

Operation Manual

iRZ ATM3-232 3G communicator





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1. Introduction

1.1. About this Document

The document contains description and operating procedure of the iRZ ATM3-232 3G communicator (hereinafter referred to as ATM). The document is intended for the users who are in charge of configuration and maintenance of systems where data is transmitted via this device.

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1.6	12.0	03	01/02/2016
Written by	Y. Petrova, P. Malikova		
Approved by	D. Pavlov, G. Samakova		

Also refer to

- getting started with the ATM Control application and the modem basic setup – the "Setting Up iRZ ATM Step by Step. ATM Control" document;
- setting up the modem via ATM Control – the "User Guide on the ATM Control Modem Configuration Utility" document;
- setting up the modem via AT commands – the "AT Commands to Set Up the iRZ ATM2-232 Modem" document;
- the benefits of the iRZ Collector special-purpose server – the "iRZ Collector. Solution Overview" document;
- the use of the iRZ Collector dispatcher application – the "iRZ Collector. Dispatching Software Setup and Operation User Guide" document.

1.2. Operating Instructions

The modem can interfere with electronic devices; therefore there are the following limitations on its use:

- Power off the modem in medical centres and keep it away from medical equipment (for example, cardiac pacemakers, and hearing aids).
- Power off the router in aircraft, take measures against accidental switch-on.
- Power off the modem near gas stations, enterprises of chemical industry, in areas where blasting operations are in progress.
- At close range the modem can interfere with television and radioreceiver operation.

To ensure safe operation, follow the recommendations:



- Do not expose the modem to aggressive influences (high temperatures, corrosive chemicals, dust, water, etc.).
- Protect the modem from impacts, falls and excessive vibration.
- Do not attempt to disassemble or modify the modem. Such actions will void the warranty.

Note! Use the device in compliance with the operating instructions. Damages caused by improper use and storage of the device are not covered by the warranty.

1.3. Terms and Definitions

Local configuration or updating firmware – configuration or updating of the modem firmware connected to a computer via a USB cable. For the ATM modem they are performed via the ATM Control program.

Remote configuration or updating firmware – configuration or updating of the modem firmware located on the site, from the dispatching center. For the ATM modem they are performed via the iRZ Collector dispatching application, which is used together with the iRZ Collector server application.

Modem-client – the ATM modem operating in the TCP/IP client mode, i.e. the modem is connected to the data collection server and transmits it data from an external device.

Server modem – the ATM modem operating in the server mode, i.e. the modem waits for incoming connections and processes them.

The system of data collection and device control (hereinafter referred to as system) – a set of tools for automated data collection from external devices, located on sites, and their control as well as its processing, accumulation and transmission.

Server – a computer or specialized computer equipment with the installed server software for processing client requests (in the terms of a client-server interaction model).

iRZ Collector solution – iRZ-manufactured software solution including the server and the dispatching applications of iRZ Collector.

iRZ Collector server application – the iRZ Collector server software to be installed on a data collection server. It enables a third-party polling software, acting as a client (in the terms of a client-server interaction model), to receive data from the modems, which also act as clients. That is, the server application serves as a kind of "layer" enabling their interaction (see Fig. 1.1). For ease of reference, hereinafter the server with the installed iRZ Collector server application is referred as the iRZ Collector server.

When ATM operates in server mode, it receives connections on its own – it no longer requires a broker to interact with the polling software, operating in a client mode. In this case the iRZ Collector solution can be still used to monitor and control the system modems (see Fig. 1.2).

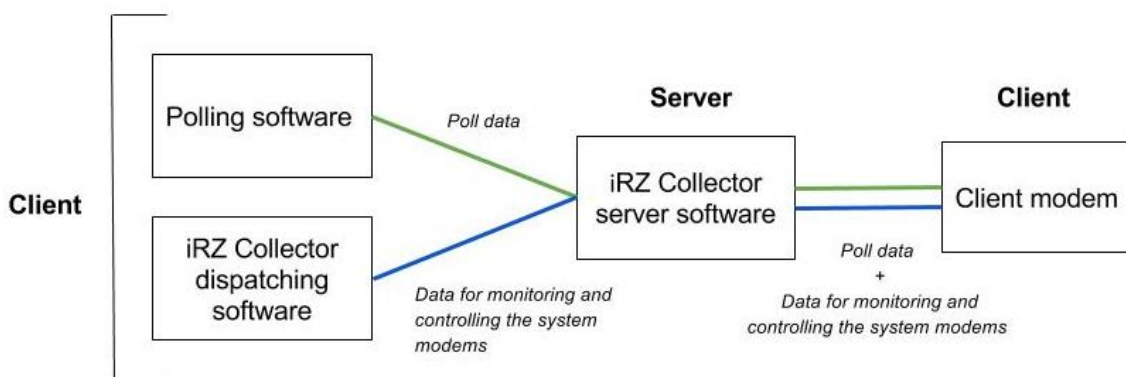


Fig. 1.1 Interaction diagram when using the iRZ Collector software solution – the modem operates in a client mode

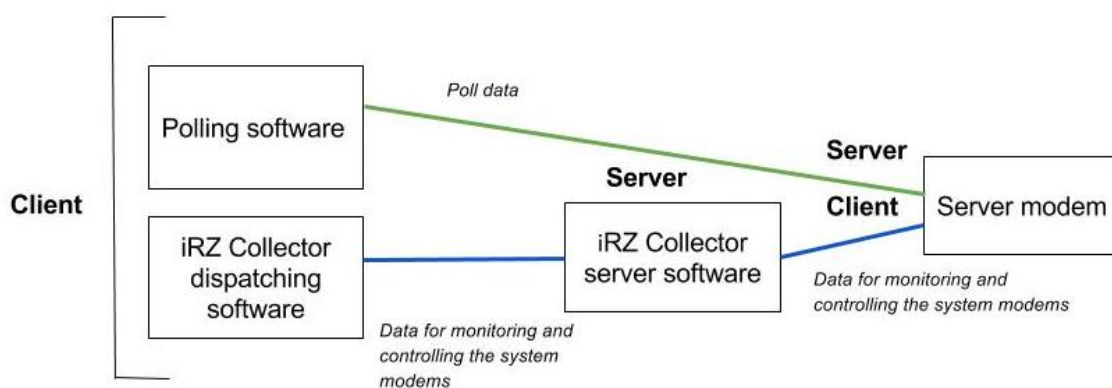


Fig. 1.2 Interaction diagram when using the iRZ Collector software solution – the modem operates in a server mode

The iRZ Collector dispatching application – the iRZ Collector dispatching software which operates together with the iRZ Collector server application and enables remote monitoring and control of the system modems. It can be used in the dispatching center or data collection server as well as in any computer with the operating system supporting the application.

External devices polling software is used in the dispatching center to poll external devices and is provided by their manufacturer. Generally, it operates in the client mode, and therefore the following two main methods are used to interact with the modem: First – the modem operates in the client mode, and a special-purpose "layer" (for example, the iRZ Collector server application) is used to interact with it. Second – the modem operates in the server mode that enables a third-party software to connect it directly. However in the second case each modem requires an external¹ static IP address.

¹ If your company rents an access point (APN) from a mobile network carrier, the modem will use an internal static address.



Dispatching center – data collection and dispatching center intended to poll external devices, installed on sites, and to monitor and control the system modems.

Data collection server¹ – the server where all the system data is accumulated and processed: data from external devices and system's service information. The modem-clients are connected to the data collection server and transmit the required data, the external device polling software is also connected to the server and requests the data received by the server from the modem.

External device – the device mounted on a site and connected to the modem via the RS232 communications interface. Heat and energy meters, as well as any systems of telemetry and telemechanics, may operate as external devices.

SMS command – an SMS message sent to the modem, containing a character-based command of a certain format.

2. Product Overview

2.1. Product Purpose and Main Functions

The iRZ ATM 3G communicator provides data transmission via TCP/IP protocol stack. The device is designed for operation in telemetry systems.

The modem can operate in any of the three modes: client, server or CSD only. In the **Client** mode (hereinafter – client modem) the modem is connected to the data collection server and transmits data from an external device. In the **Server** mode (hereinafter – modem server), the modem, on the contrary, waits for the client incoming connection (for example, from a dispatcher computer) on a certain port and processes it. In the **CSD Only** mode data is transmitted via CSD (voice channel) with no data transmission over network and the offline mode available.

For operation in the **Client** mode you can use any SIM card, for operation in the **Server** mode it is recommended to use a SIM card with an external² static IP address. For operation in the **CSD only** mode you can use any CSD-enabled SIM card.

In the **Client** and **Server** modes the modem automatically connects to the network. After that the modem establishes connection to the specified server (if operating in the client mode) or opens an incoming port and waits for incoming connections (if operating in the server mode).

¹ ² Used if the modem and the external devices polling software operate as clients. If the modem operates in the server mode, the software can be connected to it directly and read out the required data.

² If your company rents an access point (APN) from a mobile network carrier, addresses of the sites for such network will be internal. In this case it is recommended to use a private static address.



The device provides transparent communication between a third-party external devices polling software and an external device connected to the modem via RS232 interface. The modem tracks the internet connection status and in case of connection loss, the modem restores it (see section ["Device Operating Procedure"](#)).

The ATM modem supports the use of two SIM cards providing backup mobile access (see section ["Working with SIM Cards"](#)).

The client mode supports backup Internet connection – the main server switches to a backup server in case of disconnection. Switching between servers is also possible with a signal from the modem GPIO pins (see section ["Working with the Server"](#)).

The client modem can operate with a standard server (see section ["Working with the Server"](#)) or a special-purpose iRZ Collector server. The iRZ Collector server provides transparent data communication between a third-party polling software, operating as a client, and the modems which also operate as clients and do not have static IP addresses (see section ["Working with the iRZ Collector Server"](#)).

The modem supports data transmission via CSD (voice channel). If there is phone number group enabled in the modem settings, data transmission over CSD is available in the client and server mode. In addition, ATM supports a separate mode for data transmission only over CSD.

The modem has additional pins (GPIO) to monitor and control external devices (see section ["GPIO Pins Operation"](#)). ATM can send SMS messages at change of pin signal strength enabling remote control of external devices connected to the modem. The pins state can be changed sending SMS command to the modem enabling remote control of external devices.

The modem features the offline mode supporting all functions except network connection (see section ["Offline Mode"](#)). Offline mode provides economy of traffic and power consumption. It is used if there is no need for continuous connection.

ATM tracks the 3G module hangup and provides its additional restart by a signal from the configurable watchdog timer (see section ["Watchdog Timers"](#)). GSM module rebooting can be initiated with a phone call from a group of numbers, specified in ATM Control application (**Settings** → **Advanced** → **WDT** → **Phone No. for rebooting the module**), as well as with the SMS command "XXXX reboot", where XXXX is the access code for service mode (5492 by default). The modem provides operation within a wide range of input voltages and temperatures.

During its operation the modem displays messages in the log via USB interface in a real time. To view and analyze the log on a computer, use any terminal program (see section ["Main Log Messages"](#)).

2.2. Using the Document

Modem functions are described in sections ["Service Mode"](#), ["Offline Mode"](#), ["Updating Embedded Software \(Firmware\)"](#), ["Setting Up the Modem"](#), ["Working with SIM Cards"](#), ["Connecting to the Server via SMS Commands"](#), ["Data Transmission via CSD"](#), ["Watchdog Timers"](#), ["Real-Time Clock \(RTC\)"](#), ["GPIO Pins Operation"](#), ["Operating with Incoming SMS Messages"](#) can be applied both to **"Client"** and **"Server"** modes. In cases



when the action of a function depends on the modem operating mode, it is specified directly in the function description.

Sections "[Working with the Server](#)" and "[Working with the iRZ Collector Server](#)" can be applied to **Client** mode only; section "[Modem Operation in the Server Mode](#)" — can be applied to **Server** mode only.

