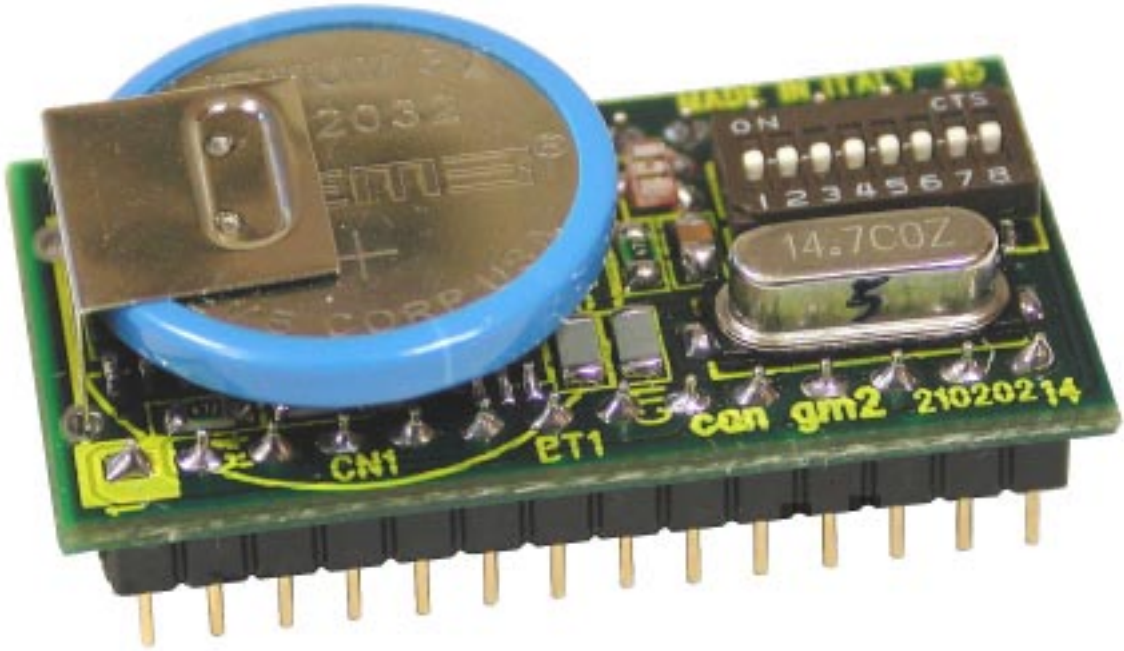
CAN GM2

CAN - grifo® MiniModule 2

TECHNICAL MANUAL



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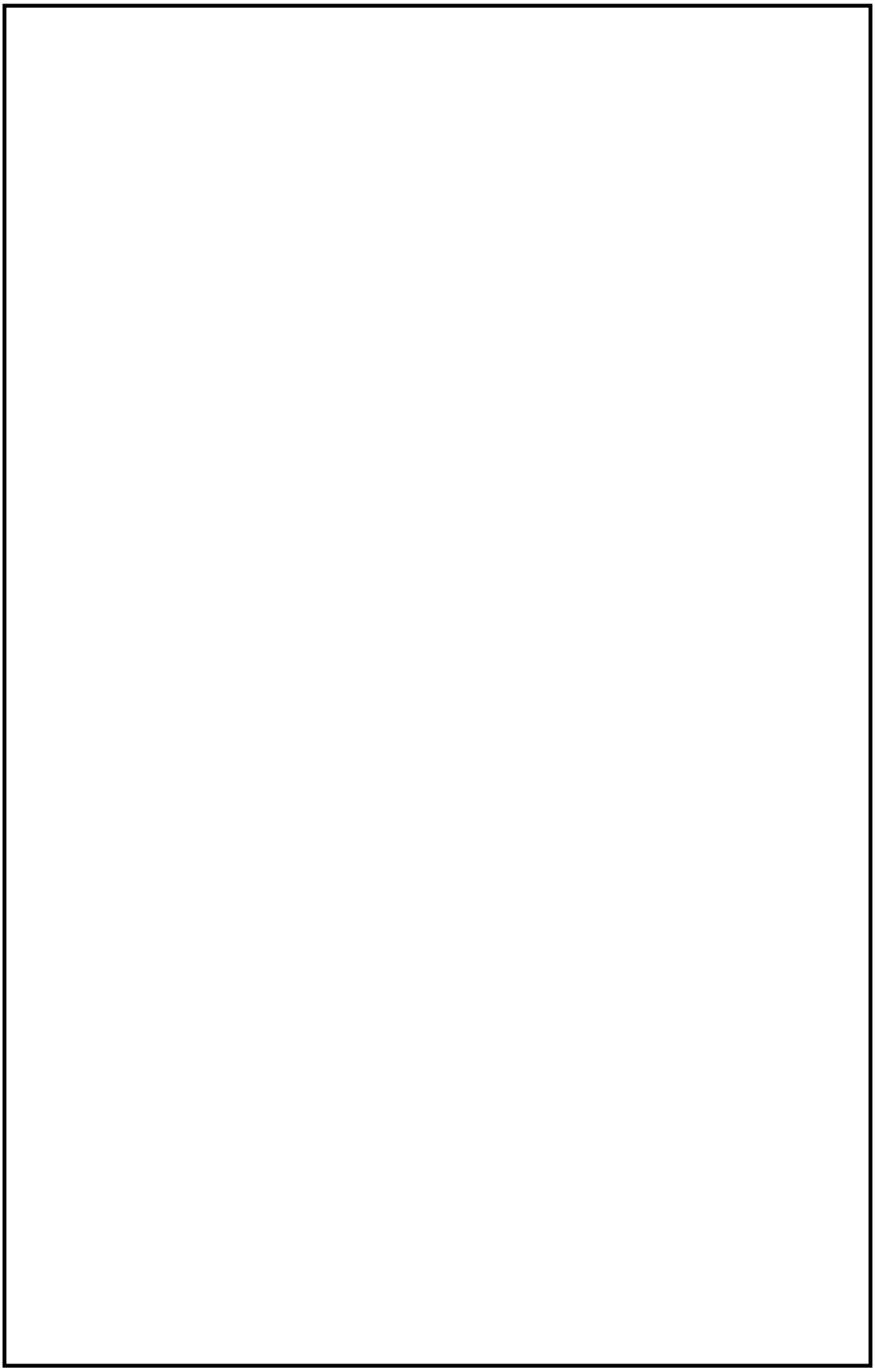

CAN GM2

CAN - grifo® MiniModule 2

TECHNICAL MANUAL

Standard container with **28 pins** male socket, DIL, 100 mils pitch, 600 mils width; **very small dimension**: 20 x 38 x 80 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 T89C51CC02** microcontroller (8051 code compatibile) with 14.74 Mhz crystal; programmable machine speed at **12 or 6 clock** cycle; **16K FLASH** for code, 2K FLASH for boot loader, 256 bytes RAM for data, **256 bytes ERAM** for data, **2K EEPROM** for data; **7 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; **2 PCA channels** up to 16 bits with PWM, watch dog, **compare**, **capture**, etc. functionality; **14 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 MAX202 for RS 232 serial line; **CAN controller** compatible with 2.0 A and 2.0 B standards; high speed transceiver 82C250 for **CAN** line up to **1 Mbit** (ISO-11898); **reset** and power supply control circuit based on MAX825; 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**; **1 status LED** 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: Assembler (MCA51); C compiler (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

Trade Marks

abaco®, **GPC®**, **grifo®** : are trade marks of **grifo®**.

Other Product and Company names listed, are trade marks of their respective companies.

GENERAL INDEX

FIGURE INDEX

INTRODUCTION

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

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 GM2** card release **210202** and later. The validity of the bring informations 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 bottom left corner on the component side and under the CPU on the solder side).

GENERAL INFORMATION

CAN GM2 (**C**ontroller **A**rea **N**etwork - **grifo® M**ini**M**odule **2**) is a module based on microcontroller **Atmel T89c51CC02**, 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's very small area some comoponents that exploit microcontrollers's performance are already mounted. In addition to this, component that completemicro's features are installed, like **CAN transceiver 82c250**, **power good and reset** generator **MAX 825**, **real time clock PCF 8583**, capable to generate periodic interrupts, etc.
Possible applications of **CAN GM2** MiniModules 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 GM2** 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**: 20 x 38 x 80 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 T89C51CC02** microcontroller (8051 code compatibile) with 14,74 Mhz crystal.
- Programmable machine speed at **12 or 6 clock** cycle.
- **16K FLASH** for code, 2K FLASH for boot loader, 256 bytes RAM for data, **256 bytes ERAM** for data, **2K EEPROM** for data.
- **7 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.
- **14 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 MAX202 for RS 232 serial line.

