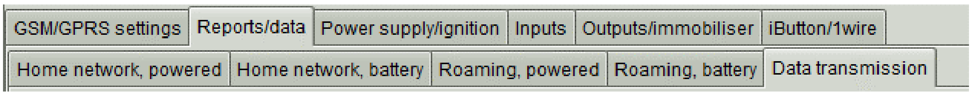
8.2 Reports/data

The tab contains basic parameters related to report generation and transmission to the server (chapter 3) and also related to data format. The parameters are grouped, into three (DS520) or five (DS520B) tabs.

Tabs for DS520   - version without battery



Tabs for DS520B - version with battery



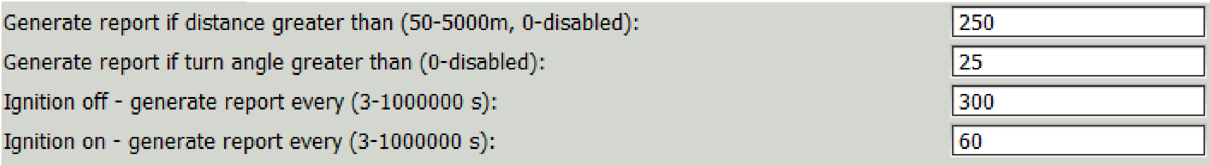
8.2.1 Reports: home network, powered
8.2.2 Reports: home network, battery
8.2.3 Reports: roaming, powered
8.2.4 Reports: roaming, battery

First two tabs for DS520 or four tabs forDS520B concern basic criteria for report generation and transmission described in section 3.1, i.e. time, angle and distance. These parameters determine how often the vehicle GPS position is stored and transmitted to the server. Increasing the number of reports leads to improved map accuracy of vehicle tracking, however this results in increase of data transfer.
The parameters are set separately for:
- device operation in home network with external power supply,
- device operation in home network from internal battery,
- device operation in roaming with external power supply,
- device operation in roaming from internal battery.

Different settings for roaming and home network operation can be set to minimise data transfer in roaming and consequently minimise data transfer costs.

Different settings for external power supply and internal battery operation can be set for power saving purposes and consequently to maximise battery operation time without external power supply.

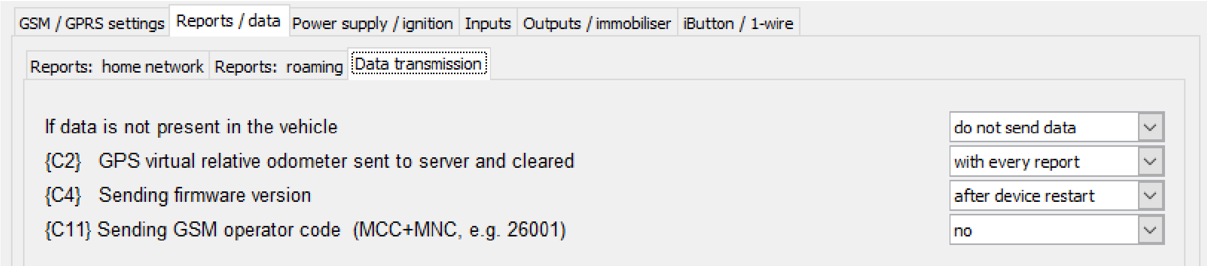
It is recommended to leave the default settings unchanged in all tabs.



Generate report if distance greater than (5m-5000m/0-disabled)	Road distance (in meters) travelled since last report, which causes a new report to be generated (stored) when greater than configured threshold (point on the map). Acceptable values 5-5000. Default value: 250. Entering *0* disables report generation after covering a given distance.
Generate report if turn angle greater than (0-disabled)	Vehicle heading angle change since last report, which causes a new report to be generated when greater than configured threshold. Default value: 25. Entering *0* disables report generation because of the vehicle heading angle change.
Ignition OFF – generate report every (3s-1000000s)	Time since last report, which causes a new report to be generated when greater than configured threshold. This parameter applies when ignition is switched off, i.e. control lamp GLOBAL_IGNITION in the signal monitor (section 7.2) is not on. Acceptable values: 3- 1000000 seconds (approx. 11 days). Default value: 300 seconds (5 minutes). There is no possibility to disable the criterion (enter 0) - the device takes the default value. The parameter also determines the time between transmissions of packets (consisting of reports) to the server. If time greater than 60 seconds is set, reports stored in the device will be transmitted to the server at a given moment (for default settings - every 5 minutes). If value from 3-59 seconds has been set, the reports will be generated and stored at a given moment, however report packets will be transmitted to the server every 60 seconds.
Ignition ON – generate report every (3s-1000000s)	Same as above, except that this parameter applies when ignition is switched on, i.e. control lamp GLOBAL_IGNITION in the signal monitor (section 7.2) is on. Default value: 60 seconds.

8.2.5 Data transmission

The tab collects settings related to the data transfer format and the operation of some DS520 functions.



If data is not present in the vehicle	This parameter determines if the length of reports sent from the device to the server is variable (dependent on data availability) or fixed (in case of no data, they are replaced with some specific numbers). This parameter sets DS520 operation mode when data transmission is enabled in the configuration, but data are not available at the moment of report generation (i.e. iButtons have not been touched against the reader at a given moment). ***do not sent data***– default setting If a piece of data cannot be read by the device it is not attached to the report. The length of reports is therefore variable and dependent on the data available in the vehicle. *send fullscale (0xFF...) data* If the device cannot read the data, special value of data described in TytanSAT protocol as „data not valid/data not present" (usually 2^8-1, 2^{16}-1, 2^{32}-1) is attached to the report.
GPS virtual relative odometer sent to server and cleared	This parameter enables the operation of built-in odometer which is calculated on the basis of GPS/GLONASS coordinates - data [C2] in TytanSAT protocol. ***with every report***– default setting Odometer counts vehicle mileage (distance) between successive reports and sends to the server. After odometer data is sent to the server, the odometer resets and mileage is calculated from zero again. This way of operation is referred to as "GPS relative odometer" in telemetry. *when ignition off* Odometer counts vehicle mileage from switching ignition on to switching ignition off. In the moment when ignition is switched off, odometer data is sent to the server and then deleted.
Sending firmware version	This parameter determines when the following additional data are sent to the server: the type of device (DS520/DS540) and the version of the software - data [C4] in TytanSAT protocol. ***after device restart***– default setting The device attaches the data after every restart. This allows to notice a possible restart of the device in the server (e.g. due to disconnection of power supply). *with every report* The device attaches the data with every report sent to the server.
Sending GSM operator code (MCC+MNC, e.g. 26001)	This parameter enables transfer of country code and GSM network provider name to the server in every report. These data are statistically significant and allow the server to response to change of e.g. a country where the vehicle is in a given moment. As regular solutions these data are not needed. ***no*** – default setting *yes*

8.3 Power supply/ignition

The tab collects parameters related to:
- device power saving mode,
- detection of ignition state,
- storing data on the change of ignition state and sending to the server,
- transfer of data concerning power supply voltage to the server.

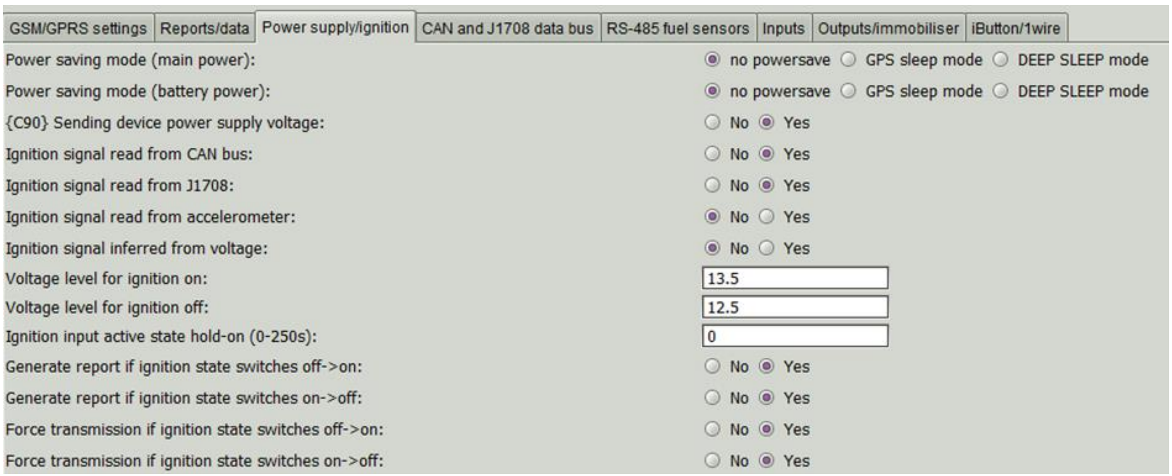
The ignition state, seen in the signal monitor as control lamp GLOBAL_IGNITION, is crucial for the device operation –it distinguished between driving and parking, determining the density of GPS sampling points, the operation of immobiliser function, GPS odometer, transmission of 1-wire identifiers etc.

The ignition state (GLOBAL_IGNITION) can be determined on the basis of:
- (+) or (-)ignition signal given to ignition input DI5,
- g-force and vibrations registered by accelerometer,
- change of power supply voltage (as a result of charging the battery while driving).

It is recommended to use ignition signal at DI5 input – to do that the input has to be programmed in *ignition+* or *ignition*-mode, which will be described later on in this manual. Other methods should be considered only if there is no possibility of such connection.

Particular signal sources have corresponding control lamps in the signal monitor. If ignition signal is programmed to be detected from a few sources, it is sufficient that one of them detects ignition – DS520 recognizes ignition (GLOBAL_IGNITION) as switched on.

Power saving modes influence the current consumed by the device when ignition signal is absent (no GLOBAL IGNITION signal). In such condition, the device can operate normally, switch GPS off or enter deepsleep mode – see section 2.1.



