Z-GP Line

Seneca micro RTU-GP

User manual

WARNINGS

To use the product safely and effectively, read carefully the following instructions before use.
The product must be used only for the use for which it was designed and built. Any other use must be considered with full responsibility of the user.
The installation, programmation and set-up is allowed only for authorized operators; these ones must be people physically and intellectually suitable.
Set up must be performed only after a correct installation and the user must perform every operation described in the installation manual carefully.
Seneca is not considered liable of failure, breakdown, accident caused for ignorance or failure to apply the indicated requirements. Seneca is not considered liable of any unauthorized changes.
Seneca reserves the right to modify the device, for any commercial or construction requirements, without the obligation to promptly update the reference manuals.
The **micro RTU-GP** works with the GSM/GPRS standard about the mobile telephony; so it can not be used outside the mobile coverage area.
The GSM/GPRS systems implement a radio-frequency technology (RF), so there may be interference in the presence of other telephone devices or problems of electronic devices inadequately protected against the RF energy.

It is forbidden to use the **micro RTU-GP**:

- Into airplain
- Into hospistals or care centers
- Near gas stations or everywhere there is a danger of explosion
- In places where there are chemicals, with particular attention at safety rules for saturated environments (or potentially saturated) of gas or volatile exhalations
- In places where there are blasting operations
- Near electrical equipments, including auxiliary systems as: pacemakers and electroacoustic devices

The product complies with safety standards regarding exposure to RF energy.

SUMMARY

1 TECHNICAL SPECIFICATIONS

1.1 MAIN FUNCTIONALITY

FUNCTIONALITY
• **Remote management systems** • **Remote control for civil applications and industrial applications (small dimensions)** • **Measures control** • **Counting** • **Data capture** • **Energy saving** • **Diagnostic for plants** • **Temporary powering for receiving / sending of SMS and/or MAIL** • **Spontaneous transmission of data via FTP / MAIL** • **Change of the parameters via SMS / MAIL**

1.2 PHYSICAL DESCRIPTION AND ENVIRONMENTAL CONDITIONS

PHYSICAL DESCRIPTION AND ENVIRONMENTAL CONDITIONS	
DIMENSIONS	65 mm (height) x 130 mm (width) x 55 (depth)
WEIGHT	350 g
OPERATING TEMPERATURE	-20..70 °C, Max stability: 0..35 °C
HUMIDITY	10..95% at +40 °C (not condensing)
INSTALLATION CATEGORY	II
POLLUTION DEGREE	2
PROTECTION CLASS	IP30

1.3 EXTERNAL CONNECTIONS

EXTERNAL CONNECTIONS	
DB9-Female connector	Interface V.24 with level RS232
Antenna connector	SMA-Socket
I/O connector	Removable screw terminals

1.4 TECHNICAL SPECIFICATIONS

MAIN TECHNICAL SPECIFICATIONS	
POWER SUPPLY	**Battery or Internal electric cells** **External battery**: 12/24 V rechargeable with a solar-panel/regulator system. **Warnings (if you use battery)**: do not short-circuit, do not disassemble, do not heat over 100 °C. Do not wet internal components with water. Do not soft-solder directly on cells. The batteries provided as Seneca equipment have a **Transport class 9**.
POWER CONSUMPTION	**Average: 3,3 mW, 1. 5 W (average) during GSM transmission, 5W max.** **Battery life (as supplied):** 3 years, if the battery operates: in normal operation; with the GSM modem that functions for 2 minutes (this time starts from the time the modem results connected with network) in a day; daily transmission of one SMS message, monthly transmission of processed data in one minute, refer to 25 hours.
MICROPROCESSOR	32 bit, core ARM7, 2 UARTS, low power
MEMORIES	• EEPROM: 64 kbyte • FLASH: 2 Mbyte • Memory Card MMC: 2 Gbyte
CLOCK	Internal RTC; Error max: 75 ppm (-10°C to 60°C).
MODEM	GSM/GPRS, dual band full type approval.
SERIAL COMMUNICATION PORT	Serial port V24-RS232, half-duplex. Configurable Baud rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud.
PROTOCOLS	• ModBus RTU RS232 with standard CCITT V.24 . Communication parameters: 1 start-bit, 8 data-bit, 1 stop-bit, no parity • Protocol SMS, Protocols SMTP/POP3, Protocol FTP
DIGITAL INPUT	N°: 4, galvanically isolated. Sampling frequency 10 Hz.
DIGITAL OUTPUT	N°: 2, relay bistable. Capacity: 30 Vdc-1 A Max (resistive load)
ANALOGUE INPUT	• N°: 2, protected against the overvoltage and overcurrent • Configurable end scale: $\pm$ 50V, $\pm$ 20V, $\pm$ 2V, $\pm$ 20mA. • Resolution: 15 bit + sign. • Accuracy a 20°C : $\pm$ 0,05%. • Input impedance $\geq$1MΩ related to voltage capacities. • Automatic zero-calibration
STANDARDS	**EN 301 511** Harmonized standard for mobile stations in the GSM 900 and 1800 bands; **EN 301 489-1** ElectroMagnetic Compatibility standard for radio equipment and services; **EN 301 489-7** Specific (EMC) conditions for mobile radio equipment (GSM 900 and 1800); **EN 60950** Safety of information Technology Equipment;

