CAN GM1

CAN - grifo® Mini Module 1

TECHNICAL MANUAL

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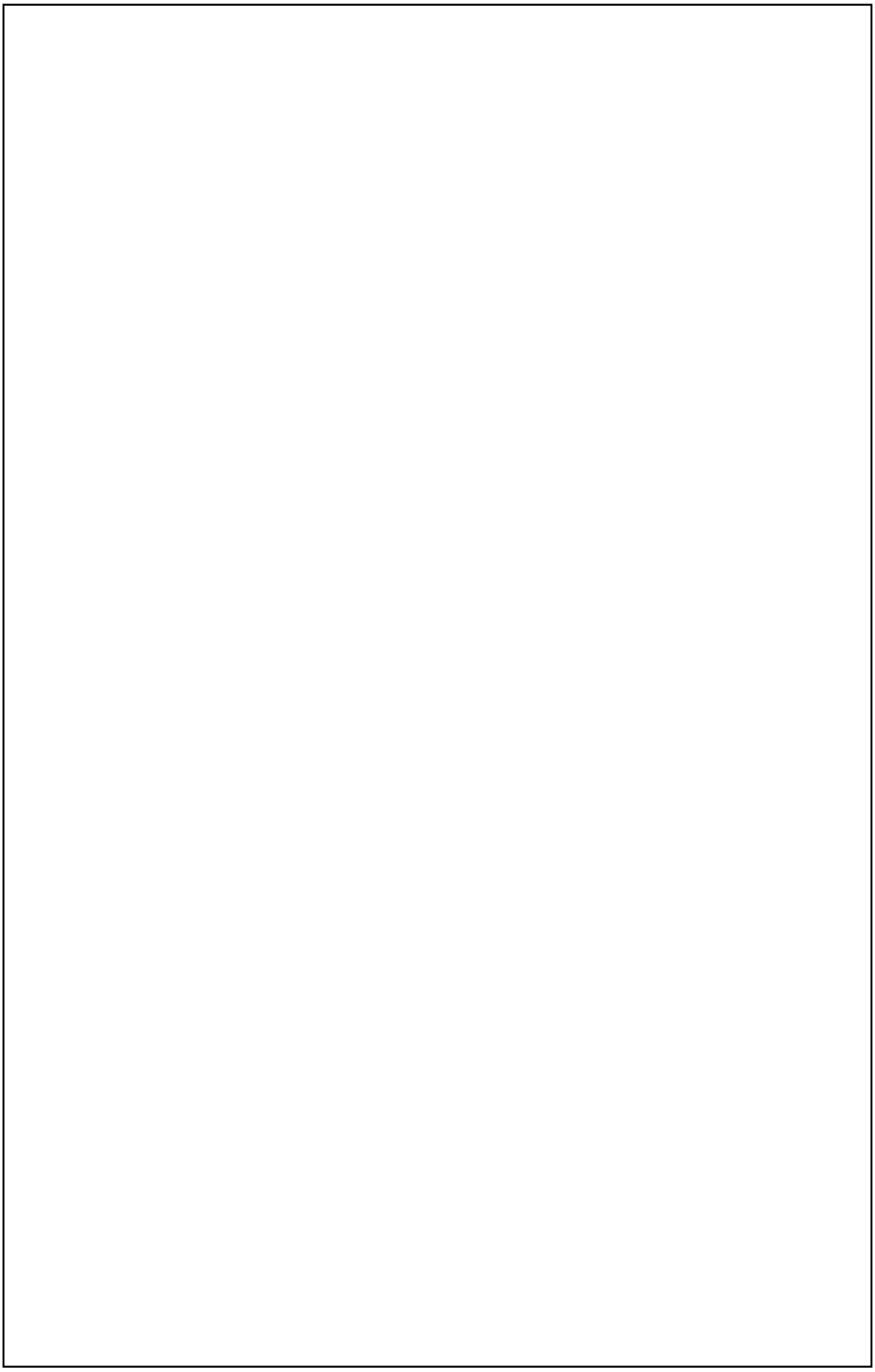
CAN GM1 Rel. 5.20 *Rel. 11 February 2004*



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Standard container with **28 pins** male socket, DIL, 100 mils pitch, 600 mils width; **very small dimension**: 25.5 x 42.7 x 14.3 mm; **4 layers** PCB to obtain **best** noisy resistance and best **EMI performance**; single power supply required **+5Vdc** (the current consumption may vary according to module connections); availability of **idle** mode and **power down mode**; **Atmel AT89C51CC01** microcontroller (8051 code compatibile) with 14.74 Mhz crystal; programmable machine speed at **12 or 6 clock** cycle; **32K FLASH** for code, 2K FLASH for boot loader, 256 bytes RAM for data, **1K ERAM** for data, **2K EEPROM** for data; **8 A/D converter channels** with **10 bits** resolution, **20 μsec** conversion time; 14 **interrupt** sources with **4 priority levels**; **3 Timers Counters** up to 16 bits; **5 PCA channels** up to 16 bits with PWM, watch dog, **compare**, **capture**, etc. functionality; **22 digital I/O lines** available on connector; hardware serial line with Baud Rate up to **115200 Baud**, **RS 232** buffered or at **TTL** level; transceiver for RS 232 serial line; **CAN controller** compatible with 2.0 A and 2.0 B standards; high speed transceiver for **CAN** line up to **1 Mbit** (ISO-11898); **reset** and power supply control circuit; software **I²C BUS line**, available on connector; **RTC** capable to manage day, month, year, week day, hours, minutes, seconds and to generate periodic interrupts; 240 bytes of **SRAM** for configuration parameters; RTC and SRAM backed with on board **Lithium battery** and driven by software I²C BUS line; 8 configuration **dip switches**; **2 status LEDs** managed by software; internal FLASH and EEPROM can be managed through **In System Programming**, or when the module is already mounted, by using the serial communication line or the CAN line; **freeware software** for PC, that supports the ISP programmation to dowload the generated code, inside on board FLASH; wide range of **development tools** as: C compiler (μC/51, MCC51, HTC51, SYS51CW, DDS Micro C51); BASIC compiler (BASCOM 8051); PASCAL compiler (SYS51PW); etc.; posibilities to implement higher level protocols, such as **CANopen**, **DeviceNet** etc.; long list of **demo programs** and use examples supplied under source form, duly remarked, for the available development tools.

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IMPORTANT

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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

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INTRODUCTION

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

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 **CAN GM1** card release **140202** and later. The validity of the bring information is subordinate to the number of the card release. The user must always verify the correct correspondence among the two denotations. On the card the release number is present in more points both board printed diagram (serigraph) and printed circuit (for example in the top left corner on the solder side and in the top right corner on the component side).

GENERAL INFORMATION

CAN GM1 (**C**ontroller **A**rea **N**etwork - **grifo® M**ini **M**odule **1**) is a module based on microcontroller **Atmel AT89c51CC01**, a powerful and complete system-on-a-chip provided with **CPU**, **internal memory** both for data and for code, **A/D converter**, **watch dog**, **interrupts**, TTL digital I/O lines, a hardware serial line, a **CAN** controller, dedicated **timer/counter** with capture/compare capability and the flexible **PCA** section. This section allows to build, with no or few external components, **PWM** outputs, more timer/counter with capture/compare, software serial lines, etc.
In modules' very small area some comoponents that exploit microcontrollers' performance are already mounted. In addition to this, component that completemicro's features are installed, like **CAN transceiver**, **power good and reset** generator, **real time clock PCF 8583**, capable to generate periodic interrupts, etc.
Possible applications of **CAN GM1** Mini Modules are several. For example, native CAN application, that is **car automation** (lights turning ON/OFF, heating and cooling systems control, supervision of electric devices, anti-teft and acces control systems, functionality checks, etc.). Also, **connection** on CAN networks with **your own protocols** or with standard protocols (like CANopen, DeviceNet, SDS, CAN Kingdom etc.). We remark the employ as **smart intelligent nodes** with local functionalities as PID algorithms for controlling temperatures, motors, valves, etc. or as **decentralized systems** as robots, automation of production line machines, big factory automations. Finally, **teleacquisition** and **telecontrol** on medium and low distances, **conversion** between **CAN** and **asynchronous serial** line or **I²C BUS** line and **home automation** (lights turning ON/OFF, heating and cooling systems control, supervision of electric devices, security and acces control systems).
Last but not least, **didactics**: **CAN GM1** offers a very low cost to learn CAN, we have many starter kits options. For this purpose it is likewise interesting the **CAN GMT** support card.
In any case, there is a short time to market: the user can see a prototype or even a ready product in one week.
Overall features are:

- Standard container with **28 pins** male socket, dual in line, 100 mils pitch, 600 mils width.
- **Very small dimension**: 25.5 x 42.7 x 14.3 mm.
- **4 layers** printed circuit to obtain **best** noisy resistance and best **EMI performance**.
- Single power supply required **+5Vdc** (the current consumption can change according with module connections).
- Availability of power saving setting as **idle** mode and **power down mode**.
- **Atmel AT89C51CC01** microcontroller (8051 code compatibile) with 14.74 Mhz crystal.
- Programmable machine speed at **12 or 6 clock** cycle.
- **32K FLASH** for code, 2K FLASH for boot loader, 256 bytes RAM for data, **1K ERAM** for data,

2K EEPROM for data.
- **8 A/D converter channels** with **10 bits** resolution, **20 μsec** conversion time.
- A/D reference voltage available on connector.
- 14 **interrupt** sources with **4 priority levels**.
- **3 Timers Counters** up to 16 bits
- **5 PCA channels** up to 16 bits with PWM, watch dog, compare, capture, etc. functionality.
- **22 digital I/O lines** available on connector. Some of these lines have multiple functions.
- Hardware serial line with programmable Baud Rate up to **115200 Baud**, **RS 232** buffered or at **TTL** level.
- Transceiver for RS 232 serial line.
- **CAN controller** compatible with 2.0 A and 2.0 B standards.
- High speed transceiver for **CAN** line up to **1 Mbit** (ISO-11898).
- **Reset** and power supply control circuit.
- Software **I²C BUS line**, available on connector.
- **Real Time Clock** capable to manage day, month, year, week day, hours, minutes, seconds and to generate periodic interrupts.
- 240 bytes of **SRAM** for configuration parameters.
- RTC and SRAM backed with on board **Lithium battery** and driven by software I²C BUS line.
- 8 configuration **dip switches**, with 3 dips acquired by software.
- **2 status LEDs** managed by software through digital I/O lines.
- Internal FLASH and EEPROM can be managed through **In System Programming**, or when the module is already mounted, by using the serial communication line or the CAN line.
- **Freeware software** for PC, that supports the ISP programmation to dowload the generated code, inside on board FLASH.
- Wide range of **development tools** as: C compiler (μC/51, MCC51, HTC51, SYS51CW, DDS Micro C51); BASIC compiler (BASCOM 8051); PASCAL compiler (SYS51PW); etc.
- Posibilities to implement higher level protocols, such as **CANopen**, **DeviceNet** etc.
- Long list of **demo programs** and use examples supplied under source form, duly remarked, for the available development tools.

DIGITAL I/O LINES

The Mini Module **CAN GM1** is provided with 22 digital I/O lines at TTL level, of the microprocessor Atmel AT89c51CC01, grouped in two 8 bit ports (P1 and P3) and in one 6 bit port (P2). Port bits are P1.0÷7, P2.0÷5 and P3.0÷7.
These lines are connected directly to 28 pins connectors with standard **grifo®** Mini Module pin out, allowing to be connected direclty to several interface cards.
By software it is possible to define and acquire the function and the status of these lines, and also to match them to peripheral devices (like Timer Counter, Interrupt, etc.), simply programming some CPU internal registers.
For further information please refer to paragraph CONNECTIONS and PERIPHERAL DEVICES SOFTWARE DESCRIPTION.

I²C BUS LINES

Standard pin out of 28 pins **grifo®** Mini Module connector reserves two pins, 6 and 7, to I²C BUS interface, in special case of **CAN GM1** I²C BUS is emulated using lines P2.0 (SCL) and P2.1 (SDA). Some Mini Modules feature such interface integrated in on board CPU hardware, others emualte it by software.
As described in paragraph "RTC + SRAM", software allows to peform all typical I/O operations of **I²C BUS**.

A/D CONVERTER ANALOG SIGNALS

Mini Module **CAN GM1** provides 8 analog inputs of Atmel AT89c51CC01 internal A/D converter, that is signals AN0÷AN7 multiplexed on signals P1.0÷P1.7.
Main feautes of this section are: resolution 10 bit; 8 analog inputs in the range 0÷3 Vdc; conversion time on a single channel 20 μsec; very easy software management; end of conversion interrupt.
A/D conversions are performed using the successive approximations technique and are made through opportune manipulation of specific microcontroller internal registers.
To easy A/D converter management, some software packages are provided with utility procedures that manage all details of this section.
For further information please refer to data sheet of appendix A of this manual or paragraph "CONNECTIONS".

WATCH DOG

Microcontroller AT89c51CC01 is provided with an internal hardware watch dog capable to reset the CPU if the user program cannot retrigger it in less than the selected intervent time.
Intervent time range is rather wide, it is from about 9 ms to 1 second.