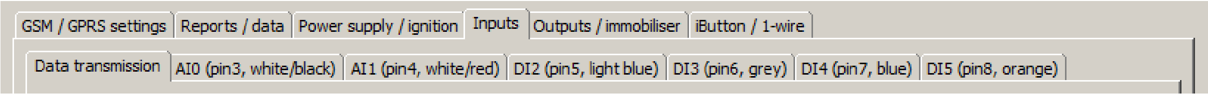
Power saving mode (main power)	This parameter activates power saving modes in the device, when operating on external power supply. ***disabled*** – default setting The device operates in the normal mode; it does not fall asleep; GPS receiver is enabled constantly. Power consumption reaches approx. 36 mA. *GPS sleep mode enabled*

	GPS receiver is kept disabled between reports if ignition (GLOBAL_IGNITION) is OFF and time left to next report (while ignition is OFF) exceeds 120 seconds. Power consumption falls to approx. 14 mA. GPS receiver is enabled when time for report generation runs out or ignition signal is detected (analogue, by accelerometer, by power supply voltage change). *DEEPSLEEP mode enabled* If ignition (GLOBAL_IGNITION) is OFF, USB cable disconnected and time left to next report (while ignition is OFF) exceeds 120 seconds, the device disables both GPS receiver and GSM modem and also makes processor asleep. Power consumption falls to approx. 1.2 mA. WARNING! 1. In deepsleep mode the device does not react to SMS commands until it wake up. 2. The device wakes up when time for report generation runs out or ignition signal is detected (analogue, by accelerometer, by power supply voltage change) and also when USB cable is connected. 3. The device neither reads CAN-bus data nor detects ignition signal via CAN-bus. 4. At waking up the device opens new GPRS session (please check your GPRS service provider tariff charging system!)
Power saving mode (battery power)	This parameter activates power saving modes in the device (same as above), when operating on internal battery – without external power supply.
{C90} Sending device power supply voltage	This parameter enables transmission of power supply voltage in every report - data [C90] in TytanSAT protocol. ***yes*** – default setting *no*
Ignition signal detected by power supply voltage change	This parameter enables detection of ignition based on g-force and vibrations registered by accelerometer. ***no*** – default setting *yes*
Ignition signal detected by power supply voltage change	This parameter enables detection of ignition based on power supply voltage. Exceeding the upper threshold for longer than 5 seconds detects the ignition state. The voltage drop below the lower threshold for longer than 5 seconds detects switching ignition off.
Voltage threshold for Ignition On	Upper threshold for reading ignition based on power supply voltage. For 12V vehicles: *13.5V*
Voltage threshold for Ignition Off	Lower threshold for reading ignition based on power supply voltage. For 12V vehicles: *12.5V*
Generate report if ignition state change off→ on	This parameter activates additional report generation (i.e. remembering time, GPS/GLONASS position and data set) in the moment of switching ignition on. Disabling the parameter is reasonable only in special cases–to reduce data transfer. ***yes*** – default setting The exact time of switching ignition on is known. *no* The exact time of switching ignition on is not known – the ignition state is sent with the nearest report.

Generate report if ignition state change on→ off	This parameter activates additional report generation (i.e. remembering time, GPS/GLONASS position and data set) in the moment of switching ignition off. Disabling the parameter is reasonable only in special cases – to reduce data transfer. ***yes*** – default setting The exact time of switching ignition off is known. *no* The exact time of switching ignition off is not known – the ignition state is sent with the nearest report.
Ignition input active state hold-on (0-250s)	This parameter activates ignition signal hold-on for a given time from the end of ignition signal detection (by any of the methods: digital input, accelerometer, voltage measurement). If the parameter is set to a non-zero value, e.g. 10 seconds, this means that within 10 seconds from the end of ignition signal detection, signal GLOBAL_IGNITION is active. This function is useful e.g. when found ignition analogue signal connection disappears during start-up. In such situation the device could unnecessarily send reports about switching ignition off and on during starting the vehicle - setting ignition signal hold-on prevents from false detection of switching ignition off.
Immediate transmission if ignition state change off → on	This parameter activates immediate report transmission to the server in the moment of switching ignition on. Disabling the parameter is reasonable only in special cases –to reduce data transfer. ***yes*** – default setting Data on switching ignition on is immediately sent to the server and hence it is immediately visible online. *no* Data on switching ignition on is sent to the server when time since last report reaches configured threshold (as described in section 8.2 – by default time between transmissions is up to 60 seconds).
Immediate transmission if ignition state change on→ off	This parameter activates immediate report transmission to the server in the moment of switching ignition off. Disabling the parameter is reasonable only in special cases – to reduce data transfer. ***yes*** – default setting Data on switching ignition off is immediately sent to the server and hence it is immediately visible online. *no* Data on switching ignition off is sent to the server when time since last report reaches configured threshold (as described in section 8.2 – by default time between transmissions is up to 5 minutes).

8.4 Inputs

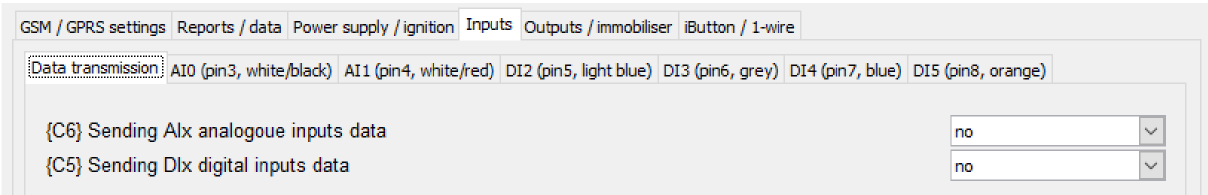
The tab contains settings related to analogue inputs AI1 and AI0 as well as digital inputs DI2/DI3/DI4/DI5. Tab names are described with input names, colours of wires and terminal number in DS520 connector.



The *Data transmission* tab contains common parameters. Parameters concerning every input individually are described in a separate tab.

8.4.1 Data transmission

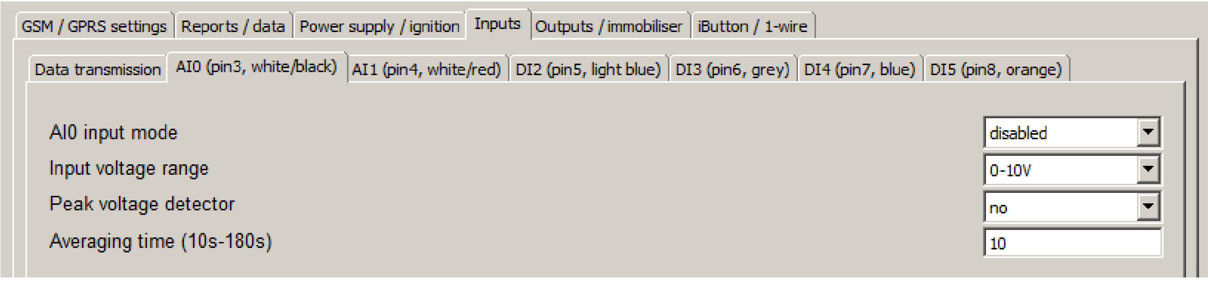
The tab contains two parameters that globally enable data transmission from analogue and digital inputs. Input data are transmitted if parameter *"{…} Sending …."* has been enabled and the input has been configured in operation mode.



{C6} Sending AIx analogue inputs data	This parameter activates transmission of voltages from analogue inputs that are configured in operation mode - data [C6] in TytanSAT protocol. The parameter allows the user to disable data transmission from analogue inputs globally, with no need to change configuration of individual inputs. It is specially important in case when fixed length of reports is selected according to point 8.2.3. If it is enabled, data [C6] filled with 0xff ... as per TytanSAT protocol specification is sent to the server for unconfigured inputs. ***yes*** – default setting Voltage measured by input AI0/AI1 is sent to the server if the input is configured for *voltage measurement*. *no* Data from inputs AI0 and AI1 are not sent to the server.
{C5} Sending DIx digital inputs data	This parameter activates transmission of data from digital inputs that are configured in operation mode - data [C5] in TytanSAT protocol. The parameter allows the user to disable data transmission from digital inputs globally, with no need to change configuration of individual inputs. It is specially important in case when fixed length of reports is selected according to point 8.2.3. If it is enabled, data [C5] filled with 0xff ... as per TytanSAT protocol specification is sent to the server for unconfigured inputs. ***yes*** – default setting Voltage measured by inputDI2/DI3/DI4/DI5 is sent to the server if the input is configured for *voltage measurement*. *no* Data from inputs DI2/DI3/DI4/DI5 are not sent to the server.

8.4.2 AI0 (pin3, white/black)
8.4.3 AI1 (pin4, white/red)

Every tab contains parameters related to the given analogue input. Recommended settings for various signals are described in section 6.4.



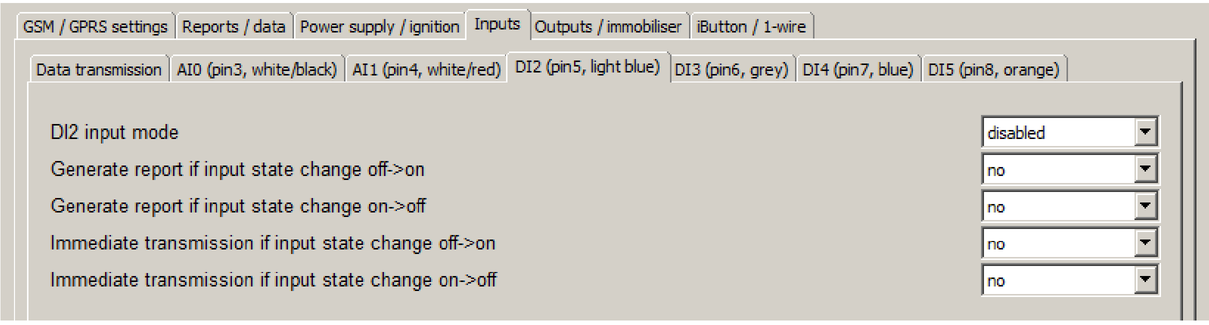
AI0 input mode	This parameter activates analogue input. The input activation causes averaged input voltage to be sent to the server if sending analogue inputs data has been enabled as described in point 8.4.1. ***disabled*** – default setting Input is disabled. Momentary voltage is displayed in the data monitor. Average voltage is neither calculated nor displayed in the data monitor. Voltage is not sent to the server. *voltage measurement* Momentary voltage is displayed in the data monitor. Average voltage is either calculated or displayed in the data monitor. It is sent to the server as data [C6] in TytanSAT protocol. *voltage measurement only when ignition* Momentary voltage is displayed in the data monitor. Average voltage is either calculated and displayed in the data monitor only if the ignition is detected (GLOBAL_IGNITION lamp). Few seconds after switching ignition on, the averaging cycle is started. The result is sent to the server as data [C6] by TytanSAT protocol in every report. If ignition is not detected, the last valid value of voltage (before the ignition was switched off) is remembered and sent to the server.
Input voltage range	This parameter enables selection of analogue input measuring range. If expected voltage does not exceed 10V, the range of 0-10V should be selected. If higher voltages are expected, the range of 0-30V should be selected. ***0-10V*** – default setting The device measures voltages from 0 to 10V. *0-30V* The device measures voltages from 0 to 30V.
Peak voltage detector	This parameter activates peak voltage detector for analogue input. Peak voltage detector is useful when AIx inputs are connected to OEM fuel level sensor in some vehicles. *Peak voltage detector* should be enabled in the following cases: - when analogue input momentary voltage is unstable (jumps) in the data monitor and has random values, - when square wave signal can be seen on the oscilloscope connected to analogue input.

	no – default setting Peak voltage detector is disabled. Averaging algorithm uses momentary signal values, sampled every second. *yes* Peak voltage detector is enabled. Averaging algorithm uses peak voltages detected in every second.
Averaging time (10s-180s)	This parameter determines averaging time of input voltage. Average voltage is calculated by complex linear algorithm and displayed in the data monitor provided that the input has been configured in *voltage measurement* mode. A given number of voltage samplings collected every second is averaged. Momentary and peak voltages are averaged – please see *Peak voltage detector*. Range: 10-180 seconds. Default setting: 10 seconds. Recommended settings for OEM fuel level sensors: 180 seconds.