- **CAN controller** compatible with 2.0 A and 2.0 B standards.
- High speed transceiver 82C250 for **CAN** line up to **1 Mbit** (ISO-11898).
- **Reset** and power supply control circuit based on MAX825.
- 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.
- **1 status LED** manageable 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: Assembler (MCA51); C compiler (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.

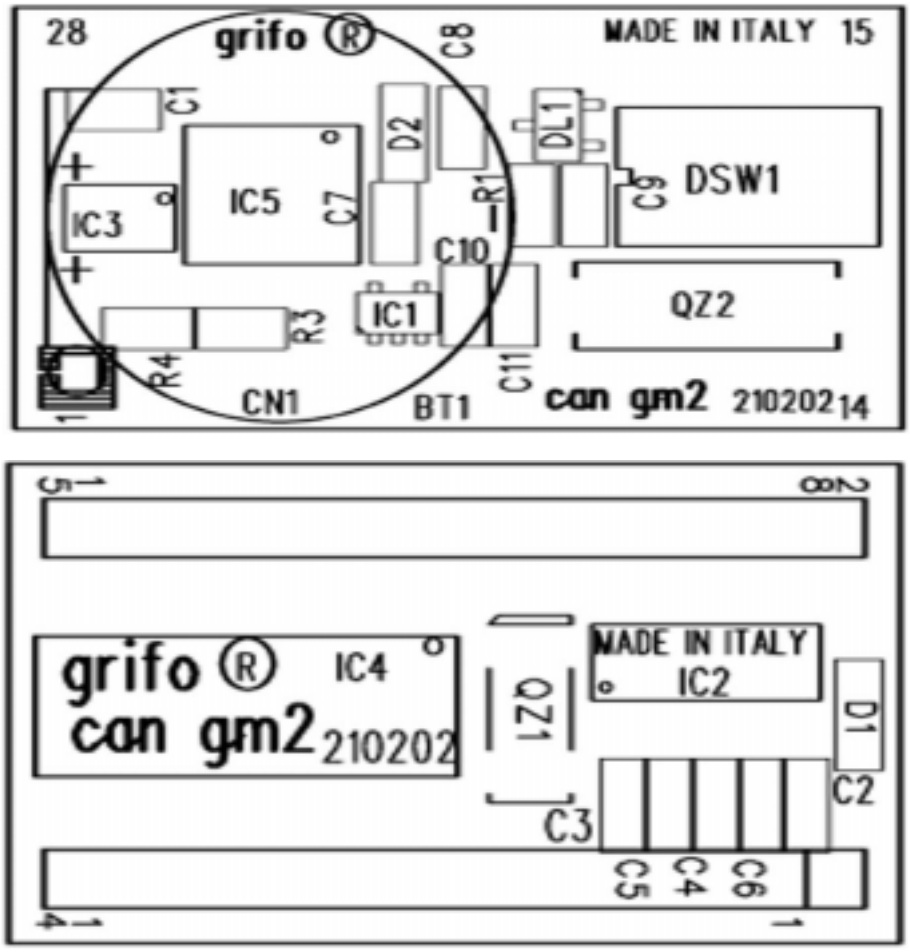


FIGURE 1: COMPONENTS MAP (ABOVE COMPONENTS SIDE AND SOLDER SIDE)

TECHNICAL FEATURES

GENERAL FEATURES

Devices:	14 digital TTL I/O signals 7 A/D converter analog inputs 1 PCA section 1 Lithium battery 1 Real Time Clock PCF 8583 1 reset generator MAX 825 1 RS 232 serial line through MAX 202 1 CAN serial line through 82c250 1 eight pins dip switch 1 status LED red
Memories:	16 Kbyte FLASH user program 2K byte FLASH boot loader 2K EEPROM user data 512 Bytes SRAM user data
CPU:	Atmel T89c51CC02
Clock frequency:	14.7465 MHz
A/D resolution:	10 bit
A/D conversion time:	20 µsec
External reset duration:	typical 280 msec

PHYSICAL FEATURES

Size:	20 x 38 x 80 mm
Weight:	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	
Current consumption:	19 mA	(power down mode)
	26 mA	(normal working mode)
	103 mA	(highest with CAN always low)
On board battery:	3.0 Vdc; 180 mAh	
Backup current:	3.3 µA	
Analog inputs impedance:	high	
Power failure theshold:	typical 4.56 Vdc	

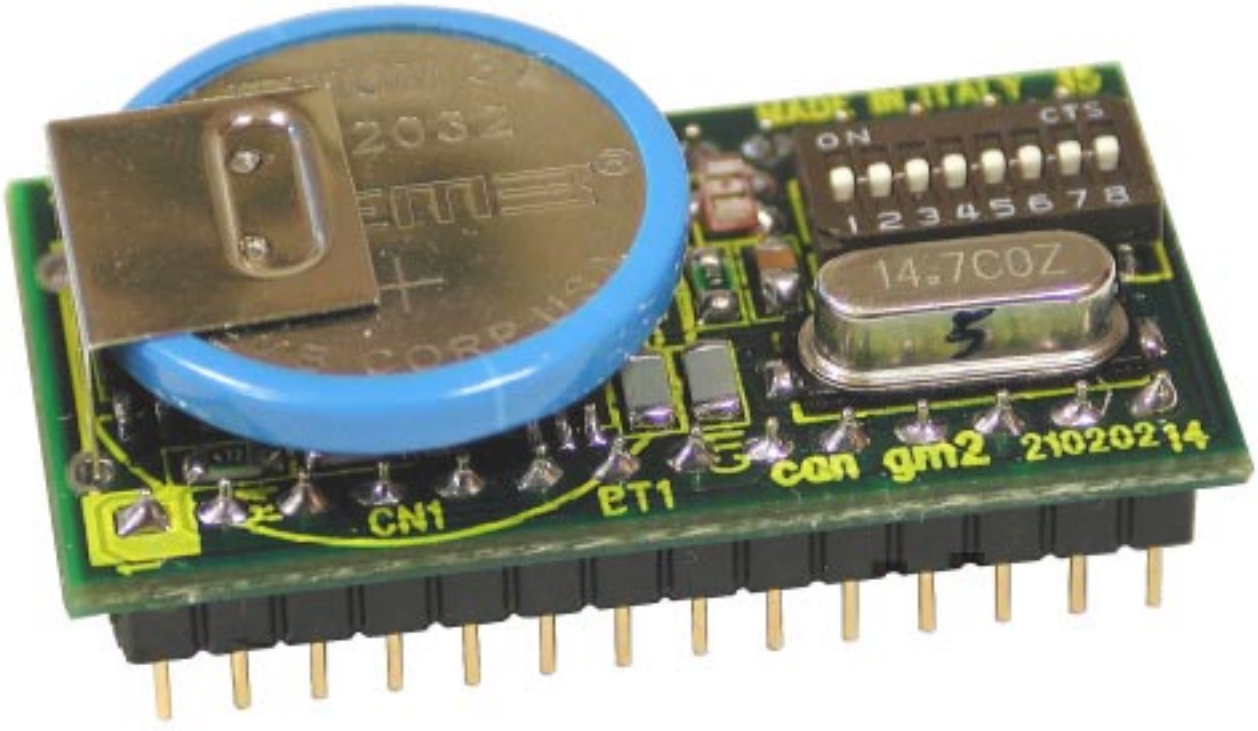


FIGURE 2: CARD PHOTO

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 connectors, jumpers, LEDs and some explanatory diagrams.

CONNECTIONS

The **CAN GM2** module has one male 28 pins DIL connector that provides +5 Vdc power supply andallows to connect to the external world the signals of on board microcontroller Atmel T89c51CC02 and the surrounding components.

