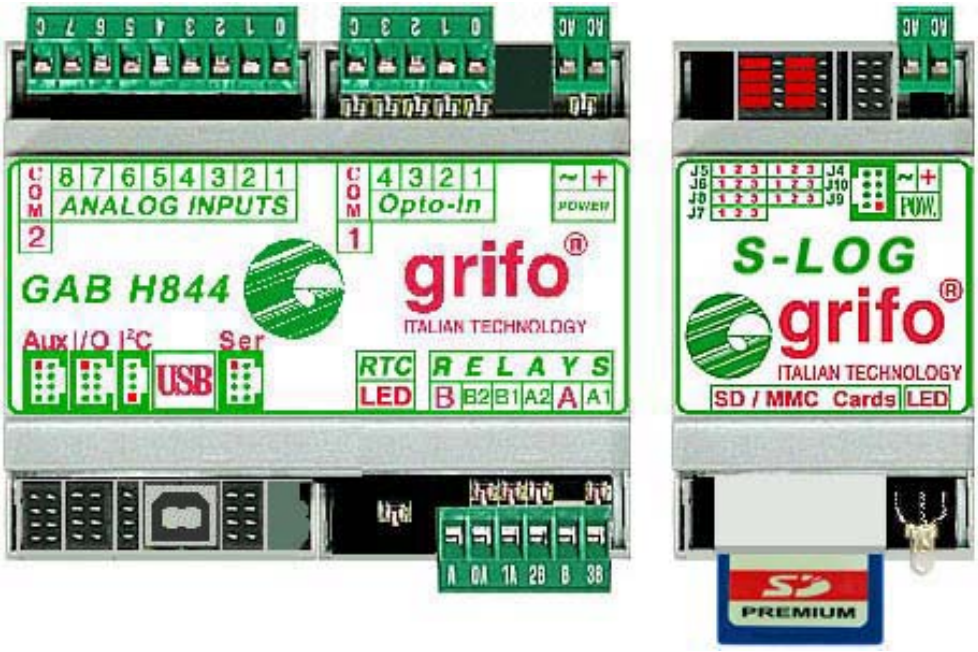
SL-Data

Serial-LOG: Data Logger on memory cards

USER MANUAL



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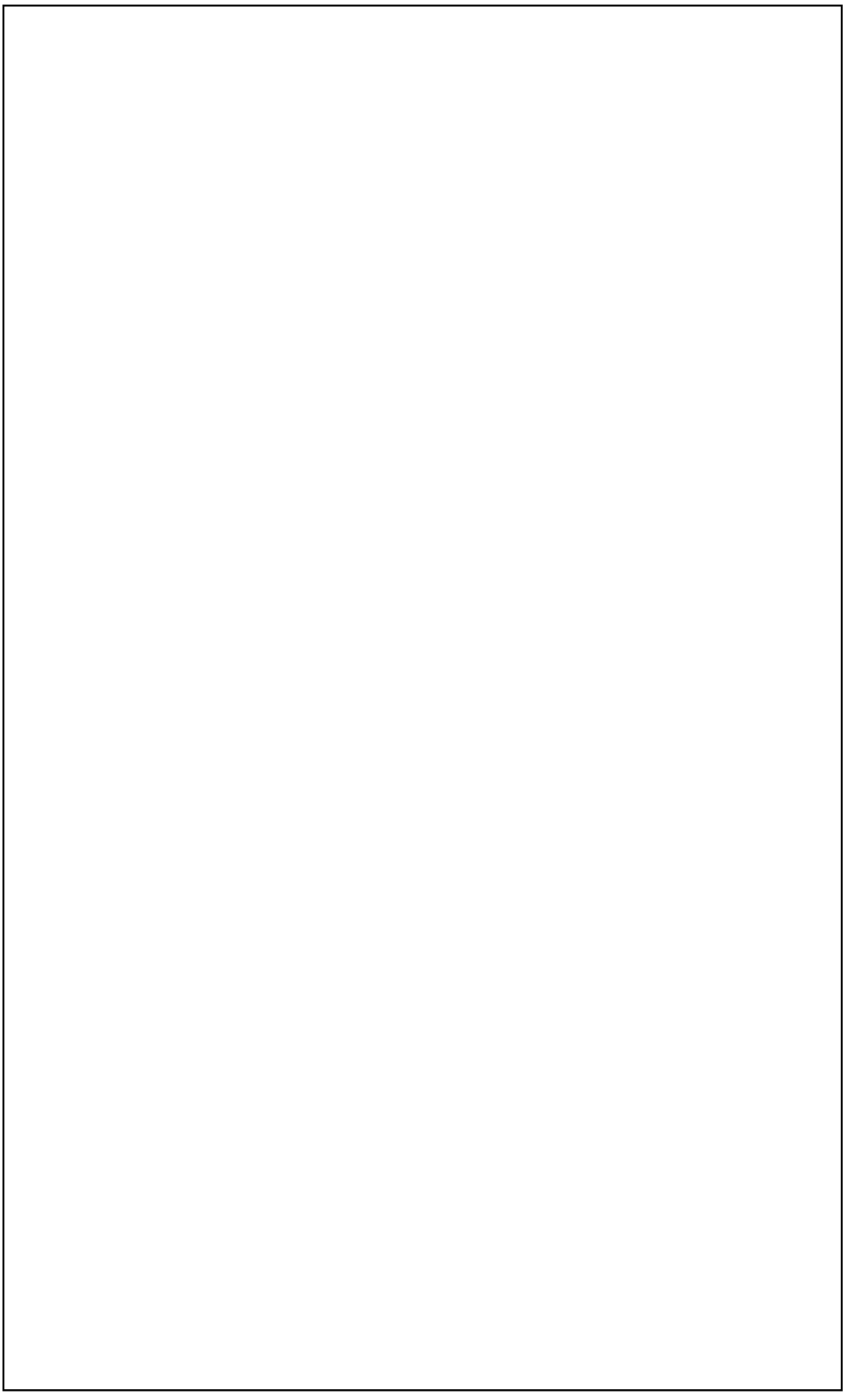
SL-Data Rel. 5.00 *Edition 16 January 2009*



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Serial-LOG: Data Logger on memory cards

USER MANUAL

SL-Data is a product capable to acquire analog data, supplied by the field, and to save them on a removable memory card , like the **SD** (Secure Digital) and **MMC** (Multi Media Card) types.
The logged data can be moved to a **PC** through a simple extraction of the memory card and a following insertion on a **PC** provided of a standard multicards interface.
The **SL-Data** is composed by a group of hardware, firmware and software. This division allow the customers to select two different working modalities: use the package directly, as it has been supplied, by taking advantage of the provided configurations in order to satisfy the application requirements; alternatively modify the program source in order to change, or add, some new required functionalities.

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IMPORTANT

Although all the information contained herein have been carefully verified, grifo® assumes no responsability for errors that might appear in this document, or for damage to things or persons resulting from technical errors, omission and improper use of this manual and of the related software and hardware.
grifo® reserves the right to change the contents and form of this document, as well as the features and specification of its products at any time, without prior notice, to obtain always the best product.
For specific informations on the components mounted on the card, please refer to the Data Book of the builder or second sources.

SYMBOLS DESCRIPTION

In the manual could appear the following symbols:

Attention: Generic danger

Attention: High voltage

Attention: ESD sensitive device

Trade Marks

GENERAL INDEX

FIGURE INDEX

INTRODUCTION

The use of these devices has turned - **IN EXCLUSIVE WAY** - to specialized personnel.

This device is not a **safe component** as defined in directive **98-37/CE**.

Pins of module are not provided with any kind of ESD protection. Many pins of the card are directly connected to their respective pins of on board's components and these last are sensitive to electrostatic noises. So personnel who handles the product/s is invited to take all necessary precautions that avoid possible damages caused by electrostatic discharges.

The purpose of this handbook is to give the necessary information to the cognizant and sure use of the products. They are the result of a continual and systematic elaboration of data and technical tests saved and validated from the manufacturer, related to the inside modes of certainty and quality of the information.

The reported data are destined- IN EXCLUSIVE WAY- to specialized users, that can interact with the devices in safety conditions for the persons, for the machine and for the enviroment, impersonating an elementary diagnostic of breakdowns and of malfunction conditions by performing simple functional verify operations , in the height respect of the actual safety and health norms.

The informations for the installation, the assemblage, the dismantlement, the handling, the adjustment, the reparation and the contingent accessories, devices, installation, etc. are destined - and then executable - always and in exclusive way from specialized warned and educated personnel, or directly from the AUTHORIZED TECHNICAL ASSISTANCE, in the height respect of the manufacturer recommendations and the actual safety and health norms.

The devices can't be used outside a box. The user must always insert the cards in a container that rispect the actual safety normative. The protection of this container is not threshold to the only atmospheric agents, but specially to mechanic, electric, magnetic, etc. ones.

To be on good terms with the products, is necessary guarantee legibility and conservation of the manual, also for future references. In case of deterioration or more easily for technical updates, consult the AUTHORIZED TECHNICAL ASSISTANCE directly.

To prevent problems during card utilization, it is a good practice to read carefully all the informations of this manual. After this reading, the user can use the general index and the alphabetical index, respectly at the begining and at the end of the manual, to find information in a faster and more easy way.

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VERSIONS

This handbook makes reference to version **1.1** of the **SL-Data** product and following ones. The validity of the information contained in this manual is subordinated to the version number of the used firmware and the user must always verify the correct correspondence beetween the notations. The version number is reported on the received CD label and it is also displayed by the device during the configuration.
Normally the **SL-Data** is always supplied with the latest firmware version that is available but, for specific requirements, the user can receive also a different version; he must carefully specify this particular condition in the order phase.
In addition, this manual reports information about other different programs that are integrant parts of **SL_Data**: each one of these programs has an own version number that is specifically described when it is necessary. Finally also the hardware is provided of his version as indicated in the related technical manuals.

When the user requires technical assistance it is really important that he provides a description of the problem plus the version numbers of the used components.

Like any products, also **SL-Data** is continuosly changed and improved to satisfy completely the new requirements of the users and correct the discovered problems and bugs. Here follows a brief description of the changes made to the package according to version number:

Ver. 1.0 -> First version for internal development and test.

Ver. 1.1 -> First realesed version.

Any eventual improvement or addition the user thinks may be interesting, can be suggested by contacting directly **grifo®**.

DEFINITIONS

In order to simplify the description, we define:

Acquisition hw -> the system dedicated to field signals connection, usually composed by the couple of cards **GAB Hxxx** + **Mini Module**.
Saving hw -> the system that save the acquired data, generally composed by **S-LOG**.

In all the manual the previous definitions are used by assuming that the user knows them and he can handle them correctly. This preliminary condition can be satisfied by reading the relative technical and user manuals of all the used cards. It is important to underline also the manuals of the coupled cards **GAB Hxxx** + **Mini Module**, as they supply capital information about acquisition hw.

GENERAL INFORMATION

SL-Data is a product capable to acquire analog data, supplied by the field, and to save them on a removable memory card , like the **SD** (Secure Digital) and **MMC** (Multi Media Card) types.
This product is the result of numerous experiences, collected in many years by **grifo®**, during the development of data logger applications. The equipment acquire and save different analog signal in a simple, reliable and cheap manner. Moreover it allows to examine and/or process the saved information, later and in a different place.
The logged data are saved on the memory cards managed by **S-LOG**, that are the SD and MMC, with **FAT16** format. The logged data can be moved to a PC through a simple extraction of the memory card and a following insertion on a PC provided of a standard multicards interface. The data are available under file/s with ASCII format and they are organized in order to be opened with Excel spread sheet. Then these data can be saved in different files, or they can be examined, processed, printed, arranged, registered, displayed on graphs, etc. according with user requirements.
The **SL-Data** is composed by a group of hardware, firmware and software. This division allow the customers to select two different working modalities:

A) Use the package directly, as it has been supplied, by taking advantage of the provided configurations in order to satisfy the application requirements.
B) Modify the provided firmware program source in order to change, or add, some new required functionalities.

The operative features, already available or to be added, of the **SL-Data** are briefly described below.

- Logging of analog signals supplied by temperature, pressure, humidity, flux, capacity, position, voltage, corrent, consumption, etc. transducers.
- Closed loop controls that mantain the checked signals to a preset set point.
- Alarms controls with periodic saving of their status.
- Logging of digital signals supplied by switches, selectors, proximities, allarms, stroke ends, etc.
- Pulses count and saving of their number, frequency, distribution, etc.
- Management of serial communications with different protocols (RS 232, RS 422, RS 485, CAN, I2C BUS, etc.) and saving of exchanged data.
- TTL digital signals controller, either input or output, that can be connected to other electronic circuits, with saving of the same signals status.
- Teleacquisition of the input signals on a long distance communication line, either standard or wireless.
- Telecontrol of the available signals on a long distance communication line, either standard or wireless.
- Etc.

The firmware and the software normally provided with **SL-Data** acquire and save the analog inputs available on **GAB H844**, coupled with a selected **Mini Module**. The supplied program, even in source format widely remarked, includes all the necessary procedures and data structures and allows the user to develop his firmware and to satisfy his specific requirements. In this manner the **SL-Data** considerably reduces the development time of data logger applications.
A comfortable configuration mode let the user arrange the **SL-Data** for the application to develop. As an example, it defines the type of the connected analog signals, the acquisition time and mode, the features of the physic values acquired (engineering format), etc. Generally the configuration mode is used only one time before the installation of the complete system.
One of the most important features of **SL-Data** is that it is a ready to use product: the user is not forced to know the selected and used hardware. Thanks to the utility programs and the sources provided with the product, it is possible to set up, test and use the data logger in few minutes.

The most important features of **SL-Data** are summarized in the following points.

