TechnoKom

GLONASS GPS
VEHICLE TRACKING SYSTEM

GSM AutoGRAPH

VEHICLE TRACKING SYSTEM

2015 VERSION 15.2
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USER MANUAL

VEHICLE & PERSONAL TRACKING SYSTEM
AutoGRAPH
GLONASS • GPS
GSM • WiFi • OFFLINE

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Some functions of AutoGRAPH-GSM Series controllers depend on capacities and configuration of the existing mobile network operator (MNO). Furthermore, some functions may be disabled by the operator, or their operating range may be limited due to the settings of the network. To check availability of a certain function, contact your mobile network operator.

All information on functions, functional capabilities and other specifications related to AutoGRAPH-GSM Series on-board vehicle tracking controllers, as well as all information contained in this User Manual is based on current data (at time of writing) and is deemed to be valid as of the date of publication. Technokom reserves the right to modify the information or specifications without prior notice or commitment.

Introduction

This User Manual applies to AutoGRAPH-GSM Series on-board vehicle tracking controller (hereafter - tracker) of hardware revision 3.0 produced by TechnoKom Ltd[1]. It contains installation and connection procedures of this device, as well as its function and control. This Manual constitutes the Operating Rules to be observed to ensure successful operation of the controller and its compliance warranty provisions.

The Manual is intended for specialists who are aware of maintenance and installation principles typical for motor vehicles and are proficient in using the electronic and electrical equipment of various vehicles.

To ensure the best performance of the AutoGRAPH-GSM controller, they should be installed and set up only by qualified specialists.
For proper operation of the AutoGRAPH-GSM controller, a user should be aware of operating principles of the vehicle tracking system as a whole, as well as understand functions of its individual components. Therefore, it is highly recommended to study the fundamentals of operation of GPS navigation, GSM communication, peculiarities of short message service (SMS), GPRS and the Internet before starting.

Version history

This table provides a summary of the document revision

Version	Description	Date
15.0	Initial release for AutoGRAPH-GSM 3.0.	12/2014
15.1	Added information on the AutoGRAPH-GSM+ modification	12/2014
15.2	Added correct structure diagram on p.16	02/2015

[1] The AutoGRAPH-GSM on-board trackers of hardware revision 3.0 have been produced from serial number 0360001.

Safe Operation Recommendations

This section contains important information for effective and safe operation. Please read the information below before using AutoGRAPH-GSM on-board vehicle tracking controllers.

Performance Characteristics

AutoGRAPH-GSM on-board vehicle tracking controllers operate using a GSM/GPRS module and function as a low power receiver and transmitter. When the device is ON, it receives and transmits electromagnetic energy in the radiofrequency range. Operating band of the device ranges from 900 MHz to 1,990 MHz; the device uses digital modulation techniques.
When the device is in operation, a call service system controls the strength of sent-out RF signal.

Exposure to Electromagnetic Fields

The design of the AutoGRAPH-GSM on-board vehicle-tracking controller complies with the following standards, which specify the safe levels of exposure to radiofrequency electromagnetic fields:
• EN 55022: 2010+AC:2011 / Class B Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement.

• EN 55024:2010 Information technology equipment. Immunity characteristics. Limit and methods of measurement.

• EN 61000-3-2:2006+A1:2009+A2:2009/ -3:2008 Electromagnetic compatibility (EMC) Limits.

• EN 61000-6-3:2007+A1:2011 Electromagnetic compatibility (EMC) Generic standards.

• EN 301 489-1 Electromagnetic compatibility and radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standards for radio equipments and services.

Antennas

Use only original supplied antennas. Antennas that have been modified may damage the device or cause violations of statutory rules and regulations.
DO NOT touch the GSM antenna of the device while it is in operation. This can impair communication quality and give rise to an undesired increase in radiated power.
DO NOT touch the GPS antenna of the device while it is in operation. This can impair the quality of reception and result in inaccurate positioning.
DO NOT use a device with a defective antenna. If there are any defects in antenna or antenna cable, replace the antenna or consult your local dealer as soon as possible.

Electromagnetic Interference and Compatibility

Almost any electronic device is subjected to electromagnetic interference unless it is adequately shielded, has proper construction or is compatible with devices operating in another frequency band.

Prohibition on Use of Mobile Communication Devices

If you come across a signage or a notice, which prohibits the use of mobile communication devices, turn off your tracker. This is required to avoid electromagnetic interference with equipment sensitive to electromagnetic fields often used in hospitals, health care institutions or petrol stations.

Medical Devices

Cardiac Pacemakers

Medical Device Manufacturers Association advises to use mobile communication devices at distances greater than 15 cm from cardiac pacemaker so as to prevent the failure of the latter. These recommendations conform to the studies carried out by independent

medical laboratories and Research Centre for Wireless Technologies.

Hearing Devices

Sometimes, use of mobile communication devices may cause troubles for wearers of certain hearing devices. In this case, consult the manufacturer of your hearing device to select another model.

Other Medical Devices

For other personal medical devices, contact your physician or device manufacturer to find out whether your device is adequately shielded from electromagnetic interference generated by mobile communication devices.

General Information on Safe Use

Vehicle

Observe the rules on using hand-held devices when driving.

- Use hands-free devices when driving.
- Stop to make or take a call.

Explosion Hazard Zones

SWITCH OFF the device when entering the explosion hazard zone. Explosion hazard zones include: fuel stations, box girder decks on sea vessels, facilities or plants for handling and storage of fuels or chemicals, areas with chemicals or solid particles such as grains, dust or metal powder in atmosphere; and any other locations where it is usually required to shut off a vehicle's engine. Explosion hazard areas are often (yet not always) expressly marked.

Blasting Areas

In order to avoid interference with blasting operations, SWITCH OFF the device in blasting areas or in any locations marked with «Two-way radio-communication is prohibited» signage. Observe the signage instructions and rules.

Product Overview

The AutoGRAPH-GSM Series on-board vehicle tracking controller is an electronic recorder which tracks all movements of a vehicle by recording the time and the route in the form of geographic coordinates received from the satellites of global navigation system GPS (NAVSTAR) or GLONASS.
In addition to coordinates, the device records a number of other parameters: speed, direction of movement, event counters, etc., as well as the states of digital inputs of the controller, external sensors and data buses.
Collected data is transferred by a GSM 900/1800 mobile network operator by means of General Packet Radio Service (GPRS) to the dedicated server where they become available via the Internet for further analysis and processing by dispatch software.
The device may be used for any type of vehicles.

Data transfer is possible only when GSM 900/1800 mobile network operator, which supports General Packet Radio Service (GPRS), is available.

Technical Specifications

Description	Value for AutoGRAPH-	
	GSM	GSM+
GNSS Receiver		
Supported GNSS	GLONASS + GPS / GALILEO / Beidou	
GNSS receiver	uBlox MAX-M8Q	
Channels	72	
A-GNSS service	Yes	
Differential GPS (D-GPS)	Yes	
Antenna (GPS/GLONASS)	External (SMA)	
GSM Module		
Communication	GSM (GPRS / SMS)	3G UMTS[1] / GSM (GPRS / SMS)
SIM card holders	2	
Antenna (GSM)	External (SMA)	
General		
Connection to PC	USB 2.0	
Internal FLASH memory, records	> 270.000	
Additional memory	External MicroSD (up to 32GB)	Internal eMMC (4GB)
Digital inputs, total number	6	
High-impedance digital inputs, total number	---	1
Configurable inputs (analogue/digital), total number	2	
Digital outputs, total number	2	
Built-in accelerometer	Yes	
1-Wire	1	
RS-232	1	
RS-485 (TIA / EIA-485-A)	2	
CAN (SAE J1939 / FMS)	1	2
Audio interface (GSM) / Loudspeaker amplifier	No	Yes
Type of external backup battery (not supplied)	Lead-acid	
Rated backup battery voltage	12 / 24	12
Battery Charger	No	Yes
Charging time, hours	---	30

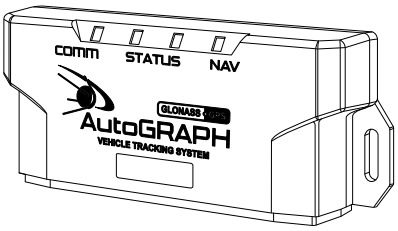
Operating voltage, V	10...50	
Maximum supply voltage, V	60	
Power consumption at 12 VDC: - recording state, mA - data transferring state, mA	70 300	80 320
Time to first start[2], sec	23	
Protective case (IP54)	Optional	
Operating temperature, °C	-40...+85	
Dimensions, mm: - standard case - protective case	138 x 67 x 27 138 x 92 x 27	
Weight, kg: - standard case - protective case	0,110 0,150	
Average life time, years	10	

[1] Optional. Specified in «Hardware version» field.
[2] With nominal navigation signals level -130dBm.

Scope of Supply

№	Description	GSM
1	AutoGRAPH-GSM (GPS/GLONASS) on-board controller	1
2	Interface Cable (primary)	1
3	Additional 4/6-pin interface cable	1*
4	6-pin RS-485 / CAN interface cable	1*
5	4/6-pin RS-232 / RS-485-2 interface cable	1*
6	«AGNA-G2» GPS/GLONASS Antenna	1
7	«AGCA-4G» GSM Antenna	1
8	1A fuse with a holder	1
9	Warrantee certificate	1

*on request



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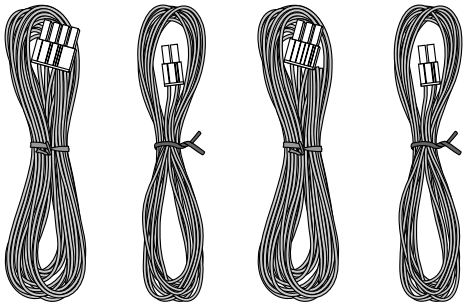

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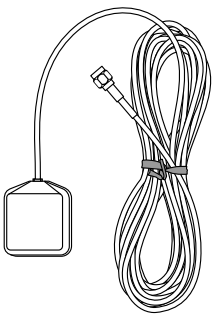

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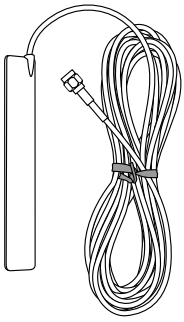

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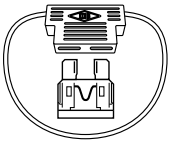

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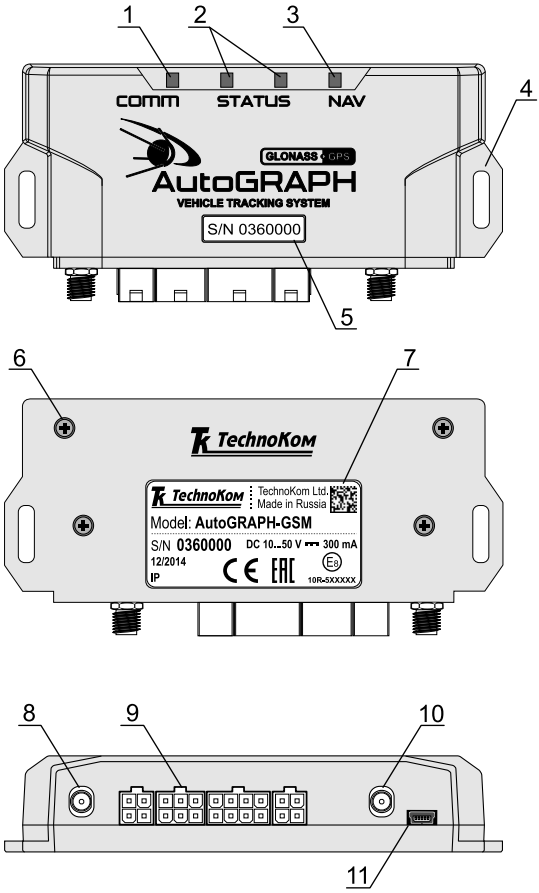
Components of AutoGRAPH-GSM Controller (standard case)

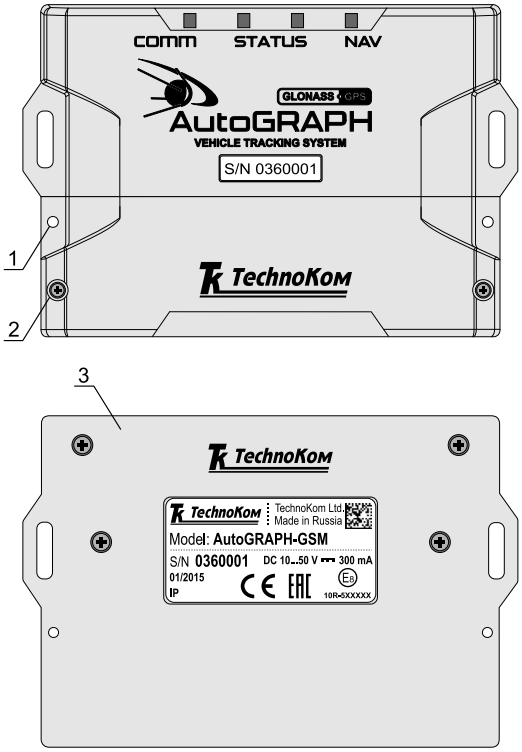


1. **COMM LED (bi-colour).**
2. **STATUS LEDs.**
3. **NAVIGATION LED (bi-colour).**
4. **Mounting bracket.**
5. **Label with serial number.**
6. **Fastening screw of a back cover (x4).**
7. **Manufacturer's label.**
8. **GSM antenna**
9. **Interface connectors.***
10. **GPS / GLONASS antenna.**
11. **Mini USB connector**

* For more detailed information on assignment of interface connectors see «Interface Connectors» section of this User Manual.