WARNING! Peak voltage detector can be enabled simultaneously only for one of the inputs.

8.4.4 DI2 (pin5, light blue)
8.4.5 DI3 (pin6, grey)
8.4.6 DI4 (pin7, blue)
8.4.7 DI5 (pin8, orange)

Every tab contains parameters related to the given digital input. Recommended settings for different combinations of input signals are described in section 6.5.



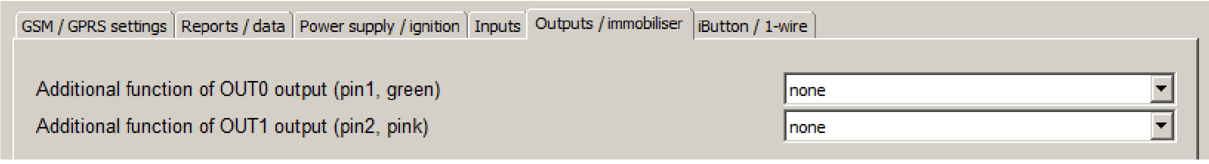
DI2 input mode	This parameter activates digital input. The input activation causes input signal to be sent to the server if sending digital inputs data has been enabled as described in point 8.4.1. ***disabled*** – default setting Input is disabled. Input signal is not sent to the server. *input+* Input mode of „general purpose". The input detects "1"if voltage is greater than $^2/_3$power supply voltage (short circuit to power supply voltage). The input detects "0" if voltage is lower than $^1/_3$power supply voltage. Input signal is sent to the server as data [C5] in TytanSAT protocol.

	input- Input mode of „general purpose". The input detects "1" if voltage is lower than $^1/_3$power supply voltage (short circuit to ground). The input detects "0" if voltage is greater than $^2/_3$power supply voltage. Input signal is sent to the server as data [C5] in TytanSAT protocol. *private trip+* The input is dedicated for "private trip/company drive" switch used to generate reports by tracking platforms on how the vehicle is used. The input detects "1" (private trip) if voltage is greater than $^2/_3$ power supply voltage (short circuit to power supply voltage). The input detects "0" (company drive)if voltage is lower than $^1/_3$ power supply voltage. Input signal is sent to the server as data [B8] in TytanSAT protocol (not as data [C5]). *private trip-* The input is dedicated for "private trip/company drive" switch used to generate reports by tracking platforms on how the vehicle is used. The input detects "1" (private trip) if voltage is greater than $^2/_3$power supply voltage (short circuit to ground). The input detects "0" (company drive) if voltage is lower than $^1/_3$power supply voltage. Input signal is sent to the server as data [B8] in TytanSAT protocol (not as data [C5]).
Generate report if input state change off → on	This parameter activates additional report generation (i.e. remembering time, GPS/GLONASS position and data set) in the moment of input activation, which means: - connect to ground in *input*-mode, - connect to ground in *private trip-* mode, - connect to power supply in *input+* mode, - connect to power supply in *private trip+* mode. ***no*** – default setting The exact time of input activation is not known – new input state is sent with the nearest report. *yes* The exact time of input activation is known. **WARNING!** **This parameter does not apply to *ignition+* and *ignition-* modes of input DI5. For these modes - settings described in section 8.3 are applicable.**
Generate report if input state change on → off	This parameter activates additional report generation (i.e. remembering time, GPS/GLONASS position and data set) in the moment of input deactivation, which means: - disconnect to ground in *input*-mode, - disconnect to ground in *private trip-* mode, - disconnect to power supply in *input+* mode, - disconnect to power supply in *private trip+* mode. ***no*** – default setting The exact time of input deactivation is not known – new input state is sent with the nearest report. *yes* The exact time of input deactivation is known.

	WARNING! **This parameter does not apply to *ignition+* and *ignition-* modes of input DI5. For these modes - settings described in section 8.3 are applicable.**
Immediate transmission if input state change off → on	This parameter activates immediate report transmission to the server in the moment of input activation in *input-, input+, private trip-* and *private trip+* modes. Enabling the parameter is reasonable in case when immediate online data is needed (e.g. NO type PANIC pushbutton). ***no*** – default setting Data on input activation is sent to the server when time since last report reaches configured threshold described in section 8.2 (by default time between transmissions is up to 60 seconds when ignition is ON and up to 5 minutes when ignition is OFF). *yes* Data on input activation is immediately sent to the server and hence it is immediately visible online. **WARNING!** **This parameter does not apply to *ignition+* and *ignition-* modes of input DI5. For these modes settings described in section 8.3 are applicable.**
Immediate transmission if input state change on→ off	This parameter activates immediate report transmission to the server in the moment of input deactivation in *input-, input+, private trip-* and *private trip+* modes. Enabling the parameter is reasonable in case when immediate online data is needed (e.g. NC type PANIC pushbutton). ***no*** – default setting Data on input deactivation is sent to the server when time since last report reaches configured threshold described in section 8.2 (by default time between transmissions is up to 60 seconds when ignition is ON and up to 5 minutes when ignition is OFF). *yes* Data on input deactivation is immediately sent to the server and hence it is immediately visible online. **WARNING!** **This parameter does not apply to *ignition+* and *ignition-* modes of input DI5. For these modes - settings described in section 8.3 are applicable.**

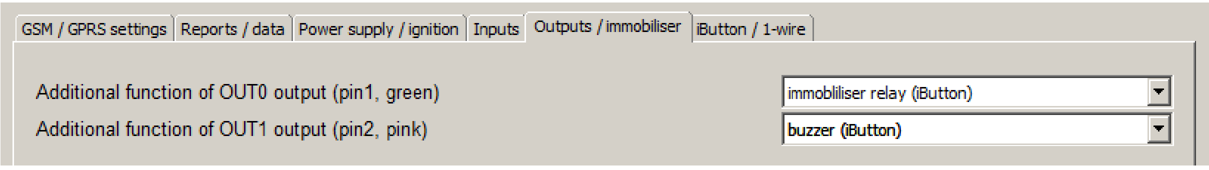
8.5 Outputs/immobiliser

The tab contains settings related to additional functions of outputs OUT0 and OUT1. Additional functions and SMS or GPRS commands that switch the output on and off operate separately, i.e. the device changes the output status according to algorithm of the given function (e.g. immobiliser) or pursuant to currently received remote command.
Both outputs can have the same function, e.g. in order to control two immobiliser relays in an independent and tamper-resistant way.



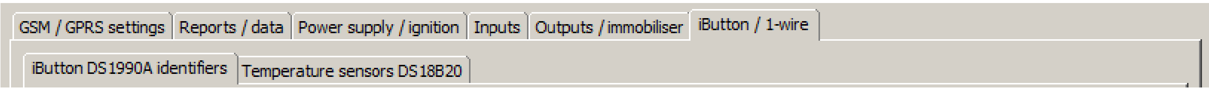
Additional function of OUTx	This parameter activates additional function of digital output, i.e. operation according to the specified algorithm. ***none*** – default setting The output can be controlled only by SMS and GPRS commands. *immobiliser relay (iButton)* The output controls the immobiliser relay acc. to diagram shown in point 6.3.2 in order to use the immobiliser function controlled by iButtons described in chapter 5. The output can be controlled by SMS and GPRS commands at any time. *buzzer (iButton)* The output controls buzzer operation (audio signalling device with built-in generator) acc. to diagram shown in point 6.3.2. Buzzer signals reading iButton identifiers and operation of immobiliser controlled by iButtons, described in chapter 5. The output can be controlled by SMS and GPRS commands at any time.

In case of using immobiliser function, the recommended configuration of outputs is as follows:



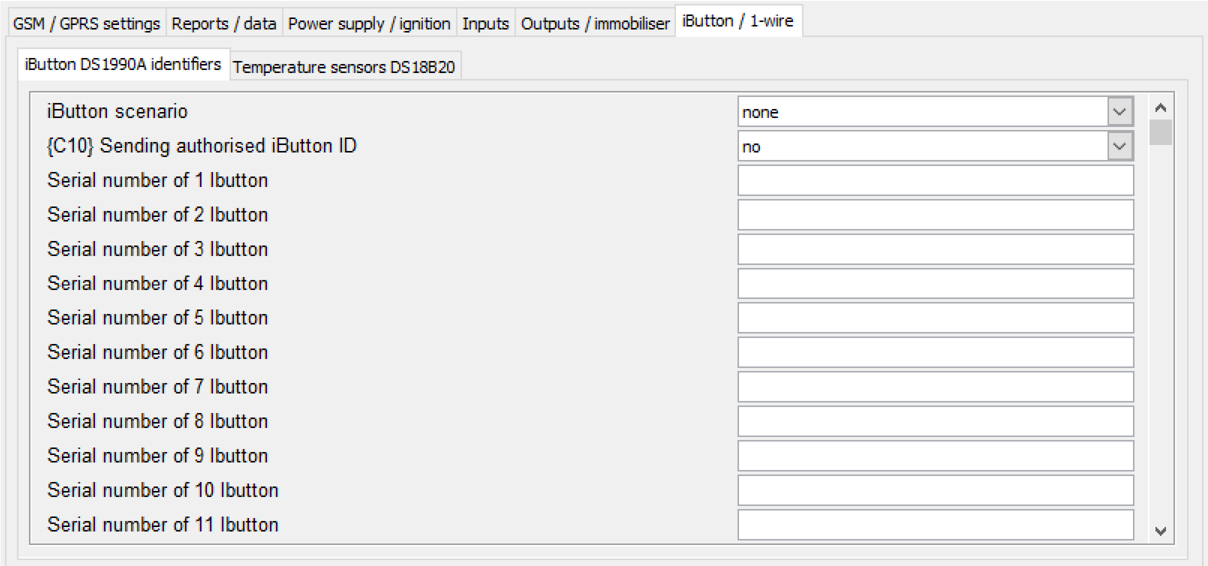
8.6 iButton/1-wire

The tab contains settings related to 1-wire devices. The settings are grouped into separate tabs for iButtonsDS1990A and DS18B20 temperature sensors.



8.6.1 iButton DS1990A identifiers

The tab contains two parameters that switch globally data transmission from analogue and digital inputs. Input data are transmitted if parameter *"{...} Sending ...."* has been enabled and the input has been configured in operation mode.

