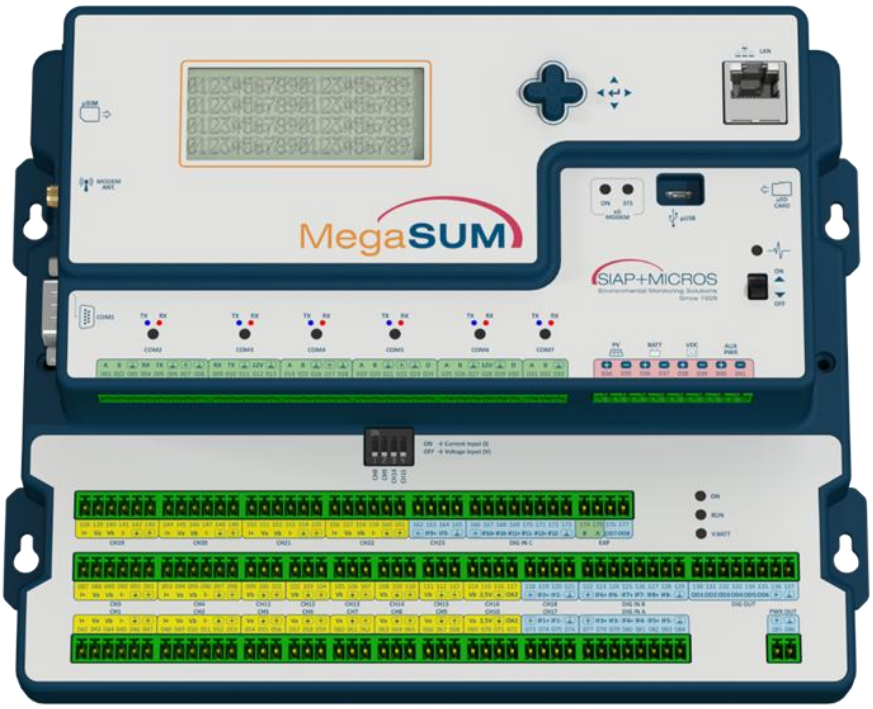
100 years Since 1925 SIAP+MICROS Environmental Monitoring Solutions

e021 MegaSUM

Data acquisition and transmission system



User Manual Vers. 05

Siap+Micros S.p.A.
Via del Lavoro, 1
31020 - San Fior (TV) - ITALY

tel.: +39 0438 491411 - fax: +39 0438 401547
e-mail: info@siapmicros.com
www.siapmicros.com

Table of contents

List of figures

List of tables

1 Introduction

MegaSUM is a data acquisition, processing, storage and transmission system for environmental and hydrometeorological station. It is equipped with analog and digital interfaces that allow to acquire data from different types of sensors, analysers, chemical-physical probes, actuators, etc. Various communication systems, such as radio-modem in free or licensed band (UHF, VHF, HF, SRD, etc.) and satellite equipment (Iridium, Meteosat and GOES) can be interconnected through serial port for remote data transmission. It has been designed to match the most various needs of data acquisition, processing and transmission, from the simplest ones related to single weather stations, to the most complex concerning monitoring networks managed by remote control centres.

MegaSUM is based on FreeRTOS™, an open-source real time operating system, meaning it is an event-driven system able to process external input stimulus within a deterministic deadline. So, it fits perfect in application where events and data processing has critically defined time constraints. Moreover, the device offers the following advantages: good programming and configuration flexibility, connection to sensors with RS232, RS485 and SDI-12 interfaces, embedded and interchangeable modem for data transmission according to country specific policy, remote programming (configuration and firmware update), local programming via USB port and good data recording autonomy.

The device is compliant to Low Voltage Directive (LVD) 2014/35/EU and Electromagnetic Compatibility Directive (EMC) 2014/30/UE. For security reasons it is necessary to follow the procedures described in this user manual and carefully read all notes and warnings.

Please retain this manual carefully and ensure that a copy is always available to operators. For technical or commercial information and support, please refer to the manufacturer's contact details.

SIAP+MICROS S.p.a.

Via del Lavoro 1,

31020 – San Fior (TV) - Italia

https://www.siapmicros.com/

https://www.siapmicros.com/contatti/

For detailed technical specification please refer to the product web page.

https://www.siapmicros.com/acquisizione_dati/datalogger/

1.1 Warning

MegaSUM is a device designed to be used by trained personnel. The manufacturer declines all responsibility in the event of failures due non-compliance with observing the instructions, tampering, uses not foreseen in this manual, improper use of the appliance, use by untrained operators. Only authorized and trained personnel must have access to the work area for normal use and maintenance operations.

Please pay particular attention to the meaning of the following symbols used throughout this manual and in product documentation (labels, technical specifications, brochures, etc.).

Caution symbol to identify general caution when using the product. Alerts the user to potential hazards or risks associated with the device or its operation.

The symbol signifies that the product is subject to the WEEE regulations. The product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling according to 2012/19/UE.

DC voltage symbol.

1.2 General safety rules

Pay attention to the following general safety rules:

- The device must be connected to the ground or earth.
- The instrument must not operate in the presence of flammable gases, fumes or in any environment at risk of explosion.
- Do not remove, replace or modify any electrical or mechanical part without authorization.
- Replacement of internal components and internal maintenance must only be carried out by qualified and trained personnel, after disconnection of the main electrical power supply.
- Pay attention to any warning labels against potentially dangerous practices.

1.3 Displacement

To avoid damage to the equipment, use caution during transportation. Upon arrival of the goods, immediately check the integrity of the packaging and report any damage to the manufacturer. We recommend always using the original packaging during transport.

1.4 Unpacking

Before unpacking and installing the instrument, make sure you have taken the following precautions:

- Use suitable gloves to protect against possible abrasions etc.
- If any damage caused by the transport carried out at the supplier's expense is found, return the instrument to the supplier.
- Once removed from the packaging, place the instrument and its component parts on a flat surface.
- Pay attention to the connectors on the side of the instrument container during the operation.

Before installing the instrument check that mains voltage in the installation area complies with the operating conditions of the instrument. Avoid turning on the instrument before carefully following the installation and start-up instructions in this manual.

1.5 Correct start-up procedure

The following procedure allows the correct power supply of the datalogger MegaSUM using lead-acid battery and photovoltaic panel.

1. Connect the battery to the power supply connector at pins BATT 036 (+) and 037 (-).
2. Pay attention to the polarity of the battery: pin 036 must be connected to positive terminal and pin 037 to negative terminal.
3. Connect photovoltaic panel to power supply connector pins PV 034 (+) and 035 (-).
4. Pay attention to the polarity of the photovoltaic panel: pin 034 must be connected to positive terminal and pin 035 to negative terminal.
5. As an alternative to the photovoltaic panel an external power supply can be connected to pin VDC 038 (+) and 039 (-).
6. Turn on the device switching the main switch to position ON.

Power cables must have a minimum cross section of 1mm^2 and a maximum of 2.5mm^2. 10A fuses must be inserted on power cables connected to BATT RECH and BATT inputs to ensure protection against the risk of fire.

If external power supplies connected to the electric distribution network are used, pay attention to the characteristics of the power supply device. The external power supply connected to VDC input must be protected against short circuits. Furthermore, the output of this power supply must not exceed 60 VDC, and there must be either double or reinforced insulation between the mains input and the output to protect against electric shock, in accordance with EN 61010-1.

MegaSUM can also be powered by a non-rechargeable 12V Li-ion battery which acts as backup power supply. In this case the Li-ion battery must be connected to the power supply connector at pins BATT 040 (+) and 041 (-), where pin 040 is the positive terminal and pin 041 is the negative terminal (see Chapter 2.2 for further details).

Correct switching on of the device is indicated by the blinking of the status LED (see Chapter 2.6). During operation, avoid maintenance operation on electrical connections and do remove power supply before making any modifications.

1.6 Storage

If the device is not used for a long time (at least one year), disconnect all cables from the equipment, place it in a plastic bag together with a bag of desiccant salts and seal the bag with tape. Put an appropriate indication on the bag about contents and weight of the equipment and attach the wording “HANDLE WITH CARE”. Store the instrument in an environment with a temperature between 0°C e 60°C and humidity not above 80%. Make sure the instrument is stored in a stable position where it cannot be damaged or moved carelessly. Do not put any other instrument on it. Do not put the instrument on other instruments and ensure the stability of the underlying support.

1.7 Maintenance

Disconnect all connecting cables before cleaning the device. For cleaning, use a soft, dry cloth. Never use damp cloths, solvents, water or other liquids. Compressed air can be used to eliminate any dusty residues.

The product is equipped with protection devices against electrostatic discharges. Furthermore, the power supplies are equipped with overcurrent protection fuses.

1.8 Proper use of the equipment

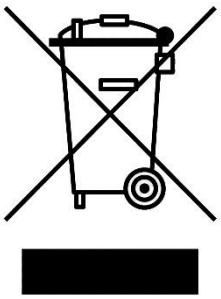
- Proper use: the device is intended exclusively for acquisition, transmission and processing of physical and chemical parameter measurements for meteorology, agrometeorology, hydrometry, environmental and climatic monitoring, remote control and automation of aqueducts, water purifiers, sewers, etc., distributed logic control and automation systems, special applications for landslide control, microbiological processes, chemicals, etc. It is not intended for unqualified or untrained people in domestic or hobby environment.
- Environmental conditions for correct use:
  - Reference temperature 20° C.
  - Operating temperature -40 ÷ +60 °C.

    Pay attention when operating in ambient temperature above 60°C. Appropriate personal protective equipment (PPE) must be used when handling the device in such environments. The wiring used to power the instrument must be rated to operate at temperatures up to 92 °C.
  - Maximum relative humidity allowed 100% no-condensing environment.
  - Storage temperature 0 ÷ +60 °C.
  - Maximum storage humidity 80%.
  - Maximum altitude 4000m

- Pollution degree 2
- Overvoltage category II

- The IP protection level of the product is IPX0. The first digit indicates the level of protection the enclosure provides against access to hazardous parts (e.g., electrical conductors, moving parts) and the ingress of solid foreign objects. The second digit indicates the level of protection that the enclosure provides against harmful ingress of water. The “X” refers to the fact that the device hasn’t been tested for solid particle protection, such as dust. The "0" indicates that the device offers no protection against water ingress.
- Installation: the datalogger must be installed inside electrical panels made of steel or flame-retardant plastic with a flammability rating of V-0 or V-1 accessible only by qualified personnel.

1.9 Waste disposal



In compliance with the European Union directive 2012/19/EU on Waste Electrical and Electronic Equipment, this product must be disposed of by taking it to a designated collection point for the recycling of electrical and electronic equipment.

For more information regarding your nearest recycling centre, contact your local authority office.

2 Characteristics and description

In this chapter a general overview of the device is provided. In particular, the operation of the datalogger is explained, main functions are highlighted and a description of the interface and each of the connectors is provided.

2.1 Overview

Datalogger MegaSUM is a data acquisition system based on a STM32F4 microcontroller (Arm® 32-bit Cortex®-M4) running a real-time operating system (FreeRTOS™). The RTOS manages connection requests, external events e incoming data quickly. The system is made up of two units: the main processing unit where microcontroller is mounted and the analog and digital input and output acquisition unit (also called base unit).

As showed by the 3D picture and the block diagram in Figure 2.1 and Figure 2.2 the datalogger is equipped with:

- 4 power supply inputs: photovoltaic panel, rechargeable battery, external power supply and auxiliary power supply.
- Analog and digital I/O acquisition unit
- 7 serial ports: RS232, RS485 and SDI-12 interfaces.
- Micro-USB connector.
- Ethernet RJ-45 connector.
- MicroSD card connector.
- 4x20 character LCD.
- 5-position joystick.
- Power switch.
- Micro-SIM connector.
- Connector for xG modem antenna.
- Status LED.
- Embedded Sierra Wireless modem.
- 16Mb flash memory.
- Temperature sensor.
- RTC.
- Embedded Wi-Fi, Bluetooth, BLE module.

Below is some information relating to the mechanical part of the box:

- Length: 182 mm
- Height: 62 mm
- Breadth: 236 mm
- Total weight: 650 g

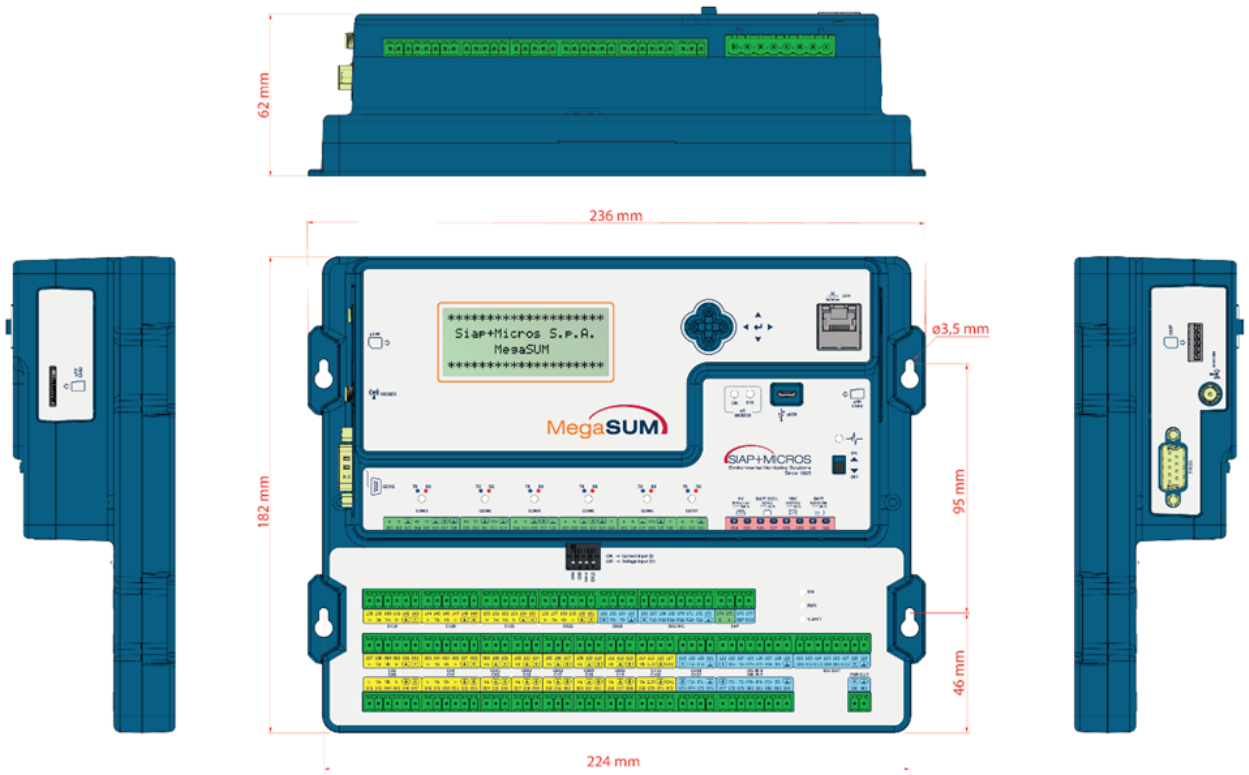


Figure 2.1: front and side images of the datalogger.

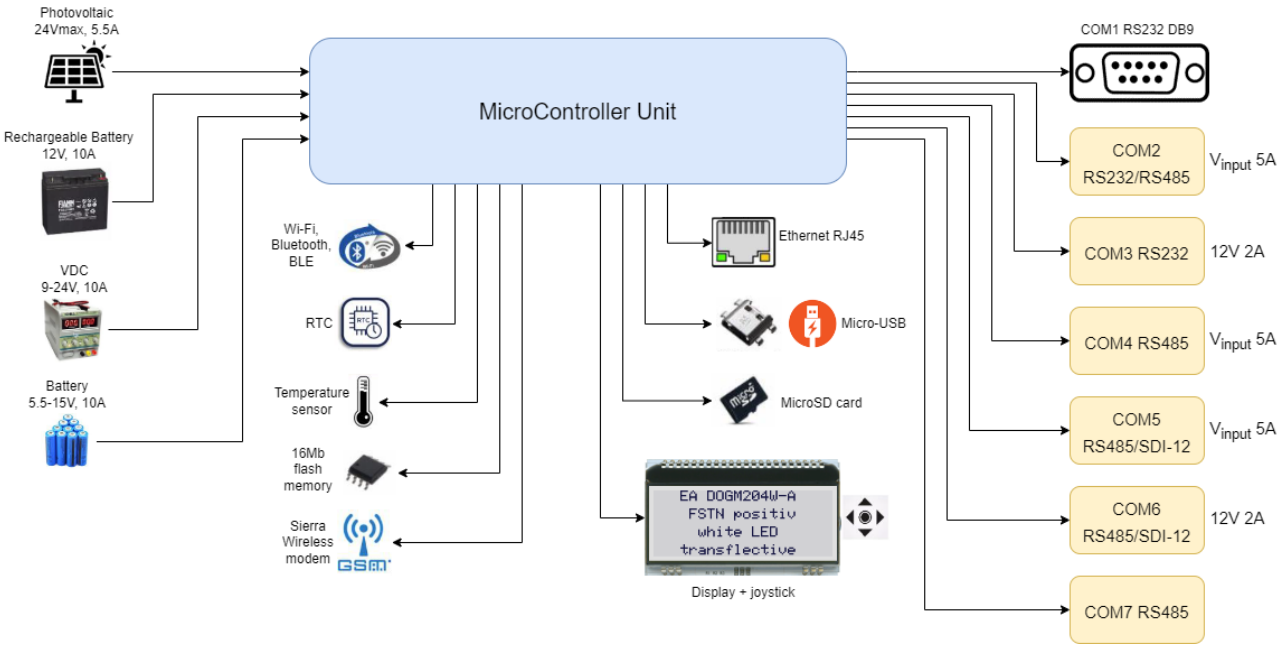


Figure 2.2: diagram block of the datalogger.

2.2 Power input

The datalogger has 4 power inputs as described in Figure 2.3:

- Photovoltaic panel 24$V_{DC\ MAX}$ ⎓ 5.5A: PV connector, pin 034 (⊕) and 035 (⊖).
- Rechargeable lead acid battery 12V_{DC} ⎓ 10A: BATT RECH. connector, pin 036 (⊕) and 037 (⊖).
- External power supply 9 – 24V_{DC} ⎓ 10A: VDC connector, pin 038 (⊕) and 039 (⊖).
- Auxiliary power supply 12V_{DC} ⎓ 10A: BATT connector, pin 040 (⊕) and 041 (⊖).

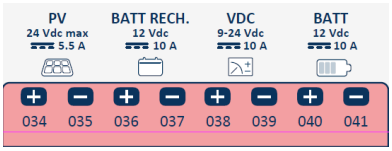


Figure 2.3: power input terminal block.

Rechargeable battery power input is the main power source of the datalogger and it is equipped with:

- Electrostatic discharge protection circuit up to 15kV with peak power at 600W (10/1000 µs) and 4kW (8/20 µs).
- Resettable fuse with maximum current up to 40A.

Photovoltaic panel input powers the system and charges the lead acid battery. Photovoltaic panels with voltage up to 24VDC and power up to 100W are supported. The datalogger is equipped with an autonomous battery charge controller able to charge the lead acid battery using power drawn from photovoltaic panel. Exposed to direct sunlight, battery charger circuit adapts the operating point of the panel to obtain the maximum power and it is able to deliver up to 5A to the battery. The dynamic tracking of the optimal operating point of the photovoltaic panel to obtain the maximum available power, defined as MPPT (maximum power point tracking), is performed by the internal circuit. Battery charge controller is also able to protect the lead acid battery from deep discharge. If battery voltage goes below 10.5V, the controller turns off the datalogger to protect the battery. Battery charger keeps running, so if it is exposed to direct sunlight it will continue to charge the battery. If battery voltage goes above 11.5V, the controller turns on the device. Photovoltaic panel input is equipped with:

- Electrostatic discharge protection circuit up to 30kV with peak power at 1500W (10/1000 µs).
- Resettable fuse with maximum current up to 40A.
- Filtering.

An external power supply can be used as an alternative to the photovoltaic panel as main voltage, while the battery works as a backup. External power supply input is equipped with:

- Electrostatic discharge protection circuit up to 30kV with peak power at 1500W (10/1000 µs).
- Resettable fuse with maximum current up to 40A.
- Filtering.

Auxiliary power supply can be provided by a non-rechargeable Li-ion battery and it is used as backup power supply. Auxiliary power input is equipped with:

- Electrostatic discharge protection circuit with peak power at 600W (10/1000 µs).
- Resettable fuse with maximum current up to 40A.

The datalogger provides three diagnostic measurement points to read voltage, current e and power useful to check the power supply status of the system:

- Photovoltaic panel input.

- Battery charge.
- Load.

Note:

Neither the photovoltaic panel power supply (PV) nor the external power supply (VDC) is sufficient to turn on the datalogger; a rechargeable lead-acid battery (BATT RECH) must also be connected. On the other hand, the auxiliary power supply is independent and is sufficient to power the datalogger.

2.3 Power outputs

The datalogger is equipped with power outputs available on serial port terminal blocks and unit base terminal blocks. On serial port terminal block the following output voltages are provided:

- COM2, COM4 and COM5 terminal blocks: switchable output voltage equal to the voltage supplied to the power supply connector and current up to 5A (pin ⊕ and ⊥).
- COM3 and COM6: 12V regulated switchable output voltage and current up to 2A (pin 12V and ⊥).

These output voltages are equipped with:

- Electrostatic discharge protection circuit up to 15kV with peak power at 600W (10/1000 µs) and 4kW (8/20 µs).
- Resettable fuse with maximum current up to 40A (COM2, COM4 and COM5) and 100A (COM3 and COM6).

On base unit terminal blocks the following output voltages are provided:

- PWR OUT terminal block (pin 085 (⊕) and 086 (⊥)): output voltage always on equal to the voltage supplied to the power supply connector and current up to 2.5A.
- DIG OUT terminal block (pin 136 (⊕) and 137 (⊥)): switchable output voltage equal to the voltage supplied to the power supply connector and current up to 2.5A (on by default).
- Analog and digital input terminals of the base unit (pins marked by symbols ⊕ – ↓ and ⊕ – ⊥): output voltage equal to the voltage supplied to the power supply connector and current up to 200mA.
- CH10 terminal block: 2.5V reference voltage and current up to 25mA (e.g. pin 70 (2,5V) and 71 (↓)).

These output voltages are equipped with:

- Electrostatic discharge protection circuit up to 30kV with peak power at 160W and IEC 61000-4-2 standard; level 4 (ESD); IEC 61000-4-5 (surge); IPP = 2.5A; AEC-Q101.
- Resettable fuse protection.

Power outputs can be used as power source for communication devices, sensors and peripherals.

Base unit output voltages, PWR OUT and DIG OUT, can supply a total of 2.5A. The total current supplied by all output voltages, on serial and base unit terminal blocks, must not exceed 10A as indicated on the front label.

2.4 Analog and digital I/O acquisition unit (base unit)

Base unit is the main data acquisition source. In this section a brief description of the connectors is provided. The following chapters explore each input and output in detail. Base unit provides:

- Analog inputs in the range 0 – 2.5V: 14 differential input at ±2.5V (8 four-wire Pt100 temperature sensors) and 28 single-ended input at 0 – 2.5V, of which 4 are configurable as current inputs in the range 0 – 20mA.
- Digital inputs: 12 opto-isolated inputs.
- Outputs: 8 open drain digital outputs, 2 analog outputs at 0 – 2.5V.

- COM RS485 communicating in Modbus protocol.
- Output power supplies with output voltage equal to the voltage supplied to the input power supply (see Chapter 2.3).

Figure 2.4 shows the terminal blocks of the base unit and Table 2.1 lists all pins and their description.

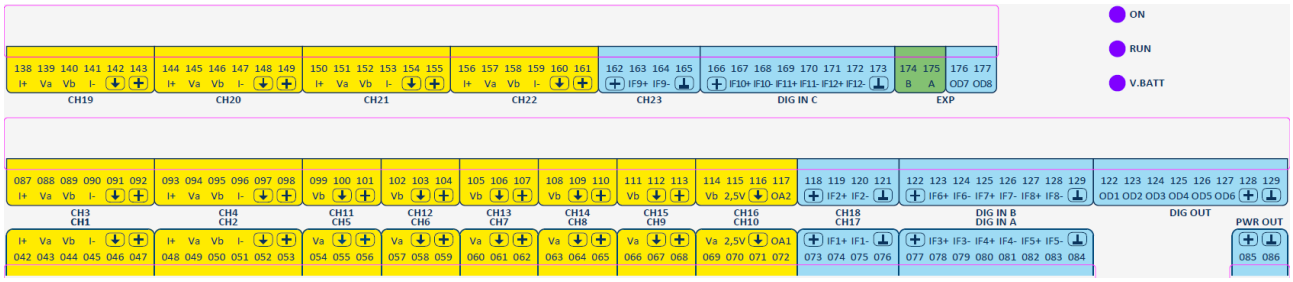


Figure 2.4: terminal blocks of the analog and digital I/O acquisition unit.

PIN	DESCRIZIONE
CH1, CH2, CH3, CH4, CH19, CH20, CH21, CH22: analog inputs with full-scale ±2.5V	• One differential input (Va – Vb) • Two single-ended inputs (Va – ⏬, Vb – ⏬) • One Pt100 input (I+ – Va – Vb – I-) • Output power supply 12V-200mA (⊕ and ⏬)
CH5, CH6, CH7, CH8, CH9, CH11, CH12, CH13, CH14, CH15: analog inputs with full-scale ±2.5V	• One differential input on each pair of connector Va – Vb (CH5/CH11, CH6/CH12, CH7/CH13, CH8/CH14, CH9/CH15) • One single-ended input on single connector (Va – ⏬, Vb – ⏬) • Output power supply 12V-200mA (⊕ and ⏬)
CH10, CH16: analog inputs with full-scale ±2.5V and analog output	• One differential input on each pair of connector Va – Vb (CH10/CH16) • One single-ended input on single connector (Va – ⏬, Vb – ⏬) • Reference voltage 2.5V-25mA (⊕ and ⏬) • Analog output 0 – 2V (OA1 and OA2)
CH17, CH18, CH23, DIG IN A, DIG IN B, DIG IN C: digital inputs	• Frequency • Counter • Logic state • Output power supply 12V-200mA (⊕ and ⏚)
DIG OUT: open drain digital outputs and output power supply	• 6 open drain digital outputs • Switchable output power supply 12V-2.5A (pin 136 (⊕) – pin137 (⏚))
EXP: RS485 serial port	• A and B lines of RS485 serial port
EXP: open drain digital outputs	• 2 open drain digital outputs
PWR OUT: output power supply	• Output power supply 12V-2.5A (pin 085 (⊕) and 086 (⏚))

Table 2.1: connectors and pins of the base unit (analog inputs and outputs are highlighted in yellow, digital inputs and outputs are highlighted in blue, serial port is highlighted in green).