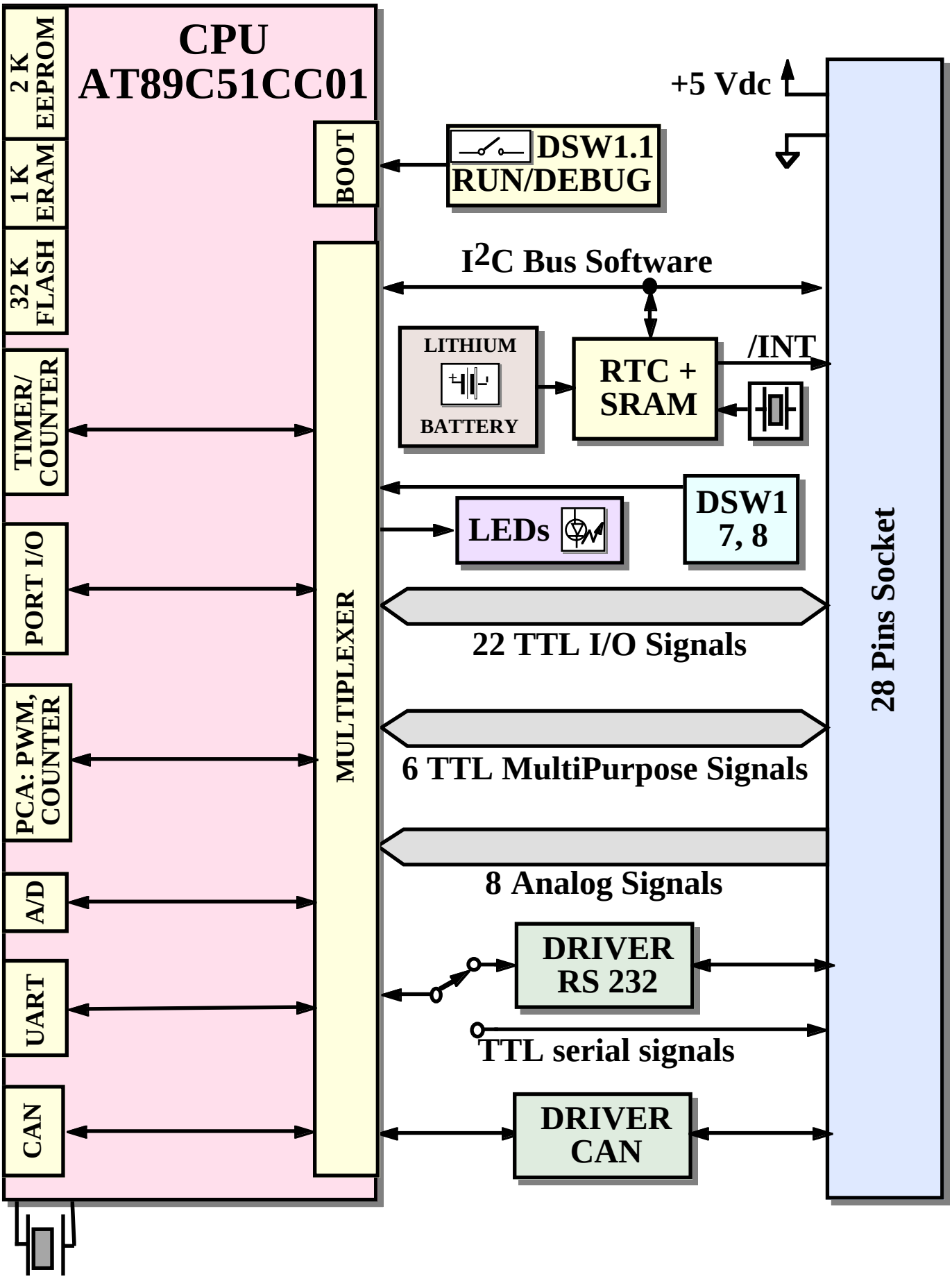


FIGURE 1: BLOCK DIAGRAM

REAL TIME CLOCK

Mini Module **CAN GM1** is provided with a Real Time Clock PHILIPS PCF 8583, capable to manage year, month, day, hour, minute, second and to generate a periodic interrupt whose period is selectable by the user.
A dedicated quartz gives the working frequency to the component.
A Lithium battery, that the user can connect or disconnect, keeps the time and SRAM content integer even when power supply is removed. By default, battery is disconnected.
The device communticates with micro through I^2C Bus (please see previous paragraph).
For further information please see the chapter "PERIPHERAL DEVICES SOFTWARE DESCRIPTION".

MEMORY DEVICES

The card is provided of 37.5K of memory divided with a maximum of **32K** Bytes FLASH EPROM, **2K** Bytes FLASH EPROM for boot loader, **256** Bytes of internal IRAM, **1024** Bytes of auxiliary external ERAM, **2048** Bytes of internal EEPROM and **256** bytes of SRAM in the backed module SRAM + RTC. The memory configuration must be chosen considering the application to realize or the specific requirements of the user.
Thanks to on board EEPROM or backed SRAM there is the possibility to keep data also when power supply is failed; in this way the card is always able to maintain parameters, logged data, system status and configuration, etc. in each working conditions.
Whenever the amount of memory for data is not sufficient (i.e. for data loghin systems), it is always possible to connect external memory devices (with SRAM, EEPROM, FLASH technologies) through the comfortable and efficient I^2C BUS interface of the card (please see previous paragraph).
The addressing of memory devices is controlled by microcontroller as described in the component data sheet or in APPENDIX A of this manual.

BOARD CONFIGURATION

CAN GM1 Mini Module is provided with an on board dip switch whose purpose is to set up several electric parameters of module itself and logical parameters of application program.
Dip 1 is used at power on or after a reset to determine which working modality, RUN or DEBUG, to use, that is, respectively, whether the micro has to run the user application program or the FLASH boot loader
Dip from 2 to 5 switch between RS 232 or TTL serial signals, dip 6 connects or disconnects on board battery.
The software can acquire dips 7 and 8 without having to access the I/O signals and manage different conditions with an unique program (like different languages, program parameter, operating modalities, etc.).
In addition, the board is also provided with two signalation LEDs, software manageable, that can be used to signal in visual ways board status and configurations, as described in the specific paragraphs.
All the configuration resources described are completely software manageable simply programming specific registers allocated in the I/O space by the control logic.
For further information refer to paragraphs "DIP SWITCH" and "CONFIGURATION INPUTS".

SERIAL COMMUNICATION

On **CAN GM1** it is always available an hardware serial line that is completely software configurable for physical protocol (baud rate, stop bits number, lenght of character, etc) by simply programming some microprocessor registers as described in the manufacturer documentation or in the appendix of this manual.
The serial line is connected to CN1 connector at TTL or RS 232 level, thanks to some on board dip switches configuration, so when the card must be connected in a network or at long distance or with other systems that use different electric protocol, the user must provide external drivers (RS 232, RS 422, RS 485, Current loop, etc.).
Please remember that on CN1 connector in addition to standard receive and transmit signals are also available other I/O signals that can be driven by software; these signals can be used to define the RS 485 line direction, to enable the RS 422 transmit drive or to generate an RS 232 handshake. For example the **MSI 01** module that converts a TTL serial line in any other electric standards in a pratical and inexpensive way can be used.
Please read "SERIAL COMMUNICATION SELECTION" paragraph of this manual or contact directly **grifo®** technician for further explanation or any other necessary information.

CLOCK

On **CAN GM1** module there are two separate and indipendent clock circuits that generate the clock signals for the microcontroller and on board RTC.
The first generates a 14.7456 MHz frequency while the second generates a 32768 Hz frequency.
The choice of using two circuits and two separated clock sources, has the advantage to reduce cost in the larger number of low, middle speed applications and to afford the high speed applications when necessary.
To improve speed performance, **CAN GM1** may also set the machine clock cycle duration to 12 or 6 clock cycles (X2 mode).
In X2 mode code execution is two times faster than in a classic I51 architecture.

TECHNICAL FEATURES

GENERAL FEATURES

Devices:	22 digital TTL I/O signals	
	8 A/D converter analog inputs	
	6 lines PCA section	
	1 Watch Dog section	
	3 Programmable Timer/Counter	
	14 interrupt sources and 4 interrupt levels	
	1 Lithium battery	
	1 Real Time Clock	
	1 reset generator	
	1 RS 232 serial line	
	1 CAN serial line	
	1 eight pins dip switch	
	2 status LEDs	
Memories:	32 Kbyte FLASH	user program
	2K byte FLASH	boot loader
	2K EEPROM	user data
	1024 Bytes ERAM	user data
	256 Bytes SRAM	
	of backed RTC module	user data
CPU:	Atmel AT89c51CC01	
Clock frequency:	14.7465 MHz	
A/D resolution:	10 bit	
A/D conversion time:	20 μsec	
Power on time:	typical 280 msec	
Watch Dog intervent time:	programmable from about 9 msec to 1 sec	

PHYSICAL FEATURES

Size:	25.5 x 42.7 x 14.3 mm
Weight:	11.8 g
Connectors:	28 pins male socket DIL
Temperature range:	0÷50 °C

Relative humidity: 20%÷90% (without condense)

ELECTRIC FEATURES

Power supply voltage: +5 Vdc ± 5%

Current consumption:
21 ma (power down mode)
26 ma (normal working mode)
109 ma (highest with CAN always low)

On board battery: 3.0 Vdc; 180 mAh

Backup current: 2.3 µA

Analog inputs voltage range: 0 ÷ 3 Vdc

Analog inputs impedance: high

Power failure theshold: typical 4.56 Vdc

Pull up of I^2C BUS lines: 4.7 KΩ

Impedance of CAN lines: 60 Ω

FIGURE 2: PHOTO OF CARD CAN GM1

INSTALLATION

In this chapter there are the information for a right installation and correct use of **CAN GM1** card. In detail there are the locations and functions of each connector, of the user settable dip switches, LEDs, and so on.

VISUAL SIGNALATIONS

CAN GM1 features the LEDs described in the following table:

LED	PURPOSE
LD1	Visualizes status of line P2.6 of Mini Module and can be used as user LED. Can be driven software.
LD2	Visualizes status of line P2.7 of Mini Modulo and can be used as user LED. Can be driven software.

FIGURE 3: LEDS TABLE

The main function of LEDs is to inform the user about card status, with a simple visual indication and in addition to this, LEDs make easier the debug and test operations of the complete system.
To recognize the LEDs location on the card, please refer to figure 7. while for further information please refer to paragraph ACTIVITY LED.

CONNECTIONS

The **CAN GM1** module has 1 connector that can be linkeded to other devices or directly to the field, according to system requirements.
In this paragraph there are connector pin out, a short signals description (including the signals direction) and connectors location (see figure 7) that simplify and speed the installation phase. Some additional figures shows the pins functionalities and some of the most frequently used connections.

CN1 - EXTERNAL MINI MODULE SIGNALS CONNECTOR

CN1 is a 28 pins, male, dual in line, socket connector with 100 mils pitch and 600 mils width.
On CN1 are available all the interfacement signals of the Mini Module as the power supply, the I/O lines, the asynchronous communication lines, the on board peripheral devices signals, the operating mode selection lines, etc.
Some pins of this connector have multiple purposes, in fact they can be multiplexed by programming some software registers with several CPU internal devices and the following figure lists all these possible functionalities.

So the signals available on CN1 have different types as described in the following CONNECTOR SIGNALS INTERFACEMENT paragraph and they follow **grifo®** Mini Module standard pin out. To avoid problems in pin counting and numbers the figure 4 shows the signals directly on the top view of the **CAN GM1**; moreover the serigraph reports the pins number on the four corner of the card both on bottom (solder) and top (component) side.

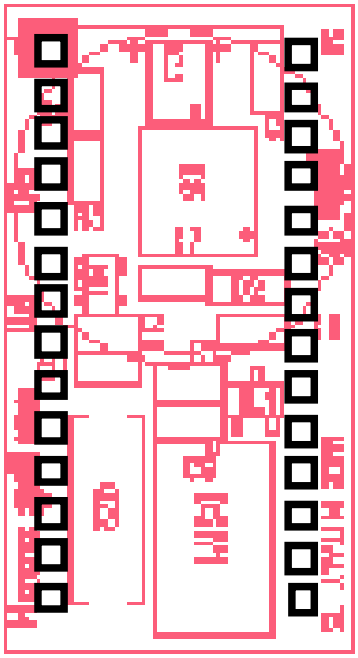


FIGURE 4: SOCKET AND MINI MODULE SIGNALS

Signals description:

+5 Vdc	= I - Power supply +5 Vdc
GND	= - Ground
CANH	= I/O - Differential line high for CAN BUS
CANL	= I/O - Differential line low for CAN BUS
RxD RS232	= I - Receive Data in RS 232
TxD RS232	= O - Transmit Data in RS 232
RxD TTL	= I - Receive Data in TTL
TxD TTL	= O - Transmit Data in TTL
/INTRTC	= O - Periodic interrupt generated by RTC
/INTn	= I - CPU internal interrupt (/INT0 and /INT1)
Tn	= I - External inputs for timer 0, 1 and 2 count
T2EX	= I - Trigger inputs for timer 2
/RES	= I/O - CPU reset signal
SCL	= O - Clock signal of software I^2C Bus
SDA	= I/O - Data signal of softwareI^2C Bus
Px.0÷7	= I/O - CPU TTL I/O digital Port 1 signals
ADC0÷7	= I - Analog inputs
CEX.0÷4	= I/O - Digital inputs or PWM outputs of PCA 0÷4 (multiplexed)
ECI	= I - External clock digital input of PCA 0÷4 (multiplexed)
Vref	= I - A/D converter reference voltage

CONNECTOR SIGNALS INTERFACEMENT

To prevent possible connecting problems between **CAN GM1** and the external systems, the user has to read carefully the previous paragraph information and he must follow these instrunctions:

- For RS 232 and CAN signals the user must follow the standard specifications of this protocol, defined by CCITT normative;
- All TTL signals must follow the rules of this electric standard. The connected digital signals must be always referred to card ground (GND) and then the 0V level corresponds to logic status 0, while the 5V level corrisponds to logic status 1. The connection of these lines to devices of the controlled system (encoders, switches, proximity, electric valves, power relays, etc.) must be performed through proper power interfaces; it is preferible to adopt opto coupled interfaces that ensure an electric insulation between Mini Module electronic and external noisy, typically generated by power electronic.
- The inputs for analog comparators must be connected to low impedance signals in the range from 0 to 3.0 V, to assure greater stability and precision.
- PWM signals generated by Timer Counter and CCU sections are TTL type so they must be buffered to interface the power circuitery. Typical interfaces can be current driver (if PWM signal is still required) or an intergrator circuit if analog voltage is required.
- Also I^2C BUS signals are at TTL level, as defined by the same standards; for completeness it is remarked that in a network with several devices and rather long it is better to study the connection lay out and to set properly the output stage, the best operational modes and the programmable bit rate: all these conditions allow communications in any condition. They also are provided with pull up of 4.7 KΩ.

INTERRUPTS MANAGEMENT

One of the most important **CAN GM1** features is the powerful interrupts management. Here is a short description of how the board's hardware interrupt signals can be managed; a more complete description of the hardware interrupts can be found in the microprocessor data sheets or in appendix A of this manual.

- Pin 5 of CN1	->	Generates a programmable periodic interrupt through on board RTC. CPU can detect this interrupt using pin P2.5.
- Pin 19 of CN1	->	Generates /INT0 = P3.2 on the CPU.
- Pin 18 of CN1	->	Generates /INT1 = P3.3 on the CPU.
- CPU inside devices	->	Can generate an internal interrupt. Possible sources of internal interrupt events are: timer 0÷2, PCA, UART, CAN controller, A/D converter, CAN timer.

The microprocessor features a programmable priority structure that manages the case of contemporary interrupts.
The addresses of the interrupt response subroutines can be software programmed by the user placing them on the proper code areas while the interrupts priority level and activation are sofware programmable through internal CPU registers. So the user program has always the possibility to react promptly to every external event, deciding also the priority of interrupts.

