

GW-GSM-02

IQRF GSM Gateway

Firmware v1.00

User's Guide

Preliminary



Smarter wireless. Simply.

Description

GW-GSM-02 is an IQRF gateway with GSM connectivity intended as an interface between IQRF and GSM/GPRS networks. The user can implement specific functionality by software for internal IQRF TR module.

Main components are 8 b microcontroller, GSM/GPRS transceiver module and IQRF TR module with antennas, FLASH memory and backup accumulator.

GW-GSM-02 can be configured and firmware can be upgraded from PC. Application software for TR module can be uploaded via IQRF IDE4 using the gateway as a programmer.



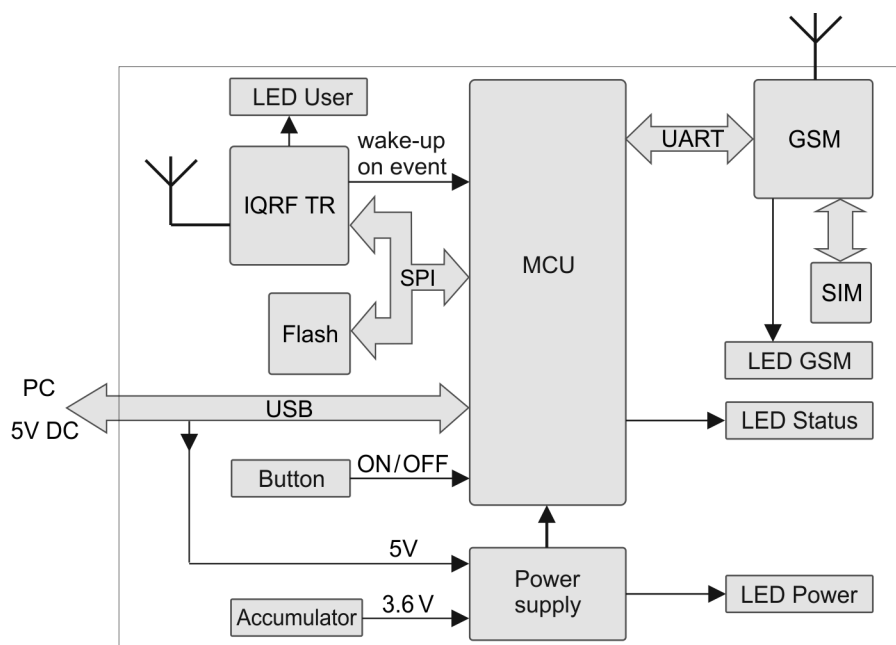
Key features

- TCP Server mode with public IP address
- SMS alarm feature
- Data logging
- IP filtering
- RTCC (real time clock/calendar)
- Backup accumulator
- Very low power consumption in Sleep mode
- Documented application protocol
- Firmware upgrade via PC software
- Programmable application in internal TR module

Applications

- Remote monitoring and control
- Data acquisition / collection
- Datalogger
- Interface to building / home automation
- Remote control of IQRF network
- Connection of more IQRF networks to one PC
- Access to IQRF network from more locations

Block diagram



Electrical specifications

(typical values unless otherwise stated)

Power supply	4.8 V – 5.5 V DC
Accumulator	LI14500-1L, 3.7V, 700 mAh
Supply current	
Standby (all peripherals disabled)	12 μ A
Operational	
TR and GSM inactive	75 mA
Additional current	
TR active	See datasheet of TR module
GSM transmitting	175 mA
Accumulator charging	450 mA max.
Temperature range	
Operational	0 °C to +60 °C
Accumulator charging	0 °C to +45 °C
Storage	10 °C to +20 °C (recommended)
IQRF	
Frequency bands	868 MHz or 916 MHz (SW selectable)
RF output power	According to TR module, programmable
TR module	TR-54DA
Antenna	PCB antenna built-in TR module
GSM	
frequency bands	900 MHz or 1800 MHz
Antenna	External, SMA, gain 2.15 dBi
Flash memory	1 MB, serial interface SPI, 100 000 erase/write cycles typ.
Data logging	Up to 3200 events
Temperature sensor	Optional, built-in TR module
Dimensions	
without antenna	86 mm x 60 mm x 24 mm
with antenna	104 mm x 60 mm x 60 mm
Weight	90 g

Absolute maximum ratings

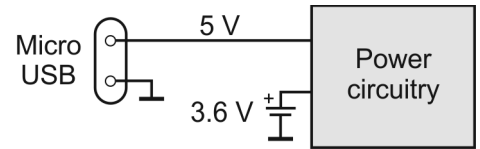
Stresses above those values may cause permanent damage to the device. Exposure to maximum rating conditions for extended periods may affect device reliability.