2 GENERAL DESCRIPTION OF THE MICRO RTU-GP DEVICE

The **microRTU-GP** device (Remote-measure unit for generic applications, hereinafter called RTU) is a integrated unit, powered with battery or solar panel, a simply solution to use and install, compact and versatile for: remote control, datalogging and I/O management.
The microRTU-GP is able to capture, process, store and transmit the data coming from its analog-digital channels, sending messages and data to the Control Center automatically, using the GSM and GPRS network. The transmission modem is integral part of the micro RTU-GP.

The micro RTU-GP is able to perform the following operations:

- Data capture from analogue channels with sampling period settable from 1 second to 1 hour and from digital channels with sampling frequency equal to 10 Hz.
- Spontaneous transmission of Data and signallings via SMS/MAIL/FTP.
- **Manage of Events** related to:
    - Totalizers
    - Level of analogue inputs
    - State of digital inputs
    - Receiving of SMS
    - Settable timers
- **Manage of Actions** related to:
    - Digital outputs
    - Totalizers
    - Switching from a state to another state
- Implementation of a **Machine with four states**, each characterized by:
    - Vector to enable **Events**.
    - Setting of **Actions** in function of **Events.**
    - Setting of signallings via **SMS/MAIL/FTP** in function of **Events.**
    - Possibility to save the status of the RTU in the Flash memory, in function of the **Events**.
- Storage in Flash memory of status and values of input channels.
- Possibility to make a remote connection from the control center
- Control of the totalizers related to the digital inputs, defining two threshold levels.
- Control of the level of analogue inputs, defining two thresholds (high level/low level).
- It is possible to activate the **Integrators** to the analogue inputs. This functionality is employed in the control systems of flow-volume.
- It is possible to power the input sensor only during the measure, to save energy: one of the two digital outputs can be closed automatically

The previous operations will be described in Chapter 3.

The link in Data Modality is possible when modem GSM/GPRS is power on (as remote link) and through RS232 serial port (as local link); in Data Modality, the Control Center can configure the micro-RTU and require:

- Reading/change of configuration
- Reading/change of Date – Hour of device
- Sending configuration
- Configuration test: istantaneous data and states
- Download of saved data (File0, File1 and SMS/MAIL/files FTP) and creation of a database.
- Report of downloaded data

These operations can be performed using the MICRO-RTU WORKBENCH: three software that act as Configurator, Datastore and Report Builder.

While the modem is power on, the micro RTU-GP is able to receive SMS or email; by sending messages (SMS or mail), the Control Center can require the change of parameters or the execution of some operations. In the chapter 4 will be described the features of possible requests by SMS/mail.

3 FUNCTIONING SPECIFICATIONS

3.1 CONFIGURATION OF THE MICRO RTU-GP UNIT

To configure the micro RTU-GP unit, is necessary an interchange of parameters and data between itself and Control center.
This interchange can be performed through both modem (locally) and the PC connection to the RS232 serial port of device; configuration is kept although the power is off. When the powering returns on, the device will resume to operate with the parameters previously configured. However, if the interval time of powering off is over 30 min, the internal clock is no longer synchronized: the time stamp and the programmed start times ecc. will be wrong. In this case is necessary to resume the clock synchronization.

In the following paragraphs are described the required parameters to configure a micro RTU-GP unit.

3.1.1 MAIN DATA

The main data to configure the micro RTU-GP unit are described in the following points:

- **Micro-RTU code**: 16 bit integer without sign
- **Code location**: 16 bit integer without sign
- **Status**: (in operation – failed)
- **Status of battery-electric cells**: (full charge-discharge)
- **Temperature**
- **Firmware version**: 16 bit integer without sign
- **Days of functioning**
- **Hour and date**
- **Interval time to capture analogue data**: seconds, from min 1 second to max 1 hour.
- **Configuration of the two analogue channels.**
- **Configuration of the comparison thresholds for the two analogue channels**.
- **Enabling and configuration of Integrators for analogue input.**
- **Configuration of the 4 digital input channels ON-OFF**
- **Configuration of the totalizers and comparison thresholds for the 4 digital inputs**.
- **Configuration of the two digital output channels ON-OFF**
- **Configuration of the matrix report between the Events and Actions and signalling Events by SMS/MAIL/FTP.**
- **Type of powering used**: Electric cells-Internal Battery / External Battery12/24 V.
- **Min threshold to signal the battery discharge**.
- **Setting of data stored in flash**.