In the **CSD Only** mode the modem cannot operate as a client or a server, data can be transmitted only over CSD. Internet connection (including operation with the server), offline mode, remote firmware updating and settings change as well as the Modbus protocol for a COM port. Other features are supported in the same way as for the **Client** and **Server** modes.



2.3. Data Transfer Technology

The ATM 3G communicator supports the following data transmission technologies:

- UMTS/HSPA+;
- EDGE/GPRS;
- CSD;
- SMS.

2.4. Hardware Specifications

ATM has the following hardware specifications:

- 3G module — EHS5-E;
- Mini USB for setting up and logging the modem operation;
- dual SIM card support;
- antenna connector – SMA;
- communication connector – RS232;
- power connector – MicroFit 4;
- terminal connector – 2 GPIO* + 1 GPO.

2.5. Physical Specifications

ATM has the following physical specifications:

- housing dimensions (without connectors) – max 66 × 83 × 25 mm (L × W × D);
- product dimensions (with connectors) – max 74 × 83 × 25 mm (L × W × D);
- weight, maximum – 120 g;
- operation temperatures: -40°C to +65°C;
- storage temperatures: -50°C to +85°C;
- permissible humidity – the device ensures safe operation at relative humidity of maximum 80% at 25°C.

2.6. Electrical Specifications

Power Supply

- Power supply voltage: 7 to 40V (DC)
- current consumption when connected to a network, maximum:
 - at power voltage of +12 V – 250 mA;
 - at power voltage of +24 V – 125 mA.

* If set to input, GPIO 2 can work as ADC in current or voltage measurement modes.



- current consumption in the offline mode, maximum:
 - at power voltage of +12 V – 60 mA;
 - at power voltage of +24 V – 30 mA.

GPIO 1 and 2 in the "input" mode:

- resistance of the programmable pullup to power voltage – 10 k Ω ;
- Programmable pull-down resistor – 47 k Ω ;
- Maximum "0" level voltage (low level) – 0.8 V;
- Minimum "1" level voltage (high level) – 2.0 V;
- maximum allowable input voltage – 40 V.

GPIO 2 in the "input" mode set as ADC:

- Current measurement parameters:
 - Current measuring range, mA: 0 to 30.
 - Current measurement error, mA: ± 0.2 .
- Voltage measurement parameters:
 - Voltage measuring range, V: 0 to 40.
 - Voltage measurement error, V: ± 0.2 .

GPIO 1 and 2 in the "output" mode:

- output type – open collector to ground;
- output resistance – 120 Ω ;
- maximum output current – 10 mA.

GPO 3 in the "output" mode:

- output type – open collector to power voltage;
- output resistance – max2 Ω ;
- maximum output current – 500 mA.

2.7. GSM Module Specifications

Bandwidth:

- 900/1800 MHz;
- 900/2100 MHz.

2.8. Device Functional Circuit

The modem main components:

- power connector;



- voltage converter;
- 3G module;
- SMA connector for external antenna;
- microcontroller (MC);
- Mini USB;
- RTC module battery;
- 9-pin RS232 (DB-9);
- 4-pin terminal connector (GPIO);
- SIM1 and SIM2 holder;
- an operating SIM selection module (SIM selection);
- LEDs;
- hard reset and signal strength detection button (Firmware key).

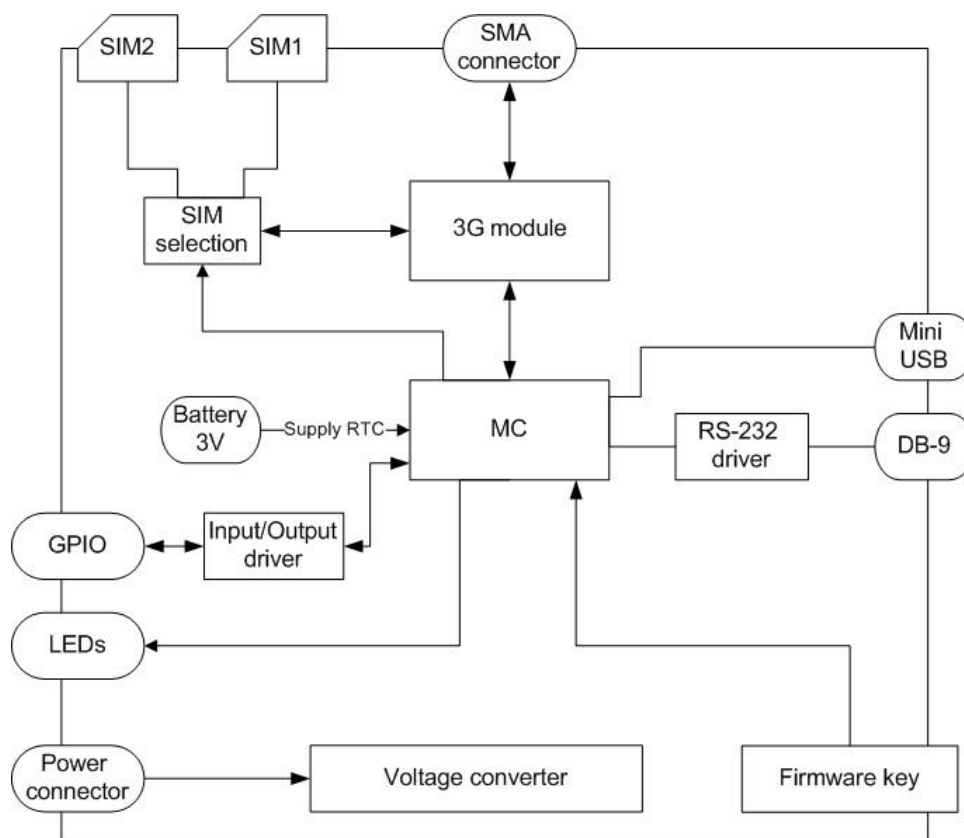


Fig. 2.1 ATM functional diagram



2.9. Device View

The device view is given in Fig. 2.2 and Fig. 2.3.

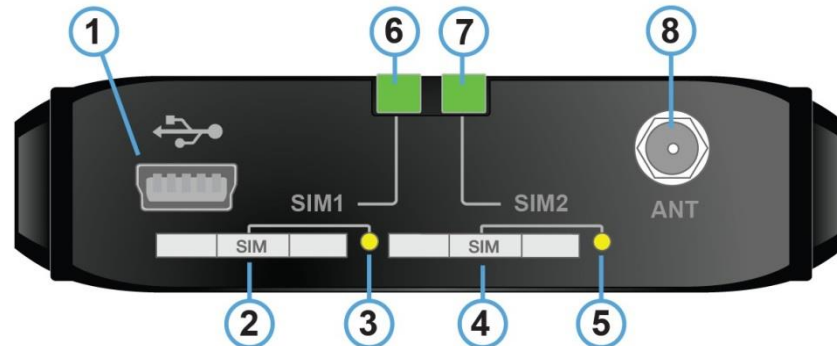


Fig. 2.2 Front panel

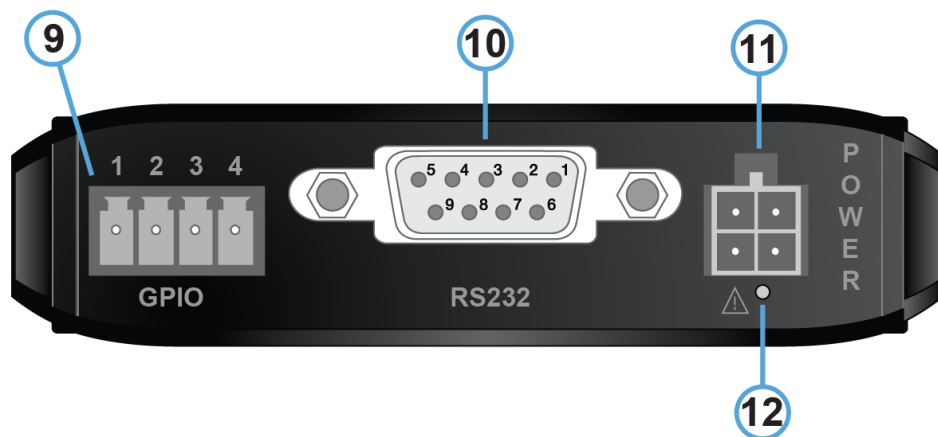


Fig. 2.3 Back panel

The numbers in Fig. 2.2 and Fig. 2.3 illustrate:

1. mini USB connector;
2. SIM 1 tray (SIM 1);
3. SIM 1 tray eject button (SIM 1);
4. SIM 2 tray (SIM 2);
5. SIM 2 tray eject button (SIM 2);
6. SIM 1 LED indication (SIM 1);
7. SIM 2 LED indication (SIM 2);
8. antenna connector;
9. terminal connector (2 GPIO + 1 GPO);
10. DB9 Connector (RS232);



- 11. MicroFit 4 power connector;
- 12. hard reset and signal strength detection button.

2.10. Interfaces

The device is equipped with two serial interfaces: Mini USB and RS232 as well as the GPIO programmable interface.

2.10.1. Mini USB Connector

The mini USB interface is used to set up the modem and log its operation (log removal). For operation of the modem via Mini USB, it is required to install the USB driver which can be downloaded from the official website of the Radiofid System Company (www.radiofid.ru) in "Support" section). The computer determines the modem as a virtual COM port. The modem is powered via Mini USB interface only for operation in the service mode.



Fig. 2.4 Mini USB Connector

Note 1 USB is used in the "device" mode, therefore it can be used only for connection to a computer or other host controller.

Note 2 With a terminal program, for example, Hyper Terminal, close a COM port in this program before you connect a USB cable. You can open a COM port after connecting a USB cable.

2.10.2. DB9 Connector (RS232)

The connector is used to connect the modem to an external device with the RS232 interface (COM port). Port factory settings: baud rate – 9600, data bits – 8, parity – not used, stop bits – 1. All the parameters of the operating COM port are changed in the service mode.

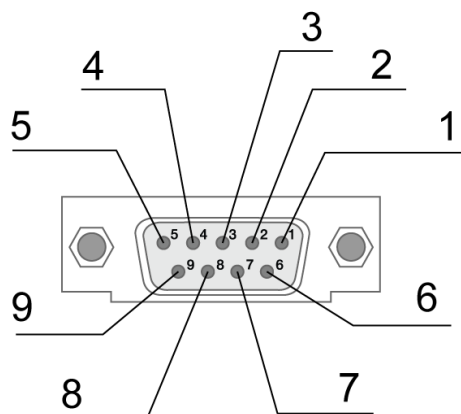


Fig. 2.5 DB9 connector

Table 2.1 DB9 connector pins assignment

Pin	Signal	Direction	Function
1	DCD	Modem – device	Carrier Detect
2	RXD	Modem – device	Receive Data
3	TXD	Device – modem	Transmit Data
4	DTR	Device – modem	Data Terminal Ready
5	GND	–	Ground Connected to the negative terminal of the power supply
6	DSR	Modem – device	Data Set Ready
7	RTS	Device – modem	Request To Send
8	CTS	Modem – device	Clear To Send
9	RI	Modem – device	Ring Indicator

Note! The RS232 (COM port) standard does not allow hot plugging. To prevent damage to the COM port, wait at least 5 seconds to plug and unplug connected devices after turning off the power.

The DCD, DSR, CTS, RING pins can be set to a high or low state in the encapsulation mode (see section "[Encapsulation Mode](#)") or in the service mode using the ATM Control application. By default, the DCD, DSR, CTS pins are set to a high state, RING – to a low state.

The modem supports operation with the COM port via the Modbus protocol. There are two protocol implementations available – Modbus RTU and Modbus ASCII.

Modbus RTU – the packet data protocol used for communication with external devices via RS232, RS485 and RS422. When operating in the GPRS network, overload of base stations might cause data link failure. The



modem operating with Modbus RTU prevents data link failure (over 1.5 times character length), i.e. the modem task is to transmit a single data packet over the RS232/RS422/RS485 interfaces. The **Pause** option allows the user to manually set the time interval of data absence, which will enable the modem to identify the end of data package. Foremost, the Modbus RTU protocol is to be used if an external device operation is based on it.