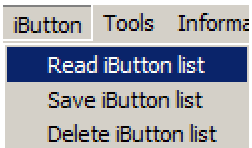
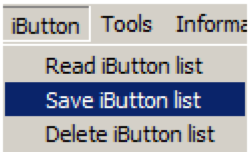
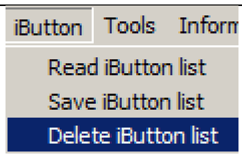


iButton scenario	This parameter activates and sets scenario of operation for driver's identification and immobiliser function using iButtons DS1990A. Scenarios are described in detail in chapter 5. ***none*** – default setting - driver's identification is not used, - list of iButtons is ignored, - ID of IButton that has been touched against the reader as the last one is not sent to the server, - immobiliser function is not active, - output configured in *immobiliser relay* mode is not controlled, - output configured in *buzzer* mode is not controlled. *every iButton is authorised* - driver's identification by any iButton DS1990A, - list of iButtons is ignored, - ID of every iButton that has been touched against the reader as the last one is sent to the server, acc. to conditions described in chapter 5 (if parameter *"Sending ...."* has been enabled), - immobiliser function is active– output OUT0 or OUT1 need to be programmed, - output programmed in *immobiliser relay* is controlled, - output programmed in *buzzer* is controlled. *only iButton from list is authorised* - driver's identification only by authorised iButton DS1990A listed in DS520 (up to 500 iButton IDs), - list of iButtons is verified – for proper operation the list cannot be empty, - ID of authorised iButton that has been touched against the reader as the last one is sent to the server, acc. to conditions described in chapter 5 (if parameter *"Sending ...."* has been enabled), - immobiliser function is active – output OUT0 or OUT1 need to be programmed, - output programmed in *immobiliser relay* is controlled, - output programmed in *buzzer* is controlled.
{C10} Sending authorised iButton ID	This parameter activates sending ID of authorised iButton that has been touched against the reader as the last one to the server. ***yes*** – default setting

	If the scenario *every iButton is authorised* has been selected, ID of every iButton touched against the reader is sent to the server. If the scenario *only iButton from list is authorised* has been selected, only authorised iButton ID is stored and sent to the server. Other iButtons are ignored. If no scenario has been selected, iButton ID is not sent to the server. Conditions for iButton ID transmission is described in chapter 5 (iButton ID is stored and sent to the server as long as ignition is switched off for more than 30 seconds). *no* iButton ID is not sent to the server.
Serial number of 1 iButton … … Serial number of 500 iButton	Serial numbers of authorised iButtons DS1990A. IDs can be entered in 3 ways: - write manually the number engraved on the iButton, - add automatically in the *1-wire monitor* (section 7.4): touch iButton against the reader and press *Add to configuration* button - read from computer disk the text file with iButton identifiers in HEX-ASCII format, separated with CR/LF signs by use of commands in the programmer iButton drop-down menu.

8.6.2 iButton drop-down menu

The menu contains commands related to handling the list of authorised iButtons as described in point 8.6.1.

	Read the list of authorised iButton IDs to the computer disc.
	Save the text file containing a list of authorised iButtons' IDs to the computer disc.
	Delete a list of authorised iButtons' IDs from the configuration programmer.

Format of text file containing a list of iButton identifiers:

```
1C000009029FE301<CR><LF>
4C000009005ADE01<CR><LF>
D80000089E07D801<CR><LF>
F4000008FFA5EA01<CR><LF>
FF000009027BFF01<CR><LF>
```

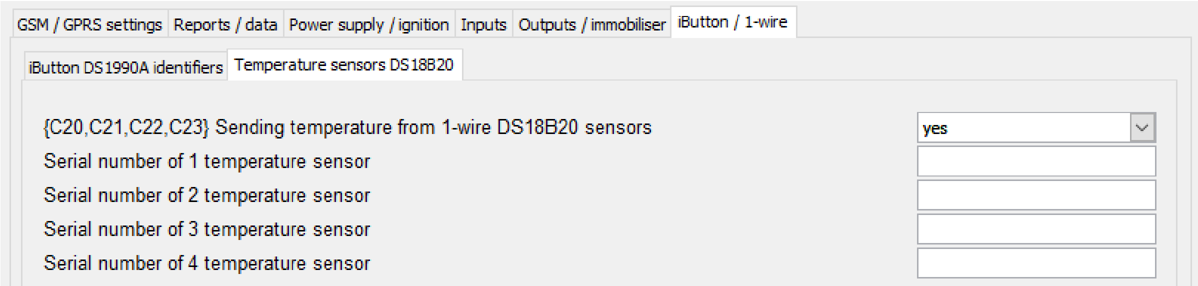
where:

<CR> - 13 code ASCII sign

<LF> - 10 code ASCII sign

8.6.3 Temperature sensors DS18B20

The tab contains parameters and serial numbers of DS18B20temperature sensors connected to 1-wire bus.



{C20, C21, C22, C23} Sending temperature from 1-wire DS18B20 sensors	This parameter activates sending temperatures read by DS18B20 temperature sensors connected to 1-wire bus, to the server - data [C20, C21,C22,C23] in TytanSAT protocol. ***yes*** – default setting Data are sent to the server if temperature sensor with stored ID has been connected to 1-wire bus. If the serial number does not match the ID stored in configuration programmer or the list of temperature sensors' IDs is empty, data are not sent to the server. *no* Data are not sent to the server.
Serial number of 1 temperature sensor … Serial number of 4 temperature sensor	Serial numbers of temperature sensors connected to 1-wire bus. IDs can be entered in 2 ways: - write manually the serial number of DS18B20 temperature sensor, - add automatically in the *1-wire monitor* (section 7.4): connect temp. sensor (or temp. sensors) and press *Add to configuration* button in the *1-wire monitor* – IDs of temp. sensors connected to DS520 are added to configuration programmer.

9. Configuration procedure and device start-up

This chapter describes the configuration procedure and device start-up. Procedures described in further parts of the chapter refer to the information from two previous chapters concerning diagnostic tools and parameters for DS520 configuration.
Configuration procedure is divided into two parts:
- basic configuration (only data on vehicle location),
- advanced configuration.
Basic configuration is sufficient for vehicle location and requires only parameters related to data transmission, GPS/GLONASS signals and ignition signal to be set and checked.
Advanced configuration includes the following issues: fuel level measurement, digital input signals, analog inputs signals, iButtons, temperature sensors, driver's identification, immobiliser.

9.1 Basic configuration

The basic configuration is described step by step, repeating some information from previous chapters for the clarity. Sections 9.1 and 9.2 can be separate instructions how to configure and test DS520 in the basic level.
So-called templates should be available with the device – they are basic configuration standard files created for specified tracking platforms. The manufacturer of DS520 provides templates for several popular platforms. It is advised to prepare such configuration templates for device installers.

9.1.1 Parameters setting for basic configuration

(a) Disconnect DS520 from power supply, SIM card is out of device.

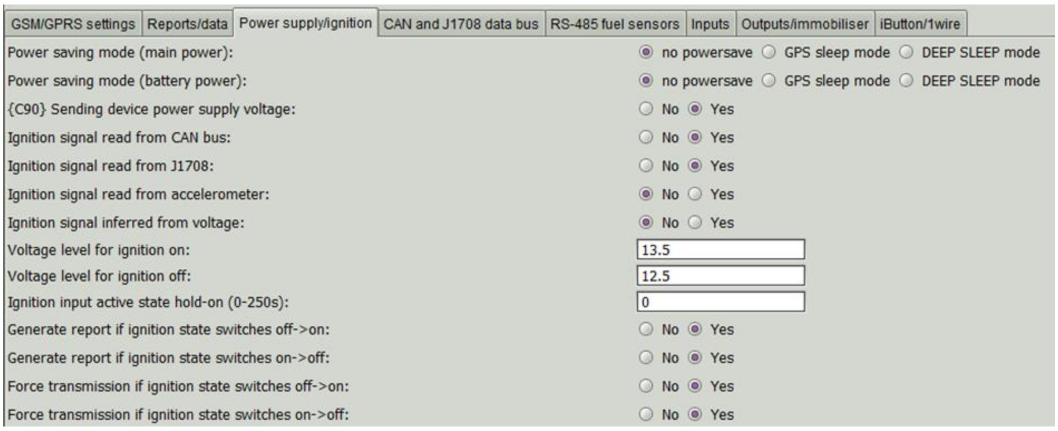
(b) Connect DS520 to USB or select device type: DS520 in configuration programmer.

(c) Read from the computer disk the file *.cfg with default settings for specified tracking platform (server)
or
read from the computer disk the universal file with DS520 configuration.

(d) Check in the *GSM/GPRS settings* tab (section 8.1):

- if data server IP address, server port and protocol type are correct for the selected tracking platform(server),
- if SIM card PIN code is disabled or programmed as 6789, then check if *SIM card PIN code* field is empty. If SIM card requires PIN code, check if it is written in the programmer.
- if APN name, login and password comply with SIM card provider instructions.

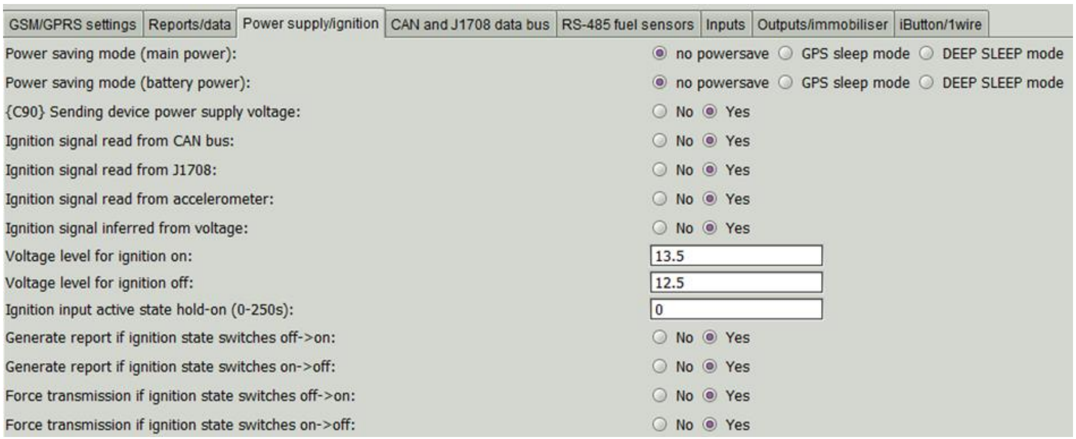
(e) If it is possible to connect DI5 input to ignition circuits:
- check if in the *Inputs/DI5* tab *ignition+* or *ignition*-mode of DI5 input has been selected (point 8.4.7),
- make sure that in the *Power supply/Ignition* tab – section 8.3 – ignition signal detected by accelerometer and power supply voltage change has been disabled,



- if ignition signal disappears at the time of starting the engine and finding other wire with ignition signal is difficult, it is recommended to set ignition signal hold-on for over a dozen of seconds.