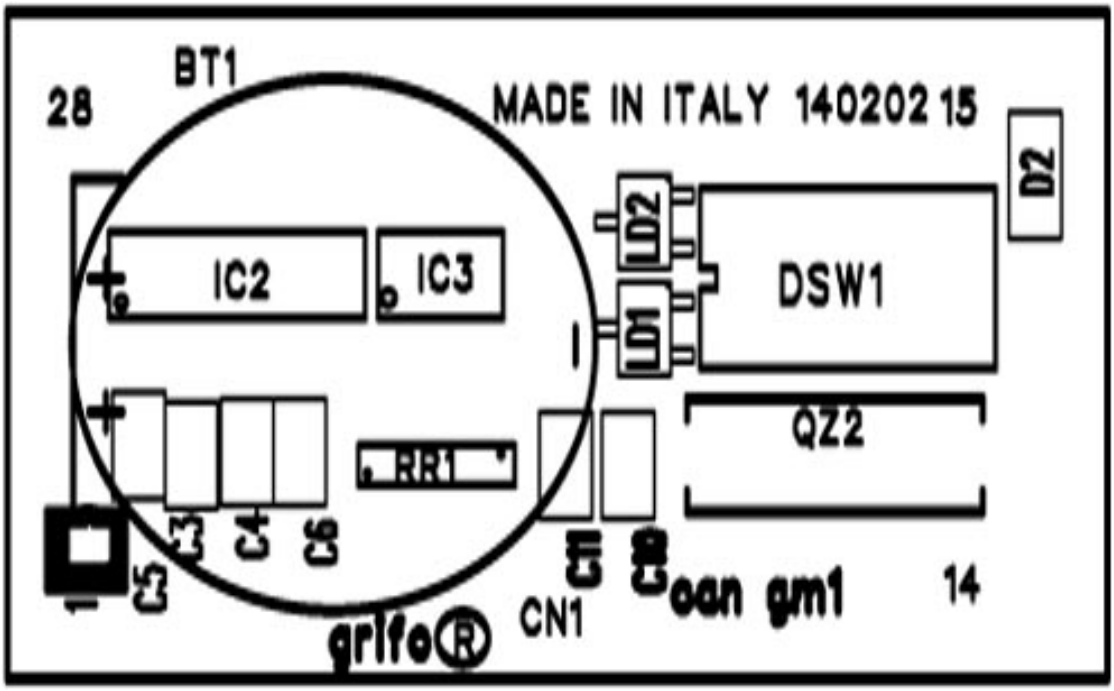


FIGURE 5: COMPONENT MAP (TOP SIDE=COMPONENT SIDE)

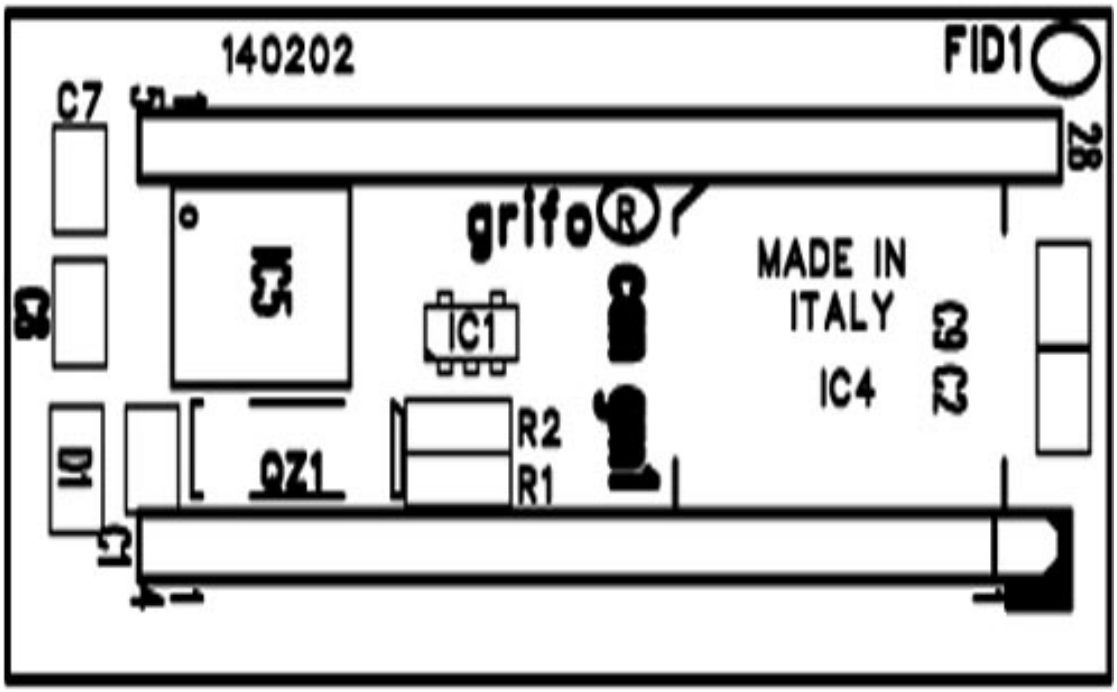


FIGURE 6: COMPONENT MAP (BOTTOM SIDE=SOLDER SIDE)

BACK UP

Mini Module **CAN GM1** is provided with Lithium battery to keep the time of RTC and content of its SRAM even when power supply fails.
Please remark that to insert the battery (to make it buffer real time and SRAM) you **MUST** connect **DIP 6 of DSW1** in position **ON.** By default DIP 6 is OFF, to keep battery life longer.

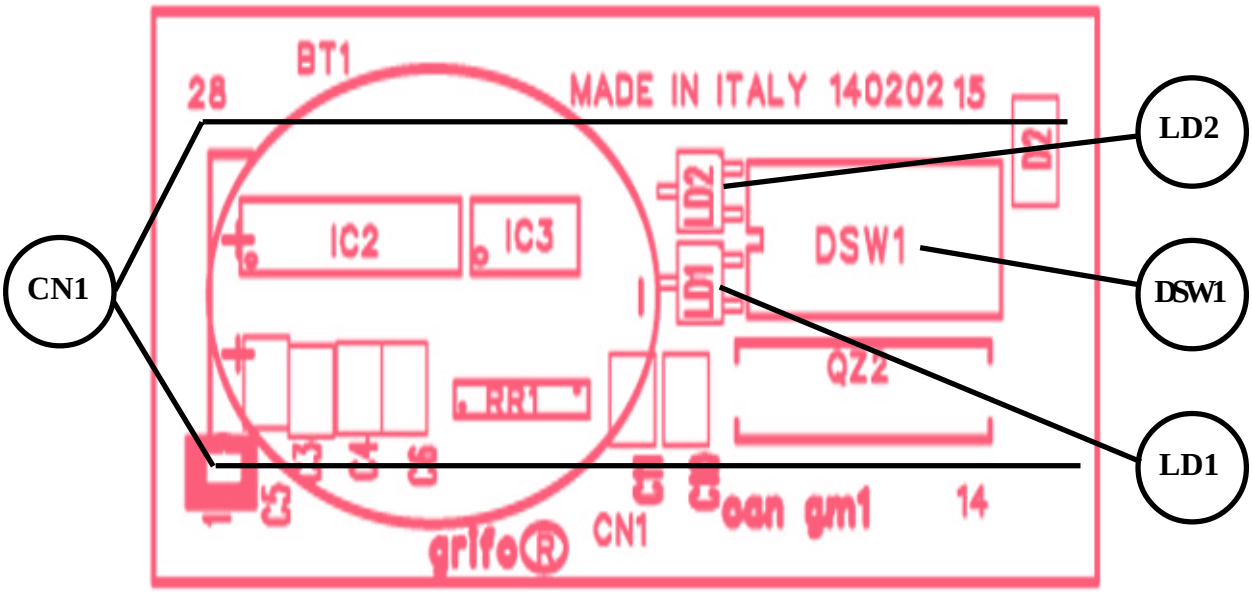


FIGURE 7: LEDS, DIP SWITCH, CONNECTOR, ETC. LOCATION

DIP SWITCH

An 8 pins dip switch is installed on **CAN GM1** Mini Module. It allows to perform selection regarding the module's working way. Figure 8 shows a list of swithces connection and purpose, in the table * (asterisk) means default connection, that is the configuration of the board after test in our laboratories. To locate the dip switch, please refer to figure 7.

SWITCH	POSITION	PURPOSE	DEF.
1	ON	Connects Boot Loader activation circuitery. If Mini Module is turned on or reset in this condition DEBUG mode is enabled and Boot Loader is started.	
	OFF	Does not connect Boot Loader activation circuitery. If Mini Module is turned on or reset in this condition RUN mode is enabled and user program in internal FLASH is started.	*
2	ON	Connects signal TxD RS 232 , TxD TTL , P3.1 of CN1 to serial driver. DSW1.4 must be OFF to avoid conflicts. Used in conjunction with switch DSW1.4.	*
	OFF	Does not connect signal TxD RS 232 , TxD TTL , P3.1 to serial driver, allowing direct connection to CPU.	
3	ON	Connects signal RxD RS 232 , RxD TTL , P3.0 of CN1 to serial driver. DSW1.5 must be OFF to avoid conflicts. Used in conjunction with switch DSW1.5.	*
	OFF	Does not connect signal RxD RS 232 , RxD TTL , P3.0 to serial driver, allowing direct connection to CPU.	
4	ON	Connects signal TxD RS 232 , TxD TTL , P3.1 of CN1 directly to CPU. DSW1.2 must be OFF to avoid conflicts. Used in conjunction with switch DSW1.2.	
	OFF	Does not connect signal TxD RS 232 , TxD TTL , P3.1 directly to CPU, allowing connection to serial driver.	*
5	ON	Connects signal RxD RS 232 , RxD TTL , P3.0 of CN1 directly to CPU. DSW1.3 must be OFF to avoid conflicts. Used in conjunction with switch DSW1.3.	
	OFF	Does not connect signal RxD RS 232 , RxD TTL , P3.0 directly to CPU, allowing connection to serial driver.	*
6	ON	Connects on board battery to RTC + SRAM module, allowing to keep its content.	
	OFF	Does not connect on board battery to RTC + SRAM module.	*
7	ON	Connects signal P0.0 to logic level 0, allowing to acquire it as user input.	
	OFF	Sets signal P0.0 to logic level 1, allowing to acquire a logic level 1 as user input.	*
8	ON	Connects signal P0.1 to logic level 0, allowing to acquire it as user input.	
	OFF	Sets signal P0.1 to logic level 1, allowing to acquire a logic level 1 as user input.	*

FIGURE 8: DIP SWITCH TABLE

CONFIGURTATION FOR SUPPORT CARDS

CAN GM1 Mini Module can be used as a macro components for some support cards either developed by the user or directly chosen from the **grifo®** boards. In the following paragraphs are reported the suggested configuration of the most interesting support cards.

USE WITH GMB HR84 MODULE

Amongst **grifo®** cards, **GMB HR84** module is the one designed specifically to provide to 28 pins Mini Modules many interesting features as: 8 optocoupled inputs, 4 relay outputs, mechanical mounting on omega rails and a comfortable wiring through screw terminal connectors. The complete description of the product is available in the relative data sheet and technical manual while in this paragraph are listed the advantages obtained by using this pair of cards:

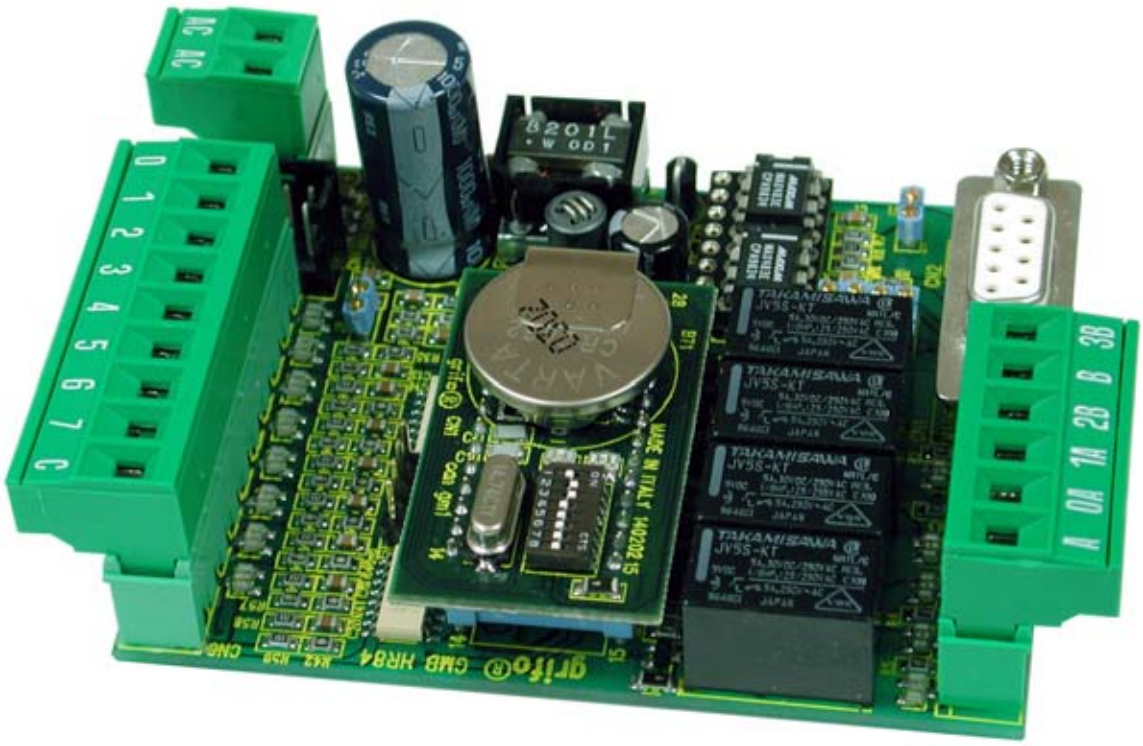


FIGURE 9: GMB HR 84 + CAN GM1 PHOTO

The **GMB HR84** allows easily to:

- supply the Mini Module through on board wide range AC, DC power supply;
- have eight I/O signals of microcontroller ports optocoupled NPN and PNP at the same time and visualized through green LEDs; I/O signals are multiplexed with internal peripheral devices, so high level functions as couters, status recognition, etc.,are immediatly available;
- have other four I/O signals of microcontroller ports on bufferd relays and visualized through red LEDs; I/O signals are multiplexed with internal peripheral devices, so high level functions like sqare waves, time based signals, etc., are immediatly available;
- connect I^2C BUS and +5 Vdc power supply on a dedicated connector;

- connect immediately RS 232 serial line through a comfortable 9 pins D type connector;
- buffer easily the TTL serial line in RS 422, RS 485 or Current Loop;
- connect PWM lines on AMP connector;
- program the FLASH in ISP modality.