3.1.2 DATA TO CONFIGURE THE MODEM

3.1.2.1 GSM Configuration

The data to configure the modem for the sending/receiving SMS are described in the following points:

- **PIN Code** (can be modified only using local connection)
- **Number of Services Center** it allows the sending of the messages SMS (in function of the SIM operator, where the SIM is placed into microRTU GP)
- **Telephone number**: the daily ***REPORT*** and other signalling of ***Events*** will be sent by SMS to this telephone number.
- **Hour when the modem is power on**
- **Interval time while the modem is power on**
- **Frequency to powering on the modem**: 1-2-3: if it is equal to 1: once a day, if it is equal to 2: once every two days, and so on
- **Frequency to sending of the daily report**: 1-2-3. If the “Frequency to powering on the modem” is less than “Frequency to sending processed data (in a day)”, the “Frequency to sending of daily report” will be equal to the “Frequency to powering on the modem”.

3.1.2.2 GPRS Configuration

To allow the spontaneous transmission of data via email/FTP and the receiving of commands via mail it is necessary to set the following **GPRS parameters**

- **APN:** access point for the GPRS connection (depends on the SIM operator into microRTU GP)
- **User and password:** safety parameters
- **DNS1 and DNS2**

In this way, is possible:

To configure the parameters of SMTP connection for e-mail outwards (data and signallings)

- **Server SMTP:** it allows the e-mail transmission via internet, by microRTU GP (depends on the SIM operator into microRTU GP)
- **TCP Port** associated to the service (sending mail: default value is 25)
- **User and Password:** safety parameters
- **Sender address:** address of account mail, related to the microRTU GP
- **Receiver address:** address of account mail, which receives the mails come from the microRTU GP

To configure the parameters to access at Server FTP, used to receiving data and signalling messages (format file: .csv)

- **Server FTP:** the microRTU GP must send spontaneously the files to this address (address of the Server FTP)

- **TCP Port:** related to the service (FTP connection: default value is 21)
- **User and Password:** safety parameters
- **The path and file-name of prefix sent**

To configure the parameters of POP3 connection for e-mail inwards (commands)

- **Server POP3:** To download the mails from mail account related to the microRTU GP, it is possible to set this address as parameter.
- **TCP port:** related to the service (POP3 connection: default 110)
- **User and Password:** authentication parameters of microRTU GP mail account
- **Interval time between one check of mail inwards and the next one**

3.1.3 DATA RELATED TO ANALOGUE CHANNELS

For each of the analogue channels are considered the following data:

- **Selection of the Sensor End Scale**
- **Technical End Scale**
- **Measure unit**
- **Min Threshold (Technical scale)**
- **Max Threshold (Technical scale)**
- **Setting of two Integrators and related thresholds (in sec)**
- **Hysteresis in the thresholds comparison**
- **Prestarting of Sensors**

3.1.4 DATA RELATED TO DIGITAL INPUT CHANNELS

For each of the digital channels are considered the following data:

- **Status and description of digital input**
- **Pulse Totalizer related to the digital input**
- **Threshold 1 Totalizer**.
- **Threshold 2 Totalizer**.
- **Hysteresis switching ON/OFF**

3.1.5 DATA RELATED TO DIGITAL OUTPUT CHANNELS

For each of the output digital channels are considered the following data:

- **Output status**.
- **Programmable pulse time**.

3.1.6 DATA RELATED TO EVENTS

The events are generated:

- By status transitions of digital inputs.
- By threshold comparators of analogue inputs.
- By thresholds configurated for totalizers related to digital inputs.
- By configurated timing (TIMER).
- By SMS receiving, with a particular text.

For each generated event, the following informations can be received:

- *Timestamp* of the time when the event was generated (ms)
- Input status when the event was generated
- Signal description or change of the state that generated the event

3.1.7 DATA RELATED TO INPUT/OUTPUT CONTROL ALGORITHM

The control algorithm defines the modalities of data processing and the type of status machine that manages the control of digital outputs.

The **main** control algorithm manages:

- Counter “start delay”.
- Measurement sessions and saving of RTU status in function of the Events.
- Four matrix of relationships between Events and Actions.
- One matrix to manage the signallings by SMS/MAIL/FTP (daily *REPORT* and instantaneous messages).

The status machine manages:

- Configuration and Enabling of signallings.
- Generations of timing events (reset totalizers, control of outputs).
- Processings for the daily *REPORT*.

3.1.8 DEFAULT RTU CONFIGURATION

The RTU unit has the following default configuration:

- Micro RTU-GP code number equal to zero.
- Firmware version:1881 or next
- Power supply: Electrical cells-Battery type Lithium ion.
- PIN Code equal to default value.
- Date and clock resetted.
- Days of functioning resetted.
- Communication parameters through Modbus RTU protocol:
    - Baudrate: 19200
    - Address 1

- Data bit: 8
- Stop bit: 1
- No parity

In default configuration, the GSM/GPRS modem is always kept off.