Supply voltage (VCC)	5.5 V
Storage temperature	-20 °C to +60 °C

Hardware

Power supply

GW-GSM-02 is intended to be supplied by external stabilized 5 V DC connected to micro USB connector.



Accumulator

Backup accumulator is intended especially for short failures of external power supply. It is not removable and enables continuous charging when external power is connected.

Power control button (ON / OFF)

- Short press (< 3s): no effect
- Long press (> 3s): Switching between operational and sleep modes

LED indication

Power LED (red)

Power LED is on when main power is on.

GSM LED (yellow)

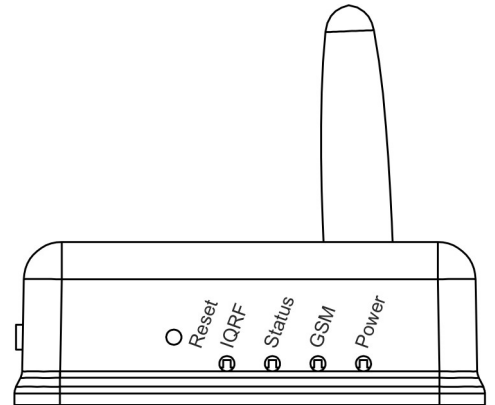
- Flashes once per second when GSM module is powered.
- Flashing twice per second when communicating via GSM/GPRS.

Status LED (green)

- Status LED is on when GSM module is establishing connection to network.
- Flashing once per two seconds when GSM is logged in the network.
- Flashing two times per second when an error occurred (missing SIM card etc.)

IQRF LED (red)

This LED is controlled by the TR module, the LEDG output. Functionality is fully under control of user application program. IQRF OS functions dedicated to LEDG can be used. In Demo SW this LED shortly flashes whenever an RF packet is transmitted or received by TR module.



MCU

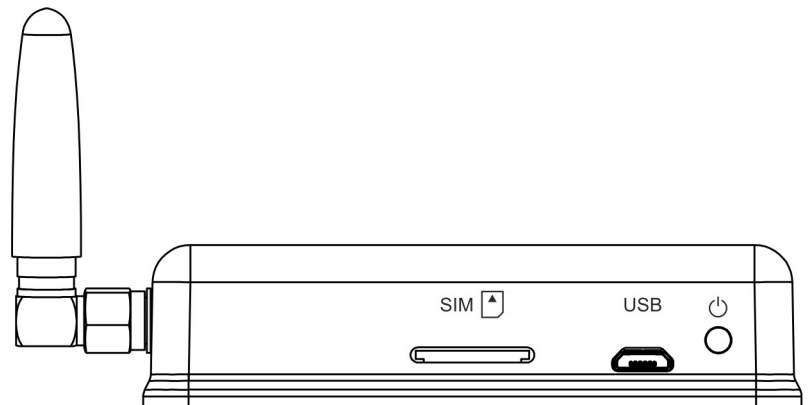
Microcontroller PIC18F26J50 by Microchip is used.

GSM

M590E dual band wireless module by Neoway is used for GSM/GRPS connectivity.

SIM card

SIM card with activated data services from mobile network operator must be plugged in the SIM connector under the cover. Public IP address is required (see below).



IQRF

TR-54DA wireless transceiver module is used for IQRF connectivity. Antenna is built in TR module.

Flash memory

SST25VF080B 1 MB Flash memory by Microchip/SST is used for gateway configuration and message buffer. Up to 100 000 erase/write cycles (typical) is allowed.

Operation

GW-GSM-02 can completely be configured by the *GW-GSM Tool* PC software which is also intended for testing and debugging. See the screenshots below.

It is necessary to obtain fixed public IP address from mobile network operator. GW replies to TCP packets sent to port 10001. The GW-GSM-02 can handle only one connection at the same time. Each connection is terminated 5 seconds after sending data.

Date and time

GW-GSM-02 contains a real time clock/calendar (RTCC). Date and time must be set after every GW reset. Current time is necessary for proper logging only.