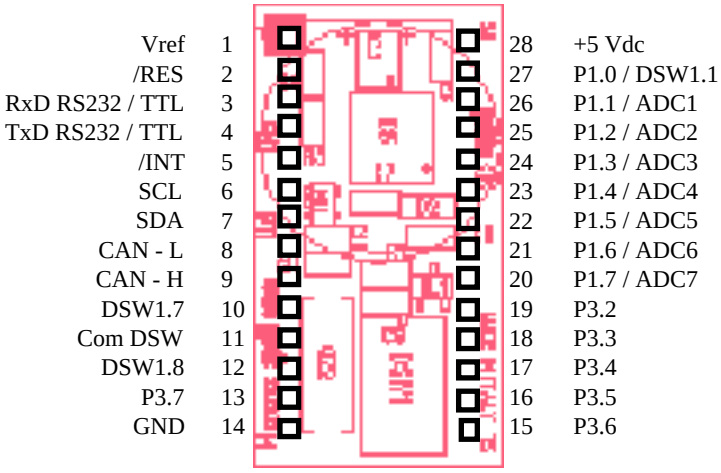


FIGURE 3: PINOUT OF 28 PIN SOCKET (COMPONENTS SIDE)

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 / TTL	= I	- Receive Data in RS 232 or TTL
TxD RS232 / TTL	= O	- Transmit Data in RS 232 or TTL
/INT	= O	- Periodic interrupt generated by RTC
/RES	= I/O	- CPU reset signal
SCL	= O	- Clock signal of software I^2C Bus
SCA	= I/O	- Data signal of softwareI^2C Bus
DSW1.7	=	- Switch number 7 of DSW1
DSW1.7	=	- Switch number 8 of DSW1
Com DSW	=	- Common signal of switches number 7 and 8
P1.0 / DSW1.1	= I/O	- Bit 0 of port 1 and RUN / DEBUG selector
P1.1÷7	= I/O	- CPU TTL I/O digital Port 1 signals
P3.2÷7	= I/O	- CPU TTL I/O digital Port 3 signals
ADC1÷7	= I	- Analog inputs
Vref	= I	- A/D converter reference voltage

UART RS 232 / TTL

An RS 232 buffer is installed on board of **CAN GM2** MiniModule allows to connect easily the module to any device provided with the same serial interface.
As the UART used is the one internal to the microcontroller, which generates only TTL signals, it is possible to provide directly on the socket these TTL signals instead of RS 232, to let the user connect buffers of different electric protocols like, for example, RS 422, RS 485, current loop, etc.
To connect immediatly the MiniModule to a system provided with RS 232 serial interface it is possible to use the D type connector available on **CAN GMT** board (please see the successive paragraph "USE WITH CAN GMT BOARD").

NOTE
In the following diagram the first figure indicates the pin of D type connector available on **CAN GMT**, the second figure indicates the pin of the 28 pins DIL male connector of **CAN GM2** MiniModule, which allows direct connection.
Please remember to configure correctly dip switch DSW1 to select between RS 232 and TTL signals (please see paragraph "DIP SWITCH" for further information).

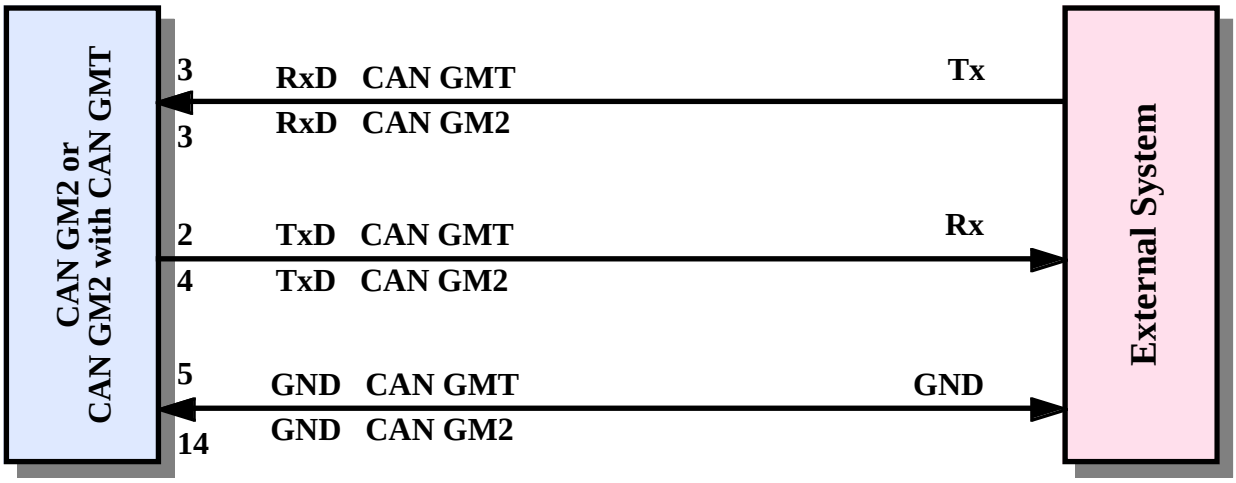


FIGURE 4: RS 232 POINT TO POINT CONNECTION EXAMPLE (WITH AND WITHOUT CAN GMT)

TTL DIGITAL I/O SIGNALS

CAN GM2 MiniModule provides 17 TTL digital I/O signals of microcontroller Atmel T89c51CC02, that is signals P1.0÷P1.7 and P3.2÷P3.7.
These signals can be driven programming the specific microprocessor internal registers or using the specific high level commands of programming languages.

A/D CONVERTER ANALOG SIGNALS

CAN GM2 MiniModule provides 8 analog inputs of Atmel T89c51CC02 internal A/D converter, that is signals AN1÷AN7 multiplexed on signals P1.1÷P1.7.
A/D conversion is made through opportune manipulation of specific microcontroller internal registers. For further information please refer to data sheet of appendix A of this manual or the comments in high level languages example source programs.

DIP SWITCH

CAN GM2 MiniModule is provided with an on board dip switch whose purpose is to set up several electric parameters of module itself and eventually logical parameters of application program. In fact switch 1 is connected to TTL I/O digital signal P1.0 and is used at power on or after a reset to determine whether the micro has to run the user application program or the FLASH boot loader, switches 2 to 5 switch between RS 232 or TTL serial signals, switch 6 connects the on board battery and the remaining 2 switches are available to the user program. For further information please see the chapter “DIP SWITCH”.

RTC

CAN GM2 MiniModule is provided with a Real Time Clock PHILIPS PCF 8583, capable to manage year, month, day, hout, minute, second and to generate a periodic interrupt whose period is selectable by the user. The device communticates with micro through I^2C Bus software. For further information please see the chapter “PERIPHERAL DEVICES SOFTWARE DESCRIPTION”.

WATCH DOG

Microcontroller T89c51CC02 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.

CAN CONTROLLER

A CAN controller compatible to standard 2.0 A and 2.0 B is installed on **CAN GM2** MiniModule. There is also a transceivere capable to reach about 1 Mbits/sec (ISO - 11898). These devices allow to connect easily the MiniModule 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 successive paragraph "USE WITH CAN GMT BOARD").