Specify the **Modbus ASCII** protocol in the modem settings only if it is recommended to use this protocol by the manufacturer of the external device.

2.10.3. Power Connector

Microfit 4 connector is used to connect power to the modem.

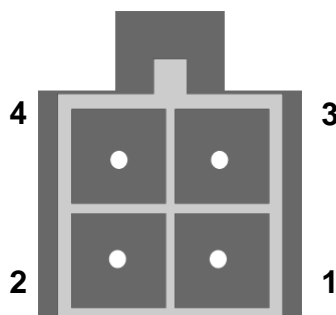


Fig. 2.6 Power Connector

Table 2.2 Power connector's pin assignments

Pin	Signal	Function
1	Not used	
2	Not used	
3	GND	Negative terminal of power supply voltage
4	+ U _{in}	Positive terminal of constant power supply voltage. Protected by a fuse and overvoltage (when applying voltage to input of over 40V) and reverse polarity protection circuit

2.10.4. Terminal Connector (2GPIO+1GPO)

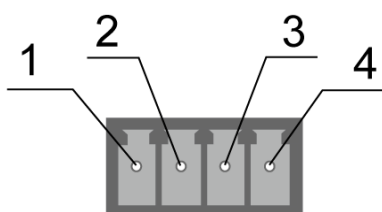


Fig. 2.7 Plug terminal connector



Table 2.3 Terminal strip connector pin assignments

Pin (see Fig. 2.7)	Name	Function
1	GPIO3 (GPO)	Power general-purpose output
2	GPIO2/ADC	Configurable general-purpose output
3	GPIO1	Configurable general-purpose output
4	GND	Ground Connected to the negative terminal of the power supply

2.11. The Modem Status Indication

To display the modem operation status, it is equipped with LED indication. The LEDs are placed above the SIM card trays.

When you turn on the modem, both LEDs light up for 300 mc. In case of the RTC-timer failure, LEDs can light up for 10 seconds while RTC is being initialized.

At the modem operation the indication is performed via the LED placed above the tray with an active SIM card (a SIM card operating at a given moment is called active, the second one – inactive). LED signal interpretation is shown in 2.4.

Table 2.4 LED indication signals

Active SIM card indicator	Inactive SIM card indicator	Operating mode
300 ms on / 300 ms off	Off	Module loading, SIM card verification, logging to network
150 mc on/ 1500 mc off	Off	Establishing connection
Continuously lit.	Off	GPRS connection is established, the modem is connected
Off	Off	No power
Single simultaneous blinking (150 ms on / 150 ms off)		Switching off and restart / switching on
Both LEDs are solid		Service Mode
Both LEDs are blinking (150 ms on / 150 ms off)		SIM cards operation error (PIN code error or no SIM cards in the trays)



2.11.1. Signal Strength Indicators

The ATM modem is equipped with the¹ hard reset button which also designed for measuring the signal strength of the modem. This feature allows you to find an optimal place to mount the modem antenna on a site. Signal strength is displayed in the log and indicated by the LED for each SIM card of the modem.

To determine the signal strength, press the button using a thin object and release it. The LEDs indicate the signal strength within a minute, after that the modem returns to the previous operation mode. With GPRS, 3G or CSD connection established, the connection is terminated by pressing the button, and after the end of signal verification it is re-established. Signal detection is not supported in the service mode.

When pressing the button, both LEDs light up for 2 sec, after the pause of one second active SIM LED starts to blink in accordance with a signal strength of its SIM card (only if modem is registered in GSM network).

Depending on the CSQ signal strength, the LED of each SIM card blinks certain times:

- signal strength is below 9 – 1 time;
- signal strength is from 9 to 15 – 2 times;
- signal strength is from 16 to 19 – 3 times;
- signal strength is from 20 to 24 – 4 times;
- signal strength is above 24 – 5 times;

Each LED blinking lasts for 80 / 400 ms: 80 ms – LED is on, 400 ms – LED is off. The pause of 4 seconds is followed by LED blinking of certain number of times. After that the modem detects signal level and the process is repeated – the LED blinks the number of times corresponding to the CSQ signal strength, then follows a four-second pause – and so until a minute passes from the time the button has been pressed (see the sample in Fig. 2.8).

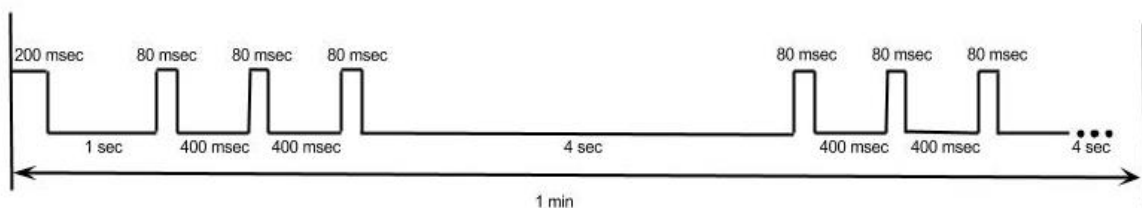


Fig. 2.8 Signal Strength Indicators (a sample for the strength from 16 to 19 via CSQ)

2.12. Parameters and Attributes Used

Key Attributes of the ATM3-232 Modem

1. Device model – Automatic Terminal-Modem ATM3-232.
2. Software version.

¹ The button is placed on the side of the modem with the RS232 connector (see Fig. 2.3). Early models are not equipped with this button. The hard reset button function is described in section "[Updating Embedded Software \(Firmware\)](#)".



3. Hardware board version.
4. Device name – a unique device name containing 4 characters (digits and Latin letters). It is specified in each SMS message¹ sent by the modem. The device name is used to distinguish SMS messages from different modems. Case-insensitive: That is to say **aaaa** and **AAAA** – are identical names. Default value – name.
5. Login – a string of 4–16 characters (digits and Latin letters, case sensitive), unique for each device. It can be used for the modem authentication on a standard server (not iRZ Collector) if IMEI-based authentication is not sufficient. In addition, it can be used for iRZ protocol-based authentication (for more details, refer to section "[Authentication of Connecting Clients](#)"). By default the modem login is equal to the modem IMEI value.

SIM Cards Key Attributes

1. Mobile network carrier settings:
 - APN (Internet access point name);
 - Login (user name);
 - Password.

Request for network settings at the mobile operator of your SIM card.

2. PIN code (required if PIN code request is activated on the SIM card)

Key Attributes (for the modem-client operation)

1. Server IP address – the server IP address to which the modem-client is to be connected and transmit data from an external device. It is required to specify a public static IP address of the data collection server or network gateway (if the data collection server is in the local network behind the gateway). In the latter case it is required to set up port forwarding from the gateway IP port to the server data collection IP port. If you rent an APN from a service provider, it is required to specify the private address of the data collection server in the IP address field. The address is 4 bytes long, consists of four decimal numbers, each ranging from 0 to 255, separated by dots. For example, 83.58.124.13
2. Server port is a network port of data collection server where it waits for connection of client modems. Value – 0 to 65000. This port should not be used by other services. If data collection server is located in the local network behind network gateway, it is required to set up port forwarding from the gateway IP port to the IP port of the server data collection.

If you plan to use the backup server, it is required to enter its IP address and port and authorize its use.

Key Attributes (for the server modem operation)

1. Incoming port is a network port of the modem-server where it waits for connection of clients. Value – 0 to 65000. This port should not be used by other services.

¹ For example, the modem can send SMS messages in case of connection loss or on signals from external outputs.



ATM Passwords

- The password to access the service mode – 4 characters (digits or Latin characters, case sensitive). It is used to protect against unauthorized configuration of the modem. Access to the modem settings is provided when the correct password to access the server mode is entered. Default value — 5492

Password to access the modem server mode is requested in the ATM Control utility when connecting the modem to a computer. In this case the utility does not require a password if it corresponds to the default value or to the password of a previous connected modem. The latter is implemented for easy consecutive configuration of several modems with identical passwords.

When configuring the modem by AT commands, the password should be entered in the terminal program to switch to the modem service mode (otherwise, you may fail to configure it).

- SMS command password – 4 characters (digits and Latin characters, case-sensitive). This password is to be specified at the beginning of texts with SMS commands sent to the modem. If the password is not specified or incorrect, the modem will ignore the SMS command. Default value — 5492
- The password to access the iRZ Collector server (GPRS password) – 4-16 characters (digits and Latin characters, case-sensitive). It is used to protect the modem against unauthorized connections to the iRZ Collector server or to the ATM server modem. Default value — 5492

ATM Modes

- Service mode – designed to configure the modem.
- Operating mode – the basic mode of the modem to transmit data.
- Offline mode – an operating mode in which the modem performs all of its functions except for connection to a network. It is used to save traffic and power consumption, when no continuous connection to network is required.



3. SIM Card Installation and Device Mounting

3.1. SIM Card Installation

To connect the modem to the Internet over cellular network, a mini-SIM card is required (a standard SIM card). Prepare a SIM card, if required, reset the PIN code request.

Note. A mini-SIM card differs from SIM cards of other formats by its size. Take notice when buying a SIM card from your mobile operator since the modem does not provide support for SIM cards of other formats.

To install the SIM card in the modem, follow the steps below:

1. Press the button near the SIM card tray using a thin object (see 1 in Fig. 3.1)
2. Remove the SIM card by pulling the tray (see 2 in Fig. 3.1).
3. Place the SIM card in the ejected tray (see Fig. 3.2).
4. Insert the tray with the installed SIM card back into the SIM 1 slot.

If you plan to use two SIM cards for backup mobile connection, repeat the stages 1-4 for the second SIM card and insert the tray with it into the SIM 2 slot.

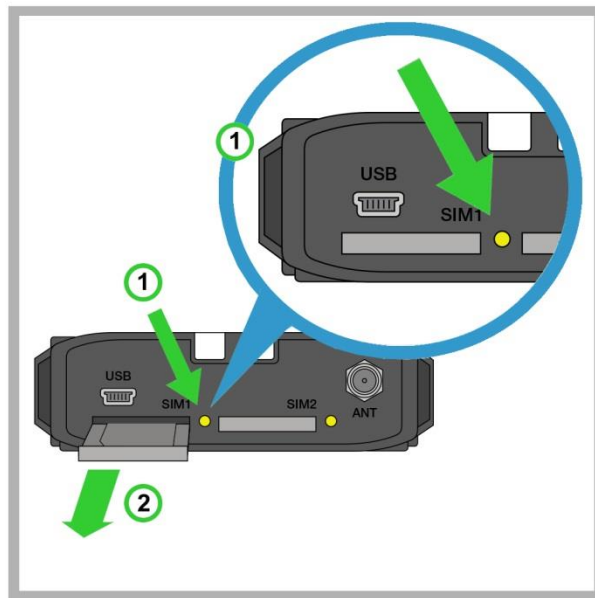


Fig. 3.1 Removing the SIM Card Tray from the Modem

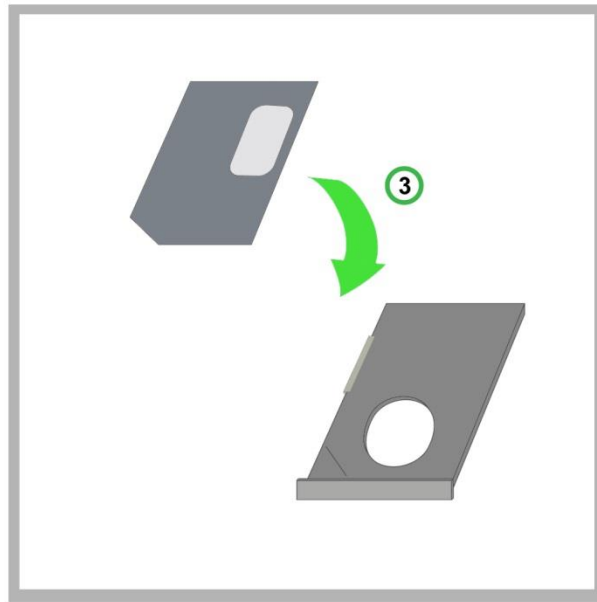


Fig. 3.2 Inserting the SIM card into the tray

Note! The tray placed in the SIM card slot must be turned with the SIM card contact side facing up. Failure to observe this requirement may result in the damage of the SIM card and tray.