Use SMS Alarm

This feature allows to send a short message to selected telephone number if an alarm is activated. Alarm activation is initiated by the high logic level (log.1) pulse with minimum length 50 ms on pin C1 of TR module (MCU pin PORTA.0). After alarm activation the gateway sends data prepared in *bufferCOM* in TR module. Alarm activation may precede sending data itself. The data is sent only after the TR module executes the *startSPI(n)* command.

Access restriction

It is possible to enable IP address filtering. If enabled, only addresses specified in the address list are allowed for communication with the server. The gateway supports up to 15 addresses in the list.

TR module data exchange

Data transmission from TR module to MCU in gateway is performed by command *startSPI(n)*, where *n* is the length of SPI data in *bufferCOM* in TR module. The maximum length of the SPI packet is 64 bytes. TR module receives data from the main MCU to variable *bufferCOM*.

TR module powering

If the main MCU communicates with serial Flash memory, the TR module is switched off. This may occur also when communicating with PC or during GSM transmission or reception. Thus, it is strongly recommended to provide TR modules with a communication protocol ensuring proper communication in IQRF network (requesting to resend an answer to incoming data not being served due to temporarily disabled TR module in GW-GSM-02).

Data logging

GW-GSM-02 automatically stores data packets received from TR in internal Flash memory. Up to 3200 records can be saved. The memory is organized as circular FIFO buffer. When the buffer is full, the sector (for 32 records) with the latest messages is cleared and new records start to be saved there.

Data records format

#number#DDMMYYHHmmSS#data#

- number - record serial number
- DD – days
- MM – months
- YY – years
- HH - hours
- mm – minutes
- SS – seconds
- data - record payload data, length up to 64 B
- # - separator

System logging

GW-GSM-02 automatically logs system status and events. These messages are stored in Flash with the same format as data records.

System records format

#number#DDMMYYHHmmSS#data#

- number - record serial number
- DD – days
- MM – months
- YY – years
- HH – hours
- mm – minutes
- SS – seconds
- data - event data and status
- # - separator

Event data and status

Each system record payload has the same length 8 B.

0	1	2	3	4	5	6	7
Event	System agent	GSM RSSI		External Power	Accumulator voltage		

Event	Type of event, see below
System Agent	Additional information for start up and shutdown events, see below
GSM RSSI	GSM Received Signal Strength Indication value in ASCII format (from 0 to 99)
Ext. Power	0x30 - External power not available, 0x31 - External power applied
Accumulator Voltage	Value from A/D converter in hex format (AD = 000 to 3FF) To calculate voltage, use this formula $V_{bat} = (AD + 671.03)/327.71$ V. Example for AD = 190: 190 in hexadecimal = 400 in decimal, $V_{bat} = (400 + 671.03)/327.71$ V = 3.27 V.

Event byte

Code	ASCII	Event
0x30	0	Reset
0x31	1	Power On (wake up)
0x32	2	GSM login correct
0x33	3	Power Off (sleep)
0x34	4	GSM login failed
0x35	5	Server login failed
0x36	6	Send SMS failed

System agent byte

Code	ASCII	Agent
0x30	0	Not defined
0x31	1	Accumulator - GW switched to sleep because of low accumulator voltage
0x32	2	USB - GW has been switched to sleep using software from PC
0x33	3	Button - GW has been switched to sleep using power button

Application

Firmware upgrade

MCU firmware is fixed but can be upgraded by the user with a new version released by the IQRF manufacturer via USB and *IQRF UDU* software.

TR module application

GW-GSM-02 is delivered with the `TR-GW-GSM-Demo` application SW uploaded in TR module. It implements basic operations and can be used as a template for user specific applications.

The Demo functionality is as follows:

TR module inside the GSM gateway continually attempts to receive IQRF packets possibly incoming from (an)other IQRF device(s). If a packet containing temperature is recognized, it is checked whether the temperature exceeds the predefined limit. If so, TR module generates an alarm signal via dedicated pin to main MCU and the gateway generates the alert SMS.

All incoming IQRF packets can be accessed remotely by TCP client or locally using USB connectivity. Both can be done using *GW-GSM Tool* software.

Format of the packet containing the temperature is: "`T:xx`", where `xx` is the temperature in degrees, all 4 bytes in ASCII characters. E.g. "`T:35`" means temperature 35 °C. The shape of the alarm signal is log. high for 50 ms on the `PORTA.0` pin.