In detail, the correspondance between Mini Module CPU internal devices signals and **GMB HR84** external interfaces are:

SIGNAL CAN GM1	SIGNAL GMB HR84	CONNECTOR GMB HR84	FUNCTION
P2.5 , /INTRTC	/INTRTC	pin 4 of CN4	I/O TTL connected to Real Time Clock interrupt.
P1.0 , ADC0 , T2	A/D	pin 8 of CN4	I/O TTL, analog input ADC0 and external clock input of Timer 2.
CANH	CANH	pin 5 of CN4	Line H of CAN interface.
CANL	CANL	pin 3 of CN4	Line L of CAN interface.
P1.3 , ADC3 , CEX0	D/A	pin 6 of CN4	I/O TTL, input capture/compare, output PWM of PCA 0 or analog input ADC3.
P2.2	I/O	pin 2 of CN4	I/O TTL.
P2.3	DIR	-	Selects direction in RS 422 or enables transmission in RS 485, if installed.
P1.1 , /T2EX	IN 1	pin 1 of CN6	I/O TTL, Timer 2 counter input.
P1.2 , /ECI	IN 2	pin 2 of CN6	I/O TTL, external clock input for PCA sections.
P3.2 , /INT0	IN 3	pin 3 of CN6	I/O TTL, trigger of interrupt INT 0.
P3.3 , /INT1	IN 4	pin 4 of CN6	I/O TTL, trigger of interrupt INT 1.
P3.4 , T0	IN 5	pin 5 of CN6	I/O TTL, Timer 0 counter input.
P3.5 , T1	IN 6	pin 6 of CN6	I/O TTL, Timer 1 counter input.
P3.6	IN 7	pin 7 of CN6	I/O TTL.
P3.7	IN 8	pin 8 of CN6	I/O TTL.
P1.4 , ADC4 , CEX1	OUT A1	pin 1 of CN1	I/O TTL, PWM Output of PCA section 1.
P1.5 , ADC5 , CEX2	OUT A2	pin 2 of CN1	I/O TTL, PWM Output of PCA section 2.
P1.6 , ADC6 , CEX3	OUT B1	pin 4 of CN1	I/O TTL, PWM Output of PCA section 3.
P1.7 , ADC7 , CEX4	OUT B2	pin 5 of CN1	I/O TTL, PWM Output of PCA section 4.

FIGURE 10: FUNCTIONS CONNECTORS CAN GM1 + GMB HR84

FIGURE 11: PHOTO OF GMB HR 84 IN ITS CONTAINER

The following configuration is suggested to use the couple **GMB HR84** + **CAN GM1** in their base version, that is RUN mode with serial line buffered in RS 232:

CAN GM1 *configuration*

DSW1.1	=	ON
DSW1.2	=	ON
DSW1.3	=	ON
DSW1.4	=	OFF
DSW1.5	=	OFF
DSW1.6	=	OFF
DSW1.7	=	OFF
DSW1.8	=	OFF

GMB HR84 *configuration*

J1	=	not connected
J2	=	2-3
J3	=	2-3
J4	=	2-3
J5	=	don't care
J6	=	1-2
J7	=	1-2
J8	=	not connected
J9	=	not connected
J10	=	2-3
J11	=	2-3

The serial connection cable with development P.C. is the CCR 9+9 R (or in other words an extension reversed cable provided of D9 Female and D9 Male connectors).

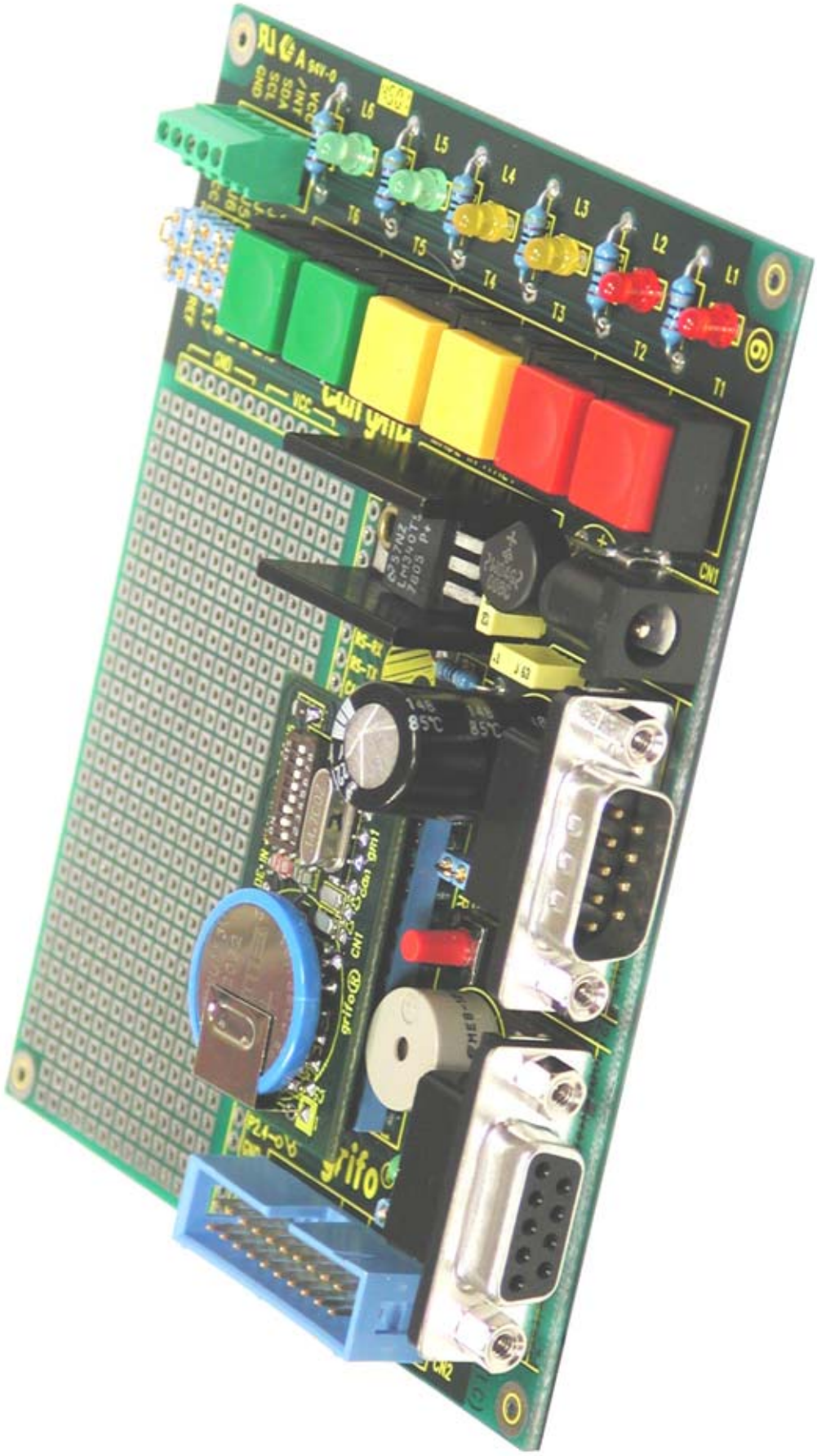


FIGURE 12: CAN GM1 INSTALLED ON A CAN GMT

USE WITH CAN GMT BOARD

Amongst **grifo®** cards, **CAN GMT** is the one designed specifically to be the prototyping board supporting **CAN GMx** 28 pins Mini Modules.
CAN GMT allows easily to:

- to supply the Mini Module through on board power supply
- to have I/O port and A/D converter signals on a comfortable low profile connector compiant to standard **I/O ABACO®**
- to have I^2C Bus and interrupt signals on a specific connector, to be able to expand the system with any I^2C Bus device, driven both in polling and in interrupt
- to connect immediatly RS 232, TTL and CAN signals through two comfortalbe D type connectors
- to set and visualize the status of up to 6 microcontroller I/O signals through coloured push buttons and LEDs excludible by jumpers
- to generate sound feedback using the autoscillating on board buzzer
- to develop quickly and comfortably any application taking advantage of the wide prototyping area provided with duplicated signals

The following configuration is suggested to use the couple **CAN GMT** + **CAN GM1** in their base version, that is RUN mode with serial line buffered in RS 232:

*Configuration **CAN GM1***

DSW1.1	=	ON
DSW1.2	=	ON
DSW1.3	=	ON
DSW1.4	=	OFF
DSW1.5	=	OFF
DSW1.6	=	OFF
DSW1.7	=	OFF
DSW1.8	=	OFF

*Configuration **CAN GMT***

J1	=	1-2
J2	=	1-2
J3	=	1-2
J4	=	1-2
J5	=	1-2
J6	=	1-2
J7	=	1-2
J8	=	not connected
J9	=	1-2

The serial connection cable with development P.C. is the CCR 9+9 E (or in other words an extension cable provided of D9 Female and D9 Male connectors).

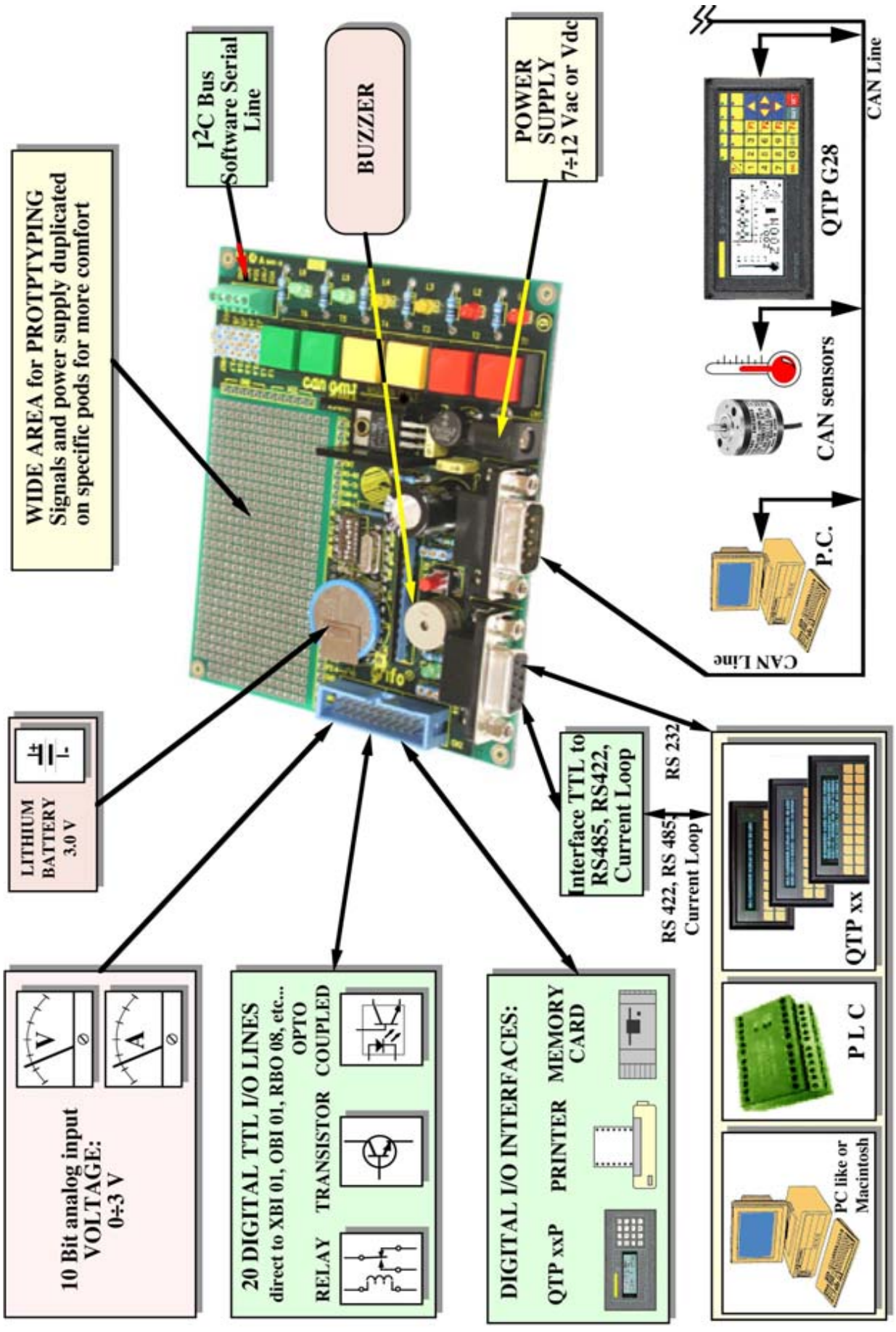


FIGURE 13: CONNECTIONS OF A CAN GM1 INSTALLED ON A CAN GMT

HOW TO START

One of the most important features of **CAN GM1** Mini Module is the possibility to program the microprocessor AT89c51CC01 internal memory with in system programming (ISP) through serial interface, both UART and CAN controller, according to the model installed.
Below are listed the sequence of operations that must be performed by the user to use this feature:

A) *Check serial connection between Mini Module and PC:*

A1) Make the connection described on figure 14 or install the Mini Module on a **CAN GMT**, **GMB HR84** or a **GMB HR168**, in these cases please refer to respective manual.

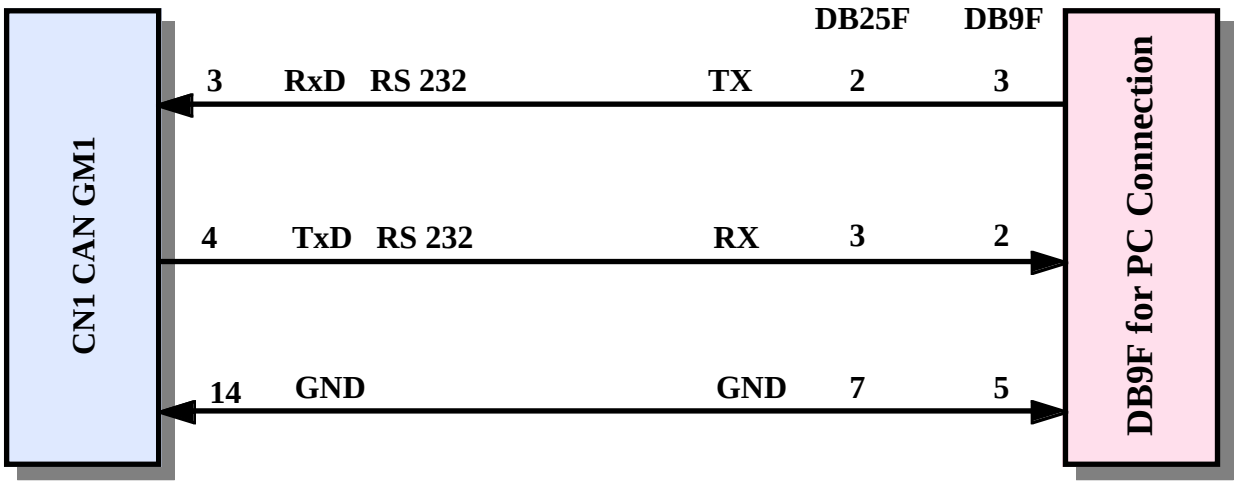


FIGURE 14: RS 232 POINT TO POINT CONNECTION TO A PC EXAMPLE

A2) Start a terminal emulator on PC, configure it to use the serial port where Mini Module is connected with 19200 baud, 8 data bits, 1 stop bit, no parity.

A3) Set Mini Module in RUN mode, that is DSW1.1 OFF.

A4) Supply the Mini Module; each Mini Module is delivered with its demo program already programmed in internal FLASH and configured to make it start when Module is supplied, if you don't see the starting screen of demo on terminal emulator, check serial connection and that switch 1 of DSW 1 is OFF.

B) *Reprogramming of internal FLASH:*

B1) The file containing the demo already programmed in internal FLASH, called prgm1_uk.hex, is available on **grifo®** CD, locate and save to a comfortable position on PC hard drive.

B2) On **grifo®** CD is also available FLIP, the utility program that manages **CAN GM1** microcontroller memories programming through the simple serial connection made at point A; locate and save to a comfortable position on PC hard drive.