Components of AutoGRAPH-GSM Controller (protective case)

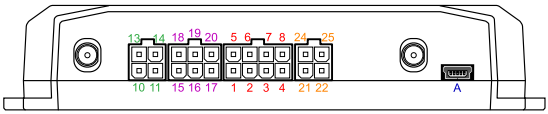
Optionally, the AutoGRAPH-GSM may be supplied in a protective case providing high ingress protection rate and sealing option. The protective case has built-in case tamper switch intended to fix any attempts of the case disclosing.



1. **Sealing hole (x2).**
2. **Fastening screw of a protective cover (x2)**
3. **Back protective cover.**

Interface Connectors

AutoGRAPH-GSM (GPS/GLONASS)



Primary interface connector

№	Colour of a wire in a cable	Assignment
1	Red (long)	+ Vin
2	Black	-Vin
3	Yellow	Digital input 1 (active low)
4	Green	Analogue input 1 (0…10 V) / Digital input 5 (active high)
5	Red (short)	+ Backup supply voltage
6	Gray	Open collector output 1 (0.5 A)
7	White	Digital input 2 (active low)
8	Brown	Analogue input 2 (0…24 V) / Digital input 6 (active high)

4-pin interface connector

№	Colour of a wire in a cable	Assignment
10	Blue	Digital input 3 (active low)
11	Orange	Open collector output 2 (0.5 A)
13	Blue with a white stripe	Digital input 4 (active low)
14	Pink	1-Wire

6-pin CAN / RS-485 interface connector

№	Colour of a wire in a cable	Assignment
15	Green with a white stripe	CAN (H)
16	Black with a white stripe	Digital input 7 (active high)
17	Brown with a white stripe	RS-485 (B)
18	Yellow with a white stripe	CAN (L)
19	Red with a white stripe	Digital input 8 (active high)
20	Orange with a white stripe	RS-485 (A)

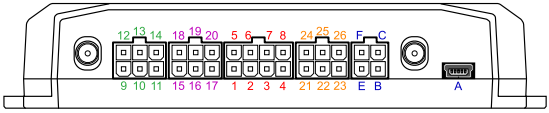
4-pin RS-232 / RS-485 interface connector

№	Colour of a wire in a cable	Assignment
21	Brown with a blue stripe	RS-232 TxD
22	Brown with a white stripe	2: RS-485 (B)
24	Orange with a green stripe	RS-232 RxD
25	Orange with a white stripe	2: RS-485 (A)

Additional connectors

ID	Assignment
A	Mini USB connector (programming / data reading / GPS mouse)

AutoGRAPH-GSM+ (GPS/GLONASS)



Primary interface connector

№	Colour of a wire in a cable	Assignment
1	Red (long)	+ Vin
2	Black	-Vin
3	Yellow	Digital input 1 (active low)
4	Green	Analogue input 1 (0…10 V) / Digital input 5 (active high)
5	Red (short)	+ Backup rechargeable battery
6	Gray	Open collector output 1 (0.5 A)
7	White	Digital input 2 (active low)
8	Brown	Analogue input 2 (0…24 V) / Digital input 6 (active high)

6-pin interface connector

№	Colour of a wire in a cable	Assignment
9	Green with a white stripe	CAN2 (H)
10	Blue	Digital input 3 (active low)
11	Orange	Open collector output 2 (0.5 A)
12	Yellow with a white stripe	CAN2 (L)
13	Blue with a white stripe	Digital input 4 (active low)
14	Pink	1-Wire

6-pin CAN / RS-485 interface connector

№	Colour of a wire in a cable	Assignment
15	Green with a white stripe	CAN (H)
16	Black with a white stripe	Digital input 7 (active high)
17	Brown with a white stripe	RS-485 (B)
18	Yellow with a white stripe	CAN (L)
19	Red with a white stripe	Digital input 8 (active high)
20	Orange with a white stripe	RS-485 (A)

6-pin RS-232 / RS-485 interface connector

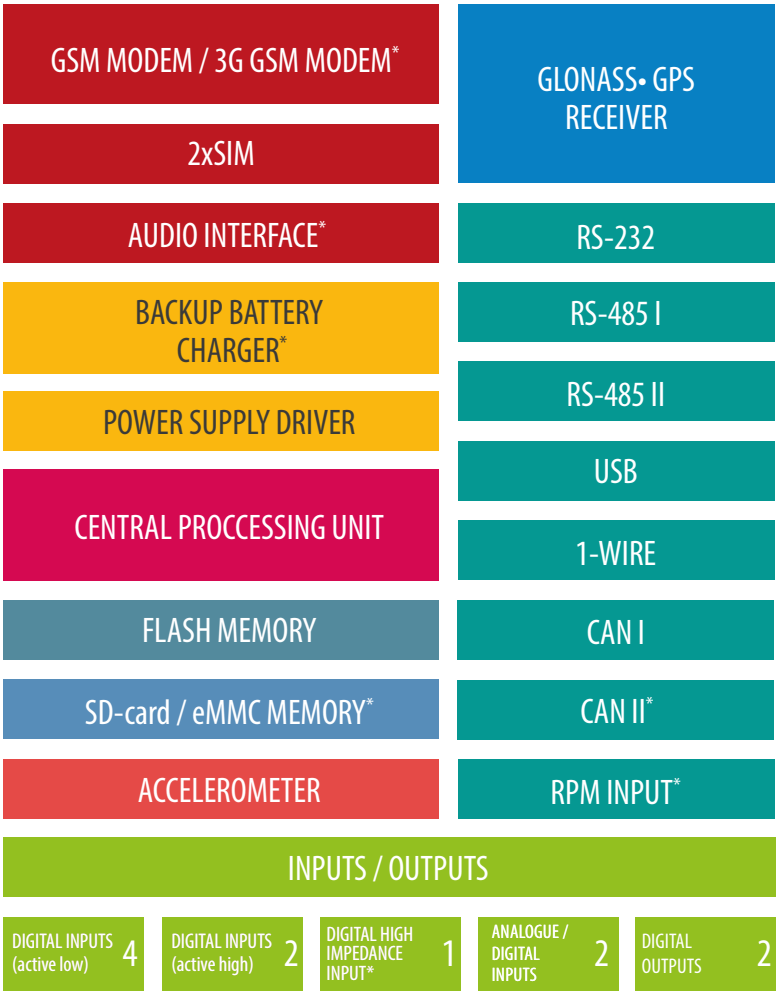
№	Colour of a wire in a cable	Assignment
21	Brown with a blue stripe	RS-232 TxD
22	Brown with a white stripe	2: RS-485 (B)
23	Yellow with a grey stripe	RPM input*
24	Orange with a green stripe	RS-232 RxD
25	Orange with a white stripe	2: RS-485 (A)
26	Pink	Digital input 9 (high-impedance)

* Unavailable in h/w 3.0

Additional connectors

ID	Assignment
A	Mini USB connector (programming / data reading / GPS mouse)
B	+Microphone signal input
C	Loudspeaker signal output (2.65 W amplifier)
E	Ground
F	Call / Answer button input

Structure Diagram of AutoGRAPH-GSM (GPS/GLONASS)



IMPORTANT

**Module is built-in only in the AutoGRAPH-GSM+.*

GSM-modem

The GSM modem is intended to provide a connection between the controller and the GSM mobile network. The GSM signal is received and transmitted via an external GSM antenna. The controller is equipped with a SIM card to be identified by the GSM network and to be able to access the services provided by the mobile network operator. The GSM modem performs several functions:

• Enables the device to access the GSM network and to be identified by the network using the SIM card.

• Enables data exchange (including transfer of track points) between the AutoGRAPH-GSM controller and the server via TCP/IP through the Internet by means of General Packet Radio Service (GPRS).

• Enables exchange of information and control SMS messages and USSD requests (for example, for subscriber's personal account monitoring).

GPS / GLONASS module

The GNSS module is designed using a highly sensitive receiver based on high performance u-blox M8 engine. It receives coded signals by means of external active GPS/GLONASS antenna from the satellites of the Global Positioning System (NAVSTAR) and GLONASS, and uses its internal computer to determine the geographical coordinates of the receiver position, the exact time, speed and direction of movement. Received data is transferred via NMEA protocol from the GNSS module output to the central processing unit for further processing.

The u-blox MAX-M8 supports concurrent reception of two GNSS systems and, as a result, the information being received is highly accurate and available even in the case of very poor visibility of satellites.

CPU

The central processing unit is the core of the AutoGRAPH-GSM controller, which unites all of the system components together and ensures their interaction in accordance with the program stored in the device. The processing unit is a high-speed single-chip microcomputer able to perform computations of at a speed and accuracy level that is sufficient to meet various navigation and service challenges. The custom firmware, developed by TechnoKom specialists, enables the CPU to receive data from the different modules of the system, to perform logical and mathematical processing of the data and to control the modules as appropriate. It should be noted that the functional capability of the controller firmware is being constantly enhanced and extended so as to provide users with new and improved features and options.

Power Supply Driver

The power supply driver with protection circuits generates all of the necessary supply voltages for controller components. The primary power supply input ensures operation at vehicle system voltage of 10-50 V, which makes it possible to use the controller on the majority of vehicles without employing any additional voltage regulation.

Furthermore, the power supply driver protects the controller against polarity reversal, voltage overload, interference, etc. A resettable fuse is installed in the supply circuit of the printed circuit board in order to provide extra protection.

Long-term exposure of the controller to the maximum values of the supply circuit may cause irreparable damage to the protection circuits due to overheating or disruption. This may lead to failure of the device. DO NOT exceed the maximum values stated. Operating voltage range and maximum supply voltage values are specified in Technical Specifications section.

Non-Volatile FLASH Memory Module / Additional Memory

The Non-Volatile FLASH memory module serves as a black box storage device to store the collected data. The FLASH memory module is designed to store up to 270,000 records for up to 10 years – even when the device is powered off. The FLASH memory module in the AutoGRAPH-GSM is designed to use the ring buffer principle, which means that new records will be written over the oldest records first, ensuring that the most recent data is always available.
The AutoGRAPH-GSM controller is equipped with additional memory to store log-files and photos from cameras connected to the controller. The AutoGRAPH-GSM controller uses an external micro SD card to store additional data.

Inputs / Outputs

The I/O block is designed for monitor and measure parameters of external equipment and devices, as well as for control various actuators and warning devices.
The I/O block is divided into three sections:

Digital inputs.

These inputs have two states: «1» and «0» , and are able to show a change of input state, count pulses and measure frequency.
The controller has the four active low inputs and 2 active high inputs.
In addition, analogue inputs of the controller can operate as digital inputs with the configurable switching threshold.
Logic of the discrete inputs operation is shown in the table below:

Physical state of the input	Logic state of	
	active low input	active high input
High (connected to supply voltage)	1	1
Open-Circuit	1	0
Low (connected to ground)	0	0

Note that logic states of the two inputs differ in open-circuit state (see the table above). This must be taken into account when making connections.

Operation modes of the discrete inputs are fully programmable for each input and include:
• **Normal input**. In this mode, the digital inputs are monitored. When the input state changes, the time and location data is stored into the device memory. Normal mode is useful for recording the time of different sensors' activation and for monitoring the performance of

equipment and mechanisms, such as an alarm button, oil pressure sensor, ignition system, passenger presence sensor, security alarm triggering, opening of doors, limit switches of various special-purpose and construction machinery mechanisms, etc. This mode also enables the device to perform unscheduled transmission of data to the server via GPRS upon input state changes, as well as to send an SMS message to the specified phone number.

• **Storage counter.** This mode is intended to track the input switching states and to count various events. This may include counting of pulses from fuel-flow pulse output sensor (of DRT-5 or VZO type), passenger count, speed sensor, tipper body lift sensor, etc. In storage counter mode, the number of pulses from each sensor is stored in memory. The location data is not stored.

• **Periodic counter.** This mode is intended for counting of pulses within one minute. Periodic counter mode is used for taking the readings of sensors, which transmit measured values in pulse bursts in amounts proportional to the measured value. This mode is used, for example, for fuel level, temperature and engine speed sensors with pulse outputs. This mode does not involve recording of a track point into the storage memory when the input state changes.

• **Frequency**. This mode is intended for sensors with frequency outputs. The device is capable of measuring frequencies of 0 – 2,500 Hz. Frequency measurement mode is used, for example, for fuel level sensors with frequency outputs, engine and shaft speed sensors, proximity sensors etc.

High-impedance inputs

Furthermore, the AutoGRAPH-GSM+ controller is equipped with one digital high-impedance active high input with logic levels independent of the supply voltage of the device connected to this input.