Remote temperature sensor can be simulated by another TR module connected to PC e.g. by *CK-USB-04* development kit or *GW-USB-05* gateway connected to PC. Then packets can easily be created by IQRF IDE development environment using built-in SPI Terminal.

The demo also enables to send IQRF packets. Any data received by TCP client is transmitted by GW into the IQRF network. The TCP client uses an application protocol, described below.

The demo SW can be downloaded from the *GW-GSM-02* product web page.

Application code can be developed and uploaded inside the *GW-GSM-02* using the IQRF IDE 4 development environment.

Application protocol

The communication is realized with the application protocol described below. It uses the transport protocol TCP according to the OSI reference model.

Connection establishment

To connect to the gateway operating in the Server mode, it is necessary to know the IP address of the gateway. IP can be obtained from the GSM provider or it can be read using the *GW-GSM Tool*. The default port is set to 10001.

Commands

The GW-GSM-02 listens to commands from allowed IPs. The complete set of supported commands is listed in the following table.

Command string	Gateway action
record = <i>ffff</i>	Returns last record
record = <i>number</i>	Returns record with index <i>number</i>
dump	Returns all records
dump_index = <i>number</i>	Returns all records starting from index <i>number</i>
send_data = <i>data</i>	Sends <i>data</i> to TR module
syslog	Returns all system records

Number is formatted as four digit HEX value with lower case letters. *Data* is strictly in binary format.

Responses

Standard response to record data request (e.g., "record = 002f") may be "#002f#060512031245#data#" according to data and system record format described on the Data logging page. In some cases, the gateway replies error codes or statements. The complete set of reply codes is listed in the following table.

Reply code	Interpretation
FF0000000001	Invalid command
FF0000000002	Record not found
FF0000000003	Empty buffer
FF0000000005	Registration not successful
FF0000000006	No data to send
FF0000000007	Data successfully sent

Connection termination

TCP connection is terminated after 5 seconds of last TCP data packet sent.

GW-GSM Tool

GW-GSM Tool is a PC program for setup, operation, testing and debugging of the GSM part of the gateway. It is free to download from www.iqrf.org/321.

First steps

- Press the power button for at least 3 seconds to wake up the GW (if in sleep mode).
- Connect the gateway to PC using a USB cable.
- Install *USB driver – Custom Class*. You can download it from www.iqrf.org/89. This driver is the same also for other IQRF USB devices. See the IQRF Quick start guide www.iqrf.org/235. If the IQRF IDE or another software using the same USB driver (e.g. IQRF UDU) is installed, this step can be omitted.
- Run the *GW-GSM Tool*.

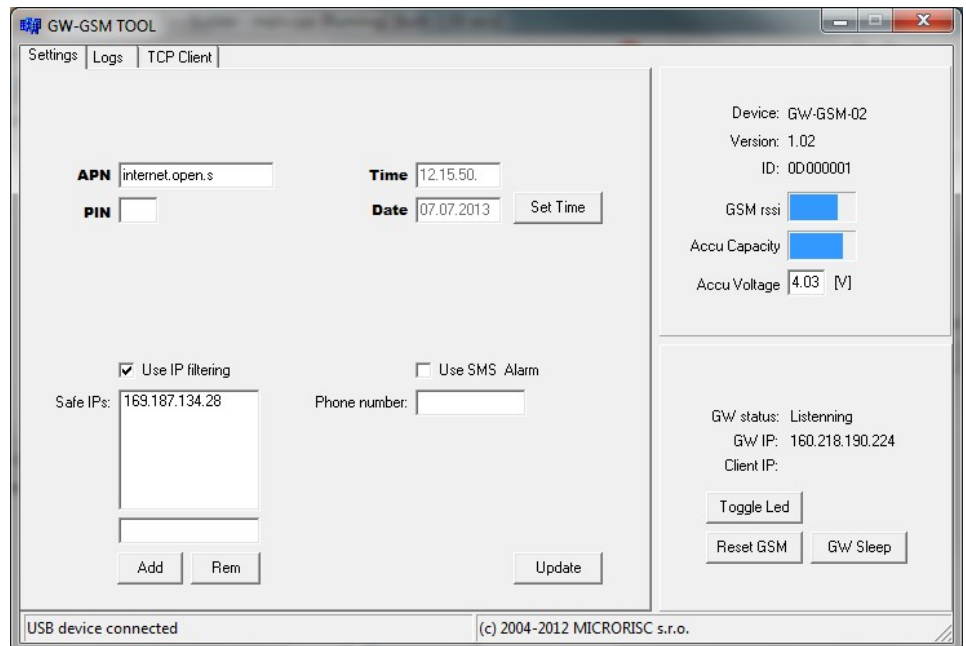
Caution: No other program communicating with any IQRF device via USB (e.g. IQRF IDE or IQRF UDU) is allowed to run at the same time.