3.2. Device mounting

There are two ways of mounting the modem on DIN rail as well as mounting on a wall using self-tapping screws.

The special clips on the side allow you to mount the modem on DIN rail with no extra attachments – just snap the modem side clips on the DIN rail (see Fig. 3.4).

To mount the modem on a DIN rail on the front side, use two WAGO mounting brackets (see Fig. 3.5). Fasten the mounting brackets with four Din7982 ST2.2x9 self-tapping screws at the rear side of the device (the housing is provided with 4 holes). The mounting brackets and self-tapping screws are not included in the package and to be purchased separately from the manufacturer.

To enable mounting to the wall, the modem housing is provided with two holes for them (see Fig. 3.6). It is recommended to use the Din7981 ST2.9x25 self-tapping screws.

The dimensions of the device (in mm), clips and holes for self-tapping screws are illustrated in the drawing figure (see Fig. 3.3).

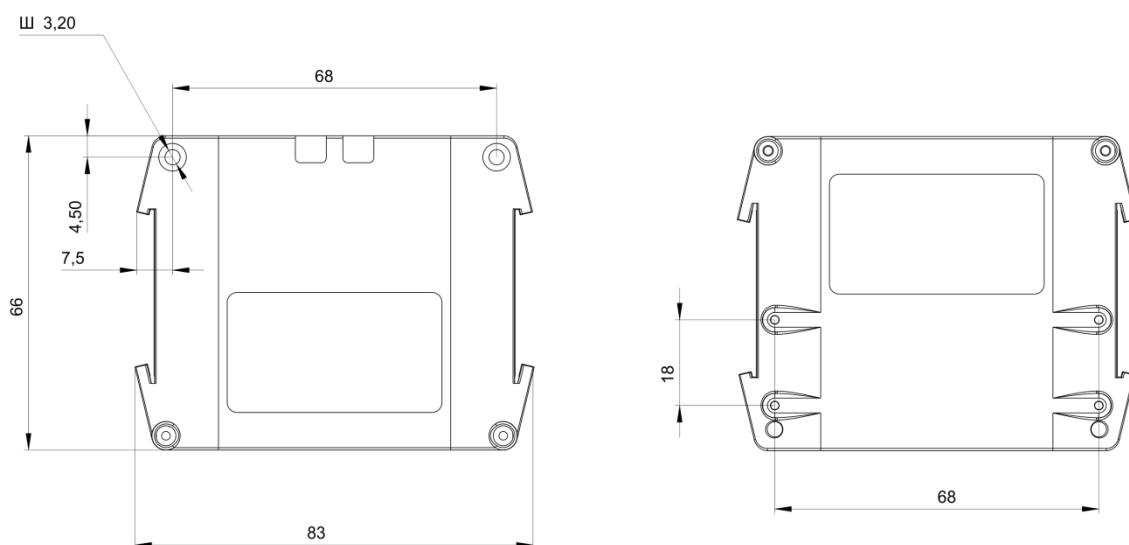


Fig. 3.3 The ATM modem drawing dimensions

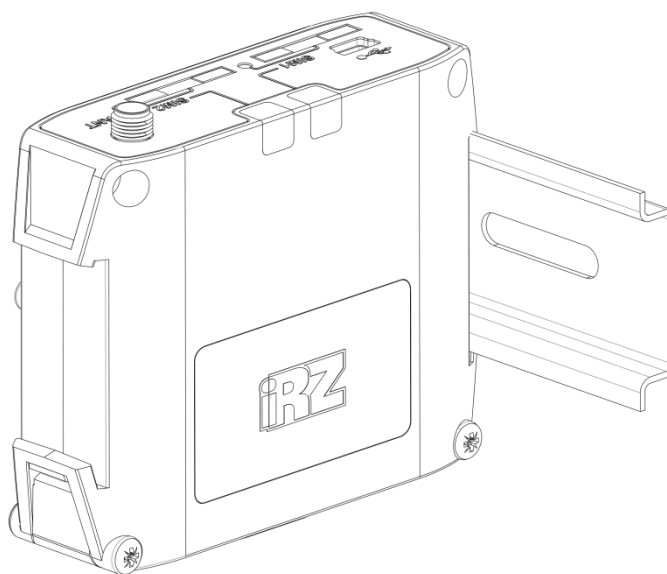


Fig. 3.4 Device mounting – mounting the modem on a DIN rail on the lateral side.

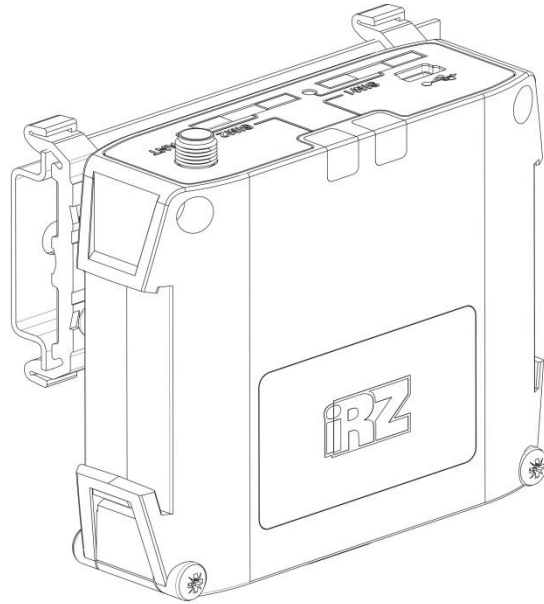


Fig. 3.5 Device mounting – mounting the modem on a DIN rail on the lateral side.

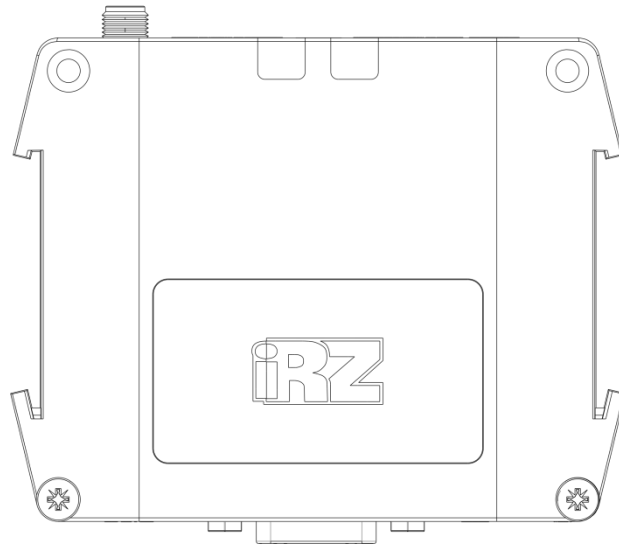


Fig. 3.6 Device mounting – mounting the modem on the wall



4. Device Operation Description

4.1. Modem Setup Preparation

Before you use the modem in a site, it needs to be configured. To do this, follow the steps below:

1. Prepare the modem for configuration:
 - a. Connect the modem to a computer using the USB A cable — Mini USB cable (not supplied with the package).
 - b. Press the eject button for each SIM tray using a thin object.
 - c. Pull both SIM card trays out of the modem (no need to remove them fully).
 - d. Start the ATM Control configuration utility – the program will display all data on the modem except for current time and IMEI.
 - e. If the password used to access the service mode for the connected modem is not the default one, enter it¹ and click **OK** – the utility will show current time and the modem IMEI.
2. Set up the modem using the application²:
 - a. Open tab **Settings** → **Basic** and enter modem's basic parameters: mobile network carrier parameters for the SIM cards used and communications server settings (when using the modem in the **Client** mode) / network settings (when using the modem in the **Server** mode).
 - b. If more advanced settings are required, specify advanced options in the tab **Settings** → **Advanced**.
 - c. Save settings specified in the application to the modem using the "**Write**" button with an arrow pointing down.
3. If you need to use the specified parameters later on, save them to a file on your computer using the Save button. In this case two files with the same names, but with different extensions — **.atm** and **.atm2**, are created. The file with the **.atm** extension is designed for further use in the ATM Control utility. The file with the **.atm2** extension is designed for further remote configuration of the modem via the iRZ Collector dispatching application.
4. Unplug the USB cable from the modem.
5. Set the modem into the operating mode:
 - a. Insert the SIM cards into the trays, the trays – into the modem.
 - b. Plug the antenna, data cable and power cable into the modem.
 - c. Apply voltage to the modem using the power connector. The modem establishes connection using the primary SIM card. The start log with main settings and state of its pins is displayed over the USB interface.

¹ The password is not requested when using the default value (5492) or using the same password that was entered for the previous modem.

² For more detailed information on the modem setup via the ATM Control program, refer to the document "[User Guide on the ATM Control Modem Configuration Utility](#)".



To switch off the modem, disable power voltage applied to it. Data transmission over GPRS (or 3G) will be terminated.

4.2. Device Operating Procedure

When enabled, the modem verifies power supply voltage. If it is less than the minimal allowed voltage, the log will prompt an error message ("POWER ERROR"), and the modem will wait for power voltage sufficient to operate.

After supplying voltage to the modem sufficient for operation, the SIM card is verified. If the SIM card requests a PIN code, the modem is loaded using the PIN code specified in the settings. When the PIN code is incorrect, the modem deletes it from the memory to prevent SIM card locking. If the PIN code is not specified in the modem settings, but the SIM card requires it, the modem does not operate with this SIM card until the tray is restarted.

After the SIM card's successful loading, the modem registers with the network and clears the memory of SMS messages. The modem establishes internet connection and connects to the server (in the **Client** mode) / opens the port for incoming client connections (in the **Server** mode).

When operating with the standard server (not iRZ Collector), the modem re-establishes connection with it if there is no data transmission within the time interval (set by the **Connection Check Interval** setting). Default time interval – 10 minutes. Changing the interval as well as learning the current value is only possible via AT commands.

When operating with the iRZ Collector specialized server, the modem sends a keepalive packet to the iRZ Collector server to verify connection if data transmission is not available for over a minute. If there is no response to the keepalive packets, the server clears the connection.

When the modem operates in the **Server** mode, test connection to the public servers is performed to verify connection. For more details on the basic settings, refer to the "[TCP/IP Connection Control](#)" section.

If going online and connecting to the modem is impossible, the modem repeatedly retries connection at the set time intervals (**Connection Retry Interval** setting). Default value for this parameter is 30 minutes. Changing the interval as well as learning the current value is only possible via AT commands.

The modem provides continuous monitoring of pins and checks for incoming¹ SMS messages. The modem checks for SIM cards and switches to the service mode if both trays are not available.

¹ SMS messages received by the modem. Such message may contain the command to connect to the server, enable or disable the offline mode or to control the modem pins. For more details on the modem SMS commands, refer to sections "[Connecting to the Server via SMS Commands](#)", "[Offline Mode](#)" и "[GPIO Pins Control via SMS Commands](#)".



4.3. Service Mode

The modem is configured in the service mode. The service mode is enabled automatically if both SIM trays are ejected from the modem. If the modem has at least one tray available, it switches to the operating mode.

Data communication with a computer is carried out via USB interface in the service mode. In this case the modem is recognized as a virtual COM port. The computer detects the modem as a virtual COM port.

You can configure the modem using the ATM Control configuration utility as well as using the AT commands in any terminal program. The ATM Control utility is available for free download from the official website of the Radiofid System Company (www.radiofid.ru).