- Acquisition of the **analog inputs** available on acquisition hw.
- Analog inputs configurable among different **types**: two are **Voltage** inputs (0÷Vmax value, 0÷Vmax value*4) and two are **Current** inputs (0÷20 mA, 4÷20 mA).
- Analog inputs can be **filtered** or not by firmware, and enabled in the acquisition hw configuration.
- **Gain factor** application on the analog inputs.
- Analog inputs are converted in **engineering units**.
- Engineering units for analog inputs defined under configuration with **begin scale** and **end scale** values.
- Values in engineering units are saved on memory cards.
- **Automatic format** of the values in engineering units, in order to provide always the maximum number of **significant digits**.
- Data saved on **memory card** with **SD** or **MMC** type, up to **2 GBytes**.
- **FAT16** format for memory cards.
- Memory card completely managed by **S-LOG**.
- Data on memory card are organized on single or different **ASCII files**, compatible with electronic spreadsheet as **Excel**.
- Possibility to add **label**, **prefix**, **suffix** to saved data, with the saving hw configuration.
- Label, prefix and suffix can be widely composed and include also **time indication** (current date and time).
- The memory cards and the saved data can be managed by any **PC** provided of proper multicards interface.
- Comfortable **configuration modes** either for acquisition hw and saving hw.
- Configurations are mantained in non volatile memories (**EEPROM**) with specific algorithms and reliability controls.
- Connection between acquisition hw and saving hw can be performed either with **asynchronous RS 232** or **synchronous I2C BUS** communication.
- Serial **communication line** can be selected under configurations.
- Easily define of RS 232 **physic protocol** for asynchronous communication (Baud Rate, Stop Bit, Parity, etc.).
- The not used communication line of the acquisition hw (asynchronous RS 232 or synchronous I2C BUS) remains free for the connection to different **external systems**.
- **Acquisition time** can be defined under configuration among **18** standard values (from **1 second** to **1 day**), or alternatively with a time inserted by user.
- Time control of the acquisition hardware based on a **periodic interrupt**, with **10 msec** resolution.
- **Check** configuration **validity** and signal possible errors.
- Saving hw **functionality is cheked** by acquisition hw and possible anomalies are signalized.
- Firmware source developed with **modular procedures** dedicated to any section of the acquisition hw (**EEPROM**, **A/D**, **buffered inputs**, **buffered outputs**, **serial communication**, **timing**, etc.).
- Firmware and software support double language: **Italian** and **English**.
- Wide **documentation** and rich list of **examples** both in **source** and **executable** format.
- **No license** nor additional costs. The user is free to develop all the applications that he requires.

REQUIREMENTS

Following there is a list of necessary material in order to use **SL-Data**:

a) One acquisition hw and one saving hw, that are **GAB H844** + **Mini Module** and **S-LOG**.

b) User documentation or, in other words, this manual and those of the cards that have been selected as acquisition and saving hws.

c) A power supply either for acquisition hw and saving hw, compatible with ordered configuration (please see POWER SUPPLY paragraphs for details).

d) A personal computer capable to configure the hws for the system under development and to examine the logged data. This PC must have the following minimum requirements:

Personal Computer:	IBM or compatible
RAM memory:	≥ 64 MBytes
Hard disk:	≥ 8 MBytes free
Video card:	≥ 800x600 pixels, 65536 colours
Monitor:	Colour
Mouse:	Microsoft compatible, correctly managed.
Interfaces:	One free COM serial line, orrectly managed.
	Multicard slots for memory cards, correctly managed.
Operating system:	Windows 98, ME, 2000, XP

In the previous description the indications "correctly managed" mean that the device must be previously installed. This installation includes both hardware and software configurations as defined by the manufacturing company. In other words the supplied programs have no dedicated software driver for these devices, but they uses those already available in the operating system.

e) One SD or MMC memory card, up to 2 GB capacity, with FAT or FAT16 format.

f) The serial connection cables that allows the communication between all the systems described in point a and the PC described on point d. To realize this cables please see the several figures on this manual.

In order to speed up the development of the final application, are available some example and utility programs. First of all the customer has to find the interesting components and then to use them as described in the same programs or in following chapters.
Some of described elements, as the manual, can be downloaded from **grifo®** web sites.

TECHNICAL FEATURES

Signals acquired and saved: Up to 8 analog inputs

Acquired signals types: Voltage 0÷Vmv (Vmv=max. value voltage of acquisition hw)
Voltage 0÷4*Vmv(Vmv=max. value voltage of acquisition hw)
Current 0÷20 mA
Current 4÷20 mA

Analog acquisition type: Direct (1 conversion) and Filtered (average of 8 conversions)

Acquisition time: Configurable among 18 predefined values (1 sec, 2 sec, 5 sec, 10 sec, 20 sec, 30 sec, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 1 hour, 2 hour, 5 hour, 10 hour, 12 hour, 24 hour)
or a number of seconds inserted by user

Timings resolution: 10 msec

Communication: Acquisition hw <-> saving hw: asynchronous RS 232 or synchronous I2C BUS
Acquisition hw <-> configuration PC: asynchronous RS 232
Saving hw <-> configuration PC: asynchronous RS 232

RS 232 physical protocol: 19200 Baud**,** 8 Bits per character, no Parity, 1 Stop bit

Configuration saving: On EEPROM not volatile

Supported memory cards: SD or MMC up to 2 GBytes

Memory cards format: FAT or FAT16

Saved data format: ASCII aligned in columns (compatible with Excel)

Saved data measure unit: Engineering unit, with configurable scale

Signals, measures relationship: Linear transfer function of first degree

Meaningful digits number: Automatic, up to 8

2GB card fill up time: About 265 days in the maximum usage conditions (acquisition each second, on 8 inputs, with 8 meaningful digits, plus time and date)

INSTALLATION

In this chapter there are the information for a right installation of **SL-Data**. In detail there are the cables descriptions, the jumpers settings and any other information concerning hardware arrangement. All components not described in this chapter are not involved in **SL-Data** functionalities and they can't be used.

CONNECTIONS

The **SL-Data** hardware is provided of 8 connections used to link some sections of the used cards and all the field signals. Below are briefly described these connections, with the figures of the relative cables.
In addition the figures of next chapter show the connectors position on the boards, in order to simplify their recognitions.

POWER SUPPLY CONNECTION

The **SL-Data** system generally requires two power supply either for acquisition and saving hws. these power sources can be the same or separate, and they must strictly respect the indications reported in the manual of the used cards, inside the POWER SUPPLY chapters. Alternatively the user can choose even different power supply modalities, in order to reduce the cost of the complete system, upon agreement with **grifo®**. As an example it can be supplied a single power source to acquisition hw and then, the generated +5 Vdc can be used to supply power at saving hw, too.

NOTE: When a single AC source is used to supply both the hws, please ensure that the two phases of AC voltage are connected at the same input pins of power supply connector. Whenever this rule is not satisfied dangerous malfunctions or damages can rise up on all the connected devices. For example, if we call Phase1 and Phase2 the two signals of the AC voltage, then Phase1 must be always connected to positive inputs (Vac, +Vdc pow) and Phase2 must be connected to negative inputs (Vac, GND).

DIGITAL INPUTS CONNECTION

The **SL-Data** acquisition hw is always provided of 4 buffered digital inputs, that can be connected to switches, selectors, proximities, allarms, stroke ends, etc.
For details on these signals please read the manuals of the used cards, where the pin out and the connection modalities are fully described.
In **SL-Data** functionalities these inputs are used to select the configuration mode, as indicated in the homonimous paragraph.

ANALOG INPUTS CONNECTION

Up to 8 analog inputs, coming from the field environment, can be connected to **SL-Data** system. These signals generally are directly provided by the sensors that transduce the measure to acquire, as temperature, pressure, humidity, flux, capacity, position, voltage, corrent, consumption, etc. In fact the outputs of these sensors are typically compatible with the acquisition hw inputs, that accept voltage signals (0÷Vmv, 0÷Vmv*4) and current signals (0÷20 mA, 4÷20 mA).
The number and the name of the available analog inputs depend on the selected acquisition hw, and so it is also for the Voltage maximum value Vmv; these information are available in the technical manuals of the cards couple dedicated to acquisition hw, that are **GAB H844+Mini Module**. From these manuals the following values are obtained:

Vmv	Range 0÷Vmv	Range 0÷4*Vmv
2,5 V	0÷2,5 V	0÷10 V
5,0 V	0÷5,0V	0÷20 V

Once the available analog inputs have been located, before to connect them, they must be properly configured either by hardware and software, as described in the following paragraphs.

RS 232 CONNECTION BETWEEN ACQUISITION HW AND SAVING HW

The acquisition hw and the saving hw must be interconnected through a serial communication line, selectable by the user. When an asynchronous RS 232 connection has been choosen, the two units must be linked with the cable described in the following figure:

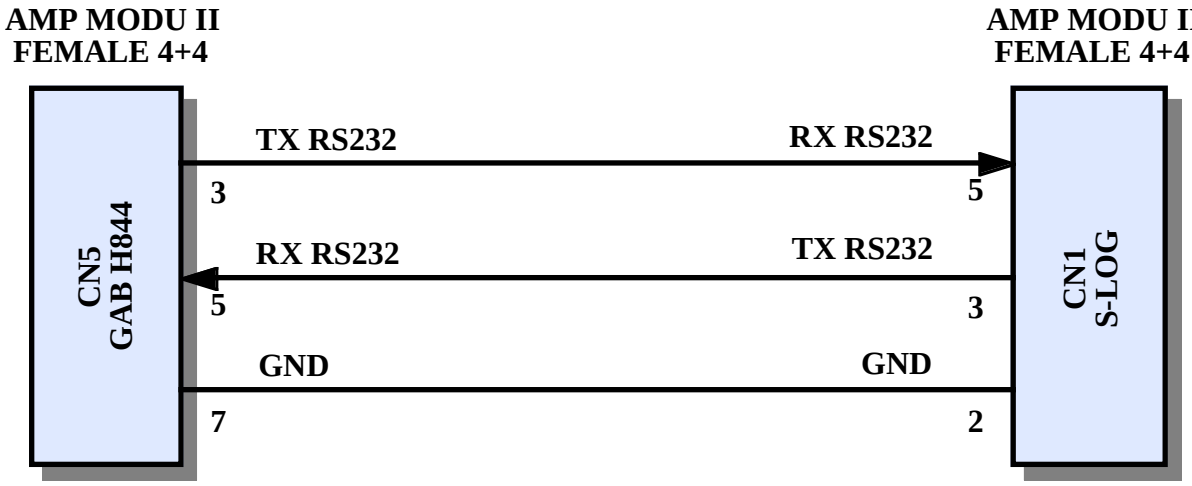

FIGURE 1: RS 232 CONNECTION BETWEEN GAB H844 AND S-LOG

Female connectors for this cable are directly available between grifo® accessories, and they can be ordered by using the codes **CKS.AMP8** or **AMP8.Cable**, as described in APPENDIX A of the manual.

I2C BUS CONNECTION BETWEEN ACQUISITION HW AND SAVING HW

The acquisition hw and the saving hw must be interconnected through a serial communication line, selectable by the user. When an synchronous I2C BUS connection has been choosen, the two units must be linked with the cable described in the following figure:

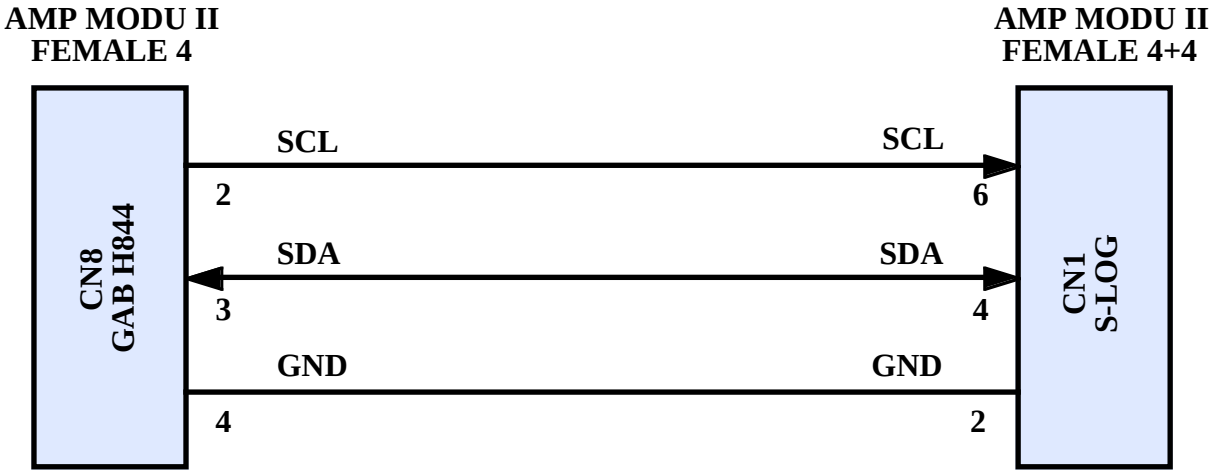

FIGURE 2: I2C BUS CONNECTION BETWEEN GAB H844 AND S-LOG

Female connectors for this cable are directly available between grifo® accessories, and they can be ordered by using the codes **CKS.AMP4**, **AMP4.Cable**, **CKS.AMP8**, **AMP8.Cable**, as described in APPENDIX A.

RS 232 CONNECTION BETWEEN ACQUISITION HW AND CONFIGURATION PC

The acquisition hw must be connected, through the RS 232 line, to a PC that perform its software configuration. Generally this configuration is performed only one time, before than **SL-Data** is installed in the application under development; consequently this connection is not required during standard work, when installation is already completed.

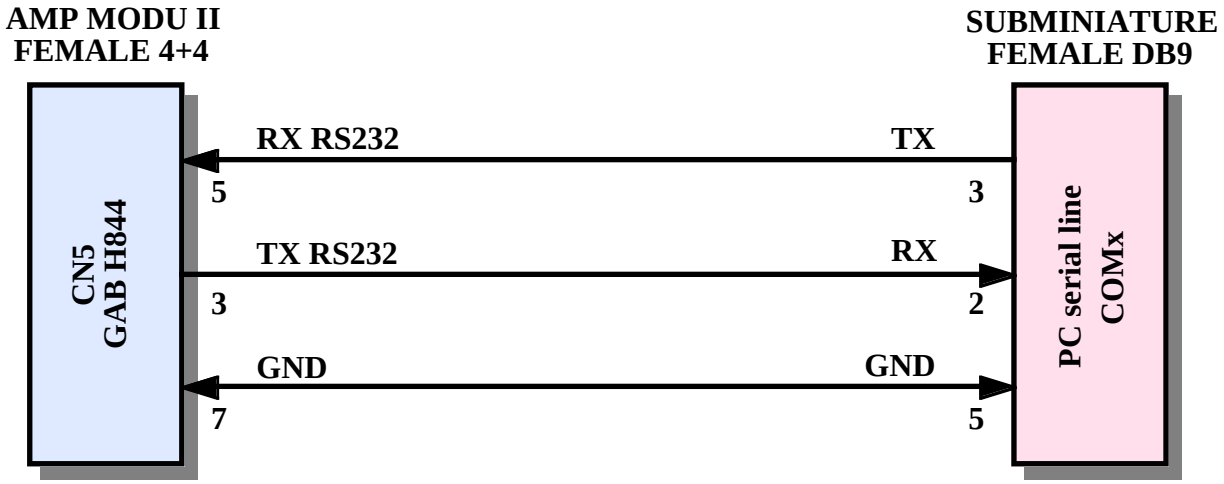

FIGURE 3: RS 232 CONNECTION BETWEEN GAB H844 AND CONFIGURATION PC

Female connectors for this cable are directly available between grifo® accessories, and they can be ordered by using the codes **CKS.AMP8** or **AMP8.Cable**, as described in APPENDIX A.