2.4.1 Pt100 inputs

Base unit is equipped with eight analog inputs configured to acquire data from Pt100 sensor, namely CH1, CH2, CH3 e CH4, CH19, CH20, CH21 and CH22[1].

Measuring of the resistance thermometer value is done using the four-wire technique and involves terminals **I+** (excitation current generation), **Va** and **Vb** (measurement of the voltage at the ends of the resistance thermometer) and **I-** (excitation current return). The resistance thermometer is connected with one end at I+ and Va and the other end at I- and Vb. In particular, at each acquisition cycle an impulsive current[2] is generated at terminal I+ which, flowing on the resistance thermometer, creates a potential drop measured between inputs Va and Vb. The current closes on I- and generates a reference for the ratiometric measurement of the potential drop on the resistance thermometer.

Pt100 inputs are 24-bit resolution analog input that provides:

- Electrostatic discharge protection circuit up to 20kV with peak power at 25W and IEC 61000-4-2 standard; level 4 (ESD); IEC 61000-4-5 (surge); IPP = 2.5A on both voltage terminal inputs, where measure is read, and current terminal inputs, where reference is generated.
- Differential low-pass filter with cutoff frequency of 530Hz.
- Common mode low-pass filter with cutoff frequency of 780Hz.

2.4.2 Analog inputs

Base unit is equipped with 28 24-bit resolution analog inputs with full-scale ±2.5V. Voltage analog inputs are indicated as Va and Vb and they are acquired either as single-ended input or in pairs as differential inputs where Va is the positive terminal and Vb is the negative terminal. 12V output power supply and 2.5V reference voltage, useful for measuring signals acquired via potentiometer such as wind direction, are also provided on these connectors.

Four analog inputs are configurable to acquire current signals in the range 4 – 20 mA without using external precision resistor. These 100Ω resistors are already included in the device and allow conversion of 4 – 20mA current signals in 0.4 – 2V voltage signals. Channels set up for this functionality are CH8, CH9, CH14 and CH15. In order to enable these resistors, the state of the four switches placed above base unit connectors must be changed. Each switch enables a resistor on an acquisition channel.

Characteristics of analog inputs are:

- 0.3µV resolution.
- Accuracy of 0.1% of reading.

Moreover, they are equipped with:

- Electrostatic discharge protection circuit up to 20kV with peak power at 25W and IEC 61000-4-2 standard; level 4 (ESD); IEC 61000-4-5 (surge); IPP = 2.5A on both voltage terminal inputs, where measure is read, and current terminal inputs, where reference is generated.
- Differential low-pass filter with cutoff frequency of 530Hz.
- Common mode low-pass filter with cutoff frequency of 780Hz.

2.4.3 Digital inputs

Base unit is equipped with 12 opto-isolated digital inputs available on connectors CH17, CH18, CH23, DIG IN A, DIG IN B and DIG IN C. Digital inputs are composed of two terminals **IF+** and **IF-** (for example IF1+ e IF1 for digital input 1 on connector CH17). Characteristics of digital inputs are:

- $5kV_{RMS}$ isolation voltage between IF+ and IF- terminals.

[1] Pt100 inputs are acquired on differential channels, therefore each Pt100 connected reduces the number of differential channels available.

[2] Only active during the measurement cycle so as not to alter the temperature conditions of the Pt100 (Joule effect).

- 10KΩ internal resistance limit.
- Acquisition: frequency (0.25 – 5000Hz), counter and digital state.

Digital inputs allow to acquire square wave signals, by connecting IF- to ground and IF+ to positive signal, and dry contacts. In the latter case it is necessary to provide power supply on IF+ to polarize the photodiode and connect the dry contact to IF-. For this purpose, a 12V output voltage is available on connectors. For example, in order to connect a dry contact to CH17 terminal, a bridge between 12V output voltage and IF1+ pin must be wired and then the dry contact can be wired between IF-1 and GND. If contact is open, no current flows on photodiode and a high-level logic state signal is read by datalogger due to the internal pull-up resistors. If contact is closed to ground, a current flow on photodiode and a low-level logic state signal is read by datalogger.

Moreover, four comparator inputs for AC sensors are available, for example variable reluctance sensors such as some wind speed sensors. Digital inputs are divided among the connectors as follows:

- Connector CH17: opto-isolated digital input IF1.
- Connector CH18: opto-isolated digital input IF2.
- Connector DIG IN A: opto-isolated digital inputs IF3, IF4 and IF5.
- Connector DIG IN B: opto-isolated digital inputs IF6, differential comparator digital inputs IF7 and IF8.
- Connector CH23: opto-isolated digital inputs IF9.
- Connector DIG IN C: opto-isolated digital inputs IF10, differential comparator digital inputs IF11 and IF12.

Comparator inputs provide a differential comparator which, given a sinusoidal signal at the input, produces a square wave with the same frequency used for acquisition. This behaviour allows to acquire from passive sensors such as some wind speed sensors with sine wave output. As for opto-isolated digital inputs, comparator inputs can be read as frequency, counter or logic state measures and they are equipped with electrostatic discharge protection circuit up to 23kV with peak power at 500W and IEC 61000−4−2 standard, level 4 (ESD), IEC 61000−4−5 (surge) Ipp = 18A.

2.4.4 Analog outputs

Base unit provides two analog outputs in the range 0 – 2.5V with 12bit resolution on pin OA1 (connector CH10) and OA2 (connector CH16). Analog outputs can be set via Modbus commands (see Chapter 3.5.3).

2.4.5 Digital outputs

Base unit provides eight open drain digital outputs, six on DIG OUT connector and two on EXP connector. Characteristics of digital inputs are:

- Open drain with 1Ω – 0.25W limit resistor.
- Current up to 500mA.
- Electrostatic discharge protection circuit up to 25kV with peak power at 350W and IEC 61000−4−2 (ESD) standard, 15 kV (air), 8 kV (contact), IEC 61000−4−4 (EFT) 40A (5/50 ns), IEC 61000−4−5 (lightning) 23A (8/20 µs).

Digital outputs can be set via Modbus command (see Chapter 3.5.2).

2.4.6 Connectivity

A RS485 serial port is available on EXP connector. Its configuration is: 57600bps, 8 data bits, parity none and 1 stop bit. Analog and digital measurements can be directly acquired through this serial port

2.5 Serial ports

The datalogger provides seven serial ports:

- COM1: RS232 interface, DB9 connector.
- COM2: RS232 and RS485 interfaces.
- COM3: RS232 interface.
- COM4: RS485 interface.
- COM5: RS485 and SDI-12 interface.
- COM6: RS485 and SDI-12 interface.
- COM7: RS485 interface.

Moreover, output power supplies are available on five serial port connectors, namely:

- COM2, COM4 and COM5: output voltage equal to the voltage supplied to the input power supply connector and current up to 5A.
- COM3 and COM6: 12V output voltage and current up to 2A.

Serial ports are configurable in different ways. As shown in Table 2.2 setting of the number of data bits and the number of stop bits are different.

SERIAL	NUMBER OF DATA BITS	NUMBER OF STOP BITS	PARITY
COM1	5, 6, 7, 8	1, 1.5, 2	None, even, odd
COM2	5, 6, 7, 8	1, 1.5, 2	None, even, odd
COM3	5, 6, 7, 8	1, 1.5, 2	None, even, odd
COM4	5, 6, 7, 8	1, 1.5, 2	None, even, odd
COM5	8, 9	1, 2	None, even, odd
COM6	8, 9	1, 2	None, even, odd
COM7	8, 9	1, 2	None, even, odd

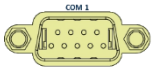
Table 2.2: configuration setting of datalogger serial ports.

Warning:

When configuring the datalogger (see Chapter 3), pay attention to the setting of the serial ports. Serial port configuration must be in accordance with what is reported in Table 2.2.

RS485 interfaces are equipped with electrostatic discharge protection circuit up to 20kV with peak power at 500W (8/20µs), while SDI-12 interfaces are equipped with electrostatic discharge protection circuit up to 30kV with peak power 4kW (8/20µs).

Table 2.3: describes serial port connector in details.

CONNETTORE	DESCRIZIONE
	DB9 connector

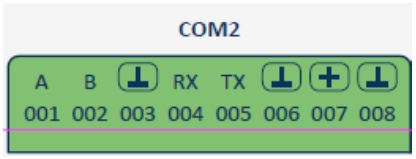
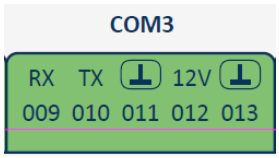
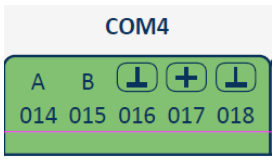
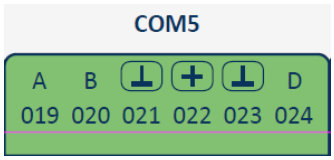
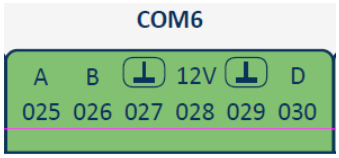
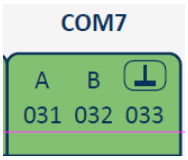
	Pin1: RS485 A Pin2: RS485 B Pin3: ground Pin4:RS232 Rx Pin5: RS232 Tx Pin6: ground Pin7: 12V Pin8: ground
	Pin9:RS232 Rx Pin10: RS232 Tx Pin11: ground Pin12: 12V Pin13: ground
	Pin14:RS485 A Pin15: RS485 B Pin16: ground Pin17: 12V Pin18: ground
	Pin19:RS485 A Pin20: RS485 B Pin21: ground Pin22: 12V Pin23: ground Pin24: SDI-12 data line
	Pin25:RS485 A Pin26: RS485 B Pin27: ground Pin28: 12V Pin29: ground Pin30: SDI-12 data line
	Pin31:RS485 A Pin32: RS485 B Pin33: ground

Table 2.3: description of serial port connectors.

2.6 LED indicators

The data logger is equipped with the following LED indicators:

LED	DESCRIPTION
	Status LED: provides an indication of the operating state of the datalogger, the blinking frequency depends on how many operations are performed by the system.

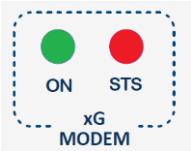
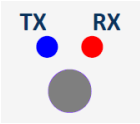
	Modem operating status LEDs: ON LED indicates the state of the modem power supply, while STS LED indicates the operating status of the modem (on during communication).
	Serial ports operating status LEDS: COM2, COM3, COM4, COM5, COM6 and COM7 serial ports are equipped with an operating status LED (blue during transmission, red during reception).
	Base unit status LEDs: • ON blinks at each measurement cycle • RUN indicates the state of the internal watchdog. • VBATT indicates the status of the battery charger (1 blink means battery is dead, 5 blinks mean battery is fully charged)

Table 2.4: description of LED indicators.

2.7 USB device port

Micro-USB connector is located on the front panel of the datalogger (Figure 2.5). USB port can be used to establish a connection with the device via PC. Two operating modes are available: virtual COM port and mass storage (see Chapter 6).

Figure 2.5: micro-USB connector.

2.8 Ethernet RJ45 connector

Ethernet RJ45 connector is located on the front panel of the datalogger (Figure 2.6) and it is internally connected to a 10/100 Mbps Base-T/TX Ethernet switch. The datalogger is equipped with a TCP/IP protocol suite that allows to perform TCP and UDP connections for data transmission and date and time synchronization from a NTP server.

Figure 2.6: Ethernet RJ45 connector.

2.9 MicroSD card connector

Push-push microSD card connector is placed on the right side of the datalogger (Figure 2.7). Full compliance to MicroSD card specifications version 2.0 is supported. SD cards with higher and more recent versions must be backwards compatible, otherwise correct operation is not guaranteed. The label on the front panel of the box indicates the direction of the insertion of the SD card.

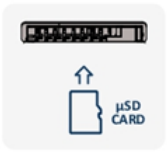


Figure 2.7: microSD card connector.

2.10 Micro SIM connector

Push-pull connector for micro-SIM il placed on the left side of the datalogger (Figure 2.8). SIM card must be inserted as shown on the label on the front panel of the box.

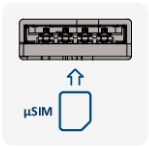


Figure 2.8: micro-SIM connector.

2.11 Antenna connector

RF connector is located on the left side of the datalogger (Figure 2.9).

Figure 2.9: RF connector.

3 Setup guide

This chapter describes in detail how to configure the datalogger. The software program DAK allows you to create a new configuration or modify an existing one (see Chapter 15). The created configuration is saved to a file with XML extension which is loaded by the datalogger. The configuration is made up of seven main sections: remarks, parameters, acquisitions, processing, controls, storages and transmission. Each section is described in the following chapters.

3.1 Remarks

Remarks section allows you to add notes reporting the author who create or modify the configuration. Table 3.1 lists the fields that made up the note.

PARAMETER	DESCRIPTION	VALUE
Version	Version number of the note.	Max 25 characters
Author	Author's name.	Max 30 characters
Comments	Author's comment.	Max 100 characters

Table 3.1:fields of the Remark configuration item.

3.2 Parameters

Inside Parameters section you can define the identification information of the datalogger and create numerical parameter that can be used in formulas for processing the acquired measures. From Parameters section 4 type of elements can be created:

- Identity of the datalogger
- Modem
- Modbus communication channel
- Parameter

3.2.1 Identity of datalogger

The identity of the datalogger is defined by a name, a Modbus address and a storage identifier. This configuration element must be unique. Table 3.2 describes configuration fields of the identity of the datalogger.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the identity entry.	Max 25 characters
Station name	Station name.	Max 20 characters
Modbus ID	Modbus address of the station.	Integer number
Storage ID	Storage ID of the station.	Integer number

Table 3.2: fields of the Datalogger Identity configuration item.

3.2.2 Modem

This entry allows to set parameters used by internal modem (see Chapter 4.4). Only one modem entry must be defined in the configuration. Table 3.3 describes configuration fields of the modem entry.

PARAMETER	DESCRIPTION	VALUE
Name	Modem name	Max 25 characters

AT commands	List of semicolon-separated AT commands used to initialize the modem.	Max 100 characters
APN	Access point name.	Max 30 characters
NTP	NTP server to read date and time from.	Max 30 characters. Leave this field blank you do not want to perform time synchronization via NTP.
Time zone	Time zone as number of hours. Time zones expressed as fractions of hours are also allowed (e.g. UTC+3:30=3.5)	Floating point number
Synchronization time	Maximum time difference in seconds between datalogger clock and NTP clock to update system time.	Integer number
Network connection waiting time	Connection timer in seconds to wait for network registration.	Integer number, range 1-120 (default 30 seconds)

Table 3.3: fields of the Modem configuration item.

Warning:

The internal modem doesn't work if Modem entry is not defined or not enabled. Therefore, for a proper operation of the modem this entry must be defined in configuration.

You can specify AT commands to be sent to the modem during initialization. These commands are executed before all default initialization commands and their responses are not evaluated in the modem startup procedure.

Warning:

Do not send AT commands that cause the modem to reboot. In this case the attempts to communicate with the modem will fail and its startup procedure will also fail.

3.2.3 Parameter

Parameter entry allows to define a numerical parameter and its unit of measurement. Parameters can be used in measurement processing formulas and logical expressions. Table 3.4 describes configuration fields of the Parameters entry.

PARAMETER	DESCRIPTION	VALUE
Name	Parameter name.	Max 25 characters
Enabled	Specifies if parameter is enabled.	0=No, 1=Yes
Memory location	Number of the datalogger memory location where parameter is stored.	Integer number
Unit of measurement	Parameter unit of measurement.	Max 10 characters
Value	Parameter value.	Floating point number

Table 3.4: fields of the Parameter configuration entry.

3.2.4 Modbus communication channel

This entry defines a serial communication channel with the datalogger to which Modbus commands can be sent and received. The datalogger responds to Modbus RTU messages with public and Siap+Micros user-defined function codes (see Chapter 8 for further details). This channel can be used to communicate with the datalogger through a PC (for example using DAK program) for debug purposes or to check the datalogger internal status. Description of configuration fields of Modbus channel entry is detailed in Table 3.5.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the Modbus channel entry.	Max 25 characters
Enabled	Specifies if Modbus channel is enabled.	0=No, 1=Yes
COM	Serial port number.	1=COM1 2=COM2 … 7=COM7
Baudrate	Baudrate of the serial port (bps).	1200, 2400, 4800, 9600, 19200, 38400, 57600, 1115200
Data bits	Number of data bits.	5, 6, 7, 8, 9
Parity	Parity.	0=None, 1=Odd, 2=Even
Stop bits	Number of stop bit(s).	0=1 bit, 1=1.5 bit 2=2 bit
Interfaces	Serial port interface.	0=RS232 1=RS485 2=SDI-12

Table 3.5: fields of the Modbus Channel configuration entry.

3.2.5 Network interface

This entry specifies the network interface of the datalogger. Only one network interface must be defined in configuration. Table 3.6 describes configuration fields of the network interface.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the network interface entry.	Max 25 characters
Enabled	Specifies if configuration of the network interface is enabled.	0=No, 1=Yes
IP address	IP address assigned to the datalogger.	Max 16 characters
Netmask	Netmask assigned to the datalogger.	Max 16 characters
Gateway	Gateway assigned to the datalogger.	Max 16 characters

Table 3.6: fields of the Network Interface configuration entry.

3.2.6 Wi-Fi & Bluetooth

This entry allows to configure the operating mode of the Wi-Fi & Bluetooth module. Only one Wi-Fi & Bluetooth entry must be defined in configuration.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the Wi-Fi & Bluetooth entry.	Max 25 characters
Operating mode	Specifies the Wi-Fi & Bluetooth module operating mode.	0=App BLE, 1=Wi-Fi Web Server
SSID (service set identifier)	Datalogger's Wi-Fi network name (only in Wi-Fi Web Server mode).	Max 20 characters

Wi-Fi password	Password for accessing the datalogger's Wi-Fi network (only in Wi-Fi Web Server mode).	Max 20 characters

Table 3.7: fields of the Wi-Fi & Bluetooth configuration entry.

3.3 Acquisition

Acquisition section allows to add measurement acquisition from different type of sensors. Five different acquisition elements can be defined:

- Analog and digital I/O acquisition.
- Serial data acquisition (Modbus and SDI-12).
- Internal diagnostic acquisition.
- Clock acquisition.
- Local acquisition.

3.3.1 Analog and digital I/O

Base unit is connected to COM7 and it is configured at baudrate 57600bps. There are six different acquisition entries based on the type of measurements you want to read, in particular:

- Analog input measurement
- Digital input state
- Digital output state
- Analog output measurement
- Measurement from base unit extension inputs.
- Rainfall measurement

Configuration fields of acquisition from base unit are the same for the six measurements described above and are listed in Table 3.8. The next chapter highlights the configuration of a single measure acquired by the base unit.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the analog/digital acquisition entry.	Max 25 characters
Enabled	Specifies if acquisition is enabled.	0=No, 1=Yes
Base ID	Modbus address of the acquisition unit.	Integer number (default 1)
Sampling time	Data sampling interval in seconds.	Integer number
Timeout	Maximum response waiting time following a data request command in milliseconds.	Integer number
Attempts	Maximum number of communication attempts.	Integer number
Rain gauge lever resolution	Resolution of the lever of the tipping bucket rain gauge.	1=0.1mm 2=0.2mm
Reset rain gauge measure	Reset rainfall measurement at startup.	0=No, 1=Yes

Table 3.8: fields of the Analog and Digital I/O acquisition entry.

3.3.1.1 Analog and digital I/O measure

Configuration fields describing a single measure acquired from the base unit are listed in Table 3.9.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the measure entry.	Max 25 characters
Enabled	Specifies if measure is enabled.	0=No, 1=Yes
Register to be acquired	Register where the measure to be acquired is stored.	Integer number
Data type	Data type.	1=Boolean 2= 2-byte integer 3=Float 4=Swapped float 5=4-byte integer 6=4-byte swapped integer
Formula	Formula to be applied to the acquired measure.	Max 150 characters
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Lower limit	Lower limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number

Table 3.9: fields of the Base Unit Measure.

Note:

If analog and digital I/O acquisition process is disabled, all its measurements are automatically disabled. If a single measurement is disabled the acquisition process keeps running and the disabled measure is not acquired.

3.3.2 Serial acquisition

Modbus and SDI-12 sensors can be acquired via serial port acquisition. As described in Chapter 2.5 the datalogger is equipped with 7 serial ports with RS232, RS485 and SDI-12 interfaces. Table 3.10 shows configuration fields that made up the serial acquisition.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the acquisition entry.	Max 25 characters
Enabled	Specifies if serial acquisition is enabled.	0=No, 1=Yes
Sampling time	Data sampling interval in seconds.	Integer number
COM	Serial port number.	1=COM1 2=COM2 … 7=COM7
Baudrate	Baudrate of the serial port (bps).	1200, 2400, 4800, 9600, 19200, 38400, 57600, 1115200

Data bits	Number of data bits.	5, 6, 7, 8, 9
Parity	Parity.	0=None, 1=Odd, 2=Even
Stop bits	Number of stop bits.	0=1 bit, 1=1.5 bit 2=2 bit
Interfaces	Serial port interface.	0=RS232 1=RS485 2=SDI-12
Attempts	Maximum number of communication attempts.	Integer number
Power on interval time	How many seconds before the sampling time COM power supply must be enabled.	Integer number. 0=always on.

Table 3.10: fields of the Serial Acquisition configuration entry.

From serial acquisition process two types of measurement can be defined: Modbus and SDI-12.

3.3.2.1 Modbus measurement

Configuration fields describing a Modbus measurement are listed in Table 3.11.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the Modbus measure entry.	Max 25 characters
Enabled	Specifies if measure is enabled.	0=No, 1=Yes
Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number
Modbus address	Sensor Modbus address.	Integer number
Function code	Modbus function code.	1=Read Coils 2=Read Discrete Inputs 3=Read Holding Registers 4=Read Input Registers
Starting register	Starting register to acquire from.	Integer number
Number of registers	Number of registers to acquire.	Integer number
Data type	Data type.	1=Boolean 2=2-byte integer 3=Float 4=Swapped float 5=4-byte integer 6=4-byte swapped integer
Register to be acquired	Register where the measure to be acquired is stored.	Integer number
Timeout	Maximum response waiting time following a data request command in milliseconds.	Integer number
Formula	Formula to be applied to the acquired measure.	Max 150 characters
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Lower limit	Upper limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Table 3.11: fields of the Modbus Measurement configuration entry.

From a serial acquisition process more than one measurement can be configured. Setting the starting Modbus register and the number of registers you can acquire all the measures in a single data request command. If subsequent measurements need to acquire a value from a register that is already included in the registers range of a data command request, these measures will be automatically read without sending other Modbus requests. For example, in case of two measurements configured as shown in Table 3.12 the first Modbus request specifies registers 1, 2, 3 and 4. Therefore, with a single command both measures are acquired. In Table 3.13 is presented another scenario where measurements are acquired with two data request commands.

Name	Measure1
Function code	3
Starting register	1
Number of registers	4
Data type	Float
Register to be acquired	1

Name	Measure2
Function code	3
Starting register	1
Number of registers	4
Data type	Float
Register to be acquired	3

Table 3.12: configuration of Modbus measurements acquired with a single data request command.

Name	Measure1
Function code	3
Starting register	1
Number of registers	2
Data type	Float
Register to be acquired	1

Nome	Measure2
Function code	3
Starting register	3
Number of registers	2
Data type	Float
Register to be acquired	3

Table 3.13: configuration of Modbus measurements acquired with a two data request commands.

3.3.2.2 SDI-12 measurement

Configuration fields describing an SDI-12 measurement are listed in Table 3.14.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the SDI-12 measure entry.	Max 25 characters
Enabled	Specifies if measure is enabled.	0=No, 1=Yes
Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number
Sensor address	Sensor SDI-12 address (0-9, A-Z, a-z).	Integer number
Starting measurement command	Start measurement command.	0=aM! 1=aM1! … 9=aM9! 10=aMC! 11=aMC1! … 19=aMC9!

Send data command	Send measurement command.	0=aD0! 1=aD1! … 9=aD9!
Position	Position of the data to read in the response message.	Integer number
Timeout	Maximum response waiting time following a data request command in milliseconds.	Integer number
Formula	Formula to be applied to the acquired measure.	Max 150 characters
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Lower limit	Upper limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Table 3.14: fields of the SDI-12 Measurement configuration entry.

3.3.2.3 ASCII measurement

PARAMETER	DESCRIPTION	VALUE
Name	Name of the ASCII measure entry.	Max 25 characters
Enabled	Specifies if measure is enabled.	0=No, 1=Yes
Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number
Command	Data request command to be sent to the sensor. If empty the datalogger opens the configured COM port and listens for incoming messages.	Max 32 characters
Message header	Initial characters of the response message.	Max 64 characters
Message tail	Trailing characters of the response message.	Max 64 characters
Delimiters	One or more separation characters used to split the response message into tokens.	Max 10 characters
Data position	Token to read after splitting of the response message (1 = first token).	Integer number
Data type	Type of data acquired.	0=Decimal 1=Integer hexadecimal 2=ASCII code
Timeout	Maximum response waiting time following a data request command in milliseconds.	Integer number
Formula	Formula to be applied to the acquired measure.	Max 150 characters
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Lower limit	Upper limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Table 3.15: fields of the ASCII measurement entry.

For command, message header, message tail and delimiters fields it is possible to define special characters using the following syntax:

- <CR> = carriage return.
- <LF> = line feed.
- <TAB> = horizontal tab.

Acquisition from a sensor using a generic ASCII protocol has two operating modes:

- Polling mode: the datalogger send the configured command and wait for the response.
- Listening mode: if sensor automatically outputs data, leave command field as an empty string. The datalogger opens the configured COM port and listens for incoming messages from sensor.

In order to correctly parse the content of the response message, the datalogger searches for the trailing characters of the message. Then, it discards any header characters and extracts the various tokens by splitting the message based on the delimiters characters.

Nota:

Bear in mind that a COM port always open listening for incoming messages from a sensor in ASCII protocol cannot be used also to acquire data from other sensors in polling mode (Modbus or ASCII).

Nota:

If serial acquisition process is disabled, all its measurements are automatically disabled. If a single measurement is disabled the acquisition process keeps running and the disabled measure is not acquired.