Analogue inputs

Analogue inputs are designed to measure the signal level generated by analogue sensors and can be used to measure fuel level in a tank, temperature, pressure and other properties. The AutoGRAPH-GSM controller is equipped with two 10-bit analogue inputs, which are fully configurable. Each analogue input of the controller can be set up to record data when the level of the analogue signal changes by a specified value.
The measuring range of the first analogue input is 0 to 10 V or 0 to 1023 ADC stages.
The measuring range of the second analogue input is 0 to 24 V (but not more than supply voltage level of the controller) or 0 to 1024 ADC stages.

Furthermore, the analogue inputs of the controller can be set up to operate as active high digital inputs with a configurable switching threshold. When an analogue input operates as a digital one, the controller simultaneously records both analogue data and corresponding logical state. This allows analogue inputs to be used to measure an analogue value and detect a threshold crossing (for example, critical pressure level, temperature or fuel level etc.).

Digital outputs

Digital outputs are intended to control any external actuators and turn on warning devices. The controller has two programmable, open collector, discrete outputs. The outputs are controlled by an SMS command and can be set up to send a pulse of a specified length or to switch to specified state. Advanced users can send control commands via the data server.

In simple case, the discrete output can be used to warn about speeding, an entrance or exit of the geofenced area, etc.

USB Port

The USB port embedded into controller is intended to:
• configure and check the performance of the controller by means of the configuration program – GSMConf;

- read data from the device so as to deliver them to the AutoGRAPH Dispatch Software;
- update processor microcode (firmware) of the device;
- use the controller in the «GPS mouse» mode.

When using the device as a GPS mouse, the tracker, which is connected to the USB port of a PC, laptop or PDA with a data cable via virtual serial port (COM port), transmits the location data in RMC format through the NMEA protocol once per second. This enables the users to locate the object equipped with the AutoGRAPH-GSM using software such as OziExplorer, Google Earth Plus/Pro, 2GIS for PC 3.0, Garmin, Navitel and many others. For details please refer to «Using the GPS mouse» document.

CAN Bus (SAE J1939/FMS)

The CAN bus is an industrial network standard primarily designed for interconnection of various actuators and sensors in a single network. It is used in the automotive industry as a management and control line. The CAN interface of the controller may be connected to the CAN bus of a vehicle and is intended for use with SAE J1939 / FMS standard protocol. This standard is widely used in vehicles of well-known truck manufacturers, such as SCANIA, MAN, VOLVO, DAF, IVEKO, RENAULT, MERCEDES (DaimlerChrysler), KAMAZ and MAZ trucks of latest models etc. Advanced users can set up the tracker to receive data in any CAN protocol using the GSMConf program.
Use of the two-wire CAN bus enables quick connection and allows access to a great number of parameters directly from the sensors of vehicles.
Using the CAN bus, the following information would become available: vehicle speed, cruise control status, accelerator pedal position, brakes and clutch switch statuses, fuel consumption, fuel level in tanks (up to 6 sensors), engine speed, service distance, engine hours, engine coolant temperature, oil and fuel temperatures, total vehicle distance and vehicle distance per day and axle weight. Furthermore, it enables monitoring of some custom parameters not covered by SAE J1939 / FMS standard.

RS-485 (TIA / EIA-485-A)

RS-485 (TIA / EIA-485-A) is a data transfer standard for data transmission via a two-wire serial channel. This bus serves to simultaneously connect up to 32 different devices and sensors compatible with the controller's firmware by two wires.
The controller is equipped with two RS-485 buses. Additional RS-485-2 Bus is designed for connecting a photo camera to the tracker.
The bus enables users to connect up to 8 fuel level LLS sensors, as well as Escort-TD, Strela-D485, DUT-E-485, DT7.3-06, UZI-1.x and other sensors, and some extra expansion modules to extend the controller's functions, e.g. display for indication and messaging with a vehicle driver, passenger traffic metering unit, expansion modules for discrete and analogue inputs, barometrical altimeter, RS-232/RS-485 converters, etc.
The RS-485 port of AutoGRAPH-GSM controllers support MODBUS protocol that enables the users to connect the controller to the thermal sensors, which transmit data via this protocol.

1-Wire

1-Wire, designed by Dallas Semiconductor Corporation, is a simple and convenient bus typically used to communicate with small devices and sensors such as digital thermometers, iButton keys, card readers, and other devices equipped with 1-Wire bus and compatible with the controller's firmware.

RS-232 (EIA/TIA-232-E)

RS-232 is a communication standard for serial communication between two devices: the AutoGRAPH-GSM controller and any external device compatible with the controller's firmware.
The AutoGRAPH-GSM controller supports interaction with the external GPS/GLONASS receiver via NMEA 0183 standard, the CAN-LOG module and the AutoGRAPH-NAVIGATOR Display via RS-232.

Accelerometer

The AutoGRAPH-GSM is equipped with 3-axis digital accelerometer with wide range of full scales from ±2g to ±16g intended to detect motion, determine the tracker's orientation, measure vibration level, etc. The tracker can be set up to send a notification to a preset telephone number or data to a preset server, when detecting the acceleration exceeding a preset threshold.

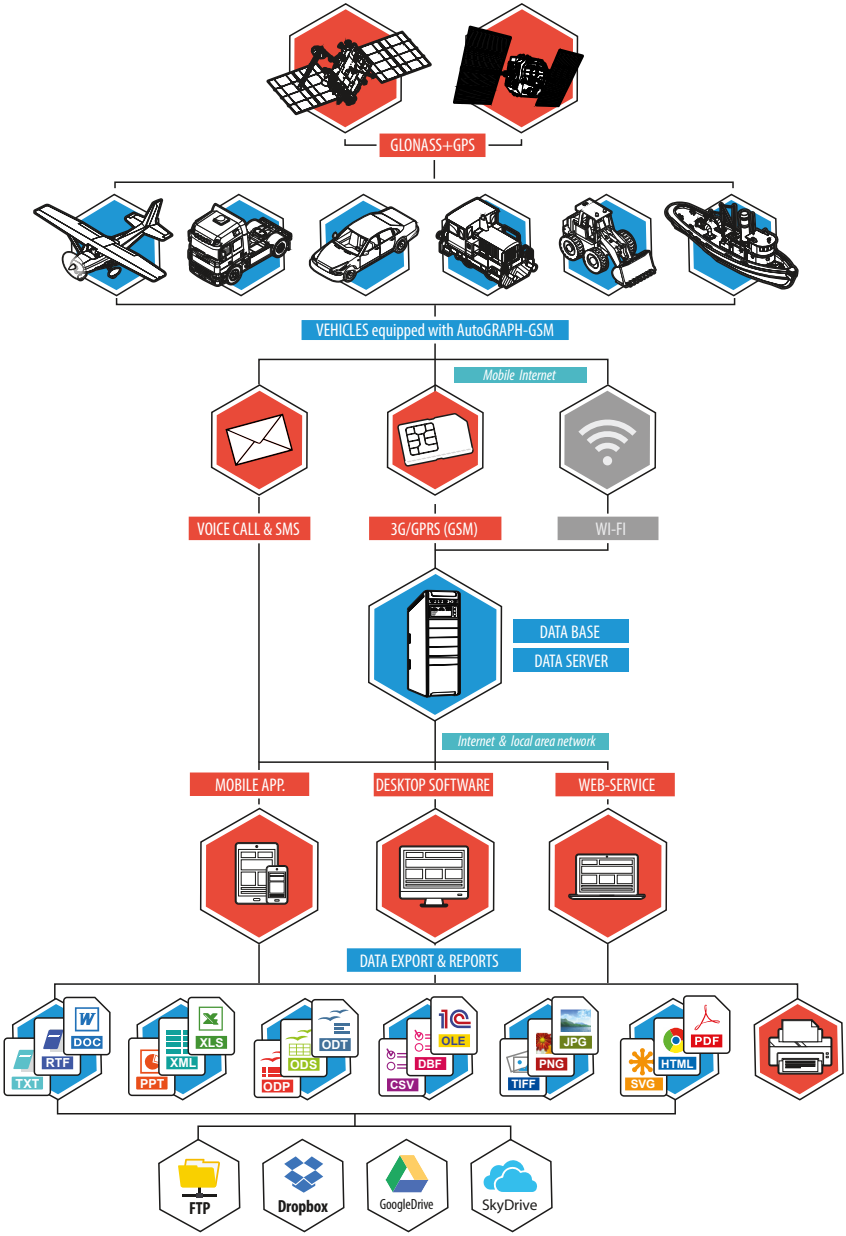
Battery Charger*

The AutoGRAPH-GSM+ has a built-in charger to charge an external backup battery. When the controller is powered by the vehicle power system, the power supply driver turns on the charger. The controller sends a notification to a preset telephone number when the backup battery voltage falls below the threshold.

Audio Interface (with loudspeaker amplifier)*

The audio interface provides voice communication between vehicle driver and a dispatcher via GSM.
The AutoGRAPH-GSM+ is equipped with a loudspeaker, a microphone and an Answer/Call button to make a two-way voice communication.
A built-in amplifier increases the signal amplitude 2.65 times and transfers it into the speaker. The speaker output, microphone input and pins for connecting an external Answer/Call button are arranged on the singular 4-pin Mini-Fit connector.
Answering and making a call are performed by means of the button on the loudspeaker. Furthermore, the controller automatically answers calls coming from numbers those have masks specified in the controller. For example, if the number «543» is specified, the tracker will automatically answer a call from all numbers that contain «543».

Brief Description of Vehicle Tracking System Operation



AutoGRAPH-GSM controllers, installed on vehicle, constantly receive coded signals from Global Positioning System (NAVSTAR) and GLONASS satellites. These signals are used to determine exact coordinates of the vehicle location.

The coordinates are written to the non-volatile memory of the AutoGRAPH-GSM controller, either on a regular basis or adaptively. Furthermore, the storage memory records and stores the statuses of various sensors connected to the tracker or data buses, and other parameters required by the software.

Either on a regular basis or upon occurrence of a preset event, the collected data is transferred to the dedicated AutoGRAPH server over the Internet using General Packet Radio Service (GPRS) supported by a GSM mobile network operator.

The server is a computer running Microsoft Windows Server with an Internet connection, permanent IP-address and reliable data storage device. The server is responsible for receiving data from AutoGRAPH-GSM controllers, storing the data and transmission upon request to the dispatcher stations. Key files are used to provide data access security on the server.

Dispatcher workstations are personal computers or laptops with the AutoGRAPH dispatch software installed (and with the key files required for particular vehicles) that has either Internet access or server connection via LAN. An Internet connection and computer with the Dispatch Software will enable users to obtain data from anywhere in the world. Easy deployment of the Dispatch Software without the need to install third-party database support enables users to immediately create new dispatcher workstations with any PC running MS Windows 2000/XP/Vista/7/8. The number of workstations is unlimited. Dispatch Software is completely free of charge and the latest version may be downloaded from the official website of TechnoKom: http://www.tk-chel.ru.

Mobile users can easily track vehicle movement in real-time using WEB based AutoGRAPH.WEB dispatch software run on any mobile device connected to the Internet.

Upon the user's request or on a regular basis the dispatcher workstation connects with the server to update data on. Depending on version of the AutoGRAPH Server Software, access to the data is provided according the controller key or the personal login and password. The received data is stored in a local folder on the dispatcher workstation that enables processing of the data without being connected to the server. Furthermore, to reduce the web traffic, the dispatching network may be organized in such a way as to send any missing data through the Internet to only one workstation, while all other users may use these downloaded data via LAN by retrieving them from the local data folder of the workstation. The users may use this data to track the vehicles on a map, browse through various parameters, events and readings of various sensors. In addition, it is possible to generate various types of reports and charts both for each particular vehicle and in groups.

To interact with various external applications and handlers (including 1C), AutoGRAPH Software incorporates OLE server application (COM server) which enables data exchange between AutoGRAPH Software and the programs written in the majority of existing programming languages which support OLE-enabled data exchange, as well as programs and systems based on their own embedded programming language (1C Enterprise, MS Office, various databases, etc.).

Furthermore, there is an option to upload all tracking data and reports in the form of MS Excel, DBF and CSV files, as well as to use an external customizable reporting module which allows users not only to generate a large number of reports with fully customized layout, data and charts to be presented, but also to save them in many different formats to enable further processing, sending or presentation: PDF, Open Office ODS, Open

Office ODT, MS Excel (OLE), MS Excel (XML), XML, RTF, HTML, TEXT, CSV, BMP, JPEG, TIFF, GIF.

Control SMS commands and preset events enables sending of vehicle location coordinates and various notification messages to an ordinary cell phone of GSM standard by means of SMS messages. Furthermore, SMS commands can be used to configure AutoGRAPH-GSM+ tracker directly from a cell phone or a PDA.

It should be noted that this brief description covers just one of the simple operation schemes of the vehicle tracking system based on AutoGRAPH-GSM hardware and software. The device has a range of customizations available to tailor the product to the users' needs.

There are various third-party software solutions that can be interfaced with the AutoGRAPH-GSM, which may support some specific functionality.