RS 232 CONNECTION BETWEEN SAVING HW AND CONFIGURATION PC

The saving hw must be connected, through the RS 232 line, to a PC that perform its software configuration. Generally this configuration is performed only one time, before than **SL-Data** is installed in the application under development; consequently this connection is not required during standard work, when installation is already completed.

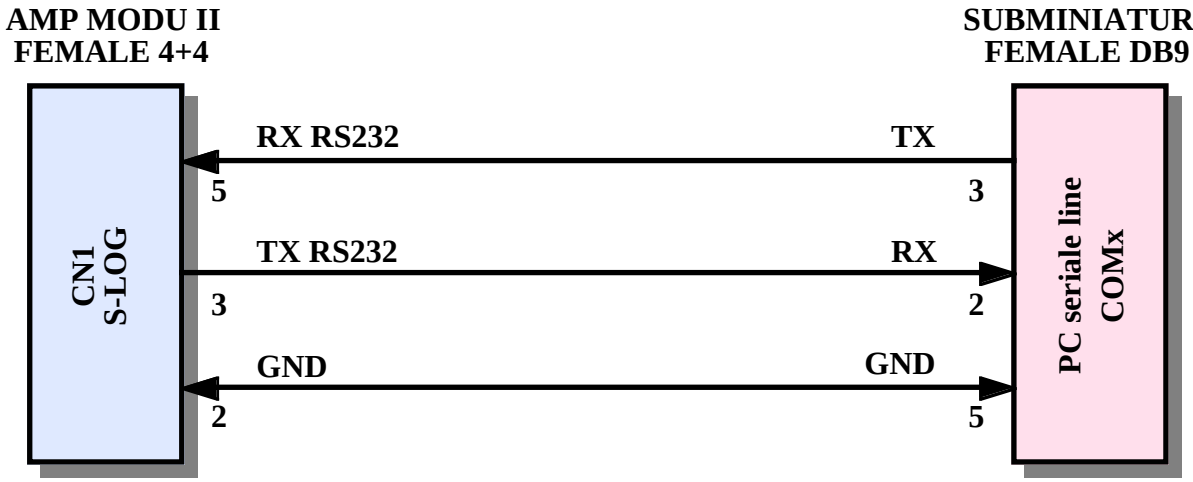

FIGURE 4: RS 232 CONNECTION BETWEEN S-LOG AND CONFIGURATION PC

Female connectors for this cable are directly available between grifo® accessories, and they can be ordered by using the codes **CKS.AMP8** or **AMP8.Cable**, as described in APPENDIX A.

RELAYS OUTPUTS CONNECTION

The **SL-Data** acquisition hw includes up to 4 digital relays outputs, that can be connected to motors, lamps, indicator lights, hooters, drivers, electric valves, etc.
For details on these signals please read the manuals of the used cards, where the pin out, the connection modalities and their availability are fully described.
In **SL-Data** functionalities one outputs is used to signalize possible malfunctions or anomalies of the system, as indicated in the following paragraphs.

HARDWARE CONFIGURATIONS

The **SL-Data** hw requires an hardware configuration in order to correctly perform its work, according with the connections described in previous paragraphs and the functionalities described in following chapters.
The hardware configuration that must be performed is summarized below:

Acquisition hw (**GAB H844** + **Mini Module**):

Asynchronous serial line	->	RS 232 buffered
CAN line termination	->	Don't care (*1)
Vrefreference voltage	->	Depends on selected Mini Module (see cards couple manuals)
Analog inputs	->	Depends on connected signals (*1)
Digital inputs	->	Connected to optocoupled NPN or PNP inputs.
USB shielding	->	Don't care (*1)
Operating mode	->	RUN

Saving hw (**S-LOG**):

Asynchronous serial line	->	RS 232 buffered
Power supply voltage	->	Don't care (*1)
Back up battery	->	Connected
Operating mode	->	Reception and data saving mode

(*1) The configuration is meaningless for the base functionality of **SL-Data** and it can be freely choosen by the user, according with his requirements.

The configurations can be performed through a simple and fast intervent on the jumpers and dip switches available on the boards, as described in the proper technical manuals. These last in fact report the positions, the connections and the descriptions of all the elements dedicated to hardware configuration of the card.
The above listed configurations refer to final operating condition of **SL-Data** and they must be partially changed during the development phase and the software configuration, as described in next paragraphs.

SOFTWARE CONFIGURATION

In order to complete the **SL-Data** installation, it must be performed a software configuration, too. With the software configuration the user can define many working modalities as: the used communication line, the type of connected analog signals, the acquisition time and type, the features of the acquired physic measures, the prefix and suffix added to saved data, the number and the name of the files generated on memory card, etc. The listed working modalities refer either to acquisition and saving hws, so botht them must be software configured.
A detailed description of software configuration can be found in the paragraph SL-DATA CONFIGURATION and in the chapter HOW TO START.

FUNCTIONALITIES

The **SL-Data** is a data logger for analog signals that saves the performed measures on a removable memory card. In this chapter are described all the executed functions, properly divided in three main subgroups.

SL-DATA CONFIGURATION

As described in ISTALLATION chapter, both the systems that realize the SL-Data (acquisition and saving hws) must be configured by software, before they can be used. The software configuration defines many aspects of the final product functionalities, especially for the acquired signals and saved data. In normal working conditions the software configuration must be performed only one time during the installation or when the use conditions, and/or user requirements, change.

ACQUISITION HW CONFIGURATION

The acquisition hw can be software configured by performing the following steps:
ca1) Connect the RS 232 line of acquisition hw to a PC, as described on figures 3 and 5.

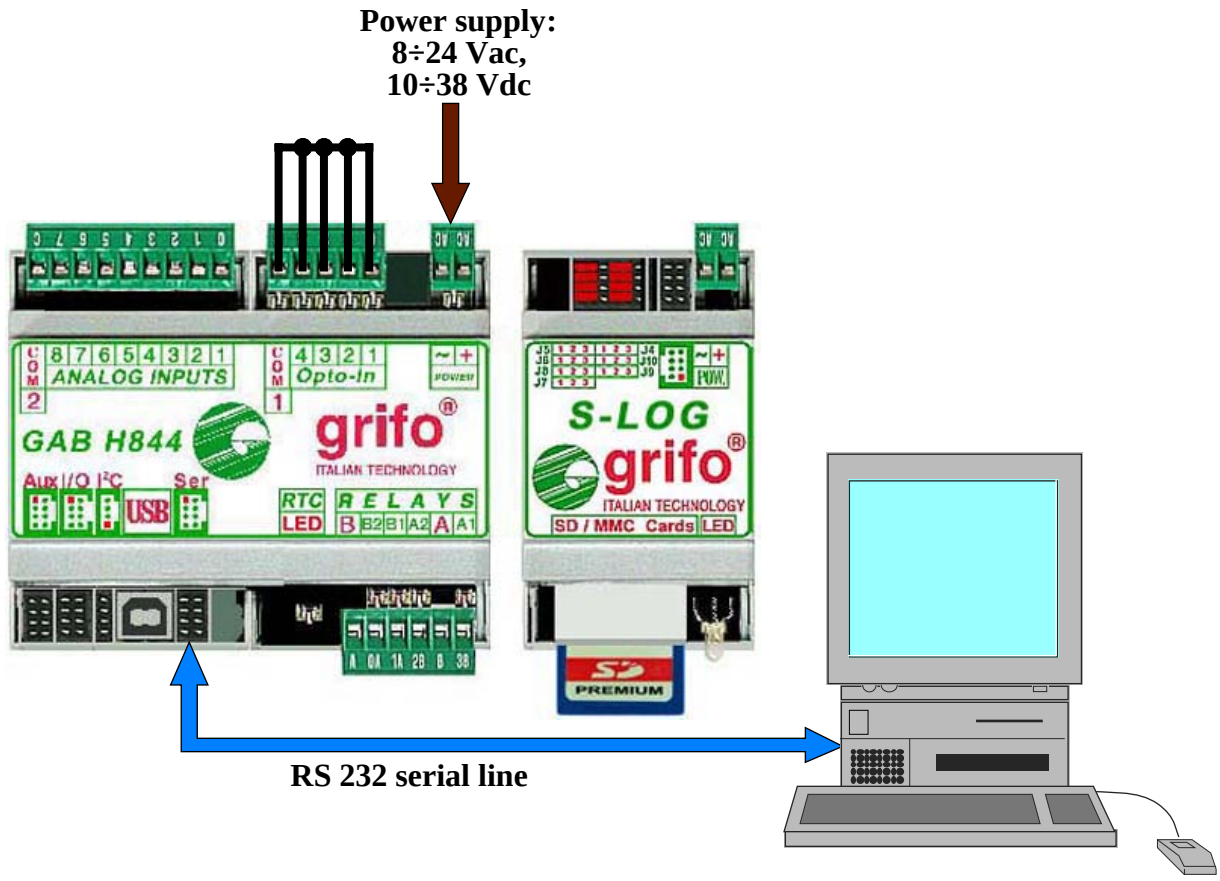

FIGURE 5: CONNECTIONS FOR ACQUISITION HW CONFIGURATION

ca2) On PC execute a terminal emulation program, set to:

19200 Baud,
8 Bits,
1 Stop bit,
No Parity,
No Handshake,

for the COMx serial line, connected at point ca1.

ca3) Enable the configuration mode by suppling power to acquisition hw, with all the digital inputs enabled. If digital inputs have been connected to optocoupled inputs of **GAB H844** (as stated in HARDWARE CONFIGURATION paragraph) it is sufficient a short circuits on all the 5 pins of CN3. In other words, when power is supplied if the pins are short circuited then the acquisition hw starts in configuration mode, viceversa it starts in acquire and saving mode. The user can arrange a quick release female screw driver connector, with all the 5 pins wired together, and connect it to CN3 of **GAB H844** to start or not the software configuration of acquisition hw.

ca4) Once the configuration is enabled the user can interact with acquisition hw through the PC previously connected, that works as a serial console. On the PC's monitor all the provided configurations will appear in sequence, as described in the following steps.

ca5) Select the **representation language** between *English* and *Italian*, by typing the relative first letter. Please remind that this choice concerns only the language used in acquisition hw configuration, not in all the other **SL-Data** operations.

ca6) Examine the status line immediately displayed after: here there are the **SL-Data** firmware version and the Mini Module name, used in acquisition hw. This line is not a configuration to perform and it has only information purpose; moreover this is the only point where the user can get the firmware version.

ca7) Select the **communication line** that it will connect the acquisition hw and the saving hw, between *RS 232* and *I2C BUS*, by typing the relative first letter. For details and other info about the communication line selection, please read the ACQUIRE AND SAVING paragraph.

ca8) Examine the information line displayed immediately after: here are summarized the configurations to perform on the saving hw **S-LOG**, in order to complete the selection of communication line.

ca9) Select the **acquisition time** by typing the relative letter. Please remind that are available 18 predefined values equal to *1 sec, 2 sec, 5 sec, 10 sec, 20 sec, 30 sec, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 1 hour, 2 hour, 5 hour, 10 hour, 12 hour, 24 hour* or a value in secondss inserted by user (*Other*).

The acquisition time is the time elapsed between one acquisition and the following one and the time distance of data saved on memory card.

ca10) Select the features of the analog signals connected to acquisition hw that are the **electric signal type** and the engineering unit of the relative physic measure. The electric signal can be selected among the 4 available on **GAB H844** (*0÷Vmv*, *0÷Vmv*4*, *0÷20 mA*, *4÷20 mA*) by typing the associated letter, while the engineering unit is defined by inserting the **begin scale** plus **end scale** values, of the acquired measure. Both the scale values are composed by 8 maximum digits, including sign and decimal point, thus they accept values included in *-9999999÷99999999* range.

The terns of configurations just described must be repeated for each analog input signal and the number of inputs changes according with acquisition hw. During the configuration it is also displayed the name of the input in order to simplify the recognition and connection of the sensors.

ca11) Select the **acquisition type** between *Direct* and *Filtered*, by typing the relative first letter. With the acquisition type the user can decide if the analog signals are converted only one time (direct), or 8 times and then averaged (filtered) resulting in more stable values.

ca12) At this point the configuration is complete and the user must select to confirm the performed settings or viceversa abort them. With the first choice the acquisition hw firmware saves the settings, exits from configuration mode and automatically passes to acquire and saving mode; viceversa with the second choice the configuration restarts from first selection (point ca5) and the last inserted settings are re-proposed.

ca13) When the user exits from configuration, the performed settings are accepted and saved on EEPROM in order to be always available, even after a power on. Moreover they are equipped with specific algorithms and reliability controls that ensure the settings validity in any working conditions.

ca14) In the software configuration of the acquisition hw, for each selection it is always suggested a starting value that is the previous setting. At this point the user can delete it with the backspace key and then type the new one: all valid characters are accepted and shown while every invalid keys pressed aren't accepted and it is produced an acoustic error feed back, on PC.

In the chapter HOW TO START it is reported a configuration example, complete of figures, that illustrates all the above steps.