3.3.3 Diagnostic data acquisition

Diagnostic measurements are acquired from the internal sensors of the datalogger. There are 11 different measurements acquired from 4 internal sensors and internal modem:

- Temperature sensor: board temperature expressed in °C.
- Photovoltaic panel power monitor: PV voltage in V, current in mA and power in mW.
- Battery charge power monitor: battery voltage in V, charge current in mA and charge power in mW.
- Load power monitor: load voltage in V, current drawn by load in mA and power consumption in mW.
- Modem: signal quality (RSSI) in dBm.

Table 3.16 describes configuration fields that made up diagnostic acquisition.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the diagnostic acquisition entry.	Max 25 characters
Enabled	Specifies if diagnostic acquisition is enabled.	0=No, 1=Yes
Sampling time	Sensor data sampling interval in seconds.	Integer number

Table 3.16: fields of the Diagnostic Acquisition entry.

3.3.3.1 Internal measurement acquisition

Configuration fields describing a measurement from an internal sensor are listed in Table 3.17.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the internal measure entry.	Max 25 characters
Enabled	Specifies if internal measure is enabled.	0=No, 1=Yes
Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number
Diagnostic type	Type of diagnostic measure.	0=PV current [mA] 1=PV voltage [V] 2=PV power [mW] 3=Batt. charge current [mA] 4=Battery voltage [V] 5=Batt. charge power [mW] 6=Curr. drawn by load [mA] 7=Load voltage [V] 8=Power consumption [mW] 9=Internal temperature [°C] 10=Signal quality of internal modem [dBm]
Formula	Formula to be applied to the acquired measure.	Max 150 characters
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Lower limit	Upper limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Table 3.17: fields of the Internal Measurement configuration entry.

Nota:

If diagnostic acquisition process is disabled, all its measurements are automatically disabled. If a single measurement is disabled the acquisition process keeps running and the disabled measure is not acquired.

3.3.4 Clock acquisition

Acquisition clock allows to acquire data and time of the datalogger and save the data in a memory location. You can save the year, month, day, hour, minutes and seconds. Table 3.18 lists configuration fields of the clock acquisition.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the clock acquisition entry.	Max 25 characters
Enabled	Specifies if clock acquisition is enabled.	0=No, 1=Yes
Sampling time	Data reading interval in seconds.	Integer number
Data type	Type of data acquired from date and time.	0=Year 1=Month 2=Day 3=Hour 4=Minutes 5=Seconds

Memory location	Number of the datalogger memory location where acquired measure is stored.	Integer number

Table 3.18: fields of the Clock Acquisition configuration entry.

3.3.5 Local acquisition

A local acquisition combines two or more measurements through the application of a formula and obtain a new measure (such as a pre-processed value) that is saved to a memory location of the datalogger. Table 3.19 shows configuration fields of the local acquisition.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the local acquisition entry.	Max 25 characters
Enabled	Specifies if local acquisition is enabled.	0=No, 1=Yes
Scan time	Formula execution interval in seconds.	Integer number
Memory location	Number of the datalogger memory location where the result of the formula.	Integer number
Formula	Formula to be applied to the acquired measure.	Max 150 character
Upper limit	Upper limit above which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.
Lower limit	Upper limit below which the measure is invalidated. The limit is applied to the result of the formula.	Floating point number. If empty no upper limit is applied.

Table 3.19: fields of the Local Acquisition configuration entry.

3.4 Processing

Processing section allows to configure the processing of the acquired measures. There are 3 different types of processing:

- Standard processing.
- Wind processing.
- Rainfall processing.

3.4.1 Standard processing

Standard processing collects a sequence of measures acquired by an acquisition process and at the end of the processing interval computes statistical data based on these measures. In particular, the output data of the standard processing are:

- Summation of measures
- Total number of received measures
- Number of valid received measures
- Average
- Minimum
- Time of the minimum data expressed as number of minutes in the current day
- Maximum
- Time of the maximum data expressed as number of minutes in the current day.

- Percentage of valid measures
- Variance
- Standard deviation
- Last acquired value
- Positive deviation of the measure compared to the initial value

Configuration fields of the standard processing are listed in Table 3.20.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the standard processing entry.	Max 25 characters
Enabled	Specifies if processing is enabled.	0=No, 1=Yes
Scan time	Processing execution interval in seconds.	Integer number
Validity	Minimum percentage of valid data to perform the processing	Integer number from 0 to 100
Input memory location	Number of the datalogger memory location where the data to be processed is stored.	Integer number
Output memory locations	13 memory locations of the datalogger where processing results are stored.	Integer number

Table 3.20: fields of the Standard Processing configuration entry.

3.4.2 Wind processing

Wind processing receives data from wind direction and wind speed sensors and at the end of the processing interval computes the following results:

- Number of valid wind direction measures
- Average wind direction
- Number of valid wind speed measures
- Average wind speed
- Wind speed vector
- Wind direction vector
- Direction of max speed
- Maximum wind speed
- Standard deviation of wind speed
- Standard deviation of wind direction

Table 3.21 describes configuration fields of the wind processing.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the wind processing entry.	Max 25 characters
Enabled	Specifies if processing is enabled.	0=No, 1=Yes
Scan time	Processing execution interval in seconds.	Integer number
Validity	Minimum percentage of valid data to perform the processing.	Integer number from 0 to 100
Minimum wind speed	Minimum speed in m/s to validate wind direction data.	Floating point number

Input memory locations	Memory locations of the datalogger where wind direction and speed data are stored.	Integer number
Output memory locations	10 memory locations of the datalogger where processing results are stored.	Integer number

Table 3.21: fields of the Wind Processing configuration entry.

3.4.3 Rainfall processing

Rainfall processing is specifically created to compute data from precipitation measurements therefore the input data must be received from a rain gauge. This processing allows to distinguish data collected by the datalogger in normal operating state from data collected out of service, for example during maintenance operation (to disable and enable the datalogger functions see Chapter 7.11.3). The output data of the rainfall processing are:

- Total number of received data
- Number of valid data received
- Instantaneous rainfall collected in the cycle (mm)
- Cumulative rainfall in the interval (mm)
- Percentage of valid measures
- Total accumulated rainfall (mm)
- Out of service precipitation (mm)

Configuration fields of the rainfall processing are listed in Table 3.22.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the rainfall processing entry.	Max 25 characters
Enabled	Specifies if processing is enabled.	0=No, 1=Yes
Scan time	Processing execution interval in seconds.	Integer number
Validity	Minimum Percentage of valid data to perform the processing.	Integer number from 0 to 100
Input memory location	Number of the datalogger memory location where the data to be processed is stored.	Integer number
Output memory locations	7 memory locations of the datalogger where processing results are stored.	Integer number

Table 3.22: fields of the Rainfall Processing configuration entry.

3.5 Controls

Controls section allows to add control operation and monitoring operation of the acquired measures. There are 3 types of control operation:

- Measurement alarm.
- Setting of a digital output of the base unit.
- Setting of an analog output of the base unit.

3.5.1 Measurement alarm

Measurement alarm process monitors the state of a measurement. There are 5 possible states: normal, upper warning, lower warning, upper alarm and lower alarm (see Chapter 4.2). Table 3.23 lists configuration fields that made up the configuration of the measurement alarm.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the measurement alarm entry.	Max 25 characters
Enabled	Specifies if control is enabled.	0=No, 1=Yes
Scan time	Control interval in seconds.	Integer number
Input memory location	Number of the datalogger memory location where measure to be controlled is stored.	Integer number
Upper alarm	Upper alarm threshold.	Floating point number. If empty no upper threshold is applied.
Upper warning	Upper warning threshold.	Floating point number. If empty no upper threshold is applied.
Lower warning	Lower warning threshold.	Floating point number. If empty no lower threshold is applied.
Lower alarm	Lower alarm threshold.	Floating point number. If empty no lower threshold is applied.
Hysteresis	Hysteresis applied to thresholds.	Floating point number.
Waiting time	Time interval in seconds in which the measure must remain in a state different from the current one before changing its alarm state.	Integer number
Output memory location	Number of the datalogger memory location where the state of the measure is stored.	Integer number

Table 3.23: fields of the Measurement Alarm configuration entry.

3.5.2 Digital output

This control operation drives the state of the open-drain digital outputs and the 12V output voltage of the base unit. Table 3.24 lists configuration fields of the digital output control.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the digital output entry.	Max 25 characters
Enabled	Specifies if control is enabled.	0=No, 1=Yes
Base ID	Modbus address of the acquisition unit.	Integer number (default 1)
Scan time	Control interval in seconds.	Integer number
Formula	Formula to be applied to define the state of the digital output.	Max 150 characters
Channel	Digital output driven by the control process.	0=12V output voltage 1=Digital output OD1 2= Digital output OD2 … 8= Digital output OD8

Table 3.24: fields of the Digital Output configuration entry.

The 12V output voltage is on by default, so at the startup of the datalogger this output voltage is available on terminal DIG OUT.

3.5.3 Analog output

Analog output control operation drives the state of the analog outputs of the base unit. Table 3.25 lists configuration fields of the analog output control.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the analog output entry.	Max 25 characters
Enabled	Specifies if control is enabled.	0=No, 1=Yes
Base ID	Modbus address of the acquisition unit.	Integer number (default 1)
Scan time	Control interval in seconds.	Integer number
Input memory location	Number of the datalogger memory location where measure to be controlled is stored.	Integer number
Formula	Formula to be applied to the input measure.	Max 150 characters
Channel	Analog output driven by the control process.	1=Analog output OA1 3=Analog output OA2

Table 3.25: fields of the Analog Output configuration entry.

The formula should output a numeric value expressed in mV in the range 0 – 2500mV (see Chapter 2.4.4).

3.6 Storage

Storage section allows to configure how to save the acquired measures and the processing data. There is only one type of memorization element available: Record saving.

3.6.1 Data record

Data record saving process saves to memory the acquired and processed data as text files. Records are built in two different formats: Siap+Micros format and ASCII (CSV) format. Siap+Micros format records three different types of data: statistical, alarm and instantaneous. Records are collected and organized in archives (see Chapter 4.3). Configuration fields of the data record are described in Table 3.26.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the data record entry.	Max 25 characters
Enabled	Specifies if data record is enabled.	0=No, 1=Yes
Scan time	Memorization interval in seconds.	Integer number
Time offset	Memorization interval offset in seconds.	Integer number
Format	Record format.	0=Siap+Micros format 1=ASCII format
Type	Record type.	0=Statistical 1=Instantaneous 2=Alarm
Archive	Number of archive where records are stored.	Integer number
Backup	Specifies if data record backup to SD card is enabled.	0=No, 1=Yes

Table 3.26: fields of the Data Record configuration entry.

3.6.1.1 Measure written to the record

This entry defines the single measure written to the record based on the format specified in the record saving process. Table 3.27 lists configuration fields of the measure written to the record.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the measure entry.	Max 25 characters
Enabled	Specifies if measure is written to the record.	0=No, 1=Yes
Measure ID	Measure identifier.	Integer number
Attribute	Type of data (only for statistical record)	A=Instantaneous data B=Average C=Minimum D=Maximum E=Number of samples F=Standard deviation G=Variance H=Sum L=Minute of minimum M=Minute of maximum
Number of decimal digits	Number of digits after the decimal point.	Integer number
Memory location	Number of the datalogger memory location where measure to be written to the record is stored.	Integer number

Table 3.27: configuration fields of the Measure written to the record.

Nota:

If data record process is disabled, all its data records are automatically disabled. If a single data record is disabled the record saving process keeps running and the disabled data record is not written to the record.

3.7 Transmission

Transmissions section allows to configure the transmission of the records saved in memory. Data can be sent using the internal Sierra Wireless modem (see Chapter 4.4) or through an external transmitter connected via serial port or Ethernet port. There are 5 different types of data transmissions:

- FTP transmission via internal modem.
- SMS transmission via internal modem.
- Iridium satellite transmission.
- GOES/Meteosat satellite transmission.
- UHF radio transmission.
- Transmission via Ethernet port.

3.7.1 FTP transmission via internal modem

FTP transmission allows to send data records to one or more FTP server with a specified interval (see Chapter 4.5.1). Table 3.28 lists configuration fields of the FTP transmission.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the FTP transmission entry.	Max 25 characters
Enabled	Specify if FTP transmission is enabled.	0=No, 1=Yes
Scan time	Transmission interval in seconds.	Integer number
Time offset	Transmission interval offset in seconds.	Integer number

Table 3.28: fields of the FTP Transmission configuration entry.

3.7.1.1 FTP Server

Datalogger connects to a remote server via FTP protocol to send data records. An FTP server is defined by configuration fields listed in Table 3.29.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the FTP server entry.	Max 25 characters
Enabled	Specifies if FTP server is enabled.	0=No, 1=Yes
Archive	Number of the archive from which to read data.	Integer number
Host	Server IP address.	Max 20 characters
Port	Number of FTP port.	Integer number (default 21)
Username	Username to log in to the server.	Max 30 characters
Password	User password to log in to the server.	Max 30 characters
Remote path	Path to the directory on the server where data files are saved.	Max 50 characters
Connection timer	Connection timer in seconds to wait for connection to FTP server.	Integer number in the range 1-120 (default 60 seconds)

Table 3.29: fields of the FTP Server configuration entry.

Nota:

If FTP transmission process is disabled, all its FTP servers are automatically disabled. If a single server is disabled the transmission process keeps running and data are not sent to the disabled server.

3.7.2 SMS transmission

SMS transmission process receives and responds to a predefined set of SMS commands (see Chapter 4.5.3.1). Only one SMS transmission process must be specified in configuration since the messages are related to the SIM inserted to the datalogger. Once they are read, they are deleted from the incoming message list. Table 3.30 lists configuration fields of the SMS transmissions.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the SMS entry.	Max 25 characters
Enabled	Specifies if transmission and reception of SMS is enabled.	0=No, 1=Si
Scan time	Time scan in seconds.	Integer number.

Table 3.30: fields of the SMS Transmission configuration entry.

3.7.2.1 Telephone number

Adding telephone numbers to an SMS transmission process allows to send, to the configured users, SMS notification when the alarm state of a measurement changes. So, at least one measurement alarm control must be defined in configuration (see Chapter 3.5.1). Configuration fields of the telephone number are listed in Table 3.31.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the telephone number entry.	Max 25 characters
Enabled	Specifies if telephone number is enabled.	0=No, 1=Yes
Phone number	User telephone number.	Max 15 characters

Table 3.31: fields of the Telephone number configuration entry.

Nota:

If SMS transmission process is disabled, the process taking care of SMS reception and sending of alarm SMS to the user phone numbers is automatically disabled. If a single phone number is disabled the transmission process keeps running and any alarm SMS won't be sent to the disabled phone number. If no phone number is configured the transmission process just receives and responds to SMS commands.

3.7.3 Iridium Satellite transmission

Iridium satellite transmission process is used to send data over the Iridium satellite system (see Chapter 4.5.4.1). Configuration fields of the Iridium satellite transmission are described Table 3.32.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the satellite transmission entry.	Max 25 characters
Enabled	Specifies if satellite transmission is enabled.	0=No, 1=Yes
Scan time	Transmission interval in seconds.	Integer number
COM	Serial port number	1=COM1 2=COM2 … 7=COM7
Baudrate	Baudrate of the serial port (bps)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 1115200
Data bits	Number of data bits.	5, 6, 7, 8, 9
Parity	Parity.	0=None, 1=Odd, 2=Event
Stop bits	Number of stop bits.	0=1 bit, 1=1.5 bit 2=2 bit
Interfaces	Serial port interface.	0=RS232 1=RS485 2=SDI-12

Message reception	Defines how often to check for incoming messages.	0=only if there are data to send 1=at each session N=every N session

Table 3.32: fields of the Iridium Satellite Transmission configuration entry.

3.7.3.1 Iridium data

Iridium data specifies the data to send and the time range these data belongs to. Data Iridium is described by configuration fields shown in Table 3.33.

PARAMETER	DESCRIPTION	VALUE
Nome	Name of the Iridium data entry.	Max 25 characters
Enabled	Defines if Iridium data is enabled.	0=No, 1=Yes
Data range	Time interval in second of the data packet.	Integer number
Archive	Number of the archive from which to read data.	Integer number

Table 3.33: fields of the Data Iridium configuration entry.

Nota:

If Iridium satellite transmission process is disabled, all its data are automatically disabled. If a single data is disabled the transmission process keeps running and records of the archive defined in the disabled data are not sent.

3.7.4 GOES/Meteosat satellite transmission

GOES/Meteosat satellite transmission process is used to send data over GOES and Meteosat satellite system (see Chapter 4.5.4.2). Configuration fields of the GOES/Meteosat satellite transmission are listed in Table 3.34.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the satellite transmission entry.	Max 25 characters
Enabled	Specifies if satellite transmission is enabled.	0=No, 1=Yes
Scan time	Transmission interval in seconds.	Integer number
Time offset	Transmission interval offset in seconds.	Integer number
COM	Serial port number	1=COM1 2=COM2 … 7=COM7
Baudrate	Baudrate of the serial port (bps).	1200, 2400, 4800, 9600, 19200, 38400, 57600, 1115200
Data bits	Number of data bits.	5, 6, 7, 8, 9
Parity	Parity.	0=None, 1=Odd, 2=Event
Stop bits	Number of stop bits.	0=1 bit, 1=1.5 bit

		2=2 bit
Interfaces	Serial port interface.	0=RS232 1=RS485 2=SDI-12
Archive	Number of the archive from which to read data.	Integer number
Header	Optional data packet header (only for pseudo-binary packets).	Max 10 characters. 'Sdmyhn' must be set for Meteosat.
Number of packets	Number of data packets to send.	Integer number (default: 0=last packet only)
Clock synchronization	Time interval in seconds that defines how often to perform clock synchronization.	Integer number
Time zone	Time zone as number of hours. Time zones expressed as fractions of hours are also allowed (e.g. UTC+3:30=3.5).	Floating point number.
Synchronization time	Maximum time difference in seconds to perform clock synchronization with satellite transmitter.	Integer number

Table 3.34: fields of the GOES/Meteosat satellite transmission configuration entry.

3.7.5 UHF radio transmission

UHF radio transmission allows to configure data transmission and reception via an UHF radio connected to a serial port (see Chapter 4.5.5). Table 3.35 lists configuration fields of the radio transmission.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the radio transmission entry.	Max 25 characters
Enabled	Specifies if radio transmission is enabled.	0=No, 1=Yes
COM	Serial port number	1=COM1 2=COM2 … 7=COM7
Baudrate	Baudrate of the serial port (bps).	1200, 2400, 4800, 9600, 19200, 38400, 57600, 1115200
Data bits	Number of data bits.	5, 6, 7, 8, 9
Parity	Parity.	0=None, 1=Odd, 2=Even
Stop bits	Number of stop bits.	0=1 bit, 1=1.5 bit 2=2 bit
Interfaces	Serial port interface.	0=RS232 1=RS485 2=SDI-12
Holding time	Time in seconds that defines the data interval requested via Siap+Micros Modbus command.	Integer number
Formula	Formula to apply to turn on/off the radio.	Max 150 characters.

Table 3.35: fields of the UHF Radio Transmission configuration entry.

3.7.6 Clock synchronization via Ethernet port

This process sets up a connection to specified NTP server via Ethernet port to read current date and time once an hour. Table 3.36 lists configuration fields of the clock synchronization process.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the clock synchronization entry.	Max 25 characters
Enabled	Specifies if clock synchronization is enabled.	0=No, 1=Yes
NTP server	NTP server to read date and time from.	Max 30 characters
Time zone	Time zone as number of hours. Time zones expressed as fractions of hours are also allowed (e.g. UTC+3:30=3.5).	Floating point number
Synchronization time	Maximum time difference in seconds to perform clock synchronization	Integer number

Table 3.36: fields of the Clock Synchronization configuration entry.

3.7.7 Transmission via Ethernet port

This process sends data to one or more server via Ethernet port with a specified sending interval time. Table 3.37 lists configuration fields of the Ethernet transmission.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the Ethernet transmission entry.	Max 25 characters
Enabled	Specifies if Ethernet transmission is enabled.	0=No, 1=Yes
Scan time	Transmission interval in seconds.	Integer number
Time offset	Transmission interval offset in seconds.	Integer number

Table 3.37: fields of the Ethernet Transmission configuration entry.

3.7.7.1 FTP client

The FTP Client allows you to configure a remote server that the datalogger connects to via the FTP protocol for data transmission (see Chapter 4.5.1). Configuration fields of the FTP client are shown in Table 3.38.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the FTP client entry.	Max 25 characters
Enabled	Specifies if FTP client is enabled.	0=No, 1=Yes
Archive	Number of the archive from which to read data.	Integer number
Host	Server IP address.	Max 20 characters
Port	Number of FTP port.	Integer number (default 21)
Username	Username to log in to the server.	Max 30 characters
Password	User password to log in to the server.	Max 30 characters
Remote path	Path to the directory on the server where data files are saved.	Max 50 characters

Table 3.38: fields of the FTP Client configuration entry.

3.7.7.2 TCP/UDP client

The TCP/UDP Client allows you to configure a remote server that the datalogger connects to via the TCP or UDP protocol for data transmission. Configuration fields of the TCP/UDP client are shown in Table 3.39.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the TCP/UDP client entry.	Max 25 characters
Enabled	Specifies if TCP/UDP client is enabled.	0=No, 1=Yes
Protocol type	Client connection protocol type.	0=TCP, 1=UDP
Server	Server IP address.	Max 20 characters
Port	Port number.	Integer number
Archive	Number of the archive from which to read data.	Integer number
Data format	Format of the data to be sent.	0=Siap+Micros, 1=NMEA 0183

Table 3.39: fields of the TCP/UDP Client configuration entry.

Nota:

If Ethernet transmission process is disabled, all clients are automatically disabled. If a single client is disabled the transmission process keeps running and data are not sent to the disabled server.

3.8 Tunnel communication

A direct communication can be established with a datalogger through a TCP tunnel to send and receive data. (see Chapter 4.5.6). Table 3.40 lists configuration fields of the tunnel communication.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the tunnel entry.	Max 25 characters
Enabled	Specifies if tunnel is enabled.	0=No, 1=Yes
Server	Server IP address.	Max 20 characters
Port	Port number.	Integer number
Scan time	Tunnel connection interval in seconds.	Integer number. 0=always on.
Connection duration	Duration of tunnel connection in seconds.	Integer number
Echo string	String sent to keep the connection active.	Max 10 characters
Echo sending interval	Time interval in seconds to indicate how many times to send the echo string.	Integer number

Table 3.40: fields of the Tunnel Communication configuration entry.

3.9 TCP server

Sets a TCP/IP server over Ethernet listening to a configurable port. The IP address is defined by the network interface (Chapter 3.2.5). Table 3.41 lists configuration fields of the TCP server.

PARAMETER	DESCRIPTION	VALUE
Name	Name of the TCP server entry.	Max 25 characters
Enabled	Specifies if server is enabled.	0=No, 1=Yes

Port	Port number.	Integer number

Table 3.41: fields of the TCP Server configuration entry.

3.10 Datalogger registers

The datalogger reserves a memory area where 500 memory locations are allocated. Each location is accessible as a register where data are read and written as 4-byte floating point number. In configuration these memory locations are assigned to acquisition, processing, control and storage processes.

Warning:

The datalogger has 500 registers identified by an index from 1 to 500. If an index with a value out of this range is used in configuration, the data allocated in that location is not saved in the datalogger memory.

3.11 Formulas

As already mentioned in the previous chapters, mathematical formulas and logic expression can be defined to process one or more measurements. The set of operators available are (some operators can be expressed using an alternative syntax denoted in parentheses):

Operator	Description
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Remainder of division
^	Raise to power

Table 3.42: arithmetic operators.

Operator	Description
>	Greater than
<	Less than
?	Not equal to
=	Equal to

Table 3.43: relational operators.

Operator	Description
|	Bitwise OR
&	Bitwise AND

Table 3.44: bitwise operators.

Operator	Description
NOT (!)	Logical NOT
AND	Logical AND
OR	Logical OR

Table 3.45: logic operators.

Moreover, the following functions are available:

Function	N° parameters	Description
SIN(x)	1	Computes the sine of an angle of *x* radians.
INT(x)	1	Return the largest integral value that is not greater than *x*.
COS(x)	1	Computes the cosine of an angle of *x* radians.
SQR(x)	1	Computes the square root of *x*.
LOG(x)	1	Computes the common (base-10) logarithm of *x*.
LN(x)	1	Computes the natural logarithm of *x*.
ABS(x)	1	Computes the absolute value of *x*.
TAN(x)	1	Computes the tangent of an angle of *x* radians.

ATN(x)	1	Computes the principal value of the arc tangent of *x*, expressed in radians.
EXP(x)	1	Computes the base-e exponential function of *x*.
SGN(x)	1	Returns the sign of *x*: 0 = zero, -1 = negative value, 1 = positive value.
LIM(x,max,min)	3	Returns the value *x* limited in the range defined by the maximum value *max* and the minimum value *min*. If *x* > *max* it returns the maximum value, while *x* < *min* it returns the minimum value.
MAX(x,y)	2	Returns the largest of *x* and *y*.
MIN(x,y)	2	Returns the smallest of *x* and *y*.

Table 3.46: set of functions supported by the formula parser.

The data saved in the datalogger memory locations can be retrieved and used in a formula using the syntax "**M*n***", where *n* is the index of the memory location. For example, **M14** in a formula is replaced with the value saved in the register number 14. Formulas specified in acquisition processes or in a process that depends on an input value saved in a specific memory location the syntax "M0" is replaced with the value of the acquired measure or the value saved in the input memory location. Similarly, the syntax "**$*n***" is used to get the value of a parameter, where *n* is the index of the memory location where the parameter is stored.

The formula and expression parser supports numbers formatted in scientific notation. Therefore, 1e (or 1E) is 10 raised to power, that is "10^" (for example, 1e-6 is 10^{-6} and 1e+6 is 10^{6}).

4 Datalogger operations

Configuration defines the processes manged by the datalogger and each process is composed of one or more phases. Processes run in parallel with a specific execution time interval, while phases are executed in sequence. If there are more processes with the same scan time, they are started according to the order defined in configuration. If more processes share the same resource, for example they use the same serial port, they are executed in sequence as the resource cannot be used by multiple processes at the same time. The same logic applies to the transmission processes that require the internal modem. In the following chapters a detailed description of the functionalities of the datalogger is given.

4.1 Acquisition

The datalogger is equipped with 7 serial ports with RS232, RS485 and SDI-12 interfaces. The first two types are used to communicate using Modbus protocol. The analog and digital I/O acquisition unit is internally connected to COM7 at 57600bps. So, care must be taken if other sensors are connected to COM7 as they share the same serial port with the base unit.

