GMB HR168

Housing Relay - 16 Opto In, 8 Outputs

GMM AC Zero

grifo® Mini Module AT89c51CC03

TECHNICAL MANUAL

grifo®
ITALIAN TECHNOLOGY

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GMB HR168 & GMM AC Zero Rel. 5.00 *Edition 01 October 2004*

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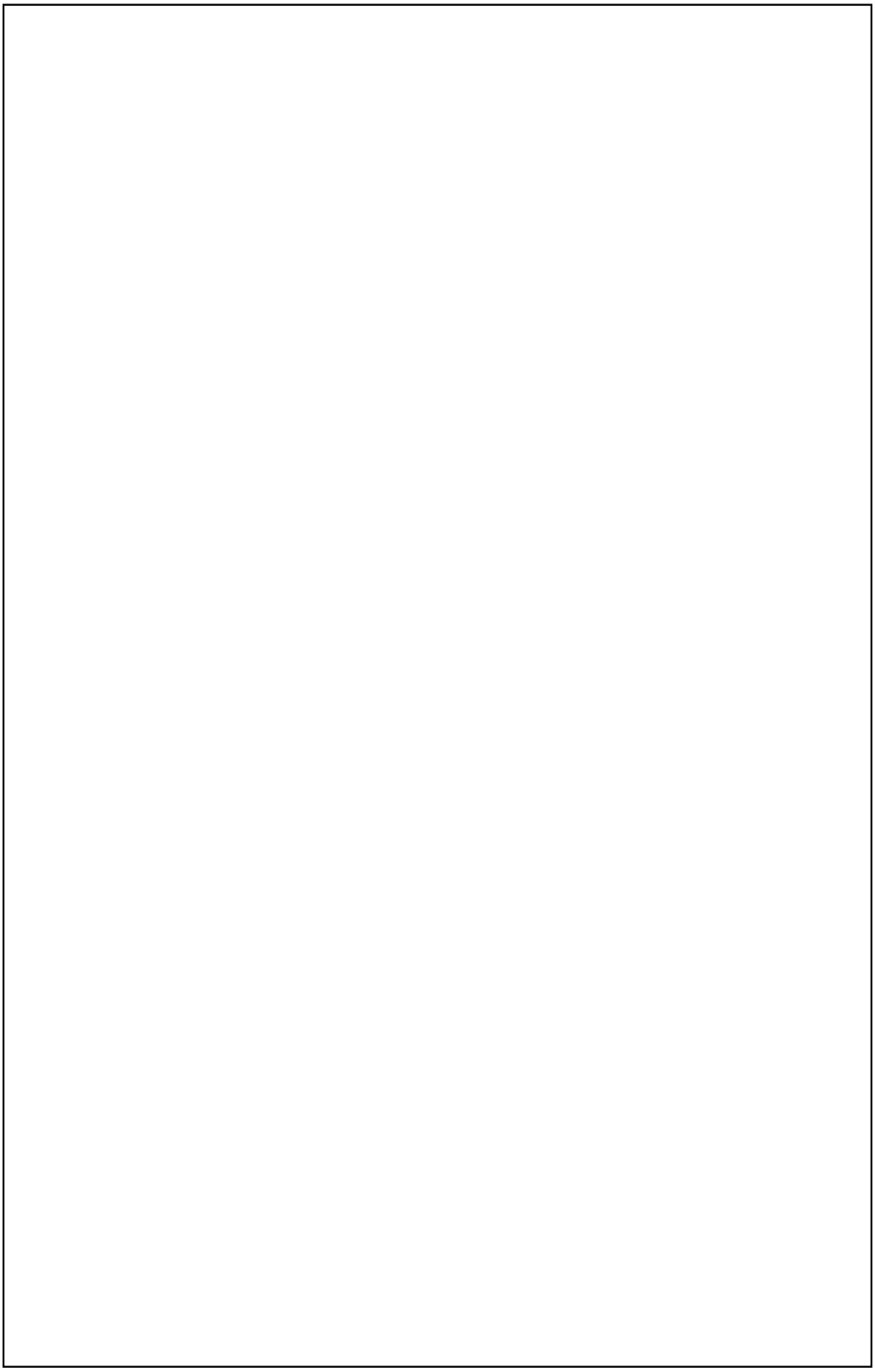

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Modular plastic Container **DIN 50022 Modulbox**, model **M6 HC53**; size: front **90** x **106** mm, height **58** mm; mounting on **Omega** rail DIN 46277-1 and DIN 46277-3; **GMM AC Zero** already installed on the 40 pin socket; **16 Optocoupled Inputs** that can be both **NPN** or **PNP**; status of **16** inputs shown by **16 LEDs**; two inputs can pefrom **Interrupt** functions; three inputs can perform **Counter** functions; **8 Relay** Outputs **5 A**; status of 8 outputs shown by **8 LEDs**; four outputs can perfrom automatic timing functions; **1 TTL** output drivern by optional **RTC** and visualized by a specific LED; **Serial Line** in RS 232, RS 422, RS 485, current loop or TTL; 1 anaolog signal for **A/D** conversion with selectable full range; all signals can be connected through connectors featuring **Normalized** pin out; **3 I/O TTL** signals; **I^2C BUS** availabe on connector for external devices; **Switching** power supply on board; protection of on board logic, through **TransZorb**; power supply in **DC** or in **AC**: 10 ÷ 40 Vdc or 8÷24 Vac for logic supply and 8 ÷ 30 Vdc or 4 ÷ 24 Vac for optocouplers; possibility to manage internal FLASH and EEPROM in **In System Programming** mode; free software for PC, downloadable from ATMEL web site, to support **ISP** programming upload the generated code into on-board FLASH memory; wide range of development software available: C compilers (**µC/51**); BASIC compilers (**BASCOM 8051**); LADDER compilers (**LadderWORK**); etc.; several demo programs and use examples provided as source code completely commented available for every development structure

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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

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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 Mini Module are not provided with any kind of ESD protection. They are connected directly to their respective pins of microcontroller. Mini Module is affected by electrostatic discharges. Personnel who handles Mini Modules is invited to take all necessary precautions to 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 etc. installation are destined - and then executable - always and in exclusive way from specialized warned and educated personnel, or directly from the TECHNICAL AUTHORIZED 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.

CARD VERSION

The present handbook is reported to the **GMB HR168** card release **110104** and **GMM AC Zero** card release **101102**. The validity of the bring informations is subordinate to the number of the card release.

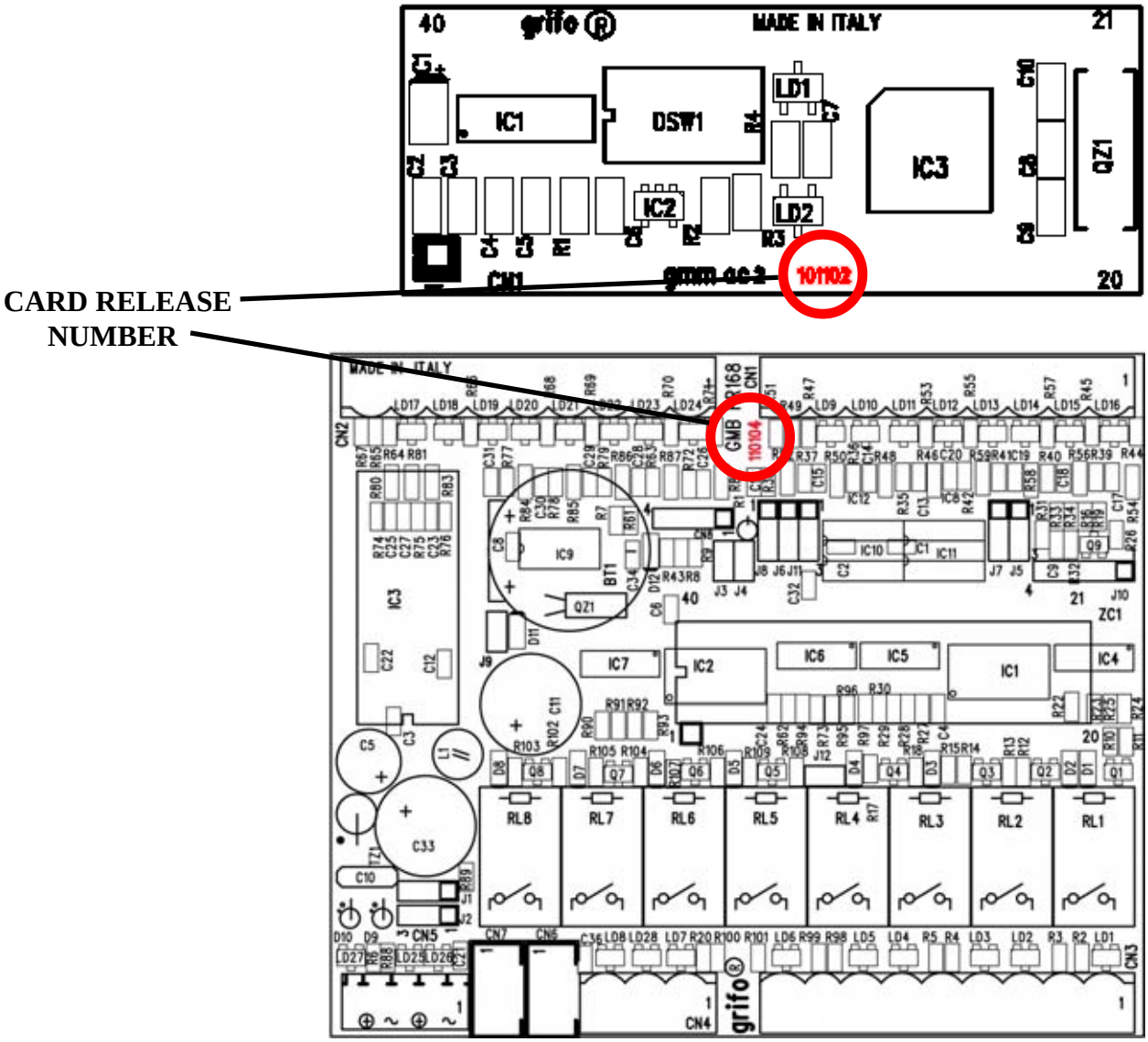

FIGURE 1: POSITION OF CARD RELEASE OF GMM AC ZERO AND GMB HR168

NOTE ABOUT MINI MODULE NAME

Please note the Mini Module name, near the printed circuit revision number.
The name is **GMM AC2**.
GMM AC Zero is made starting from a **GMM AC2** printed circuit where a AT89C51CC03 is installed.
To distinguish **GMM AC2** and **GMM AC Zero** it is compulsive to refer the type of CPU installed, as reported here:

CPU installed:	**AT89C51CC03**	**AT89C51AC2**
Mini Module name	**GMM AC Zero**	**GMM AC2**

GENERAL INFORMATION

GMB HR168 & GMM AC Zero is a module for DIN rail with a **grifo®** Mini Module CPU type **GMM AC Zero** already installed.
The board features 16 galvanically isolated inputs and 8 relays outputs with LEDs visualizations; an asynchronous serial line; an I²C BUS serial line; an anlog input for A/D converter; a PWM output; up to 5 I/O TTL. Its rank is low cost controller, that can work as intelligent peripheral in autonomy and/or remoted inside a wider telecontrol/teleacquisition network.
The union **GMB HR168 & GMM AC Zero** is provided with a standard plastic container with clamps for common Omega rails that can be found in any electric panel.
Low cost of this interface and CPU Mini Modules allow to build with great profit a serie of low budget automation systems.
It is possible to create complete applications in astonishing short times and minumum costs by taking advantage of wide variety of software development tools, like **BASCOM 8051**., unexpensive and portable, or C compilers **µC/51** and **HTC 51**, all available from **grifo®.**
The union is provided with a set of comfortable connectors that can be easily linked to the signals of the field without any additional module, so there is no additional cost.
Such connectors easy also update and assistance phases, that can be needed in time.
Overall features of union **GMB HR168 & GMM AC Zero** are:

- Modular plastic Container **DIN 50022 Modulbox**, model **M6 HC53**; size: front **90** x **106** mm, height **58** mm
- Mounting on **Omega** rail DIN 46277-1 and DIN 46277-3
- **GMM AC Zero** already installed on the 40 pin socket
- **16 Optocoupled Inputs** that can be both **NPN** or **PNP**
- Status of **16** inputs shown by **16 LEDs**; two inputs can pefrom **Interrupt** functions
- Three inputs can perform **Counter** functions
- **8 Relay** Outputs **5 A**
- Status of 8 outputs shown by **8 LEDs**
- Four outputs can perfrom automatic timing functions
- **1 TTL** output drivern by optional **RTC** and visualized by a specific LED
- **Serial Line** in RS 232, RS 422, RS 485, current loop or TTL
- 1 anaolog signal for **A/D** conversion with selectable full range
- All signals can be connected through connectors featuring **Normalized** pin out
- **3 I/O TTL** signals
- **I²C BUS** availabe on connector for external devices
- **Switching** power supply on board; protection of on board logic, through **TransZorb**
- Power supply in **DC** or in **AC**: 10 ÷ 40 Vdc or 8÷24 Vac for logic supply and 8 ÷ 30 Vdc or 4 ÷ 24 Vac for optocouplers
- Possibility to manage internal FLASH and EEPROM in **In System Programming** mode
- Free software for PC, downloadable from ATMEL web site, to support **ISP** programming upload the generated code into on-board FLASH memory
- Wide range of development software available: C compilers (**µC/51**); BASIC compilers (**BASCOM 8051**); LADDER compilers (**LadderWORK**); etc.
- Several demo programs and use examples provided as source code completely commented available for every development structure

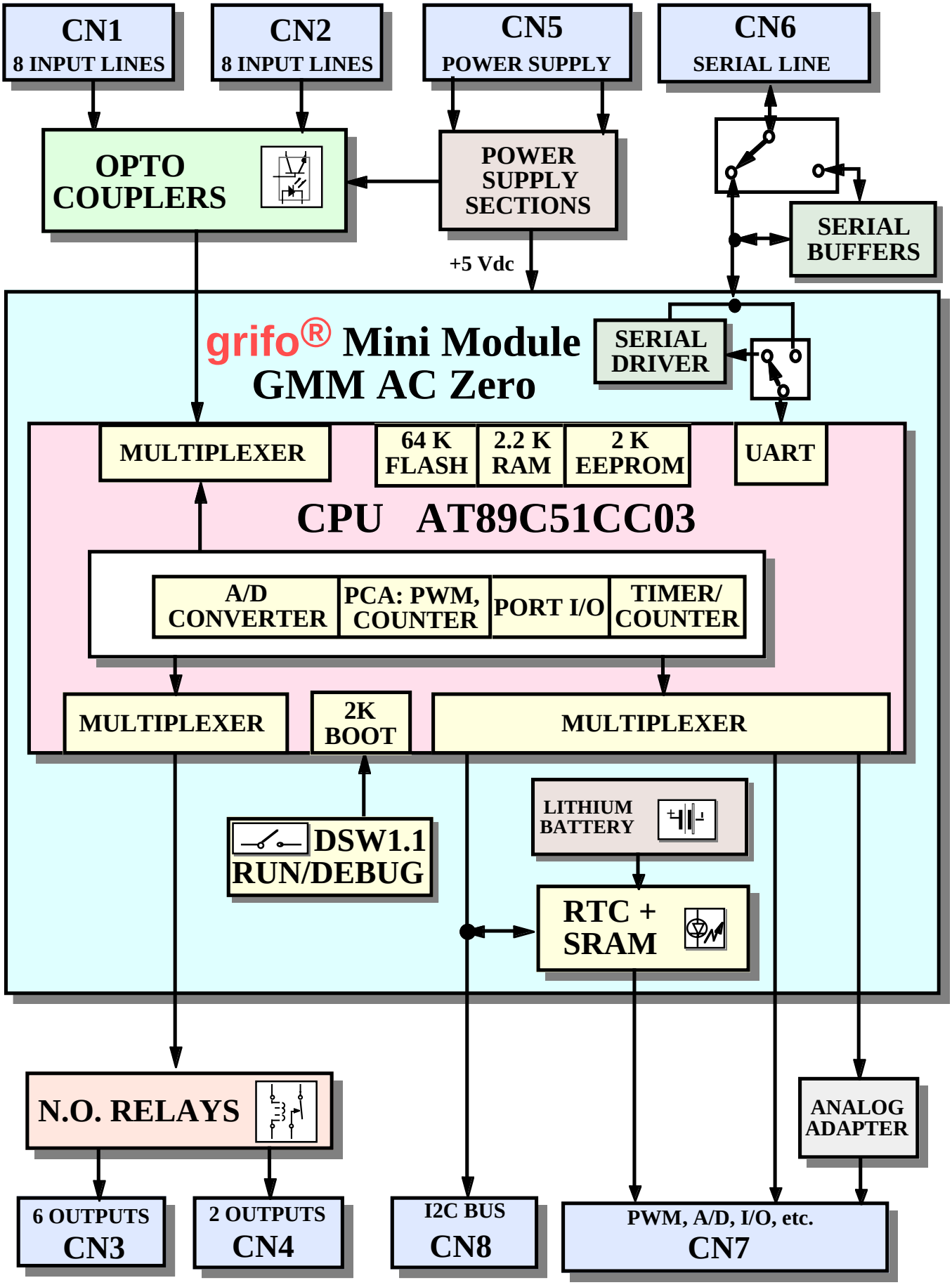

FIGURE 2: BLOCKS DIAGRAM

ANALOG INPUT

One analog input is available on pin 8 of connector CN7 (input signal AN0 corresponding to I/O signals P1.0),
For further information please refer to manual **GMB HR 168**.