To obtain detailed information on the implementation of particular features for customization of the monitoring system in accordance with your needs, please contact your regional authorized representative of TechnoKom and the manufacturer's technical support service.

Connection of AutoGRAPH-GSM controller

This section covers connection procedures of AutoGRAPH-GSM/GSM+ controllers:

- Installation of a SIM card
- Installation of an microSD card
- Connection of a GPS/GLONASS antenna
- Connection of a GSM antenna
- Power supply connection
- Digital inputs connection
- Analogue inputs connection
- Outputs connection
- 1-Wire connection
- RS-485 bus (TIA / EIA-485-A) connection
- RS-232 bus connection
- CAN bus (SAE J1939 / FMS) connection

To make the device ready for the simplest operation scheme it would be sufficient just to install a SIM card, GPS/GLONASS and GSM antennas, and to connect a device to a power supply source.

However, the hardware and software of AutoGRAPH-GSM controllers includes an extensive range of features and capabilities, which allow for easy configuration, customization and adaptation of the system to the needs of the user.

Application of digital and analogue inputs, outputs and data buses enables permanent monitoring of various parameters (for example, fuel consumption and fuel level), as well as to monitor operating conditions and performance of external equipment and devices and to promptly respond to various events (for example, to the pushing of an alarm button). The output of the controller enables the device to control various actuators and warning devices. An external backup battery enables the controller to operate even when the main power fails. All of these features allow the creation of diverse variants of the system able to perform monitoring of a great number of parameters and to respond to various events.

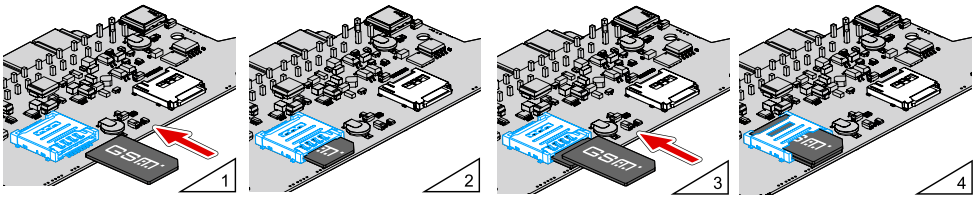
The following sections focus on basic connection diagrams of various interfaces, inputs and outputs of the AutoGRAPH-GSM controller.

Installation of SIM Card

The AutoGRAPH-GSM controller is equipped with a dual SIM holder.

To insert SIM cards:

- Unscrew the four fastening screws and remove the back cover of the tracker.
- Insert a SIM card in the lower retaining slot of the SIM card holder with the card's contacts facing the PCB (see fig.1). Be sure that the card's keying matches the key on the PCB (see fig.2).
- If necessary, insert a second SIM card in the upper retaining slot of the SIM card holder with the card's contacts facing the PCB (see fig.3). Be sure that the SIM card is inserted into the retaining slot with its cut angle facing the edge of the printed circuit board (see fig.4).
- When the SIM cards are connected place the back cover back and tighten the four fastening screws.



The SIM card installed in the lower retaining slot of the SIM card holder is the main card. When switched on, the AutoGRAPH-GSM controller will operate with this SIM card. The SIM card installed in the upper retaining slot of the SIM card holder is the backup card. The tracker will switch to the backup SIM card when the main card is unavailable (disabled, damaged or not inserted).
For proper operation it is quite sufficient to insert the main SIM card into the tracker. But the backup card provides the appropriate operation of the controller even if the main SIM card is damaged. Due to this the controller will stay connected and be able to transfer data full time.

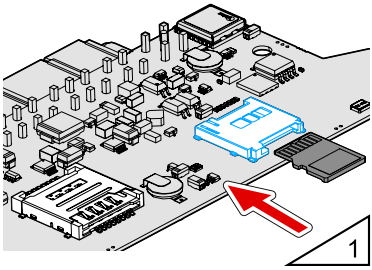
Do a test of a new SIM card in a cell phone before you install it into the controller. This ensures that GPRS / SMS / USSD services are enabled and operate properly, the PIN code matches the code preset in the controller (in order to prevent locking), and a personal account associated with the SIM card has the sufficient balance for successful operation of the services.

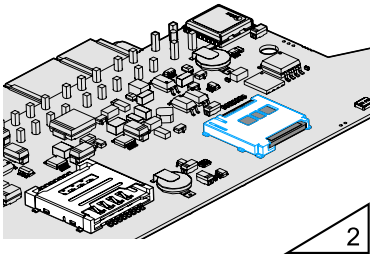
Installation of MicroSD Card

The AutoGRAPH-GSM controller is equipped with a microSD card slot located on the upper side of the PCB. The microSD card is used to store photos from cameras connected to the tracker. The tracker supports operation with microSD cards with maximum capacity of 32GB.

To insert microSD card:

- Unscrew the four fastening screws and remove the back cover of the tracker.
- Insert a microSD card in the slot with the card's contacts facing the PCB (see fig.1).
- When the microSD card is inserted, place the back cover back and tighten the four fastening screws.





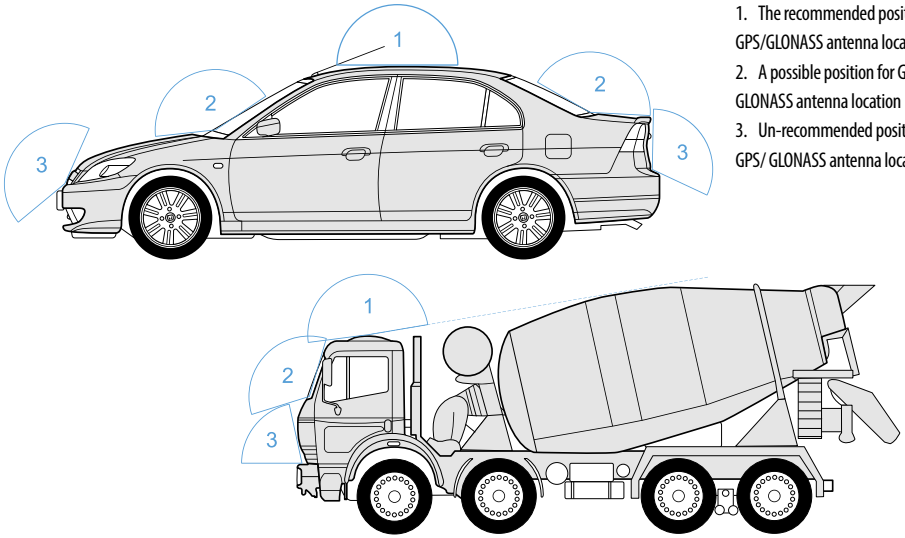
To remove the microSD card, gently push the card's external edge and release it. Then remove the card.

Connection of GPS/GLONASS Antenna

The controller is supplied with magnetic mounted waterproof, active GPS/GLONASS antenna. The GPS/GLONASS antenna is connected to the connector in the lower-right part of the AutoGRAPH-GSM controller.

The position of the GPS/GLONASS antenna is critical to goof performance of the GPS receiver, therefore it is highly recommended to plan the antenna's position on a vehicle before installation.

The antenna should be located in an open area, which shall ensure free GPS signal transmission; its active surface should face the sky and be parallel to the celestial sphere. Possible variants are illustrated in the picture below:



1. The recommended position for GPS/GLONASS antenna location
2. A possible position for GPS/ GLONASS antenna location
3. Un-recommended position for GPS/ GLONASS antenna location

NOTE

When locating the antenna make allowance for the length of its cable. When laying the cable, avoid sharp edges. Cable bend radius should be at least 10 cable diameters (about 3. . . 5 cm).
Do not fix antenna before you make settings and configure your system, it is highly recommended to determine its final position and install only when you are absolutely sure that the system is configured and operates properly.

IMPORTANT

Do not splice or cut the antenna cable.

Connection of GSM Antenna

The AutoGRAPH-GSM controllers are supplied with a flat GSM antenna. The antenna has an adhesive coating for it to be stuck to the window.

The GSM antenna is connected to the connector in the lower-left part of the controller.

The position of the GSM antenna is critical to good performance of the GSM and GPRS communication; therefore it is highly recommended to plan the antenna's position on a vehicle before installation.
The antenna should be located in an open area, which shall ensure free GSM signal transmission.

Wipe the window surface with the cloth supplied with the antenna before you attach the GSM antenna. If antenna is supplied without a cloth, clean the window surface with any cloth damped with alcohol-based liquid before sticking the antenna.

When locating the antenna make allowance for the length of its cable. When laying the cable, avoid sharp edges. Cable bend radius should be at least 10 cable diameters (about 3-5 cm).
Do not fix antenna before you make settings and configure your system, it is highly recommended to determine its final position and install only when you are absolutely sure that the system is configured and operates properly.

Do not splice or cut the antenna cable.

In order to avoid cross-talk effects place the GSM and GPS/GLONASS antennas at least 50 cm away from each other.

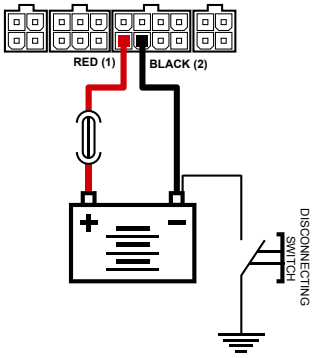
Power Supply Connection

The AutoGRAPH-GSM controller is connected to the power supply source through the interface cable supplied with the device. The device is supplied with a fuse intended to provide a short circuit protection of power supply. The fuse holder is installed on a wire ring, which should be cut before operation.

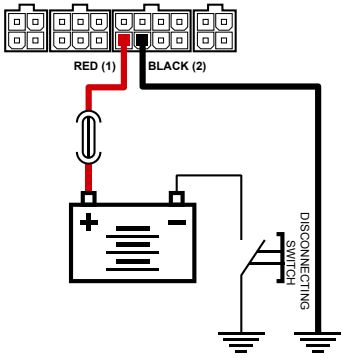
When making connections, pay special attention to the safety rules stipulated by the regulations for motor vehicle repair procedures. All connections should be properly isolated and securely connected. If the wire is too short, it can be spliced with a wire of at least 0.5 mm^2 cross section (20 AWG or thicker).

The power supply input of the controller is rated for the vehicle system operating voltage of 10-50 V DC.

Power can be fed to the controller either before or after the vehicle's battery disconnect switch:



Power connection before the vehicle battery disconnect switch



Power connection after the vehicle battery disconnect switch

If power is connected before the vehicle battery disconnect switch, the controller shall always be ON, therefore, it is highly recommended to use adaptive position recording for this case so as to minimize an amount of data to be transferred, as well as to reduce GPRS and web traffic.

The fuse should be placed as close as possible to the point where the AutoGRAPH-GSM is connected to the vehicle power system.

Backup Power Supply Connection

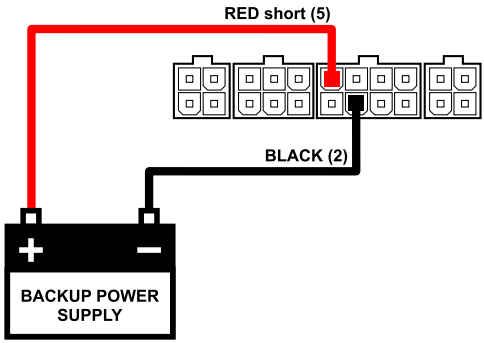
To avoid the tracker turning off, if the main power supply shuts down, the power supply driver supports connection of a backup power supply.

Switching between the main power supply and the backup power supply is performed automatically. If the main power supply turns off, the tracker switches to the backup power supply. As soon as the main power supply is restored, the controller will switch back to the main power supply.

The tracker can be setup to send a low voltage notification via SMS to a preset telephone number, if the backup supply voltage falls below 11 V.

It should be note, that the AutoGRAPH-GSM is not equipped with the battery charger.

Backup Power Connection Diagram:



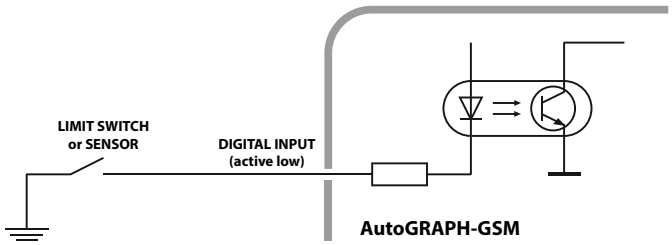
Connection of Digital Inputs 1...4 (active low)

The AutoGRAPH-GSM controller has four active low digital inputs: two inputs - on primary interface connector (pin 3, pin 7), two inputs – on additional 4-pin interface connector (pin 9, pin 11).
Active low digital input has two states:
logical «1» , when the input is connected to the supply voltage or open-circuit.
logical «0» , when the input connected to the ground. This state is considered to be active.

The input is able to show change of the input state, count pulses and measure frequency and is intended for connection to various dry contact sensors. Ensure that the sensors are in good order and able to maintain reliable operation. The manufacturer shall not bear any responsibility for correct state recording of these sensors (chatter, loss of contact and etc.).