3.2 FUNCTIONING

The functioning of microRTU during a measurement session involves the following steps:

- Data capture from analogue channels
- States capture from digital channels
- Storage of processed data and update of the totalizers.
- Control of events and output signals.
- Daily powering on of the modem GSM/GPRS.
- Spontaneous Transmission of daily ***REPORT*** and spontaneous transmission of data (File0 and File1).
- Signallings transmission referred to the enabled events

The RTU unit detects, during programmable interval times, the sampled value from configured analogue channels and counts the pulses of digital inputs. The unit controls the state of output signals in function of the comparison thresholds configured for inputs.
The control algorithm starts and stops the measure session, controls the timing and the matrix report between events in input and output signals; it signals the programmed events by messages via SMS/MAIL/FTP.

3.2.1 DATA ACQUISITION FROM ANALOGUE CHANNELS

The RTU unit detects, at programmable interval time, the sampled value from configured analogue channels.

The interval of sampling time may change, with a resolution equal to 1 sec, from min 1 sec to max 1 hour, with programmable intervals :

1,2, 5, 10, 30 sec
1, 2, 5, 10, 30, 60 min

Two inputs are settable (regardless of each other):

- Input disabled
- End scale ± 50 V
- End scale ± 20 V
- End scale ± 2 V
- End scale ± 20 mA
- Scale: 4..20 mA

For the two inputs there are two thresholds with hysteresis:

- Max value threshold
- Min value threshold

For each input are settable 2 indipendent events:

- Measure higher than max threshold
- Measure lower than min threshold

It is possible to enable the **Integrators** referred to the analogue inputs, too.
The functioning is described in the following points:

- The integrators are available (can be activated) instead of totalizers referred to the digital inputs 1 and 2.
- A totalization can be obtained with a time integration of input measure: more specifically, for each acquisition, the totalization is increased with the corresponding input value, up to the reaching of the configured threshold value.
  Example: the integral (in sec) of the flow rate (liter/sec), in a tubing, represents the quantity of liquid through tubing (total liters).

3.2.2 DATA ACQUISITION FROM DIGITAL INPUTS

For the 4 digital inputs are sampled the states at frequency equal to 10.66 Hz and are counted the pulses. So, the max frequency of pulses acquired through input can be 5 Hz.
If the duty is different from 50%, the pulse duration must be higher than 100 ms.

For each totalizer are settable two thresholds:

- Threshold 1 count
- Threshold 2 count

For each input are settable two indipendent events:

- Count higher or equal to Threshold 1
- Count higher or equal to Threshold 2

3.2.3 CONTROL OF DIGITAL OUTPUTS

The two output signals can be supplied accordance with the following procedures:

- By states (ON/OFF).
- By pulses (with programmable duration).

3.2.4 STATE MATRIX AND EVENTS

The microRTU-GP allows to enable up to 32 Events and, for each of them, to define up to 16 Actions. Moreover, there is the possibility to define up to 4 different vectors to enable events: ABL1, ABL2, ABL3, ABL4 and 4 Matrix report for events-actions: CTR1, CTR2, CTR3, CTR4.
Also, if an event occurs, it is possible to establish the transition from a enabling vector to another. (ABL1, ABL2, ABL3, ABL4) and to the corresponding Matrix report (CTR1, CTR2,CTR3,CTR4) implementing a four state machines. It is possible to choose, for each event, if the SMS/MAIL/file sending is enabled and/or the Flash storage. Each of the four states is then defined by:

- **Vector to enabling events: ABLi**
- **Configurable relation of the actions in function of Events: CTRi**
- **Configurable relation of the signallings SMS/MAIL/file in function of Events.**
- **Configurable relation of the events that allow to save the status of RTU in Flash memory.**

In the following table are described the **Events** and **Actions.**

EVENTS

Num.	Description
00	DIN1 : Switched to STATUS 0
01	DIN2 : Switched to STATUS 0
02	DIN3 : Switched to STATUS 0
03	DIN4 : Switched to STATUS 0
04	DIN1 : Switched to STATUS 1
05	DIN2 : Switched to STATUS 1
06	DIN3 : Switched to STATUS 1
07	DIN4 : Switched to STATUS 1
08	AIN1 < MIN
09	AIN2 < MIN
10	AIN1 > MAX
11	AIN2 > MAX
12	TOT1 > Threshold 1
13	TOT2 > Threshold 1
14	TOT3 > Threshold 1
15	TOT4 > Threshold 1
16	TOT1 > Threshold 2
17	TOT2 > Threshold 2
18	TOT3 > Threshold 2
19	TOT4 > Threshold 2
20	TOT1 Reset/Overflow (0000) when totalizer is resetted or is equal to 0
21	TOT2 Reset/Overflow (0000)
22	TOT3 Reset/Overflow (0000)
23	TOT4 Reset/Overflow (0000)
24	SMS 0 (event SMS EX)
25	SMS 1 (event SMS EX)
26	Timer TMR SEC (count of seconds)
27	Timer TMR 1
28	Timer TMR 2
29	Timer TMR DAY every day
30	RTU LOW_BAT
31	RTU RESET (reset of functioning)