(f) If it is impossible to connect DI5 input to ignition circuits:
- if starting the engine and charging the battery are supposed to be detected as switching ignition on: enable *Ignition signal detected by power supply voltage change* and set voltage thresholds (for 12V installations: 12.5V/13.5V are recommended).
- if vehicle vibrations and movements are supposed to be detected as switching ignition on: enable *Ignition signal detected by accelerometer*.

WARNING! If there is no ignition signal wire, it is recommended to enable both below parameters:
Ignition signal detected by accelerometer,
Ignition signal detected by power supply voltage change.

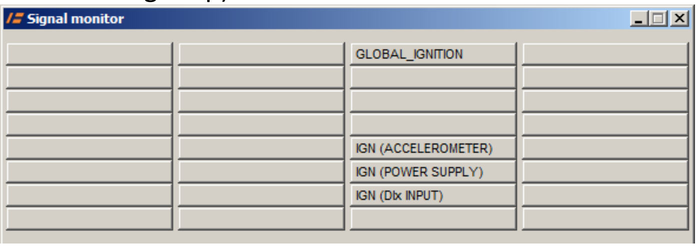


9.1.2 Checking device operation for basic configuration (with use of either PC or LEDs)

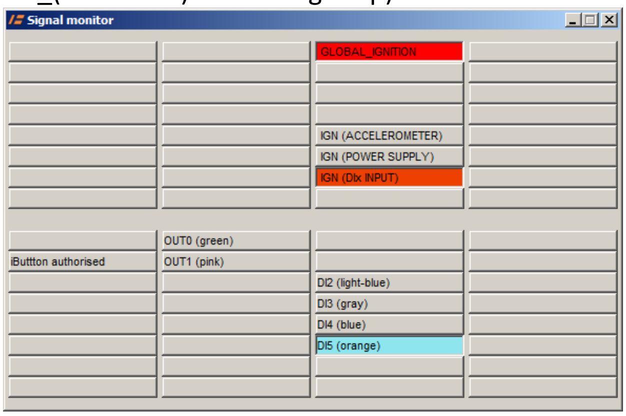
(a) Disconnect USB cable from DS520, insert SIM card, connect antennas, connect power supply, connect USB cable. Red and green LEDs in DS520 light up for 15 seconds.

(b) Go to the signal monitor.

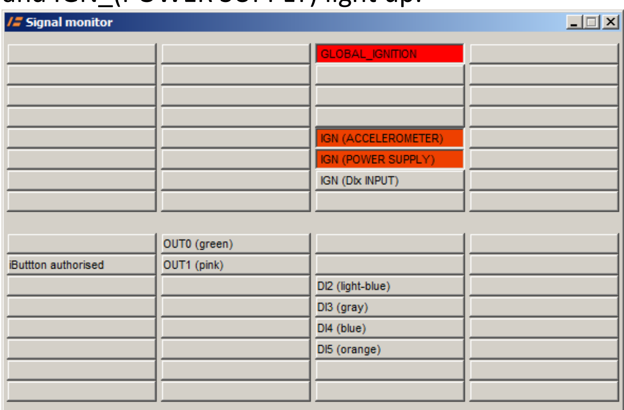
(c) When ignition is switched off, check if DS520 does not receive ignition signal (control GLOBAL_IGNITION does not light up).



(d) If DI5 input has been connected and configured to ignition circuits acc. to point9.1.1 (e), switch ignition on and check if DS520 receives ignition signal from DI5 input (control lamps GLOBAL_IGNITION, IGN_(DIx INPUT) and DI5 light up):



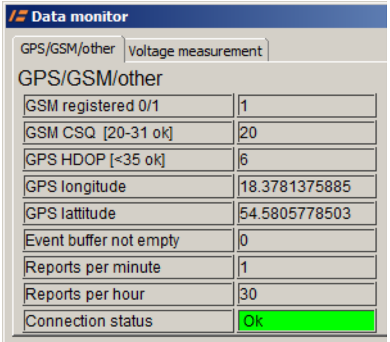
(e) If DI5 input has not been connected to ignition circuits and both accelerometer and power supply voltage change are enabled to detect ignition signal –acc. to point 9.1.1 (f), start the engine and check if DS520 detects ignition signal in a few seconds (control lamps GLOBAL_IGNITION, IGN_(ACCELEROMETER) and IGN_(POWER SUPPLY) light up:



Switch ignition off. Check if control lamps turn off in over a dozen of seconds.

(f) Go to the data monitor.

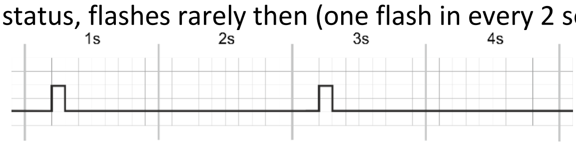
(g) Wait for a while. Meaning of parameters are described in point 7.3.1. Below only main principles are reminded.



(h) Check GSM signal level and registration to GSM network:

GSM registered	*GSM CSQ (signal level)*	**Meaning**
1	20-31	**Proper signal**, DS520 is registered in GSM network.
1	1-20	Too weak GSM signal – GSM antenna should be fixed in a place with a better GSM signal coverage. When GSM signal level is too low (CSQ in lower than 10) DS520 can possibly register to GSM network (GSM registered =1)however connection to the server is not available.
0	99	DS520 cannot register to GSM network (invalid SIM card) or no GSM signal coverage in a given place.
0	0	Problem with SIM card logging into GSM network, e.g. due to damaged or missing SIM card contact.

(i) Check quality of GPS/GLONASS signal: *GPS HDOP* parameter should be in range of 1-35. Green LED in DS520, that signals GPS status, flashes rarely then (one flash in every 2 seconds):

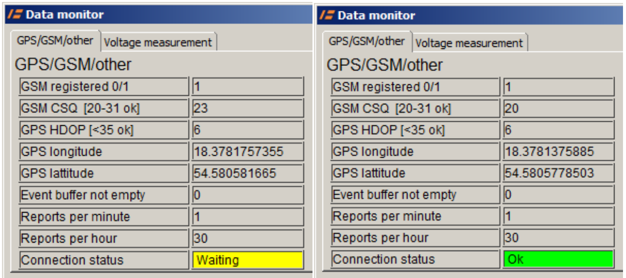


If quality of GPS/GLONASS signal is improper, the first connection to the server is not possible. In such case:

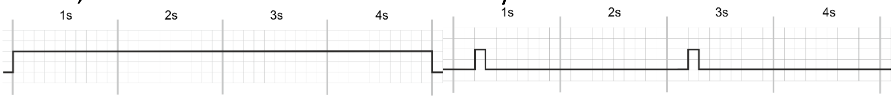
- DS520 user should move the vehicle outdoors,
- GPS/GLONASS antenna should be fixed in a place where better GPS/GLONASS signal is available.

(j) **Control lamp *Connection status* glowing green together with message „OK" confirm DS520 correct connection to the server**. Red LED in DS520, that signals GSM connection, flashes rarely then (one flash in every 2 seconds).

(k) Switch ignition on/switch ignition off. DS520 should generate and send a report to the server. Control lamp *Connection Status* should indicate „*Waiting"* and then „Ok".



Red LED in DS520should light up for 4 seconds to signal correct data transmission to the server, then it should flashes once in every 2 seconds.



9.2 Advanced configuration

Advanced configuration requires the knowledge of:
- DS520 operation (Chapter 2),
- configuration parameters (Chapter 8),
- device diagnostics (Chapter 7).

Issues regarding advanced configuration are presented in the form of guidelines.
In order to avoid repeating chapter 7, this chapter does not present methods to test operation of specified functions.

9.2.1 GSM/ignition/power saving settings

Set and check GSM parameters same as for basic configuration. If power saving modes are to be used when the device is in standby (ignition off), the configuration parameters described in section 8.3 should be set according to information given in section 2.1.

9.2.2 Digital inputs

If digital inputs are supposed to be used in DS520, i.e. DS520 is to send On/Off states of DI2/DI3/DI4 inputs, please follow the below steps:
- Check if input signals connected to the line are positive (+)or negative (–) signals.
- If input signals come from additional switches or buttons (NO or NC), find right input configuration and connection method using descriptions and diagrams from section 6.5.
- Bind DI2/DI3/DI4 inputs to specified signals and set appropriate input modes: input- or input+, according to points 8.4.4 - 8.4.6.
- If the moment of switching the input should be remembered, set report generation parameters, and in case when inputs are used as PANIC/ATTACK/HIJACK buttons (PANIC) also configure settings to force immediate data transmission to the server. The rules are described in section 2.3 and point 3.2.2. In case of switches, it is advised to react to the state changes off → on and on → off. For pushbuttons (returning to the initial state when released), it is sufficient to react only to the state change that is a result from pressing the pushbuttons.

9.2.3 Analogue inputs

If analogue inputs are supposed to be used in DS520, i.e. DS520 is to send voltage measured by AI0 and AI1 analogue inputs to the server, please follow the below steps:
- Check the expected range of input voltage changes - determine whether 0-10V or 0-30V range is required.
- Read guidelines on connecting analogue signals described in section 6.4 (e.g. signal averaging time).
- If DS520 is connected to circuits of OEM fuel level sensor, check acc. to the description in point 6.4.1 if the use of peak voltage detector is required. It is recommended to use an oscilloscope to check this before parameters are set. In case there is no oscilloscope, check voltages in the data monitor after DS520 is programmed and then correct the data. WARNING! Only one analogue input can use a peak voltage detector.
- Bind AI0 and AI1 inputs to the specified signals.
- Configure parameters for analogue inputs acc. to points 8.4.2-8.4.3. (range, averaging time, peak voltage detector).

9.2.4 Driver's identification with iButton DS1990A/immobiliser

If iButtons are supposed to be used in DS520 for driver's identification or immobiliser operation, please follow the below steps:
- Connect the reader of iButton DS1990A acc. to diagrams shown in section 6.3.
- Determine if DS520 is supposed to send driver's identification data to the server (iButton identifier). If yes→enable *{C10} Sending authorised iButton ID* as described in point 8.6.1.

WARNING!
Immobiliser function can operate without sending iButton identifiers to the server.

- Determine whether to authorise the driver with any iButton (and possibly send every iButton identifier to the server) or to authorise the driver only with iButton stored in the list saved in DS520 (and send only authorised iButton ID to the server). Set the proper scenario of iButton operation as described in chapter 5 and in point 8.6.1.
- If scenario no.2 has been selected (*only iButton from list is authorised*), enter the list of authorised iButton identifiers to the configuration programmer using one of the method described in point 8.6.1 / 8.6.2.
- Determine if DS520 should operate as immobiliser without driver's identification. If yes, configure OUT0 output as *immobiliser relay (iButton)*acc. to section 8.5 and connect immobiliser relay as shown in the diagram in point 6.3.2.
- Determine if immobiliser function and iButton reading are supposed to be signalised by buzzer. If yes, configure OUT0 output as *buzzer (iButton)* acc. to section 8.5 and connect buzzer as shown in the diagram in point 6.3.2.