Internal Connection Diagram of Active Low Digital Input

Internal connection diagram of the active low digital input is shown in the picture below:



NOTE

It should be noted that all voltage levels of active low digital inputs under 5 V shall be considered to be logical '0', while all voltage levels above 6 V shall be considered to be logical «1» . If the input is disconnected it shall denote logical «1» .

NOTE

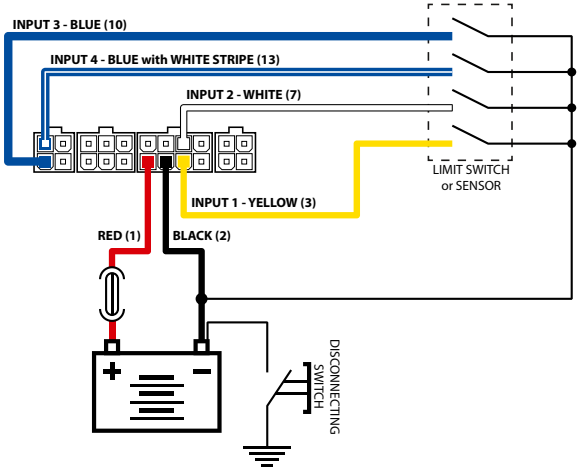
It is convenient to connect the active low digital input to an emergency oil pressure relief sensor to control the engine performance. In this case, the AutoGRAPH dispatch software shall enable metering of engine hours and application of various filters related to the engine's operating time. For example, «Skip the coordinates» filter when the engine is shut down reduces traffic and filters coordinate drift at stops when the engine is not running.

External Connection Diagram of Active Low Digital Input

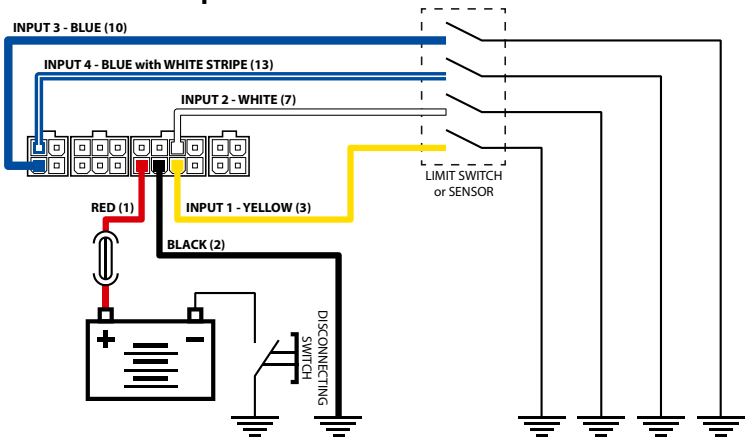
The external connection diagram for the active low digital input can vary depending on the position of the vehicle battery disconnect switch in the circuit (see Power Supply Connection diagrams).

This is due to the fact that when the sensors are connected to the vehicle body (after vehicle battery disconnect switch option), and the disconnect switch opens; the tracker will not be able to record sensor states on the digital input 1 correctly.

Connection Diagram for Active Low Digital Input «Before Disconnect Switch» Option:



Connection Diagram for Active Low Digital Input «After Disconnect Switch» Option:



Connection Diagram for Active Low Digital Input Inductive Load Circuit:

Sometimes, it is necessary to integrate the controller's digital input into a circuit with an inductive load, such as a relay winding, solenoid valve or any other device that has an inductance coil.
When an inductive load is being disconnected, stored current must be dissipated, this causes a self-induced electromotive force of inversed polarity (back EMF) that may damage the controller.
To prevent this, use one of the following protection options if an inductive load is being applied to the controller:

1. **Protective diode** (fig. 1) – to be installed in parallel to the inductive load. In this case, forward current of the protective diode (I_{fw}) should be at least 1.5 • $I_{holding,\ coil}$. If the coil holding current is unknown or uncertain, use the option with safety relay protection.

2. **Safety relay** (fig. 2) – to be installed in parallel to the inductive load. In this case, the safety relay contacts are used for closing the controller's input on ground.

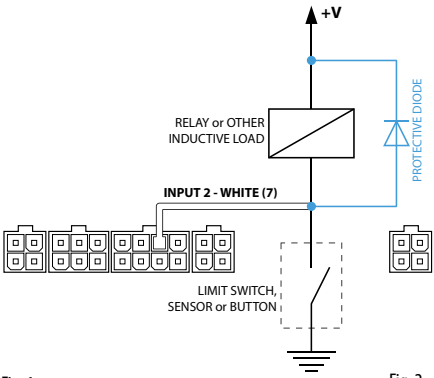


Fig. 1.

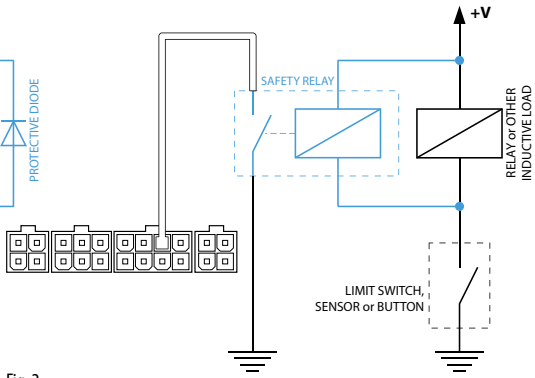


Fig .2.

NOTE

You may use following protective diodes: KD212, KD116-1 or similar.

NOTE

Use may use safety relays designed for switching of direct current circuits with voltage rating compatible with the vehicle system voltage. For example, relays of 901.3747 type manufactured by AVAR, AO, (www.ellink.ru/co/avar) for a vehicle system voltage of 24 V.

Connection of Digital Inputs 7...8 (active high)

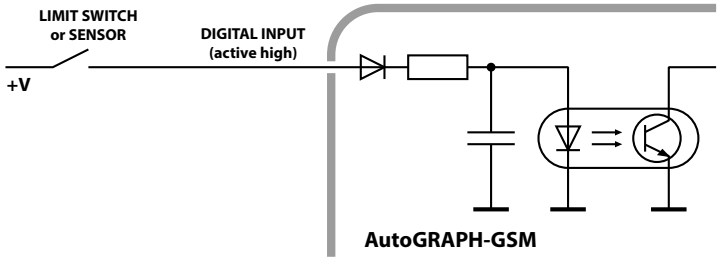
AutoGRAPH-GSM controllers have two active high digital inputs, arranged on additional 6-pin CAN/ RS-485 interface connector (pin 14, pin 17).

Active high digital input has two states:
logical «1» , when the input is powered by supply voltage. This state is considered to be active.
logical «0» , when the input is connected to the ground or open-circuit.

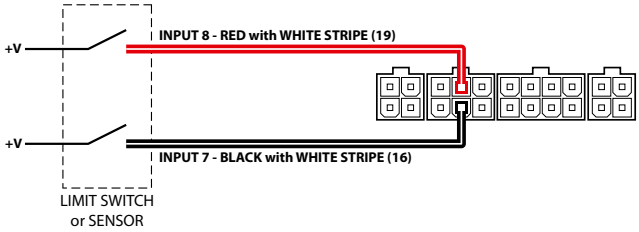
The input is able to show change of the input state, count pulses and measure frequency and is intended for connection to various dry contact sensors. Ensure that the sensors are in good order and able to maintain reliable operation. The manufacturer shall not bear any responsibility for correct state recording of these sensors (chatter, loss of contact and etc.).

It should be noted that all voltage levels of digital inputs on «+» under 5 V will be considered to be logical zero ('ground'), while all voltage levels above 6 V shall be considered to be logical «1» ('+'). If the input is open-circuit it shall denote logical «0» .

Internal Connection Diagram of Active High Digital Input



External Connection Diagram of Active High Input



Connection Diagram for Active High Digital Input Inductive Load Circuit:

Sometimes, it is necessary to integrate the controller's digital input into a circuit with an inductive load such as a relay winding, solenoid valve or any other device, which has inductance coil.
When an inductive load is being disconnected, stored current must be dissipated, this causes a self-induced electromotive force of inversed polarity (back EMF) that may damage the controller.
To prevent such breakdown, use one of the following protection options, if an inductive load is being applied to the tracker:

1. **Protective diode** (fig. 1) – to be installed in parallel to the inductive load. In this case, forward current of the protective diode (I_{fw}) should be at least 1.5 • $I_{holding,\ coil}$. If the coil holding current is unknown or uncertain, use the option with safety relay protection.
2. **Safety relay** (fig. 2) – to be installed in parallel to inductive load. In this case, the safety relay contacts are used for closing the controller's input on supply voltage.

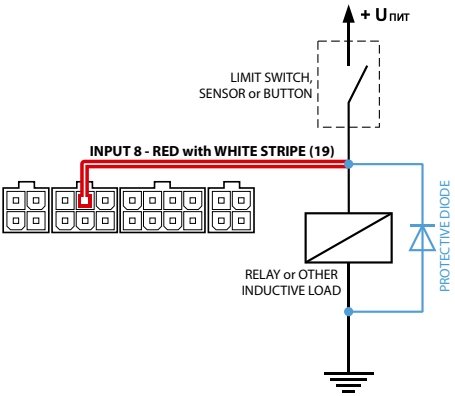


Fig 1.

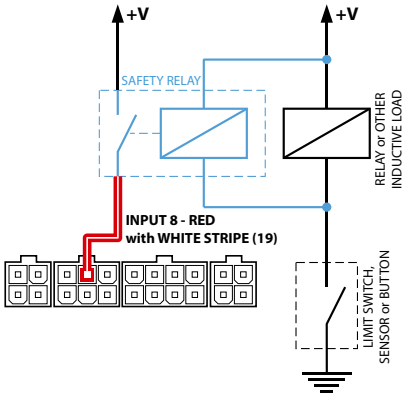


Fig 2.

NOTE

You may use following protective diodes: KD212, KD116-1 or similar.

NOTE

Use may use safety relays designed for switching of direct current circuits with voltage rating compatible with the vehicle system voltage. For example, relays of 901.3747 type manufactured by AVAR, AO, (www.ellink.ru/co/avar) for a vehicle system voltage of 24 V.

Connection of Analogue Inputs

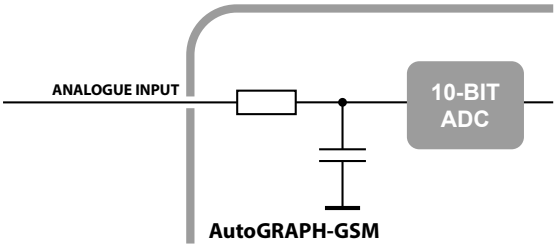
The AutoGRAPH-GSM controller has two 10-bit analogue inputs: pin 4 and pin 8 on the primary interface connector. The analogue inputs allow measurement of voltage levels from devices with an analogue voltage level output, i.e. signals from an analogue fuel level sensor.
The measuring range of the first analogue input (pin 4) is 0 to 10 V which is converted to a figure between 0-1023.
The measuring range of the second analogue input (pin 8) is 0 to 24 V (but not more than supply voltage) which is converted to a figure between 0-1023.
The input resistance of the analogue inputs is 1 mega-ohm (1MΩ).
The analogue readings are smoothed using the moving average method with a configurable averaging window.
The cut-off frequency of the input low-pass filter is 1600 Hz.

The analogue inputs of the controller can be used as active high digital inputs with a configurable switching threshold: analogue input 1 can be set up as digital input 5; analogue input 2 can be set up as digital input 6. The operational properties of the analogue inputs can be specified using the GSMConf configuration program or remotely, using the control SMS commands.
When the analogue input is used as a digital input, it is considered to be open-circuit in the case of a logical «0» and a voltage below 6 V. In digital mode, the input operates both as digital input and as analogue input. Along with the current logical state, voltage level on the input is measured and recorded into the FLASH memory at the specified intervals.

The maximum frequency of the impulse signal on an analogue input in Pulse Counter mode is 500 Hz.

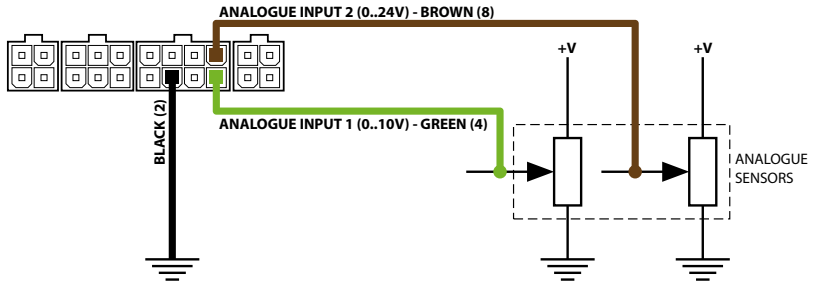
Connection Diagrams of analogue inputs in digital mode is given in «Connection of Digital Inputs 7..8 (active high)» section.