Basic setup

Settings – The tab to configure basic gateway functions.

- **APN** – Access Point Name obtained from the GSM network operator.
- **PIN** - if the SIM card is protected, insert the PIN code and press Update button
- **Time** – Time in HH.MM.SS format.
- **Date** – Date in DD.MM.YYYY format.
- **Set Time button** – sets a new time to the RTCC. Other settings stay unchanged. Once the button is pressed, the time and date are enabled for editing. Another press of the button will launch the RTCC with updated values.

Use SMS Alarm – If the box is checked the *Send SMS* function is enabled. Telephone number must be specified in the box below.



The Settings tab

Use IP filtering – If the box is checked the access restriction function is enabled. Only IP addresses listed in *Safe IPs* list can communicate with the gateway.

Safe IPs – To add a new address to the list, enter the address in the box below the list and press the *Add* button. To remove an address from the list, select it and press the *Rem* button.

Update button - Updates the configuration of the *GW-GSM-02*.

Data logging

Logs – the tab to read system or data records and clear all log memory.

Read button – loads the entire contents of the internal memory to the list above.

Clear Memory button – deletes all logs stored in Flash memory

Log type selection

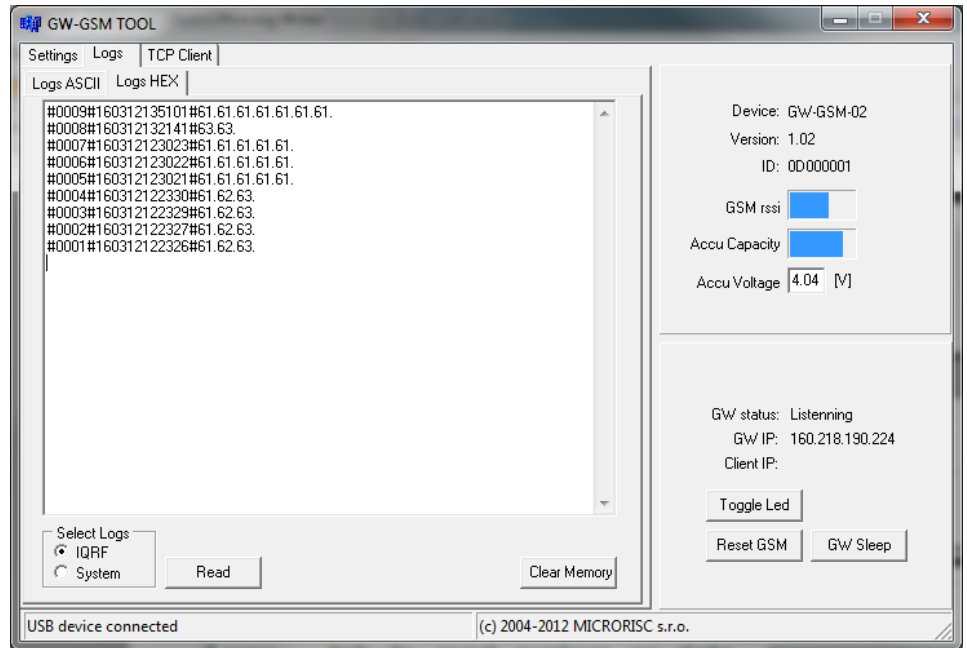
IQRF – To display data records logged from TR module only.

System – To display records with logged system states and events only.

Log display selection

ASCII tab - All recorded bytes are interpreted and displayed as ASCII characters.

HEX tab - All recorded bytes are displayed in hexadecimal format. Each byte is separated by the dot character.