Tip:

It is not advisable to connect sensors with very short sampling time to COM7 as they can keep the serial busy for too long and therefore hinder the communication with the base unit.

Warning:

To avoid acquisition errors, do not assign the same Modbus address assigned to the base unit to sensors connected to COM7.

Acquisition processes acquire a measure from a sensor, apply the formula set in configuration and finally compare the resulting value with the specified limits (optional). If the resulting value is outside the limits, an invalid value is recorded in the corresponding memory location. The processing flow is described in Figure 4.1.

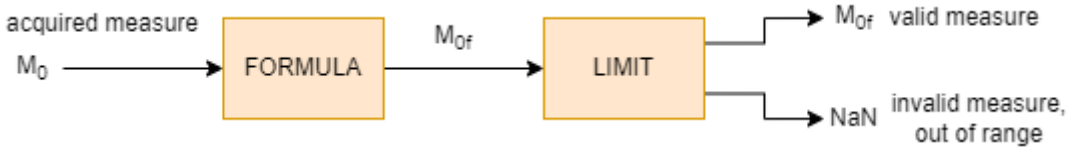


Figure 4.1: processing flow of an acquired measurement.

4.2 Monitoring the state of a measurement

The alarm measurement control compares the value of a measurement with one or more threshold to define its status. There are 5 different states:

- Normal.
- Warning: it might be upper or lower warning based on the value of the measurement.
- Alarm: it might be upper or lower alarm based on the value of the measurement.
- Out of range: acquired value is outside the limits set in configuration (see Chapter 4.1)
- Acquisition error: measurement is not acquired due to a communication error with the sensor.

Figure 4.2 shows the different states of a measurement: normal state in green, warning state in orange and alarm state in red. The hysteresis, if defined, prevents continuous changes of the states if measurement values lay around a threshold value. Furthermore, a waiting time can be set so that the change of the state occurs only after the measurement remains in a different state from the previous one for a time longer than the waiting time. This avoids unwanted state changes due to a single anomalous value or a single acquisition error.

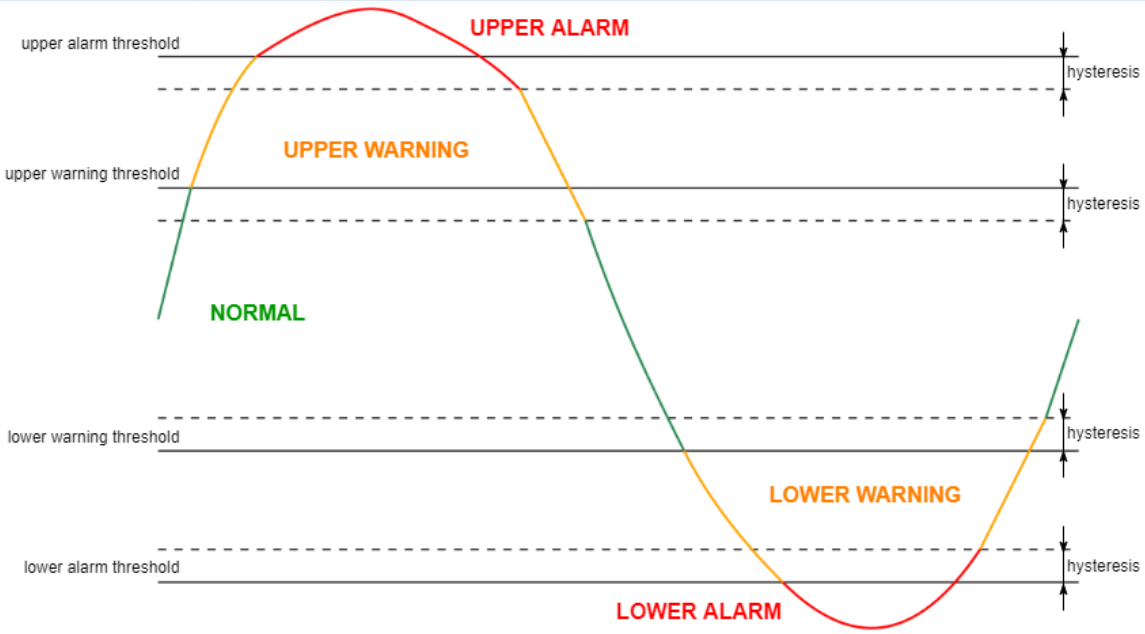


Figure 4.2: definition of the states of a measurement.

States of a measurement are identified by a numerical code:

MEASURE STATE	CODE
Lower alarm	-2
Lower warning	-1
Normal	0
Upper warning	1
Upper alarm	2
Error acquisition	3
Out of range	4

Table 4.1: measure state codes.

4.3 Data memory

The datalogger include two types of memory: 16Mb NOR flash and SD card (optional). Storage processes build records in a format specified in configuration and save them in memory. The datalogger provides 6 archives for record saving. For each archive is defined the format and the type of the records. Available formats are: Siap+Micros format and ASCII (CSV) format. An archive is identified by an index from 1 to 6. This allows to keep backward compatibility with the previous versions of the Siap+Micros datalogger. You can assign the following configuration to the archives:

- Archive 1: instantaneous data record.
- Archive 2: free to be used.
- Archive 3: free to be used.
- Archive 4: alarm data record.
- Archive 5: free to be used.
- Archive 6: statistical data record.

To reduce the number of write operations on the NOR flash memory, a caching mechanism has been implemented. Records are temporarily stored in cache and then flushed to flash memory. The need to reduce the number of write operation to flash memory occurs only for statistical records, therefore a cache memory

area is provided only for archives 5 and 6. The flushing of data from cache to flash memory is periodically performed by the datalogger application.

Tip:

It is recommended to use archives 5 and 6 for saving statistical records, so as to take advantage of cache memory and extend the life time of the internal flash memory, especially if the recording interval is very short (such as less than 5 minutes).

Note:

If datalogger is turned off, data saved in cache (and therefore not flushed to flash yet) are lost. To avoid losing data you can trigger a safe reboot procedure of the system in which all data saved in RAM are flushed to flash. See Chapter 7.11.3 for further details.

If SD card memory is connected and the data backup is enabled in configuration, at each recording interval of storage processes records are always written in the SD card. See Chapter 5 for further details about the management of the data records in file system.

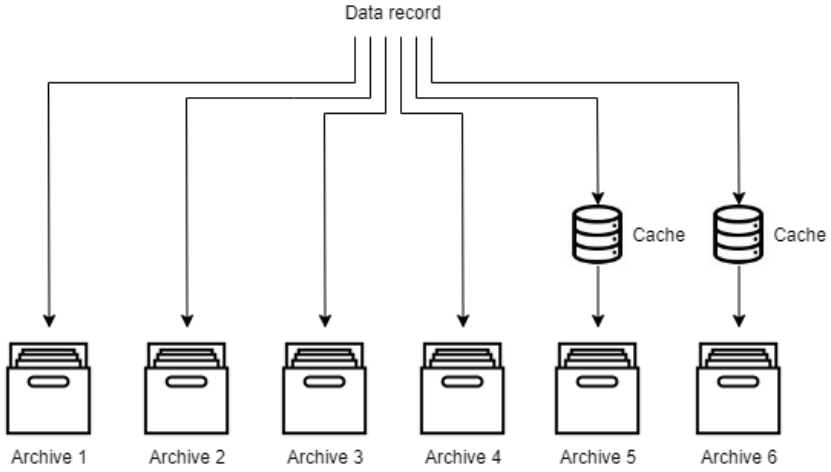


Figure 4.3: description of the record archives.

4.4 Modem

The datalogger allows to install different type of Sierra Wireless modem based on the coverage of 2G, 3G and 4G technologies and the frequency bands available in the country where the station is installed. The set of modems supported are listed in Table 4.2.

SERIES	MODULES	NETWORK
HL85xx	HL8548 and HL8548-G	2G, 3G global
HL76xx	HL7692 HL7688 HL7650	4G cat-1 with 2G fallback for EMEA 4G cat-1 with 3G fallback for America 4G cat-1 with 3G fallback for Australia
HL78xx	HL7802	NB-IoT cat-M1/NB1 and 2G for EMEA and America
RC76xx	RC7620 RC7620-1	4G cat-4 with 2G-3G fallback for EMEA and Australia 4G cat-1 with 2G-3G fallback for EMEA and Australia

Table 4.2: series of Sierra Wireless modems supported by the datalogger.

During startup modem is initialized with a sequence of AT commands. First commands set in configuration are executed (see Chapter 3.2.2) and then the predefined commands based on the modem type. Once initialization procedure is completed, a TCP connection to the NTP server specified in configuration is established to read

current date and time and update the system clock if needed. After the first connection to the NTP server, subsequent ones are executed 1 hour later.

The signal quality detected by the internal modem (RSSI), which can be recorded as a diagnostic measurement (Chapter 3.3.3), is expressed as a negative number in dBm. The lower the value, the better the signal. +99dBm means signal not known or not detectable. Possible causes of undetected signal are:

- Modem not registered to the network; in this case it is recommended to use an antenna with higher gain.
- SIM not correctly inserted.

Tip:

For a good connection with 4G technologies it is recommended to use M2M (machine-to-machine) SIM. This is not necessary for 2G and 3G technologies.

4.5 Transmission

This chapter explains in more details how data transmission processes work.

4.5.1 FTP transmission

FTP transmission processes send data records saved in the archives to one or more servers. For each server, IP address, port, login credentials (username and password), remote path where data are written and the archive number where data records are read are defined. The name of the data file written in the remote path is:

ST<storage id>_<year><month><day><*hour*><*minutes*><*seconds*>.txt

For example, *ST007_20220704081038.txt* is the data file sent by the station with storage ID 7 at 8:10:38 on 04/07/2022. For each server the datalogger keeps track of the last record sent, in order to ensure a correct sequence of the sent data at each transmission interval. To preserve this information from systems shutdown, the data transfer pointers are saved in NOR flash memory. Data transfer pointers are updated every 1 hour and they are uniquely identified by the name assigned in configuration to FTP server phase.

Warning:

In configuration FTP server phases must have different name to ensure a proper functioning of the data transfer pointers. The datalogger manages up to 10 transfer pointers.

FTP transmissions via internal modem and via Ethernet port work in the same way. In the latter case a network interface must be defined (see Chapter 3.2.5) and transmission is performed by an external router connected to RJ45 connector. If the network interface is not configured the datalogger use the following default values:

- IP address: 192.168.1.5
- Netmask: 255.255.255.0
- Gateway: 192.168.1.1

Note:

The internal modem and the Ethernet port are turned on when the transmission interval expires and remain active for the time required to perform the data transmission to the FTP server. Once the operation is completed, the devices are powered off to reduce the power consumption of the datalogger.

4.5.1.1 FTP commands

It is also possible to perform some operations remotely through text commands. For this purpose, a text command file named CMD.TXT can be saved in a specific remote directory on a server. The transmission process, after completing data file transfer, downloads the command file from the following path:

<*remote path*>/Config/ST<storage id>/CMD.TXT

If command file exists, it is download and then deleted from server. “Remote path” and “storage id” are specified in the configuration. Bear in mind that Storage ID must be written in three digits adding leading zeros; for example, if Storage ID is 1 and remote path is “data”, the complete remote path is:

data/Config/ST001/CMD.TXT

In the file commands can be written in uppercase or lowercase and must be separated by a carriage return and line feed. Below are listed the supported commands.

- Command: **CFGUPDT**

  Description:

  Configuration update command. The datalogger tries to download an XML file from the following path:

  <*remote path*>/Config/ST<*storage id*>/CFG_TMP.XML

  If file exists, it is downloaded. Upon completion, *CFG_TMP.XML* file is deleted from server and the datalogger starts uploading to the same remote directory the current configuration file with the name *CFG_OLD.XML* and the new configuration file with the name *CFG.XML* in this order. After this download and upload phase, the datalogger starts the configuration update procedure that eventually cause the system to be rebooted.

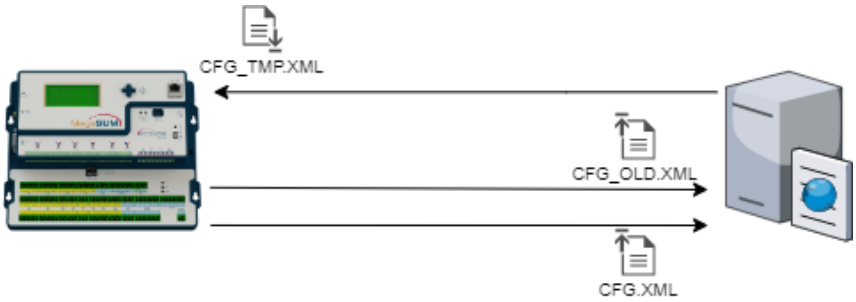


Figure 4.4: update datalogger configuration by downloading a new XML file from an FTP server.

- Command: **FWUPDT**

  Description:

  Firmware update command. The datalogger tries to download an HEX file from the following path:

  <*remote path*>/Config/ST<*storage id*>/MEGASUM.HEX

  If file exists, it is downloaded. Upon completion, *MEGASUM.HEX* file is deleted from server and the datalogger starts the firmware update procedure that eventually cause the system to be rebooted.

Note:

Make sure the name of the file to be downloaded is correct, otherwise the download will fail. Bear in mind that the download of an HEX file might require several minutes.

The update commands (configuration and firmware) are mutually exclusive, therefore are handled one at a time. If you need to perform both operations, it is recommended to set a command file to start configuration update and then another command file to start firmware update.

- Command: **GETCFG**

  Description: command to request the configuration. The datalogger responds by sending the CFG.XML file.

4.5.2 TCP/UDP transmission

TCP/UDP transmission allows data stored in an archive to be sent to a server using the TCP or UDP protocol. For each transmission, the protocol type, server IP address, port, archive number, and data format are defined. The available formats are Siap+Micros format and NMEA 0183 format.

In NMEA format, the Siap+Micros proprietary sentence, in accordance with the standard, begins with “$P” followed by the letters “SPM” and the data fields consisting of the record in Siap+Micros format. The message ends with “*” delimiter followed by the two-character cheksum and carriage return and line-feed characters.

$PSPM,…….*XX<CR><LF> (where XX is the two characters checksum)

For each TCP/UDP client, the data logger keeps track of the last record sent, ensuring the correct data sending sequence at the various scheduled transmission intervals. Data transmission pointers are stored in memory, as in FTP transmission processes.

4.5.3 SMS transmission

SMS transmission process manages two different operations (see Chapter 3.7.2): receiving commands and sending alarm notifications.

4.5.3.1 SMS command

The datalogger receives and responds to a set of predefined commands. Below are listed the supported commands:

COMMAND	RESPONSE
SHOW THRESHOLD <*id*>	THRESHOLD <*id*> ALmax=<*upper alarm threshold*> ATmax=<*upper warning threshold*> ATmin=<*lower warning threshold*> ALmin=<*lower alarm threshold*> HY=<*hysteresis*>

Description:

Returns the thresholds of the alarm measurement control that save the state of the measurement in the memory location indexed by <*id*>.

COMMAND	RESPONSE
CHANGE THRESHOLD <*id*> ALmax=<*upper alarm threshold*> ATmax=<*upper warning threshold*> ATmin=<*lower warning threshold*> ALmin=<*lower alarm threshold*> HY=<*hysteresis*>	THRESHOLD <*id*> ALmax=<*upper alarm threshold*> ATmax=<*upper warning threshold*> ATmin=<*lower warning threshold*> ALmin=<*lower alarm threshold*> HY=<*hysteresis*>

Description:

Sets the thresholds of the alarm measurement control that save the state of the measurement in the memory location indexed by<*id*>. You can change all or some thresholds. Response returns all thresholds of the alarm measurement control.

COMMAND	RESPONSE
STATUS LAST	LAST <*measure name 1*>=<*value 1*> <*measure name 2*>=<*value 2*> <*measure name 3*>=<*value 3*>

Description:

Returns the last value acquired by acquisition processes. Each measure is represented by the string <*measure name*>=<*value*>.

COMMAND	RESPONSE
REBOOT	No response

Description:

Send a request to reboot the system.

COMMAND	RESPONSE
FTP "<*ftp server name*>" FROM "<*YY/MM/DD-hh:mm*>"	OK

Description:

Sets the data transfer pointer of an FTP server phase to specified date and time. You need to define the name of the FTP server followed by year (*YY*), month (*MM*), day (*DD*), hour (*hh*) and minutes (*mm*).

COMMAND	RESPONSE
CHANGE APN=<*apn*>	OK APN=<*apn*>

Description:

Sets a new APN (<*apn*> is the new APN to be set).

COMMAND	RESPONSE
CHANGE FTP "<*ftp server name*>" IPADDR=<*ip address*> USERNAME=<*username*> PWD=<*pwd*>	OK <*ftp server name*> IPADDR=<*ip address*> USERNAME=<*username*> PWD=<*pwd*>

Description:

Sets IP address and login credentials of an FTP server phase. You need to define the name of the FTP server to change followed by the new parameters. You can change all or some parameters. Response returns all parameters of the FTP server.

COMMAND	RESPONSE
CHANGE FTP "<*ftp server name*>" PATH=<*remote path*> ARCHIVE=<*archive index*>	OK <*ftp server name*> PATH=<*remote path*> ARCHIVE=<*archive index*>

Description:

Sets remote path and archive of an FTP server phase. You need to define the name of the FTP server followed by the new parameters. You can change all or some parameters. Response returns all parameters of the FTP server.

COMMAND	RESPONSE
SAVE RUNTIME	OK

Description:

Allows to save the configuration with the changes made with the previous commands.

COMMAND	RESPONSE
GET FW	FW VERSION X.Y.Z

Description:

Returns the firmware version of the datalogger.

COMMAND	RESPONSE
GET HW	HW ID=<*hw*> SN=<*sn*>

Description:

Returns the hardware identifier of the and the serial number of the datalogger.

COMMAND	RESPONSE
GET DIAG	Example: Vbatt=12.35V Vps=18.95V Ich=560mA Temp=23.48°C

Description:

Returns diagnostic data from internal sensors, battery voltage, photovoltaic voltage, battery charge current and internal temperature.

COMMAND	RESPONSE
GET MODEM	Example (for HL8548): Model: HL8548 Revision: RHL85xx.5.5.18.0.201506301553.x6250 IMEI: 359515059889513 FSN: HD734603011410 RSSI: -58dBm

Description:

Returns the identification information of the internal Sierra Wireless modem: model, revision, IMEI, serial number and RSSI.

Table 4.3: list of supported SMS commands.

Note:

Changes of some parameters of the configuration (integer number or string) using **CHANGE THRESHOLD**, **CHANGE APN** and **CHANGE FTP** commands are only temporary. To make new settings permanent you need to send **SAVE RUNTIME** command. Otherwise, after a reboot the system retrieve the previous configuration and new settings are lost. Therefore, **SAVE RUNTIME** command involves a change of the datalogger configuration (see Chapter 11.1).

4.5.3.2 Measurement alarm notification SMS

In order to send SMS to notify the alarm state of a measurement a measurement alarm control (see Chapter 4.2) and one or more telephone numbers must be defined in configuration. If the state of a measurement changes, the SMS transmission process builds a message with the information related to the measurement and sends it to all telephone numbers specified in configuration. SMS text is defined as follows:

Station: <*station name*> Measure: <*measure name*> State: <*state*> Value: <*value*> Threshold: <*threshold*>

Measurement state can be: “NORMAL” in normal state or if measurement goes back to a normal state after an alarm state, “LOW WARNING” in lower warning state, “UP WARNING” in upper warning state, “LOW ALARM” in lower alarm state, “UP ALARM” in upper alarm state, “ACQ ERROR” if measurement value is invalid due to an acquisition error and “OUT OF RANGE” if measurement value is not within the range specified

by the limit set in configuration. Measurement value written in text is the value that cause the change of the state followed by the value of the exceeded threshold (thresholds are set in the measurement alarm control).

4.5.4 Satellite transmission

There are two types of satellite transmission: Iridium and GOES/Meteosat. Records sent by transmission processes are converted from statistical Siap+Micros format to pseudo-binary format. So, the archive defined in the satellite transmission configuration (see Chapters 3.7.3.1 and 3.7.4) must be set in statistical Siap+Micros format.

4.5.4.1 Iridium satellite transmission

Iridium transmission manages two different operating modes: backup transmission and stand-alone transmission. The first operating mode requires an FTP transmission process that send records of the same archive set in the satellite transmission configuration. If an error occurred during FTP transmission, the satellite transmission takes over to send the missing data. The second operating mode is a stand-alone transmission that send records of the specified archive. The Iridium satellite transmitter connected via serial can be powered directly from the serial port terminal block.

4.5.4.2 GOES/Meteosat satellite transmission

GOES/Meteosat satellite transmission process works only as a stand-alone transmission. The datalogger supports the communication via serial port with Microcom GTX 2.0, an integrated satellite data transmitter and datalogger. The power supply must be supplied separately, as it is not managed by the serial port terminal block.

If a satellite transmission is configured it is likely that the internal modem is not installed. So, the datalogger periodically performs a request to the satellite transmitter to read current date and time and update the system time. See Chapter 3.7.4 for clock synchronization settings.

Note:

Microcom GTX must be configured before installation since the datalogger configuration doesn't allow to define initialization commands for Microcom GTX transmitter.

4.5.5 Radio transmission

Radio transmission requires an external radio (such as Satel radio) connected to the datalogger through a serial port. The radio can be powered from the serial port terminal block (see Chapter 2.5 to verify the maximum voltage and current that can be supplied).

Radio transmission process every ten seconds evaluates the formula set in configuration. If the result is zero, power supply is turned off and the serial port is closed. If the formula evaluates to a value other than zero, power supply is enabled and the serial port is opened and the process listens for incoming messages. The holding time (see Chapter 3.7.5) defines a time interval of collected data. If Modbus !LTR command is received (or !LBR and !LKR!, see Chapter 8.3) the datalogger returns all the records recorded in that time interval preceding the request. For example, if holding time is set to 30 minutes and the Modbus data request is received after 17:00 and before 17:30 the datalogger returns records recorded from 16:30 to 17:00. This functionality is supported only for archive configured in statistical Siap+Micros format and ASCII (CSV) format.

4.5.6 Tunnel communication

A tunnel allows to create a direct communication channel with the datalogger using the internal modem. The datalogger responds to Modbus commands (see Chapter 8) encapsulated in TCP packets. This communication channel allows to performs some operations remotely, such as record download, configuration update, firmware update and inspection the status of the datalogger. Moreover, the display can also be driven

and its screen can be read remotely. Therefore, all the information available on the display are accessible remotely.

Bear in mind that setting of connection interval and its duration affect the average power consumption of the datalogger. Moreover, maintaining an active connection for a long time may not be sustainable in conditions of poor signal. Any connection errors cause the immediate disconnection from the server and the session will not be restored until the next activation. The time interval for sending the “keep alive” message must be set in order to keep the connection active. The lack of data exchange for a certain time may cause the connection to be close by the service provider.

If the connection interval is set to zero the tunnel is always enabled. This operating mode is useful for carrying out long operations, such as sending of data with a frequency of less than 5 minutes.

Note:

Firmware update via tunnel communication might require several minutes to complete. Usually, the download of an HEX file from an FTP server is faster. So, if connection is not stable enough the operation might be interrupted. In this case it is recommended to perform the firmware update using other methods.

4.5.7 TCP server

The datalogger exposes a TCP port listening for incoming connections over Ethernet and responds as TCP server. This functionality is similar to tunnel connection, therefore the datalogger responds to Modbus commands (see Chapter 8) encapsulated in TCP packets. Operations can be performed remotely to download records, read and modify the configuration, update the firmware and check the status of the datalogger by downloading its internal diagnostic data. Moreover, the display can also be driven and its screen can be read remotely. Therefore, all the information available on the display are accessible remotely.

4.5.8 Warning for modem usage

Note:

When the transmission interval of a data transmission activity via FTP expires, the internal modem is turned on and then it’s turned off at the end of operations to reduce the datalogger’s power consumption. During startup, the modem checks the APN and connects to the network. Connection time may vary depending on the radio access technology (2G, 3G or 4G) and the quality of the signal. Maximum connection waiting time is configurable (see Chapter 3.2.2). After that, a connection to the configured NTP server is periodically established to read date and time (see Chapter 4.4) Once this phase is completed, data transmission processes to the configured FTP servers are started. For each server a configurable maximum connection time is defined (see Chapter 3.7.1.1). Considering this stream of operation, it is recommended to set a transmission interval not less than 5 minutes in configuration to allow a proper time window for connection and data sending activities.

Warning:

All transmission activities using the internal modem (FTP, SMS and tunnel) are run one at a time and not in parallel. Therefore, a tunnel connection always on does not allow the execution of other transmission activities via internal modem. For example, if a tunnel connection is active, an FTP transmission cannot be performed.

5 File system

The datalogger is equipped with a generic FAT file system to manage and organize data in memory (NOR flash and SD card). When the system starts file system is mounted on NOR flash and main directories are created. To NOR flash memory is assigned the logic unit number 0, so its root directory is "**0:/**". When file system is mounted to SD card (if connected) the logic unit number assigned is 1, so its root directory is "**1:/**".

In the root directory of the file system there are three directories (Figure 5.1):

- **CONFIG**: contains the configuration files of the datalogger.
- **DATA**: contains record data files.
- **VAR**: contains data files that vary during operation.

The following description is only valid for file system mounted on NOR flash memory. SD card is used as backup for data files, so only the **DATA** directory is created.

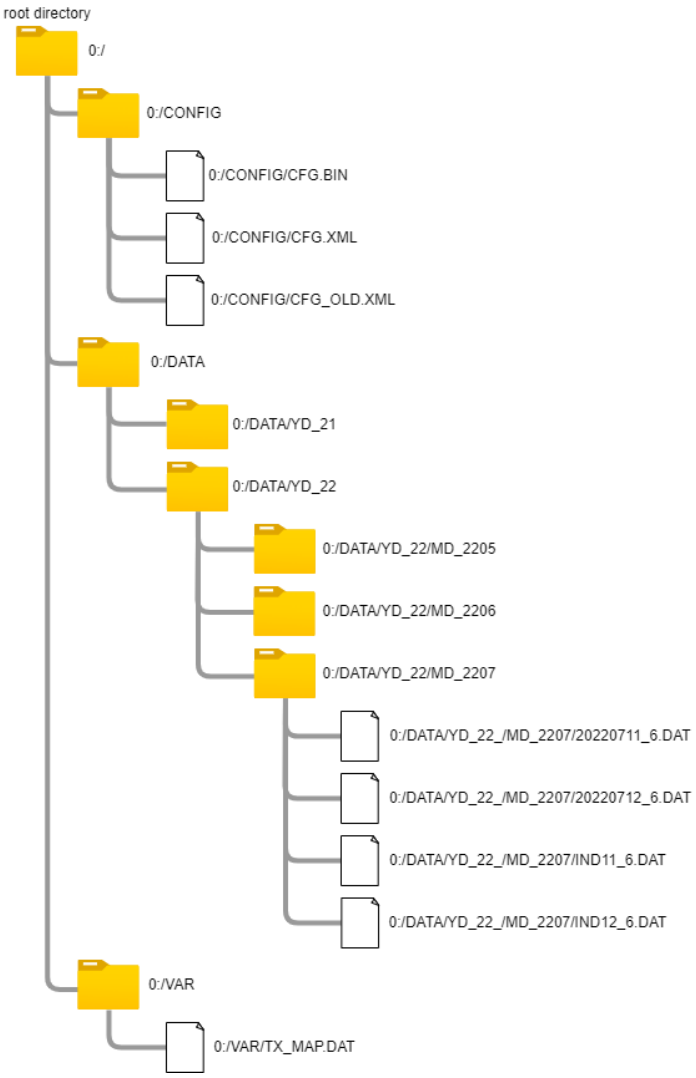


Figure 5.1: organization of files and directories on file system.