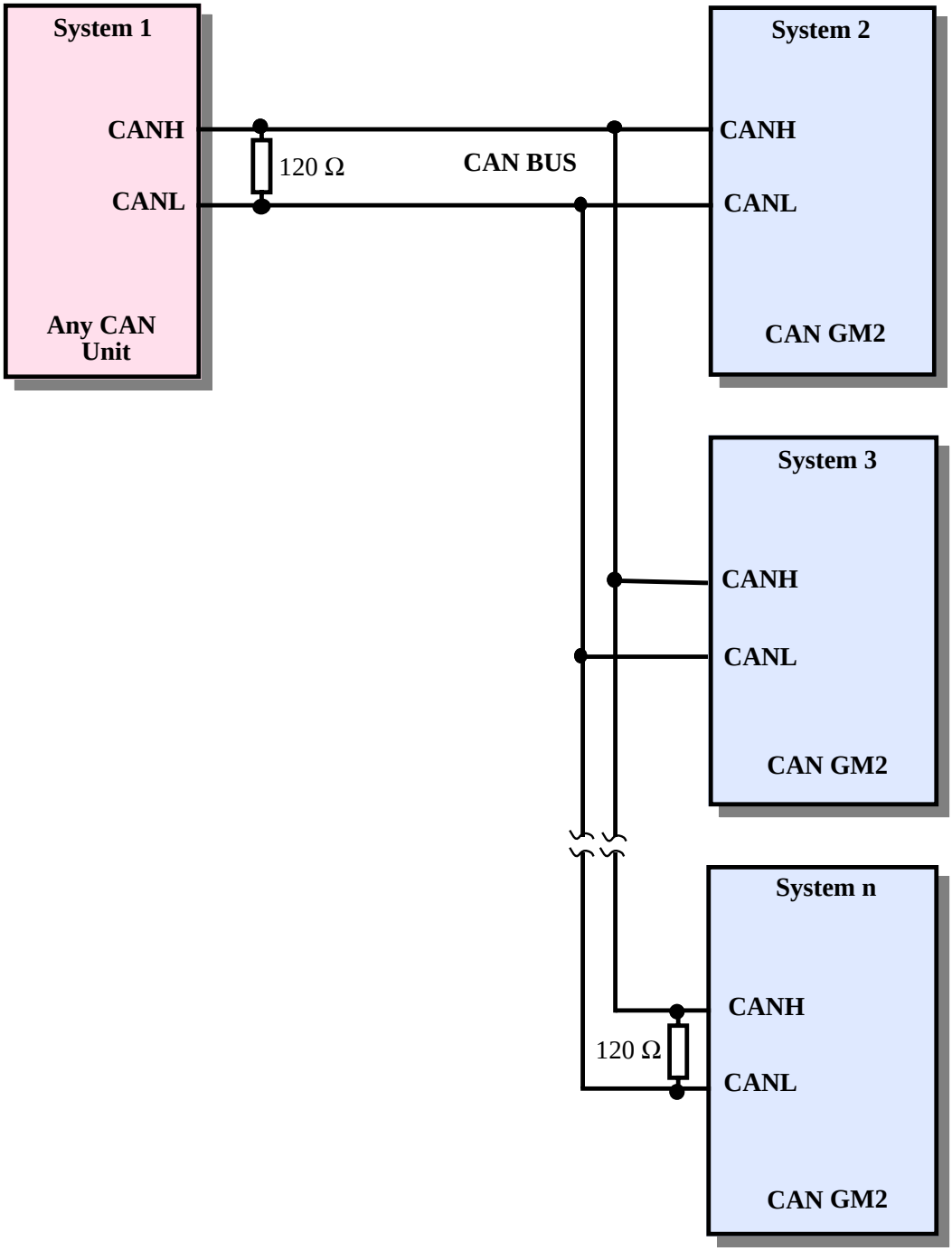


FIGURE 5: CAN BUS NETWORK CONNECTION EXAMPLE

USE WITH CAN GMT BOARD

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

- to supply the MiniModule 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

IN SYSTEM PROGRAMMING

One of the most important features of **CAN GM2** MiniModule is the possibility to program the microprocessor T89c51CC02 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:

1) develop the application program through a proper software tools that generate an executable code;
2) set switch 1 of DSW1 ON;
3) connect RS 232 serial line to a personal computer free COM line;
4) power on the card;
5) program the microprocessor internal FLASH EPROM by using the specific program supplied by ATMEL: **FLIP**.
6) power off the card;
7) set switch 1 of DSW1 OFF;
8) power on the card: the programmed application programm will start execution from internal ROM.

The ISP reduces the total application cost, in fact it eliminates the requirements of EPROM, EPROM programmer, external FLASH EPROM, etc. For further informations on in system programming please refet to specific technical documentation from ATMEL.

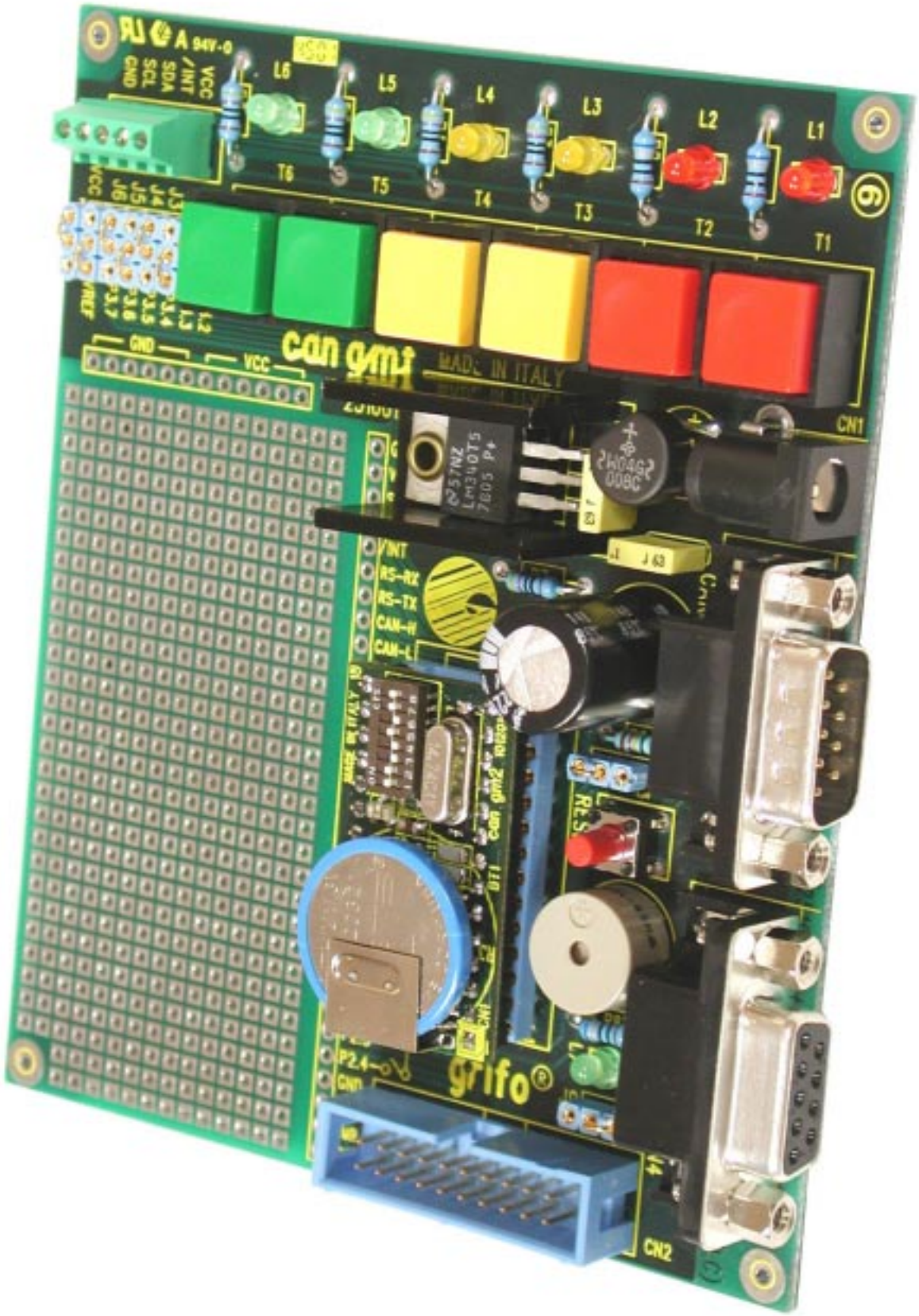


FIGURE 6: PHOTO OF CAN GMT WITH CAN GM2

VISUAL FEEDBACK

CAN GM2 MiniModule is provided with one LED as described in the following table:

LED	PURPOSE
DL1	If ON, indicates that signal P1.0 (pin 28 of microcontroller) is at low level (zero volt).

FIGURE 7: VISUAL SIGNALATIONS TABLE

DIP SWITCH

An 8 pins dip switch is installed on **CAN GM2** MiniModule. It allows to perform selection regarding the module's working way. Figure 9, in the next page, shows a list of swithces connection and purpose, in the table * means default connection, that is the configuration of the board after test in our laboratories.
To locate the dip switch, please refer to figure 8.

I/O CONNECTION

To prevent possible connecting problems between **CAN GM2** and the external systems, the user has to read carefully the information of the previous paragraphs and he must follow these instrunctions:

- For RS 232 and CAN communication signals the user must follow the standard rules of these protocols.
- 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 (GND). For TTL signals, the 0 Vdc level corresponds to logic state "0", while 5Vdc level corrisponds to logic state "1".
- The analog inputs (A/D section) must be connected to low impedance signals in the range: 0÷3 Vdc.