All AT commands, except passwords, are case-insensitive (**at\$sim1?** is equivalent to **AT\$SIM1?**). Any AT command must end with the <CR> new line character (the Enter key). If the entered command is incorrect, an error message is displayed in the log.

To enter the service mode, it is required to enter the corresponding password (default value – 5492). Before entering the password in the terminal application, only the query for the version and model of the device and the IMEI module are available.

4.4. Offline Mode

In the offline mode the modem performs all its functions, except for connection to the network. In this case the modem remains registered in the GSM network, supports calls and SMS messages, operation of the GPIO pins, watchdog timers and switch to the primary SIM card. Offline mode provides economy of traffic and power consumption. It is used if no continuous network connection is required.

Switch to the offline mode indicates disconnection; exit from the offline mode indicates setting up connection (network access).

Switch to the offline mode can be implemented:

- If the GPRS operation interval set in the settings is expired
- On call
- When recognizing the code word by the modem
- When data is not transmitted within the set time interval
- By SMS command

Exiting the offline mode:

- By the specified exact time
- By period
- On call



- By SMS command
- By GPIO status change

Enter/exit the offline mode on call

For this option to work, enable switching to network mode on call or switching to the offline mode on call. Also, an authorized phone No. group must be assigned to each of the options.

If you have both the switch to offline mode on call and network access on call configured, the device will change its status – if the device has been in the offline mode, it switches to the network access, and vice versa, if internet connection has been established, it switches to the offline mode.

Exiting the offline mode by SMS

SMS command format:

XXXX wait on – to switch to the offline mode (disconnect from network)

XXXX wait off – to exit the offline mode (connect to network)

Where XXXX – password for SMS message (four digits or Latin letters, case-sensitive). Default password – 5492. There must be a space after the password in the message.

Switch to the offline mode by a code word

When detecting a set of characters in data stream with the sequence corresponding to the sequence specified in the settings, the modem terminates connection and switches to the offline mode.

The code word can be a sequence of any symbols from 1 to 32 and from 0x00 to 0xFF. When entering the code word, it is recommended to use non-printable characters in addition to ASCII-symbols, since in this case the coincidence probability of the code word with payload is reduced.

It is not recommended to specify the commands used by the 3-G module and the commands used in the communications protocol between the ATM modem and the iRZ Collector software as well as sequences that are parts of these commands.

The following commands are not to be used as a code word:

- NO CARRIER
- CONNECT
- SISW (^SISW; SISW:)
- SISR (^SISR; SISR:)
- RING
- ERROR
- OK
- \xB5\xBC\xBD\xBE\xBF (\x indicates hexadecimal notation)



- AT\$IMEI=ATM
- TYP=ATM
- PSW=
- VER=
- SIM=
- CSQ=
- TIM=
- TIM=CALL
- TIM=SMS
- WORD=
- LOG=
- INT=
- REV=
- HDW=
- MOD=SRV
- IP=
- PORT=
- OK%%%
- MOD=FRM
- MOD=SET
- MOD=DAT
- PASSWRONG
- PASSOK

Data can be written in hexadecimal format with a special character \$ (for example, \xB5 = \$B5) in the code word filed of the ATM Control configuration utility.

The modem configuration via AT commands and the terminal application is given in the document ["The AT commands for the iRZ ATM2-232 Modem Configuration"](#).

Exit the offline mode on exact time.

When this option is enabled, the modem will establish internet connection at a specified time once a day. There will be no changes if the modem has not switched to the offline mode. The period is set in the hh:mm format from 0:00 to 23:59. To apply this option, enable it in the service mode.

Exit the offline mode by GPIO status change.

To enable this option in the ATM Control application, do the following steps:

- Set GPIO to "input";
- Select the servers to which ATM is to be connected;



- Set a fixation step for ADC.

Exiting the offline mode by period

When this option is enabled, the modem establishes connection at regular intervals beginning from its activation or exit from the service mode. There will be no changes if the modem has not switched to the offline mode. The period is set in the hh:mm format from 0:00 to 1000:59. If the value is set to 0:00, operation by period is disabled, i.e. connection will not be established.

If the GPRS operation interval set in the settings is expired

The internet connection duration is set in the hh:mm format from 0:00 to 1000:59. If the value is set to 0:00, the operation time in network is not limited, in this case the modem does not switch to the offline mode. The modem operation interval at internet connection is started when any indication of the network access is activated.

For proper operation of this option with the configured network access by exact time, the duration of internet connection must not exceed 24 hours. When operating by period, the duration of internet connection must not exceed the specified period in the settings.

If the modem operates with the iRZ Collector server, the modem is connected to the server and sends the offline mode schedule in the start log when supplying power and exiting the service mode.

You can set up¹ the offline mode in the service mode via the ATM Control configuration utility in the tab **Settings** → **Advanced** → **Wait** or using special AT commands via any terminal application. The ATM Control utility, starting from version 4.5, supports all the settings of the offline mode.

Setting examples.

1. Network access by exact time.

For example, the modem is set for internet access at 07:30; GPRS connection duration is 0:40. In this case, the modem will enable internet connection at 07:30 on a daily basis and disable it (switch to the offline mode) at 08:10.

2. Periodic operation mode

For example, the modem is set for network access at 10:00; duration – 01:00; the code word – "ENDLINK", the power to the modem has been supplied at 15:30. In this case the modem will enable internet connection

¹ If the modem RTC has failed, the access to the offline mode by the parameters set in the settings is not performed, i.e. the modem has a permanent connection to the server.



immediately after power supply and will support it for an hour, but if during this hour the modem does not run into the word "ENDLINK" in the data flow, it will disable internet connection and switch to the offline mode. Next connections are to be established at 1:30; 11:30; 21:30; 7:30, etc.

If power is switched off and resupplied, for example, at 20:10, report on establishing internet connection is made from this time, i.e. the first connection is enabled immediately after supplying power, and the next one – at 6:10; 16:10, etc.

4.5. Updating Embedded Software (Firmware)

The modem can use two firmwares of various types to operate. First type – the factory firmware installed by the manufacturer and is no longer changed. Second type – a firmware which you can update via ATM Control (hereinafter referred to as updatable firmware). The factory firmware is always installed on the modem. If the firmware fails to update, the modem switches to the operation with the factory firmware. When the modem has a successfully installed updatable firmware, the modem will always boot up with it.

When the modem operates with the updatable firmware and receives a request for the next updating, the modem switches to operation with the factory firmware, after that deletes an old version of the updatable firmware and loads a new one. After a successful firmware loading, the modem operates with a new version of the updatable firmware.

The firmware version can be found in the log via any terminal program or in the ATM Control Configuration Utility (the **Device** tab). The first two digits in the version number stand for the firmware type used by the modem: 01 – factory firmware, 02 – updatable firmware. The next two digits in the version number is a sequence number of the firmware version. For example, 01-02 – a factory firmware of the second version, 02-03 – an updatable firmware of the third version.

The ATM modem is provided with a hard reset button (see Fig. 2.3). This function may be required if the operation of the updatable firmware has had a failure, preventing its updating and the modem switch to the factory firmware. In this case it is required to perform a hard reset, and update the firmware (updatable) which caused the failure using the ATM Control utility.

To implement a hard reset, power off the modem, press the button using a thin object, and holding the button apply power to the modem. After supplying power, release the button.

The modem firmware can be updated both locally by connecting it to a computer – via the ATM Control configuration utility, and remotely (when using the iRZ Collector solution) – via the iRZ Collector dispatching application. Remote firmware updating is supported if you use the iRZ Collector solution in your data collection and device management system.

Local configuration via the ATM Control utility is viewed in the section ["Modem Settings"](#) of the ["User Guide on the ATM Control Modem Configuration Utility"](#) document. For more details on remote firmware updating via iRZ Collector, refer to the document ["iRZ Collector. Dispatching Software Setup and Operation User Guide"](#).



To update a firmware, use the off-the-shelf firmware files. They are available for downloading on the official website of the Radiofid System Company at (www.radiofid.ru). Download the required firmware file to your computer from which you will update the modem firmware.

Use the **Device** tab in the ATM Control utility (the **Software Updating** button) for local firmware updating.

4.6. Setting Up the Modem

The ATM initial settings are made using the ATM Control utility or AT commands. Further changes of the modem parameters can be made both locally using the ATM Control utility or AT commands and remotely via the iRZ Collector dispatching application. Remote configuration is supported if you use the iRZ Collector solution in your data collection and device management system.

Local configuration via the ATM Control utility is viewed in the section "[Modem Settings](#)" of the "[User Guide on the ATM Control Modem Configuration Utility](#)" document. Local configuration via AT commands is viewed in the document "[AT Commands to Set Up the iRZ ATM2-232 Modem](#)". For more details on the remote modem configuration, refer to the document "[iRZ Collector. Dispatching Software Setup and Operation User Guide](#)".

Use a previously created modem configuration file to provide remote configuration of the modem. The ATM configuration file can be created and saved via the ATM Control utility.

Note! The modem does not handle incoming calls, SMS commands and pins signals in the firmware update and setup modes. In addition, watchdog timers, offline mode access on schedule and switch to a primary SIM card are disabled.

4.7. Working with SIM Cards

The modem supports two SIM cards and enables backup mobile communication. SIM card to be deployed for current operation is regarded as an operating card (or active). After supplying power and prior to each activation of the module, the modem selects an operating SIM card and verifies its PIN code. If one of the SIM cards is not available in the modem or the PIN code specified in the modem settings is invalid, the modem switches to another SIM card. To switch to a problem SIM card, restart its tray or the modem.

By priority, the SIM card can be primary or secondary. The primary SIM card is recognized in accordance with the specified settings or on a signal from GPIO pins (see "[GPIO Pins Operation](#)"). SIM1 is primary by default. When the tray with the primary SIM card appears in the modem, the modem switches to it.

The modem switches from the operating SIM card to another SIM card in the following cases:

- the operating SIM card is removed from the device;
- the primary SIM card has appeared in the modem;
- the primary SIM card is reassigned on the pins signal, and it is not an operating one at the given moment;



- the modem cannot enable internet connection using the operating SIM card within the specified time interval;
- it is time to switch to the primary SIM card.

When enabling **Schedule** option, operation of each SIM card can be scheduled separately. The modem operation with SIM cards is set up in the tab **Settings** → **Advanced** → **SIM** of the ATM Control utility.

4.8. Working with the Server

The client modem provides transparent data communication between the server and an external device, connected to the modem, in the network over TCP/IP. To set up connection, specify an IP address and the server port in the modem settings (the tab **Settings** → **Basic** in the ATM Control utility).

Either one or two IP ports can be arranged to access the modems in the backup mode on one server. When using the second IP address (for example, from other provider), the access to the server is available when it is not provided for the first address. Taking this into account, the following combinations with maximum available use of backup:

- one server – with two IP ports (two IP ports for the modems in overall count);
- two servers – with two IP ports (four IP ports for the modems in overall count);
- three servers – one server with two IP ports and two servers with one IP port (four IP ports for the modems in overall count);
- four servers – each has one IP port (four IP ports for the modems in overall count);

If you intend to use backup server(s), enable the use of these servers in the modem settings and specify their IP address and port. The modem switches to the backup server (or to other IP address of the same server) if connection to the first server is lost (or to the first IP address of the same server) or on a signal from the modem pins. The flow diagram (see Fig. 4.1) illustrates the procedure of selecting a production server when operating with two servers, one of which is a backup one.