OPTOCOUPLED DIGITAL INPUT LINES

The card features 16 NPN/PNP inputs connected to two quick release screw terminal connectors and visualized by specific LEDs.
Optocoupled inputs are supplied by a specific voltage called +Vopto generated on board by a specific circuitery galvanically isolated from +5 Vdc generation circuitery.
Selection between PNP and NPN inputs is made by moving a match of jumpers called J1 and J2.
For further information please refer to manual **GMB HR 168**.

DIGITAL RELAYS OUTPUTS

The board is provided with 8 relays outputs 4 A, normally open, whose status is visualized by 8 LEDs.
Each line is driven directly by a signal of **GMM AC Zero**, buffered through a specific driver and connected to a comfortable quick release screw terminal connector to easy interface to the field signals.
For further information please refer to manuals **GMB HR 168** and **GMM AC Zero**.

FIGURE 3: SNAPSHOT OF GMB HR168 AND MINI MODULE GMM AC ZERO

I²C BUS LINES

GMB HR168 is provided with one connector (CN8) dedicated to I²C BUS, software emulated, connected to two signals of **GMM AC Zero** (P2.0 and P2.1), each provided with a 4.7 kΩ pull-up. This kind of interface allows to connect devices featuring the same communication standard, to easily improve the system performances.
A wide set of software examples explains the management of most common I²C BUS peripherals like A/D and D/A converters, display drivers, memories, temperature sensors, etc.
For this purpose it can be intresting to condifer **K51-AVR**, for which both technical manual and electric diagram are available, also a wide set of examples in several languager are avalable.
GMB HR168 can be ordered with a Real Time Clock provided with 240 bytes of SRAM already installed (option **.RTC**) and backed by a Lithium battery, in such case the slave address **A0H** is already taken by this peripheral, eventual third part hardware cannot use it.
For further information please refer to manuals **GMB HR 168** and **GMM AC Zero**.

POWER SUPPLY SECTION

GMB HR168 is provided with two power supply sectio, galvanically isolated. First section includes connectors CN5, pin 3 and 4, and provides supply voltages for **GMB HR168**. In detail this switching section generates +5 Vdc voltage needed by logic and output circuits.
A second section is present, includes CN5 (pin 1 and 2), is independent and galvanically isolated from the first one, and generates the rectified and livelled voltage "**Vopto**", to supply optocouplers of inputs.
The board features components and circuits designed to reduce consumptions and to reduce noise sensibility.
Remarkable is protection circuit on CN5.3 and CN5.4 based on TransZorb™ that avoids damages due to incorrect voltages.
For further information please refer to chapter “ELECTRIC FEATURES” and paragraph “SUPPLY VOLTAGES”.

SERIAL COMMUNICATION

GMB HR168 features one AMP MODU II 2x4 P/N 280365 dedicated connector (CN6) for serial communication.
By hardware it is possible to select the electric protocol, through a comfortable set of jumpers and drivers to install.
In detail line can be buffered in **current loop, RS 232, RS 422 or RS 485**; in these last two cases also abilitation and direction of line can be defined using signals P1.3 or P2.3, according to the configuration of jumper J10.
For further information please refer to manuals **GMB HR 168** and **GMM AC Zero**.

I/O TTL SIGNALS

GMB HR168 features up to 3 digital I/O TTL signals of **GMM AC Zero** connected to a specific connector (CN7).
For further information please refer to manuals **GMB HR 168** and **GMM AC Zero**.

TECHNICAL FEATURES

GENERAL FEATURES

On board resources:	16 optocoupled digital inputs NPN and PNP 2 optocoupled digital inputs NPN and PNP are interrupts 3 optocoupled digital inputs NPN and PNP are counters 8 relays digital buffered outputs 1 serial line (RS 232, TTL, RS422, RS485, Current Loop, etc.) 1 connector for I^2C BUS lines 1 RTC with back up Lithium battery and 240 bytes SRAM 1 Open Collector RTC interrupt output 1 analog input 1 eight bit PWM output Up to 3 digital I/O TTL 1 switching power supply section 1 optocouplers supply section 28 status LEDs + 2 internal LEDs 1 internal eight pin Dip Switch
Mini Module:	**GMM AC Zero**
Opto input cut-off frequency:	13 KHz

PHYSICAL FEATURES

Size:	90 x 106 x 58 mm (container DIN 50022) 85 x 120 x 32 mm (without container)
Container:	DIN 50022 modulbox, model M6 HC53
Montaggio:	On Ω rails type DIN 46277-1 and DIN 46277-3
Weight:	249 g
Connectors:	CN1: 9 pins quick release screw terminal connector CN2: 9 pins quick release screw terminal connector CN3: 9 pins quick release screw terminal connector CN4: 3 pins quick release screw terminal connector CN5: 4 pins quick release screw terminal, pitch 3.5 mm CN6: 2x4 vie AMP MODU II, male, vertical CN7: 2x4 vie AMP MODU II, male, vertical CN8: 4 pins strip, male, vertical
Temperature range:	from 0 to 50 centigrad degreeses
Relative humidty:	20% up to 90% (without condense)

ELECTRIC FEATURES

Power supply:	10÷40 Vdc or 8÷24 Vac	(control logic)
Power required for logic:	5.25 W	(*)
Output power supply:	+5 Vdc	
Current required by GMB HR168:	582 mA max 32÷150 mA max	(+5 Vdc) (+V opto)
Current on +5 Vdc output:	950 mA - 582 mA (corrente required) = 368 mA	
Relays max voltage:	30 Vdc	
Relays max non inductive current:	5 A	(resistive load)
On board battery:	3.0 Vdc; 180 mAh	
Backup current:	2.3 μA	
Optocouplers input voltage:	+V opto = 8 ÷ 30 Vdc or 8 ÷ 24 Vac	(*)
Power required for optocouplers:	4.4 W	
Analog input range:	0÷2.5; 0÷10 V	
Analog input impedance:	4.7 kΩ	
Pull-up on I^2C BUS dedicated lines:	4.7 kΩ	
Termination network RS 422-485:	Line termination resistor Positive pull up resistor Negative pull down resistor	=120 Ω =3.3 KΩ =3.3 KΩ

(*) The data are referred to 20 C° work temperature (for further information please refer to chapter "POWER SUPPLY VOLTAGE").

INSTALLATION

In this chapter there are the information for a right installation and correct use of the card.
The user can find the location and functions of each connector, LEDs, jumper, etc. and some explanatory diagrams.

CONNECTIONS

Module **GMB HR168 & GMM AC Zero** has 8 connectors that can be linkeded to other devices or directly to the field, according to system requirements. In this paragraph there are connectors pin out, a short signals description (including the signals direction) and connectors location (see figure 23).

CN5 - POWER SUPPLY CONNECTOR

CN5 is a 4 ways, quick release screw terminal connector, vertical, 3.5 mm pitch.
CN5 allows to provide power needed by the switching power supply to generate logic control and optocouplers supply voltage.

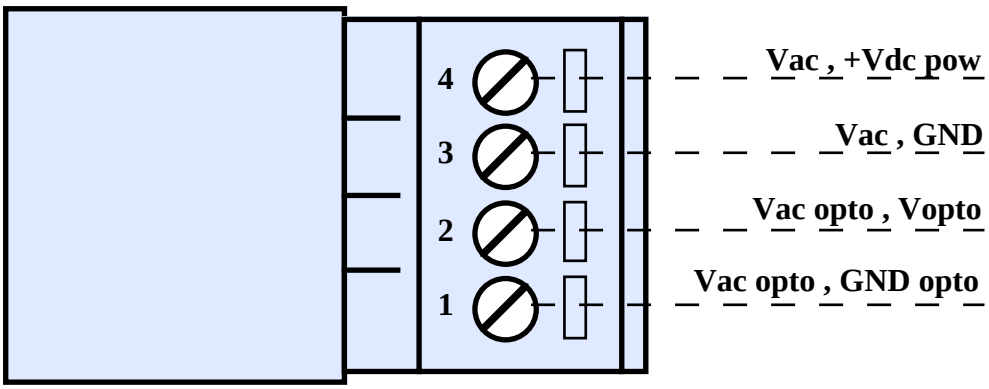

FIGURE 4: CN5 - POWER SUPPLY CONNECTOR

Signals description:

Vac , +Vdc pow = I - Positive terminal of direct supply voltage.
Vac , GND = I - Negative terminal of direct supply voltage.
Vopto = I - Terminal of alternate optocouplers supply voltage.
GND OPTO = I - Terminal of alternate optocouplers supply voltage.

For further information please refer to paragraphs "POWER SUPPLY" and "ELECTRIC FEATURES".

CN8 - I²C BUS LINE CONNECTOR

CN8 is a 4 ways, male, vertical, strip connector with 2.54mm pitch.
On CN8 is available a standard interface for any I²C BUS peripheral device.
The connector features +5 Vdc supply voltage generated by on board switching power supply that can be connected to external devices or systems.
Signals are TTL compliant, according to I²C BUS standard, their disposition has been designed to reduce interferences and so easy the connection.

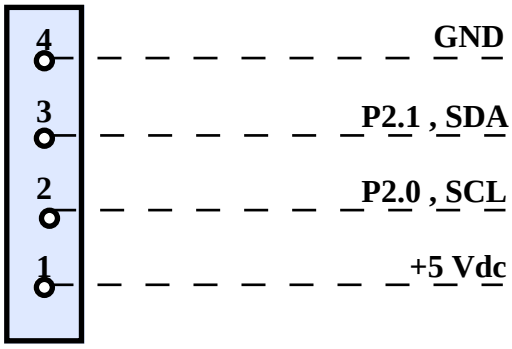

FIGURE 5: CN8 - I²C BUS LINE CONNECTOR

Signals description:

P2.1, SDA = I/O - Data signal of I²C BUS software serial line connected to P2.1.
P2.0, SCL = O - Clock signal of I²C BUS software serial line connected to P2.0.
+5 Vdc = O - Unique +5 Vdc power supply.
GND = - Ground.

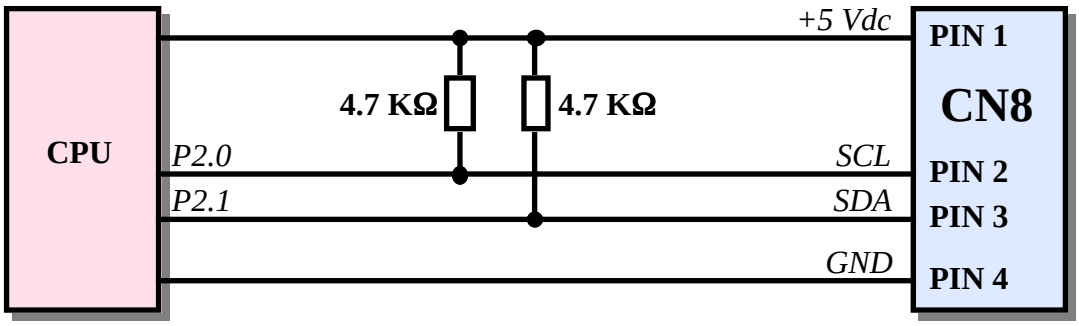

FIGURE 6: I²C BUS CONNECTION DIAGRAM

CN6 - SERIAL LINE CONNECTOR

CN6 is a 8 ways, male, vertical, AMP MODU II 4x2 type connector, 2.54 mm pitch.
This connector features signals for serial communication in RS 232, RS 422, RS 485, current loop and TTL, performed through hardware module on ZC1 hardware serial port.
Signals position, reported as follows, has been designed to reduce interferences and easy connections to the field, while signals are compliant to CCITT standard of protocol used.
Female connector can be ordered from **grifo®** (cod. **CKS.AMP8**) or its parts can be purchased from AMP catalog (P/N 280365: connector and P/N 182206-2: pins to crimp).
For further information please refer to figure 8 or to the manual of a **grifo®** Mini Module combinaton.

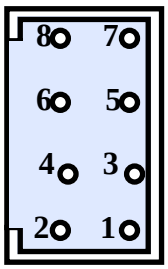

FIGURE 7: CN6 - SERIAL LINE CONNECTOR

Pin	*Signal*	*Direction*	*Description*
RS 232 serial line (please see paragraph "SERIAL COMMUNICATION SELECTION"):			
5	**RX RS232**	= I -	Receive Data for RS 232.
3	**TX RS232**	= O -	Transmit Data for RS 232.
7	**GND**	= -	Ground signal.
RS 422 serial line (please see paragraph "SERIAL COMMUNICATION SELECTION"):			
6	**RX- RS422**	= I -	Receive Data Negative for RS 422.
5	**RX+ RS422**	= I -	Receive Data Positive for RS 422.
3	**TX- RS422**	= O -	Transmit Data Negative for RS 422.
4	**TX+ RS422**	= O -	Transmit Data Positive for RS 422.
7	**GND**	= -	Ground signal.
RS 485 serial line (please see paragraph "SERIAL COMMUNICATION SELECTION"):			
6	**RXTX+ RS485**	= I/O-	Receive/Trasmit Data Positive for RS 485.
5	**RXTX- RS485**	= I/O-	Receive/Trasmit Data Negative for RS 485.
7	**GND**	= -	Ground signal.
Current Loop serial line (please see paragraph "SERIAL COMMUNICATION SELECTION"):			
6	**RX- C.L.**	= I -	Receive Data Negative for Current Loop.
5	**RX+ C.L.**	= I -	Receive Data Positive for Current Loop.
3	**TX- C.L.**	= O -	Transmit Data Negative for Current Loop.
4	**TX+ C.L.**	= O -	Transmit Data Positive for Current Loop.
Power supply voltages:			
1	**+5 Vdc**	= -	+5 Vdc generated by on board switching power supply.
7	**GND**	= -	Ground signal.
2	**Vopto A**	= O -	Optocoupled digital inputs power supply voltage.
8	**Vopto B**	= O -	Optocoupled digital inputs power supply voltage.