ACTIONS

bit	Description
00	OUT1 reset (lower priority)
01	OUT2 reset
02	OUT1 set
03	OUT2 set
04	OUT1 toggle
05	OUT2 toggle (higher priority in case of simultaneous actions)
06	OUT1 start impulse (status is defined by lower bits, otherwise current)
07	OUT2 start impulse (status is defined by lower bits, otherwise current)
08	TOT1 Reset (0000)
09	TOT2 Reset (0000)
10	TOT3 Reset (0000)
11	TOT4 Reset (0000)
12	CMD_0 (bit 0 command)
13	CMD_1 (bit 1 command)
14	CMD_2 (bit 2 command)
15	EXE (execute the command)

COMMANDS THAT CAN BE PERFORMED

Num	Description
00	CTR1 (enables events ABL1 and matrix report CTR1)
01	CTR2 (enables events ABL2 and matrix report CTR2)
02	CTR3 (enables events ABL3 and matrix report CTR3)
03	CTR4 (enables events ABL4 and matrix report CTR4)
04	START SESSION
05	CLEAR SESSION
06	STOP SESSION
07	Call the center(number for SMS sending)

The events are processed in ascending order.
The actions are performed in ascending order.

3.2.5 CONTROL ALGORITHMS

The control algorithm manages the 4 matrix report between Events in Input and Actions.
Using the 4 matrix and the control actions CTR1,CTR2,CTR3,CTR4, it is possible to configure a status machine with 4 states.

Boolean matrix with STATUS of RTU:

Num.	Description
00	DIN1
01	DIN2
02	DIN3
03	DIN4
04	
05	
06	OUT1
07	OUT2
08	TOT1 comparator Threshold 1
09	TOT2 comparator Threshold 1
10	TOT3 comparator Threshold 1
11	TOT4 comparator Threshold 1
12	TOT1 comparator Threshold 2
13	TOT2 comparator Threshold 2
14	TOT3 comparator Threshold 2
15	TOT4 comparator Threshold 2
16	AIN1 comparator MAX
17	AIN2 comparator MAX
18	AIN1 comparator MIN
19	AIN2 comparator MIN
20	
21	
22	
23	
24	CTR (bit 0) status of control algorithm
25	CTR (bit 1) status of control algorithm
26	
27	
28	
29	
30	
31	

The status of RTU, measure session and totalizers, is saved in EEPROM every hour and it is resumed if the RTU is power off.

3.2.6 SIGNALLINGS

The unit sends a daily *REPORT* via SMS/MAIL/FTP with the status of RTU: the instantaneous values of analogue inputs and totalizers, input status and digital outputs, Temperature and GSM signal level (modem).
For each event, is configurable the sending of a SMS/MAIL/FTP message with the RTU status and a text of 16 characters (maximum).
The text with signallings is saved in EEPROM and it is defined by software (Configurator) or by SMS/MAIL message.
When RTU is resetted, all messages are deleted.

3.2.7 STORAGE OF PROCESSING DATA

The unit records in Flash memory the input values, the states and the events caused by input comparators. For the analogue inputs, the sampled values are stored in pairs, in sequence, from the start of measure session in a file called File0. The events and the variations of counts are registered, instead, with a reference *timestamp,* related to the start of measure session, in a file called File1.
The data buffer can be configured as "*single-shot*" (with overflow signalling), or circular (with a loss of saved data, overwriting oldest data).

If there is a reset and restart of µRTU, the measure session can be resetted.

3.2.8 DAILY POWERING OF MODEM GSM

The RTU turns on the GSM/GPRS modem according to the "***Frequency to powering on the modem***" (for hypothesis, the day of the last starting is the first day of functioning) at "***Initial hour to powering on the modem***" for a time equal to the "***Interval time while the modem is power on***": these parameters are determined during configuration, to allow the receiving of calls and/or messages SMS/MAIL sent from Control Center or to transmit to the indicated Receiver the daily ***REPORT***.
When the functioning time is concluded, the RTU must power off the modem (unless it is in remote data link with the control center, or if the three attempts of spontaneous transmission of daily ***REPORT*** are not completed or if the three attempts of transmission required from the Control Center are not completed).

NOTE: If the microRTU is supplied with 12/24 V (using a power supply), it is possible to keep the modem power on always (to do this, enable the corresponding item during modem configuration procedure).

3.2.9 SIGNALLING OF MODEM GSM RESET

When the RTU is power on and has a configuration different from default, it sends a SMS towards the "telephone number to which send the data by SMS in a day", which describes the beginning of operation.