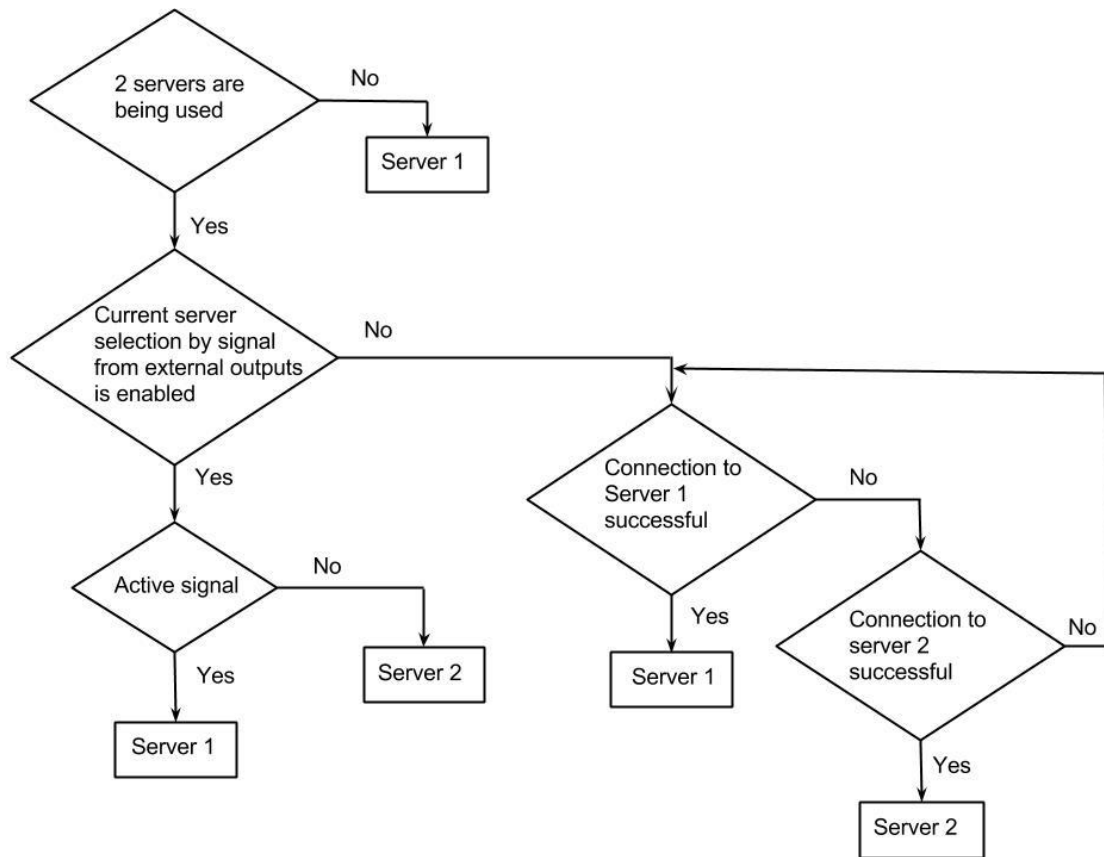


Fig. 4.1 Procedure of selecting a production server

The figure illustrates the diagram of operation with the server without backup Internet connection (see Fig. 4.2, the diagram of operation with two servers (see Fig. 4.3) and the diagram of operation with two IP addresses on one server (see Fig. 4.4).

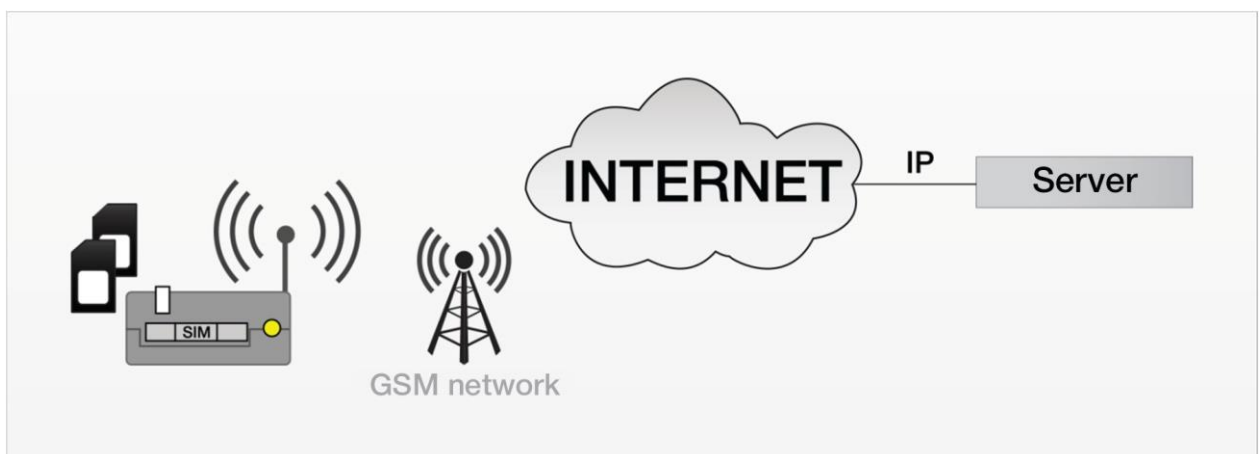


Fig. 4.2 The diagram of operation with one server without backup



Fig. 4.3 The diagram of operation with two servers



Fig. 4.4 The Diagram of Operation with Two IP Addresses on One Server

4.9. Working with the iRZ Collector Server

The ATM modem supports operation both with a common server and the server with the installed iRZ Collector server software (hereinafter – the iRZ Collector server).

The primary function of the iRZ Collector server is to provide communication between the client modem and the external device polling software, which also serves as a client. Two clients cannot intercommunicate directly, server is required. This is the iRZ Collector server has been developed. It serves as a "layer" between the modem client and the software-client providing their communication. What's more, the iRZ Collector provides remote monitoring, firmware updating and configuring the system of modems, as well as sending SMS command to the modem via the dispatching application.

When the modem operates in the **Client** mode, the iRZ Collector server is used for its first intended purpose – to receive data from external devices. In addition, the modems can be monitored and controlled via the iRZ Collector dispatching application.



When the modem operates in the **Server** mode, it is accessed directly from the dispatching center. Thus, it is not required to refer to the iRZ Collector server to receive data from external devices. However, the iRZ Collector software solution can be still used to monitor and control the modems.

When establishing internet connection, the modem sends a start packet to the iRZ Collector server and waits for a response. After receiving the response the modem switches to the data transmission mode. In case of a response error, the modem re-establishes connection.

To set up the operation of the client modem with the iRZ Collector server, use the ATM Control utility (tab **Settings** → **Basic**) check the box for the **Integration into iRZ Collector** and specify an IP address and the server port.

On server modem operation with iRZ Collector see section "[Monitoring and Control via iRZ Collector](#)".

4.10. Working without iRZ Collector Protocol

In the client mode ATM is able to send starting ID when connecting to the server working without iRZ Collector protocol. Starting ID text is set in the modem settings via ATM Control application and can consist of any printable and non-printable characters as well as insertions of the following info: IMEI, CSQ, SCID, operating SIM card (see "[ATM Control User Guide](#)", section "[Setting Up Connection](#)"). Each server requiring starting ID must have respective option "Add ID" enabled via ATM Control application (**Settings** → **Basic**).

Maximal starting ID text size that can be specified in ATM Control is 254 bytes. Also in ATM Control application it is possible to set package text awaited from the server by the modem. It is possible to choose the starting action: receiving server message or sending of the starting ID.

4.11. Encapsulation Mode

When operating with the iRZ Collector server, the encapsulation mode is available. The encapsulation mode enables the modem to receive control commands and response to the server inquiries without interrupting connection to the server. Control over Encapsulation mode is carried out via ATM Control program.

The following inquiries can be made from the server:

- CSQ signal strength;
- data on detected base stations;
- the module temperature;
- GPIO pins status;
- COM port pins status;
- current settings reading.

ATM can process the following commands:

- GPIO status change;



- change of external COM port pins status;
- external COM port rate change. (ATM immediately responds to server, but carries out the command a minute after receiving it);
- selection of a primary SIM card. (ATM immediately responds to server, but carries out the command a minute after receiving it);
- switching to the offline mode.

4.12. Connecting to the Server via SMS Commands

The modem provides the option of a single connection to the server by an SMS command. When receiving such command, the modem is connected to the server with the address specified in the SMS message. In this case the server switch is not allowed. The sample of SMS command to connect to the server:
0000 ATIP208.245.23.12:10234TIME255IRZ.

You can include command for changing network parameters of one or both SIM cards into SMS (APN, login, password). Additional commands must be separated with comma with no spaces. Message, containing additional commands must end with a comma.

The sample of SMS command to connect to the server, containing additional commands:

0000 ATIP208.245.23.12:10234TIME255IRZ,ENC,APN1=internet,PASS1=gdata,LOG1=gdata,

- 0000 – password for SMS commands, set on the modem. Putting white space after the password is imperative. Format – 4 characters (Latin characters and digits, case sensitive). Default value – 5492 (can be changed in the service mode).
- ATIP208.245.23.12:10234 – the command to the modem for its connection to the server via IP address 208.245.23.12 with the port 10234 (entered with no character spacing).
- TIME255 – time in minutes within which the modem is to be connected to the server (10 – 36 minutes) Parameter is optional: if it is not specified in the SMS message, the connection is established for 10 minutes. If it is set to **TIME0**, the modem will operate with the specified server before any of the following events take place: power reset, entering service mode or receiving another SMS command. IRZ – required to be specified if the iRZ Collector server is used. If the system uses an ordinary server, the iRZ parameter is not required.
- ENC – command for switching to Encapsulation mode If ENC command will not be present in the following message, the Encapsulation mode will be disabled In other words, if the modem receives several SMS commands for connection to the server and it needs to stay in Encapsulation mode, then all of the SMS commands must contain ENC command.
- APN1=internet — access point to the APN network for SIM 1.
- PASS1=gdata — APN network password for SIM 1.
- LOG1=gdata — APN login for SIM 1.



The time settings, specified in the SMS message, are not stored in the device memory and are valid only within the time, specified in the message. After the time, specified in the SMS message, the modem is loaded with the saved settings. The modem switches to the saved settings when it is restarted on power or exiting the service mode.

Maximum size of a SMS message, consisting only of numbers and only of Latin characters – 160 symbols. If SMS message contains at least one Cyrillic character, then maximal size is 70 symbols.

4.13. Sending SMS message

When an event occurs, ATM can send SMS notifications to selected phone no. groups, which are specified in the ATM Control program in tab **Settings** → **Advanced** → **Phone No.** The group can contain up to 14 numbers.

ATM can send SMS notification on the following events:

- IP address change in "server" mode (tab **Settings** → **Advanced** → **Connect**);
- Internet connection loss (tab **Settings** → **Advanced** → **Connect**);
- detecting active signal at GPIO1 pin (tab **Settings** → **Advanced** → **GPIO** → **GPIO1**);
- Detecting active signal at GPIO1 pin (tab **Settings** → **Advanced** → **GPIO** → **GPIO2**).

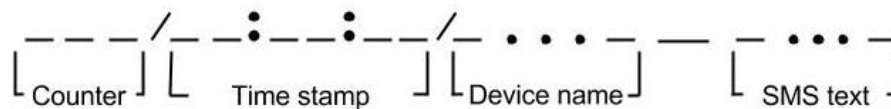


Fig. 4.5 Outgoing SMS – structural diagram

Outgoing SMS can contain up to 65 characters (see Fig 4.5). If sending SMS is impossible, ATM makes another attempt after time, set in **Settings** → **Advanced** → **SMS** (setting **SMS resending time out**), default value is 30 minutes. If new event occurs while SMS resending time out have not expired yet, the timeout will refresh and only the last event notification will be sent. To disable SMS resending, set the resending interval to 0.

Enabling the option **SMS Counter** (**Settings** → **Advanced** → **SMS**) will add a numerical message number at the beginning of every message (maximal value – 999).

Enabling the option **Add time stamp** (**Settings** → **Advanced** → **SMS**) will add a time stamp of event occurring into the message text.

Constant «Device name» can contain up to 30 characters and is specified in tab **Settings** → **Advanced** → **SMS**. Default name – ATM.