B3) Set Mini Module in DEBUG mode, that is DSW1.1 ON.

B4) Close the terminal emulator.

B5) Reset or power off and then on the card.

B6) Run **FLIP**, the ISP programming software installed at point B2 (version >= 2.2.0), latest version can be found at Atmel web site: www.atmel.com. Minimum version of operating system is Windows 98; suggested version is Windows XP.

B7) Select the device to program, that is AT89C51CC01, by pressing the first button on the top left, picking the correct name in the window and pressing OK:

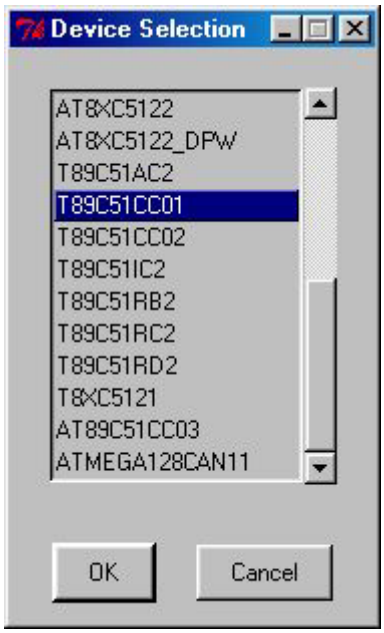


FIGURE 15: FLIP SETTINGS WINDOWS (1 OF 3)

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:

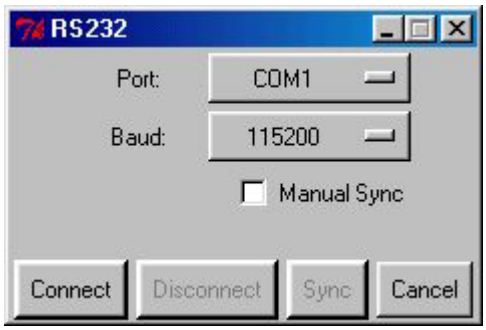


FIGURE 16: FLIP SETTINGS WINDOWS (2 OF 3)

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.

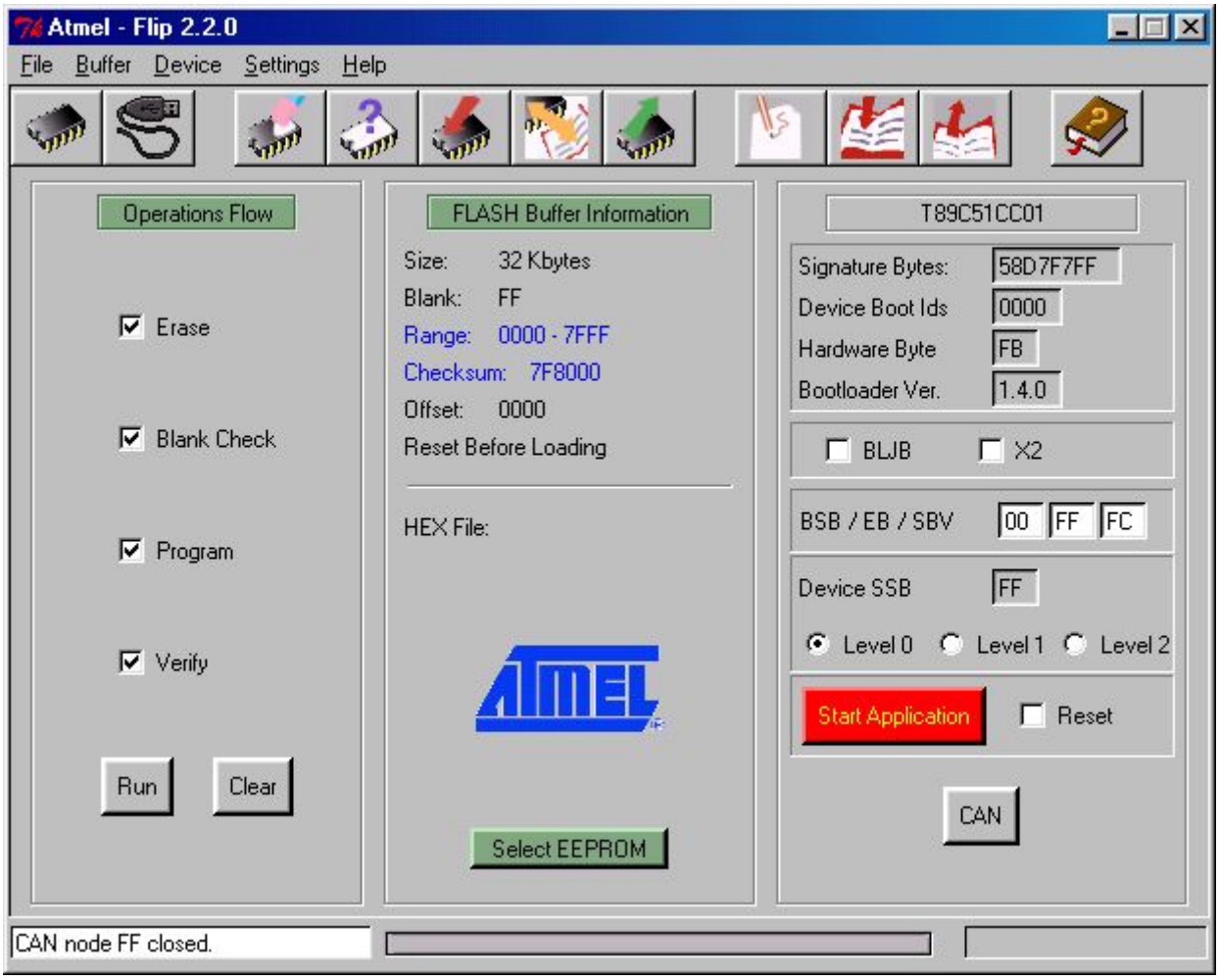


FIGURE 17: FLIP SETTINGS WINDOWS (3 OF 3)

B9) Make sure that text boxes in the frame "AT89C51CC01" fill with text, like in figure 17; in detail the box "Signature Bytes" must have the same content as in figure 17.

B10) Load the file to write in FLASH (that is prgm1_uk.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" like in figure 17.

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 A2.

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) *Creation of an application program:*

C1) Install on the hard disk of the development P.C. the software environment selected to develop the application program. As described in the chapter SOFTWARE DESCRIPTION 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 B1, there are also the source file of the same. These have an extension that identifies the used software development tools (for example prgm1_uk.bas for BASCOM 8051 or prgm1_uk.c for µC/51) and they are properly organized inside demo programs tables available on CD, together with possible definition file (89c51CC01.dat for BASCOM 8051, canary.h for µC/51, 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 prgm1_uk.hex must be obtained equal to those available on **grifo®** CD and already used at points B.

C4) Reperform the programmation of the obtained HEX file in the Mini Module FLASH, by executing again the points B2÷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 firts application program that coincides with demo of **CAN GM1**. 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 B6 to C3) 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) *Final preparation of application:*

D1) Set up the RUN mode (DSW1.1=OFF) and disconnect development P.C.

POWER SUPPLY

Mini Module can be supplied with +5 Vdc.
On the board all the circuits and components have been chosen to obtain the best noisy immunity and the lowest consumption, including the possibility to use four different power down setting of the microcontroller. In the best conditions a minimum consumtion of 21 mA is reached and it is suitable for portable applications where battery life time is increased.
Detailed information are reported in "ELECTRIC FEATURES" chapter.

MEMORY ARCHITECTURE

Memory of MiniModule **CAN GM1** is made by microprocessor internal memory and SRAM in the RTC module, this latter can be backed up with Lithium battery (please see paragraph "DIP SWITCH" for further information). In detail:

Internal memory

- 32K bytes FLASH of user memory
- 256 bytes IRAM of user memory
- 2K bytes FLASH for boot loader
- 2K bytes EEPROM of user memory
- 1024 bytes ERAM of user memory

External memory

- 256 bytes SRAM that can be backed up in the RTC

Acces to microcontroller inernal memory is explained in the component data sheet, so please refer to this latter or to appendix A of this manual for further information.
Acces to RTC and to its SRAM is explained in the next paragraph "RTC + SRAM".

OPERATING MODE SELECTION

As described on figure 8 and in the previous paragraphs, the dip switches DSW1.1 selects the **CAN GM1** Mini Module operating mode. In detail are available two modes relative to the following configurations:

DSW1.1		Operating mode
OFF	->	RUN mode
ON	->	DEBUG mode

In RUN mode after a power on the application program saved in FLASH is always executed, independently by external conditions, while in DEBUG mode the boot loader is always executed. Programs for P.C. as the FLIP (for ISP management of FLASH EPROM) and HYPERTERMINAL (for the console terminal emulation) are able to perform these settings and they make up the only necessary development aids.
The ISP tecnique (In System Programming) reduces the cost and the time for development in fact it eliminates the use of external EPROMs, programmer, eraser, etc. For further information on ISP programmation please consult the specific technical documentation released by ATMEL.

SERIAL COMMUNICATION SELECTION

Serial line of **CAN GM1** can be buffered in RS 232 or TTL. By software the serial line can be programmed to operate with all the standard physical protocols, in fact the bits per character, parity, stop bits and baud rates can be decided by setting opportunes microprocessor's internal registers. By hardware can be selected which one of the electric standards is used, through dip switches configuration, as described in the previous tables; the user can select in autonomy one or the other type by following the information below:

- SERIAL LINE IN RS 232 (default configuration)

DSW1.2	=	ON
DSW1.3	=	ON
DSW1.4	=	OFF
DSW1.5	=	OFF

- SERIAL LINE IN TTL

DSW1.2	=	OFF
DSW1.3	=	OFF
DSW1.4	=	ON
DSW1.5	=	ON

The following figures shows how a generic external system can be connected to **CAN GM1** serial line, with both the electric standard.

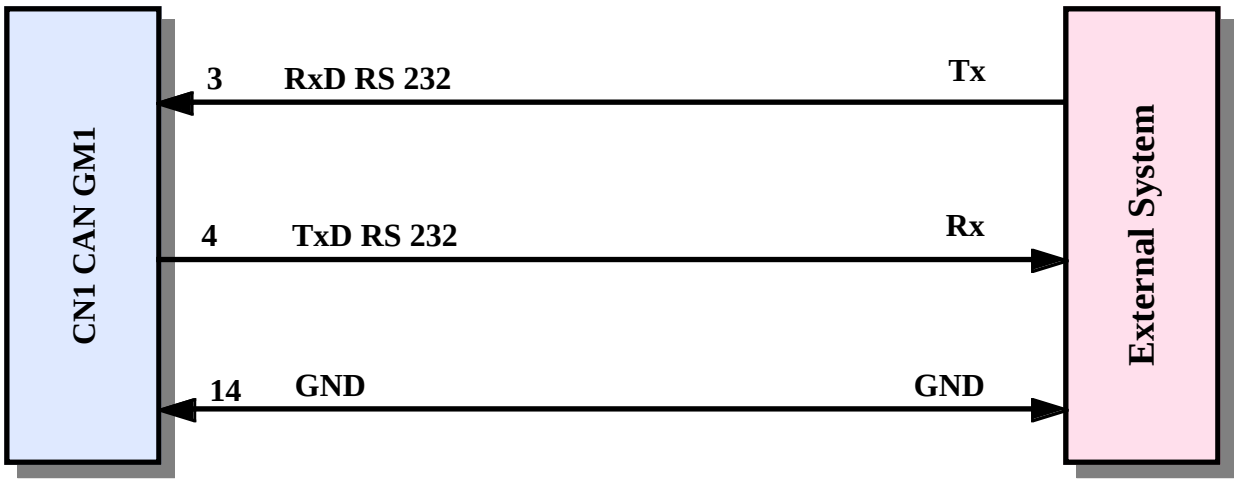


FIGURE 18: RS 232 SERIAL CONNECTION EXAMPLE

FIGURE 19: TTL SERIAL CONNECTION EXAMPLE

CAN CONTROLLER

A CAN controller compatible to standard 2.0 A and 2.0 B is installed on **CAN GM1** Mini Module. There is also a transceivere capable to reach about 1 Mbits/sec (ISO - 11898). These devices allow to connect easily the Mini Module to any system provided with the same interface. As the controller used in inside the micro, it is completely configured and managed through internal registers accessible in the CPU addressing space. For further information please see the data sheet in appendix A of this manual.
To connect immediatly the MiniModule to a system provided with CAN serial interface it is possible to use the D type connector available on **CAN GMT** board (please see the paragraph “USE WITH CAN GMT BOARD”).

CAN bus must be a differential line with 60 Ω of impedance so termination reistors must be connected to obtain this value.
There can be also two termination resistors (120 Ω) at the extremities of the line.
CAN GM1 provides no terminaton resistors.
CAN line is galvanically isolated from board supply voltage.
Ground of Mini Module is available on pin 14 of connector CN1.
This latter can be used to equilibrate difference of potentials amongst several CAN systems, but also to shield physical connection, using CAN shielded cable, to obtain the greatest protection against external noise.