3.3 FUNCTIONING ON REQUEST FROM CONTROL CENTER

When the Control Center performs a request to the RTU, this one do not affect in ordinary functioning of the RTU.
The Control Center can communicate with the micro RTU-GP unit in the following ways:

- link in Data Modality.
- by SMS/MAIL.

3.4 LINK IN DATA MODALITY

This data communication is possible in remote-link while the GSM modem is power on and in local-link through RS232 serial port.
If link is in Data Modality, the Control Center can require the following ones:

- Data required and istantaneous states
- Required of processed data
- Required of configuration reading
- Required of Date – Hour of clock
- Sending of a configuration change
- Sending of a reset command
- Sending of a update command for Date-Hour.

3.4.1 Data request and istantaneous states

The control center can test the configuration saved in microRTU GP: in particular, it is possible to examine the istantaneous values detected from configured analogue channels, totalizer values and the state of input/output signals ON – OFF.

3.4.2 Request of record saved in flash

The request of saved data includes for a particular step: the Control Center requires at the RTU unit the dimensions of each file (in records) and stops the index at the last saved record (if the measure is not suspended) .
Then the Control Center requires the data, specifying the number of the record (starting from the current index: 0 = last record saved).

3.4.3 Request of the configuration

The control center requires the configuration of the RTU (main data and data related to the Analogue channels).

3.4.4 Sending of configuration change

With this command, the Control Center changes the current configuration. The change of data configuration, deletion or addition of an analogue channel to the configuration does not affect the processed and saved data.

3.4.5 Sending of Reset command

The command “RESET DATA STATION” resets the data saved in flash memory.

3.4.6 Sending of a command to update Date-Hour

With this command, the Control Center changes the Date-Hour of RTU clock.

3.5 LINK BY MESSAGES

The messages can be received from the RTU while the modem GSM/GPRS is power on. Using these SMS/MAIL messages, the Control Center can require the following points:

- Change of parameters “frequency to powering on the modem”, “initial hour to powering on the modem” and “interval time to powering on the modem”
- Change of parameters “frequency to sending the processed data in a day”
- Change of the thresholds and totalizers
- Event SMS/MAIL
- Perform an action

For more information about the previous requests and the text of the corresponding messages, see Paragraph 4.2.
In the following figure is shown an example of a RTU system: more connections and communications can be realized with the supervision system:

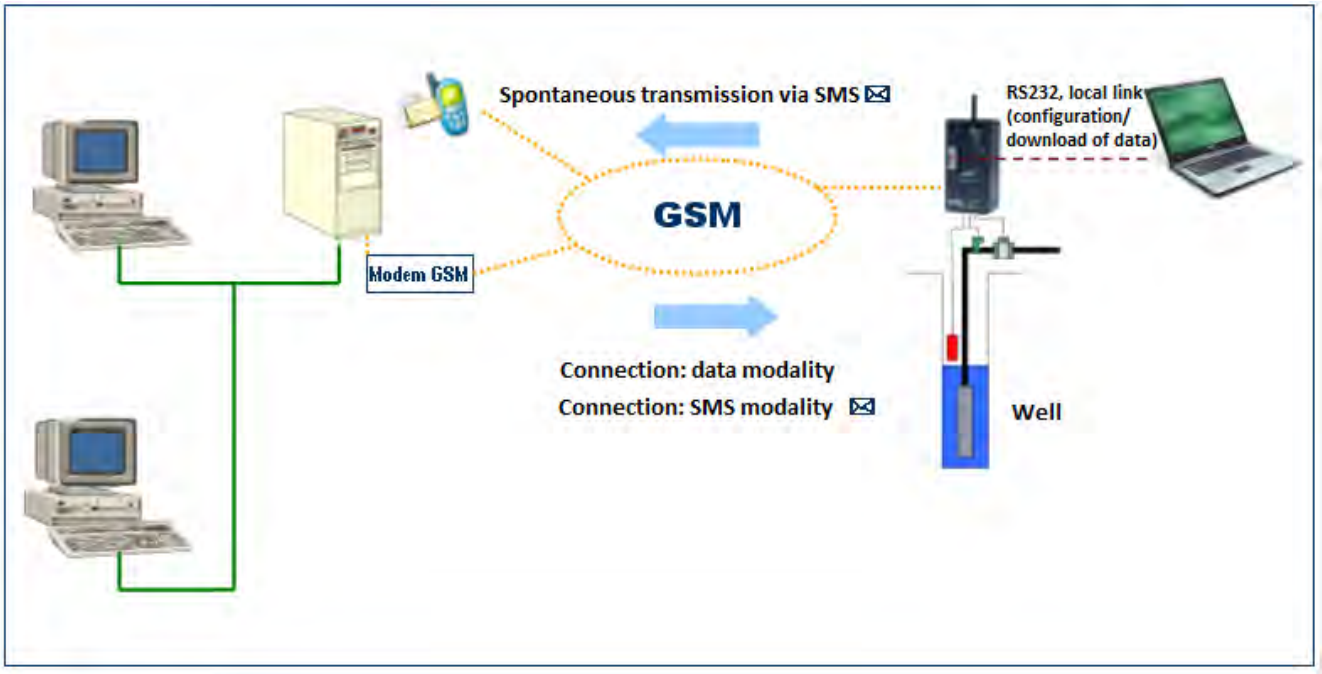

FIG. 2: Tipical layout of a micro RTU-GP system

4 COMMUNICATION PROTOCOLS

The format of data, parameters, queries and commands from control center to RTU unit and viceversa are defined in the protocols:

- Connection protocol of data modality (standard MODBUS)
- Connection protocol by messages: the messages can be sent from microRTU to Control Center (REPORT, EVENTS) by SMS/MAIL/FTP. Instead, the messages sent from Control Center to microRTU (COMMANDS) can be sent by SMS and/or MAIL (in this case, for e-mail, the text of the message must be specified in the OBJECT of e-mail itself)

4.1 CONNECTION PROTOCOL OF DATA MODALITY

Below are described the main features of the protocol used.

PHYSICAL LEVEL

Communication :	Half Duplex
Support :	RS232 connection according to the standard CCITT V-24; it can be used for a direct connection between a RTU unit and a supervisory program in local modality. Connection via GSM network through data channel
Protocol type:	Asynchronous byte oriented
Transmission parameters:	1 start bit, 8 data bit, 1 stop bit, no parity
Velocity:	Settable via software.

Note that the default parameters of serial communication about microRTU are:

Baudrate: 19200, Address 1, Data bit: 8, Stop bit: 1, No Parity

4.2 CONNECTION PROTOCOL BY MESSAGES

The following messages have a text-format (ASCII–7 bits).

<*blank*>	1	Space character
<*RTUcode*>	4	hhhh (0000 … FFFF) hexadecimal digits
<*locationCode*>	4	hhhh (0000 … FFFF) hexadecimal digits
<*Channel*>	2	1> or 2>
<*measureValue*>	6	±ddddd (-32768 … +32768) decimal digits
<*date*>	8	dd/mm/yy decimal digits
<*hour*>	5	hh:mm decimal digits
<*telephoneNumber*>	18	ddddddddddddddddd decimal digits
<*timestamp*>	13	/ddmmyyyyhhmm decimal digits

4.2.1 Automatic transmission of data

When the GSM modem is turned on daily, during its ordinary functioning, the RTU sends to the Control Center a message as follows:

“RP D>iiii00oo 1> ±ddddd 2> ±ddddd T: ddddddddddd ddddddddddd ddddddddddd ddddddddddd / ddmmyyyyhhmm:hhhh”

In the following table is shown the meaning of the previous message:

RP	2	
<*blank*>	1	
D>	2	
<*blank*>	1	
iiii00oo	8	Status input/output (0=off,1=on)
<*blank*>	1	
1>	2	AIN 1
<*blank*>	1	
±ddddd	6	Input value
<*blank*>	1	
2>	2	AIN 2
<*blank*>	1	
±ddddd	6	Input value
<*blank*>	1	
T:	2	Totalizer
<*blank*>	1	
ddddddddddd	10	TOT1
<*blank*>	1	

ddddddddd	10	TOT2
<*blank*>	1	
ddddddddd	10	TOT3
<*blank*>	1	
ddddddddd	10	TOT4
<*blank*>	1	
<timestamp>	11	/ ddmmyyyyhhmm sending date and sending time
:	1	
<RTU code>	4	:hhhh (0000 … FFFF) hexadecimal digits
	98	

4.2.2 Functioning and Events Recovery

If the RTU takes on a configuration different from default setting, when RTU is power on, it sends a message as follows:

“EV nn <label> D> iiii00oo 1> ±ddddd 2> ±ddddd : ddddddddd ddddddddd ddddddddd ddddddddd /ddmmyyyyhhmm:hhhh”

In the following table is described the meaning of the previous message:

EV	2	
<*blank*>	1	
nn	2	Number of event (0-31)
<*blank*>	1	
<*label*>	16	LABEL + blank (if configurated)
<*blank*>	1	
D>	2	
<*blank*>	1	
iiii00oo	8	Input/output status (0=off,1=on)
<*blank*>	1	
1>	2	AIN 1
±ddddd	6	Value of measure
<*blank*>	1	
2>	2	AIN 2
±ddddd	6	Value of measure
<*blank*>	1	
T:	2	Totalizer
<*blank*>	1	
ddddddddd	10	TOT1
<*blank*>	1	
ddddddddd	10	TOT2
<*blank*>	1	
ddddddddd	10	TOT3

<*blank*>	1	
ddddddddddd	10	TOT4
<*blank*>	1	
<timestamp>	11	/ ddmmyyyyhhmm sending date and sending time
:	1	
<RTU code>	4	:hhhh (0000 … FFFF) hexadecimal digits
	116	

4.2.3 Parameters change “Frequency to powering on the modem”, “ Initial hour to powering on the modem” and “Interval time to powering on the modem”

From the control center, this message allows to modify the following parameters: “frequency to powering on the modem”, “initial hour to powering on the modem” and “interval time to powering on the modem”; these parameters are related of General Data of RTU Configuration. When RTU receives this message, it responds with another message, to confirm the successful of configuration.