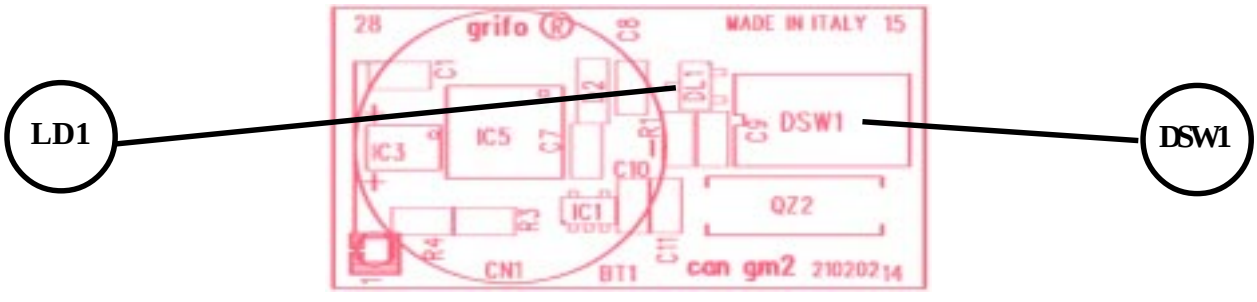


FIGURE 8: DL1 AND DSW1 LOCATION

SWITCH	POSITION	PURPOSE	DEF.
1	ON	Connects signal P1.0 (pin 28 of microcontroller) to ground (zero volt). If MiniModule is turned on or reset in this condition DEBUG mode is enabled and Boot Loader is started.	
	OFF	Does not connect signal P1.0 (pin 28 of microcontroller) to ground (zero volt). If MiniModule 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 of on board RS 232 serial line to pin 4 of 28 pins socket. Used in conjunction with switches 3, 4 and 5.	*
	OFF	Does not connects signal TxD of on board RS 232 serial line to pin 4 of 28 pins socket.	
3	ON	Connects signal RxD of on board RS 232 serial line to pin 3 of 28 pins socket. Used in conjunction with switches 2, 4 and 5.	*
	OFF	Does not connects signal RxD of on board RS 232 serial line to pin 3 of 28 pins socket.	
4	ON	Connects signal TxD of microcontroller TTL serial line (pin 13) to pin 4 of 28 pins socket. Used in conjunction with switches 2, 3 and 5.	
	OFF	Does not connects signal TxD of microcontroller TTL serial line (pin 13) to pin 4 of 28 pins socket.	*
5	ON	Connects signal RxD of microcontroller TTL serial line (pin 14) to pin 3 of 28 pins socket. Used in conjunction with switches 2, 3 and 4.	
	OFF	Does not connects signal RxD of microcontroller TTL serial line (pin 14) to pin 3 of 28 pins socket.	*
6	ON	Connects on board battery to RTC + SRAM module.	
	OFF	Does not connects on board battery to RTC + SRAM module.	*
7	ON	Connects pins 10 (P2.4 on **CAN GMT**) and 11 (P2.3 on **CAN GMT**) of the 28 pins socket.	
	OFF	Does not connect pin 11 (P2.3 on **CAN GMT**) of the 28 pins socket.	*
8	ON	Connects pins 12 (P2.2 on **CAN GMT**) and 11 (P2.3 on **CAN GMT**) of the 28 pins socket.	
	OFF	Does not connect pin 12 (P2.2 on **CAN GMT**) of the 28 pins socket.	*

FIGURE 9: DIP SWITCH TABLE

INTERRUPTS MANAGEMENT

One of the most important **CAN GM2** 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.

- 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, external interrupts.

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.

MEMORY ARCHITECTURE

Memory of MiniModule **CAN GM2** 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

- 16K bytes FLASH of user memory
- 2K bytes FLASH for boot loader
- 2K bytes EEPROM of user memory
- 256 bytes SRAM 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 “BACKED SRAM + SERIAL RTC”.

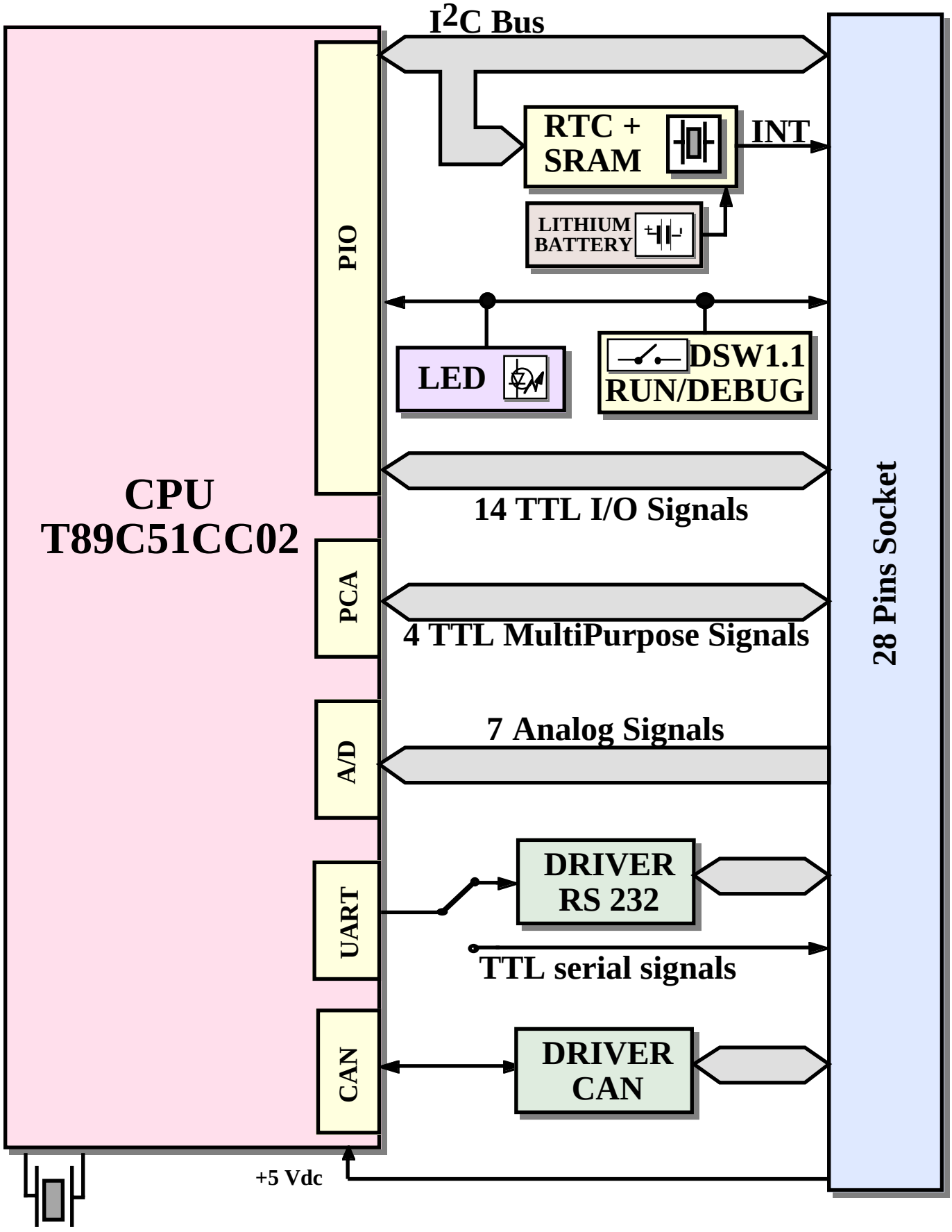


FIGURE 10: BLOCK DIAGRAM

SOFTWARE

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.

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.

FORTH: complete software development tools to program the card with FORTH high level language. It needs a P.C. for user interface and it is really interesting for its fast execution and small size, of the generated code.

MCC 51: integer cross compiler for source files in standard ANSI C. It produces a source assembly file compatible with MCA 51 or with Intel macro relocatable assembler MCS 51.

MCA 51: macro cross assembler available for MS-DOS operating system in absolute and relocatable version. In this relocatable version is supplied with a linker and a library manager.

MCS 51: source level debugger and simulator. Allows to simulate microcontrollers of family 51 and to monitor a program's status. It is executed on P.C. without any additional hardware and it allows loading of HEX and SYMBOLIC files, breakpoint setting, instruction execution in trace mode, registers and memory dump, etc.

MCK 51: it is the sum of MCC 51 and MCA 51 and it is a complete C compiler with an output file type compatible with MCS 51.

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.