Internal Functional Diagram of Analogue Inputs:

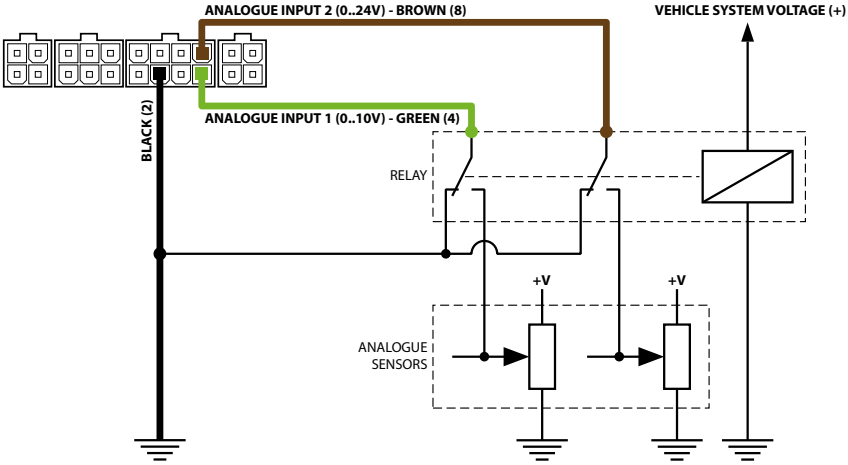


It is highly recommended to connect analogue inputs to –Vin line, if the inputs are not used.

External Connection Diagram of Analogue Inputs:



Most analogue sensors are connected to the –Vin line of the vehicle power system. So, if the –Vin line is disconnected (e.g., by a disconnecting switch), the state of the analogue input will be undefined and analogue readings will not be considered to be valid. Therefore, if the tracker is connected to the vehicle power system via a disconnecting switch, it is highly recommended to connect the analogue sensors via a relay.



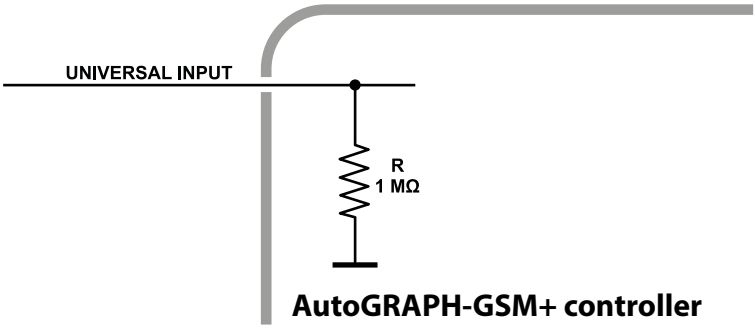
It is recommended to use a relay intended to switch dc circuits and with operating voltage equal to voltage of vehicle power system. For example, 901.3747 relay, designed by AVAR Corp. (www.ellink.ru/co/avar) for 24 V vehicle network.

Connection of High-impedance Digital Input

The AutoGRAPH-GSM+ controller has one high-impedance input (pin 26 on the 6-pin RS-232 / RS-485 interface connector).
It is a high-impedance active high digital input intended to connect a device with a voltage output to the tracker.

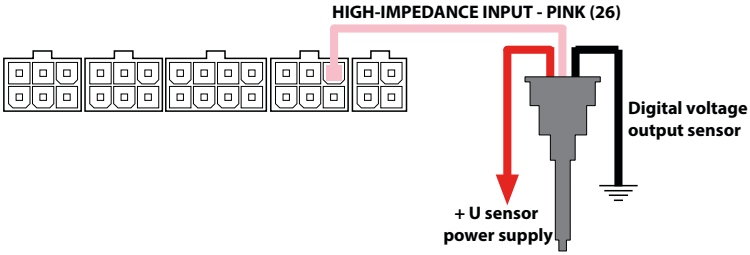
The high-impedance input has two states:
logical “1” – when input voltage is greater than 7 V;
logical “0” – when input voltage is lower than 3 V.
If the high-impedance input is open-circuit it shall denote logical “0”.

Internal Diagram of High-impedance Input:



The input resistance of the high-impedance input is 1 mega-ohm (1MΩ).
The cut-off frequency of the input low-pass filter is 5,000 Hz.

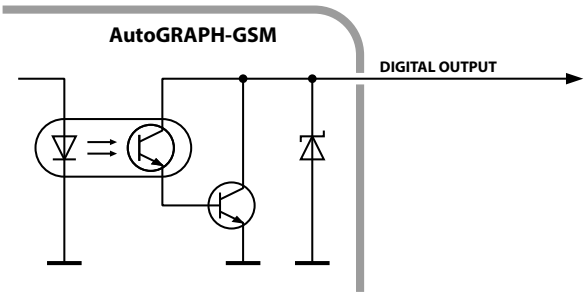
Internal Diagram of High-impedance Input:



Connection of Outputs

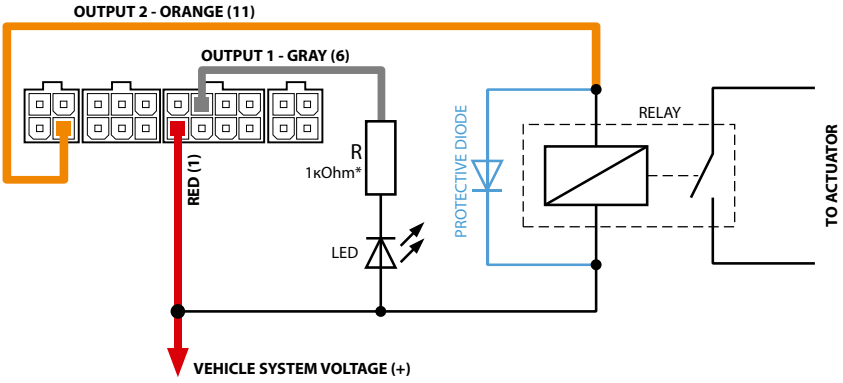
The AutoGRAPH-GSM has two open collector digital outputs: the first output is arranged on the primary interface connector (pin 6), the second is arranged on the additional 4-pin interface connector (pin 10).
The outputs are intended to control various external actuators, as well as to activate warning devices
Minimum recommended load current is 10 mA.
Maximum load current should not exceed 500 mA.

Internal Diagram of Outputs



External Connection Diagram of Digital Outputs:

The following is an example of a LED and relay connected to the controller output. To avoid damage of the controller output due to back EMF, induced from disconnecting an inductive load, connect a protective diode in parallel to the relay. To select a correct diode make sure that direct current of this protective diode is at least 1.5 times greater than the relay holding current.

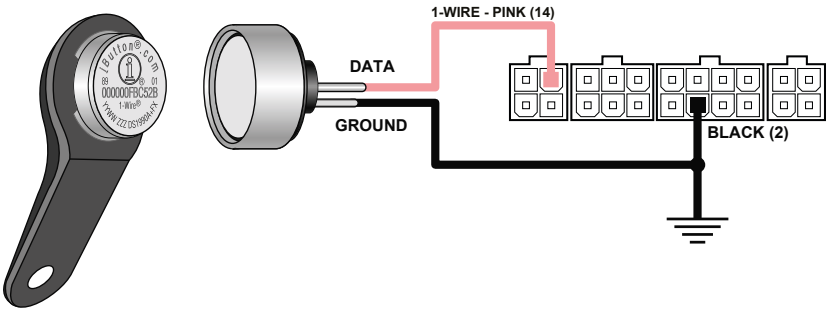


* Use R = 1 . . . 2 kOhm, if supply voltage is 24 V.
Use R = 500 Ом . . . 1 kOhm, if supply voltage is 12 V.

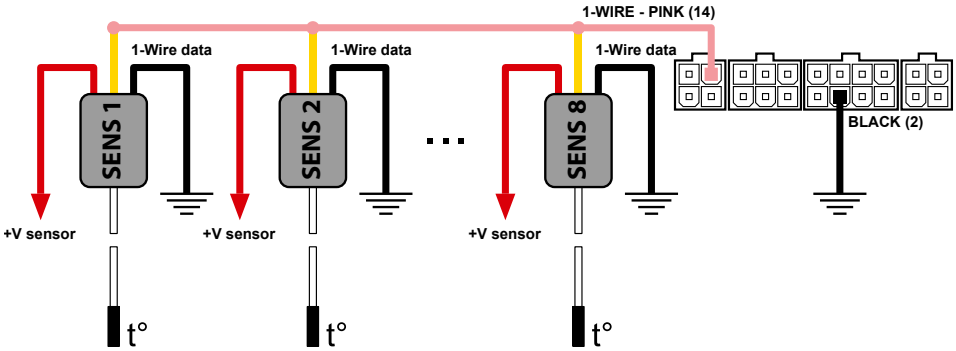
1-Wire

The AutoGRAPH-GSM controller are equipped with a 1-Wire bus intended to connect a touch memory iButton reader and up to 8 temperature sensors, designed by TechnoKom Ltd. or DS18B20 thermometers. Furthermore, proximity card readers compatible with the iButton protocol can be connected to the controller via the 1-Wire bus. This provides supervising drivers and identification of other staff using individual cards and keys.

Connection Diagram of Touch Memory iButton readers:



Connection of Temperature Sensors Designed by TechnoKom Ltd.:



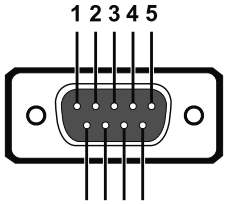
NOTE

For detailed information on operation and configuration of the controller for interaction with the touch memory iButton reader and the temperature sensors via 1-Wire bus see «1-Wire temperature sensors» document.

RS-232 (EIA / TIA-232-E)

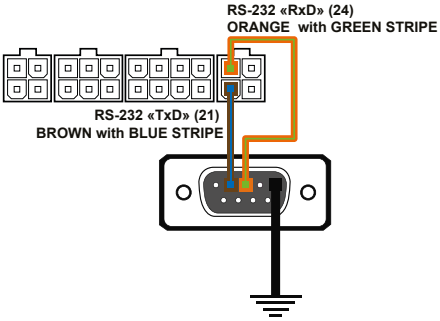
The AutoGRAPH-GSM controller is equipped with an RS-232 (EIA/TIA-232-E) bus.
RS-232 is bi-directional serial data transmission interface between a transceiver and peripheral devices. The main advantages of the RS-232 interface are reliability, and flexibility of implementation.

RS-232 Serial Connector Pin Assignment (DE-9):



1	DCD	Not used
2	RxD	Receive Data
3	TxD	Transmit Data
4	DTR	Not used
5	GND	System Ground
6	DSR	Not used
7	RTS	Not used
8	CTS	Not used
9	RI	Not used

RS-232 (EIA/TIA-232-E) Connection Diagram:



The AutoGRAPH-GSM controller supports interaction with following devices via RS-232 Bus:

1. **AutoGRAPH-NAVIGATOR** – is a software-based vehicle tracking system running on a laptop and designed by TechnoKom Ltd. When connected to the controller, the AutoGRAPH-NAVIGATOR is capable of displaying current position of the vehicle on a map, monitor of movement parameters and routing. Using the AutoGRAPH-Navigator, a dispatcher can send a list of tasks to a driver and monitor progress of the tasks. In addition, the device is capable of message handling between the driver and the dispatcher. The AutoGRAPH-NAVIGATOR is supplied with a special connector for connecting to the controller.

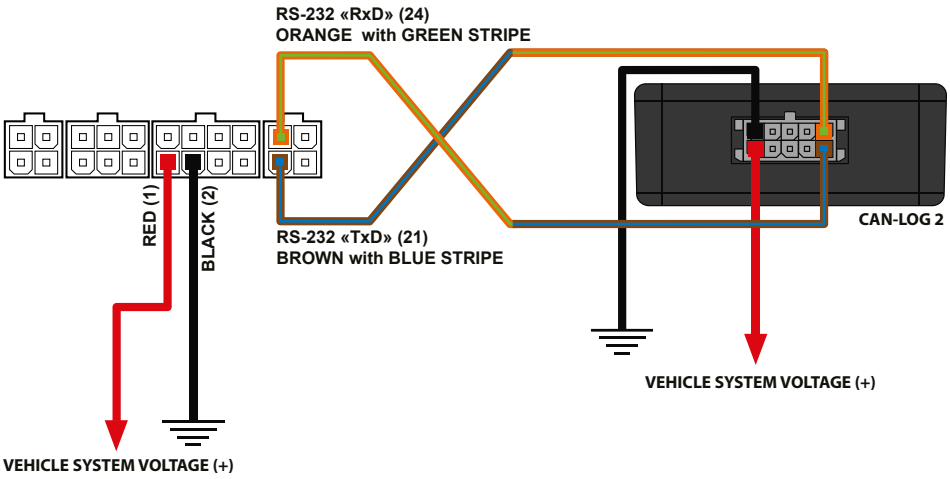
2. **CAN-LOG 2 (CAN-LOG) –** is a device intended for connecting to the vehicle CAN Bus, scanning data and transferring it to another device connected to the CAN-LOG via RS-232. The CAN-LOG 2 supports many CAN protocols. When connected to the controller, the CAN-LOG is capable of reading data from the CAN bus and transferring it to the controller, even if the CAN protocol is not known in advance. The data from the CAN-LOG 2 is transferred in text format.

3. **External GPS / GLONASS receiver with NMEA 0183 standard -** is a high-precision receiver, which allows to acquire asset position with high accuracy.