5.1 Directory CONFIG

Directory **CONFIG** contains the following configuration files of the datalogger:

- *CFG.XML*: XML file containing the datalogger configuration. It is the file created by the configurator and parsed by the datalogger to build the binary configuration.
- *CFG_OLD.XML*: XML file containing the previous configuration. It is used as a backup if *CFG.XML* file is invalid or not readable. It is created during a configuration update procedure.
- *CFG.BIN*: binary data file containing the datalogger configuration. All information regarding how to run each process is stored in this file.

5.2 Directory DATA

Directory **DATA** contains data files where records are saved in different formats. Files are saved in subdirectories divided by year and month. Year directory is named as follows:

<*root*>/DATA/YD_<*year*>

For example, *0:/DATA/YD_22* is the directory of data recorded in the year 2022 (the year is expressed using two digits). Inside a year directory there are subdirectories for each month in which the datalogger recorded data. Month directory is named as follows:

<*root*>/DATA/YD_<*year*>/MD_<*year*><*month*>

For example, *0:/DATA/YD_22_/MD_2207* is the directory of data recorded in July 2022. Inside a month directory there are daily data files with the following name:

<*root*>/DATA/YD_<*year*>/MD_<*year*><*month*>/<*year*><*month*><*day*>_<*archive*>.DAT

For example, *0:/DATA/YD_22_/MD_2207/20220711_6.DAT* is the name of the data file containing data recorded in archive 6 on 11/07/2022. The number of data file depends on the number of days in which the datalogger recorded data, while the size of the file depend on recording time interval of storage processes and how many measures are saved in the record.

Moreover, inside month directories there are metadata files used by the system to retrieve record during record search operations based on recording date and time. This metadata files are named as follows:

<*root*>/DATA/YD_<*year*>/MD_<*year*><*month*>/IND<*day*>_<*archive*>.IDX

For example, *0:/DATA/YD_22_/MD_2207/IND11_6.DAT* is the metadata files of archive 6 recorded on 11/07/2022.

The system periodically monitors the state of the memory usage of the NOR flash. If the free space available on memory is less than 2Mb (over a total of 16Mb) the system starts deleting oldest data to free at least 2Mb.

Note:

Records saved in instantaneous Siap+Micros format are not written to data files in memory. The archive set with this format contains only one record which is overwritten at each recording interval defined by its storage process. So, on file system there are no data file and metadata files related to that archive.

5.3 Directory VAR

Directory **VAR** contains a file named *TX_MAP.DAT* where data transfer pointers used by FTP transmission processes are saved. Data are written in binary mode and are managed by the system.

6 USB functions

USB port provides two different operating modes:

- Communication device.
- Mass storage.

These functions are mutually exclusive, so before connecting the USB cable you need to set the operating mode. By default, USB port works as communication device. The operating mode can be modified from display menu (see Chapter 7.11.2).

Moreover, USB cable provides 5V voltage useful to power the datalogger. If datalogger is only powered by USB voltage, the system is started in minimal mode without loading the configuration (see Chapter 10).

6.1 Communication device

When working as communication device the USB port appears as virtual COM port used to communicate with the datalogger. By default, from this serial port you can read the logs of the device and monitor the state of the processes. You can communicate with the datalogger using the software program DAK to read data, update the configuration, etc. The datalogger responds to standard Modbus RTU commands and commands defined by Siap+Micros (see Chapter 8). When the serial port is busy communicating with a PC, logs are temporary disabled.

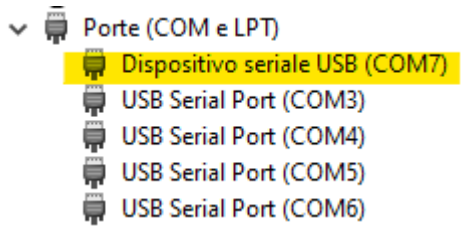


Figure 6.1: virtual COM port loaded by operating system device manager.

6.2 Mass storage

This function allows to load the internal memories of the datalogger (16Mb NOR flash and SD card) as storage devices. Memories are mounted by PC file system and you can browse through the directories and see their contents (configuration files, data files, etc.). See Chapter 5 for description of file system organization.

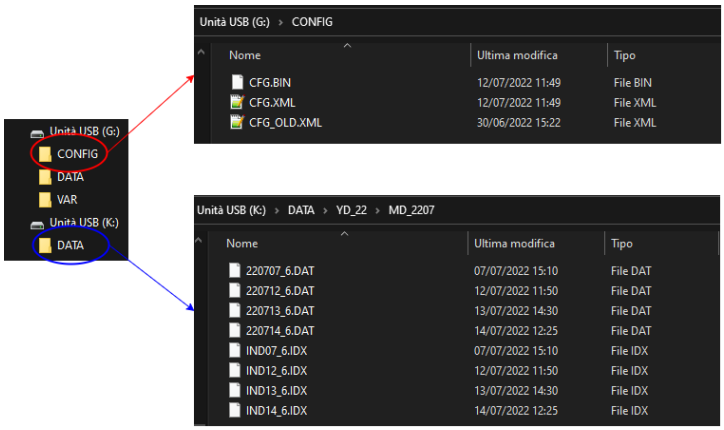


Figure 6.2: internal datalogger memories loaded by PC as storage devices.

Warning:

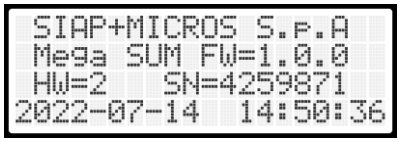
When datalogger memories are mounted by PC file system, the datalogger can't access to its memories. Therefore, all reading and writing operations, such as data recording and record search for transmission, are postponed as long as the memories are mounted by PC file system.

7 Display

The datalogger is equipped with 4x20 character LCD and 5-position joystick (UP, DOWN; RIGHT; LEFT and CENTER) used to browse through the display menus. To turn on the display you need to push any of the joystick buttons. To turn it off you have to push the LEFT button from the start menu. Display stays on as long as joystick is used to browse through menus. If joystick is no longer pressed display remains on for 10 minutes. The following chapters describes all menus in details.

7.1 Start menu

Start menu is the first screen that appears when the display is turned on.



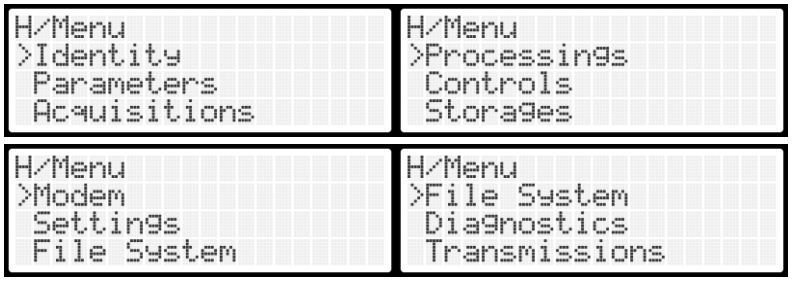
Joystick buttons:

- RIGHT to access the main menu
- LEFT to turn off the display.

Description:

First screen shows the name of the datalogger, firmware version, hardware ID, serial number and date and time of the system.

7.2 Main menu(home)



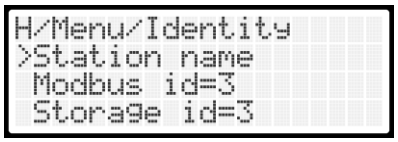
Joystick buttons:

- UP and DOWN to scroll through submenus.
- RIGHT to access to a submenu.
- LEFT to go back to start menu.

Description:

From main menu you can view and access to submenus Identity, Parameters, Acquisitions, Processing, Controls, Storages, Modem, Settings, File System, Diagnostics and Transmissions.

7.3 Identity menu



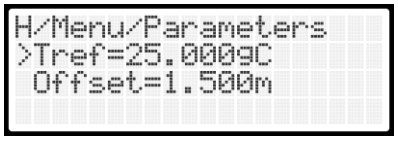
Joystick buttons:

- UP and DOWN to scroll through entries.
- LEFT to go back to main menu.

Description:

Identity menu shows the name of the station and Modbus address and storage ID assigned to datalogger.

7.4 Parameters menu



Joystick buttons:

- UP and DOWN to scroll through parameters.
- RIGHT to change the value of a parameter.
- LEFT to go back to main menu.

From parameter edit screen:

- UP and DOWN to scroll through the characters of a single digit.

- LEFT and RIGHT to scroll through the digits of a number. If cursor il positioned under the leftmost digit, pressing LEFT allows to go back to parameters menu without saving the changes made to the value.
- CENTER to save the new value.

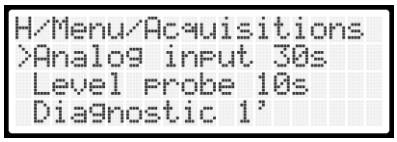
Description:

Lists configuration parameters. For each parameter name, value and unit of measurement are displayed. Example screen shows two parameters: a reference temperature and an offset. Parameter edit screen allows to change the value of a parameter. Blinking cursor indicates the digit you are positioned on.

Note:

Changing parameters value involves a change of the datalogger configuration (see Chapter 11.1).

7.5 Acquisition menu



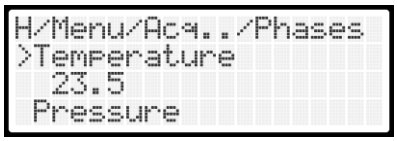
Joystick buttons:

- UP and DOWN to scroll through acquisition processes.
- RIGHT to access to the measurements.
- LEFT to go back to main menu.

Description:

Lists all acquisition processes. For each acquisition the name of the process is displayed. Example screen shows three acquisitions: analog measurements, level probe and diagnostic measurements.

7.5.1 Measurement menu



Joystick buttons:

- UP and DOWN to scroll through measurements.
- RIGHT to request an instant measurement from senor.
- LEFT to go back to acquisition menu.

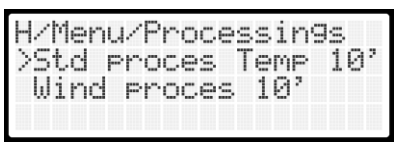
Description:

Lists all measurements configured in an acquisition process. For each measurement the name and value are displayed. Example screen shows two measures: temperature and pressure of a level probe.

Note:

Pressing RIGHT button allows to request an instant measurement from sensor. The new acquired value is updated and displayed in the screen. This functionality is useful during maintenance to check the operation of a sensor (see Chapter 14.1).

7.6 Processing menu



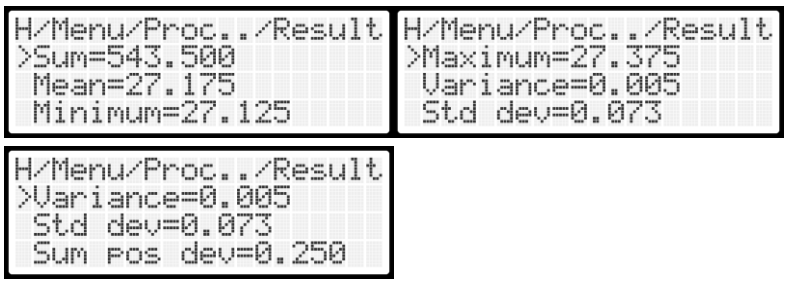
Joystick buttons:

- UP and DOWN to scroll through processing processes.
- RIGHT to access to processing results.
- LEFT to go back to main menu.

Description:

Lists all processing processes. For each processing the name of the process is displayed. Example screen shows two processing: a standard processing of a temperature measurement and a wind processing.

7.6.1 Processing results menu



Joystick buttons:

- UP and DOWN to scroll through results.
- LEFT to go back to processing menu.

Description:

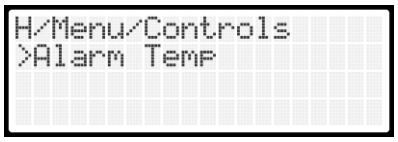
Lists the results of a processing.

Standard processing results displayed are: summation, average, minimum, maximum, variance, standard deviation and positive deviation (see the example screen).

Wind processing results displayed are: average wind direction, average wind speed, wind speed vector, wind direction vector, direction of max speed, maximum wind speed, wind speed standard deviation and wind direction standard deviation.

Rainfall processing results displayed are: instantaneous precipitation, cumulative rainfall in the interval, total precipitation and out of service precipitation.

7.7 Controls menu



Joystick buttons:

- UP and DOWN to scroll through control processes.
- RIGHT to access to control process.
- LEFT to go back to main menu.

Description:

Lists all control processes. For each control the name of the process is displayed. Example screen shows a measurement alarm control of a temperature measurement.

7.7.1 Measurement alarm menu

Joystick buttons:

- LEFT to go back to control menu.

Description:

Displays the state of a measurement. In the example screen the measurement state is upper warning. Possible states are: NORMAL, UP WARNING, LOW WARNING, UP ALARM, LOW ALARM, ACQ ERROR, OUT OF RANGE.

7.8 Storage menu

Joystick buttons:

- UP and DOWN to scroll through storage processes.
- RIGHT to access to storage process data.
- LEFT to go back to main menu.

Description:

Lists all memorization processes. For each memorization the name of the process is displayed. In the example screen three memorizations are shown: a statistical record of a temperature measurement, an alarm record and an instantaneous record.

7.8.1 Record menu

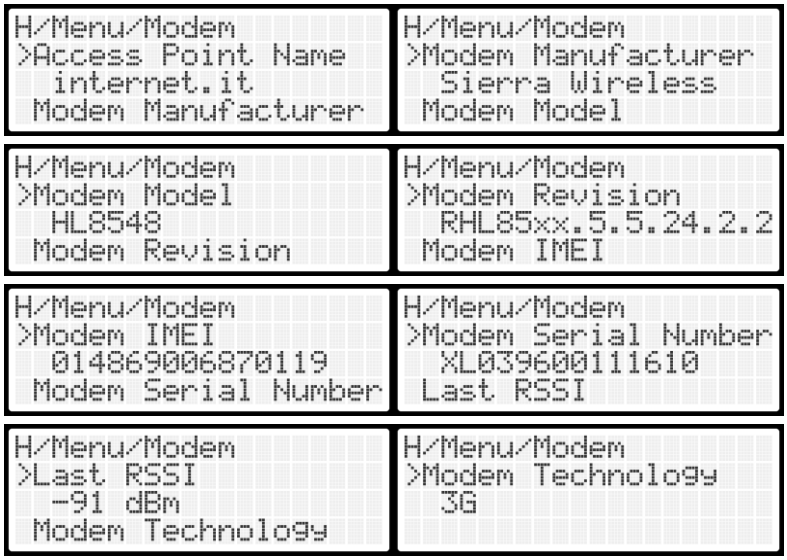
Joystick buttons:

- LEFT to go back to storage menu.

Description:

Lists the name of the measures saved in a record together with archive index and the recording interval. Example screen shows a record written on archive 6 every 10 minutes that contains average, minimum, maximum and standard deviation of a temperature measurement

7.9 Modem menu



Joystick buttons:

- UP and DOWN to scroll through modem information.
- LEFT to go back to main menu.

Description:

Displays the identification information of the internal modem: APN, model, firmware version, IMEI, serial number, last RSSI detected and the technologies of the network to which is connected.

7.10 Transmission menu

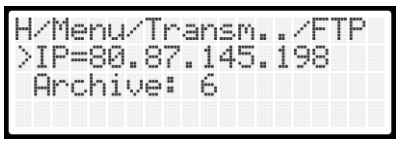
Joystick menu:

- UP and DOWN to scroll through transmission processes.
- RIGHT to access to transmission process data.
- LEFT to go back to main menu.

Description:

Lists all transmission processes. For each transmission the name of the process is displayed. Example screen shows two transmissions: an FTP transmission and an SMS transmission.

7.10.1 Transmission menu



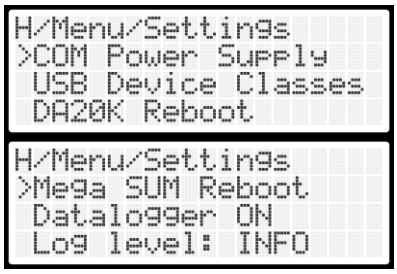
Joystick buttons:

- UP and DOWN to scroll through transmission process data.
- LEFT to go back to transmission menu.

Description:

Displays some configuration information of transmission processes. For an FTP transmission server IP address and archive number are displayed. For an SMS transmission users telephone numbers are displayed. For a satellite transmission time interval packet and archive number are displayed. For a radio transmission the serial port to which the radio is connected is displayed.

7.11 Settings menu



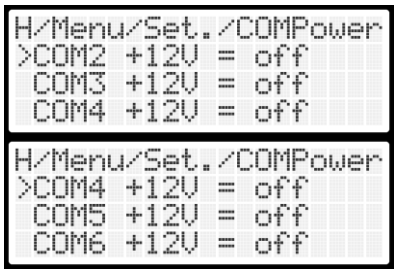
Joystick buttons:

- UP and DOWN to scroll settings menu entries.
- RIGHT to access to a submenu or change a setting.
- LEFT to go back to main menu.

Description:

Lists datalogger settings.

7.11.1 Output power supply menu



Joystick buttons:

- UP and DOWN to scroll through output power supplies.
- RIGHT to change the state of power supply.
- LEFT to go back to settings menu.

Description:

Displays the state of the output power supplies available on serial port block terminals.

Note:

If you turn on one or more power supplies on menu Settings/COM Power Supply they are automatically turned off when the display is turned off. Pressing RIGHT button allows to change the state of a power supply only if there are no other system task that are using that power supply. If power supply is already on, because it is used for example by an acquisition process, the attempt to change its state won't do anything. In this case you have to wait for the acquisition to be completed. Therefore, if a power supply is configured to be always on you cannot change its state from display menu since it is always used by another process.

7.11.2 USB function menu

Joystick buttons:

- UP and DOWN to scroll through menu entries.
- RIGHT to change the state of a setting.
- LEFT to go back to settings menu.

Description:

Displays the state of the USB connection and the selected operating mode.

“Class” shows the operating mode:

- “Comm. Device”: communication device (virtual COM port).
- “Mass Storage”: mass storage, mount the datalogger internal memories.

“USB connection” shows the state of the connection:

- “off”: USB cable not connected.
- “on”: USB cable connected.

7.11.3 System reboot

Joystick buttons:

- RIGHT to reboot the system.

Description:

Press RIGHT button to start a safe reboot procedure of the system.

7.11.4 Disable datalogger functions

Joystick buttons:

- RIGHT to change the state of datalogger functions.

Description:

Press RIGHT button to disable the datalogger functions. “ON” means all functions are running, “OFF” means that all functions are not active. Functions disabling is temporary and lasts up to 1 hour.

7.11.5 Log level setting

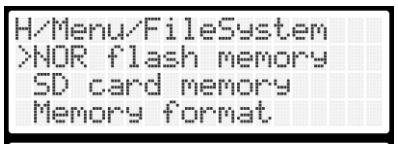
Joystick buttons:

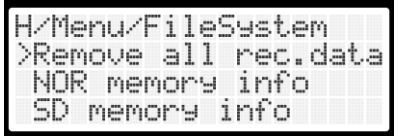
- RIGHT to change the log level.

Description:

Press RIGHT button to change the minimum log level.

7.12 File system menu





Joystick buttons:

- UP and DOWN to scroll through menu entries.
- RIGHT to access to a submenu or start an operation.
- LEFT to go back to main menu.

Description:

Lists datalogger storage devices and allows to start advanced operation on memory devices.

7.12.1 NOR flash memory menu

Joystick buttons:

- UP and DOWN to scroll through file and directories.
- RIGHT to access to a directory.
- LEFT to go back to the parent directory up to file system menu.
- CENTER to select a file or directory.

From within a memory device:

- UP and DOWN to scroll through available operations.
- RIGHT to start an operation.
- LEFT to go back.

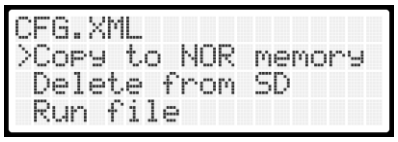
Description:

Accesses to NOR flash memory file system and you can browse through files and directories. First example screen displays the content of the root directory. You can select a file or directory to copy and delete it. Deleting a directory removes also all its contents. Second example screen displays the operation available on a selected file or directory.

7.12.2 SD card memory menu

Joystick buttons:

- UP and DOWN to scroll through file and directories.
- RIGHT to access a directory.
- LEFT to go back to the parent directory up to file system menu.
- CENTER to select a file or directory.



From within a memory device:

- UP and DOWN to scroll through available operations.
- RIGHT to start an operation.
- LEFT to go back.

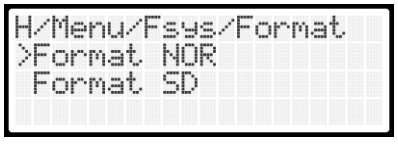
Description:

Accesses to SD card memory file system and you can browse through files and directories. First example screen displays the content of the root directory. You can select a file or directory to copy and delete it. Deleting a directory removes also all its contents. Second example screen displays the operation available on a selected file or directory. From SD card you can run file with XML extension to start a configuration update and file with HEX extension to start a firmware update.

Note:

Copy, delete and run operations may fail. If the operation is successfully completed message "*Copy/Delete/Run successfully*" is displayed, otherwise error message "*Copy/Delete/Run error*" is displayed. Running an HEX file to update the firmware might take few minutes to complete.

7.12.3 Memory format menu



Joystick buttons:

- UP and DOWN to scroll through menu entries.
- RIGHT to run an operation.
- LEFT to go back to file system menu.

Description:

Formats datalogger memory devices. Press RIGHT button to start formatting a memory. After first pressing a message (“Are you sure?”) will be displayed to confirm the operation. Press RIGHT button again to confirm and start the operation.

7.12.4 Record data deletion

Joystick button:

- RIGHT to start data deletion.

Description:

Deletes all data recorded and empties archive cache memories. DATA directory will be empty after the operation. Press RIGHT button to start data deletion. After first pressing a message (“Are you sure?”) will be displayed to confirm the operation. Press RIGHT button again to confirm and start the operation.

7.12.5 Memory usage

Joystick buttons:

- UP and DOWN to scroll menu entries.
- LEFT to go back to file system menu.

Description:

Shows the memory usage of datalogger storage devices. Example screen displays NOR flash memory usage in Mb and percentage usage with respect to total available space.

7.13 Diagnostic data menu

Joystick buttons:

- UP and DOWN to scroll through diagnostic data.
- LEFT to go back to main menu.

Description:

Displays datalogger diagnostic data: battery voltage, photovoltaic voltage, battery charge current and internal temperature.

8 Modbus RTU commands

The datalogger responds to Modbus RTU commands. Three public function codes and one user-defined function code are supported:

- Function code 3 (0x03): read holding registers.
- Function code 4 (0x04): read input registers.
- Function code 16 (0x10): write multiple registers.
- Function code 65 (0x41): Siap+Micros commands.

Values allowed for address (first byte according to Modbus protocol) are in the range 1-247 and 255 (hex code 0x01-0xF7 and 0xFF). Value 255 is used to specify a broadcast message. So, the datalogger responds to a Modbus message if the address specified in the message is equal to the datalogger Modbus ID (see Chapter 3.2.1), or equal to 255.

8.1 Read Holding Registers and Read Input Registers

As described in Chapter 3.8, the datalogger has 300 registers where parameters, acquired measure and processing results are saved. Registers are identified by an index from 1 to 300 e contain 4-byte floating point numbers.

Read Holding Registers and Read Input Registers function codes are used to read data from datalogger memory locations (both functions respond in the same way). Since in Modbus protocol register size is 2 bytes, each datalogger memory location is mapped to 2 Modbus registers (see Figure 8.1). Therefore, to read a memory location you have to read two Modbus registers starting from register

$$R_{modbus} = R_{da} \times 2 - 1,$$

where R_{modbus} is the Modbus register to be specified in Modbus request and R_{da} is the datalogger register to be read. Bear in mind that based on Modbus protocol registers are addressed starting at zero, so this explains the “-1” in the formula.

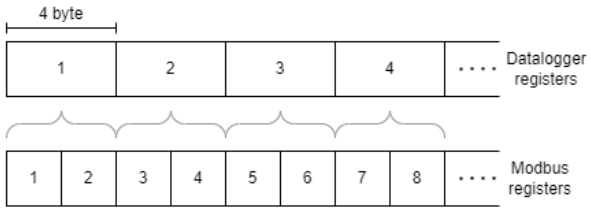


Figure 8.1: datalogger registers mapped to Modbus registers.

Syntax of request command and corresponding responses are complaint to Modus protocol specification (see Table 8.1).

Request

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	3 – 4
Starting address	2 bytes	2 – 600
Number of registers (N)	2 bytes	1 – 125
CRC	2 bytes	checksum

Response

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	3 – 4
Byte count	1 byte	2xN byte
Register value	2xN byte	values
CRC	2 bytes	checksum

Table 8.1: syntax of request command and corresponding responses to Modbus read holding registers and read input registers.

For example, let's read register 1 containing value 10.5 from a datalogger with Modbus address 3. The Modbus register to be specified in the request message is 19 ($10 \times 2 - 1$). Modbus request and response are shown below in hex format (in this case Read Holding Registers function is used):

Request	03	03	00	13	00	02	34	2C	
Response	03	03	04	00	00	41	28	E9	BD

8.2 Write Multiple Registers

Write Multiple Registers function code is used to write a block of contiguous registers. Syntax of Modbus request and corresponding response are complaint to Modus protocol specification (see Table 8.2).