9.2.5 Temperature measurement by DS18B20 temperature sensors

If DS520 is supposed to measure the temperature using DS18B20 temperature sensors, please follow the below steps:

- Connect temperature sensors to 1-wire bus acc. to diagrams in section 6.3.
- Enter the list of temperature sensor identifiers to the programmer as described in point 8.6.3.

9.2.6 Change of report generation parameters

Below two setting configurations are described: **default** and dedicated to achieve the possibly lowest data transfer.

	Default configuration	Min. data transfer configuration
Distance travelled since last report which causes a new report to be generated	250 m	0
Vehicle heading angle change since last report which causes a new report to be generated	25°	0
Time since last report which causes a new report to be generated – ignition OFF	300 seconds	3600 seconds
Time since last report which causes a new report to be generated – ignition ON	60 seconds	300 seconds

Default settings represent a compromise between data transfer and map accuracy of vehicle tracking. The example of "economical" parameter configuration does not guarantee the proper projection of vehicle routes but reduces data transfer even several times. In such cases vehicle routes are projected by polylines because vehicle position is sent to the server and stored with accuracy to 5 minutes (while driving). Vehicle position while parking is sent to the server every 1 hour.

Using "economical" parameter configuration can be reasonable in roaming (data transfer and cost saving) or battery operating conditions (extending battery operation time).

WARNING! It is recommended to leave the default settings. Changes of parameters can either increase data transfer or deteriorate projection of vehicle route.

9.2.7 Change of GPS odometer type

Odometer, calculated on the basis of GPS/GLONASS coordinates, operates in 2 modes described in point 8.2.3. The default mode of operation, *GPS relative odometer,* is accepted by most tracking platforms that have been tested for operation with TytanSAT protocol. If the mode of operation needs to be changed, please refer to the information in point 8.2.3.

9.2.8 Change of operation mode – fixed/variable length of report

By default the device generates reports of variable length. Change of parameter *If data are not present in the vehicle* described in point 8.2.3 makes DS520 operate in the mode with fixed-length reports. Both modes are described in chapter 3. If DS520 is planned to be used in the mode with fixed-length reports, the user is advised to contact Digital Systems' technical support.

10. SMS/GPRS commands. Remote configuration and firmware upgrades.

DS520 device can execute the following remote commands:
- control of OUT0/OUT1 outputs,
- device restart,
- checking the device geographical position via SMS,
- checking the type of device and software version,
- setting basic configuration parameters (retrieving GPRS connection with the device),
- checking 1-wire devices connected to the device,
- immediate reading of the configuration file from the device and transmission to FTP server,
- immediate download of the configuration file from FTP server and save in the device,
- immediate reading of the file with the new firmware from FTP server and immediate update of DS520 firmware.

Commands can be sent to DS520:
- from mobile phones using SMS commands,
- from the server using GPRS commands as described in TytanSAT protocol.

For both methods the command structure is as far identical as possible.

In case of SMS commands it is necessary to enter additional 5-digit security code, so-called DSPIN code. By default DSPIN code is 12345. It can be programmed via PC programmer or SMS/GPRS dedicated commands.

Commands are presented in the table below. The default DSPIN 12345 is used in the description.

In case of GPRS commands, they are sent in text format (ASCII), using TCP or UDP protocol from the server where DS520 sends the telemetry data. The device's responses are sent also in text format (ASCII) to the same server.

Commands are presented in the table below.
- In the example SMS commands the default access code DSPIN 12345 is used.
- In the example GPRS commands the responses are sent from the device with serial no. 5.
- In the example command for new firmware downloading the address of actual Digital Systems company server with real firmware file is given.
- In the example commands for DS520 configuration file downloading and sending, addresses of free FTP servers are given.

The exact description of step-by-step procedures for changing DS520 firmware and configuration using FTP server is presented in Chapter 11 (SMS commands) and Chapter 12 (GPRS commands).

No.	Purpose	Command	Format for SMS commands	Format for GPRS commands
1	Setting SMS pin code in the device.	setpin	Example 1: SMS sent to DS520: „12345 setpin 54321 54321” SMS received from DS520: „New pin: 54321” Example 2: SMS sent to DS520: „12345 setpin 54321 53421” SMS received from DS520: „Wrong pin repetition”	Example 1: Message sent to DS520: „*setpin 34567 34567” Message received from DS520: „@00000005,New pin: 34567” Example 2: Message sent to DS520: „*setpin 34567 34467” Message received from DS520: „@00000005,Wrong pin repetition”
2	OUT0/OUT1 outputs control	outxY x- output no. Y- command: s (set) r (reset)	Example: SMS sent to DS520: „12345 out1s” SMS received from DS520: „OUT1S,ok”	Example: Message sent to DS520: „*out1s” Message received from DS520: „@00000005,OUT1S,ok”
3	Query for the device GPS/GLONASS position	position	Response to SMS command containing current geographical position. Example: SMS sent to DS520: „12345 position” SMS received from DS520: „Position: Latitude=54.580558 Longitude=18.378162 Speed=0km/h Google maps link: http://mapy.google.pl/maps?q=N54.580558+E18.378162&t=h&z=16 ”	After the receipt of this GPRS command, an extra report with current geographical position is forced to be generated and transmitted to the server immediately.
4	Query for type and firmware version of the device	deviceinfo	Example: SMS sent to DS520: „12345 deviceinfo” SMS received from DS520: „DEVICEINFO,0001,520”	Example: Message sent to DS520: „*deviceinfo” Message received from DS520: „@00000005,DEVICEINFO,0001,520”
5	Query for the list of authorised iButtons and temperature sensors connected to 1-wire bus	1wire	Example: SMS sent to DS520: „12345 1wire” SMS received from DS520: „1WIRE,9E000005FC54A028,D80000052DEB3328,32000005FCD8C728,CC0000052CF87728”	Example: Message sent to DS520: „*1wire” Message received from DS520: „@00000005,1WIRE,9E000005FC54A028,D80000052DEB3328,32000005FCD8C728,CC0000052CF87728”

6	Immediate device restart	restart	Example: SMS sent to DS520: „12345 restart” SMS received from DS520: „RESTART,ok”	Example: Message sent to DS520: „*restart” Message received from DS520: „@00000005,RESTART,ok”
7	Cancellation of the data buffered in the device memory	rmhist	Example: SMS sent to DS520: „12345 rmhist” SMS received from DS520: „RMHIST,OK”	Example: Message sent to DS520: „*rmhist” Message received from DS520: „@00000005,RMHIST,OK”
8	Change of the device basic configuration	rconfig	Example: SMS sent to DS520: „12345 rconfig,185.17.41.184,50015,internet,,,udp” SMS received from DS520: „RCONFIG: IP=185.17.41.184->185.17.41.184\nPORT=50015->50015\nAPN=internet->internet” „RCONFIG:\n Al=->\n Ah=->\n SockType=UDP” Other possible responses: RCONFIG-recreated-ER {hexadecimal error number} RCONFIG-Error-{hexadecimal error number}	Example: Message sent to DS520: ”*rconfig,192.168.0.11,515,internet,internet,internet,TCP” Message received from DS520: „@00000005,RCONFIG:IP=185.17.41.184->192.168.0.11,PORT=50015->515,APN=internet->internet,Al=->internet,Ah=->internet,SockType=TCP”

9	Command to read configuration file from the device and send to FTP server	getconfig	Configuration file download (the file will be transmitted to FTP server with name format **id.cfg** – where **id** is the device ID, e.g. 00AABBCC.cfg) SMS sent to DS520: „12345 getconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware" SMS received from DS520: After successful validation of getconfig command format: „GETCONFIG,ADDRESS-FORMAT-OK" Error while executing the command: „GETCONFIG,ERROR-NR" – where NR is an error no., SMS that informs about unsuccessful attempt to send configuration: „GETCONFIG,FAIL" SMS that informs about operation timeout: „GETCONFIG,TIMEOUT" SMS that informs about successful configuration transmission to the server: „GETCONFIG,COMPLETED"	Configuration file download (the file will be transmitted to FTP server with name format **id.cfg** – where **id** is the device ID, e.g. 00AABBCC.cfg) Message sent to DS520: „*getconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware" Messages received from DS520: After successful validation of getconfig command format: „@00000005,GETCONFIG,ADDRESS-FORMAT-OK" Error while executing the command: „@00000005,GETCONFIG,ERROR-NR" – where NR is an error no., Message that informs about unsuccessful attempt to send configuration: „@00000005,GETCONFIG,FAIL" Message that informs about operation timeout: „@00000005,GETCONFIG,TIMEOUT" Message that informs about successful configuration transmission to the server: „@00000005,GETCONFIG,COMPLETED"

10	Command to read configuration file from FTP server and save in the device	setconfig	Configuration download specifying file name: SMS to DS520: „12345 setconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware/default.cfg” Configuration download without specifying file name (in this case the device attempts to download a file named **id.cfg** where **id** is the device ID in hex-ASCII form, e.g. 00AABBCC.cfg): SMS to DS520: „12345 setconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware/” Possible responses: SMS that informs about successful command verification: „SETCONFIG,ADDRESS-FORMAT-OK” SMS that informs about successful configuration download: „SETCONFIG,DOWNLOAD-COMPLETED” SMS that informs about wrong command: „SETCONFIG,ERROR-nr” – where nr is an error number	Configuration download specifying file name: Message to DS520: „*setconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware/default.cfg” Configuration download without specifying file name (in this case the device attempts to download a file named **id.cfg** where **id** is the device ID in hex-ASCII form, e.g. 00AABBCC.cfg): Message to DS520: „*setconfig ftp://ftp:haslo123@ftp.dsftp.awsome.pl/firmware/” Possible responses: Message that informs about successful command verification: „@00000005,SETCONFIG,ADDRESS-FORMAT-OK” Message that informs about successful configuration download: „@00000005,SETCONFIG,DOWNLOAD-COMPLETED” Message that informs about wrong command: „@00000005,SETCONFIG,ERROR-nr” – where nr is an error no.