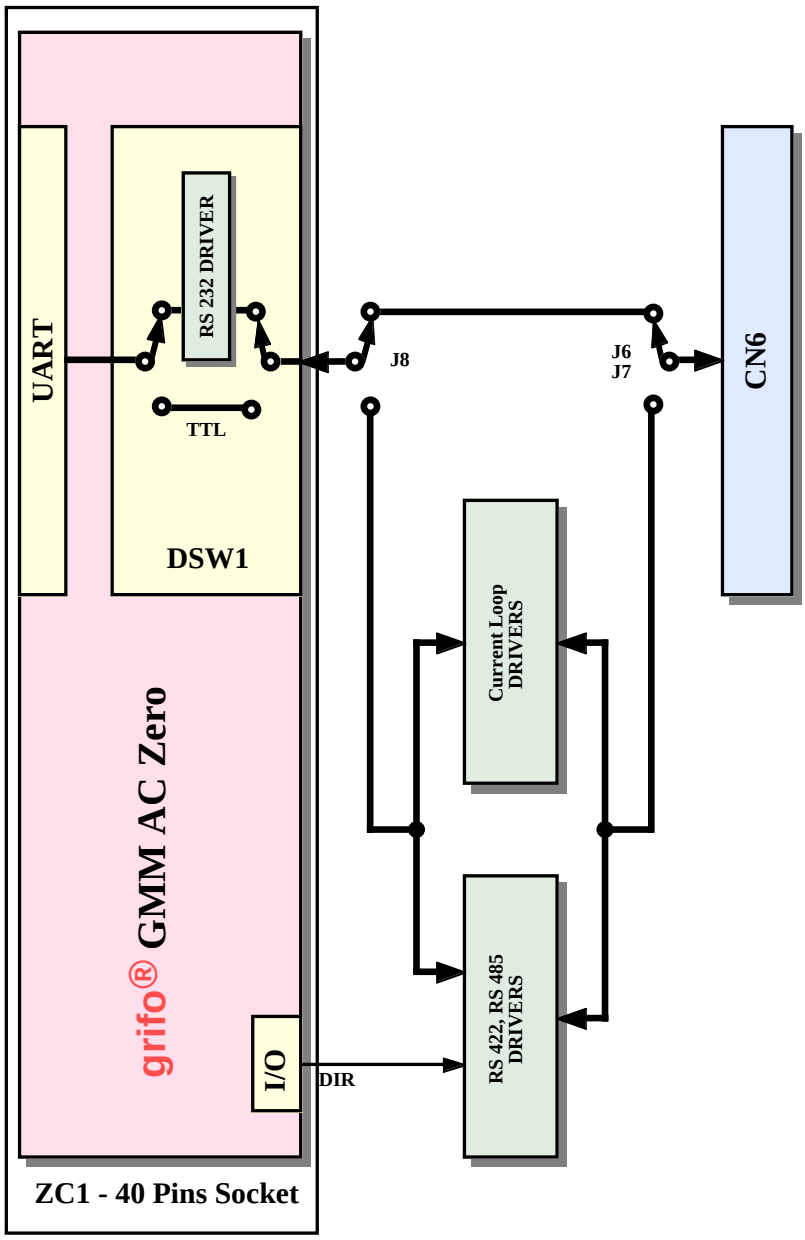

FIGURE 8: SERIAL COMMUNICATION BLOCK DIAGRAM

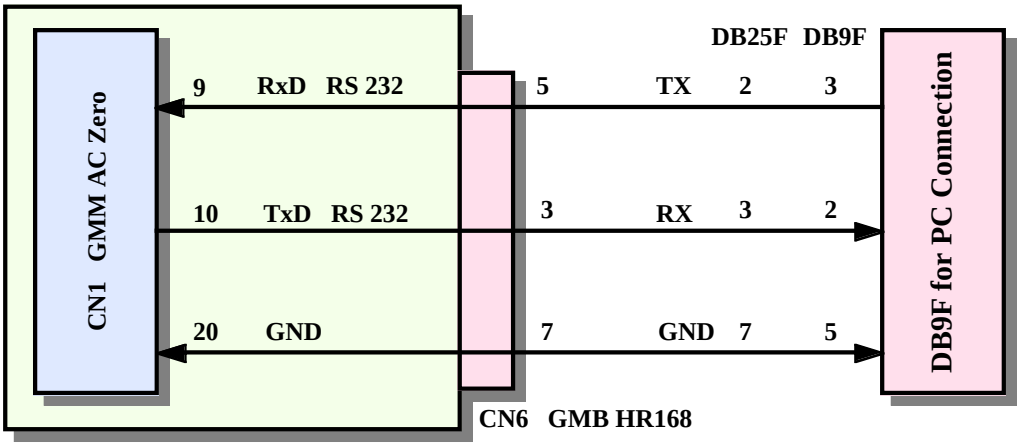

FIGURE 9: RS 232 AND TTL POINT TO POINT CONNECTION EXAMPLE

CN1 - OPTOCOUPLED DIGITAL INPUTS CONNECTOR GROUP 1

CN1 is a 9 ways, quick release, screw terminal connector, pitch 5.0 mm.
CN1 is used to connect the 8 out of 16 optocoupled NPN or PNP input signals that the card manages and are visualized by green LEDs.
Two of these **inputs** (IN3 and IN4) are connected directly to **interrupt** signals, so they can generate an immediate interrupt request to the CPU.
Two more of these **inputs** (IN5 and IN6) are connected to the exernal trigger of timer/counters, so transictions on these inputs can be **counted by hardware** by CPU.
Please refer to figure 25 for further information.
Connector also features the common pin where to connect one input to close it.
These signals are software managed through **GMM AC Zero** I/O ports have been carefully selected to take advantage of grifo® Mini Modules internal peripherals.
For further information please refer to manual **GMB HR168**.

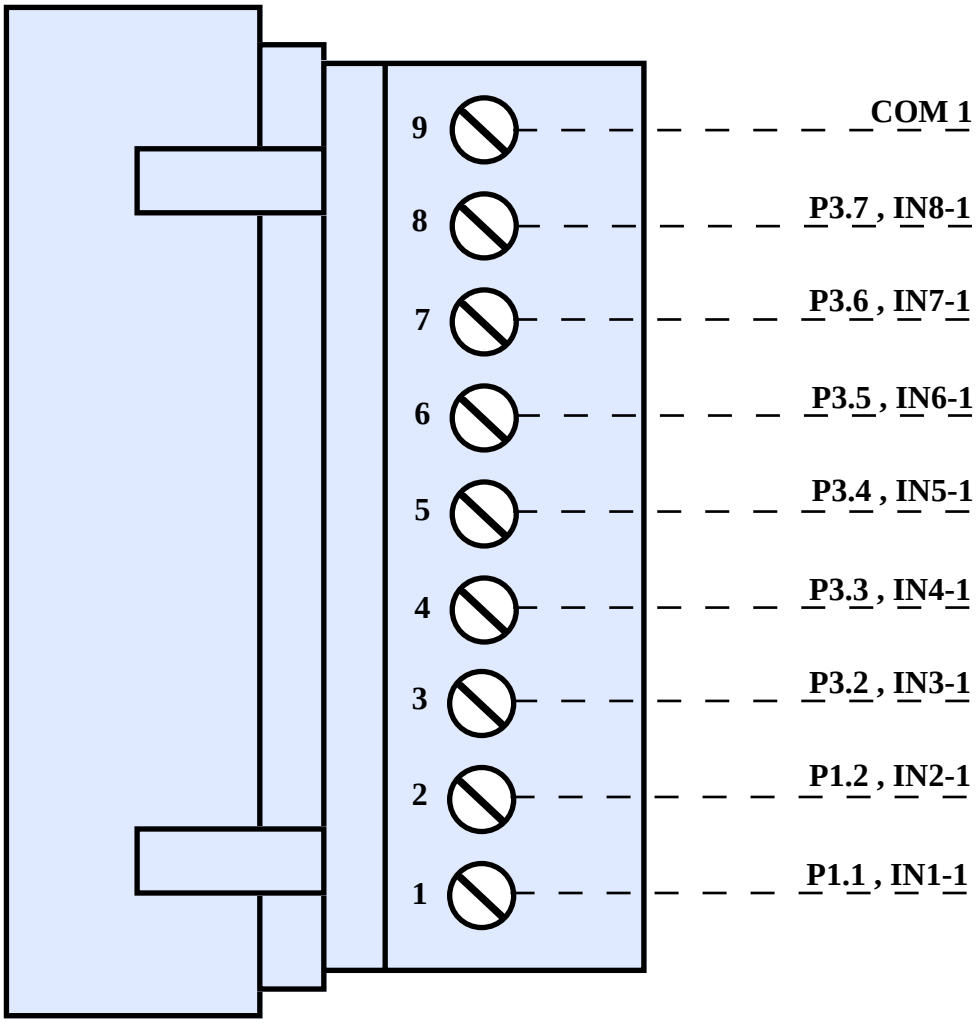

FIGURE 10: CN1 - OPTOCOUPLED DIGITAL INPUTS CONNECTOR GROUP 1

Signals description:

Px.y, IN n-1 = I - n-th optocoupled input type NPN or PNP, connected to indicated port.
COM 1 = - Common pin where an input must be connected to close it.

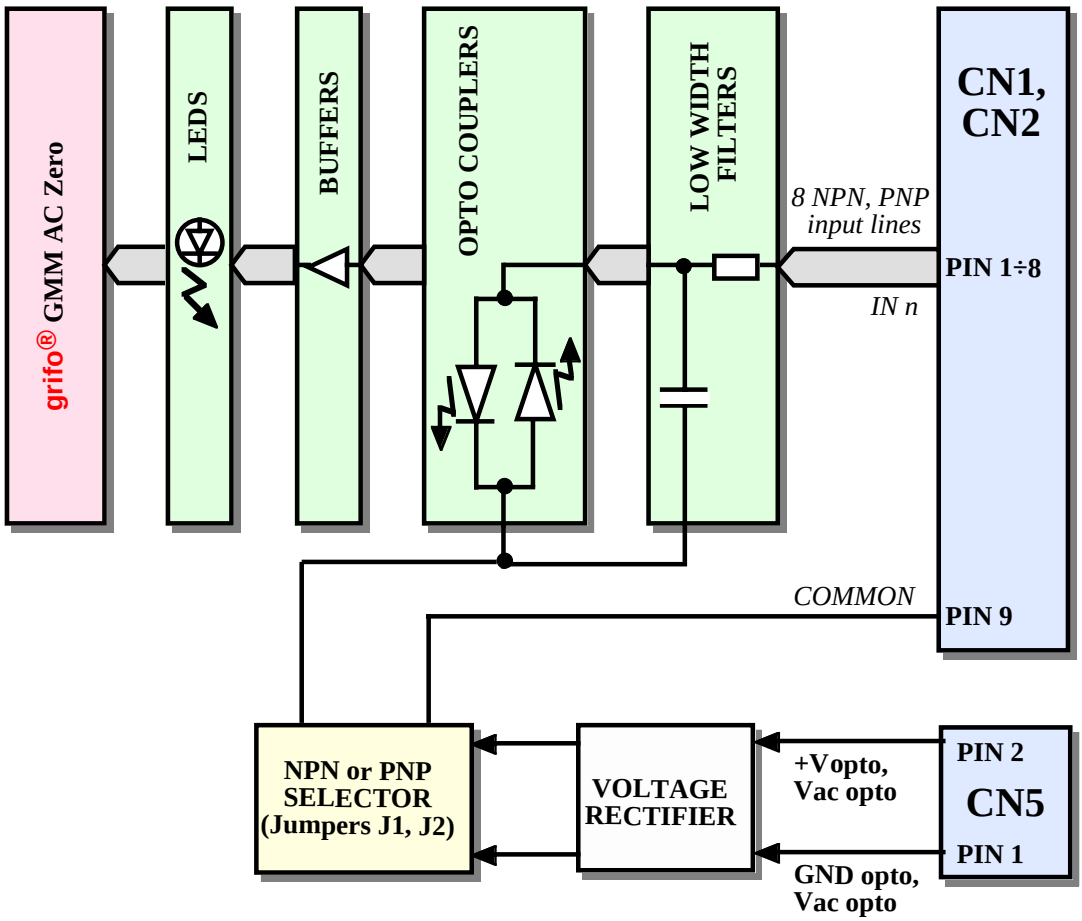

FIGURE 11: OPTOCOUPLED INPUTS BLOCK DIAGRAM

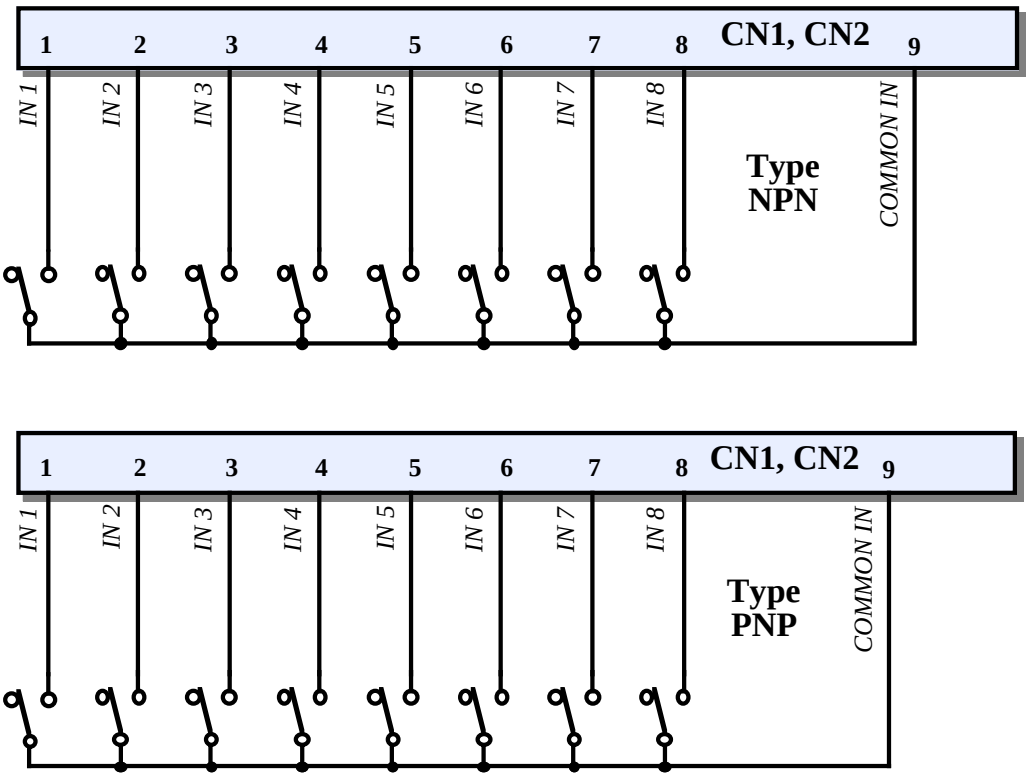

FIGURE 12: OPTOCOUPLED INPUTS CONNECTION DIAGRAM

CN2 - OPTOCOUPLED DIGITAL INPUTS CONNECTOR GROUP 2

CN2 is a 9 ways, quick release, screw terminal connector, pitch 5.0 mm.
CN2 is used to connect the 8 out of 16 optocoupled NPN or PNP input signals that the card manages.
Connector also features the common pin where to connect the inputs.
These input signals are software managed through **GMM AC Zero** I/O ports that have been carefully selected to take advantage of **grifo®** Mini Modules internal peripherals, so they can generate interrupts, count by hardware counters, etc.