Before connecting any device to the tracker, the RS-232 interface mode must be specified in the controller. The customer can set this using the GSMConf configuration program or control commands via SMS or the server.

Connection of CAN-LOG 2 to the controller Designed by TechnoKom Ltd.:

The following is an example of connection the CAN-LOG 2 module to the tracker. This device is powered by P145_20 controllers, designed by Farvater Ltd. .

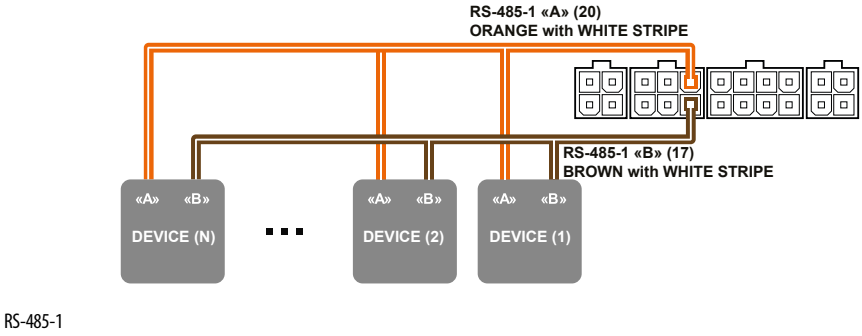


RS-485 (TIA / EIA-485-A)

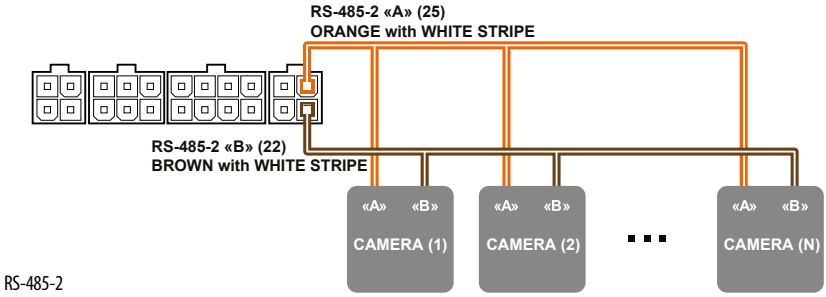
The AutoGRAPH-GSM controller is equipped with two RS-485 (TIA/EIA-485-A) interfaces.

RS-485 is one of the most commonly used industrial standards of communication. A network based on an RS-485 interface consists of transceivers connected with twisted pair wires. All devices are connected to one twisted pair in the same manner: non-inverting outputs (A) to one wire and inverting outputs (B) to another wire.
The controller allows up to 16 devices to be connected simultaneously to one RS-485 bus. There are many sensors, interfaces and expansion modules that are compatible with the tracker's firmware. Amongst such devices are: fuel level sensors (up to 8 sensors simultaneously), passenger traffic metering system, input expander, display for messaging with a vehicle driver, AutoGRAPH-CR device, temperature sensors which support MODBUS protocol, etc.
The additional RS-485-2 bus is intended for connecting photo cameras to the controller. Interaction with photo cameras is supported by controllers equipped with additional memory. The AutoGRAPH-GSM stores photos in an external microSD card.

General Block Diagram of Connection of External Devices to RS-485 Bus:



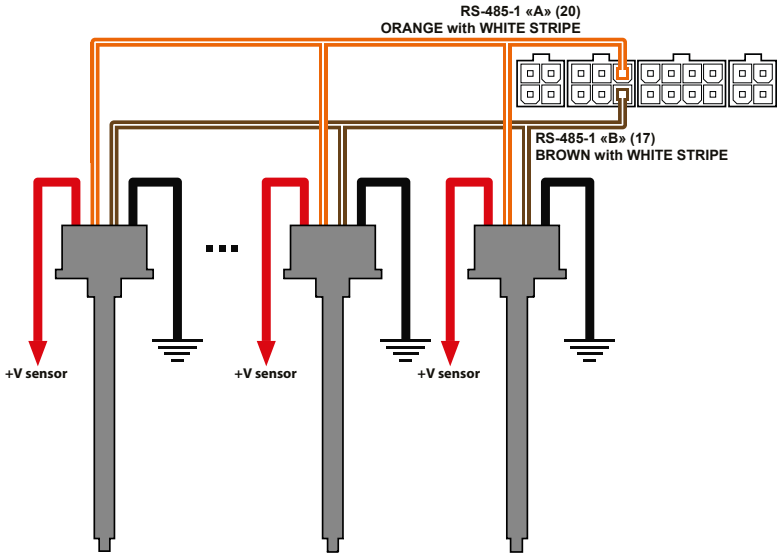
RS-485-1



RS-485-2

Connection of Fuel Level Sensors to RS-485 Bus

Currently, the AutoGRAPH-GSM controller supports interaction with any fuel level sensors with an RS-485 interface which use LLS protocol. The following is an example of connection the TKLS fuel level sensors, designed by TechnoKom Ltd, to the tracker.



IMPORTANT

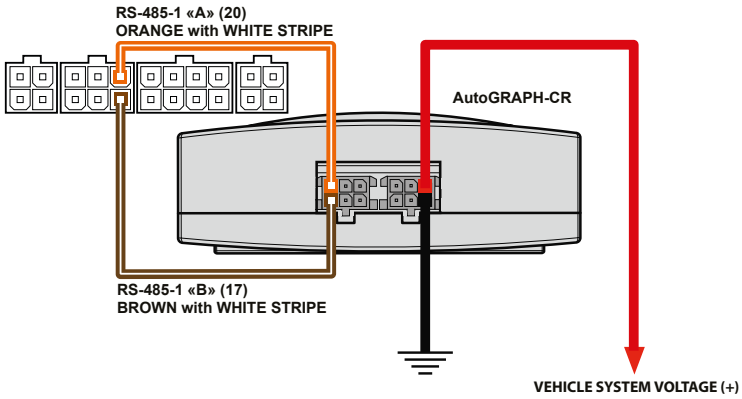
Before making any connections study the manuals for fuel level sensors supplied by the sensor manufacturers. Pay attention to the supply voltage range of the sensors and peculiarities of their configuration. Some sensors require external supply voltage stabilization. If you have any doubts on making connections or configuration, consult the representative of the sensor manufacturer or your regional TechnoKom dealer.

NOTE

RS-485 Bus of the controller has to be customized to interact with fuel level sensors. It can be performed by means of the GSMConf configuration program and control commands via the data server or a SMS.

Connection of AutoGRAPH-CR to RS-485 Bus

The AutoGRAPH-CR is designed for reading RFID and SIM cards. The ID (identification number) of inserted card is transmitted to the AutoGRAPH-GSM controller via RS-485 bus. Up to 250 IDs can be stored in the flash memory of the Card reader. Each card can customize outputs of the card reader when connecting.



NOTE

For more information on connection and configuration of the tracker for interaction with the AutoGRAPH-CR via RS-485 bus see «AutoGRAPH-CR User Manual» .

IMPORTANT

All connections should be made when the controller and all external devices to be connected to the RS-485 bus are disconnected from power supply.

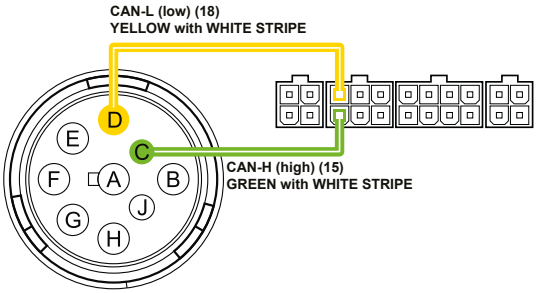
IMPORTANT

Be careful not to cross the «A» and «B» wires, otherwise the device connected to the tracker may operate incorrectly.

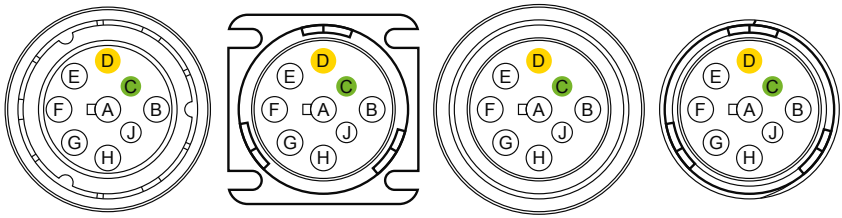
CAN Bus (SAE J1939 / FMS)

The AutoGRAPH-GSM controller is equipped with Can Bus (SAE J1939 / FMS) that allows to connect the tracker to CAN bus of a vehicle and read required data. By default, the tracker supports SAE J1939 / FMS protocol of CAN. However, advanced users can specify any other known protocol in the tracker and operate with it. CAN Bus of the tracker can be configured using the GSMConf program or remotely by means of control commands.
The AutoGRAPH-GSM+ controller is equipped with additional Can Bus (CAN II).

Connection to CAN Bus (SAE J1939 / FMS)



Typical Vehicle Connectors of SAE J1939-13 Standard



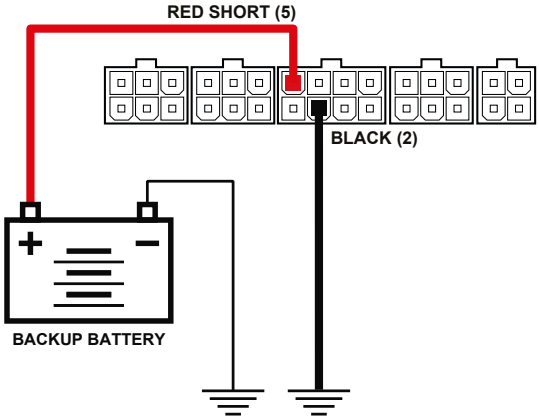
Pin	Assignment (SAE J1939-13)
A	Battery (–)
B	(+) Unswitched - with Unconditioned 10 A fuse
C	**SAE J1939 CAN-H (high)**
D	**SAE J1939 CAN-L (low)**
E	CAN-SHIELD (for SAE J1939-11) or No Connection (for ISO 11783-2)
F	SAE J1708 (+)
G	SAE J1708 (–)
H	Proprietary OEM Use or Implement Bus CAN-H
J	Proprietary OEM Use or Implement Bus CAN-L

Connection of Backup Battery

To avoid the AutoGRAPH-GSM+ controller turning off, if the main power supply shuts down, the power supply driver supports connection of a rechargeable backup battery.

As a backup battery, the tracker uses a lead/acid rechargeable battery of 12 V and 1.2 to 2 Ah capacity.
The AutoGRAPH-GSM+ has a built-in charger to charge the backup battery. The charger turns on automatically and limits the charging current to 75 mA.
If the backup battery voltage drops below 11 V, the tracker will send a low battery notification to specified number by SMS.
Switching between the main power supply and the backup power supply is performed automatically. If the main power supply turns off, the tracker switches to the backup power supply. As soon as the main power supply is restored, the controller will switch back to the main power supply.

Connection Diagram of backup battery



The manufacturer recommends using small package lead/acid DT12012 or BPL2-12 batteries and another battery with capacity not more than 2Ah as a backup power supply. Example of lead/acid battery is given on the figure.

It takes about 30 hours to charge fully discharged 2 Amh capacity battery. So the presented diagram is not applicable in case of frequently shutdowns of main power supply.

Audio Interface

The AutoGRAPH-GSM+ controller is equipped with an audio interface that provides two-way communication between a driver and a dispatcher. The audio interface consists of an input for connecting a microphone, an output for connecting a loudspeaker and an input for connecting an Answer/Call button. The audio interface is on the additional 4-pin audio interface connector.

In order to be able to receive an incoming call and to make a dialed call, a GS-2 type loudspeaker, designed by TechnoKom Ltd, should be connected to the controller. The loudspeaker with built-in Answer/Call button should be connected to the 4-pin audio interface connector.
The AutoGRAPH-GSM+ is equipped with an audio amplifier, which multiplies the output signal to the loudspeaker 2.65 times.

Receiving an incoming voice call

An incoming call is indicated by producing a ringtone on the loudspeaker.
To answer the call, press and hold Answer/Call button on the loudspeaker for 1-2 seconds.
A second press on Answer/Call button ends the call.

Making a dialed call

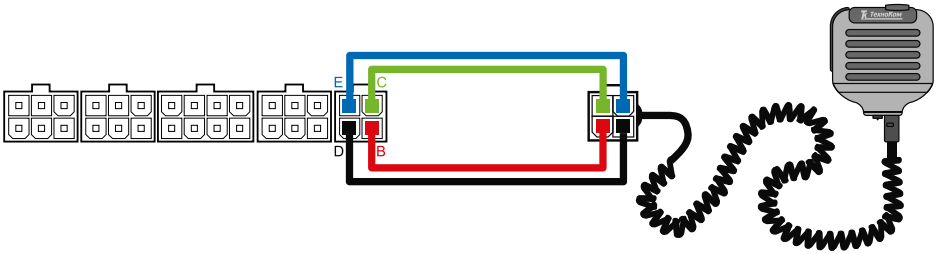
To make a dialed call, press and hold Answer/Call button on the loudspeaker for 1-2 seconds.
The tracker starts to dial to the first telephone number, stored in the controllers memory. If the first number is not available, the controller will dial the second preset number. The tracker will try to call all preset numbers in order, until one of the numbers answers the call. If no calls are answered, the tracker will loop back to the first number and continue the dialling process until a call is answered.