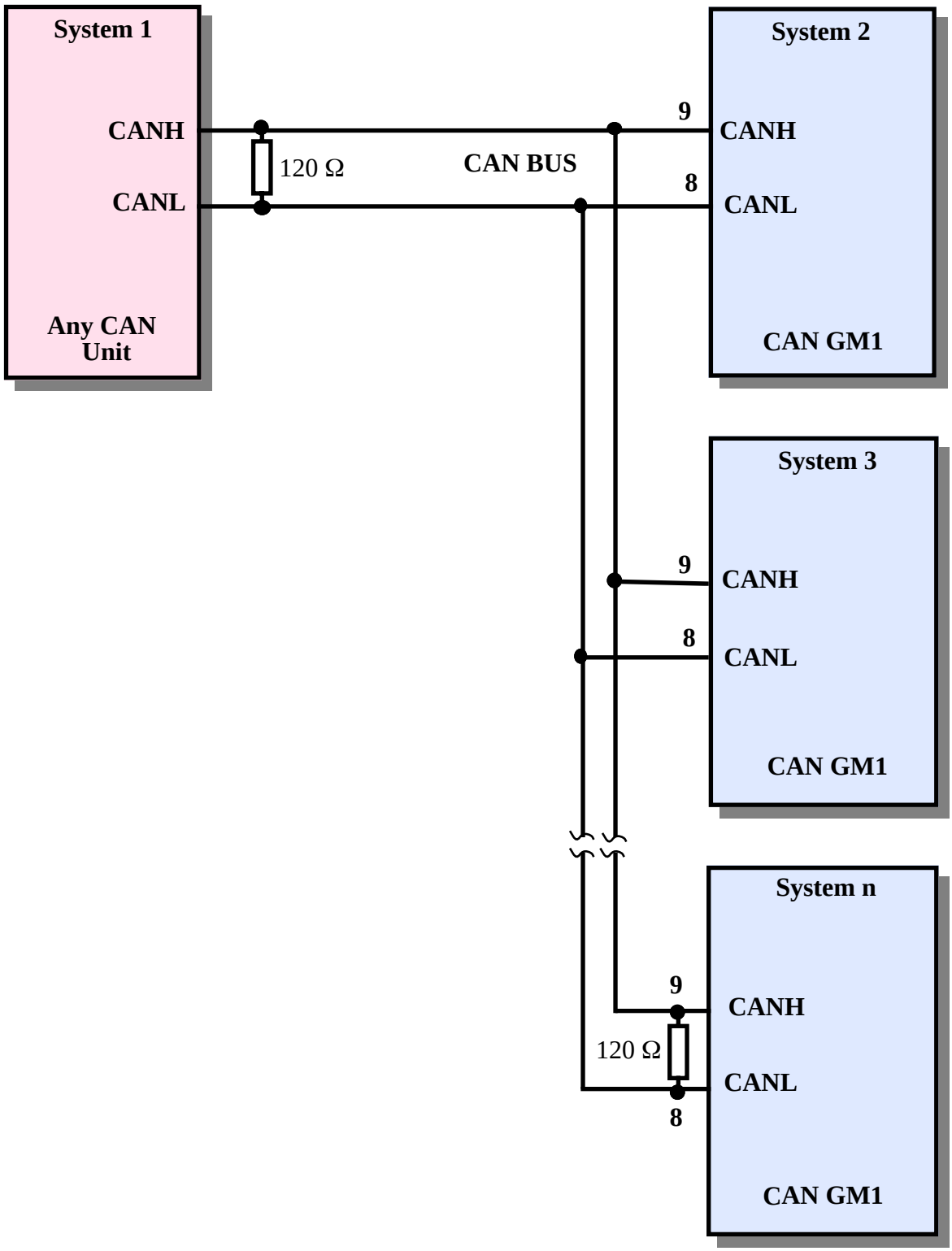


FIGURE 20: CAN BUS NETWORK CONNECTION EXAMPLE

SOFTWARE DESCRIPTION

A wide selection of software development tools can be obtained, allowing use of the module as a system for its own development, both in assembler and in other high level languages; in this way the user can easily develop all the requested application programs in a very short time. Generally all software packages available for the mounted microprocessor, or for the 51 family, can be used.
All the software development tools supplied by **grifo®** always include many example programs, in source and executable format, fully remarked, that shows how to manage each section of the card. Among these we remind:

GET 51: it is a complete program with editor, communication driver and mass memory management for all '51 family cards. This program developed by **grifo®** allows to operate in the best conditions. The program is menu driven and mouse driven. It is designed to run undr MS-DOS but can run also in MACINTOSH environment with VIRTUAL-PC. It is delivered in MS-DOS 3”1/2 floppy disks.

BASCOM 8051: cross compiler for BASIC source program. It is a powerful software tool that includes editor, BASIC compiler and simulator included in an easy to use integrated development environment for Windows. Many memory models, data types and direct use of hardware resource instructions are available.

HI TECH C 51: cross compiler for C source program. It is a powerful software tool that includes editor, C compiler, assembler, optimizer, linker, library, and remote symbolic debugger, in one easy to use integrated development environment.

SYS51CW: cross compiler for C source program. It is a powerful software tool that includes editor, C compiler, assembler, optimizer, linker, library, simulator and remote symbolic debugger, included in an easy to use integrated development environment for Windows.

SYS51PW: cross compiler for PASCAL source program. It is a powerful software tool that includes editor, PASCAL compiler, assembler, optimizer, linker, library, simulator and remote symbolic debugger, included in an easy to use integrated development environment for Windows.

DDS MICRO C 51: low cost ross compiler for C source program. It is a powerful software tool that includes editor, C compiler (integer), assembler, optimizer, linker, library, and remote debugger, in one easy to use integrated development environment. There are also included the library sources and many utilities programs.

µC/51: It is a comfortable, low cost, software package with a colplete IDE that allows to use an editor, and ANSI C compiler, and assembler, a linker and a remote source level debugger user configurable. Souces of main libraries and remote debugger are included, and so severl utility and demo programs.

LADDERWORK: It is a easy to use system to generate automation application using the very famouts contact logic. It features a graphic editor to place and connect components that refer to hardware resources (like digital I.O, counters, A/D, etc.) like on an electric diagram and define their properties, and efficent compiler to create the executable code and an utility to download it. Integrated IDE makes comfortable use of these tools. Delivered in a CD for Windows with user manual and hardware key.

FIGURE 21: PHOTO OF CAN GM1 (COMPONENT SIDE)

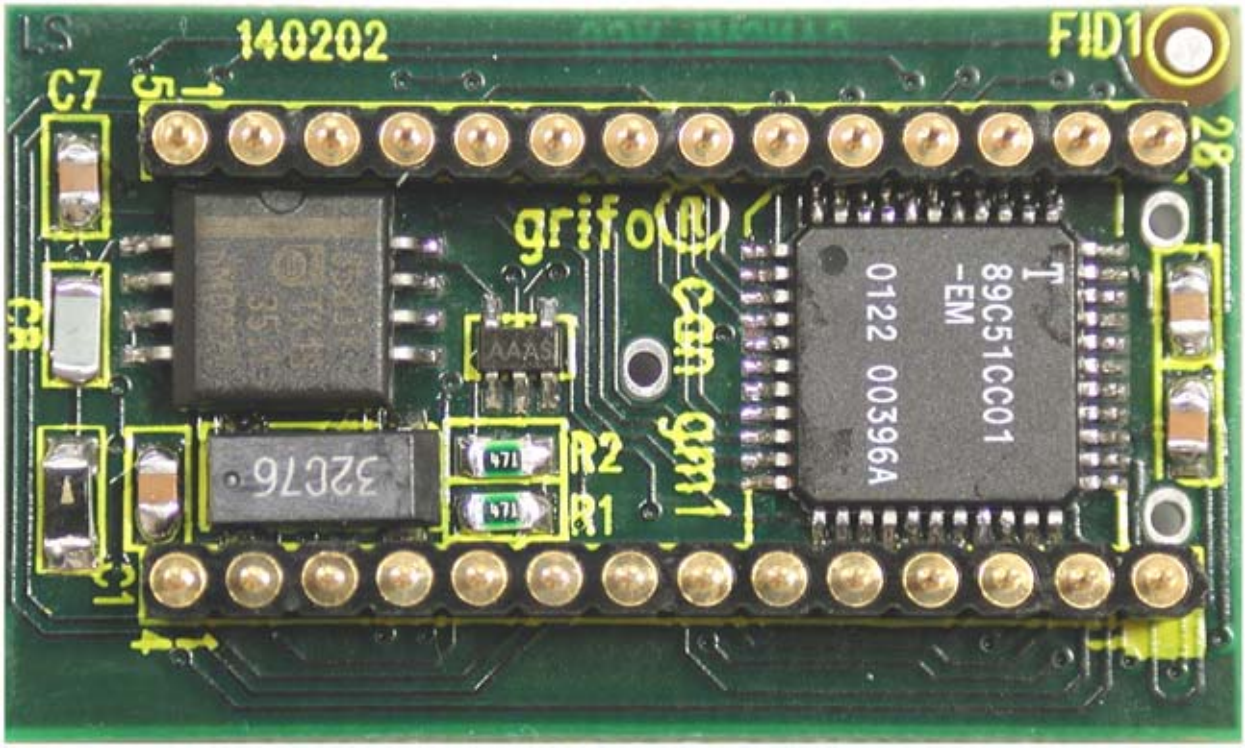


FIGURE 22: PHOTO OF CAN GM1 (SOLDER SIDE)

PERIPHERAL DEVICES SOFTWARE DESCRIPTION

In the previous paragraphes are described the external registers addresses, while in this one there is a specific description of registers meaning and function (please refer to I/O addressing tables, for the registers name and addresses values).
For microprocessor internal peripheral devices, not described in this paragraph, or for further information, please refer to manufacturing company documentation or appendix A of this manual.
In the following paragraphs the **D7÷D0** and **.0÷7** indications denote the eight bits of the combination involved in I/O operations.

CONFIGURATION INPUTS

Two switches of the on board DSW1 dip switch status can be obtained by software, through a simple read operation of bit 0 and 1 of port 0:

P0.0 -> DSW1.7
P0.1 -> DSW1.8

DSW1 is read in complemented logic, in fact "**ON**" position corresponds to logic level **0** and "**OFF**" position cooresponds to logic level **1**.
Switch 1 is the RUN or DEBUG selector, that is if the switch is ON after a reset or a power on the boot loader is run, otherwise if the switch is OFF the user program in internal FLASH is run.

STATUS LEDS

LEDs LD1 (green) and LD2 (red) can be software driven and their status can be read by simple read and write operations on port 2:

P2.6 -> LD1
P2.7 -> LD2

Driving is in complemented logic, in fact LED is **ON** when bit is **0** and LED is **OFF** when the corresponding bit is **1**.
Signals of P2 are kept at logic level 1 during the reset or the power on, so when on these phases happen, LEDs are OFF.

RTC + SRAM

The IC5 SRAM module, is provided with on board Lithium battery and with Real Time Clock which manages time (hours, minutes, seconds) and date (day, month, year, day of the week).
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 of IC5, 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 I/O microprocessor pins. The only necessary information is the electric connection:

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

Please remark that A0 of this component's slave address is bound to logic 0, so its slave address is hexadecimal **A0**.
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.

EXTERNAL DEVICES

CAN GM1, through board **CAN GMT**, **GMB HR84** and **GMB HR168**, can be connected to a wide range of block modules and operator interface system produced by **grifo®**, or to many system of other companies.The on board resources can be expanded with a simple connection to the numerous peripheral **grifo®** boards,both intelligent and not, thanks to its standard I/O **ABACO®**connector. Hereunder some of these cards are briefly described; ask the detailed information directly to **grifo®**, if required.

GMB HR84

grifo® Mini Block Housing, 8 opto inputs, 4 relays outputs

8 optocoupled **inputs NPN** or **PNP** visualized through **LEDs**; some inputs can be **counter** or **interrupt** source; **4 relay outputs** up to 5 A visualized through 4 **LEDs**; some outputs can make **PCA** functions for automatic timed commands; **Serial line** RS 232, RS 422, RS 485, current loop or TTL; switching power supply; logic protection trhough **TransZorb™**; **DC** or **AC** power supply from 12 Vdc up to 24 Vac.

GMB HR168

grifo® Mini Block Housing, 16 opto inputs, 8 relays outputs

Plastic container for rails DIN 50022 Modulbox model M6 HC53; front 90 x 106; height 58 mm; 16 optocoupled **inputs NPN** or **PNP** visualized through **LEDs**; some inputs can be **counter** or **interrupt** source; **8 relay outputs** up to 5 A visualized through **LEDs**; some outputs can make **PCA** functions for automatic timed commands; **RTC** with Lithium battery; 1 TTL output driven by RTC and visualized through LED.

GMM TST2

grifo® Mini Module Test 2

Low price card usefull for evaluating and test purpose of 28 or 40 pins **grifo®** Mini Modules type **GMM 932, GMM AM08 GMM AM32**, etc...It provides: **D9 connectors** for a direct connections to **RS 232** line and **AVR programmer**; **Buzzer**; Connectors 10 pin for a direct connections to AVR ISP; **16 Key** buttons; 2 lines **LCD** display; **power supply** section with standard connector; push buttons and LEDs for digital I/O signals management; etc.

CAN GMT

Controller Area Network - **grifo®** Mini Module Test

Low price card usefull for evaluating and test purpose of 28 pins MiniModules type **CAN GM1, CAN GM2, GMM 5115**, etc.. It provides: **D9 connectors** for a direct connections to **CAN** line and **RS 232** line; **power supply** section with standard connector; **push buttons** and **LEDs** for digital I/O signals management; prototype area; etc.

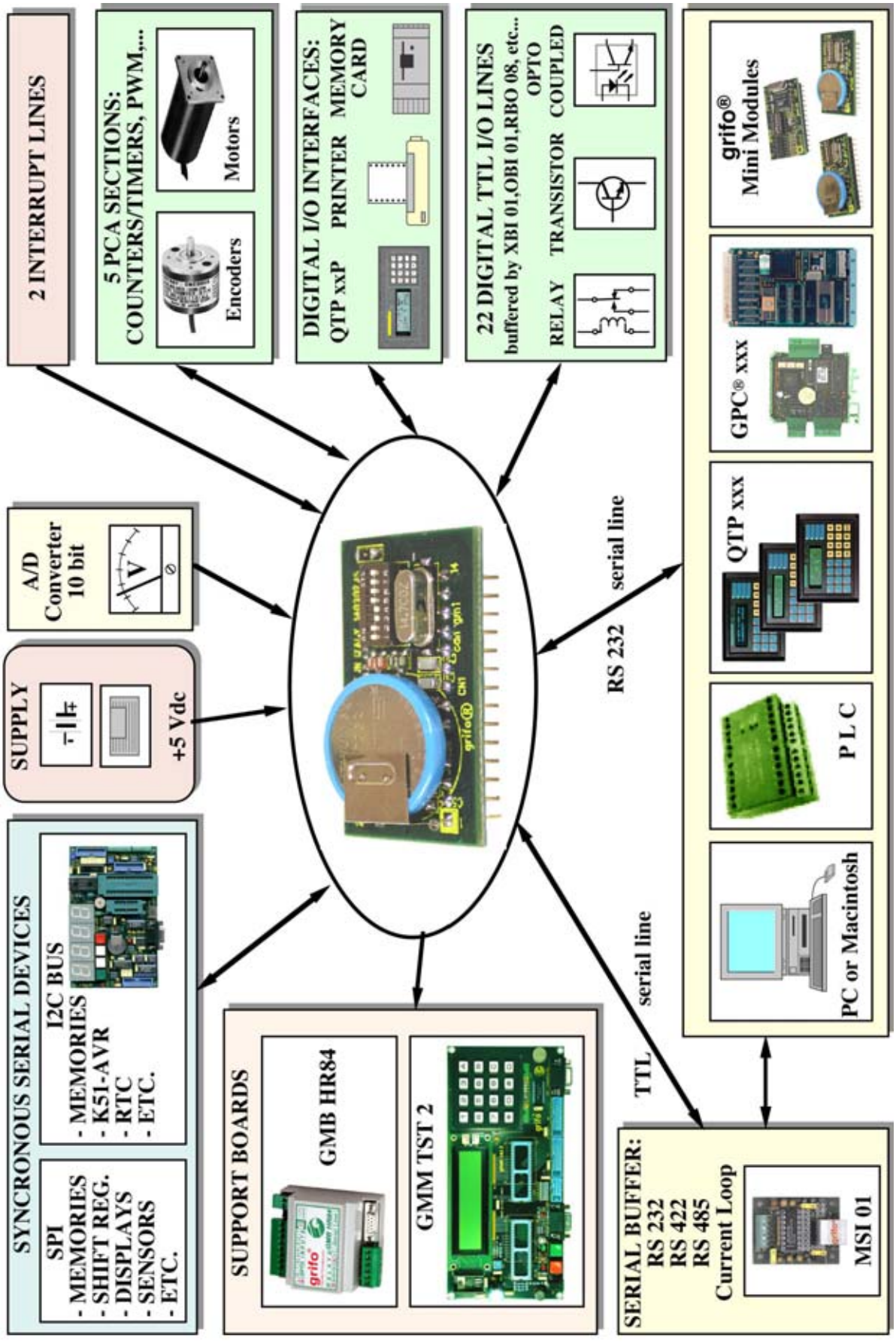


FIGURE 23: CONNECTION EXAMPLES

QTP G28

Quick Terminal Panel - LCD Graphic, 28 keys

Operator panel with LCD display 240x128 pixels, CFC backlit; Optocoupled RS 232 line and additional RS 232,422,485, Current Loop line; CAN line controller and interface; EEPROM for set up; 256K EPROM or FLASH; 128K RAM; RTC and RAM lithium backed; possibility of renaming keys, LEDs and panel name; Buzzer, 28 keys and 16 LEDs with blinking attribute, manageable by software; built in power supply; reader of magnetic badge and relay option. Plastic and metallic container. High level firmware with capabilities of terminal provided of primary graphic objects;

QTP 03

Quick Terminal Panel 3 tasti

Operator interface provided of alphanumeric display 20x2, 20x4, 20x4 BIG, 40x1 and 40x2 characters both LCD and fluorescent type; display LCD backlit by LED; interfacce for three keys external keyboard; serial interface in RS 232 or TTL; setup in EEPROM ; Buzzer. Management firmware featuring terminal functions with primitives to control visualization.