SAVING HW CONFIGURATION

The saving hw can be software configured by performing the following steps:

cs1) Connect the RS 232 line of saving hw **S-LOG** to a PC, as described on figures 4 and 6.

cs2) Install on PC the program Conf_SLOG, that is the utility software properly developed by **grifo®** in order toconfigure the **S-LOG** in easy and fast manner.

cs3) Arrange the **S-LOG** for configuration, or position jumper J1 in 1-2 and supply power.

cs4) Arrange the PC for configuration: run the Conf_SLOG program, select the Italian language and set the PC serial line connected at point cs1, for:

Baud Rate	=	*19200*
Bits per characters	=	*8*
Parity	=	*None*
Stop Bit	=	*1*
Handshaking	=	*None*

cs5) Configure the parameters for serial communication, through the specific window of Conf_SLOG, at the values indicated during acquisition hw configuration (see point ca8) and here listed:

Parameter	RS 232 connection	I2C BUS connection
Communication line:	*Async. serial (RS 232,TTL)*	*Sync. serial (I2C BUS)*
Baud Rate:	*19200*	*Don't care*
Parity:	*None*	*Don't care*
Stop Bit:	*1*	*Don't care*
Handshaking:	*None (#)*	*Don't care*
I2C BUS slave address:	*Don't care*	*128*
Timeout (*20 msec):	*250*	*250*

(#) Alternatively it can be chosen the *Repeated software (XON,XOFF)* setting, in order to allow the acquisition hw to signalize possible anomaly of saving hw.

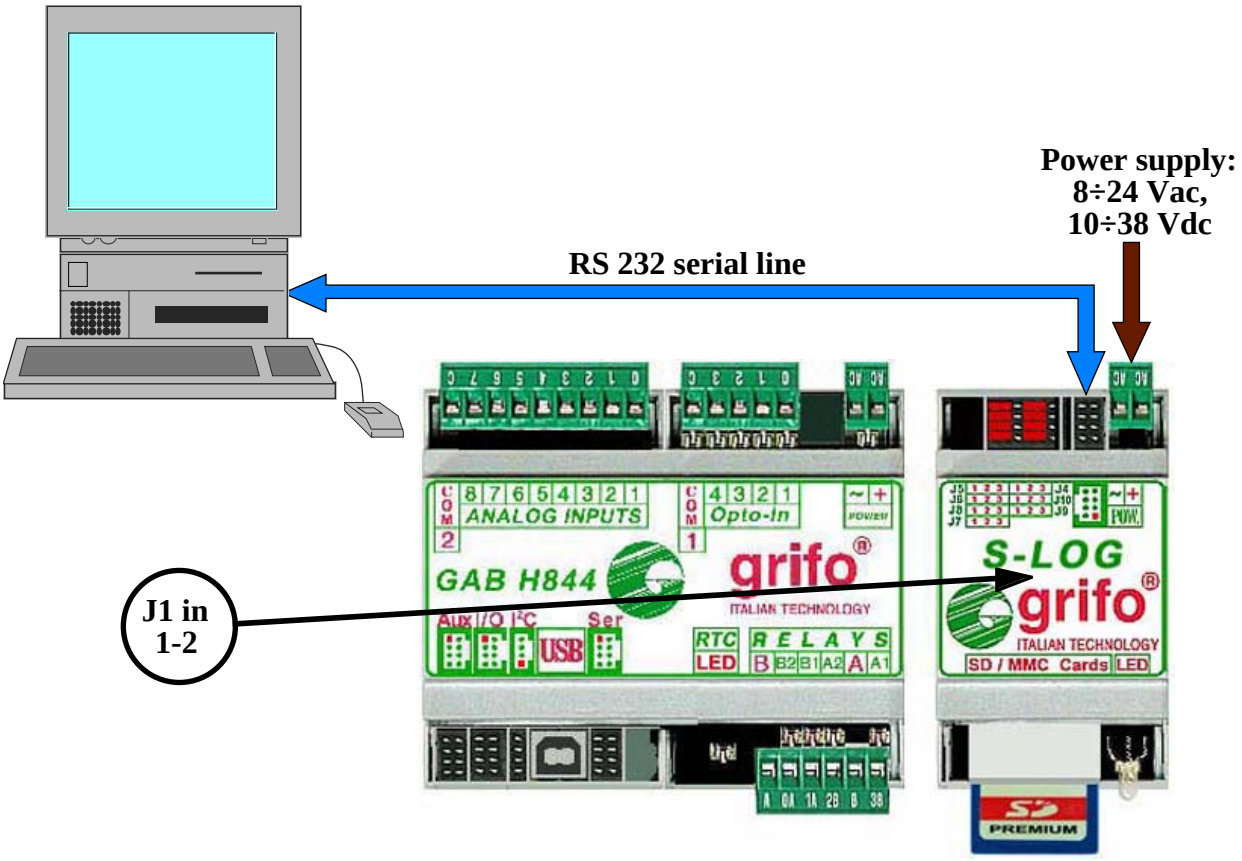

FIGURE 6: CONNECTIONS FOR SAVING HW CONFIGURATION

cs6) Configure the parameters for data saving, through the specific window of Conf_SLOG, at the values listed below:

Parameter	Value
File path and name:	Chosen by user according with application requirements
File duration:	Chosen by user according with application requirements
Insert action:	*Verify and format*
Group time (*20 msec):	*35* (when Group prefix or suffix are used)
File label:	Chosen by user according with application requirements
Group prefix:	Chosen by user according with application requirements
Group suffix:	Chosen by user according with application requirements

Further information on the parameters for saving are available in **S-LOG** user manual, while in the chapter HOW TO START it is reported a configuration example, complete of figures, that illustrates all the above steps.

DEFAULT CONFIGURATION

After the first power supply and whenever the saved configuration settings are not valid, the **SL-Data** restores a default or base configuration, featured by the following values for its parameters:

Acquisition hw:

Representation language:	*English*
Communication line:	*I2C BUS*
Acquisition time:	*10 sec*
Electric signal type:	*0÷Vmv*
Begin scale:	*0.000000*
End scale:	*100.0000*
Acquisition type:	*Direct*

Saving hw:

Communication line:	*Asynchronous serial (RS 232,TTL)*
Baud Rate:	*19200*
Parity:	*None*
Stop Bit:	*1*
Handshaking:	*None*
I2C BUS slave address:	*128*
Timeout (*20 msec):	*250*
File path and name:	*SLOG.DAT*
File duration:	*None*
Insert action:	*None*
Group time (*20 msec):	*255* (disabled)
File label:	*None*
Group prefix:	*None*
Group suffix:	*None*

This values has been selected in order to simplify the first use of **SL-Data** and contemporaneously in order to recognize the incomed anomaly. For this purpose some physic signalations have been provided; they inform the possible user located in the installation place, as described in the following paragraph.

ACQUIRE AND SAVING

The acquire and saving of **SL-Data** is the mode generally used, in fact it performs the real work of data logger for ananlog signals. As described in the previous paragraphs, dedicated to **SL-Data** configurations, the functionalities can be adapted to user requirements by setting the available configuration parameters. When the adaptation is not sufficient it is necessary to modify the management firmware, by following the indications of the last chapter FIRMWARE.
In the acquire and saving mode the operations that must be executed by user and those performed by **SL-Data**, are summarized in the following steps:

as1) Connect the acquisition hw to the fields analog signals (sensors) and to saving hw through the communication line selected in configuration, at point ca7 and cs5. For details please see figures 1, 2, 7, 8 and the paragraphs RS 232 ASYNCHRONOUS COMMUNICATION, I2C BUS SYNCHRONOUS COMMUNICATION.

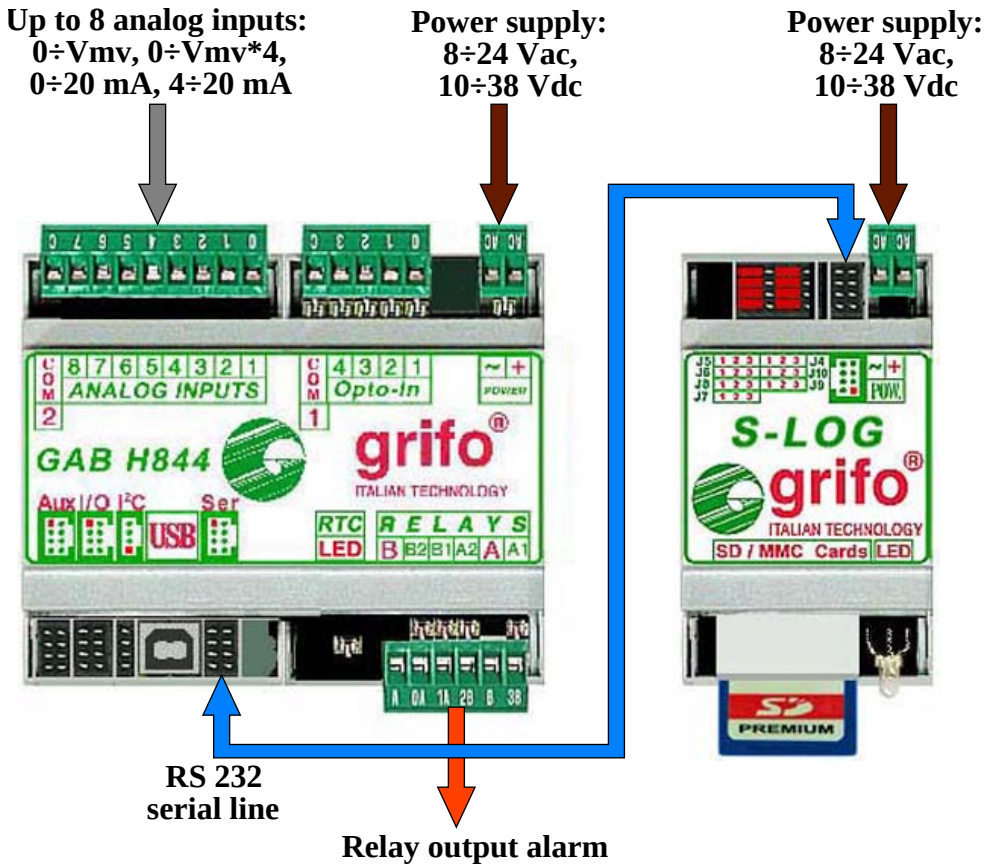

FIGURE 7: CONNECTIONS WITH RS 232 COMMUNICATION

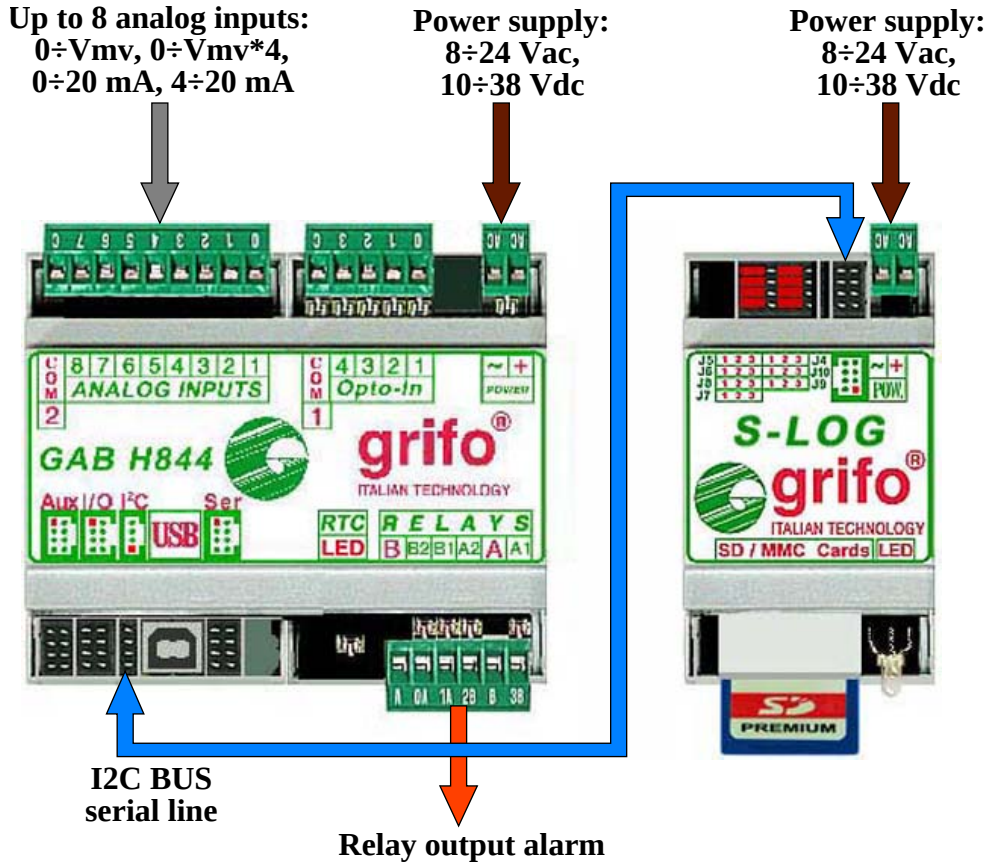

FIGURE 8: CONNECTIONS WITH I2C BUS COMMUNICATION

as2) The acquire and saving mode is selected at power on when the conditions that enables the configuration mode are not active. In details:

Acquisition hw -> at least one digital inputs of **GAB H844** not active.
Saving hw -> jumper J1 of **S-LOG** in position 2-3.

as3) Once the acquire and saving mode is started, it checks the configuration parameters saved on EEPROM and if they are valid then it loads them, viceversa it restore the default values, described in DEFAULT CONFIGURATION paragraph. In the last case it signalizes the anomalous condition to possible user that chair the installation.
Please remind that the just described configuration check is performed separately by the two hws that make up **SL-Data**, as well as the invalid configuration signalation (see anomalies at point as11).

as4) At this point the **SL-Data** enables its timing, based on a periodic interrupt each 10 msec, in order to satisfy all the required controls of elapsed time. It must be underlined that this timing is unavoidably affected by a difference, in confront of a real time clock. Consequently if saving hw is configured to save the current time as suffix of each acquisition, then this time can be displaced from **acquisition time**. This difference is a real feature of **SL-Data** firmware and it can be eliminated only by using a Real Time Clock even on the acquisition hw, when it is available.

as5) For any elapsed **acquisition time** the **SL-Data** converts all the analog inputs available on acquisition hw, taking in account the **acquisition type** that defines if the A/D conversion is single (direct) or repeated 8 times and then averaged (filtered). In both cases it obtains numeric values with the resolution of the A/D section on the used Mini Module.

as6) At the obtained numeric values then is applied the typical gain factor of **GAB H844** and after they are converted in engineering units. The last conversion is performed trough a linear transfer function of first degree (y=m*x+n), obtained by relative parameters **begin scale**, **end scale** and **electric signal type** defined in acquisition hw configuration, at point ca10.

as7) The obtained measures in engineering units are automatically formatted, in order to supply always the largest number of meaningful digits. Even the significant digits number is obtained by configuration parameters plus the points number available in the used A/D converter and in the defined engineering scale. For example with 10 bits A/D resolution, equal to 1024 points, the **SL-Data** will use the following formats according with defined scale:

Engineering scale	Scale points	Scale points / A/D points	Format
0÷1	2	2/1024=0,001953125	x.xxx
0÷10	11	11/1024=0,010742187	xx.xx
0÷100	101	101/1024=0,098632812	xxx.xx
0÷1000	1001	1001/1024=0,977539062	xxxx.x
0÷10000	10001	10001/1024=9,766601563	xxxxx
etc.			