Request

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	16
Starting address	2 bytes	2 – 600
Number of registers (N)	2 bytes	1 – 123
Byte count	1 byte	2xN
Register values	2xN byte	values
CRC	2 bytes	checksum

Response

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	16
Starting address	2 bytes	2 - 600
Quantity of registers	2 bytes	1 - 123
CRC	2 bytes	checksum

Table 8.2: syntax of request command and corresponding responses to Modbus Write Multiple Registers.

For example, let's write value 10.75 to register 1 to datalogger with Modbus address 3. Modbus request and response are shown below in hex format:

Request	03	10	00	01	00	02	04	00	00	41	2C	08	56
Response	03	10	00	01	00	02	11	EA					

Note:

All memory locations are writable, no matter if they contain a parameter or an acquired measurement. Memory locations reserved for measurements are updated and managed by datalogger processes, therefore any write operation to these registers is temporary. It is not advisable to write to these registers since they are memory location managed the datalogger and may cause error in datalogger operations.

8.3 Siap+Micros function code

Siap+Micros commands are defined by function code 65 (0x41). Syntax of request command and corresponding response are described in Table 8.3.

Request

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	65

Response

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function code	1 byte	65

Byte count	2 bytes	0 - 1018 (N)
Command	N byte	command
CRC	2 bytes	checksum

Byte count	2 bytes	0 – 1018 (N)
Response	N byte	response
CRC	2 bytes	checksum

Table 8.3: syntax of request command and corresponding responses to Siap+Micros Modbus command.

Note:

The datalogger allocates a 1Kb (1024 bytes) buffer to respond to Modbus commands, so the PDU is limited by the buffer size to 1018 bytes (1 byte of Modbus address, 1 byte of function code, 2 bytes for byte count and 2 bytes of CRC).

PDU of Siap+Micros commands contain the size of the command (expressed in bytes) and the ASCII command. The list of commands and corresponding responses are described in Table 8.4. The implementation is compatible with the previous versions of Siap+Micros datalogger.

COMMAND	RESPONSE
R IDSTAZ	IDSTAZ <*id*>

Description:

Reads datalogger Modbus address (<*id*>).

COMMAND	RESPONSE
W IDSTAZ=<*id*>	IDSTAZ <*id*>

Description:

Writes datalogger Modbus address. <*id*> is the new address to be written.

COMMAND	RESPONSE
R ID_MEM	ID_MEM <*im*>

Description:

Reads datalogger storage identifier (<*im*>).

COMMAND	RESPONSE
W ID_MEM=<*im*>	ID_MEM <*im*>

Description:

Writes datalogger storage identifier. <*im*> is the new identifier to be written.

COMMAND	RESPONSE
Read mode: CLK Write mode: CLK <*hh*> <*mm*> <*ss*> <*DD*> <*MM*> <*YY[YY]*>	<*hh*> <*mm*> <*ss*> <*DD*> <*MM*> <*YY[YY]*>

Description:

Reads or writes system date and time.

- <*hh*>=hour
- <*mm*>=minutes
- <*ss*>=seconds
- <*DD*>=day
- <*MM*>=month

- <*YY[YY]*>=year

COMMAND	RESPONSE
!FW	MegaSUM: <*major*>.<*minor*>.<*build*>, Modem: ”<*model*>” ”<*revision*>” ”<*imei*>”, AppBLE: <*major*>.<*minor*>

Description:

Returns datalogger firmware version, modem identification information and BLE App version.

COMMAND	RESPONSE
RESET MICROS	RESET MICROS

Description:

Requests a system reboot.

COMMAND	RESPONSE
!TW	Terminating Watchdog

Description:

Internal watchdog is suspended. After 60 seconds the system is rebooted.

COMMAND	RESPONSE
!IM <*n*> <*ind*>	<*val 1*> <*val 2*> … <*val n*>

Description:

Reads <*n*> memory locations starting from address <*ind*>.

COMMAND	RESPONSE
!WA <*n*> <*ind 1*> <*val 1*> <*ind 2*> <*val 2*> … <*ind n*> <*val n*>	No response

Description:

Writes <*n*> memory locations starting from <*ind 1*> to <*ind n*>.

COMMAND	RESPONSE
!RP <ind>	<*val*>

Description:

Reads value of the configuration parameter saved at address <*ind*>.

COMMAND	RESPONSE
!WP <*ind*> <*val*>	<*val*>

Description:

Sets the value <*val*> to the configuration parameter saved at address <*ind*>.

COMMAND	RESPONSE
!PR <*file*> <*YYYY_1*> <*MM_1*> <*DD_1*> <*hh_1*> <*mm_1*> <*ss_1*> [<*YYYY_2*> <*MM_2*> <*DD_2*> <*hh_2*> <*mm_2*> <*ss_2*>]	<*data*>

Description:

Looks for records in an archive at a specific date. If only one date is specified the data pointer is set to read from the corresponding data file according to the specified date. If both dates are specified, the data pointer is set to read data file between first and second date.

- <*file*>: archive index (1-6).
- <*YYYY_1*> <*MM_1*> <*DD_1*> <*hh_1*> <*mm_1*> <*ss_1*>: beginning date defined as year, month, day, hour, minutes and seconds (hour, minutes and seconds are not used in the record search, set them to zero).
- <*YYYY_2*> <*MM_2*> <*DD_2*> <*hh_2*> <*mm_2*> <*ss_2*> (optional): ending date defined as year, month, day, hour, minutes and seconds (hour, minutes and seconds are not used in the record search, set them to zero).

COMMAND	RESPONSE
!RD <*file*> 1 <*num bytes*>	<*data*>

Description:

Reads a generic data file.

- <*file*>: 0 to read the configuration file (CFG.XML), 1-6 to read from archives, 253 to read system statistics file. For archives data file must be specified by a previous !PR command. If the archive contains data recorded in Siap+Micros instantaneous format, only the last record is read.
- <*num bytes*>: number of 200-byte packets.

COMMAND	RESPONSE
!RE 0 1	No response

Description:

Sets the data pointer to send the configuration file CFG.XML.

COMMAND	RESPONSE
!RS <*file*> 1	No response

Description:

Updates data pointer. !RS command follows !RD command to confirm the number of bytes previously read from file.

COMMAND	RESPONSE
R _FILE0	_FILE0 <*dim*>

Description:

Returns the maximum size of configuration file CFG.XML in Kb.

COMMAND	RESPONSE
!FR 0	<*dim*>

Description:

Returns the difference between maximum size and current size of configuration file CFG.XML.

COMMAND	RESPONSE
!WR <*file*> <*data*>	No response

Description:

Writes a generic file.

- <*file*>: 0 to write a new configuration file, 255 to write a file with .HEX extension.
- <*data*>: data to be written to file.

COMMAND	RESPONSE
!WRB <*file*> <*pointer*> <*data*>	No response

Description:

Writes a generic file specifying a data writing pointer.

- <*file*>: 0 to write a new configuration file, 255 to write a file with .HEX extension.
- <*data*>: data to be written to file.

COMMAND	RESPONSE
!DTR <*file*> <*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>	<*data*>

Description:

Reads from an archive the record at specific date and time. Response contains the record in the format specified for that archive. If a radio transmission process is defined in configuration, this command returns the record at the specified date and time and last N records according to the holding time defined in the radio process. (see Chapter 3.7.5). This functionality is available only for records saved in Siap+Micros statistical format and ASCII (CSV) format.

- <*file*>: archive index (1-6).
- <*YYYY*>: year.
- <*MM*>: month.
- <*DD*>: day.
- <*hh*>: hour.
- <*mm*>: minutes.
- <*ss*>: seconds.

COMMAND	RESPONSE
!DBR <*file*> <*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>	<*data*>

Description:

Reads from an archive the record at specific date and time. Response contains the record in binary format. If a radio transmission process is defined in configuration, this command returns the record at the specified date and time and last N records according to the holding time defined in the radio process. (see Chapter 3.7.5). Records can be converted to binary format only from Siap+Micros statistical format, so the archive specified in !DBR command must contain data in this format.

- <*file*>: archive index (1-6).
- <*YYYY*>: year.
- <*MM*>: month.
- <*DD*>: day.
- <*hh*>: hour.
- <*mm*>: minutes.
- <*ss*>: seconds.

COMMAND	RESPONSE
!DKR <*file*> <*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>	<*data*>

Description:

Reads from an archive the record at specific date and time. Response contains the record in compressed binary format. If a radio transmission process is defined in configuration, this command returns the record at the specified date and time and last N records according to the holding time defined in the radio process. (see Chapter 3.7.5). Records can be converted to compressed binary format only from Siap+Micros statistical format, so the archive specified in !DKR command must contain data in this format.

- <*file*>: archive index (1-6).
- <*YYYY*>: year.
- <*MM*>: month.
- <*DD*>: day.
- <*hh*>: hour.
- <*mm*>: minutes.
- <*ss*>: seconds.

COMMAND	RESPONSE
!LTR <*file*> [<*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>]	<*data*>

Description:

Returns the last record saved in the specified archive. If a radio transmission process is defined in configuration, this command returns last N records according to the holding time defined in the radio process (see Chapter 3.7.5). This functionality is available only for records saved in Siap+Micros statistical format and ASCII (CSV) format. Optionally date and time can be defined to update datalogger system time.

- <*file*>: archive index (1-6).
- <*YYYY*> (optional): year.
- <*MM*> (optional): month.
- <*DD*> (optional): day.
- <*hh*> (optional): hour.
- <*mm*> (optional): minute.
- <*ss*> (optional): seconds.

COMMAND	RESPONSE
!LBR <*file*> [<*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>]	<*data*>

Description:

Returns the last record saved in the specified archive in binary format. If a radio transmission process is defined in configuration, this command returns last N records according to the holding time defined in the radio process (see Chapter 3.7.5). Records can be converted to binary format only from Siap+Micros statistical format, so the archive specified in !LBR command must contain data in this format. Optionally date and time can be defined to update datalogger system time.

- <*file* archive index (1-6).
- <*YYYY*> (optional): year.
- <*MM*> (optional): month.
- <*DD*> (optional): day.
- <*hh*> (optional): hour.
- <*mm*> (optional): minutes.
- <*ss*> (optional): seconds.

COMMAND	RESPONSE
!LKR <*file*> [<*YYYY*> <*MM*> <*DD*> <*hh*> <*mm*> <*ss*>]	<*data*>

Description:

Returns the last record saved in the specified archive in compressed binary format. If a radio transmission process is defined in configuration, this command returns last N records according to the holding time defined in the radio process (see Chapter 3.7.5). Records can be converted to compressed binary format only from Siap+Micros statistical format, so the archive specified in !LKR command must contain data in this format. Optionally date and time can be defined to update datalogger system time.

- <*file*>: archive index (1-6).
- <*YYYY*> (optional): year.
- <*MM*> (optional): month.
- <*DD*> (optional): day.
- <*hh*> (optional): hour.
- <*mm*> (optional): minutes.
- <*ss*> (optional): seconds.

COMMAND	RESPONSE
JOY U/D/L/R/P/G	<display screen>

Description:

Simulates joystick buttons to remotely drive the display. JOY command is followed by a letter:

- U: press UP joystick button.
- D: press DOWN joystick button.
- L: press LEFT joystick button.
- R: press RIGHT joystick button.
- P: press CENTER joystick button.
- G: update current screen.

Returns a string containing display screen with the following format:

- Display on:
  "N<*CR*><*LF*><*first_row*><*CR*><*LF*><*second_row*><*CR*><*LF*><*third_row*><*CR*><*LF*><fourth_*row*>"
- Display off:
  "F<*CR*><*LF*><*first_row*><*CR*><*LF*><*second_row*><*CR*><*LF*><*third_row*><*CR*><*LF*><*fourth_row*>"
- Display in parameter editing mode:
  "<*row_number*><*column_number*><*CR*><*LF*><*first_row*><*CR*><*LF*><*second_row*><*CR*><*LF*><*third_row*><*CR*><*LF*><*fourth_row*>", where row number is expressed with one digit and column number is expressed in two digits.

COMMAND	RESPONSE
SYS STAT	SYS STAT OK SYS STAT KO

Description:

Writes a file containing system statistics and saves it to memory. After that this file can be read using !RD and !RS commands specifying the identifier 253. Upon completion the file is deleted from memory. If file is successfully written in memory response is “SYS STAT OK”, otherwise “SYS STAT KO”.

COMMAND	RESPONSE
RESET STAT	No response

Description:

Resets datalogger system statistics.

COMMAND	RESPONSE
LOG START <*level*> <*chunks*>	No response

Description:

Starts recording logs to file. Parameter <*level*> specifies log verbosity level according to the following values:

- 0: no log
- 1: only error log

- 2: warning and error log
- 3: info, warning and error log
- 4: debug, info, warning and error log

Parameter <*chunks*> specifies how many blocks of log data to write to the file, where each block has a size of 20Kb. For example, setting <*chunks*>=3 a log file of about 60Kb will be written.

COMMAND	RESPONSE
LOG DELETE	No response

Description:

Deletes log file if any.

Table 8.4: description of Siap+Micros ASCII commands.

Note:

Write Multiple Registers, **!WP**, **W IDSTAZ** and **W ID_MEM** commands involve a change of the datalogger configuration (see Chapter 11.1).

8.4 Modbus error codes

If an error occurred during reception or reading of a Modbus command, the datalogger responds with an error message according to the Modbus protocol (see Table 8.5). Exception codes are described in Table 8.6.

Field	*Size*	*Value*
ID Modbus	1 byte	1 – 247, 255
Function	1 byte	Function code + 0x80
Exception code	1 byte	1, 2, 3
CRC	2 bytes	checksum

Table 8.5: syntax of exception responses.

Field	*Size*	*Value*
1	Illegal function	Function code not supported
2	Illegal data address	Memory address not valid
3	Illegal data value	A value contained in the query data field is not an allowable value

Table 8.6: Modbus exception code.

9 Wi-Fi & Bluetooth module

MegaSUM is equipped with a Wi-Fi & Bluetooth Low energy (BLE) module that can be loaded with two different firmware versions, each implementing a distinct operating mode: BLE application and Wi-Fi Web Server.

9.1 BLE application

The device broadcasts a BLE signal identified as “MegaSUM-BLE”, which can be detected and connected to by other devices. Using the *MegaSUM BLE* Android app[3] on a smartphone or tablet, it is possible to establish the connection and communicate with the datalogger.

To reduce overall power consumption, the Wi-Fi & Bluetooth module is turned on for 18 seconds every 2 minutes (18 seconds on and 102 seconds off). The Bluetooth connection is discoverable only during the time window when the module is active. Once the app is connected to the datalogger, the module remains active and will be turned off only when the app disconnects.

The main functionalities of the application are:

- Reading and editing the configuration.
- Reading acquired measurements and displaying data through graphs.
- Downloading data records.
- Display simulation.
- Viewing system log.

The application is not available on store yet. Please contact Siap+Micros to install the application on your personal devices.

9.2 Wi-Fi Web Server

The device broadcasts a Wi-Fi network with the name defined in the configuration (see Chapter 3.2.6) and hosts an HTTPS web server available at https://megasum.local (via mDNS resolution). Alternatively, the device's IP address can be used. The interface uses a WebSocket channel for real-time updates (status, logs, activity progress) without having to reload the page. On the client side, messages are displayed in the GUI (progress bar, status labels, and log area). All major modern browsers are supported. The main features are described below.

9.2.1 General information

Datalogger general information are listed in this page (Figure 9.1): name of the station, storage ID, Modbus ID, serial number, hardware ID, fw version and sw version.

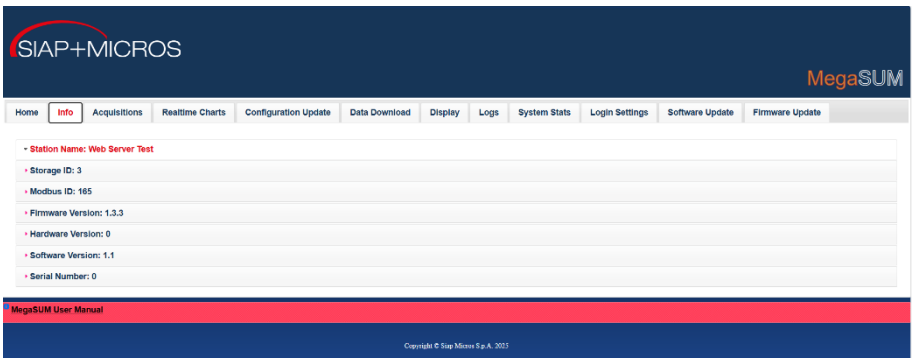


Figure 9.1: web page showing datalogger general information.

[3] The application has been tested on Android OS up to version 13.

9.2.2 Acquisition

The acquire measures of the station are displayed. Press the *Refresh* button to update the data with the last acquired value (Figure 9.2).

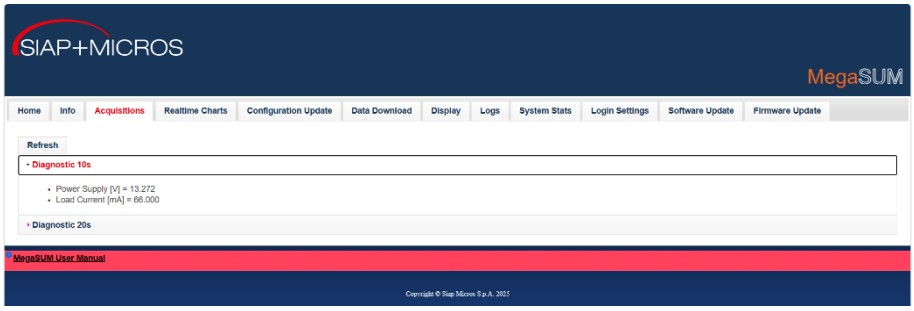


Figure 9.2: web page showing the acquired measure.

9.2.3 Real-time charts

You can view the acquired measurements over time through graphs. Each graph updates automatically at the acquisition rate defined during the configuration of the individual measurement (Figure 9.3).

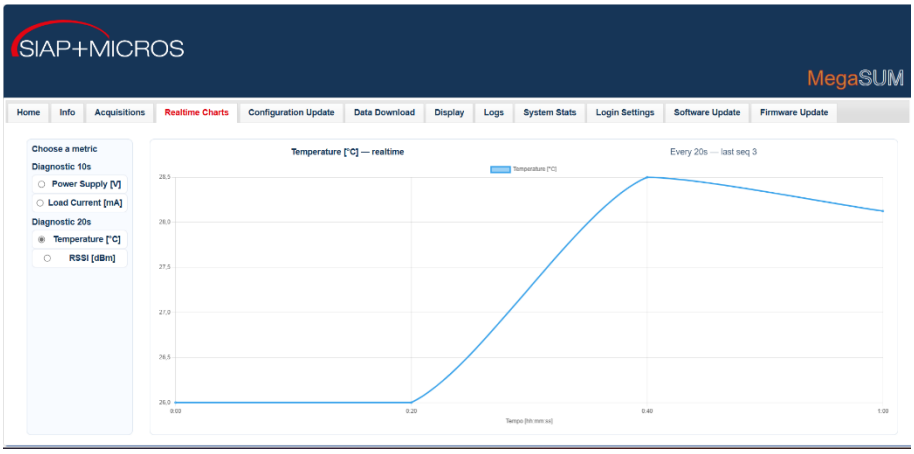


Figure 9.3: web page showing real-time charts.

9.2.4 Configuration update

This page allows you to load a new datalogger configuration file (Figure 9.4). File must be in XML format and can be created using DAK software (see Chapter 15).

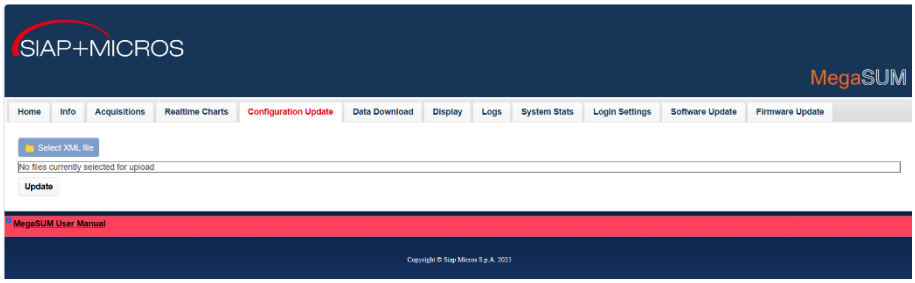


Figure 9.4: web page to run datalogger configuration update.

9.2.5 Data download

On this page, you can download the recorded data for a specific date range. Simply define the start and end date, the archive number and the file name to save the data (Figure 9.5).

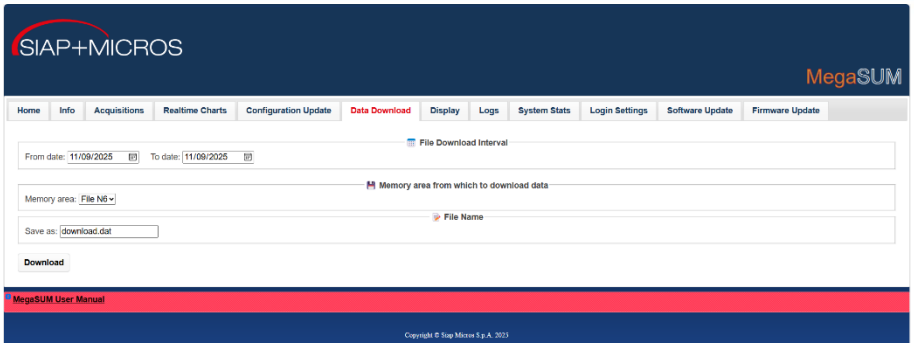


Figure 9.5: web page to download datalogger data.

9.2.6 Display

This page provides an interface that replicates the datalogger's display screen. Using the virtual buttons, you can turn the display on and off, browse the display menus to view all the available information, change settings and modify the value of the parameters (Figure 9.6).

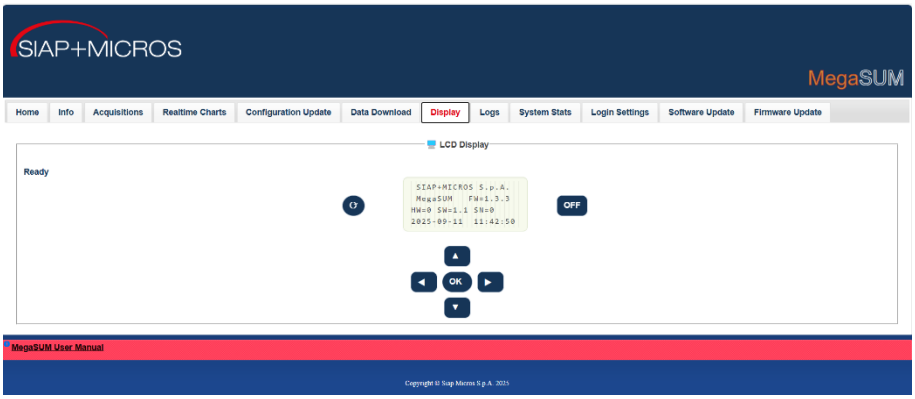


Figure 9.6: web page showing the datalogger display.

9.2.7 Log view

This page allows you to view the datalogger logs in real time. The following buttons are present:

- Start: start log view.
- Stop: stop log view.
- Clear: clear the screen
- Download: download the logs viewed on the page to a file.

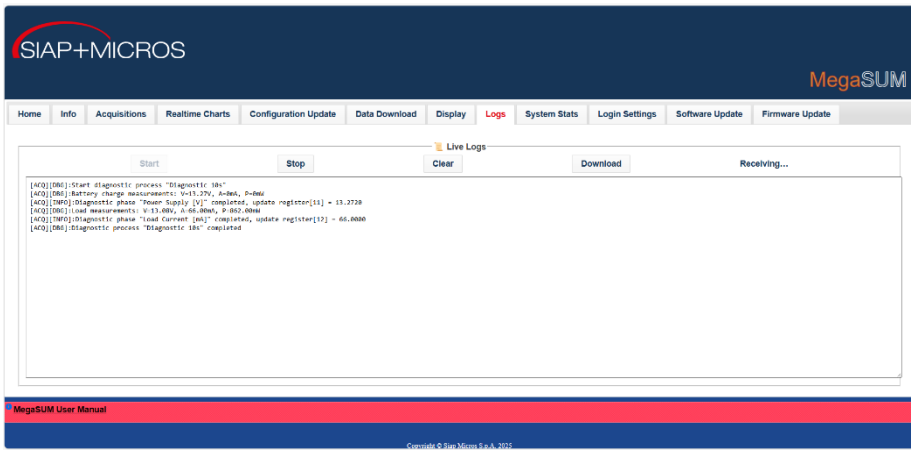


Figure 9.7: web page to view datalogger logs.

9.2.8 System statistics

This page shows all the system statistics of the datalogger.

9.2.9 Login settings

On this page, you can modify the web server login credentials. The default settings are:

- Username: admin
- Password: admin01

9.2.10 Software update

On this page, you can start the web server software update. The update procedure is performed in pull mode: the device downloads the firmware device from the URL entered by the user in the appropriate field an starts the OTA update.

Field and requirements:

- Firmware URL: enter the full (HTTP/HTTPS) URL of the file to download, e.g. http://192.168.1.10/firmware.bin. The URL must start with http. Otherwise, the page will block invalid values. The IP address in the URL refers to the server hosting the firmware.bin file (a local PC or a network server), not the IP address of the device.
- The file must be named firmware.bin (this is the compiled binary file to be uploaded to the Wi-Fi & Bluetooth module).
- Authentication: to start the OTA update procedure, you must be authenticated. The endpoint then verifies the credential before proceeding.

Update procedure description:

- Open the *Software update* page.
- Enter the URL of the firmware.bin file in the appropriate field.
- Press *Start OTA*: the page sends a request to /api/ota and displays the status (“Starting OTA… / OTA started”).
- Wait for the operation to complete: the device downloads the file and starts the update. Do not power off the device or close the page during the procedure.

Note:

If the file is hosted on a local PC, make sure the PC is on the same network as the device and that any firewalls allow the HTTP/HTTPS access (for example, hosts the file at http://<IP_PC>:8080/firmware.bin). If the URL is invalid, the page will display an error before sending the request.

9.2.11 Firmware update

On this page, you start the datalogger firmware update:

- Press *Select HEX file* button and select the .hex file.
- Press *Upload* button to send the hex file to the Wi-Fi & Bluetooth module. A progress bar will give the user and indication of the progress of the operation.
- Once the sending operation is completed, the firmware is transferred to the datalogger. The status of this operation is also indicated by the progress bar and the estimated remaining time in mm:ss format.
- If the process completes successfully, the progress bar reaches 100% and a completion message is displayed. In case of an error, the Log area shows the details (e.g., invalid file or connection lost).