11	Firmware upgrade	upgrade	SMS to DS520: „12345 upgrade ftp://dsclient:tytansat123@ftp.tytansat.com/DS520_DS540F3-CRC-6A32-1-3.b64” SMS that informs about successful command verification: „UPGRADE,ADDRESS-FORMAT-OK” SMS that informs about partial download of new firmware: „UPGRADE,FILE nr DOWNLOAD-PART-nr-OK” – where „nr” is a no. of the firmware part, SMS that informs about successful download of new firmware: „UPGRADE,DOWNLOAD-COMPLETED” SMS that informs about an error of new firmware download: „UPGRADE,ERROR-nr” SMS that informs about timeout of new firmware download: „UPGRADE,FTP timeout” SMS that informs that downloaded file is incorrect (improper CRC or signature): „UPGRADE,DOWNLOAD-COMPLETED with error X”	Message sent to DS520: „*upgrade ftp://dsclient:tytansat123@ftp.tytansat.com/DS520_DS540F3-CRC-6A32-1-3.b64” Message that informs about successful command verification: „@00000005,UPGRADE,ADDRESS-FORMAT-OK” Message that informs about partial download of new firmware: „@00000005,UPGRADE,FILE nr DOWNLOAD-PART-nr-OK” – where „nr” is a no. of the firmware part, Message that informs about successful download of new firmware: „@00000005,UPGRADE,DOWNLOAD-COMPLETED” Message that informs about an error of new firmware download: „@00000005,UPGRADE,ERROR-nr” Message that informs about timeout of new firmware download: „@00000005,UPGRADE,FTP timeout” Message that informs that downloaded file is incorrect (improper CRC or signature): „@00000005,UPGRADE,DOWNLOAD-COMPLETED with error X”

11. Remote configuration and firmware upgrade via SMS

The chapter describes in detail commands and presents examples of remote procedures how to save the latest device configuration, read current configuration and update firmware in case of control via SMS commands.

11.1 New configuration downloading from FTP server and writing into DS520

To demonstrate the process of configuration download from FTP server and saving to the device, a free FTP server on hosting servers of "friko.pl" company with the following parameters has been used:

FTP server address (host):	ftp.dsftp.awsome.pl
User's login:	dsftp.awsome.pl
Password:	haslo123

11.1.1 Command

To download a new device configuration from FTP server an SMS with the below command should be sent to SIM card number inserted in DS520:

[DSPIN] setconfig ftp://login:password@server-address.pl/file_name.cfg

where:

[DSPIN]	- DSPIN access code to the device (by default 12345),
setconfig	- command,
ftp://	- protocol ID,
login	- FTP server user's name,
:	- sign separating login and password,
password	- user's password on FTP server,
@	- sign separating access parameters and FTP server address,
server-address.pl	- FTP server address,
file_name.cfg	- name of configuration file to be downloaded*[1]

*[1] – Typing in a file name is not mandatory. If a file name is not typed in, the device will download a file called **id.cfg**. In such case the server address should be finished with a slash "/". **id** - is a device serial number shown as 4-byte hexadecimal number, e.1g. for unit with SN 31983 the file name is 00007CEF.cfg

While connecting to FTP server the device can send the following SMS responses:

SETCONFIG,ADDRESS-FORMAT-OK
- when the format of transferred command is correct,

SETCONFIG,DOWNLOAD-COMPLETED
- after configuration file transmission is completed,

SETCONFIG,ERROR-NR
- when configuration file transmission error occurs,
where NR- error number.

After sending SMS confirmation, the device resets and restarts with new configuration settings.

11.1.2 Example 1 - downloading configuration file with automatically generated name

Send SMS to the device with the following contents:

12345 setconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl/
where:

12345	- DSPIN code – access code to the device,
setconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl	- FTP server address.

The device confirms receipt of correct command by sending SMS with the following contents:

SETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to download from FTP server the configuration file with automatically generated name based on the device serial number. For unit with SN 31983 the file name is 00007CEF.cfg

As a confirmation of downloading configuration file from FTP server the device sends SMS with the following contents:

SETCONFIG,DOWNLOAD-COMPLETED

After sending SMS confirmation, the device resets and restarts with new configuration settings.

11.1.3 Example 2 - downloading configuration file with a given name

Send SMS to the device with the following contents:

12345 setconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl/myconfigfile.cfg
where:

12345	- DSPIN code – access code to the device,
setconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl	- FTP server address,
myconfigfile.cfg	- name of the file to be downloaded.

The device confirms receipt of correct command by sending SMS with the following contents:

SETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to download from FTP server the configuration file named myconfigfile.cfg

As a confirmation of downloading configuration file from FTP server the device sends SMS with the following contents:

SETCONFIG,DOWNLOAD-COMPLETED

After sending SMS confirmation, the device resets and restarts with new configuration settings.

11.2 Sending the file with current DS520 configuration to FTP server

To demonstrate the process of configuration download from the device to FTP server, a free FTP server on hosting servers of "friko.pl" company with the following parameters has been used:

FTP server address (host):	ftp.dsftp.awsome.pl
User's login:	dsftp.awsome.pl
Password:	haslo123

11.2.1 Command

To read the device current configuration and send to FTP server an SMS with the below command should be sent to SIM card number inserted in DS520:

[DSPIN] getconfig ftp://login:password@server-address.pl

where:

[DSPIN] - DSPIN access code to the device (by default 12345),
getconfig - command,
ftp:// - protocol ID,
login - FTP server user's name,
: - sign separating login and password,
password - user's password on FTP server,
@ - sign separating access parameters and FTP server address,
server-address.pl - FTP server address.

While connecting to FTP server the device can send the following SMS responses:

GETCONFIG,ADDRESS-FORMAT-OK
- when the format of transferred command is correct,

GETCONFIG,COMPLETED
- after configuration file transmission is completed,

GETCONFIG,ERROR-NR
- when configuration file transmission error occurs, where NR – error number.

After configuration file transmission is completed successfully, a configuration file named **id.cfg**, where **id** is a device serial number shown as 4-byte hexadecimal number, is saved on FTP server. For unit with SN 31983 the file name is 00007CEF.cfg

11.2.2 Example

Send SMS to the device with the following contents:

12345 getconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl

where:

12345	- DSPIN code – access code to the device,
getconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl	- FTP server address.

The device confirms receipt of correct command by sending SMS with the following contents:

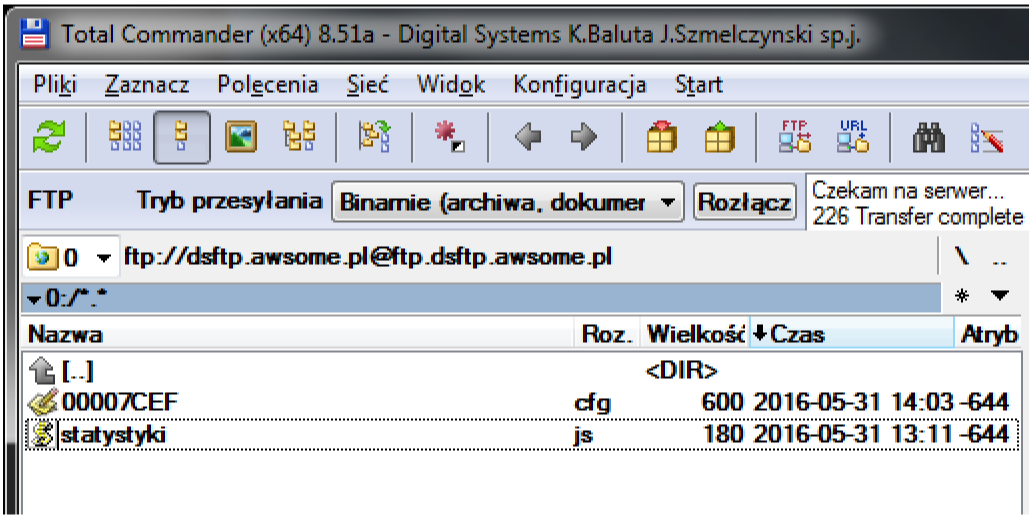
GETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to write to FTP server the configuration file with automatically generated name based on the device serial number. For unit with SN 31983 the file name is 00007CEF.cfg

As a confirmation of writing the configuration file to FTP server the device sends SMS with the following contents:

GETCONFIG,COMPLETED

The below screenshot taken from Total Commander presents the view of FTP server directory with the configuration file read from the unit with SN 31983.



11.3 DS520 firmware update via firmware file downloaded from FTP server

To demonstrate the process of device firmware update the FTP server of Digital Systems company with the following parameters has been used:

FTP server address (host):	ftp.tytansat.com
User's login:	dsclient
Password:	tytansat123

On the FTP server there is DS520 firmware file consisting of 3 files.

11.3.1 Command

To update the device current configuration an SMS with the below command should be sent to SIM card number inserted in DS520:

[DSPIN] upgrade ftp://login:password@server-address.pl/file_name.b64

where:

[DSPIN] - DSPIN access code to the device (by default 12345),
upgrade - command,
ftp:// - protocol ID,
login - FTP server user's name,
: - sign separating login and password,
password - user's password on FTP server,
@ - sign separating access parameters and FTP server address,
server-address.pl - FTP server address,
file_name.b64 - name of configuration file to be downloaded*[1]

*[1] – To update firmware the user should select first of 3 files, i.e. the one that contains the string "-1-3.b64" in the end of the name, e.g. DS520_DS540_0005_CRC-B5BD-1-3.b64

While connecting to FTP server the device can send the following SMS responses:

UPGRADE,ADDRESS-FORMAT-OK
- when the format of transferred command is correct,

UPGRADE,FILE file_name-1-3.b64 **DOWNLOAD-PART-1-OK**
- confirmation of firmware first part receipt,

UPGRADE,FILE file_name-2-3.b64 **DOWNLOAD-PART-2-OK**
- confirmation of firmware second part receipt,

UPGRADE,FILE file_name-3-3.b64 **DOWNLOAD-PART-3-OK**
- confirmation of firmware third part receipt,

UPGRADE,DOWNLOAD-COMPLETED
- confirmation of firmware all parts receipt,

UPGRADE,ERROR-NR
- when configuration file transmission error occurs, where NR – error number.

If configuration file has been transmitted correctly, the device resets and restarts with new configuration settings.

11.3.2 Example

Send SMS to the device with the following contents:

12345 upgrade ftp://dsclient:tytansat123@ftp.tytansat.com/DS520_DS540_0005_CRC-B5BD-1-3.b64

where:

12345	- DSPIN code – access code to the device,
upgrade	- command to download configuration file from FTP server,
ftp://	- marking of transmission type,
dsclient	- login to FTP server,
:	- sign separating login and password to FTP server,
tytansat123	- password to FTP server,
@	- sign separating access parameters and FTP server address
ftp.tytansat.com	- FTP server address,
DS520_DS540_0005_CRC-B5BD-1-3.b64	- name of downloaded file.

The device confirms receipt of correct command by sending SMS with the following contents:

UPGRADE,ADDRESS-FORMAT-OK

After the first part of DS520 firmware is downloaded properly:

UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-1-3.b64 DOWNLOAD-PART-1-OK

After the second part of DS520 firmware is downloaded properly:

UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-2-3.b64 DOWNLOAD-PART-2-OK

After the third part of DS520 firmware is downloaded properly:

UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-3-3.b64 DOWNLOAD-PART-3-OK

and then:

UPGRADE,DOWNLOAD-COMPLETED

Next, if configuration file has been transmitted correctly, the device resets and restarts with new configuration settings.