CONTROL CENTER

To modify the parameters to starting the modem, the control center must to send a message as follows:

“CM d dd.dd ddddd d /ddmmyyhhmm ”

In the following table is described the meaning of the previous message:

CM	2	
<*blank*>	1	
d	1	Frequency to powering on the modem
<*blank*>	1	
dd.dd	5	Hour to powering on the modem (oo:mm)
<*blank*>	1	
ddddd	5	Interval time during which the modem is power on (seconds)
<*blank*>	1	
d	1	Sending Frequency of processed data (in a day)
<*blank*>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
	30	

RTU

To notify the successful of parameters modification, the RTU responds with a message as follows:

“CM d dd dd ddddd d /ddmmyyyyhhmm:hhhh”

CM	2	
<*blank*>	1	
d	1	Frequency to powering on the modem
<*blank*>	1	
dd dd	5	Hour to powering on the modem (hh:mm)
<*blank*>	1	
dddd	5	Interval time during which the modem is power on (seconds)
<*blank*>	1	
d	1	Sending Frequency of processed data (in a day)
<*blank*>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
	30	

4.2.4 Thresholds modification

To modify the min and/or max threshold about a channel, the control center have to send a message as follows. When RTU receives this message, it responds with another message, to confirm the successful of configuration change.

CONTROL CENTER

To modify the alarm thresholds, the control center sends a message as follows:

“CS dddddddddd ddddddddddd ddddddddddd ddddddddddd 1> ±ddddd ±ddddd 2> ±ddddd ±ddddd /ddmmyyhhmm”

CS	2	
<*blank*>	1	
ddddddddddd	10	TH1
<*blank*>	1	
ddddddddddd	10	TH 2
<*blank*>	1	
ddddddddddd	10	TH 3
<*blank*>	1	
ddddddddddd	10	TH 4
<*blank*>	1	
1>	2	CHANNEL 1
<*blank*>	1	
±ddddd	6	Over range, max threshold
<*blank*>	1	
±ddddd	6	Over range, min threshold

<*blank*>	1	
2>	2	CHANNEL 2
<*blank*>	1	
±ddddd	6	Over range, max threshold
<*blank*>	1	
±ddddd	6	Over range, min threshold
<*blank*>	1	
<timestamp>	14	/ddmmyyyyhhmm sending date and sending time
	95	

RTU

The RTU sends the following message to notify the successful of thresholds modification:

"CS 1> ±ddddd ±ddddd 2> ±ddddd ±ddddd /ddmmyyyyhhmm:hhhh"

CS	2	
<*blank*>	1	
1>	2	CHANNEL 1
<*blank*>	1	
±ddddd	6	Over range, max threshold
<*blank*>	1	
±ddddd	6	Over range, min threshold
<*blank*>	1	
2>	2	CHANNEL 2
<*blank*>	1	
±ddddd	6	Over range, max threshold
<*blank*>	1	
±ddddd	6	Over range, min threshold
<*blank*>	1	
<timestamp>	11	ddmmyyyyhhmm sending date and sending time
	48	

4.2.5 SMS/MAIL Event

If this message is received, one of the following events occurs:

- Event 24
- Event 25

CONTROL CENTER

The control center sends a message with the following structure:

“EX n /ddmmyyyyhhmm”

EX	2	
<*blank*>	1	
<*number*>	1	0 = event 24, 1 = event 25
<*blank*>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
	16	

RTU

When the microRTU received this message, it sends to the control center the following SMS, to confirm the successful of operation

“ES OK /ddmmyyyyhhmm:hhhh”

ES	2	
<*blank*>	1	
OK	2	
<*blank*>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
:	1	
<RTU code>	4	hhhh (0000 … FFFF) hexadecimal digits
	22	

4.2.6 Execute an action

With this message, the control center can require at microRTU one of the allowed actions.

CONTROL CENTER

The message has the following structure (from control center to microRTU):

“AZ nnnnn /ddmmyyhhmm”

AZ	2	
<*blank*>	1	
<*action*>	5	Action code (decimal integer: see action table)
<*blank*>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
	20	

RTU

When the microRTU received the message, it sends to the control center the following sms to confirm the successful of receiving:

“AZ OK /ddmmyyyyhhmm:hhhh”

AZ	2	
<blank>	1	
OK	2	
<blank>	1	
<timestamp>	11	/ddmmyyyyhhmm sending date and sending time
:	1	
<RTU code>	4	hhhh (0000 … FFFF) hexadecimal digits
	22	