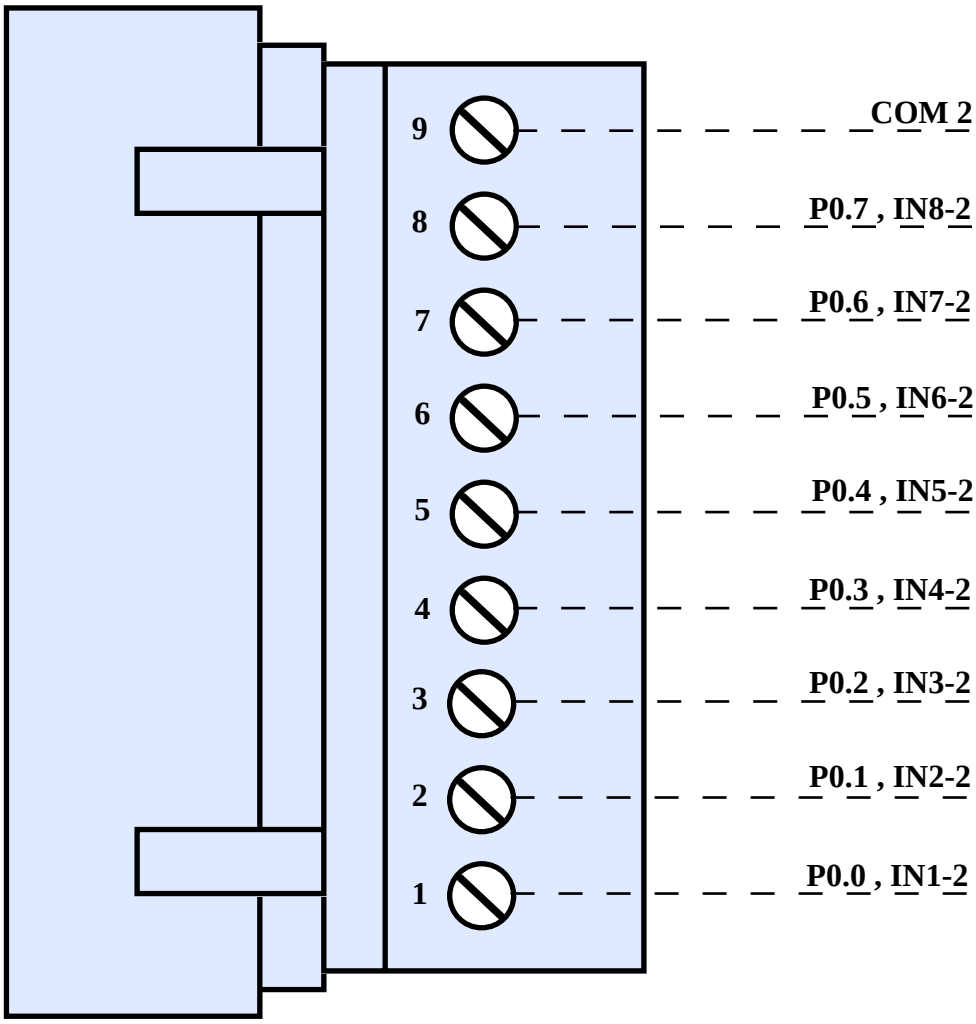

FIGURE 13: CN2 - OPTOCOUPLED DIGITAL INPUTS CONNECTOR GROUP 2

Signals description:

P0.x, IN n-2 = I - n-th optocoupled input type NPN or PNP, connected to port P0.
COM 2 = - Common pin where an input must be connected to close it.

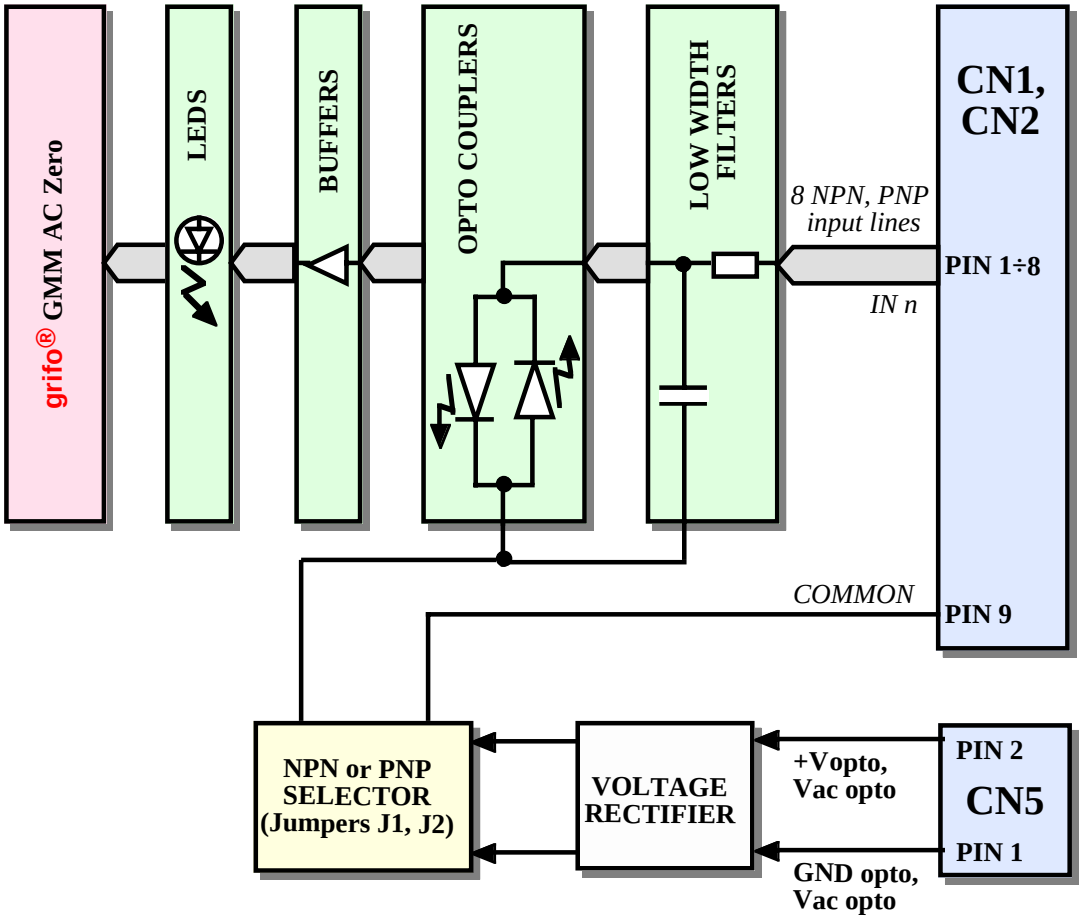

FIGURE 14: OPTOCOUPLED INPUTS BLOCK DIAGRAM

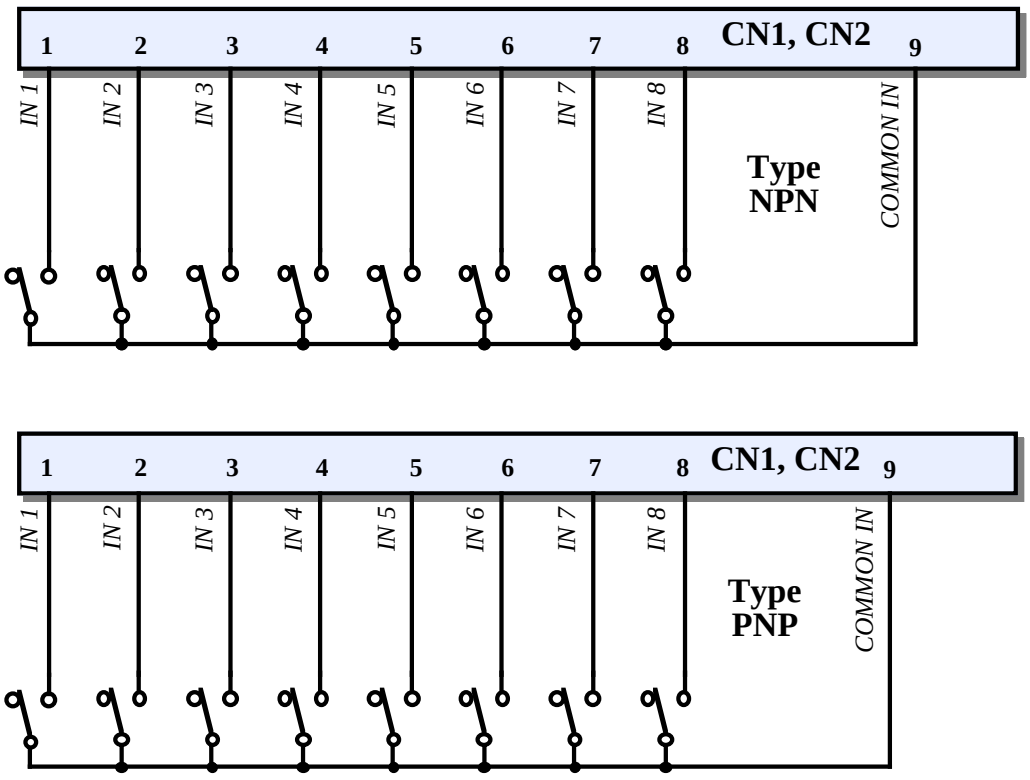

FIGURE 15: OPTOCOUPLED INPUTS CONNECTION DIAGRAM

CN3 - RELAYS OUTPUTS CONNECTOR GROUPS A, B AND C

CN3 is a 9 ways, quick release screw terminal connector, pitch 5.0 mm.
This connector allows to connect 6 normally open contacts and common pins out of 8 relays outputs available on **GMB HR168**.
Please remark that maximum (resistive) load for each line is **5 A** and maximum voltage is **30 Vdc**.
These signals are software managed through **GMM AC Zero** I/O ports, opportunely buffered, and selected carefully to easy management (plese refer to chapter "PERIPHERAL DEVICES SFOTWARE DESCRIPTION").
For further information please refer to manual **GMB HR168**.

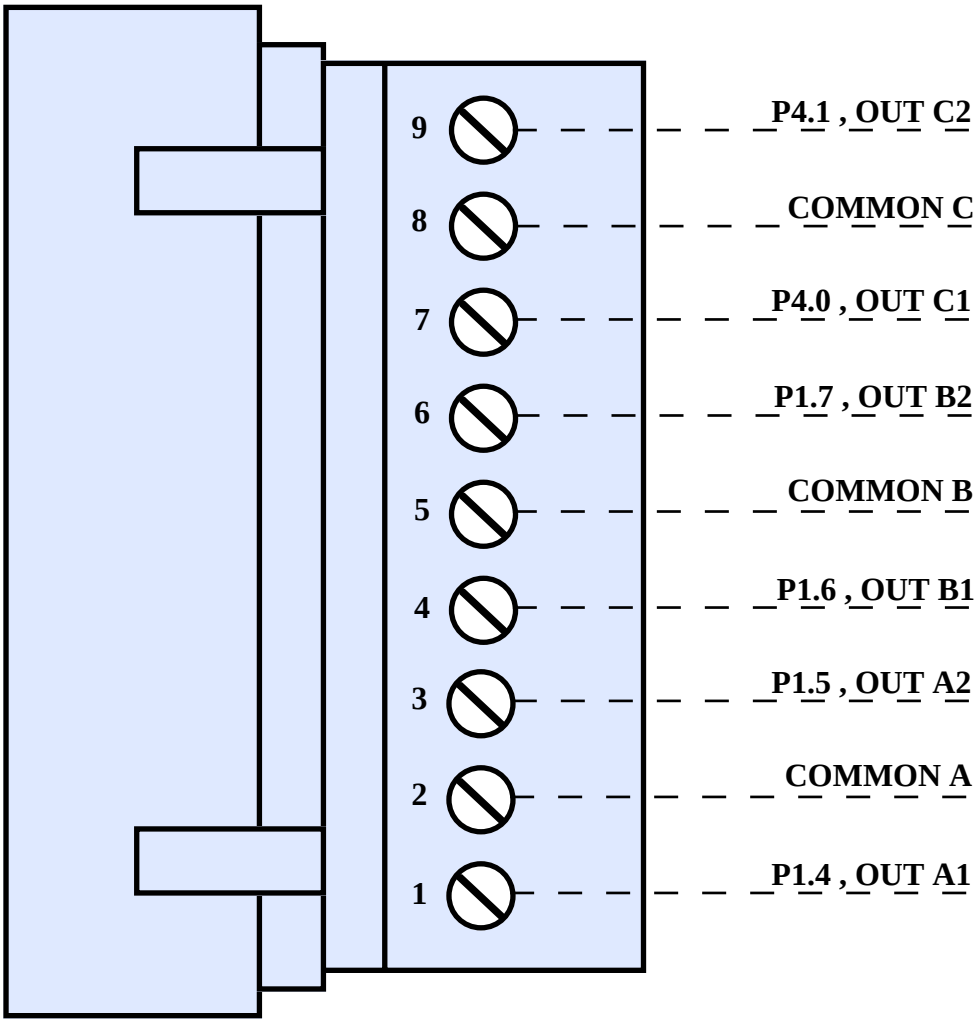

FIGURE 16: CN3 - RELAYS OUTPUTS CONNECTOR GROUPS A, B AND C

Signals description:

P1.x, OUT An = O - Normally open contact for n-th relay of group A, connected to P1.x.
COMMON A = - Common contact for relays of group A.
P1.x, OUT Bn = O - Normally open contact for n-th relay of group B, connected to P1.x.
COMMON B = - Common contact for relays of group B.
P4.x, OUT Cn = O - Normally open contact for n-th relay of group C, connected to P4.x.
COMMON C = - Common contact for relays of group C.