12. Remote configuration and firmware upgrade via GPRS

The chapter describes in detail commands and presents examples of remote procedures how to save the latest device configuration, read current configuration and update firmware in case of control via GPRS commands.

12.1 New configuration downloading from FTP server and writing into DS520

To demonstrate the process of configuration download from FTP server and saving to the device, a free FTP server on hosting servers of "friko.pl" company with the following parameters has been used:

FTP server address (host):	ftp.dsftp.awsome.pl
User's login:	dsftp.awsome.pl
Password:	haslo123

12.1.1 Command

To download a new device configuration from FTP server to DS520 a GPRS command in text format (ASCII) should be sent to the device **from the server that it sends telemetry data to**:

*setconfig ftp://login:password@server-address.pl/file_name.cfg

where:

*setconfig	- command,
ftp://	- protocol ID,
login	- FTP server user's name,
:	- sign separating login and password,
password	- user's password on FTP server,
@	- sign separating access parameters and FTP server address,
server-address.pl	- FTP server address,
file_name.cfg	- name of configuration file to be downloaded*[1]

*[1] – Typing in a file name is not mandatory. If a file name is not typed in, the device will download a file called **id.cfg** (if such file exists on FTP server). In such case the server address should be finished with a slash "/". **id** - is a device serial number shown as 4-byte hexadecimal number, e.g. for unit with SN 31983 the file name is 00007CEF.cfg

While connecting to FTP server the device can respond via GPRS command (in ASCII format) to the server that it sends telemetry data to with the following messages:

@id,SETCONFIG,ADDRESS-FORMAT-OK

- when the format of transferred command is correct,

@id,SETCONFIG,DOWNLOAD-COMPLETED

- after configuration file download is completed,

@id,SETCONFIG,ERROR-NR

- when configuration file download error occurs
where NR – error number.

After sending GPRS confirmations, the device resets and restarts with new configuration settings.

12.1.2 Example 1 - downloading configuration file with automatically generated name

Send a GPRS command to DS520 from the server that the device sends telemetry data to:

*setconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl/
where:

*setconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl/	- FTP server address.

Unit with SN 31983 confirms receipt of correct command by sending text message (in ASCII format) to the server that the device sends telemetry data to:

@00007CEF,SETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to download from FTP server the configuration file with automatically generated name based on the device serial number. For the unit with SN 31983 the file name is 00007CEF.cfg

As a confirmation of downloading the configuration file from FTP server the device sends text message to the server:

@00007CEF,SETCONFIG,DOWNLOAD-COMPLETED

After sending GPRS confirmation, the device resets and restarts with new configuration settings.

12.1.3 Example 2 - downloading configuration file with a given name

Send a GPRS command to DS520 from the server that the device sends telemetry data to:

*setconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl/myconfigfile.cfg
where:

*setconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl	- FTP server address,
myconfigfile.cfg	- name of the file to be downloaded.

Unit with SN 31983 confirms receipt of correct command by sending text message (in ASCII format) to the server that the device sends telemetry data to:

@00007CEF,SETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to download from FTP server the configuration file named myconfigfile.cfg

As a confirmation of downloading configuration file from FTP server the device sends text message to the server:

@00007CEF,SETCONFIG,DOWNLOAD-COMPLETED

After sending a GPRS confirmation, the device resets and restarts with new configuration settings.

12.2 Sending the file with current DS520 configuration to FTP server

To demonstrate the process of configuration download from the device to FTP server, a free FTP server on hosting servers of "friko.pl" company with the following parameters has been used:

FTP server address (host):	ftp.dsftp.awsome.pl
User's login:	dsftp.awsome.pl
Password:	haslo123

12.2.1 Command

To read the device current configuration and send to FTP server a GPRS command in text format (ASCII) should be sent to DS520 **from the server that the device sends telemetry data to**:

*getconfig ftp://login:password@server-address.pl

where:
*getconfig - command,
ftp:// - protocol ID,
login - FTP server user's name,
: - sign separating login and password,
password - user's password on FTP server,
@ - sign separating access parameters and FTP server address,
server-address.pl - FTP server address.

Unit with SN 31983 confirms receipt of correct command by sending text message (in ASCII format) to the server that the device sends telemetry data to:

@id,**GETCONFIG,ADDRESS-FORMAT-OK**
- when the format of transferred command is correct,

@id,**GETCONFIG,COMPLETED**
- after configuration file transmission is completed,

@id,**GETCONFIG,ERROR-NR**
- when configuration file transmission error occurs,

where:
id is a device serial number shown as 4-byte hexadecimal number, e.g. for unit with SN 31983 the file name is 00007CEF.cfg
NR – error number.

After configuration file transmission is completed successfully, a configuration file named **id.cfg** is saved on FTP server.

12.2.2 Example

Send a GPRS command to DS520 from the server that the device sends telemetry data to:

*getconfig ftp://dsftp.awsome.pl:haslo123@ftp.dsftp.awsome.pl

where:

*getconfig	- command to send configuration file to FTP server,
ftp://	- marking of transmission type,
dsftp.awsome.pl	- login to FTP server,
:	- sign separating login and password to FTP server,
haslo123	- password to FTP server,
@	- sign separating access parameters and FTP server address,
ftp.dsftp.awsome.pl	- FTP server address.

Unit with SN 31983 confirms receipt of correct command by sending text message (in ASCII format) to the server that the device sends telemetry data to:

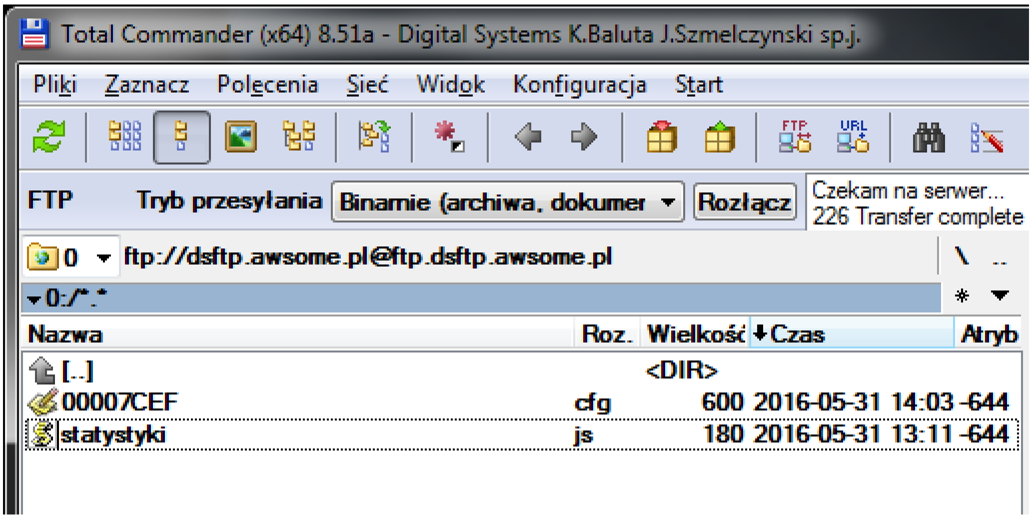
@00007CEF,GETCONFIG,ADDRESS-FORMAT-OK

Then it attempts to write to FTP server the configuration file with automatically generated name based on the device serial number. For unit with SN 31983 the file name is 00007CEF.cfg

As a confirmation of writing the configuration file to FTP server the device sends text message to the server:

@00007CEF,GETCONFIG,COMPLETED

The below screenshot taken from Total Commander presents the view of FTP server directory with the configuration file read from the unit with SN 31983.



12.3 DS520 firmware update via firmware file downloaded from FTP server

To demonstrate the process of the device firmware update the FTP server of Digital Systems company with the following parameters has been used:

FTP server address (host):	ftp.tytansat.com
User's login:	dsclient
Password:	tytansat123

On the FTP server there is DS520 firmware file consisting of 3 files.

12.3.1 Command

To update the device firmware a GPRS command in text format (ASCII) should be sent to DS520 **from the server that the device sends telemetry data to**:

*upgrade ftp://login:password@server-address.pl/file_name.b64

where:

*upgrade	- command,
ftp://	- protocol ID,
login	- FTP server user's name,
:	- sign separating login and password,
password	- user's password on FTP server,
@	- sign separating access parameters and FTP server address,
server-address.pl	- FTP server address,
file_name.b64	- name of configuration file to be downloaded*[1]

*[1] – To update firmware the user should select the first of 3 files, i.e. the one that contains the string "-1-3.b64" in the end of the name, e.g. DS520_DS540_0005_CRC-B5BD-1-3.b64

While connecting to FTP server the device can respond via GPRS command (in ASCII format) **to the server that it sends telemetry data to** with the following messages:

@id,UPGRADE,ADDRESS-FORMAT-OK
- when the format of transferred command is correct,

@id,UPGRADE,FILE file_name-1-3.b64 **DOWNLOAD-PART-1-OK**
- confirmation of firmware first part receipt,

@id,UPGRADE,FILE file_name-2-3.b64 **DOWNLOAD-PART-2-OK**
- confirmation of firmware second part receipt,

@id,UPGRADE,FILE file_name-3-3.b64 **DOWNLOAD-PART-3-OK**
- confirmation of firmware third part receipt,

@id,UPGRADE,DOWNLOAD-COMPLETED
- confirmation of firmware all parts receipt,

@id,UPGRADE,ERROR-NR
- when configuration file transmission error occurs,
where NR – error number.

If configuration file has been transmitted correctly, the device resets.

12.3.2 Example

Send a GPRS command to DS520 from the server that the device sends telemetry data to:

*upgrade ftp://dsclient:tytansat123@ftp.tytansat.com/DS520_DS540_0005_CRC-B5BD-1-3.b64

where:

*upgrade	- command to download configuration file from FTP server,
ftp://	- marking of transmission type,
dsclient	- login to FTP server,
:	- sign separating login and password to FTP server,
tytansat123	- password to FTP server,
@	- sign separating access parameters and FTP server address
ftp.tytansat.com	- FTP server address,
DS520_DS540_0005_CRC-B5BD-1-3.b64	- name of downloaded file.

Unit with SN 31983 confirms receipt of correct command by sending text message (in ASCII format) to the server that the device sends telemetry data to:

@00007CEF,UPGRADE,ADDRESS-FORMAT-OK

After the first part of DS520 firmware is downloaded properly:

@00007CEF,UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-1-3.b64 DOWNLOAD-PART-1-OK

After the second part of DS520 firmware is downloaded properly:

@00007CEF,UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-2-3.b64 DOWNLOAD-PART-2-OK

After the third part of DS520 firmware is downloaded properly:

@00007CEF,UPGRADE,FILE DS520_DS540_0005_CRC-B5BD-3-3.b64 DOWNLOAD-PART-3-OK

and then:

@00007CEF,UPGRADE,DOWNLOAD-COMPLETED

Next, if configuration file has been transmitted correctly, the device resets.