A second press on the button ends the call.

Digital input 1 of the controller can be used for indicating an incoming call using an LED, or a sound device, connected to this input.
Call indication on digital input 1 should be set up using the GSMConf program or a control command.
The tracker can be set up to answer the call automatically or by pressing the Answer/Call button on the loudspeaker.
The tracker automatically answers the calls from telephone numbers, that the auto answer is enabled for in the tracker' settings.
To answer calls from other telephone numbers, press the Answer/Call button.

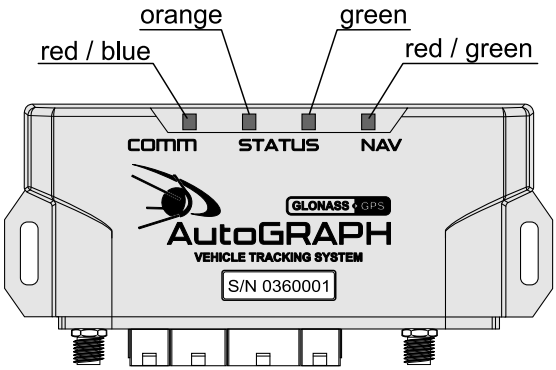
A press on Answer/Call button must be 1-2 seconds long. A short press won't be processed.

Connection Diagram of GS-2 type loudspeaker:



The GS-2 loudspeaker is equipped with micro-jack type connector for connecting a hands-free kit. If the hands-free kit is connected to the loudspeaker, press the answer button on the hands-free kit to answer an incoming call.

Indication of Operation



The AutoGRAPH-GSM has four LEDs arranged on the front side of the tracker and intended to indicate the tracker operation.

- **Bi-colour COMM LED (red / blue)** indicates operation of GSM modem.
- **STATUS LED1 (green)** indicates a state of position acquisition.
- **STATUS LED2 (orange)** indicates GSM state of data transmission.
- **Bi-colour NAV LED (red / green).** The LED indicates the GPS/GLONASS receiver mode. If «GLONASS only» mode is set up, the LED will flash red. If «GPS (NAVSTAR) only» mode or combined GPS / GLONASS mode is set up, the LED will flash red and green simultaneously.

Before turning on the AutoGRAPH-GSM, connect GPS / GLONASS and GSM antennas to the tracker.

• Power the tracker up.

• Wait until the tracker acquires the position and connects to a GSM. In normal mode, the COMM LED flashes red every 3 seconds, STATUS LED2 is constantly ON, NAV LED flashes once a second. The NAV LED flashing colour depends on GPS / GLONASS receiver mode.

• Starting time takes approximately 23 seconds. If the tracker does not start for a long time, verify compliance with the operating conditions.

Indication of GPS / GLONASS Module Operation:

• **When powering up** both STATUS LED1 and NAV LED light up and go out after one second.

• **Upon normal operation**, the NAV LED flashes once a second. The STATUS LED1 is constantly green after positioning of the vehicle and goes out upon loss of signal from satellites.

Indication of GSM Module Operation:

• **Searching for a network** – the COMM LED flashes red once a second.

• **When transferring data to a server** - the STATUS LED2 is constantly ON.

• **Error of data transmission** - the STATUS LED2 flashes twice a second.

• **When connecting to GPRS** - the STATUS LED2 flashes once per two seconds.

• **Normal connection to GSM network** – the COMM LED flashes red once every three seconds.

• **Switching off or fault of GSM module** – the COMM LED is OFF.

Error Indication:

The NAV LED and the STATUS LED1 can be used for indication of the tracker's errors. When an error is detected, the NAV LED lights up in red, the STATUS LED1 flashes green several times, after that the NAV LED goes out. Number of flashings of the STATUS LED1 determines an error code.

Number of flashing	Description of error
1	GSM turning on failure. Ensure, that SIM card is not damaged and correct PIN is entered
2	FLASH memory failure
3	GSM modem power supply circuit is damaged
4	Tracker firmware is damaged
5	FLASH memory failure. Memory is protected
6	FLASH memory failure. Memory is protected
7	SIM PUK is required
8	SIM is not inserted

Operation with PC:

- **Memory cleaning** – the bi-colour NAV LED lights constantly red.
- **Data reading** – the STATUS LED1 is constantly ON.
- **Writing the settings** – the bi-colour NAV LED frequently flashes red.

When the bi-colour LEDs flashes with two colours simultaneously, the customer will see a mix of the both colours.

Drivers Installation

This section covers the procedure of installing the drivers of the AutoGRAPH-GSM controller for Microsoft Windows 7 OS.

The AutoGRAPH-GSM controller drivers required for Windows 2000, XP, Server 2003, Vista, 7, 8, Server 2003, Server 2008 (x86 and x64) are free of charge and can be downloaded from the official website of TechnoKom: http://www.tk-chel.ru

To install the tracker drivers onto Microsoft Windows 7 OS:

1. Connect the tracker to your PC using the interface cable. The system will automatically search for new equipment (Fig.1). For proper operation, it is sufficient to install drivers for AutoGRAPH device. The AutoGRAPH CDC drivers are required for the tracker operation in the GPS-mouse mode.

2. If the Internet connection is available, Windows 7 will automatically connect to the Windows Update website and install suitable driver for the tracker. If the Internet connection is not available, continue with the procedure outlined below.

3. Download the archived drivers folder from the official website of TechnoKom - AGUSBDriver.zip and extract files to a temporary directory on a hard drive.

4. Launch the driver update wizard and select «Browse my computer for driver software» to search for drivers manually (Fig.2).

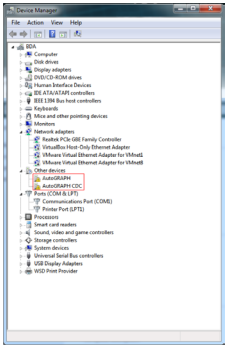


Figure 1.

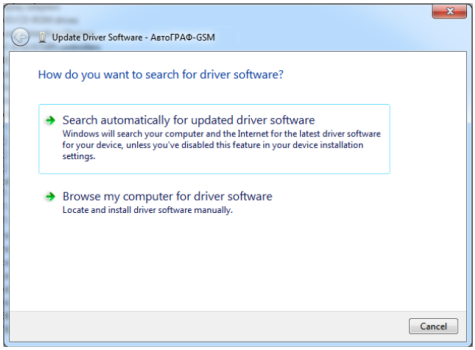


Figure 2.

5. Browse to the location where the drivers are saved (Fig.3).

6. Install the driver. When the driver is installed the system will automatically identify connected device (Fig.4).

7. If necessary, install drivers for the AutoGRAPH CDC device following the outlined instruction.

8. Drivers for the AutoGRAPH-GSM are successfully installed. The device is ready to operate with troubleshooting utilities, dispatch software and other applications (Fig.5).

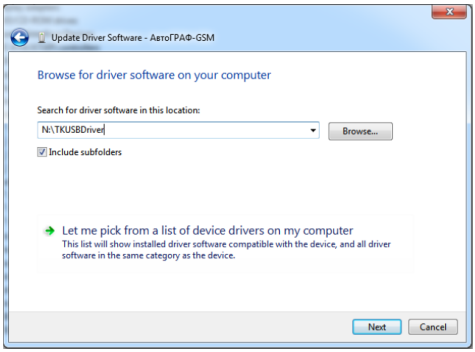


Figure 3.

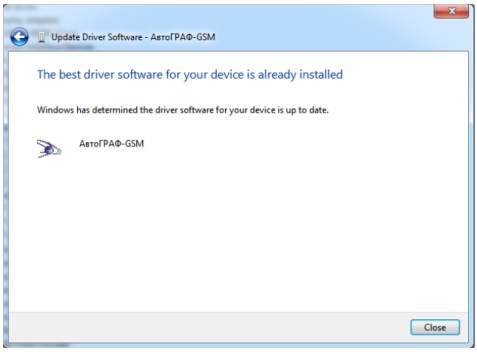


Figure 4.

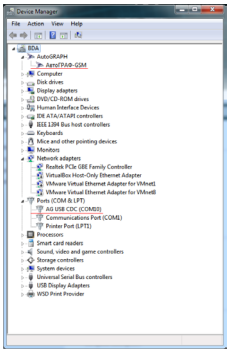


Figure 5.

Connection to PC

Some cases may require connection of the AutoGRAPH-GSM controller to a personal computer (PC) or a laptop. A PC connection may be required for:

- configuration and checking of the performance of the tracker by means of the configuration program – GSMConf;
- using the tracker in the «GPS mouse» mode;
- reading the data from the tracker storage memory and writing the data directly to the AutoGRAPH dispatch software.

To connect the tracker to a PC:

- Disconnect the tracker from the vehicle power supply.
- Disconnect the antennas and remove the device from the vehicle.
- Connect the tracker to your PC using a USB cable.
- If the drivers are installed, the system automatically identifies the controller. If the drivers are not installed, install them following the steps specified in the «Installing the drivers» section.
- The tracker is now ready to operate with the applications.

For detailed information on configuration the tracker using the GSMConf program see «GSMConf Configuration Program» document.

For more information on reading data from the tracker using the AutoGRAPH Dispatch Software see «AutoGRAPH Dispatch Software User Manual» document.

Warranty Provisions (summary)

TechnoKom, OOO, hereby secures the consumer's rights granted by local laws within the Russian Federation and CIS countries, and no other rights.
TechnoKom warrants the AutoGRAPH-GSM controller shall comply with TU 6811-002-12606363-2013 (Technical Requirements) provided that the customer adheres to the operating rules set forth in this User Manual.
Warranty period of the device shall be Thirty Six (36) months from the date when the controller is sold (delivered) to the consumer, but it shall not exceed Forty (40) months from the date of its manufacture.
If the warranty certificate or other document supporting the fact that the controller has been sold (delivered) to the customer lacks date of selling, name and official seal of a dealer, warranty period shall be deemed to start from the date of manufacture of the controller.
Customer shall have a right to repair the product in TechnoKom service centre, if any workmanship or structural defects are found in the device within the warranty period.
Customer has a right to aftersales service and maintenance within the warranty period.
Customer has any other legal rights stipulated by the legislation of the Russian Federation and CIS countries laws.
If the cause of breakdown cannot be identified at the moment of warranty claim application, it is required to carry out the technical expertise, which shall last for 30 days from the date when the customer files its warranty claim application.

Warranty does not cover any other problems that arise as a result of:

- Violation of transportation, storage and operation rules set forth in this User Manual.
- Unauthorized dismantling of the device if it has guarantee seals and labels.
- Unauthorized repairs or repairs carried out by the third parties within the warranty period.
- Unallowable change of parameters of the external electric power, misuse, abuse or improper operation of the product as indicated by traces of electrical and/or other damage.
- Unauthorized soldering or unauthorized attempts to connect any leads or other elements and connectors to a circuit board of the controller as indicated by the corresponding traces.
- Mechanical damage of body or circuit board of the controller, SIM card holder, antennas, connectors or broken wires.
- Corrosion of external or internal parts or ingress of moisture into the device as indicated by the corresponding traces.
- Misappropriation or malicious damage of external antenna and cable.
- Damage caused by penetration of foreign objects, contaminants, liquids, or insects into the device.
- Damages caused by high or low temperature or exposure to intensive microwave radiation.
- Damages caused by nature, fire, social factors, casual external factors and unexpected accidents.
- Damages caused by incompatibility of parameters or incorrect connection of add-on devices, buses, interfaces and sensors to the controller.
- Operation of the controller at the vehicle system voltage that goes beyond the range specified in technical specifications.
- Damages caused by attempts to configure the controller by means of a third party program.
- Improper functioning due to incompetent or incorrect configuration of the controller, using either the configuration program or SMS commands.

• Improper functioning due to the fact that a SIM card installed by the customer in the controller is not subscribed to the following services:
  - General Packet Radio Service (GPRS);
  - Voice communication;
  - reception/sending of SMS messages

or a mobile network operator disabled these services because of negative account balance of a SIM card or for any other reason.
• Improper functioning due to the faulty SIM cards installed in the controller or due to SIM card locking.

Any warranty provisions that conflict with legislation in force shall have no legal effect and shall be governed by the legislation.

If the customer fails to adhere to warranty provisions, the warranty shall be cancelled.

TechnoKom disclaims any liability for claims concerned with damage or loss of data which exceed the product cost, as well as for claims concerned with accidental, intentional or consequential damage caused by use or inability to use the product to the extent permissible by law.*

This warranty has no effect on legal consumer rights such as adequate quality protection, fitness for the purpose for which similar products are usually used upon normal conditions, and aftersales service, as well as on any other rights you may have in relation to the seller of the product which may arise from a deed of purchase and purchase-and-sale contract.

* * Including but not limited to, damages for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings.

GSM

AutoGRAPH

USER MANUAL v. 15.2

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