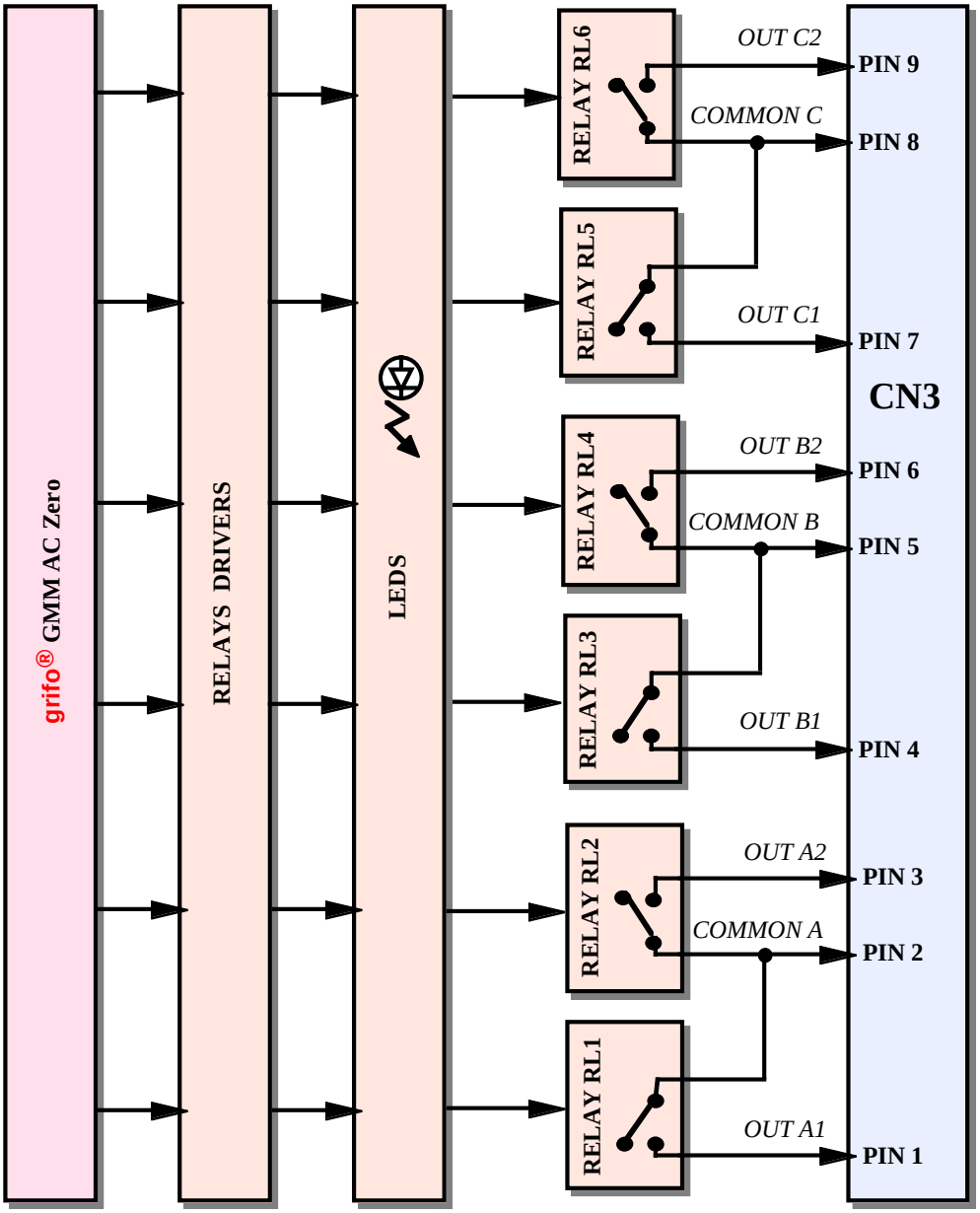

FIGURE 17: RELAY OUTPUS A, B AND C BLOCK DIAGRAM

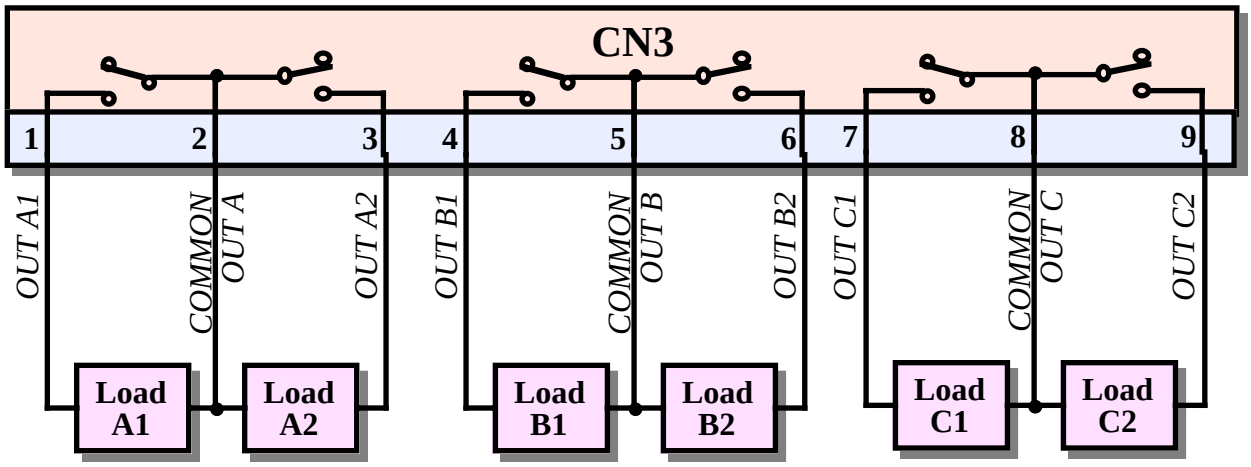

FIGURE 18: RELAY OUTPUS A, B AND C CONNECTION DIAGRAM

CN4 - RELAYS OUTPUTS CONNECTOR GROUP D

CN4 is a 3 ways, quick release screw terminal connector, pitch 5.0 mm.
This connector allows to connect 2 normally open contacts and common pins out of 8 relays outputs available on **GMB HR168**.
Please remark that maximum (resistive) load for each line is **5 A** and maximum voltage is **30 Vdc**.
These signals are software managed through **GMM AC Zero** I/O ports, opportunely buffered, and selected carefully to easy management (plese refer to chapter "PERIPHERAL DEVICES SFOTWARE DESCRIPTION").

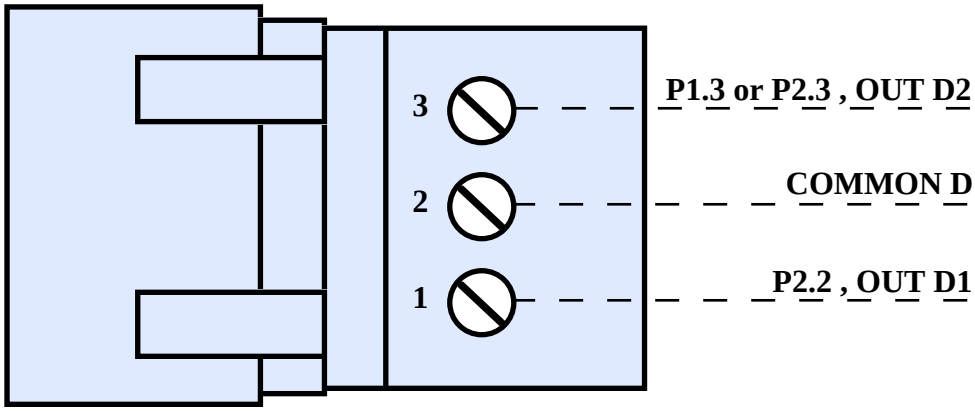

FIGURE 19: CN4 - RELAYS OUTPUTS CONNECTOR GROUP D

Signals description:

Px.y, Dn = O - Normally open contact for n-th relay of group D.
COMMON D = - Common contact for relays of group D.

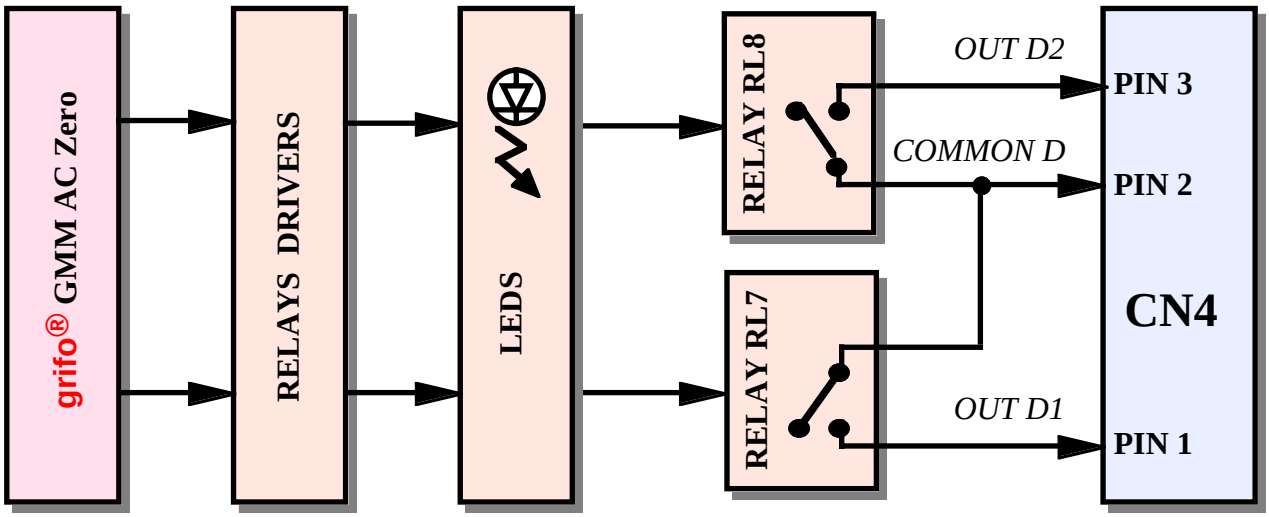

FIGURE 20: RELAY OUTPUS D BLOCK DIAGRAM

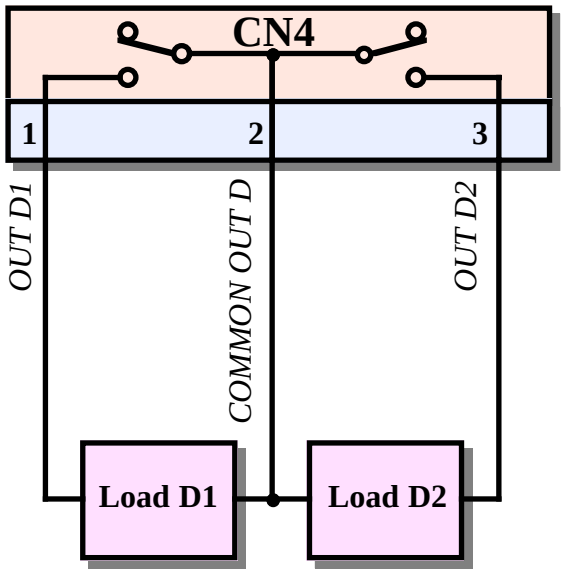

FIGURE 21: RELAY OUTPUS A, B AND C CONNECTION DIAGRAM

CN7 - TTL I/O, A/D, ETC. CONNECTOR

CN7 is a 8 ways, male, vertical, AMP MODU II 2x4 connector with pitch 2.54 mm.
This connector features +5 Vdc supply voltage (generated by on board switching power supply), up to 5 TTL digital I/O signals and an analog input connected to A/D section.
In case an optional Real Time Clock is installed, pin 4 is connected to its interrupt signal, so it cannot be used as generic I/O signal.
Female connector can be ordered from **grifo®** (cod. **CKS.AMP8**) or its parts can be purchased from AMP catalog (P/N 280365: connector and P/N 182206-2: pins to crimp).
It is also possible to order the female connector with pins to crimp already mounted and one meter long cables (**grifo®** cod. **AMP8.cable**).
For further information please refer to figure 8 or to the manual of a **grifo®** Mini Module combinaton.

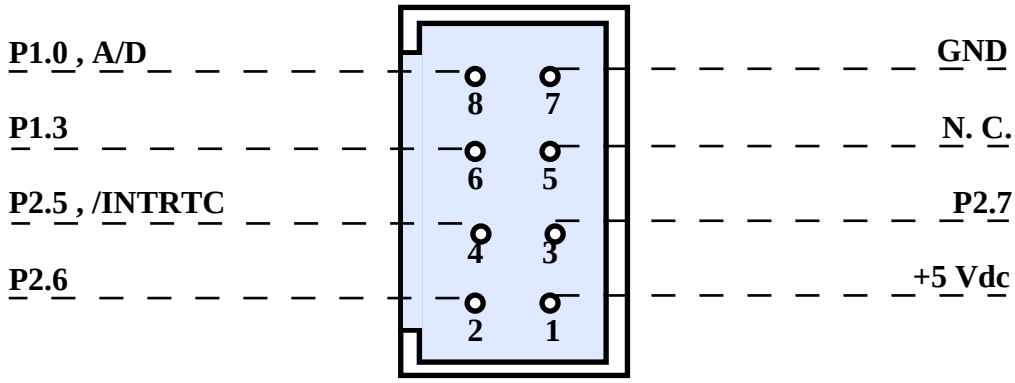

FIGURE 22: CN7 - TTL I/O, A/D, ETC. CONNECTOR

Signals description:

Px.y	= I/O	- TTL digital I/O signal, connected to pin x of socket ZC1.
A/D	= I	- Analog input for A/D converter section (please see manual **GMB HR168**).
/INTRTC	= I/O	- Interrupt signal of optional Real Time Clock (option **.RTC**).
+5 Vdc	= O	- Positive terminal of +5 Vdc power supply.
GND	=	- Ground signal.
N. C.	=	- No connection.

INTERRUPTS

Possible interrupt sources are:

- Input IN3 of CN1 -> Generates an external interrupt called /INT0.
- Input IN4 of CN1 -> Generates an external interrupt called /INT1.
- CPU internal peripherals -> Generate internal interrupts. In detail interrupt sources can be: Timer 0, Timer 1, Timer 2, PCA, UART, A/D converter.

Please refer to **GMM AC Zero** manual for further information.

I/O CONNECTION

To prevent possible connecting problems between **GMB HR168 & GMM AC Zero** and the external systems, the user has to read carefully the previous paragraph information and he must follow these instrunctions:

- For RS 232, RS 422, RS 485, Current Loop and I^2C BUSsignals the user must follow the standard rules of each one of these protocols, I^2C BUS signals are also provided with 4.7 kΩ pull up.

- For all TTL signals the user must follow the rules of this electric standard. The connected digital signal must be always referred to card digital ground and if an electric insulation is necessary, then an opto coupled interface must be connected. For TTL signals, the 0V level corresponds to logic state 0, while 5V level corrisponds to logic state 1.

- The analog inputs (A/D Converter section) on CN7 is provided with filtering capacitors that warrant more stability on the signal to acquire and lower the cut-off frequency. It is also possible to connect a voltage divider that divides by 4 the signal amplitude.

- Optocoupled input signals can be configured as NPN or PNP through jumpers J1 and J2, these jumpers must be moved together. In detail, if inputs are configured as NPN, positive voltage is present on input pins (INx-1, INy-2) and ground is present on the common pins (COM1 and COM2), while if the inputs are configured as PNP the situation is reversed, this means ground on input pins and positive signal on common pins.

- Relays outputs must be connected directly to the load to drive (remote control switches, power relays, etc.). Board contact is normally open and can bear **5 A** up to **30 Vdc**. To drive load with different supplies, different COMMONS for the groups of relays are available.

POWER SUPPLY

GMB HR168 & GMM AC Zero is provided with an efficent circuitery that solves in a comfortable and efficent way the problem to supply the card in any condition of use.
Here follow the volages required by the card:

+V opto: Provides power supply to optocouplers of board input section; input voltage must be in the range 8 ÷ 30 Vdc or 8 ÷ 24 Vac and must be provided on connector CN5 through pins 1 and 2, connecting pin 2 to the positive terminal of external power supply and pin 1 to its ground terminal, if it is direct voltage.
It is also possible to fetch the optocouplers section supply voltage through pins 2 and 8 of CN7. Please refer to paragraph about CN7 for further information.
Current fetch must be compatible with electric features of rectifier section that generates the voltage, such features are written in paragraph "ELECTRIC FEATURES".

Vac, +Vdc pow, GND: Provide power supply to control logic and to output section of the board through the on board switching power supply; input voltage must be in the range 10 ÷ 40 Vdc or 8 ÷ 24 Vac and must be provided though puns 3 and 4 of CN5 (in case of Vdc, pin 4 must be connected to positive terminal). This allows to supply the cards using standard devices of industrial sector like transformers, batteries, solar cells, etc. If external loads must be supplied, a +5 Vdc voltage can be fetched from pins 1 and 7 of CN6, CN7. Also, if there is the need to supply I^2C BUS external peripherals from **GMB HR168 & GMM AC Zero**, pins 1 and 4 of CN8 can be used. Please remark that on board switching power supply is provided with single diode rectifier, so in case of Vdc supply, all ground signals (GND) of the card are at the same potential.

To warrant highest immunity against noise and so a correct working of the cards, it is essential that these two voltages are galvanically isolated
In order to obtain this power supply **EXPS-2** can be ordered.
This device performs galvanic isolation starting from mains power supply.
GMB HR168 features a **TransZorb™**-based protection circuit to avoid damages from incorrect tensions and break-down of power supply section.
On board power supply is visualized through a LED on the bottom left corner.
Current available to supply external loads using +5 Vdc **is less than 360 mA.**

For further information please refer to paragraph “ELECTRIC FEATURES”.