Logs tab - hex format

TCP Client

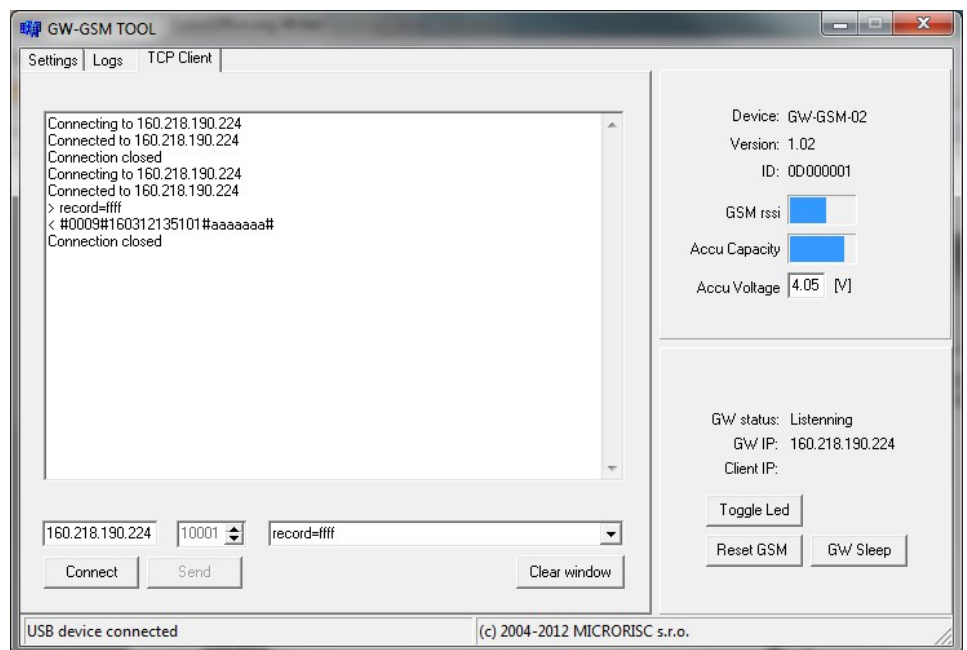
TCP client tab to test the gateway.

IP address of the gateway must be filled in the box above the **Connect** button. When the **GW-GSM Tool** is connected to the gateway via USB cable, the IP address is stated automatically.

Port number – fixed 10001 value is used.

Connect button establishes a TCP connection to the gateway.

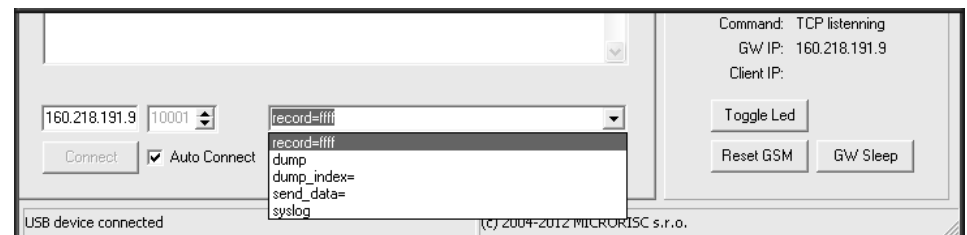
Send button – Sends packet to the gateway containing data from the box above the **Send** button. This control works only when the client is connected to a TCP server.



TCP client tab

Data box - This box contains predefined commands for TCP server. Any additional data can be entered into the box.

Clear window button - clears the TCP client terminal window.