Note:

During the update procedure do not power off the device or close the page.

10 Datalogger operating mode

The datalogger provides two operating modes:

- Normal operating mode.
- Minimal operating mode if powered by 5V USB port.

In normal operating mode the datalogger is powered by rechargeable battery, external power supply or auxiliary power supply. Analog and digital components of the board are powered, configuration is loaded and processes start to run.

In minimal mode the datalogger is only powered by 5V USB port and so only low power circuits are on. Configuration is not loaded as not all functionalities are available, therefore no processes are running. In this case USB port works as a virtual COM port as described in Chapter 6.1 and the user can communicate with the datalogger, for example to load a configuration.

11 Configuration management and update

The datalogger saves the *CFG.XML* configuration file in **CONFIG** directory in NOR flash memory (see Chapter 5.1). At the first start XML file is parsed and configuration is loaded in RAM as data binary structure which is saved in *CFG.BIN* file in the same directory. It is used to make configuration loading faster in subsequent startups. To avoid losing a valid configuration there are two backup levels available (see Figure 11.1). Previous XML configuration file is kept in **CONFIG** directory with name *CFG_OLD.XML*. Moreover, XML file of current configuration is saved in microcontroller flash memory. Both files are updated following a configuration update procedure. Upon startup the datalogger carries out the following operations to load the configuration:

1. Load configuration from *CFG.BIN* file.
2. If reading *CFG.BIN* file fails, configuration is loaded from *CFG.XML* file.
3. If reading *CFG.XML* fails, configuration is loaded from *CFG_OLD.XML* file.
4. If reading *CFG_OLD.XML* fails, the datalogger checks if a configuration file is baked up in microcontroller flash memory and try to restore the binary configuration.

The situation described in point 4 occurs in following cases: if NOR flash memory has been formatted, if **CONFIG** directory has been deleted or if configuration files are corrupted and so not readable by file system.

There are two methods to update the configuration: by updating XML file and by modifying binary configuration.

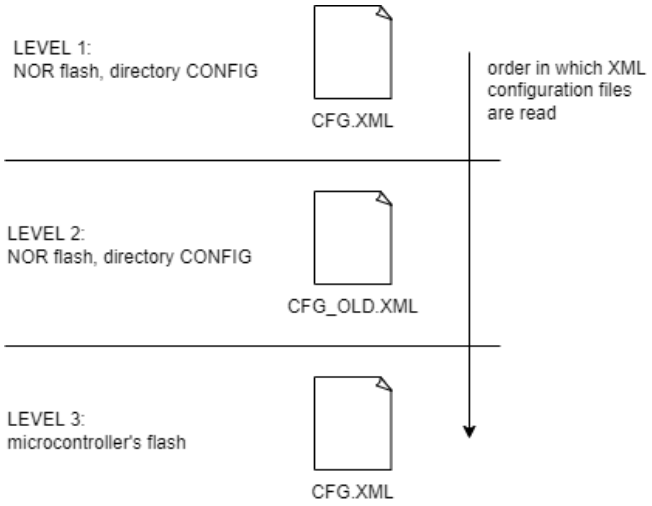


Figure 11.1: backup and management of the datalogger configuration.

There are three methods to update the XML configuration file:

- Download via FTP from a remote server (see Chapter 4.5.1.1).
- Copying a configuration file from SD card using display (see Chapter 7.12.1).
- Download via Modbus commands, for example through serial port or tunnel connection (see Chapter 8.3).

New configuration file replaces the current one which is renamed as *CFG_OLD.XML* and previous *CFG_OLD.XML* file is deleted. A this point the system is rebooted and new configuration is loaded. A new configuration data binary structure is created and saved in *CFG.BIN* file which replaces the previous one.

11.1 Updating binary configuration

Binary configuration can be changed by three methods:

- Changing the value of a parameter via display (see Chapter 7.4).
- Changing one or more processes parameters via SMS commands, e.g. FTP parameters, APN and measurement alarm thresholds (see Chapter 4.5.3.1).

- Changing the value of a parameter or datalogger identification data via Modbus command (see Chapter 8.3).

Following a change of binary configuration, *CFG.BIN* file is overwritten with the new binary configuration, *CFG.XML* file is renamed as *CFG_OLD.XML* (the previous one is deleted) and a new *CFG.XML* file created. In this case the system is not rebooted.

Note:

Changing binary configuration involves the update of configuration files in file system. Therefore, continuous changes to binary configuration involves a lot of write operations to flash memory.

11.2 Restore previous configuration

If current configuration is not correct or doesn't fit the user needs, previous configuration can be restored by deleting *CFG.XML* and *CFG.BIN* files and then reboot the system. These operations can be carried out from File System and Settings menus of the display (see Chapter 7.12 and 7.11). After system reboot configuration is loaded from CFG_OLD.XML file as described in Chapter 11. This configuration recovery operation could be useful in case current configuration has erroneous settings which make the station impossible to be reached remotely (for example due to a wrong APN). Moreover, there is no need to load a new configuration from SD card.

12 Firmware update

There are three methods to update the datalogger firmware:

- Download of a HEX file via FTP from a remote server (see Chapter 4.5.1.1).
- Copying of a HEX file from SD card using display (see Chapter 7.12.1).
- Writing a HEX file using DAK software (see Chapter 15.9).

Upon completion of the new firmware the datalogger is rebooted and configuration is loaded from CFG.XML file. During update procedure the status LED blinks slowly. Once the update is completed, you can check the new firmware version from display.

13 System clock update

The datalogger is equipped with an internal RTC that manages the system clock. RTC is fed by a supercapacitor that retains date and time up to 100 days in case of external power removal. System clock is periodically updated by the datalogger or it can be changed using external commands. System clock updating methods are listed below:

- Updating via TCP connection to an NTP server (see Chapter 4.4).
- Updating via satellite connection (see Chapter 4.5.4.2).
- Updating via Siap+Micros Modbus commands (see Chapter 8.3).

Note:

If the time difference between new time set and previous time is greater than 5 minutes, the datalogger is rebooted in order to reload the deadlines of all internal processes.

14 Test and maintenance

This chapter highlights good practices to test the datalogger and to interact with main application.

14.1 Acquisition of instantaneous measurements from display

As described in Chapter 7.5, from *Acquisition* menu the user can request an instant measurement from a sensor outside the sampling interval set in configuration. Measures acquired in this way are displayed but not included in the computation performed by any processing and are not checked by any measurement alarm control process.

When a measurement is requested from a sensor connected to a serial port, power output on that serial port terminal block is enabled and it is kept active as long as the display is on. This allows the operator to have enough time to install and test a sensor.

14.2 Disabling datalogger functions

If an operator needs to carry out some tests on sensors without affecting processing, controls and storages processes, datalogger functions can be temporary disabled from *Settings* menu (see Chapter 7.11.4). Local acquisition, processing, control and storage processes are disabled. Therefore, data records are not updated and written to memory. As a consequence, transmission processes have nothing to send. Only acquisition is running and so the update of the measurement saved in datalogger memory locations. The operator can carry out the test he needs and see the value of the measurement from display.

Operator can disable and enable again datalogger functions from display. If display is turned off without re-enabling datalogger functions, they remain disabled for a maximum of 1 hour.

14.3 Enabling output power supply

Settings menu provides a submenu to enable power outputs on serial port terminal block (see Chapter 7.11.1). If a power output has been activated, it can be turned off from the same menu. Otherwise, it remains enabled as long as the display is on. This is useful if an operator needs to control the power source to an external peripheral (such as sensor, radio, etc.).

14.4 Data deletion

If you need to delete all data recorded by the datalogger and so all data saved in **DATA** directory, it is recommended to use the data deleting function available from *File System* menu (see Chapter 7.12.3). This function allows for a secure deletion of all data saved in **DATA** directory, reset cache memory of archive 5 and 6 and reset data transfer pointers.

Warning:

Deleting **DATA** directory from *File System/NOR flash memory* submenu is not safe. This operation could lead to errors of transmission processes.

14.5 Memory format

Memory format operation deletes all the content of a memory e then re-mount the file system. If the operation is run on NOR flash memory, it causes a system reboot. File system is restored and all data are deleted. Formatting an SD card do not cause a system reboot. If you want to save a copy of the **DATA** directory saved in NOR flash, you can copy it from NOR flash to SD card using display (see Chapter 7.12).

14.6 Log

Logs provide for information about the operating status of the system and, as described in Chapter 6.1, are sent by default over virtual COM port. You just need a PC and a terminal emulator. Logs are divided by task and level. Examples of log messages are shown in Figure 14.1.

Tasks are main processes of the FreeRTOS system. The datalogger application is made up of 6 tasks:

- Acquisition: performs data acquisition, processing, control and memorization. Moreover, it periodically runs some operation to check system status.
- Transmission: manages transmission processes (FTP, SMS, satellite, radio and tunnel).
- Modem: manages the internal modem.
- Display: implements the graphical interface on display and manages all operations requested by pressing joystick buttons.
- Utility: service task that manages specific operation requested by other tasks.
- Ethernet: manages transmission processes over Ethernet port.
- ESP32: manages the communication with the internal Wi-fi, BLE module.
- TCP server: manages incoming TCP client connections.

Each task is identified by a 3-letter name: “ACQ” for Acquisition task, “TXM” for Transmission task, “MDM” for Modem task, “DSP” for Display task, “UTL” for Utility task, “ETH” for Ethernet task, “ESP” for ESP32 task and “SVR” for TCP server task.

A log level defines the importance of a log message. Available log levels, sorted in ascending order of severity, are:

- DEBUG: debug log messages are used to provide the progress of the program at a fine-grained level. These are mostly used for debugging and may contain excessive information such as internal variables, buffers, or other specific information.
- INFO: these messages describe normal execution of a task. They provide the progress of the program at a coarse-grained level.
- WARNING: these messages describe the situations when a module or function encounters abnormal event that may be indicative of an error.
- ERROR: These messages describe the situations when a task encounters an error.

Logs can be disabled by setting the log level to LOG_OFF. Log level is identified by a string at the beginning of a message: “DBG” for debug, “INFO” for info, “WARN” for warning and “ERR” for error. Using the display, you can select the minimum log level (see Chapter 7.11.4). For example, setting the minimum level to INFO only INFO, WARNING and ERROR log will be sent.

Each message is prefixed with the name of the task that prints that log (highlighted in red in Figure 14.1) and the level of the message in square brackets (highlighted in blue in Figure 14.1).

```
[MDM][INFO]:Modem: manufacturer = Sierra Wireless
model = HL8548
revision = RHL85xx.5.5.24.2.201710111800.x6250_2
imei = 014869006870119
serial number = XL039600111610
standard = UMTS
rat = 4
creg = 1
cgreg = 1
cereg = -1
rssi = -89
connection status = -1

[MDM][DBG]:Modem ready for process 47
[TXM][DBG]:Modem ready for FTP tx process "Transmission FTP"
[TXM][INFO]:Start FTP server phase "FTP server"
[TXM][DBG]:Send command to modem: AT+KFTPCFG=1,"80.86.147.198","VittorioA","Vittorio4",21
[TXM][DBG]:Modem response:
+KFTPCFG: 1

OK

+KCNX_IND: 1,4,1

[TXM][DBG]:FTP server "FTP server" configured
[TXM][DBG]:Modem response:
+KCNX_IND: 1,1,0

[ACQ][DBG]:Watchdog kicked!
[TXM][DBG]:FTP status notification: +KFTP_IND: 1,1

[TXM][DBG]:Modem response:
+KFTP_IND: 1,1

[TXM][INFO]:FTP server "FTP server" ready: FTP session id = 1, FTP status = 1
[TXM][INFO]:Record search, open file 0:/DATA/YD_22/MD_2207/220713_6.DAT
[TXM][DBG]:Send command to modem: AT+KFTPSND=1,,"Due","ST003_20220713140025.txt",0,0
[TXM][DBG]:Modem response:
CONNECT

[TXM][INFO]:FTP server "FTP server" connected
[TXM][INFO]:Read 135 bytes from file 0:/DATA/YD_22/MD_2207/220713_6.DAT
[TXM][DBG]:FTP server "FTP server": send 135 bytes
[TXM][DBG]:Send command to modem: --EOF--Pattern--
[ACQ][DBG]:Start diagnostic process "Diagnostic 15s"
[ACQ][DBG]:Internal temperature 27.12Â°C
[ACQ][INFO]:Diagnostic phase "Internal temperature" completed, update register[5] = 27.1250
[ACQ][DBG]:Diagnostic process "Diagnostic 15s" completed
[ACQ][DBG]:Input state of standard processing "Tint 10'" updated
[ACQ][DBG]:New input value for standard processing "Tint 10'"
[ACQ][DBG]:Control "Alarm Tint 30s": current state NORMAL, previous state NORMAL, last recorded state NORMAL, counter 0
[ACQ][DBG]:Control "Alarm Tint 30s" completed

...

[TXM][DBG]:Send FTP tx event: pid = 48, val = 1
[TXM][INFO]:FTP tx process "Transmission FTP" completed
[MDM][DBG]:Modem done event, pop process 47 from modem queue
[MDM][INFO]:Turn off modem
[MDM][DBG]:Modem task minimum free stack space: 1624 bytes
[ACQ][DBG]:Start diagnostic process "Diagnostic 15s"
[ACQ][DBG]:Internal temperature 27.12Â°C
[ACQ][INFO]:Diagnostic phase "Internal temperature" completed, update register[5] = 27.1250
[ACQ][DBG]:Diagnostic process "Diagnostic 15s" completed
[ACQ][DBG]:Input state of standard processing "Tint 10'" updated
[ACQ][DBG]:New input value for standard processing "Tint 10'"
[ACQ][DBG]:Control "Alarm Tint 30s": current state NORMAL, previous state NORMAL, last recorded state NORMAL, counter 0
[ACQ][DBG]:Control "Alarm Tint 30s" completed
[ACQ][DBG]:Start diagnostic process "Diagnostic 15s"
[TXM][DBG]:Transmission task minimum free stack space: 3256 bytes
[ACQ][DBG]:Internal temperature 27.25°C
[ACQ][INFO]:Diagnostic phase "Internal temperature" completed, update register[5] = 27.2500
[ACQ][DBG]:Diagnostic process "Diagnostic 15s" completed
[ACQ][DBG]:Input state of standard processing "Tint 10'" updated
[ACQ][DBG]:New input value for standard processing "Tint 10'"
[ACQ][DBG]:Control "Alarm Tint 30s": current state NORMAL, previous state NORMAL, last recorded state NORMAL, counter 0
[ACQ][DBG]:Control "Alarm Tint 30s" completed
[ACQ][DBG]:Watchdog kicked!
[ACQ][INFO]:***** DA date and time: 13/07/2022 Wed 14:01:00 *****
[ACQ][DBG]:Acquisition task minimum free stack space: 2780 bytes. SPI-UART task minimum free stack space: 1788 bytes. Minimum free heap: 93928 bytes
```


Figure 14.1: example of datalogger operating log.

15 DAK software for management of MegaSUM datalogger

This chapter describes how to use DAK software to configure and work with MegaSUM datalogger.

15.1 How to install

Before proceeding with DAK installation, please check the PC has this minimum System requirement:

- **Pentium** or later
- **RAM 16 Mb** or more of RAM
- **1 Gb Herd Drive** or more
- **CD ROM player**
- O.S. **Microsoft Windows** 95, 98, ME, Win NT, Windows 2000, XP, Vista, Windows 7, Windows 10, Windows 11

Follow the instructions below to install the software:

- Insert DAK CD ROM into the player
- From Task Bar, click on *Start* | *Run...*
- Digit **D:\Setup.exe** in the text box or thumb the CD ROM
- Click **OK** button
- Follow the instruction shown during guided installation process until the end

15.2 User interface overview

To work with MegaSUM datalogger, make sure that DAK is set to the correct target. In the menu bar select *Tools*/*Target*/*Mega SUM Datalogger* (Figure 15.1). If current target is different, a pop-up will ask the user to restart the program in order for the target type change to take effect.

Figure 15.2 shows the user interface. In details:

1. Selected target and program version.
2. Menu bar.
3. Name of the configuration file.
4. Configuration tree.
5. List of configurable fields of the selected feature.
6. Description of the selected feature.

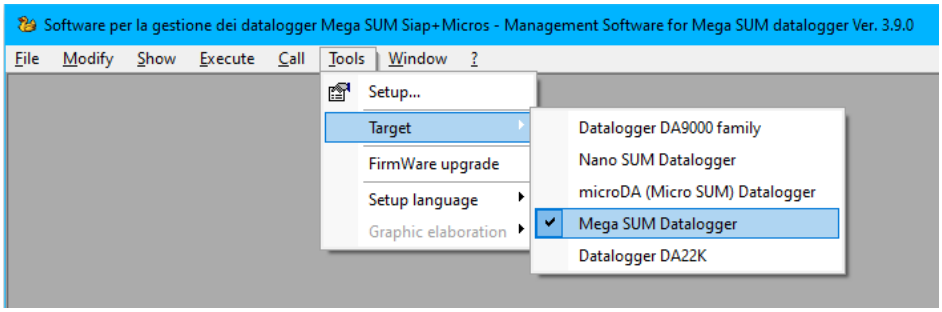


Figure 15.1: target selection.

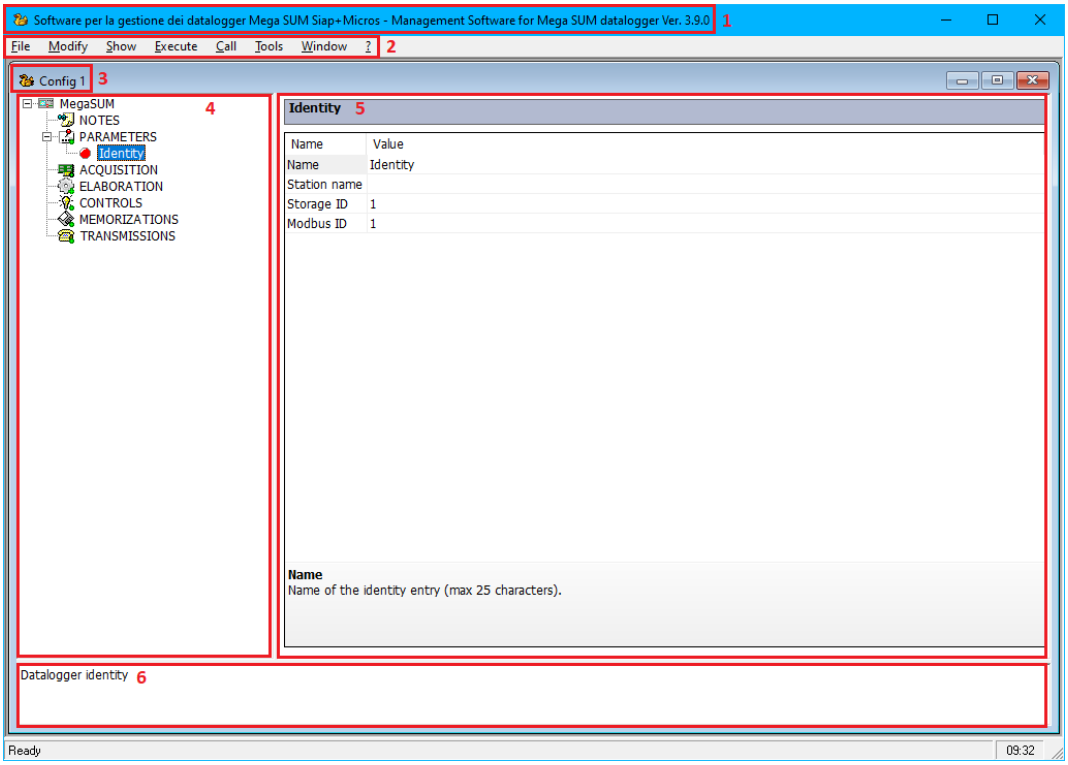


Figure 15.2: user interface.

15.3 Build a new configuration

Scheduled activities and functionalities of the MegaSUM datalogger are defined in a configuration file saved in XML format (eXtensible Markup Language).

To create a new configuration from scratch, select *File*/*New…* from menu bar. A new window will open with the temporary name “Config 1” (the name can be changed later).

As shown in Figure 15.2 MegaSUM has 7 main sections:

- Notes: allows the user to add notes about the configuration.
- Parameters: internal settings (such as identity and internal modem) and definition of numeric parameters.
- Acquisition: defines data acquisition activities.
- Elaboration: defines data processing activities.
- Controls: defines control activities.
- Memorizations: defines data storage activities.
- Transmissions: defines data transmission activities.

For a detailed description of all elements of each section and their configurable fields see Chapter 3.

To add an entry, select the section of interest:

- From *Modify* menu select *Insert*, a list of all elements available for that section will appear (Figure 15.3 left).
- Alternatively, right-click on the section and select *Insert* (Figure 15.3 right).

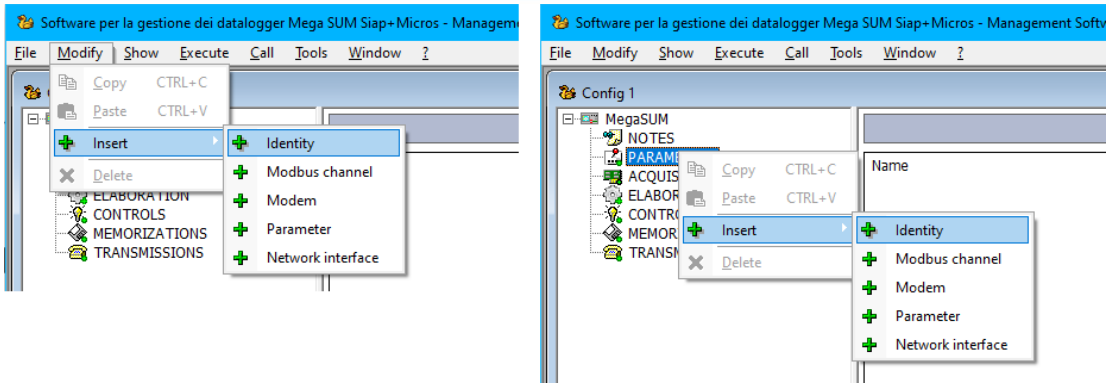


Figure 15.3: insert of an entry from Parameters section.

For example, Figure 15.3 shows how to insert the identity of the datalogger from Parameters section and Figure 15.4 shows how the configuration tree will appear after the insertion of the identity. Please note that the configuration fields are listed on the adjacent window where the user can change their values.

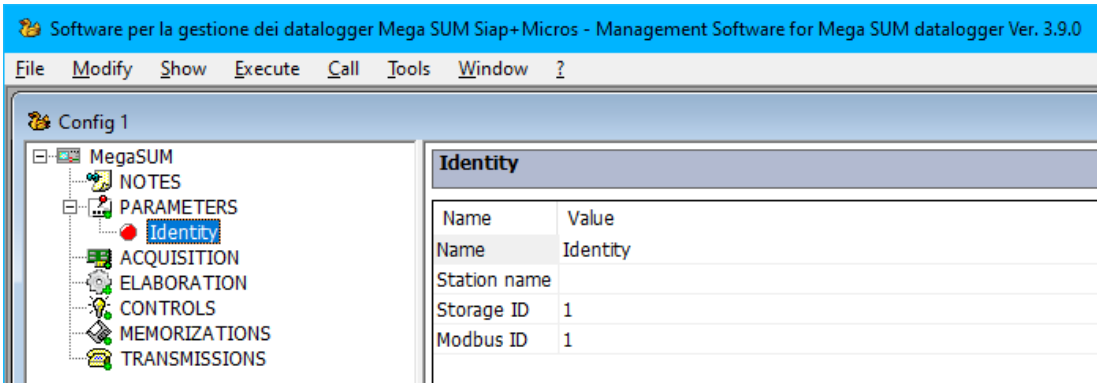


Figure 15.4: configuration fields of datalogger identity.

To set a value, double-click on the corresponding box. The cursor will be positioned inside the box allowing the user to write or edit the value. Note that some configuration fields have a default value. These can be of 3 different types:

- Character string
- Number
- Enumerated type selectable from a drop-down menu.

Numeric values have limits. If you enter a number outside the allowed range of values, you will be warned with a pop-up.

To delete an entry, select it from configuration tree (Figure 15.5):

- From *Modify* menu, select *Delete*.
- Alternatively, right-click on the entry and select *Delete*.

Some activities are composed of one or more phases. For example, to insert a serial data acquisition (RS232 or RS485) from a Modbus sensor:

- Insert a serial data acquisition activity (Figure 15.6 left).
- From serial acquisition add the measurements read from a Modbus sensor (Figure 15.6 right).

Similarly, to add a data transmission to an FTP server:

- Insert an FTP transmission activity (Figure 15.7 left).
- From FTP transmission add the server phase (Figure 15.7 right).

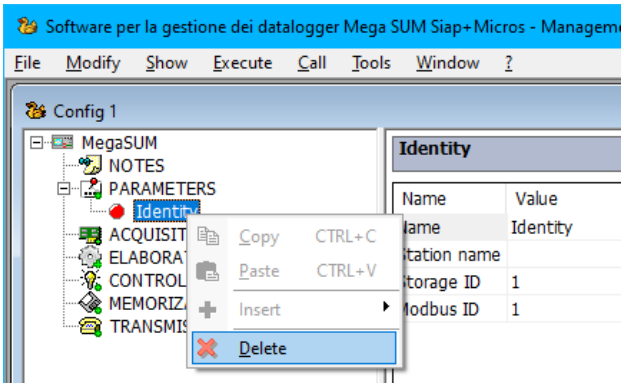


Figure 15.5: delete a configuration entry.

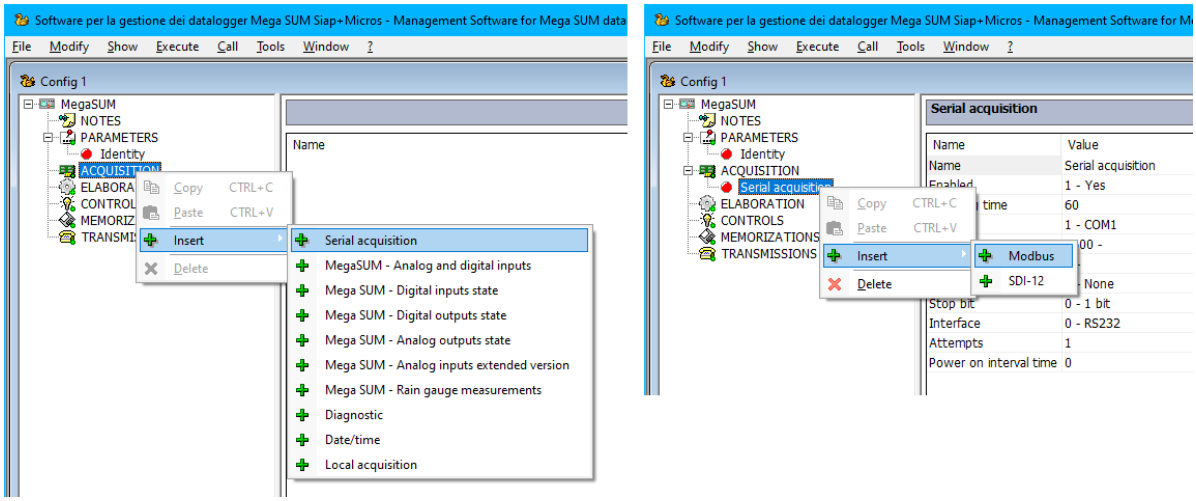


Figure 15.6: insert a serial acquisition from Modbus sensor.