GPC® R/T94

General Purpose Relays/transistors 9 inputs 4 outputs

CMOS card, 14 MHz 89C4051 CPU; 4K FLASH; 128 byte RAM; 256 byte SRAM+RTC backed through battery; 1K serial EEPROM; 1 TTL, RS 232, RS 422, RS 485 or Current Loop line; 9 optocoupled NPN inputs; 4 relays outputs (5 A) or transistor (4A 45 Vdc) optocoupled and displayed; I/O lines displayed by LEDs; one 16 bits counter; analog inputs converted with 11 bits resolution. Screw terminal connectors; +5 Vdc power supply or 8÷24 Vac wide range; plastic container for DIN Ω rails.

GPC® 184

General Purpose Controller Z80195

Microprocessor Z180 at 22 MHz; complete CMOS implementation; 512K EPROM or FLASH; 512K RAM; Back up with Lithium battery internal or external; 1 serial line RS 232 + 1 RS 232, RS 422-485, Current Loop + another TTL serial line; 18 I/O TTL; 4 timer counter 8 bits and 2 timer 16 bits; 2 Watch Dog; backed Real Time Clock; activity LED; EEPROM; power failure; 2 DMA sections; interface for **ABACO®** I/O BUS.

GPC® 150

General Purpose Controller 84C15

Microprocessor Z80 at 16 MHz; full CMOS implementation; 512K EPROM or FLASH; 512K SRAM; RTC; Back-Up through external Lithium battery; 4M serial FLASH ; 1 serial line RS 232 plus 1 RS 232 or RS 422-485 or Current Loop; 40 I/O TTL; 2 timer counter; 2 watch dog; dip switch; EEPROM; 8 A/D converter with 12 bits resolution; activity LED. Interface for **ABACO®** BUS.

GPC® 553

General Purpose Controller 80C552

80C552 μP, 22÷33 MHz; 1 RS 232 line (software); 1 RS 232 or RS 422-485 or Current Loop line (hardware); 16 TTL I/O lines; 8 A/D 10 bits lines; 3 Timers Counters up to 16 bits; 32K EPROM; 32K SRAM; socket for 32K EEPROM,SRAM, EPROM or FLASH. back up circuit for SRAM and RTC; up to 8K serial EEPROM; 2 PWM lines; 1 activity LED; Watch dog; 5 readable DIPs; **ABACO®** I/O BUS interface. Different power supply sources.

IBC 01

Interface Block Comunication 1 line

Conversion card for serial communication, 2 RS 232 lines; 1 RS 422-485 line; 1 optical fibre line; selectable DTE/DCE interface; quick connection for DIN Ω rails.

MSI 01

Multi Serial Interface 1 line

Interface for TTL serial line and buffered serial line in RS 232, RS 422, RS 485 or Current Loop. The TTL line is on a screw terminal connector and the buffered one is on a standard plug connector.

CAN GM1

grifo® CAN Mini Module with Atmel T89C51CC01

28 pins Mini Module with 32K FLASH; 256 Bytes RAM; 1024 Bytes ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timer Counters and 5 Programmable Counter Array channels (for PWM, watch dog, compare, capture); RTC + 240 Bytes SRAM, backed with on board Lithium battery; I2C BUS; 17 I/O lines TTL; 8 A/D lines with 10 bits resolution; RS 232 or TTL serial line; complete CAN interface; 2 status LEDs; configuration Dip switch; etc.

GMM AC2

grifo® Mini Module with Atmel T89C51AC2

This **grifo®** Mini Module has a 40 pin connector and it is based on Atmel T89C51AC2 CPU with 32K FLASH; 256 Byte RAM;1K ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timers Counters and 5 Programmable Counter Array channels (for PWM, watch dog, compare, capture); 32 TTL I/O lines; 8 A/D 10 bits; RS 232 or TTL serial line; I2C BUS; 2 status LEDs; configuration Dip switch; etc.

GMM AM32

grifo® Mini Module with Atmel ATmega32

This **grifo®** Mini Module has a 40 pin connector and it is based on Atmel ATmega32L CPU with 32K FLASH; 2K SRAM; 1K EEPROM; 3 Timer Counter eand 2 Programmable Counter Array channels; 4 PWM; 8 A/D; 1 Comparator; RTC + 240 Bytes SRAM, backed by Lithium battery; I2C BUS; Master/Slave SPI Serial Interface; JTAG Interface; 32 TTL I/O lines; RS 232 or TTL serial line; 2 status LEDs; configuration Dip switch; etc.

SBP 02-xx

Switch BLOCK Power xx version

Low cost switching power supply able to generate voltage from +5 to +40 Vdc and current up to 2.5 A; Input from 12 to 24 Vac; screw terminal quick release connector. Container for DIN C type and Ω rails; very small size.

MCI 64

Memory Cards Interfaces 64 MBytes

Interfacing card for managing 68 pins PCMCIA memory cards, it is directly driven from any I/O **ABACO®** standard connector. Availability of high level languages software drivers.

BIBLIOGRAPHY

In this chapter there is a complete list of technical books, where the user can find all the necessary documentations on the components mounted on **CAN GM1**.

Technical documentation MAXIM: *True RS 232 Transceivers*

Manual PHILIPS: *I2C-bus compatible ICs*

For further information and upgrades please refer to specific internet web pages of the manufacturing companies.

Data sheet della CPU is available also at our technical documentation service:
http://www.grifo.it/PRESS/DOC/Temic/T89C51CC01.pdf

APPENDIX A: DATA SHEET

grifo® provides a completely free technical documentation service to make available data sheets of on board components, through its web site. In this chapter the user found the complete and ready to use links and URLs to these information, together with the first pages of the same documents. To use our technical documentation service just connect to our site www.grifo.com and click its icon.

AT89C51CC01

Link: Home | Technical documentation Service | ATMEL | Data-Sheet AT89C51CC01
URL: http://www.grifo.com/PRESS/DOC/ATMEL/AT89C51CC01.pdf

Features

- 80C51 Core Architecture
- 256 Bytes of On-chip RAM
- 1K Bytes of On-chip ERAM
- 32K Bytes of On-chip Flash Memory
  - Data Retention: 10 Years at 85°C
    Read/Write Cycle: 10K
- 2K Bytes of On-chip Flash for Bootloader
- 2K Bytes of On-chip EEPROM
  Read/Write Cycle: 100K
- 14-sources 4-level Interrupts
- Three 16-bit Timers/Counters
- Full Duplex UART Compatible 80C51
- Maximum Crystal Frequency 40 MHz
  - In X2 Mode, 20 MHz (CPU Core, 40 MHz)
- Five Ports: 32 + 2 Digital I/O Lines
- Five-channel 16-bit PCA with:
  - PWM (8-bit)
  - High-speed Output
  - Timer and Edge Capture
- Double Data Pointer
- 21-bit WatchDog Timer (7 Programmable Bits)
- A 10-bit Resolution Analog to Digital Converter (ADC) with 8 Multiplexed Inputs
- Full CAN Controller:
  - Fully Compliant with CAN Rev2.0A and 2.0B
  - Optimized Structure for Communication Management (Via SFR)
  - 15 Independent Message Objects:
    - Each Message Object Programmable on Transmission or Reception
    - Individual Tag and Mask Filters up to 29-bit Identifier/Channel
    - 8-byte Cyclic Data Register (FIFO)/Message Object
    - 16-bit Status and Control Register/Message Object
    - 16-bit Time-Stamping Register/Message Object
    - CAN Specification 2.0 Part A or 2.0 Part B Programmable for Each Message Object
    - Access to Message Object Control and Data Registers Via SFR
    - Programmable Reception Buffer Length Up To 15 Message Objects
    - Priority Management of Reception of Hits on Several Message Objects at the Same Time (Basic CAN Feature)
    - Priority Management for Transmission
    - Message Object Overrun Interrupt
  - Supports:
    - Time Triggered Communication
    - Autobaud and Listening Mode
    - Programmable Automatic Reply Mode
  - 1-Mbit/s Maximum Transfer Rate at 8 MHz (1) Crystal Frequency in X2 Mode
  - Readable Error Counters
  - Programmable Link to On-chip Timer for Time Stamping and Network Synchronization
  - Independent Baud Rate Prescaler
  - Data, Remote, Error and Overload Frame Handling
- On-chip Emulation Logic (Enhanced Hook System)
- Power Saving Modes:
  - Idle Mode
  - Power-down Mode

1. At BRP = 1 sampling point will be fixed.

Enhanced 8-bit MCU with CAN Controller and Flash Memory

T89C51CC01

Rev. 4129E–8051–03/02

- **Power Supply: 5V ± 10% (or 3V (1) ± 10%)**
- **Temperature Range: Industrial (-40° to +85°C)**
- **Packages: VQFP44, PLCC44, CA-BGA64**

Description

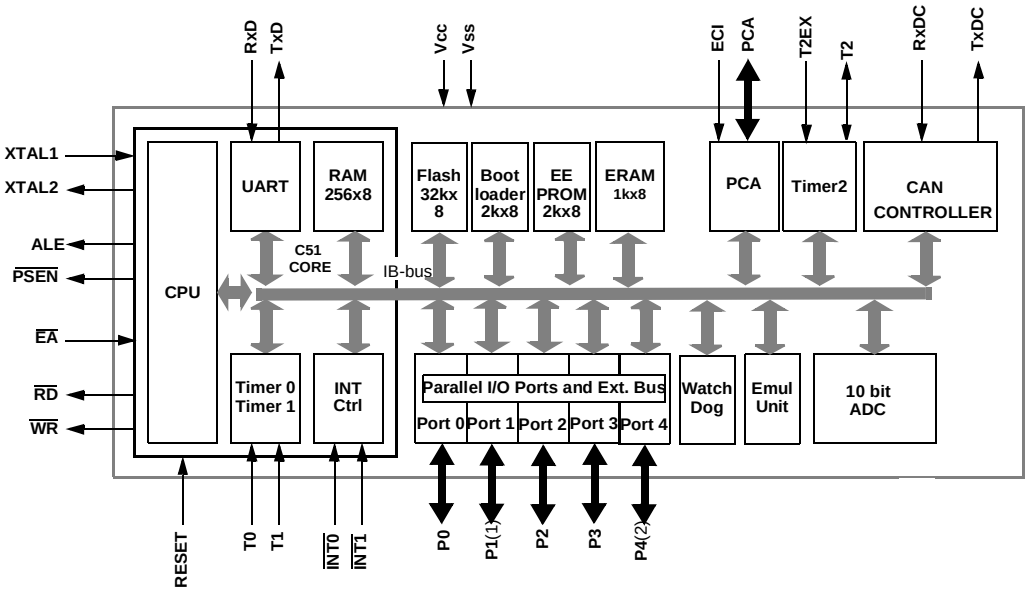
The T89C51CC01 is the first member of the CANary™ family of 8-bit microcontrollers dedicated to CAN network applications.

In X2 mode a maximum external clock rate of 20 MHz reaches a 300 ns cycle time.

Besides the full CAN controller T89C51CC01 provides 32K Bytes of Flash memory including In-System-Programming (ISP), 2K Bytes Boot Flash Memory, 2K Bytes EEPROM and 1.2-Kbyte RAM.

Primary attention is paid to the reduction of the electro-magnetic emission of T89C51CC01.

Block Diagram



Notes: 1. 8 analog Inputs/8 Digital I/O
2. 2-Bit I/O Port

1. Ask for availability

7 FUNCTIONAL DESCRIPTION

The PCF8583 contains a 256 by 8-bit RAM with an 8-bit auto-increment address register, an on-chip 32.768 kHz oscillator circuit, a frequency divider, a serial two-line bidirectional I^2C-bus interface and a power-on reset circuit.

The first 16 bytes of the RAM (memory addresses 00 to 0F) are designed as addressable 8-bit parallel special function registers. The first register (memory address 00) is used as a control/status register.
The memory addresses 01 to 07 are used as counters for the clock function. The memory addresses 08 to 0F may be programmed as alarm registers or used as free RAM locations, when the alarm is disabled.

7.1 Counter function modes

When the control/status register is programmed, a 32.768 kHz clock mode, a 50 Hz clock mode or an event-counter mode can be selected.

In the clock modes the hundredths of a second, seconds, minutes, hours, date, month (four year calendar) and weekday are stored in a BCD format. The timer register stores up to 99 days. The event counter mode is used to count pulses applied to the oscillator input (OSCO left open-circuit). The event counter stores up to 6 digits of data.

When one of the counters is read (memory locations 01 to 07), the contents of all counters are strobed into capture latches at the beginning of a read cycle. Therefore, faulty reading of the count during a carry condition is prevented.

When a counter is written, other counters are not affected.

7.2 Alarm function modes

By setting the alarm enable bit of the control/status register the alarm control register (address 08) is activated.

By setting the alarm control register a dated alarm, a daily alarm, a weekday alarm or a timer alarm may be programmed. In the clock modes, the timer register (address 07) may be programmed to count hundredths of a second, seconds, minutes, hours or days. Days are counted when an alarm is not programmed.

Whenever an alarm event occurs the alarm flag of the control/status register is set. A timer alarm event will set the alarm flag and an overflow condition of the timer will set the timer flag. The open drain interrupt output is switched on (active LOW) when the alarm or timer flag is set (enabled). The flags remain set until directly reset by a write operation.

When the alarm is disabled (Bit 2 of control/status register = 0) the alarm registers at addresses 08 to 0F may be used as free RAM.

7.3 Control/status register

The control/status register is defined as the memory location 00 with free access for reading and writing via the I^2C-bus. All functions and options are controlled by the contents of the control/status register (see Fig.3).