For each of the GPIO1 and GPIO2 pins text can be separately specified in tab **Settings** → **Advanced** → **GPIO** → **GPIO1/GPIO2** (see "[Setting Up Pins of an "Input" Type](#)"). A message can contain up to 20 of any characters. Message example on active signal detection in GPIO1 pin: **005/15:15:57/ATM GPIO1**.



Text of notification on changing the IP address contains new IP address in the following format: "IP=xxx.xxx.xxx.xxx". Message example on change of IP address: **006/15:15:58/ATM IP=123.456.789.012**".

Text of SMS on internet connection loss: "GPRS-ERR". The SMS message on losing the internet connection is not sent if connection is restored within the specified time interval set in the **SMS resending time out** parameter, as well as when the modem switches to the service, offline or CSD mode. The sample of SMS on internet connection loss: **007/15:15:59/ATM GPRS-ERR**.

4.14. Data Transmission via CSD

The ATM modem supports data transmission via CSD (over voice channel).

The following conditions are required for data transmission via CSD:

- mobile network operator supports the technology of data transmission via CSD;
- authorized phone numbers are specified in the modem settings.

Calls can be authorized from any number or only from a specified group of numbers. Enabling **Any phone no.** option or specifying the group of phone no. can be done in the tab **Settings** → **Advanced** → **CSD** of the ATM Control utility.

CSD is supported both in the **Client** and the **Server** modes of the modem operation. In addition, modem supports a separate mode for data transmission only over CSD.

At an incoming call the modem determines its type: voice call or data transmission. If it is a voice call, the modem refers it to the offline mode. If it is determined as data transmission, the modem compares the telephone number, from which the call has been received, with the phone numbers enabled in the settings. If the number coincides with the enabled ones (or all numbers are enabled), the modem switches to the CSD mode. In this case, transparent data communication between an external device and a connection initiator¹ is established. Connection is supported until the initiator ends the call. The automatic exit from the CSD mode will be initiated only when the SIM card is removed for the modem.

You can enable up to four phone numbers or enable the CSD mode initiation from any number.

CSD mode is considered dominant: if the call is received during data transmission over network, the internet connection is broken and the CSD mode is set. After data transmission via CDS is complete, the modem returns to the action performed before switching to the CSD mode. If it was connected to server, it tries to re-establish connection. If it server modem was online, then the modem goes back online and awaits incoming connections. If the modem was in network mode, then it will re-establish internet connection, and if it was in offline mode, then it will go back to offline mode.

¹ For example, by the dispatching centre.



CSD connection is always available in 2G mode. When operating in 3G mode; 2G/3G autoselection with 2G preferred mode; 2G/3G autoselection with 3G preferred mode, the modem inspects incoming calls. If the calling number matches the number, specified in CSD settings, the modem closes the current call and all the existing connections with servers, and then switches to 2G mode for 5 minutes in order to await new CSD connection. After CSD connection is over, modem enters the previously used mode.

Switching modes can take up to 20 seconds, which is why the second call from remote equipment should be made no earlier than 20 seconds later.

The CSD mode is not available during the embedded software (firmware) update process and the modem settings change.





In the **Only CSD** mode, in which data transmission is possible only via CSD, GPRS connection, offline mode, remote firmware updating and settings change and Modbus protocol for COM port are unavailable.

4.15. Data transmission in 3G mode

The ATM modem supports 3G data transmission.

3G transmission is supported both in the Client and the **Server** modes of the modem operation.

Connection type can always be selected at tab **Settings** → **Advanced** → **Connect** of the ATM Control utility:

-  2G;
-  3G;
-  2G/3G autoselection with 2G preferred;
-  2G/3G autoselection with 3G preferred;

4.16. Watchdog Timers

The modem provides continuous monitoring of the 3G module state. If the 3G module stops responding to the service commands, it restarts. However, if there has been a fault, but the module continues to respond to the service commands, the module will not restart. In case of such fault, the modem is fitted with two types of watchdog timers.

The modem has an interval and daily watchdog timers. The interval watchdog timer restarts the module at the specified interval after its last activation. Default restart interval – 24 hours.

The daily watchdog timer restarts the module once a day at the specified time. By default, daily timer is disabled. Watchdog timer is set up in the tab **Settings** → **Advanced** → **WDT** of the ATM Control utility.



4.17. Real-Time Clock (RTC)

Real-time clock (RTC) is a source of time for the modem services which require timestamps or compliance with a schedule to operate. For example, the modem determines time of SMS sending and receiving via RTC and starts the watchdog timers. RTC configuration is set up in the tab **Settings** → **Advanced** → **RTC** of the ATM Control utility.

When enabled, the modem performs the RTC verification. If there has been the RTC fault, both LEDs glow for 4 seconds, and the current time is set to 0:00:00.

When the modem is connected to the iRZ Collector server, the modem RTC time is synchronized with it.

4.18. GPIO Pins Operation

To control external devices (for example, sensors), the modem has three configurable GPIO pins (see Fig. 2.7). Pin 1 and 2 can be configured both as "input" and "output"; pin 2 can be configured as ADC. Pin 3 is power, always operates as an "output".

The modem GPIO is set up in the tab **Settings** → **Advanced** → **GPIO** of the ATM Control utility.

4.18.1. Setting Up Pins of an "Input" Type

The pin set to "input" can operate in the normal or inverse modes. In the normal mode the input high level (level "1") is regarded as an active signal, and the low level (level "0") – a passive one. In the inverse mode the modem perceives high input/output signal as an active signal, and low signal – as a passive one.

To set an action to be performed when an active input signal appears, it is required to specify the operation algorithm for an input. The signal, coming to input, is a signal of at least 1 second duration.

The input operation algorithm (see 4.1) is set in the tab **Settings** → **Advanced** → **GPIO** of the ATM Control utility.

Table 4.1 Assignments of pins set to input

Input operation algorithm		State at the active level on input	State at the passive level on input
Code	Function		
0	No settings	—	—
1*	Selection of a primary SIM card.	Primary SIM card	Secondary SIM card
10	Event with SMS sending	Sending SMS message	—
15	Pulse counter**	Counting pulses received	—



* if similar code of an algorithm is assigned for two pins at once, this algorithm will be relevant only for the GPIO1 operation.

** The pulse counter is active only when the ADC mode is disabled. It has the **Minimum pulse width**, ms, setting corresponding to the minimum period time during which the GPIO active level must be supported to detect the pulse by the modem.

The modem is fitted with the input pull-up to supply voltage. By default, the pull-up is disabled and the input is pulled down to the negative supply voltage (GND) via the 47 kOhm resistor. When the pull-up is enabled, the input is pulled up to the U_{in} power supply voltage (MicroFit 4 connector) via the 10 kΩ resistor.

The encapsulation mode has an option of pin state automatic sending to the selected server (see section "[Encapsulation Mode](#)"). Each pin has its own server selected in the ATM Control utility. And it can be one and the same server.

The change in state for a digital pin is considered to be a change for ≥ 1 sec

The GPIO 2 pin, set to input, can operate as ADC. Depending on the settings, ATM can measure current or voltage.

Current measurement parameters:

- Current measuring range, mA: 0 to 30
- Current measurement error, mA: ± 0.2 .

Voltage measurement parameters:

- Voltage measuring range, V: 0 to 40
- Voltage measurement error, V: ± 0.2 .

Change of the measurable value (voltage/current) is considered its change by a fixation step. Fixation step is set in the ATM Control configuration utility.

For automatic data sending to the ADC server, do the following steps in the ATM Control configuration utility:

- select a server for data transmission;
- set up the server sending mode:
 - by state change (measurements are performed once per second);
 - by period:
 - measurement interval:
 - number of measurements to be sent.

In the automatic data transmission mode ATM can store up to 150 last values for ADC and 2 last states after the change for digital inputs and measurement time. There is an option to exit the offline mode by the GPIO pin state change to send data (see section "[Offline Mode](#)").





4.18.2. Setting Up Pins of "Output" Type

The pin set to "output" can operate in normal or inverse mode. In the normal mode the output high level (level "1") is regarded as an active signal, and the low level (level "0") – a passive one. When enabling the inverse mode, output high level corresponds to a passive signal, and the low level – to an active signal.

To select an event by which the modem will produce an active or passive output signal, it is required to specify the output operation algorithm. The input operation algorithm (see 4.2) is set in the tab **Settings** → **Advanced** → **GPIO** of the ATM Control utility.



Table 4.2 Output operation algorithm

Output operation algorithm		Output active state	Output active state
Code	Function		
0	No functions	—	—
1	Connection status	Internet connection established	No internet connection
2	Active SIM card	Primary SIM card	Secondary SIM card
3	SIM cards are available	SIM card is available (at least one)	No SIM cards
4	Operation via CSD.	Operation via CSD.	—
6	Data link activity	Internet	
		When data is received over the network, the pin switches to an active state, and data transmission begins after the pause of 150 ms*.	 when no data is available to be transmitted within the time period specified in the Data absence time option (in the ATM Control application);  after module restart.
		CSD	
		CSD connection is open	CSD connection is closed
7	Alarm status	Module is enabled	Module is disabled
8	Command mode (performing a task by SMS command)	See section "GPIO Pins Control via SMS Commands" .	

The command mode enables the modem output to be controlled via single-acting SMS commands. The output can be transferred into an active or passive state as well as an output signal can be generated by sending an SMS command to the modem. Two types of output signal are available for the command mode: pulse of set duration and trigger. By default, the trigger is used. For more details on the basic settings, refer to the ["GPIO Pins Control via SMS Commands"](#) section.

* If the pin is in an active state, data is transmitted without a pause when received.



Table 4.3 Available types of signals in the command mode

Signal type	Description
Pulse	Pulse is generated by the output active state. Pulse duration – 1 to 255 minutes. Default value – 1 second. If during the pulse action an event, reinitializing the pulse output triggering, occurs, the output remains in the active state for the specified duration starting a count from the time of the event.
Trigger	The pin state is changed into the opposite one and stored (if output state memory is enabled).
Up (Active state)	Set for an output only by an SMS command. The output state switches to active and is stored (if state memory is enabled).
Down (Passive state)	Set for an output only by an SMS command. The output state switches to passive and is stored (if state memory is enabled).

The modem can save the outputs state and restore it when restarted. By default, this option is disabled for pins 1 and 2, enabled – for pin 3. Only impulse's active state is not recorded: after modem has been rebooted, state of input will be set to passive.

You can disable saving of each pin state – in this case the pin is set to the passive state after restarting the modem.

Note. When changing the GPIO settings, the state of all the modem pins is reset to the passive state.

4.18.3. GPIO Pins Control via SMS Commands

The modem can perform an action with an output by an SMS command:

- to set the active state of an output;
- to set the passive state of an output;
- to change the output state into the opposite one (trigger);
- to generate a pulse of the specified duration.

To control pins via SMS commands, first set up this pin (otherwise the modem will ignore an SMS command for the pin):

- "direction" – "output";
- "output operation algorithm" = 8 (command mode).

The modem GPIO is set up in the tab **Settings** → **Advanced** → **GPIO** of ATM Control utility.

SMS command to control the pin must contain the following data (all enumerated parameters below must be separated from each other by a space):



- SMS command password – 4 characters (digits and Latin characters, case-sensitive), default value – 5492;
- output number (out1, out2 or out3);
- command (if the command is not specified, the device produces the signal set in the settings);
- duration (for pulse only).

The samples of SMS messages for pins control:

- **5492 out3** – the signal, specified in the modem settings, appears at pin 3 (pulse or trigger).
- **5492 out2 up** – pin 2 is set to the active state.
- **5492 out3 down** – pin 3 is set to the passive state.
- **5492 out2 pulse** – a pulse appears at pin 2. The pulse duration is equal to the value set in the modem settings (default value – 1 second);
- **5492 out2 pulse** – a pulse of 2 seconds duration appears at pin 2.