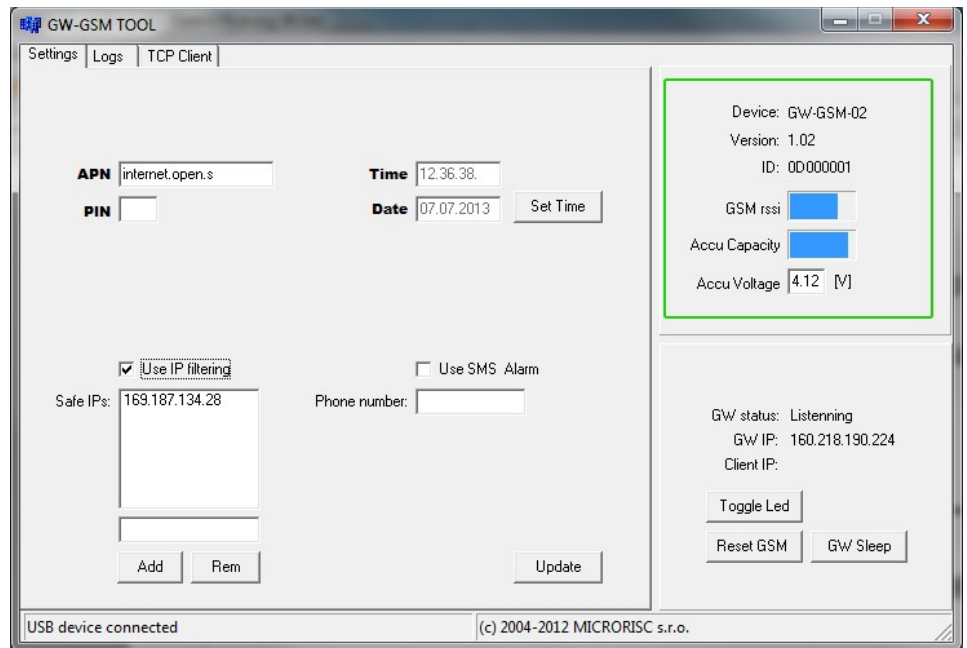


Predefined commands

Info window

This window shows the simplified information from the gateway.

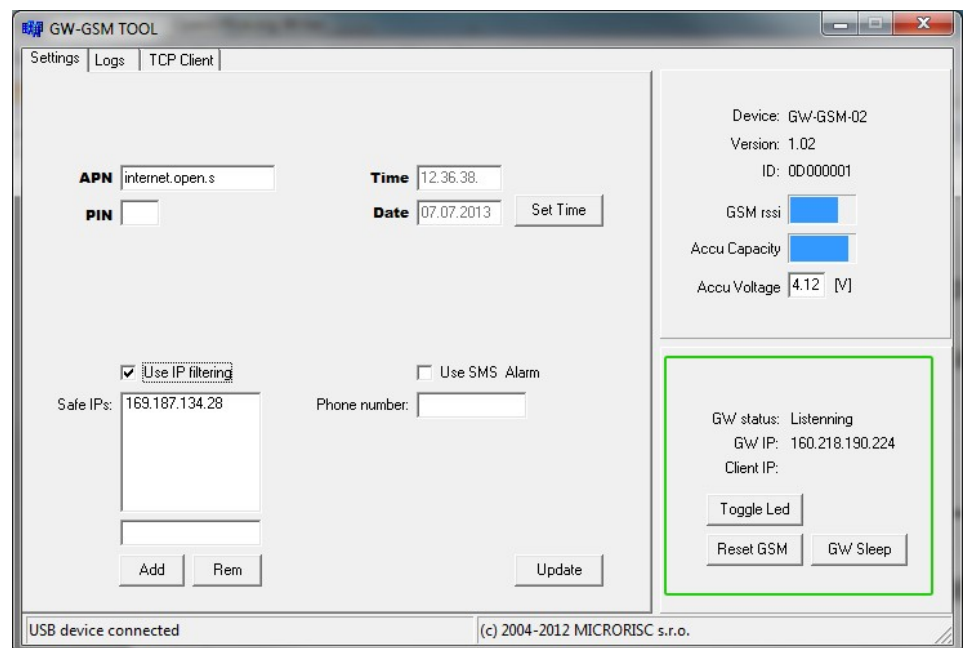
- **Device** - Gateway product code
- **Version** - Gateway firmware version
- **ID** - Unique gateway identification number
- **GSM RSSI** - Receive Signal Strength Indicator of GSM network
- **Accu Capacity** - Estimated backup battery life
- **Accu Voltage** - Actual battery voltage



Info window

Command window

- **GW status** - Current command executing by GSM module
- **GW IP** - Gateway IP address
- **Client IP** - IP address of connected client
- **Toggle LED** - Toggles gateway status LED
- **Reset GSM** - Reset GSM module in the gateway
- **GW Sleep** - Switches gateway into the sleep mode



Command window

Product information

Pack list

- GW-GSM-02 IQRF GSM gateway, with the accumulator and GSM SMA antenna
- TR-54DA IQRF TR module (with built-in antenna) inside, demo SW uploaded
- TY-A6 Power supply (Input: 100 V – 240 V AC, EU plug. Output: 5 V DC, 500 mA, USB A connector, cordless.)
- CAB-USBABMICRO Power supply cord (for TY-A6) with microUSB output connector

Ordering codes

- GW-GSM-02 IQRF GSM gateway

Requested option

- SIM card with activated data services from mobile network operator

Firmware history

- v1.00 First release

Document history

- 131016 First release

Sales and Service

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Partners and distribution

Please visit www.iqrf.org/partners

Quality management

ISO 9001 : 2009 certified

Complies with Directive 2002/95/EC (RoHS)



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