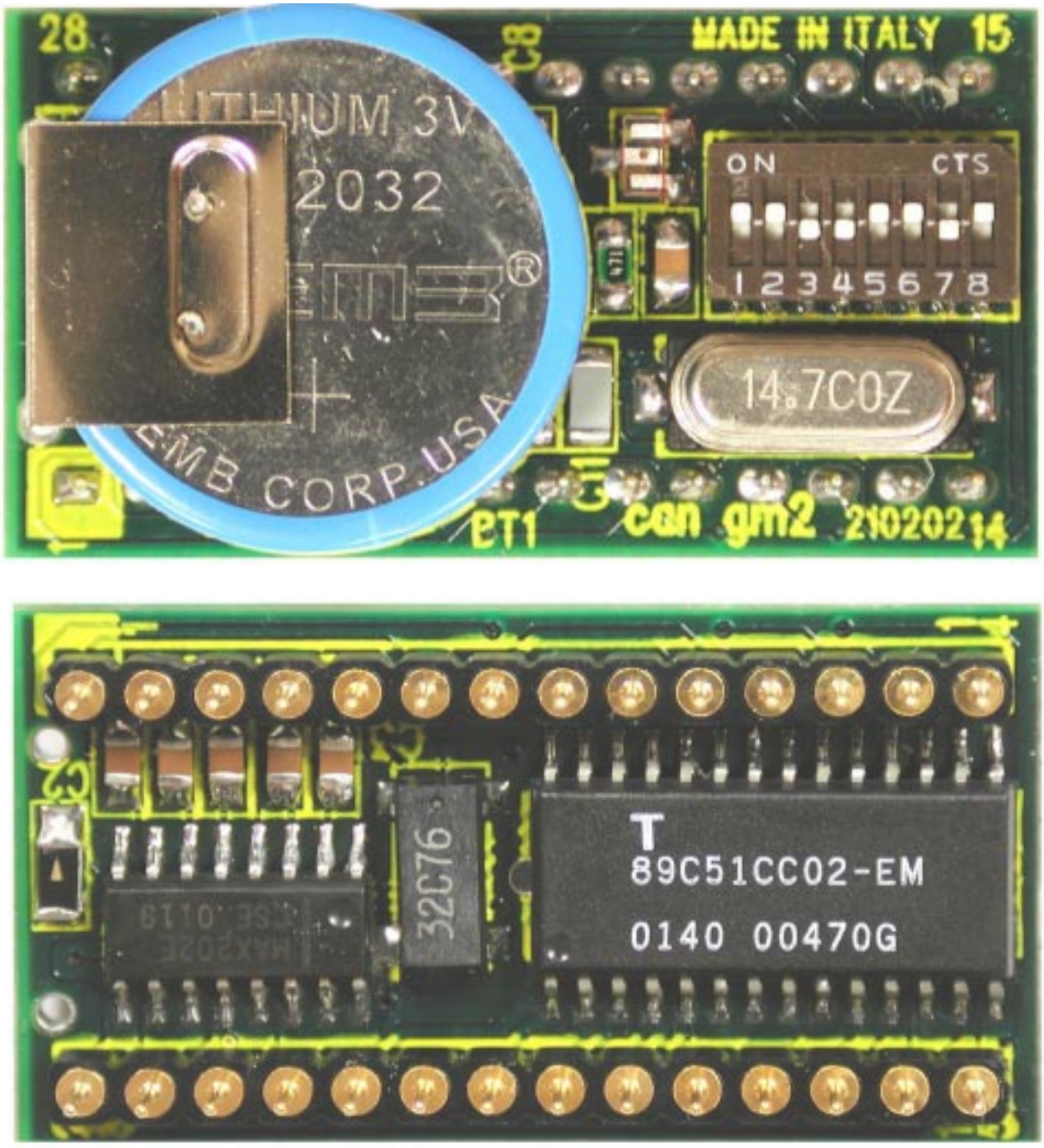


FIGURE 11: COMPONENT SIDE (ABOVE) AND SOLDER SIDE PHOTO

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.

DIP SWITCH DSW1 AND RUN/DEBUG

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

P1.0 -> DSW1.1

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.
DSW1 is read in complemented logic, in fact "**ON**" position corresponds to logic level **0** and "**OFF**" position cooresponds to logic level **1**.

BACKED SRAM + SERIAL RTC

For software management of serial SRAM + RTC backed module, please refer to specific manufacturer documentation. This manual reports no software information because management of this component is complex and requires a deep knowledge, anyway the user can use the demo programs supplied with the card. The board control logic alloes to 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.

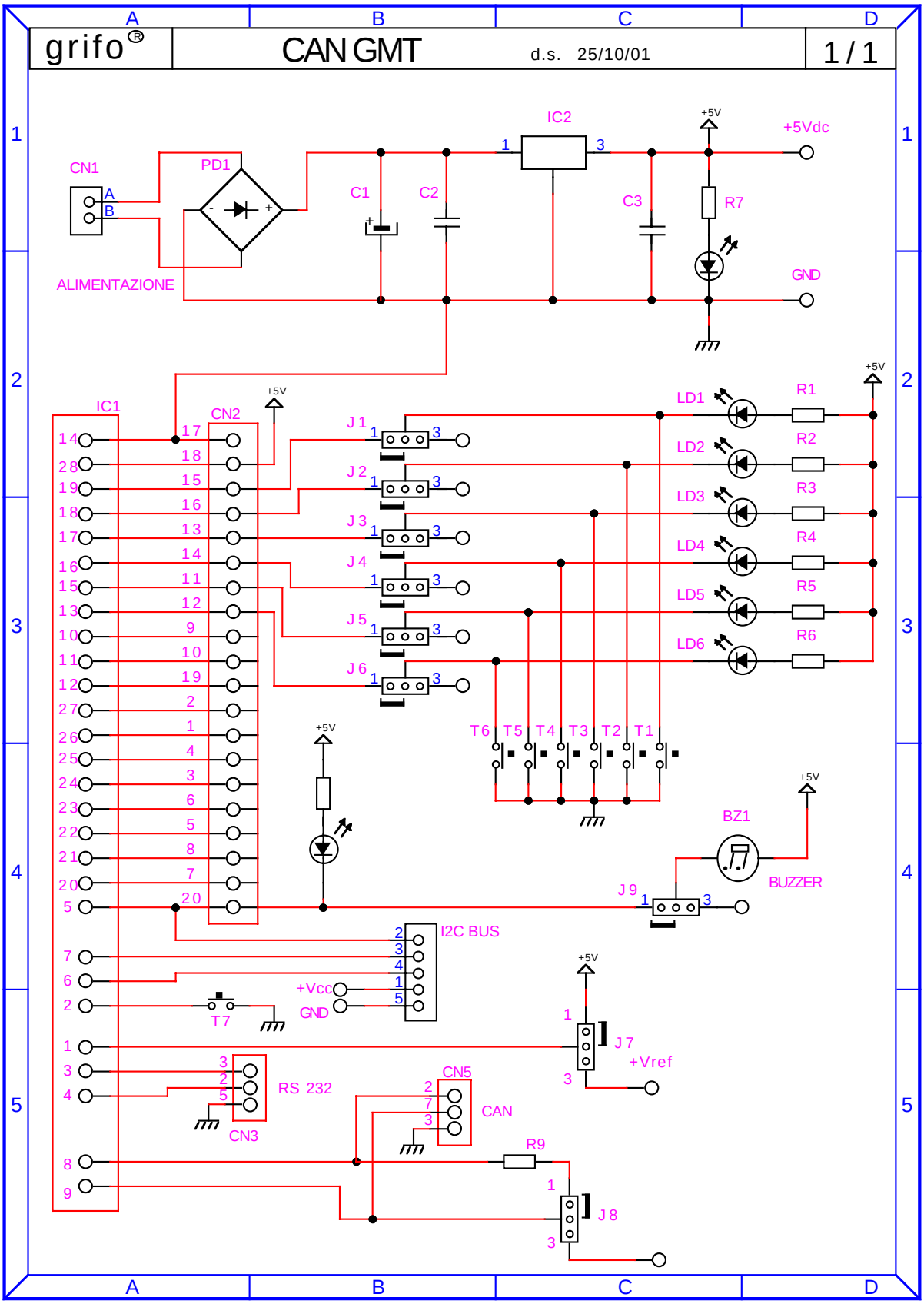


FIGURE 12: CAN GMT ELECTRIC DIAGRAM

EXTERNAL DEVICES

CAN GM1, through board CAN GMT, 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.

QTP G28

Quick Terminal Panel - LCD Graphic, 28 keys

LCD display 240x128 pixels, CFC backlit; Optocoupled RS 232 line and additional RS 232/422/485/ Current Loop line; CAN line controller; E^2 for set up; RTC and RAM lithium backed; primary graphic object; possibility of re-naming keys, LEDs and panel name; 28 keys and 16 LEDs with blinking attribute and buzzer manageable by software; Buzzer; built in power supply; reader of magnetic badge and relay option.