In the produced format the digits on the left of decimal point are present only when they are meaningful; for example with the 0÷1000 scale, if the measure in engineering format is 5, once it is formatted it becomes *5.0* not *0005.0*.

as8) The measures in formatted engineering units are then transmitted to saving hw, with the addition of new line characters (CR LF) at the beginning and of separation characters (TAB) among the measures. As even the measures are transmitted in ASCII format, then all the transmitted and saved data can be examined with any program capable to manage this format (i.e. text editor, spread sheet as listed in USE OF SAVED DATA paragraph).

as9) Moreover the acquisition hw verifies the right functionality of saving hw, according with the performed serial connection. Whenever the verify discovers a malfunction, it is signalized as described at point as11.

as10) The data transmitted by acquisition hw are received by saving hw that save them on memory card. The saving hw can autonomously adds informations like **group prefix**, **group suffix**, **file label**, etc. as defined in the saving hw configuration. These configuration parameters are completely described in **S-LOG** user manual where the user can obtain many information and explanatory examples.
For example with a group suffix properly set , the current time and date can be placed side by side to measures of every acquisition, the data can be divided in different files, etc.

as11) During its normal work if the **SL-Data** recognizes some anomalies, then it signalizes them as follows:

Acquisition hw	->	changes status of relay output OUT A1 on **GAB H844** each second, for 3 minutes and then mantains the output always active.
Saving hw	->	sets the visualization LED available on **S-LOG**, yellow and blinking.

Both the signalations are astable and they remain active until the concerned hardware is turned off. By this way in the unchaired installations, it is anyway possible to recognize an incomed anomaly even at a long time distance, when the operator reaches the installation place, for example when he must replace the memory card.

RS 232 ASYNCHRONOUS COMMUNICATION

When the user decides that acquisition hw comunicates with saving hw through an RS 232 asynchronous serial line, he must interconnect the two units as described in figure 7, with the cable illustrated in figure 1.
With the RS 232 asynchronous connection, it can be selected two different settings for the **handshaking** parameter, in the communication configuration of **S-LOG**:

None	->	the acquisition hw can't verify the right functionality of saving hw, and it will never signal this anomaly.
Repeated software (XON,XOFF)	->	the acquisition hw can verify the right functionality of saving hw, and it will signal this possible anomaly.

By chosing this connection, the I2C BUS synchronous serial line of the acquisition hw remain free and it can be used for other units connection, with a proper intervent on the management firmware.

I2C BUS SYNCHRONOUS COMMUNICATION

When the user decide that acquisition hw comunicates with saving hw through an I2C BUS synchronous serial line, he must interconnect the two units as described in figure 8, with the cable illustrated in figure 2.
With the I2C BUS synchronous connection the acquisition hw can always verify the right functionality of saving hw, and it will signal this possible anomaly.
By chosing this connection, the asynchronous serial line in RS 232 (or RS 422, RS 485, Current Loop, TTL) of the acquisition hw remain free and it can be used for other units connection (as modem, operator panel, PLC, PC, etc.), with a proper intervent on the management firmware.

USE OF SAVED DATA

The functionalities of **SL-Data** are closed with the extraction of memory card , where all the acquired measures are saved, and its insertion in a PC capable to hadle it. These operations are summarized in the following steps:

ud1) During the normal work of **SL-Data**, the saving hw signalize the writing on memory card by setting red, the LED of **S-LOG**.
The operator encharged of memory card extraction must wait that **S-LOG**'s LED is not red and then remove the card before the next acquisition and saving start. In other words once a saving is completed, he dispose of an **acquisition time** for a safety extraction or replacement of the memory card. When the acquisition time is too short (<5 sec) the operator hasn't enough time to perform the intervent. In these conditions he must:
- remove serial communication cable between acquisition hw and saving hw;
- proceed with the memory card replacement;
- switch off the **SL-Data** power supply, in order to clear the possible anomalies signalation, caused by disconnected cable;
- re-connect the serial cable;
- switch on power supply.

ud2) The memory card extracted from **SL-Data** can be inserted in a PC provided of multicard interface and then the file/s available on the card must be copied to PC's hard disk, by using operating system commands.
The files number and files names are settings defined by the user during saving hw configuration, with the specific parameters **file path and name** and **file duration**, as described at point cs6.

ud3) Delete the file/s from memory card in order to clear it for a new acquire and saving. This delete operation can coincide even with a card format, by ensuring the selection of FAT or FAT16 format.

ud4) The final operator can choose how the memory cards are managed in order to take the acquired data from **SL-Data**. For example he can decide to use more memory cards and when data must be taken, he replace the full card with an empty one. Alternatively he can use a single memory card and data can be taken by using a portable laptop PC carried in the installation location by the user; here the full memory card is copied, cleared and reinserted directly in the installation place.

ud5) At this point the data copied on PC can be used by operator according with his needs. All data are saved in ASCII format, aligned in columns, with one acquisition for each row and consequently the file/s can be examined by a generic text editor (i.e. Windows Notepad) or opened and processed by elettronic spreadsheets (Excel). In details the files generated by **SL-Data** follow the next rules:
- each acquisition starts with carriage return (CR=13=0DH) and line feed (LF=10=0AH) characters;
- the measure values are in engineering units defined in configuration (see point ca10) and with automatic format (see point as7). This means that the digits numbers either before or after the decimal point change according with the defined scale;
- the decimal point coincide with "." character (46=2EH);
- any value of measures is separated by previous one with an alignement character (TAB=9=09H);
- the number of measures depend on used acquisition hw and it ranges from 4 to 8.

ud6) Thanks to PC the data can be saved in different files, can be examined, processed, printed, ordered, archivied, displayed on a graph, etc. according with specific requirements of the final user. These operations can be performed with programs and/or commands already available on PC or with specific new programs developed by the user, for example in Visual Basic, Visual C, Delphi, Java, etc.

HOW TO START

In this chapter are described the operations necessary for a first use of **SL-Data** in a linear and quickly mode, without none beginning problem. In detail it is reported the correct sequence of operations that user has to execute firstly to configure and then to basically use the product.
In order to semplify the starting phase, in this chapter we suppose to acquire and save every 30 seconds, 4 transducers for physic measures, installed in a green house:

Transducer	Converted physic measure	Generated electric signal
Temperature	-50÷150 °C	0÷2,5 V
Humidity	0÷100 %	0÷20 mA
Pressure	800÷1200 mBar	4÷20 mA
Shutter position	0÷1000 mm	0÷10 V

and to be provided of a PC with Windows XP operating system.

1) Read all the received documentation.

2) Arrange the **SL-Data** for working and configuration, that is:
- provide a proper power supply source;
- realize the communication cables described in figure 2, 3, 4;
- open the plastic containers of acquistion hw (**GAB H844**) and saving hw (**S-LOG**);
- extract possible memory card from **S-LOG**;
- plan the PC with all the features described in REQUIREMENTS paragraph.

3) Perform the hardware configurations of both hws as described in homonimous paragraph. For the selected application the jumpers must be placed as follow:

GAB H844	J1,J9,J8,JS1	->	not connected
	J2,J3,J4,J5,J10,J18,J20,J21	->	2-3
	J13,J14,J15,J16,J17,J19,J22÷J38	->	1-2
	J11	->	depend on used Mini Module
Mini Module	Dip switch or jumpers	->	serial line in RS 232
		->	RUN mode
S-LOG	J2	->	connected
	J1,J4,J5,J6,J7,J8,J9,J10	->	1-2

4) Connect CN5 of **GAB H844** to COMx communication line of PC, by using the proper communication cable , as described in figures 3, 5.

5) On PC run the HYPERTERMINAL emulation terminal program (*Start* | *Programs* | *Accessory* | *Communication* | *Hyperterminal*), inside the window *File* | *Property* select the serial line COMx connected at point 4, set the physic protocol for the acquisition hw configuration and define the emulation modalities, as described in figure 9.

6) Short circuit the 5 pins of connector CN3 on **GAB H844** in order to enable all the digital inputs and thus activate the configuration mode of acquisition hw.

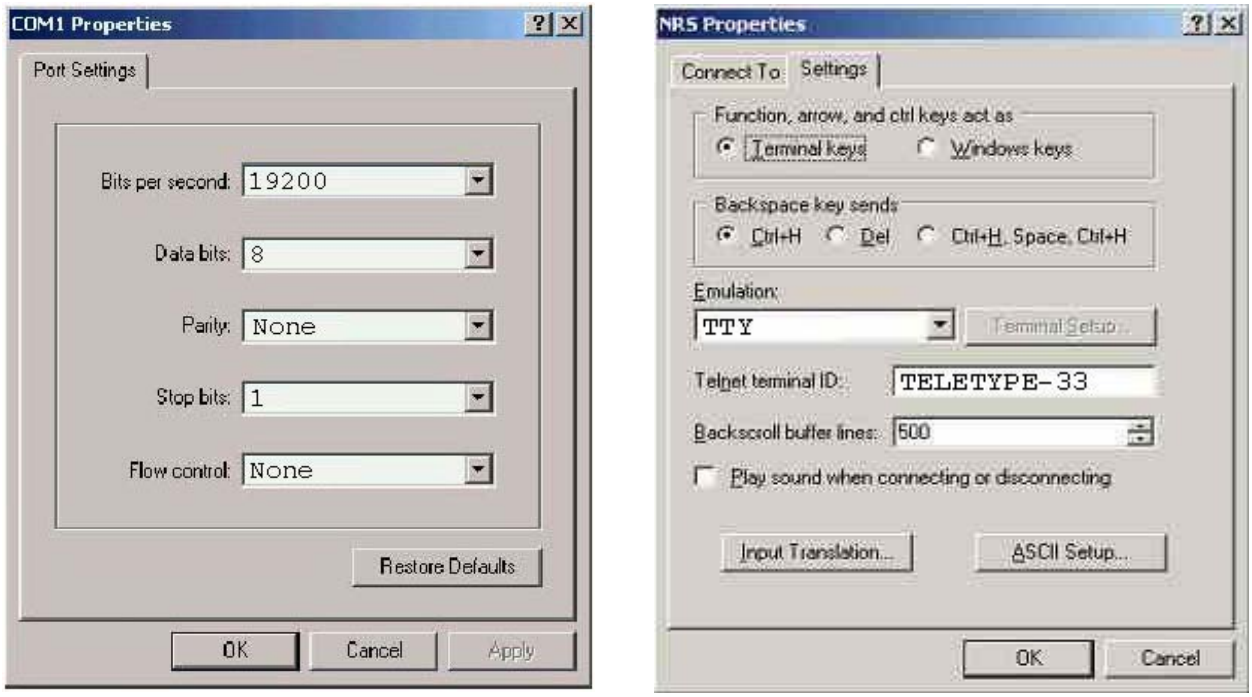

FIGURE 9: HYPERTERMINAL SETTINGS FOR ACQUISITION HW CONFIGURATION

7) Supply power to **GAB H844** and check that the configuration mode starts and it is shown on the PC monitor.

8) Perform the configuration of acquisition hw, by using the instructions listed in homonimous paragraph and providing the settings reported in following figure.

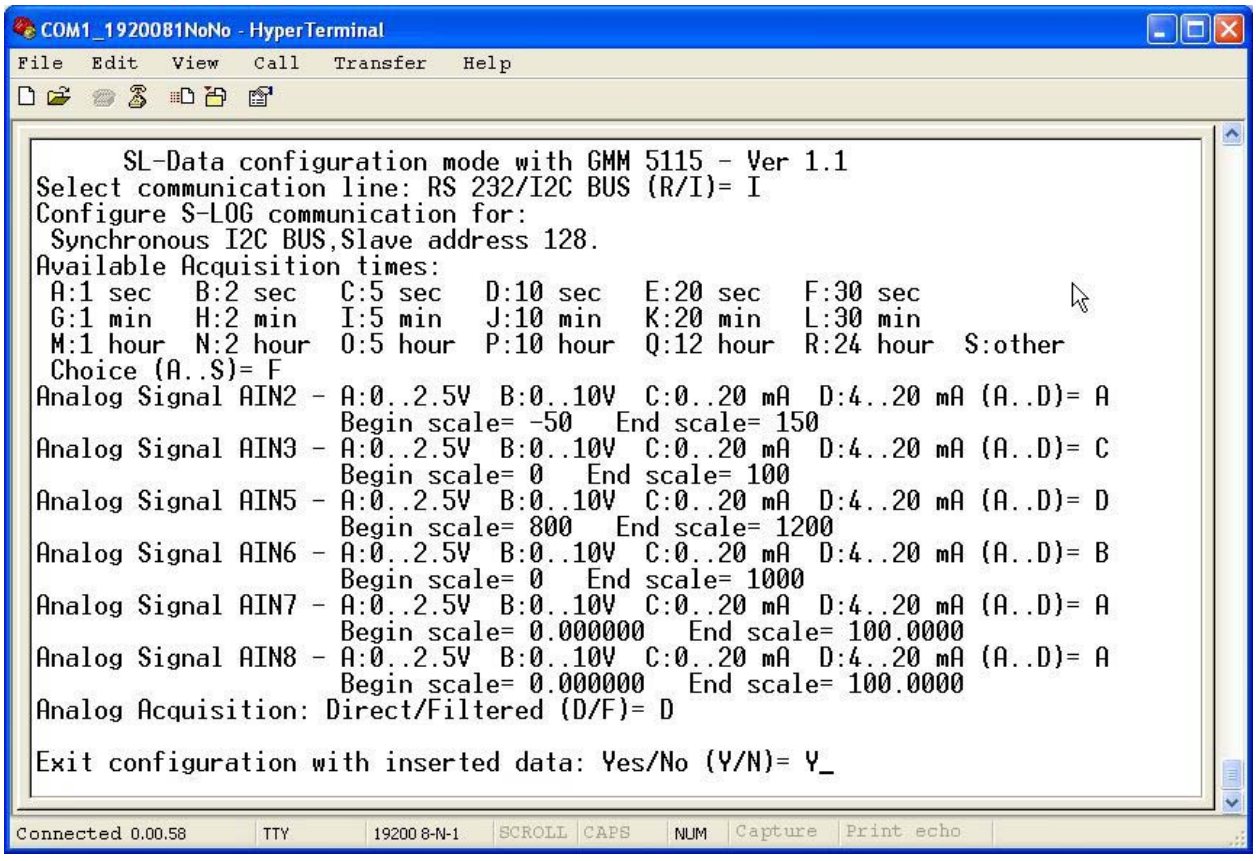

FIGURE 10: SETTINGS FOR ACQUISITION HW CONFIGURATION

9) It is important underline that the values reported in figure 10 are those required by the suggested application, that the not used signals have mantained the default settings, that acquisitions are direct and it has been selected the I2C BUS communication line.