7.4 Counter registers

In the clock modes 24 h or 12 h format can be selected by setting the most significant bit of the hours counter register. The format of the hours counter is shown in Fig.5.

The year and date are packed into memory location 05 (see Fig.6). The weekdays and months are packed into memory location 06 (see Fig.7). When reading these memory locations the year and weekdays are masked out when the mask flag of the control/status register is set. This allows the user to read the date and month count directly.

In the event-counter mode events are stored in BCD format. D5 is the most significant and D0 the least significant digit. The divider is by-passed.

In the different modes the counter registers are programmed and arranged as shown in Fig.4. Counter cycles are listed in Table 1.

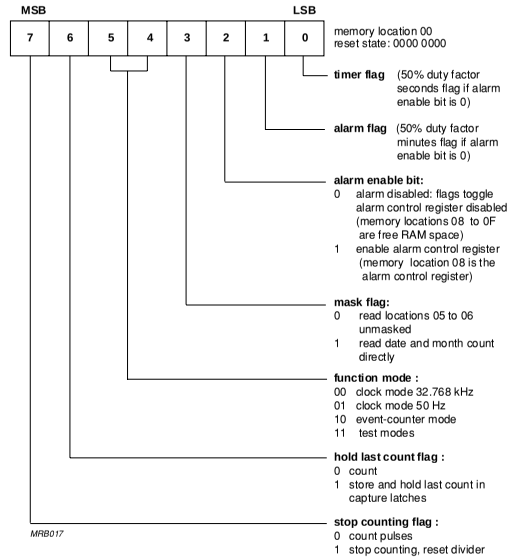


Fig.3 Control/status register.

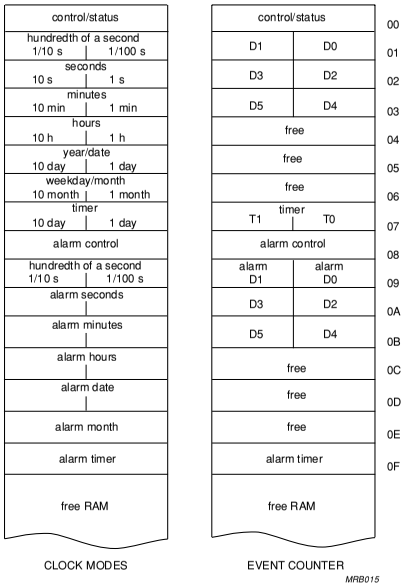


Fig.4 Register arrangement.

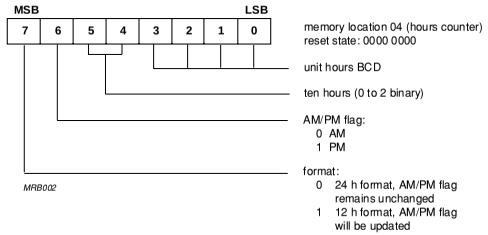


Fig.5 Format of the hours counter.

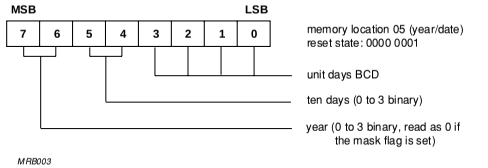


Fig.6 Format of the year/date counter.

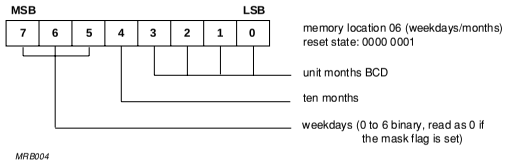


Fig.7 Format of the weekdays/month counter.

Table 1 Cycle length of the time counters, clock modes

UNIT	COUNTING CYCLE	CARRY TO NEXT UNIT	CONTENTS OF THE MONTH COUNTER
Hundredths of a second	00 to 99	99 to 00	–
Seconds	00 to 59	59 to 00	–
Minutes	00 to 59	59 to 00	–
Hours (24 h)	00 to 23	23 to 00	–
Hours (12 h)	12 AM	–	–
	01 AM to 11 AM	–	–
	12 PM	–	–
	01 PM to 11 PM	11 PM to 12 AM	–
Date	01 to 31	31 to 01	1, 3, 5, 7, 8, 10 and 12
	01 to 30	30 to 01	4, 6, 9 and 11
	01 to 29	29 to 01	2, year = 0
	01 to 28	28 to 01	2, year = 1, 2 and 3
Months	01 to 12	12 to 01	–
Year	0 to 3	–	–
Weekdays	0 to 6	6 to 0	–
Timer	00 to 99	no carry	–

7.5 Alarm control register

When the alarm enable bit of the control/status register is set (address 00, bit 2) the alarm control register (address 08) is activated. All alarm, timer, and interrupt output functions are controlled by the contents of the alarm control register (see Fig.8).

7.6 Alarm registers

All alarm registers are allocated with a constant address offset of hexadecimal 08 to the corresponding counter registers (see Fig.4, Register arrangement).

An alarm signal is generated when the contents of the alarm registers matches bit-by-bit the contents of the involved counter registers. The year and weekday bits are ignored in a dated alarm. A daily alarm ignores the month and date bits. When a weekday alarm is selected, the contents of the alarm weekday/month register will select the weekdays on which an alarm is activated (see Fig.9).

Remark: In the 12 h mode, bits 6 and 7 of the alarm hours register must be the same as the hours counter.

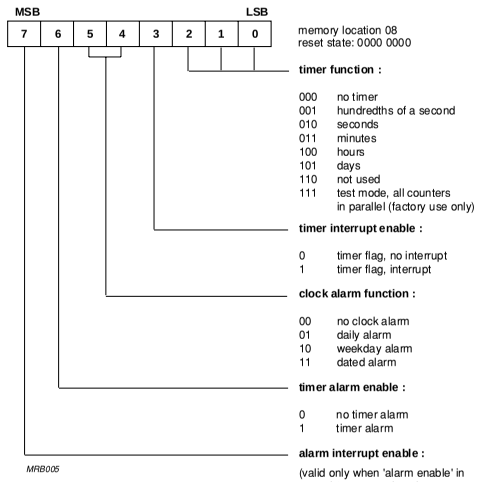


Fig.8 Alarm control register; clock mode.

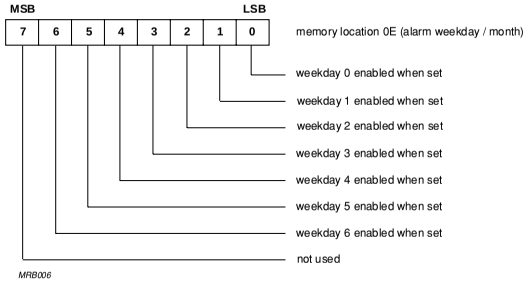


Fig.9 Selection of alarm weekdays.

7.7 Timer

The timer (location 07) is enabled by setting the control/status register = XX0X X1XX. The timer counts up from 0 (or a programmed value) to 99. On overflow, the timer resets to 0. The timer flag (LSB of control/status register) is set on overflow of the timer. This flag must be reset by software. The inverted value of this flag can be transferred to the external interrupt by setting bit 3 of the alarm control register.

Additionally, a timer alarm can be programmed by setting the timer alarm enable (bit 6 of the alarm control register). When the value of the timer equals a pre-programmed value in the alarm timer register (location 0F), the alarm flag is set (bit 1 of the control/status register). The inverted value of the alarm flag can be transferred to the external interrupt by enabling the alarm interrupt (bit 6 of the alarm control register).

Resolution of the timer is programmed via the 3 LSBs of the alarm control register (see Fig.11, Alarm and timer Interrupt logic diagram).

7.8 Event counter mode

Event counter mode is selected by bits 4 and 5 which are logic 1, 0 in the control/status register. The event counter mode is used to count pulses externally applied to the oscillator input (OSCO left open-circuit).

The event counter stores up to 6 digits of data, which are stored as 6 hexadecimal values located in locations 1, 2, and 3. Thus, up to 1 million events may be recorded.

An event counter alarm occurs when the event counter registers match the value programmed in locations 9, A, and B, and the event alarm is enabled (bits 4 and 5 which are logic 0, 1 in the alarm control register). In this event, the alarm flag (bit 1 of the control/status register) is set. The inverted value of this flag can be transferred to the interrupt pin (pin 7) by setting the alarm interrupt enable in the alarm control register. In this mode, the timer (location 07) increments once for every one, one-hundred, ten thousand, or 1 million events, depending on the value programmed in bits 0, 1 and 2 of the alarm control register. In all other events, the timer functions are as in the clock mode.

7.9 Interrupt output

The conditions for activating the open-drain n-channel interrupt output $\overline{INT}$ (active LOW) are determined by appropriate programming of the alarm control register. These conditions are clock alarm, timer alarm, timer overflow, and event counter alarm. An interrupt occurs when the alarm flag or the timer flag is set, and the corresponding interrupt is enabled. In all events, the interrupt is cleared only by software resetting of the flag which initiated the interrupt.

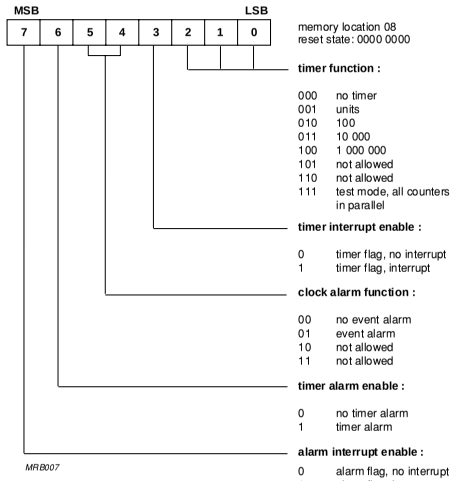


Fig.10 Alarm control register, event-counter mode.

In the clock mode, if the alarm enable is not activated (alarm enable bit of control/status register is logic 0), the interrupt output toggles at 1 Hz with a 50% duty cycle (may be used for calibration). This is the default power-on state of the device. The OFF voltage of the interrupt output may exceed the supply voltage, up to a maximum of 6.0 V. A logic diagram of the interrupt output is shown in Fig.11.

7.10 Oscillator and divider

A 32.768 kHz quartz crystal has to be connected to OSCI (pin 1) and OSCO (pin 2). A trimmer capacitor between OSCI and V_{DD} is used for tuning the oscillator (see quartz frequency adjustment). A 100 Hz clock signal is derived from the quartz oscillator for the clock counters.

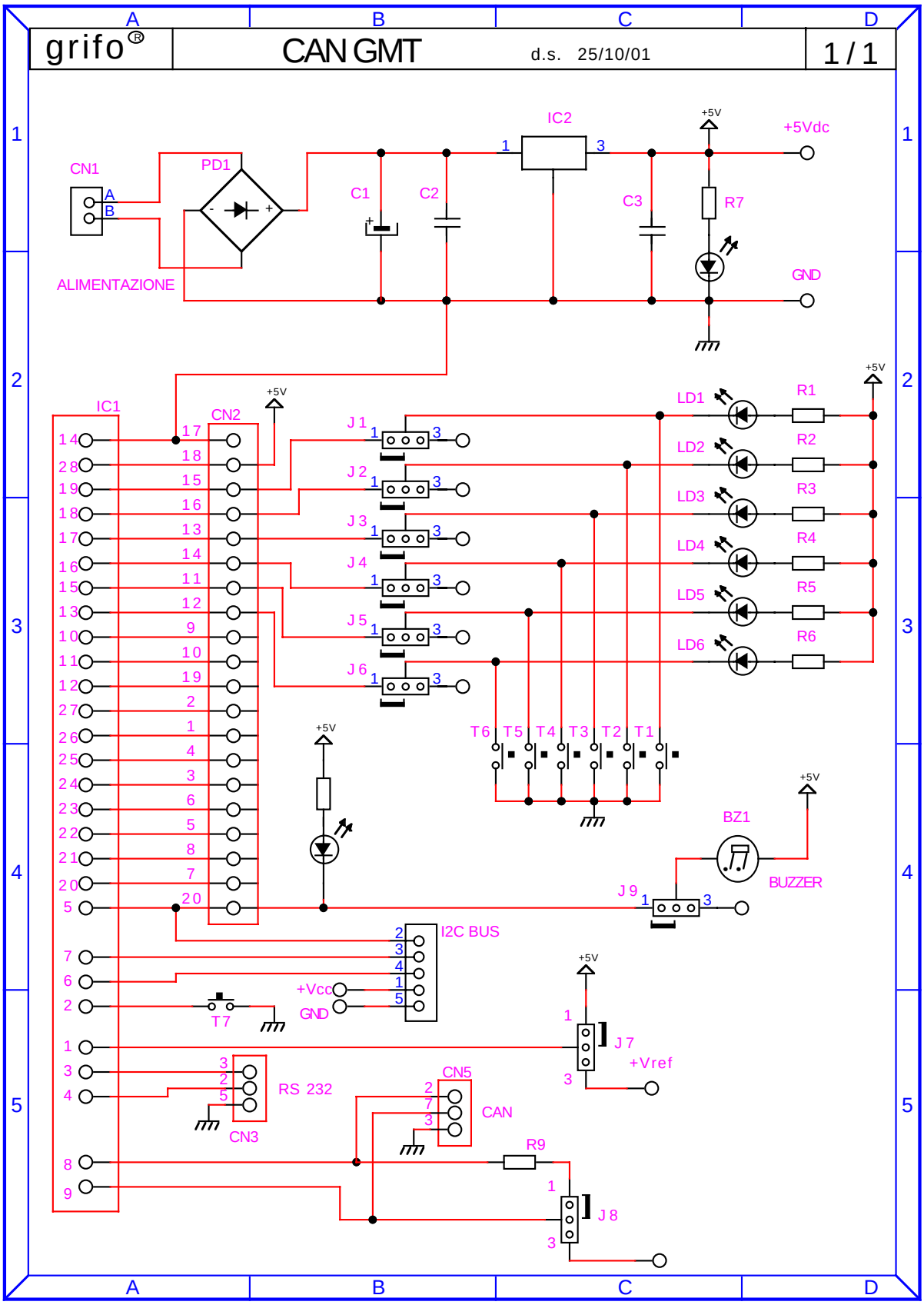
In the 50 Hz clock mode or event-counter mode the oscillator is disabled and the oscillator input is switched to a high impedance state. This allows the user to feed the 50 Hz reference frequency or an external high speed event signal into the input OSCI.

7.11 Initialization

When power-up occurs the I^2C-bus interface, the control/status register and all clock counters are reset. The device starts time-keeping in the 32.768 kHz clock mode with the 24 h format on the first of January at 0.00.00: 00. A 1 Hz square wave with 50% duty cycle appears at the interrupt output pin (starts HIGH).

It is recommended to set the stop counting flag of the control/status register before loading the actual time into the counters. Loading of illegal states may lead to a temporary clock malfunction.

APPENDIX B: CAN GMT ELECTRIC DIAGRAM



APPENDIX C: ALPHABETICAL INDEX

SYMBOLS

/INT0 **11**, **12**
/INT1 **11**, **12**

A

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M

MEMORY **6**, **26**
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N

NPN **16**

P

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