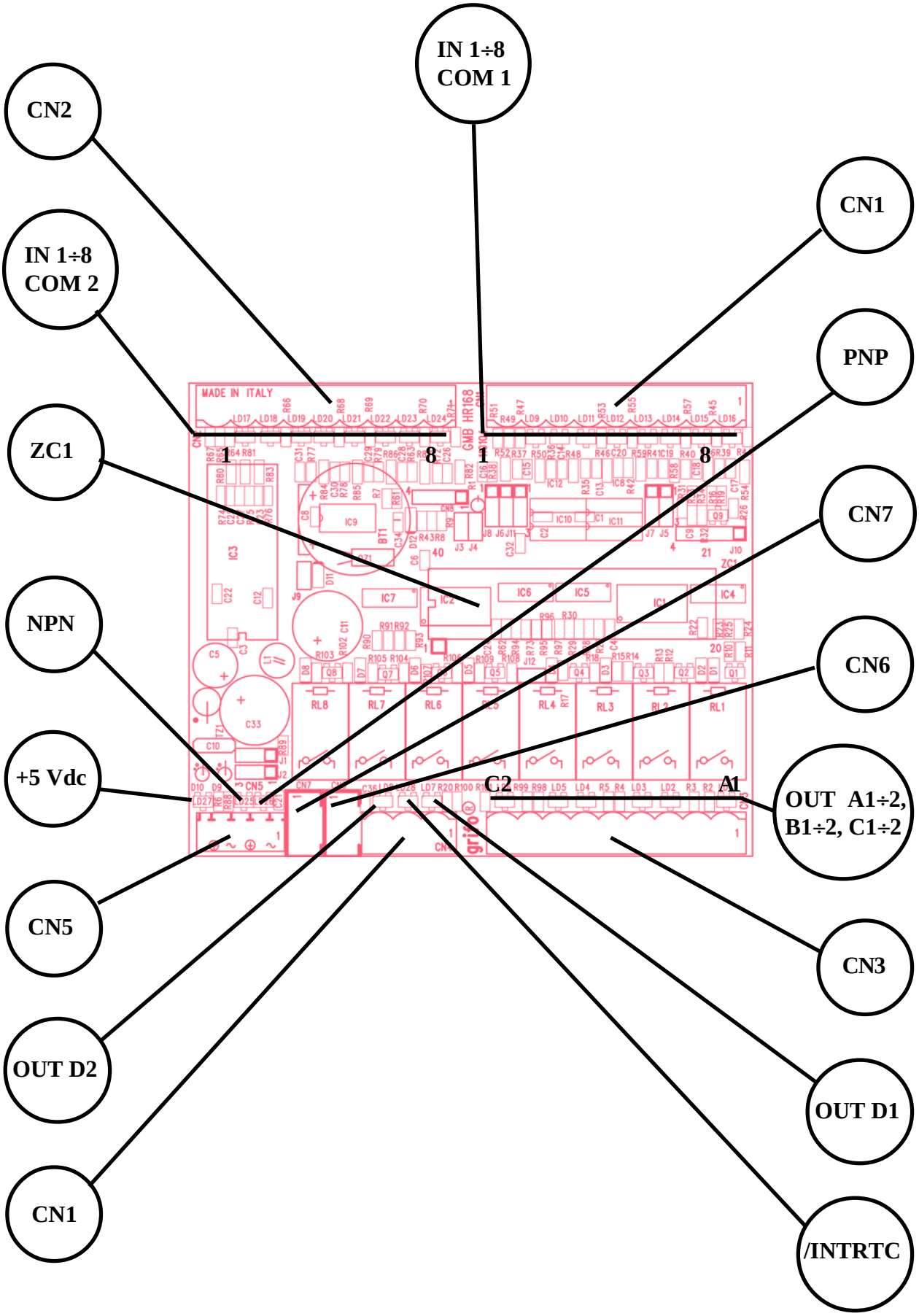

FIGURE 23: LEDS, CONNECTORS, ETC. LOCATION

INPUTS CONFIGURATION AS NPN OR PNP

The 16 optocoupled inputs of **GMB HR168 & GMM AC Zero** can be configured as NPN or PNP according to the connection of jumpers J1 and J2.
For further information please refer to manual of **GMB HR168**.

BACK UP

GMB HR168 & GMM AC Zero can be ordered with an optional Real Time Clock and a back up Lithium battery already installed (option **.RTC**). Lithium battery keeps the time and the content of SRAM even when power supply is off, if jumper J9 is connected. By default, jumper J9 is NOT connected.
For further information, please refer to paragraph "ELECTRIC FEATURES".

ANALOG INPUT

GMB HR168 features an interface for one analog input that can accept an input voltage in a variable range according to connection of jumper J11.
For further information please refer to manual of **GMB HR168**.

CORRESPONDANCE OF SIGNALS

All hardware resources of **GMB HR168 & GMM AC Zero** are managed by GMM AC **Zero** through signals and peripherals of local microcontroller, Atmel AT89C51CC03.
To have the complete control of such resources, it is enough to refer to the table in the near page, which indicates the signal and/or peripheral that drives a specific resource.

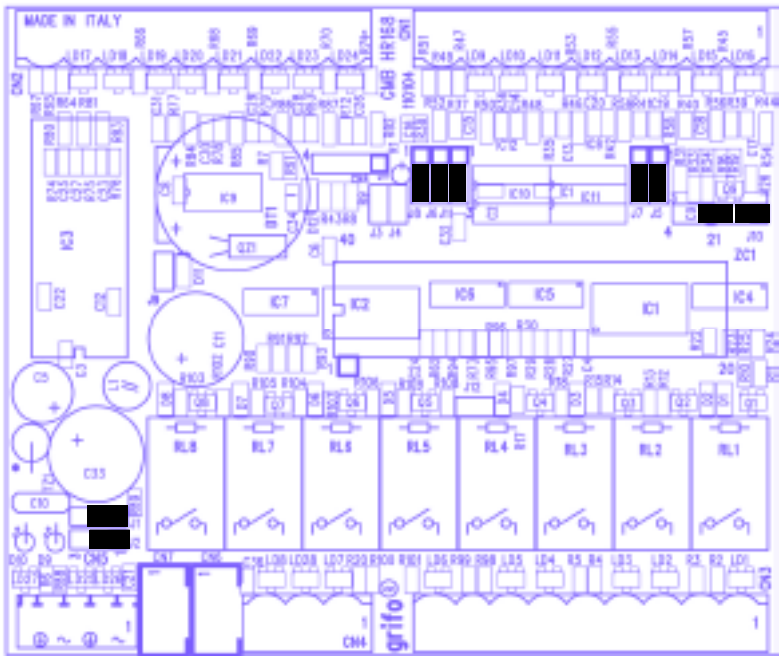

FIGURE 24: JUMPERS DEFAULT CONNECTION

Connector GMB HR168	PIN	Signal GMB HR168	PURPOSE	PIN CN1 GMM AC0	Signal GMM AC0
OPTO INPUTS COM 1	1	Input 1	Optocoupled input n° 1.	pin 32	P1.1
	2	Input 2	Optocoupled input n° 2 or counter PCA.	pin 31	P1.2, ECI
	3	Input 3	Optocoupled input n° 3 or Interrupt 0.	pin 25	P3.2, /INT0
	4	Input 4	Optocoupled input n° 4 or Interrupt 1.	pin 24	P3.3, /INT1
	5	Input 5	Optocoupled input n° 5 or counter Timer 0.	pin 23	P3.4, T0
	6	Input 6	Optocoupled input n° 6 or counter Timer 1.	pin 22	P3.5, T1
	7	Input 7	Optocoupled input n° 7.	pin 21	P3.6
	8	Input 8	Optocoupled input n° 8.	pin 19	P3.7
	9	Common pin of optocoupled inputs on connector CN1			
OPTO INPUTS COM 2	1	Input 1	Optocoupled input n° 9.	pin 1	P0.0
	2	Input 2	Optocoupled input n° 10.	pin 2	P0.1
	3	Input 3	Optocoupled input n° 11.	pin 3	P0.2
	4	Input 4	Optocoupled input n° 12.	pin 4	P0.3
	5	Input 5	Optocoupled input n° 13.	pin 35	P0.4
	6	Input 6	Optocoupled input n° 14.	pin 36	P0.5
	7	Input 7	Optocoupled input n° 15.	pin 37	P0.6
	8	Input 8	Optocoupled input n° 16.	pin 38	P0.7
	9	Common pin of optocoupled inputs on connector CN2			
RELAY OUTPUTs	A1	Output 1	Relay output 5 A n° 1.	pin 29	P1.4
	A	Common pin of buffered relay outputs of group A on connector CN3			
	A2	Output 2	Relay output 5 A n° 2.	pin 28	P1.5
	B1	Output 3	Relay output 5 A n° 3.	pin 27	P1.6
	B	Common pin of buffered relay outputs of group B on connector CN3			
	B2	Output 4	Relay output 5 A n° 4.	pin 26	P1.7
	C1	Output 5	Relay output 5 A n° 5.	pin 14	P4.0
	C	Common pin of buffered relay outputs of group C on connector CN3			
	C2	Output 6	Relay output 5 A n° 6.	pin 15	P4.1
RELAYs	D1	Output 7	Relay output 5 A n° 7.	pin 18	P2.2
	D	Common pin of buffered relay outputs of group D on connector CN3			
	D2	Output 8	Relay output 5 A n° 8.	pin 16	P2.3 (if J10 in 3-4)
				pin 30	P1.3 (if J10 in 4-5)
AMP 8 I/O	pin 1	+5 Vdc	Power supply +5 Vdc	pin 40	+5 Vdc
	pin 2	I/O TTL	I/O TTL.	pin 5	P2.6
	pin 3	I/O TTL	I/O TTL.	pin 6	P2.7
	pin 4	/INTRTC	Interrupt of optional RTC or I/O TTL.	pin 11	P2.5
	pin 6	D/A	PWM of CEX0 or I/O TTL.	pin 30	P1.3
	pin 7	GND	Ground of Mini Block.	pin 20	GND
	pin 8	A/D	Input AN0 or I/O TTL.	pin 33	AN0

FIGURE 25: TABLE OF CORRESPONDANCE BETWEEN SIGNALS AND RESOURCES

HOW TO START

One of the most important features is the possibility to program the microprocessor Atmel AT89C51CC03 internal FLASH through RS232 serial connecton without removing Mini Module from socket ZC1.

A) MAKE SERIAL CONNECTION BETWEEN HARDWARE AND PC:

A1) First of all, open the container of **GMB HR168** to install Mini Module **GMM AC Zero** on socket ZC1.

. A2) To supply **GMB HR168**, power supply **EXPS-2** can be used. It can provide two galvanicallt isolated tensions, required for the correct working of **GMB HR168 & GMM AC Zero**. Also any other power supply capable to generated the two required voltages can be used.

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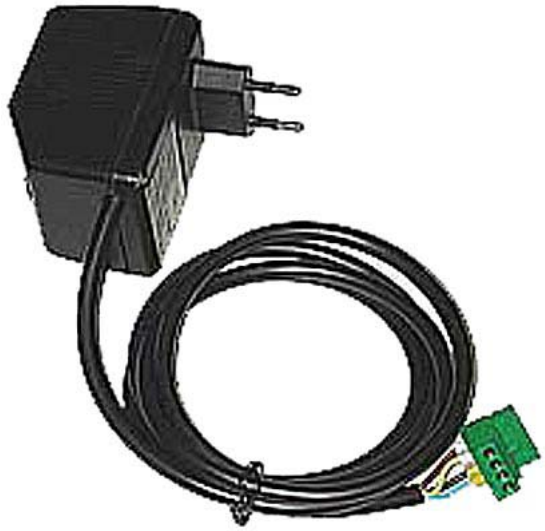

FIGURE 26: PICTURE OF POWER SUPPLY EXPS-2

A3) Make the connection described in figure 9.

A4) Keep ready a terminal emulatore on the PC, configure it to use the serial port conneted to the Mini Module with 19200 baud, 8 data bit, 1 stop bit, no parity.

A5) Set DEBUG mode, that is move dip switch DSW1.1 of **GMM AC Zero** to position ON.

. A6) Supply **GMB HR168 & GMM AC Zero**. Please, find the demo program of **GMB HR168 & GMM AC Zero** on grifo® CD, the file is called "prgmb168.hex" and can be found from the starting follwing the path: English | Examples Tables | Mini Block and Mini Modules programs | GMB HR 168.

.

BOARD TYPE	GET	ASM	Ladder	Abaco® Link BUS	BASIC CBZ80	BASIC BASCOM 8051	BASIC BASCOM AVR	PIC BASIC	BASIC VARI	MCS® Basic 52	C	PASCAL	CPU / BLOCK TYPE
MISCELL.	-	-	-	-	-	●	-	-	-	-	-	-	-
CAN GM0	●	-	-	-	-	●	-	-	-	-	●	-	Atmel T89C51cc03 - 8051 Code
CAN GM1	●	-	-	-	-	●	-	-	-	-	●	-	Atmel T89C51cc01 - 8051 Code
CAN GM2	●	-	-	-	-	●	-	-	-	-	●	-	Atmel T89C51cc02 - 8051 Code
GMM 5115	●	-	-	-	-	●	-	-	-	-	●	-	Atmel T89C5115 - 8051 Code
GMM 876	●	-	-	-	-	-	-	●	-	-	-	-	Microchip PIC16F876A - PIC 14 Code
GMM 932	●	-	-	-	-	●	-	-	-	-	-	-	PHILIPS P89LPC932 - 8051 Code
GMM AC2	●	-	-	-	-	●	-	-	-	-	●	-	Atmel T89C51AC2 - 8051 Code
GMM AM08	●	-	-	-	-	-	●	-	-	-	-	-	Atmel ATMega08 - AVR Code
GMM AM32	●	-	-	-	-	-	●	-	-	-	-	-	Atmel ATMega32 - AVR Code
GMB HR84	●	-	-	-	-	●	●	●	-	-	●	-	Mini Block 8 input opto 4 output relè
GMB HR168	●	-	-	-	-	●	-	-	-	-	●	-	Mini Block 16 input opto 8 output relè

FIGURE 27: EXAMPLES TABLES

B) FLASH REPROGRAMMING:

B1) Find and save to a comfortable position on your hard drive the file "prgmb168.hex".

B2) On grifo® CD it is also available the utility program FLIP. that manages the ISP programming of microcontroller memories on board of **GMM AC Zero** through the simple serial connection seen at point A; find it and install it on a comfortable position on your hard drive. It is suggested to use version 1.8.2 or greater, the latest verion is available on Atmel website: www.atmel.com.

B3) Put switch 1 of DSW1.1 of **GMM AC Zero** in position ON, to set DEBUG mode.

B4) Close the terminal emulator.

B5) Turn off and then turn on again **GMB HR168 & GMM AC Zero**.

B6) Run ISP programming sofware installed at step B2.

B7) Select the CPU to program, that is AT89c51CC03, by pressing the first button on top left, picking the name in the window that appears and pressing OK.

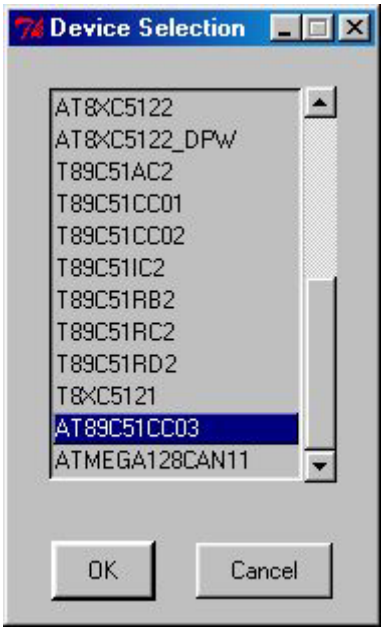

FIGURE 28: FLIP SETTINGS WINDOW (1 OF 3)

B8) Select communication speed with Mini Module by pressing the second button on the top left, picking RS 232 the 115200 and the serial port used to connect the PC to Mini Module then press OK:

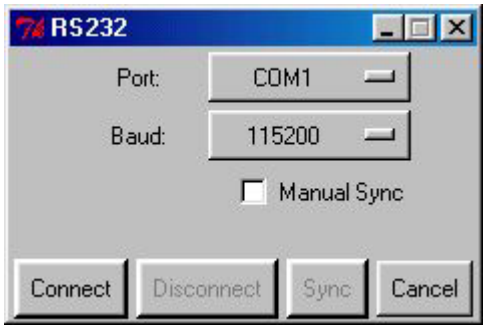

FIGURE 29: FLIP SETTINGS WINDOWS (2 OF 3)

If a window with the message "Timeout Error" should appear after 20 seconds, try to decrease the baud rate; or to repeat point from B1 to here; or verify the correct connection between PC and Mini Module repeating the points from A1 to A4.