QTP 24 - QTP 24P

Quick Terminal Panel 24 keys with Parallel interface

Intelligent user panel equipped with Fluorescent or LCD display, LEDs backlit, 20x2 or 20x4 characters; RS 232, RS 422, RS 485 or current loop serial line; serial E2 for set up and message. Pssibility of re-naming keys, LEDs and panel name by inserting label with new name into the proper slot; 24 Keys and 16 LEDs with blinking attribute and buzzer manageable by software; built in power supply; RTC option, reader of magnetic badge and relay. The QTP 24P is low cost no intelligent (passive) version. It is directly driven from 16 TTL I/O lines; high level languages supported.

ADC 812

Analog to Digital Converter, 12 bits, multi range

DAS (Data Acquisition System) multi range 8 channels 12 bit A/D conversion lines; track and hold; 6µs conversion time; range ±10, ±5, +10, +5Vdc or 0÷20, 4÷20mA; analog inputs connections through quick terminal screw connectors; **ABACO®** I/O BUS interface; direct mounting for DIN 247277-1 and 3 rails; 4 type dimension.

DAC 212

Digital to Analog Converter 12 bits, multi range

Digital to Analog converter; multi range 2 channels 12 bits ± 10, +10 Vdc output; analog outputs connections through quick terminal screw connectors; **ABACO®** I/O BUS interface; direct mounting for DIN 247277-1 and 3 rails; 4 type dimension.

CAN 14

Control Area Network, 1 channel, galvanically insulated

UART CAN SJA1000; 1 serial channels galvanically insulated; **ABACO®** I/O BUS interface; 4 type dimension; support of CAN 2.0B protocol; transfer rate up to 1M bit/sec; direct mounting for DIN 247277-1 and 3 rails.

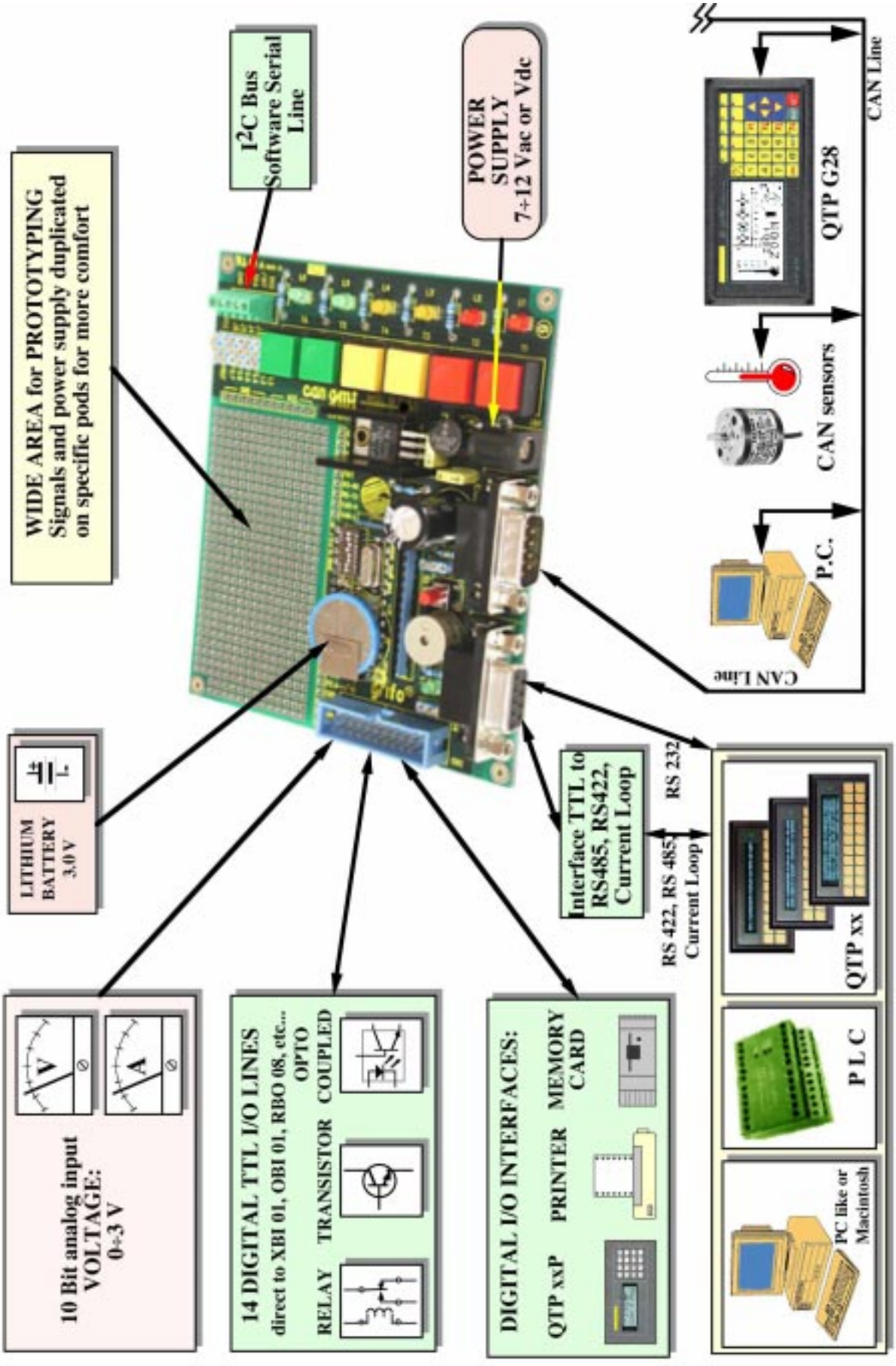


FIGURE 13: CONNECTION EXAMPLE

MCI 64

Memory Cards Interfaces 64 MBytes

Interfacing card for managing 68 pins PCMCIA memory cards, it is directly driven from any **ABACO**® I/O standard connector; High level languages GDOS supported.

KDL xxx - KDF xxx

Keyboard Display interface - LCD or Fluorescent

Interface with Fluorescent or LCD display, LEDs backlit, 20x2 or 20x4 characters; up to 24 keys matrix keyboard connector. It is directly driven by 16 TTL I/O lines; High level languages supported.

OBI N8 - OBI P8

Opto BLOCK Input NPN-PNP

Interface between 8 NPN, PNP optocoupled and displayed input lines, with screw terminal and **ABACO**® standard I/O 20 pins connector; power supply section; connection for DIN Ω rails.

TBO 01 - TBO 08

Transistor BLOCK Output

Interface for **ABACO**® standard I/O 20 pins connector; 16 or 8 transistor output lines 45 Vdc 3 A open collector; screw terminal; optocoupled and displayed lines; connection for DIN 247277-1 and 3 rails.

XBI R4 - XBI T4

miXed BLOCK Input-Output

Interface for **ABACO**® standard I/O 20 pins connector; 4 Relays 3A with MOV or 4 optocoupled Transistors 3A open collectors; 4 input lines optocoupled; screw terminal; connection for DIN Ctype and Ω rails.

FBC xxx

Flat Block Contactxxx pins

This interconnection system "wire to board" allows the connection to many type of flat cable connectors to terminal for external connections. Connection for DIN Ω rails.

IBC 01

Interface Block Comunication

Conversion card for serial communication, 2 RS 232 lines; 1 RS 422-485 line; 1 optical fibre line; selecatble DTE/DCE interface; quick connection for DIN 46277-1 and 3 rails.

DEB 01

Didactis Experimental Board

Supporting card for 16 TTL I/O lines use. It includes: 16 keys, 16 LEDs, 4 digits, 16 keys matrix keyboard, Centronics printer interface, LCD display and fluorescent display interface, **GPC**® **68** I/O connector, field connection with screw terminal.

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 GM2**.

Manual MAXIM:	*New Releases Data Book - Volume IV*
Manual MAXIM:	*New Releases Data Book - Volume V*
Manual NATIONAL SEMICONDUCTOR:	*Linear Databook - Volume 1*
Manual PHILIPS:	*I^2C bus*
Manual PHILIPS:	*Application notes and development tools for 80C51 microcontrollers*

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/T89C51CC02.pdf

APPENDIX A: DATA SHEET

T89C51CC02

8-bit MCU with CAN controller and Flash

1. Description

Part of the CANary™ family of microcontrollers dedicated to CAN network applications, the T89C51CC02 is a low pin count 8-bit Flash microcontroller.

While remaining fully compatible with the 80C51 it offers a superset of this standard microcontroller. In X2 mode a maximum external clock rate of 20 MHz reaches a 300 ns cycle time.