10) Once the configuration exit is confirmed with the inserted settings the acquisition hw starts to acquire the analog measures and transmit them to saving hw. As the last one is still not configured and nor connected, the acquisition hw will inevitably signal an anomaly: in this phase it doesn't care.

11) Remove power supply from acquisition hw, disconnect the CN3 connector on **GAB H844**, remove the serial connection with PC and on the last exit from Hyperterminal program.
At this point the configuration of acquisition hw is completed and we proceed with saving hw configuration.

12) Connect CN1 of **S-LOG** to COMx communication line of PC, by using the proper communication cable, as described in figures 4, 6.

13) Install on PC the **Conf_SLOG** program, that is the utility realized by **grifo®** to quickly and easily configure the **S-LOG**. When the installation program asks to substitute some system files, please reply to mantain the original ones (*Keep*).

14) Run the **Conf_SLOG** that at the first execution is already set for the English language. If so it isn't, please change the selction, through the *Programma* | *Lingua* | *Inglese*.

15) Configure the communication line of PC for physical protocol of **S-LOG**, through the option *Program* | *Serial*. In the displayed window select the serial line connected at point 12 and the parameters reported in follow figure.

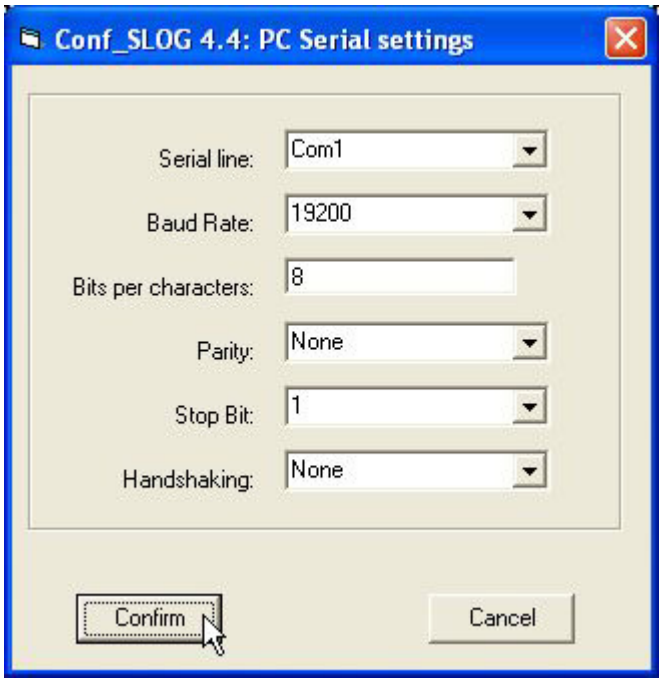

FIGURE 11: PC SERIAL SETTINGS WITH CONF_SLOG

16) Define the parameters for serial communication that **S-LOG** will use to receive data from acquisition hw, through *Configure* | *Communication* option. Once all the values reported in next figure have been inserted, press the *Set configuration* button, then wait the end of configuration (finished after tens of seconds) and verify that no errors are found (all parameters on green background).

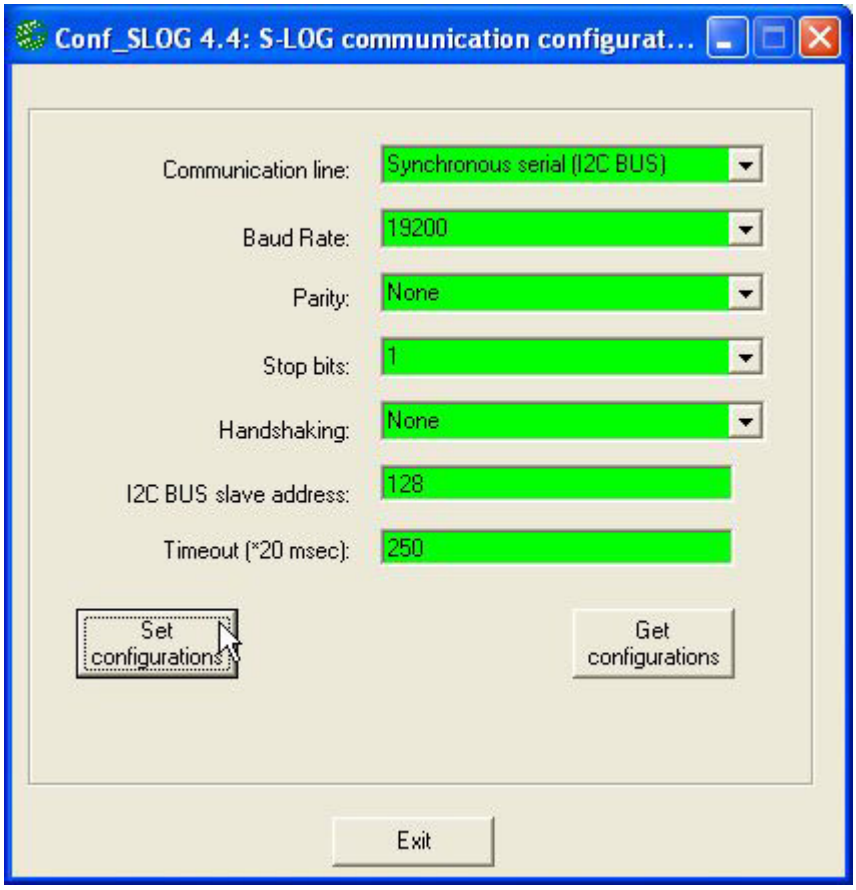

FIGURE 12: COMMUNICATION CONFIGURATION WITH CONF_SLOG

17) Define the parameters for saving that the **S-LOG** will perform on memory card, through *Configure* | *Saving* option. Once all the values reported in figure 13 have been inserted, press the *Set configuration* button, then wait the end of configuration (finished after tens of seconds) and verify that no errors are found (all parameters on green background).
In the suggested application, only one file is created, named *GREENH01.DAT*, with brief columns headers (for name and units of the measure) and current date plus time added at the end of each saving.

18) Check and if needed set, the current date and time of **S-LOG** clock, through *General* | *Clock* option.

19) When configurations and verifies are completed, exit from **Conf_SLOG** and return to Windows operating system. Remove the power supply from **S-LOG**, position jumper J1 in 2-3 and remove the serial connection with PC.
At this point both the hws are completely configured, they can be re-enclosed in the relative plastic containers and they are ready for the suggested application.

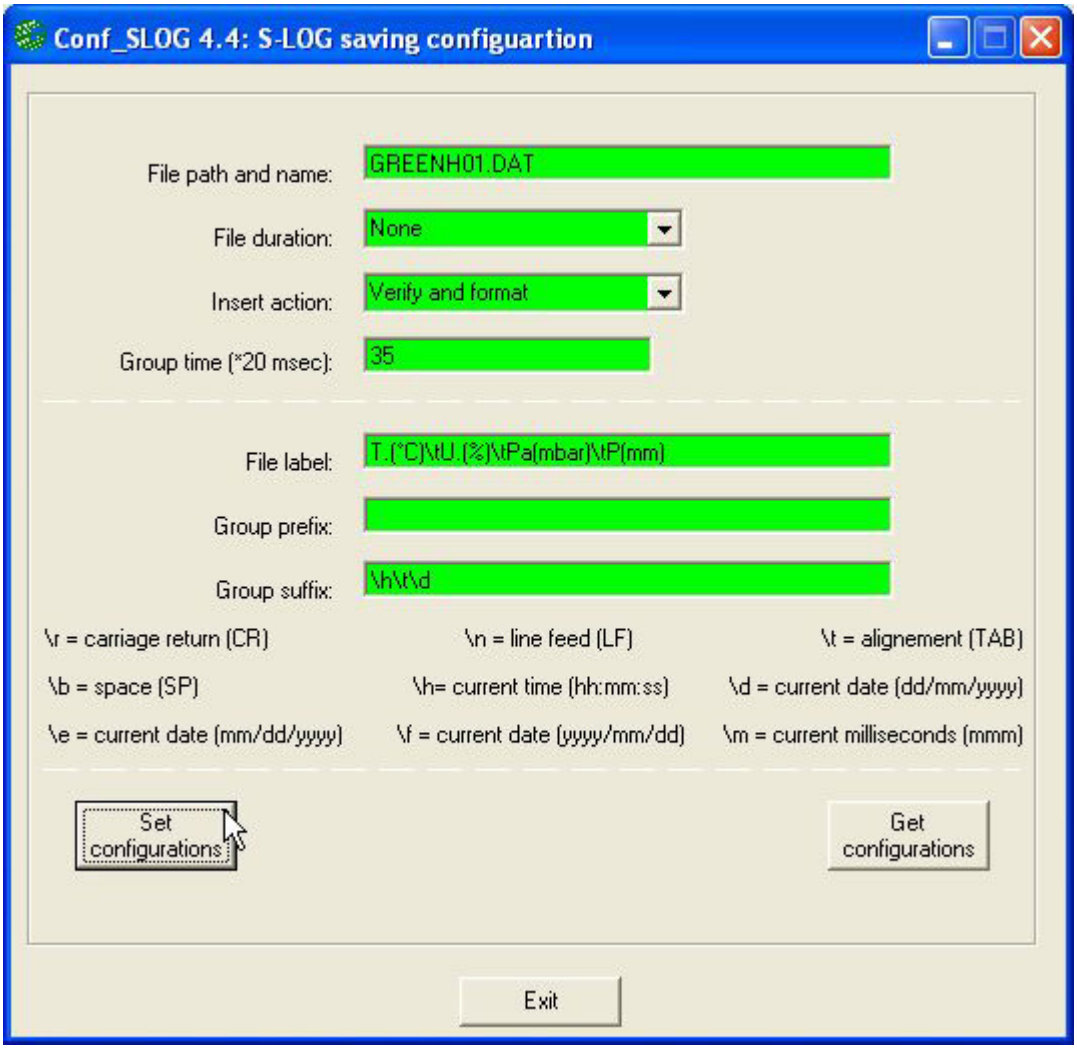

FIGURE 13: SAVING CONFIGURATION WITH CONF_SLOG

20) Coonect the sensors (transducers) to acquire to CN4 of **GAB H844** and acquisition hw to saving hw, with the preselected I2C BUS communication line, as described in figure 8.

21) Format a memory card with FAT or FAT16 format, through the PC, and then insert it in the saving hw **S-LOG**.

22) Supply power to **SL-Data** and check if the LED on **S-LOG** becomes green fixed.

23) From this momemnt each 30 seconds the **SL-Data** acquires the analog inputs available on acquisition hw, it transforms them in engineering unit measures, it formats the measures with the maximum number of meaningful digits and finally saves them on memory card and adds current time and date.

24) The user must simply wait the end of necessary observation period of the green house; in the mean time the **S-LOG** LED must be normally green fixed and it must becomes red during the described savings. Contemporaneously the user can also check that the acquisition hw doesn't signal anomalies (relay output OUT A1 of **GAB H844** must be disabled).

25) When required, the memory card can be extracted from **SL-Data**, by simply checking that the **S-LOG** LED is not red. If so it isn't the user must wait until it is no more red.

26) If the extracted card is not replaced within 30 seconds (before than selected acquisition time) the **SL-Data** recognizes an anomaly, caused by the impossibility to save the next acquired data, and it signalizes this alarm by enabling the relay output OUT A1 of **GAB H844**, every seconds. After 3 minutes the signalation changes and the same outputs become always enabled and it can be disabled only with a power off and on of **SL-Data**.

27) The removed memory card can be inserted in any PC and here it can be found the *GREENH01.DAT* file, that contains all the measures acquired and converted, accompanied by time and date. This information can be examined opening the file through any text editor, like NotePad of Windows operating system.
The *GREENH01.DAT* file must be firstly copied on the PC's hard disk and then deleted from the memory card: in this way the empty card is ready for the following usage.

28) In the suggested application the file with logged data can be opened with a spread sheet program like Excel. In order to correctly perform this operation, the following steps must be performed:
a) select the *File* | *Open* of Microsoft Excel;
b) in the displayed dialog window select the file *GREENH01.DAT* copied from memory card; whenever the file is not listed, please remind to set the field *File type = All files (*.*)*;
c) at this point it is shown the windows *Text import Wizard - Step 1 of 3* where the following settings must be performed:
Delimited
Start import from row: 1
File origin: Windows (ANSI)
and press *Next* to continue;
d) in the second window for text import, perform only the following settings:
Delimiters: Tab (it must be checked only the Tab item!!)
Text qualifier: "
and press *Next* to continue;
e) in the third window for text import perform only the following settings:
Column data format: General
Advanced | *Decimal separator: .* (point)
Advanced | *Thousand separator: '* (apex)
and first press *Ok* to close the *Advanced text import* window and then *Finish* to complete the file open.
At this point all the logged data are already placed in a table provided of a column for each measure, one for the time and one for the date.
It is suggested to save the opened file in Excel format, especially if it will be opened and used other times; it is sufficient supply the *File* | *Save as* command, select a *Save as type: Microsoft Excel (*.XLS)* and set the same file name, but with XLS extension.