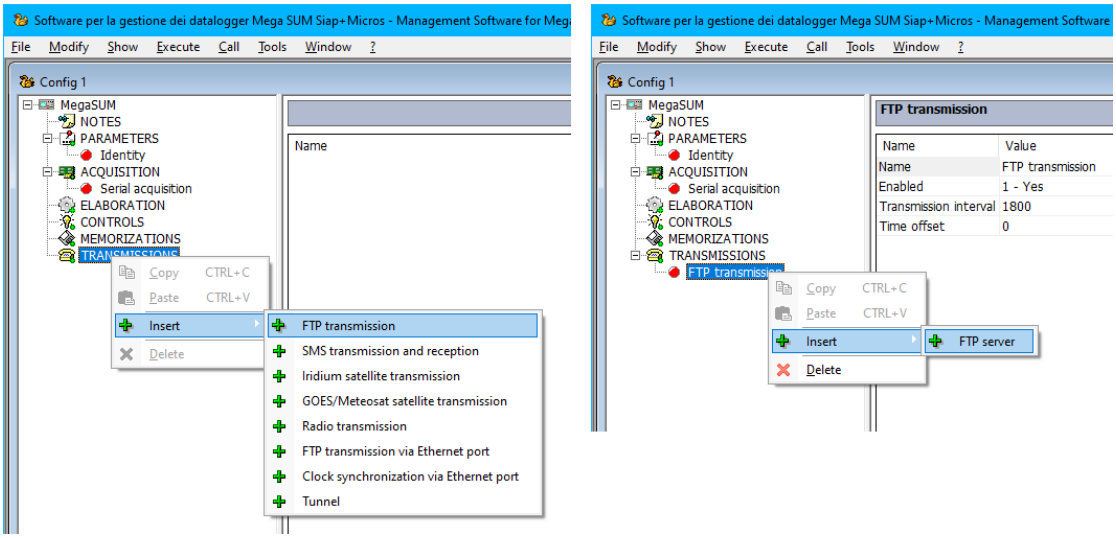


Figure 15.7: insert an FTP transmission.

15.4 Save configuration file

From *File* menu, select *Save* or *Save as…*, a dialog box will open allowing the user to define the name of the XML file and select the directory where the file will be saved.

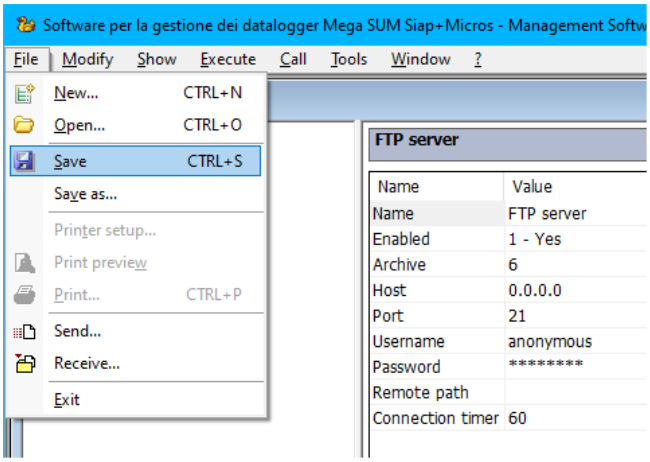


Figure 15.8: save a configuration.

15.5 Open an XML configuration file

From *File* menu select *Open…*, a dialog box will open allowing the user to browse the filesystem and select an XML file. Once opened, the user can edit every part of the configuration, insert new entries and delete existing ones as described in the previous chapters. Pay attention that if a file is not well formatted, DAK will not be able to read all sections of the configuration correctly.

If multiple configuration files are opened at the same time, the windows will overlap and the one corresponding to the last opened file will be positioned at the top of the list. Select *Window* from bar menu and click *Tile*, *Arrange horizontal* or *Arrange vertical* to arrange the windows more clearly.

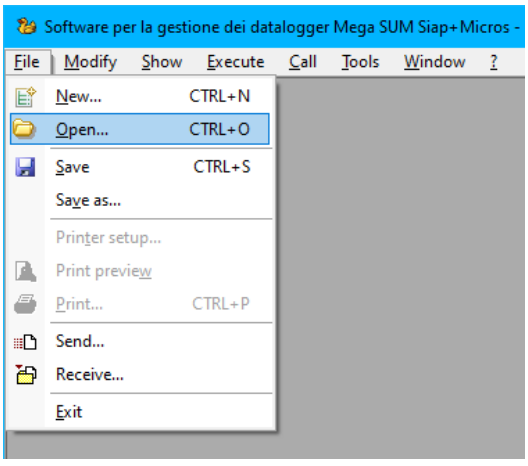


Figure 15.9: open a configuration file.

15.6 Setting up communication with the datalogger

There are two ways to set up a communication between the datalogger and a computer:

- Using an USB cable connected to the micro-USB connector of the datalogger.
- Using a serial port of the datalogger. To create this communication channel the user needs to configure a Modbus channel from Parameters section along with the serial port settings (see Figure 15.10). See

Chapter 3.2.4 for more details. In this case the user must use an USB-RS232 or USB-RS485 converter, depending on the chosen serial port.

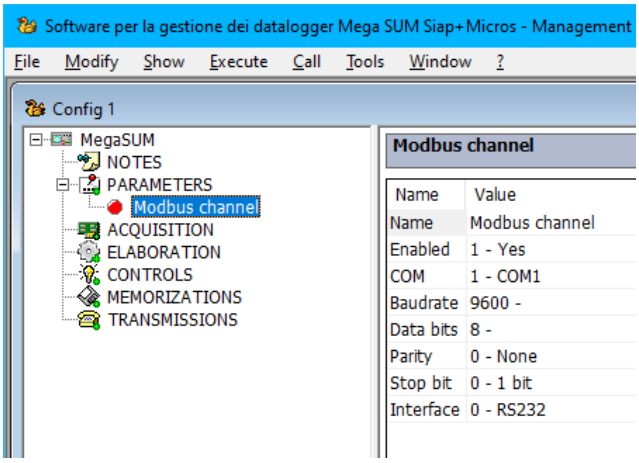


Figure 15.10: configuration of a Modbus channel.

After that, the user needs to specify the COM port of the PC to which the datalogger is connected from *Tool*/*Settings* menu. A window will open allowing the user to select the COM port and specify the serial port settings (baudrate, number of data bits, parity and stop bits). If communication is set up via USB cable, serial port settings are useless since communication is managed by USB protocol. If a communication via serial port is established, serial port settings must be set according to the Modbus channel configuration. Select the COM port, click *Apply* and then *OK*.

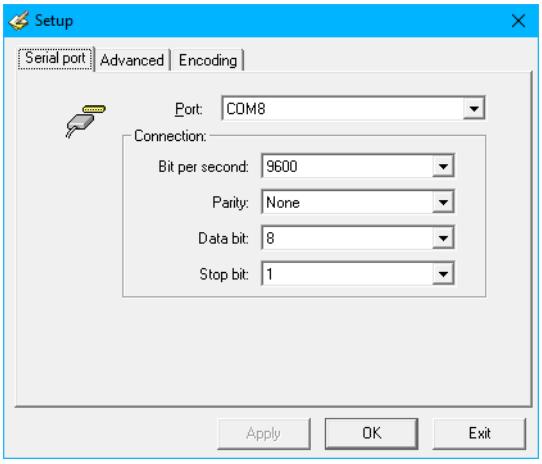


Figure 15.11: setup window of the serial port connected to the datalogger.

All the operations described in the following chapters assume that there is a communication between the datalogger and a PC.

15.7 Upload and download a configuration file

To read the configuration from the datalogger select *File* from menu bar and click *Receive…*, then a communication between datalogger and DAK will start to download the XML file. A progress bar is used to give the user an indication of the progress of the operation (Figure 15.12). At the end of the operation a new window will open showing the configuration tree with a name automatically assigned by DAK.

Similarly, to send a new configuration to the datalogger select *File* and click *Send…*, then a communication will start to send the opened XML file. Upon completion, the datalogger will restart and load the new configuration.

15.8 Checking of datalogger data and operation

The following chapters explain the other functionalities provided by DAK to monitor the datalogger data and its operating status.

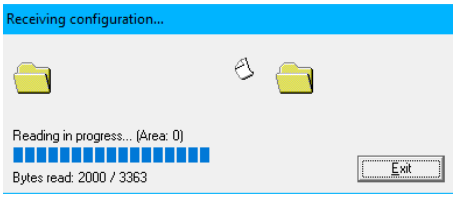


Figure 15.12: reading a configuration from datalogger.

15.8.1 Reading station ID

From *Execute* menu click *Station ID*, a window will open allowing the user to read datalogger station ID and storage ID. Click *Request* button to send the request and read the two IDs.

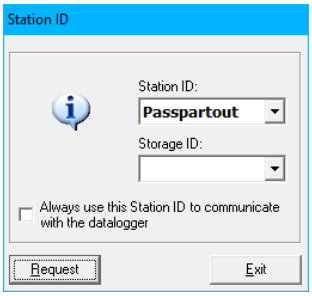
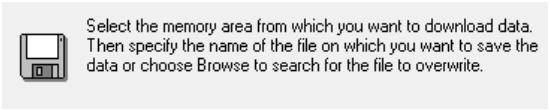


Figure 15.13: reading station ID and storage ID.

15.8.2 Data download

From *Execute* menu click *Data download*, a window will open allowing the user to download the data recorded in a specified range of days (Figure 15.14). Follow the instructions provided at the top of the dialog box, select the range of days from drop-down menus in the “File download mode” section and finally in the “Data writing mode” section specify whether to overwrite the data of an existing file or to append them to the end. If you want to write a new file, the choice of the writing mode is useless.



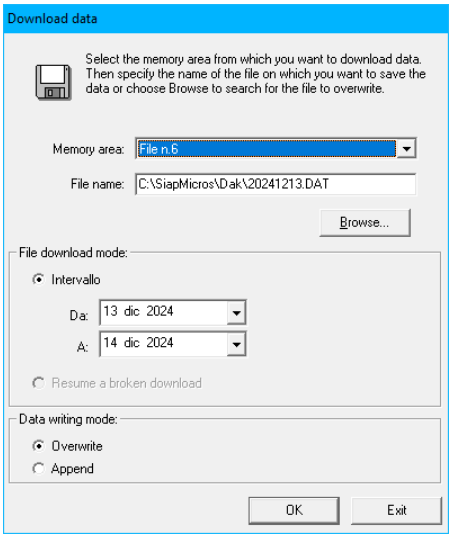


Figure 15.14: data download from datalogger.

Click *OK* to start the download operation which will be indicated by a progress bar along with the number of read bytes (Figure 15.15).

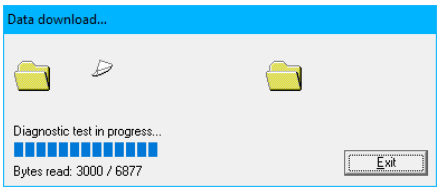


Figure 15.15: data download in progress.

15.8.3 Reading parameters

Select *Execute* from menu bar and click *Parameters* to read the numeric parameters from datalogger configuration. A window will open to list the parameters along with their name, unit of measurements and value. For example, Figure 15.16 shows a parameter named Offset with value equal to 10m.

To change a parameter, follow the instructions below:

- Click the value box to place the cursor inside it.
- Type a new value and press Enter. After that, the box value will be highlighted in light blue (Figure 15.16 right).
- Click *Send* button to send the new parameter value to the datalogger. After that, the parameters will be automatically read again and refreshed on the dialog box.

At any time, pressing the *Refresh* button allows the user to read the parameters again.

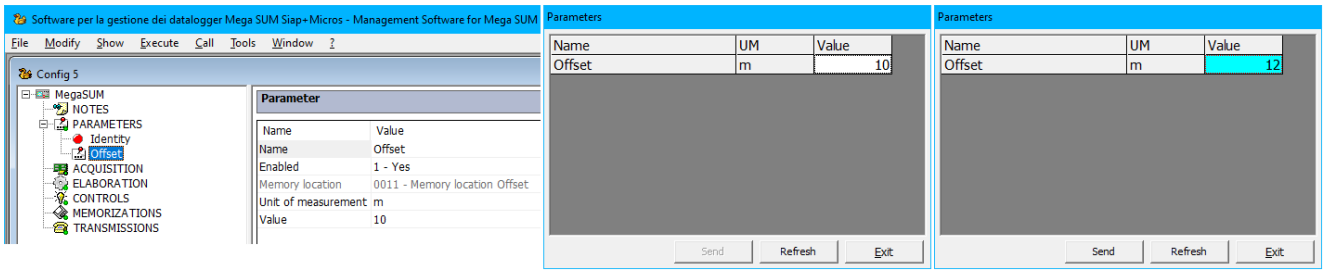


Figure 15.16: configuration of a parameter from Parameters section (left), reading datalogger parameters from Execute menu (middle) and modifying the value of a parameter (right).

15.8.4 Instant data request

Select *Execute* from menu bar and click *Instant data request*. A window will open allowing the user to send requests to the datalogger to read the instantaneous value of the configured measures. Click *Request* button and the window will be filled with the latest values acquired by sensors. Measurement name, value and status are displayed. For example, in Figure 15.17 three measures are shown, a temperature data from Pt100 (24.2°C), the battery voltage (13.7V) and the total accumulated precipitation (0mm).

By setting the value of “Auto refresh” from drop-down menu, instant data requests will be sent periodically to the datalogger at the chosen time. This is useful if you want to monitor the values acquired by sensors without having to click *Request* button every time.

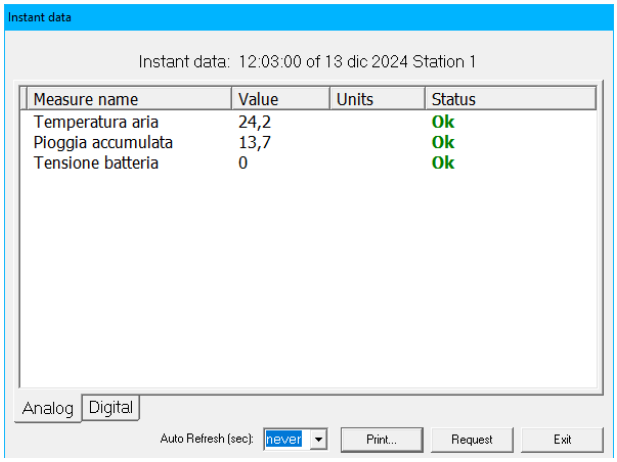


Figure 15.17: instantaneous data.

15.8.5 Synchronize clock

Select *Execute* from menu bar and click *Synchronize clock*. A window will open allowing the user to set date and time of the datalogger. Keep “Synchronize with PC clock” option checked to use your PC time for clock synchronization. Otherwise, uncheck the option and manually set date and time. Finally, click *Send* button to send a command to set the new date and time to the datalogger. “Send reset datalogger” option appends a command to restart the datalogger after clock synchronization (Figure 15.18).

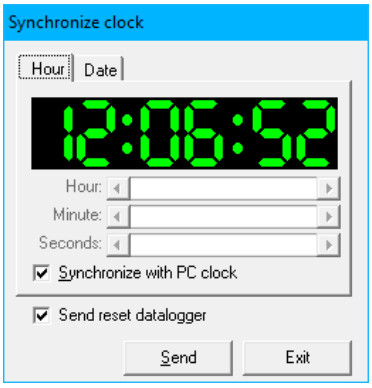


Figure 15.18: setting date and time of the datalogger.

15.8.6 Custom commands

Select *Execute* from menu bar and click *Custom commands*. A window will open where the user can manually insert a command to send to the datalogger (Figure 15.19). Please note that the datalogger responds to the ASCII commands described in Chapter 8.3.

The first line is a one-line text editor where the user can insert the command. The second line shows the last command sent to the datalogger. It’s a drop-down menu listing the latest commands. *Erase* button deletes the history of the latest commands. In the Answer window, the datalogger response is printed. The response time and the number of bytes will also be reported after the response.

There are 4 buttons at the bottom right of the window:

- Two arrow buttons to set the period in seconds to send the command. By default, the value is OFF, that is disabled, so commands must be manually sent by user.
- *Reset* to send a command to restart the datalogger.
- *Send* to send a command.
- *Exit* to exit the window.

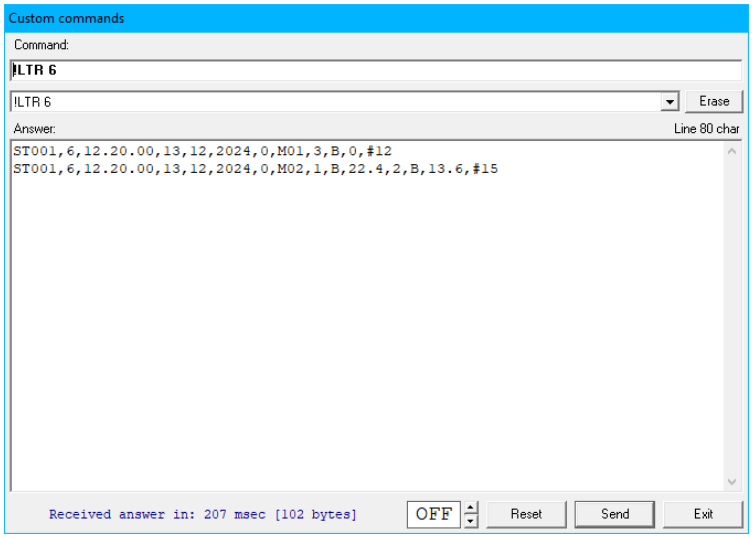


Figure 15.19: example of custom command.

15.8.7 Display

MegaSUM datalogger is equipped with a 20x4 character LCD module that can be emulated by DAK. Select *Execute* from menu bar and click *Display* to open a window showing a graphic display and 5 buttons. You can scroll and view all the menus of the display using the four arrow buttons and the central button. There is also a *Refresh* button to update current screen and *Exit* button to exit the display window.

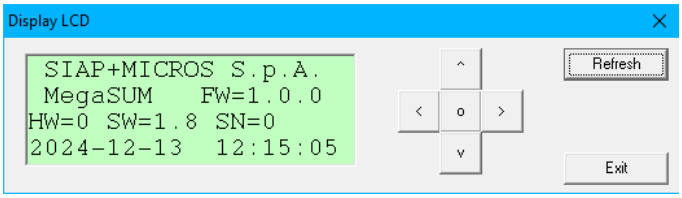


Figure 15.20: display and joystick emulator.

15.8.8 TCP/IP connection

Select *Connect* from *Call* menu, a window will open where the user can insert the TCP/IP address and the port to connect to remotely. Click *TCP/IP connection* button to start a remote connection. A dialog box will inform the user about the result of the operation (Figure 15.21). If the connection has been successfully established, the user can run all the operations with the datalogger described in the previous chapters.

Bear in mind that to establish a remote connection you need to configure a tunnel communication (Chapter 3.8) or a TCP server (Chapter 3.9).

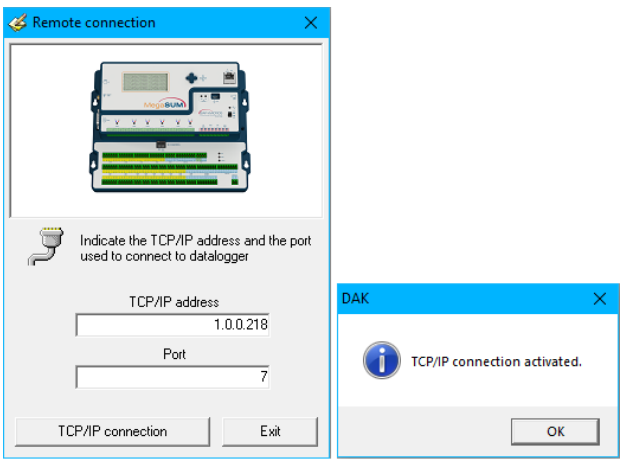


Figure 15.21: TCP/IP connection.

To close the connection from *Call* menu select *Disconnect*.

15.9 Firmware upgrade

Select *Tool* from menu bar and click *FirmWare upgrade*. A window will open showing the current firmware version, internal modem data (if a transmission activity using the internal modem is configured) and the Bluetooth application version in this order.

To start a firmware update you need an executable file with .hex extension released by Siap+Micros. Click *Commands*/*Load program* to open a dialog box to browse the filesystem and select a .hex file. After that, the update procedure will start. The status of the operation will be indicated by a progress bar.

At the end of the operation the datalogger will restart and load the new firmware. To verify the actual upgrade, just click *File*/*Program information* and check the firmware version number. To exit from programming window, click *File*/*Exit*.

Note:

The writing operation might take a few minutes. Once completed, wait for the datalogger to load the new firmware into flash memory. This operation also takes a few minutes. After that, you can query the datalogger to check the firmware version.

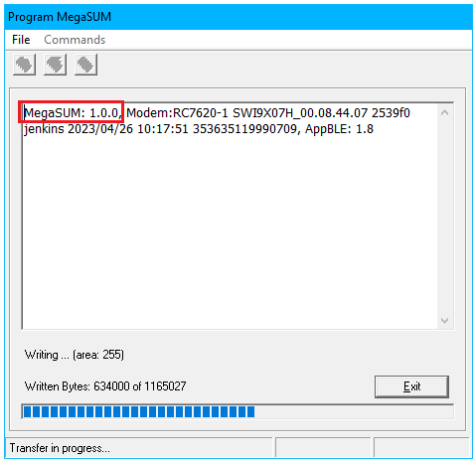


Figure 15.22: firmware update dialog box, in red is highlighted the datalogger fw version.

15.10 Language setting

Click *Tools*/*Setup language* to select a different language. If you change the language, DAK will close and the language setting will be updated at the next start.

16 Revision history

The following table provides a description of the changes made to this document.

Version	Date	Updates
01	*01/03/2024*	*First document version.*
02	*10/12/2024*	*Added:* • *Chapter 14: DAK software for management of MegaSUM datalogger.* *Updated:* • *Chapter 2.2: label of power inputs.* • *Chapter 4.5.1: added default values of datalogger network interface.*
03	*07/04/2025*	*Added:* • *Chapter 3.3.2.3: acquisition of a measure from a sensor using ASCII protocol.* • *Chapter 3.9: TCP server configuration.* • *Chapter 4.5.7: description of TCP server.* • *Chapter 4.5.8: warning for modem usage.* • *Chapter 15.8.8: TCP/IP connection using DAK.* *Updated:* • *Chapter 2.3: added note about the usage of input power supplies.* • *Chapter 4.5.1.1: added command to download the configuration.* • *Chapter 14.6: added TCP server task.*
04	*05/05/2025*	*Updated:* • *Chapter 4.5.1: added a note about the usage of the devices to send data over FTP connection.* • *Chapter 8.1: improved the description of datalogger registers.*

05	*15/09/2025*	*Added:* • *Chapter 3.2.6: Wi-Fi & Bluetooth configuration.* • *Chapter 3.7.7.2: TCP/UDP client transmission configuration.* • *Chapter 4.5.2: description of TCP/UDP transmission.* • *Chapter 9: description of Wi-Fi & Bluetooth module.* *Updated:* • *Chapter 1: added manufacturer's contact details.* • *Chapter 1.1: added description of warning symbols.* • *Chapter 1.5: added description of power cables and added technical specification of external power supply.* • *Chapter 1.8: modified the temperature range, added maximum temperature of power cables, added overvoltage category, added description of IPX0, added flame-retardant plastic panel.* • *Chapter 2.2: updated maximum voltage of photovoltaic panel and updated nominal voltage of auxiliary BATT power input.* • *Chapter 2.3: added indication of maximum current supplied by output voltages.* • *Chapter 3.3.4: added sampling time in clock acquisition.* • *Chapters 3.7.1.1 e 3.7.7.1: updated description of host field.* • *Chapter 4.4: added RSSI description.* • *Chapter 8.3: added RESET STAT and LOG commands.*

17 Declaration of Conformity

MD 751.1 rev. 03

EU Declaration of Conformity (DoC)

Manufacturer: SIAP+MICROS S.p.A.
Via del Lavoro, 1 – 31020 S. Fior (TV) – Italy
https://www.siapmicros.com/en/

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration:

Description	Product Code/Model
Megasum – Low Power Multifunction Datalogger with integrated UMTS/LTE module, WiFi/BLE module, analog and digital inputs, serial and microUSB interfaces and with standard configuration	PEM-e021b-MEGASUM-LTE

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

- **2014/53/EU** The Radio Equipment Directive (RED)
- **2011/65/EU** The Restriction of Hazardous Substances Directive (RoHSD)

The following harmonised standards and technical specifications have been applied:

RED references:

ELECTROMAGNETIC COMPATIBILITY (Article 3.1b):

EN 61326-1 2021-06	Electrical equipment for measurement, control and laboratory use - EMC requirements - General requirements
EN 301 489-1 V2.2.3:2019	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility
EN 301 489-52 V1.2.1:2021-11	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication User Equipment (UE) radio and ancillary equipment; Harmonised Standard for ElectroMagnetic Compatibility

EFFECTIVE AND EFFICIENT USE OF RADIO SPECTRUM (Article 3.2):

EN 301 511 V12.5.1:2017-03	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
EN 301 908-1 V13.1.1:2019-11	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 1: Introduction and common requirements

MD 751.1 rev. 03

EN 301 908-2 V13.1.1:2020-06	IMT cellular networks; Harmonised Standard Standard for access to radio spectrum; Part 2: CDMA Direct Spread (UTRA FDD) User Equipment (UE)
EN 301 908-13 V13.1.1:2019-11	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)
EN 300 328 V2.2.2	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum

HEALTH & SAFETY (Article 3.1a):

EN 61010-1 2010+A1:2021-11	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements
EN 62311 2019	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz)

RoHSD references:

EN 63000 2016+AMD1:2022	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Date
31-05-2025

CEO
Alex Stevanin