4.19. Operating with Incoming SMS Messages

Incoming SMS commands are used for pins control in this modem version (see section ["GPIO Pins Control via SMS Commands"](#)) to enter and exit the offline mode (see section ["Offline Mode"](#)) as well as for single connection to the server (see section ["Connecting to the Server via SMS Commands"](#)).

The SMS commands, received by the modem, are displayed in the log, and the password specified in the SMS command is not displayed in the open form. If the password or command is invalid, the modem ignores the SMS command received. If the password is invalid, the log prompts an error message "Password Error".

4.20. Modem Operation in the Server Mode

The server mode can be relevant if a company rents an access point (APN) from the mobile network carrier (or a public static IP address is rented for each modem). When APN is rented to all devices of the system (modems and a dispatcher center), private IP addresses are set. In this case, there is no need to rent public static IP addresses for modems or operate with modems via the iRZ Collector server (see Fig. 4.6).

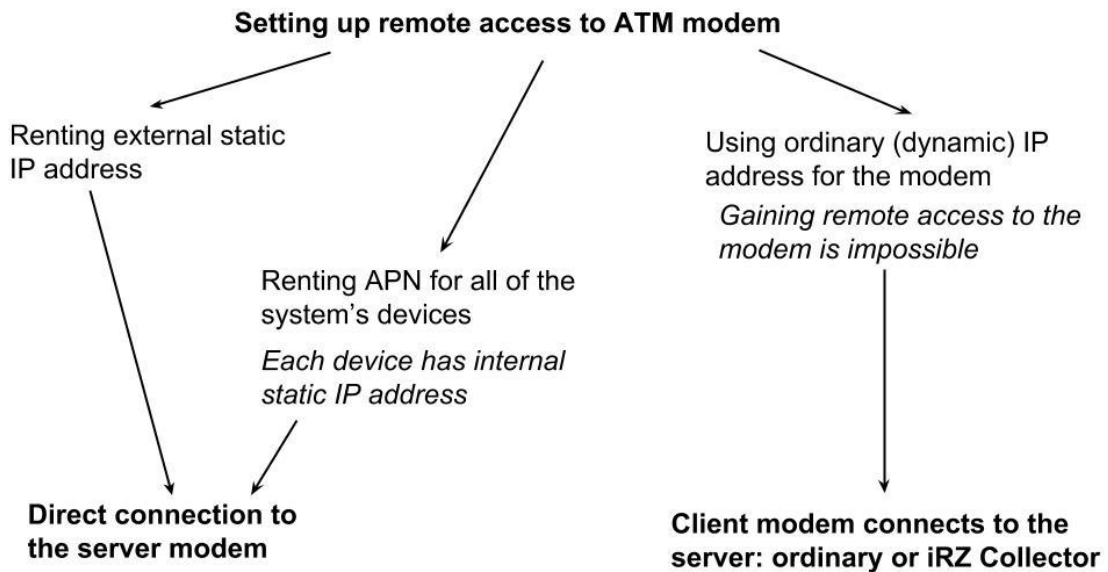


Fig. 4.6 Methods of gaining remote access to the modem

In the **Server** mode the modem supports the same functions as in the **Client** mode. In the same way that is described in sections ["Service Mode"](#), ["Offline Mode"](#), ["Updating Embedded Software \(Firmware\)"](#), ["Setting Up the Modem"](#), ["Working with SIM Cards"](#), ["Connecting to the Server via SMS Commands"](#), ["Data Transmission via CSD"](#), ["Watchdog Timers"](#), ["Real-Time Clock \(RTC\)"](#), ["GPIO Pins Operation"](#), ["Operating with Incoming SMS Messages"](#).

In the **Server** mode the modem supports operation with the iRZ Collector software solution. To receive data from an external device connected to the server modem there is no need to deploy the iRZ Collector server – the server modem can be accessed directly. However, the iRZ Collector server enables the remote modems to be monitored and controlled from the dispatching center. On server modem operation with iRZ Collector see section ["Monitoring and Control via iRZ Collector"](#).

What's more, modem in **Server** mode has additional functions: the mode of client's connection to the modem, and sending SMS message when changing IP address. However, the option of the offline mode access is not available if no data is found.

For operating in **Server** mode you need to specify the port number for incoming connections (the **Incoming Port** parameter in the tab **Settings** → **Basic** of the ATM Control utility).

4.20.1. Authentication of Connecting Clients

The server modem can operate only with one client at one time.

The server modem can limit the attempts to connect clients. One of authentication types is used: by iRZ protocol, by IP address or with no authentication. Please note: If authentication is disabled, connection is established to any client which tries to connect to the server modem.

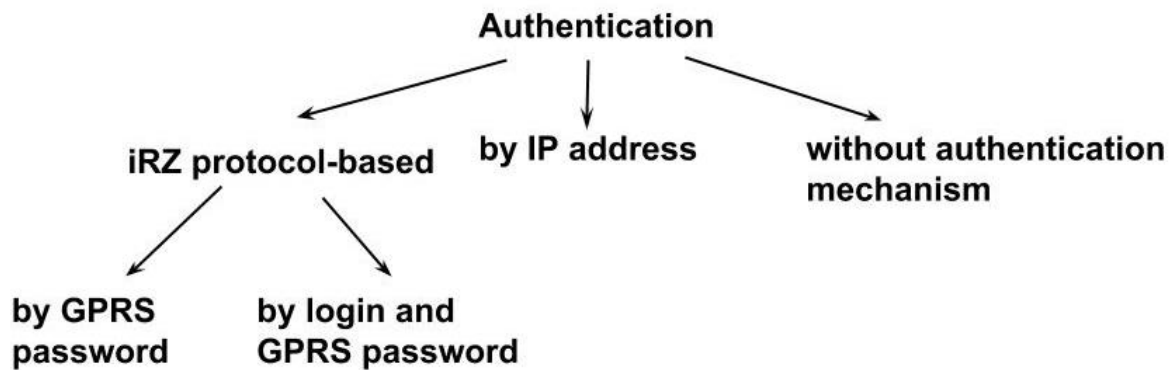


Fig. 4.7 Types of client authentication at connection to the server modem

The iRZ protocol-based authentication is designed for the cases when the ATM client modem or iRZ protocol-enabled software, is installed in the dispatching center. The iRZ protocol-based authentication is implemented by the GPRS password or by the login – GPRS password pair. The right to connect to the server modem is not provided for each client, but only for one which has a valid GPRS password or the login – GPRS password pair (depending on the server modem settings). This means that their values, specified in the settings of a connected client, must coincide with those specified in the server modem settings.

GPRS password authentication: if a new client tries to connect to the modem, and there has been no data or keepalive packets communication with a current client within a minute, operating connection to the current client is terminated and connection to a new client is established. Operation with the current client continues in a different way.

Login and GPRS password authentication: if a new client tries to connect to the modem and its login and password are valid, the modem establishes operating connection to a new client and terminates the previous connection. If the login and password do not match, the server modem continues to operate with the previous client.

IP address authentication is used when the client holds a public static IP address (when renting APN from the mobile network carrier – a private static IP address); the clients with other IP addresses fail to operate with the server modem.

At authentication by **IP address**: An IP address of the connecting client is compared with the IP address set in the server modem settings. If the address matches, connection to a new client becomes operational and the previous connection is terminated. If not, the server modem continues its operation with the previous client.

No authentication mechanism: when the modem is already working with the current client, and a new client is trying to connect the modem at the same time, 2 options are possible:

- If data has been transmitted within the last minute, operation with the current client proceeds. In this case connection of a new client is terminated.
- If data has not been transmitted within a minute, connection to a current client is terminated, and connection to a new connected client is established.



The type of authentication is set up in the tab **Settings** → **Advanced** → **Connect** of the ATM Control utility (the **Connection Mode** parameter).

4.20.2. Monitoring and Control via iRZ Collector

When the modem operates in the **Server** mode, data from an external device can be received directly without a "layer" in the form of the iRZ Collector server application. However the iRZ Collector software solution enables the modems to be monitored and controlled¹ via the iRZ Collector dispatching application. In this case the server modem is monitored and controlled in the same way as the client modem since the modem is still a client in relation to the iRZ Collector server (see Fig. 4.8).

When the command for the settings change and the firmware update is received from iRZ Collector, the modem-server terminates all connections and switches to the **Client** mode. After setting up / updating the firmware, the modem returns to the **Server** mode and opens the port for incoming connections.

The operation of the modem-server with the iRZ Collector server can be set up in the tab **Settings** → **Basic** of the ATM Control application. Check the box for the **Control via iRZ Collector** option and specify an IP address and port of the iRZ Collector server.

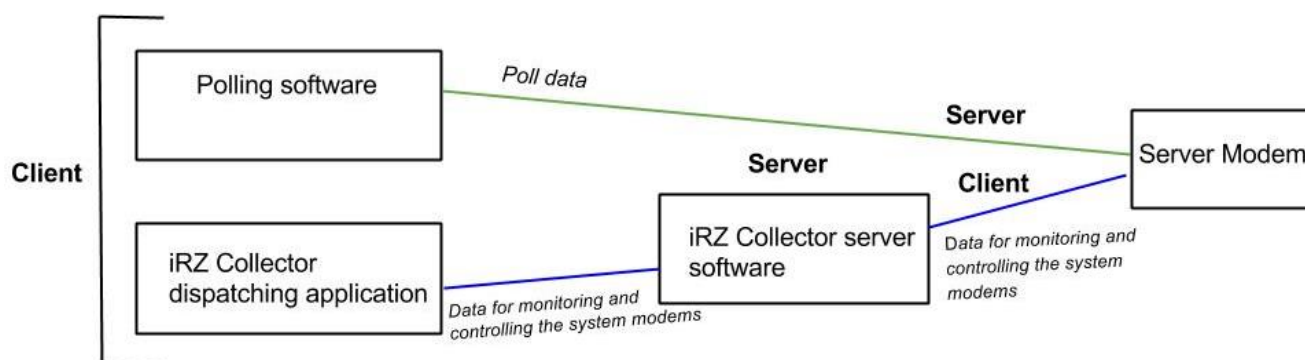


Fig. 4.8 Interaction diagram when using the iRZ Collector software solution – the modem operates in a server mode

4.20.3. TCP/IP Connection Control

To establish test connection check, the server modem can connect to two public servers. When using iRZ Collector, test connection is available only with one public server.

If the modem is unable to connect to any of the test servers (or TCP/IP connection control is disabled), the modem closes an incoming connection port and opens it again.

¹ For more details on the modem monitoring and control via the iRZ Collector dispatching application, see the document ["iRZ Collector. Dispatching Software Setup and Operation User Guide"](#).



This connection check is performed in the connection check intervals specified in the modem settings. Changing the interval as well as checking the current value is only possible via AT commands.

By default, Yandex (www.ya.ru with port 80) and Google public DNS server (8.8.8.8 with port 53) are used as a public server to verify connections.

Set addresses of test servers for TCP/IP connection check using the **Settings** → **Basic** tab of the ATM Control utility.

4.20.4. SMS on IP Address Change

The server modem supports sending of SMS messages to the specified phone number reporting on an IP address change. The server modem sends an SMS message at the first connection and at each subsequent connection when the current IP address differs from the previous one. IP address can be changed due to SIM card change or when using a SIM card with a dynamic public IP address.

SMS message sending on the server modem IP address change can be enabled in the tab **Settings** → **Advanced** → **Connect** of the ATM Control utility.



5. Contacts and Support

New firmware, documentation and companion software versions can be obtained addressing to the following contacts.

St. Petersburg	
The company's website:	www.radiofid.ru
Phone number in St. Petersburg:	+7 (812) 318 18 19
E-mail:	support@radiofid.ru
Moscow	
The company's website:	www.digitalangel.ru
Phone number in Moscow:	+7 (495) 974 74 22
E-mail:	info@digitalangel.ru

Our specialists are always ready to answer your questions, assist in installation, configuration and resolve difficulties with using the iRZ equipment.

Note. Before contacting technical support it is recommended to update your router firmware up to a current version.