29) By taking advantage from the several possibilities of Excel, and of Windows operating system, the same data can be printed, processed, shown on graphics, zipped, archieved, etc. according with the final user's requirements.

Microsoft Excel - GREENH01.xls

File Edit View Insert Format Tools Data Window Help

Arial 10

	A	B	C	D	E	F	G	H	I
1	T.(°C)	U.(%)	Pa(mbar)	P(mm)	N.C.	N.C.	Time	Date	
2	20,0	65,1	1020	500	0,00	0,00	17.15.51	23/12/2008	
3	19,7	65,2	1020	500	0,00	0,00	17.16.21	23/12/2008	
4	19,7	65,1	1020	500	0,10	0,10	17.16.51	23/12/2008	
5	20,0	65,1	1020	500	0,10	0,10	17.17.20	23/12/2008	
6	19,7	65,0	1020	500	0,00	0,10	17.17.50	23/12/2008	
7	20,0	65,1	1020	500	0,00	0,00	17.18.21	23/12/2008	
8	19,5	65,0	1020	500	0,00	0,00	17.18.51	23/12/2008	
9	19,5	65,0	1020	500	0,00	0,00	17.19.21	23/12/2008	
10	19,7	65,0	1020	500	0,10	0,10	17.19.51	23/12/2008	
11	20,0	65,0	1020	500	0,10	0,10	17.20.20	23/12/2008	
12	19,7	65,0	1020	500	0,00	0,00	17.20.50	23/12/2008	
13	19,7	65,0	1020	500	0,00	0,10	17.21.20	23/12/2008	
14	20,0	65,1	1030	500	0,00	0,00	17.21.51	23/12/2008	
15	19,7	65,0	1030	550	0,10	0,00	17.22.21	23/12/2008	
16	20,0	65,0	1030	550	0,10	0,10	17.22.51	23/12/2008	
17	19,7	65,1	1030	550	0,10	0,10	17.23.20	23/12/2008	
18	20,0	65,0	1030	550	0,10	0,10	17.23.50	23/12/2008	
19	20,0	65,0	1030	550	0,10	0,00	17.24.20	23/12/2008	
20	20,0	65,1	1030	550	0,10	0,10	17.24.50	23/12/2008	
21									

GREENH01

Ready NUM

FIGURE 14: OPEN LOGGED DATA WITH EXCEL

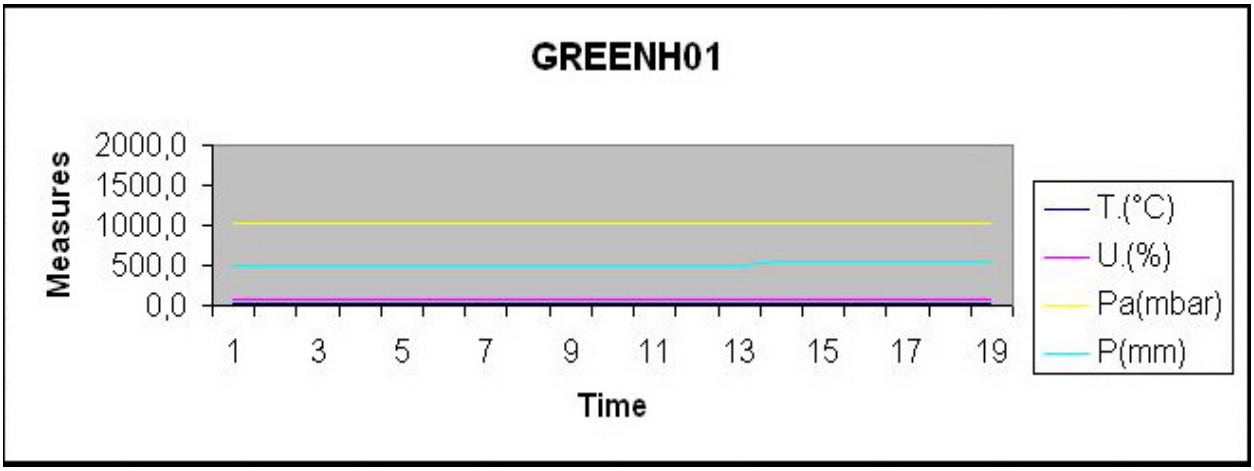

FIGURE 15: GRAPHIC VISUALIZATION OF LOGGED DATA

FIRMWARE

The two hardware elements that compose the **SL-Data** are provided of their own management firmwares, that define the functionalities of the product. The saving hw has a closed firmware (described in **S-LOG** user manual) that can't be modified by the user; instead the acquisition hw firmware can be freely modified by the user, according with his requirements.
In this chapter are described the foundamental information that allow to modify this firmware.

FIRMWARE DEVELOPMENT

The management firmware of acquisition hw can be changed by performing the following steps. Some operations are obviously complex and articulate and in this paragraph they are briefly described; the user can found detailed explanations in the specific documentation, as stated in the same steps.

fd1) Copy all the files that make up the management firmware on PC's hard disk. These files are supplied by **grifo®** and coincide with firmware source, executable code ready for acquisition hw, some surrounding files as header, project, utility, etc.

fd2) Instal and/or arrange the firmware development tools, that is the program for PC encharged to translate the firmware source in executable code for the selected acquisition hw. Among these development tools we can remind the numerous distribuited by **grifo®**: BASIC compilers (**BASCOM 8051**, **BASCOM AVR**, **PIC BASIC PRO**, etc.), C compilers (**uC/51**, **ICC AVR**, **HTC PIC**, etc.), PASCAL compilers (**KSC-PASCAL-51**, **Mikro PASCAL**, etc.).
The choice of the development tools must be performed by user according with his experiences and preferences, but it must match the type of microcontroller mounted on Mini Module used on acquisition hw.
Each development tools is provided of its user's documentation.

fd3) Install and/or arrange the firmware programming tools, that is the program and accessories for PC, encharged to save the firmware executable code, in the FLASH of the selected Mini Module. Among these tools we can remind: serial Boot Loader (**FLIP**, **Micro Code Loader**, **AVR Bootloader Grifo(r)**, etc.), ISP programmers (**MP AVR/51 USB**, **MP PIK USB**, **AVR ISP MKII**, **MPLAB ICD 2**, etc.). Many programming tools can be integrated in the development tools described at step fd2; in this way the user obtain a single working environment on PC and he can save time.
These tools change according with type of microcontroller mounted on Mini Module and they are completely described in their specific documentation or in the Mini Module technical manuals.

fd4) Modify the firmware source according with the new requirements of the application to develop. In this phase the user takes advantages by numerous remarks of the source and by the firmware description reported in the following paragraphs.

fd5) Compile the modified source of the firmware, through the development tools, by checking that no errors happen and the new executable code is correctly generated. Generally this code is saved in a file with the same source name and .HEX extension.

fd6) Program the modified executable code on the Mini Module used on acquisition hw, by following the instructions of programming tool. In order to perform this step, sometimes it is necessary an hardware intervent on Mini Module, for example to change the dip switch that select DEBUG mode.

fd7) Test the modified code just programmed, directly on acquisition hw, by checking that everything works fine as required. If bugs and problems come out, the user must repeat the steps fd4÷fd7 in a cycle, until the desidered functionalities are obtained. At this point the modified firmware development is finished and the acquisition hw is ready to work joined with saving hw.

fd8) Whenever the user that has to change the **SL-Data** functionalities doesn't want to modify the firmware autonomously, he can ask directly to **grifo®**.

FIRMWARE DESCRIPTION

The **SL-Data** firmware changes according with the selected development tool and the Mini Module used on the acquisition hw. Independently from these choices it can be individualized a common structure that is described in the following paragraphs. On the other side, the specific specializations are described in the sources of the same firmwares.

SOURCE HEADER

It is the first part of the source where are described the features of the firmware, the information of the developing company, the changes made in the released versions and the settings required in order to use the development tools.

COMPILER DIRECTIVES

They are all the information and directives required to compile the source without errors, or in details:
- the code area start address;
- the data area start and end address;
- the used memories sizes;
- the possible redirections of interrupts and console;
- etc.

DATA STRUCTURE

The firmware uses numerous data structures either global or local types. Below are descrbed the main ones, with a subdivision that simplify the research and a brief description.

Microcontroller's signals defines

They are the definitions of few signals of microcontroller used for some firmware functions as the I2C BUS communication (Pinsda, Pinscl), the activity LED management on Mini Module (Ldat), etc.

ASCII codes constants
They are one byte constants with the used ASCII codes for visualization and communication or for the codes of pressed codes on console (Cret, LF, Bell, Tab, Esc, Xon, Xoff, Kret, Kesc, Kbsp, etc.).

Periodic interupts constants
They are two bytes constants with the time values used to generate a periodic interrupt each 10 msec., with one of the internal timer of microcontroller. These values are theoretically established from microcontroller data sheet and then calibrated in order to reduce the unavoidably errors on elapsed time ((Irq10ms, Rel10ms). If the user want to eliminate the differences on time between saving hw and acquisition hw, he must use a Real Time Clock also on the second hardware, that is a Mini Module provided of RTC.

Timings constants
They are two bytes constants with the numbers of periodic interrupts that happens in some time intervals (1 sec, 2 sec, 5 min) used by some processes of the firmware (Irq1sec, Irq2sec, Irq5min).

Timeout constants
They are two bytes constants with the numbers of maximum cycles that the firmware can perform during the waiting processes (Ee_timeout, I2c_timeout).

Analog inputs constants
They are constants relative to analog inputs of acquisition hw as the number of available signals (Maxain), the maximum A/D combinations for the connectable signals types (Vcmbmax, Acmbmax, Acmb4ma), the gain factor (Gainfact), etc.

Configuration constants
They are constants with the number of bytes allocated by some configuration data, used for reading and writing the same data from and to EEPROM (Sizeainarr, Sizecnf).

Serial communication constants
They are constants used to define the parameters of the serial communication with saving hw or configuration console (Slog_sla, Baud, etc.).

General purpose constants
They are all the constants that are not included in previous categories and have general purposes.

General purpose variables
They are all the global variables used as indexes, temporary storages, counters and all the others not included in following categories (Hlpb, I, Hlpw, Tout, Onestr, etc.)

Console variables
They are global variables used to manage the console during the software configuration (Key, Pch, Num, Gstr, Choice, Ch1, Ch2, Allch, etc.).

I2C BUS variables
They are global variables used to manage the I2C BUS synchronous communication with saving hw (I2cbit, I2cack, I2cbyte, Erri2c),

A/D variables
They are global variables used for the A/D converter section (Chad, Cmbad).

EEPROM variables
They are global variables used for reading and writing data from/to EEPROM (Datee, Addee).

Buffered I/Os variables
They are global variables used for mantaining the status of buffered digital inputs (Bufin) and the status of relays outputs (Bufout).

Configuration variables
They are global variables used for managing the configuration (Confok, Crcr, Crcc, ...) and for storing the software configuration parameters of acquisition hw, as described in homonimous paragraph, and permanently saved on EEPROM (Language, Comline, Atime, Atimesec, Anatype(), Anabeg(), Anaend(), Afilter).

Counters variables
They are global variables used as counters of the firmware events, like the allarms and anomalies (Alrcnt, Oldalrcnt), the interrupts (Irqcnt, Debcnt, Atimeirq), etc.

Program variables
They are global variables used for different functions of the program. Among these it is important remind the coeficients of linear transfer functions y=m*x+n (Mtf(), Ntf()), those for the analog inputs (Ain, Inad(), Ingab()), those for measures in engineering units (Decdig(), Meas) and others (Clrcnt, Slogok, Consi2c, ...).

ROUTINES

The firmware includes and uses some subroutines that perform operations either dedicated to hw sections and perform functionalities of the acquisition hw. Below are descrbed the main ones, with a subdivision that simplify the research and a brief description.

Periodic interrupt service routine
This routine first of all re-set the Timer in order to proceed the periodic interrupt generation and then increments the variable that counts the number of happened interrupts, used to check if the acquisition time is elapsed. Furthermore, in order to avoid aliasing problems, the same variable can be cleared by the routine, when a proper flag is active.
Finally the routine update the time counter for the anomalies or allarms signalations.

Console output redirection routine
This routine manage the representation of a single character on a selected console device. The available console device are 2 (RS 232 asynchronous serial line or I2C BUS synchronous serial line) and they are selected by proper global flag Consi2c. The choice of redirecting the console is certainly profitable; in fact it allows the programmers to transmit the data to **S-LOG** with both the communication lines supported by **SL-Data**, through the powerful high level instructions dedicated to console, of the selected programming language (PRINT with BASIC, printf() with C, Write() with PASCAL, etc.). The programmers can obviously use all the possibilities offered by these instructions, as those for showing (equal to saving) characters, text and variables of each type, those for aligning data, those for formatting data, etc.

Configuration data acquisition routines
These routines acquire all the parameters for the software configuration of the acquisition hw, either in alphabetic format (Getchr()) or numeric (Getnum()). The routines interacts with the user through an RS 232 serial console and they check if the user selections are valid, too.

A/D routines
They include the routine that initializes the A/D converter section of Mini Module (Adinit()) and those that converts the analog inputs in polling (Adconv(chad)).

EEPROM routines
They are the routines used for reading and writing a byte from/to EEPROM at a specified address (Rd_ee(), Wr_ee()).

Buffered I/Os routines
They are the routines used for acquiring the status of buffered digital inputs (Get_bufin()) and for setting the status of relays outputs (Set_bufout(bufout)).

I2C BUS routines
They are the routines used to manage the I2C BUS synchronous communication with saving hw, in master transmit mode (Ini_i2c(), Del_i2c(), Wrbit_i2c(), Rdbit_i2c(), Start_i2c(), Stop_i2c(), Wrbyte_i2c(), Rdbyte_i2c()).

Configuration routines
They are the routines used for managing the software configuration of acquisition hw, as described in homonimous paragraph, and permanently saved on EEPROM. Among these routines there are those that initialize, acquire and store the configuration parameters (Defcnf(), Rdcnfee(), Wrcnfee()), one that verifies the validity of the parameters saved on EEPROM with specific safety algorithms (Getchkcnf()) and finally those that manage the software configuration with the user (Conf(), Is_conf()).
All the configuration routines use the homonimous global variables and they always define the values of all the configuration parameters.