Besides the full CAN controller T89C51CC02 provides 16 Kbytes of Flash memory including In-system Programming (ISP), 2-Kbyte Boot Flash Memory, 2-Kbyte EEPROM and 512 bytes RAM.

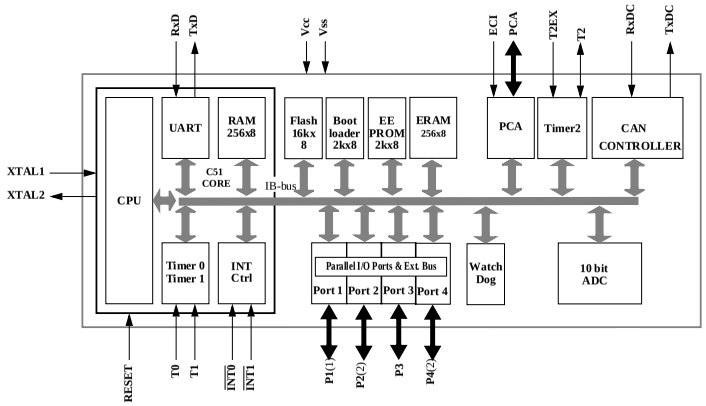
Special attention is payed to the reduction of the electro-magnetic emission of T89C51CC02.

2. Features

- 80C51 core architecture:
  - 256 bytes of on-chip RAM
  - 256 bytes of on-chip ERAM
  - 16 Kbytes of on-chip Flash memory
    Read/Write cycle : 10k
    Data Retention 10 years at 85°C
  - 2 Kbytes of on-chip Flash for Bootloader
  - 2 Kbytes of on-chip EEPROM
    Read/Write cycle : 100k
  - 14-source 4-level interrupt
  - Three 16-bit timer/counter
  - Full duplex UART compatible 80C51
  - maximum crystal frequency 40 MHz. In X2 mode, 20 MHz (CPU core, 40 MHz)
  - three or four ports: 16 or 20 digital I/O lines
  - two-channel 16-bit PCA with:
    - PWM (8-bit)
    - High-speed output
    - Timer and edge capture
  - Double Data Pointer
  - 21-bit watchdog timer (including 7 programmable bits)
- A 10-bit resolution analog to digital converter (ADC) with 8 multiplexed inputs
  - Separate power supply for analog
- Full CAN controller:
  - Fully compliant with CAN standard rev 2.0 A and 2.0 B
  - Optimized structure for communication management (via SFR)
  - 4 independent message objects:
    - Each message object programmable on transmission or reception
    - individual tag and mask filters up to 29-bit identifier/message object
    - 8-byte cyclic data register (FIFO)/message object
    - 16-bit status & control register/message object
    - 16-bit Time-Stamping register/message object
    - CAN specification 2.0 part A or 2.0 part B programmable message objects
    - Access to message object control and data register via SFR
    - Programmable reception buffer lenght up to 4 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
    - Automatic reply mode programmable
  - 1 Mbit/s maximum transfer rate at 8MHz* 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
- Power saving modes:
  - Idle mode
  - Power down mode
- Power supply: 5V +/- 10% ,3V +/- 10%
- Temperature range: Industrial (-40° to +85°C)
- Packages: PLCC28, SOIC28, (TSSOP28, SOIC24)**

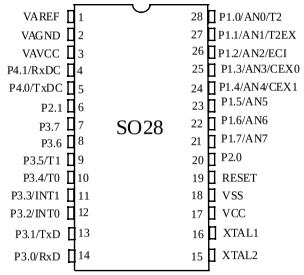
* At BRP = 1 sampling point will be fixed.
** Ask for availability

3. Block Diagram



(1): 8 analog Inputs / 8 Digital I/O
(2): 2-Bit I/O Port

4. Pin Configuration



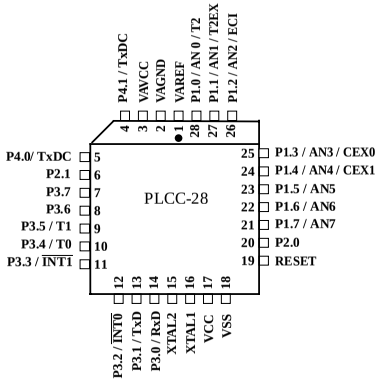


Table 1. Pin Description

Pin Name	Type	Description
VSS	GND	**Circuit ground potential.**
VCC		**Supply voltage during normal, idle, and power-down operation.**
VAREF		**Reference Voltage for ADC**
VAVCC		**Supply Voltage for ADC**
VAGND		**Reference Ground for ADC / Analog Ground**
P1.0:7	I/O	**Port 1:** is an 8-bit bi-directional I/O port with internal pull-ups. Port 1 pins can be used for digital input/output or as analog inputs for the Analog Digital Converter (ADC). Port 1 pins that have 1's written to them are pulled high by the internal pull-up transistors and can be used as inputs in this state. As inputs, Port 1 pins that are being pulled low externally will be the source of current (IIL, on the datasheet) because of the internal pull-ups. Port 1 pins are assigned to be used as analog inputs via the ADCF register. As a secondary digital function, port 1 contains the Timer 2 external trigger and clock input; the PCA external clock input and the PCA module I/O. P1.0 / AN0 / T2 Analog input channel 0, External clock input for Timer/counter2. P1.1 / AN1 / T2EX Analog input channel 1, Trigger input for Timer/counter2. P1.2 / AN2 / ECI Analog input channel 2, PCA external clock input. PIn the T89C51CC02 Port 1 can sink or source 5mA. It can drive CMOS inputs without external pull-ups.
P2.0:1	I/O	**Port 2:** Is an 2-bit bi-directional I/O port with internal pull-ups. Port 2 pins that have 1's written to them are pulled high by the internal pull-ups and can be used as inputs in this state. As inputs, Port 2 pins that are being pulled low externally will be a source of current (IIL, on the datasheet) because of the internal pull-ups. In the T89C51CC02 Port 2 can sink or source 5mA. It can drive CMOS inputs without external pull-ups.
P3.0:7	I/O	**Port 3:** Is an 8-bit bi-directional I/O port with internal pull-ups. Port 3 pins that have 1's written to them are pulled high by the internal pull-up transistors and can be used as inputs in this state. As inputs, Port 3 pins that are being pulled low externally will be a source of current (IIL, on the datasheet) because of the internal pull-ups. The output latch corresponding to a secondary function must be programmed to one for that function to operate. The secondary functions are assigned to the pins of port 3 as follows: P3.0 / RxD: Receiver data input (asynchronous) or data input/output (synchronous) of the serial interface P3.1 / TxD: Transmitter data output (asynchronous) or clock output (synchronous) of the serial interface P3.2 / $\overline{INT0}$: External interrupt 0 input / timer 0 gate control input P3.3 / $\overline{INT1}$: External interrupt 1 input / timer 1 gate control input P3.4 / T0: Timer 0 counter input P3.5 / T1: Timer 1 counter input P3.6 P3.7 In the T89C51CC02 Port 3 can sink or source 5mA. It can drive CMOS inputs without external pull-ups.

Pin Name	Type	Description
P4.0:1	I/O	**Port 4:** Is an 2-bit bi-directional I/O port with internal pull-ups. Port 4 pins that have 1's written to them are pulled high by the internal pull-ups and can be used as inputs in this state. As inputs, Port 4 pins that are being pulled low externally will be a source of current (IIL, on the datasheet) because of the internal pull-up transistor. The output latch corresponding to a secondary function RxDC must be programmed to one for that function to operate. The secondary functions are assigned to the two pins of port 4 as follows: P4.0 / TxDC: Transmitter output of CAN controller P4.1 / RxDC: Receiver input of CAN controller. In the T89C51CC02 Port 4 can sink or source 5mA. It can drive CMOS inputs without external pull-ups.
RESET	I/O	**Reset:** A high level on this pin during two machine cycles while the oscillator is running resets the device. An internal pull-down resistor to VSS permits power-on reset using only an external capacitor to VCC.
XTAL1	I	**XTAL1:** Input of the inverting oscillator amplifier and input of the internal clock generator circuits. To drive the device from an external clock source, XTAL1 should be driven, while XTAL2 is left unconnected. To operate above a frequency of 16 MHz, a duty cycle of 50% should be maintained.
XTAL2	O	**XTAL2:** Output from the inverting oscillator amplifier.

APPENDIX B: ALPHABETICAL INDEX