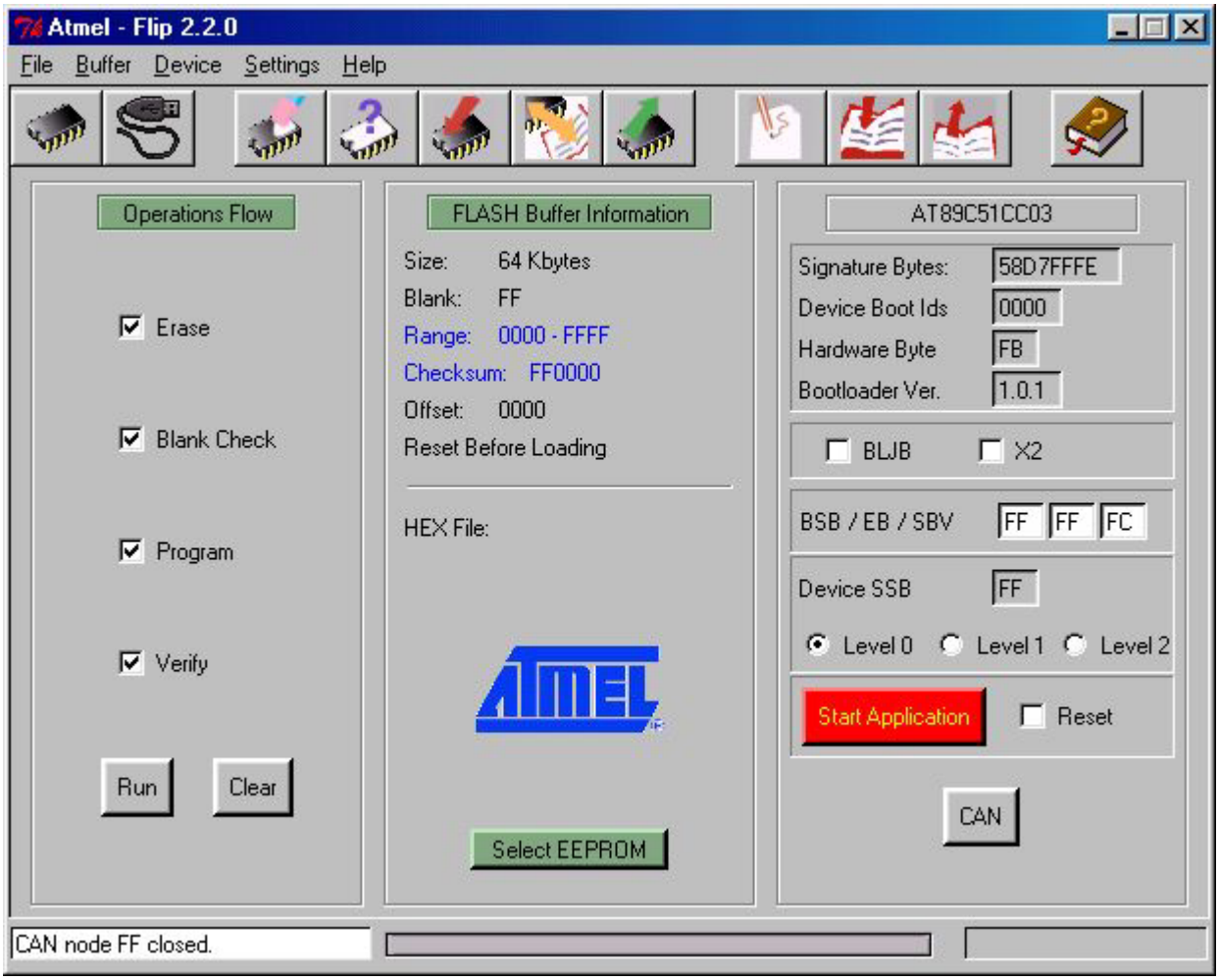

FIGURE 30: FLIP SETTINGS WINDOWS (3 OF 3)

B9) Make sure that text boxes in the frame "AT89C51CC03" fill with text, like in figure 30.

B10) Load the file to write in FLASH (that is prgmb168.hex) pressing the third button on top right and selecting the file using the dialog box. In the frame "FLASH Buffer Information" several information about the file just loaded appear; in detail the box "HEX File:" must report the file name.

B11) Check all the check boxes in the frame "Operations Flow".

B12) Press button "Run" in the same frame.

B13) The status bar on the bottom reports operation progess, text box in the bottom left reports operation status, check boxes become red and then green when the respective operation is succesfully completed. Wait for "Verify" check box to become red.

B14) Close **FLIP**.

B15) Start the terminal emulator configured like in point A4.

B16) Set RUN mode, that is DSW1.1 OFF.

B17) Reset or Power off and them on the card; the terminal emulation window now must show the demo program start screen, like in point A4.

C) GENERATING DEMO EXECUTABLE CODE:

C1) Install on the hard disk of the development P.C. the software environment selected to develop the application program. There are many different software tools that satisfy any customers requirements but here we remind only the most diffused as the BASCOM 8051, µC/51, LADDER WORK, etc.

C2) On **grifo®** CD in addition to file with the executable code of the demo program, described at point A6, there are also the source file of the same. These have an extension that identifies the used software development tools (for example prgmb168.bas for BASCOM 8051, prgmb168.c for µC/51 or prgmb168.pjn for LADDER WORK) and they are properly organized inside demo programs tables available on CD, together with possible definition file (prgmb168.mak and canary.h for µC/51, 89c51cc03.dat for BASCOM 8051, etc.). Once these files have been located they must be copied in a comfortable folder on the hard disk of development P.C.

C3) Compile the source file by using the selected software tools: the file prgmb168.hex must be obtained equal to those available on **grifo®** CD and already used at steps B. This operation is very different according to the programming environment selected, so here follws the details:

I) *Ricompilation using BASCOM 8051.*

Ia) When in BASCOM IDE, load the program source with menu File | Open:

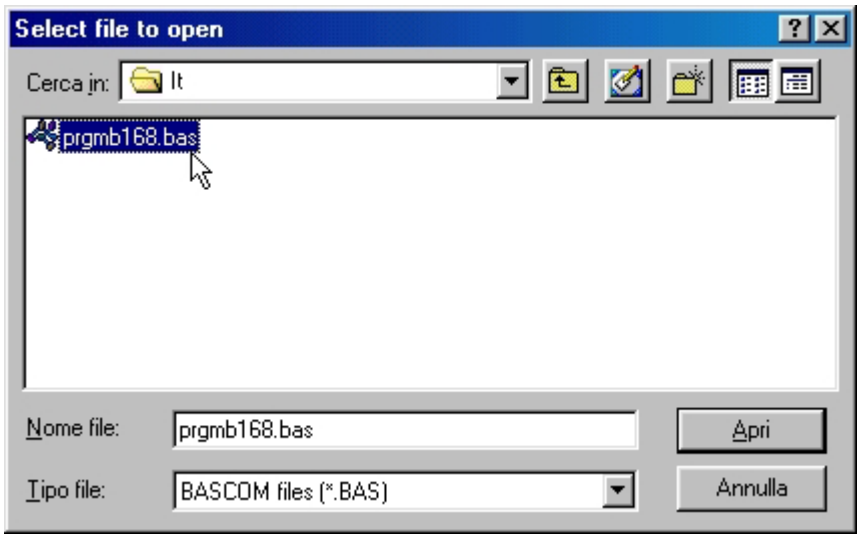

FIGURE 31: LOADING A SOURCE FILE WITH BASCOM 8051

Ib) From menu Options | Compiler | Misc set the value of Byte End to A0, as suggesterd also in the source code, and press OK:

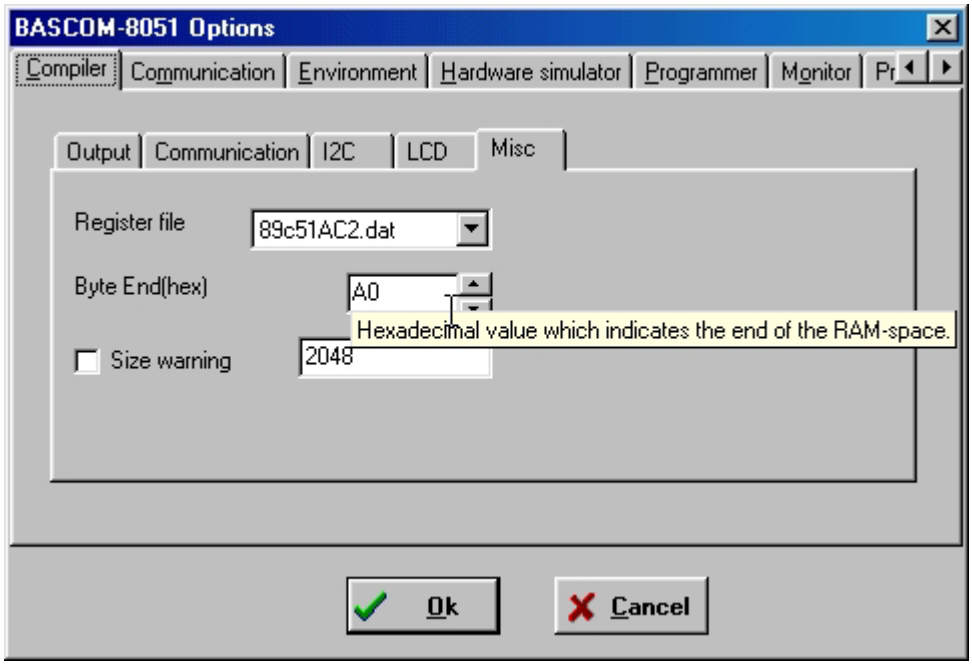

FIGURE 32: CONFIGURATION OF COMPILER BASCOM 8051

Ic) Compile the source file by pressing the button with the icon of an integrated circuit. Presence of file 89c51CC03.DAT in BASCOM installation folder is required in order to compile correctly:

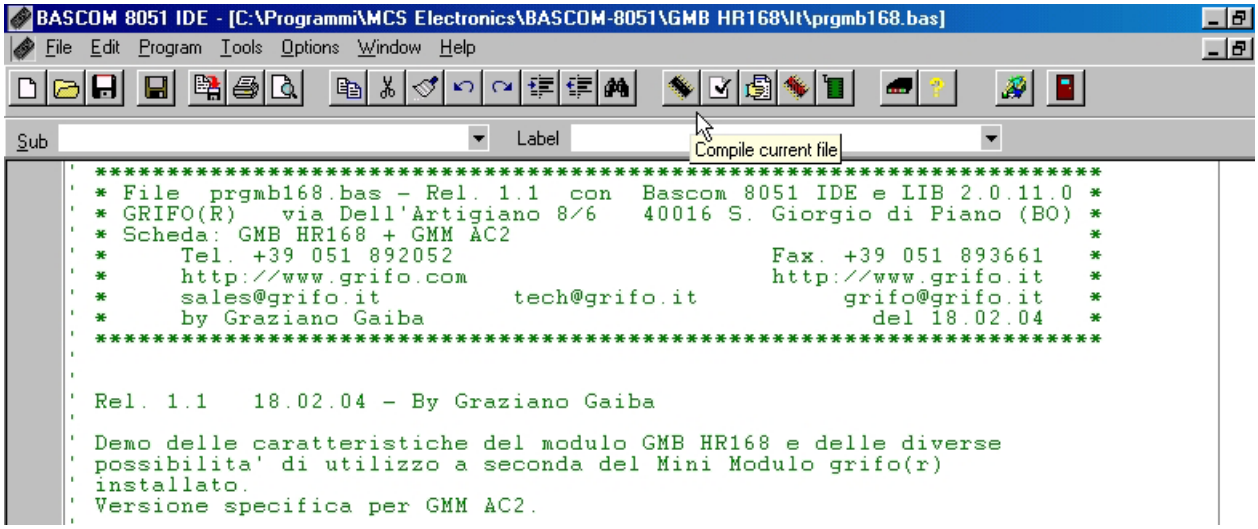

FIGURE 33: COMPILATION WITH BASCOM 8051

II) *Ricompilatione with µC/51.*

IIa) After opening standard editor uedit.exe, load the source file pressing the fifth button from the left, the presence of file canary.h in the same folder of file prgmb168.c is required for a correct compilation:

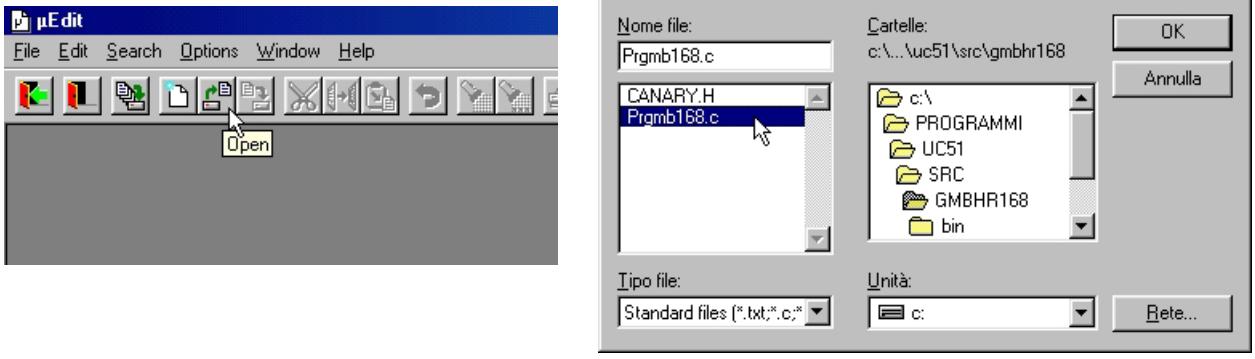

FIGURE 34: LOADING SOUCE FILE WITH µC/51

IIb) Open also MakeFile editor, that is program umshell.exe, and load file prgmb168.mak with the menu File | Load:

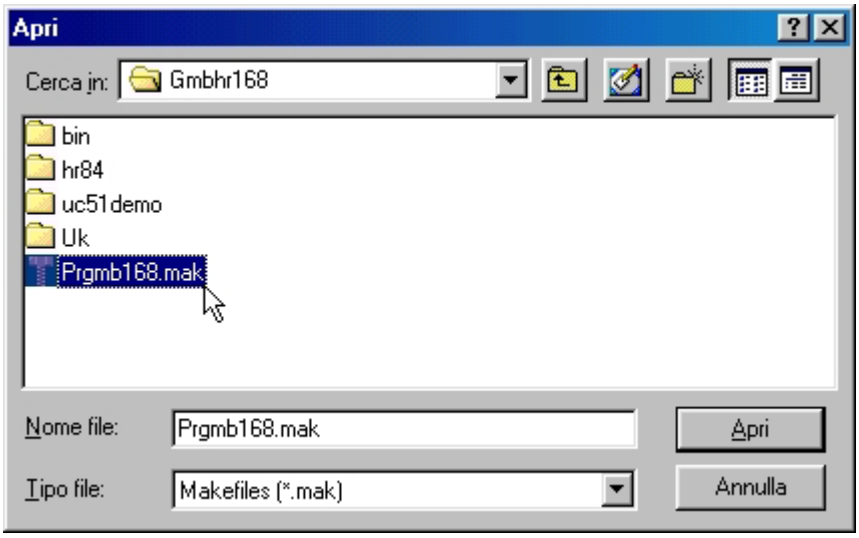

FIGURE 35: LOADING MAKEFILE (COMPILING CONFIGURATION) WITH µC/51

IIc) Compile the source file pressing the first button from the right:

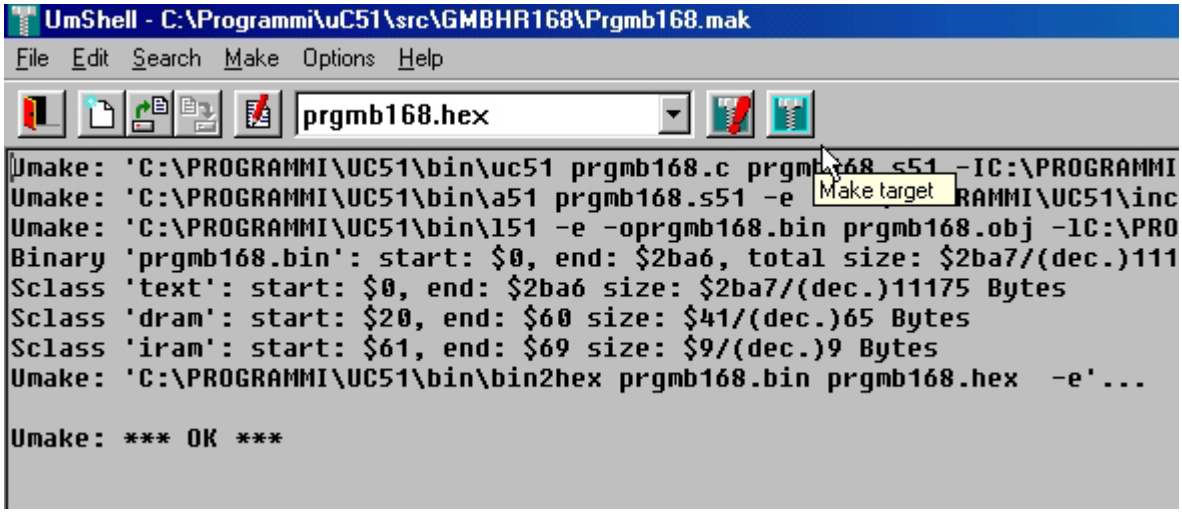

FIGURE 36: COMPILATION USING µC/51

III) *Ricompilation using LADDER WORK.*

IIIa) After opening IDE of LADDER WORK, open the schematic file called prgmb168.pjn with menu File | Open:

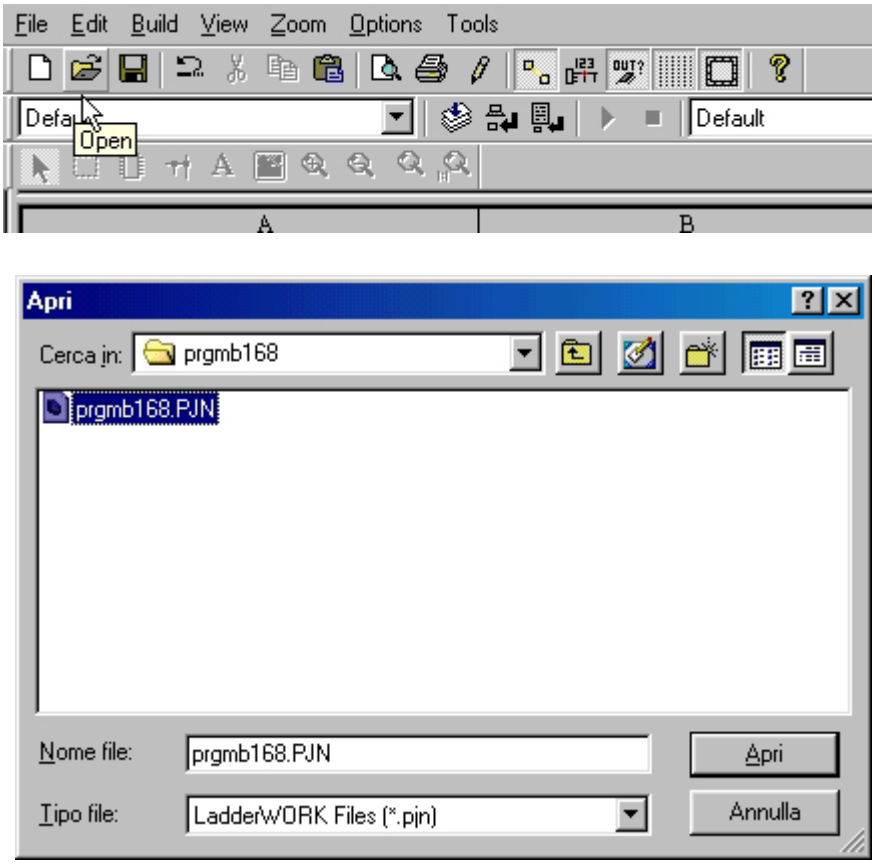

FIGURE 37: LOADING SOURCE SCHEMATIC WITH LADDER WORK

IIIb) Assure that the selected profile is the one specific for **GMM AC Zero & GMB HR168**:

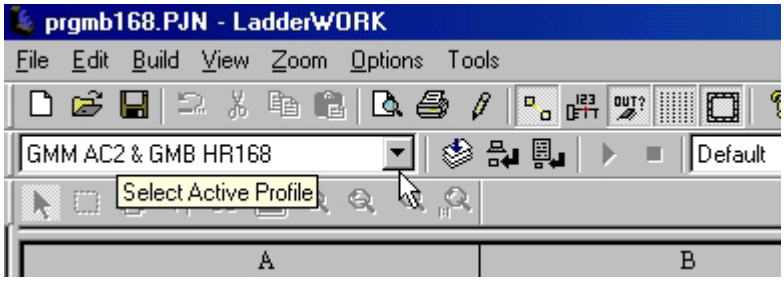

FIGURE 38: COMPILER CONFIGURATION FOR LADDER WORK

IIIc) Compile the source schematic pressing the first button from the right:

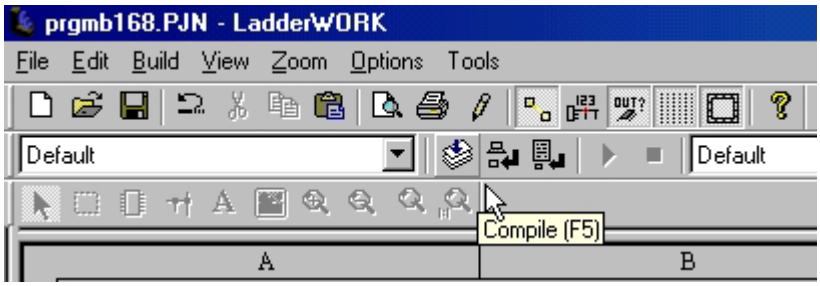

FIGURE 39: COMPILATION WITH LADDER WORK

C4) Reperform the programmation of the obtained HEX file in the Mini Module FLASH, by executing again the points B3÷B17.
About the FLASH MAGIC settings, please remind that they could be inserted only the first time in fact the same program mantains the last setting sucesfully used.

When during execution of the steps above described a problem or a malfunction is found, we suggest to read and repeat again all the steps carefully and if malfunction persists please contact directly grifo® technician.
Instead when execution of all the steps above described is right, the user has realized his first application program that coincides with demo of **GMM AC Zero & GMB HR168**.
At this point it is possible to modify the source of the demo/s program according to application requirements and test the obtained program with the steps above listed (from B3 to C4) in cyclic mode, until the developed application program is completely well running.
When this focus is reached the developmnet P.C. can be eliminated, by obtaining a self running card, as below described:

D) *PREPARAZIONE DEFINITIVA DELL'APPLICAZIONE*

D1) Impostare modalità RUN (DSW1.1=OFF) e scollegare P.C. di sviluppo.

PERIPHERAL DEVICES SOFTWARE DESCRIPTION

In the previous paragraphs are described the peripheral connections to the field, while in this one there is a specific description of registers meaning and function (please refer to I/O addresses table, for the registers names and addresses values).
For a more detailed description of the devices, please refer to documentation of **GMB HR168** and **GMM AC Zero**.
In the following paragraphs the **D7÷D0** and **.0÷7** indications denote the eight bits of the combination used in I/O operations.

RELAYS OUTPUTS

Staus of 8 digital relays outputs is set through 8 signals of 40 pin socket ZC1, which means TTL I/O signals of **GMM AC Zero**.
Please remark that signal driving relay OUT D2 can be connected either to signal P1.3 or to signal P2.3 according to the connection of jumper J10:

J10 connected in 3-4	->	OUT D2 driven by P1.3
J10 connected in 4-5	->	OUT D2 driven by P2.3

When the signal of socket ZC1 is set to logic state low (logic 0), the corresponding output is actived (relay contact is connected to its common pin).
Viceversa when the signal is set to logic state high (logic 1) the corresponding output is deactived (relay open).
As previously said, LEDs LD1÷8 provide a visual indication of digital outputs status (LED ON = output actived).
Summarizing, the correspondance is:

P1.4 , OUT A1	->	LED LD1	P4.0 , OUT C1	->	LED LD5
P1.5 , OUT A2	->	LED LD2	P4.1 , OUT C2	->	LED LD6
P1.6 , OUT B1	->	LED LD3	P2.2 , OUT D1	->	LED LD7
P1.7 , OUT B2	->	LED LD4	(see above) , OUT D2	->	LED LD8

SERIAL LINE

The **GMM AC Zero** signals used are the ones called TxD and RxD.

I²C BUS

Signals used are pin 2 of CN8 (SDA) and pin 3 of CN8 (SCL).
Please remark that **GMM AC Zero** is not provided with an hardware I²C BUS interface, so this must be emulated by sofware using the high level instructions of the development language or the functions that can be found in the demo programs.
Signals SDA and SCL are also provided with 4.7 kΩ pull up resistors.
Only slave addresses from **00H** to **9FH** and from **A1H** to **FFH** can be used by user if the optional Real Time Clock of **GMB HR168** (option **.RTC**) is installed.

OPTOCOUPLED INPUTS

Status of 16 digital optocoupled inputs can be acquired by software reading the status of corresponding **GMM AC Zero**.
When NPN or PNP inputs are enabled, corresponding signals are at logic state low (logic 0), viceversa when inputs are disabled a logic level high is acquired (logic 1).
As previously said, LEDs LD9÷24 give a visual indication of digital inputs status (LED ON means input actived).
In detail, green LEDs (from LD9 to LD16), visualize optocoupled inputs from IN1-1 to IN8-1 of group 1 and referring to common pin COM1, while yellow LEDs (from LD17 to LD24), visualize optocoupled inputs from IN1-2 to IN8-2 of group 2 and referring to common pin COM2.
Summarizing, the correspondance is:

P1.1 , IN1-1	->	LED LD16	P0.0 , IN1-2	->	LED LD24
P1.2 , IN2-1	->	LED LD15	P0.1 , IN2-2	->	LED LD23
P3.2 , IN3-1	->	LED LD14	P0.2 , IN3-2	->	LED LD22
P3.3 , IN4-1	->	LED LD13	P0.3 , IN4-2	->	LED LD21
P3.4 , IN5-1	->	LED LD12	P0.4 , IN5-2	->	LED LD20
P3.5 , IN6-1	->	LED LD11	P0.5 , IN6-2	->	LED LD19
P3.6 , IN7-1	->	LED LD10	P0.6 , IN7-2	->	LED LD18
P3.7 , IN8-1	->	LED LD9	P0.7 , IN8-2	->	LED LD17

DIGITAL TTL I/O

They are pins 2, 3, 4 and 6 of connector CN7, connected respectively to signals P2.6, P2.7, P2.5 and P1.3.
Pin 8 of CN7 can also be used as digital I/O connected to signal P1.0 (if J11 is connected in position 1-2), but remembering that it is always connected to a 4.7 kΩ pull-down.
In addition, pin 4 is connected to a yellow LED (LD28) that visualizes its status; in case an optional Real Time Clock is installed this signal is connected to its open collector output /INTRTC and cannot be used as user digital I/O.

RTC + SRAM

GMM AC Zero & GMB HR168 can be ordered with an optional Real Time Clock + SRAM module already installed (option **.RTC**).
The SRAM module, is provided with 240 bytes and the Real Time Clock which manages time (hours, minutes, seconds) and date (day, month, year, day of the week).
Option is delivered with on board Lithium battery installed.
RTC section can also generate periodic interrupts whose period can be programmed by the user, so it can be used to awaken CPU from low consumption working modes.
For software management of serial SRAM+RTC module, please refer to specific documentation or to demo programs supplied with the card.
The user must realize a serial communication with I^2C bus standard protocol, through two ZC1 socket signals.
The only necessary information is the electric connection:

DATA line (**SDA**)	->	**P2.1** (input/output)
CLOCK line (**SCL**)	->	**P2.0** (output)

Please remark that A0 of this component's slave address is bound to logic 0, so its slave address is hexadecimal **A0H**.
Logic state 0 of line corresponds to low level logic state (= 0 V), while logic state 1 correspons to high level logic state (= 5 V).
We also would want to remark that SDA and SCL lines are connected to a 4.7 KΩ pull-up resistor.

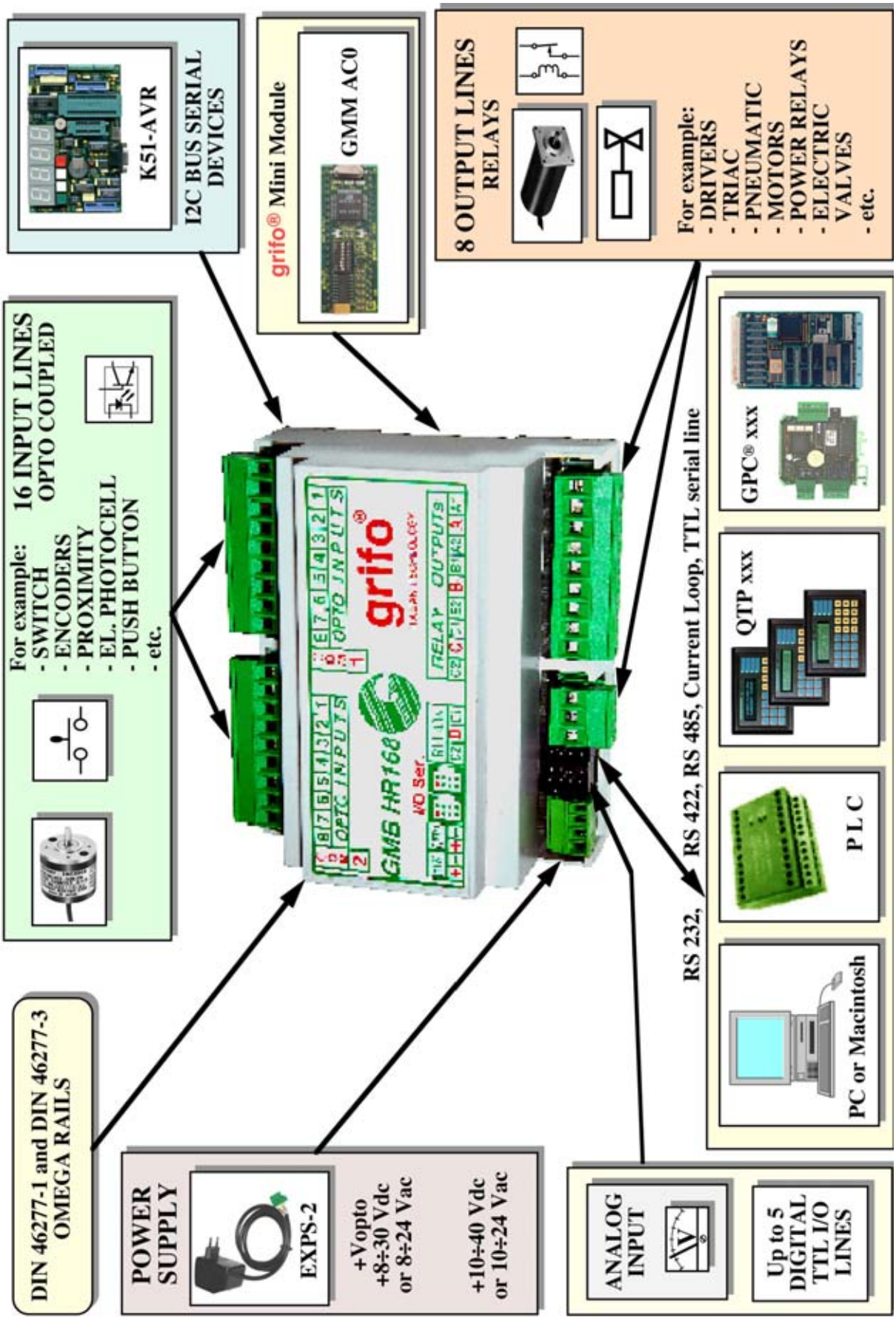

FIGURE 40: CONNECTIONS EXAMPLE

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