Initialization routines
These are the routines that initializes the hardware peripheral devices, not listed in previous categories, and the system variables (Inihw(), Inivar(), Check(), Tmr0irqinit()).

Firmware functionalities routines
In this category are inluded the routines that perform all the **SL-Data** functions, through the other already described routines. In detail we remind those that gets the current number of periodic interrupts with anti aliasing debouncing (Deb_irqcnt()); those that start and stop a saving on **S-LOG** (Start_save(), Stop_save()); the one that acquires, processes, transforms and saves the analog measures (Getsave_ain()); the one that verifies the possible anomalies and allarms and when active, it signalizes them (Alarm()).
The routine Getsave_ain() needs a detailed description in fact it performs in sequence the following operations, on all the analog inputs available on acquisition hw:
- acquire the analog input, convert it in numeric combination, through the A/D converter;
- apply the gain factor of **GAB H844** to acquired combination;
- converts the combination in engineering units measure with the relative linear transfer function y=m*x+n, by using the coeficients stored in the program variables;
- format the engineering units measure with the maximum number of meaningful digits;
- transmit the formatted measure to saving hw, complete of proper separators.

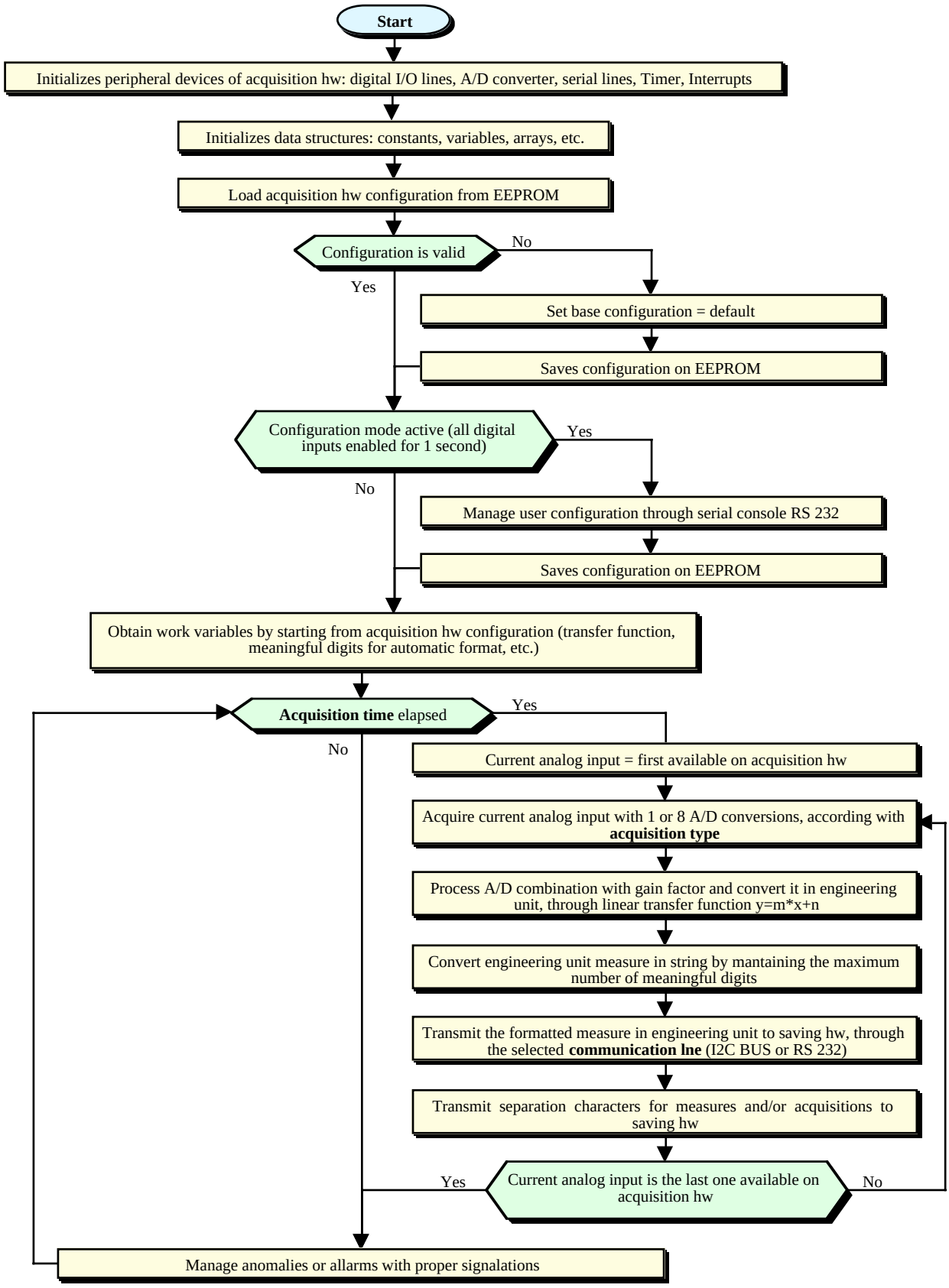

FIGURE 16: FLOW CHART OF ACQUISITION HW FIRMWARE

Debug routines

They are a group of routines (Ad(), Eeprom(), Iobuf(), ...) that allows to debug either the acquisition hw and its firmware. In the firmware there are also other instructions for debugging, in the critical points of the source. All the debug instructions are inserted with the conditional compile technique and they can be added or removed from executable code, with a simple modification of the ISdebug or Debug constant. Generally the debug instrunctions show variables and informations on the RS 232 serial console; but for some development tools there could be other possibilities: the user can read the relative documentation.

MAIN PROGRAM

The main program of the firmware includes the instructions that perform all the functionalities of acquisition hw, by using the routines described in previous paragraph. In details the main program:

- initializes all the acquisition hw, by calling the routine Inihw();
- initializes the variables, by calling the routine Inivar();
- reads the configuration parameters from EEPROM and if they are valid stores them in proper variables, viceversa sets the default values, by calling the routine Chkconf();
- if configuration mode is enabled manage it and saves the new parameters (inserted by user) on EEPROM, by calling the routine Is_conf();
- starts and endless loop that:
- - verifies if the acquisition time is elapsed through the periodic interrupts counter and the routine Deb_irqcnt();
- - when the time is elapsed it acquires, processes, transforms, formats and saves the measures associated to analog inputs, by calling the routine Getsave_ain();
- - verifies and signals the possible anomalies and allarms, by calling the routine Alarm();
- - when the debug instructions are active and the user has pressed a key on console it enters in the test modality where, through a menu, he can verify the functionality of hardware and firmware.

The operations just listed are graphically displayed in the flow chart of figure 16.

APPENDIX A: DEFAULT CONFIG., OPTIONS, ACCESSORIES

In corrispondence of the first purchase, or after a reparation, the **SL-Data** is supplied in its base configuration. The features of this configuration has been described many times in the manual (by using also the name default configuration) and in this appendix they are summarized.

PARAMETER	*DEFAULT SETTING*	*FUNCTION*
Representation language	English	Representation language used in software configuration of acquisition hw = English
Communication line	I2C BUS	Communication line used for data exchange with saving hw = I2C BUS synchronous serial line
Acquisition time	10 sec	Acquisition time for analog inputs and saving of relative measures on memory card
Electric signal type	0÷Vmv	Type and range of ananlog inputs (the Vmv max. value voltage depend on used acquisition hw)
Begin scale	0.000000	Begin scale for the measures in engineering units (together with end scale defines a 0÷100 range, equal to a percentage value, that can be easily used on each acquired measure)
End scale	100.0000	End scale for the measures in engineering units (together with begin scale defines a 0÷100 range, equal to a percentage value, that can be easily used on each acquired measure)
Acquisition type	Direct	Analog inputs acquired with a single A/D conversion

FIGURE A1: DEFAULT SOFTWARE CONFIGURATION OF ACQUISITION HW

The values listed in previous table can be modified through the configuration mode, as described with details in the homonimous paragraph.
The default hardware configuration of acquisition hw is reported in the technical manuals of **GAB H844** and of selected Mini Module.
The default hardware and software configurations of saving hw are reported in the user manual of **S-LOG**.

SL-Data can be also provided of some options, added during order phase, to both the hws. Please refer to just listed manuals, to get information about these possible options.

Moreover there are a list of accessories that simplify and speed up the use of the module. Among these ones we remind:

- **CKS.AMP4** kit composed by female AMP Mod II 4 pins, plus 4 contacts to crimp;

FIGURE A2: CKS.AMP4 CONNECTION ACCESSORY

These components can be acquired directly from AMP dealers by using P/N 280359 and P/N 182206-2.

- **AMP4.Cable** complete connector with 4 coloured wires, 1 metre length;

FIGURE A3: AMP4.CABLE CONNECTION ACCESSORY

- **CKS.AMP8** kit composed by female AMP Mod II 8 pins, plus 8 contacts to crimp;

FIGURE A4: CKS.AMP8 CONNECTION ACCESSORY

These components can be acquired directly from AMP dealers by using P/N 280365 and P/N 182206-2.

- **AMP8.Cable** complete connector with 8 coloured wires, 1 metre length;

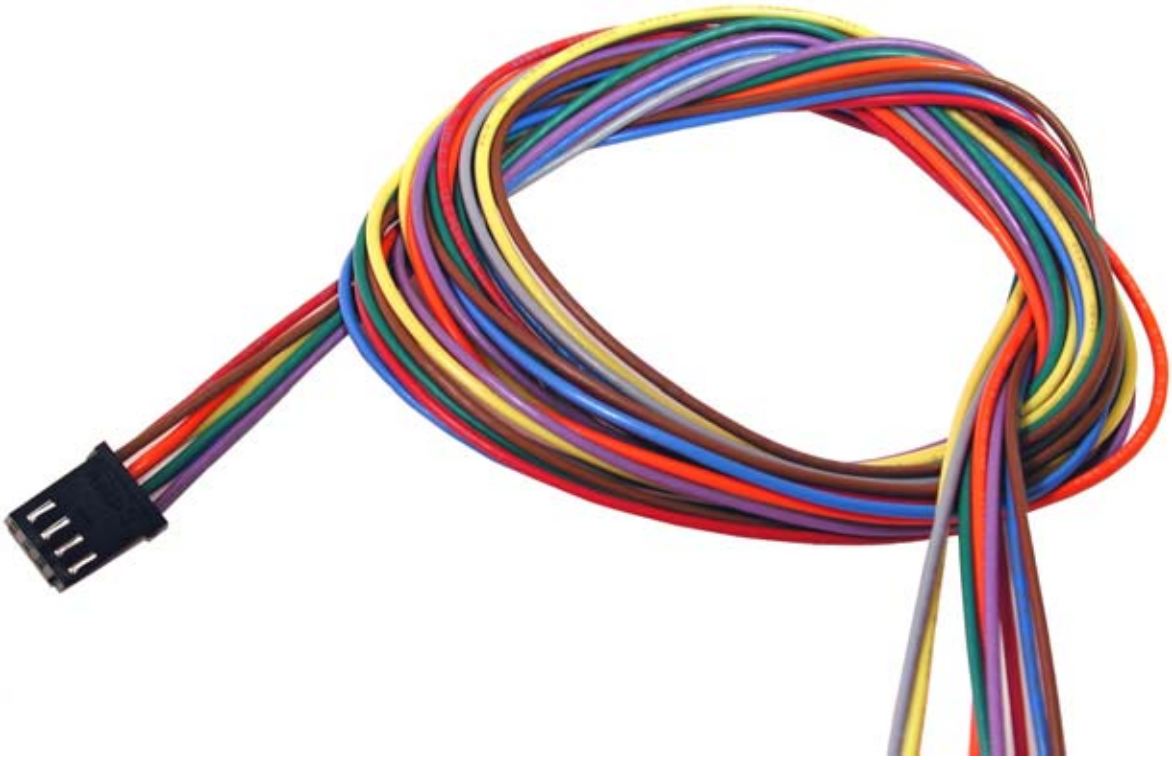

FIGURE A5: AMP8.CABLE CONNECTION ACCESSORY

- EL 12 power supply for direct connection to mains voltage at 230 Vac, 50 Hz, that generates an output voltage of 12 Vac, suitable for **SL-Data** power supply. Further information are available in POWER SUPPLY CONNECTION paragraph.

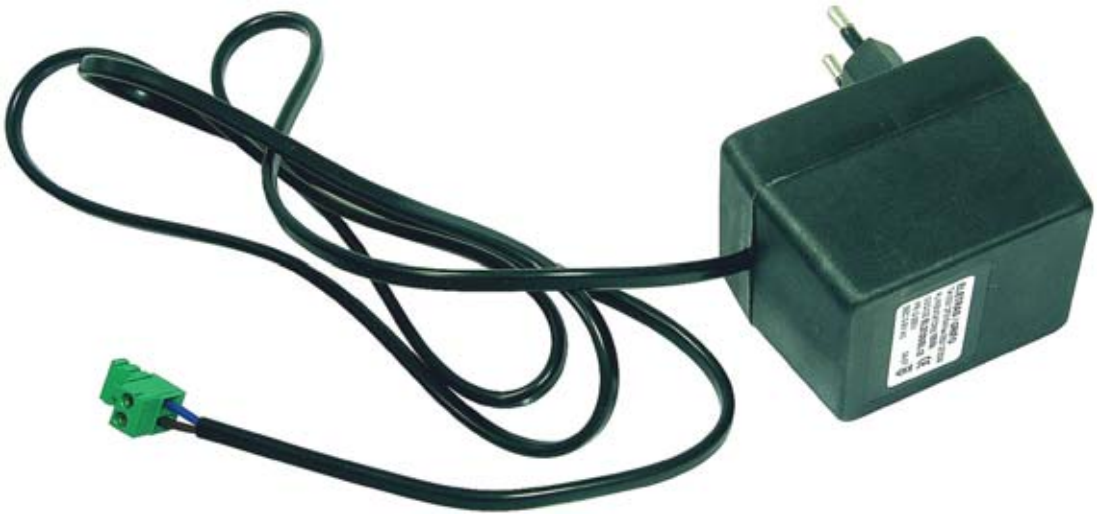

FIGURE A6: EL 12 POWER SUPPLY ACCESSORY

APPENDIX B: ALPHABETICAL INDEX

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